Work support

7 MPa

**Hydraulic lift,
support force enhanced model**
model **CSU-H**10-L

**Hydraulic lift,
standard model**
model **CSU**10-L

Spring lift
model **CST**10-L

Work support

CS□

**Hydraulic lift,
support force enhanced model**
model **CSY**03-L

**Hydraulic lift,
standard model**
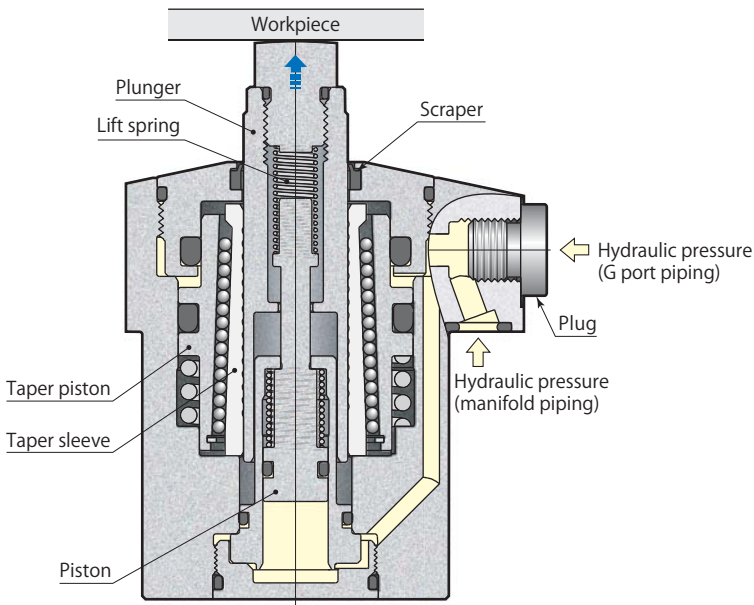model **CSN**03-L

Spring lift
model **CSK**03-L

Hydraulic lift

Standard model **CSU□-□□**
Support force enhanced model **CSU-H□-□**

Plunger
Lift spring
Scraper
Hydraulic pressure (G port piping)
Plug
Hydraulic pressure (manifold piping)
Taper piston
Taper sleeve
Piston
Workpiece

Air cleaning
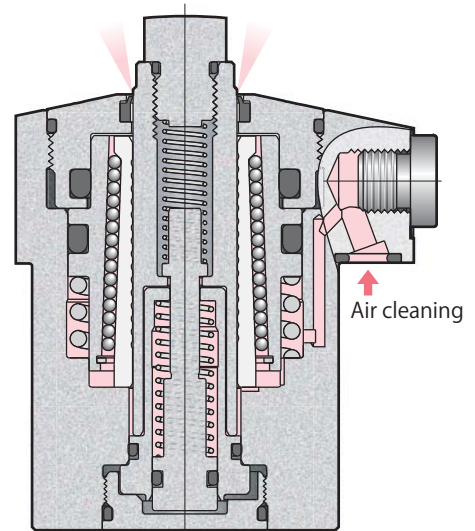
Lock

Unlock

Hydraulic and pneumatic circuit diagram
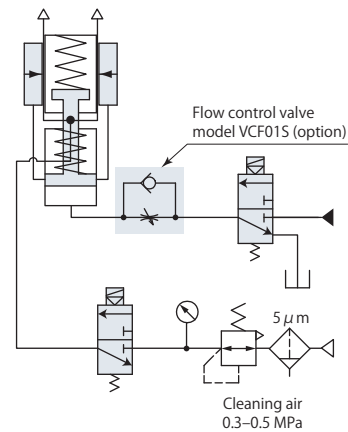
Flow control valve
model VCF01S (option)

5 μm

Cleaning air
0.3–0.5 MPa

Spring lift

model CST□-□

Workpiece

Plunger

Lift spring

Scraper

Taper piston

Taper sleeve

Hydraulic pressure
(G port piping)

Plug

Hydraulic pressure
(manifold piping)

Lock

Air cleaning

Unlock
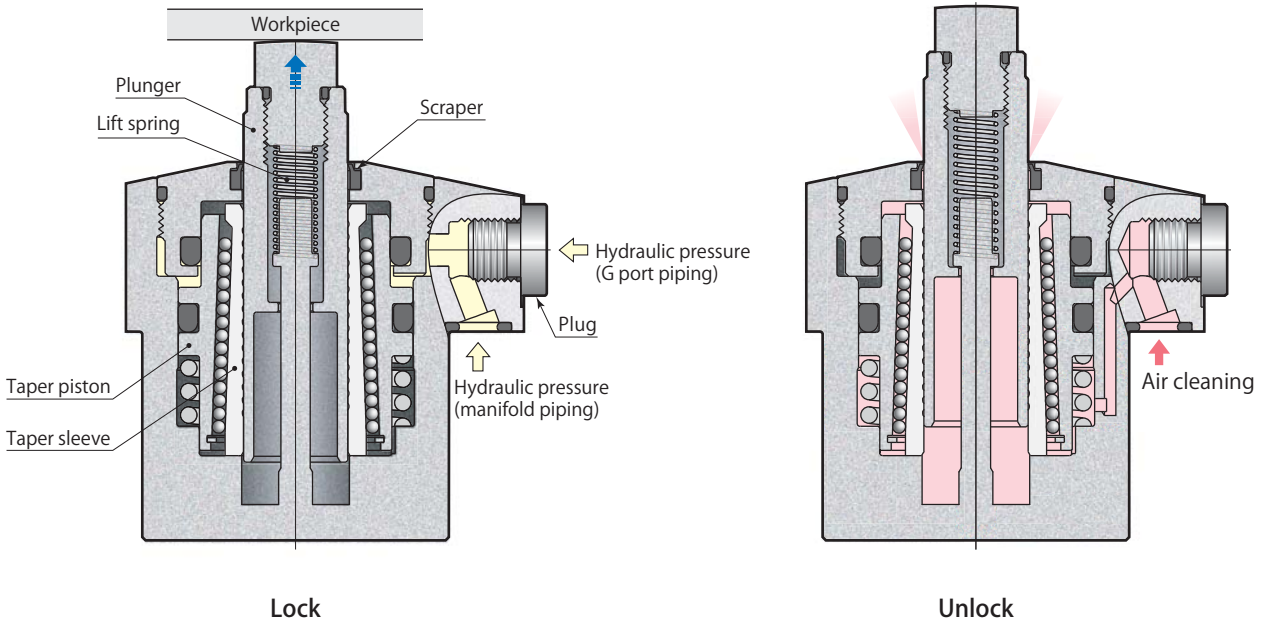
Work support

CST
Spring lift

Hydraulic and pneumatic circuit diagram
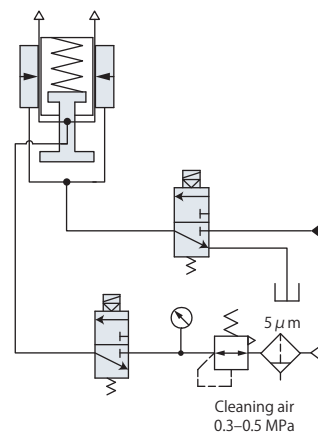
5 μm

Cleaning air
0.3–0.5 MPa

Hydraulic lift (model CSU)

①The piston moves upward

Plunger is locked after it stroked by the structure containing sequencetial movement, which enables a workpiece to hold securely.
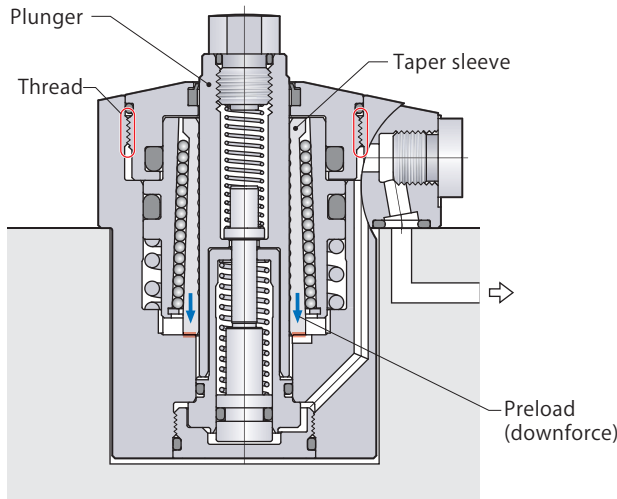
Plunger
Thread
Taper sleeve
Preload (downforce)

Hydraulic pressure

Piston

● The taper sleeve is preloaded by the thread and is kept the position lower.
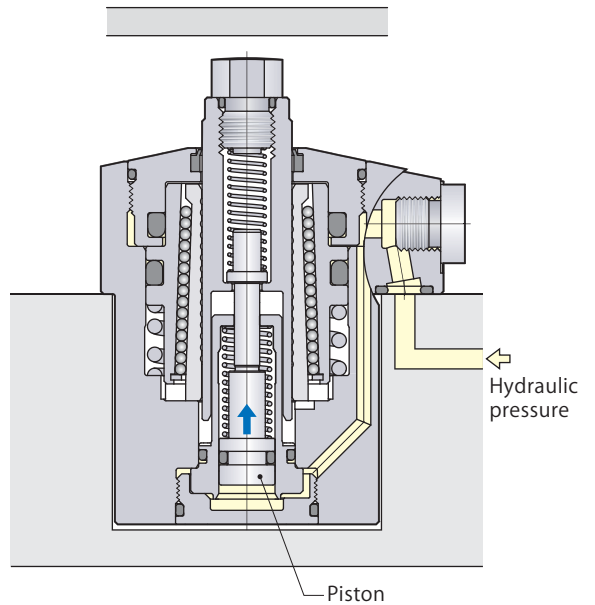
● Piston moves upward by the hydraulic force.

Spring lift (model CST)

①Before the workpiece approaches

Plunger
Thread
Taper sleeve
Preload (downforce)

● The taper sleeve is preloaded by the thread and is kept the position lower.

Work support

CS□

②Contact with the workpiece

Head cap
Lift spring
Plunger
Hydraulic pressure
Piston

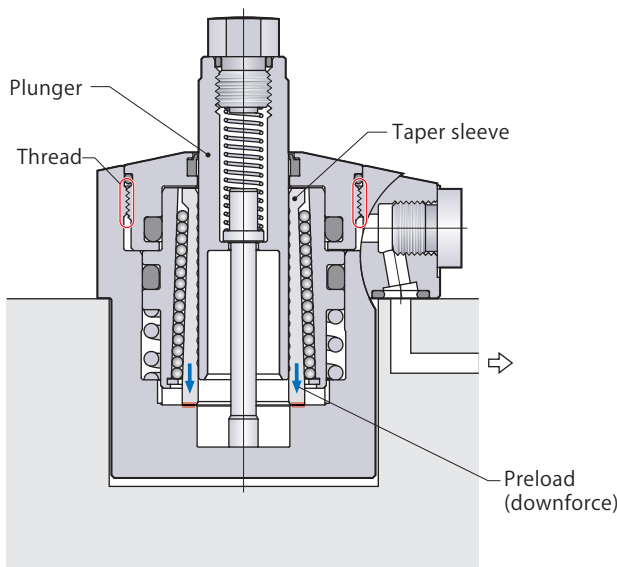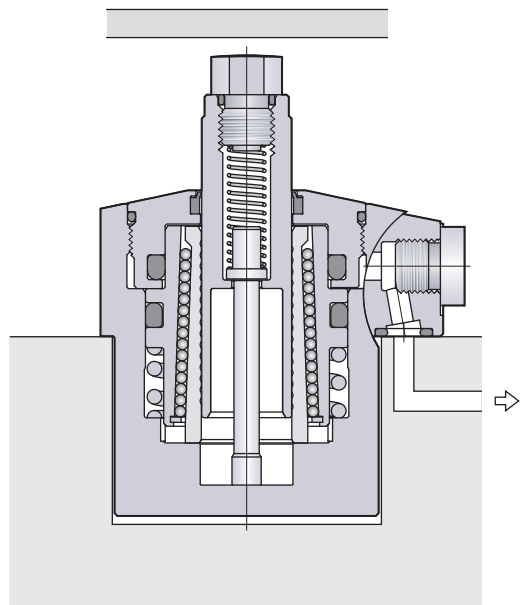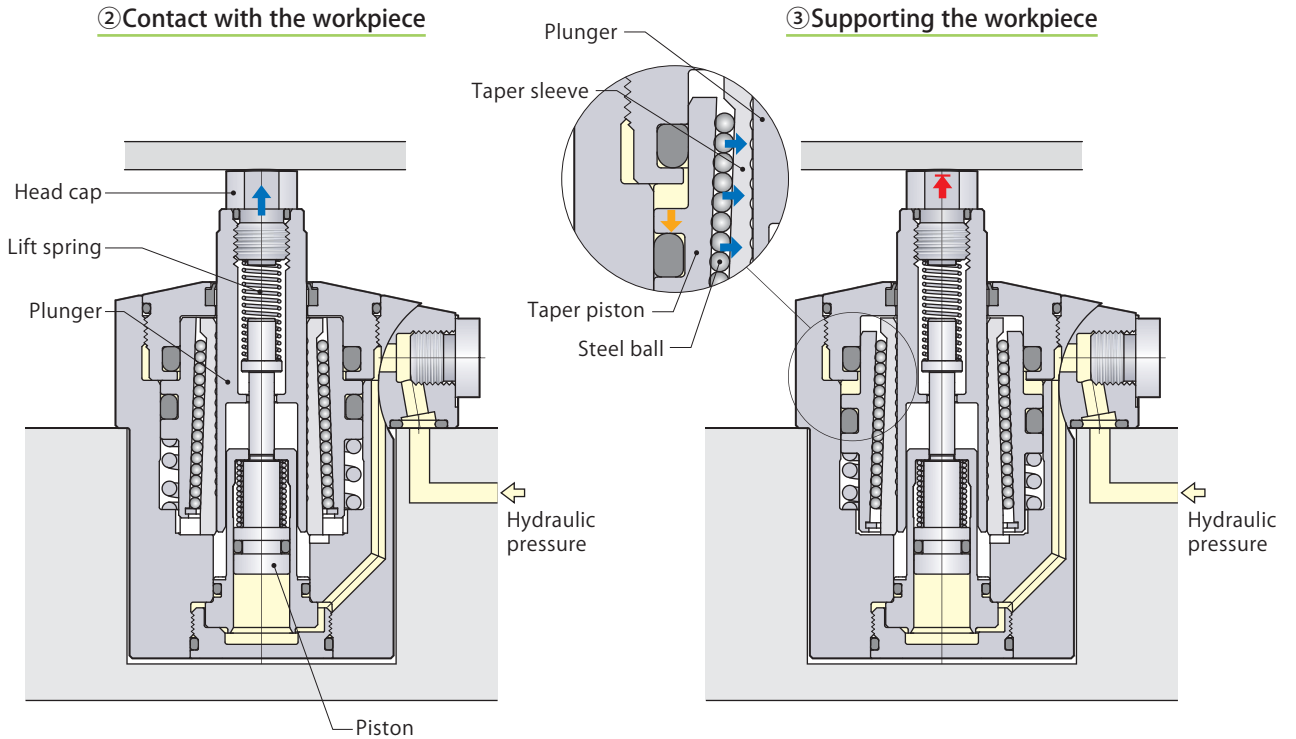● The plunger with a head cap strokes upward by the lift spring to contact the workpiece. The plunger puts a load on the workpiece since the piston continues to move upward to the end of its stroke.

③Supporting the workpiece

Plunger
Taper sleeve
Taper piston
Steel ball
Hydraulic pressure

● After piston stroking, the taper piston moves down by the hydraulic force to depress the taper sleeve by means of the steel balls. Then the taper sleeve locks the plunger firmly.

②Contact with the workpiece

Head cap
Lift spring
Plunger
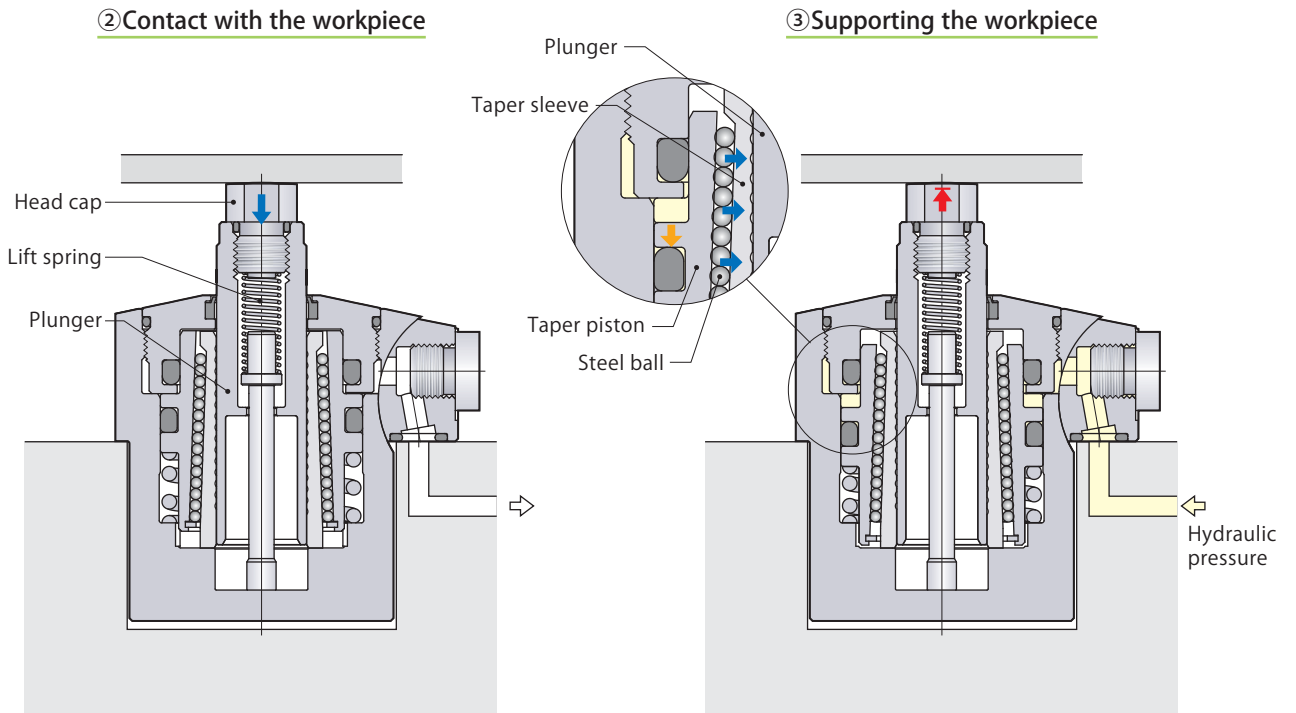
● The workpiece touches head cap then depresses the plunger until it reaches to the seating surface. The lift spring puts a load onto the workpiece.

③Supporting the workpiece

Plunger
Taper sleeve
Taper piston
Steel ball
Hydraulic pressure

● The taper piston is pushed down by the hydraulic force to depress the taper sleeve by means of the steel balls. Then the taper sleeve locks the plunger firmly.

Work support

CS□

Specifications

Size   Lift spring force

CSU : Hydraulic lift, standard

CSU-H : Hydraulic lift, support force enhanced

CST : Spring lift

04
06 — **L** : Standard   (Nil) : Standard
10
16   **H** : Strong   **B** : Air sensor
25

□ indicates made to order.

Air sensor is not applicable for CSU-H (support force enhanced model) and CST.

Model			CSU□04 CST04	CSU□06 CST06	CSU□10 CST10	CSU□16 CST16	CSU□25 CST25
Support force (hydraulic pressure 7MPa)*1	Standard	kN	5	7	10	16	25
	Support force enhanced	kN	7	10	14	23	36
Cylinder capacity	CSU	cm³	1.2	1.8	2.6	3.9	5.7
	CST	cm³	0.7	0.9	1.2	2.1	3.3
Lift spring force*2	L : Standard — Standard	N	3.0–4.1	4.3–8.1	5.3–10.8	5.5–10.8	6.9–13.2
	L : Standard — Support force enhanced	N	4.5–6.0	5.0–11.0	8.0–17.0	9.0–17.0	11.0–20.0
	H : Strong — Standard	N	4.8–7.5	6.6–11.1	7.8–13.3	11.2–19.8	13.5–22.4
	H : Strong — Support force enhanced	N	6.0–9.5	8.0–14.0	11.0–20.0	11.0–21.0	20.0–25.0
Plunger stroke		mm	8	12	12	16	16
Max. allowable mass of head cap		kg	0.15	0.2	0.2	0.3	0.3
Mass	CSU	kg	0.6	1.0	1.2	2.0	3.3
	CST	kg	0.5	0.9	1.1	1.8	3.1
Recommended tightening torque of mounting screws*3 N·m			7	7	7	12	29

● Pressure range：2.5–7 MPa　● Proof pressure：10.5 MPa　● Operating temperature：0–70 ℃

● Fluid used：General mineral based hydraulic oil (ISO-VG32 equivalent)

● Seals are resistant to chlorine-based cutting fluid. (not thermal resistant specification)

*1：When work support and clamp are used facing each other, work support and clamp must be selected in such a way that the support force is 1.5 times the applied load (clamping force + machining force).

*2：Figures are for "upper end to lower end" of plunger action.　*3：ISO R898 class 12.9

Manifold piping and G port piping are available.

Manifold piping

When choosing manifold piping, a flow control valve (model VCF) and an air bleeding valve (model VCE) are mountable on the G ports of the clamp.

Plug
O-ring
⇧Hydraulic pressure
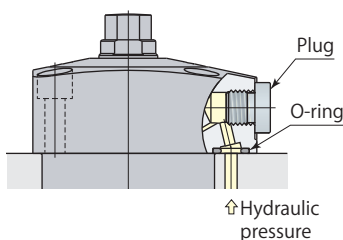
G port piping

Remove plugs when choosing G port piping. (O-ring must be used.) Refer to **page →174** for details on G port piping flareless fitting. The flow control valve and the air bleeding valve should be installed in the middle of oil path.

Parallel thread connector
⇦Hydraulic pressure
O-ring

Work support

CS□
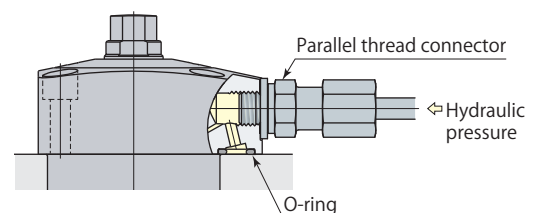
Hydraulic pressure & support force

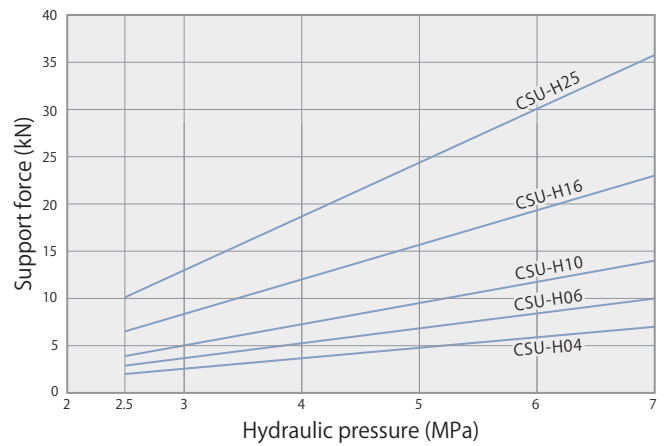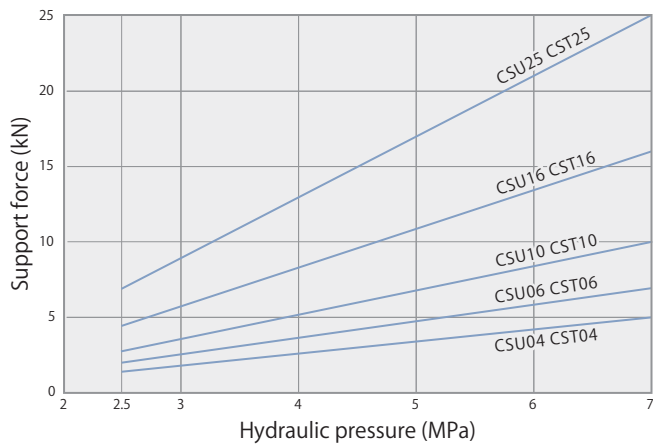| Hydraulic pressure MPa	Support force	kN			
	CSU04 CST04	CSU06 CST06	CSU10 CST10	CSU16 CST16	CSU25 CST25
2.5	1.4	2.0	2.8	4.5	7.0
3.0	1.8	2.6	3.6	5.8	9.0
3.5	2.2	3.1	4.4	7.1	11.0
4.0	2.6	3.7	5.2	8.3	13.0
4.5	3.0	4.2	6.0	9.6	15.0
5.0	3.4	4.8	6.8	10.9	17.0
5.5	3.8	5.3	7.6	12.2	19.0
6.0	4.2	5.9	8.4	13.4	21.0
6.5	4.6	6.4	9.2	14.7	23.0
7.0	5.0	7.0	10.0	16.0	25.0

Hydraulic pressure MPa	Support force	kN			
	CSU-H04	CSU-H06	CSU-H10	CSU-H16	CSU-H25
2.5	2.0	2.9	3.9	6.5	10.1
3.0	2.6	3.7	5.0	8.3	13.0
3.5	3.1	4.5	6.1	10.2	15.9
4.0	3.7	5.3	7.3	12.0	18.7
4.5	4.2	6.1	8.4	13.8	21.6
5.0	4.8	6.9	9.5	15.7	24.5
5.5	5.3	7.6	10.6	17.5	27.4
6.0	5.9	8.4	11.7	19.3	30.2
6.5	6.4	9.2	12.9	21.2	33.1
7.0	7.0	10.0	14.0	23.0	36.0

Applied load & deformation
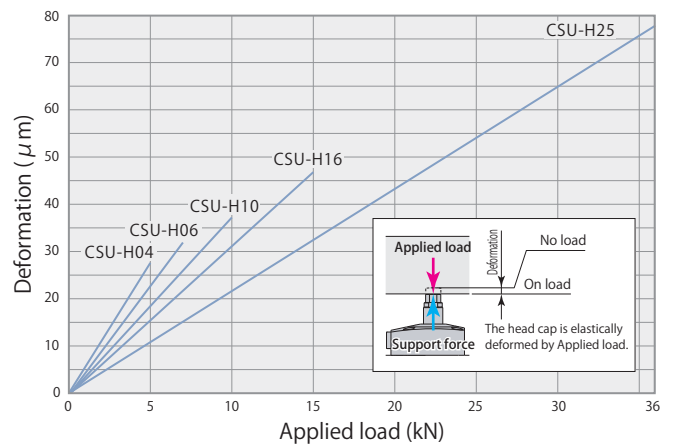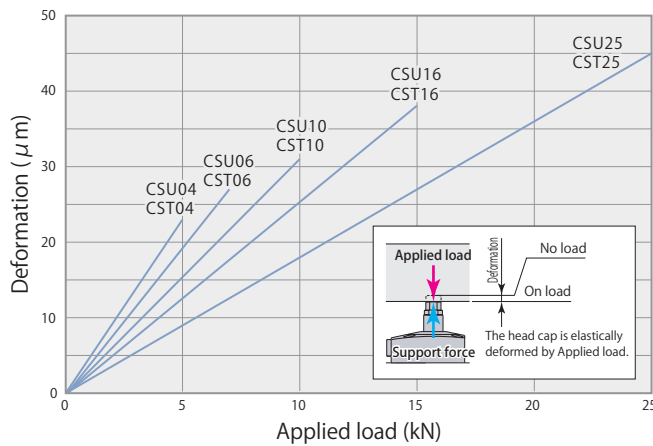
Applied load kN	Deformation	μm			
	CSU04 CST04	CSU06 CST06	CSU10 CST10	CSU16 CST16	CSU25 CST25
0	0	0	0	0	0
5	23	19	16	13	9
7		27	22	18	13
10			31	26	18
15				38	27
20	Nonusable range				36
25					45

Applied load kN	Deformation	μm			
	CSU-H04	CSU-H06	CSU-H10	CSU-H16	CSU-H25
0	0	0	0	0	0
5	27.6	22.8	18.6	15.6	10.8
7		31.9	26	21.8	15.1
10			37.2	31.2	21.6
15				46.8	32.4
20					43.2
25	Nonusable range				54
36					77.8

Held with hydraulic pressure of 7 MPa.

Held with hydraulic pressure of 7 MPa.

Dimensions
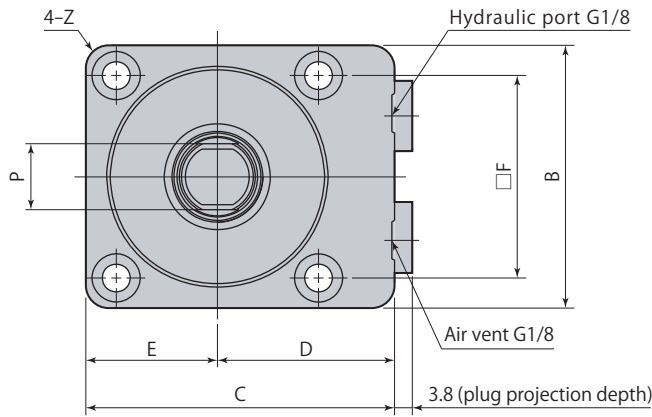
4–Z

Hydraulic port G1/8

P

□F

B

E   D

C

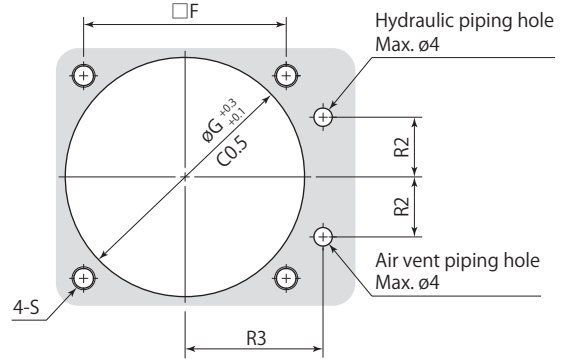Air vent G1/8

3.8 (plug projection depth)

Mounting details

□F

Hydraulic piping hole
Max. ø4

$\phi G^{+0.3}_{+0.1}$

C0.5

R2

R2

4-S

Air vent piping hole
Max. ø4

R3

Plunger tip section details

Head cap

Plunger

Lift spring

øH

Stroke

Plunger tip section

4-ø X

N

ø14

L

V

12.5

R0.4

4-øW

M

J

A

K

2-O-ring FA

$\phi G^{0}_{-0.2}$

Head cap details
Hardness：HRC52

øHL
When producing：Min. øHL

HK

Y   Y

øHD±0.05

Rz6.3

SR HJ

O-ring FB

HH

HG

HF

1

Thread HM

øHC

HE

øHC

øHB

øHA

Y-Y

Air vent

R2

R2

Hydraulic port

R3

Work support

CSU
Hydraulic lift

mm
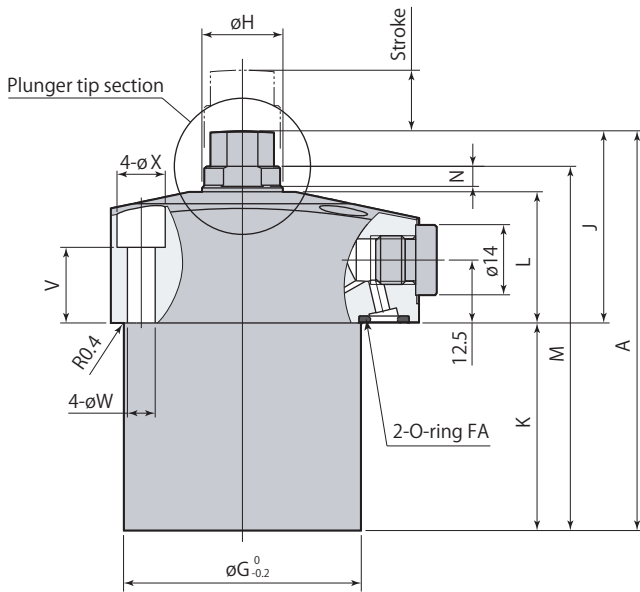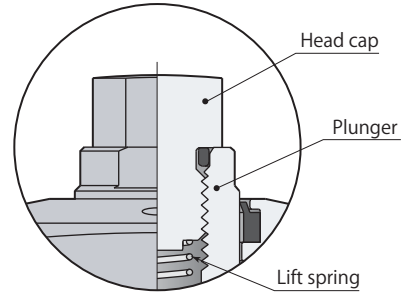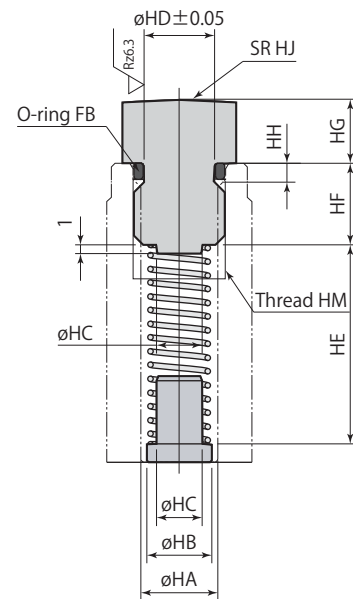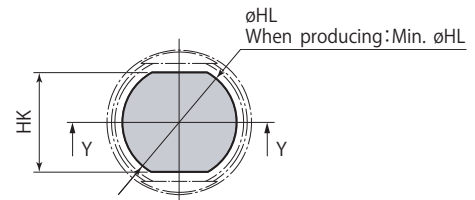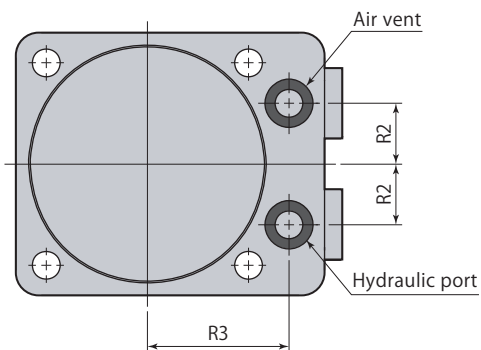
Model	CSU□04-□	CSU□06-□	CSU□10-□	CSU□16-□	CSU□25-□
A	68	79	82	102	122
B	45	52	56	65	78
C	55	61	65	73	85
D	32.5	35	37	40.5	46
E	22.5	26	28	32.5	39
F	34	40	44	52	62
øG	40	47	52	60	72
øH	15	16	20	22	25
J	38	38	40	45	46
K	30	41	42	57	76
L	26	26	28	30	30
M	61	72	75	93	113
N (width across flats height)	4	4	4.5	5	6
P (width across flats)	13	13	17	19	22
R2	10	12	13	15	18
R3	25.5	28	30	33.5	39
S	M5	M5	M5	M6	M8
V	15	15	16.5	15.9	12
W	5.5	5.5	5.5	6.8	9
X	9.5	9.5	9.5	11	14
Z	R3	R5	R5	R6	R7
O-ring FA (fluorocarbon hardness Hs90)	P7	P7	P7	P7	P7
Flow control valve (meter-in)	VCF01S	VCF01S	VCF01S	VCF01S	VCF01S
Air bleeding valve	VCE01	VCE01	VCE01	VCE01	VCE01

● The mounting surface finish must be no rougher than Rz6.3 (ISO4287:1997).

● Always attach head cap (lift spring cannot be retained).

● Mounting screws are not included.

Head cap details

mm

Model	CSU□04-□	CSU□06-□	CSU□10-□	CSU□16-□	CSU□25-□
øHA	8.5	8.5	10.3	10.3	14
øHB	7.2	7.2	9.2	9.2	11.2
øHC	5	5	6	6	7.5
øHD	7.8	7.8	9.2	9.2	13.5
HE	17.6	22	22.5	32.5	39
HF	9	9	11	11	15
HG	7	7	7	9	9
HH	1.9	1.9	2.3	2.3	3.5
HJ	70	70	90	110	140
HK	11	11	14	14	18
øHL	12.6	12.6	16.5	16.5	21.5
Min. øHL	12.5	12.5	16.5	16.5	21.5
HM (recommended tightening torque)	M10×1.5 depth 11 (30 N·m)	M10×1.5 depth 11 (30 N·m)	M12×1.75 depth 13 (50 N·m)	M12×1.75 depth 13 (50 N·m)	M16×2 depth 20 (80 N·m)
O-ring FB (fluorocarbon hardness Hs70)	S8	S8	P9	P9	AS568-014

● When fabricating head cap, ensure that O-ring slot, spring spot facing and guide are made by referring to head cap details. Be sure to always use included O-ring.

● When fabricating a lift spring, determine dimensions by referring to head cap details. Furthermore, rustproofing must be implemented (however, there is no guarantee for operation).

● This diagram indicates a situation where head cap has been fitted into plunger with no pressure applied.

Work support

CSU
Hydraulic lift

Air sensor unit

Supplier and model	ISA3-G series manufactured by SMC
	GPS2-05, GPS3-E series manufactured by CKD
Air supply pressure	0.1 MPa
Inner diameter of piping	ø4 mm
Overall piping length	5 m or less

● Air supply to air sensor unit should be provided to the air vent port. Supplied air should be dried and filtered with particulate size 5 μm or less.

● Use a solenoid valve with needle for air sensor unit and control it supplying air all the time in order to eliminate intrusion of chips or coolant.

● There is a case that air sensing cannot be successfully made as designed when it is used out of the above usage. Contact Technical service center for more details.

● Refer to the sensor supplier's instruction manual for the details of setting.

● Sensing performance such as detectable time and pressure differs depending on the supplier and model number of the sensor. Select the right model referring to sensor's application and characteristics.

● When performing workpiece contact detection for multiple workpieces (in parallel fittings) using one air sensor, consider detection range of air sensor before determining the number of workpiece contacts to be detected.

● Setting air pressure that exceeds air pressure range results in leaking of air from scraper and accurate detection will not be possible.

● If the lowering operation slows down due to air pressure, stop air supply during lowering operation.

Workpiece contact force

Workpiece contact force (lift spring + air pressure lift) is exerted onto workpiece during workpiece setting. Lift spring force varies according to the stroke used. Use following formula to obtain lift spring force:

Lift spring force calculation formula $Ps = P1-(P1-P2) \times D2/D1$

Example: model CSU06-LB using stroke of 5 mm:
Lift spring force = $8.1-(8.1-4.3) \times 5/12 = 6.5$ (N)

Workpiece contact force varies according to the air pressure used. Use following formula to obtain workpiece contact force:

Workpiece contact force calculation formula $P = Ps + \eta \times Pa$

Example: model CSU06-LB using stroke of 5 mm and air pressure of 0.05 MPa,
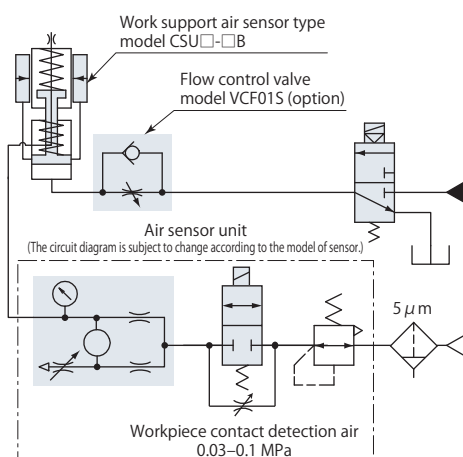Workpiece contact force = $6.5+200 \times 0.05 = 16.5$ (N)

P1 : Lift spring force at lower end (N)
P2 : Lift spring force at upper end (N)
D1 : Full stroke   (mm)
D2 : Used stroke   (mm)
Ps : Lift spring force   (N)
η : Push up coefficient
   (refer to table below)
Pa : Air pressure   (MPa)
P : Workpiece contact force (N)

Lower end of plunger   Upper end of plunger

The workpiece contact force varies depending on sliding resistance of scraper. Use calculated figures only as reference.
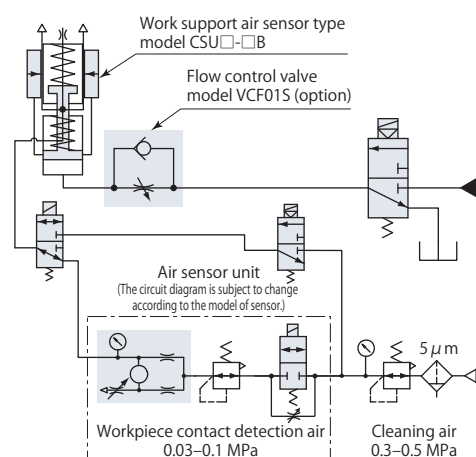
Model		CSU04-□B	CSU06-□B	CSU10-□B
Lift spring force N	L : Standard	3.0–4.1	4.3–8.1	5.3–10.8
	H : Strong	4.8–7.5	6.6–11.1	7.8–13.3
Air pressure range MPa		0.03–0.1		
Plunger stroke mm		8	12	12
Push up coefficient η		180	200	310

Lift spring force is shown as spring force for "upper end to lower end" of plunger action.

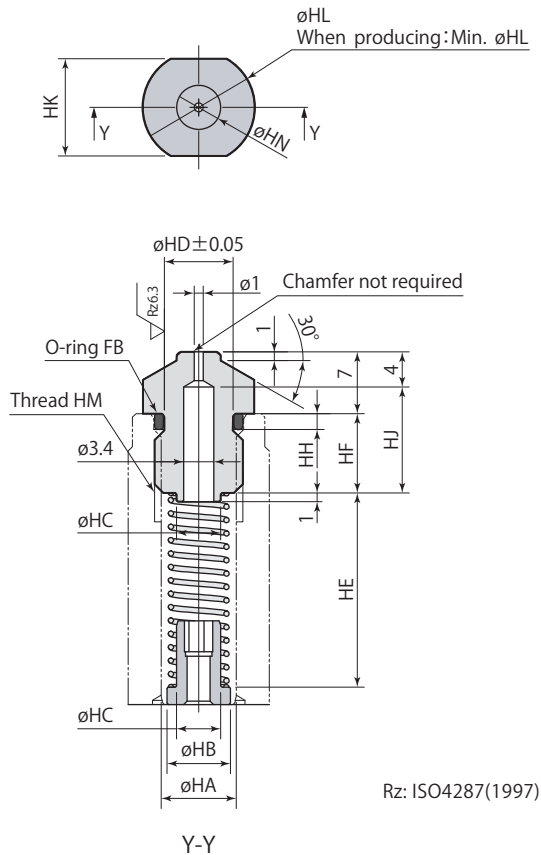### Air sensor & hydraulic circuit diagram

Work support air sensor type model CSU□-□B
Flow control valve model VCF01S (option)
Air sensor unit
(The circuit diagram is subject to change according to the model of sensor.)
Workpiece contact detection air 0.03–0.1 MPa
5 μm

Air sensor & air cleaning & hydraulic circuit diagram

Work support air sensor type model CSU□-□B
Flow control valve model VCF01S (option)
Air sensor unit
(The circuit diagram is subject to change according to the model of sensor.)
Workpiece contact detection air 0.03–0.1 MPa
Cleaning air 0.3–0.5 MPa
5 μm

Work support
Air sensor

CSU-B
Hydraulic lift

Air sensor head cap details

Hardness：HRC52

Y-Y

● Workpiece contact detection is not possible merely by replacing head cap of standard work support.

● There is no air sensor available for model CSU16 or CSU25.

● This diagram indicates a situation where head cap has been fitted into plunger with no pressure applied.

mm

Model	CSU04-□B	CSU06-□B	CSU10-□B
øHA	8.5	8.5	10.3
øHB	7.2	7.2	9.2
øHC	5	5	6
øHD	7.8	7.8	9.2
HE	17.6	22	22.5
HF	9	9	11
HH	1.9	1.9	2.3
HJ	12	12	14
HK (width across flats)	11	11	14
øHL	12.6	12.6	16.5
Min. øHL	12.5	12.5	16.5
HM (recommended tightening torque)	M10×1.5 depth 11 (30 N·m)	M10×1.5 depth 11 (30 N·m)	M12×1.75 depth 13 (50 N·m)
øHN	5	5	8
O-ring FB (fluorocarbon hardness Hs70)	S8	S8	P9

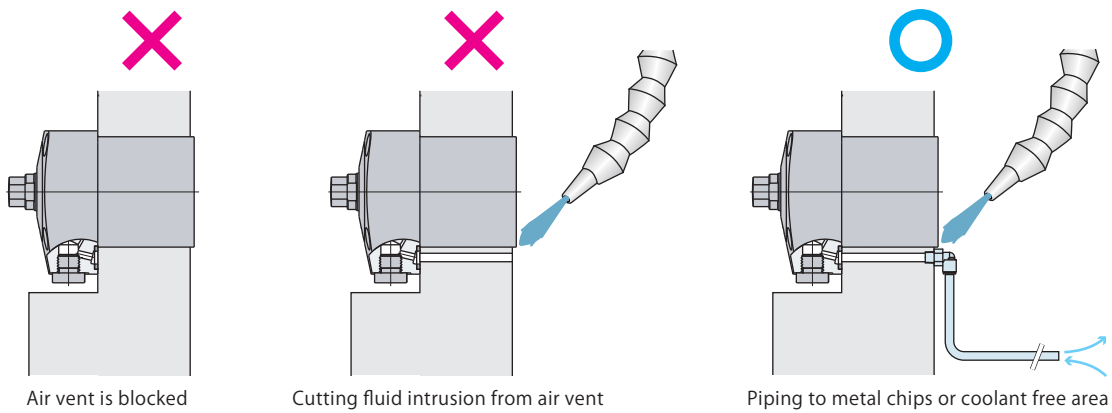● CSU□-□B (Air sensor) is made to order.

Caution in use

● The lift spring in the plunger may push the workpiece upward if it is light weight and seating detection cannot be complete. Review the weight of workpiece or lift spring force and make it appropriate to seat the workpiece perfectly and acutate the work support.

● Set the plunger lifting time to 0.5 seconds or longer by adjusting the flow control valve with check valve (meter-in). Reasonable plunger ascending speed can prevent the parts from breakage also curbs plunger contact false.
Use a flow control valve with cracking pressure of 0.05MPa or less, in order to shorten plunger descending speed.
(Cracking pressure of optional flow control valve model VCF01S is 0.04 MPa.)

Rebound and clearance

If the plunger ascends to reach a workpiece too fast, it rebounds after hitting the workpice and will create a small clearance between the two. The clearance may cause a supporting fault of the workpiece.
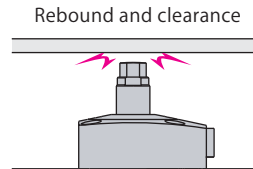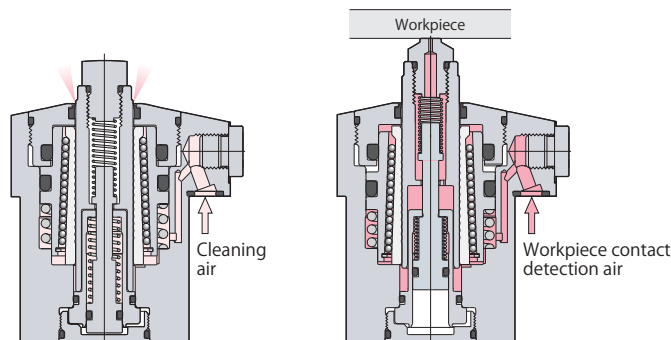
● Avoid following usages. These may cause sleeve deformation that could lead to malfunction of plunger or decreased support force.
　✕ Applying eccentric load on plunger.
　✕ Applying load that exceeds rated support force.
　✕ Rotating plunger when locked.

● Air vent must be opened to atmosphere. Any blockage on the vent results in malfunction. Provide the piping if there is a risk of coolant or metal chips intrusion. Allowing intrusion of cutting fluid may cause rusting and other problems.

Air vent is blocked　　　　Cutting fluid intrusion from air vent　　　　Piping to metal chips or coolant free area

● Air (oil free) must be fed through a 5 μm filter that is connected to an air vent port for air cleaning or workpiece contact detection (air sensor).
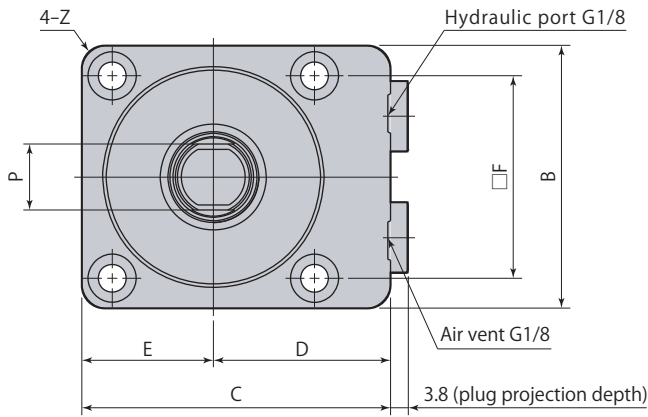Perform air cleaning only when replacing workpiece. Plunger will rise during air cleaning.

Workpiece

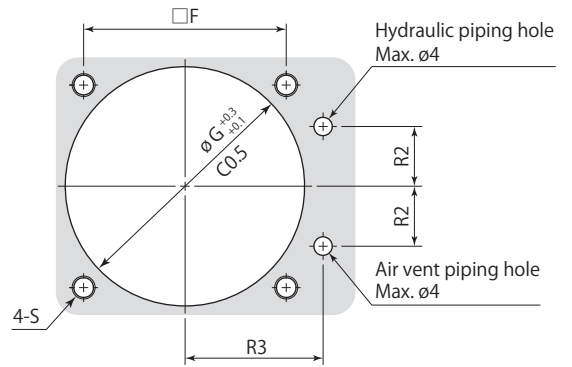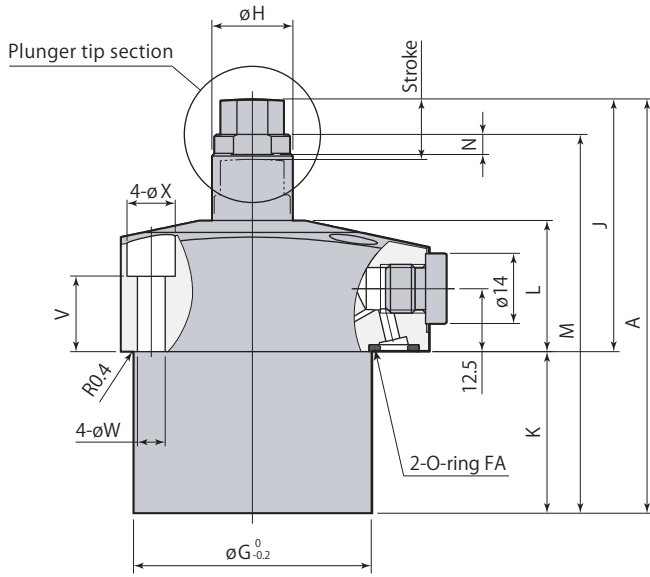Cleaning air　　　　Workpiece contact detection air

Dimensions

4–Z

Hydraulic port G1/8

P

□F

B

E

D

C

Air vent G1/8

3.8 (plug projection depth)

Mounting details

□F

Hydraulic piping hole
Max. ø4

øG $^{+0.3}_{+0.1}$

C0.5

R2

R2

Air vent piping hole
Max. ø4

4-S

R3

Plunger tip section details

Head cap

Plunger

Lift spring

Head cap details

Hardness：HRC52

øHL
When producing：Min. øHL

HK

Y

Y

øHD±0.05

Rz6.3

SR HJ

O-ring FB

HH

HG

HF

1

Thread HM

øHC

HE

øHC

øHB

øHA

Y-Y

øH

Plunger tip section

Stroke

N

4-øX

ø14

L

J

V

M

A

R0.4

12.5

4-øW

2-O-ring FA

K

øG $^{0}_{-0.2}$

Air vent

R2

R2

Hydraulic port

R3

Work support

CST
Spring lift

mm
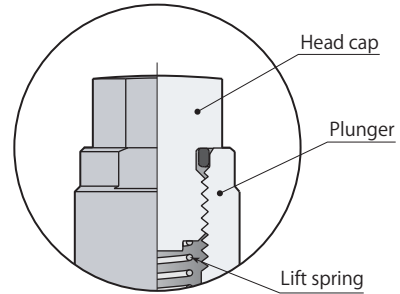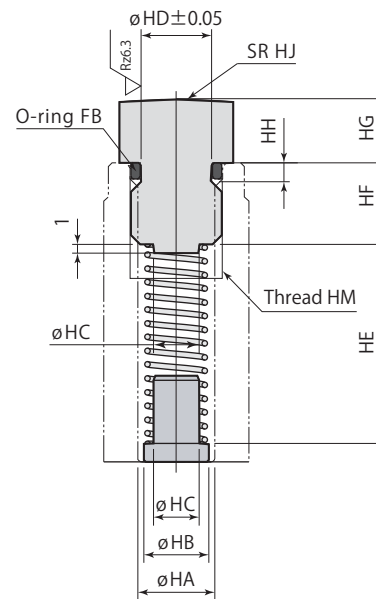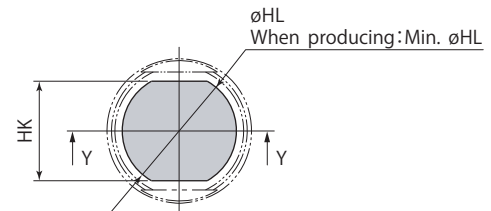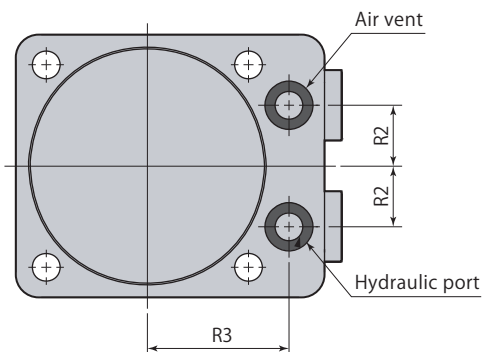
Model	CST04-□	CST06-□	CST10-□	CST16-□	CST25-□
A	67	82	85	108	129
B	45	52	56	65	78
C	55	61	65	73	85
D	32.5	35	37	40.5	46
E	22.5	26	28	32.5	39
F	34	40	44	52	62
øG	40	47	52	60	72
øH	15	16	20	22	25
J	46	50	52	61	62
K	21	32	33	47	67
L	26	26	28	30	30
M	60	75	78	99	120
N (width across flats height)	4	4	4.5	5	6
P (width across flats)	13	13	17	19	22
R2	10	12	13	15	18
R3	25.5	28	30	33.5	39
S	M5	M5	M5	M6	M8
V	15	15	16.5	15.9	12
W	5.5	5.5	5.5	6.8	9
X	9.5	9.5	9.5	11	14
Z	R3	R5	R5	R6	R7
O-ring FA (fluorocarbon hardness Hs90)	P7	P7	P7	P7	P7
Air bleeding valve	VCE01	VCE01	VCE01	VCE01	VCE01

● The mounting surface finish must be no rougher than Rz6.3 (ISO4287:1997).

● Always attach head cap (lift spring cannot be retained).
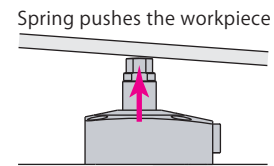
● Mounting screws are not included.

Head cap details

mm

Model	CST04-□	CST06-□	CST10-□	CST16-□	CST25-□
øHA	8.5	8.5	10.3	10.3	14
øHB	7.2	7.2	9.2	9.2	11.2
øHC	5	5	6	6	7.5
øHD	7.8	7.8	9.2	9.2	13.5
HE	17.6	22	22.5	32.5	39
HF	9	9	11	11	15
HG	7	7	7	9	9
HH	1.9	1.9	2.3	2.3	3.5
HJ	70	70	90	110	140
HK	11	11	14	14	18
øHL	12.6	12.6	16.5	16.5	21.5
Min. øHL	12.5	12.5	16.5	16.5	21.5
HM (recommended tightening torque)	M10×1.5 depth 11 (30 N·m)	M10×1.5 depth 11 (30 N·m)	M12×1.75 depth 13 (50 N·m)	M12×1.75 depth 13 (50 N·m)	M16×2 depth 20 (80 N·m)
O-ring FB (fluorocarbon hardness Hs70)	S8	S8	P9	P9	AS568-014

● When fabricating head cap, ensure that O-ring slot, spring spot facing and guide are made by referring to head cap details. Be sure to always use included O-ring.

● When fabricating a lift spring, determine dimensions by referring to head cap details. Furthermore, rustproofing must be implemented (however, there is no guarantee for operation).

● This diagram indicates a situation where head cap has been fitted into plunger with no pressure applied.
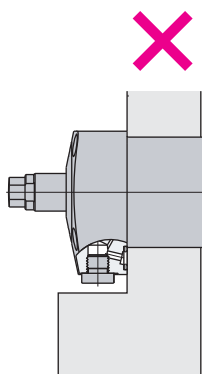
Work support

CST
Spring lift

Caution in use

● If the workpiece is light weight, the plunger cannot be pressed down by the weight of workpiece and seating detection cannot be complete. Review the weight of workpiece or lift spring force to make the workpiece seat perfectly, and lock the work support.
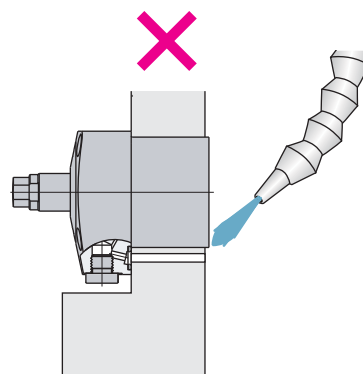
Spring pushes the workpiece

● Avoid following usages. These may cause sleeve deformation that could lead to malfunction of plunger or decreased support force.

✕ Applying eccentric load on plunger.

✕ Applying load that exceeds rated support force.
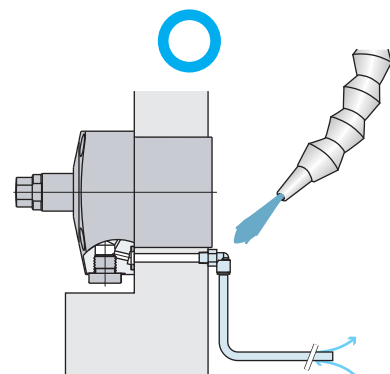
✕ Rotating plunger when locked.

● Air vent must be opened to atmosphere. Any blockage on the vent results in malfunction. Provide the piping if there is a risk of coolant or metal chips intrusion. Allowing intrusion of cutting fluid may cause rusting and other problems.

Air vent is blocked | Cutting fluid intrusion from air vent | Piping to metal chips or coolant free area

● Air (oil free) must be fed through a 5 μ m filter that is connected to an air vent port for air cleaning. Perform air cleaning only when replacing workpiece.

Work support

CST
Spring lift