NAKAKITA'S
CONTROL
VALVES

INHERENT FLOW CHARACTERISTICS

Inherent flow characteristics of valves are determined by the valve plug configurations or cage port configurations. In selecting a control valve, it is necessary to select a valve flow characteristic most suited to the controlled system. The basic inherent flow characteristics of valves are as shown in Fig. 3A. For valve plug configurations, see the next page.
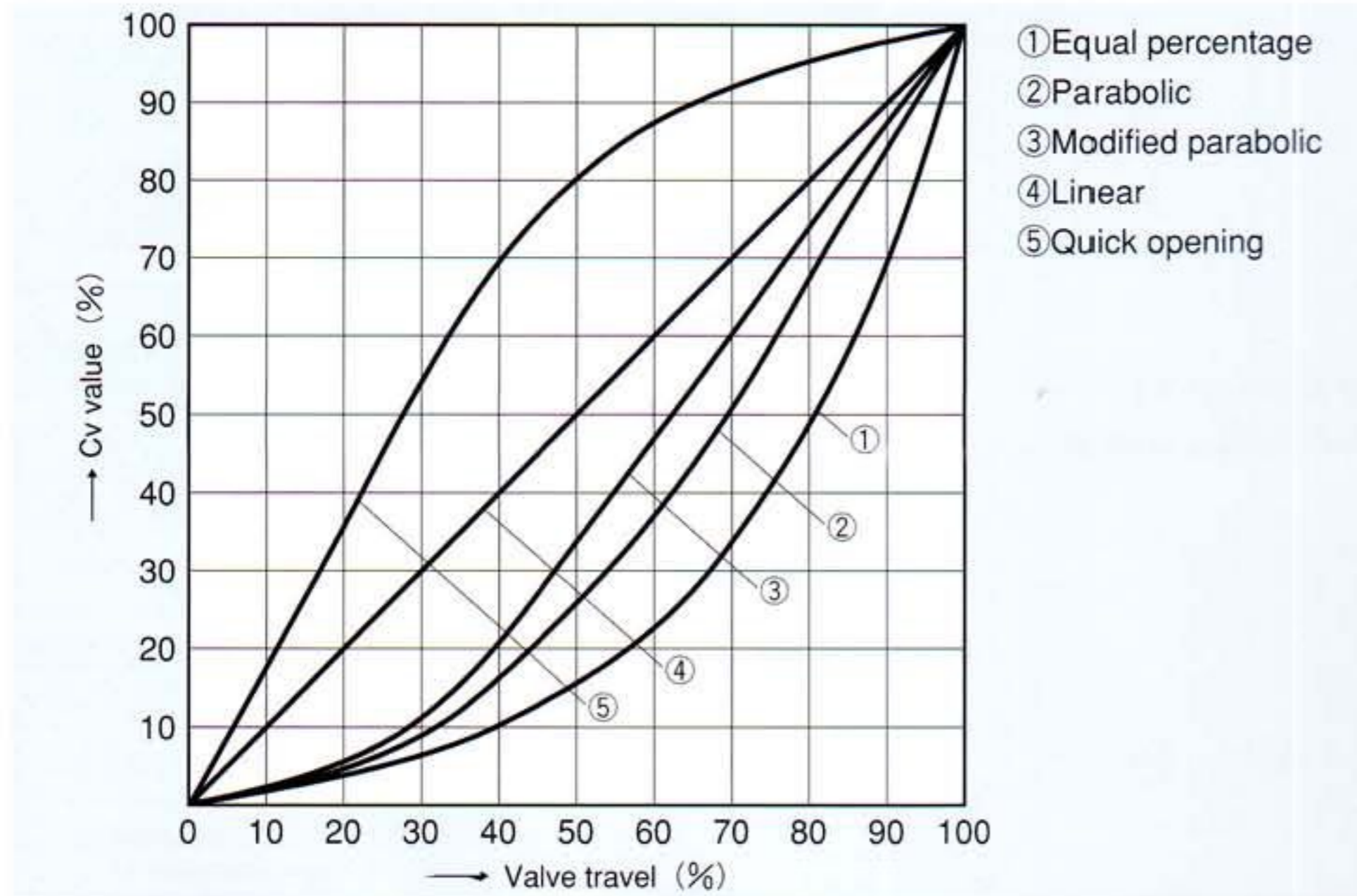
Fig. 3A Inherent flow characteristics

① Equal percentage
② Parabolic
③ Modified parabolic
④ Linear
⑤ Quick opening

Table 3. 1 Inherent flow characteristics and applications

	Characterstic	Application
①Equal percentage	As shown in the figure above, when the travel increases by 10%, the theoretical flow rate will be increased by a fixed rate from the previous flow rate.	Valves of this characteristic are used when large pressure drop is feared in the piping system, or when large pressure fluctuation is expected to happen.
②Parabolic	The flow rate changes in proportion to the square of the travel.	This type is used when the pressure drop of the piping system is to be born mostly by the control valve. Valves of this type are most frequently used for pressure control, flow rate control and liquid level control.
③Modified parabolic (V -port linear)	This characteristic has a modified from of the parabolic characteristic, The curve becomes almost linear beyond 40% of the travel.	
④Linear	The flow rate changes in proportion to the travel.	This type is used when a linear relationship is required.
⑤Quick opening	With the increase of the travel from the closed position, the flow rate increases quickly.	This type is used when it is necessary to obtain a quick increase in flow rate from the closed position.

〔Remarks〕　● The above-mentioned flow characteristics are theoretical inherent ones. Actual characteristics are slightly different from them.
　　　　　● The inherent flow characteristics of control valves will be altered, under the actual conditions of use, by the flow rate changes according to the proportion of pressure drop due to the control valve and to other items (piping system: stop valve, etc.). The resulting characteristics are called effective flow characteristics. In selecting valve flow characteristic, due consideration should be given to this point.

VALVE PLUG AND CAGE CONFIGURATION

Valve plugs are manufactured in various kinds and configurations to meet any kind of specifications. Major sampiesare shown below.

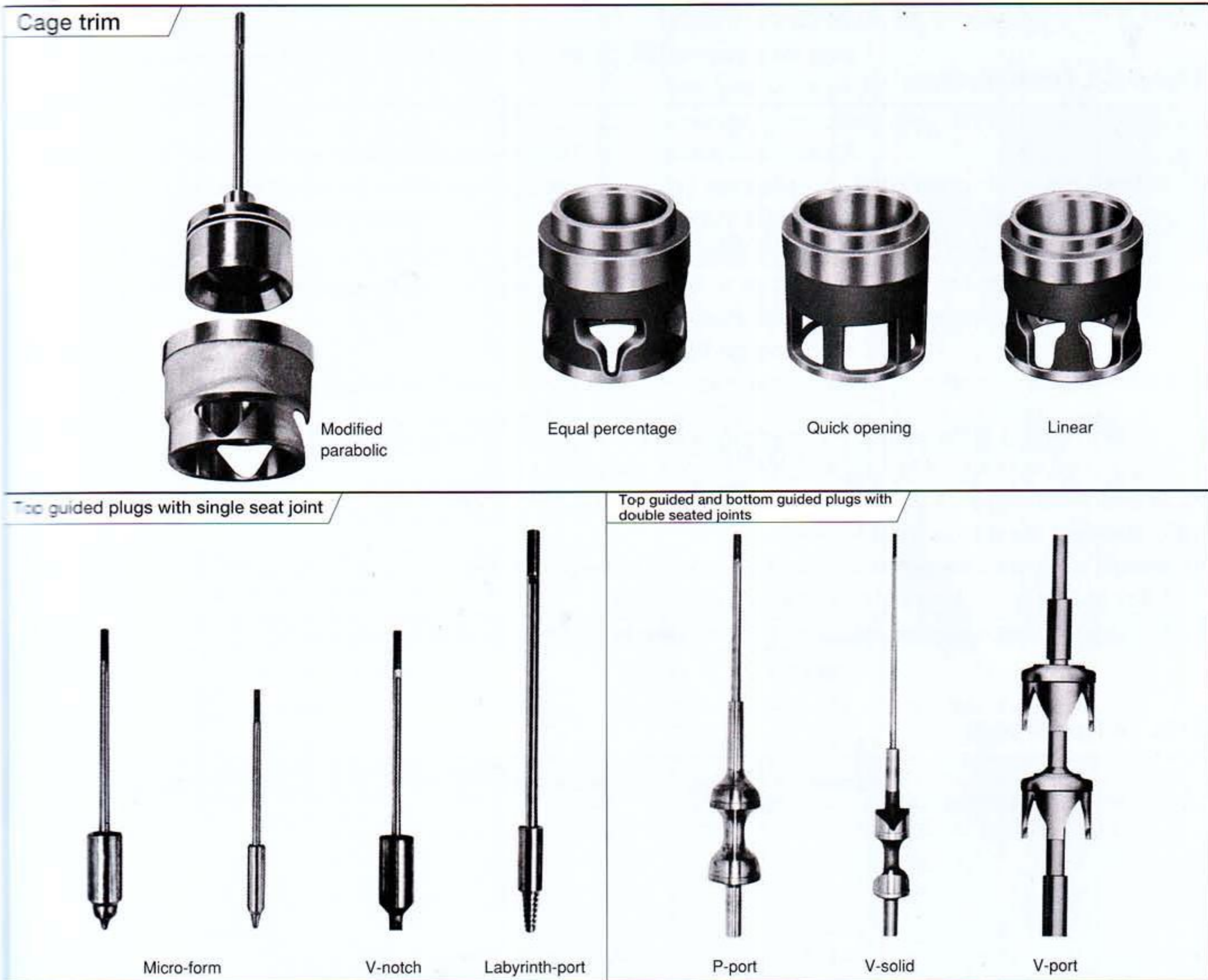**Fig. 3B Kind and configuration of valve plug and cage**

Cage trim

| Modified parabolic | Equal percentage | Quick opening | Linear |

Top guided plugs with single seat joint

| Micro-form | V-notch | Labyrinth-port |

Top guided and bottom guided plugs with double seated joints

| P-port | V-solid | V-port |

Table 3. 2 Configuration and application of valve plug and cage

Configuration	Application
Cage port	As the unbalanced force on the stem is stabilized throgh full travel, stable control can be expected even under high differential pressure conditions. This type is used for high-performance purpose in general.
V-solid	These types are used to reduce vibration, nise, wear on guide etc. of the valves under high differential
V-notch	pressure condition, irrespective of the property of fluid, non-compressible or compressible. The available standard valve flow characteristics are equal-percentage and parabolic.
P-port	This type is widely used for general applications. The available standard balve flow characteristics are parabolic and liner.
V-port	This type is used when scale collects and accumulates in the throttle of the plug to hinder proper control. For example, it is used in the drain contorol valve of the feedwater heater of a power plant.
Micro-form	This type is windely used as a general type for ordinary small size valves. The available standard valve flow characteristics are equal-percentage, parebolic and liner.
Labyrinth-port	This type is used in small size valves when the differential pressure of incompressible fluid is high. (For prevention of cavitation erosion.) For example, in water flow control valves of a desuper heater.

PRESSURE-TEMPERATURE RATING

The valve body and bonnet contact the controlled fluid, and varios fluid pressures are exerted on them. These valve body assemblies are generally determined by the pressure-temperature ratings shown in the table on page 63. The ratings of our control valves are as shown in Table 4.1.
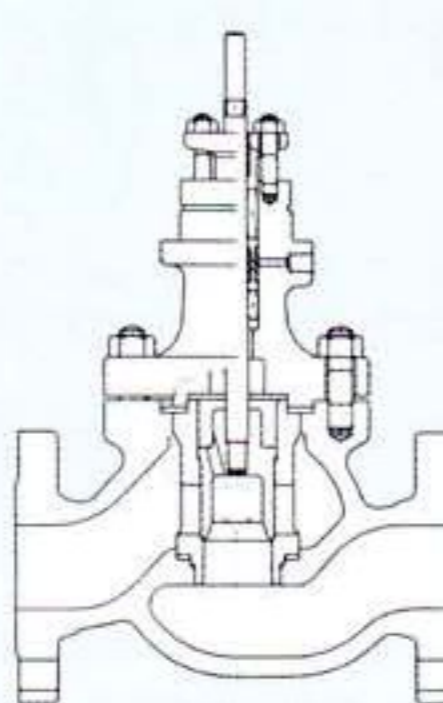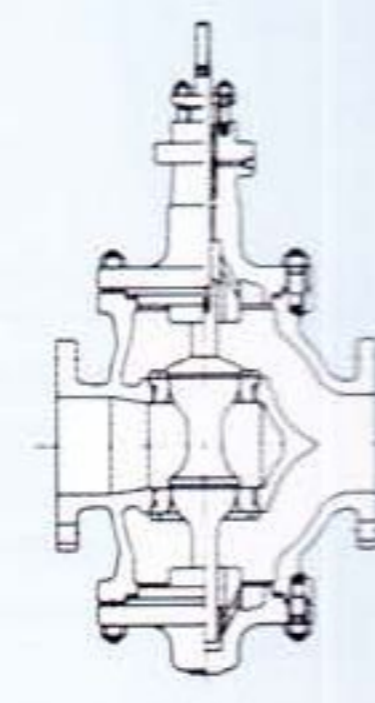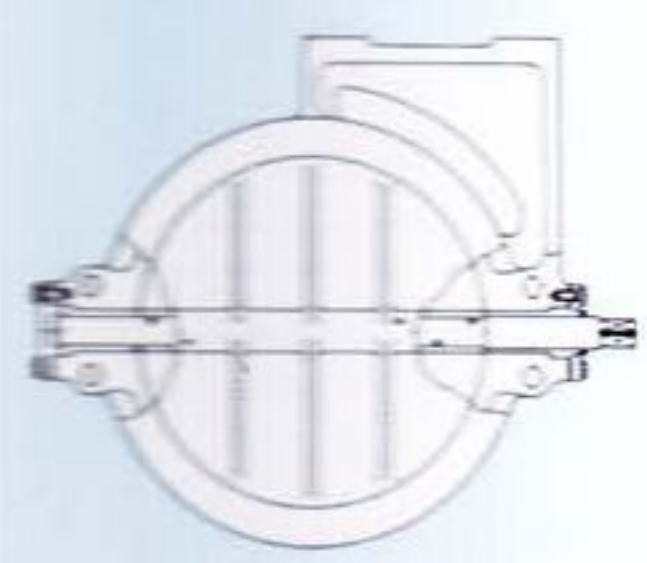
Table 4.1 Pressure rating

JIS （K）	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	—	—	—

TYPE OF BODY

- The wall thickness of the valve body assembly is determined in accordance with ANSI B16.34.
- The standard connections are JIS and ANSI flanges and weding types.
- The face dimension is based on IEC Standard. For valves of JIS 63^K (ANSI 900) rating and over not specified in IEC standars, our standard is available.
- Materials to be used are generally selected accoding to the pressure-temperature rating as shown on pages 13 to 18. For special fluids, a variety of materials are available.
- For cryogenic temperature applications, the extension bonnet type is used.

Fig. 4A Type of body

	Cage type	Gereral purpose type	Butterfly type
Body construction	DY-CODO	DY-D	DY-B
Rating	JIS 5~63K $\frac{ANSI}{125~2500}$	JIS 5~63K $\frac{ANSI}{125~1500}$	JIS 5~20K $\frac{ANSI}{125~150}$
Nominal bore mm (inch)	32 ~ 300 (1¼~12)	25 ~ 400 (1~6)	80 ~ 1500 (3~60)
Features of body	• Easy replacement of trim components. • Various valve pluge can be combined. • Unbalance force on the valve stem is small.	• Varied and wide range of application to suit various conditions.	• For large size valves. • Compact and economical in comparison with glove valves. • Simple construction allows easy disassembly and assembly.

TYPE OF BONNET

The following four types of bonnet configuration are used to suit the purpose of use according to fluid kind and its temperature

Standard type

This type is used when the fluid temperature is in the range from 0 to 220℃.

Fin type

- This type is used when the fluid temperature is 220℃ and over. The temperature inside the stuffing box is lowered to protect the gland packing.
- When the fluid temperature is below 0 ℃ and not lower than −20℃, the fin type shown in Table 4.2 is used.

Extension type

This type is used for low temperature fluids (−268℃ ≦ temperature < −20℃) such as liquid oxygen, LNG and liquid helium. The extension construction where the gland paking is separated from the valve body is used so as to keep the gland packing temperature at the ambient temperature of 0 ℃ and over. The arrangement prevents the valve stem from freezing.

Bellows seal type

This type is used for fluids which may be ignited, generate explosive and toxic gases, or cause radioactive leakage.

The double construction using the gland packing and bellows prevents dangerous fluids from leaking out of the valve. Bellows are mainly made of austenitic stainless steel or inconel welded construction which guarantees pressure resistance, heat resistance and durability.

Stuffing box type

For both asbestos coil packing and V type PTFE packing, the dimensions of the stuffing boxes and the degree of finishing of the inner surfaces are the same; thus they are interchangeable. For the materials of gland packing, see paga 18.

Table. 4.2 Applicable temperature rang of bonnet

Name		Standard material	Length of extension (mm)	Application
Standard type		Cast iron or cast steel	—	Over 0℃ and below 220℃
Fin type		Cast steel	—	220℃ and over, or −20℃ and over and less than 0℃
Extension type	I	Cast steel	150 and over	−100℃ and over and less than −20℃
	II	Stainless steel (sus pipe)	350 and over	−268℃ and over and less than −100℃
Bellows seal type		Stainless steel	—	For non-leak or when contamination due to fluid (radioactive for example) must be avoided.

Fig. 4B Type of bonnet

Standard type

Fin type (for general purpose type)

Fin type (for cage type)

Bellows seal type

Extension type
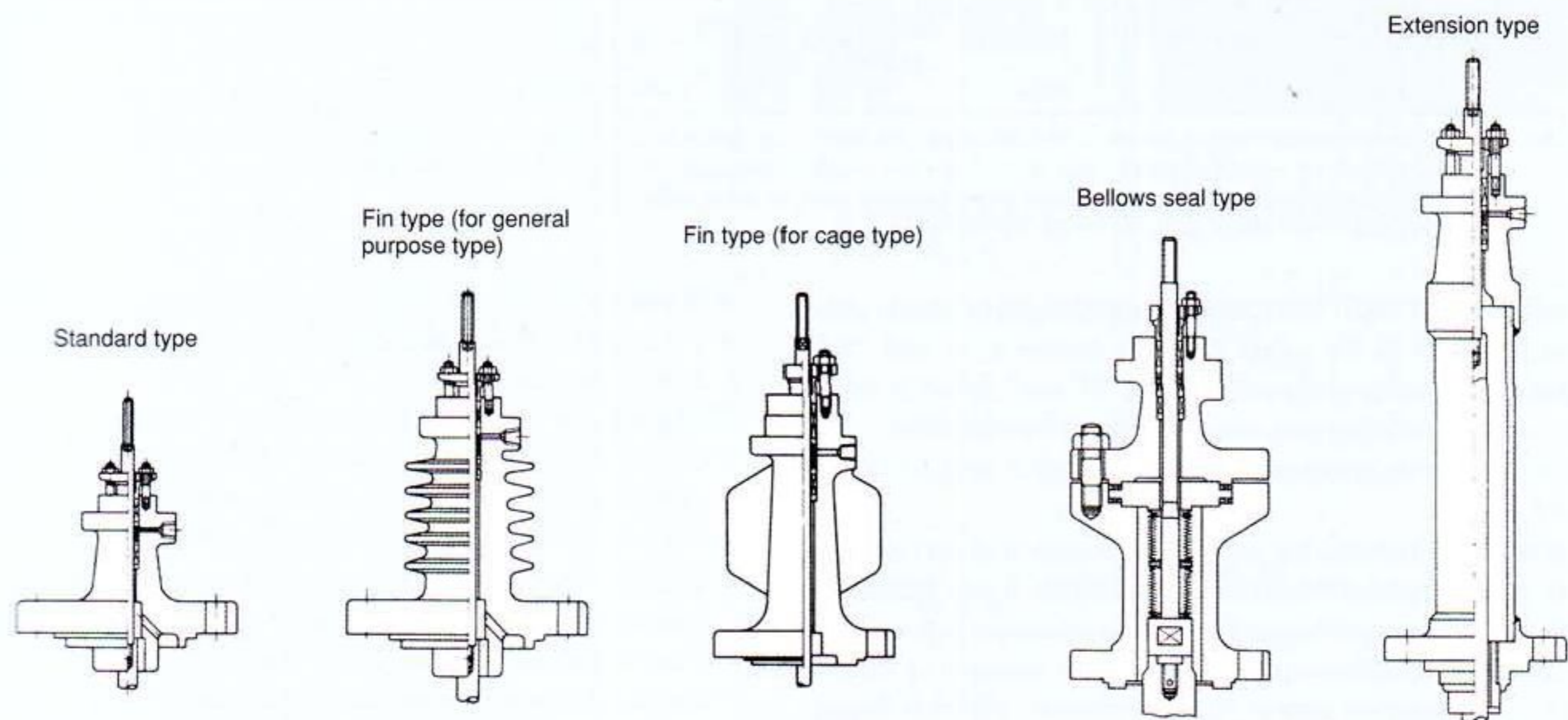
MATERIALS OF PRESSURE CONTAINNING PART

The materials the pressure containing part such as valve body and bonnet are selected in conformity with the pressure-temperature ratings of JIS and ANSI (page 63) also with due consideration given to the following condition.

- Applicabe regulations and standards
- Corrosion resistance against the fluid
- Flashing fluid, high velocity, large pressure drop jet,

Table 5.1 Service temperature limits of materials

Material		Material mark		Service temperature range (℃)			Main component	Application
		JIS	ASTM	JIS (B-8270)	High pressure gas contorol act	ANSI (B 16.34)		
Gray cast iron		FC 200	A126 GradeA	0～250 220 and under *1	0～250	—		Low pressure
Nodular graphite cast iron		FCD 450	A536 Gr.65-45-12	0～350	0～250	—		
Bronze casting		CAC 403	B 584	−196～225	−196 and over	—		Sea water, corrosion resistance, low temperature
		CAC 406	B 584	−196～225	−196 and over	—		
Cast or forged steel for high temperature and high pressure service	Cast	SCPH 2	A216-WCB	−5～450 425 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	−5～550 475 and under *1	−5 and over	−29～455	0.5Mo	
	Forged	—	A182-F1	—	—	−29～455		
	Cast	SCPH 21	A217-WC6	−5～575 510 and under *1	−5 and over	−29～593 *2	1.25Cr-0.5Mo	
	Forged	—	A182-F11	—	—	−29～593 *2		
	Cast	SCPH 32	A217-WC9	−5～650	−5 and over	−29～593 *2	2.5Cr-1Mo	
	Forged	—	A182-F22	—	—	−29～593 *2		
	Cast	SCPH 61	A217-C5	−5～650	−5 and over	−29～650 *2	5.25Cr-0.5Mo	
	Forged	—	A182-F5a	—	—	−29～650 *2		
Cast or forged stainless steel		SCS 13A	A351-CF8	−196～800	−196 and over	−29～800 *2	18Cr-8Ni	Corrosion resistance, high temperature and high pressure, and low temperature
		SUS 304	—	−253～800	−253 and over	—		
		SCS 14A	A351-CF8M	−196～800	−196 and over	−29～800 *2	18Cr-12Ni-2.5Mo	
		SUS 316	—	−253～800	−253 and over	—		
		SCS 16A	A351-CF3M	−196～450	−196 and over	−29～455		
		SUS 316L	—	−268～450	—	—		
		SCS 19A	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	—	0.5Mo	
		SCPL 21	A352-LC2	−70～350	−70 and over	—	2.5Ni	
		SCPL 31	A352-LC3	−100～350	−100 and over	—	3.5Ni	

〔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 2238／9 flange type valve.
 ＊2. The upper limit must be 540℃ for flange type valves.

Materials for high temperature and high pressre use

The materials to be used for high temperature and high pressure applications contain Mo, Cr, Ni, or V. Each of these elements has excellent properties against high temperature.

- Mo is added so as to increase the creep resistance at high temperature.
- Cr is added to increase the oxidization resistance at high temperature and to impreve the corrosion resistance. It also stabilozes carbide and increases the graphitization resistance at high temperature. (Graphitization extremaly enbrittles materials.) As the corrosion resistance against high temperature steam is largely affected by the Cr content, it is desirable to use a material of high Cr content for high temperature applications.

- Ni strengthens ferrite and improves its impact resistnace value.
- V is added to Cr-Mo alloy steel to increase the creep resistnace at high temperature.

Materials fow low temperature use

Ordinary cast iron and carbon steel show sudden drop in toughness (impact valve) below 0℃ or cold brettleness.

- When temperature is lowered, ferritic steel shows increased tensile strength. However, its toughness drops suddenly beyond a certain temperature valve. Austenitic stainless steel shows somewhat lower impact valve at low temperature, however, it can be adequately useable even at every low temperature range by stabilizing its structure by means of heat treatment.
- Materials generally used for low temperature applications are cast

steel for low temperature and high pressure service, copper alloys, and austenitic stainless steel, as shown in Table 5.1.

Miscellaneous

It is possible to give rubber lining or coating to the interior of cast iron valve body so as to prevent corrosion due to corrosive fluids, sea water, etc.

Cavitation- and flashing- resistant materials

When incompressible fluid id suddenly depressurized, bubbles will be locally generated by the pressure drop just past the throttle of the valve plug. When these bubbles disappear with the recovery of pressure, the impact generated by the disappearing bubbles will damage nearby material. On theother hand, when the downstream side pressure of the inner throttle is lower than the saturated vapor pressure of the fluid temperature, some portion of the fluid will be evaporeted and vapor and fluid will be present together. Namely, flashing will happen. This phenomenon may give damages to the valve materials and attack the inner wall of the valve body. NAKAKITA there-fore uses high chrome steel for some low temperature applications. We have technical data obtaind by demonstrations on these pointd.

Table 5.2 Demarcasion 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. ($^\circ$C)
G 3201	Carbon Steel Forgings	SF	SF440A, SF490	−5
G 5101	Carbon Steel Castings	SC	All	
G 5102	Steel Castings for Welded Structure	SCW	SCW410, SCW480, SCW550, SCW620	
G 5151	Steel Castings for High Temperature and High Pressure Service	SCPH	Confined to SCPH1, SCPH2, SCPH11, SCPH21, SCPH32, SCPH61	
G 4051	Carbon Steel for Machine Structural use	S-C	S10C, S12C, S15C, S17C, S20C, S22C, S28C, S30C	−10
G 3454	Carbon Steel Pipe for Pressure Service	STPG	All	
G 3459	Stainless Steel Pipes	SUS TP	Confined to SUS304HTP, SUS316HTP, SUS321HTP, SUS347HTP	−30
G 4105	Chromium Molybdenum Steels	SCM	Confined to SCM430, SCM432, SCM435, SCM440, SCM445	
G 5121	Stainless Steel Castings	SCS	SCS1	
G 5152	Steel Castings for Low Temperature and High Pressure Service	SCPL	SCPL1	−45
G 5152	Steel Castings for Low Temperature and High Pressure Service	SCPL	SCPL11	−60
G 5152	Steel Castings for Low Temperature and High Pressure Service	SCPL	SCPL21	−80
G 5152	Steel Castings for Low Temperature and High Pressure Servic	SCPL	SCPL31	−100
G 3460	Steel Pipes for Low Temperature Service	STPL	STPL450	
G 3459	Stainless Steel Pipes	SUS TP	Confined to SUS309TP, SUS309STP, SUS310TP, SUS310STP, SUS317TP, SUS321TP, SUS347TB	−196
G 5121	StainlessSteel Castings	SCS	SCS13, SCS13A, SCS14, SCS14A, SCS16, SCS16A, SCS17, SCS18, SCS19, SCS19A, SCS21	
H 4600	Titanium Sheets, Plates and Strip	TP TR	All	
H 4630	Titanium Pipes and Tubes for Ordinary Piping	TTP		
H 4650	Titanium Rods and Bars	TB		
H 5120	Bronze Castings	CAC	Confined to CAC102, CAC103, CAC106, CAC107	
H 5202	Aluminium Alloy Casting	AC	AC4C, AC7A	
G 3214	Forged Stainless Steel Flanges, Fittings, Valves and Ports of Pressure Vessel for High-Temperature Service	SUS F	Confined to SUSF304, SUSF316	−253
G 3459	Stainless Steel Pipes	SUS TP	Confined to SUS304TP, SUS316TP	
G 4303	Stainless Steel Bars	SUS	Confined to SUS304, SUS316	
G 4304	Hot Rolled Stainless Steel Sheet and Plate	SUS	Confined to SUS304, SUS316	
G 3214	Forged Stainless Steel Flanges, Fittings, Valves and Parts of Pressure Vessel for High-Temperature Service	SUS F	Confined to SUSF304L, SUSF316L	−269
G 3459	Stainless Steel Pipes	SUS TP	Confined to SUS304LTP, SUS316LTP Confined to SUS304L, SUS316L,	
G 4303	Stainless Steel Bars	SUS	SUS316J1L, SUS317L	
H 3250	Brass Rods and Bars	CXXXB	C1020, C100, C1201, C1220	

TRIM OF CAGE TYPE CONTROL VALVE

The materials of the valve trim should be selected with due consideration given to erosion resistance and corrosion resistance to the controlled fluid, wear resistance, durability, etc. The standard trim materials for cage type control valves (DY-C) are shown in Table 5.3

Table 5.3 Standard trim materials for cage type control valves (nom of materials: JIS)

Body material	Cage split type			Valve stem *3	Packing seat	Lantern ring	Gland
	Cage integrated type						
	Plug *1	Cage *1	Seat ring *2				
SCPH 2, etc. Carbon steel : Castings or forgings Low alloy steel : Castings or forgings	SUS 403 SCS 1 SUS 431 16Cr. 2Ni S.S.Casting SUS 440C SUS 304 SUS 316 SCS 13 SCS 14	SUS 403 SCS 1 SUS 431 16Cr. 2Ni S.S.Casting SUS 630 SCS 24 SUS 304 SUS 316 SCS 13 SCS 14	SUS 304 SUS 316	SUS 316 SUS 630	SUS 316	SUS 316	SUS 316
SCS 13, etc. Stainless steel : Castings or forgings		SUS 304 SUS 316 SCS 13 SCS 14			SUS 304 SUS 316	SUS 304 SUS 316	SUS 304 SUS 316

*1. When body material is [SCPH2, etc.], the standard material is heat-treated by hardening and annealing. Austenitic stainless steel is available as option.

*2. The standard seat ring material is austenitic stainless steel.

*3. The standard valve stem material is SUS 316 stem plated with hard chrome.
  ● SUS 630 is used when the valve cutoff force is large and sufficient strength of the stem is required.

[Remarks] ● Cage and valve plugs of materials other than surface hardened materials and precipitation hardened materials are plated with hard chrome or treated with special surface ultra-hardening, according to the conditions of use, so as to prevent sticking and wear due to sliding.
  ● As for austenitic steel valve plugs and seat rings, the contacting faces of plug and ring or inner surface of ring is strengthened by building stellite, according to the size of valve pressure drop.

Seal ring

The type and material of the seal ring of the cage type control valve (DY-COB) is selected according to the kind of fluid and its temperature. The seal ring is used for fluids of 392F and under. The teflon based cap seal is installed on the "sliding surface" of the O ring to increase its durability and to seal with low friction.

Fig. 5A

	Cap	"O" ring
Standard materials	Teflon (only) Teflon Glass fiber + Lubricants grease	NBR (nitrile rubber) EPDM (ethylenepropylene rubber) FPM (fluorine rubber)
Application	For low-leakage	
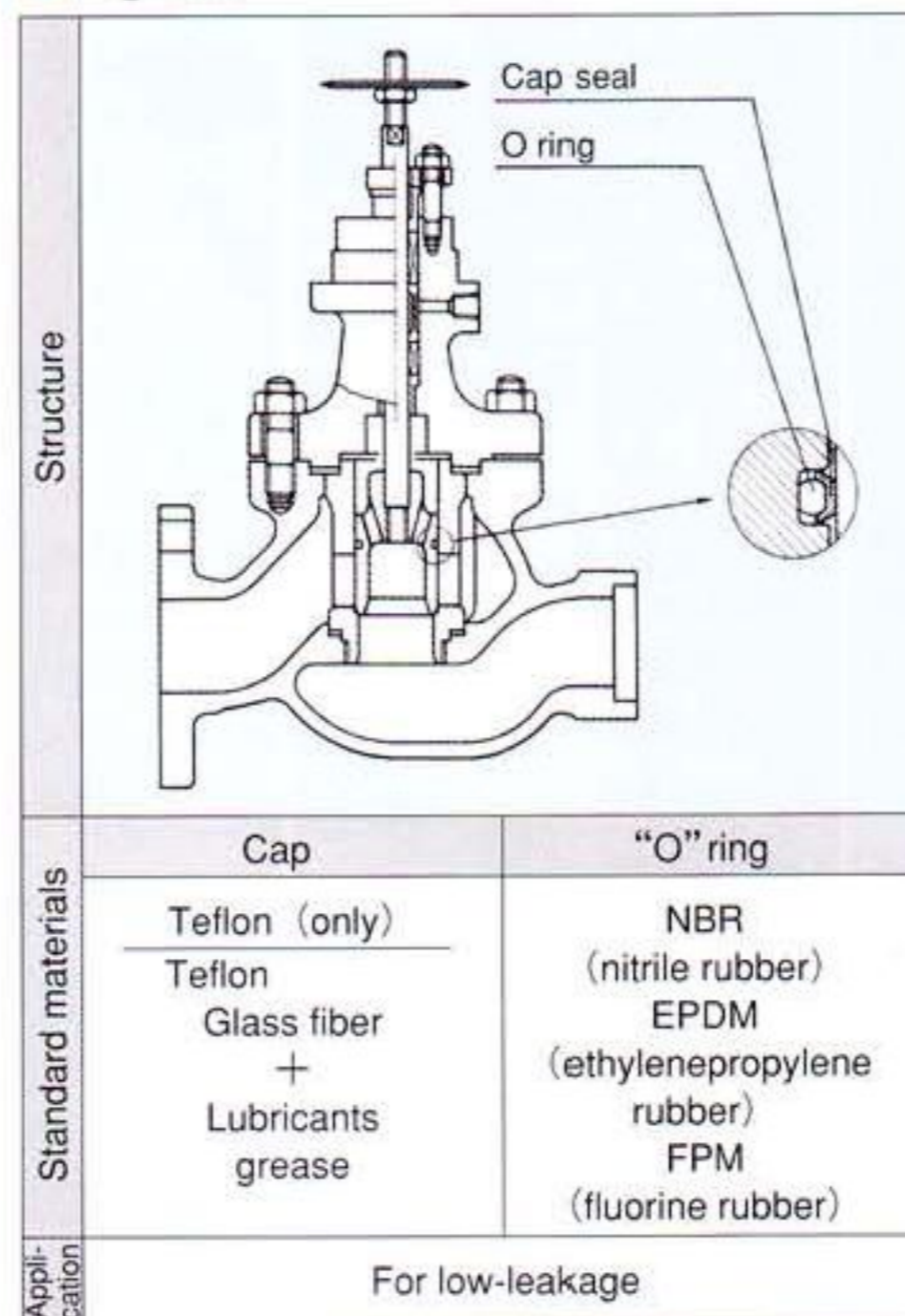
Soft seal

Soft elastic materials such as synthetic rubber, teflon and nylon are used as the seal materials of the seat ring face. Bubble-tight searing of the seat ring can be achieved by a small actuator output.

The selection of the seal material, shape and mounting method is made to suit the actual service condition, by considering physical properties and durability of the seal on the past results.

Fig. 5B

TRIM OF GENERAL PURPOSE TYPE CONTROL VALVE

The trim materials of the general purpose type control valves are as shown in Table 5.4。

▌Table 5.4 Standard trim materials for general purpose type control valve (nom of materials: JIS)

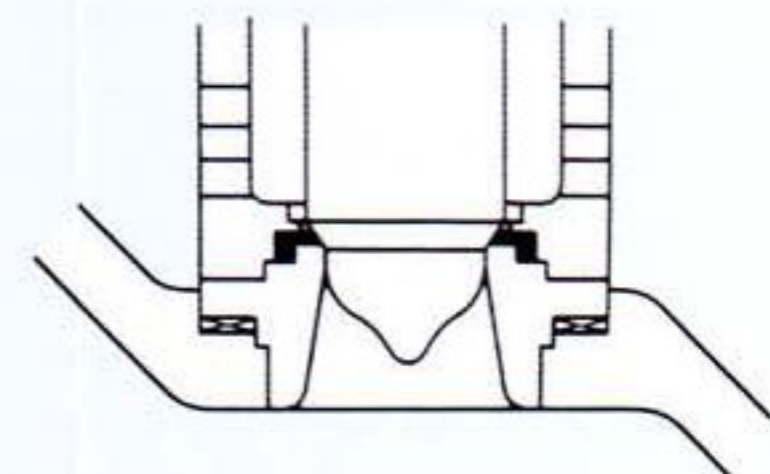| Applicable control valve type	Trim No.	Valve plug	Seat ring	Valve stem	Guide bushing	Packing seat	Lantern ring	Gland	Service temperature of fluids such as water, oil, steam, air and gas (℃)
DY-D DY-P DY-S DY-G	11	SUS 403 or SCS 13	SUS 304	SUS 316 Ⓒ SUS 630 Ⓒ	SUS 440C Ⓗ	SUS 316	SUS 316	SUS 316	220 and under
	12	SUS 304 or SCS 13 Ⓢ₁ Ⓢ₂ Ⓒ	SUS 304 or SCS 13 Ⓢ₁						Over 220 up to 300
	13	SUS 316 or SCS 14 Ⓢ₃							Over 300 up to 400
	14	SUS 316 or SCS 14 Ⓢ₄	SUS 316 or SCS 14 Ⓢ₂						Over 400 up to 475
	16	SUS 316 or SCS 14 Ⓢ₄			Stellite (casting)				Over 475

[Remarks] In addition to the above-mentioned trim numbers, trim materials for mainly high pressure drop of incompressible fluids, cavitation and erosion resistance
are available. They are SUS440A, 440C, etc. heat-treated by hardening and annealing, SUS630, etc. precipitation-hardened, and SUS304, SCS13, SCA14, etc. not quenched but surface-hardened.

═ Explanation of marks of Table 5.4 ═

Ⓢ : Indicates building of stellite. The number indicates the position.

Stellite-built part	Ⓢ₁	Ⓢ₂	Ⓢ₃	Ⓢ₄
Contacting surfaces of valve plug and seat ring	○	○	○	○
Valve plug port		○		○
Inner surface of seat ring		○		○
Valve plug guide			○	○

Ⓒ : Valve plug guide and valve stem are completely plated with hard chrome.。

Ⓗ : Heat treatment by hardening and annealing.
  ● Wet vapor is locally generated at the throttle during depressurization due to large pressure drop and the conditions of use such as pressure and temperature.

DY-D DY-P

DY-S

DY-G DY-W
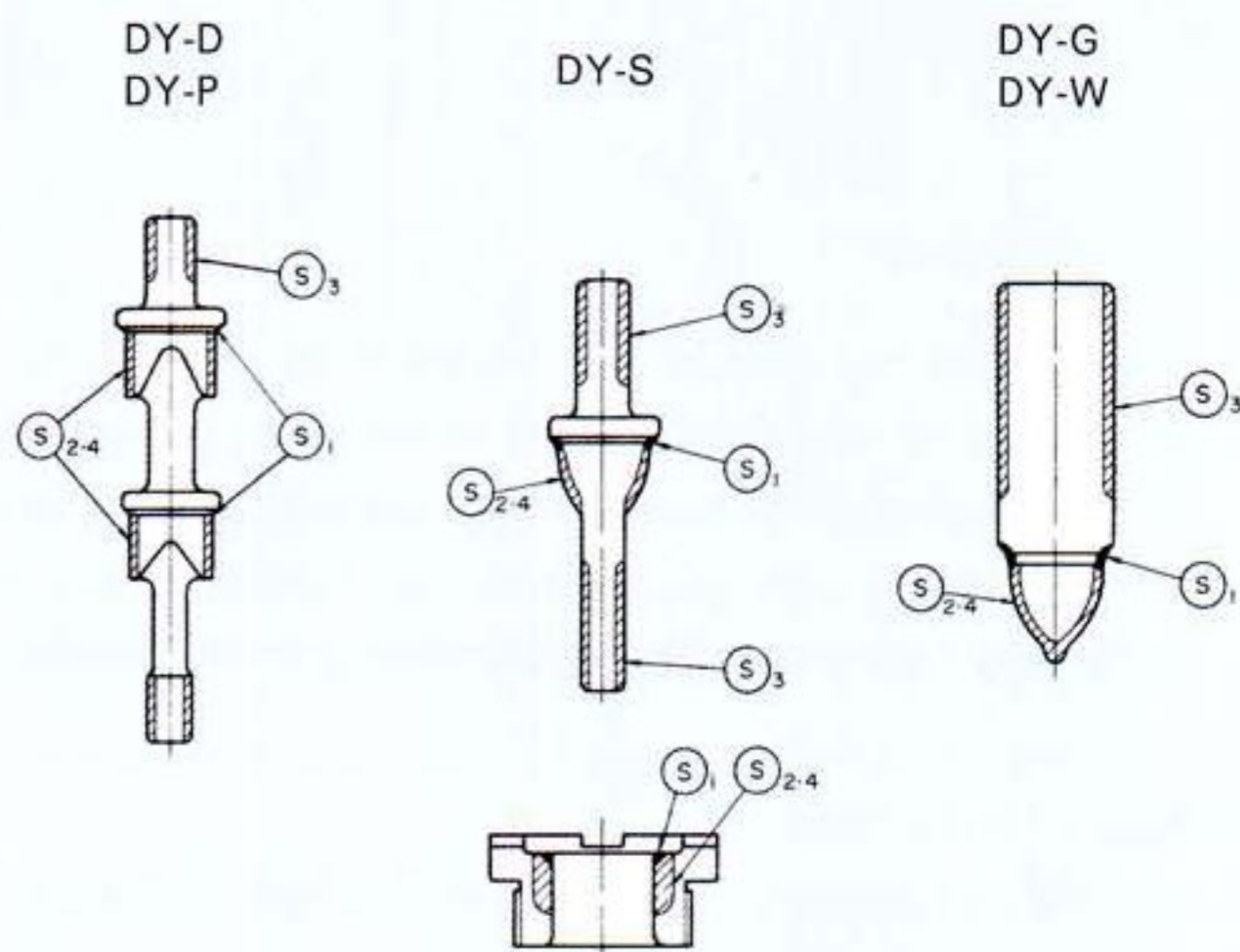
GASKET

As for gaskets, when the rating is Class 300 and under, asbestos joint seat (standard prodect of JIS B2404) is used. When the rating is Class 600 and over, spiral gasket (standard product of JIS B2404) is used.

For low temperature fluids such as LPG and LNG. PTFE type gaskets are used.

For valves of nuclear power use, gasket with restricted content of chlorine ion is used.

Table 5.5 Standard selection of gaskets

○ : Applicable item

		Joint seat	Spiral gasket	
			PTFE	Flezible graphite
General	Cage type		○	○
	General purpose type	○	○	○
For high temperature				○
For low temperature			○	○
For strict sealing				○

BOLTS AND NUTS

The standard materials of the bolts and nuts of the pressure containing part are as shown in Table 5.6.

Table 5.6 Standard materials of bolts and nuts

Valve body material	temper- ature ℃	Bolt	Nut
FC·FCD Meehanite		SS400	
CAC 403, 406		SUS 304	C 3771
SCPH2 (WCB) S25C·S45C		S45C or SNB 7	S45C
SCPH11 (WC1)·F1 SCPH21 (WC6)·F11 SCPH32 (WC9)·F22 SCPH61 (C5)·F5a	Within specified valves	SNB 16	ASTM A194 Gr 4
SCS13 (CF8)·13A SCS14 (CF8M)·14A USCS13 USCS14 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 with strain hardening so as to prevent seizure.

As for bolts and nuts which are specially specified such as those for nuclear power plant, the applicable requirements are followed.

GLAND PACKING

Gland packing should be resistant to secular distorsion and heat cycle so as to possess stable properties of low friction and sealing for a long period. Otherwise, the contorol performance of the contorol valve itself can not be maintained. The properties of low friction and sealing of this important gland packing are guaranteed 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).

Criteria of selection

An optimum gland packing is selected to suit the individual specifications required, according to Table 5.7 "Selection of gland packing".

As for packings, four types have been carefully chosen out of packing said to be universal to ordinary gases, liquids and vapors except special chemicals. The properties of these selected packings (in terms of heat resistance, pressure resistance, low friction, and sealimg effect) have been clarefied by experimental studies conducted over many years. In the actual application, their functional combinations have been classified and standardized into four basic types which fully utilize the properties of each packing. For special service conditions, the requirements can be fully met by partially altering the combination of packings.

Table 5.7 Selection of gland packing
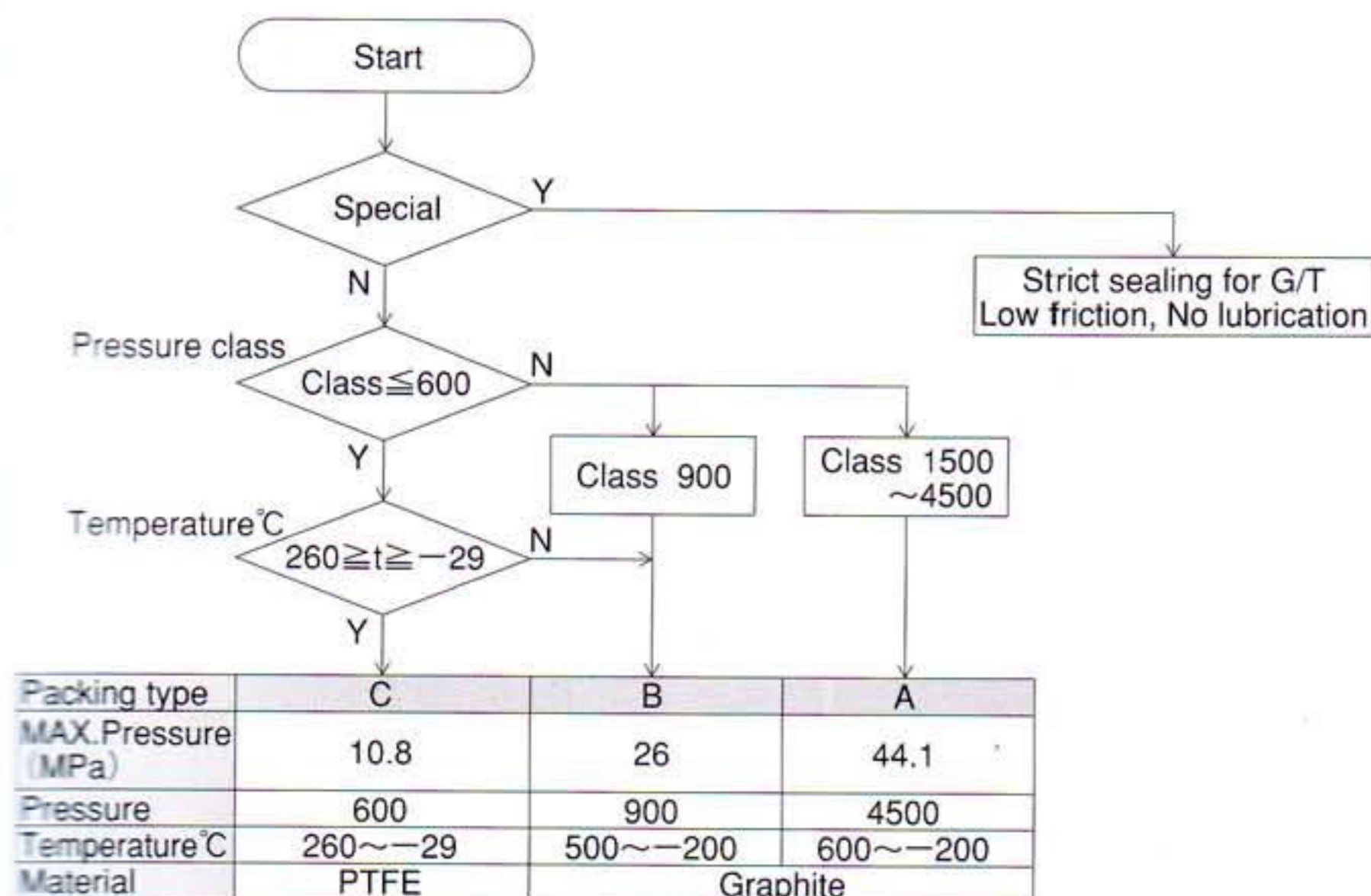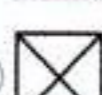
[Remarks]
1. Nuclear power used are not applicable.
2. The selection table and the arrangement diagram show the basic ones.

Start → Special — Y → Strict sealing for G/T Low friction, No lubrication

Special — N → Pressure class Class≦600 — N → Class 1500 ~4500

Class≦600 — Y → Temperature ℃ 260≧t≧−29 — N → Class 900

260≧t≧−29 — Y →

Packing type	C	B	A
MAX.Pressure (MPa)	10.8	26	44.1
Pressure	600	900	4500
Temperature ℃	260~−29	500~−200	600~−200
Material	PTFE	Graphite	

Fig. 5D Gland packing type and installation

A   B   C   D
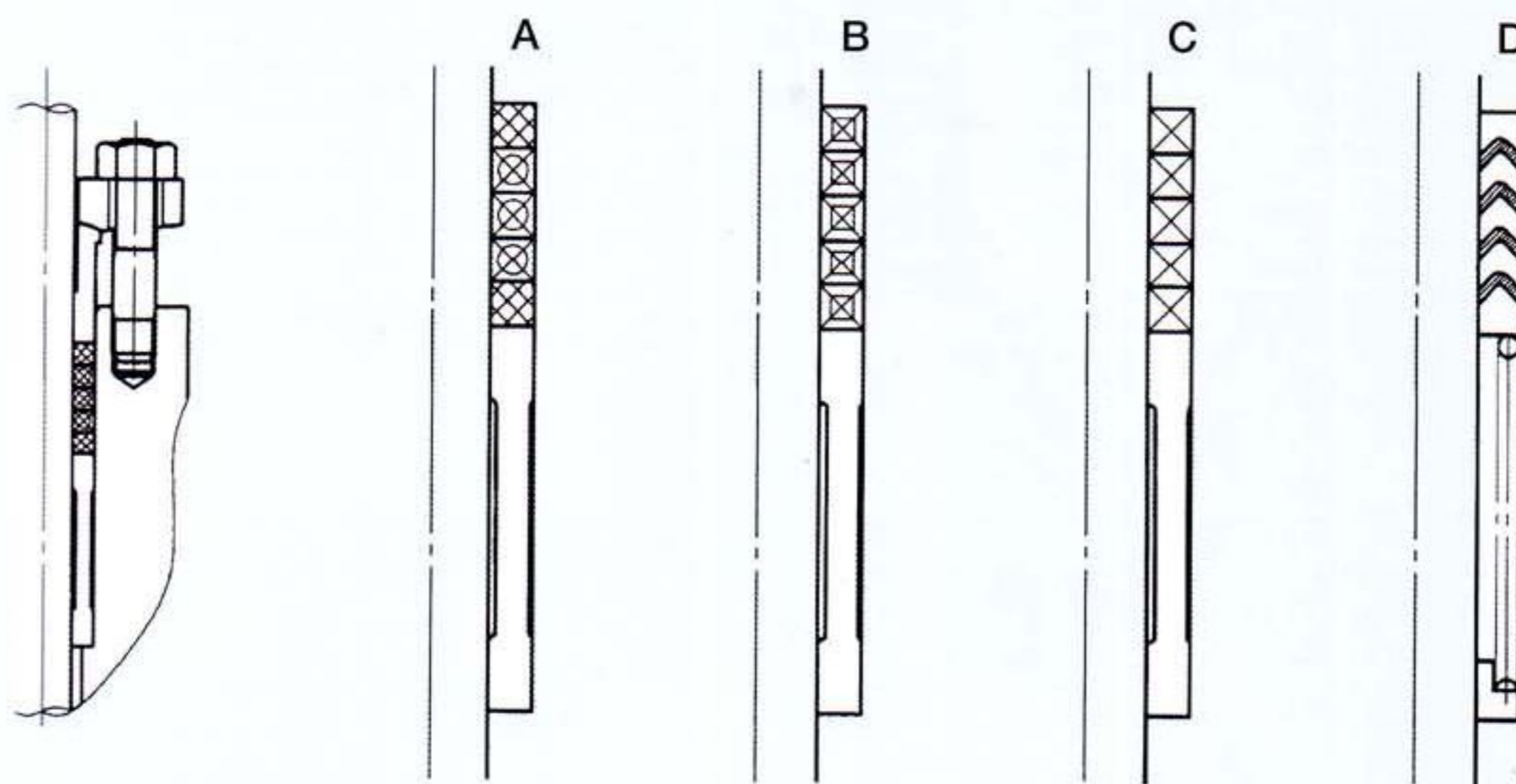
=Type of gland packing=

① : Adaptor packing in a bag woven from Monel-nire reinforced graphite yarn.

② : Heat resistent antierosion is mixed into graphite and maldet, to be joint-used with①

③ : A bag wouen from Monel-wire reinforced graphite yarn and its surface is heat-treated with graphite.

④ : The core of carbon fiber is covered in a bag woven from PTFE fiber.

⑤ : V-shape molded PTEF.

PREFACE

In the pursuit of further economics, safety and reliability, technical innovations are now endlessly appearing in industrial plants. Automatic control systems which determine the economics and safety of plants have been increasingly sophisticated and integrated by the use of computers. In the midst of these changes, the importance of tha role of [control valves] which directly control fluids as tha final process control elements can not be overemphasized. More reliability and safety are required of [control valves] as well as their accessories.

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 have been appreciating our technology and quality control system highly, and our plant has designated as their certified plant. On the other hand, the high quality and reliability of our products are quaranteed by our acquisition of type certification for very strict environmental tests of each classification society.

[NAKAKITA control valves], one of our main products, are systematized and many standard models are produced in series, on the basis of our resouceful experiences and past performances in various plants 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 much help in your making an instrumental engineering plan. We hope your selection will be made from the abundant types of [NAKAKITA control 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.

Technical terminology hereafter is based upon ASME STANDARD No.112

DY-CODO☐ CAGE TYPE DOUBLE SEATED CONTROL VALVE

The feature of this control valve is the simple construction which allows easy trim exchange in a short time without disconnecting the body from the piping during maintenance.

The cage has flow characteristic ports in its circumference. The plug guided by the cage has balance holes. With this arrangement, unbalanced forces are offset and the dynamic unbalanced force on the stem is stable over the whole range of the valve travel. This in turn reduces the load on the actuator to secure stable controllability.

As this control valve is a balancing type double seated one, it is possible to limit the leakage at full closure within 0.3%, from low temperature range up to high temperature range, by adopting materials of small thermal expansion difference for cage and valve plug.

Bodies are avaiable in two types for most of the sizes and pressure ratings; S-series body (S : standard), and E-series body (E : enlarget)。

DY-CODO cage type double seated control valve

			32A (1¼B)					40A (1½B)					50A (2B)					65A (2½B)				
RATING	JIS	(K)	5/10	16/20	30/40	63		5/10	16/20	30/40	63	(100)	5/10	16/20	30/40	63	(100)	5/10	16/20	30/40	63	(100)
	ANSI	(Class)	125/150	300	600	900		125/150	300	600	900	1500	125/150	300	600	900	1500	125/150	300	600	900	1500
	IEC (※1)	(PN-bar)	10/16	25/40	64/100			10/16	25/40	64/100			10/16	25/40	64/100			10/16	25/40	64/100		
RATED (※2) Cv VALUE (Value by reduced valve plug)	Flow characteristics Eq % Liner ※2	S series body	[9.5]	18			(※2)	[9.5 18]		26		(※2)	[18 26]		36		(※2)	[36 48 56]			72	(※2)
	Quick opening	E series body	21				(※2)	36				(※2)	55				(※2)	100				(※2)
DIMENSIONS (mm)	Face to Face L (※3)		200	213	229	275	—	222	235	251	295	320	254	267	286	310	380	276	292	311	365	430
	Height	G	50				—	55			60	65	70				75	70			75	80
		H (※4)	708				—	715				800	796				818	812				905
	Additional valve to H	With fin	100				—	100					100					100				
		With hand wheel Top	185				—	185				215	215				276	215				276
		Side	0				—	0				0	0				0	0				0
Km / XT		(※7)	0.82 / 0.69					0.82 / 0.69					0.79 / 0.66					0.81 / 0.68				

ALLOWABLE PRESSURE DROP (MPa) (※5) — Actuator size (J) mm / Off Balance (kPa)

Actuator size (J) mm	Off Balance (kPa)	32A	40A	50A	65A
275	20	1.4	1.2		
	40	2.0 / 2.8	2.0 / 2.4		
	60	4.9	4.0		
355	20	2.0 / 3.0	2.0 / 2.4	2.0	1.4
	40	4.9 / 5.9	4.8	4.0	2.0 / 2.8
	60	10.6	4.9 / 8.7	4.9 / 6.9	4.9 / 5.3
410	20		2.8	2.0 / 2.4	1.8
	40		5.5	4.8	2.0 / 3.5
	60		10.2	4.9 / 8.3	4.9 / 6.3
465	20			2.8	2.2
	40			5.5	4.4
	60			10.2	7.9
520	20				
	40				
	60				
645	20				
	40				
	60				
Mass (kg) (※6)		50 / 55 / 60 / 80 / —	50 / 55 / 60 / 90 / 130	65 / 70 / 80 / 115 / 185	80 / 90 / 100 / 145 / 225

(in case of single action diaphragm actuator)

(※1) IEC in the column of rating indicates the ratings of valve groups formed in terms of face-to face dimension.

(※2) Linear Cv value is larger than that of equal percent type by 10 to 20%. Quick open Cv value is larger than that of equal percent type by 10 to 30%. The Cv values of ANSI Class 1500 S body, and of ANSI Class 900 and 1500 E body are 65 to 85% of Cv values of ANSI Class 150~600.

(※3) As for face-to-face dimension, new face-to-face dimensions according to IEC are given up to PN 100. However, for individual items, please refer to dimension indicated on the drawing for approval for the time being. 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.

SPECIFICATIONS

Type of valve body assembly	Double seated globe type valve of casting, with cage guided plug.
Pressuere rating	JIS 5~63K or ANSI 125~1500
Normal bore	32~300A
Service temperature range	−196~550°C (−321~1022°F)
Standard materials	• Valve body assembly FC200、FCD400、CAC403、CAC406 SCPH2、11、21、32、61、SCS13、14 • Trim See Table 5.3 "Standard trim materials for cage type control valves" • Packing・Gasket (Asbestos Free) PTFE, graphite etc.

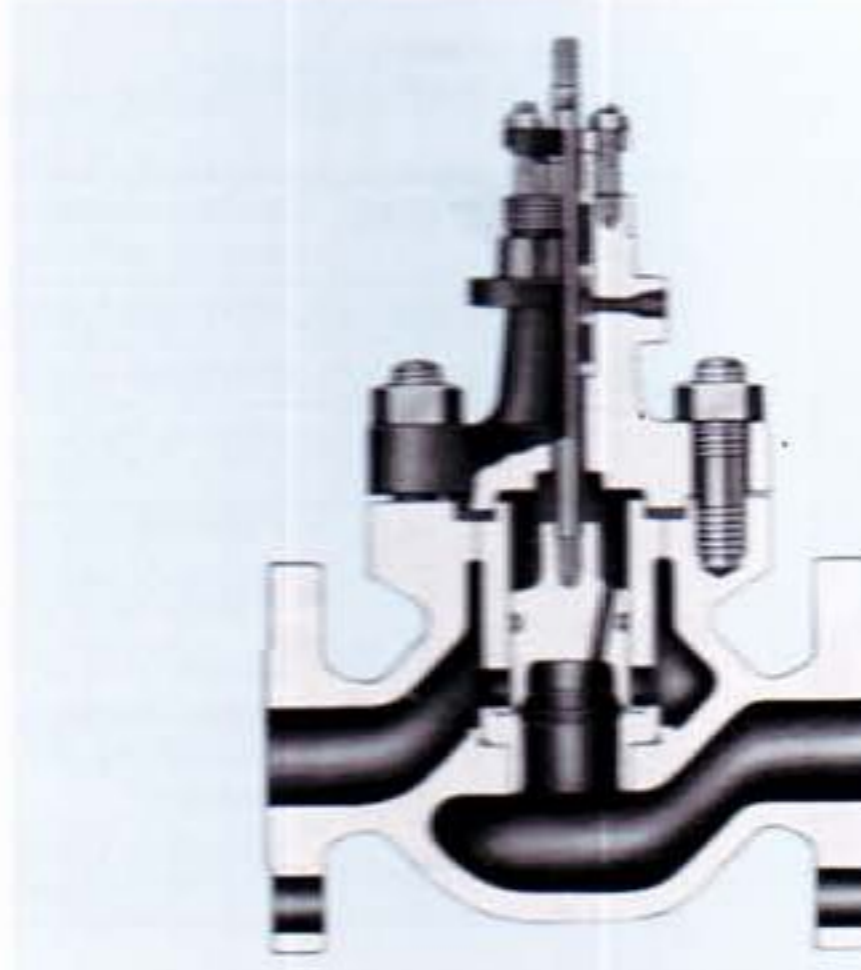|	
Cv valve	See the table below. Smaller rated Cv values not listed in the table can be manufactured with reduced size valve plug trim.
Flow characteristics	Equal percentage. Modified Parabolic, and Linear.
Performance	• Rangeability 50 : 1 • Leakage at full closure Not more than 0.3% of the rated Cv.
Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action diaphragm pressure drop is used. Maximum pressure drop is shown in the table below.
Dimensions and mass	See the table below and the drawing in it.

DY-CODOO

Dimensions, Cv and mass table

Size	80A (3B)					100A (4B)					125A (5B)					150A (6B)				200A (8B)			250A (10B)			300A (12B)		
JIS K	5/10	16/20	30/40	63	(100)	5/10	16/20	30/40	63	(100)	5/10	16/20	30/40	63	(100)	5/10	16/20	30/40	—	5/10	16/20	—	5/10	16/20	—	5/10	16/20	—
ANSI	125/150	300	600	900	1500	125/150	300	600	900	1500	125/150	300	600	900	1500	125/150	300	600	—	125/150	300	—	125/150	300	—	125/150	300	—
(PN)		10/16	25/40	64	100		10/16	25/40	64	100		10/16	25/40	64	100		10/16	25/40	—		10/16	—		10/16	—		10/25	—
Cv	[56	72]	96		(※2)	[72	96	125]	155	(※2)	[125	155	190]	250	(※2)	[190	275]	390		[276	390]	500	800			950		
Cv		130			(※2)		230			(※2)		275			(※2)		—				730		950			1200		
L	298	317	337	375	470	352	368	394	445	550	403	425	457	510	690	451	473	508	—	543	568	—	673	708	—	737	775	—
	80			85	90	100				105	110			115	120	125			—	170		—	215		—	260		—
Mass	830				920	965				1090	1090				1270	1120			—	1325		—	1590		—	1640		—
	100					100					140					140			—	150		—	160		—	170		—
	215				276	276				330	330				522	330			—	522		—	528		—	528		—
	0				0	0				200	0				250	200			—	250		—	250		—	250		—
FL / xT	0.80/0.67					0.81/0.68					0.78/0.66					0.78/0.66				0.77/0.65			0.81/0.68			0.82/0.69		
(bottom)	105	115	125	155	250	160	170	190	250	380	260	275	305	360	640	310	325	360	—	490	510	—	710	730	—	870	890	—

Maximum allowable pressure drop (MPa) (additional values, read across size/rating columns)

1.2				
2.4				
4.4				
1.4	1.2			
2.0 / 2.8	2.4			
4.9 / 5.1	4.2			
1.8	1.4	1.2	1.0	
3.6	2.0 / 2.8	2.4	2.0	
6.5	4.9 / 5.3	4.2	3.5	
1.7	1.4	1.2		
3.4	2.0 / 2.8	2.4		
6.1	4.9	4.2		
2.4	1.5	1.2	1.0	
4.8	2.0 / 3.0	2.0 / 2.4	2.0	
8.5	4.9	4.4	3.6	

Dimensional drawing

(Handwheel / Side type) (Handwheel / Top type)

ø J, H, G, L

※4 H dimension gives the longest dimension of the valve with standard type bonnet. However, in cases of fin type bonnet or handwheel installation, add the respective [additional H valve] of the table above to H.

※5 Allowable pressure drop and actuator shown in the table are for S series. Those for E series may differ slightly.

※6 Mass indicated is that of a valve with fin type bonnet, handwheel and positioner (=maximum mass).

※7 FL valve has a relationship with FL² = Km = X_T/0.84.

DY-COBS□ CAGE TYPE SINGLE SEATED CONTROL VALVE

DY-COBSO

This control valve is a cage guided single seat valve of cage type balancing construction. Leakage at full closure is minimum, and it is far more suited than ordinary single seated valves to handle fluids of large pressure drop.

SPECIFICATIONS

Type of valve body assembly	Balancing type, single seated globe valve of casting, with cage guided plug.
Pressure rating	JIS 5～63K, or ANSI 125～900
Nominal bore	32～300ᴬ
Service temperature range	−30～200℃
Standard materials (JIS)	• Valve body assembly FC200、FCD400、CAC403、CAC406 SCPH2、11、21、32、61、SCS13、14 • Trim See Table 5.3 "Standard trim materials". • Packing・Gasket (Asbestos Free) PTFE, graphite etc

Cv value	See the table below
Flow characteristics	Equal percentage, modified Parabolic, and linear.
Performance	• Rangeability 50 : 1 • Leakage at full closure Not more than 0.01% of the rated Cv value.
Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action diaphragm type is normally used. maximum shown in the table below.
Dimensions and mass	See the table below and the dimensional drawing (page 20)

NOMINAL BORE mm(inch)			32ᴬ (1¼ᴮ)			40ᴬ (1½ᴮ)			50ᴬ (2ᴮ)			65ᴬ (2½ᴮ)			80ᴬ (3ᴮ)			100ᴬ (4ᴮ)			125ᴬ (5ᴮ)			150ᴬ (6ᴮ)			200ᴬ (8ᴮ)			250ᴬ (10ᴮ)		300ᴬ (12ᴮ)	
RATING	JIS (K)		5 10	16 20	30 40	5 10	16 20	30 40	5 10	16 20	30 40	5 10	16 20	30 40	5 10	16 20	30 40	5 10	16 20	30 40	5 10	16 20	30 40	5 10	16 20	30 40	5 10	16 20	5 10	16 20
	ANSI (Class)		125 150	300	600	125 150	300	600	125 150	300	600	125 150	300	600	125 150	300	600	125 150	300	600	125 150	300	600	125 150	300	600	125 150	300	600	125 150	300	125 150	300
	IEC (PN-bar) ※		10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	10 16	25 40
RATED Cv VALUE Value by reduced valve plug	Flow Characteristics Eq% (Linear Quick opening)	S	[9.5]		18	[9.5	18]	26	[18	26]	36	[36 56	48]	72	[56	72]	96	[72 125	96]	155	[125 190	155]	250	[190 275]		390	[275 390]		500	800		950	
		E	21			36			55			100			130			230			275			—			730			950		1200	
DIMENSIONS (mm)	Face to Face L ※1		200	213	229	222	235	251	254	267	286	276	292	311	298	317	337	352	368	394	403	425	457	451	473	508	543	568	610	673	708	737	775
	Height G		50			55			70			70			80			100			110			125			170			215		260	
	Height H ※2		708			715			830			796			812			965			1090			1120			1325			1590		1640	
	Additional value; with handwheel		185			185			215			215			215			276			330			330			522			528		528	
Km／Xᴛ			0.82／0.69						0.79／0.66			0.81／0.68			0.80／0.67			0.81／0.68			0.78／0.66			0.78／0.66			0.77／0.65			0.81／0.68		0.82／0.69	

ALLOWABLE PRESSURE DROP (MPa) (in case of single action diaphragm actuator)	Actuator size (J)	Off Balance (kPa)		32A		40A		50A		65A		80A		100A		125A		150A		200A		250A	300A
	275	20		1.0		0.9																	
		40		2.0		1.8																	
		60			4.0	2.0	3.2																
	355	20	2.0	2.2		1.8		1.5		1.2		1.0											
		40		4.4	2.0	3.6	2.0	3.0	2.0	2.4		2.0											
		60	4.9	8.1		4.9	6.7	4.9	5.3		4.0		3.8										
	410	20						1.8		1.4		1.2		0.9									
		40			2.0		3.6	2.0	2.8	2.0	2.4		1.8										
		60					4.9	6.4		4.8		4.2	2.0	3.4									
	465	20												1.2		1.0		0.8					
		40											2.0	2.4		2.0		1.6					
		60												4.2		3.5	2.0	3.0					
	520	20													1.2		1.0		0.7				
		40											2.0		2.4		2.0		1.5				
		60													4.2		3.5	2.0	2.8				
	645	20																1.2		1.0		0.8	
		40														2.0		2.5		2.0		1.6	
		60																3.6			3.6	2.0	3.0

Mass (kg) (※3)	50	55	60	50	55	60	65	70	80	80	90	100	105	115	125	160	170	190	260	275	305	310	325	360	490	510	660	710	730	870	890

(※1) As for face-to-face dimension, new face-to-face dimensions according to ICE are indicated. However, for individual items, please refer to the dimension indicated on the drawing for approval for the time being. 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.

(※2) H dimension gives the longest dimension of the valve with standard type bonnet. However, when a handwheel is mounted, add the respective value shown above to H.

(※3) Mass indicated is that of a valve with handwheel and positioner(= the maximum mass).

* ICE in the column of rating indicates the ratings of valve groups formed in terms of face-to-face dimension.

DY-CEDO☐ CONTROL VALVE WITH CAVI-CAGE

DY-CEDOO
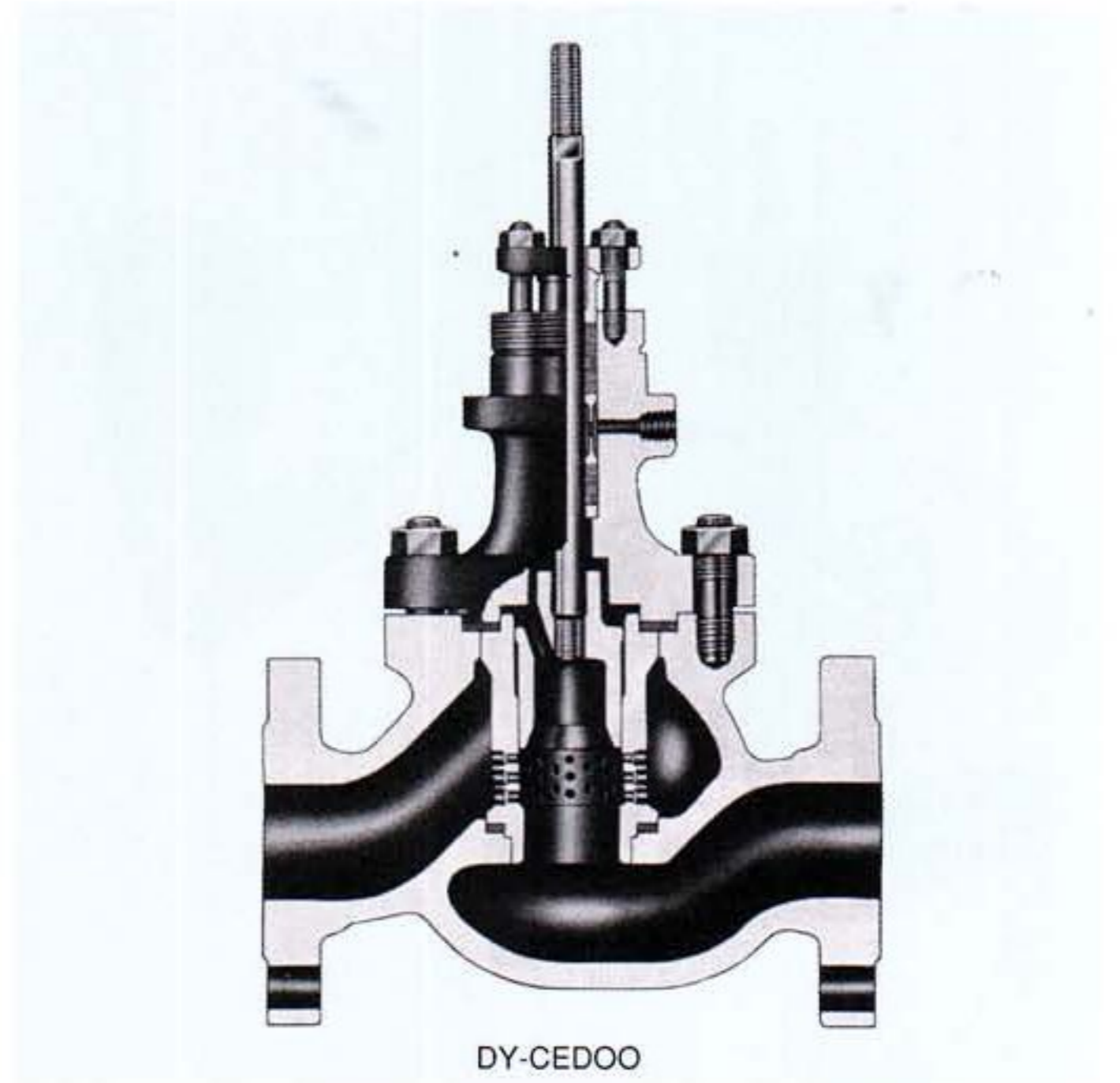
This control valve is equipped with trim-exchangeable multiport cage. It is used to prevent erosion of the body and trim.

In boiler feedwater contorol valves, etc., the pressure drop at start-up or during low load running may become excessive and come into the range of caviation generation. It reduces the service life of the body and trim and causes maintenance problems.

The cavi-cage has such construction that the fluid jets into the cage towards its center through small holes in the circumference of the cage. At the throttle of each small hole, the static pressure decreases due to high velocity of the fluid, and the resulting choked flow generates bubbles which cause cavitation. These jets are arranged to collide with each other directly in the center of the channel to dissipate cativation energy.

Erosion of the body and trim is thus prevented by arranging small holes opposing with each other in the circumference of the cage to suit the flow characteristic.

SPECIFICATINS

Type of valve body assembly	Double seated globe valve of casting, with multi-hole port cage.	Cv value	40~60% of those shown on page 19, 20. (Km value: 0.88)
Pressure rating	JIS 5~63K or ANSI 125~2500	Flow characteristics	Equal percentage, Parabolic, and Linear.
Nominal bore	32~300A	Performance	● Rangeability 20 : 1
Service temperatur range	−196~550℃		● Leakage at full closure Not more than 0.5% of the rated Cv value.
Standard materials (JIS)	● Valve body assembly SCPH2 · 11 · 21 · 32 · 61, SCS13 · 14	Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action diaphragm type is normally used. Maximum allowable pressure drop is shown on page 19 and 20.
	● Trim See Table 5.3 "Stndard trim materials for cage type control valves"	Dimensions and Mass	See the table (page 19 and 20) and the dimensiosal drawing (page 20).
	● Packing · Gasket (Asbestos Free) PTFE, graphite etc.		

DY-CNDO□ LOW NOISE CONTROL VALVE

DY-CNDOO

DY-CCSS□ UNBALANCED SINGLE SEATED CONTROL VALVE WITH CAGE GUIDED PLUG

DY-CCSSO
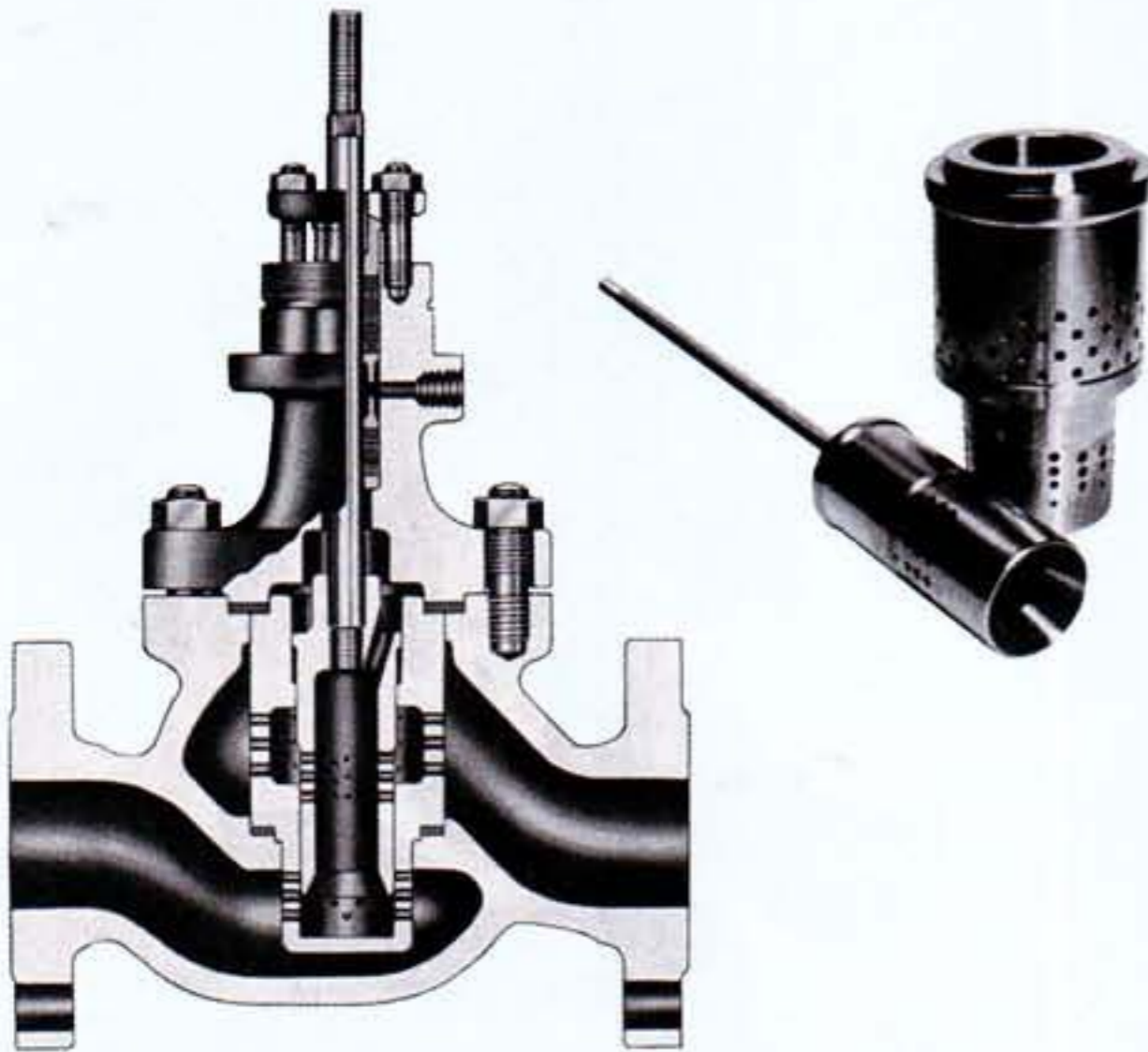
This contorol valve exhibits effective noise reduction by means of multi-stage pressure reduction and dispersion of the flow and frictional resistance into many small hole throttles. It has a unique construction developed by NAKAKITA.

The flow of the liquid enters the plug, from the lower side of the body, through the control port consisting of many small holes in the lower portion of the cage. The flow then goes through the control port consisting of small holes in the central portion of the plug and enters the recess at the center of the cage, and the flow velocity is reduced. This flow then runs out to the downstream side of the body, through the small holes of fixed resistance in the outer circumference of the cage, in dispersed small streams.

In this way, pressure reduction and flow dispersion are repeated through three stages consisting of two-tier control ports and fixed orifice, so as to reduce the noise.
For noise countermeasures, see page 60.

This control valve is an unbalanced single seated valve with rigid trim construction where P-port heavy guide plug is guided by the cage. As for its actuator, a powerful high output diaphragm type or cylinder type is used.

The stored cage receives the jet out of the throttle and releases the flow through small holes in the circumference of the cage to the body side. It thus protects the inner wall of the body from erosion due to the jet of the flud.

This valve is used for large pressure drop service which generates flashing, cavitation, etc. One of the main application is the emergency drain escape valve of high pressure feedwater heater.

SPECIFICATION

This low noise control valve is DY-C control valve equipped with low noise trim. For the detailed specification, see those of DY-CODO double seated control valve (pages 19 and 20).

Cv value	25~40% of those shown in the table (page 19). (Km value; 0.9 X$_T$ Value; 0.76)
Flow characteristics	Equal percentage, Parabolic, and Linear.
Performance	● Rangeability 20 : 1 ● Leakage at full closure Not more than 0.5% of the rated Cv value

For other specifications, see the specifications on page 20.

▊DY-CNDO Cv TABLE

Nominal bore mm	50^A	65^A	80^A	100^A	125^A	150^A	200^A	250^A	300^A
Max.Cv value	15	24	34	60	96	140	250	360	500
	12.5	18	26	48	72	105	190	275	390
	9.5	14	20	36	56	76	135	190	275

SPECIFICATIONS

Type of valve body assembly	Single seated valve, with P-port heavy guided plug, and cage
Pressure rating	JIS 5~63K, ANSE 150~900.
Nominal bore	50~200A
Service temperature range	−196~550℃ (−321~1022°F)
Standard materials	See the specifications on page 20.
Cv value	Maximum Cv value is indicated in the table below. However, reduced valve plug is normally used. (Km value: 0.8 X$_T$ value: 0.67)

▊DY-CCSS Cv TABLE

Nominal bore mm	50^A	65^A	80^A	100^A	125^A	150^A	200^A	250^A	300^A
Max.Cv value	15	24	34	60	96	140	250	360	500
	12.5	18	26	48	72	105	190	275	390
	9.5	14	20	36	56	76	135	190	275

DY-LODS☐ | CAGE TYPE DOUBLE SEATED ANGLE CONTROL VALVE
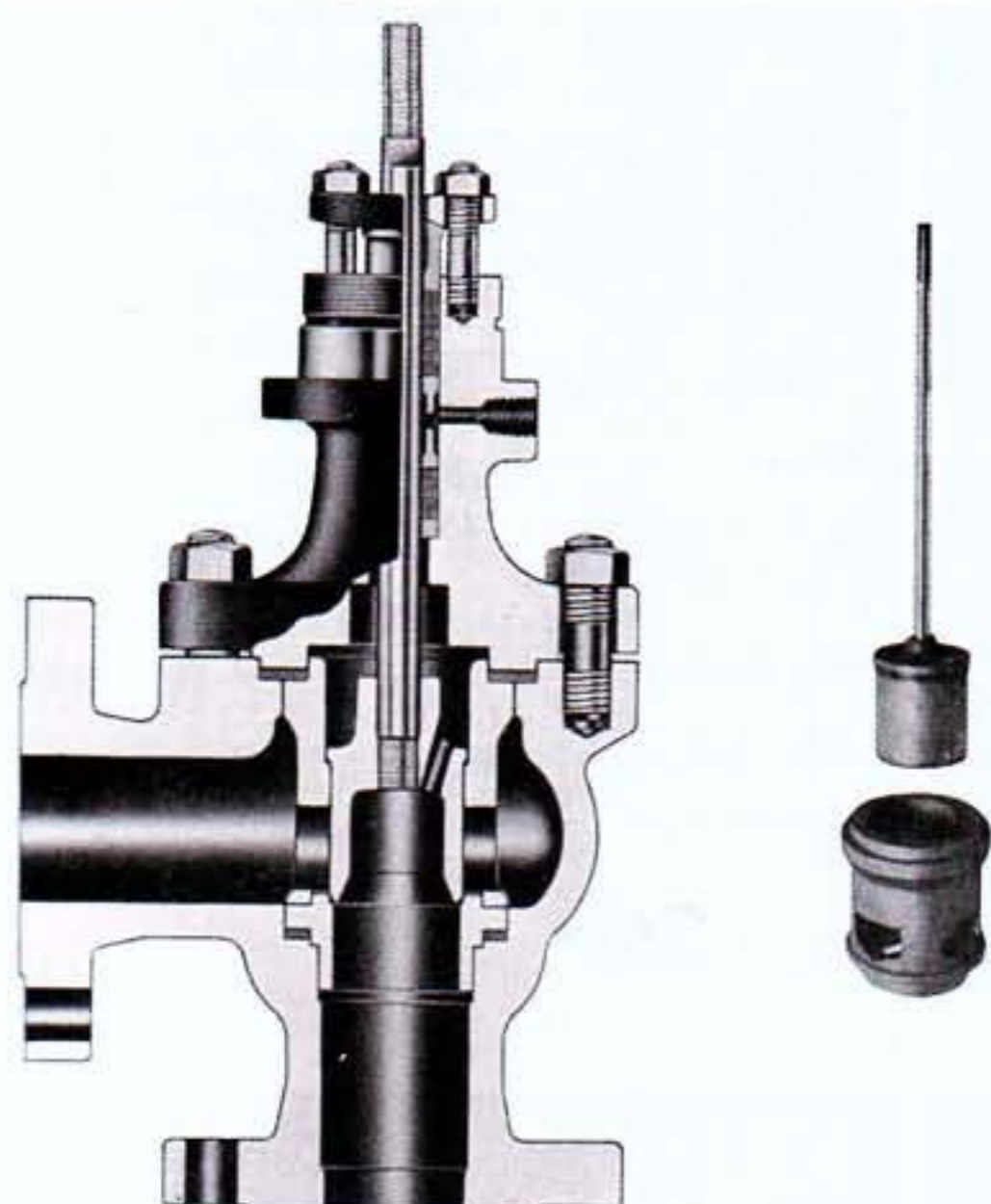
DY-LODSO

This control valve is DY-C control valve of which body type (globe type) is replaced with the angle type. Cage trim and actuator are common to the DY-C type, and this control valve allows winder application of the excellent features of DY-C type such as maintenance and controllability.

It is possible to fit cavi-cage (page 22) or low noise trim (page 23) on this valve.

■Advantage of this control valve

The installation of the protective liner which is a seat ring elongated to the downstream side prevents erosion of the inner wall of the body due to cavitation and flashing.

SPECIFICATIONS

For the detailed specifications, see those of DY-C double seated control valve (pages 19 to 20). Note that the face-to-face dimension is L/2.

■Dimensional drawing
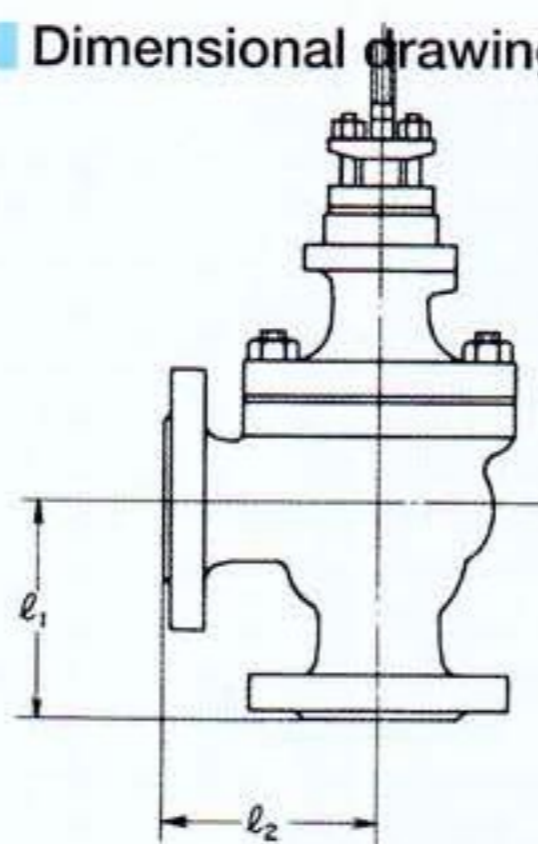
$\ell_1 = \ell_2 = L/2$

DY-COSO☐ | CAGE TYPE SINGLE SEATED CONTROL VALVE
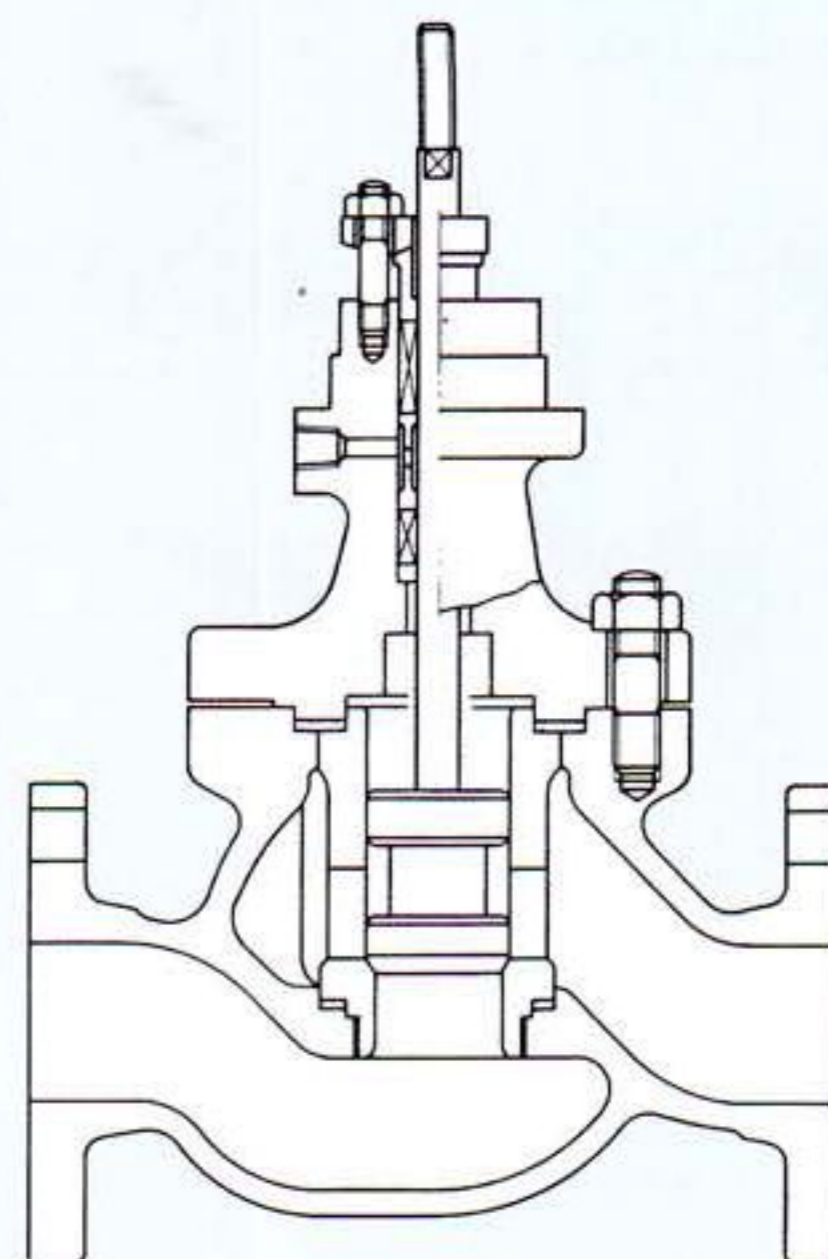
DY-COSO

This control valve is a single seated valve using cage port. It is used when low leakage is required.

As it is a single seated valve, a large force is required to close the valve. Accordingly, its use is normally confined to small pressure drop services. However, when pressure drop is large, a high output diaphragm type or cylinder type actuator is used. It is possible to meet non-leakage requirement by using soft sealing material on the seat of this valve.

SPECIFICATIONS

Type of valve body assembly	Single seated globe valve of casting, with cage port.。
Pressure rating	JIS 5～63K or ANSI 125～900
Nominal bore	32A and over.
Service temperature range	−196～550℃
Standard materials	See page 20.
Cv value	Shown on the table below Km value: 0.8 X_T value: 0.67
Flow	Equal percentage, Parabolic, and linear.
characteristcs Perfomance	● Rangeability 50 : 1
	● Leakage at full closure Not more than 0.01% of the rated Cv value.
	Refer to the technical data or apply to us for relevant information.
Dimensions and mass	See pages 19 and 20

■DY-COSO Cv TABLE

Nominal bore mm	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A	300A
Cv value	9.5	9.5	18	36	56	72	125	190	275	500	800
		18	26	48	72	96	155	275	390		
				56		125	190				
	17	29	44	80	104	184	220	−	584	760	960

DY-GCSS□ SINGLE SEATED CONTROL VALVE
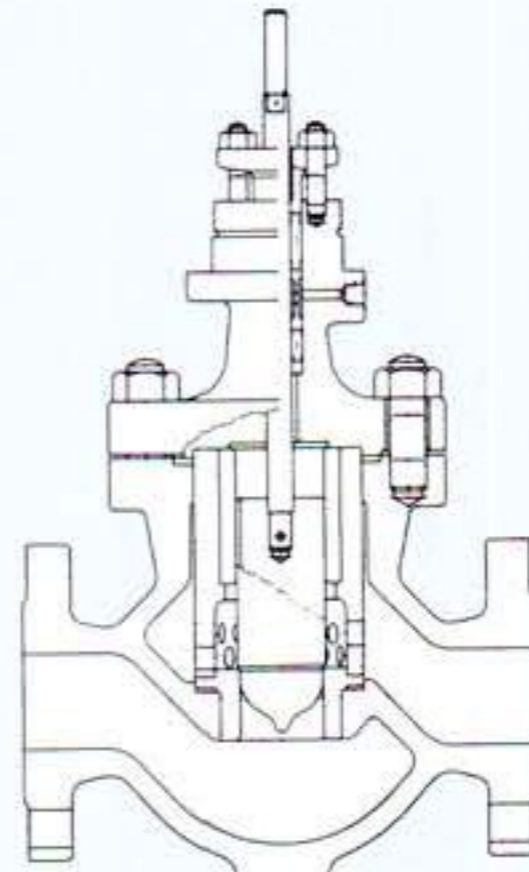
DY-GCSSO

This control valve is a single seated valve of which construction allows easy and quick replacement of trim without disconnecting the body from the piping. Special consideration is given to its durability and maintenance. As this valve allows numerous combinations of pressure rating, Cv value, valve flow characteristic, actuator, etc., a wide range of service conditions can be met by this valve.

■ DY-GC single seated control valve

NOMINAL BORE mm (inch)			20A (3/4B)									25A (1B)			
RATING	JIS (Kgf/cm²)		5, 10			16, 20		30, 40		63		5, 10	16, 20	30, 40	63
	ANSI (Class)		125, 150			300		600		900		125, 150	300	600	900
	IEC * (PN-bar)		10, 16			25, 40		64, 100				10, 16	25, 40	64, 100	
RATED Cv VALUE	Flow Characteristics	Eq%														(※1)
		Para														
		Linear	0.23	0.44	0.8	1.1	1.7	2.3	3.2	4.2	5.4	7.2		9.5	11
DIMENSIONS (mm)	Face to Face L (※2)		187			194		206		256		184	197	210	235
	H (※3)		678					705		808		678		705	808
	Height Additional value to H	With fin	105					100		115		105		100	115
		With handwheel	185							215		185			215
Km			0.9												
ALLOWABLE PRESSURE DROP (MPa) (in case of single action diaphragm actuator)	Actuator size (J) mm 275	Off Balance (kPa) 20				8.4	4.8	3.0	1.8	1.5	1.2	0.9		0.7	0.6
		40				14.9	9.5	5.9	3.5	3.0	2.4	1.8		1.5	1.2
		60					14.9	10.8	6.4	5.5	4.4	3.4		2.8	2.4
	355	20				14.9	9.7	6.1	3.8	3.2	2.4	2.0		1.6	1.4
		40					14.9	12.3	7.5	6.3	4.8	4.0		3.2	2.6
		60						14.9	13.3	11.6	8.9	6.9		5.7	4.8
	410	20					11.3	7.4	4.4	3.8	3.0	2.4		2.0	1.6
		40					14.9	14.7	8.7	7.5	5.9	4.6		3.8	3.2
		60						14.9	13.8	10.8	8.4	6.9		5.7	
Mass (kg) (※4)			38			40		55		70		42	45	60	75

(※1)   In this type, valves of bore marked (※1) can select rated Cv values of valves of bore smaller than the marked one. For example, for the valve of nominal bore 50 mm, rated Cv value can be selected from the range of Cv max. = 36 to Cv min = 0.23.

(※2)   As for face-to-face dimension, new face-to-face dimensions according to IEC are given up to JIS 40 kgf/cm² (PN 100). However, for individual orders, please refer to the dimension indicated on the drawing for approval for the time being. When the same face-to-face dimension as that of a valve already delivered is required, please infrom us the relevant serial number of the valve.

(※3)   H dimension gives the longest dimension of the valve with the standard type bonnet. In cases of fin type bonnet or handwheel installation, add the respective value shown above.

(※4)   Mass indicated is that of the valve with fin type bonnet, handwheel and positioner (= maximum mass).

  *   IEC in the column of rating indicates the ratings of valve groups formed in terms of face-to-face dimension.

SPECIFICATIONS

Type of valve body assembly	Cage guided type single seated globe valve of casting.
Pressure rating	JIS 5~63K or ANSI 125~900
Nominal bore	20~50A
Service temperature range	−196~550°C (−321~1022°F)
Standard materials	• Valve body assembly FC200、FCD400、CAC403、CAC406 SCPH2、11、21、32、61、SCS13、14 • Trim See Table5.3 "Standard trim materials" • Packing・Gasket (Asbestos Free) PTFE, graphite etc.

Cv value	See the table below. (Values down to the minimim Cv value 0.07 can be manufactured)
Flow characteristics	Equal percentage, parabolic, and linear.
Perfomance	• Rangeability 20:1~30:1 • Leakage at full closure Not more than 0.01% of the rated Cv value.
Maximum allowable	Diaphragm type or cylinder type actuator can be mounted. Single action diaphragm type is normally used. allowable pressure drop is shown in the table below.
Dimensions and mass	See the table below and the drawing on the right.

■ Dimensional drawing

Ho＝H＋(additional value in the table)

32A (1¹/₄B)				40A (1¹/₂B)				50A (2B)			
5, 10	16,20	30, 40	63	5, 10	16,20	30, 40	63	5, 10	16,20	30, 40	63
125,150	300	600	900	125,150	300	600	900	125,150	300	600	900
10, 16	25,40	64,100		10, 16	25,40	64,100		10, 16	25,40	64,100	
			(※1)				(※1)				(※1)
14		18		20		26		36			
200	213	229	275	222	235	251	295	254	267	286	310
698		708	776	792		790	796	826		822	830
98	100			100				100			
185			215	185			215	215			
0.9				0.8							
0.5				0.4				0.3			
1.0				0.7				0.5			
1.8				1.2				0.9			
1.0				0.7				0.5			0.3
2.0				1.4				1.0			0.6
3.6				2.5				1.8			1.1
1.2				0.9				0.6			0.4
2.4				1.7				1.2			0.8
4.4				3.0				2.2			1.4
45	50	60	80	55	60	70	90	75	80	90	110

[Remarks]

1. In the table above, dimnsions correspond to the respective ratings in the column of rating.
2. In the table above, maximum allowable pressure drops correspond to the respective Cv values of the column of rated Cv value. (For example, when Cv = 3.2, if the actuator size (J) is 275 and off-balance pressure is 40 kPa, the allowable pressure drop is 35 MPa.)

DY-WCSS□ SINGLE SEATED CONTROL VALVE FOR HIGH PRESSURE AND HIGH TEMPERATURE USE

DY-WCSSF
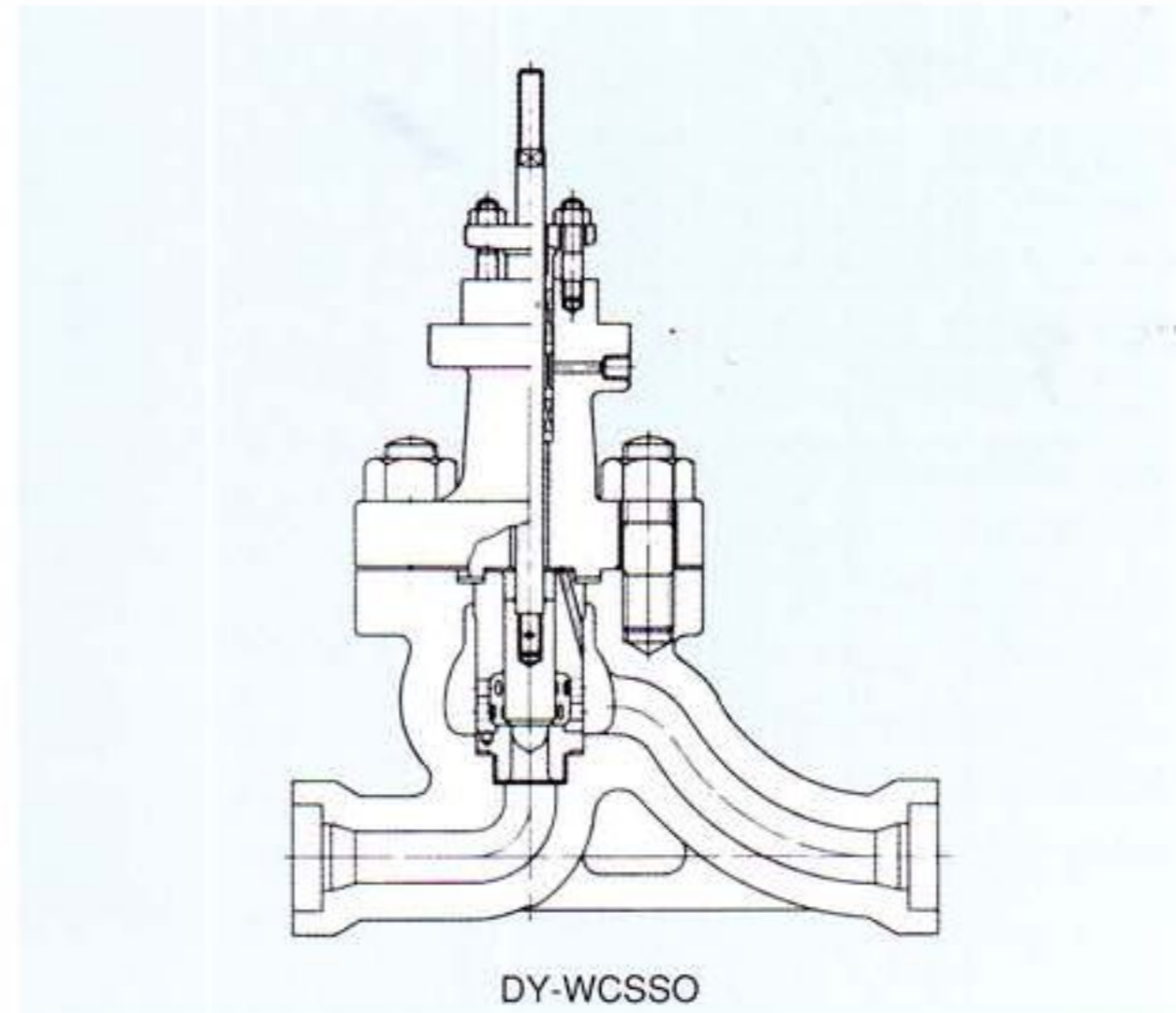
DY-WCSSO

This control valve is, so to speak, DY-GC control valve of which pressure raiting is raised to 1500 or 2500. It is a single seated valve with due consideration given to its durebility and maintenance. The body is shaped in a wave from most suited to high pressure and high velocity fluids so as to secure smooth flow.

SPECIFICATINS

Type of valve body assembly	Single seated globe valve of casting, with cage guided plug.
Pressure rating	ANSI 1500, 2500
Nominal bore	20~50A
Maximum service temperatur	550℃ (1022°F)
Standard materias (JIS)	• Valve body assembly SCPH2・11・21・32, SCS13・14 • Trim SUS304, SUS316, with hard facing stellite, etc. • Packing・Gasket (Asbestos Free) PTFE, graphite etc.

Cv value	See the table below. (Km value: 0.8)
Flow characteristics	Equal percentage, parabolic, and linear.
Performance	• Rangeability 20：1 ～ 30：1 • Leakage at full closure Not more than 0.01% of the rated Cv value.
Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action diaphragm type is mormally used. Maximum allowable pressure drop is shown in the table below.
Dimensions and mass	See the table and the drawing below.

■ DY-W Single seated control valve for high pressure and high temperature use

NOMINAL BORE mm (inch)					20A (3/4B)									25A (1B)	32A (1¼B)	40A (1½B)	50A (2B)
RATING	ANSI (Class)							1500			2500						
	IEC (PN-bar)							—									
DIMENSIONS (mm)	Face to Face L							380									
	Height	Additional value to H	H (※2)					975									
			With fin					130									
			With handwheel					276									
	Actuator J			Refer to following (J)													
RATED Cv VALUE	Flow Charac- teristics	Eq %													(※1)		
		Para															
		Linear	0.23	0.44	0.8	1.1	1.7	2.3	3.2	4.2	5.4	7.2		9.5		11	
ALLOWABLE PRESSURE DROP (MPa) (in case of single action diaphragm actuator)	Actuator size (J) mm	410	Off Balance (kPa)	20	20.6		11.3	7.4	4.4	3.8	3.0	2.4		2.0		1.6	
				40	41.2		23.1	14.7	8.9	7.7	5.9	4.6		4.0		3.2	
				60			41.7	27.1	16.1	13.8	10.6	8.4		6.9		5.7	
		465		20	25.9		14.6	9.4	5.5	4.8	3.6	3.0		2.4		2.0	
				40	41.7		29.0	18.7	11.0	9.7	7.3	5.9		4.8		4.0	
				60			41.7	34.2	20.2	17.5	13.4	10.6		8.7		6.9	
Mass (kg) (※3)								125									

■ Dimensional drawing
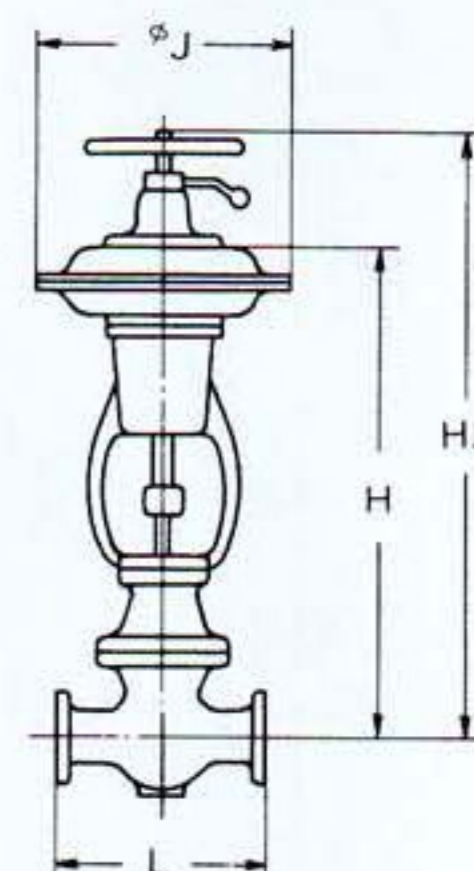

Ho=H+ (additional value in table)
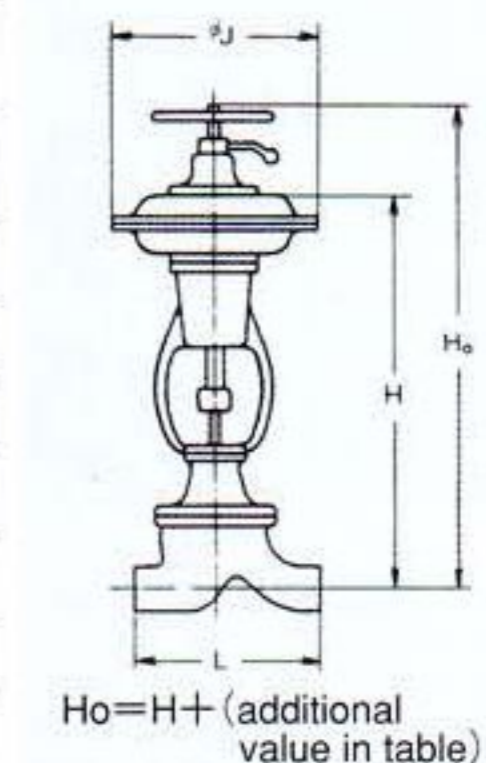
(※1) In this type, for valves of bore marked (※1), rated Cv values of valves of bore smaller than the marked one can be selected. For example, for the valve of nominal bore 50A rated Cv value can be selected in the range from Cv max. =11 to Cv min. =0.23。

(※2) H dimension gives the longest dimension of the valve with the standard bonnet. However, in cases of fin type bonnet or handwheel installation, add the respective value shown above. For individual orders, please refer to the dimensions indicated in the drawing for approval.

(※3) Mass indicated is that of the valve with fin type bonnet, handwheel and positioner (= maximum mass).

DY-WCLS□ / DY-GCLS□ CONTROL VALVE WITH LABYRINTH TRIM

DY-WCLSO
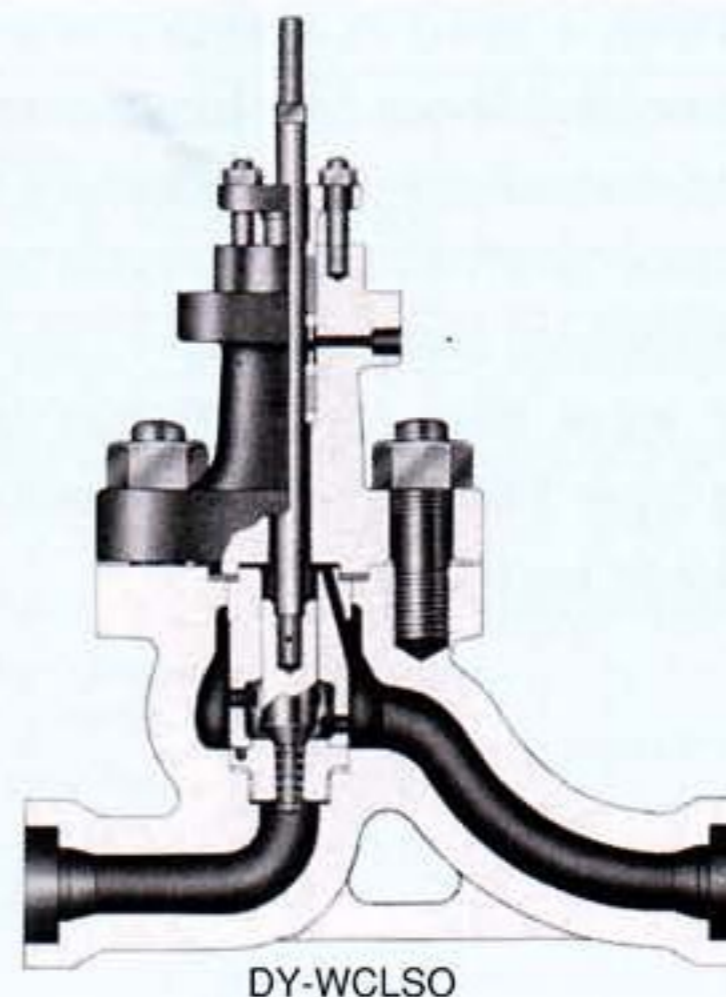
This control valve is trim-exchangeable DY-GC or DY-W control valve equipped with this labyrinth trim. It is normally used for prevention of erosion due to incompressibile fluids.

Generally speaking, control valves used as feedwater control valve for boiler start-up, feedwater pump recirculation valve, hot water control valve for desuperheater, etc. experience large pressur drop, and cavitation generated in the throttle will cause many problems such as erosion, vibration and noise.

This valve uses the labyrinth trim (tapered plug or valve seat) so as to divide a large a pressure drop into many stages by means of the groves made in the plug as shown in the figure below and prevent generation of cavitation.

As for the distribution of the pressure drop over the labyrinth trim, as shown in the figure below, the first stage is large and the final stage is vary small. The distribution is made effectively according to the effective characteristic of the process, and the static pressure in the throttle is carefully kept above the saturated pressure at which cavitation will be generated.

DY-WCLS
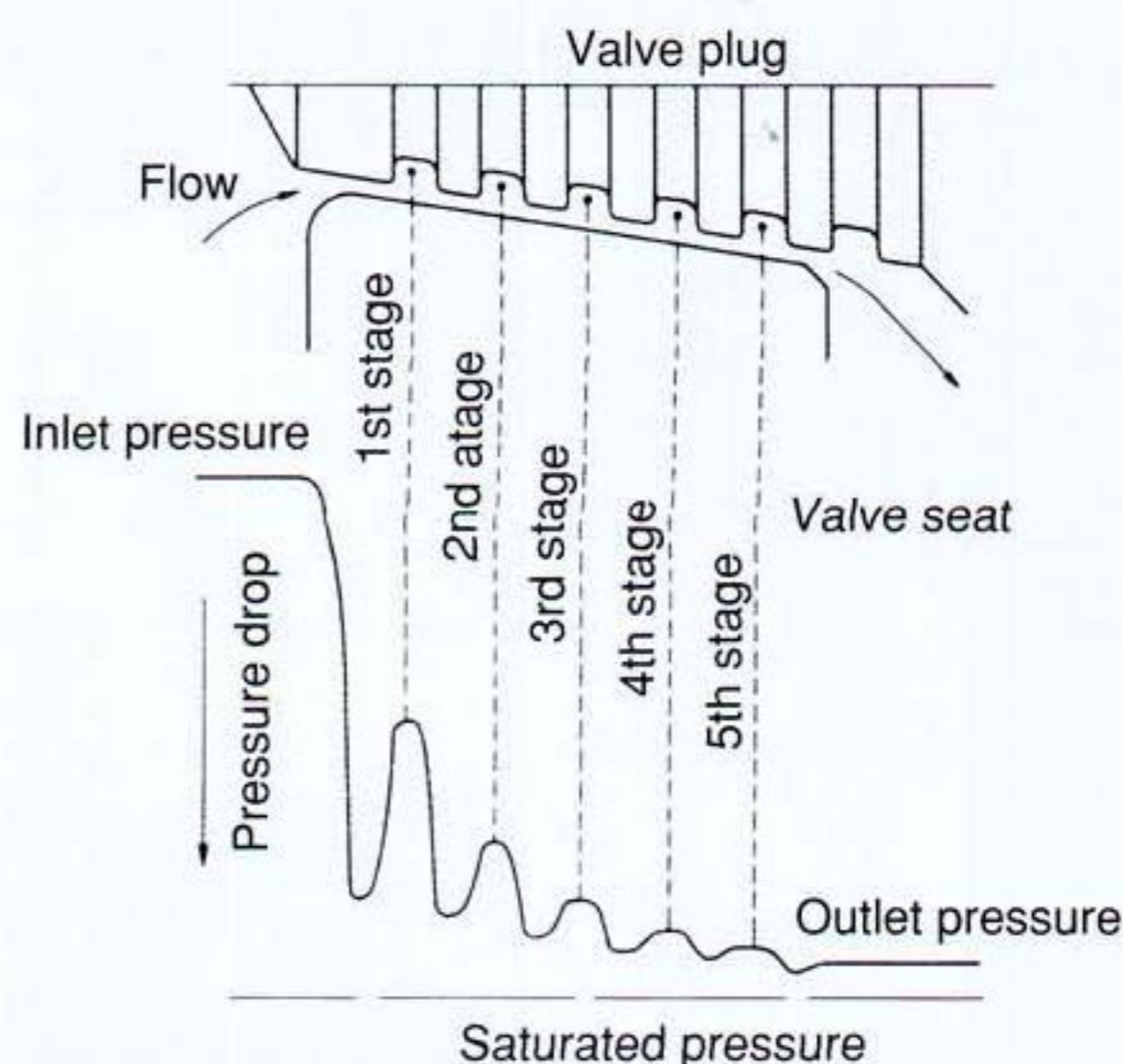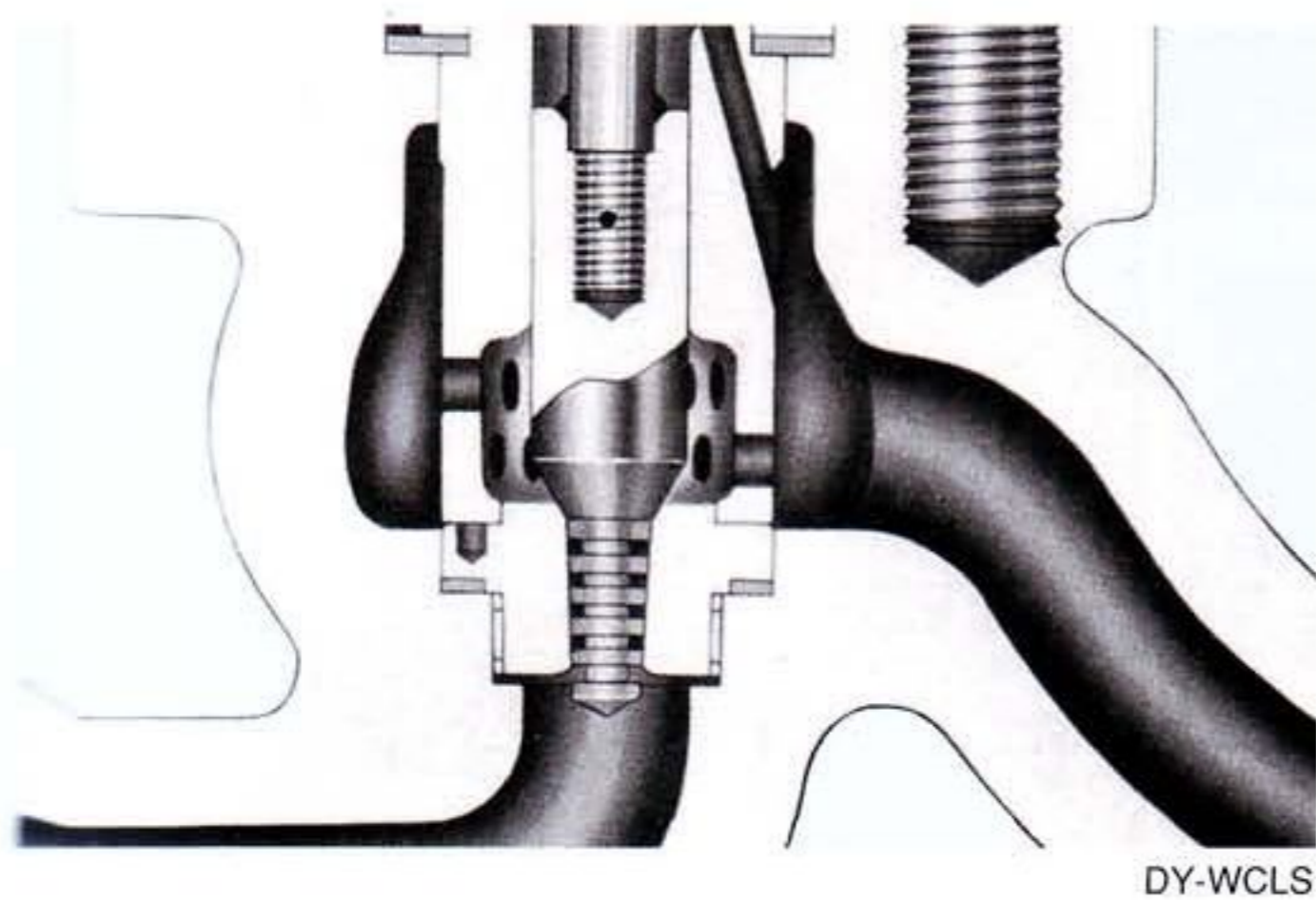
SPECOFICATIONS

For the detailed specifications, please see those of DY-GCSS□ and DY-WCSS□ control valves (pages 25 to 27).

CONTENTS

Preface ·· 1□

DY-D DOUBLE SEATED CONTROL VALVE

This control valve is used in a wide range of services. The use of two ports, upper one and lower one (double seats) for the valve plug woks to balance and cancell the back pressure exerted on the valve. As the unbalanced force exerted on the valve stem is extremely small, the valve has an excellent controllability.

Two types of valve plug are available; the direct plug type and the reversed plug type. For easier maintenance, we recommend the direct plug type for large bore valves.

■ DY-D double seated control valve

NOMINAL BORE mm (inch)			25A (1B)				32A (1¼B)					40A (1½B)					50A (2B)					65A (2½B)					80A (3B)				
RATING	JIS (K)		5 10	16 20	30 40	63	5 10	16 20	30 40	63	(100)	5 10	16 20	30 40	63	(100)	5 10	16 20	30 40	63	(100)	5 10	16 20	30 40	63	(100)	5 10	16 20	30 40	63	(100)
	ANSI (Class)		125 150	300	600	900	125 150	300	600	900	1500	125 150	300	600	900	1500	125 150	300	600	900	1500	125 150	300	600	900	1500	125 150	300	600	900	1500
	IEC (PN-bar)		10 16	25 40	64 100		10 16	25 40	64 100			10 16	25 40	64 100			10 16	25 40	64 100			10 16	25 40	64 100			10 16	25 40	64 100		
RATED Cv VALUE	Flow Characteristic Equal % Parabolic Linear	P-port	12.5				14	18	24			20	26	31			26	36	48			56	72	96			96		125		
		V-solid	—				14		18			20		26			26		36			56		72			72		96		
DIMENSIONS (mm)	Face to Face L (※1)		184	197	210	235	200	213	229	275		222	235	251	295	320	254	267	286	310	380	276	292	311	365	430	298	317	337	375	470
	G		108		115		120		125			130		158	162	186	170			174	215	194		204	200	236	212		222	218	242
	Height	H (※2)	692		705		705		715	718		720		748	755	832	812		832	838	968	838		858	862	978	858		868	870	985
		Additional value to H — With fin	100		102		98		102			107		102		130	100		102		130	96		102		130	88		102		130
		Additional value to H — With handwheel	185				185					185				215	215				276	215				276	215				276
	Actuator J		Refer to following (J)																												

ALLOWABLE PRESSURE DROP (MPa) (in case of single action diaphragm actuator)

Actuator size (J) mm — Off Balance (kPa)

Actuator size	kPa	25A				32A					40A					50A					65A					80A				
275	20	2.0		3.0				2.0					1.6																		
	40		4.9	6.1			3.8				2.0		3.2																		
	60			10.0	11.3		4.9	6.9			4.9		5.9																		
355	20	2.0	4.9	6.5		2.0		4.0			2.0		3.4			2.0		2.8			2.0		2.6			2.0		1.8		
	40			10.0	13.0		4.9	7.9			4.9		6.7				4.9	5.5				4.2				2.0		3.6		
	60				14.9			10.0	14.4			10.0	12.2					10.0				4.9	7.7				4.9	6.5		
410	20													4.2	2.0			3.4			2.0		2.6			2.0		2.2		
	40													8.1		4.9		6.7					4.9					4.4		
	60													14.7			10.0	12.2					9.3			4.9		7.9		
465	20																			4.2				3.2					2.8	
	40																			8.4				6.4					5.4	
	60																			15.3				11.6					9.8	
520	20																													
	40																													
	60																													
645	20																													
	40																													
	60																													
Mass (kg) (※3)		60	65	70	80	65	70	75	100		70	75	90	115	175	100	105	115	145	120	105	115	135	180	270	120	135	150	195	95

(※1) As for face-to-face dimension, new face-to-face dimensions according to IEC are givev up to JIS 40 K (PN 100). However, for individual orders, please refer to the dimension indicated on the drawing for approval for the time being. 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.

(※2) H dimension gives the longest dimension of the valve with the standard type bonnet. However, in cases of fin type bonnet or handwheel installation, add the respective value shown in the table.

SPECIFICATIONS

Type of valve body assembly	Double seated globe type valve of casting, with top and bottom guided plug.
Pressuere rating	JIS 5~63K or ANSI 125~1500
Normal bore	25~400A
Service temperature range	−196~550℃ (−321~1022°F)
Standard materials (JIS)	• Valve body assembly FC200, FCD400, CAC403, CAC406, SCPH2, 11, 21, 32, 61, SCS13, 14 • Trim See Table 5.4 "Standard trim materials valves". • Packing · Gasket (Asbestos Free) PTFE, graphite etc.
Cv valve	See the table below (Km value : 0.75)
Flow characteristics	Equal percentage, Parabolic, and Linear.
Performance	• Rangeability 30 : 1 • Leakage at full closure Not more than 0.5% of the rated Cv value.
Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action diaphragm type is normally used. Maximum allowable pressure drop is shown in the table below.
Dimensions and mass	See the table below

DY-DOO

	100A (4B)				125A (5B)					150A (6B)					200A (8B)					250A (10B)			300A (12B)			350A (14B)			400A (16B)		
5 10 / 16 20 / 30 40 / 63 / (100)	16 20	30 40	63	(100)	5 10	16 20	30 40	63	(100)	5 10	16 20	30 40	63	(100)	5 10	16 20	30 40	63	(100)	5 10	16 20	30 40	5 10	16 20	30 40	5 10	16	—	5 10	16	—
125 150 / 300 / 600 / 900 / 1500	300	600	900	1500	125 150	300	600	900	1500	125 150	300	600	900	1500	125 150	300	600	900	1500	125 150	300	600	125 150	300	600	125 150	300	—	125 150	300	—
10 16 / 25 40 / 64 100	25 40	64 100			10 16	25 40	64 100			10 16	25 40	64 100			10 16	25 40	64 100			10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	—	10 16	25 40	—
155		190			250		310			390		470			500		720			950	1200		1200	1600		2200		—	2800		—
125		155			190		250			310		390			310		500			950			1200								
352	368	394	445	550	403	425	457	510	690	451	473	508	565	770	543	568	610	675	870	673	708	752	737	775	819	889	927	—	1016	1057	—
230		252	242	275		290		305	345		334		350	352	400		434		442	402		510	605		588	605		696	—		735	—
968		995	1000	1145		1150			1155	1320		1190			1200	1370		1450	1440	1444	1368		1760	1775		1835	1860		2395	—	2430	—
92		130		156		114		158	155	102		158		155	150	85		172	175	138		85	182		100	185		116	—	120	—
276		330			330			522		330			522		522						528			528			528			528	—

Dimensional drawing

Ho＝H＋(additional value in table)

	100A (4B)				125A (5B)					150A (6B)					200A (8B)					250A (10B)			300A (12B)			350A (14B)			400A (16B)		
		1.8																													
2.0		3.6																													
	4.9	6.5																													
2.0		2.2					1.6					1.2																			
	4.4				2.0		3.2			2.0		2.5																			
	4.9	82.0				4.9	5.9				4.9	4.6																			
		2.8			2.0		2.2			1.5		1.8			1.2																
	5.5				4.0		4.4	2.0		3.0		3.6	2.0		2.5															
	9.7			4.9		7.1	7.9		4.9	5.5		6.3		4.6																
		3.8								3.0	2.0	2.2		3.0		1.8			1.5			1.2			1.0					
		7.5								5.9			4.4	5.9	2.0		3.6	2.0		3.0	2.0	2.5		2.0						
		13.6								10.8	4.9	7.9	10.8		4.9	6.5		4.9	5.3		4.8			3.8						
150	190	230	295	445	305	320	384	540	810	370	385	470	685	1030	645	665	840	1100	1650	900	920	1280	1180	1200	1300	1400	1450		1800	1870	

÷3   Mass indicated is that of a valve with fin type bonnet, handwheel and positioner (= maximum mass).

＊   IEC in the column of rating indicates the ratings of valve groups formed in terms of face-to-face dimension.

DY-S SINGLE SEATED CONTROL VAIVE

This control valve is our representative single seated valve with a top and bottom guided plug. This type is offered in a wide range of sizes, from small bore up to large bore, This valve is most suited to an application which requires to reduce the leakage at full closure to the minimum.

Valve plug types are direct one and reverse one. We recommend the use of the direct type for large bore valves for easier maintenance.

DY-S

DY-S single seated control valve

NOMINAL BORE mm (inch)			25A (1B)				32A (1¼B)				40A (1½B)				50A (2B)				65A (2½B)			
RATING	JIS (K)		5 10	16 20	30 40	63	5 10	16 20	30 40	63	5 10	16 20	30 40	63	5 10	16 20	30 40	63	5 10	16 20	30 40	63
	ANSI (Class)		125 150	300	600	900	125 150	300	600	900	125 150	300	600	900	125 150	300	600	900	125 150	300	600	900
	IEC * (PN-bar)		10 16	25 40	64 100		10 16	25 40	64 100		10 16	25 40	64 100		10 16	25 40	64 100		10 16	25 40	64 100	
RATED Cv VALUE	Flow characteristics	Eg % Para Linear	12.5				18		24		26		31		36		48		72		96	
DIMENSIONS (mm)	Face to Face L (※1)		184	197	210	235	200	213	229	275	222	235	251	295	254	267	286	310	276	292	311	365
	Height	G	102		112		110		118		122		126	130	146		176	150	172		195	165
		H (※2)	692		702	704	700		708	710	710		716	722	804		838	815	825		860	830
	Additional value to H	With fin	100		102		98		102		108		102		100		102		96		102	
		With hand-wheel	185				185				185				215				215			
	Actuator J		Refer to following (J)																			

ALLOWABLE PRESSURE DROP (MPa) (in case of single action diaphragm actuator)

Actuator size (J) mm	Off Balance kPa	25A	32A	40A	50A	65A
275	20	0.38	0.24	0.15		
	40	0.75	0.48	0.3		
	60	1.4	0.9	0.53		
355	20	0.8	0.51	0.32	0.22	0.14
	40	1.6	1.1	0.63	0.44	0.26
	60	2.9	1.9	0.13	0.77	0.48
410	20				0.26	0.15
	40				0.51	0.3
	60				0.94	0.55
465	20					
	40					
	60					
520	20					
	40					
	60					
645	20					
	40					
	60					

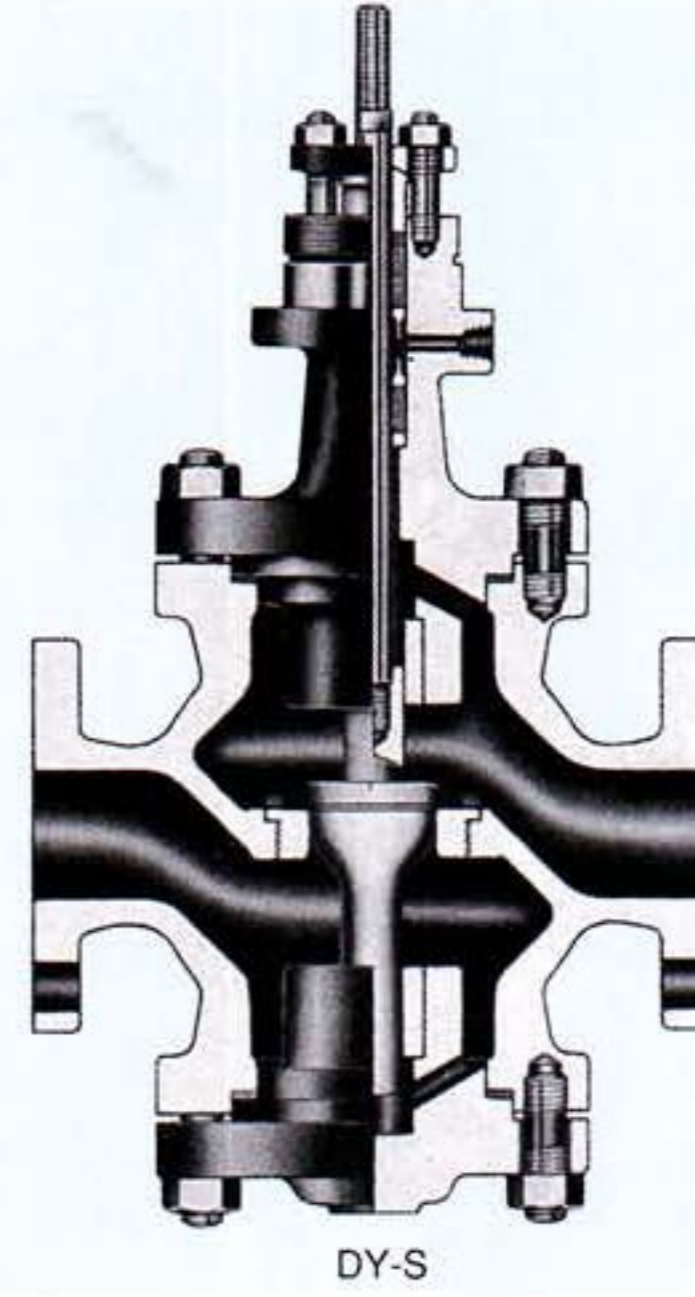| Mass (kg) (※3) | | 52 | 56 | 60 | 80 | 52 | 56 | 60 | 80 | 55 | 60 | 72 | 92 | 80 | 84 | 92 | 116 | 82 | 92 | 108 | 144 |

(※1) As for face-to-face dimension, new face-to-face dimensions according to IEC are given up to PN100. However, for individual orders, please refer to the dimension indicated on the drawing for approval for the time being. 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.

(※2) H dimension gives the longest dimension of the valve with the standard type bonnet. However, in cases of fin type bonnet or handwheel installation, sdd the respective value shown in the table.
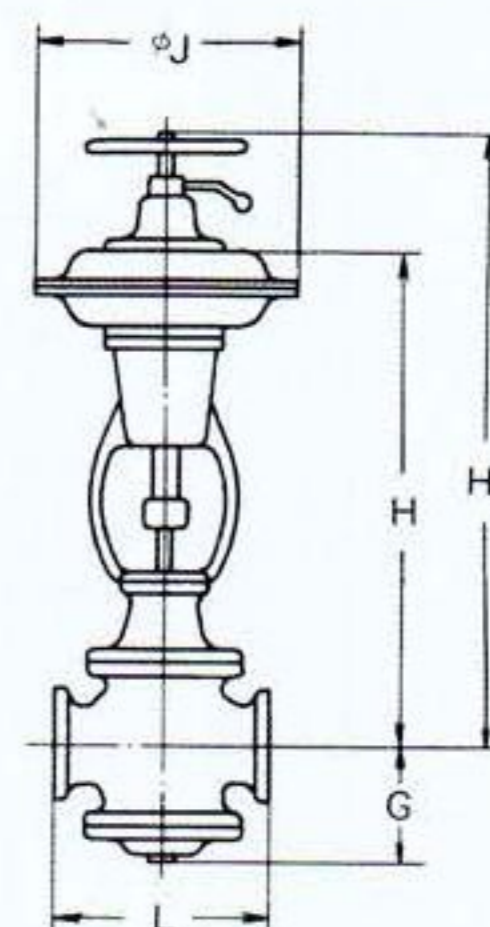
SPECIFICATIONS

Type of valve body assembly	Single seated globe valve of casting, with top and bottom guided plug
Pressure rating	JIS 5~63k or ANSI 125~900.
Nominal bore	25~300mm(1~12inch)
Service temperature range	-196~550°C (-321~1022°F)
Standard materials (JIS)	• Valve body assembly FC200, FCD400, CAC403,406, SCPH32, SCPH11, SCPH11, SCPH21, SCPH32,61, SCS13, SCS14. • Trim gasket See Table 5.4 "Standard trim materials". • Packing・Gasket (Asbestos Free) PTFE, graphite etc.

Cv value	See the table below. (Km value : 0.7)
Flow characteristics	Equal percentage, Parabolic, Linear.
Performance	• Rangeability 30 : 1
	• Leakage at full closure Not more than 0.01% of the rated Cv value.
Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action diaphrsgm type is normally used. Maximum allowable pressure drop is shown in the table below
Dimensions and weight	See the table and the figure below.

Rating designations

	80A (3B)				100A (4B)			125A (5B)			150A (6B)			200A (8B)			250A (10B)		300A (12B)	
JIS	5/10	16/20	30/40	63	5/10	16/20	30/40	5/10	16/20	30/40	5/10	16/20	30/40	5/10	16/20	30/40	5/10	16/20	5/10	16/20
ANSI	125/150	300	600	900	125/150	300	600	125/150	300	600	125/150	300	600	125/150	300	600	125/150	300	125/150	300
	10/16	25/40	64/100		10/16	25/40	64/100	10/16	25/40	64/100	10/16	25/40	64/100	10/16	25/40	64/100	10/16	25/40	10/16	25/40

Dimensions and Cv (by nominal size)

	80A (3B)	100A (4B)	125A (5B)	150A (6B)	200A (8B)	250A (10B)	300A (12B)
Cv	96 / 125	155 / 190	250 / 310	390 / 470	500 / 720	950 / 1200	1200 / 1600
L	(298) 317 / 337 / 375	352 / 368 / 394	403 / 425 / 457	451 / 473 / 508	543 / 568 / 610	673 / 708	737 / 775
	(195) 204 / 218	240 / 245	292 / 310	312 / 342	378 / 425	420	500
H	(850) 866 / 882	982 / 1000	1150 / 1155	1170 / 1182	1400 / 1425	1670	1750
	(98) 102	92 / 130	114 / 157	102 / 158	85 / 172	85	100
	215	276	330	330	522	528	528
Mass	(98) 108 / 120 / 156	142 / 152 / 184	240 / 256 / 308	290 / 308 / 376	510 / 532 / 672	715 / 736	940 / 960

Maximum allowable pressure drop (staircase)

| 80A	100A	125A	150A	200A	250A	300A
0.1						
0.2						
0.34						
0.12	0.08					
0.24	0.16					
0.4	0.28					
	0.1	0.06	0.04			
	0.2	0.12	0.08			
	0.35	0.22	0.14			
		0.08	0.05	0.03		
		0.15	0.1	0.06		
		0.24	0.16	0.1		
				0.05	0.03	0.02
				0.1	0.06	0.05
				0.18	0.12	0.08

Dimensional drawing

Ho=H+(additional value in table)

※3 Mass indicated is that of a valve with fin type bonnet, handwheel and positioner (=maximum mass).

※ IEC in the column of rating indicates the ratings of valve groups formed in terms of face-to-face dimension.

DY-P DOUBLE SEATED CONTROL VALVE FOR HIGH PRESSURE AND HIGH TEMPERATURE USE
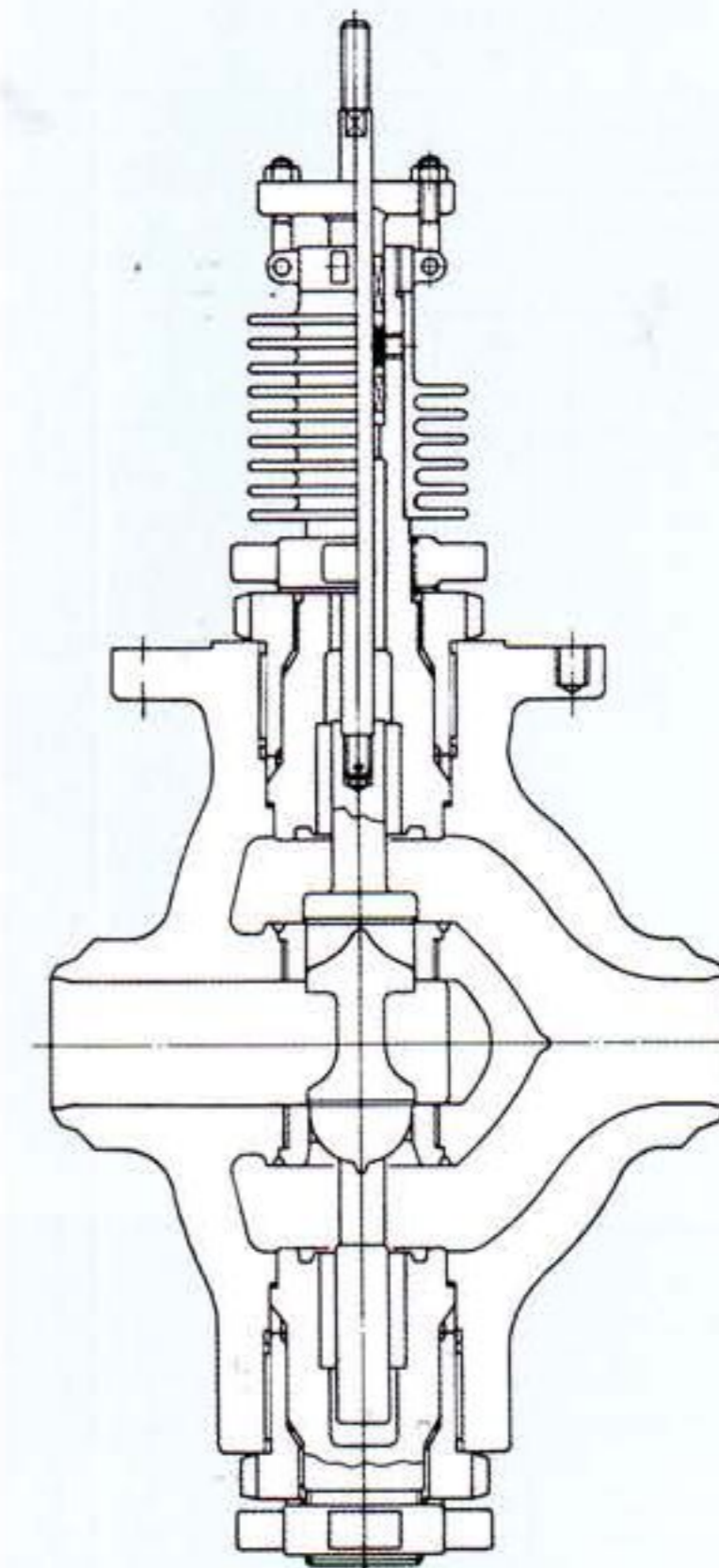
DY-P

This control valve is for high pressure, high temperature (ANSI 1500 ～ 2500) and large capacity applications. The sealing of the joint between the body and the bonnet is the so-called self pressure seal type which tightly seals the joint with a metallic seal ring using the fluid pressure. this allows a compact size inspite of its large pressure and large capacity application.

When high pressure steam is decompressed, excessive fluid velocity at the delivery side will generate noise. To avoid this nois generation, the delivery side bore is made to be the same size or twice of the inlet side bore.

▌DY-P double seated control valve for high pressure and high temperature use

NOMINAL BORE mm (inch)				50A (2B)		65A (2½B)		80A (3B)		100A (4B)		125A (5B)		150A (6B)		200A (8B)	
RATED	ANSI	(Class)		1500						2500							
	IEC	(PN-bar)		—													
RATED Cv VALUE	Floe Characteristics	Para Eg %		24	14	31	20	36	26	96	56	125	72	155	96	310	190
DIMENNSIONS (mm)	Height	Fsce to face L		425		425		425		450		600		650		74	
		G		280		305		315		380		430		470		520	
		H		1190		1210		1325		1460		1515		1555		1610	
		With handwheel: additionalvalve to H		330						522							
		Actuator J		Refer to follwoing													
ALLOWABLE PRESSURE DROP (MPa) (in case of single action diaphragm actuator)	Actuator size (J) mm	465	Off Balance (kPa) 20	4.8		4.4		3.6	4.4								
			40	9.5		8.7		7.1	8.7								
			60	17.2		15.3		12.8	15.3								
		520	20	5.5		4.9		4.2	4.9	3.4	3.8	2.6	2.8	2.4	2.6	1.6	2.0
			40	11.0		9.8		8.3	9.8	6.7	7.5	5.3	5.5	4.8	5.3	3.2	4.0
			60	20.1		18.2		15.1	18.2	12.0	13.8	9.7	10.3	8.9	9.7	5.9	7.1
		645	20							5.7	6.5	4.6	4.8	4.2	4.6	2.8	3.4
			40							11.4	13.0	9.1	9.5	8.3	9.1	5.5	6.7
			60							20.6	23.6	16.7	17.7	15.2	16.7	10.2	12.3
Mass (kg) (※1)				290		370		425		590		915		1070		1700	

(※1) Msss indicated is that of the valve with fin type bonnet, handwheel and positioner (=maximum mass).

SPECIFICATIONS

Type of valve body	For hige temperature and high pressure use. Double seated globe valve of casting, with top and bottom guided plug
Pressure rating	ANSI 1500 and 2000
Normal bore	50 ~ 200A (2~8inch)
Service temperature range	Not exceeding 700° C.(1292° F)
Standard materials JIS	• Valve body assembly SCPH2, SCPH11, SCPH21, SCPH32, SCPH61, SCS13, SCS14. • Trim see table 5.4 "Standard Trim materials" • Paking gasket (Asbestos Free) PTFE grphite etc.
Cv value	• See the table in the left. (Km valve: 0.75)
Flow characteristics	Equal percntage and parabolic
Performance	• Rangeability 30 : 1 • Leakage at full closure Not more than 0.5% of the rated Cv value.
Maximum allowable pressure	Disphragm type or cylinder type actuator n be mounted. Single action diaphragm type is normally used. Maximum allowable pressure drop is shown in the table ontheleft
Dimensions and mass	See the table on the left and the figure below.

Dimensional drawing
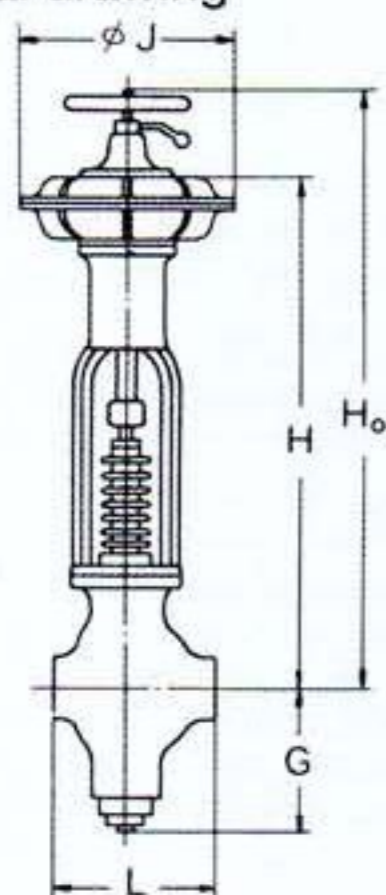
Ho=H+(additional valve in table)

DY-DF
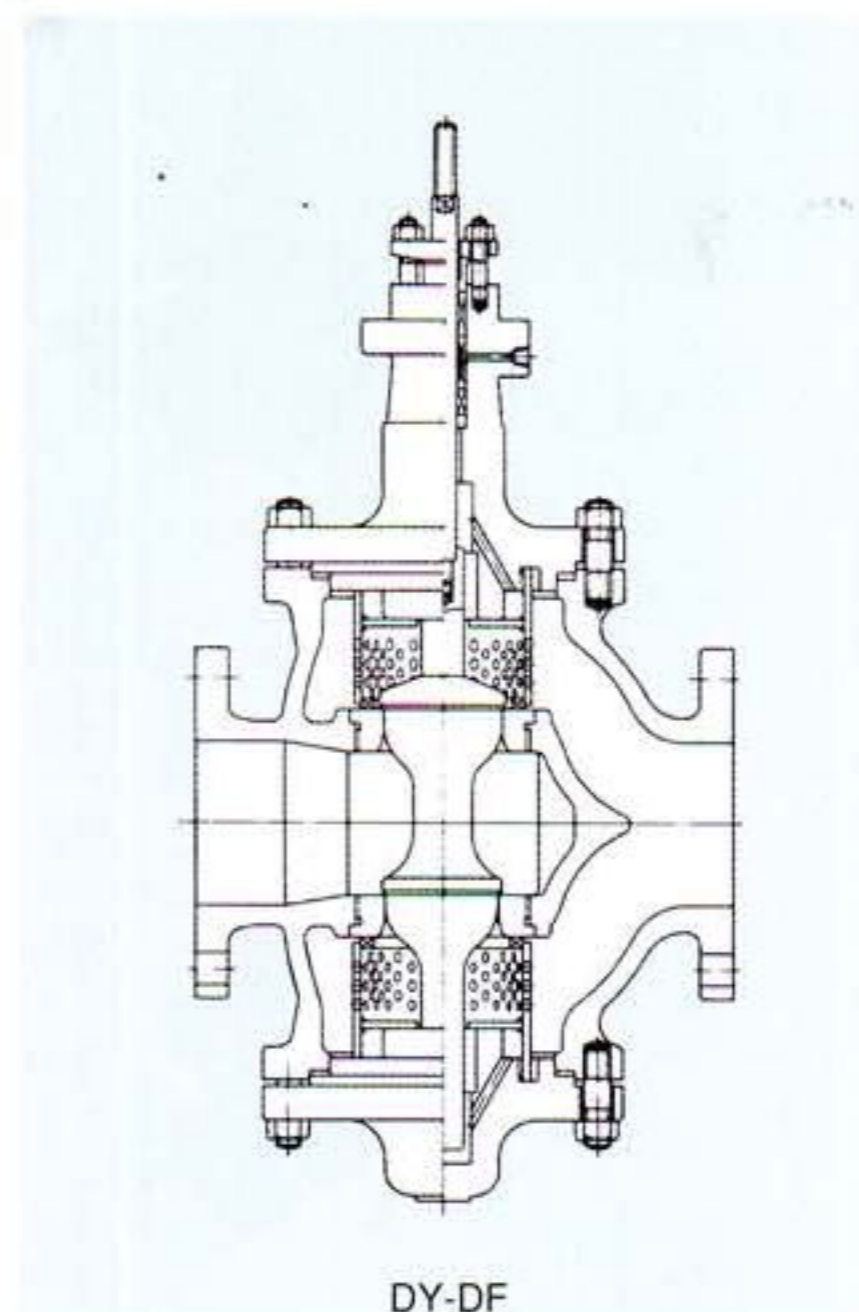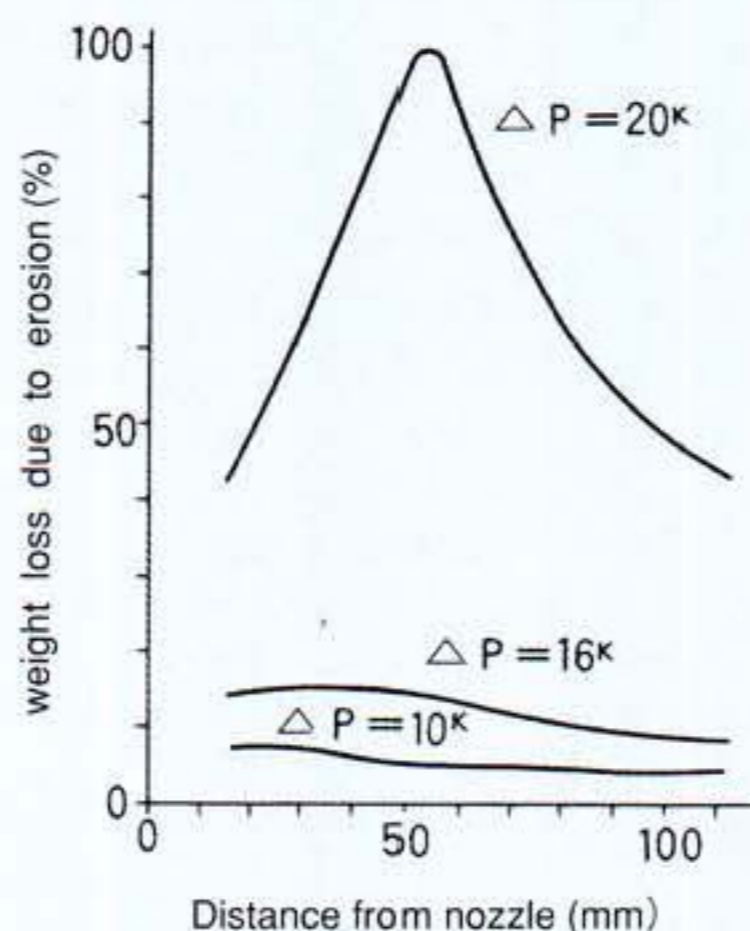
This contorol valve is the standard DY-D, DY-P or DY-S control valve equipped with flashing guards inside the valve body. The flashing guard is used to prevent erosion of the inner wall of the body due to flashing fluid.

High temperature drain such as that of a drain valve of feedwater heater flows in and flashes out of the throttle at an extremely high velocity. Water droplets in the steam collide on the inner wall of the body and accelerate erosion of that portion. According to our erosion tests, the relationship of loss in weight due to erosion, distance between the throttle and the inner wall of the body, and pressure drop at the throttle is as shown in the figure above.

The flashing guard to be fitted in the body is a cylinder with many holes. The guards are fixed to the bonnet and the cover.

The jet of the flashing fluid coming out of the throttle is dispursed in these guards, and the energy of the jet is locally disipated by the friction due to small holes. As the fluid slowly flows out of the small holes in the circumference of the guard, the direct effect of high energy of the jet out of the throttle is minimized, and the inner wall of the body is thus protected from erosion.

SPECIFICATIONS

For the detailed specifications, see those of DY-D, DY-S, and DY-P control valves. (Page 29, 31, and 33) Cv values are as shown in the following table.

Cv value of control valve with flashing guards

Nominal bore mm (inch)	50A (2B)		65A (2½B)		80A (3B)		100A (4B)		125A (5B)		150A (6B)		200A (8B)	
Cv value	36	26	72	56	96	72	155	125	250	190	390	310	500	310

DY-G SINGLE SEATED CONTROL VALVE

DY-G
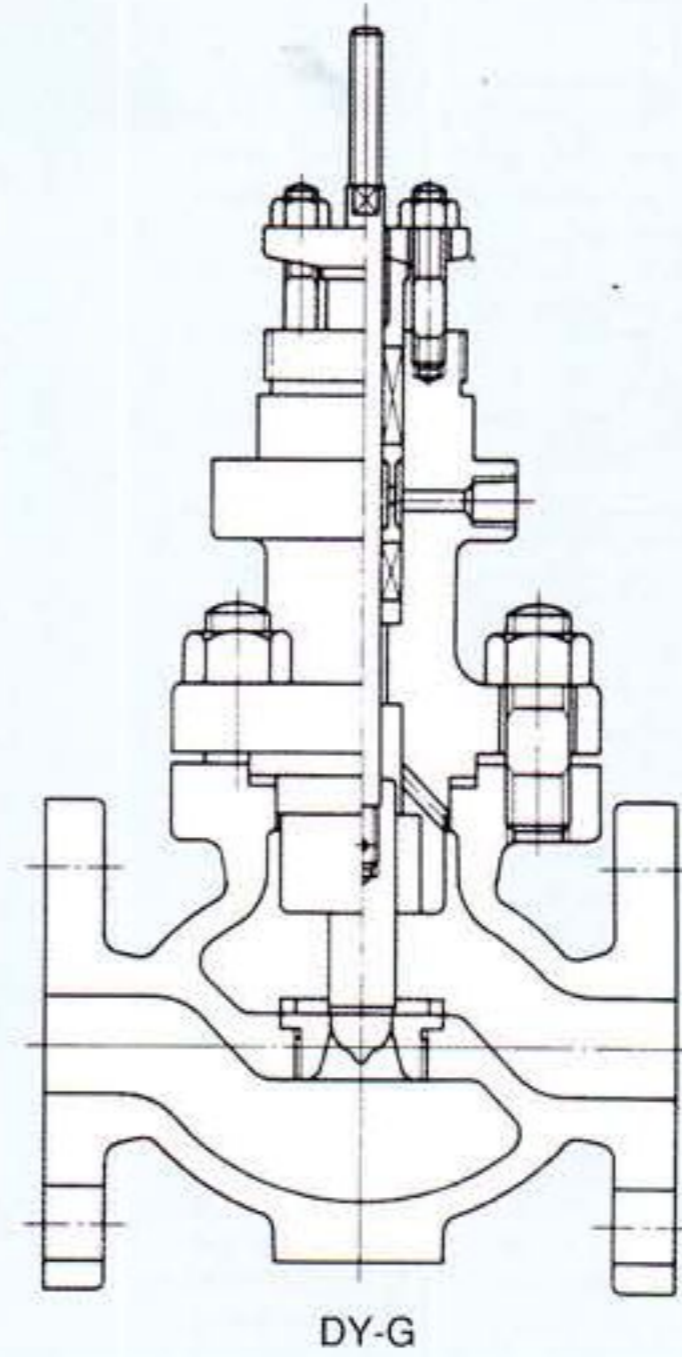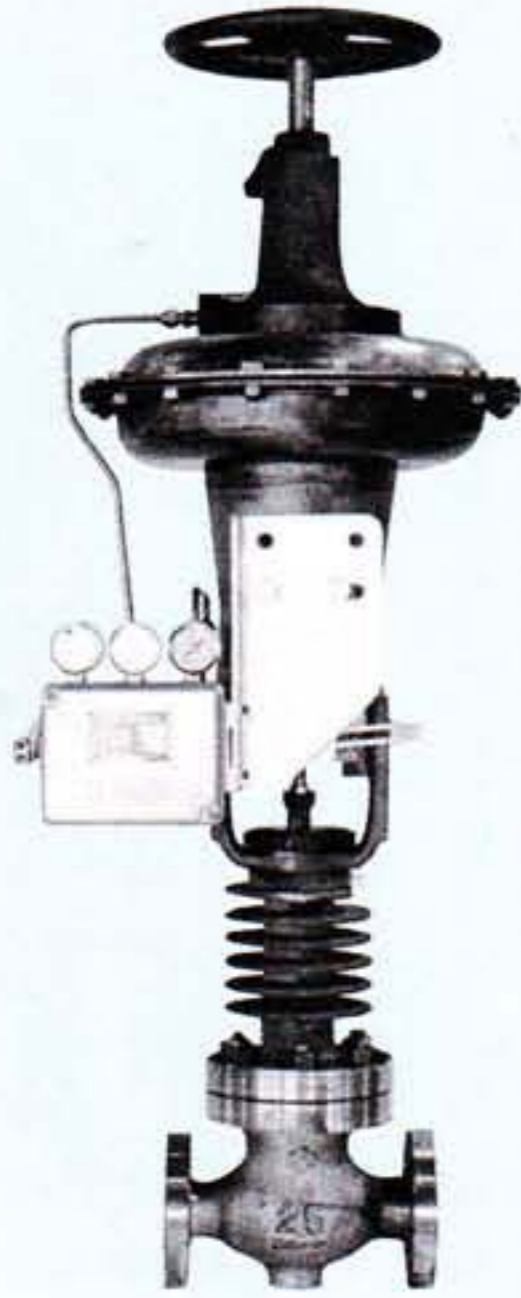
DY-G control valve is a small size single seated valve with top guided plug. In combination with a variety of reduced valve plugs and actuators, it can meet a wide range of services such as large pressure drop and very small flow rate.

SPECIFICATIONS

Type of valve body assembly	Single seated globe valve of casting, with top guided plug.
Pressure rating	JIS 5 ~ 63K or ANSI 125 ~ 1500
Nominal bore	20ᴬ and 25ᴬ
Service temperature range	−196~550℃(−321~1022°F)
Standard materials (JIS)	• Valve body assembly FC200、FCD400、CAC403、CAC406、 SCPH2、11、21、32、61、SCS13、14 • Trim See Table 5.4 "Standard trim materials". • Packing・Gasket Asbestors free PTFE, graphite, etc.

Cv value	See the table on the right page. (It is possible to produce down to the minimum Cv value of 0.07.) (Km value : 0.8)
Flow characteristics	Equal percentage, parabolic, and linear.
Performance	• Rangeability 20 : 1 ~30 : 1 • Leakage at full closure Not more than 0.01% of the rated Cv value.
Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action diaphragm type is normally used. Maximum allowable pressure drop is shown in the table (page 36).
Dimensions and Mass	See the table and the dimensional drawing on the right page.

DY-G single seated control valve

Rating and Dimensions

|			20A (3/4B) 5, 10	16,20	30,40	63	(100)	25A (1B) 5, 10	16,20	30,40	63	(100)
RATING	JIS	(K)	5, 10	16,20	30,40	63	(100)	5, 10	16,20	30,40	63	(100)
	ANSI	(Class)	125, 150	300	600	900	1500	125, 150	300	600	900	1500
	IEC *	(PN-bar)	10, 16	25,40	64,100			10, 16	25,40	64,100		
RATED Cv VALUE (Flow Characteristics Eq % / Para / Linear) (※1)			0.23, 0.44	0.8, 1.1	1.7, 2.3	3.2, 4.2	5.4	7.2	7.2	9.5	11	11
DIMENSIONS (mm)	Face to Face L (※2)		187	194	206	256	274	184	197	210	235	274
	Height	H (※3)	678	678	708	810	915	678	678	708	810	915
		Additional value to H — With fin	105	105	100	115	125	105	105	100	115	125
		Additional value to H — With hand wheel	185	185	185	215	276	185	185	185	215	276
	Actuator J		Refer to following (J)									
Mass (kg) (※4)			38	40	55	70	90	42	45	60	75	100

ALLOWABLE PRESSURE DROP (Off Balance, kPa) — (in case of single action diaphragm actuator)

Allowable pressure drop values correspond to the rated Cv value columns below.

Actuator size (J) mm	Off Balance (kPa)	0.23 / 0.44	0.8 / 1.1	1.7 / 2.3	3.2	4.2	5.4	7.2	9.5	11
275	20	8.4	4.8	3.8	1.8	1.5	1.2	0.9	0.7	0.6
275	40	16.7	9.5	5.9	3.5	3.0	2.4	1.8	1.5	1.2
275	60	25.0	16.7	10.8	6.4	5.5	4.4	3.4	2.8	2.4
355	20	16.7	9.7	6.1	3.8	3.2	2.4	2.0	1.6	1.4
355	40	25.0	19.2	12.3	7.5	6.3	4.8	4.0	3.2	2.6
355	60		25.0	22.6	13.3	11.6	8.9	6.9	5.7	4.8
410	20	20.6	11.3	7.4	4.4	3.8	3.0	2.4	2.0	1.6
410	40	25.0	23.1	14.7	8.7	7.5	5.9	4.6	3.8	3.2
410	60			25.0	15.7	13.8	10.8	8.4	6.9	5.7
465	20	25.0	14.6	9.4	5.5	4.8	3.8	3.0	2.4	2.0
465	40	25.0	25.0	18.7	11.0	9.7	7.3	5.9	4.7	4.0
465	60			25.0	20.2	17.5	13.4	10.6	8.7	7.1

※1 In this type, a valve of 25A bore can adopt the rated Cv of a valve of 20A bore as reduced valve plug.

※2 As for face-to-face dimension, new face-to-face dimensions according to IEC are given up to PN100. However, for individual orders, please refer to the dimension indicated on the drawing for approval for the time being. 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.

※3 H dimension gives the longest dimension of the valve with the standard type bonnet. However, in cases of fin type bonnet or handwheel installation, add the relevant value shown above.

※4 Mass indicated is that of a valve with fin type bonnet, handwheel and positioner (=maximum mass).

* IEC in the column of rating indicates the ratings of valve groups formed in terms of face-to-face dimension.

[Remarks]

1. In the table above, the dimensions correspond to the ratings of the rating column.
2. In the table above, the allowable pressure drop values correspond to Cv values of the rated Cv value column. (For example, when Cv =3.2, if the actuator size is (J) 275 and the off balance pressure is 40 kPa, the maximum allowable pressure drop is 3.5 MPa.)

Dimensional drawing
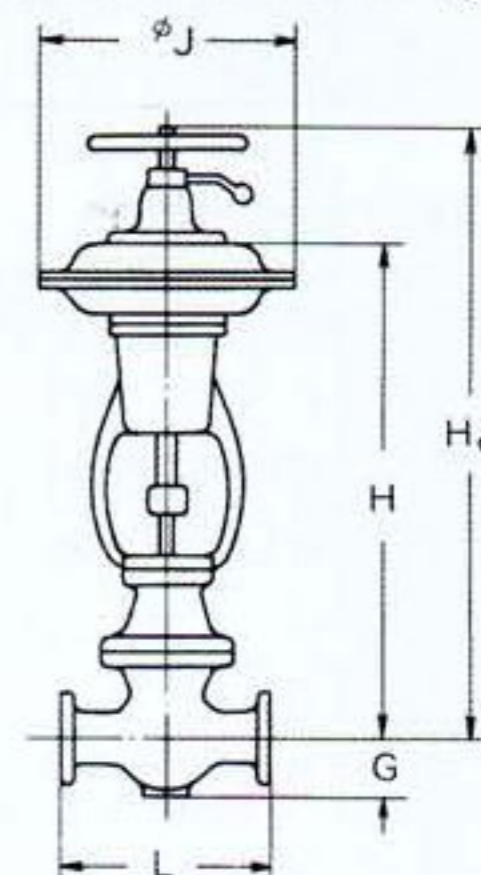
Ho=H+ (additional in table)

DY-GOZ SINGLE SEATED CONTROL VALVE
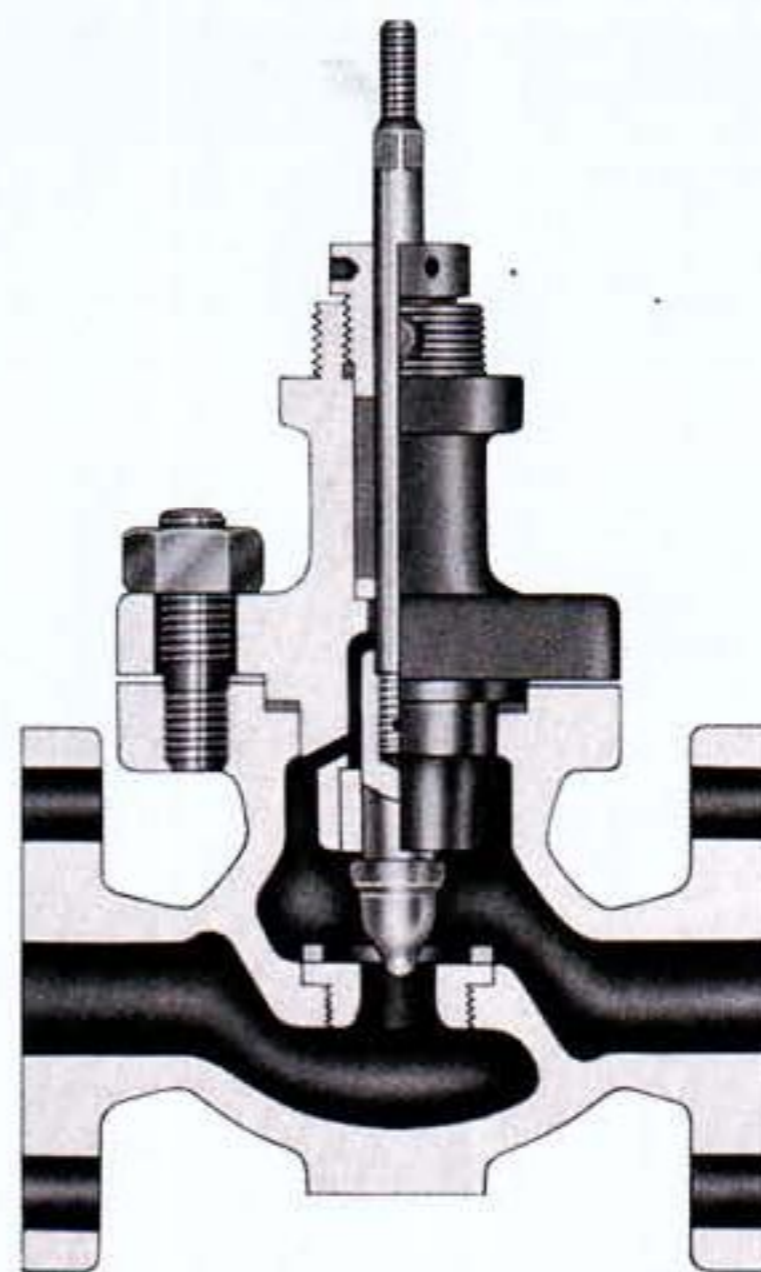
DY-GOZ control valve is a sister type of DY-G control valve (page 35). It is a simple small-size single seated valve using a smallsize diaphragm type actuator. This type is popular for applications of JIS 5~20K ratings.

SPECIFICATIONS

Type of valve body assembly (JIS)	Single seated globe valve of casting,with top guided plug.
Pressure rating	JIS 5~20K or ANSI 125~300.
Normal bore	20 and 25 mm (³/₄, 1inch)
Service temperature range	0~200℃ (32~392'F)
Standard materials (JIS)	• Valve body assembly FC200, FCD400, CAC403, CAC406, SCPH2, 11, 21, 32, 61, SCS13, 14 • Trim See Table 5.4 " Standard trim materials". • Packing · Gasket (Asbestors Free) PTFE, graphite, etc.

Cv Value	See the table below. (Km value : 0.8)
Flow characteristics	Equal percentage, parabolic and linear.
Performance	• Rangeability 20：1～30：1 • Leakage at full closure Not more than 0.01% of the rated Cv value.
Maximum allowable pressure drop	See the table below.
Dimensions and mass	See the table and the drawing below. Lubricator or positioner can not be fitted on this control valve.

Cv value/Maximum allowable pressure drop

Nominal bore mm (inch)	20ᴬ (³/₄ᴮ)						25ᴬ (1ᴮ)
Rated Cv value	0.23	0.44	0.8	1.7	3.2	5.4	9.5
Max. allowable pressure drop (Mpa)	5			2.5	1.5	1.0	0.64

Rating/Dimensions

Norminal bore mm (inch)		20ᴬ (³/₄ᴮ)		25ᴬ (1ᴮ)	
Rating	JIS (K)	5, 10	16, 20	5, 10	16, 20
	ANSI (Class)	125, 150	300	125, 150	300
	IEC ＊ (PN-bar)	10, 16	25, 40	10, 16	25, 40
Dimensions (mm)	L (※ 2)	187	194	184	197
	Height H	400			
	Height With handwheel: additional value	135			
	Actuator J	200			
Mass（kg)		17 (20 with handwheel)			

Dimensional drawing
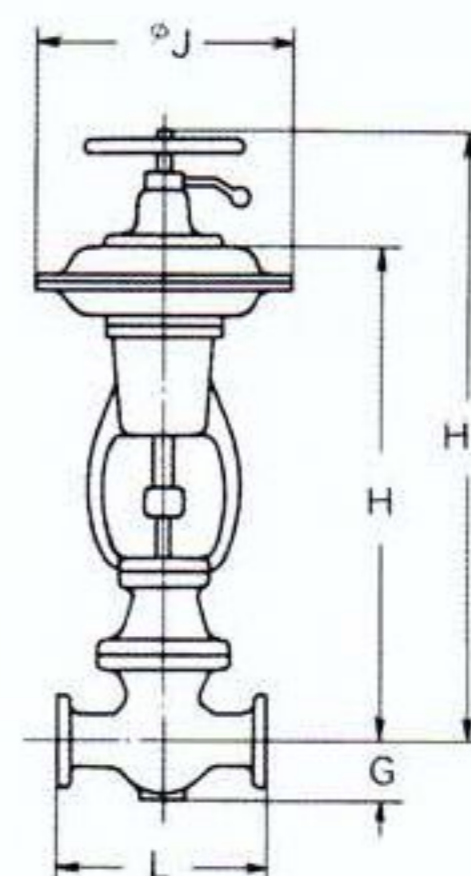
Ho＝H＋（additional value in table)

DY-U BALANCE PISTON TYPE CONTROL VALVE

DY-U
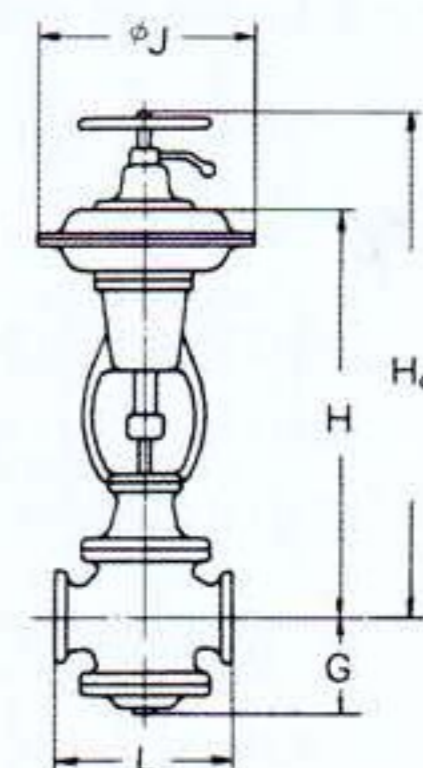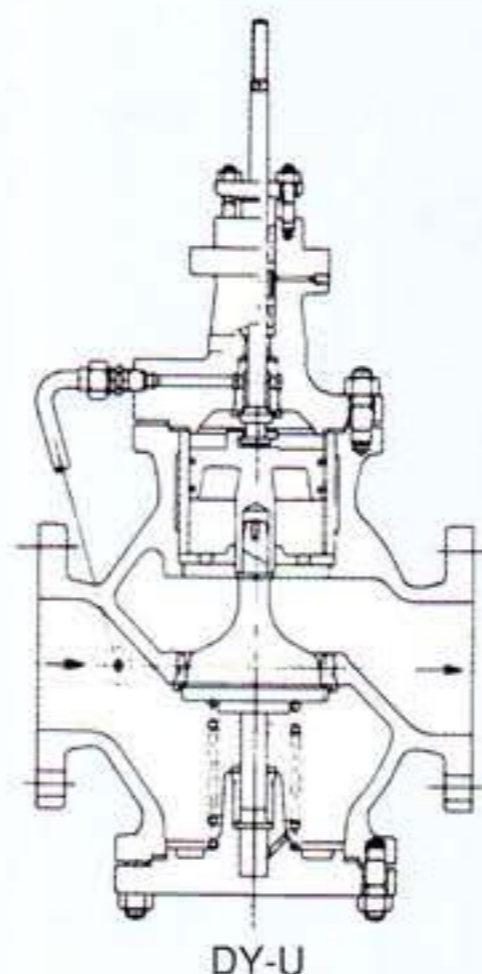
Ho=H+ (additional value in table)

This control valve is a single seated valve with a top and bottom guided plug. As the valve is equipped with a piston type balancing mechanism, it has the merit of the single seated valve (low leakage) as well as the property of the double seated valve (small thrusting force on the valve stem). The valve is more suitable to control of fluid of large pressure drop than DY-S single seated valve.

SPECIFICATIONS

	Balance piston type single seated globe valve of casting, with top and bottom guided plug.
Pressure rating	JIS 5~20K or ANSI 125~300.
Nominal bore	40~300mm(1$\frac{1}{2}$~12inch)
	−196~550℃ (−321~1022°F)
Standard materials (JIS)	● Valve body assembly FC200、FCD400、CAC403、CAC406、SCPH2、11、21、32、61、SCS13、14 ● Trim (SUS403・304・316, or SUS304・316 with stellite building.SCS13・14 or SUS13・14with stellite building. ● Packing・Gasket (Asbestos Free) PTFE, graphite, etc.

Cv value	See the table belpw. (Km value : 0.7)
Flow characteristics	Equal percentage, parabolic, and linear.
Performance	● Rangeability 20 : 1 ● Leakage at full closure Not more than 0.01% of the rated Cv value.
Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action diaphragm type is nomally used. Maximum allowable pressure drop is within 6 times of that of DY-S single seated valve.

▌DY-U balance piston type control valve

NOMINAL BORE mm (inch)			40^A(1$\frac{1}{2}$^{B})		50^A(2^B)		65^A(2$\frac{1}{2}$^{B})		80^A(3^B)		100^A(4^B)		125^A(5^B)		150^A(6^B)		200^A(8^B)		250^A(10^B)		300^A(12^B)	
RATING	JIS	(K)	5 10	16 20	5 10	16 20	5 10	16 20	5 10	16 20	5 10	16 20	5 10	16 20	5 10	16 20	5 10	16 20	5 10	—	5 10	—
	ANSI	(Class)	125 150	300	125 150	300	125 150	300	125 150	300	125 150	300	125 150	300	125 150	300	125 150	300	125 150	—	125 150	—
	IEC ✳	(PN-bar)	10 16	25 40	10 16	25 40	10 16	25 40	10 16	25 40	10 16	25 40	10 16	25 40	10 16	25 40	10 16	25 40	10 16	—	10 16	—
RATED Cv VALUE	Flow characteristics	Eq % Para Linear	26		40		72		110		170		250		390		650		950		1400	
DIMENSIONS (mm)	Face to Face L (※1)		222	235	254	267	276	292	298	317	352	368	403	425	451	473	543	568	673	—	737	—
	Height	G	155		160		180		190		220		240		280		340		455		465	
		H (※2)	764		842		868		890		1000		1156		1192		1420		1758		1820	
	Additional value to H	With fin	100										120				130		146		138	
		With handwheel	185		215						276		330				522		528			
	Actuator J		275	355	355			410			410	465	465			520	520	645		645			
ALLOWABLE PRESSURE DROP (MPa) (in case of single action diaphragm actuator)			Within 6 times of that of DY-S single seated valve.																			
Mass (kg) (※3)			62	66	90	95	100	105	115	120	160	165	265	275	310	330	560	580	780	800	1050	1100

※1 As for face-to-face dimension, new face-to-face dimensions according to IEC are given. For individual orders, however, please refer to the dimension indicated in 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.

※2 H dimension gives the longest dimension of the valve with the standard type bonnet. In cases of fin type bonnet or handwheel installation, add the respective value shown above.

※3 Mass indicated is that of the valve with fin type bonnet, handwheel and positioner (=maximum mass).

✳ IEC in the column of rating indicates the ratings of valve groups formed in terms of face-to-face dimension.

# NAKAKITA'S CONTROL VALVES ARE WIDELY ADOPTED IN MANY PLANTS ALL OVER THE WORLD !

DY SERIES CONTROL VALVES ⊢ CAGE TYPE CONTROL VALVES
GENERAL PURPOSE TYPE CONTROL VALVES
BUTTERFLY TYPE CONTROL VALVES

FEATURES

1	**RICH SELECTIONS**	• [NAKITA control valves] have been adopted as optimum products of high quality for services ranging from high temperature & high pressure to cryogenic temperature & vacuum in all types of industrial facilities such as nuclear power, thermal power, iron and steel making, chemical plants, and ships.
2	**HIGH RELIABILITY**	• [NAKITA control 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 verification tests conducted by our highly competent technical staff using the latest facilities.
3	**STABLE QUALITY**	• Every production process is thoroughly contorolled by competent NAKAKITA-men well trained for quality control. They are assisted by fully rationaliezed facilities including NC machines and by carefully maintained measuring instruments. From general purpose valves to special ones, NAKAKITA assures stable and reliable quality. (ISO9001)
4	**ECONOMICAL MECHANISM**	• [NAKITA's technical capability] nurtured by numerous past performances and persistent research and development efforts is utilized in every detail of individual products and systems. The economical mechanisms thus created contribute much to saving energy and lowering costs.
5	**EASY MAINTENANCE**	• Every type is designed with due consideration given to maintenace. [NAKAKITA cage type] pursuing further ease in maintenance is now in production in series. • Our nationwide network of after-sale service promises quick and satisfactory services after delivery, including supply of parts and field service. [After-delivery management] of our products is exercised by each serial number.
6	**COMPREHENSIVE ENGINEERING**	• Since NAKAKITA executes integrated production, from design to manu-facture, of valves and their accessories for automatic control systems, includ-ing control valves, as tha core, and various pneumatic indicating controllers, we provide you with the optimum planning for automation of various systems.
7	**CERTIFICATION OF PUBLIC AGENCIES**	• We are certified to produce high pressure gas valves for services of 500K and under, and of ranges from high temperature down to ultra-low temper-ature, by the Minister of International Trade and Industry in accrdance with the High Pressure Gas Control Act. We have many actual results in various high pressure gas facilities including LNG facilities. • Our proructs have passed the environmental tests for unmanned machinery space system given by each classification society, and have lived up to the customers' expectation on the seas.
8	**ADVANCES INTO NEW TECHNICAL FIELDS**	• With our reliable engineering capability based on numerous past performances and competent engineers, we are actively challenging to meet the new and severe needs including nuclear power generation, gas turbine generator low temperature plant, coal & oil mixture fuel, and saline water conversion plant. We are fully prepared to meet the customers' requirements.

DY-C☐☐☐X
DY-DOX
DY-GOX
DY-SOX
DY-AOX

CONTROL VALVE FOR LOW TEMPERATURE USE

DY-AOX
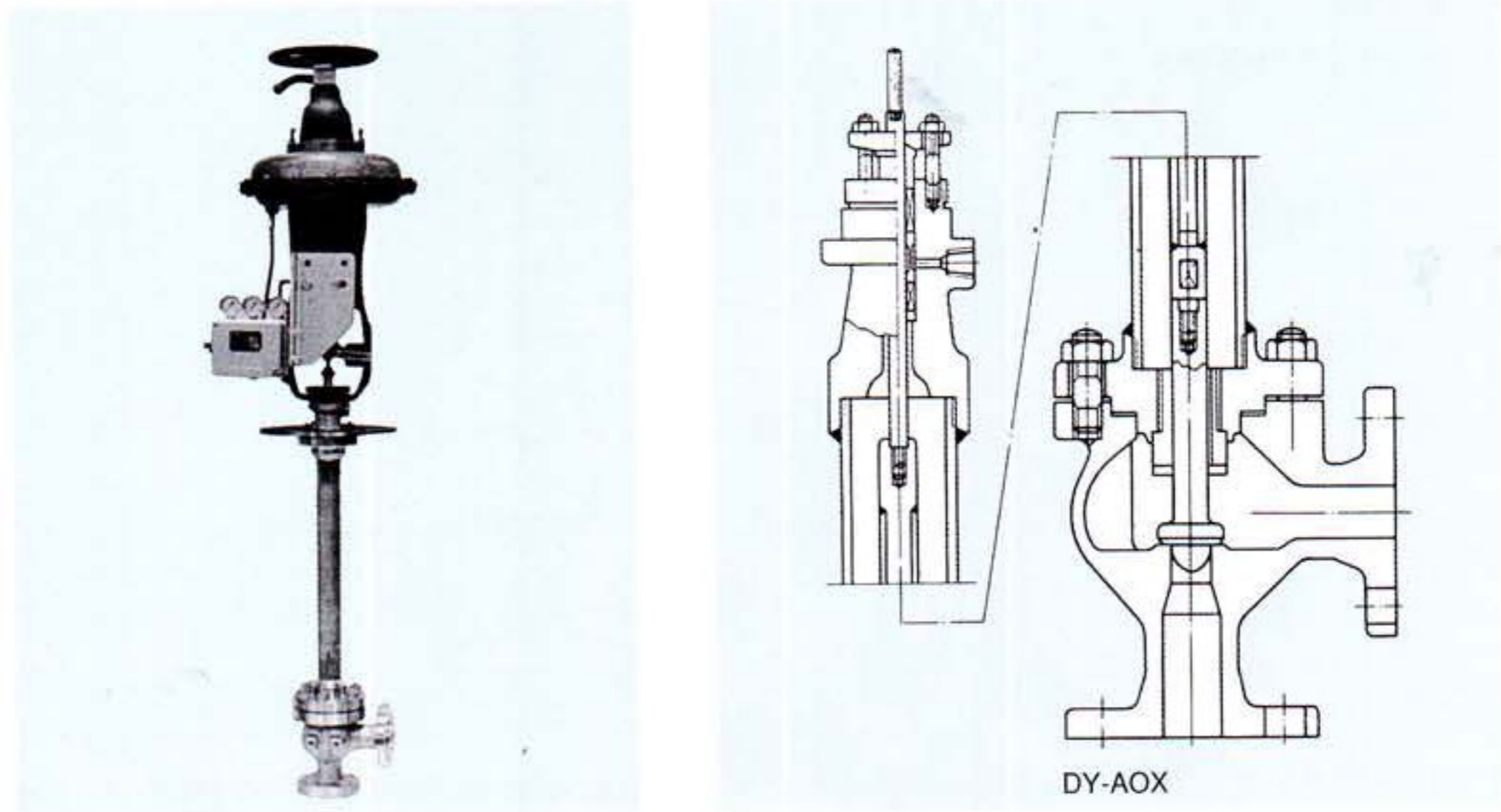
The demands for control valves for so-called low temperature range services like handling LNG (liquefied natural gas), oxygen, nitrogen or helium are now increasing. And their service requirements are becoming severer.

The valves indicated here are control valves each of which consists of a standard valve body assembly and an extension type bonnet. Many types are provided to control fluids of low and very low temperature ranges and to meet the diversifying low temperature specifications.

● The length of the extension type bonnet is determined according to temperature as shown in the table on the right page.

● As to the gland packing, complete sealing is assured by our special combination developed and demonstrated by many low temperature experiments.

▌DY-AOX control valve for low temperature use

Dimensions (mm)

	15A (½B)				20A (¾B)		25A (1B)		32A (1¼B)		40A (1½B)		50A (2B)		65A (2½B)		80A (3B)	
RATED Cv VALUE	1.1	1.7	2.3	3.2	4.2	5.4	7.2	9.5	18	24	26	31	36	48	72	96	96	125
Face to Face $L_1 \times L_2$	100×110								120×110		120×130				140×140		170×170	
H (※1)	1590														1670			
Additional value with handwheel	185														215			
Actuator J	Refer to following (J)																	

ALLOWABLE PRESSURE DROP (MPa) (in case of single action diaphragm actuator)

Actuator size (J) mm	Off Balance (kPa)	1.1	1.7	2.3	3.2	4.2	5.4	7.2	9.5	18	24	26	31	36	48	72	96	96	125
275	20	2.0	2.0	1.5	1.0	0.9	0.74	0.61	0.51	0.26	0.24	0.2	0.15						
275	40	2.0	2.0	2.0	2.0	1.8	1.5	1.23	1.02	0.51	0.46	0.4	0.3						
275	60	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	0.94	0.84	0.75	0.55						
355	20					1.9	1.6	1.3	1.1	0.53	0.48	0.42	0.32	0.24	0.2	0.15	0.13	0.13	0.09
355	40					2.0	2.0	2.0	2.0	1.06	0.95	0.83	0.63	0.48	0.4	0.3	0.26	0.26	0.18
355	60					2.0	2.0	2.0	2.0	2.0	1.8	1.6	1.2	0.87	0.75	0.55	0.47	0.47	0.32
410	20													0.29	0.25	0.18	0.15	0.15	0.1
410	40													0.57	0.5	0.36	0.3	0.3	0.2
410	60													1.04	0.9	0.64	0.55	0.55	0.38
465	20																		
465	40																		
465	60																		
520	20																		
520	40																		
520	60																		
645	20																		
645	40																		
645	60																		
Mass (kg) (※2)		60				62		65		68		75		95		115		140	

(※1) H dimension gives the longest dimension of the valve with bonnet of 1000 mm in length. In case of the valve with a handwheel, add the respective value shown in the table.

(※2) Mass indicated is that of the valve with a handwheel and a positioner (=maximum mass).

SPECIFICATIONS

In the following specifications, those marked ☆ describe DY-AOX. For other types, see the pages of the relevant type.

Type of valve body assembly

Type of valve body	Description
DY-C□□□X	DY-C valve (pagw 19 to 24) combined with an extension type bonnet.
DY-AOX	DY-A valve (single seated angle valve of casting, with top guided plug) combined with an extension type bonnet.
DY-DOX	DY-D valve (page 29) combined with an extension type bonnet.
DY-GOX	DY-G valve (page 35) combined with an extension type bonnet.
DY-SOX	DY-S valve (page31) combined with an extension type bonnet.

Pressure rating	JIS 5~40K, or ANSI 125~900.
Nominal bore	15~300A
Standard materials (JIS)	• Valve body assembly CAC403、CAC406、SCPL1·11·21·31、SCS13·14 • Trim {SUS304·316, or SUS304·316 / SCS13·14, or SCS13·14} • Packing · Gasket (Asbestos Free) PTFE, graphite, etc.
☆ Cv value	See the DY-AOX table below. (Km value : 0.7)
Flow characteristics	Equal percentage, parabolic, and linear.
☆ Performance	• Rangeability 30 : 1 • Leakage at full closure Not more than 0.01% of the rated Cv value.
☆ Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action diaphragm type is normally used. Maximum allowable pressure drop is shown in the table below.
☆ Dimensions and mass	See the table and the drawing below.

▌Length of extension type bonnet

Temperature range (°C)	Lenght (mm)
−100 and over, and less than −20.	150 and over.
−196and over, and less than −100.	350 and over.

100A (4B)	125A (5B)	150A (6B)	200A (8B)	250A (10B)	300A (12B)
55 190	250 310	390 470	500 720	950 1200	1200 1600
180×180	200×200	250×250	280×280	320×320	
1750	1850	2010	2230		
276	330	522	528		
0.08 0.08					
0.16 0.15					
0.3 0.28					
0.1 0.09	0.07 0.06	0.05			
0.2 0.18	0.14 0.12	0.09			
0.38 0.35	0.26 0.22	0.16			
	0.08 0.07	0.05 0.04	0.03		
	0.17 0.14	0.1 0.07	0.06		
	0.31 0.26	0.2	0.12		
		0.06 0.05	0.04 0.04	0.03 0.03	
		0.11 0.1	0.08 0.07	0.06 0.05	
		0.2 0.19	0.15 0.14	0.1 0.09	
190	335	425	640	730	850

▌Dimensional drawing

Ho=H+(additional value in table)

DY-T 3-WAY CONTROL VALVE

A (B) — B (A) — C

This control valve is mainly used for temperature control of cooling water fed to large-size diesel engine or speed reducer, or of lubricating oil system.
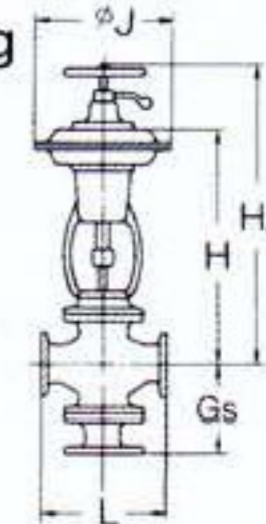
Depending on the direction of the flow of the fluid, the valve can be used for mixing (from two ways to one way) as well as stream splitting (from one way to two ways). However, the valve is normally used for blending which gives better controllability.

The bottom side connection is available in two types, bend type and straight type, to suit the application.

SPECIFICATIONS

|	
Type of valve body assembly	Single seated 3-way valve of casting, with top and bottom guided plug.
Pressure rating	JIS 5K and 10K, or ANSI 125 and 150.
Nominal bore	25～350mm (1～14 inch)
Service temperature range	0～220℃ (32～428 F)
Standard materials (JIS)	● Valve body assembly FC200、CAC403、SCPH2、SCS13・14 ● Trim SUS304・316 or SCS13・14 ● Packing・Gasket (Asbestos Free) PTFE, graphite, etc.
Cv value	See the table below. (Km value: 0.72)
Floe characterstic	Linear
Performance	● Rangeability 30：1 ● Leakage at full cloaure Not more than 0.1% of the rated Cv value
Maximum allowabe Pressure drop	Diaphragm type or cylinder type actuator can be mounted. Single action disphragm type is normally used. Maximum allowable pressure drop is shown in the table below.
Dimensions and mass	See the table and the figure

Dimensional drawing

Ho＝H＋(additional value in table)

DY-T 3-Way Control Valve

NOMINAL BORE mm (inch)			25A(1B)	40A(1½B)	50A(2B)	65A(2½B)	80A(3B)	100A(4B)	125A(5B)	150A(6B)	200A(8B)	250A(10B)	300A(12B)	350A(14B)
RATING	JIS	(K)	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10	5 / 10
	ANSI	(Class)	125 / 150	125 / 150	125 / 150	125 / 150	125 / 150	125 / 150	125 / 150	125 / 150	125 / 150	125 / 150	125 / 150	125 / 150
	IEC *	(PN-bar)	10 / 16	10 / 16	10 / 16	10 / 16	10 / 16	10 / 16	10 / 16	10 / 16	10 / 16	10 / 16	10 / 16	10 / 16
RATED Cv VALUE	Flow characteristic	Linear	9.5	33	48	86	115	180	270	400	630	950	1400	1900
DIMENSIONS (mm)	L	JIS (FC20)	162 / 170	260 / 268	260	268	300	308 / 316 / 324 / 350 / 358	420 / 428	480 / 488	570 / 574	740 / 748	860 / 868	900 / 908
		ANSI (FC20)	158	258	260	268	300	310 / 318 / 328 / 358	428	488	580	750	868	910
	Gb Bend type		150	221	221	181	196	219 (※3 250)	275	321	370	459	520	581
	Gs Straight type			210	215	225	240	265	300	340	375	430	480	530
	H (※1)		678	682	750	745	752	755	842	985	1158	1395	1440	1492
	Additional value	With handwheel	185	185	215	215	215	215	215	276	330	522	528	528
	Actuator J		Refer to following (J)											

ALLOWABLE PRESSURE DROP (MPa) — (in case of single action diaphragm actuator)

Actuator size (J)	Off Balance (kPa)	25A	40A	50A	65A	80A	100A	125A	150A	200A	250A	300A	350A
275	20	0.57	0.21										
	40	1.14	0.42										
	60	1.71	0.62										
355	20	1.2	0.44	0.24	0.16	0.12	0.08						
	40	2.4	0.87	0.48	0.32	0.24	0.16						
	60	3.6	1.1	0.71	0.48	0.36	0.24						
410	20			0.32	0.19	0.15	0.1	0.07					
	40			0.63	0.38	0.3	0.2	0.14					
	60			0.95	0.56	0.45	0.3	0.21					
465	20							0.08	0.06				
	40							0.16	0.12				
	60							0.24	0.18				
520	20								0.07	0.05			
	40								0.14	0.1			
	60								0.21	0.15			
645	20									0.09	0.05	0.04	0.03
	40									0.18	0.1	0.08	0.06
	60									0.27	0.15	0.11	0.08
Mass (kg) (※2)		60	110	135	145	155	215	275	340	530	805	880	980

(※1) H dimension gives the longest dimension of the valve with the standard bonnet type. For the valve with a handwheel, add the value shown above.
(※2) Mass indicated is that of the valve with handwheel and positioner (=maximum mass).
(※3) Gb dimension in the table indicates those of ANSI flanged valves.
* IEC in the column of rating indicates the ratings of valve groups formed in terms of face-to-face dimensions.

3-WAY MIXING CONTROL VALVE WITH ROTARY PLUG

NAKAKITA
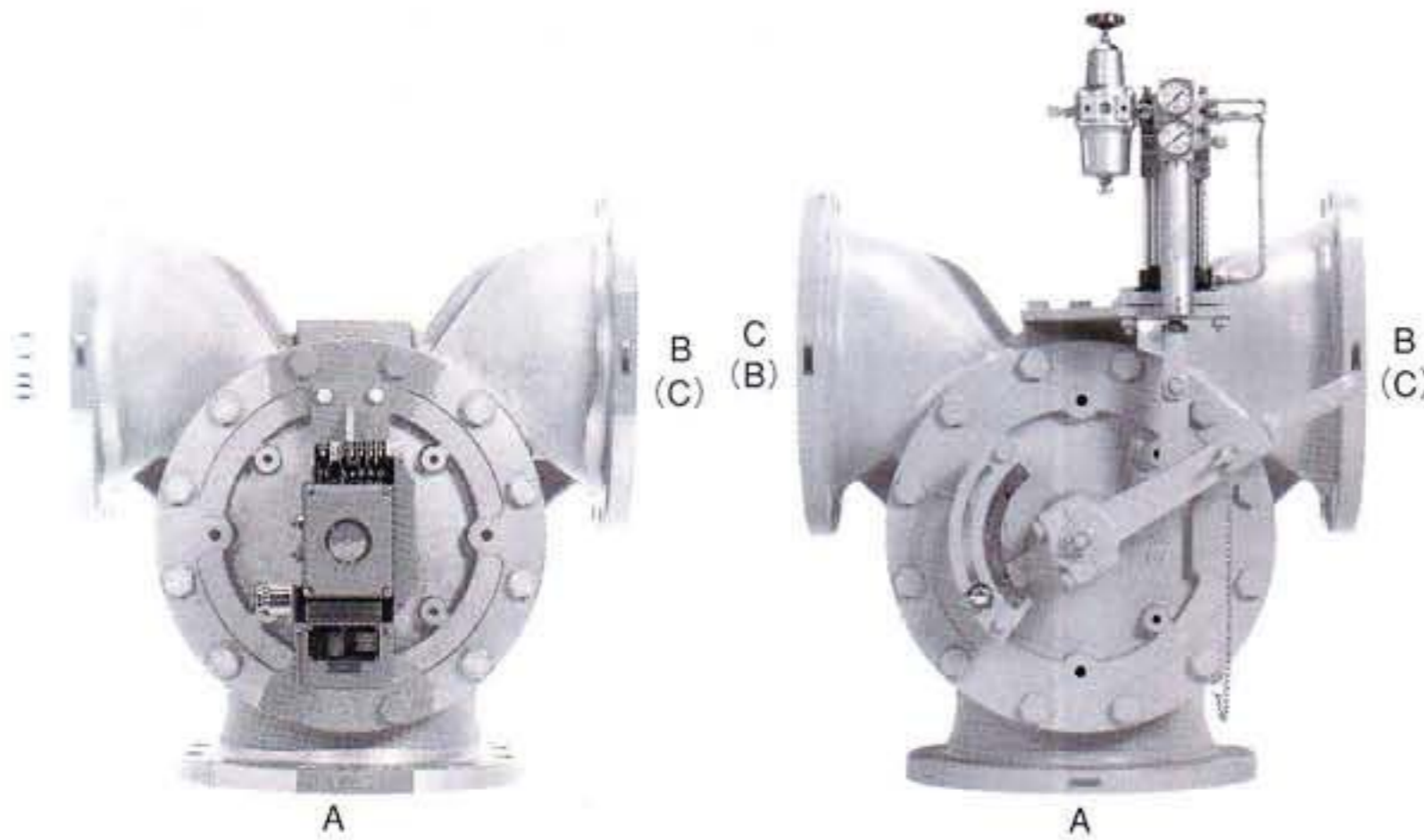
SPECIFICATIONS

Type of valve body	Rotary plug type 3-way valve of casting
Pressure rating	JIS5K,10K、ANSI 125,150
Nominal bore	80～650A
Service temperature range	0～100℃
Standard material (JIS)	• Valve body FC、FCD、CAC403、SCPH2、SCS13 • Trim CAC403、CAC406、SCS13、SCS14 • Gasket　　Asbestos free
Cv value	See the table below （Km:0.8)
Flow characteristic	Linear
Flow direction	Mixind type （550A～650A Mixing type only) divideing type
Performance	• Rangeability 30：1 • Maximum seat leakage 2% of rated Cv （Max.)
Actuator	Cylinder type,Diaphragm type or Motor type

Inherent flow characteristic

(0%) 100% — A–C / A–B — 100% (0%)

Cv — VALVE TRAVEL

Dimensional drawing

Motor type　　Cylinder type　　Diaphragm type φJ
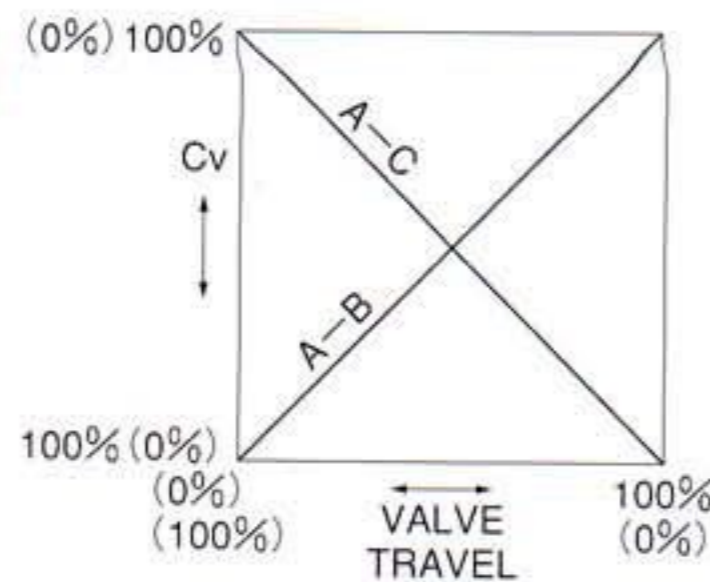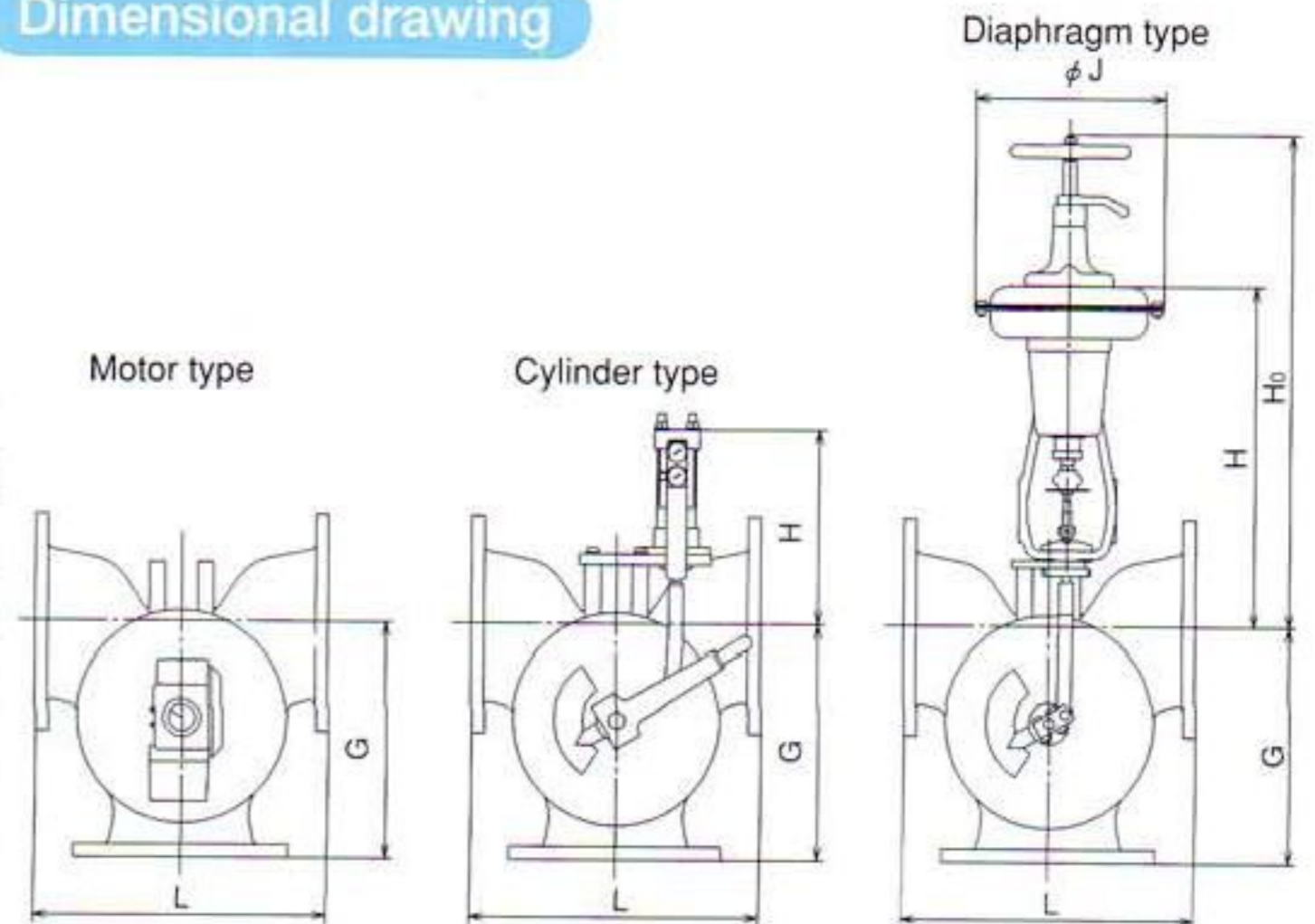
The applications and function of this control valve are the same as those of DY-T 3-way control valve already mentioned, however this valve is more suited to larger capacity or lager bore applications. The construction is simple with a small number of components. It's a rotary plug type 3-way valve where the flow channel is altered by turning the valve plug. For handling corrosive fluids such as sea water, it is possible to apply corrosion-resistant rubber lining or other coating onto the inner wall of the body. As the turning torque of the valve stem is small size actuator can be used, and the required space can be small. The valve can be mainpulated by mean of the level.

DY-M　3-way mixing control valve

			80A(3B)		100A(4B)		125A(5B)		150A(6B)		200A(8B)		250A(10B)		300A(12B)		350A(14B)		400A(16B)		450A(18B)		500A(20B)		550A(22B)	600A(24B)	650A(26B)
RATING	JIS	(K)	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	5	5
	ANSI	(Class)	125	150	125	150	125	150	125	150	125	150	125	150	125	150	125	150	125	150	125	150	125	150	125	125	125
	ISO *	(PN-bar)	10	16	10	16	10	16	10	16	10	16	10	16	10	16	10	16	10	16	10	16	10	16	10	10	10
RATED Cv	Characterristics Linear		125		190		310		470		720		1200		1600		2200		2800		3900		4800		5400	6600	7800
DIMENSION (mm) ※3	Face to face L	JIS	286	294	290		320	328	360		450	454	550	558	660		730	738	820	832	960	976	1024	1040	1090	1200	1300
		ANSI	288	298	298	298	328	328	368	368	460	460	560	560	668	668	740	742	834	834	980	980	1048	1048	—	—	—
		ISO	294	294	298		332	332	368		454	462	564	582	660		730	742	824	836	964	980	1028	1044	—	—	—
	Hight G	JIS	215	219	215		250	254	285		365	367	435	439	510		565	569	625	631	725	733	781	789	882	996	1052
		ANSI	216	221	219	219	254	254	289	289	370	370	440	440	514	514	570	571	632	632	735	735	792	792	—	—	—
		ISO	219	219	219		256	256	289		367	371	437	441	510		565	571	627	633	727	735	783	791	—	—	—
CYLINDR TYPE	Size (mm)		63														80						100		125		
	Hight H (mm)		556		556		542		527		492		463		465		477		476		475		500		360	385	413
	Mass (kg)		50		50		60		85		110		180		250		310		440		603		750		1080	1300	1600
DIAPHRAGM TYPE	Size J (mm)		355		355		355		410		410		410		465		465		520		520	645	645		—	—	—
	Hight H (mm) (※1)		600		600		600		584		584		630		714		714		840		1055		1055		—	—	—
	Additional value with handwheel		270		270		270		270		270		332		385		385		540		540		540		—	—	—
	Mass (kg) (※2)		87		92		100		125		150		240		375		435		630		765		910		—	—	—

※1　H dimension indicates the longest dimension. However when the valve is fitted with the handwheel, add the respective value shown in the table abobe.
※2　Weight indicated is that of the valve with a handwheel and positioner. （=maximum mass)
※3　Motor type of hight add to a half of flange diameter.
*　　ISO in the column of rating indicates the ratings of valve groups formed in terms of face to face dimension.

DY-B BUTTERFLY VALVE

DY-BOO
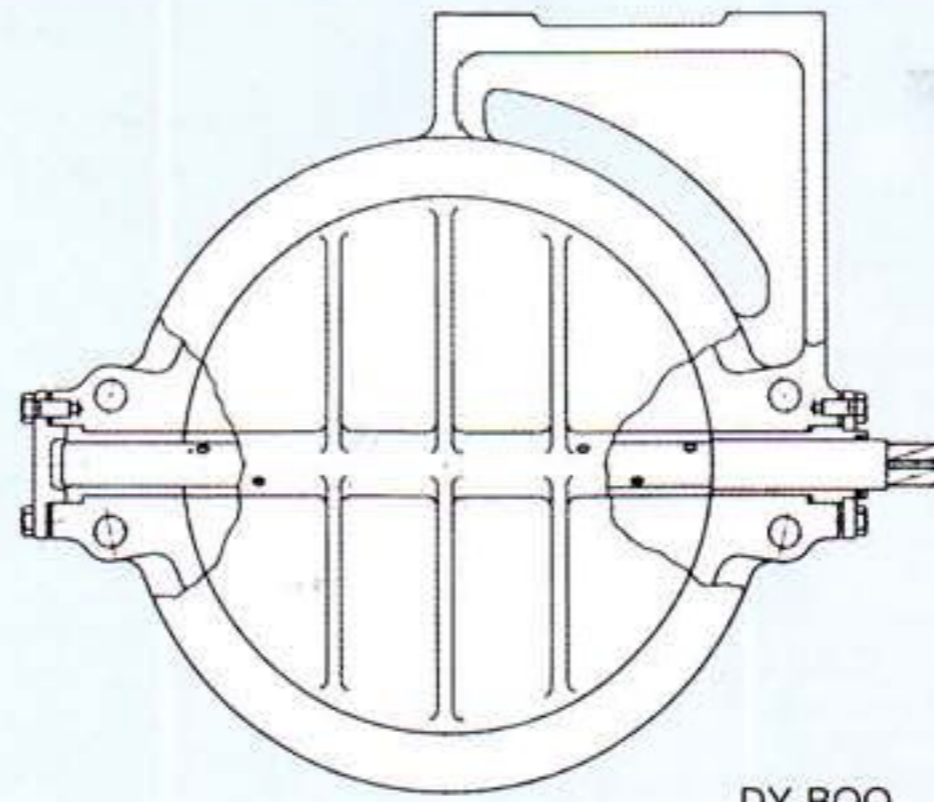
This control valve has a simple construction, and in comparison with the globe type control valve, is suitable to relatively low pressure drop services of large capacity or large bore. Many control valves of this type have been used in a wide rang of services from low temperature to high temperature.

This wafer type (binding type) valve has a very small face-to-face dimension and can be easily connected to the piping system by means of through bolts.

For handling corrosive fluids such as sea water, it is possible to apply rubber lining of coating onto the inner surface of the body.

SPECIFICATIONS

Type of valve body assembly	Wafer type butterfly valve of casting.
Pressure rating	JIS 5K、10K or ANSI 125・150
Nominal bore	100~700 mm (4~28 inch)
Service temperature range	−196~550℃ (-321 ~ 1022° F)
Standard materials	• Valve body assembly FC200、FCD400、CAC403、CAC406、SCPH2、11、21、32、61、SCS13、14 • Trim SUS403・304・316, SCS13・14 • Packing, Gasket (Asbestors Free) PTFE, graphite, etc.

Cv value	See the table below. At fullyp open position, Km value: 0.38, Xt value: 0.32
Flow characteristics	Approximately parabolic characteristic.
Performance	• Rangeability 20:1 / Leakage at full closure — Not more than 3% of the rated Cv value
Maximum allowable pressure drop	Diaphragm type or cylinder type actuator can be mountes. Single action diaphragm type is normaly used. Maximum allowable pressure drop is shown in the table below.
Dimensions and mass	See the table below and the figure on the right.

Dimensional drawing

$Ho=$ $H+$ (anddition al valve in table)
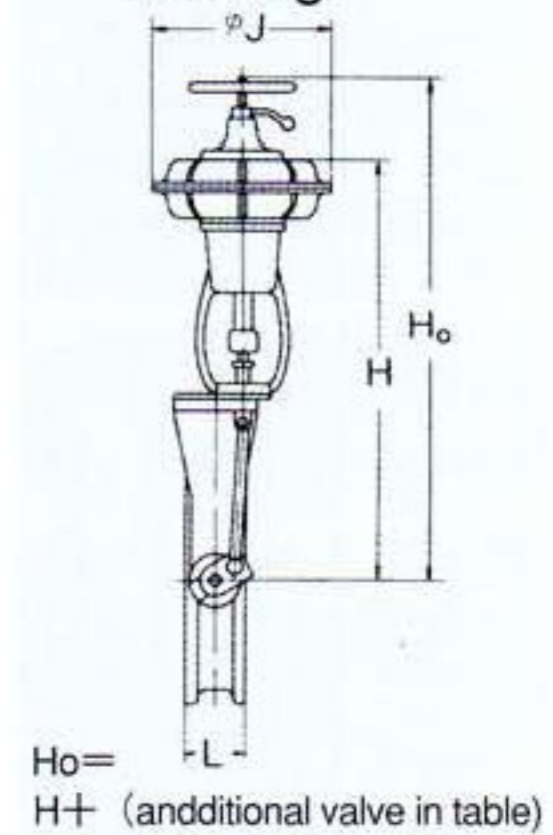
DY-B butterfly control valve

NOMINAL BORE mm (inch)			100A(4B)	125A(5B)	150A(6B)	200A(8B)	250A(10B)	300A(12B)	350A(14B)	400A(16B)	450A(18B)	500A(20B)	550A(22B)	600A(24B)	650A(26B)	700A(28B)
RATED Cv VALUE			220	400	580	1030	1600	2300	3100	4000	5200	6400	7500	9000	10500	12000
DIMENSIONS (mm) Face to Face L (※1)			80	80	80	100	115	115	120	120	120	140	140	140	180	180
Height H (※1)			935	935	950	975	1005	1295	1325	1355	1390	1430	1465	1495	1535	1575
Additional valve; with handwheel			385	385	385	385	385	540	540	540	540	540	540	540	540	540
Actuator J			Refer to following (J)													
ALLOWABLE PRESSURE DROP (Kgf/cm²) / Actuator size (J) mm	275	Range when open (kPa) 20~100	0.32	0.16	0.09	0.04	0.02									
		40~200	0.38	0.2	0.12	0.07	0.04									
		Off Balance when close (kPa) 20	2.0	1.2	0.66	0.4	0.3									
		40	2.0	1.2	0.66	0.4	0.4									
	355	Range when open (kPa) 20~100	0.36	0.19	0.11	0.05	0.03	0.02	0.02	0.01	0.01	0.01				
		40~200	0.38	0.2	0.12	0.07	0.05	0.04	0.03	0.02	0.02	0.01				
	410	Off Balance when close (kPa) 20	2.0	1.2	0.66	0.4	0.35	0.28	0.18	0.12	0.08	0.06				
		40	2.0	1.2	0.66	0.4	0.4	0.4	0.25	0.24	0.16	0.12				
	465	Range when open (kPa) 20~100						0.04	0.02	0.02	0.01	0.1	0.01	0.01	0.01	0.01
		40~200						0.66	0.04	0.03	0.02	0.14	0.15	0.02	0.01	0.01
		Off Balance when close (kPa) 20						0.4	0.25	0.2	0.15	0.1	0.11	0.09	0.07	0.08
		40						0.4	0.25	0.24	0.17	0.17	0.13	0.16	0.14	0.11
Mass (kg) (※2)			140	145	150	170	180	235	245	265	290	340	380	410	495	600

(※1) H dimension gives the longest dimension. However, when the valve is fitted with a handwheel, add the respective value shown above.

(※2) Mass indicated is that of the valve with a handwheel and positioner (=maximum mass).

DY-BR LOW LEAK BUTTERFLY CONTROL VALVE

valve disk

Hexagon socket head cap screw
Stopper ring
Seal ring

Seat surface

body
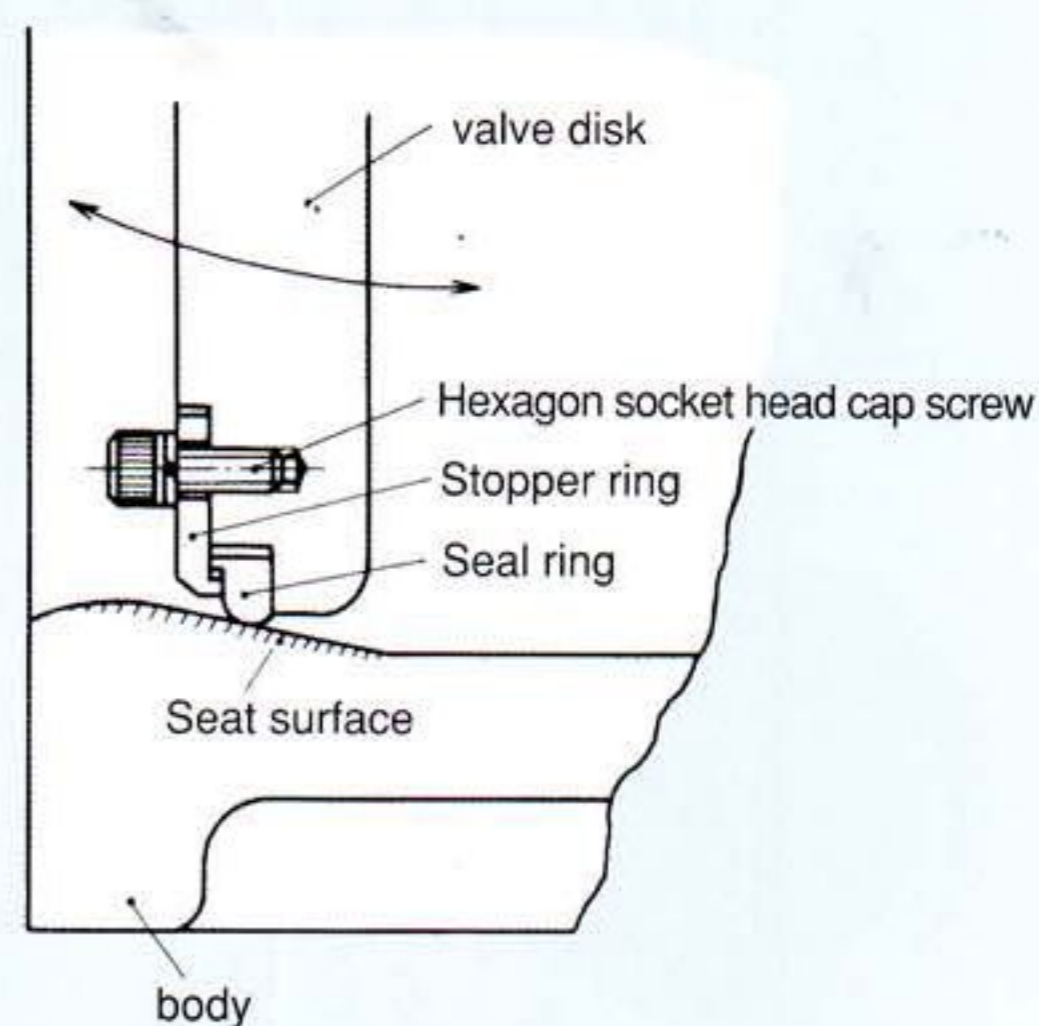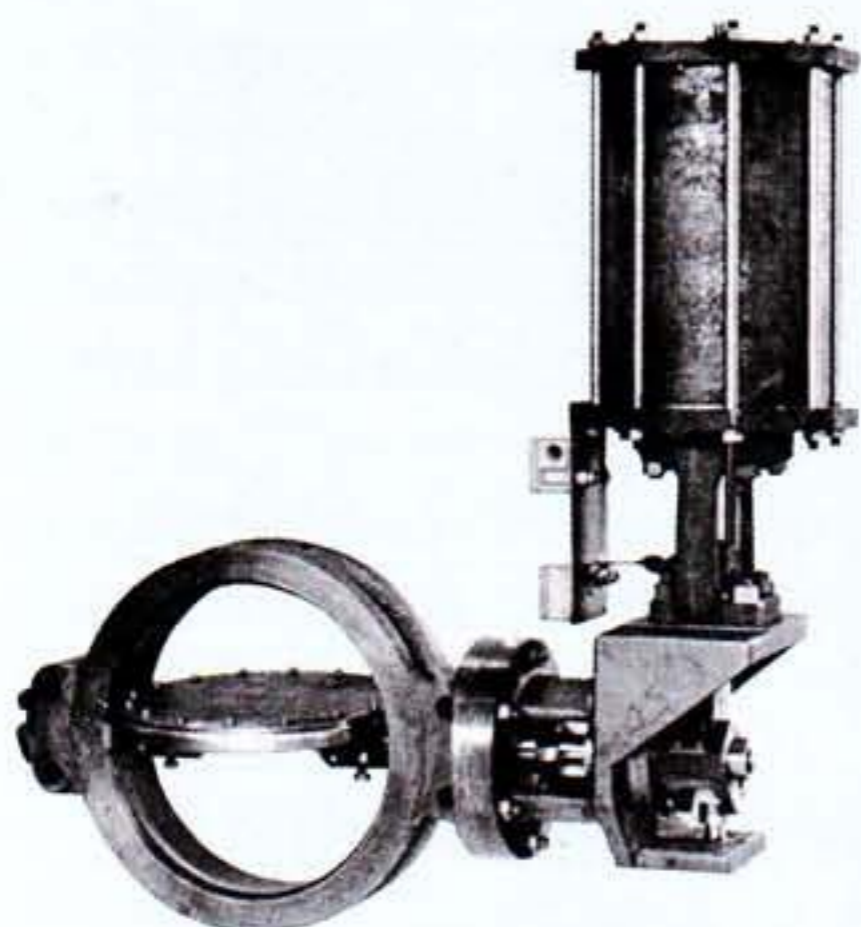
For relatively low pressure drop services of large bore, butterfly valves have advantages in space and cost. This control valve uses a seal ring construction to minimize leakage at full closure, which is the weak point of butterfly valves, and assures low leakage of not more than 0.1% in a wide temperature range from low to high,

An appropriate slope is formed on the seat surface of the body by building stainless steel so as to ease sliding-in of the seal ring as well as to add corrosion resistance. On the other hand, a flexible seal ring margin for fixing is fitted on the outer circumference of the valve disk with a stopper ring so as to obtain smooth leak-off. The stopper ring is for fixing the margin of the seal ring as well as preventing slip-off.

This control valve is normally used for all typesof fluid, gas, vapor or liquid, However, it is not suitable to corrosive fluids like sea water or fluids with much slurry or scale.

SPECIFICATIONS

Type of valve body assembly	Wafer type butterfly valve of casting. Seal ring construction.
Pressure rating	JIS 5K and 10K or ANSI 125 and 150
Nominal bore	100~700A (4 ~ 28 inch)
Service temperature range	−196~550°C (-321 ~ 1022°F)
Standard materials	● Valve body asseembly SCPH2 · 11 · 21 · 32、SCPL1 · 11 · 21 · 31
	● Trim SUS304 (surface-hardened) , or SCS13 (surface-hardened).
	● Packinng · Gasket (Asbestors Free) PTFE, graphite, etc.
Cv value	See the table (page 43).
Flow characteristic	Approximately parabolic characteristics.
Performance	● Rangeability 20：1
	● Leakage at full closure Not more than 0.1% of the rated Cv value.
Maximum allowable pressure drop	For single action diaphragm type, see the table (page43). For cylinder type, it is obtained from the output ratio to the abovementioned diaphragm type shown in the detailed data on actuators on page 50, which is about 5 times larger.
Dimensions and Mass	See the table (page 43).

ID SERIES DAMPER TYPE BUTTERFLY CONTROL VALVE
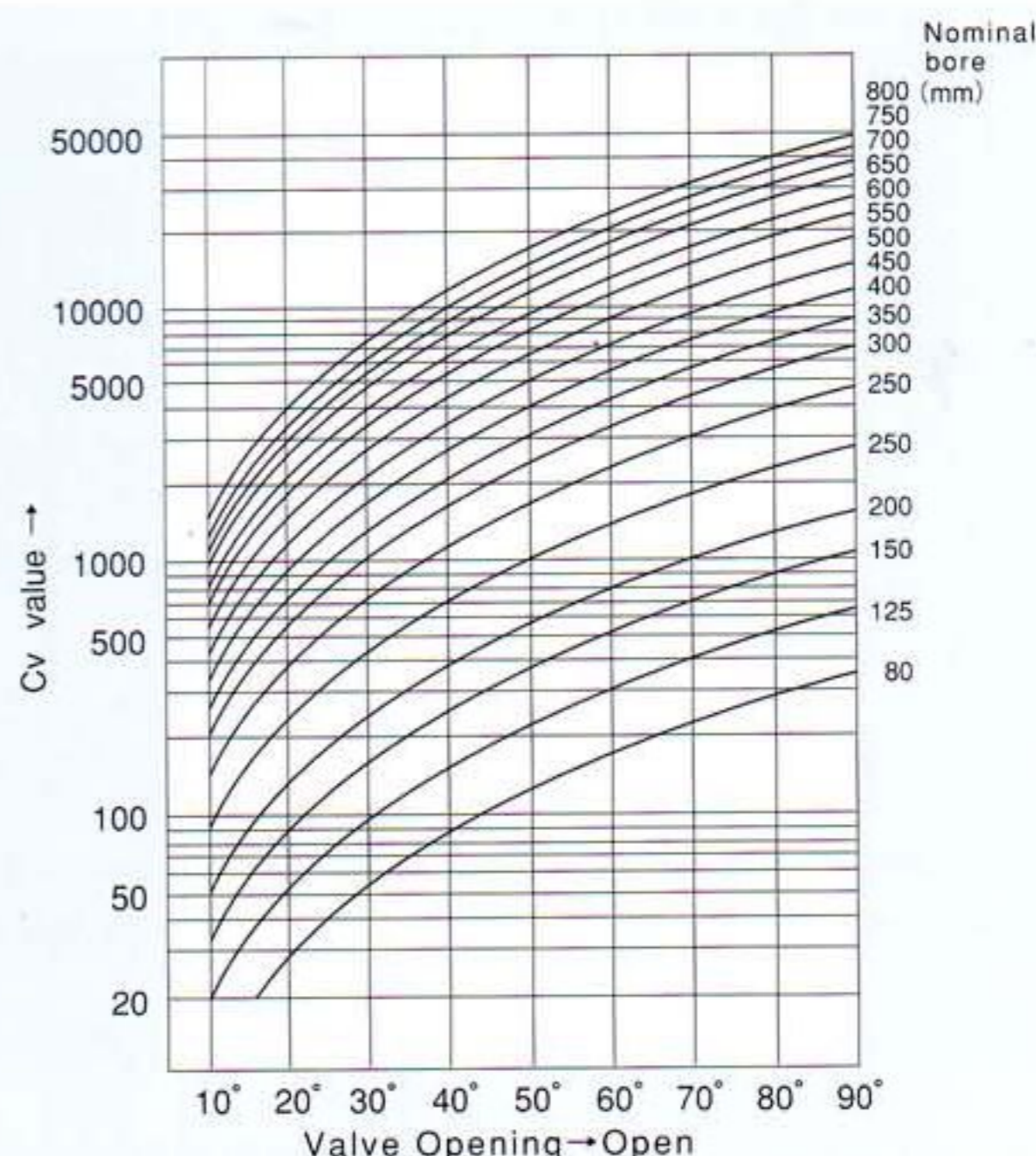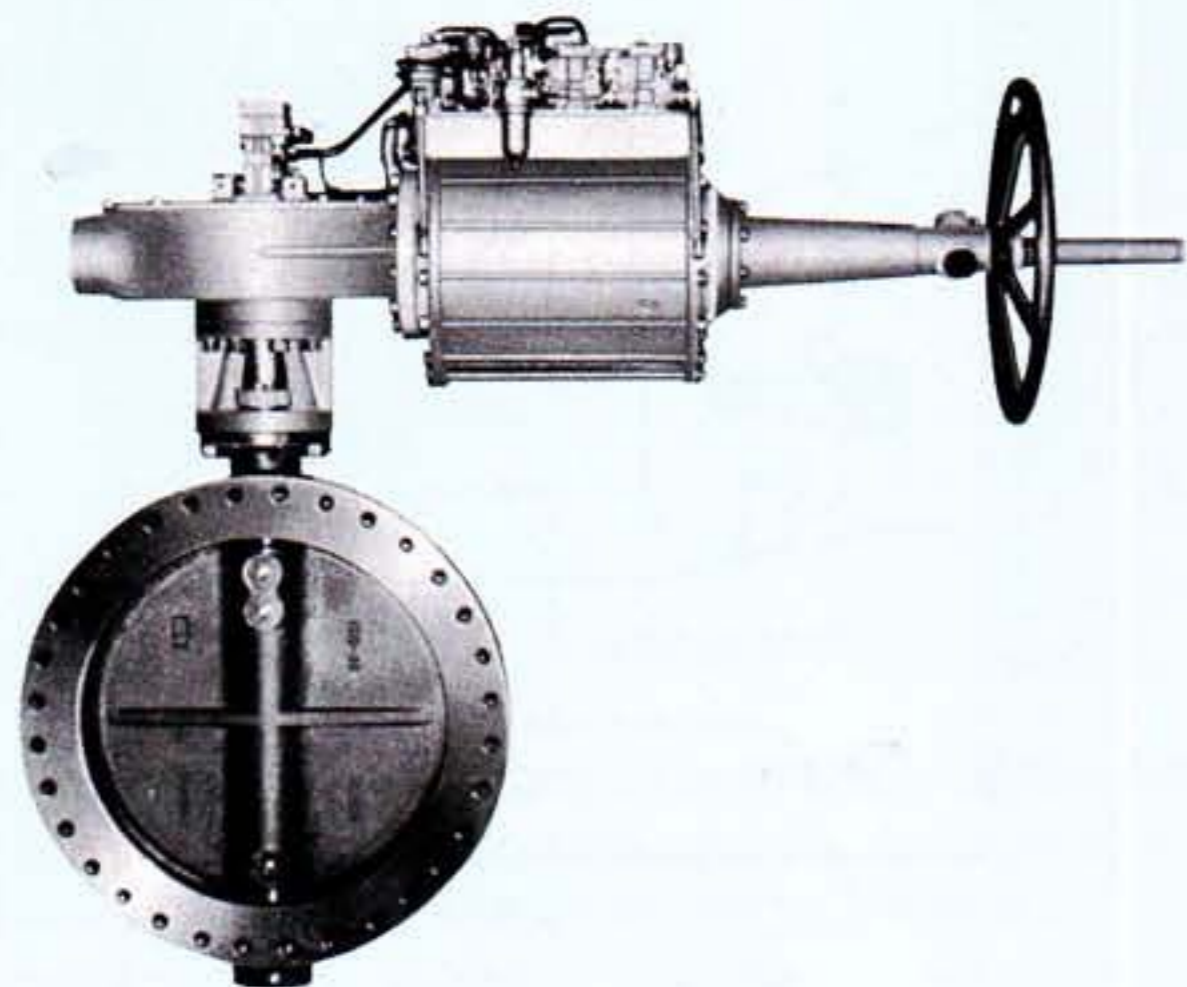
This valve is similar to DY-B type butterfly control valve, and is equipped with a cylinder type actuator.

As no valve seat is provided for sealing at full closure, there is a slight gap left between the zalve body and the valve disk, and some leakage can not be avoided. We have many actual results of this valve for special applications such as fluid flow rate control around intermediate valve travel.

The power source of actuator is mainly pneumatic. The pneumatic type is a combination of a pneumatic positioner and a cylinder, and the pressure is normally 0.49 to 0.69MPa. We also produce oil hydraulic type and electric type.

SPECIFICATIONS

Type of valve assembly	Wafer type butterfly valve of casting.
Pressure rating	JIS 5K～16K, or ANSI 125～150.
Nominal bore	80^A～1500^A
Service temperature range	0～425℃ (32～797°F). When the temperature exceeds 70℃, the frame type is used.
Standard materials	● Valve body assembly FC200, FCD400, SCPH2 (SCS13、14), etc. ● Valve disk SC (outer circumference:SUS304 facing), etc. ● Packing・Gaskket (Asbestos Free) PTFE, graphite, etc.
Cv value	See the figure above.
Flow characteristics	See the figure above.
Performance	● Rangeability 20：1 ● Leakage at full closure Max. 5% of the Cv value.
Dimensions and Mass	See the figure above.

■ Dimensional drawing

■ Table of dimensions and weight

(mm)
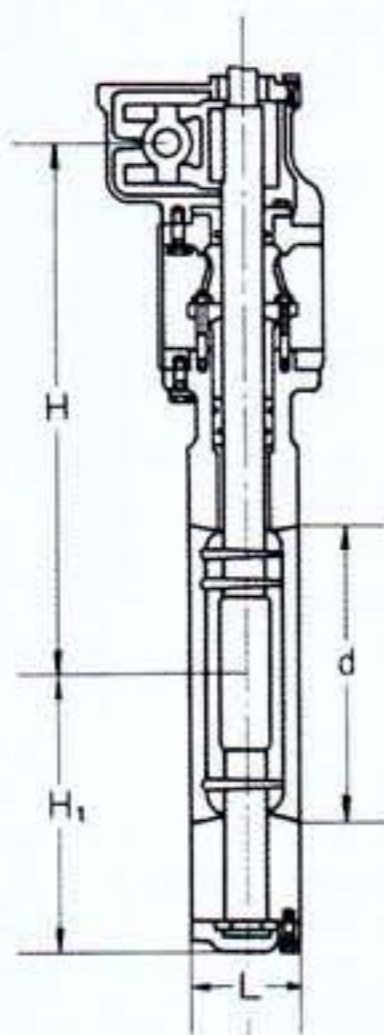
Nominal bore mm (inch)	d	L	H／HG *	H$_1$	ℓ$_1$	ℓ$_2$	ℓ$_3$	Weight (kg)
80^A (3^B)	80	60	253／353	120	325	98	40	55／65
100^A (4^B)	100	60	268／388	124	325	102	40	67／78
150^A (6^B)	150	70	312／457	164	340	102	40	80／90
200^A (8^B)	200	80	338／483	189	340	102	40	105／115
250^A (10^B)	250	90	410／570	226	406	135	50	128／138
300^A (12^B)	300	90	435／595	251	406	135	50	155／168
350^A (14^B)	335	100	465／645	271	443	142	55	186／200
400^A (16^B)	380	110	521／701	306	505	162	65	240／255
450^A (18^B)	430	130	559／759	336	555	188	80	310／323
500^A (20^B)	480	140	601／821	368	575	198	85	368／385
550^A (22^B)	530	150	664／884	403	605	218	95	445／460
600^A (24^B)	580	160	697／947	428	640	231	105	532／566
650^A (26^B)	630	170	738／990	451	735	251	120	655／710
700^A (28^B)	680	180	788／1038	483	820	290	145	745／805
750^A (30^B)	730	190	818／1068	518	820	290	145	920／982
800^A (32^B)	780	200	851／1101	543	920	345	175	1064／1130

* HG : When valve is fitted with frame (and gland packing). For measurement of ℓ$_1$, ℓ$_2$ and ℓ$_3$, see the dimensional drawing of page 47. This table is for valves without manual control unit. ℓ$_1$ of valve with manual control unit is longer.

HD SERIES DAMPER TYPE BUTTERFLY CONTROL VALVE

This valve is modeled on the "NS-C series" H-type butterfly valve which is one of our representative products, and is designed as control valve.

Although the valve has a valve seat, it does not give complete sealing at fully closed posotion. There is a small gap between the valve disk and the seat, and some leakage can not be avoided. The valve is used, in the same way as ID series valve, for flow rate control around the intermediate valve travel. We have many actual results of this valve in special applications.

The feature of this valve is that it allows replacement of the valve seat in case it is damaged.

The power source of the actuators is mainly pneumatic.

● Pneumatic type is a combination of a pneumatic positioner and a cylinder. The pressure is normally 0.49 to 0.69 MPa.

We also produce oil hydraulic type and electric type.

SPECIFICATIONS

Type of valve body assembly	Wafer type butterfly valve of casting.
Pressure rating	JIS 5K~16K, or ANSI 125 and 150.
Nominal bore	$150^A \sim 1500^A$ (6 ~ 60 inch)
Service temperature range	0~425℃ (32~797°F). When the temperature exceeds 70°C, the frame (and gland packing) type is used.
Standard materials	● Valve body assembly FC200,FCD400,CAC403,CAC406,SCPH2,11,21,32,61,SCS13,14 ● Valve disk SC (outer circumference: SUS304facing), etc. ● Valve seat S25C, SUS304, etc. ● Packing・Gasket (Asbestors Free) PTFE, graphite, etc.
Cv value	See the top right figure on page 47.
Flow characteristic	See the top right figure on page 47.
Performance	● Rangeability 20：1 ● Leakage at full closure Max, 3% of the Cv below.
Dimensions and mass	See the table below
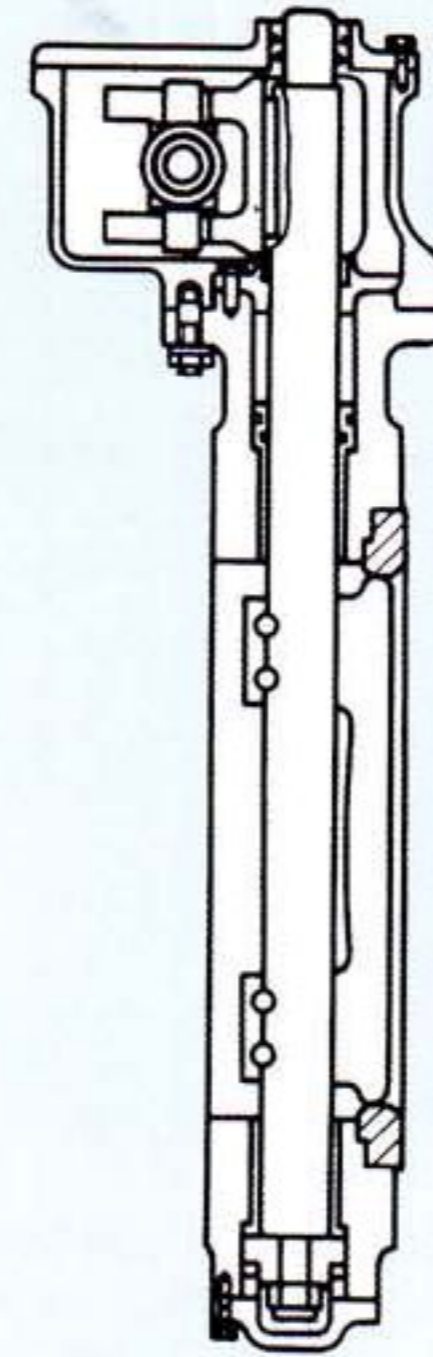
Table of dimensions weight

(mm)

Dimensional drawing
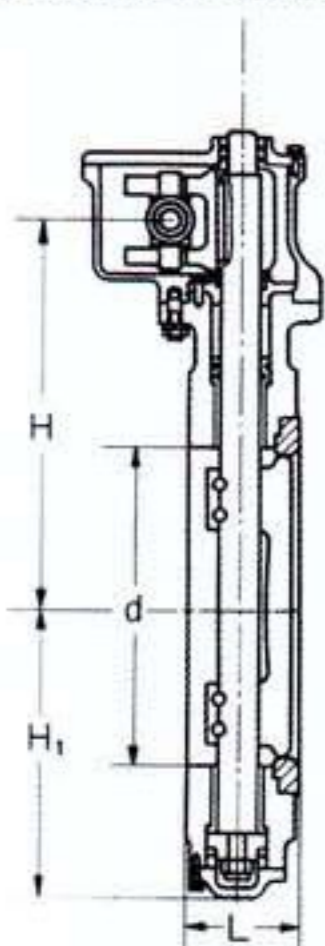
Nominaru bore mm(inch)	d	L	H/HG *	H₁	ℓ₁	ℓ₂	ℓ₃	Mass (kg)
150ᴬ(6ᴮ)	150	91	361／506	196	389	135	50	87／98
200ᴬ(8ᴮ)	200	101	396／541	207	421	138	50	116／127
250ᴬ(10ᴮ)	250	111	436／596	247	443	142	55	140／152
300ᴬ(12ᴮ)	300	111	482／642	272	505	162	65	170／185
350ᴬ(14ᴮ)	335	122	520／700	322	555	188	80	205／220
400ᴬ(16ᴮ)	380	132	567／747	342	575	198	85	265／280
450ᴬ(18ᴮ)	430	152	630／830	392	605	218	95	340／355
500ᴬ(20ᴮ)	480	162	673／893	418	640	231	105	405／422
550ᴬ(22ᴮ)	530	172	745／965	445	735	251	120	490／507
600ᴬ(24ᴮ)	580	202	774／1024	479	820	290	145	585／623
650ᴬ(26ᴮ)	630	212	839／1089	483	820	300	145	720／780
700ᴬ(28ᴮ)	680	222	872／1122	523	920	345	175	820／885
750ᴬ(30ᴮ)	730	232	933／1183	538	1090	365	195	1010／1080
800ᴬ(32ᴮ)	780	242	967／1217	592	1070	405	220	1170／1245

* HG : When valve is fitted with frame (and gland packing). For measurement of ℓ₁, ℓ₂, and ℓ₃, see the dimensional drawing on page 47.

NS-C NON-LEAK BUTTERFLY CONTROL VALVE
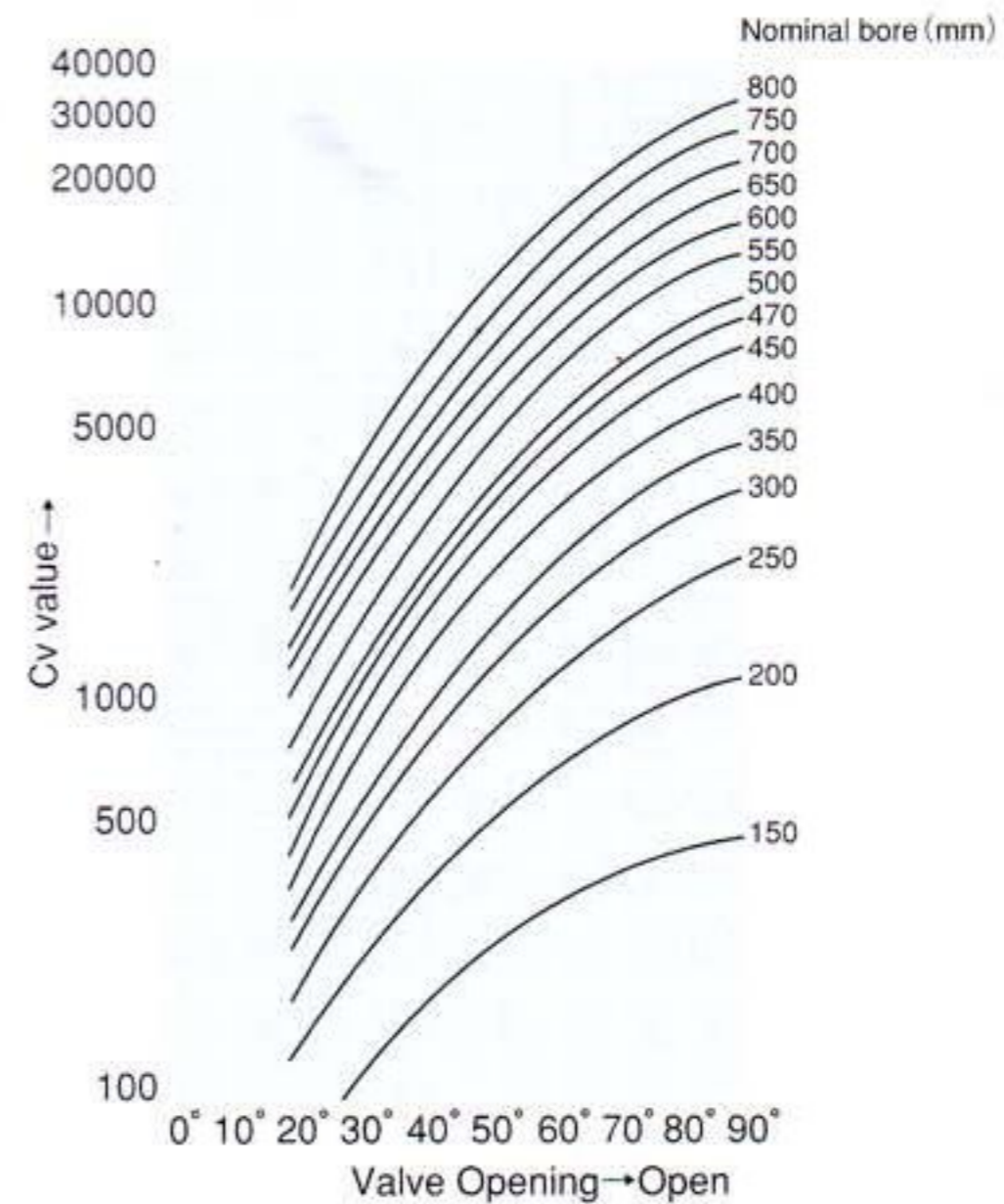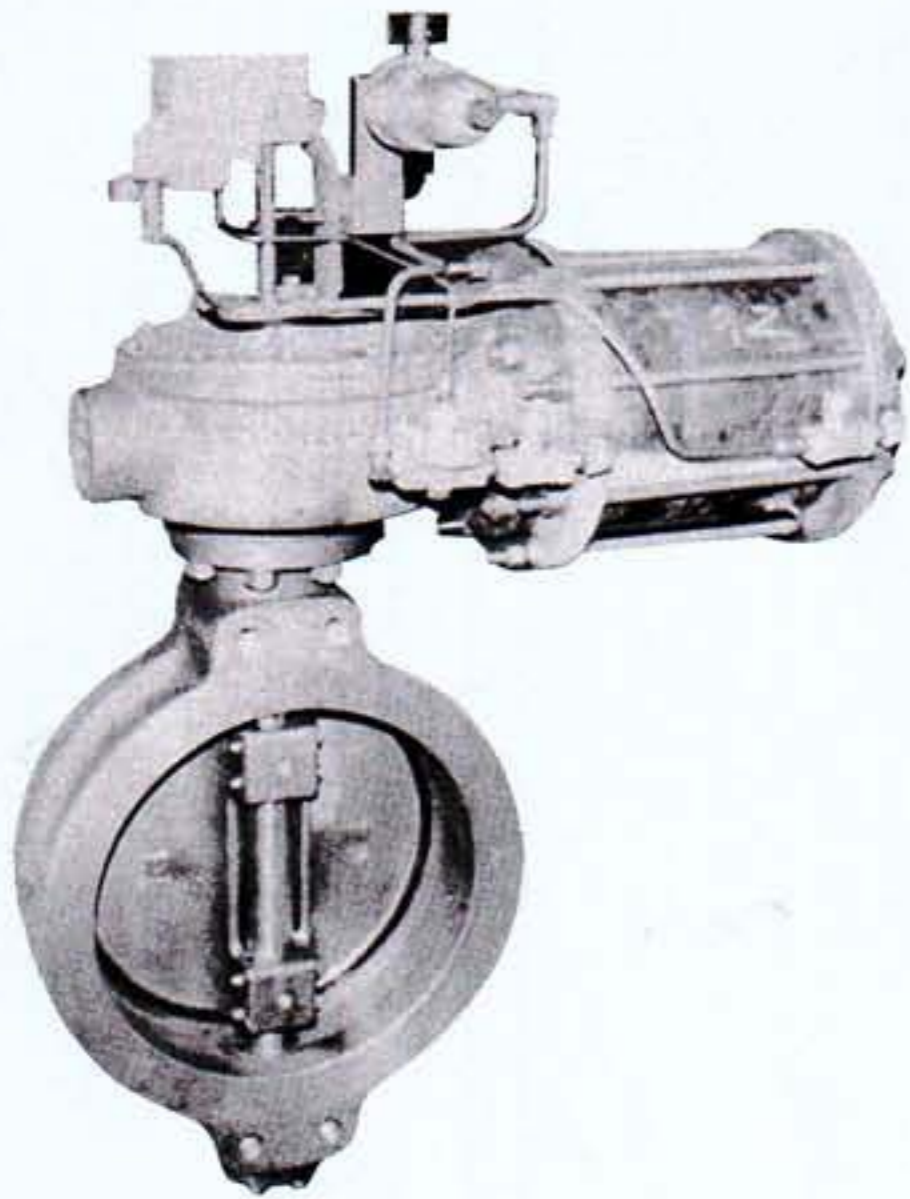
This valve is NS-C series non-leak type butterfly valve, one of our representative products, which is equipped with an appropriate actuator to be used as control valve. We have many actual results of this valve in special application.

The features of this valve are rubber-lining type valve seat, completely nil leakage at full closure, easy replacement of valve seat, and small piping space requirement.

The power source of actuator can be either oil hydraulic, pneumatic, or electric one.

- The oil hydraulic type is an air-oil (or electiricity-oil) positioner, and feedback is effected by transmitting pneumatic signal of valve travel. Oil hyd. pressure 4.9 to 6.9 Mpa is made the standard, and suitable for high pressure and large bore valves.
- The pneumatic type is a combination of a pneumatic positioner and a cylinder. Pressure is 4.9 to 6.9 Mpa.
- "Twin power" is available as a special rotary type actuator. (See the separate "Technical Manuar".)

For the valve body assembly of butterfly valve, see the separate catalogue (Cat, No. 565).

SPECIFICATIONS

Type of valve body assembly	Wafer type butterfly valve of casting, with rubber lining seat.
Pressure rating	JIS 5K~16K, or ANSI 125 and 150
Nominal bore	150~1500A
Maximum service temperature	70℃(158°F)
Standard materials	● Valve body assembly FC200、FCD400、CAC403、CAC406、SCPH2、11、21、32、61、SUS13、14
	● Trime (Valve seat…SS400+rubber lining (NBR・CR) Valve dish…SC(Seat contacting surface is given SUS304 facing)、etc
	● Packing Gasket (Asbestos Free) PTFE graphite etc.
Cv value	See the figure above. At fully open position, Km value：0.38 X^{T}value：0.32
Flow characteristic	See the figure above.
Performance	● Rangeability 20：1 ● Leakage at full closure Nil.
Dimensions and mass	See the table and the figure below.

■ **Dimensional drawing**
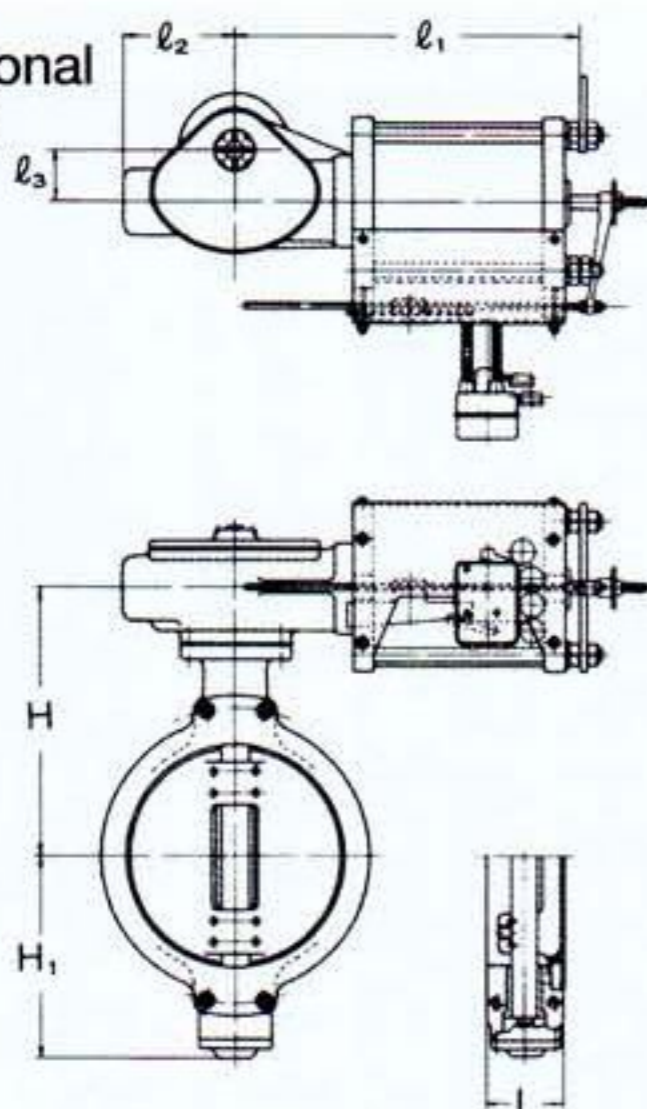
This drawing shows without handwheel.

■ Table of dimensions and weight   (mm)

Nominalbore mm(inch)	d	L	H	H$_1$	ℓ_1	ℓ_2	ℓ_3	Mass (kg)
150A (6B)	150	90	361	196	389	135	50	87
200A (8B)	200	100	396	207	421	138	50	116
250A (10B)	250	110	436	247	443	142	55	140
300A (12B)	300	110	482	272	505	162	65	170
350A (14B)	335	120	520	322	555	188	80	205
400A (16B)	380	130	567	342	575	198	85	265
450A (18B)	430	150	630	392	605	218	95	340
500A (20B)	480	160	673	418	640	231	105	405
550A (22B)	530	170	745	445	735	251	120	490
600A (24B)	580	200	774	479	820	290	145	585
650A (26B)	630	210	839	483	820	300	145	720
700A (28B)	680	220	872	523	920	345	175	820
750A (30B)	730	230	933	538	990	365	195	1010
800A (32B)	780	240	967	592	1070	405	220	1170

● Please consult us for sizes not listed on the table

DM SERIES METALLIC VALVE SEAT TYPE BUTTERFLY CONTROL VALVE
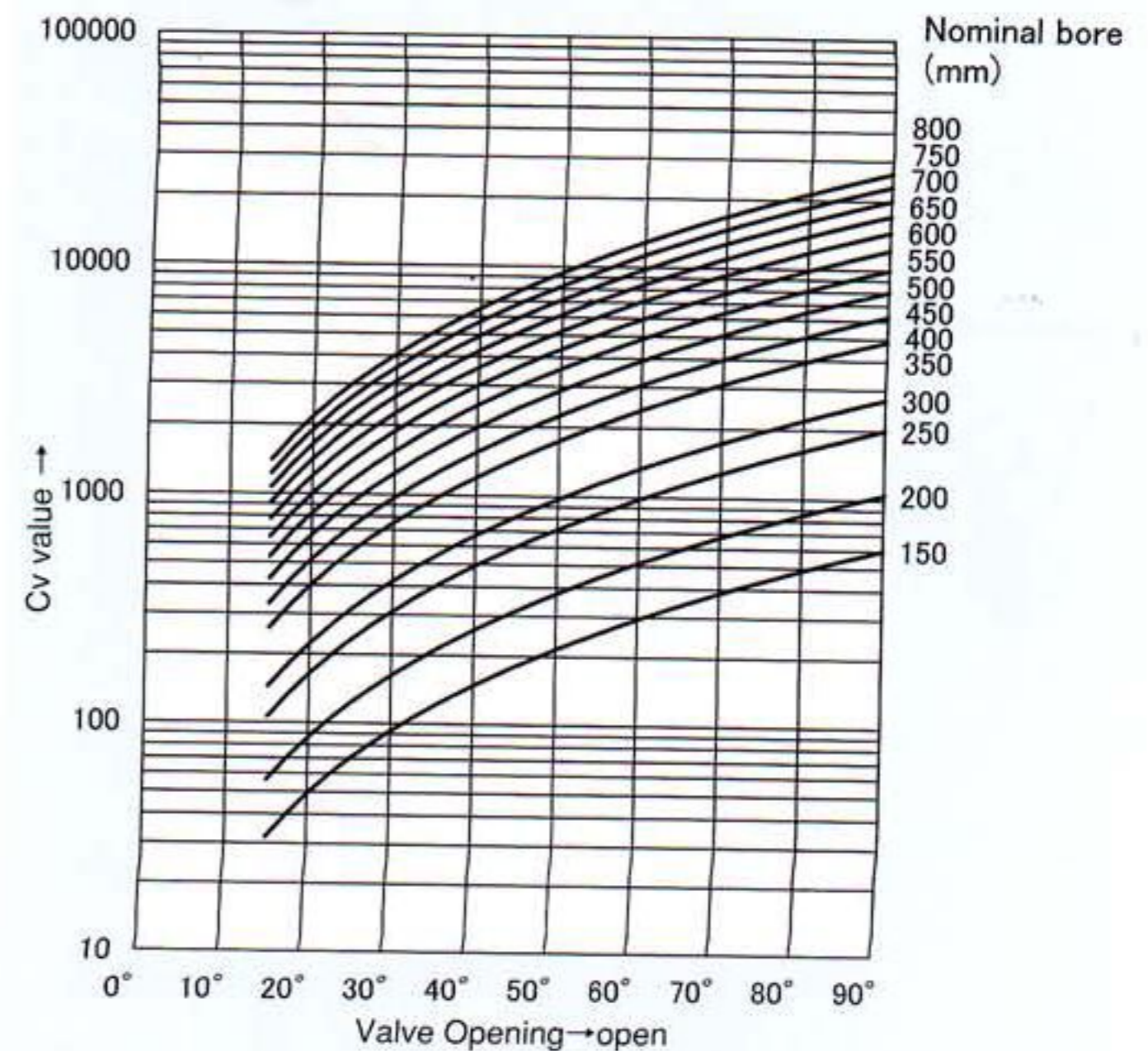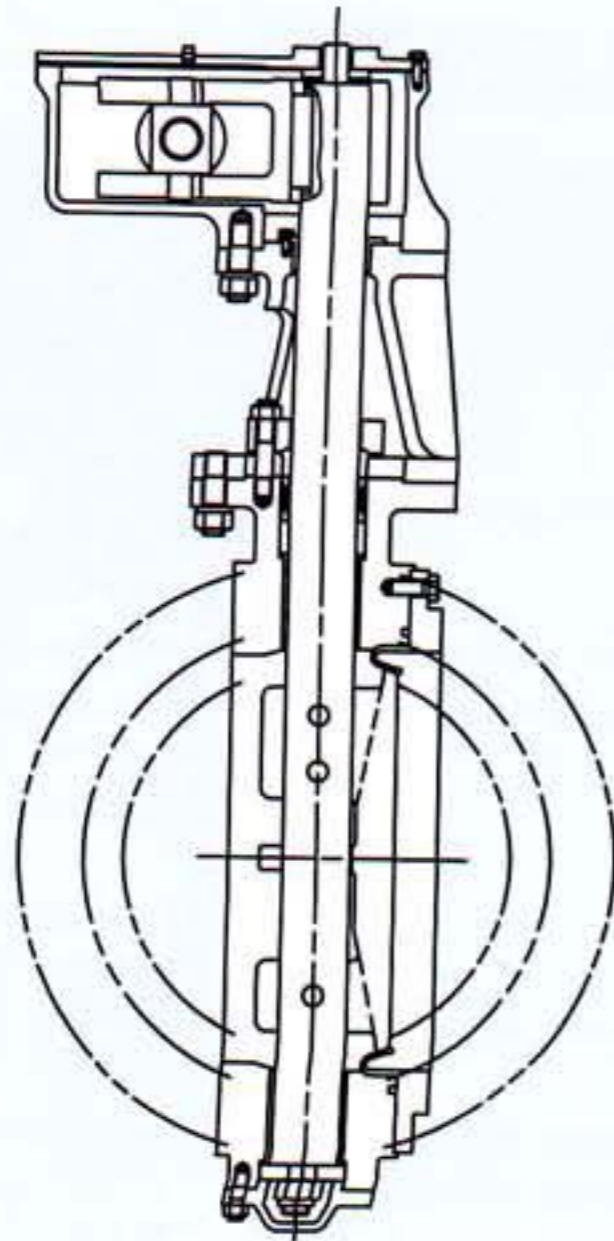
This valve is not influenced by the kind of fluid or the temperature of fluid . It severs in a wide temperature range from very low up to high, and has a special feature of fireproof design.

The valve has a double eccentric construction which permits the contact between the valve disk and the seat only at the fully closed position. As the deformation or/and defacement of the valve seat is very small, leakage is almost nil.

The powr source of the actuator is mainly pneumatic. The pneumatic type is a combination of a pneumatic positioner and a cylinder. The pressure is normally 0.49 to 0.69MPa. We also produce-oil hydraulic type and electric type.

SPECIFICATIONS

Type of valve body assembly	Wafer type butterfly valve of casting.(valve for cryogenic service is flange type.)
Pressure rating	JIS 5K~20K or ANSI 125~300
Nominal bore	150 ~ 1500(6~60inch)

Service temperature range	−253~+475℃ (−423~887°F)
Standard materials	● Valve body assembly FC200、FCD400、SCPH2、SCPH21、SCS13、SCS14, etc。 ● Trim (Valve seat…S25C、SFVAF11A、SUS304、SUS316 Valve disk …SCPH2、SCPH21、SCS13、SCS14 Contacting surfaces of both parts are given stellite fancing ● Packing, gasket (Asbestos Free) PTFE, graphite.
Cv value	See the figure above
Flow characteristic	See the figure above
Perfomance	● Rangeability 20 : 1 ● Leakage at full closure 100cc/minute/inch of nominal bore.
Dimensions and Mass	See the table and the figure below.

Table of dimensions and weight

(mm)

Dimensional drawing
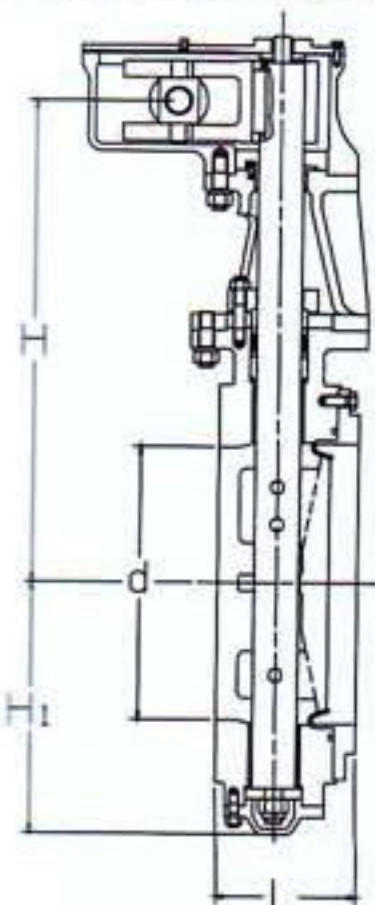
Nominal bore mm(inch)	d	L	H／HG *	H₁	ℓ₁	ℓ₂	ℓ₃	Mass (kg)
150A (6B)	150	150	361／506	190	421	138	50	96／108
200A (8B)	200	160	396／541	212	443	142	55	128／140
250A (10B)	250	165	441／601	247	505	162	65	155／169
300A (12B)	300	170	492／652	288	575	198	85	190／207
350A (14B)	335	185	544／724	338	640	231	105	236／250
400A (16B)	380	200	600／780	367	735	251	120	310／351
450A (18B)	430	220	653／853	400	820	290	145	388／438
500A (20B)	480	240	696／916	446	920	345	175	460／520
550A (22B)	530	260	775／995	485	1070	405	220	560／628
600A (24B)	580	280	830／1080	526	1318	438	240	690／790
650A (26B)	630	300	865／1140	554	1318	438	240	816／980
700A (28B)	680	320	944／1194	605	1500	475	280	975／1130
750A (30B)	730	340	996／1246	650	1535	475	280	1186／1365
800A (32B)	780	370	1023／1273	695	1570	475	280	1360／1563

* HG : When valve is fitted with frame (and gland packing).
For measurement of ℓ₁, ℓ₂, and ℓ₃, see the dimensional drawing on page 47. Flange standard are JIS, ANSI, and others, but some dimensions may be altered. This table does not indicate dimensions of valves of long bonnet construction. The size is different depending on the design pressure and the design temperature.
Prease refer to an individual drawing for a detailed size.

NAKAKITA's CONTROL VALVES !

• This drawing shows DY-COBOO

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 the 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, cage, guide bushing, valve stem, etc. are called the［trim］, and its combination is determined according to your ［specifications］including the fluid properties and pressure drop.

• The ［flow characteristic］ which indicates the relationship between the valve travel and the flow rate is determined by properly selecting the shape of the throttle portion consisting of the valve plug and seat ring.

• The gland packing is required to prevent leakage of the fluid as well as to possess low-friction property and durability. It has a vital role in the noemal operation of the control valve.

■DIAPHRAGM ACTUATOR

• The ［actuator］controls the travel of the valve, via the valve stem, by the balance between the operating air pressure applied to the diaphragm chamber and the compressive force of the counter spring.

• The signal (standard; 20 to 100kpa) from a pneumatic indicating controller is normally guided into the diaphrangm chamber. For further responsiveness, a positioner is installed.

• When the electric signal (4 to 20 or 10 to 50 mA DC) is used, an E/P positioner is applied.

MS-CODO□ CAGE TYPE DOUBLE SEATED CONTROL VALVE

Model MS—COD Cage-guided Double-seated Control Valve is designed using powerful multi-spring type diaphragm actuator. And it is compact and lightening that compare with using DY-series from before.

The valve trim is easy and quick replacement of trim without disconnecting the body from the piping. Special consideration is given to its durability and maintenance.

Unbalanced force is offset by the balance hole of the plug which is guided with Cage.

To secure stable controllability which dynamic unbalanced force on the stem is stable over the whole range of the valve travel.

SPECIFICATIONS

Type of valve body	Double seated glove valve of Cage guided type
Pressure rating	JIS5K~63K、ANSI 125~2500、PN10~100
Nominal bore	32~300A (11/4~12inch)
Service temperature range	-20~550°C
Standard material (JIS)	・valve body FC, FCD, SCPH2, SCPH21, 32, SCS13,14 ・Trim SUS403, SUS304, SUS316, SUS630, etc ・Gasket・Packing　　　Asbestos free
Flow characteristic	Modified Parabolic EQ% Linear etc.
Maximum allowable pressure drop	Single action diaphragm type is normally used. Maximum allowable Pressure drop is shown in the table below.
Performance	・Rangeability 50:1 ・Seat leakage 0.3% of rated Cv
Dimensions and mass	See the table and the figure below

Dimensional drawing

Structure drawing

CODO□

■MS—CODO Cage-guided double seated control valve

NOMINAL BORE mm (inch)			32A (1¼B)	40A (1½B)	50A (2B)	65A (2½B)	80A (3B)	100A (4B)	125A (5B)	150A (6B)	200A (6B)	250A (10B)	300A (12B)
RATING	JIS (K)		5 16 30 / 10 20 40 63	5 16 30 / 10 20 40 63	5 16 30 / 10 20 40 63	5 16 30 / 10 20 40 63	5 16 30 / 10 20 40 63	5 16 30 / 10 20 40 63	5 16 30 / 10 20 40 63	5 16 30 / 10 20 40	5 16 / 10 20	5 10	5 10
	ANSI (Class)		125 150 300 600 900	125 150 300 600 900	125 150 300 600 900	125 150 300 600 900	125 150 300 600 900	125 150 300 600 900	125 150 300 600 900	125 150 300 600 900	150 300	125 150	125 150
	ISO ✱ (PN-bar)		10 25 64 / 16 40 100	10 25 64 / 16 40 100	10 25 64 / 16 40 100	10 25 64 / 16 40 100	10 25 64 / 16 40 100	10 25 64 / 16 40 100	10 25 64 / 16 40 100	10 25 64 / 16 40 100	10 25 / 16 40	10 16	10 16
RATED Cv VALVE [valve by reduced valve plus]	S series body		[9.5] 18	[9.5 18] 26	[18 26] 36	[36 48 56] 72	[56 72] 96	[72 96 125] 155	[125 155 190] 250	[190 275] 390	[276 390] 500	800	950
	E series body		21	36	55	100	130	230	275		730	950	1200
DIMENSION (mm)	Face to face L		200 213 229 275	222 235 251 295	260 267 286 310	276 292 311 365	298 317 337 375	352 368 394 445	403 425 457 510	451 473 508	543 568	673 708	737 775
	Dimension H (※1)		550	555	590	685	700	765	875	905	1025	1160	1210
	additional to H — With fin		100	100	100	100	100	100	140	140	150	160	170
	additional to H — With handwheel		190	190	190	260	260	260	260	340	340	340	370
ALLOWABLE PRESSURE DROP (MPa) (※2)	Actuator size (J) 235	Off Balance Press (kPa) 30	1.5	0.7	0.1								
		120	2.0 5.2 10.3 9.6	2.0 5.2 8.0 6.8	2.0 5.2 6.1 5.1								
	270	30			1.0	0.07							
		120				2.0 5.2 5.2 4.5							
	324	30				1.8	1.1	0.4					
		120				10.3 11.7		9.6 8.6 2.0 5.2 7.2 6.4	2.0 5.2 5.0 4.6	2.0 5.2 3.8			
	430	30											
		120									2.0 5.2 10.3	2.0 5.2	2.0 5.2	2.0 5.2
MASS (kg) (※3)			39 50 70	43 81 112	64 92 141	70 125 183	109 143 224	149 218 276	178 295 470	285 357	447	586	771

(※1)　H dimension gives the longest dimension of the valve with standard type bonnet. However, in case of fin type bonnet or handwheel installation (Ho. dimension), add the respective [additional H value] of the above to H.
(※2)　The off balance pressure of 120 kPa becomes a one with positioner.
(※3)　Mass indicated is that of the valve with handwheel and positioner. (=maximum mass).
　✱　ISO in the column of rating indicates the ratings of valve groups formed in terms of face to face dimension.

MS-GCSS□ CAGE-GUIDED SINGLE SEATED CONTROL VALVE

SPECIFICATIONS

Type of valve body	Cage guided type single seated glove valve
Pressure rating	JIS5K～63K、ANSI 125～900、PN10～100
Nominal bore	20～50A (3/4～2B)
Service temperature range	-20～550℃

Standard material (JIS)	・valve body
	  FC, SCPH2, SCPH21, 32, SCS13,14
	・Trim
	  SUS403, SUS304, SUS316, etc
	・Gasket・Packing　Asbestos free

Flow characteristic	Parabolic Linear EQ%
Maximum allowable pressure drop	Maximum allowable Pressure drop is shown in the table below.
Performance	・Rangeability 　30：1 ・Seat leakage 　0.01% of rated Cv 〈ANSI CLASS Ⅳ〉
Dimensions and mass	See the table and the figure below

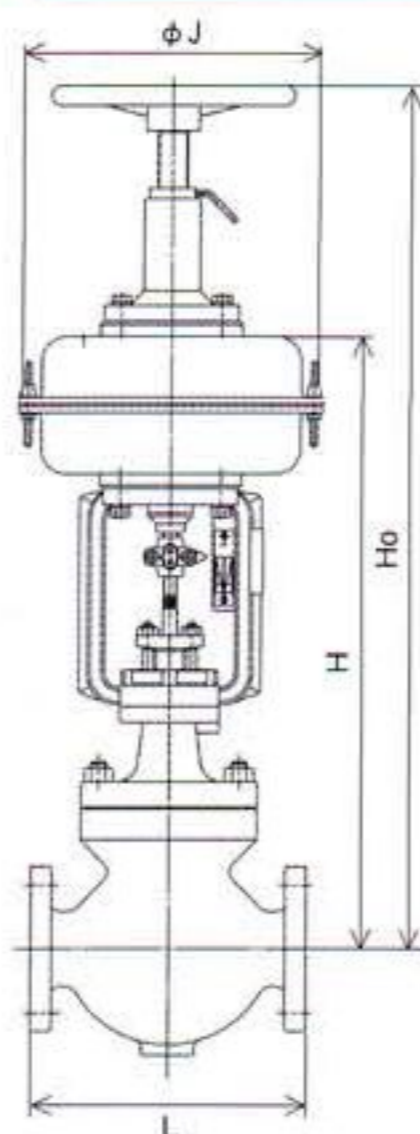### Dimensional drawing　　Structure drawing

GCSS□

Model MS-GC Cage-guided Single-seated Control Valve is designed using powerful multi-spring type diaphragm actuator. And it is compact and lightening that compare with using DY-series from before. The valve trim is easy and quick replacement of trim without disconnecting the body from the piping. Special consideration is given to its durability and maintenance.

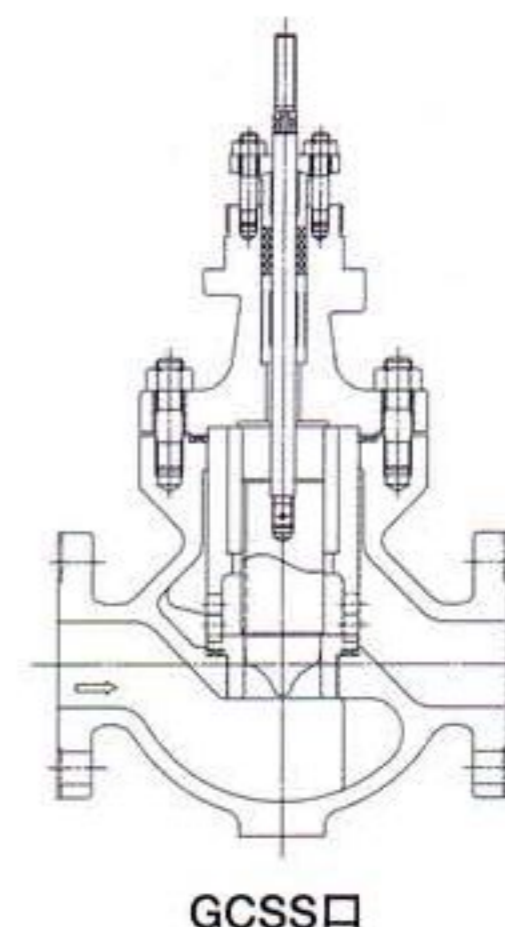## ■MS-GCS Cage-guided single seated control valve

NOMINAL BORE mm (inch)					20ᴬ (³/₄ᴮ)				25ᴬ (1ᴮ)				32A (1¹/₄B)			40A (1¹/₂B)			50A (2ᴮ)		
RATING	JIS (K)				5,10	16,20	30,40	63	5,10	16,20	30,40	63	5 10	16 20	30 40	63	5 10	16 20	30 40	63	5 10	16 20	30 40	63
	ANSI (Class)				125,150	300	600	900	125,150	300	600	900	125 150	300	600 900	125 150	300	600 900	125 150	300	600 900
	ISO * (PN-bar)				10,16	25,40	64,100		10,16	25,40	64,100		10 16	25 40	64 100	10 16	25 40	64 100	10 16	25 40	64 100
DIMENSION (mm)	Face to face L				154	162	162 166	212 216	240 256	154	162	162 166	216 220	244 262	210	220 280	235	250 305	265	275 370
	Height	Dimension H (※1)			520		550	585	520		550	585	540	550 575	570	570 575	620	620 625
		additional to H	With fin		105		100	115	105		100	115	100	100 100	100	100 100	100	100 100
			With handwheel		180				180				180		180		180	
RATED Cv VALUE					0.23 0.44	0.8 1.1	1.7 2.3	3.2 4.2 5.4	7.2	9.5	11	14	18	20	26	36
ALLOWABLE PRESSURE DROP (MPa) (※3)	Actuator size (J)	235	Off Balance Press (kPa)	30	5.2			2.7 2.2 1.6	1.1	0.8	0.6	0.4		0.1	0.06	
				120	15.5			11.5 9.8 7.4	5.7	4.5	3.6	2.7		1.8	1.2	
		270		30								0.8		0.46	0.26	0.07
				120								4.3		2.9	2.0	1.1
MASS (kg) (※2)					32	57		57	36		64	64	44	73 100	48	84 104	62	90 139

(※1) H dimension gives the longest dimension of the valve with standard type bonnet. However, in case of fin type bonnet or handwheel installation (Ho. dimension), add the respective [additional H value] of the above to H.
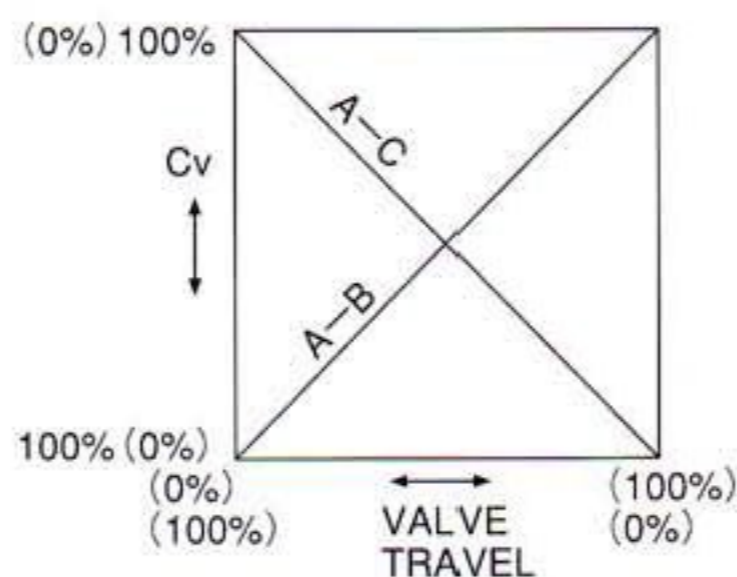(※2) Mass indicated is that of the valve with handwheel by rating 300 (=maximum mass).
(※3) The off balance pressure of 120kPa becomes a one with positioner.
* ISO in the column of rating indicates of valve groups formed in terms of face to face dimension.
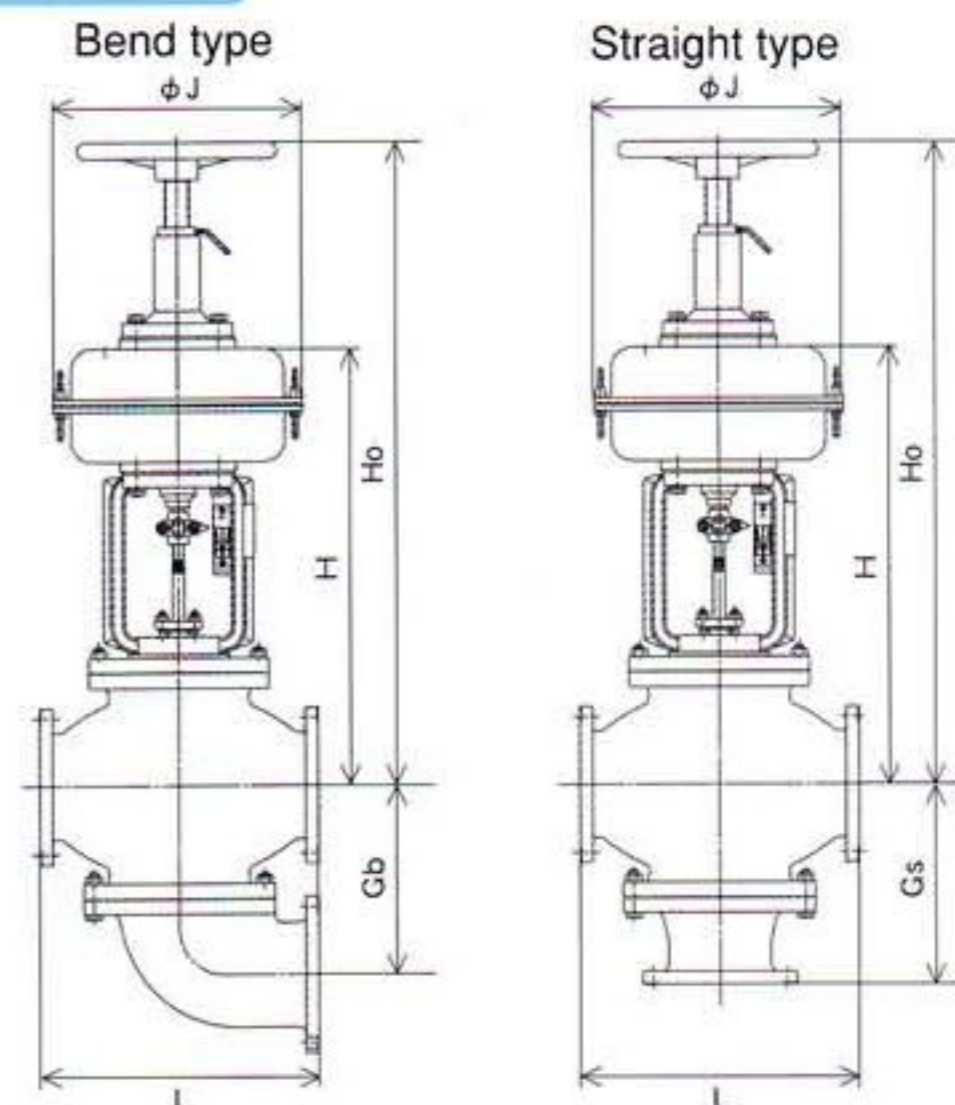
MS-T 3-WAY CONTROL VALVE

Inherent flow characteristic

SPECIFICATIONS

Type of valve body	Single seated 3-way valve with top and bottom guided plug
Pressure rating	JIS5K,10K、ANSI 125,150、PN10,16
Nominal bore	25～300A
Service temperature range	0～220℃
Standard material (JIS)	・valve body FC, FCD, CAC403, SCPH2, SCS13,14 ・Trim SUS304,316, or SCS13, SCS14 ・Gasket・Packing Asbestos free
Flow characteristic	Linear ; See the left figure.
Maximum allowable pressure drop	In the case of mixing type, maximum allowable pressure drop is shown in the table below.
Performance	・Rangeability 30:1 ・Seat leakage 0.1% of rated Cv
Dimensions and mass	See the table and the figure below

Dimensional drawing

Bend type   Straight type

Model MS-T 3-way control Valve is designed using powerful multi-spring type diaphragm actuator. And it is compact and lightening that compare with using DY-series from before.

Depending on the direction of the flow of the fluid, the valve can be used for mixing (from two ways to one way) as well as dividing (from one way to two ways). Generally, a good control-ability mixing type is used for the cooling water and the lubricating oil system which is supplied to the large-sized diesel engine and the reduction gear.

MS-T 3-way control valve

NOMINAL BORE mm (inch)			25A (1B)		40A (1½B)		50A (2B)		65A (2½B)		80A (3B)		100A (4B)		125A (5B)		150A (6B)		200A (6B)		250A (10B)		300A (12B)	
RATING	JIS (K)		5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10	5	10
	ANSI (Class)		125	150	125	150	125	150	125	150	125	150	125	150	125	150	125	150	125	150	125	150	125	150
	ISO * (PN-bar)		10	16	10	16	10	16	10	16	10	16	10	16	10	16	10	16	10	16	10	16	10	16
RATED Cv			9.5		33		48		86		115		180		270		400		630		950		1400	
DIMENSION (mm)	Face to face L (FC)	JIS	162	170	260	268	260	268	300	308	316	324	350	358	420	428	480	488	570	574	740	748	860	868
		ANSI	158	164	258	264	260	268	300	310	318	328	358	358	428	428	488	488	580	580	750	750	868	868
		ISO	166	166	264	264	264	264	304	304	324	324	358	358	432	432	488	488	574	582	744	752	860	868
	Bend Gb		150		221		221		181		196		219*3 (250)		275		321		370		459		520	
	Straight Gs				210		215		225		240		265		300		340		375		430		480	
	Height H without handwheel		500		504		521		540		548		552		620		750		838		942		984	
	Height Ho with handwheel		686		690		707		726		734		738		879		1100		1188		1322		1364	
ALLOWABLE PRESSURE DROP (MPa) (※1)	Actuator size (J) / Off Balance Press (kPa)	235 / 30	0.56		0.21																			
		235 / 120	2.72		1.00																			
		270 / 30	0.78		0.29		0.20		0.11		0.09		0.06											
		270 / 120	3.60		1.32		0.90		0.54		0.42		0.28											
		324 / 30																						
		324 / 120															0.31		0.21					
		430 / 30																						
		430 / 120																			0.31		0.19	0.14
MASS (kg) (※2)			44		60		70		74		82		95		152		262		323		509		703	

(※1)   When the actuator size is selected, to be checked " allowable pressure ⟩ differential pressure of full close cooler side + loss pressure of cooler (abt.0.03MPa) ".
       In case of dividing type, the actuator selected 1.5 times allowble pressure above the table.
(※2)   Mass indicated is that of the valve with handwheel and positioner (=maximum mass).
(※3)   Gb dimension in the table indicates those of ANGI flanged valves.
  *   ISO in the column of rating indicates the ratings of valve groups formed in terms of face to face dimension.
       The scramble size L, Gs,and Gb with piping are as common as a DY-T 3-Way control valve.

OUTLINE

- An actuator is a control element which works as the drive assembly of a control valve and controls the valve travel. It is required to exhibit high performance and high reliability under any environmental conditions. We are constantly striving to further the qualities of our actuators; our efforts can be seen in our early acquisition of each classification society's certificate for severe environmental tests (performance, vibration, temperature, humidity, dripproof, and salty fog tests) of unmanned machinery space ship.
- An actuator consists of a diaphragm (or a piston), a stem, a casing (or a cylinder), is guided etc.
- An for the output of an actuator, the output of a controller (or a positioner) is guided into the diaphragm chamber (or a cylinder) so as to generate a driving force which is proportional to the effective area of the diaphragm (or piston). Under actual service conditions, the valve travel is controlled while this driving force is countered by the compression force of the spring, force exerted on the valve plug, and sliding resistance of the gland.

■ Fig. 7A
Direct action actuator

D type

TYPES OF ACTUATOR

Diaphragm type and cylinder type are available. They are classified according to type of action as shown in the table below.

■ Table 7. 1 Classificaton of actuator

Operation type	Description	Type designation			
		Diaphragm		Cylinder	
		With spring	Without spring	With spring	without spring
Direct action	When controlled pressure is increased, the stem moves towards the valve.	D	—	Dc	—
Reverse action	When controlleed air pressure is increased, the stem is extracted towards the actuator,	R	—	Rc	—
Double action	Chambers are provided for both direct and reverse action. The stem is operated by the differential force.	—	B	—	Bc

■ Fig. 7B
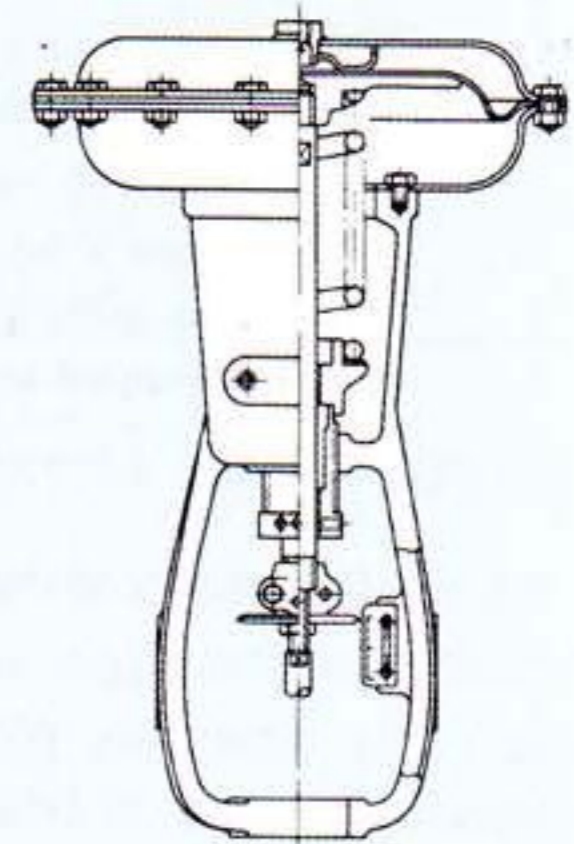**Reverse action actuator**

R type

DIAPHRAGM TYPE ACTUATOR

For the standard specification of the diaphragm type actuators, seeTable7.2.Actuators for high pressure are also available.

■Diaphragm   Diaphrgms are designed to exhibit high sensitivity and are of unique shape which assures constant effective area irrespective of the change in travel. Excellent weatherproofing rubber (CR) is reinforced with special cloth of high strength.

■Spring   Spring, together with diaphragm, is an important component which determines the performance of the actuator. Linear characteristic and strength are assured by checking parallelism,squareness and load characteristics.

■Yoke   Yoke is made of casting. Mounting seats are provided on both sides for easy mounting of positioner, air unit, etc.

■Casing   Casing is made of steel plate (large size casing is of casting) and designed to withstand desing pressure of 240 to 690kPa.

■ Table 7. 2 Standard specifications diaphragm actuators

								High power	
Nominal size	(J)	275	355	410	465	520	645	410	465
Effective area	(cm²)	234	490	590	745	880	1520	500	820
Maximum stroke	(mm)	15	35	35	50	70	100	50	60
Operating press Range	(kPa)	[20~100] [40~120] [40~200] [60~220] [0~200 (Double action)]						—	
Output force kgf	Off balance 20 (100)	468	980	1180	1490	1760	3040	1180 (5900)	1640 (8200)
	40 (200)	936	1960	2360	2980	3520	6080	2360 (11800)	3280 (16400)
	kPa 60 (400)	1404	2940	3540	4470	5280	9120	3540 (23600)	4920 (32800)
Air consumption Nℓ/ Strok		3.2	10	14	25	40	90		
Valve speed (sec.)	Without booster relay	2.3	7	13	17	27	60	—	—
	With booster relay	0.7	2	3	5	7	12		
Supply pressure	(kPa)	140			240			max. 700	
Casing material		SS400			FC·FCD·SC			SS400	

OFF-BALANCE PRESSURE

Off-balance pressure is the operating pressure when the actuator output for closing the valve is actually working as valve closing force, or the spring load corresponding to the operating pressure.

■ In the case of the air-to-close (spring open) actuator off-balance pressure is the operating pressure added to the operating pressure under no load, so as to get the valve closing force.

■ In the case of the air-to-open (spring close) actuator, off-balance pressure is the operating pressure corresponding to the spring load when the valve is in the closed state under no load.

CYLINDER TYPE ACTUATOR

For the specifications of the cylinder type actuators, see Table 7.3 below.

● Actuator of this type is more compact and shows better response than the diaphragm type one. When a diaphragm type actuator can not provide sufficient operating output, or when installation space is limited, an actuator of this type is used.

● Cylinder type actuator with dashpot is also available for high output use.

Cylinder type actuator with dashpot

● This actuator is equipped with an oil dashpot above the cylinder. The oil dashpot prevents jumpimg or slamming (sticking) of the valve plug due to a sudden change in valve stem thrust when the valve is at small or intermediate travel position.

● When a big stem thrust is generated, the insufficient stiffness of the pneumatic spring in the cylinder is covered by the incompressible oil in the dashpot.

■ Fig. 7C Single action cylinder type actuator

■ Fig. 7D Double action cylinder type actuator

▍Table 7. 3 Cylinder type actuator specifications

Nominal size (J)			100	125	150	200	250	300	335	375	400
Effective area (cm²)			76.5	119.5	171.5	306	478	687	857.5	1076	1232
Supply pressure (kPa)			400~700								
Output force N	Off-balance kPa	200	1530	2390	3430	6120	9560	13740	17150	21520	24640
		400	3060	4780	6860	1224	19120	27480	34300	43040	49280
		700	5350	8360	12000	2142	33460	48090	60020	75320	86240

[Remarks] Effective area and output are values of the stem side (minimum).

SELECTION OF ACTUATOR

▍Selection of size

The size of an actuator for a type of valve body assembly is selected according to the maximum allowable pressure drop indicated in the detailed specifications of each control valve (pages 19 to 48).

▍Selection of action type

● As to the selection of type of actuator, the operation type of the control valve itself is determined according to the plant characteristics. The type of the actuator is determined by the type of valve plug of the valve body assembly, direct or reverse. See Table 7.4.

▍Table 7. 4 Types of valve operation

Valve operation	Valve plug type	Actuator type	Remarks
Air less open	Direct plug	Direct action	
(Air to close)	Reverse plug	Reverse action	Used in special case.
Air less close	Direct plug	Reverse action	
(Air to open)	Reverse plug	Direct action	

● The determination of the valve operation type is made on the safer side according to the plant characteristics, so as to avoid interference with the process when the supply air source is failed.

● In the case of the double action type actuator, as it is a system without spring, some method is taken to keep the status quo of the valve travel (with lockvalve...page 54), or to fully close or open the valve for safety by means of an air chamber.
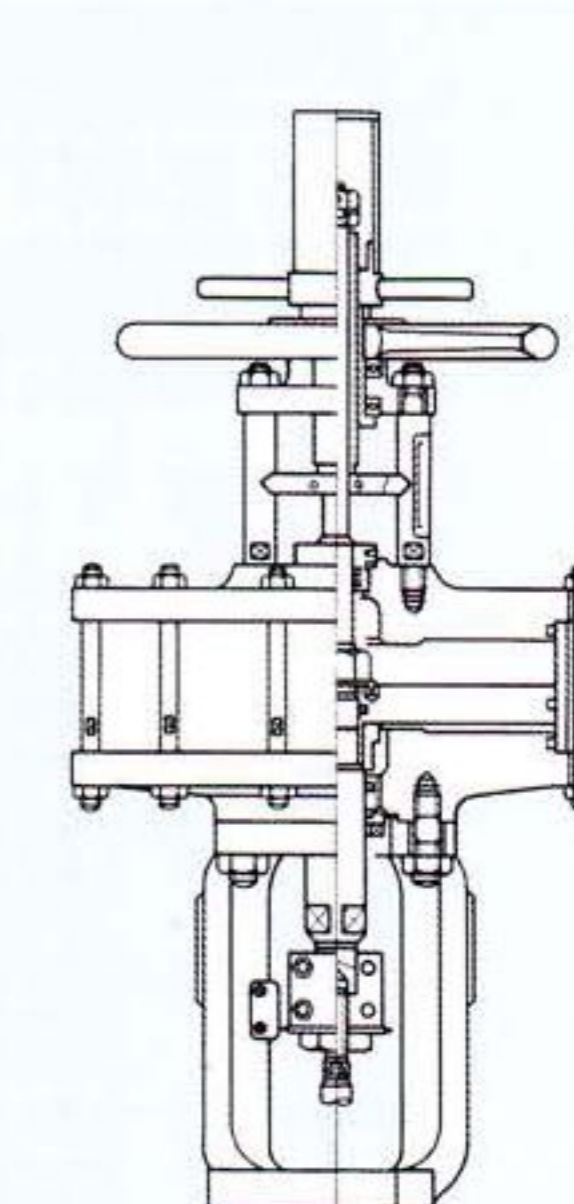
HANDWHEEL

This device is used when the controller or the controlled air system fails, when control is given manually or the valve travel is to be limited, or when a bypass valve is not installed. As shown in the figure below, two kinds of actuators are available. One is for direct action actuator, and the other one is for reverse action one. Types are also two, top type and side type. Each type can be easily installed on the actuator or the yoke.

Tsble 7.5 handwheel dimensions

Actuator size (J)			275	355	410	465	520	645
Top type	H_1 dimension	Direct action	196	279	279	343	396	540
		Reverse action	192	256	278	347	390	621
	Handle diameter (D)		160	224	224	280	355	630
Side type	A		265	340	340	400	238	280
	B		230	290	320	355	407	500
	Handle diameter (D)		280	355	355	400	280	355

[Remarks] Casings of J =275 to 465 mm are of steel plate.
Casings of J =520 and 645 mm are of casting.

Fig. 7E Handwheels

Top type

For direct action
J =275~645

For reverse action
J =275~645

Side type

J =275~465

J =520 & 645

POSITIONER

When any one of the following conditions is present, the installation of a positioner is always required.

- When the distance between the controller and the control valve is long:
  (The dead time and the time constant can be reduced by installing a positioner.) When the distance is 40 m and over, a positioner is required.
- When the effects of thrust on the valve plug due to the flow of high pressure drop fluid are large:
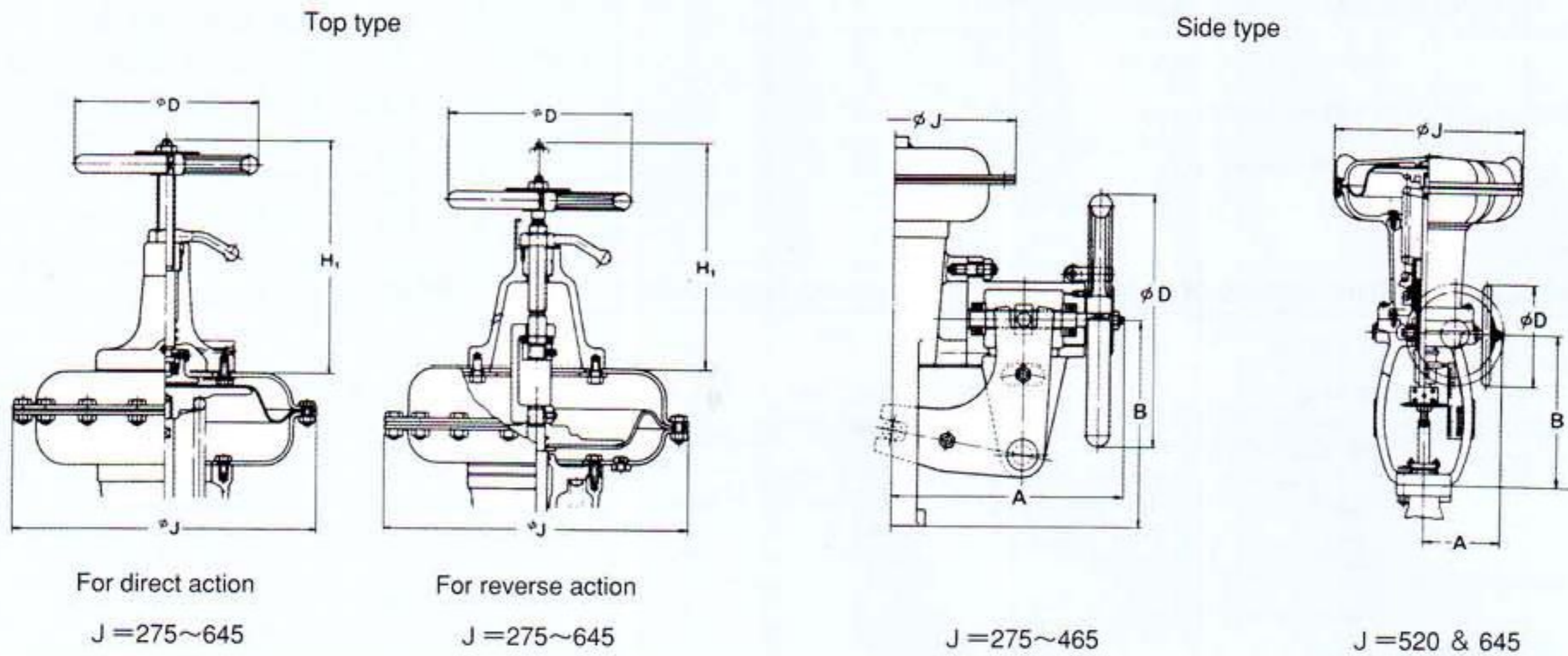 (As the driving force of the control unit is increased by the installation of a positioner, maximum allowable pressure drop can be allowed.) When the service pressure is 2MPa and over, a positioner is required.
- When valve bore is large:
  (A dead time is generated by the large capacity of the control unit.) When the bore is 100^A and over, a positioner required.
- When the accuracy of the control unit is to be raised.

- When split range is adopted:
  For example, when the rangeability required is large and the control can not be effected by one control valve, two control valves are used. The control input signal for one control valve is 0 to 50% (20 to 60 kPa) and that of the other valve is 50 to 100% (60 to 100 kPa). The rangeability is widened by operating control valves in series.
- When ample range is adopted:
  When the operating pressure range of an actuator is made wider than the control signal air pressure range 20 to 100 kPa, so as to increase the operating force.

Table 7.6

Positioner	Linearity	Hysterisis	Sensitivity
With	±2.0%under	2.0%inclusive	2.0%under
Without	±6.0%under	6.0%inclusive	* 6.0%under

Value marked * is obtained in no-load test. In actual service, the value is normally larger.

■ MULTI SPRING PNEUMATIC DIAPHRAGM ACTUATOR

The MS-□DM/RM series are designed using powerful multi-spring type diaphragm actuator.
And it is compact and lightning that compare with using DY-series before.

■ Table1   Standard specifications of multi-spring type diaphragm actuator

Nominal size (J)			235	270	324	430	430(L)
Effective area (cm²)			212	277	445	834	834
Maximum stroke (mm)			25	30	50	70	100
Operating press range (kPa)			30~110	30~110	30~110	—	—
			120~240	120~240	120~240	120~240	120~240
Output force (N)	Off balance pressure	30kPa	690	816	1332	2502	2502
		120kPa	2760	3264	5328	10008	10008
Air consumption (L)	Supply pressure	140kPa	3.2	4.6	9.7	—	—
		340kPa	5.9	8.3	18	34	55
Valve speed (sec.)	Without booster relay		≦6.5	≦8.5	≦12	≦15.5	≦28
	With booster relay		≦1.5	≦2.5	≦3	≦4	≦7

■ Table2   Dimensions and Mass of multi-spring type diaphragm actuator

Nominal size (J)			235	270	270	324	324	430	430(L)	430(L)
Actuator type			235□M1	270□M1	270□M2	324□M1	324□M2	430□M1	430□ML1	430□ML2
Maximum stroke (mm)			25	25	30	30	50	50	70	100
H Dimension (mm)	Direct action	Without	352	369	394	423	448	525	590	666
		With hand*	538	555	580	680	705	865	930	1036
	Reverse action	Without	372	389	414	443	468	545	610	686
		With hand*	517	530	555	643	668	801	872	948
Mass (kg)	Direct action	Without	12	14	15	25	27	62	64	78
		With hand*	20	23	24	37	39	85	87	100
	Reverse action	Without	12	14	15	25	27	62	64	78
		With hand*	20	23	24	37	39	85	87	100
Material	Casing		SPHC							
	York		FCD450							

[Remark] ″ Hand*″ is the abbreviation of ″ Hand-wheel.″

Direct action
without hand-wheel

Reverse action
without hand-wheel

Direct action
with hand-wheel

Reverse action
with hand-wheel
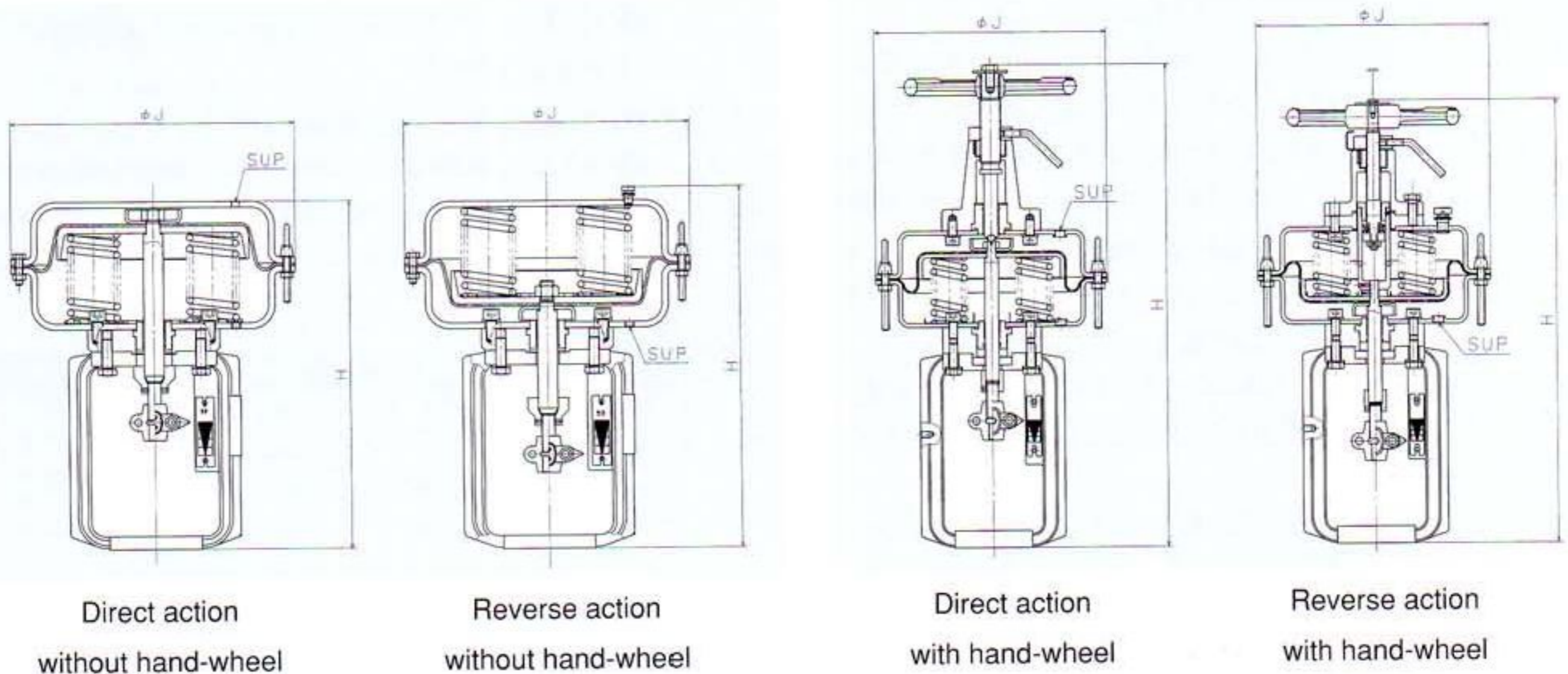
POSITIONER

〔Type: NS737, NS728〕

A positioner is installed on a diaphragm type or cylinder type actuator to improve the operating characteristics of the control valve.

The positioner drives the control valve, coping with the fictional resistance of gland packing and unbalanced force on the plug which prevent the movement of the valve stem, till the valve travel corresponding to the input pneumatic signal (20 to 100 kPa) or input current signal (4 to 20 mA・DC) is attained.

As for the features, the maximum supply air pressure is 0.69MPa, and they can be used for both single action and double action actuators; they can be used for all pneumatic type actuators from general purpose diaphragm type to high output cylinder type.

Specification

Type	NS737 (Pneu-Pneu)	NS728 (Elec-Pneu)
Input signal	20 to 100kPa	4～20mA・DC (standard)
Supply air pressure	0.14 to 0.69MPa	
Actuator type	Suitable to both single action (spring return) and double action types.	
Charactieristic	Linear, or free choice with cam.	
Split range	30～100%	50～100%
Direction of action	Direct action and reverse action, of action can be reversed.	
Input angle — Lever type	5～30°	10～30°
Input angle — Cam type	60～120°	
Air consumption	7Nℓ/min. (when supply pressure is 140kPa)	
Outlet flow rate	70Nℓ/min. (when supply pressure is 140kPa)	
Air input port	Rc ¼ female	
Explosionproof construction	—	Explosionproof construction ExdⅡBT5
Electric wire port	—	G ½ female
Wiring system	—	Conduit tube system. Pressure tight packing.

Fig. 8A
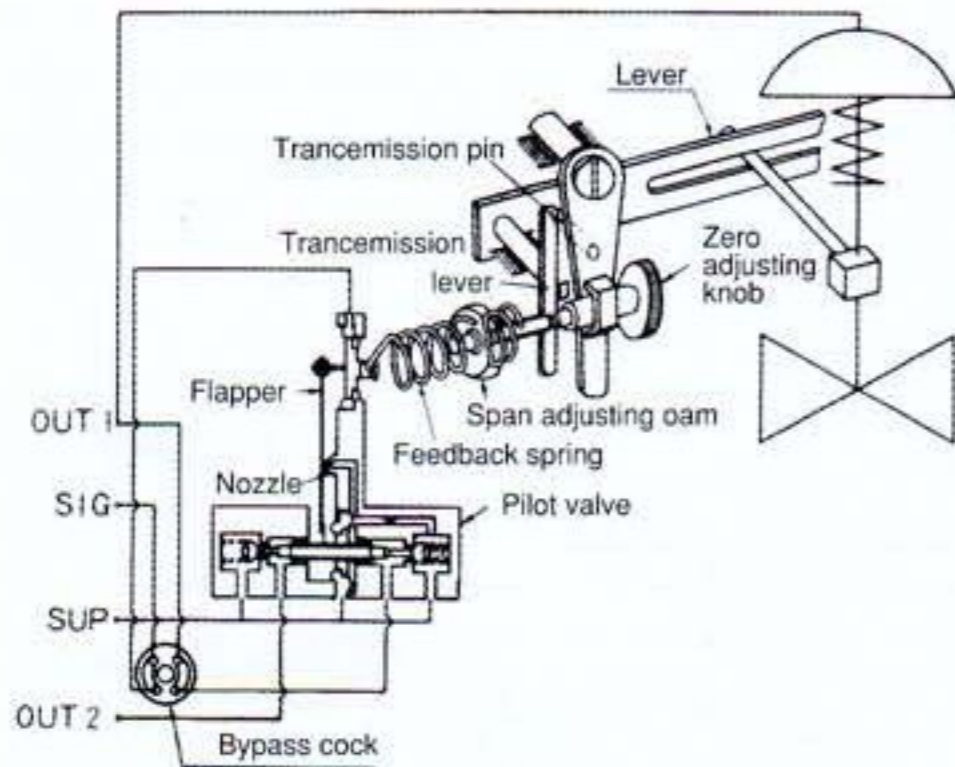
● Type NS737 （Pneu-Pneu）

Fig. 8B

● Type NS728 （Elec-Pneu）

● Type NS737 （Pneu-Pneu）

● Type NS728 （Elce-Pneu）

Type NS728

FILTER REGULATOR

[Types NS 770C and NS770CG]

A high-performance pressure regulator and a filter are integrated in a unit for supplying air to pneumatic instrumentation devices.

Many of instrumentation devices consist of orifice and nozzle-flapper, and clogging or contamination will cauce troubles. This device stores 5 μ metallic filter to removes scale, water, oil and grease.

The internally stored air outlet pilot constantly works to restore the set pressure when the secondary pressure exceeds or drops below the set pressure. The device is thus designed with special emphasis on its instrumentation application.

▌Specifications

Primary side Pressure	Less than 1MPa
Secondary side set pressure	20 to 300kPa 20 to 500kPa
Rate of flow	Max. 250N ℓ/min (when P_2=140kPa and $\triangle P$=5%, flow is 60N ℓ/min)
Air consumption	1N ℓ/min

▌**Fig. 8C**

Type NS 770C   Type NS 770CG

BOOSTER RELAY

[Type NC 766C]

This device is added to a pneumatic actuator to amplify the output of the controller or the positioner to a high capacity and substantially increase the driving speed.

In case the amplification results in overshooting or hunting, adjust the needle valve stored. Stable response can be obtained.

▌Specifications

Input & output	Max. 0.6MPa
Supply air Pressure	Less than 1.0MPa
Input/output ratio	1 : 1

▌**Fig. 8D**

Type NS766C
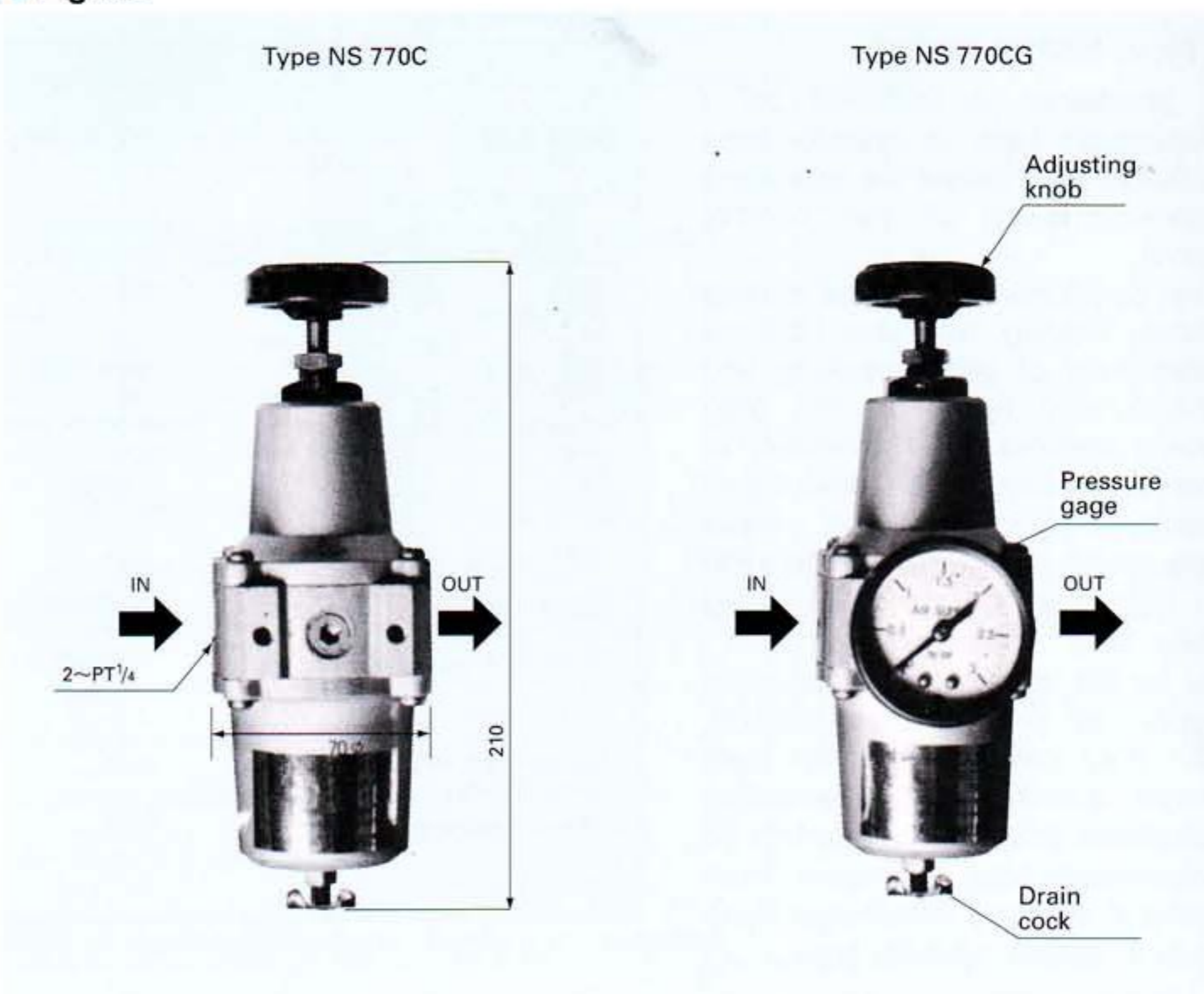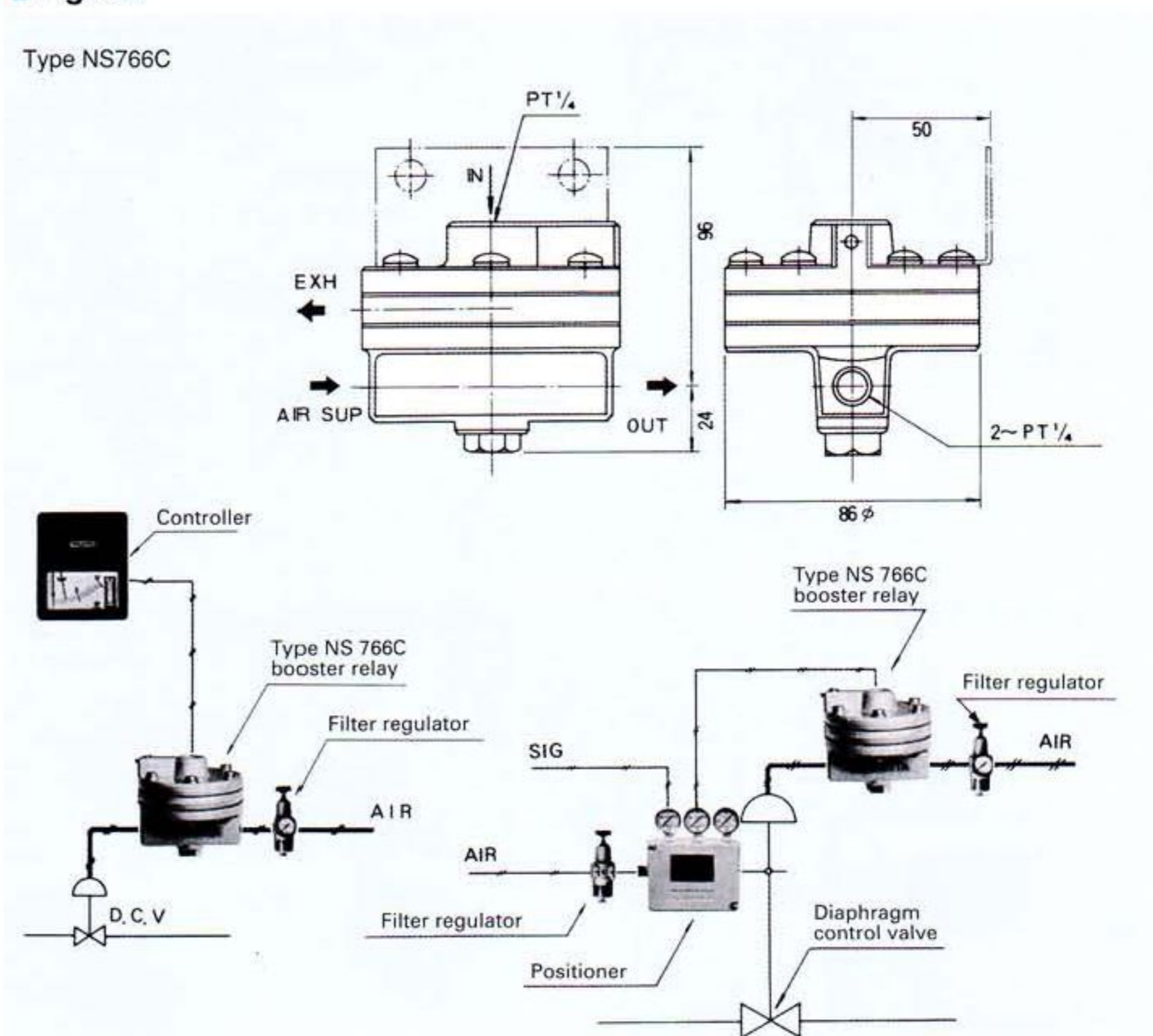
LOCK VALVE

[Types NS 772S and D]

If the air source of a pneumatic actuator fails, due to some trouble, to maintain the adequate supply pressure, the single action type actuator will resume its original position by the force of the spring, and the double action type actuator will become unstable, and in turn, the process will be adversely affected. To prevent this happening, a lock valve is installed in the control air piping of the actuator. When the supply air pressure drops, the line will be closed to keep the status quo of the final control element. When the supply air pressure is restored, the lock valve will resume the original working state.

Specifications

Lock setting pressure	0.14 to 0.69MPa
Line pressure	Max. 0.69MPa

LIMIT SWITCH FOR INDICATING VALVE OPEN/CLOSE POSITION

The limit switch is solidly designed for the use on a diaphragm control valve. A lever fixed on the valve stem actuates the switch at the full open or full shut position. A variety of switch constructions is available, from oiltight type to explosionproof one. They are used for operation displays and sequence control.

Specifications

Switch construction (service range)	Switch type	Electric rating		Circuit
Standard type	Y Ltd.: #BZE6-2RN-J	AC 125V 250V 480V	15A	Single pole double throw
Drip-proof type (outdoor)	Y Ltd.: #OP-AR-J	DC 125V 250V	0.5A 0.25A	COM o— o NC / o NO
Outdoor explosion-proof type (d₂G₄) Outdoor dust explosion proof type (SDP)	Y Ltd.: #EXZ-5000	AC 125V 250V	5A	Double pole double throw
		DC 125V 250V	0.8A 0.4A	o NO o / o NC o

Fig. 8E

TYPE NS 722S (SINGLE ACTION)   TYPE NS 722D (DOUBLE ACTION)
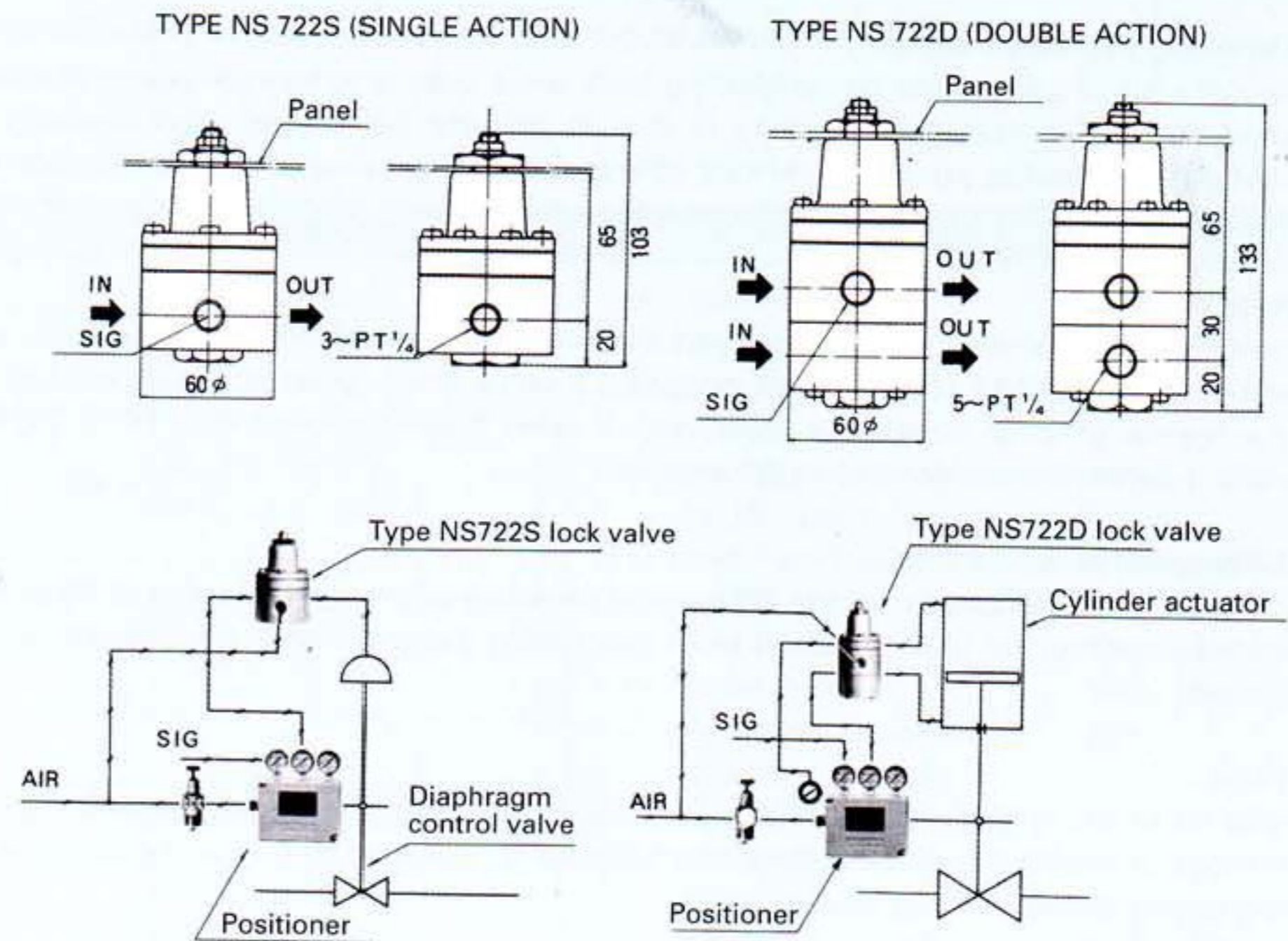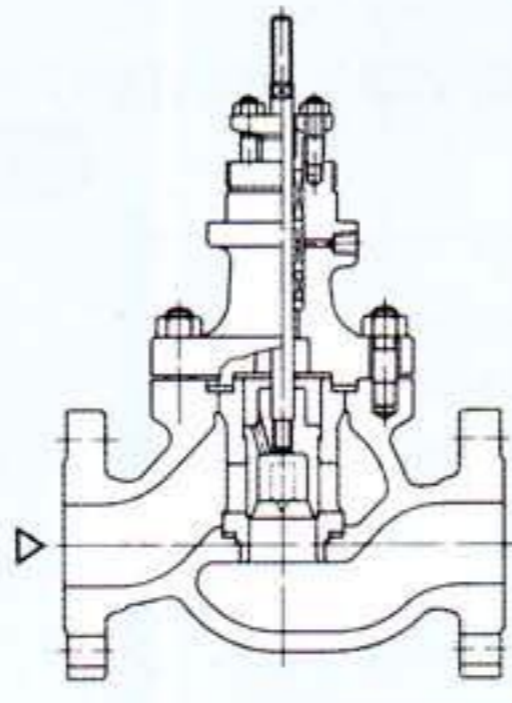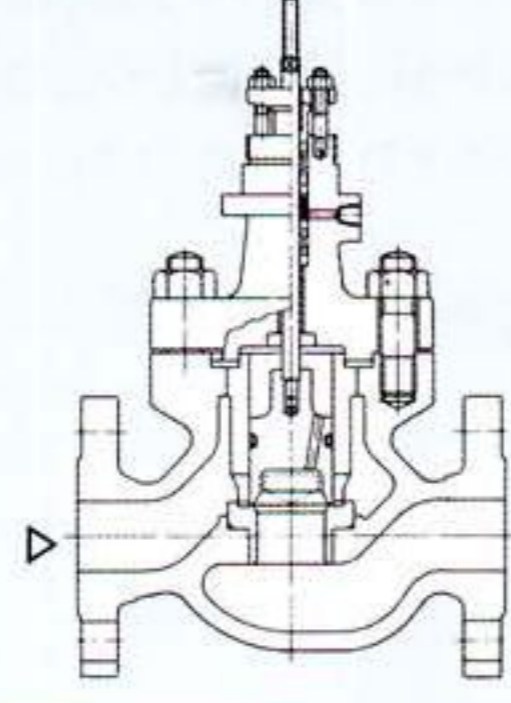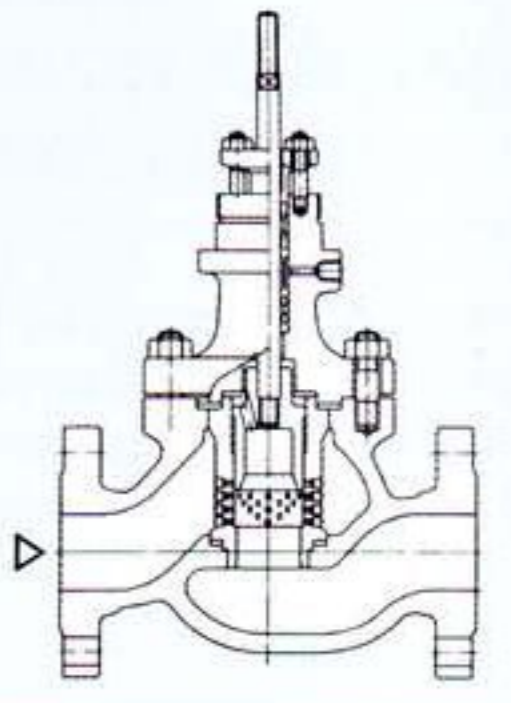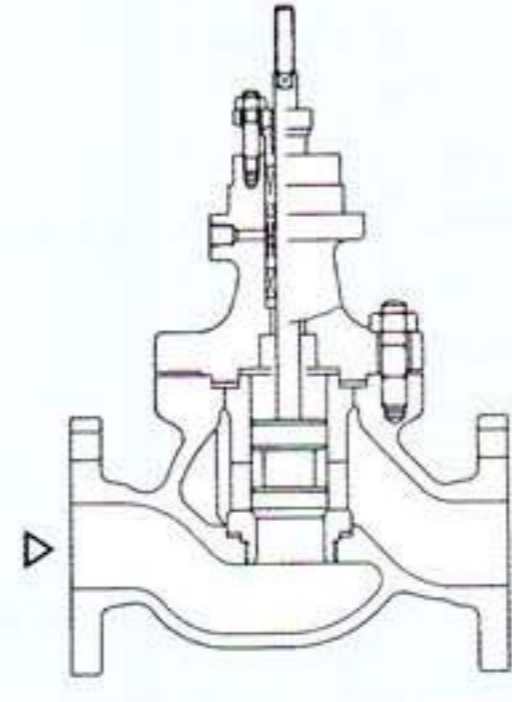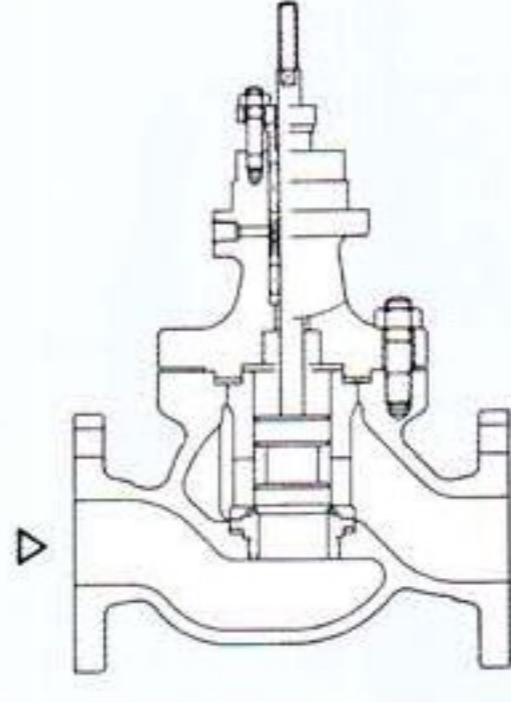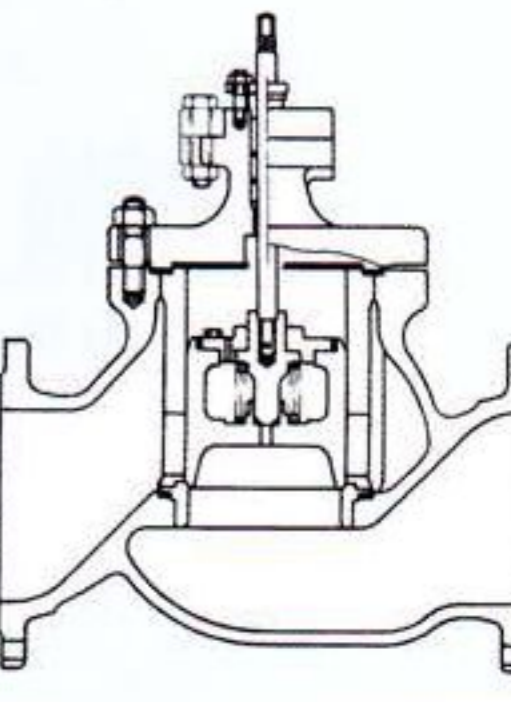
Fig. 8F
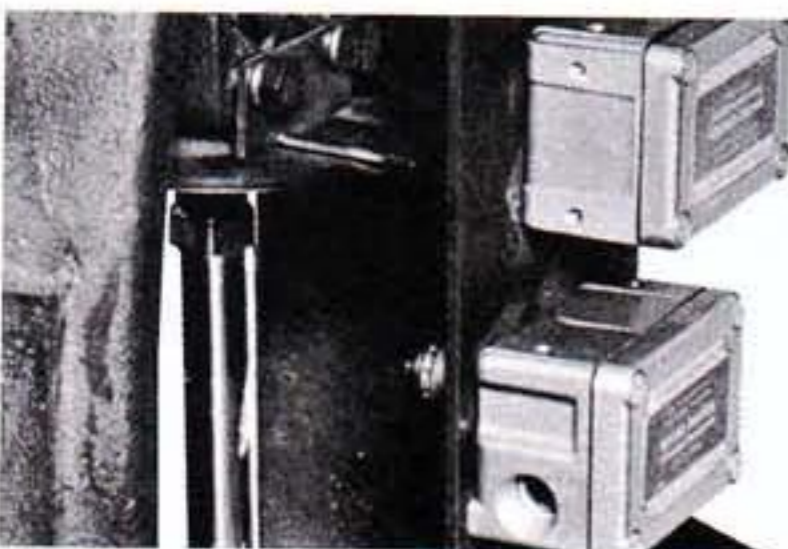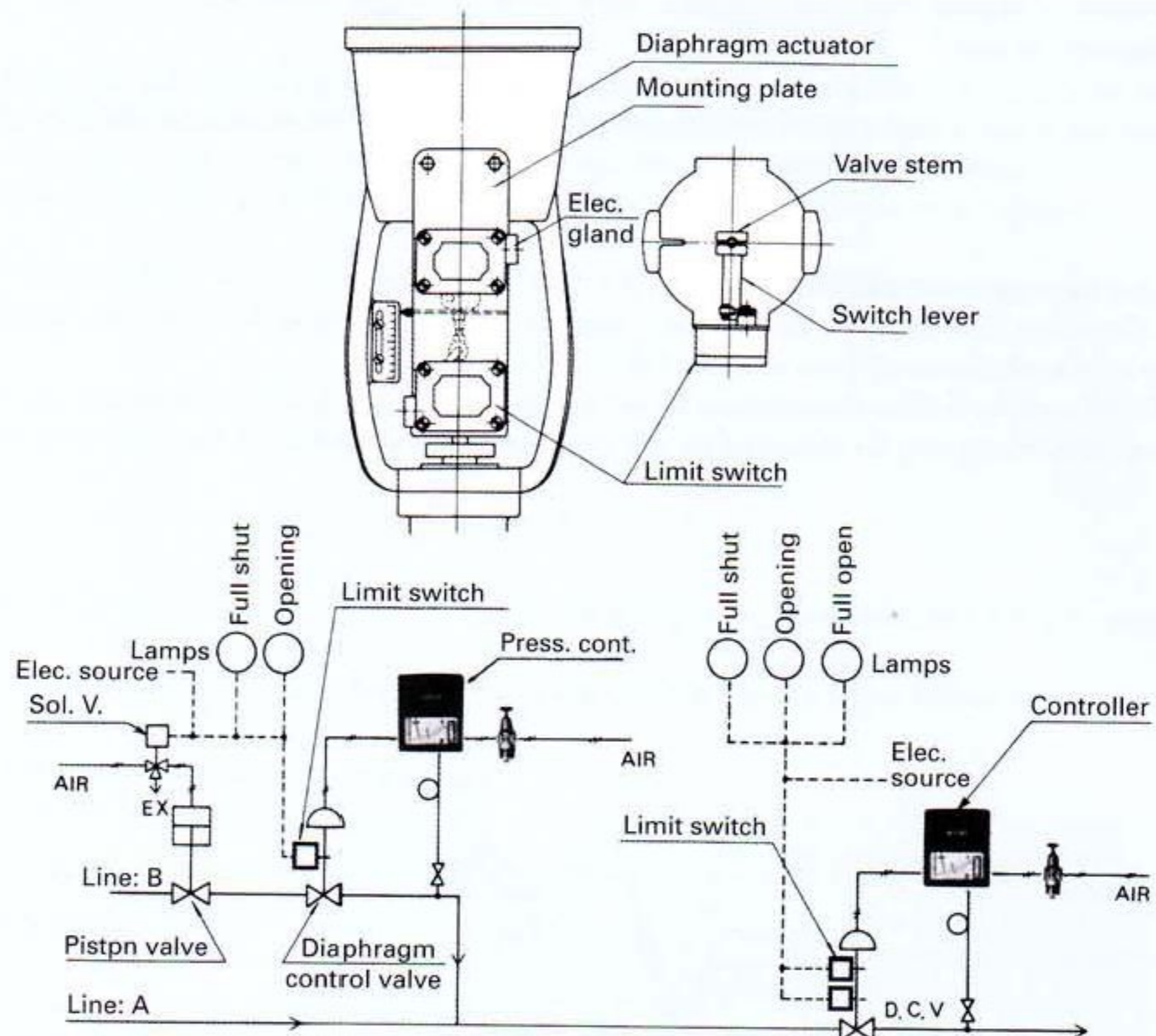
Line B is provided for backing up line A, and is normally closed. However, as the diaphragm control valve is double seated and its leakage is not desirable, a piston type valve is provided for tight shutting on the upstream side. When backup is required and the diaphragm control valve starts to open, the limit switch will send the signal to operate the diverter valve. This valve then fully opens the tight-shutting valve.

● The cage type control valves shown in this table are our standard valves. We also produce a variety of special valves.

Type	DY-CODOO	DY-COBSO	DY-CEDOO
Construction			
Features	Standard port cage, balanced valve plug, double seat ● Easy maintenance	Standard port cage, balanced valve plug, single seat ● Easy maintenance	Multi-hole port cage, balanced valve plug, double seat ● Cavitation resistance. For boiler feed water, etc. ● Easy maintenance
Nominal bore mm (inch)	32 ～ 300ᴬ	32 ～ 300ᴬ	32 ～ 300ᴬ
Pressure rating — JIS (K)	5 ～ 63	5 ～ 63	5 ～ 63
Pressure rating — ANSI (Class)	125 ～ 2500	125 ～ 900	125 ～ 2500
Max. design temperature	550℃	200℃	550℃
Rangeability	50 : 1	50 : 1	20 : 1
Max. allowable leakage	0.3% and under. (Ⅱ)*	0.01% and under. (Ⅳ)*	0.5% and under. (Ⅱ)*
Explanation given on page	19～20	21	22

Type	DY-COSOO	DY-COSEO	DY-COPSO
Construction			
Features	Unbalanced valve plug, single seat ● For low-Leak ● Easy maintenance	Unbalanced valve plug, single seat with soft seat ● For non-Leak ● Easy maintenance	Pilot balanced valve plug, single seat ● For large pressure drop ● Easy maintenance
Nominal bore mm (inch)	32 ～ 300ᴬ	32 ～ 300ᴬ	32 ～ 300ᴬ
Pressure rating — JIS (K)	5 ～ 63	5 ～ 63	5 ～ 63
Pressure rating — ANSI (Class)	125 ～ 900	125 ～ 900	125 ～ 2500
Max. design temperature	550℃	200℃	550℃
Rangeability	50 : 1	50 : 1	30 : 1
Max. allowable leakage	0.01% and under. (Ⅳ)*	(Ⅳ～Ⅴ)*	0.01% and under. (Ⅳ)*
Explanation given on page	24	——	——

▷ : Indicates the direction of flow under normal use condition.   * : Figure in ( ) indicates the corresponding leakage class prescribed in ANSI. B. 16. 104

INTRODUCTION

■ On sizing of control valves

Sizing of control valve must be decided by both valve user who has the comprehensive data of the process for which the valve is used, and valve manufacturer who is able to provide the proper valve capacity (Cv) data. Accordingly, we advise you to consider the following points on various effects on valve for proper and economical sizing, before proceeding to Cv calculation with the formula which will be introduced later.

● Rate of flow

Determine the maximum rate of flow and the minimum rate of flow, and the valve pressure drops for both rates, respectively. These data allow NAKAKITA to select or design a valve which gives adequate control even at the minimum rate of flow.
It is a normal practice to select a valve with a valve flow coefficient (Cv) 20 to 100% larger than the computed Cv value. This margin is determined according to the process.

● Differential pressure ($\triangle p$)

In general, it is desirable to set the differential pressure of the control valve at 40 to 60% of the pressure drop of the total piping system (including the control valve) from controlling point of view. It must not be less than 15%, otherwise control is hardly achieved.

● Fluid

Please let us know the name of fluid, property (liquid, gas, vapor, etc.), specific gravity (density, molecular weight), viscosity and vapor pressure. From these data, the formula for computing Cv can be selected, and by adding further corrections, proper sizing can be made.

● Pipe size

When a reducer and an expander are used before and after the valve, respectively, or when other piping accessories are present, the valve flow coefficient must be increased just for the resistance due to them. Please let us know about the use of these items and the pipe size.

● Selection of valve

Proper selection of the valve size and the type is made by satisfying the Cv obtained from the Cv formula and making much use of our experience. Please fill in the control valve specification sheet shown on page 68 and send it to us with your order.

■ Valve flow capacity coefficient "Cv"

Cv is the valve flow capacity coefficient. This coefficient indicates the flow rate in US gal/min of fresh water through the valve at a differential pressure of 1 psi and at 15.6°C (60°F).
The Cv of a valve is thus determined by actual measurement, and this valve is indicated.
On the other hand, the Cv required by the process is calculated from the following formula.

Cv FORMULAS

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

■ Table 9.1 Cv FORMULAS

FLUIDS	PRESSURE CONDITION		Cv FORMULAS	LEGEND
INCOMPRESS-IBLE FLUIDS (water, oil, etc.)		—	$Cv = \dfrac{0.366V\sqrt{G}}{\sqrt{\triangle p}*2}$ *1	V : Max. Flow Rate m^3/h (Incompressible Fluids)
AIR · GASES	(1)	Where $p_2 > 0.5p_1$ (or $\triangle p < 0.5p_1$)	$Cv = \dfrac{Q}{2947}\sqrt{\dfrac{G_1(t+273)}{\triangle p(p_1+p_2)}}$	W : Max. Flow Rate kg/h (Steam . Vapours) Q : Max. Flow Rate (Air-Gases) m^3/h (at 101.325kPa abs. 15.6℃)*3
	(2)	Where $p_2 \leqq 0.5p_1$ (or $\triangle p \geqq 0.5p_1$)	$Cv = \dfrac{Q\sqrt{G_1(t+273)}}{2549 \cdot p_1}$	N Q : Max. Flow Rate (Air-Gases) m^3 (Normal)/h (at 101.325kPa abs. 32°F) p_1 : Inlet Pressure MPa abs p_2 : Outlet Pressure MPa abs
STEAM	(1)	Where $p_2 > 0.5p_1$ (or $\triangle p < 0.5p_1$)	$Cv = \dfrac{W}{137.66\sqrt{\triangle p(p_1+p_2)}} \times K$	$\triangle p$: Differential Pressure MPa (Pressure drop = $p_1 - p_2$) G : Specific Gravity (Water = 1) G_1 : Specific Gravity (Air = 1)
	(2)	Where $p_2 \leqq 0.5p_1$ (or $\triangle p \geqq 0.5p_1$)	$Cv = \dfrac{W}{119.31 \cdot p_1} \times K$	t : Fluids Temperature ℃ K : Correction Coefficient to Superheat k=1+0.0013×deg.C of Superheat.

*1 When the viscosity is 20 cSt and under, the formula can be used without considering the viscosity correction.
*2 $\triangle p$m may be substituted for $\triangle p$. (See the following page).
*3 The flow rate of gases Q m^3/h is expressed at "Standard Conditions", or pressure of 14.7 psia (= 760 mmHg = 1 atm.) and temperature of 60°F (15.6℃). If the flow rate at "Normal State" or pressure of 101.325kPa abs. and temperature of 0℃ is denoted by N m^3/h, we get Q = 1.057 x NQ.

■ Although the above-mentioned formulas are widely accepted, as a part of the activities of the IOS (International Organization for Standardization), IEC (International Electrotechnical Commission) is now preparing for international standardization of computation of flow coefficient of control valve, etc. We are prepared to compute the valve flow coefficient according to this standard (IEC STANDARD Pub. 534-2).
Technical data on sizing formulas of IEC STANDARD are also available. Please consult our Tecnical Department.

CORRECTION OF Cv VALUE

■ Main corrections
● Correction with terminal pressure differential ratio factor may be made for valves handling compressible fluids at high pressure and large pressure drop.
● When chocked flow of incompressible fluid is generated, or when liquid of high viscosity is handled, the following corrections will be made.
● When a reducer is installed, correction will be made if necessary.
● For any uncertainties, please consult our Technical Department.

■ Correcion for chocked flow of incompressible fluid
When the inlet pressure (p_1) is reduced to the outlet pressure (p_2), if the lowest pressure (vena contracta pressure: $p$vc) drops below the saturated vapor pressure (pv) of the fluid at the inlet temperature, cavitation or flashing will occur. In this case, as shown in Fig. 9A, if p_2 is restored higher than pv, cavitation will happen.
If the reduced pressure p_2 is smaller than pv, flashing will happen.

■ Fig. 9A
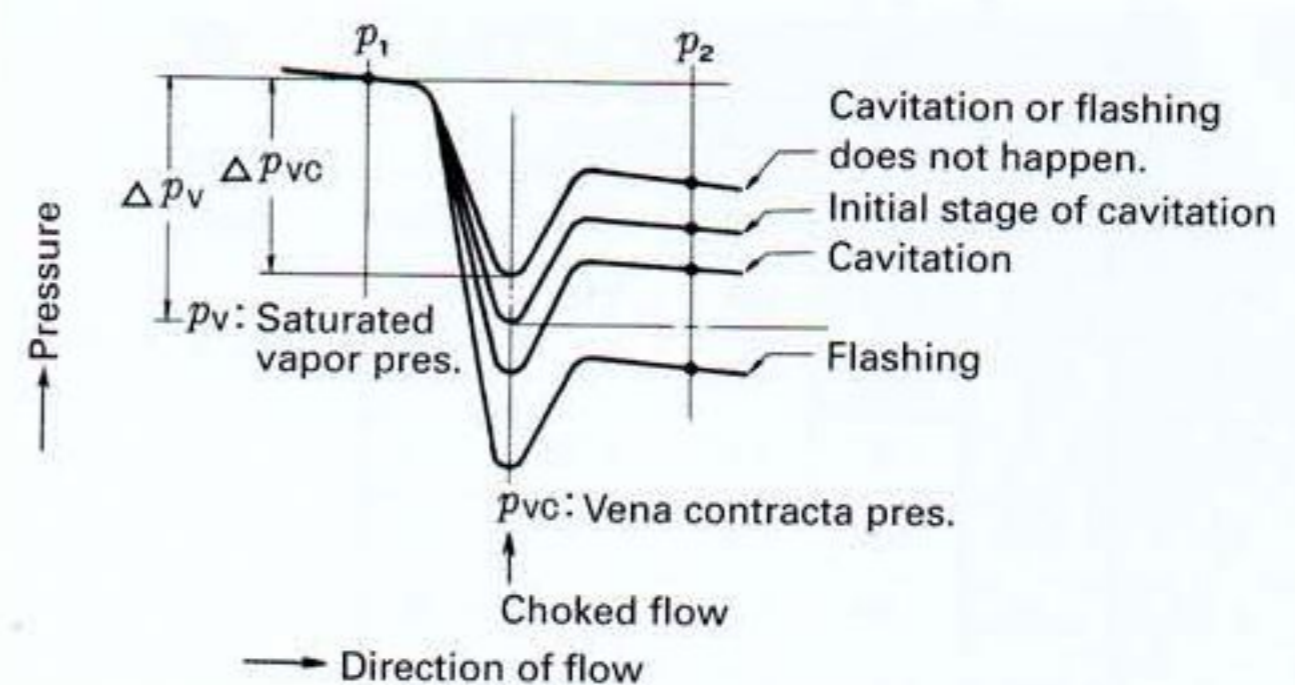
- **Cv calculation for choked flow [Based on ISA. S39.1]**

(1) First, obtain the pressure drop required to produce choked flow, using the following formula.

$$\triangle p_m = K_m (p_1 - r_c p_v)$$

(2) Compare $\triangle p_m$ obtained from the formula above with $\triangle p$ and substitute the smaller one for $\triangle p$ of the formula in Table 9.1 to get Cv.

Where
- $\triangle p_m$: Pressure drop required to produce choked flow
- $\triangle p$: Pressure drop ($\triangle p = p_1 - p_2$)
- p_1 : Inlet pressure
- p_2 : Outlet pressure
- K_m : Valve recovery coefficient ..... Indicated on the page of respective type.

$$K_m = F_L^2 = \frac{X_T}{0.84}$$

where F_L : Liquid pressure recovery factor
X_T : Pressure differential ratio factor

- p_v : Saturated vapor pressure of the liquid at the inlet temperature (MPa abs.)
- r_c : Liquid critical pressure ratio factor .... According to Figs. 9B and 9C.

Fig. 9B Critical pressure ratio factor of water: r_c
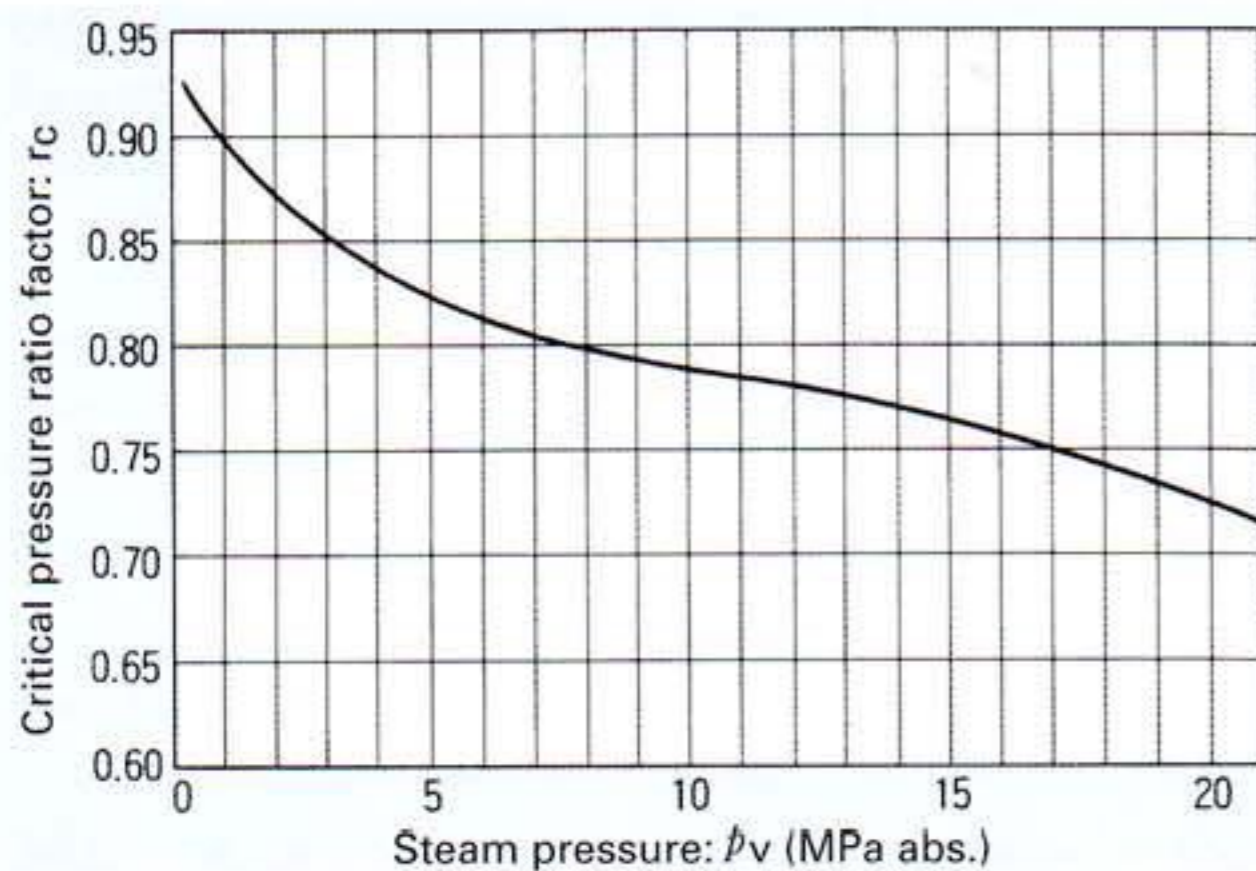
Fig. 9C Critical pressure ratio factor of liquid other than water: r_c
[IEC. 60534-2-1]
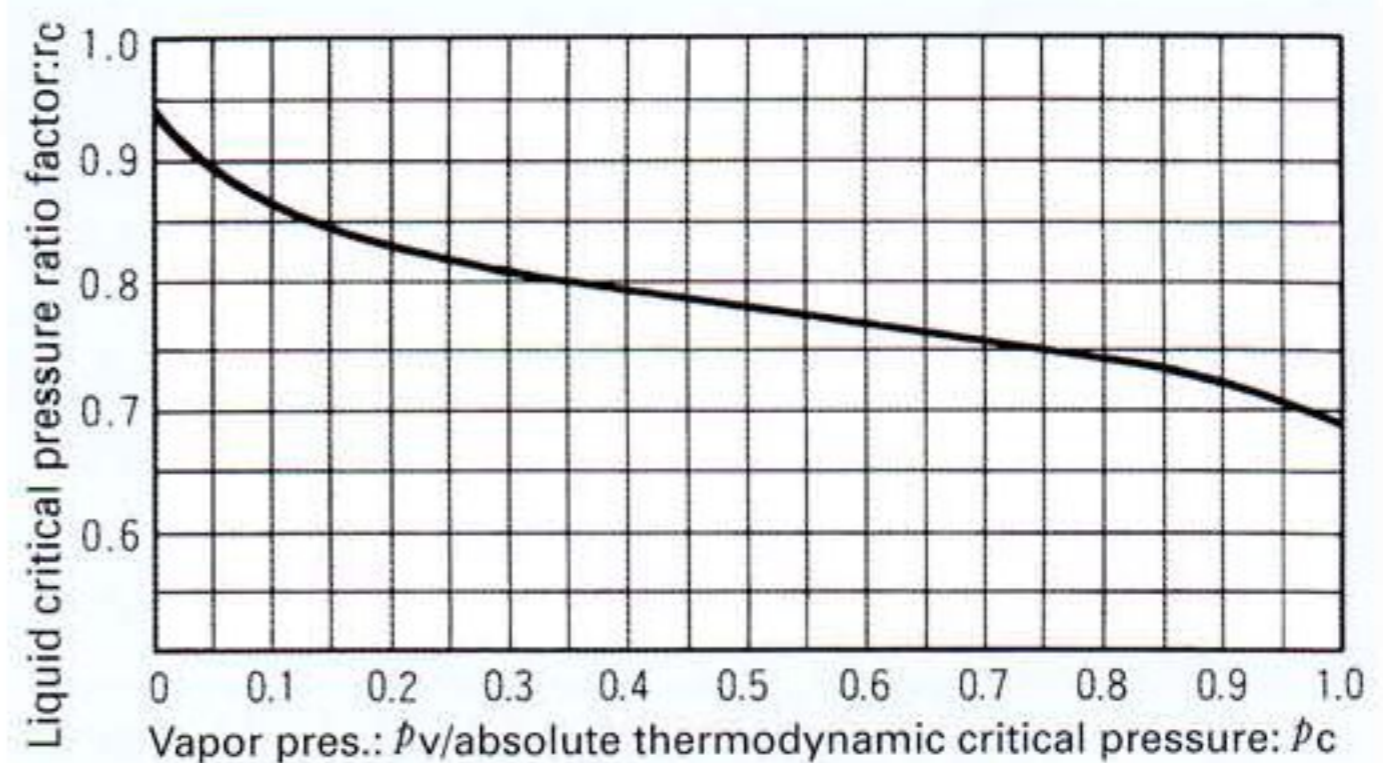
Table 9.2 Absolute thermodynamic critical pressures "p_c" of various fluids

Fluid	Molecular weight	Critical temperature [K]	Critical pressure [MPa]
Water	18.01	647.30	22.12
Carbon dioxide	44.01	304.21	7.3825
Ammonia	17.03	405.6	11.28
Ethane	30.06	305.4	4.871
Propane	44.10	369.82	4.250
Ethanol	46.07	513.9	6.14
Methanol	32.04	512.58	8.09

Correction when a reducer (or expander) is installed before or after the valve

In many cases, reducers are designed just for adjusting the valve to the pipe size, and they are normally made of short pipe. Accordingly, when the valve is to be fitted with a reducer, a valve of a flow coefficient greater by the pressure resistance of the reducer must be selected. The correction procedure is as follows:

- When the pressure-temperature condition is not that of choked flow

$$Cv_p = \frac{Cv}{F_p}$$

Table 9.3 Piping geometry factor "Fp"

d/D \ Cd	10	15	20	25	30
0.80	0.99	0.98	0.96	0.94	0.91
0.75	0.98	0.97	0.94	0.91	0.88
0.67	0.98	0.95	0.91	0.87	0.83
0.60	0.97	0.93	0.89	0.84	0.79
0.50	0.96	0.91	0.85	0.79	0.73
0.40	0.95	0.89	0.82	0.76	0.70
0.33	0.94	0.88	0.81	0.74	0.69
0.25	0.93	0.87	0.79	0.72	0.65

The area in ☐ is the range of which correction is normally omitted.

Where
- Cv_p : The required valve flow coefficient after the correction of piping geometry factor has been made.
- Cv : The valve flow coefficient obtained by the Cv formula of table 9.1.
- F_p : Piping geometry factor .... Based on Table 9.3.
  - d : Valve bore in mm
  - Cv : Outlet side pipe bore in mm
  - Cd : Relative flow coefficient of the rated Cv. Calculated with the following formula:

$$Cd = \frac{645\ Cv}{d^2}$$

- When the condition is that is choked flow, the calculation can be made with the formula of IEC.

■ Correction for laminar flow

When a fluid (liquid) has a high viscosity or when the valve pressure drop or flow rate is small, the flow rate is not proportional to $\sqrt{\triangle p}$ but to $\triangle p$. Correction in this case is made in the following manner.

(1) Calculate the Reynolds number of the valve pass from the following formula. [IEC 60534-2-1]

$$Rev = \frac{7.6 \times 10^4 \, Fd \cdot V}{v \sqrt{Fp \cdot FL \cdot Cv}} \left(\frac{Fp^2 \cdot FL^2 \cdot Cv^2 \times 10^3}{2.14 \times D^4} + 1 \right)^{1/4}$$

(2) Read out the valve Reynolds number factor FR from the figure below.
(3) Make correction of Cv with the following formula.

$$\text{Required Cv after correction} = \frac{\text{Cv before correction}}{\text{FR}}$$

Most of the flows in a process plant have Reynolds numbers of 10^4 and over, therefore the valve Reynolds number factor FR is 1.0.

Where
Rev : Valve Reynolds number
Fd : Valve style modifier factor
    Single-ported globevalves: 1.0
    Double-ported globe and butterfly valves: 0.7
v : Kinematic viscosity (in centistokes)
Fp : Piping geometry factor. Table 9.3
    When pipe bore = valve bore: 1
    When pressure loss of valve itself is large, such as glove valve: $Fp \fallingdotseq 1$
FL : Valve liquid pressure recovery factor.
    See Km of respective valve type.
    $FL = \sqrt{Km}$
Cv : The Cv value of Table 9.1 will do for approximation. Use the Cv value obtained by trial-and-error method.
D : Pipe bore [mm]
V : Rate of flow [m³/h]

■ Fig. 9D Valve Reynolds number factor: FR [IEC 60534-2-1]
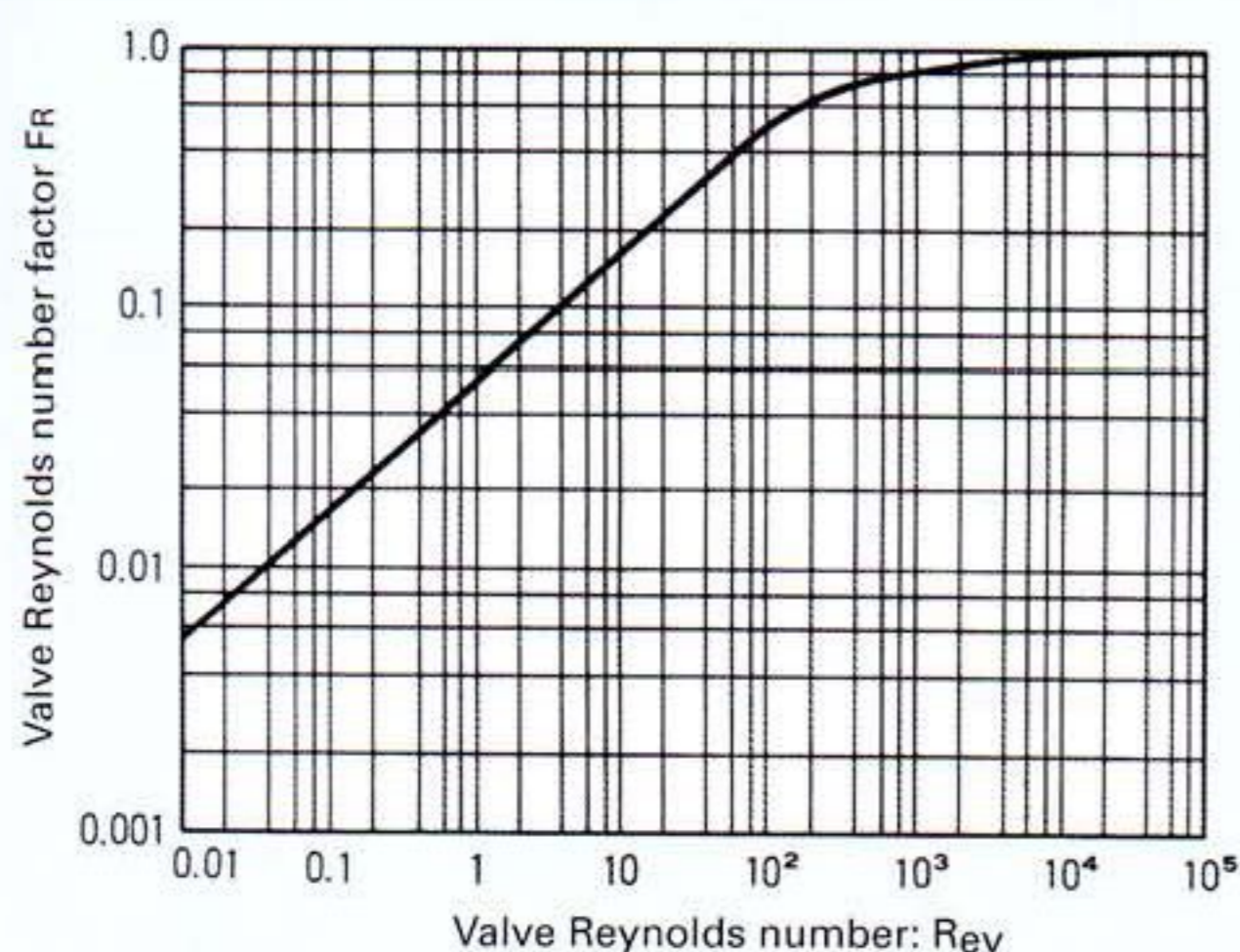
SIZING

In sizing, Cv is computed by the above-mentioned procedure. The size and type are selected with due consideration given to factors such as process condition, rated Cv, cavitation, velocity, vibration, and noise.

■ Selection of rated Cv

(1) The rated Cv value* of a valve has a margin of 20 to 100% of the computed Cv value.
    *The rated Cv value of each type is shown on pages 19 through 48.
(2) It is desirable, in ordinary processes, to keep the valve load range within its travel range of 20 to 90%.
(3) Make sure that the required minimum Cv value is within the rangeability of the rated Cv value thus selected, and that there is some margin.
(4) If erosion damage on the trim is feared, keep the valve travel above 30% during control.

Prediction of cavitation generation

Consideration whether cavitation will be generated under the given conditions is made in the following manner:

(1) Compute $\triangle p_c$ from the following formula.

$$\triangle p_c = K_c(p_1 - p_v)$$

(2) Compare $\triangle p_c$ obtained and $(p_1 - p_2)$
   if $\triangle p_c \leq (p_1 - p_2)$,
   generation of cavitation will be predicted.

Where
$\triangle p_c$: Pressure drop at which cavitation is generated. (MPa)

p_v : Saturated vapor pressure of liquid at inlet temperature. (MPa abs.)

K_c : Cavitation index. According to Fig. 9. E, F below.

Fig. 9E Cavitation index: Kc

* Km (See Km of espective valve type)
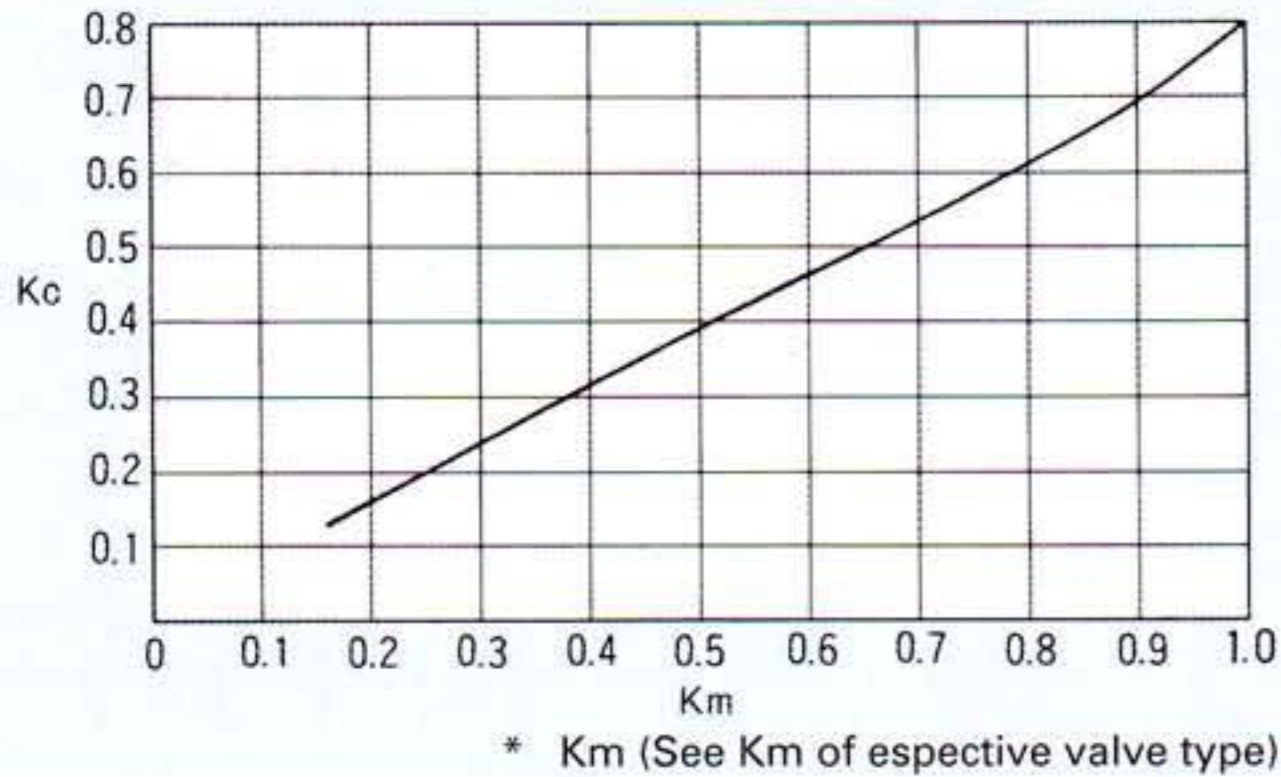
Fig. 9F Cavitation index of butterfly valve: Kc
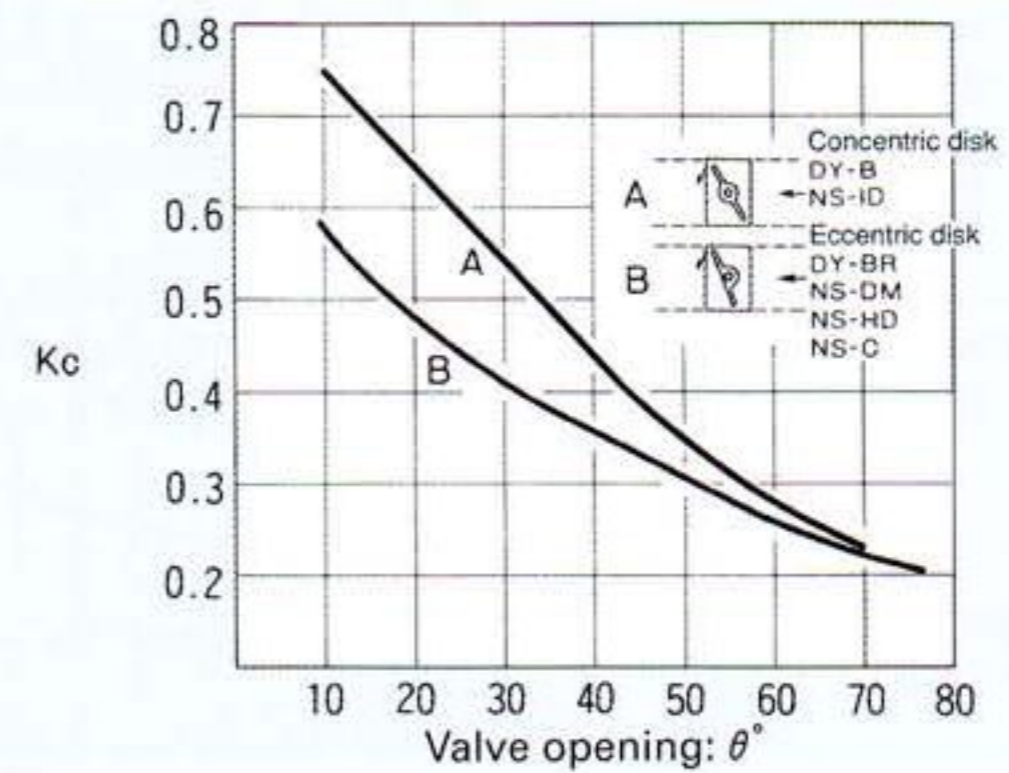
Limits of velocity and differential pressure

- We recommend the values shown in the table below for the velocity and differential pressure of controlled fluids, with consideration given to noise, vibration, erosion and durability of control valves. When flow noise of gases becomes a problem, the valve outlet velocity is designed not to exceed 30 or 50% of the velocity of sound. For noises, see pages 60 through 62.
- Formula for calculating sound velocity at outlet of valve

Superheated steam	$V_s = 111.5\sqrt{p_2 v_2}$	Moisture bearing gas	$V_s = 97.7\sqrt{k p_2 v_2}$
(Dry) saturated steam	$V_s = 104.3\sqrt{p_2 v_2}$	(Dry) air and gas	$V_s = 90.8\sqrt{\dfrac{k T_2}{M}}$

Where
V_s : Sound velocity   m/s
p_2 : Valve outlet pressure MPa abs.
v_2 : Specific volume on the valve outlet side m^3 /kg
T_2 : Absolute temperature on the valve outlet side $(273 + t_2 ℃)$

Table 9.4 Valve inlet and outlet velocity limits (Example: steel valves)

Fluid	Valve nominal bore (mm)	Valve velocity limits (m/s)	
		Inlet side	Outlet side
Water	100 and under	5.0	—
	125 to 200	4.5	—
	250 to 300	3.5	—
	350 to 400	3.0	—
Steam	15 to 25	125	500 and under. Advisable to keep not more than 230.
	32 to 50	100	
	65 to 100	85	
	125 to 200	75	
	250 to 300	65	

Remarks: Limits for cage type valve are 1.5 times as large as those shown in the table above.

Table 9.5 Representative values of M and k

Fluid	Air	Oxygen	Nitrogen	Hydrogen	Propane
M (molecular weight)	28.97	32.00	28.02	2.02	44.10
k (Ratio of specific heats of gas)	1.40	1.40	1.41	1.41	1.15

SUPPLEMENTARY EXPLANATION (REFERENCE)

- At present, Av and Kv are also used as flow coefficients, in addition to Cv. Av value is flow coefficient in SI system. Kv value is the flow rate of water in m^3/h when the pressure drop is 1 bar and water temperature is within the range of 5 to 40℃. Conversion formulas are as follows:

$$Av = \frac{24}{10^6} \times Cv \qquad\qquad Kv = \frac{Cv}{1.17}$$

With the present trends for larger capacity and higher pressure of process plants, the problems of noises of plant is attracting much attention, and noise control of control valves is urgently required in view of environmental control and industrial psychology.

To meet these requirements, we have been conducting development of low noise valves as well as noise control measures by installing noise experimentt devices to measure noises of various types of valves, and by conducting field noise measurement. An example of low noise valve has been given on page 23, which is just a part of our efforts.

In this chapter, we explain control valve noises and their countermeasures. Valve noises may be classified into mechanical noises and fluid noises due to flow.

Fig. 10A Low noise control valve

DY-CNDOO
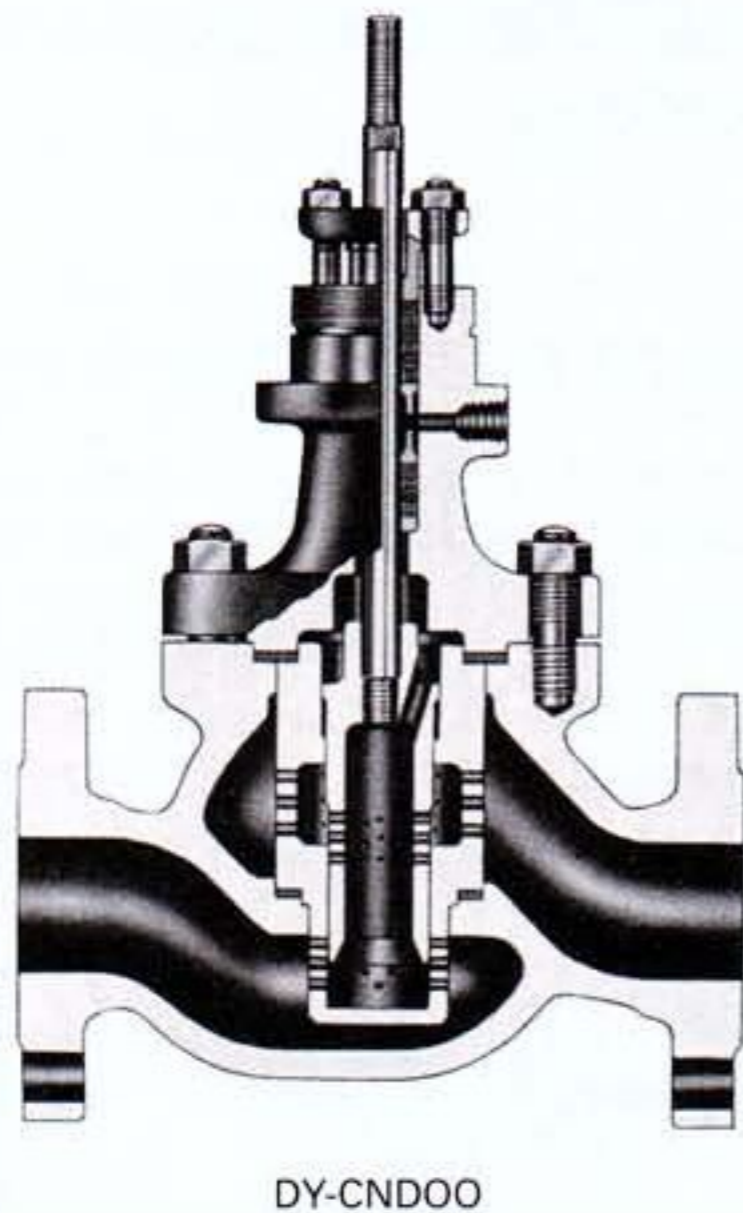
KIND OF NOISE

Mechanical noises

Mechanical noises are generated by fluctuation of forces due to jets and vortexes at movable portions inside the valve. The natural frequency of trim is normally within the range of 50 to 2000 Hz, and resonance is said to be generated around 2 to 7 kHz.

Noises due to liquid flow

When liquid passes the valve port, the velocity will increase and the static pressure will drop to generate bubbles in the liquid. These bubbles will collapse on the downstream side of the valve port when the velocity decreases and the static pressure recovers. This phenomenon is normally called cavitation. Bursting sounds generated by this cavitation are one source of noises. Noise levels of mechanical noises and of cavitation noises are usually not more than 100 dB, except few cases.

Noises due to gas flow

Most of valve noises are generated in the following manner. When the valve travel (area of path) is reduced to control the flow rate, a differential pressure will be generated at the valve port, and the fluid flowing in the pipe will be partly increased in velocity to acquire high kinetic energy. This high energy will be converted into sound energy to generate noises. Valve noises are similar to jet noises and proportional to the n th power of the veloity, n is said to be 5 to 8, and the value of n varies according to the differential pressure of the valve. This sound thus generated will be conveyed to the downstream side and transmitted outside via the vibrations of the pipe. If $(p_1 \times Cv) < 70$, the noise level will not exceed 90dB.

Sound intensity

The intensity of sound is expressed as flux of sound power through unit area normal to the direction of propagation, or as sound pressure in decibels (dB). The degree of apparent loudness of sound is called loudness level and measured in phons. For example, if some sound has an intensity of 60 phons, the apparent intensity of the sound is equal to that of sound of 60 dB at 1000 Hz. The sensitivity of ear deteriorates in both ranges of low frequencies and high frequencies. The unit of sound intensity measured with a sound level meter set to the A scale which has similar characteristics to human ear is dB (A). (See Fig. 10B below.)

As the apparent "loudness" of steady sound and that of somewhat fluctuating sound can be well expressed in this unit by finding the median, the unit is used in practical noise evaluation.

Fig. 10B Ranges of audible asound frequency and sound pressure level
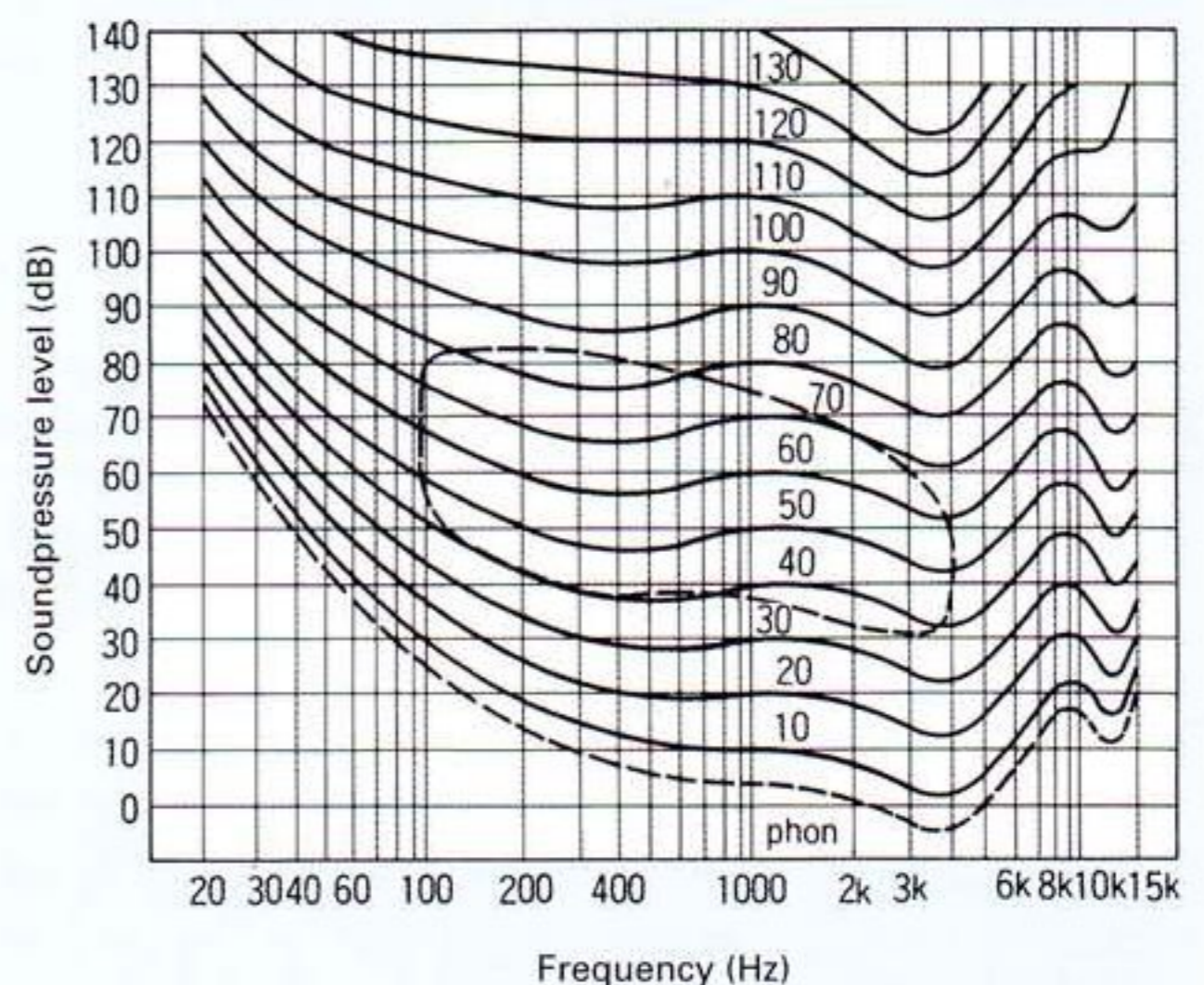
● The area enclosed by the broken line in the center of the figure indicates the range used by human voice.

Table 10.1 Noise rating curves (ISO)

Median frequency of octave band
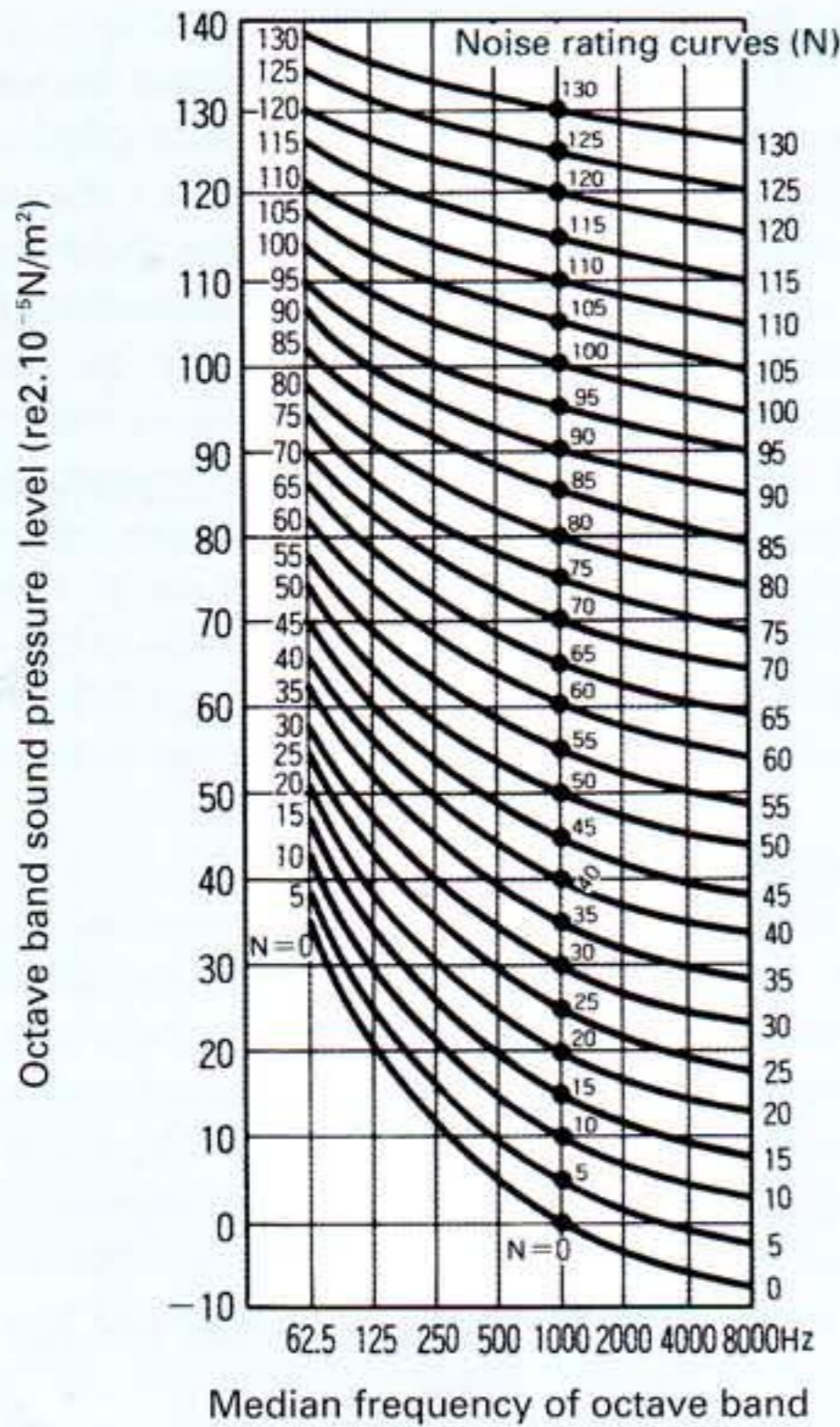
For rating noise interference of hearing of voise, a variety of methods is available. ISO system measures sound pressure levels of octave bands of median frequencies of 500, 1000 and 2000 Hz and obtains the largest N number among them from the noise rating curves of Table 10.1 as NRN (noise rating number). This value is approximately equal to the value in dB (A) minus 5.

The allowable limits for hearing protection are shown in Table 10.2 below. Since the aparent "loudness" of noise depends on the difference between the noise and its background noise (the larger the difference, the louder the noise), and also varies according to factors such as environment, psychological background, nature of noise (monotonous, intermittent, impulsive, etc.), a comprehensive analysis is required.

PREDICTION OF SOUND PRESSURE LEVEL

The prediction of noise of control valve is made on the basis of the formulas indicated in ISA HANDBOOK OF CONTROL VALVE. The prediction of sound pressure levels of our control valves is made with reference to various data.

Computation of predicted value of sound pressure level

Predicted value of sound pressure level is computed from the following formula.

$$SPL: S\triangle p + SCv + S\,(\triangle p/p^*)\,f + SI$$

Code

SPL: Overall noise level in dB (A) at predetermined point (1 m downstream of the valve outlet and 1 m from the pipe surface).

$S\triangle p$: Base SPL in dB (A) determined as a function of pressure differential.

SCv: Correction in dB (A) for Cv.

$S\,(\triangle P/P^*)f$: Correction in dB (A) for valve style and flow regime.

SI: Correction in dB (A) for acoustical treatment; i.e. heavy wall pipe.

MEASUREMENT OF SOUND PRESSURE LEVEL

As for measurement, noise test devices and measuring method are in accordance with JIS Z8731 and ISO TC43.

Some data of low noise valves developed by us are shown below. (On pages 61 and 62.)

Table 10.2 Allowable levels of noise for hearing protection.

Median frequency (Hz)	Allowable octave band level (dB)					
	480 min.	240 min.	120 min.	60 min.	40 min.	30 min.
250	98	102	108	117	120	120
500	92	95	99	105	112	117
1000	85	88	91	95	99	103
2000	83	84	85	88	90	92
3000	82	83	84	85	88	90
4000	82	83	85	87	89	91
8000	87	89	92	97	101	105

Fig. 10C Measuring point

Upstream — Downstream
Valve measured
(Floor plan)
1m
1m
Measuring microphone
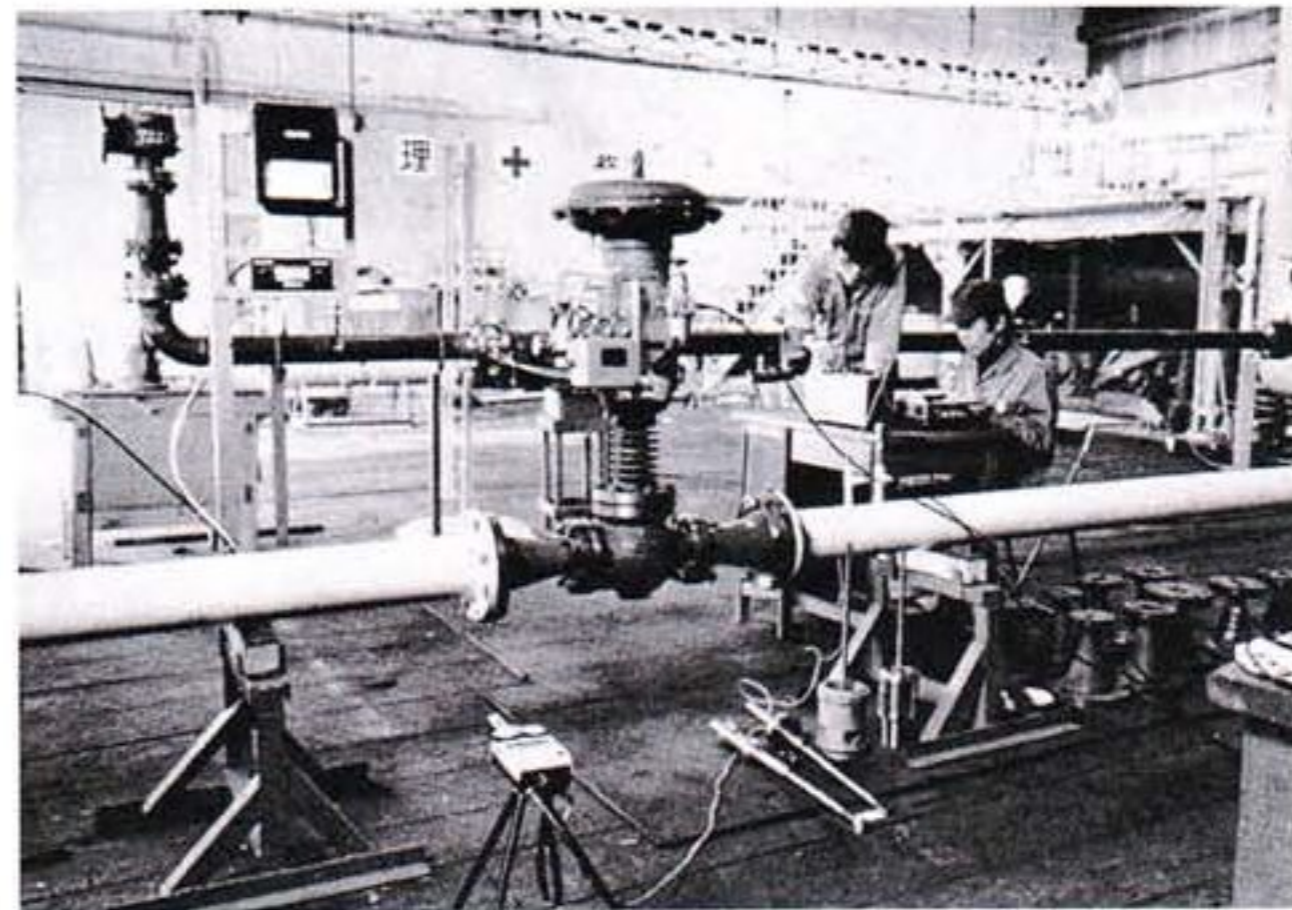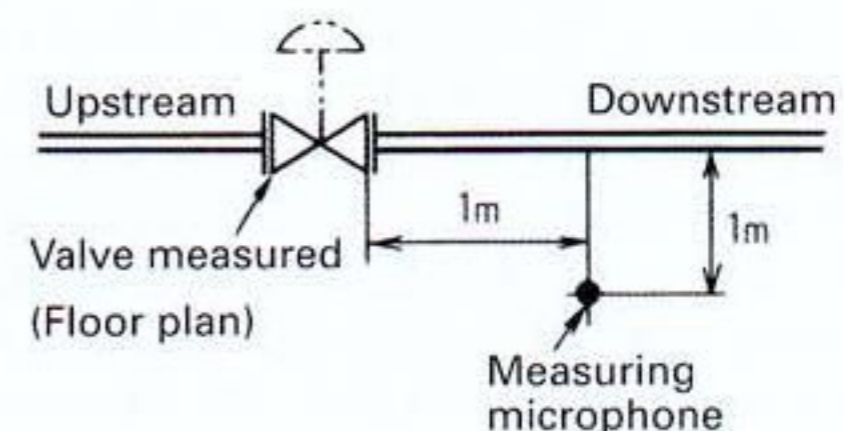
NOISE CONTROL

When noises of control valve raise a problem, the following points should be paid due attention in planning counter-measures:

1. Grasp the actual state of noise level and its frequency band.
2. Identify the main sources of noises which are affecting the receiving point.
3. Locate where the noises are coming from.

As for noise control measures, it is important to consider valve, piping, structures, environment, etc., all in a system, and use some control methods in combination so as to take economic aspect into consideration.

- Selection of valve style → Low noise valve.
- Planning of upstream and downstream flows of valve → Smaller velocity, silencer.
- Piping → Rugging, and use of thick wall pipe.
- Alternation of plan of process specifications → Smaller burden of valve differential pressure.
- Sound insulation → Sound insulation box, and sound barrier wall.
- Prevention of propagation of vibration → Support, and structures.

As for noise transmission control measures, the following points should be considered:

- Keep the noise source away from the receiving point.
- Reorientate the exhaust port, etc., by considering the directivity of noise.
- Attenuate the noise by means of wall, buildings, environmental improvement, etc.

In selecting some measures from those mentioned above, it is necessary to pay due attention to economics, effects on environment of the installation site, noise level, etc.

Fig. 10D
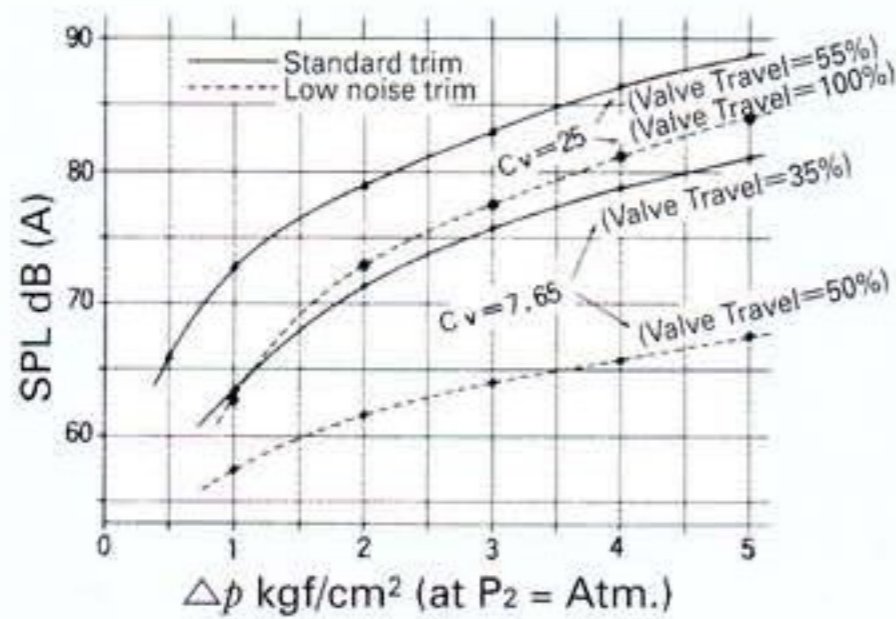
Noise data
[Comparison of standard and low noise valve trims at the same Cv]
As shown on the data, low noise trim shouwed sound reducing effects of 5 to 15 dB (A). Especially, with the decrease of valve travel, high frequency range was cut off, and noise level was substantially reduced.

Fig. 10E Examples of noise control effects on downstream side of a valve

Sound pressure level outside the pipe	110 dB	102 dB	95 dB	110 dB	85 dB	85 dB
	Untreated pipe of Sch 40	Pipe of Sch 80	Pipe of Sch 40 with acoustic absorbing material of 50 mm thick	Untreated pipe of Sch 40	With silencer (example)	Untreated pipe of Sch 40
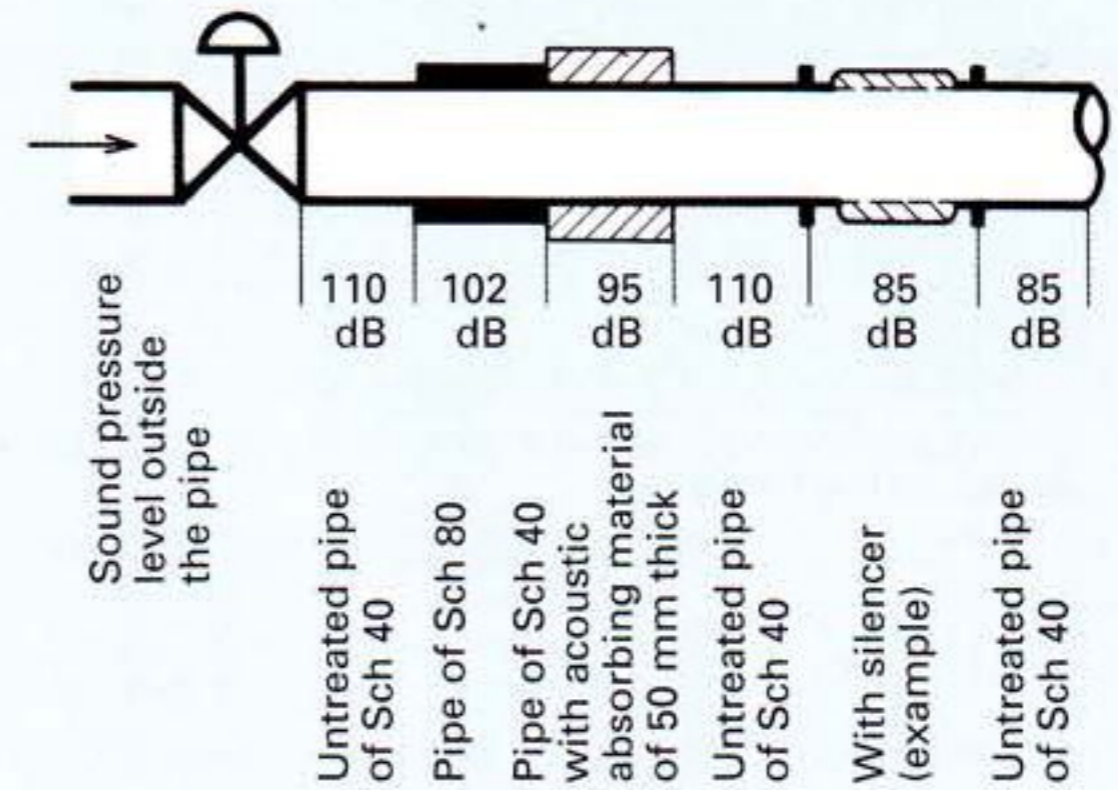
Example of low noise trim

Fig. 10F

66
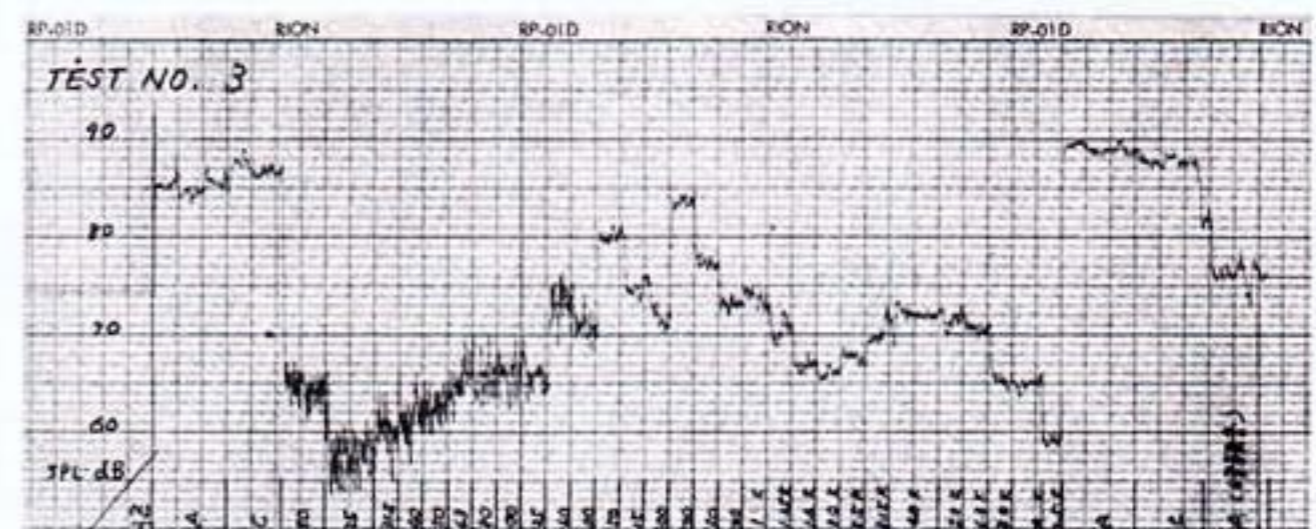
▌ Pressure ratings for ferrous material pipe flanges (JISB2238-1996) & (JISB2239-1996) [Attached table]

MPa {kgf/cm²}

NOMINAL PRESSURE	MATERIAL (1)	CONDITION OF FLUID AND MAXIMUM WORKING PRESSURE				Hydraulic test pressure (reference) (4)
		Condition of fluid				
		W	G₁	G₂	G₃	
		max. 120°C	max. 220°C	300°C	350°C	
2K	FC 200	0.29{ 3}	0.20{ 2}	—	—	0.39{ 4}
5K	FC 200	0.69{ 7}	0.49{ 5}	—	—	0.98{10}
	FCMB 340(2),FCD370,FCD 400(2),FCMB-S 35,FCD-S	0.69{ 7}	0.59{ 6}	0.49(2){ 5}	—	0.98{10}
10K	FC 200	1.37{14}	0.98{10}	—	—	1.96{20}
	FCMB 340(2),FCD370,FCD 400(2),FCMB-S 35,FCD-S	1.37{14}	1.18{12}	0.98(2){10}	—	1.96{20}
16K	FC 200	2.16{22}	1.57{16}	—	—	3.14{32}
	FCMB 340(2),FCD370,FCD 400(2),FCMB-S 35,FCD-S	2.16{22}	1.96{20}	1.77(2){18}	1.57(2){16}	3.43{35}
20K	FC 250	2.75{28}	1.96(3){20}	—	—	3.92{40}
	FCMB 340(2),FCD370,FCD 400(2),FCMB-S 35,FCD-S	2.75{28}	2.45{25}	2.26(2){23}	1.96(2){20}	4.32{44}

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.

Notation	Applicable standards
FC 200, FC 250	JIS G 5501
FCMB 340	JIS G 5702
FCD 370, FCD 400	JIS G 5502
FCMB-S 35, FCD-S	JIS B 8270's attachment 5, A&B

(2) FCMB 340 & FCD 400 are not applicable against 16K & 20K of fluid condition when nominal pressures are 5K & 10K.

(3) Applicable maximum working temperature is °F.

(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 1. Fluid condition W is applicable to still running water (with little pressure fluctuation) of °F and unber only.
2. 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.
3. When temperature or pressure is in between two figures on the table, the maximum working pressure or temperature can be determined by interpolation. (see attached table)
4. 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.
5. Figures in parenthesis are not usually used. They are given for reference in design.
6. When fluid condition is to be expressed in notation, W through G₃ are used.

MPa {kgf/cm²}

NOMINAL PRESSURE	MATERIAL (1)	CONDITION OF FLUID AND MAXIMUM WORKING PRESSURE											Hydraulic test pressure (reference) (4)
		Condition of fluid											
		W	G₁	G₂	G₃	H₁	H₂	H₃	H₄	H₅	H₆	H₇	
		120°C以下	220°C以下	300°C	350°C	400°C	425°C	450°C	475°C	490°C	500°C	510°C	
2K	SS400、SF390A(3)、S20C(2)、SC410	0.29{ 3}	0.20{ 2}	—	—	—	—	—	—	—	—	—	0.39{ 4}
5K	SS400、SF390A(3)、SFVC1、S20C(2)、SC410、SCPH1	0.69{ 7}	0.59{ 6}	0.49{ 5}	—	—	—	—	—	—	—	—	0.98{ 10}
10K	SS400、SF390A(3)、SFVC1、S20C(2)、SC410、SCPH1	1.37{ 14}	1.18{12}	0.98{10}	—	—	—	—	—	—	—	—	1.96{ 20}
16K	SF440A(3)、SFVC2A、S25C(2)、SC480(4)、SCPH2	2.65{ 27}	2.45{25}	2.26{23}	2.06{21}	1.77{18}	1.57{16}	—	—	—	—	—	3.92{ 40}
20K	SF440A(3)、SFVC2A、S25C(2)、SC480(4)、SCPH2	3.33{ 34}	3.04{31}	2.84{29}	2.55{26}	2.26{23}	1.96{20}	—	—	—	—	—	4.90{ 50}
30K	SF440A(3)、SFVC2A、S25C(2)、SC480(4)、SCPH2	5.00{ 51}	4.51{46}	4.22{43}	3.82{39}	3.33{34}	2.94{30}	—	—	—	—	—	7.35{ 75}
	SFVAF1、SCPH11	(5.00{ 51})	(4.51{46})	(4.22{43})	(3.82{39})	3.73{38}	3.53{36}	3.33{34}	2.94{30}	—	—	—	
	SFVAF11A、SCPH21	(5.00{ 51})	(4.51{46})	(4.22{43})	(3.82{39})	(3.73{38})	(3.53{36})	(3.33{34})	3.14{32}	2.94{30}	—	—	
40K	SF440A(3)、SFVC2A、S25C(2)、SC480(4)、SCPH2	6.67{ 68}	6.08{62}	5.59{57}	5.10{52}	4.51{46}	3.92{40}	—	—	—	—	—	9.81{100}
	SFVAF1、SCPH11	(6.67{ 68})	(6.08{62})	(5.59{57})	(5.10{52})	5.00{51}	4.71{48}	4.41{45}	3.92{40}	—	—	—	
	SFVAF11A、SCPH21	(6.67{ 68})	(6.08{62})	(5.59{57})	(5.10{52})	(5.00{51})	(4.71{48})	(4.41{45})	4.12{42}	3.92{40}	3.73{38}	3.53{36}	
63K	SF440A(3)、SFVC2A、S25C(2)、SC480(4)、SCPH2	10.49{107}	9.51{97}	8.83{90}	7.94{81}	7.06{72}	6.18{63}	—	—	—	—	—	15.69{160}
	SFVAF1、SCPH11	(10.49{107})	(9.51{97})	(8.83{90})	(7.94{81})	7.85{80}	7.45{76}	6.96{71}	6.18{63}	—	—	—	
	SFVAF11A、SCPH21	(10.49{107})	(9.51{97})	(8.83{90})	(7.94{81})	(7.85{80})	(7.45{76})	(6.96{71})	6.47{66}	6.18{63}	5.79{59}	5.49{56}	

Note (1) The materials shall be those given in the attached table or those satisfying requirement for flanges. Others than in the table are due to the agreement or negotiation on delivery. The material notation of the table is based on the following.

Notation	Applicable standards
SS400	JIS G 3101
SF390A、SF440A	JIS G 3201
SFVC1、SFVC2A	JIS G 3202
SFVAF1、SFVAF11A	JIS G 3203
S20C、S25C	JIS G 4051
SC410、SC480	JIS G 5101
SCPH1、SCPH2、SCPH11、SCPH21	JIS G 5151

(2) According to inspection through JIS G 0303, extension strength shall be more than 400 N/mm² {40.8kgf/mm²} for S20C and 440 N/mm² {44.9kgf/mm²} for S25C.

(3) Carbon content shall be below 0.35%.

(4) Applicable maximum working temperature shall be below °F (350°C).

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

Remarks 1. Fluid condition W is applicable to still running water (with little pressure fluctuation) of 120°C and unber only.
2. 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.
3. Fluid condition H₁ is applicable to steam, air, gas or oil of 400°C.
4. 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.
5. When temperature or pressure is in between two figures of the table, the maximum working pressure or temperature can be determined by interporation.
6. 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.
7. Figures in parenthesis are not usually used. They are given for reference in design.
8. When fluid condition is to be expressed in notation, W through H₇ are used.

Table 11.2 Pressure-temperature ratings of ASME

Extracted from Pressure Temperature Ratings of mainly steel materials prescribed in ASME B16.34 1996 Steel Valves, Flanged and Butt-Welding End.

NAKAKITA

Carbon steel (Categ.1)

Temp. in °C / Class	150	300	600	900	1500	2000	2500	3500	4500
−30~ 38	2.0	5.1	10.2	15.3	25.5	34.0	42.5	59.6	76.6
93	1.8	4.7	9.3	14.0	23.3	31.0	38.8	54.3	69.8
149	1.6	4.5	9.1	13.6	22.6	30.2	37.7	52.8	67.9
204	1.4	4.4	8.8	13.1	21.9	29.1	36.4	51.0	65.5
260	1.2	4.1	8.3	12.4	20.7	27.5	34.4	48.2	61.9
316	1.0	3.8	7.6	11.3	18.9	25.2	31.4	44.0	56.6
343	0.9	3.7	7.4	11.1	18.5	24.7	30.9	43.2	55.5
371	0.8	3.7	7.3	11.0	18.4	24.5	30.6	42.9	55.1
399	0.7	3.5	7.0	10.4	17.4	23.2	29.0	40.5	52.1
427	0.6	2.8	5.7	8.5	14.2	18.9	23.6	33.1	42.5
454	(0.4)	(1.9)	(3.7)	(5.6)	(9.2)	(12.3)	(15.4)	(21.5)	(27.6)

Remarks : when temperature or pressure is in between two figures in the table, the maximum working pressure or temperature can be determined by interpolation.
Note : Figures in parenthesis are not usually used.

0.5Mo Steel (Categ.1)

Temp. in °C / Class	150	300	600	900	1500	2000	2500	3500	4500
−30~ 38	1.8	4.8	9.6	14.4	23.9	31.9	39.9	55.8	71.8
93	1.8	4.7	9.4	14.0	23.4	31.2	39.0	54.6	70.2
149	1.6	4.5	9.0	13.5	22.5	30.0	37.5	52.5	67.4
204	1.4	4.4	8.8	13.2	22.1	29.4	36.7	51.5	66.2
260	1.2	4.3	8.6	12.9	21.4	28.6	35.7	50.0	64.3
316	1.0	4.2	8.3	12.5	20.9	27.8	34.8	48.6	62.5
343	0.9	4.1	8.1	12.2	20.3	27.0	33.8	47.3	60.8
371	0.8	3.9	7.8	11.8	19.6	26.1	32.6	45.7	58.7
399	0.7	3.7	7.3	11.0	18.3	24.4	30.5	42.7	55.0
427	0.6	3.5	7.0	10.5	17.5	23.3	29.2	40.8	52.5
454	0.4	3.3	6.7	10.1	16.8	22.4	28.0	39.2	50.4
482	(0.3)	(3.1)	(6.2)	(9.3)	(15.5)	(20.7)	(25.8)	(36.1)	(46.5)

Remarks : when temperature or pressure is in between two figures on the table, the maximum working pressure or temperature can be determined by interpolation.
Note : Figures in parenthesis are not usually used.

1Cr-0.5Mo Steel (Categ.1)

Temp. in °C / Class	150	300	600	900	1500	2000	2500	3500	4500
−30~ 38	2.0	5.2	10.3	15.5	25.9	34.5	43.1	60.3	77.6
93	1.8	5.2	10.3	15.5	25.9	34.5	43.1	60.3	77.6
149	1.6	5.0	10.0	14.9	24.9	33.2	41.5	58.1	74.7
204	1.4	4.8	9.5	14.3	23.9	31.9	39.8	55.8	71.7
260	1.2	4.6	9.2	13.8	22.9	30.6	38.2	53.5	68.7
316	1.0	4.2	8.3	12.5	20.9	27.8	34.8	48.6	62.5
343	0.9	4.1	8.1	12.2	20.3	27.0	33.8	47.3	60.8
371	0.8	3.9	7.8	11.8	19.6	26.1	32.6	45.7	58.7
399	0.7	3.7	7.3	11.0	18.3	24.4	30.5	42.7	55.0
427	0.6	3.5	7.0	10.5	17.5	23.3	29.2	40.8	52.5
454	0.4	3.3	6.7	10.1	16.8	22.4	28.0	39.2	50.4
482	0.3	3.1	6.2	9.3	15.5	20.7	25.8	36.1	46.5
510	0.2	2.2	4.4	6.6	11.0	14.7	18.3	25.6	33.0
538	0.1	1.5	3.0	4.5	7.4	9.9	12.4	17.4	22.3
566	☆0.1	1.0	2.0	3.0	5.0	6.6	8.3	11.6	14.9
593	☆(0.1)	(0.7)	(1.3)	(2.0)	(3.3)	(4.4)	(5.5)	(7.7)	(9.9)

Remarks : when temperature or pressure is in between two figures on the table, the maximum working pressure or temperature can be determined by interpolation.
Note1 : Figures in parenthesis are not usually used.
Note2 : ☆ mark does not apply to flange type.

2.5Cr-1Mo Steel (Categ.1)

Temp. in °C / Class	150	300	600	900	1500	2000	2500	3500	4500
−30~ 38	2.0	5.2	10.3	15.5	25.9	34.5	43.1	60.3	77.6
93	1.8	5.2	10.3	15.5	25.9	34.5	43.1	60.3	77.6
149	1.6	5.0	10.0	15.1	25.1	33.5	41.9	58.6	75.3
204	1.4	4.9	9.7	14.6	24.3	32.4	40.5	56.8	73.0
260	1.2	4.6	9.2	13.8	22.9	30.6	38.2	53.5	68.7
316	1.0	4.2	8.3	12.5	20.9	27.8	34.8	48.6	62.5
343	0.9	4.1	8.1	12.2	20.3	27.0	33.8	47.3	60.8
371	0.8	3.9	7.8	11.8	19.6	26.1	32.6	45.7	58.7
399	0.7	3.7	7.3	11.0	18.3	24.4	30.5	42.7	55.0
427	0.6	3.5	7.0	10.5	17.5	23.3	29.2	40.8	52.5
454	0.4	3.3	6.7	10.1	16.8	22.4	28.0	39.2	50.4
482	0.3	3.1	6.2	9.3	15.5	20.7	25.8	36.1	46.5
510	0.2	2.6	5.2	7.8	13.0	17.3	21.7	30.4	39.1
538	0.1	1.8	3.6	5.4	9.0	12.0	15.0	21.0	27.0
566	☆0.1	1.2	2.4	3.6	6.0	8.0	10.0	14.1	18.1
593	☆(0.1)	(0.8)	(1.5)	(2.3)	(3.8)	(5.1)	(6.3)	(8.8)	(11.3)

Remarks : when temperature or pressure is in between two figures on the table, the maximum working pressure or temperature can be determined by interpolation.
Note1 : Figures in parenthesis are not usually used.
Note2 : ☆ mark does not apply to flange type.

Low temperature carbon steel (Categ.1)

Temp. in °C / Class	150	300	600	900	1500	2000	2500	3500	4500
−30~ 38	1.8	4.8	9.6	14.4	23.9	31.9	39.9	55.8	71.8
93	1.7	4.5	9.1	13.6	22.6	30.2	37.7	52.8	67.9
149	1.6	4.4	8.8	13.2	22.0	29.3	36.6	51.3	65.9
204	1.4	4.3	8.5	12.8	21.3	28.4	35.5	49.7	63.8
260	1.2	4.0	8.0	12.0	20.1	26.8	33.4	46.8	60.2
316	1.0	3.7	7.3	11.0	18.4	24.5	30.6	42.9	55.1
343	(0.9)	(3.6)	(7.2)	(10.8)	(18.0)	(24.0)	(30.0)	(42.0)	(54.1)

Remarks : when temperature or pressure is in between two figures on the table, the maximum working pressure or temperature can be determined by interpolation.
Note : Figures in parenthesis are not usually used.

18Cr-8Ni Steel (Categ.1)

Temp. in °C / Class	150	300	600	900	1500	2000	2500	3500	4500
−30~ 38	1.9	5.0	9.9	14.9	24.8	33.1	41.4	57.9	74.5
93	1.6	4.1	8.3	12.4	20.7	27.6	34.5	48.3	62.1
149	1.4	3.7	7.4	11.2	18.6	24.8	31.0	43.4	55.8
204	1.3	3.4	6.9	10.3	17.1	22.8	28.5	40.0	51.4
260	1.2	3.2	6.4	9.6	16.1	21.4	26.8	37.5	48.2
316	1.0	3.0	6.0	9.0	15.1	20.1	25.1	35.1	45.2
343	0.9	3.0	5.9	8.9	14.8	19.8	24.7	34.6	44.4
371	0.8	2.9	5.9	8.8	14.7	19.5	24.4	34.1	43.9
399	0.7	2.9	5.7	8.6	14.3	19.1	23.9	33.4	43.0
427	0.6	2.8	5.6	8.3	13.9	18.5	23.2	32.4	41.7
454	0.4	2.7	5.4	8.2	13.7	18.2	22.8	31.9	41.0
482	0.3	2.7	5.4	8.0	13.4	17.9	22.3	31.3	40.2
510	0.2	2.6	5.3	7.9	13.2	17.5	21.9	30.7	39.5
538	0.1	2.2	4.4	6.7	11.1	14.8	18.4	25.8	33.2
566	☆0.1	2.1	4.2	6.4	10.7	14.2	17.7	24.8	31.9
593	☆0.1	1.8	3.6	5.3	8.9	11.8	14.8	20.7	26.6
621	☆0.1	1.4	2.8	4.1	6.9	9.1	11.4	16.0	20.6
649	☆0.1	1.1	2.1	3.2	5.3	7.1	8.9	12.4	16.0
677	☆0.1	0.8	1.6	2.3	3.9	5.2	6.5	9.1	11.7
704	☆0.1	0.6	1.2	1.8	3.0	4.0	4.9	6.9	8.9
732	☆0.1	0.4	0.9	1.3	2.1	2.8	3.6	5.0	6.4
760	☆0.1	0.3	0.7	1.0	1.7	2.2	2.8	3.9	5.0
788	☆0.1	0.2	0.5	0.7	1.2	1.6	2.0	2.8	3.6
816	(0.1)	(0.2)	(0.4)	(0.6)	(0.9)	(1.3)	(1.6)	(2.2)	(2.8)

Remarks : when temperature or pressure is in between two figures on the table, the maximum working pressure or temperature can be determined by interpolation.
Note1 : Figures in parenthesis are not usually used.
Note2 : ☆ mark does not apply to flange type.
Note3 : For over °F (540°C) materials should be selected out of C ≧ 0.04%

18Cr-9Ni-2Mo Steel (Categ.1)

Temp. in °C / Class	150	300	600	900	1500	2000	2500	3500	4500
−30~ 38	1.9	5.0	9.9	14.9	24.8	33.1	41.4	57.9	74.5
93	1.6	4.3	8.6	12.8	21.3	28.5	35.6	49.8	64.1
149	1.5	3.9	7.7	11.6	19.3	25.7	32.1	45.0	57.8
204	1.3	3.6	7.1	10.6	17.7	23.6	29.5	41.3	53.1
260	1.2	3.3	6.6	9.9	16.5	22.0	27.4	38.4	49.4
316	1.0	3.1	6.2	9.3	15.5	20.7	25.9	36.3	46.7
343	0.9	3.1	6.1	9.2	15.3	20.4	25.5	35.7	45.9
371	0.8	3.0	6.0	9.0	15.0	20.0	25.0	34.9	44.9
399	0.7	2.9	5.9	8.8	14.7	19.6	24.5	34.4	44.2
427	0.6	2.9	5.8	8.7	14.5	19.4	24.3	34.0	43.7
454	0.4	2.9	5.8	8.7	14.4	19.2	24.0	33.6	43.2
482	0.3	2.9	5.7	8.6	14.3	19.1	23.9	33.4	43.0
510	0.2	2.7	5.3	8.0	13.3	17.8	22.2	31.1	40.0
538	0.1	2.4	4.8	7.2	12.1	16.1	20.1	28.1	36.2
566	☆0.1	2.4	4.7	7.1	11.9	15.8	19.8	27.6	35.5
593	☆0.1	2.1	4.2	6.3	10.5	14.0	17.5	24.5	31.5
621	☆0.1	1.6	3.3	4.9	8.2	10.9	13.6	19.0	24.5
649	☆0.1	1.3	2.6	3.8	6.4	8.5	10.7	14.9	19.1
677	☆0.1	1.0	2.0	3.0	5.1	6.8	8.5	11.9	15.2
704	☆0.1	0.8	1.6	2.4	4.0	5.4	6.7	9.4	12.1
732	☆0.1	0.7	1.3	2.0	3.3	4.4	5.5	7.7	9.9
760	☆0.1	0.5	1.0	1.6	2.6	3.5	4.3	6.1	7.8
788	☆0.1	0.4	0.8	1.2	2.0	2.7	3.3	4.7	6.0
816	☆(0.1)	(0.3)	(0.6)	(0.9)	(1.4)	(1.9)	(2.4)	(3.3)	(4.3)

Remarks : when temperature or pressure is in between two figures on the table, the maximum working pressure or temperature can be determined by interpolation.
Note1 : Figures in parenthesis are not usually used.
Note2 : ☆ mark does not apply to flange type.
Note3 : For over °F (540°C) materials should be selected out of C ≧ 0.04%

9Cr-1Mo-V Steel (Categ.1)

Temp. in °C / Class	150	300	600	900	1500	2000	2500	3500	4500
−30~ 38	2.0	5.2	10.3	15.5	25.9	34.5	43.1	60.3	77.6
93	1.8	5.2	10.3	15.5	25.9	34.5	43.1	60.3	77.6
149	1.6	5.0	10.0	15.1	25.1	33.5	41.9	58.6	75.3
204	1.4	4.9	9.7	14.6	24.3	32.4	40.5	56.8	73.0
260	1.2	4.6	9.2	13.8	22.9	30.6	38.2	53.5	68.7
316	1.0	4.2	8.3	12.5	20.9	27.8	34.8	48.6	62.5
343	0.9	4.1	8.1	12.2	20.3	27.0	33.8	47.3	60.8
371	0.8	3.9	7.8	11.8	19.6	26.1	32.6	45.7	58.7
399	0.7	3.7	7.3	11.0	18.3	24.4	30.5	42.7	55.0
427	0.6	3.5	7.0	10.5	17.5	23.3	29.2	40.8	52.5
454	0.4	3.3	6.7	10.1	16.8	22.4	28.0	39.2	50.4
482	0.3	3.1	6.2	9.3	15.5	20.7	25.8	36.2	46.5
510	0.2	2.6	5.3	8.0	13.3	17.8	22.2	31.1	40.0
538	0.1	2.5	5.0	7.5	12.5	16.7	20.9	29.2	37.6
566	☆0.1	2.5	5.0	7.4	12.4	16.5	20.7	29.0	37.2
593	☆0.1	2.1	4.2	6.2	10.4	13.9	17.3	24.3	31.2
621	☆0.1	1.6	3.1	4.6	7.7	10.2	12.8	17.9	23.1
649	☆0.1	1.0	2.0	3.0	5.0	6.6	8.3	11.6	14.9

Remarks : when temperature or pressure is in between two figures on the table, the maximum working pressure or temperature can be determined by interpolation.
Note1 : Figures in parenthesis are not usually used.
Note2 : ☆ mark does not apply to flange type.

〔Example〕 DY-C O D O F 63

Control valve series ─┘

- Indicates pressure rating. ············ (See page 63)
- Indicates bonnet construction. ········ (See table e.)
- Indicates seat ring type. ············ (See table d.)
- Indicates valve piug type. ············ (See table c.)
- Indicates cage type. ················ (See table b.)
- Indicates body configuration. ········ (See table a.)

■ Table a. Body configuration

Symbol	Meaning
C	Cage guided type body
G	Single seated and top guided type body
L	Cage guided and angle type body
W	Single seatded and suitable flow type body
Z	Special body (other than those mentioned above)

■ Table b. Cage type

Symbol	Meaning
O	Standard port cage
C	Cage quide
E	Multi-hole port cage
N	Low-nouse cage
Z	Special type cage

■ Table c. Valve plug type

Symbol	Meaning
B	Balanced valve plug with single seat joint
D	Balanced valve plug with double seat joint
L	Labyrinth
P	Pilot type valve plug with single seat joint
S	Unbalanced valve plug with single seat joint
Z	Special type

■ Table d. Seat ring type

Symbol	Meaning
O	Cage-ring monolithic type
E	Soft seat
S	Split type (metal)
Z	Special type

■ Table e. Bonnet construction

Symbol	Meaning
O	Standard type
F	Fin type
L	Long type
B	Bellows seal type
X	Extension type
Z	Special type

DY-CNDOO	DY-CCSSO	DY-LODSO
Balanced valve piug, low noise cage, double seat • For low noise • Easy maintenance	Cage guide unbalanced valve plug, single seat • Easy maintenance	Cage balanced valve plug, double seat • Cavitation resistance • Flashing resistance • Easy maintenance
32 ～ 300ᴬ	50 ～ 200ᴬ	32 ～ 300ᴬ
5 ～ 63	5 ～ 63	5 ～ 63
125 ～ 2500	125 ～ 1500	125 ～ 1500
550℃	550℃	550℃
20 : 1	30 : 1	50 : 1
0.5% and under. (Ⅱ)*	0.01% and under. (Ⅳ)*	0.3% and under. (Ⅱ)*
23	23	24

DY-GCSSO	DY-WCSSO	DY-WCLSO
Small size single seat, unbalance valve plug, medium pressure • Easy maintenance	Small size single seat, unbalance valve plug, • High temperature • High pressure • Easy maintenance	Unbalanced and labyrinth valve plug • Cavitation resistance. For large pressure drop & non-compressible fluid. • Easy maintenance
20 ～ 50ᴬ	20 ～ 50ᴬ	20 ～ 50ᴬ
5 ～ 63	—	5 ～ 63
125 ～ 900	1500 · 2500	1500 ～ 2500
550℃ (1022°F)	550℃ (1022°F)	550℃ (1022°F)
20 : 1～30 : 1	20 : 1～30 : 1	20 : 1～30 : 1
0.01% and under. (Ⅳ)*	0.01% and under. (Ⅳ)*	0.01% and under. (Ⅳ)*
25～26	27	28

12 SPECIAL APPLICATIONS

CONTROL VALVE FOR LOW TEMPERATURE AND ULTRA LOW TEMPERATURE USES

Today, in low temperature and ultra low temperature plants, a variety of practical plants are being developed and extended rapidly, on the basis of test plants of ultra low temperature ranges, and technical innovations in the fields of cryogenic and low temperature technologies are rapidly advancing.   We have already delivered many valves. Just to show a part of our actual results, we have delivered control valves, cylinder valves, butterfly valves, etc. to the following plant facilities and devices :
following plant facilities and devices :

Example of deliveries   Working temp.

1. Control 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. . . . . $- 268°C$
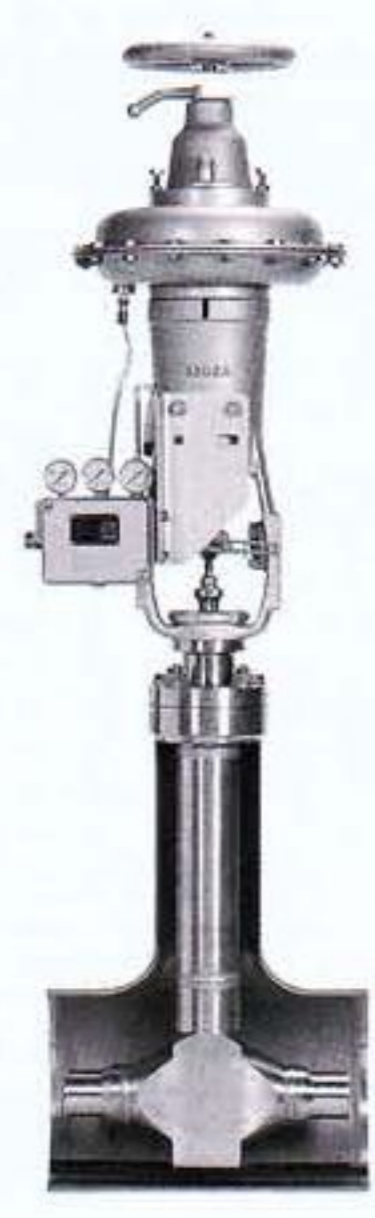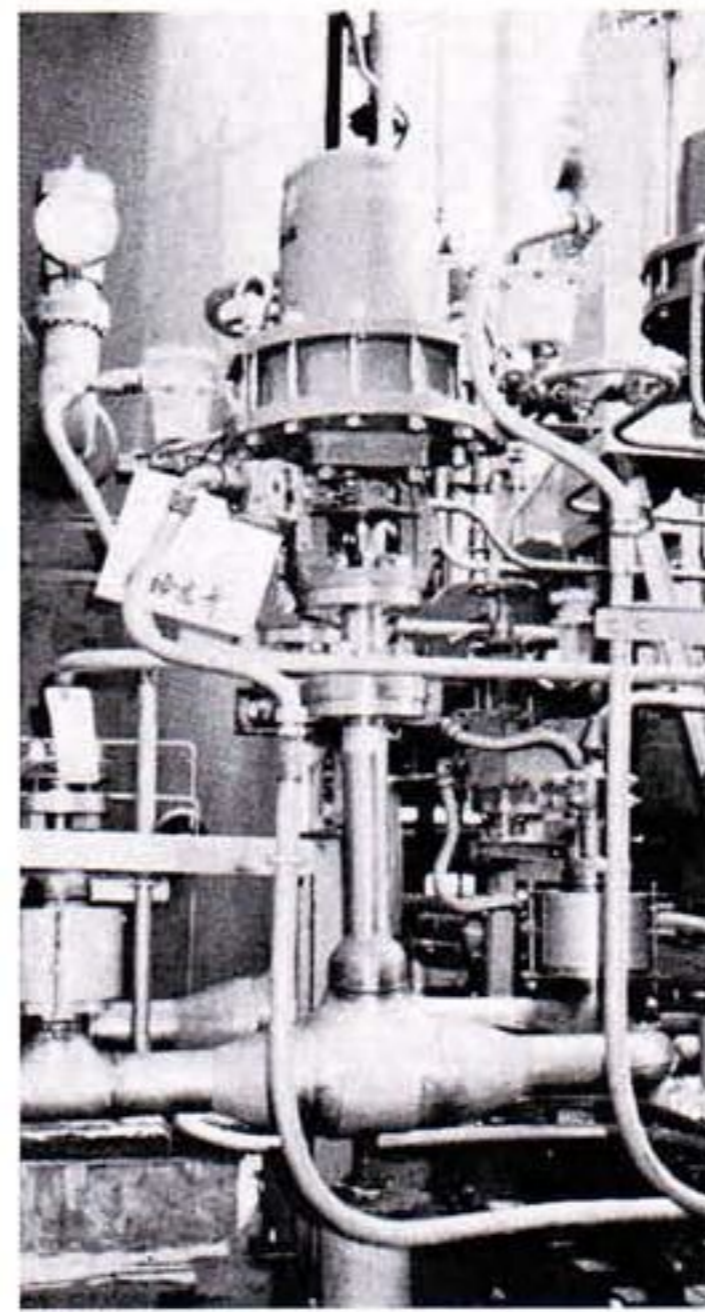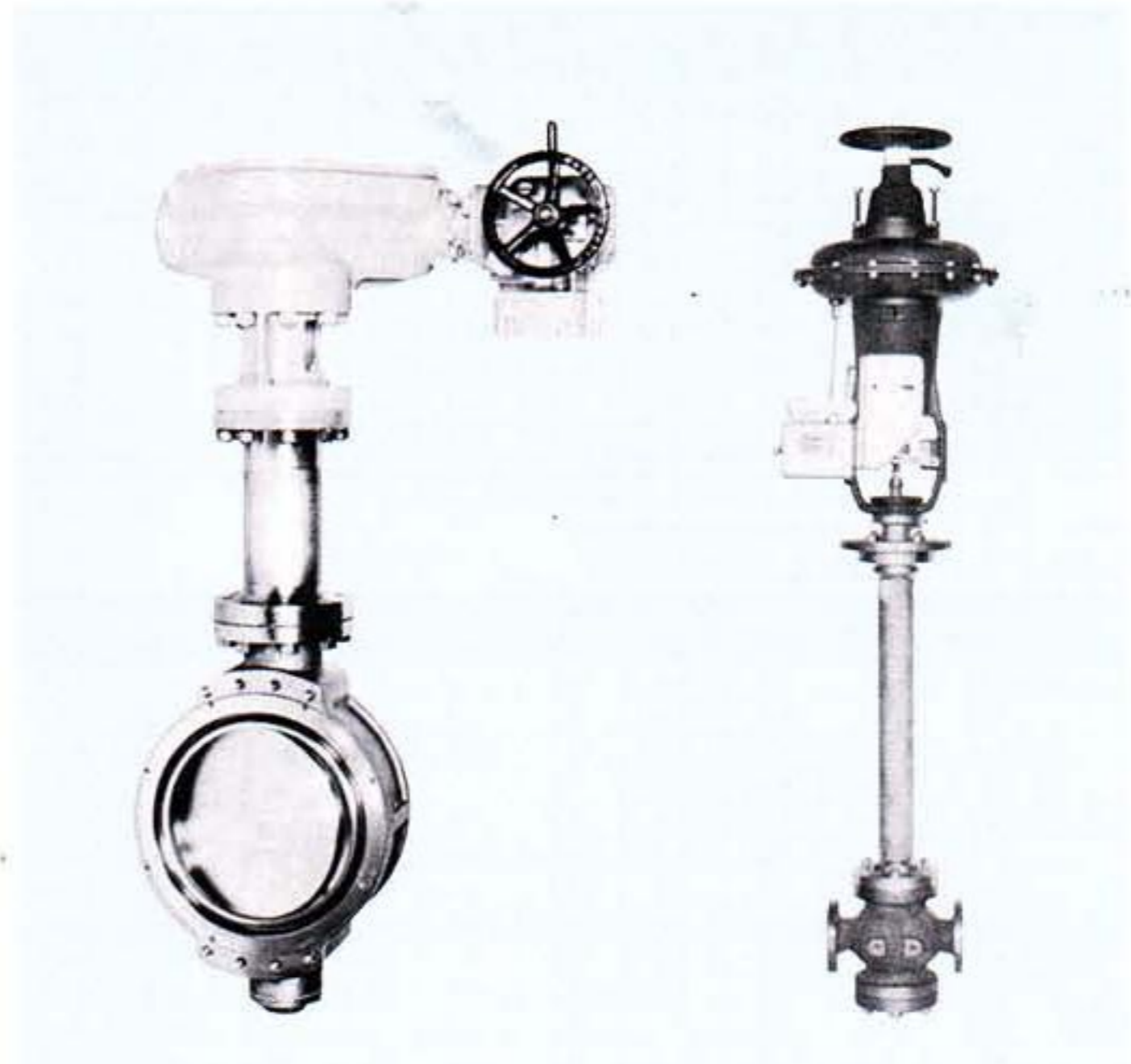
▲ Example of field installation

▲ Valve with exetension type bonnet

▲ Ultra low temperature testing device
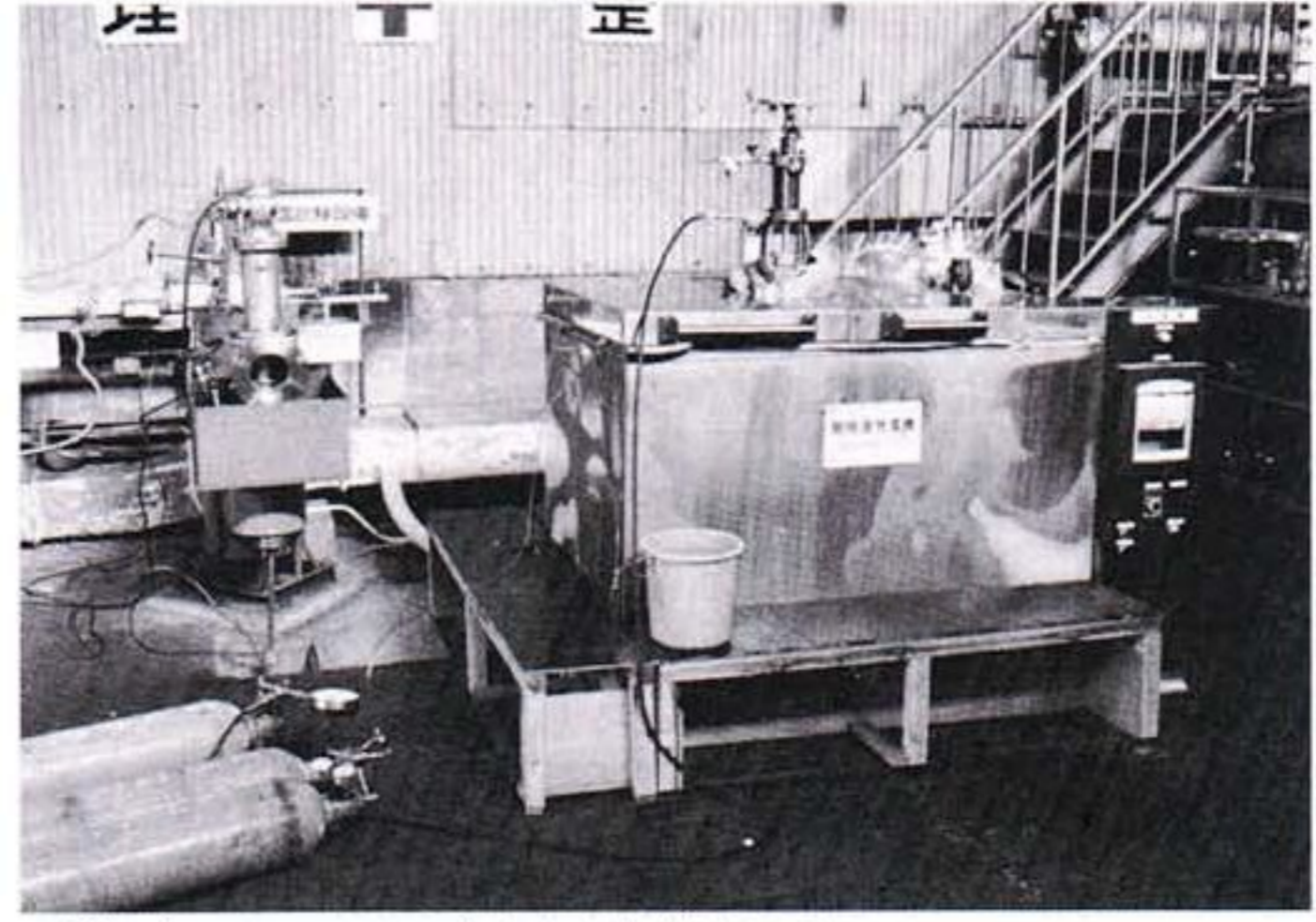
▲ Ultra low temperature leak test (bubble test)

CONTROL VALVES FOR NUCLEAR POWER PLANTS

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. We have delivered valves to Rokkasho Spent Fuel Reprocessing Plant of Japan Gennen Co., Ltd.
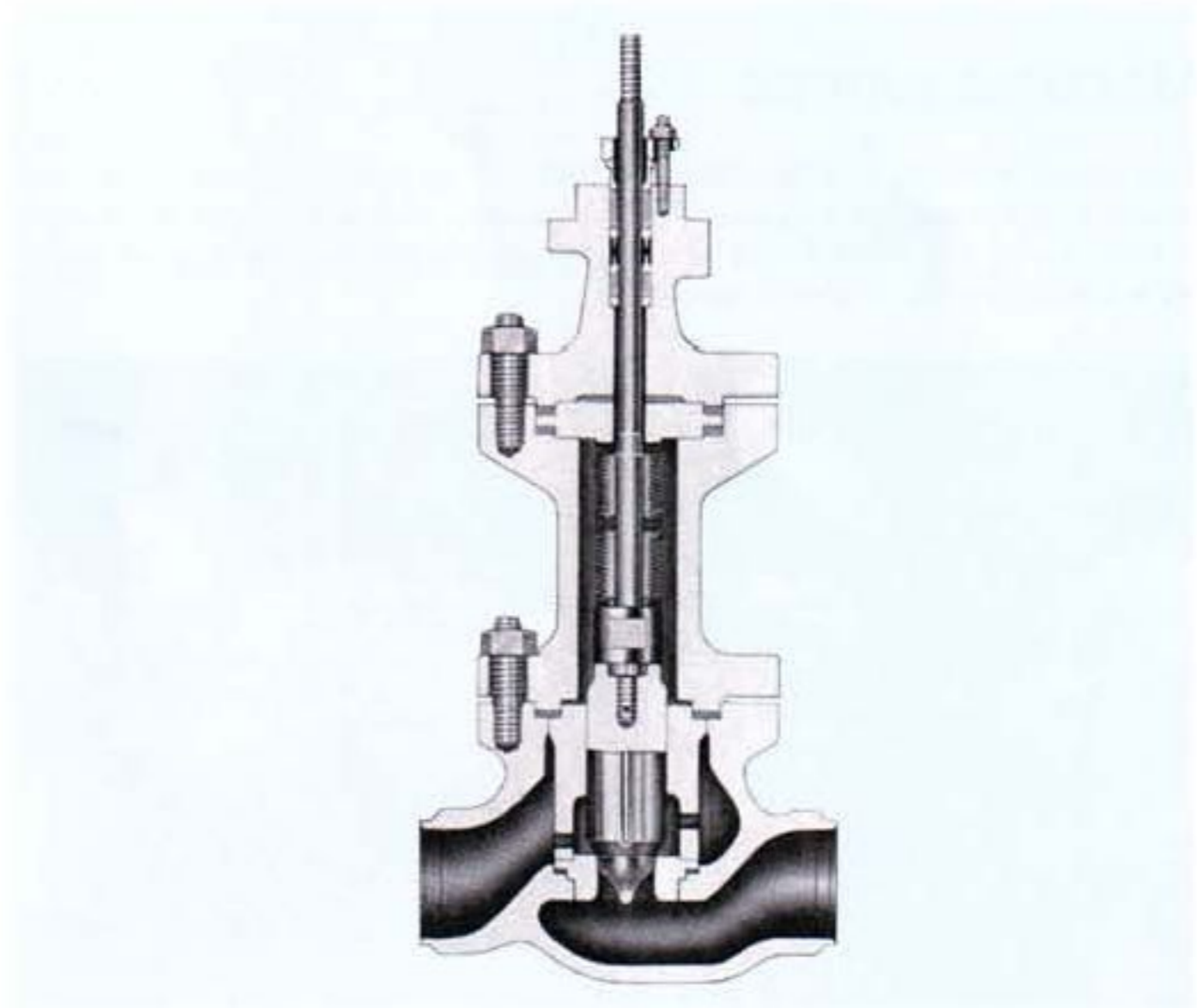
To assure safety of nuclear powr plant, valves for nuclear power plant require sophisticated quality control and quality assurance. To meet these requirements, we have established a quality assurance manual and have been exercising adequate quality control all over the production processes, from receiving 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.

▲ Cylinder type butterfly control valve

GAS TURBINE FUEL CONTROL VALVE

Fuel control valves for gas turbine requires high reliability for high response, accuracy and shut sufficiency against turbine's wide range load conditions (ignition~start-up~ load operation~emergency cut-off). Servo actuator (electric type & oil hydraulic type) is used, which makes possible higher response and larger stiffness. In order to meet wide-ranged operating conditions, rated Cv, flow characteristics, rangeability, etc. are specially designed and reafirmed through sever test and inspection. Open/close time of valve is designed within 1 second, and load shut-out makes immediate fuel cut-off. At the same time full closure brings shut sufficiency of sent leak class V. Construction is top-entry one of cage type for easier maintenance purpose.

▲ Bellows seal valve

▲ Oil hydraulic servo valve
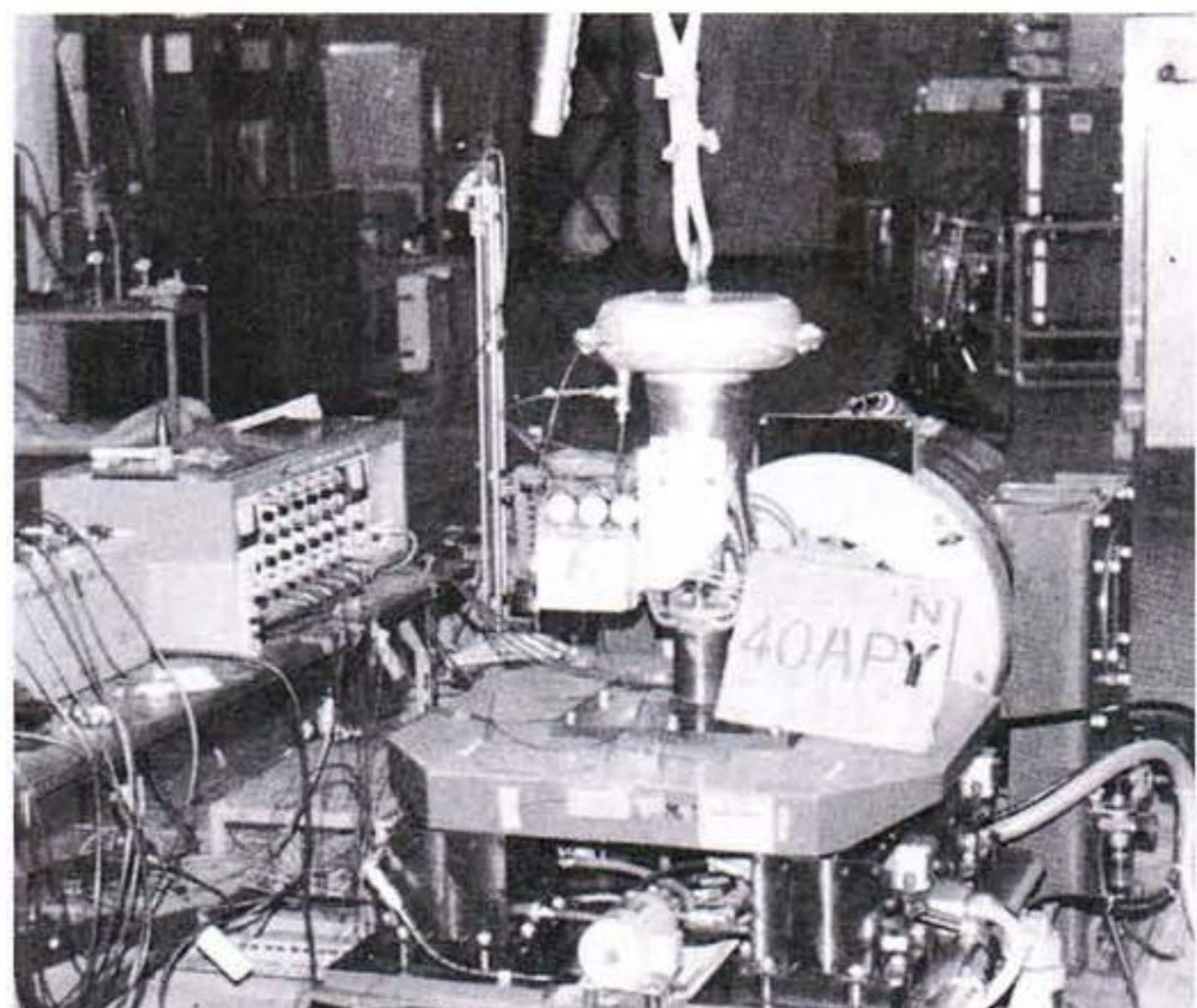
▲ Scene of demonstration test

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GENERAL OFFICE BUILDING

The general office building is the center of our plants for the production of [valves and control systems].
- The lower floor accomodates general offices of General Affairs Dept., Engineering Dept., Quality Assurance Dept., etc.
- The upper floor accomodates Technical Department (Design Section, and Production Technology Section).

▲ Disign 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.

▲ Material testing Machine

▲ Measurement device of valve flow capacity coefficient Cv (for water)

▲ Measurement device of valve flow capacity coefficient Cv (pneumatic type)
MAX, Cv=10000

▲ super-critical pressure boiler

▲ Ultra-low temperature test device (LN₂·CE)

In inquiring or placing orders for control valves, please use the following control valve specifications sheet. Always specify the items marked ☐ on the specifications sheet.
As for plant side conditions, please specify service conditions, pipe size, open/ close time of valve, atmosphere, noise regulation (limits) ,special tests, etc.

Control valve specifications sheet

(Sample)

						6/1 Mpa secondary pressure control valve		
USE (Control system)								
VALVE No.								
Service Condition	Fluid					Steam		
	Specific gravity/ Viscosity		/			/		
	Load condition					MAX.	NOR.	MIN.
	Flow rate (m³/h) (Nm³/h) (kgf/h)					10,000	5,000	500
	Valve inlet temperature (°F)					380	380	
	Valve inlet pressure (Mpa)					54		
	Valve outlet pressure (Mpa)					10	10	10
	Valve pressure drop (Mpa)					44		
	Differential pressure (Mpa) (when valve shut)					6		
	Calculation Cv							
	Valve Operation	When signal input is increased	Open,	Shut		Open,	Shut	
		When supply pressure is lost	Open,	Shut,	Lock	Open,	Shut,	Lock
	Applied standard							
	Bore (inlet/outlet) Sch No.		/			80°/150° Sch 40		
Control Valves	Valve Body Assembly	Type		—			—		
		Nominal bore — Pressure rating							
		Maximum pressure (kgf/cm²g)/ Maximum temperature (°C)		/			60	/	410
		Connection					JIS 63K RF flange		
		Valve Plug	Rated Cv value						
			Flow characteristic						
			Style	Single,	Balance,	Double	Single,	Balance,	Double
			Leakage at full shut	Less than	% Rated Cv Value		Less than	% of Rated Cv Value	
		Materials	Body · Bonnet						
			Trim No.						
			Gasket / Packing		/			/	
	Actuators	Size · Type							
		Operating pressure range (kgf/cm²g)							
		Supply air pressure (kgf/cm²g)							
		Handwheel		With, Without			With Without	Top	
Accessories	Positioner	Type							
		Input		20~100 kPa,( )~( ) mA · DC			20~100 kPa,( )~( ) mA · DC		
	Filter regulator/type								
	Limit switch (type/elec. source)		Full open Full close (/AC DC V)			Full open Full close (/AC DC V)		
	Solenoid valve · Type/elec. source			/AC DC V · 50 60 Hz			/AC DC V · 50 60 Hz	
	Lock valve · Type / Set pressure			/ (kPa)			/ (kPa)	
	Booster relay · Type							
	Regulator · Type							
	Reducer		With, Without			With, Without	150/200mm	
Painting Colour (Mancel)						Maker's st'd ; Silver.		

Any contents of this catalogue subject to change without notice.

NAKAKITA
CONTROL VALVES

CAT.No.310-6E

■Product List

- **Automatic Contorol Valves**
  Pneumatic Diaphragm Control Valves
  Hydraulic and Electric Control Valves
- **Regulating Valves (Self-powered)**
  Reducing Valves for High Pressure and
  Temperature Steam Use.
  Regulating Valves for Furnace
- **Remote Operated Valves**
  Electric Valves
  Pneumatic Cylinder Valves
  Hydaulic Clinder 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
  Safett Valvesfor Steam Service
  Relief Valves for Liquid Service
- **Butterfly**
  Hand and Remote Control Method
  Cryogenic (LNG). High Temperature
- **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 Instrementation

- **Presssure and Temperature Reducing
  Devicers for Super-Heated Steam**
- **Ship Loading and Ballast Remote
  Control Devicer**
  Control Panels
  Hydraulic
  Other Hydraulic Equipment.
- **Remote Tank Level Gauges and Alarm Devicer**
  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
  Automatic Devicer**
- **Twin Power Actuators**
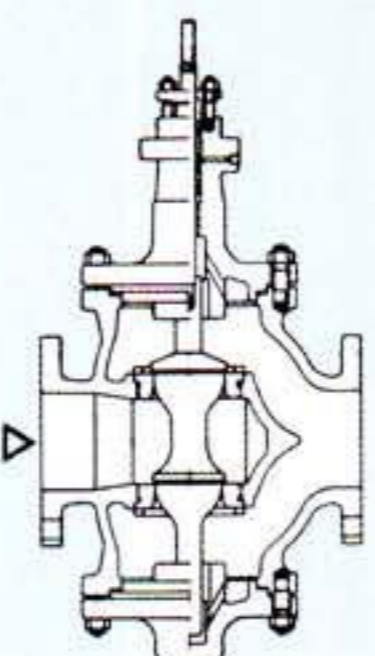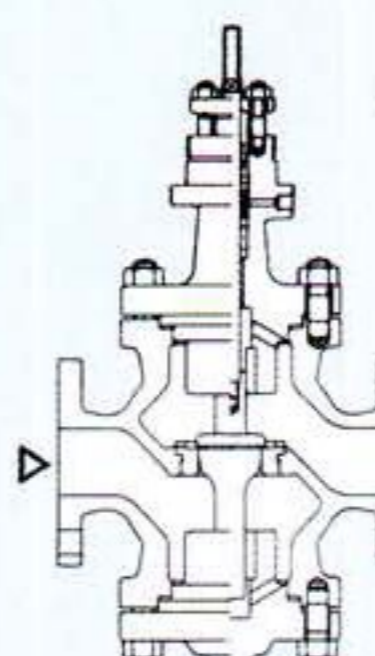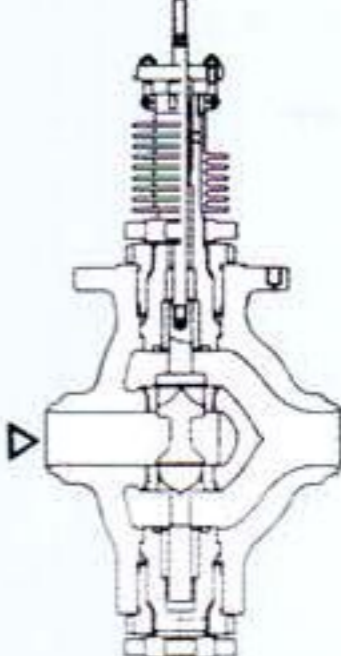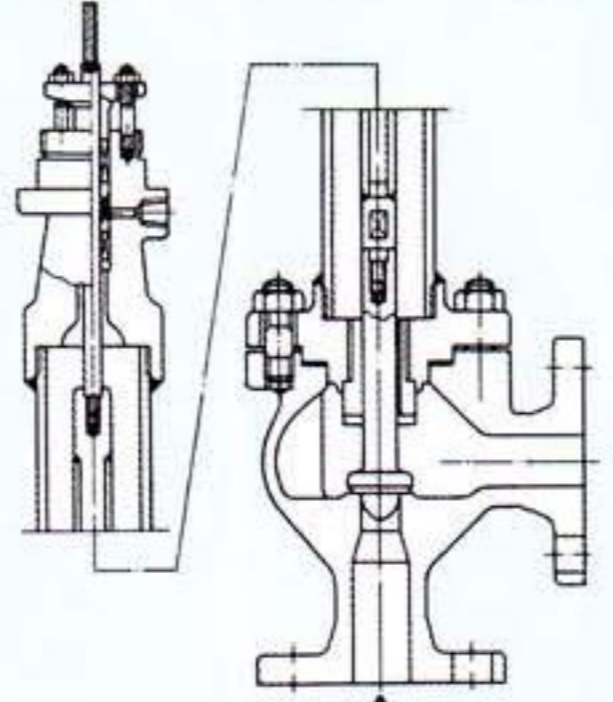 (Technical Collaboration Product)
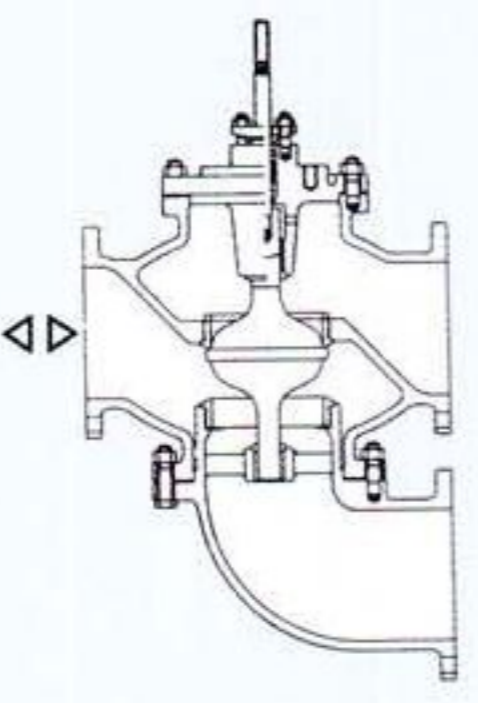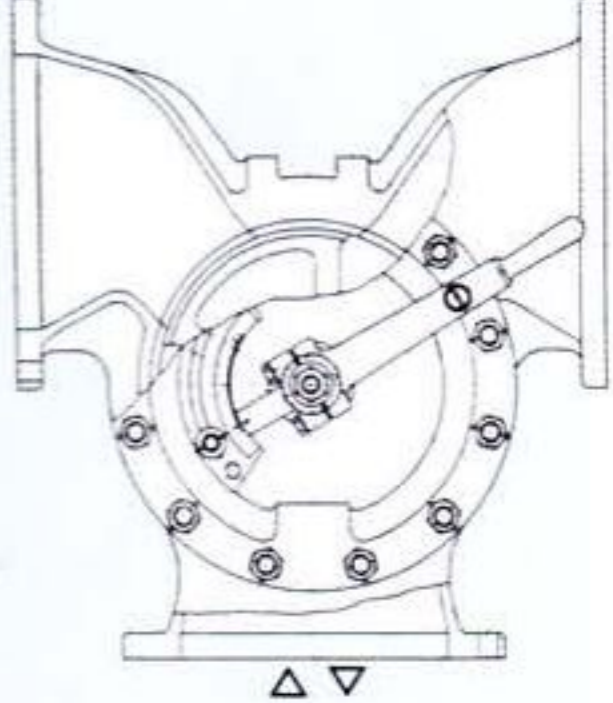
● The general purpose control valves and butterfly type control valves shown in this table are our standard valves. We also produce a variety of special valves.

Type		DY-D	DY-S	DY-P
Construction				
Features		Double seated control valve for low and medium pressure (Standard)	Single seated control valve for low and medium pressure (Standard)	Double seated control valve for high pressure and high temperature (Pressure seal bonnet)
Nominal bore mm (inch)		25 ～ 400ᴬ	25 ～ 300ᴬ	50 ～ 200ᴬ
Pressure rating	JIS (K)	5 ～ 63	5 ～ 63	—
	ANSI (Class)	125 ～ 1500	125 ～ 900	1500 · 2500
Max.desigh temperature		550℃ (1022°F)	550℃ (1022°F)	700℃ (1292°F)
Rangeability		30 : 1	30 : 1	30 : 1
Max. allowable leakage		0.5% and under	0.01% and under	0.5% and under
Explanation given on page		29～30	31～32	33

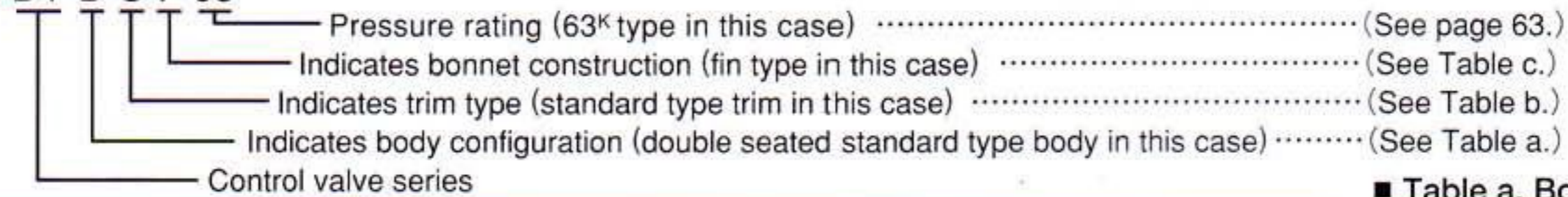| Type		DY-☐☐X	DY-T	DY-M
Construction		 This drawing shows DY-AOX		
Feature		Extension bonnet type control valve ● For low temperature plant	3-way control valve ● For temperature control of engine cooling piping system	Mixing 3-way contorol valve with rotary plug ● For temperature control of engine cooling piping system ● Small operating torque For large bore.
Nominal bore mm (inch)		15 ～ 300ᴬ	25 ～ 350ᴬ	125 ～ 500ᴬ
Pressure rating	JIS (K)	5 ～ 40	5 ～ 10	5 ～ 10
	ANSI (Class)	125 ～ 900	125 ～ 150	125 ～ 150
Max.design temperature		−196 ～ −20℃	220℃	100℃
Rangeability		30 : 1	30 : 1	30 : 1
Max. allowable leakage		0.01% and under	0.1% and under	2% and under
Explanation given on page		39～40	41	42

▷ : Indicates the direction of flow under normal use condition. ＊ : Figure in ( ) indicates the corresponding leakage class prescribed in ANSI.

The type designation of general purpose type control valve is as shown below:

NAKAKITA

[Example] DY-D O F 63

Pressure rating (63K type in this case) ·······················(See page 63.)
Indicates bonnet construction (fin type in this case) ·············(See Table c.)
Indicates trim type (standard type trim in this case) ·············(See Table b.)
Indicates body configuration (double seated standard type body in this case) ·······(See Table a.)
Control valve series

■ Table a. Body configuration

Symbol	Meaning
A	Angle type body
B	Butterfly type body
D	Double seated standard type body
G	Single seated and top guided body
M	Rotary mixing 3-way body
P	Double seated and pressure seated type body
S	Single seated and top & bottom guided type body
T	3-way standard type body
U	Single seated and balance piston type body
W	Single seated and suitable flow type body

■ Table b. Trim type

Symbol	Meaning
O	Standard type trim
F	Flashing guard type trim
L	Labyrinth trim
R	Ring trim
Z	Special type trim

■ Table c. Bonnet construction

Symbol	Meaning
O	Standard type
F	Fin type
L	Long type
B	Bellows seal type
X	Extension type
Z	Special type

DY-DF DY-PF DY-SF	DY-G DY-GOZ	DY-U
This drawing shows DY-DF		Balance piston type valve plug with single seat
Flashing guard • Drain control for feed water heater, etc.	Small size single seated • For low and medium pressure	• Pressure drop several times larger than that of single seated control valve DY-S can be accepted.
50 ～ 200A	20 ～ 25A	40 ～ 300A
10 ～ 63	5 ～ 63	5 ～ 20
150 ～ 2500	125 ～ 1500	125 ～ 300
550℃	550℃	550℃
30 : 1	20 : 1～30 : 1	20 : 1
0.5% and under.	0.01% and under.	0.01% and under.
34	35～37	38

DY-B	DY-BR	NS-ID Series NS-HD Series	NS-C Series NS-DM Series
		This drawing shows NS-HD	This drawing shows NS-DM
Butterfly type Actuator: Diaphragm (Standard)	Butterfly type with seal ring Actuator: Diaphragm and Cylinder • For Low-Leak	Damper shaped butterfly type Actuator: Cylinder • No-shut, flow rate control	Rubber seat or mental seat type Actuator: Butterfly • For non-leak
100 ～ 700A	100 ～ 700A	80 ～ 1500A	150 ～ 1500A
5 ～ 10	5 ～ 10	5 ～ 16	5 ～ 16
125 ～ 150	125 ～ 150	125 ～ 150	125 ～ 150
200℃	550℃	0～425℃	−253～475℃ (70℃and under for NS-C)
20 : 1	20 : 1	20 : 1	20 : 1
3% and under.	0.1% and under.	5%、3% and under.	100mℓ/min and under per 25mm of nominal bore. (0 for NS-C)
43	44	45～46	47～48