Sensing Swing clamp

Double acting 7 MPa

model CTM

3 point sensor model
model CTM06-LT

Clamp sensor model
model CTM06-LC

Unclamp sensor model
model CTM06-LB

Compact model
model CTM06-LN

Sensing Swing clamp model CTM

The extremely small sensing clamp can detect the loading miss and setting miss of a workpiece firmly.

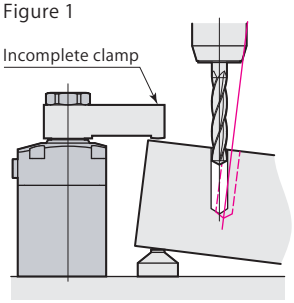
3 point sensor model

Clamp sensor model

Unclamp sensor model

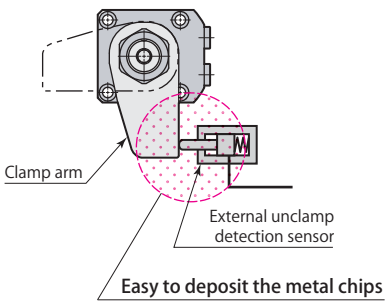
- Sensor model can prevent tool breakage and defective machining due to incomplete clamp. (Figure 1)
- Unclamp PAL sensor moves along with the piston rod and can positively detect unclamping point, thereby enabling a high-speed production line by fully synchronizing operation with workpiece lifters.
- Built-in sensors enable a compact and simple jig.
- Unclamp detection failure due to the metal chips deposit on an independent external detector can be reduced. (Figure 2)

Figure 1



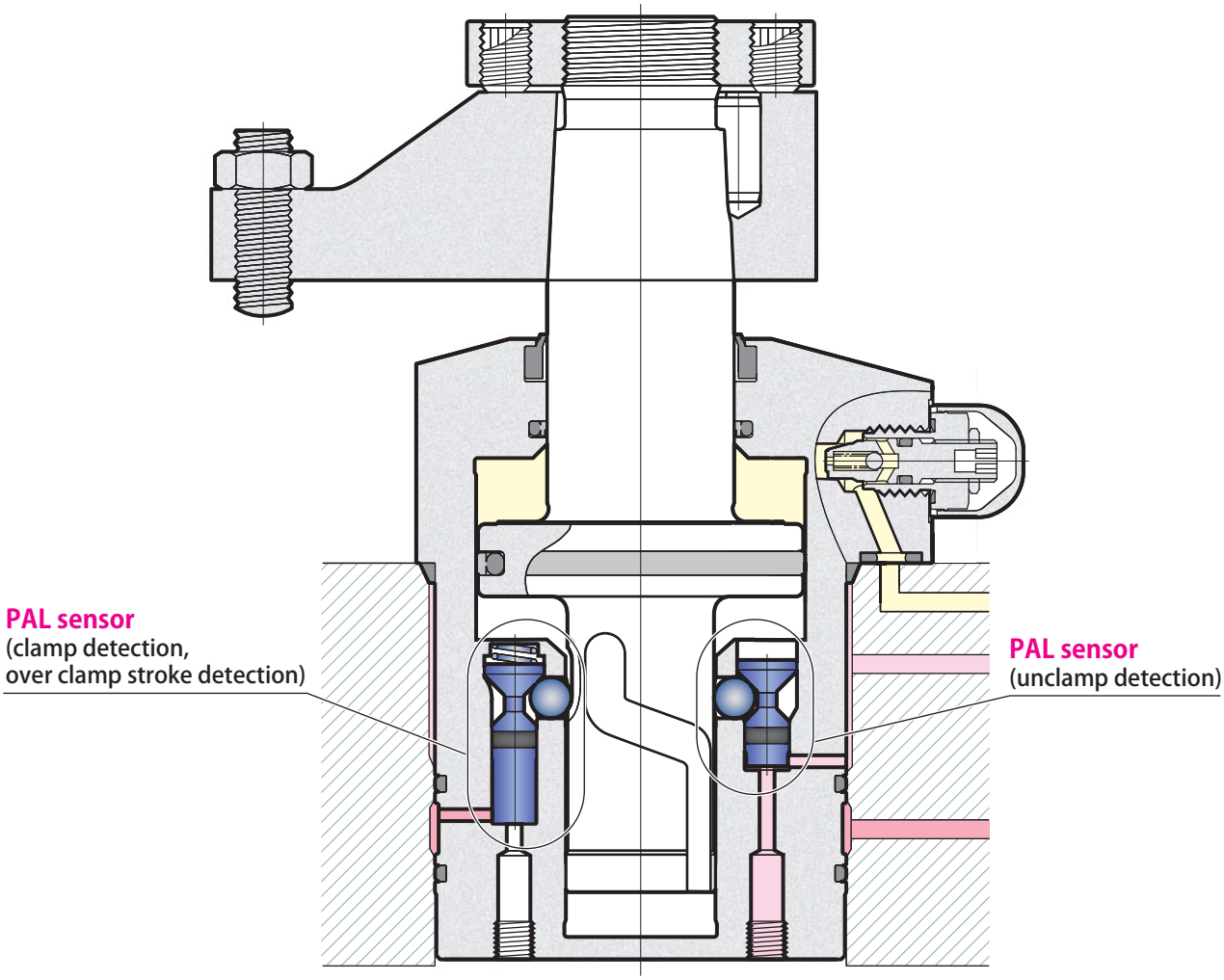
Machining failure due to incomplete clamp

Figure 2



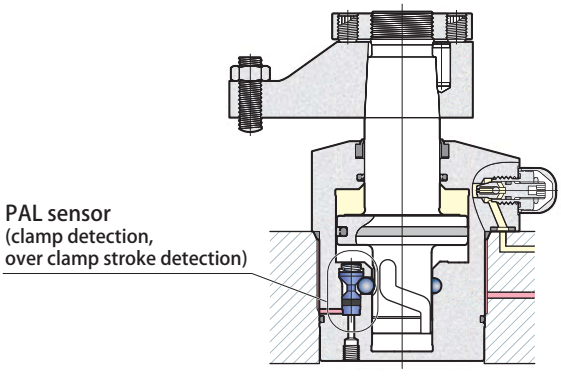
3 point sensor model

Clamp, Unclamp, Over clamp stroke (Incomplete clamp) detection



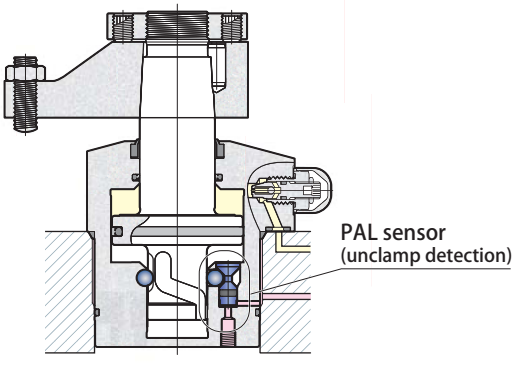
Clamp sensor model

Clamp, Over clamp stroke (Incomplete clamp) detection



Unclamp sensor model

Unclamp detection



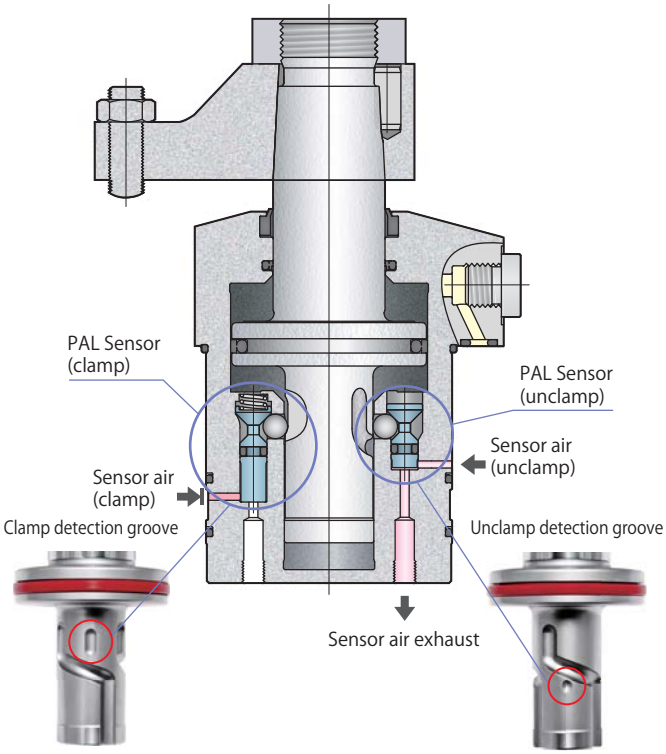
3 point sensor model T

Clamp, Unclamp, Over clamp stroke (Incomplete clamp) detection

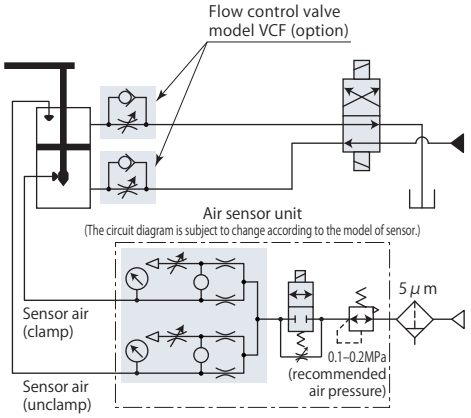
model **CTM□-□□T** PAT.

The 3 point sensor model can detect the status of clamp, unclamp and over clamp stroke with just 2 circuits of air.

Refer to **pages →18–21** for the details.



Hydraulic and pneumatic circuit diagram



Specifications	page → 12
Piping	page → 13
PAL sensor	page → 18
Short stroke	page → 22
Long stroke	page → 26

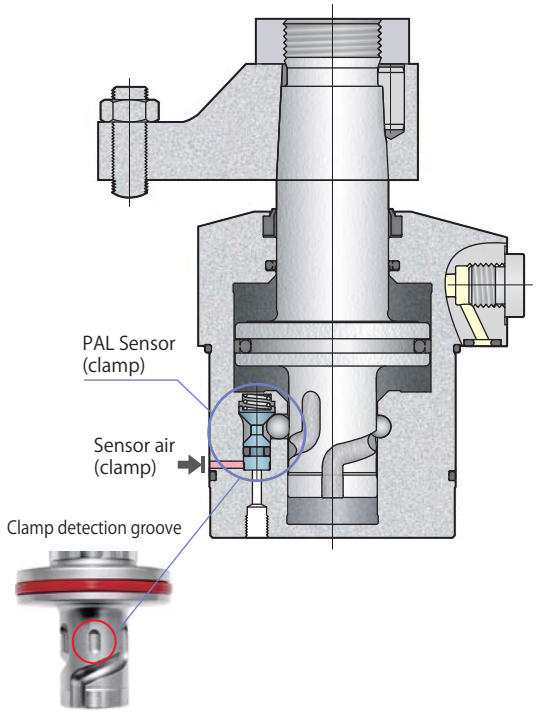
Clamp sensor model C

Clamp, Over clamp stroke (Incomplete clamp) detection

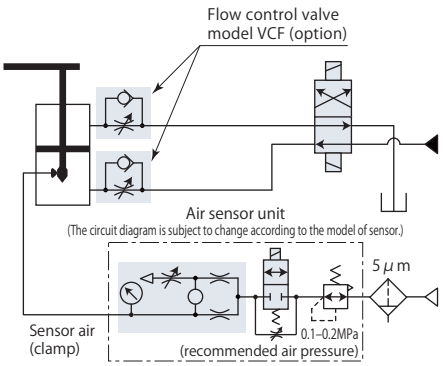
model **CTM□-□□C** PAT.

The clamp sensor model can detect the status of clamp and over clamp stroke with just 1 circuit of air.

Refer to **pages →32–35** for the details.



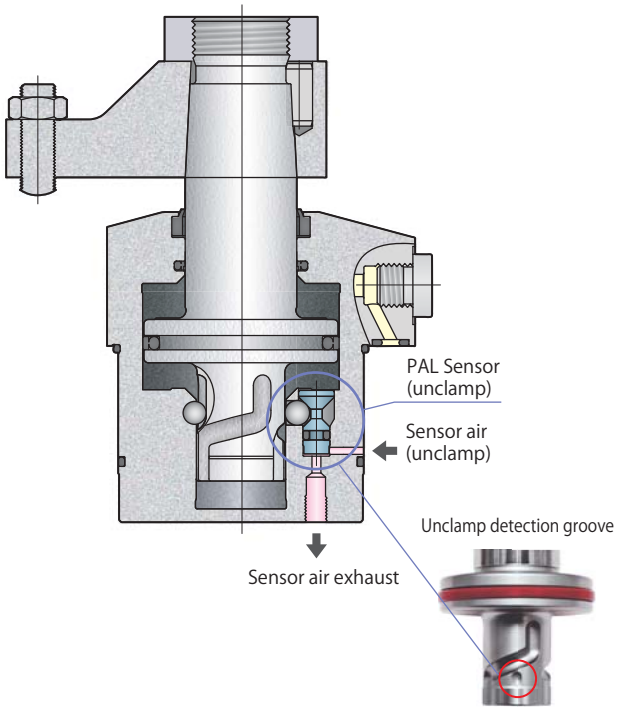
Hydraulic and pneumatic circuit diagram



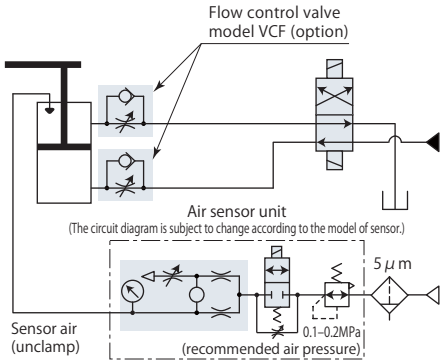
Specifications	page → 12
Piping	page → 13
PAL sensor	page → 32
Short stroke	page → 36
Long stroke	page → 40

Unclamp sensor model B

model **CTM□-□□B** PAT.



Hydraulic and pneumatic circuit diagram

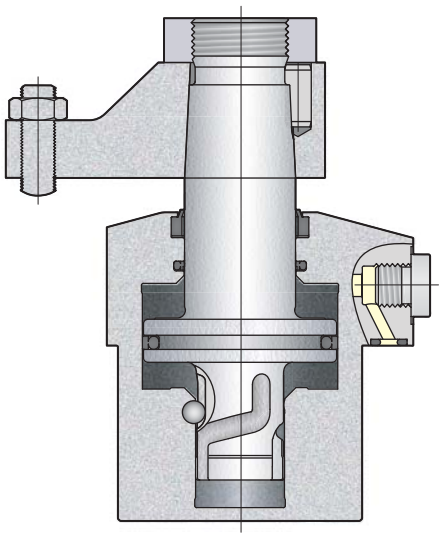


Specifications	page → 12
Piping	page → 13
PAL sensor	page → 47
Short stroke	page → 50
Long stroke	page → 54

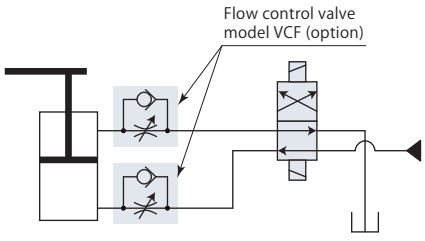
Compact model N

model **CTM□-□□N** JP PAT.

No sensors available
on compact model



Hydraulic circuit diagram

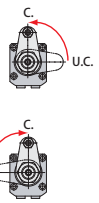


Specifications	page → 12
Piping	page → 13
Short stroke	page → 60
Long stroke	page → 64

CTM□-□□□	Swing clamp	7MPa	Double acting

Specifications

CTM — Size: 03*1, 04, 05, 06, 10, 16*2 — Swing direction (when clamping): L : Counter-clockwise, R : Clockwise



Clamp stroke: (Nil) : 5mm; S10 : 10mm; S20*3 : 20mm; S30*3 : 30mm

T : 3 point sensor model
Clamp, Unclamp, Over clamp stroke (Incomplete clamp) detection
C : Clamp sensor model
Clamp, Over clamp stroke (Incomplete clamp) detection
B : Unclamp sensor model
N : Compact model

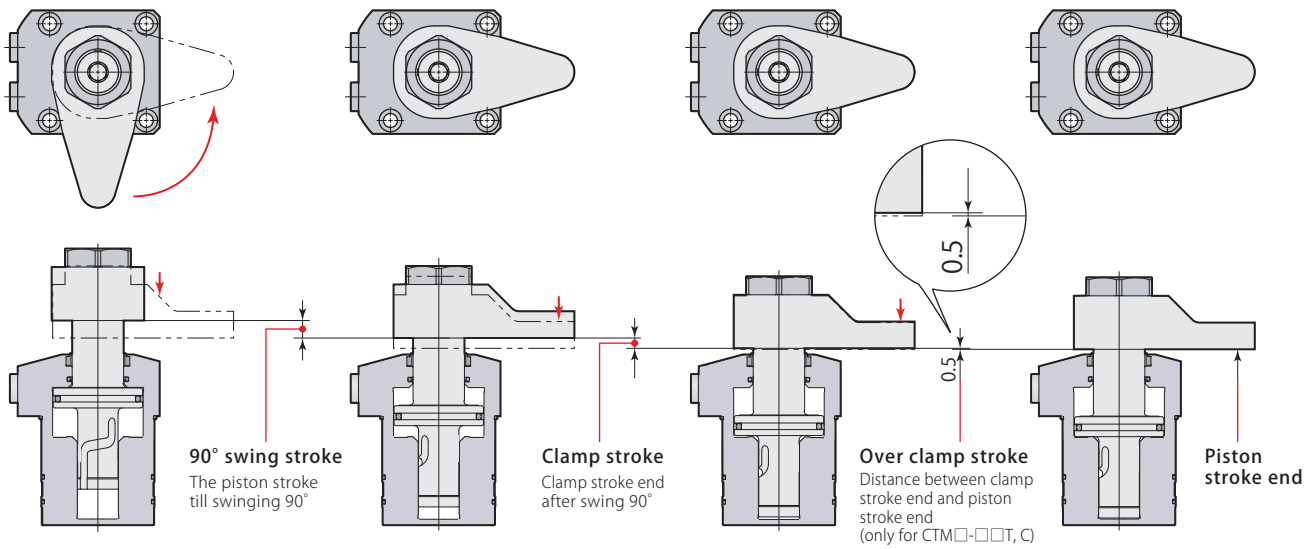
*1 : For compact model only (CTM03-□□N).
*2 : For long stroke only (CTM16-□S□□).
*3 : CTM□-□S20T, CTM□-□S20C, CTM□-□S30T, CTM□-□S30C are made to order.
Contact Pascal for more details about swing angle 30, 45 and 60 degrees, pin rod and bottom piping.

Model	Size	CTM03			CTM04			CTM05			CTM06				CTM10				CTM16		
	Clamp stroke	5	10	20	5	10	20	5	10	20	5	10	20	30	5	10	20	30	10	20	30
Cylinder force (hydraulic pressure 7MPa) kN		2.5			3.5			4.9			7.2				9.4				14.2		
Cylinder inner diameter mm		26			31			37			44				51				62		
Rod diameter mm		15			18			22			25				30				35.5		
Effective area (clamp) cm^2		3.5			5.00			6.95			10.3				13.4				20.3		
Swing angle		90° ±3°																			
Positioning pin groove position accuracy		±1°																			
Repeated clamp positioning accuracy		±0.5°																			
Full stroke	CTM□-□□T, C mm	–			12	17	27	13	18	28	14	19	29	39	15.5	20.5	30.5	40.5	22.5	32.5	42.5
	CTM□-□□B, N mm	10.5	15.5	25.5	11.5	16.5	26.5	12.5	17.5	27.5	13.5	18.5	28.5	38.5	15	20	30	40	22	32	42
90° swing stroke mm		5.5			6.5			7.5			8.5				10				12		
Over clamp stroke (CTM□-□□T, C) mm		–			0.5																
Mass	CTM□-□□T kg	–			0.9	0.9	1.0	1.2	1.3	1.4	1.8	1.9	2.1	2.3	2.7	2.8	3.1	3.5	4.2	4.7	5.2
	CTM□-□□C kg	–			0.8	0.8	1.0	1.1	1.2	1.4	1.6	1.7	2.0	2.3	2.4	2.6	3.0	3.4	4.1	4.6	5.1
	CTM□-□□B, N kg	0.6	0.6	0.8	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.7	2.0	2.3	2.4	2.6	3.0	3.4	4.1	4.6	5.1
Recommended tightening torque of mounting screws* N·m		3.5			7			7			12				12				29		
Recommended tightening torque of nut N·m		22			35			60			100				155				260		

- Pressure range : 1.5–7 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)

*: ISO R898 class 12.9

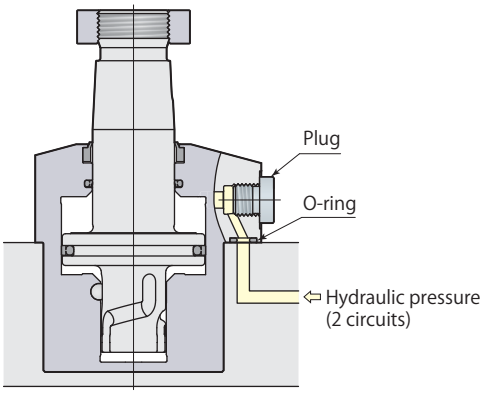
Clamping must be done within the range of clamp stroke.



Manifold piping and G port piping are available.

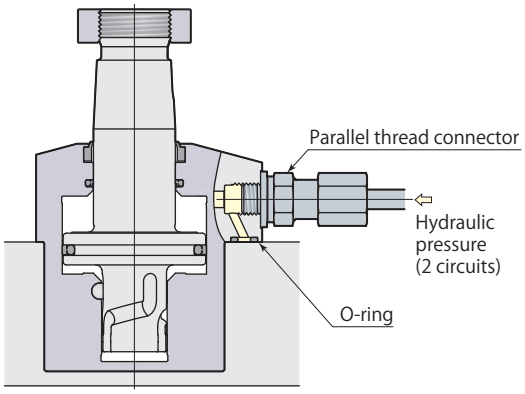
Manifold piping

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.



G port piping

Remove plugs when choosing G port piping. (O-ring must be used.) Refer to **page →220** 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.



Flow control valve model VCF

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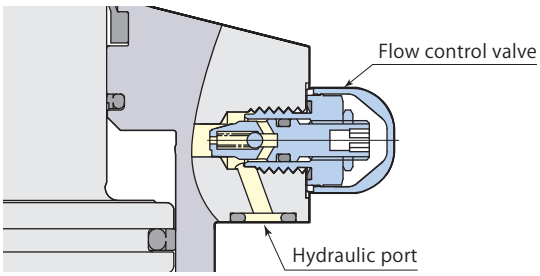

Air bleeding valve model VCE

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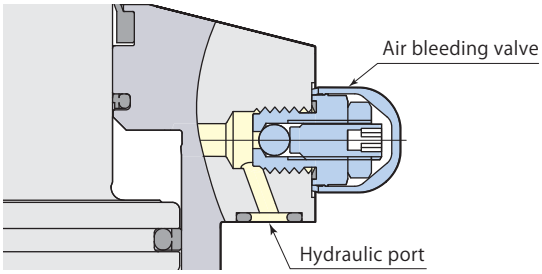
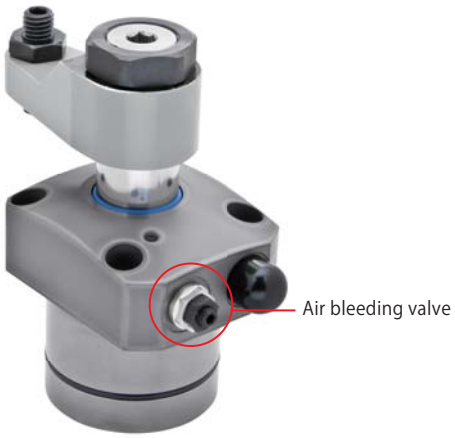
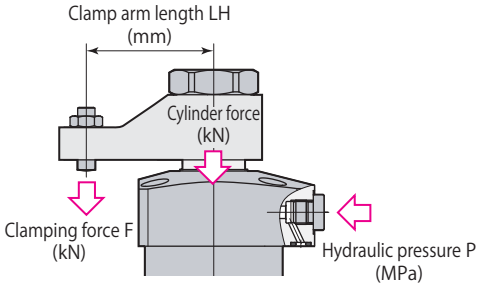




● In case of mounting flow control valve model VCF on the G port of the clamp, air bleeding valve should be installed in the piping to the clamp. (VCE Mounting details. Refer to **page →96**)

Performance table



Clamping force varies depending on the clamp arm length (LH) and hydraulic pressure (P).

Clamping force calculation formula
F = P/(Coefficient 1 + Coefficient 2 × LH)
F: Clamping force P: Hydraulic pressure LH: Clamp arm length

CTM06 with clamp arm length (LH) = 50 mm at hydraulic pressure of 7 MPa, Clamping force F is calculated by
7/(0.971+0.00427×50)=5.9 kN

Do not use the clamp in the nonusable range. It may cause damage to the cylinder and rod.

model CTM03 Clamping force F=P/(2.82+0.0153×LH)

Hydraulic pressure MPa	Cylinder force kN	Clamping force kN / Clamp arm length LH mm								Max. arm length Max. LH mm
		30	40	50	60	70	80	100	120	
7	2.5	2.1	2.0	2.0	1.9	1.8	1.7	Nonusable range		85
6.5	2.3	2.0	1.9	1.8	1.7	1.7	1.6			95
6	2.1	1.8	1.7	1.7	1.6	1.5	1.5	1.4		108
5.5	1.9	1.7	1.6	1.5	1.5	1.4	1.4	1.3		125
5	1.8	1.5	1.5	1.4	1.3	1.3	1.2	1.1	1.1	148
4.5	1.6	1.4	1.3	1.3	1.2	1.2	1.1	1.0	1.0	182
4	1.4	1.2	1.2	1.1	1.1	1.0	1.0	0.9	0.9	↑
3.5	1.2	1.1	1.0	1.0	0.9	0.9	0.9	0.8	0.8	↑
3	1.1	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.6	↑
2.5	0.9	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.5	↑
2	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.4	↑
1.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.3	182

model CTM04 Clamping force F=P/(2.00+0.0101×LH)

Hydraulic pressure MPa	Cylinder force kN	Clamping force kN / Clamp arm length LH mm								Max. arm length Max. LH mm
		40	50	60	70	80	100	120	140	
7	3.5	2.9	2.8	2.7						64
6.5	3.3	2.7	2.6	2.5	2.4					71
6	3.0	2.5	2.4	2.3	2.2	Nonusable range				79
5.5	2.8	2.3	2.2	2.1	2.0	2.0				89
5	2.5	2.1	2.0	1.9	1.8	1.8	1.7			103
4.5	2.3	1.9	1.8	1.7	1.7	1.6	1.5	1.4		121
4	2.0	1.7	1.6	1.5	1.5	1.4	1.3	1.2	1.2	148
3.5	1.8	1.5	1.4	1.3	1.3	1.2	1.2	1.1	1.0	189
3	1.5	1.2	1.2	1.2	1.1	1.1	1.0	0.9	0.9	↑
2.5	1.3	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.7	↑
2	1.0	0.8	0.8	0.8	0.7	0.7	0.7	0.6	0.6	↑
1.5	0.8	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.4	189

model CTM05 Clamping force F=P/(1.44+0.00726×LH)

Hydraulic pressure MPa	Cylinder force kN	Clamping force kN / Clamp arm length LH mm								Max. arm length Max. LH mm
		50	60	80	100	120	140	160	180	
7	4.9	3.9	3.7							79
6.5	4.5	3.6	3.5	3.2						87
6	4.2	3.3	3.2	3.0	Nonusable range					98
5.5	3.8	3.1	2.9	2.7	2.5					112
5	3.5	2.8	2.7	2.5	2.3	2.2				131
4.5	3.1	2.5	2.4	2.2	2.1	1.9	1.8			157
4	2.8	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.5	196
3.5	2.4	1.9	1.9	1.7	1.6	1.5	1.4	1.3	1.3	↑
3	2.1	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	↑
2.5	1.7	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.9	↑
2	1.4	1.1	1.1	1.0	0.9	0.9	0.8	0.8	0.7	↑
1.5	1.0	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5	196

model CTM06 Clamping force F=P/(0.971+0.00427×LH)

Hydraulic pressure MPa	Cylinder force kN	Clamping force kN / Clamp arm length LH mm								Max. arm length Max. LH mm
		50	60	80	100	120	140	160	180	
7	7.2	5.9	5.7	5.3						87
6.5	6.7	5.5	5.3	5.0						96
6	6.2	5.1	4.9	4.6	4.3	Nonusable range				108
5.5	5.7	4.6	4.5	4.2	3.9	3.7				124
5	5.1	4.2	4.1	3.8	3.6	3.4	3.2			144
4.5	4.6	3.8	3.7	3.4	3.2	3.0	2.9	2.7		172
4	4.1	3.4	3.3	3.0	2.9	2.7	2.5	2.4	2.3	203
3.5	3.6	3.0	2.9	2.7	2.5	2.4	2.2	2.1	2.0	281
3	3.1	2.5	2.4	2.3	2.1	2.0	1.9	1.8	1.7	↑
2.5	2.6	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4	↑
2	2.1	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	↑
1.5	1.5	1.3	1.2	1.1	1.1	1.0	1.0	0.9	0.9	281

model CTM10 Clamping force F=P/(0.749+0.00299×LH)

Hydraulic pressure MPa	Cylinder force kN	Clamping force kN / Clamp arm length LH mm								Max. arm length Max. LH mm
		60	80	100	120	140	160	180	200	
7	9.4	7.5	7.1							88
6.5	8.7	7.0	6.6							98
6	8.0	6.5	6.1	5.7	Nonusable range					110
5.5	7.3	5.9	5.6	5.2	5.0					125
5	6.7	5.4	5.1	4.8	4.5	4.3				144
4.5	6.0	4.8	4.6	4.3	4.1	3.9	3.7			171
4	5.3	4.3	4.0	3.8	3.6	3.4	3.3	3.1	3.0	211
3.5	4.7	3.8	3.5	3.3	3.2	3.0	2.9	2.7	2.6	273
3	4.0	3.2	3.0	2.9	2.7	2.6	2.4	2.3	2.2	↑
2.5	3.3	2.7	2.5	2.4	2.3	2.1	2.0	1.9	1.9	↑
2	2.7	2.2	2.0	1.9	1.8	1.7	1.6	1.6	1.5	↑
1.5	2.0	1.6	1.5	1.4	1.4	1.3	1.2	1.2	1.1	273

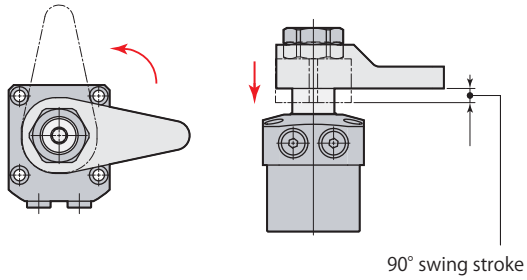
Swing speed adjustment

Swing time is restricted by the mass and length of the clamp arm (moment of inertia) since the 90° swing action impacts the cam shaft.

1.Calculate the moment of inertia according to the arm length and mass.

2.Adjust swing speed with flow control valve to ensure that 90° swing time of the clamp arm is greater than the shortest swing time in the graph shown below.

● The cam groove may be damaged in case the swing speed is set at the nonusable range in the graph.

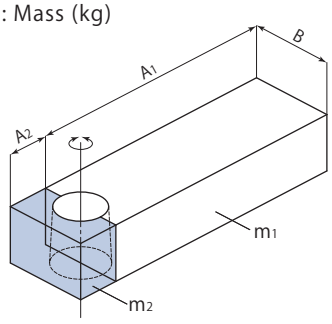


Example of calculation for moment of inertia

$$I = \frac{1}{12} m_1(4A_1^2+B^2)+\frac{1}{12} m_2(4A_2^2+B^2)$$

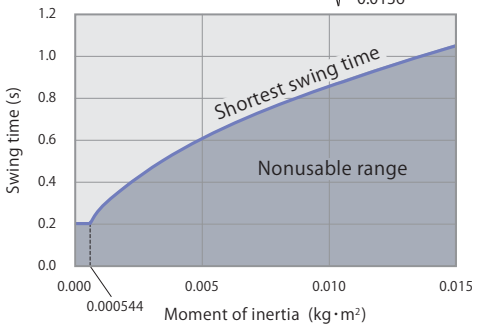
I : Moment of inertia (kg·m²)

m: Mass (kg)



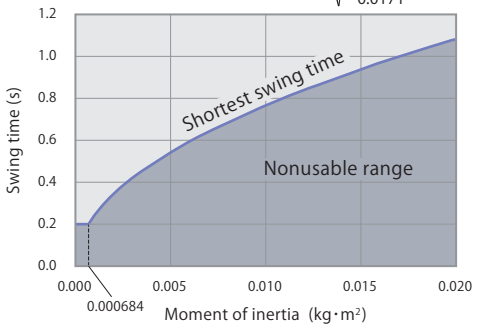
model CTM03

Shortest swing time calculation formula $t=\sqrt{\frac{I}{0.0136}}$



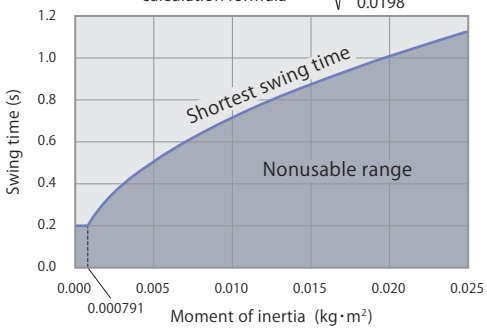
model CTM04

Shortest swing time calculation formula $t=\sqrt{\frac{I}{0.0171}}$



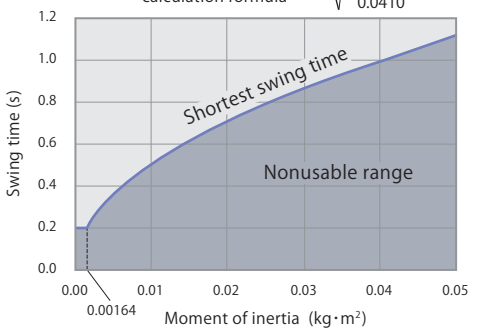
model CTM05

Shortest swing time calculation formula $t=\sqrt{\frac{I}{0.0198}}$



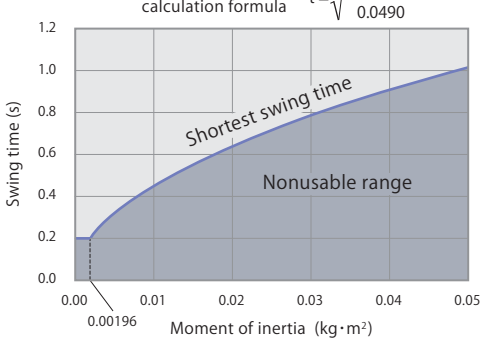
model CTM06

Shortest swing time calculation formula $t=\sqrt{\frac{I}{0.0410}}$



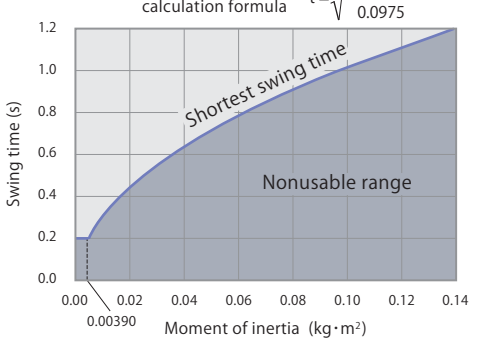
model CTM10

Shortest swing time calculation formula $t=\sqrt{\frac{I}{0.0490}}$



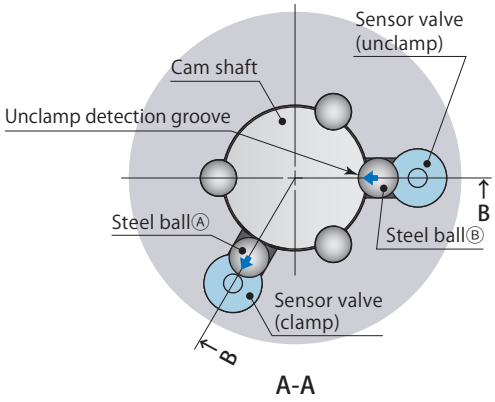
model CTM16

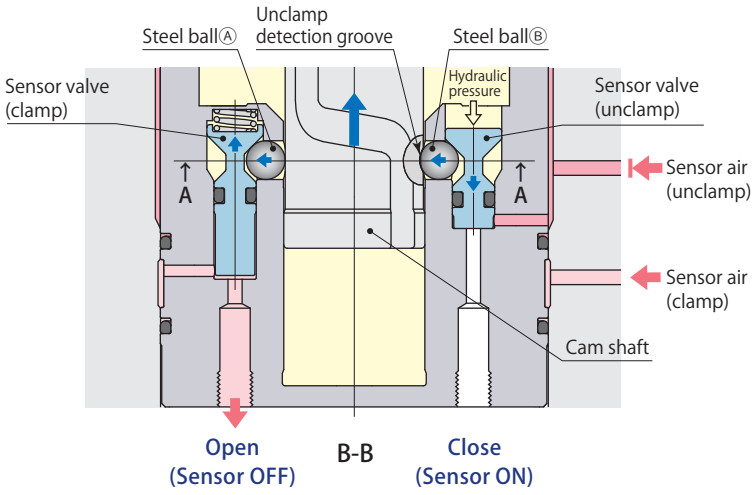
Shortest swing time calculation formula $t=\sqrt{\frac{I}{0.0975}}$



PAL sensor function and structure

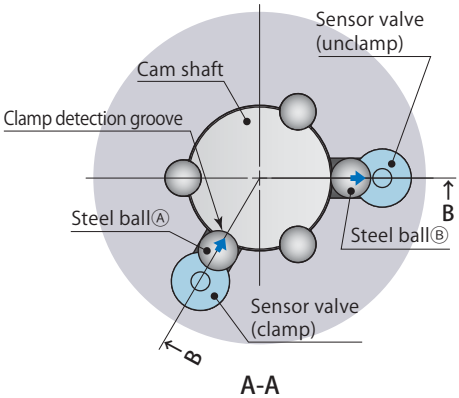
Unclamp detection

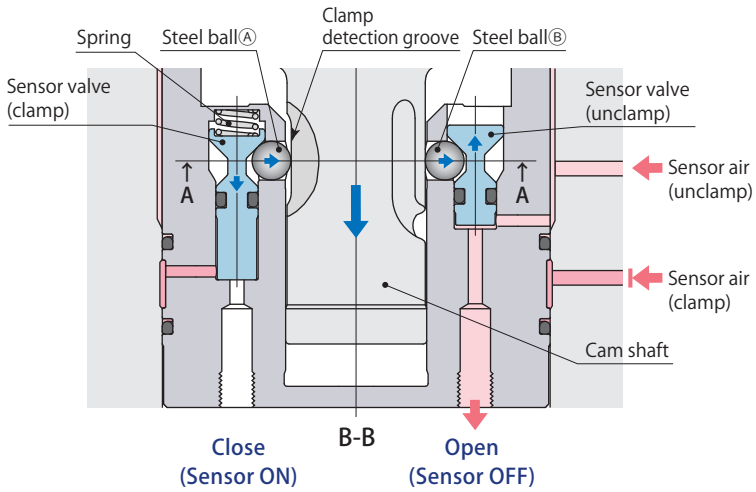




● The steel ball Ⓑ seats in the unclamp detection groove when the cam shaft reaches unclamp end, and a sensor valve (unclamp) is pushed down to shut off the sensor air by hydraulic force. The sensor valve (clamp) is pushed up by the steel ball Ⓐ to open for air exhaust and detects the unclamped condition.

Clamp detection

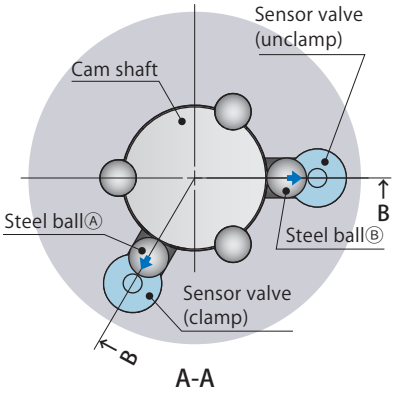


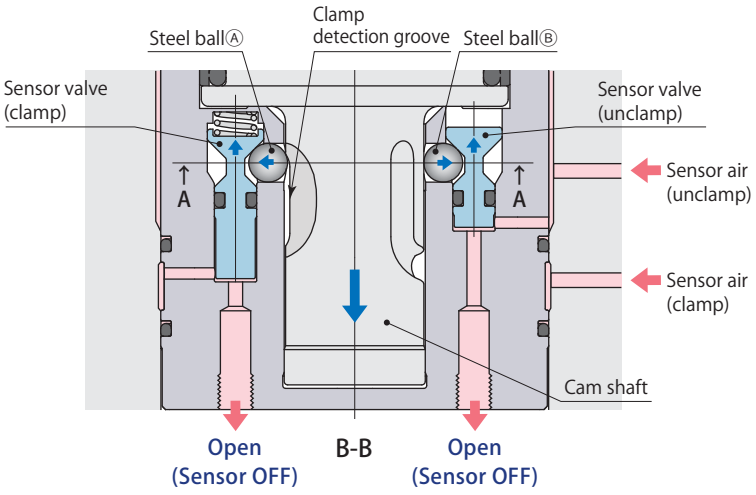


● The steel ball Ⓐ seats in the clamp detection groove when the cam shaft reaches clamping point, and a sensor valve (clamp) is pushed down to shut of the sensor air by a spring. The sensor valve (unclamp) is pushed up by the steel ball Ⓑ to open for air exhaust and detects the clamped condition.

PAL sensor function and structure

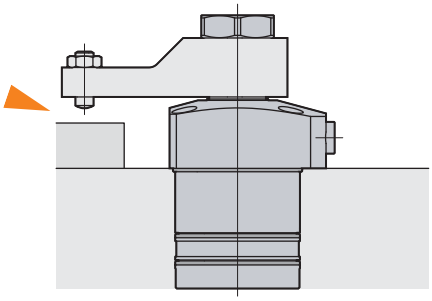
Over clamp stroke (Incomplete clamp) detection



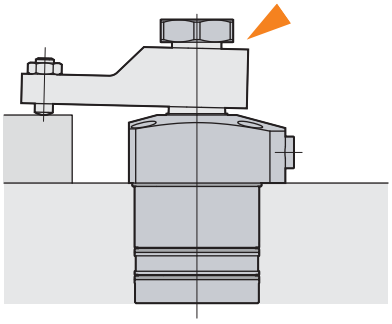


- When the cam shaft passes the clamping point, the sensor valve (clamp) is pushed up by the steel ball Ⓐ to open for air exhaust. The sensor valve (unclamp) is pushed up by the steel ball Ⓑ to open for air exhaust and detects the over clamp stroked (incomplete clamp) condition.

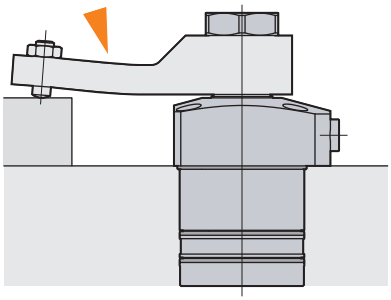
Over clamp stroke (Incomplete clamp) detection example



- Clamp disabled due to mis-setting workpiece.



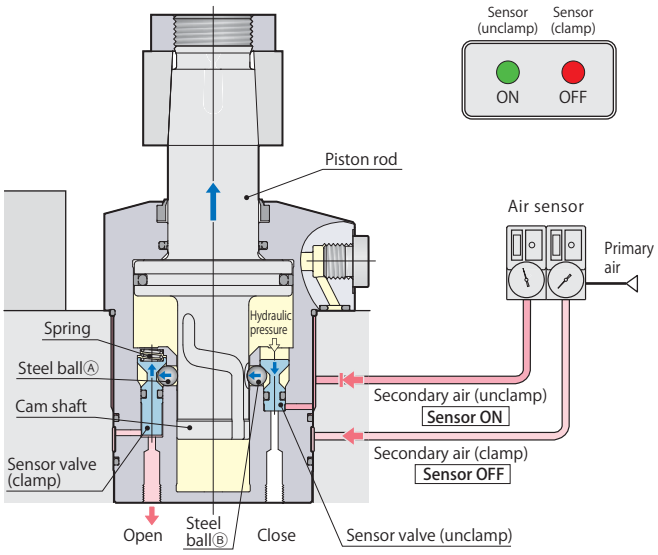
- Clamp disabled due to the damage of piston rod or loose clamp arm.



- Clamp disabled due to the deflection of clamp arm.
- Clamp disabled due to the abrasion on the tip of clamp arm during prolonged use.

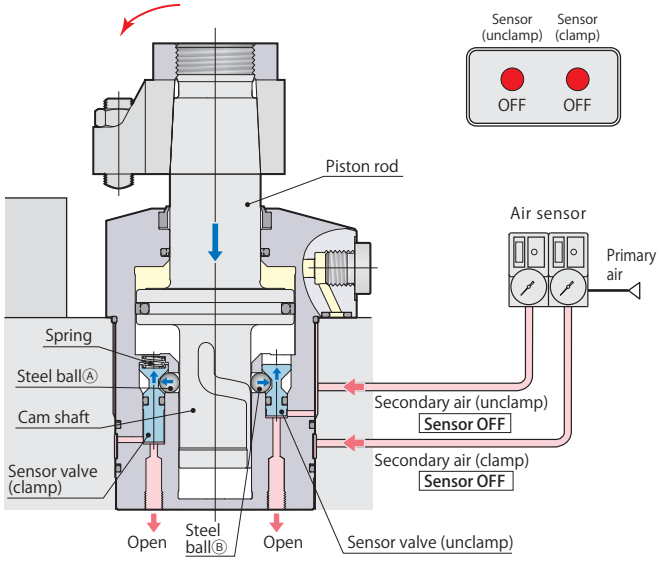
Clamp, Unclamp, Over clamp stroke detection signal

Unclamp detection



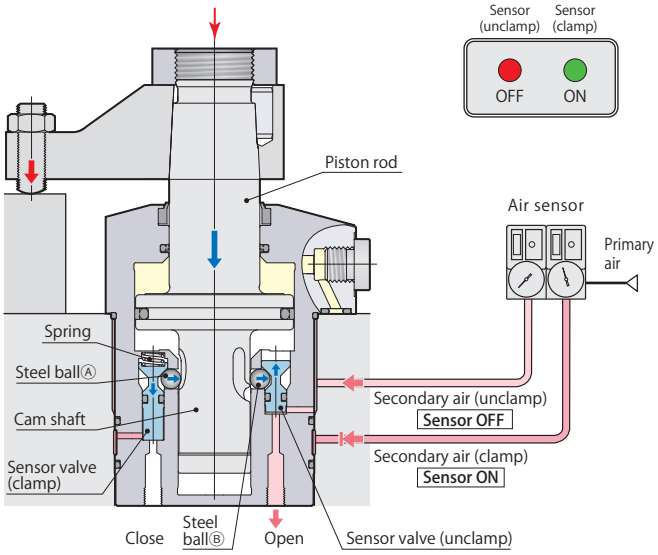
Sensor signal (unclamp)	ON	Unclamp
Sensor signal (clamp)	OFF	

In the middle of swing stroke



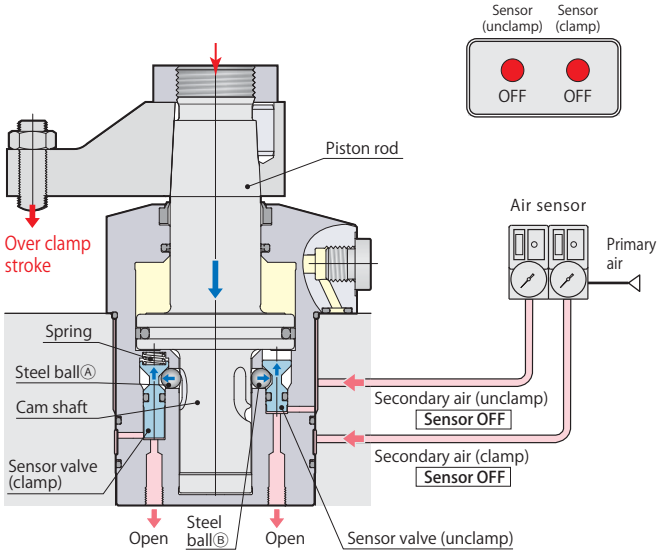
Sensor signal (unclamp)	OFF	In the middle of swing stroke
Sensor signal (clamp)	OFF	

Clamp detection



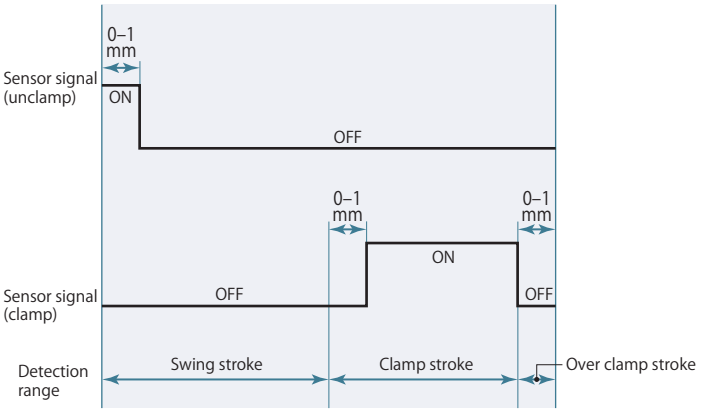
Sensor signal (unclamp)	OFF	Clamp
Sensor signal (clamp)	ON	

Over clamp stroke (Incomplete clamp) detection



Sensor signal (unclamp)	OFF	Over clamp stroke (Incomplete clamp)
Sensor signal (clamp)	OFF	

Air sensor triggering point



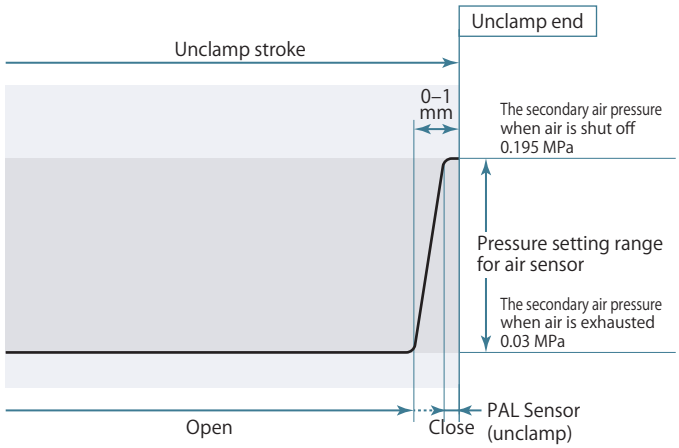
- Refer to the sensor supplier's instruction manual for the details of setting.
- Sensing performance such as detectable time and pressure differs depending on the supplier and model number of the sensor. Select the right model referring to sensor's application and characteristics.

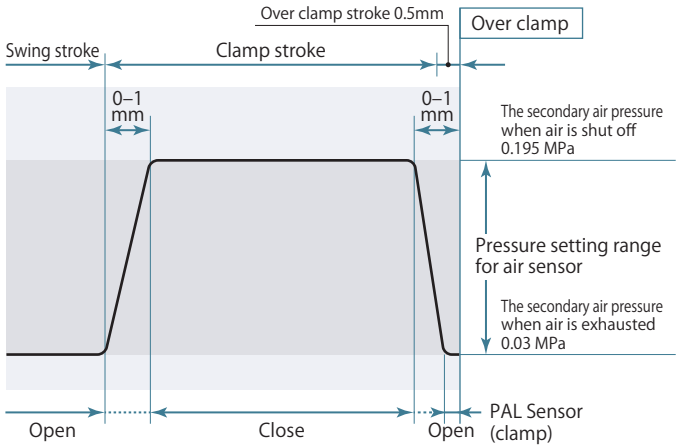
Air sensor unit recommended condition of use

Supplier and model	ISA3-F/G series manufactured by SMC GPS2-05, GPS3-E series manufactured by CKD
Air supply pressure	0.1–0.2 MPa
Inner diameter of piping	ø4 mm (ISA3-F：ø2.5 mm)
Overall piping length	5 m or less

- Supply the dry and filtered air. Particulate size 5 μm or less is recommended.
- 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.

Relation between sensor air pressure, PAL sensor and piston stroke



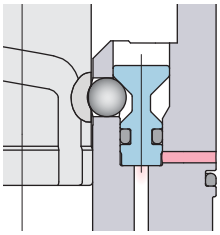


The diagram shown on the left indicates the relation between the PAL sensor, piston stroke, and secondary air pressure. (The pressure shown in the diagram is a reference based on the 0.2 MPa of primary air pressure for one piece of clamp.)

Since the new PAL sensor works with less air-leakage compared to previous sensor valve,

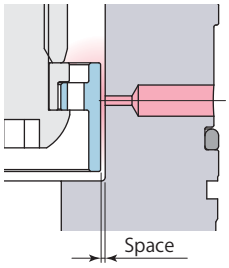
- Enhances the pressure setting range of the sensor which enables the sensor to set easily.
  (Ex. Pressure setting range 0.03–0.195 MPa in the diagram)
- Allows the use for a number of clamps by one air sensor because of better pressure holding when air is shut off.
  (Maximum number of clamps to be detected by one sensor is 10.)
- Allows to choose less air-consumed, i.e. small orifice diameter type, air sensor.
- Can create large differential-pressure when opening and closing the PAL sensor so that sensor primary pressure can be set as low as possible and reduce the consumption of air.

New PAL sensor



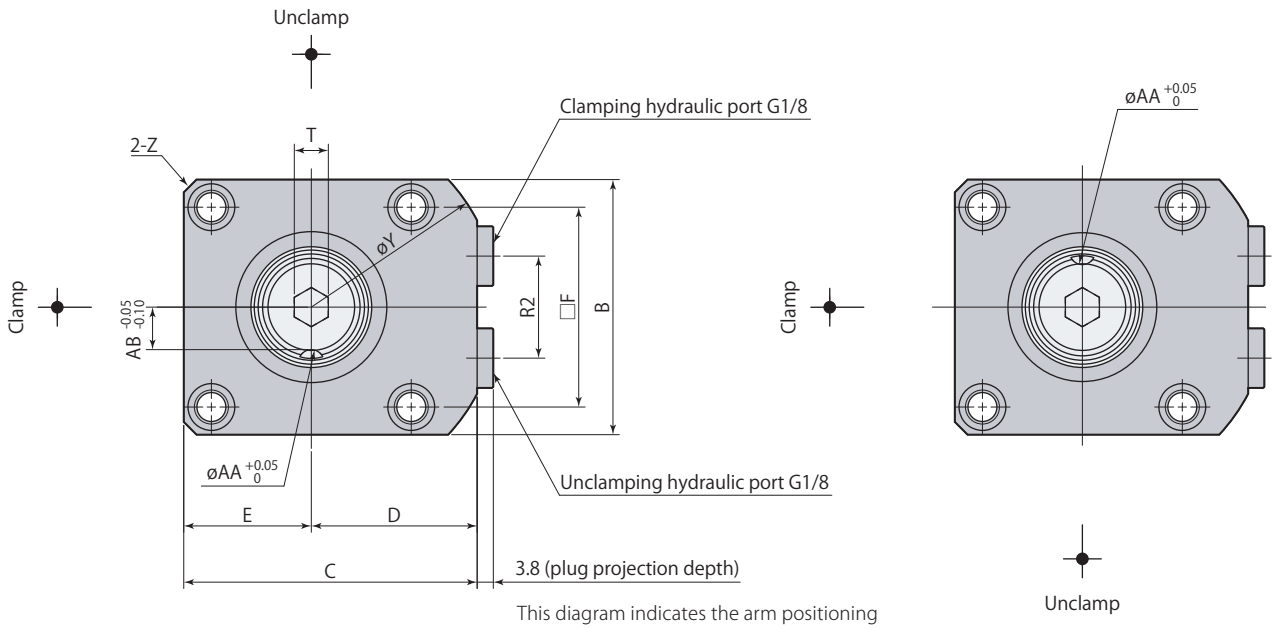
Poppet structure ensures superior sealing performance and can create large differential-pressure when the valve is opening and closing, and air leakage can be minimized.

Previous sensor valve



Air leaks easily due to a large space.

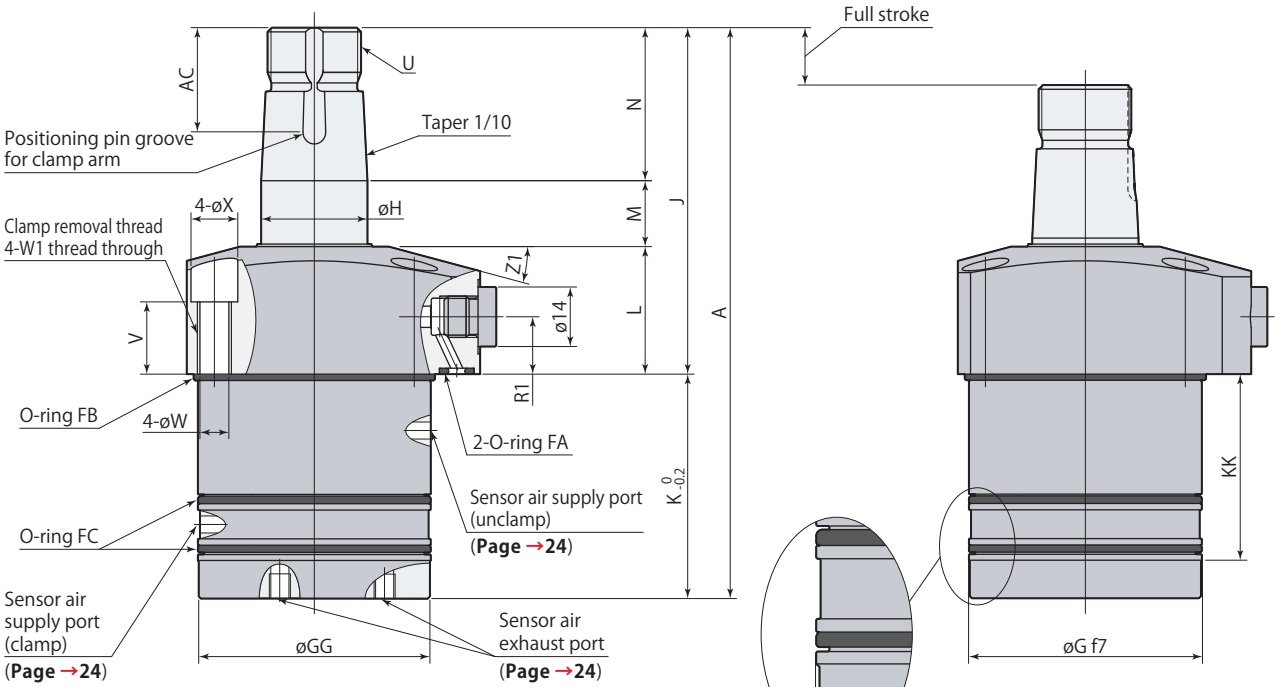
Dimensions



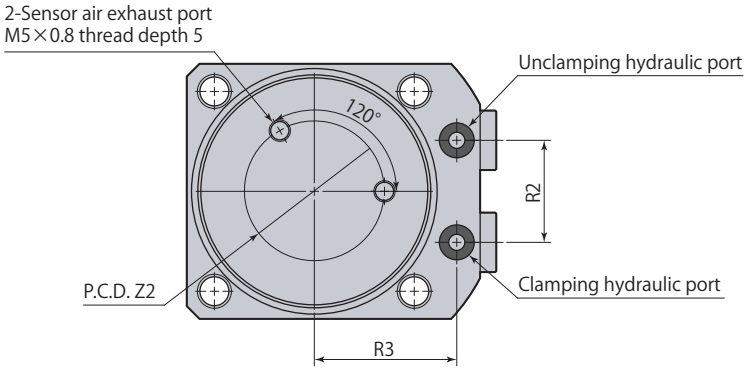
This diagram indicates the arm positioning pin groove at unclamped condition.

Swing direction L (counter-clockwise)

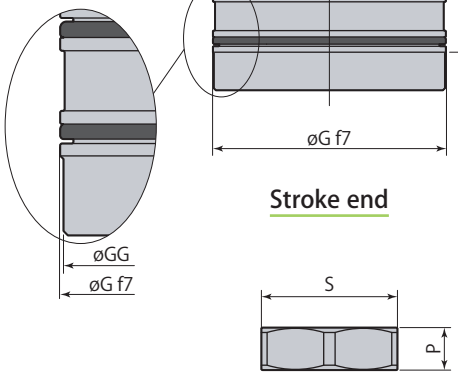
Swing direction R (clockwise)



Unclamp



Stroke end



Hex nut for arm mount

- Hex nut for arm mount is included.
- Refer to **page →72** for the details of perfect nut.
- Clamp arm, positioning pin and mounting screws are not included.

mm

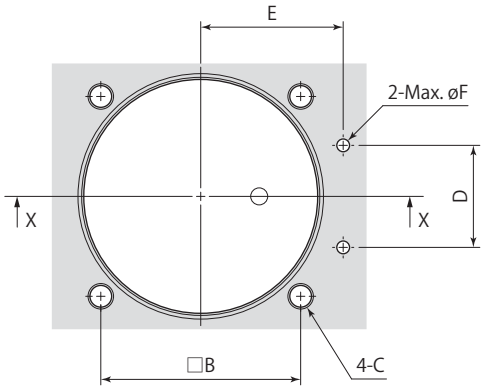
Model		CTM04-□T	CTM05-□T	CTM06-□T	CTM10-□T
Cylinder capacity (cm³)	Clamp	6.0	9.0	14.4	20.7
	Unclamp	9.1	14.0	21.3	31.7
A		113.5	120.5	134.5	146
B		45	51	60	70
C		54	61	69	81
D		31.5	35.5	39	46
E		22.5	25.5	30	35
F		34	40	47	55
øG		40 $^{-0.025}_{-0.050}$	48 $^{-0.025}_{-0.050}$	55 $^{-0.030}_{-0.060}$	65 $^{-0.030}_{-0.060}$
øGG		39.7	47.6	54.6	64.6
øH		18	22	25	30
J		65.5	74.5	81.5	88
K		48	46	53	58
KK		41.5	37.5	44	46.5
L		25	28	30	31
M		13.5	14.5	15.5	17
N		27	32	36	40
P		8	9	10	11
R1		12.5	14	13.5	14
R2		18	22	24	30
R3		26	30	33.5	39.5
S (nut width across flats)		24	30	32	41
T (hex socket)		6	8	8	10
U		M16×1.5	M20×1.5	M22×1.5	M27×1.5
V		15	17.5	17	17
øW		5.5	5.5	6.8	6.8
W1		M6×1	M6×1	M8×1.25	M8×1.25
øX		9	9	11	11
øY		73	83	88	106
Z		C3	C3	C3	C4
Z1		12°	15°	15°	15°
Z2		22	27	33	38
øAA (pin groove diameter)		4	5	6	6
AB		7	9	10	12.5
AC		18.5	21.5	24.5	27.5
Positioning pin (dowel pin)		ø4(h8)×10	ø5(h8)×12	ø6(h8)×14	ø6(h8)×16
O-ring FA (fluorocarbon hardness Hs90)		P5	P5	P5	P7
O-ring FB (fluorocarbon hardness Hs70)		38×1.5 (inner diameter×thickness)	AS568-031	AS568-034	AS568-037
O-ring FC (fluorocarbon hardness Hs70)		AS568-028	AS568-031	AS568-033	AS568-036
Taper sleeve		CTH04-MS	CTH05-MS	CTH06-MS	CTH10-MS
Flow control valve*	Meter-in	VCF01S	VCF01S	VCF01S	VCF01
	Meter-out	VCF01S-O	VCF01S-O	VCF01S-O	VCF01-O
Air bleeding valve		VCE01	VCE01	VCE01	VCE01

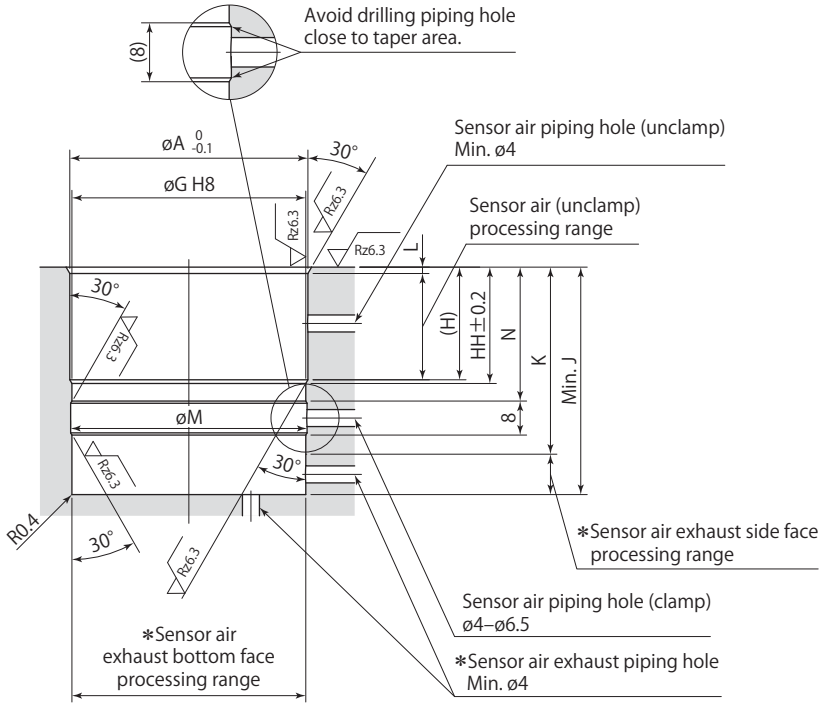
∗: Select the right model of VCF according to the size of the clamp.

Refer to each page for the details of options.

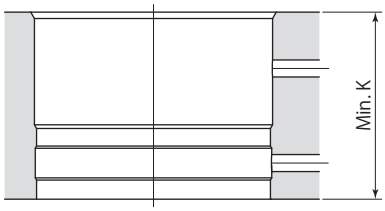
● Taper sleeve **page →70** ● Flow control valve **page →94** ● Air bleeding valve **page →96**

Mounting details





In blind hole X-X

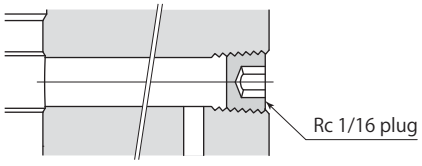


In through hole X-X

*: Sensor air exhaust piping hole must be made on either side or bottom face.

Rz: ISO4287(1997)

- Apply an appropriate amount of grease to the chamfer and the bore when mounting. Excessive grease may be a blockage in the air passage, causing malfunction of the sensor.
- The 30° taper machining must be provided to avoid the damage of the O-ring. Ensure that there are no interference on taper area when drilling the hole for sensor air.
- The sensor air piping hole can be used for a pilot hole of Rc 1/16 plug.



Mounting details

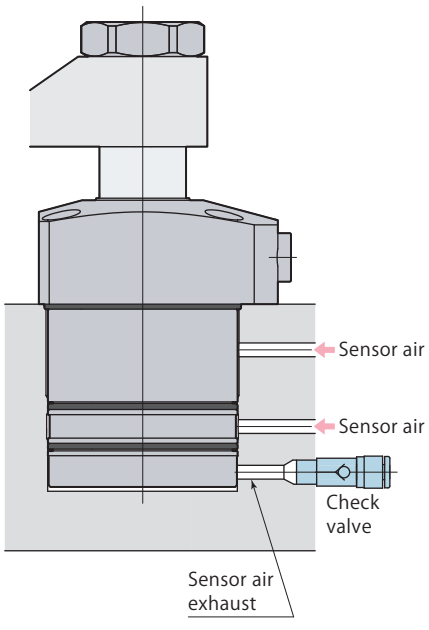
mm

Model	CTM04-□T	CTM05-□T	CTM06-□T	CTM10-□T
øA	40.8	49	56	66
B	34	40	47	55
C	M5	M5	M6	M6
D	18	22	24	30
E	26	30	33.5	39.5
øF	3	3	3	5
øG	40 $^{+0.039}_{0}$	48 $^{+0.039}_{0}$	55 $^{+0.046}_{0}$	65 $^{+0.046}_{0}$
H	24.5	20	26.5	29
HH	25.2	20.9	27.4	29.9
J	48.5	46.5	53.5	58.5
K	41.5	37.5	44	46.5
L	1.2	1.5	1.5	1.5
øM	40.6	48.6	55.6	65.6
N	29	25	31.5	34

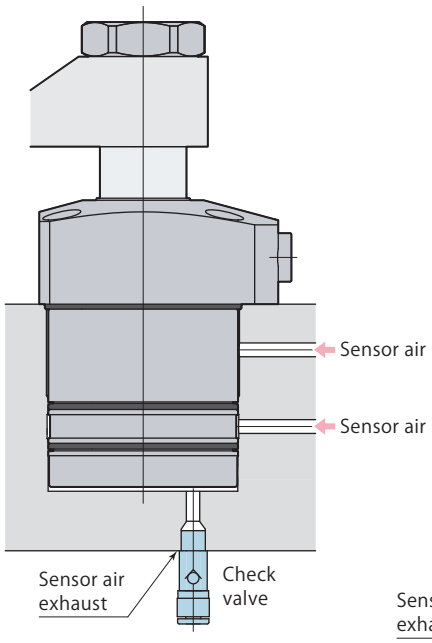
Caution for piping

Refer to the diagram shown below for the sensor air exhaust port.

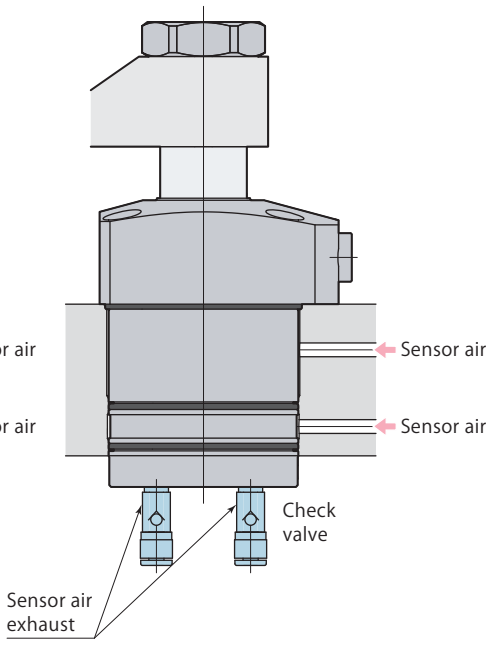
Mounting in blind hole
(Sensor air exhaust：side face)



Mounting in blind hole
(Sensor air exhaust：bottom face)



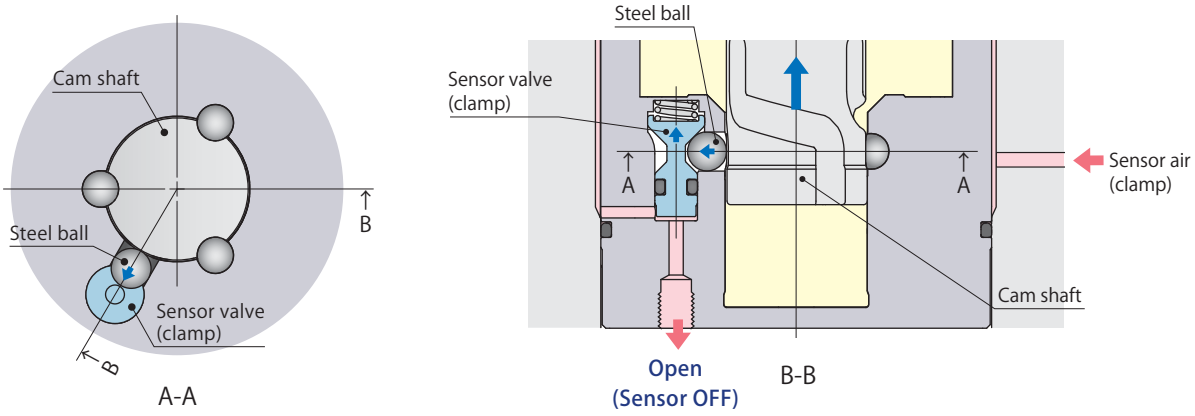
Mounting in through hole



● Use a check valve with cracking pressure of 0.005 MPa or less if there is a risk of metal chips or coolant intrusion. Recommended check valve：AKH or AKB series manufactured by SMC.

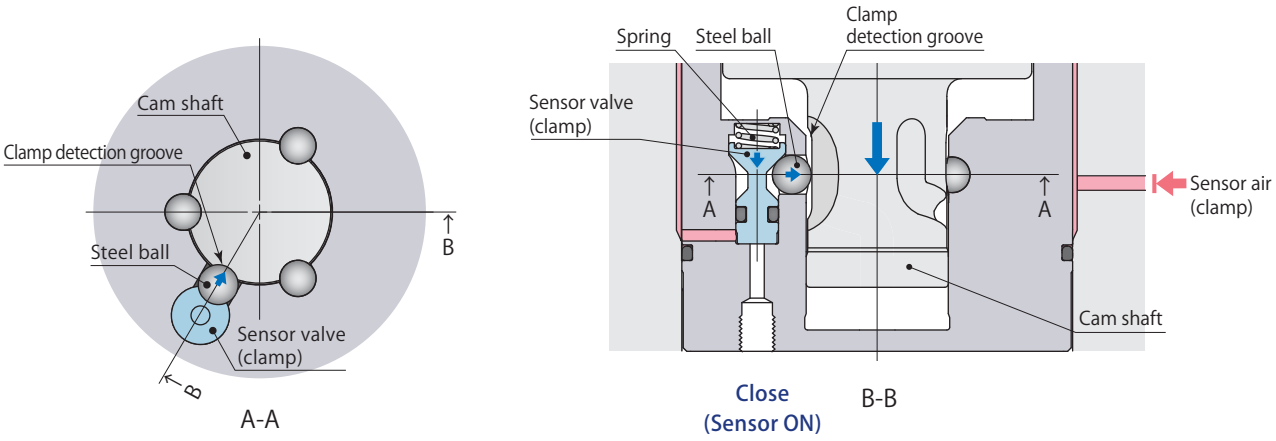
Clamp PAL sensor function and structure

In the middle of swing stroke



- The sensor valve (clamp) is pushed up by the steel ball to open for air exhaust while piston rod swing strokes.

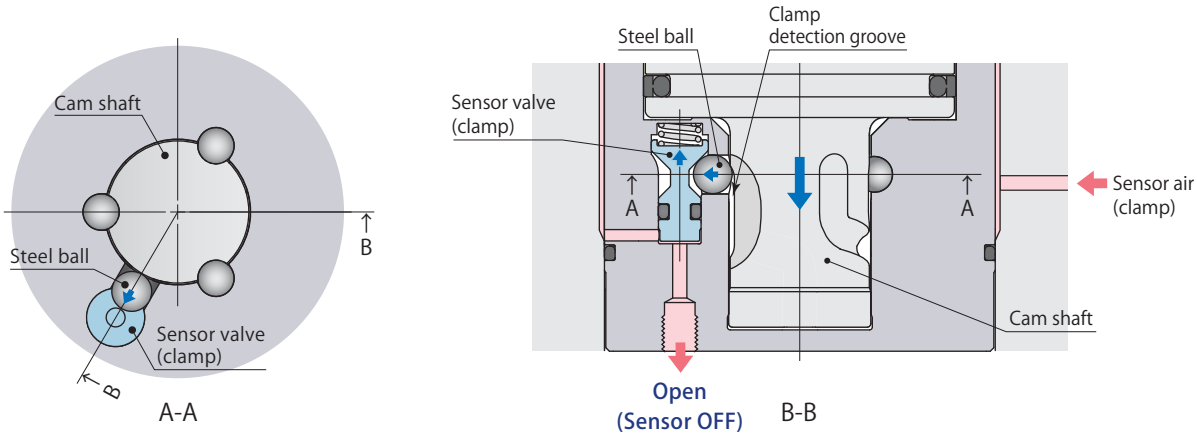
Clamp detection



- The steel ball seats in the clamp detection groove when the cam shaft reaches clamping point, and a sensor valve (clamp) is pushed down to shut of the sensor air by a spring, and detects the clamped condition.

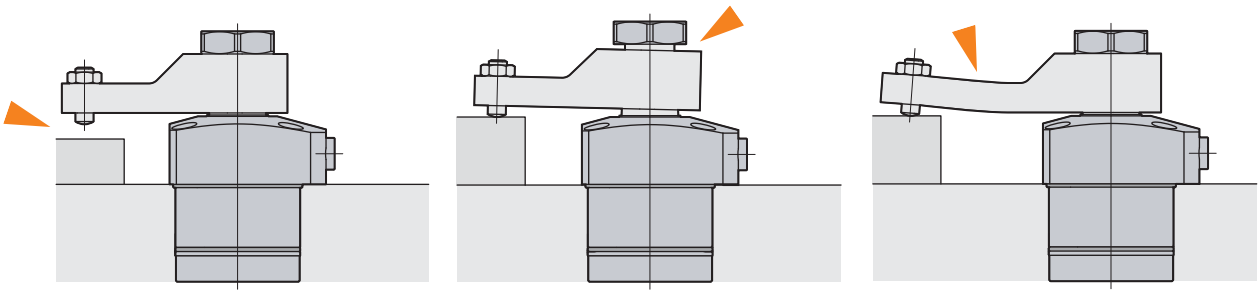
Clamp PAL sensor function and structure

Over clamp stroke (Incomplete clamp) detection



- When the cam shaft passes the clamping point, the sensor valve (clamp) is pushed up by the steel ball to open for air exhaust, and detects the over clamp stroked condition.

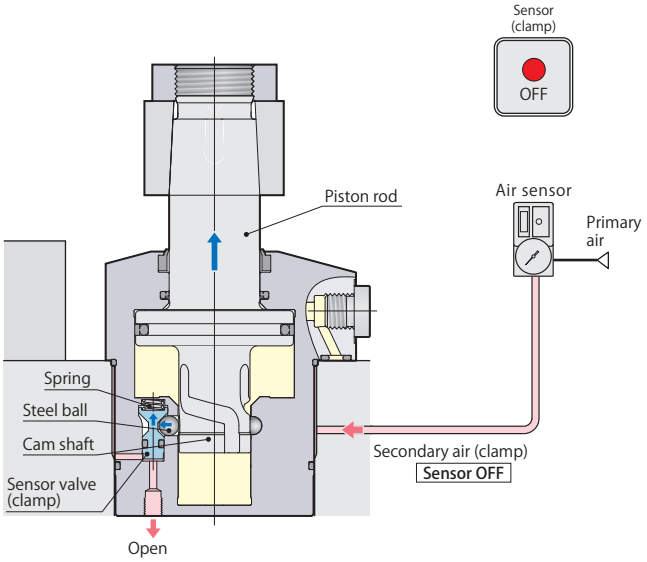
Over clamp stroke (Incomplete clamp) detection example



- Clamp disabled due to mis-setting workpiece.
- Clamp disabled due to the damage of piston rod or loose clamp arm.
- Clamp disabled due to the deflection of clamp arm.
- Clamp disabled due to the abrasion on the tip of clamp arm during prolonged use.

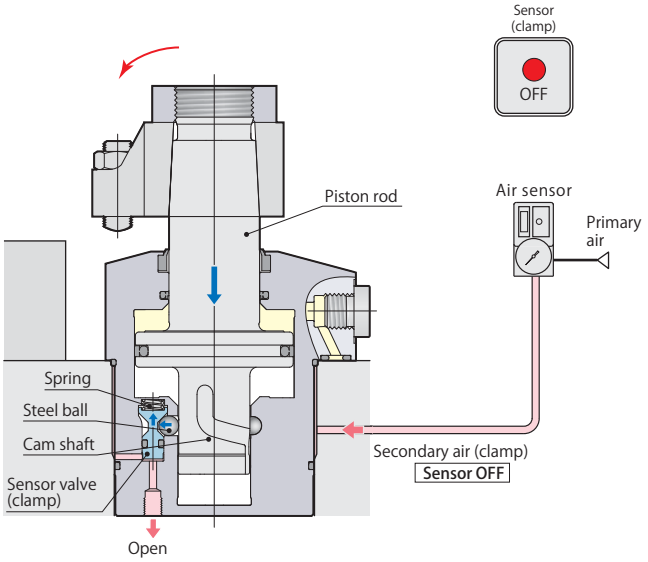
Clamp, Over clamp stroke detection signal

Unclamp



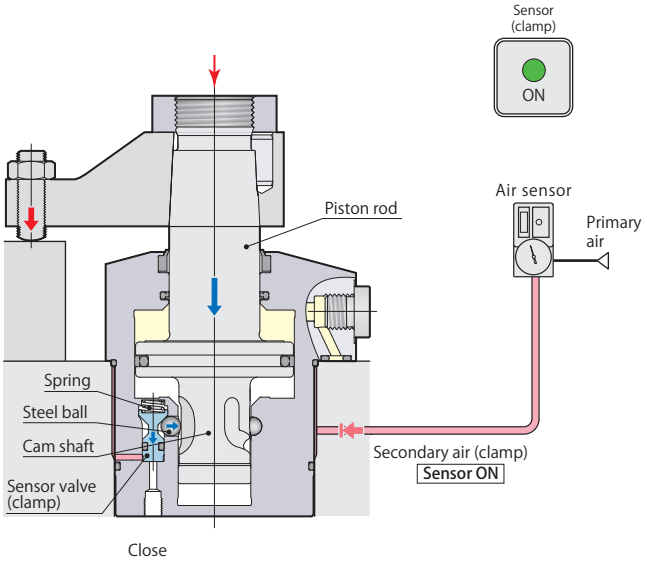
Sensor signal (clamp)	OFF	Unclamp

In the middle of swing stroke



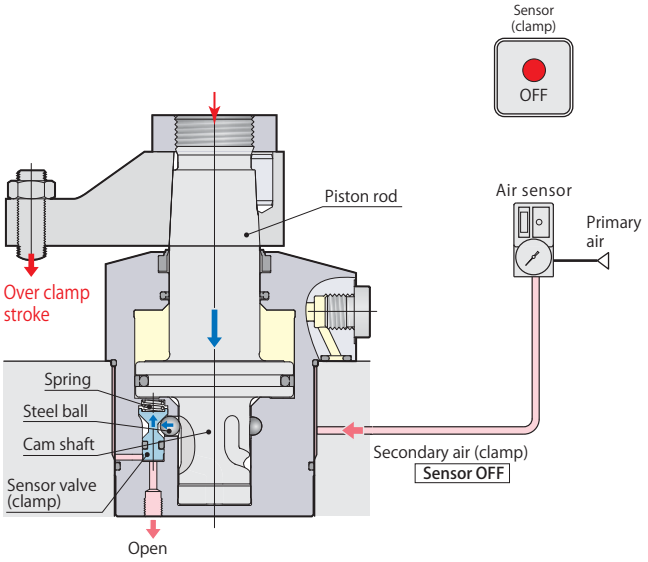
Sensor signal (clamp)	OFF	In the middle of swing stroke

Clamp detection



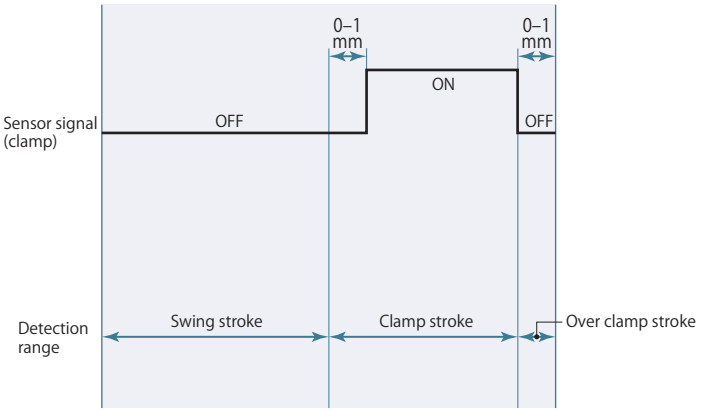
Sensor signal (clamp)	ON	Clamp

Over clamp stroke (Incomplete clamp) detection



Sensor signal (clamp)	OFF	Over clamp stroke (Incomplete clamp)

Air sensor triggering point



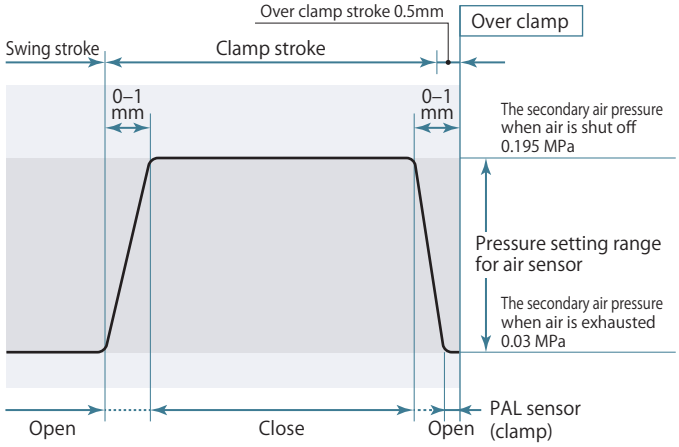
- Refer to the sensor supplier's instruction manual for the details of setting.
- Sensing performance such as detectable time and pressure differs depending on the supplier and model number of the sensor. Select the right model referring to sensor's application and characteristics.

Air sensor unit recommended condition of use

Supplier and model	ISA3-F/G series manufactured by SMC GPS2-05, GPS3-E series manufactured by CKD
Air supply pressure	0.1–0.2 MPa
Inner diameter of piping	ø4 mm (ISA3-F：ø2.5 mm)
Overall piping length	5 m or less

- Supply the dry and filtered air. Particulate size 5 μm or less is recommended.
- 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.

Relation between sensor air pressure, PAL sensor and piston stroke

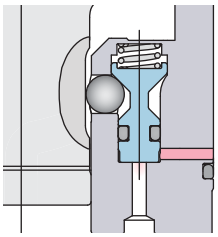


The diagram shown above indicates the relation between the PAL sensor, piston stroke, and secondary air pressure. (The pressure shown in the diagram is a reference based on the 0.2 MPa of primary air pressure for one piece of clamp.)

Since the new PAL sensor works with less air-leakage compared to previous sensor valve,

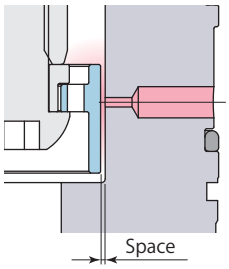
- Enhances the pressure setting range of the sensor which enables the sensor to set easily.
  (Ex. Pressure setting range 0.03–0.195 MPa in the diagram)
- Allows the use for a number of clamps by one air sensor because of better pressure holding when air is shut off. (Maximum number of clamps to be detected by one sensor is 10.)
- Allows to choose less air-consumed, i.e. small orifice diameter type, air sensor.
- Can create large differential-pressure when opening and closing the PAL sensor so that sensor primary pressure can be set as low as possible and reduce the consumption of air.

New PAL sensor



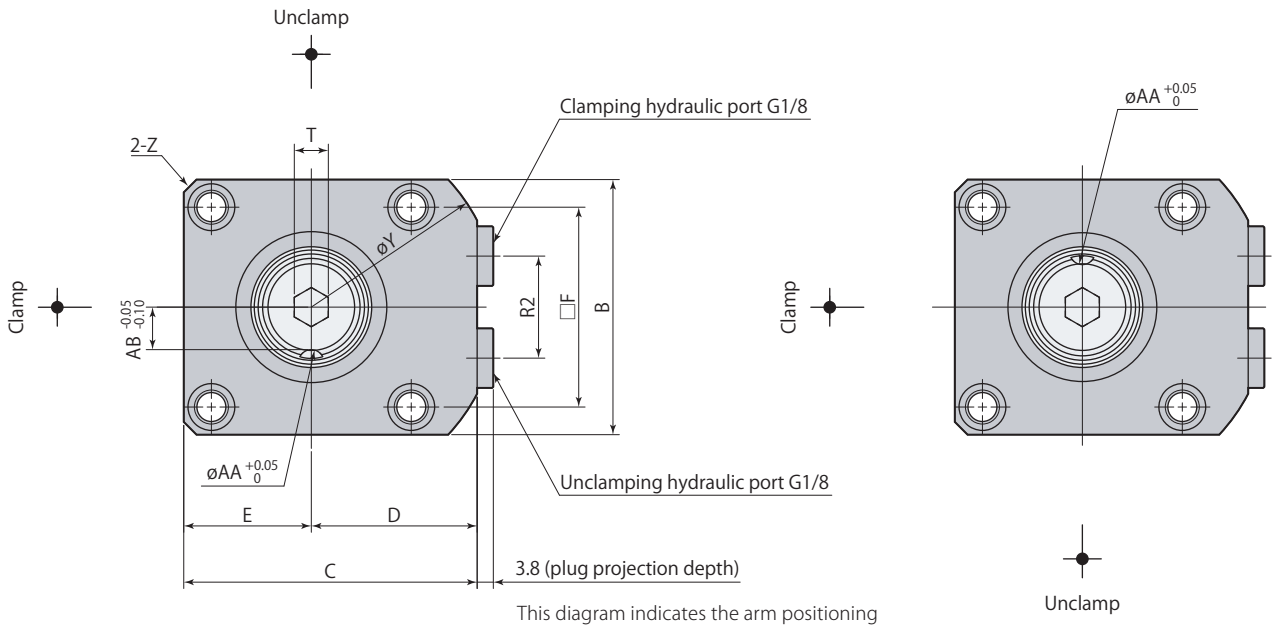
Poppet structure ensures superior sealing performance and can create large differential-pressure when the valve is opening and closing, and air leakage can be minimized.

Previous sensor valve



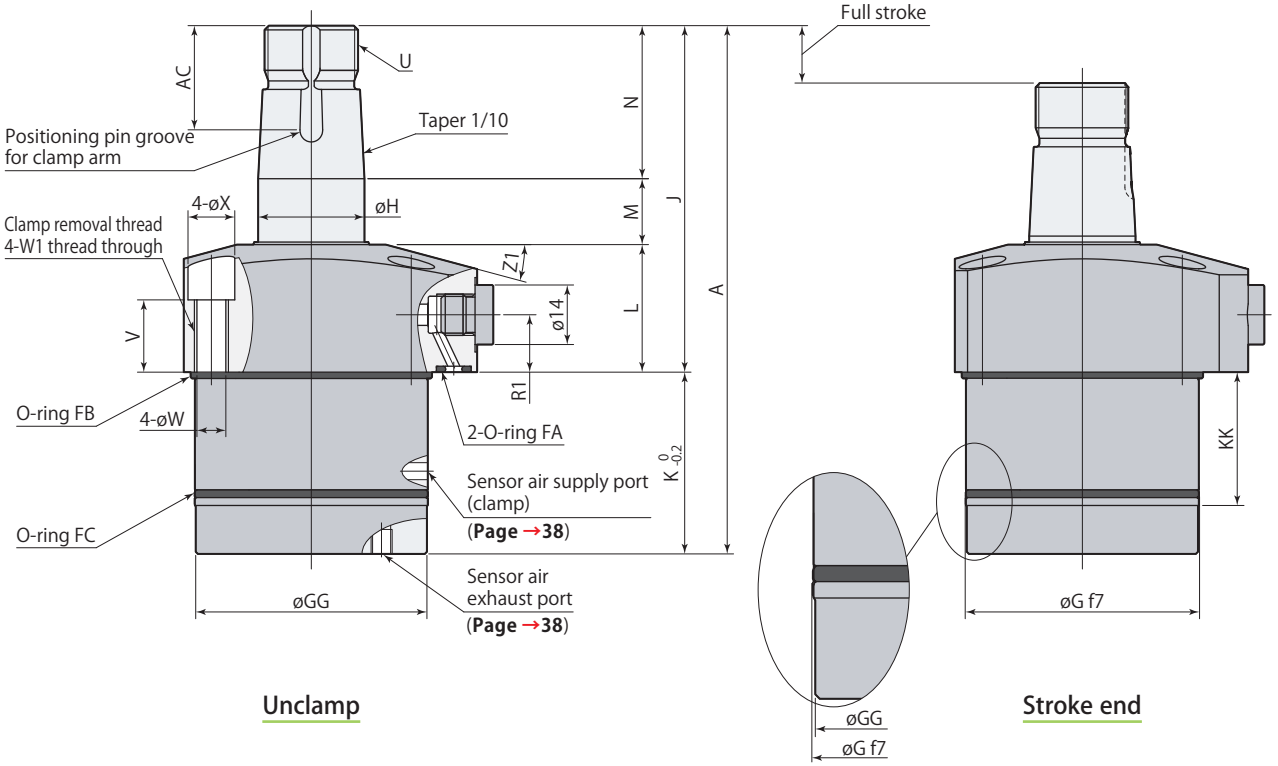
Air leaks easily due to a large space.

Dimensions



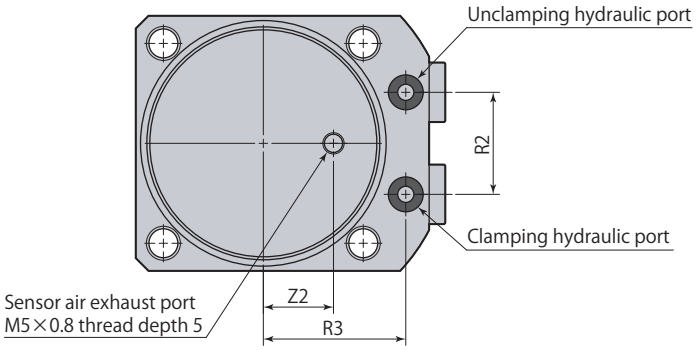
This diagram indicates the arm positioning pin groove at unclamped condition.

Swing direction L (counter-clockwise)

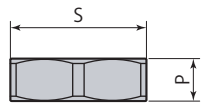


Swing direction R (clockwise)

Unclamp



Stroke end



Hex nut for arm mount

- Hex nut for arm mount is included.
- Refer to **page →72** for the details of perfect nut.
- Clamp arm, positioning pin and mounting screws are not included.

mm

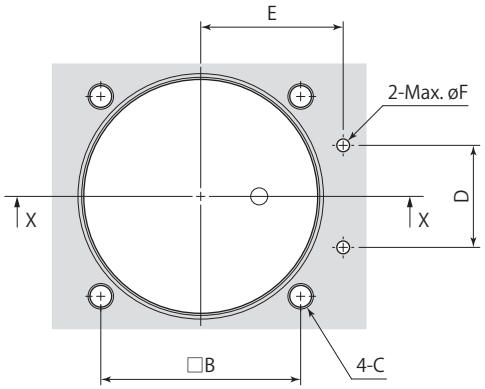
Model		CTM04-□C	CTM05-□C	CTM06-□C	CTM10-□C
Cylinder capacity (cm³)	Clamp	6.0	9.0	14.4	20.7
	Unclamp	9.1	14.0	21.3	31.7
A		103.5	110.5	124.5	136
B		45	51	60	70
C		54	61	69	81
D		31.5	35.5	39	46
E		22.5	25.5	30	35
F		34	40	47	55
øG		40 $^{-0.025}_{-0.050}$	48 $^{-0.025}_{-0.050}$	55 $^{-0.030}_{-0.060}$	65 $^{-0.030}_{-0.060}$
øGG		39.7	47.6	54.6	64.6
øH		18	22	25	30
J		65.5	74.5	81.5	88
K		38	36	43	48
KK		29.5	25	31.5	34
L		25	28	30	31
M		13.5	14.5	15.5	17
N		27	32	36	40
P		8	9	10	11
R1		12.5	14	13.5	14
R2		18	22	24	30
R3		26	30	33.5	39.5
S (nut width across flats)		24	30	32	41
T (hex socket)		6	8	8	10
U		M16×1.5	M20×1.5	M22×1.5	M27×1.5
V		15	17.5	17	17
øW		5.5	5.5	6.8	6.8
W1		M6×1	M6×1	M8×1.25	M8×1.25
øX		9	9	11	11
øY		73	83	88	106
Z		C3	C3	C3	C4
Z1		12°	15°	15°	15°
Z2		11	13.5	16.5	19
øAA (pin groove diameter)		4	5	6	6
AB		7	9	10	12.5
AC		18.5	21.5	24.5	27.5
Positioning pin (dowel pin)		ø4(h8)×10	ø5(h8)×12	ø6(h8)×14	ø6(h8)×16
O-ring FA (fluorocarbon hardness Hs90)		P5	P5	P5	P7
O-ring FB (fluorocarbon hardness Hs70)		38×1.5 (inner diameter×thickness)	AS568-031	AS568-034	AS568-037
O-ring FC (fluorocarbon hardness Hs70)		AS568-028	AS568-031	AS568-033	AS568-036
Taper sleeve		CTH04-MS	CTH05-MS	CTH06-MS	CTH10-MS
Flow control valve*	Meter-in	VCF01S	VCF01S	VCF01S	VCF01
	Meter-out	VCF01S-O	VCF01S-O	VCF01S-O	VCF01-O
Air bleeding valve		VCE01	VCE01	VCE01	VCE01

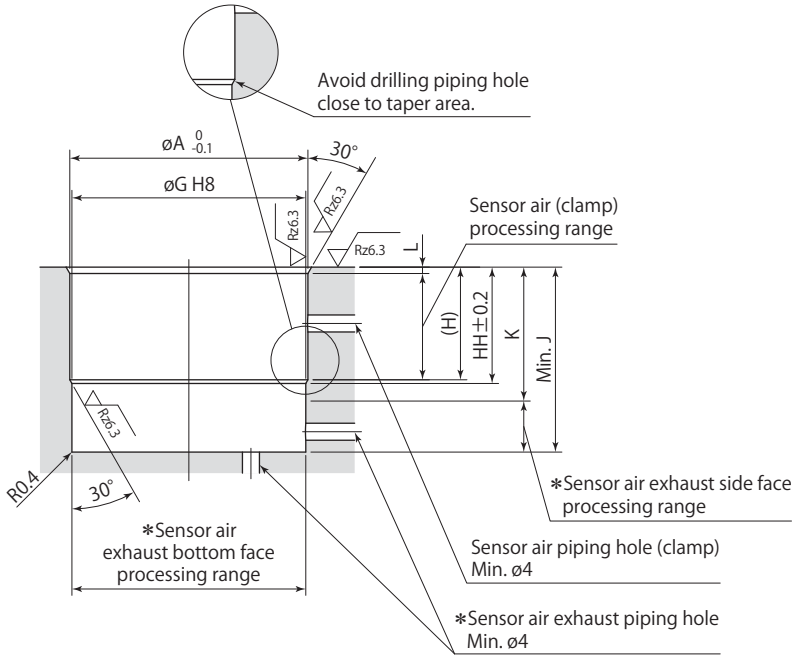
∗: Select the right model of VCF according to the size of the clamp.

Refer to each page for the details of options.

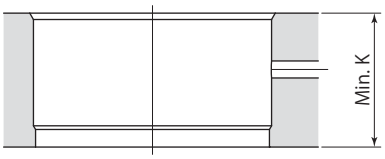
● Taper sleeve **page →70** ● Flow control valve **page →94** ● Air bleeding valve **page →96**

Mounting details





In blind hole X-X



In through hole X-X

*: Sensor air exhaust piping hole must be made on either side or bottom face.

Rz: ISO4287(1997)

- Apply an appropriate amount of grease to the chamfer and the bore when mounting. Excessive grease may be a blockage in the air passage, causing malfunction of the sensor.
- The 30° taper machining must be provided to avoid the damage of the O-ring. Ensure that there are no interference on taper area when drilling the hole for sensor air.

Mounting details

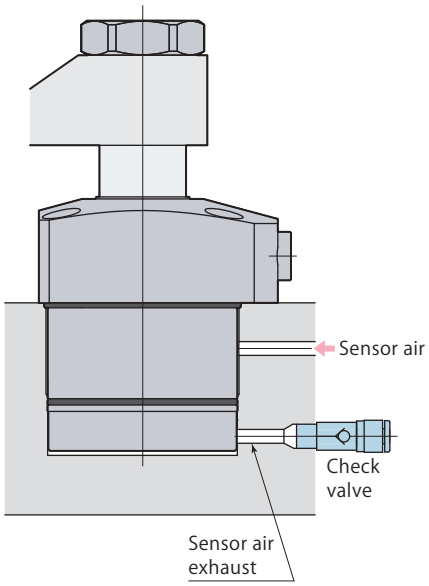
mm

Model	CTM04-□C	CTM05-□C	CTM06-□C	CTM10-□C
øA	40.8	49	56	66
B	34	40	47	55
C	M5	M5	M6	M6
D	18	22	24	30
E	26	30	33.5	39.5
øF	3	3	3	5
øG	$40^{+0.039}_{0}$	$48^{+0.039}_{0}$	$55^{+0.046}_{0}$	$65^{+0.046}_{0}$
H	24.5	20	26.5	29
HH	25.2	20.9	27.4	29.9
J	38.5	36.5	43.5	48.5
K	29.5	25	31.5	34
L	1.2	1.5	1.5	1.5

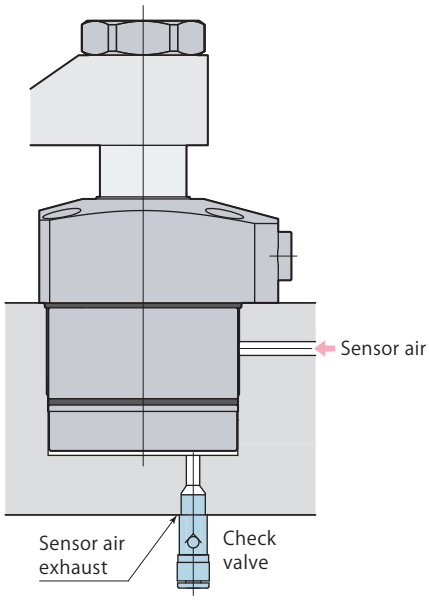
Caution for piping

Refer to the diagram shown below for the sensor air exhaust port.

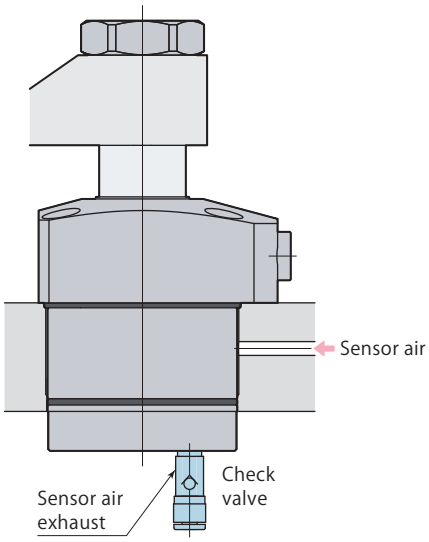
Mounting in blind hole
(Sensor air exhaust：side face)



Mounting in blind hole
(Sensor air exhaust：bottom face)



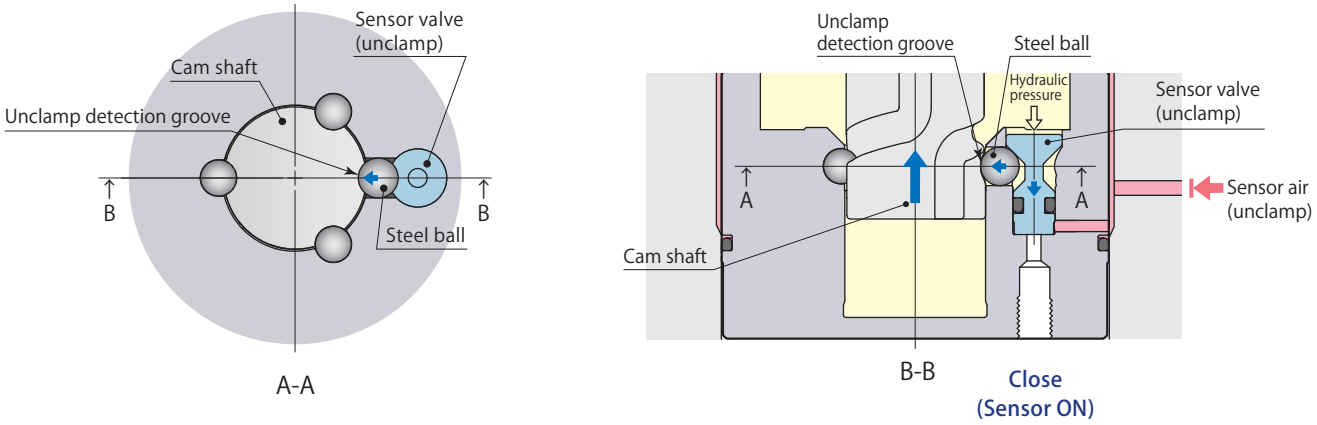
Mounting in through hole



● Use a check valve with cracking pressure of 0.005 MPa or less if there is a risk of metal chips or coolant intrusion. Recommended check valve：AKH or AKB series manufactured by SMC.

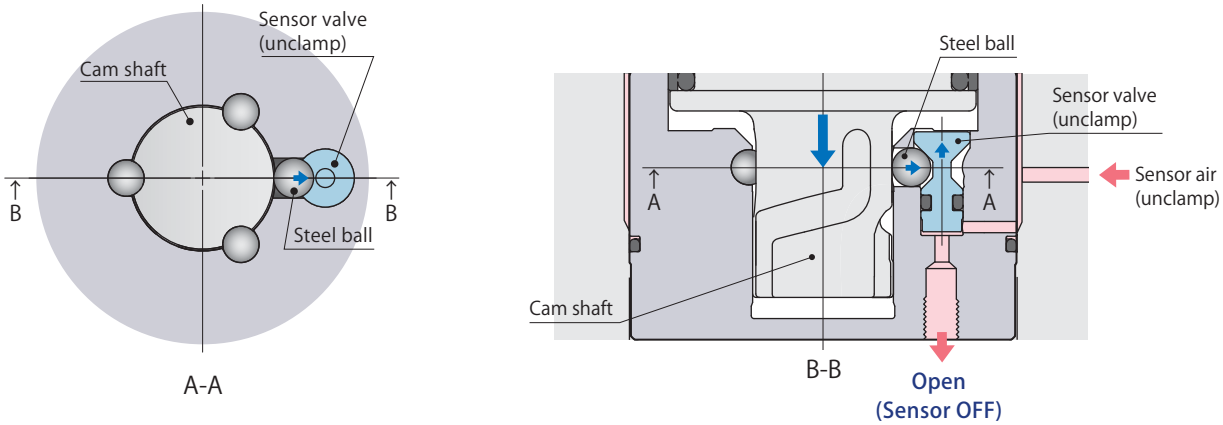
Unclamp PAL sensor function and structure

Unclamp detection



- The steel ball seats in the unclamp detection groove when the cam shaft reaches unclamp end, and a sensor valve (unclamp) is pushed down to shut off the sensor air by hydraulic force, and detects the unclamped condition.

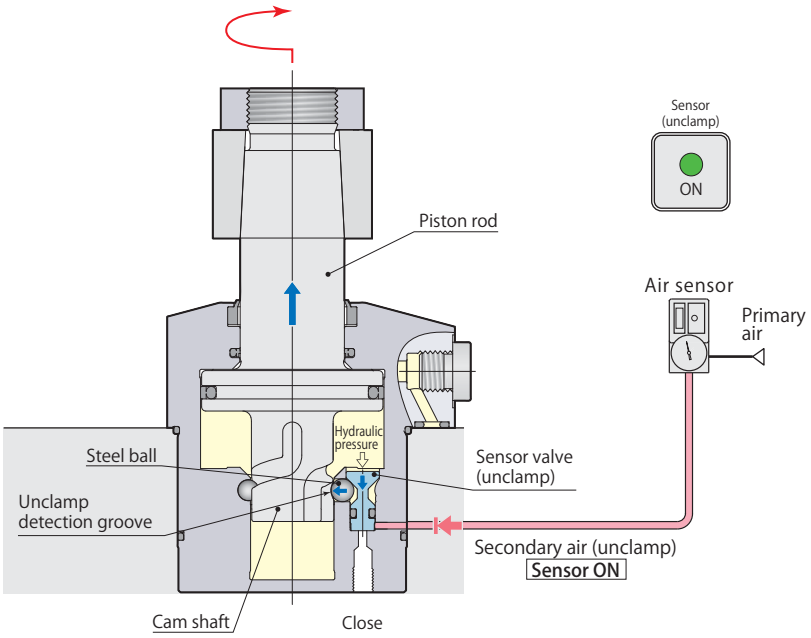
In the middle of stroke



- When the cam shaft lowers, the sensor valve (unclamp) is pushed up by the steel ball to open for air exhaust.

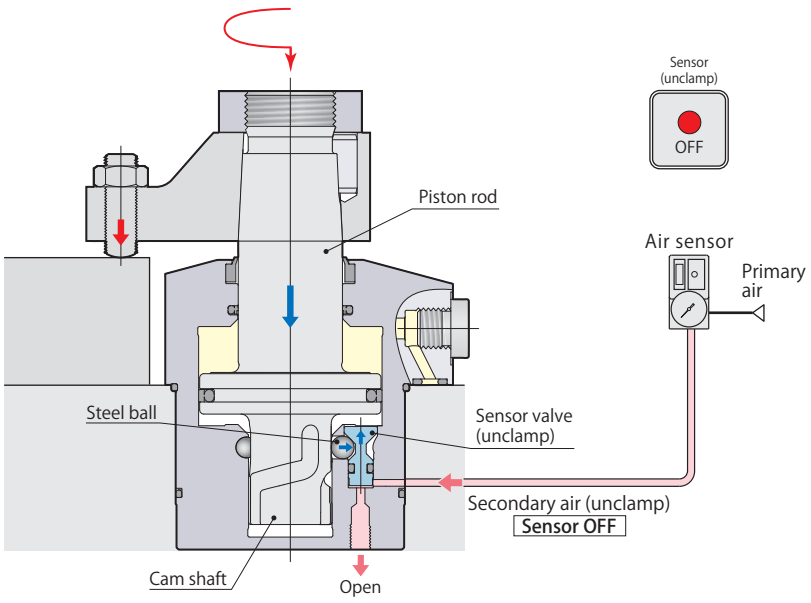
Unclamp detection signal

Unclamp detection



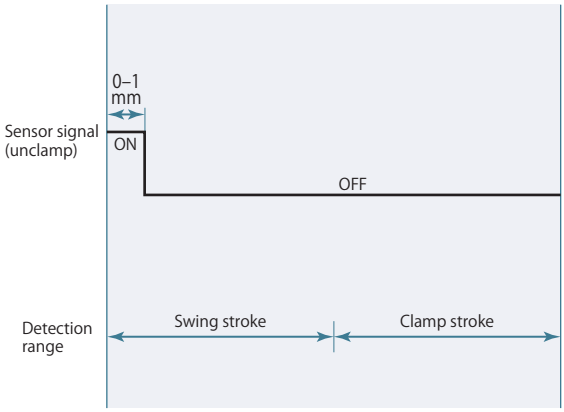
Sensor signal (unclamp)	ON	Unclamp

In the middle of stroke



Sensor signal (unclamp)	OFF	Clamp, in the middle of stroke

Air sensor triggering point



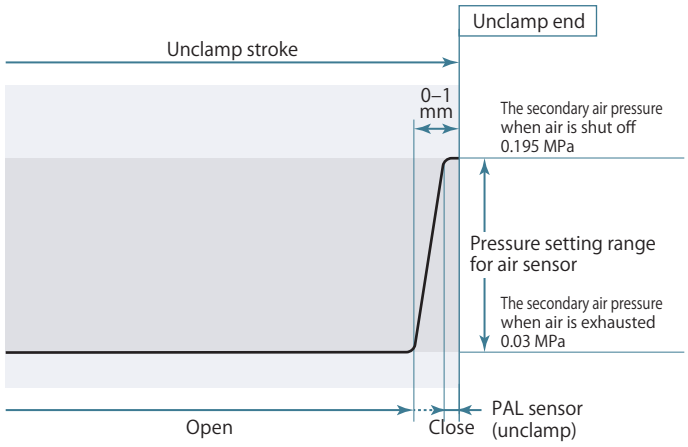
- Refer to the sensor supplier's instruction manual for the details of setting.
- Sensing performance such as detectable time and pressure differs depending on the supplier and model number of the sensor. Select the right model referring to sensor's application and characteristics.

Air sensor unit recommended condition of use

Supplier and model	ISA3-F/G series manufactured by SMC
	GPS2-05, GPS3-E series manufactured by CKD
Air supply pressure	0.1–0.2 MPa
Inner diameter of piping	ø4 mm (ISA3-F：ø2.5 mm)
Overall piping length	5 m or less

- Supply the dry and filtered air. Particulate size 5 μm or less is recommended.
- 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.

Relation between sensor air pressure, PAL sensor and piston stroke

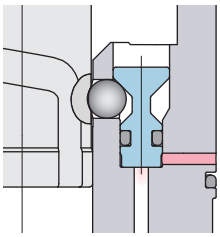


The diagram shown above indicates the relation between the PAL sensor, piston stroke, and secondary air pressure. (The pressure shown in the diagram is a reference based on the 0.2 MPa of primary air pressure for one piece of clamp.)

Since the new PAL sensor works with less air-leakage compared to previous sensor valve,

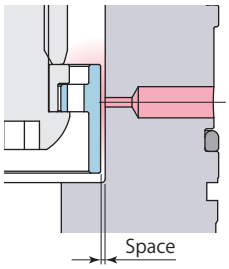
- Enhances the pressure setting range of the sensor which enables the sensor to set easily. (Ex. Pressure setting range 0.03–0.195 MPa in the diagram)
- Allows the use for a number of clamps by one air sensor because of better pressure holding when air is shut off. (Maximum number of clamps to be detected by one sensor is 10.)
- Allows to choose less air-consumed, i.e. small orifice diameter type, air sensor.
- Can create large differential-pressure when opening and closing the PAL sensor so that sensor primary pressure can be set as low as possible and reduce the consumption of air.

New PAL sensor



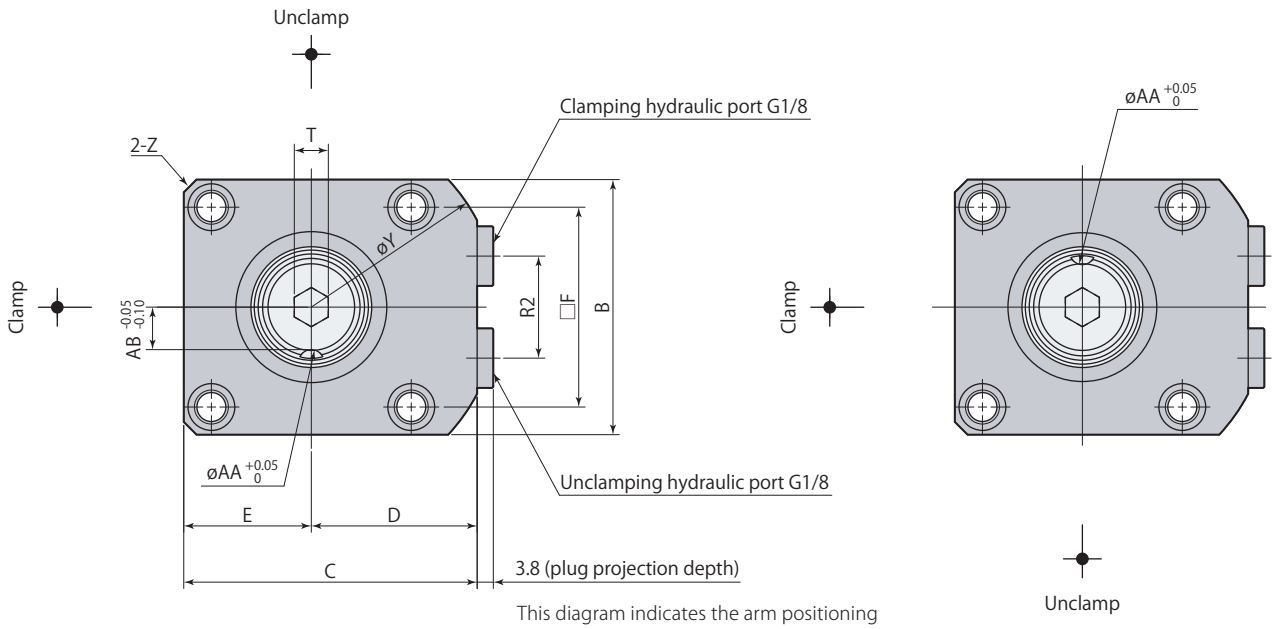
Poppet structure ensures superior sealing performance and can create large differential-pressure when the valve is opening and closing, and air leakage can be minimized.

Previous sensor valve



Air leaks easily due to a large space.

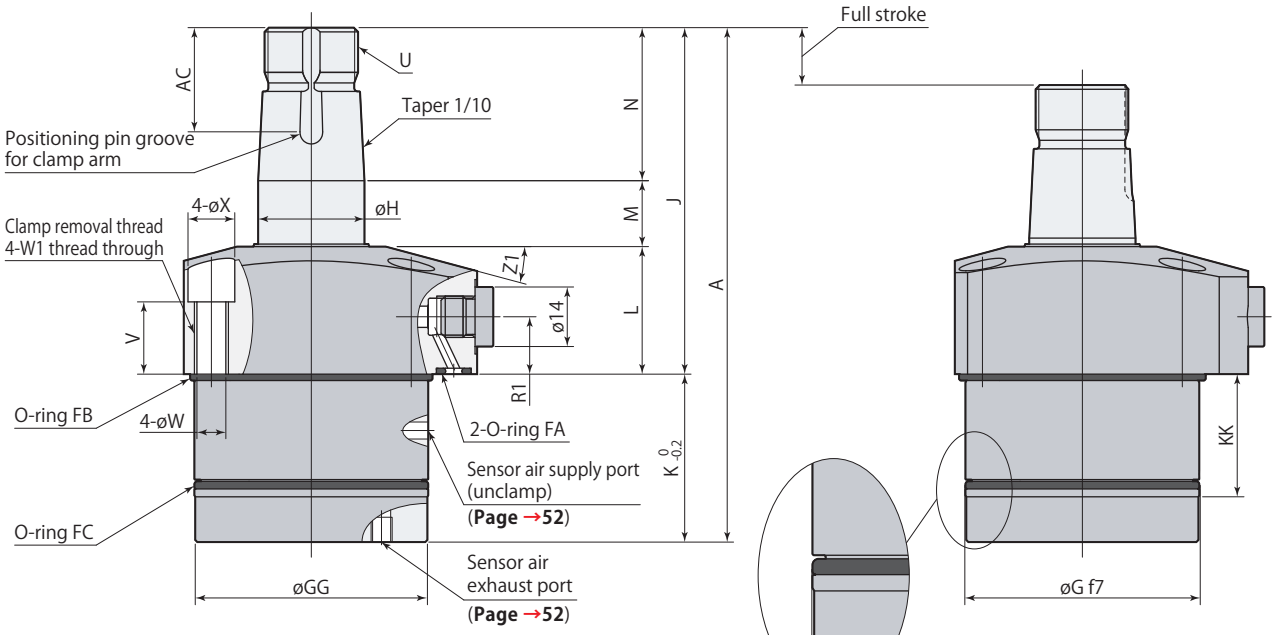
Dimensions



This diagram indicates the arm positioning pin groove at unclamped condition.

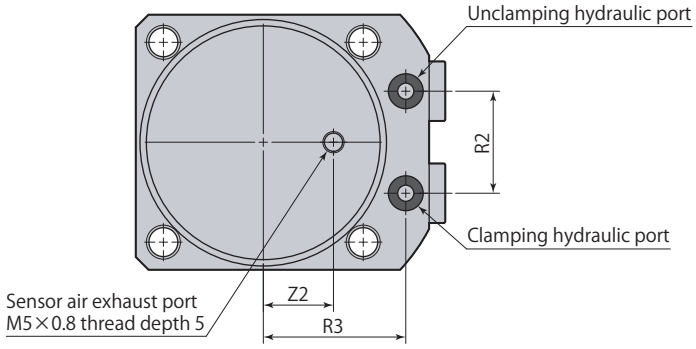
Swing direction L (counter-clockwise)

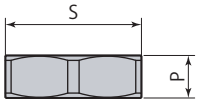
Swing direction R (clockwise)



Unclamp

Stroke end





Hex nut for arm mount

- Hex nut for arm mount is included.
- Refer to **page →72** for the details of perfect nut.
- Clamp arm, positioning pin and mounting screws are not included.

mm

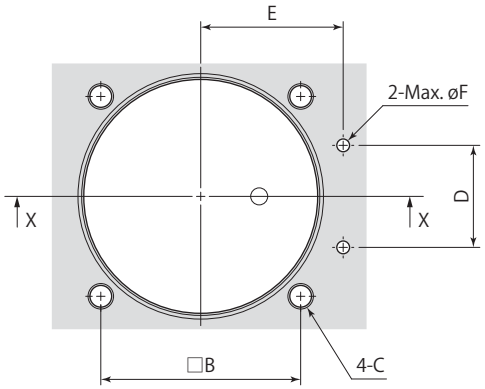
Model		CTM04-□B	CTM05-□B	CTM06-□B	CTM10-□B
Cylinder capacity (cm³)	Clamp	5.8	8.7	13.9	20.0
	Unclamp	8.7	13.4	20.5	30.6
A		99.5	107.5	121	132.5
B		45	51	60	70
C		54	61	69	81
D		31.5	35.5	39	46
E		22.5	25.5	30	35
F		34	40	47	55
øG		40 $^{-0.025}_{-0.050}$	48 $^{-0.025}_{-0.050}$	55 $^{-0.030}_{-0.060}$	65 $^{-0.030}_{-0.060}$
øGG		39.7	47.6	54.6	64.6
øH		18	22	25	30
J		65.5	74.5	81.5	88
K		34	33	39.5	44.5
KK		26	22.5	28.5	31
L		25	28	30	31
M		13.5	14.5	15.5	17
N		27	32	36	40
P		8	9	10	11
R1		12.5	14	13.5	14
R2		18	22	24	30
R3		26	30	33.5	39.5
S (nut width across flats)		24	30	32	41
T (hex socket)		6	8	8	10
U		M16×1.5	M20×1.5	M22×1.5	M27×1.5
V		15	17.5	17	17
øW		5.5	5.5	6.8	6.8
W1		M6×1	M6×1	M8×1.25	M8×1.25
øX		9	9	11	11
øY		73	83	88	106
Z		C3	C3	C3	C4
Z1		12°	15°	15°	15°
Z2		11	13.5	16.5	19
øAA (pin groove diameter)		4	5	6	6
AB		7	9	10	12.5
AC		18.5	21.5	24.5	27.5
Positioning pin (dowel pin)		ø4(h8)×10	ø5(h8)×12	ø6(h8)×14	ø6(h8)×16
O-ring FA (fluorocarbon hardness Hs90)		P5	P5	P5	P7
O-ring FB (fluorocarbon hardness Hs70)		38×1.5 (inner diameter×thickness)	AS568-031	AS568-034	AS568-037
O-ring FC (fluorocarbon hardness Hs70)		AS568-028	AS568-031	AS568-033	AS568-036
Taper sleeve		CTH04-MS	CTH05-MS	CTH06-MS	CTH10-MS
Flow control valve*	Meter-in	VCF01S	VCF01S	VCF01S	VCF01
	Meter-out	VCF01S-O	VCF01S-O	VCF01S-O	VCF01-O
Air bleeding valve		VCE01	VCE01	VCE01	VCE01

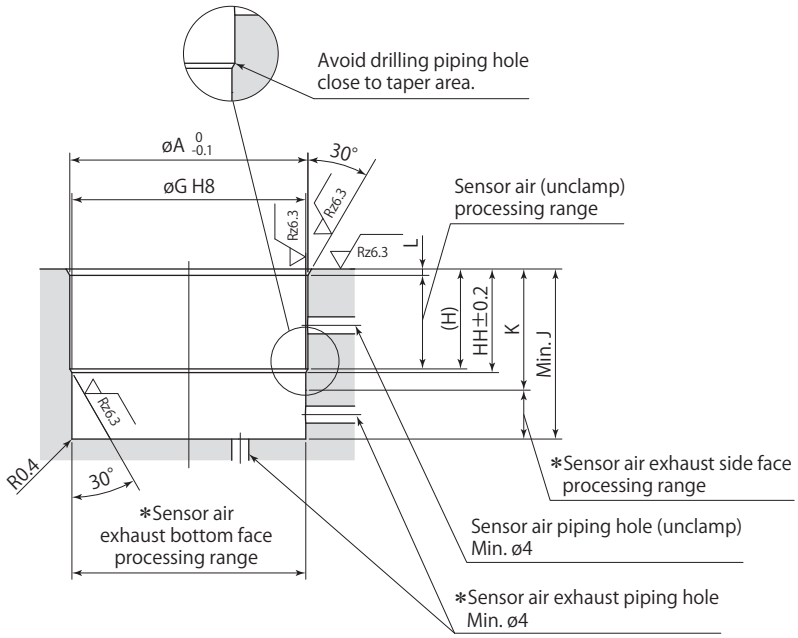
∗: Select the right model of VCF according to the size of the clamp.

Refer to each page for the details of options.

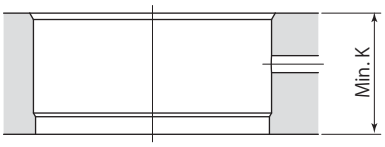
● Taper sleeve **page →70** ● Flow control valve **page →94** ● Air bleeding valve **page →96**

Mounting details





In blind hole X-X



In through hole X-X

*: Sensor air exhaust piping hole must be made on either side or bottom face.

Rz: ISO4287(1997)

- Apply an appropriate amount of grease to the chamfer and the bore when mounting. Excessive grease may be a blockage in the air passage, causing malfunction of the sensor.
- The 30° taper machining must be provided to avoid the damage of the O-ring. Ensure that there are no interference on taper area when drilling the hole for sensor air.

Mounting details

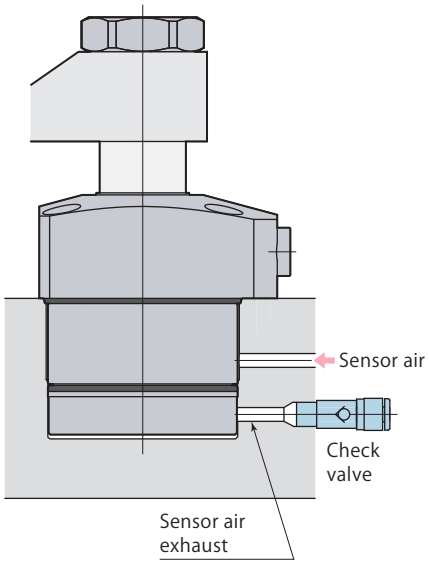
mm

Model	CTM04-□B	CTM05-□B	CTM06-□B	CTM10-□B
øA	40.8	49	56	66
B	34	40	47	55
C	M5	M5	M6	M6
D	18	22	24	30
E	26	30	33.5	39.5
øF	3	3	3	5
øG	$40^{+0.039}_{0}$	$48^{+0.039}_{0}$	$55^{+0.046}_{0}$	$65^{+0.046}_{0}$
H	21	17.5	23.5	26
HH	21.7	18.4	24.4	26.9
J	34.5	33.5	40	45
K	26	22.5	28.5	31
L	1.2	1.5	1.5	1.5

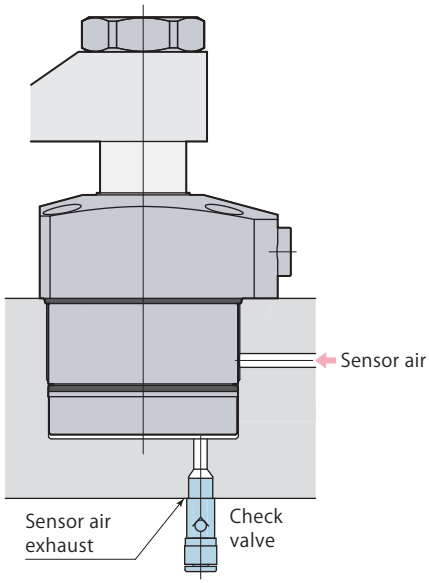
Caution for piping

Refer to the diagram shown below for the sensor air exhaust port.

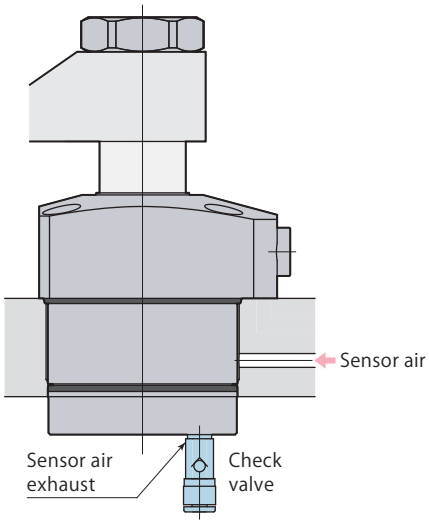
Mounting in blind hole
(Sensor air exhaust：side face)



Mounting in blind hole
(Sensor air exhaust：bottom face)

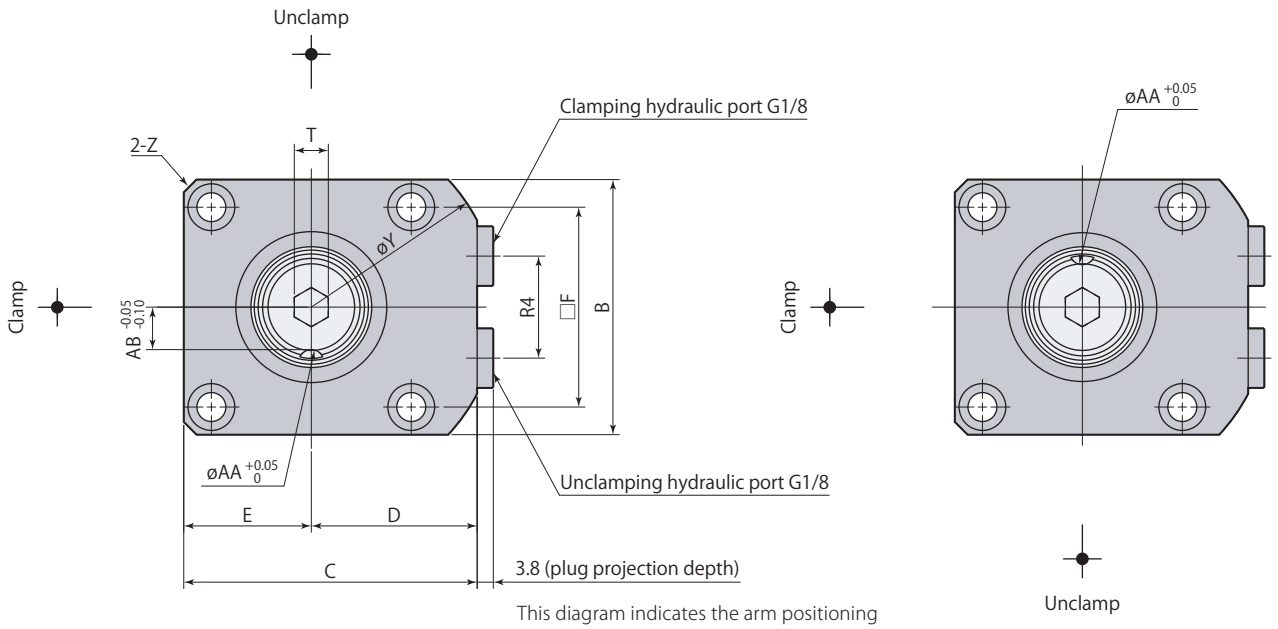


Mounting in through hole



● Use a check valve with cracking pressure of 0.005 MPa or less if there is a risk of metal chips or coolant intrusion. Recommended check valve：AKH or AKB series manufactured by SMC.

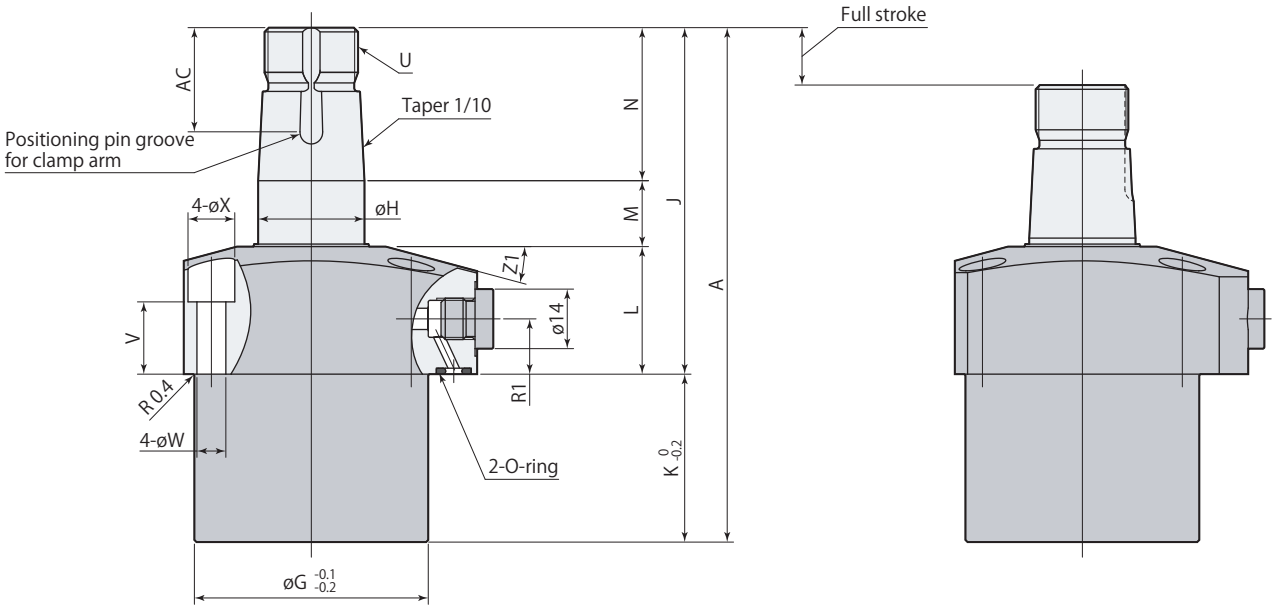
Dimensions



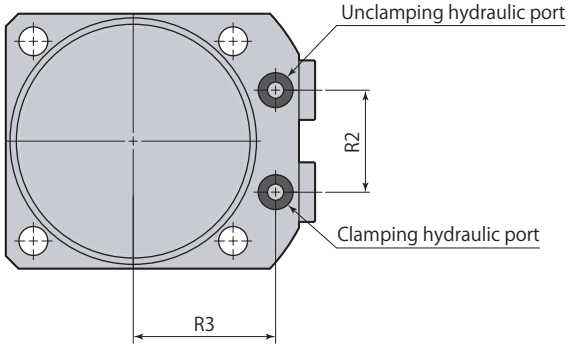
This diagram indicates the arm positioning pin groove at unclamped condition.

Swing direction L (counter-clockwise)

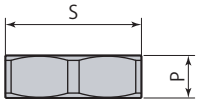
Swing direction R (clockwise)



Unclamp



Stroke end



Hex nut for arm mount

- Hex nut for arm mount is included.
- Refer to **page →72** for the details of perfect nut.
- Clamp arm, positioning pin and mounting screws are not included.

mm

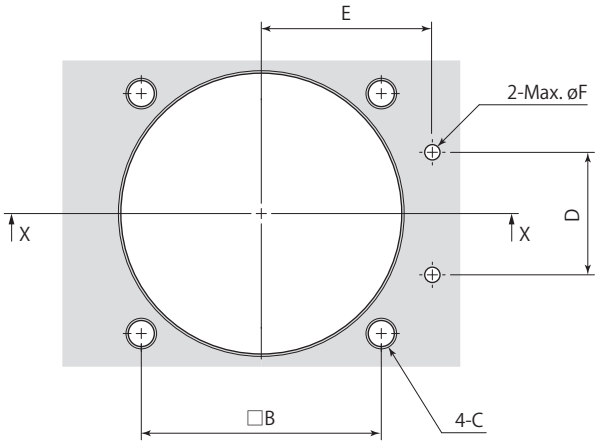
Model		CTM03-□N	CTM04-□N	CTM05-□N	CTM06-□N	CTM10-□N
Cylinder capacity (cm^3)	Clamp	3.7	5.8	8.7	13.9	20.0
	Unclamp	5.6	8.7	13.4	20.5	30.6
A		92	99.5	107.5	121	132.5
B		40	45	51	60	70
C		49	54	61	69	81
D		29	31.5	35.5	39	46
E		20	22.5	25.5	30	35
F		31.4	34	40	47	55
øG		36	40	48	55	65
øH		15	18	22	25	30
J		61.5	65.5	74.5	81.5	88
K		30.5	34	33	39.5	44.5
L		25	25	28	30	31
M		12.5	13.5	14.5	15.5	17
N		24	27	32	36	40
P		7	8	9	10	11
R1		12	12.5	14	13.5	14
R2		16	18	22	24	30
R3		23.5	26	30	33.5	39.5
R4		18	18	22	24	30
S (nut width across flats)		22	24	30	32	41
T (hex socket)		5	6	8	8	10
U		M14×1.5	M16×1.5	M20×1.5	M22×1.5	M27×1.5
V		16	15	17.5	17	17
øW		4.5	5.5	5.5	6.8	6.8
øX		7.5	9	9	11	11
øY		66	73	83	88	106
Z		C2	C3	C3	C3	C4
Z1		15°	12°	15°	15°	15°
øAA (pin groove diameter)		4	4	5	6	6
AB		6	7	9	10	12.5
AC		17.5	18.5	21.5	24.5	27.5
Positioning pin (dowel pin)		ø4(h8)×10	ø4(h8)×10	ø5(h8)×12	ø6(h8)×14	ø6(h8)×16
O-ring (fluorocarbon hardness Hs90)		P5	P5	P5	P5	P7
Taper sleeve		CTH03-MS	CTH04-MS	CTH05-MS	CTH06-MS	CTH10-MS
Flow control valve*	Meter-in	VCF01S	VCF01S	VCF01S	VCF01S	VCF01
	Meter-out	VCF01S-O	VCF01S-O	VCF01S-O	VCF01S-O	VCF01-O
Air bleeding valve		VCE01	VCE01	VCE01	VCE01	VCE01

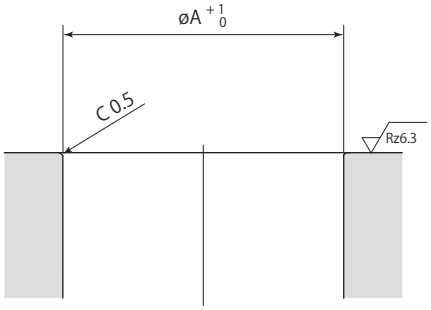
∗: Select the right model of VCF according to the size of the clamp.

Refer to each page for the details of options.

● Taper sleeve **page →70** ● Flow control valve **page →94** ● Air bleeding valve **page →96**

Mounting details





X-X

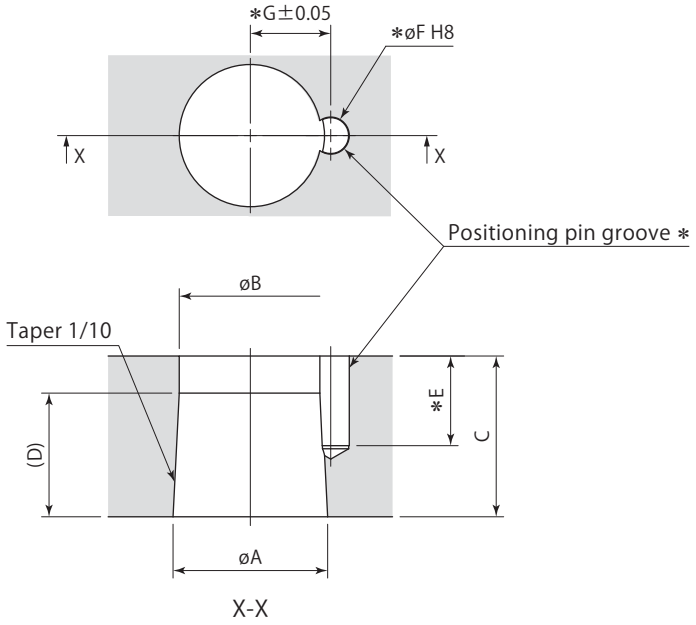
Rz: ISO4287(1997)

mm

Model	CTM03-□N	CTM04-□N	CTM05-□N	CTM06-□N	CTM10-□N
øA	36	40	48	55	65
B	31.4	34	40	47	55
C	M4	M5	M5	M6	M6
D	16	18	22	24	30
E	23.5	26	30	33.5	39.5
øF	3	3	3	3	5

Clamp arm mounting details

Clamp arm is not included. Manufacture a clamp arm with the dimensions shown in the table below.



∗: No need to machine the pin groove (E, øF, G) unless positioning pin is used for the arm.
The positioning pin enables a clamp arm to locate on the clamp firmly and easily.

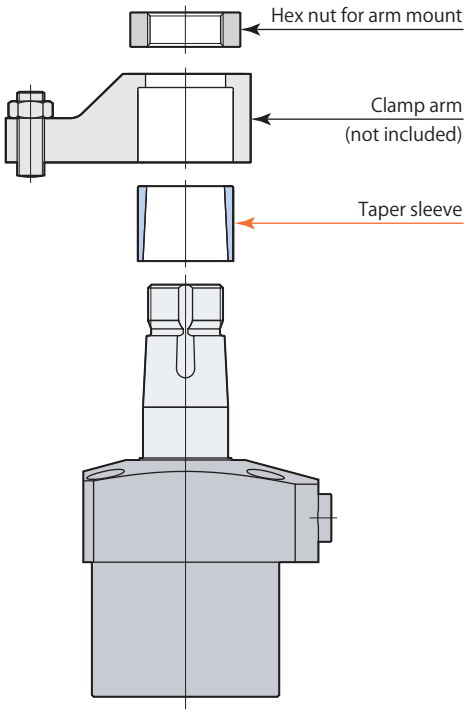
mm

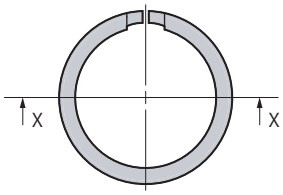
Swing clamp	CTM03	CTM04	CTM05	CTM06	CTM10	CTM16
øA	15 $^{-0.016}_{-0.034}$	18 $^{-0.016}_{-0.034}$	22 $^{-0.020}_{-0.041}$	25 $^{-0.020}_{-0.041}$	30 $^{-0.020}_{-0.041}$	35.5 $^{-0.025}_{-0.050}$
øB	14.1	16.5	20.5	23	28	(32)
C	17	19	23	26	29	35
D	9	15	15	20	20	–
E	10.5	10.5	12.5	14.5	16.5	17.5
øF (pin groove diameter)	4 $^{+0.018}_{0}$	4 $^{+0.018}_{0}$	5 $^{+0.018}_{0}$	6 $^{+0.018}_{0}$	6 $^{+0.018}_{0}$	8 $^{+0.022}_{0}$
G	8	9	11.5	13	15.5	18

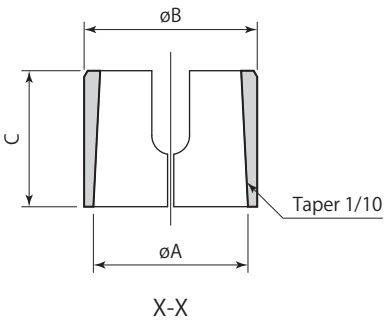
Taper sleeve

CTH — MS : Taper sleeve

Size
- 03
- 04
- 05
- 06
- 10
- 16







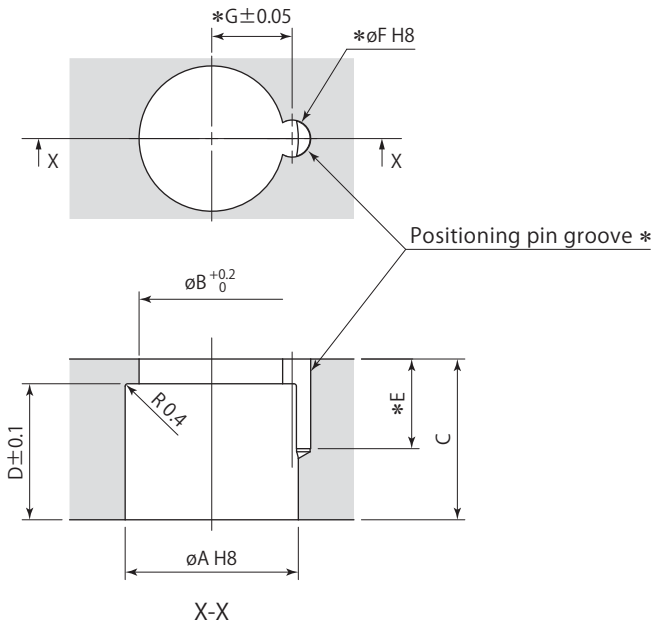
mm

Taper sleeve	CTH03-MS	CTH04-MS	CTH05-MS	CTH06-MS	CTH10-MS	CTH16-MS
Applicable swing clamp	CTM03	CTM04	CTM05	CTM06	CTM10	CTM16
øA	15	18	22	25	30	35.5
øB	17	20	25	28	34	40
C	14	16	19	22	25	31

Clamp arm mounting details

(Using taper sleeve)

Clamp arm is not included. Manufacture a clamp arm with the dimensions shown in the table below.



∗：No need to machine the pin groove (E, øF, G) unless positioning pin is used for the arm.
The positioning pin enables a clamp arm to locate on the clamp firmly and easily.

mm

Taper sleeve	CTH03-MS	CTH04-MS	CTH05-MS	CTH06-MS	CTH10-MS	CTH16-MS
Applicable swing clamp	CTM03	CTM04	CTM05	CTM06	CTM10	CTM16
øA	17 +0.027 0	20 +0.033 0	25 +0.033 0	28 +0.033 0	34 +0.039 0	40 +0.039 0
øB	15	17	21	23.5	29	33
C	17	19	23	26	29	35
D	14	16	19	22	25	31
E	10.5	10.5	12.5	14.5	16.5	17.5
øF (pin groove diameter)	4 +0.018 0	4 +0.018 0	5 +0.018 0	6 +0.018 0	6 +0.018 0	8 +0.022 0
G	8	9	11.5	13	15.5	18