Sensing air Swing clamp

Double acting 1 MPa

model CTX-T

3 point sensor model
model CTX50-LT

Sensing air Swing clamp model CTX-T

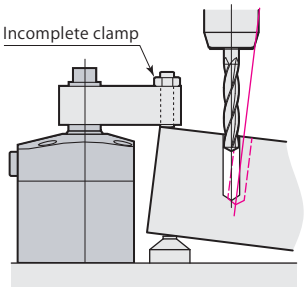
The extremely small sensing clamp can detect the loading miss and setting miss of a workpiece firmly.

3 point sensor model

Cylinder force is increased 1.1 to 1.3 times of the force of CTX standard model

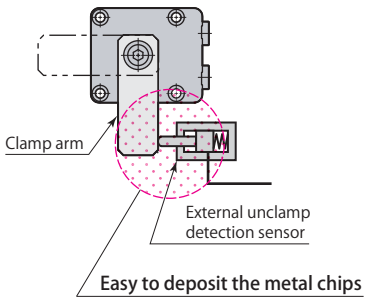
- Sensor model can prevent tool breakage and defective machining due to incomplete clamp. (Figure 1)
- Unclamp PAL sensor moves along with the piston rod and can positively detect unclamping point, thereby enabling a high-speed production line by fully synchronizing operation with workpiece lifters.
- 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



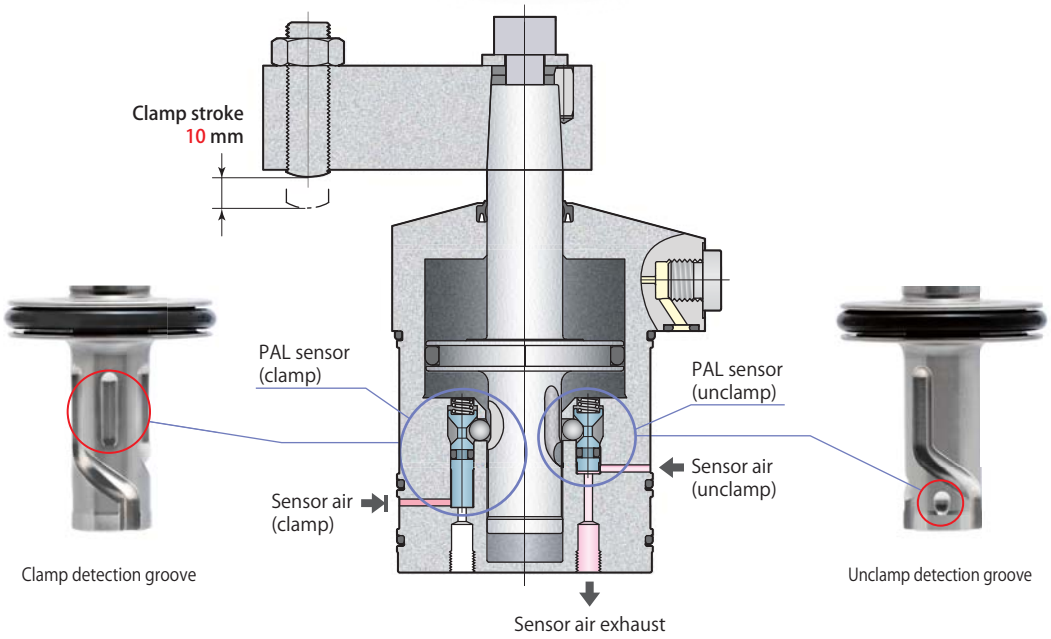
3 point sensor model T

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

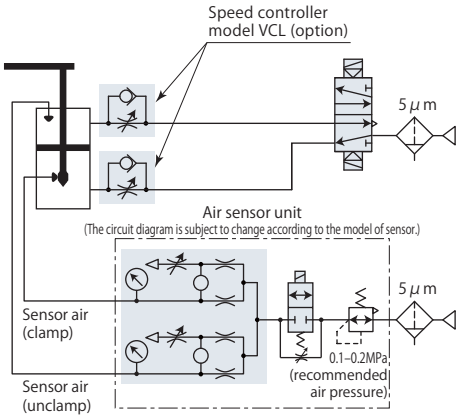
model **CTX□-□T** PAT.

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 →12–15** for the details.



Pneumatic circuit diagram



Specifications

CTX – Size: 32 / 40 / 50 / 63

Swing direction (when clamping)

L : Counter-clockwise

R : Clockwise

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

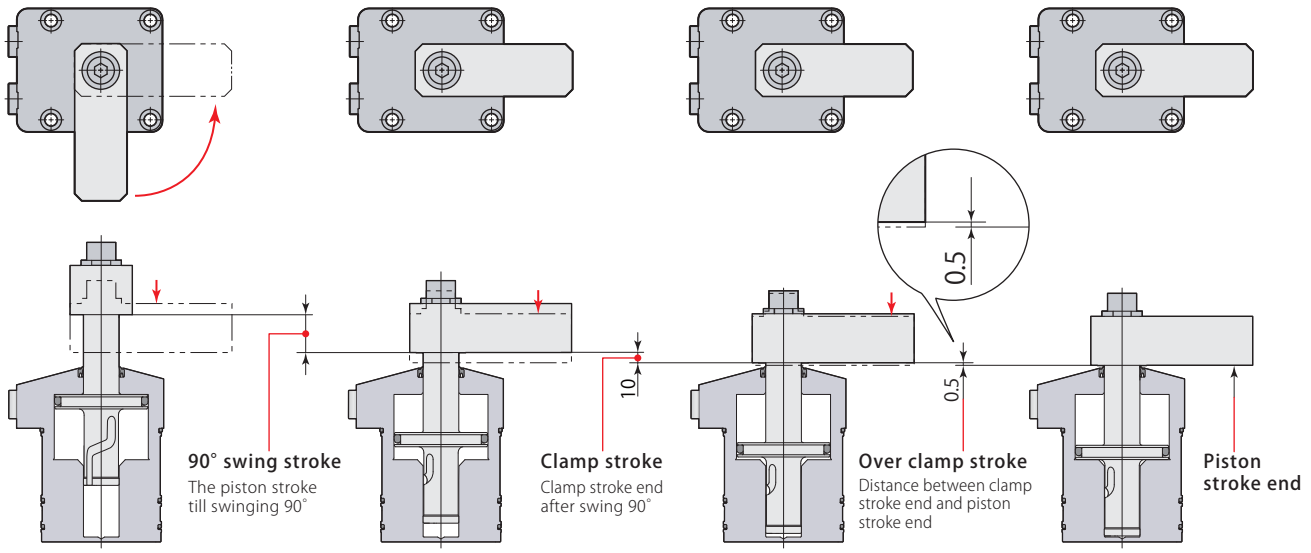
Model			CTX32-□T	CTX40-□T	CTX50-□T	CTX63-□T
Cylinder force (air pressure 0.5MPa)		N	400	590	900	1410
Cylinder inner diameter		mm	35	42	52	65
Rod diameter		mm	14	16	20	25
Effective area		mm^2	808	1184	1810	2827
Swing angle			90°±3°			
Positioning pin groove position accuracy			±1°			
Repeated clamp positioning accuracy			±0.5°			
Full stroke		mm	21	22.5	25.5	29
90° swing stroke		mm	10.5	12	15	18.5
Clamp stroke		mm	10	10	10	10
Over clamp stroke		mm	0.5	0.5	0.5	0.5
Cylinder capacity	Clamp	cm^3	17.0	26.6	46.1	82.0
	Unclamp	cm^3	20.2	31.2	54.2	96.2
Mass		kg	0.45	0.62	1.05	1.72
Recommended tightening torque of mounting screws*1		N·m	4.0	4.0	5.9	5.9
Recommended tightening torque of cap screw*2		N·m	25	25	50	53

- Pressure range : 0.2–1 MPa
- Proof pressure : 1.5 MPa
- Operating temperature : 0–70 ℃
- Fluid used : Air*3
- Oil supply : Not required
- Seals are resistant to chlorine-based cutting fluid. (not thermal resistant specification)

*1 : ISO R898 class 12.9 *2 : Arm mounting screw

*3 : Supply the dry and filtered air. Particulate size 5 μm or less is recommended.

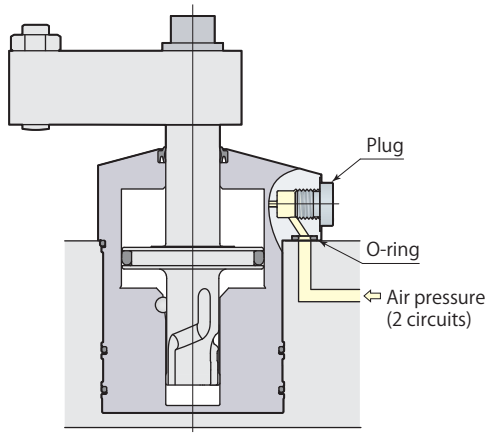
Clamping must be done within the range of clamp stroke.



Manifold piping and G port piping are available.

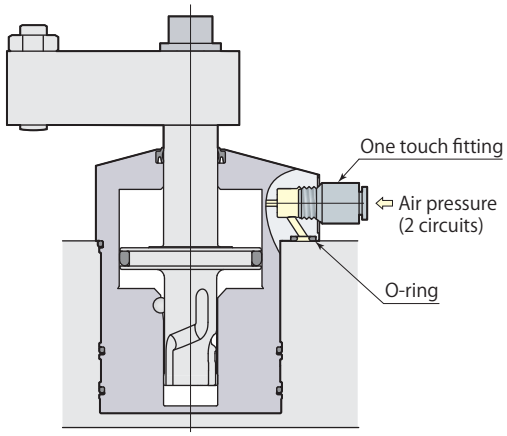
Manifold piping

When choosing manifold piping, a speed controller model VCL is mountable on the G ports of the clamp.



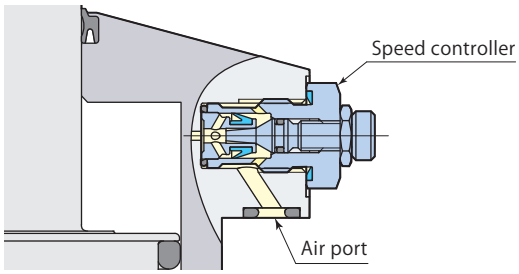
G port piping

When choosing G port piping, remove plugs. (O-ring must be used.) The one touch fitting or the speed controller with one touch fitting should be mounted when choosing G port piping.

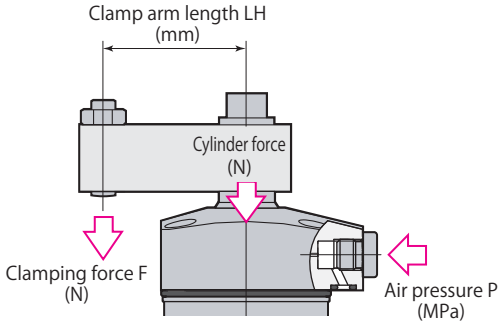


Speed controller model VCL

Page →56



Performance table



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

Clamping force calculation formula

F = P × 1000/(Coefficient 1 + Coefficient 2 × LH)

F: Clamping force P: Air pressure LH: Clamp arm length

CTX50-T with clamp arm length (LH) 60 mm at air pressure of 1.0 MPa, Clamping force F is calculated by

1.0×1000/(0.553+0.00152×60)=1550 N

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

model CTX32-□T Clamping force F=P×1000/(1.24+0.00424×LH)

Air pressure MPa	Cylinder force N	Clamping force N / Clamp arm length LH mm						Max. arm length Max. LH mm
		35	50	70	90	100	120	
1.0	810	720	690	650	Nonusable range			77
0.9	730	650	620	590				88
0.8	650	580	550	520	490	480		104
0.7	560	500	480	460	430	420	400	125
0.6	480	430	410	390	370	360	340	159
0.5	400	360	340	330	310	300	290	190
0.4	320	290	280	260	250	240	230	↑
0.3	240	220	210	200	190	180	170	↑
0.2	160	140	140	130	120	120	110	190

model CTX40-□T Clamping force F=P×1000/(0.844+0.00275×LH)

Air pressure MPa	Cylinder force N	Clamping force N / Clamp arm length LH mm						Max. arm length Max. LH mm
		50	70	90	110	130	150	
1.0	1180	1020	960					80
0.9	1070	920	870	820	Nonusable range			92
0.8	950	820	770	730				108
0.7	830	710	680	640	610	580		130
0.6	710	610	580	550	520	500	480	164
0.5	590	510	480	460	440	420	400	196
0.4	470	410	390	370	350	330	320	↑
0.3	360	310	290	270	260	250	240	↑
0.2	240	200	190	180	170	170	160	196

model CTX50-□T Clamping force F=P×1000/(0.553+0.00152×LH)

Air pressure MPa	Cylinder force N	Clamping force N / Clamp arm length LH mm						Max. arm length Max. LH mm
		60	80	100	120	140	160	
1.0	1810	1550	1480	1420	Nonusable range			104
0.9	1630	1400	1330	1280	1220			120
0.8	1450	1240	1190	1130	1090	1040		142
0.7	1270	1090	1040	990	950	910	880	172
0.6	1080	930	890	850	820	780	750	219
0.5	900	780	740	710	680	650	630	260
0.4	720	620	590	570	540	520	500	↑
0.3	540	470	440	430	410	390	380	↑
0.2	360	310	300	280	270	260	250	260

model CTX63-□T Clamping force F=P×1000/(0.354+0.000835×LH)

Air pressure MPa	Cylinder force N	Clamping force N / Clamp arm length LH mm						Max. arm length Max. LH mm
		75	90	110	130	150	170	
1.0	2820	2400	2330	2240	2160	Nonusable range		134
0.9	2540	2160	2100	2020	1950	1880		155
0.8	2260	1920	1860	1790	1730	1670	1610	184
0.7	1980	1680	1630	1570	1510	1460	1410	225
0.6	1690	1440	1400	1350	1300	1250	1210	290
0.5	1410	1200	1170	1120	1080	1040	1010	330
0.4	1130	960	930	900	860	830	810	↑
0.3	850	720	700	670	650	630	600	↑
0.2	560	480	470	450	430	420	400	330

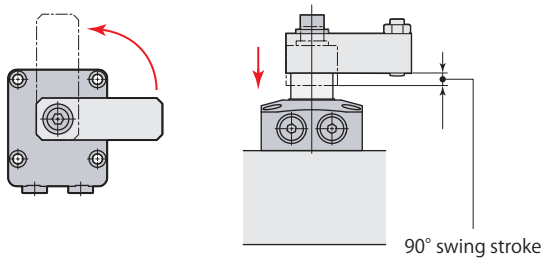
Swing speed adjustment

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 speed controller 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.

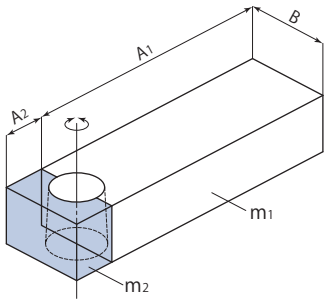


Example of calculation for moment of inertia

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

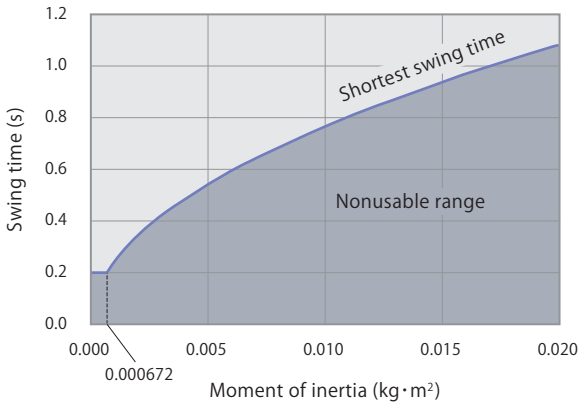
I : Moment of inertia (kg·m²)

m: Mass (kg)



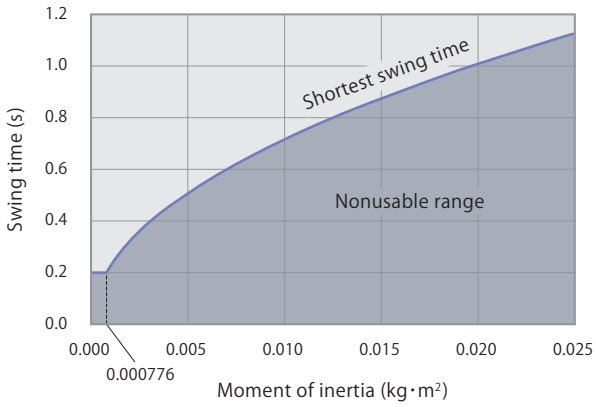
model CTX32-□T

Shortest swing time calculation formula $t = \sqrt{\frac{I}{0.0168}}$



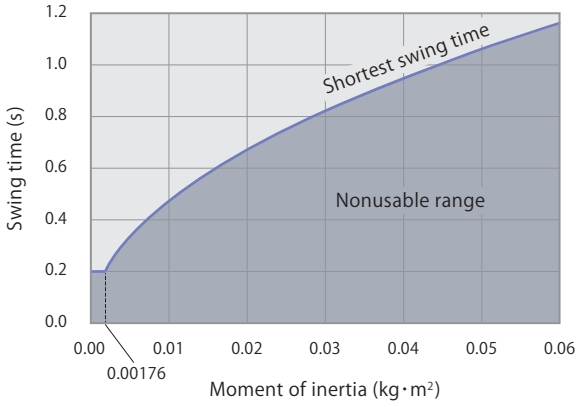
model CTX40-□T

Shortest swing time calculation formula $t = \sqrt{\frac{I}{0.0194}}$



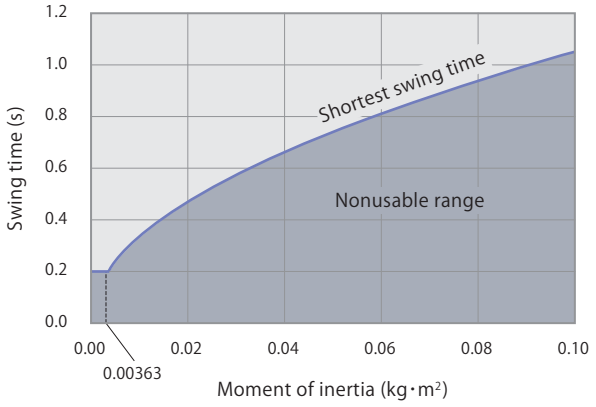
model CTX50-□T

Shortest swing time calculation formula $t = \sqrt{\frac{I}{0.0440}}$



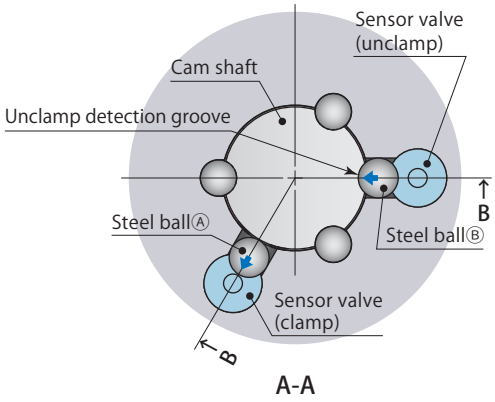
model CTX63-□T

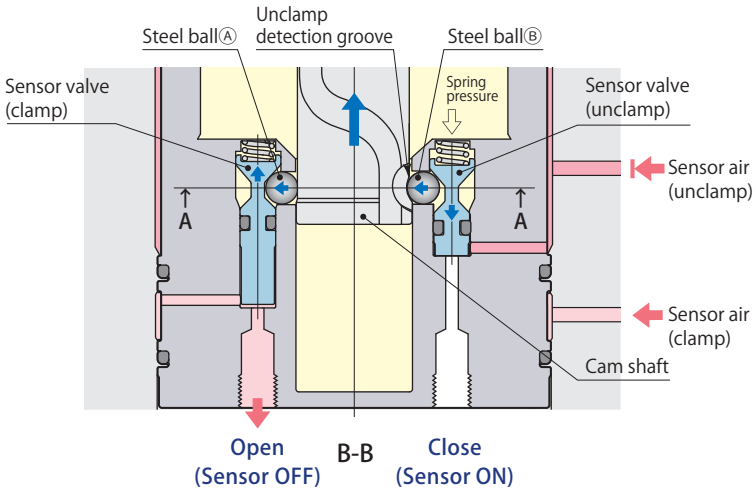
Shortest swing time calculation formula $t = \sqrt{\frac{I}{0.0908}}$



PAL sensor function and structure

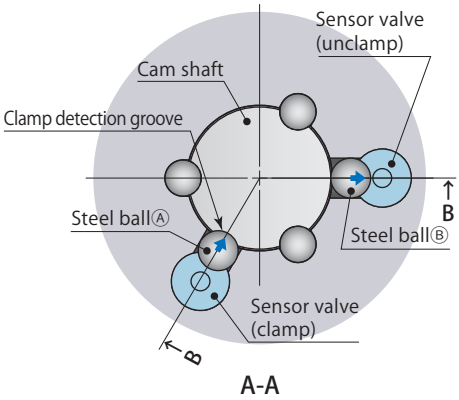
Unclamp detection

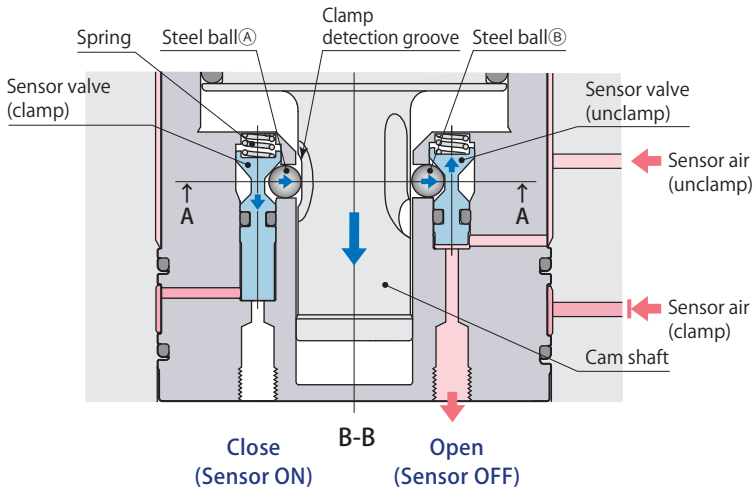




● The steel ball Ⓑ seats in the unclamp detection groove when the cam shaft reaches unclamp end, and a sensor valve (unclamp) is pushed down to shut off the sensor air by spring pressure. The sensor valve (clamp) is pushed up by the steel ball Ⓐ to open for air exhaust and detects the unclamped condition.

Clamp detection

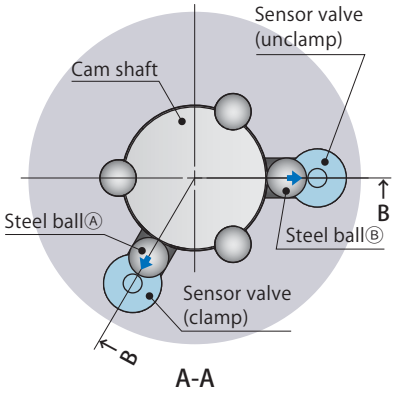


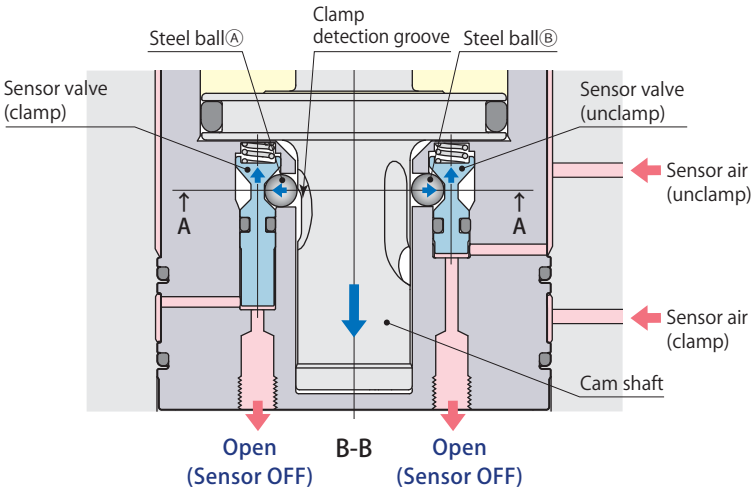


● The steel ball Ⓐ seats in the clamp detection groove when the cam shaft reaches clamping point, and a sensor valve (clamp) is pushed down to shut of the sensor air by a spring. The sensor valve (unclamp) is pushed up by the steel ball Ⓑ to open for air exhaust and detects the clamped condition.

PAL sensor function and structure

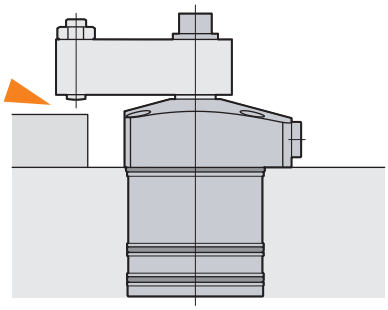
Over clamp stroke (Incomplete clamp) detection



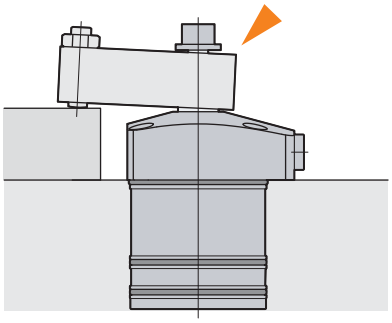


- When the cam shaft passes the clamping point, the sensor valve (clamp) is pushed up by the steel ball Ⓐ to open for air exhaust. The sensor valve (unclamp) is pushed up by the steel ball Ⓑ to open for air exhaust and detects the over clamp stroked (incomplete clamp) condition.

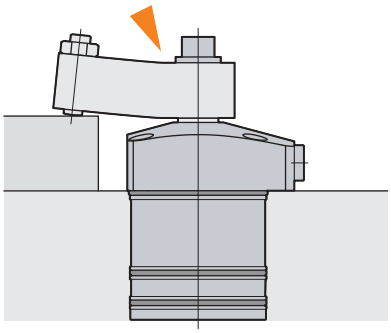
Over clamp stroke (Incomplete clamp) detection example



- Clamp disabled due to mis-setting workpiece.



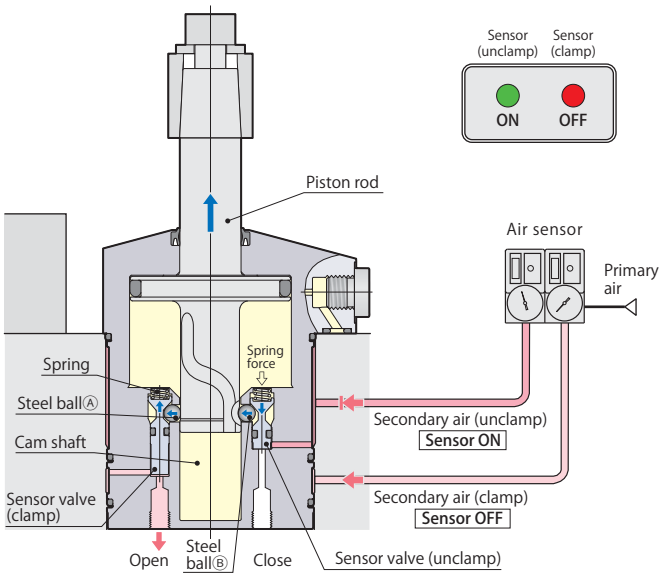
- Clamp disabled due to the damage of piston rod or loose clamp arm.



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

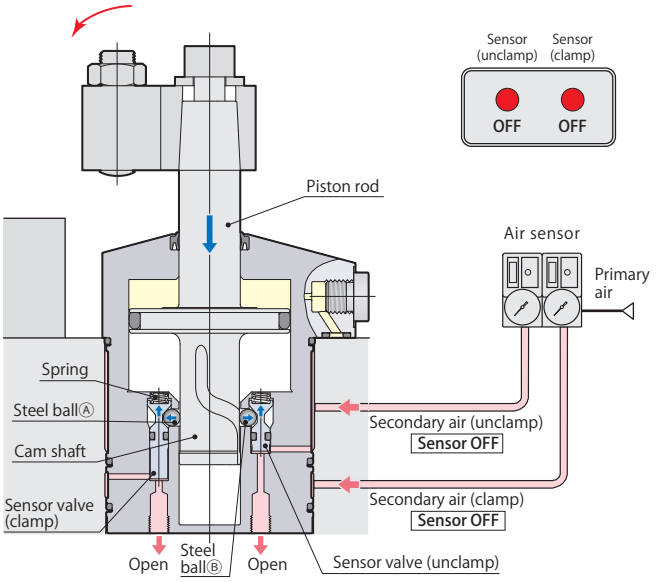
Clamp, Unclamp, Over clamp stroke detection signal

Unclamp detection



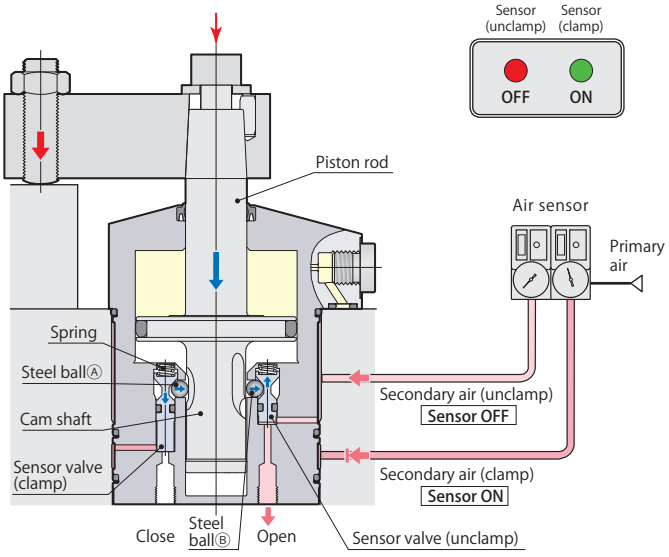
Sensor signal (unclamp)	ON	Unclamp
Sensor signal (clamp)	OFF	

In the middle of swing stroke



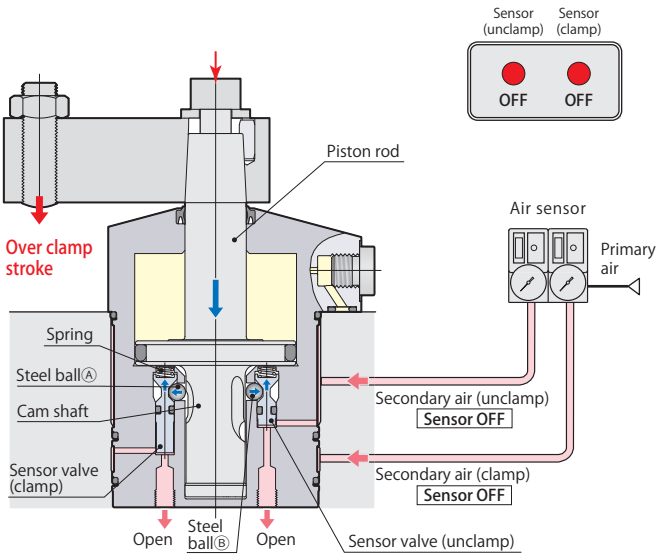
Sensor signal (unclamp)	OFF	In the middle of swing stroke
Sensor signal (clamp)	OFF	

Clamp detection



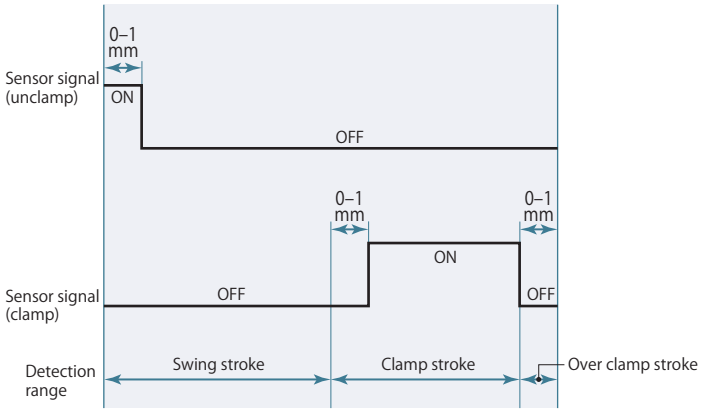
Sensor signal (unclamp)	OFF	Clamp
Sensor signal (clamp)	ON	

Over clamp stroke (Incomplete clamp) detection



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

Air sensor triggering point



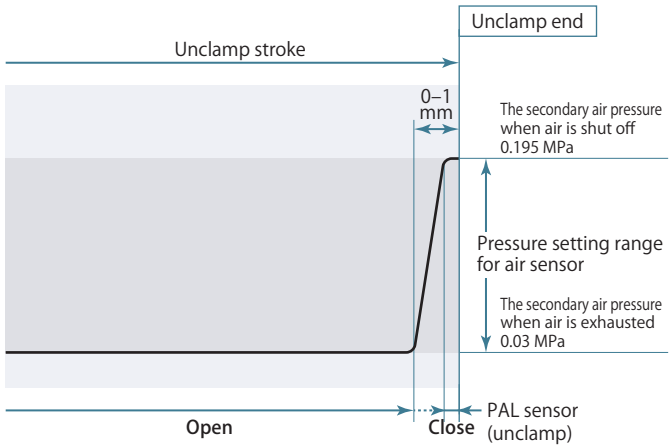
- Refer to the sensor supplier's instruction manual for the details of setting.
- Sensing performance such as detectable time and pressure differs depending on the supplier and model number of the sensor. Select the right model referring to sensor's application and characteristics.

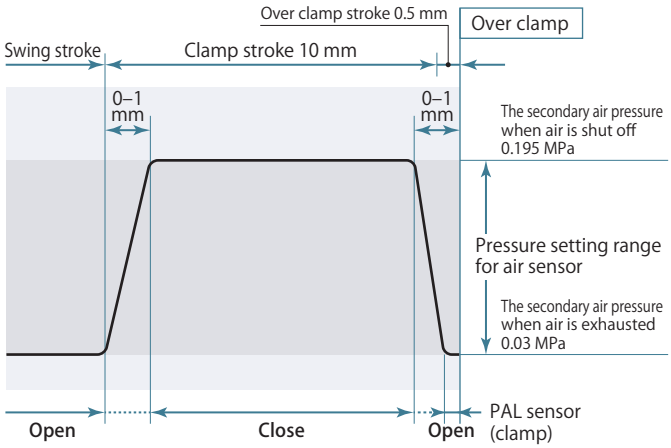
Air sensor unit recommended condition of use

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



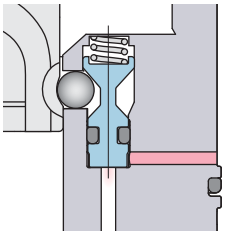


The diagram shown on the left indicates the relation between the PAL sensor, piston stroke, and secondary air pressure. (The pressure shown in the diagram is a reference based on the 0.2 MPa of primary air pressure for one piece of clamp.)

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

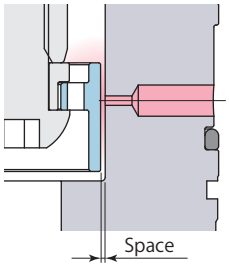
- Enhances the pressure setting range of the sensor which enables the sensor to set easily.
  (Ex. Pressure setting range 0.03–0.195 MPa in the diagram)
- Allows the use for a number of clamps by one air sensor because of better pressure holding when air is shut off.
  (Maximum number of clamps to be 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



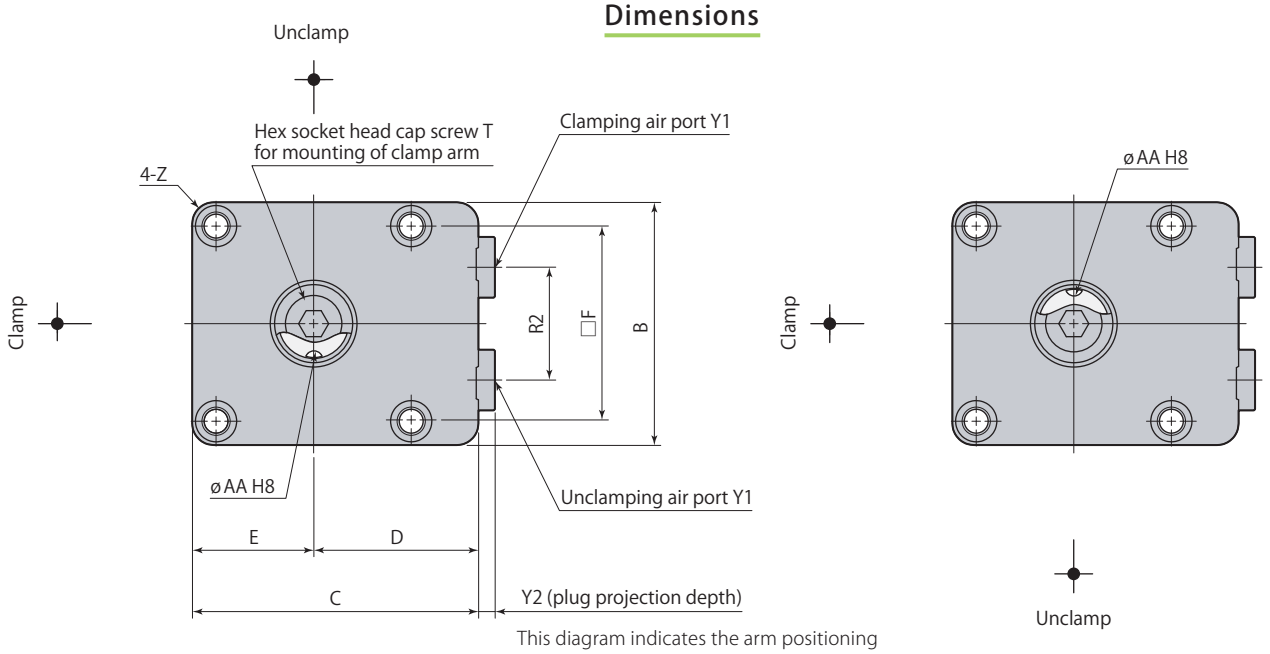
Poppet structure ensures superior sealing performance and can create large differential-pressure when the valve is opening and closing, and air leakage can be minimized.

Previous sensor valve



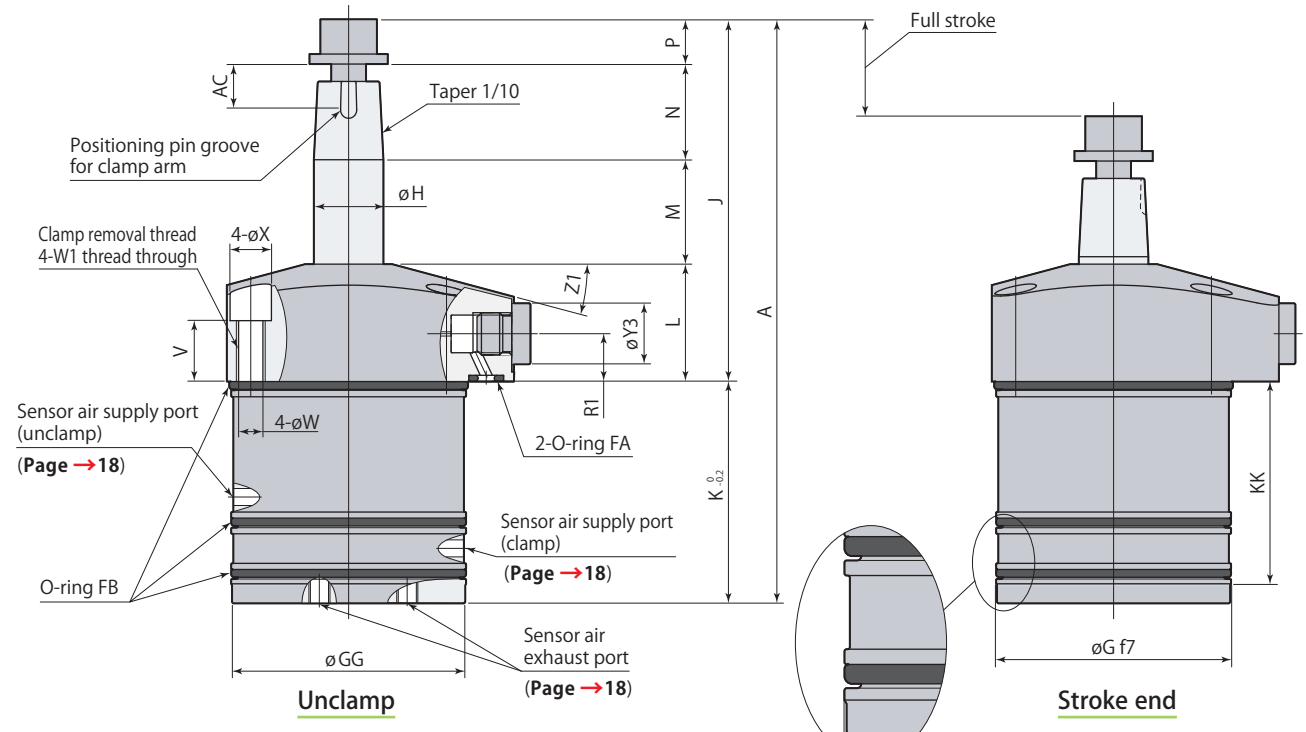
Air leaks easily due to a large space.

Dimensions



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

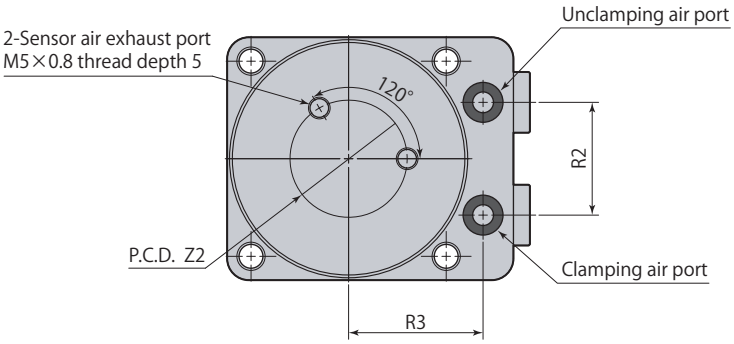
Swing direction L (counter-clockwise)

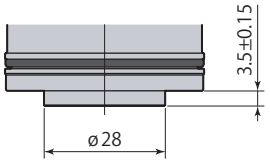


Unclamp

Swing direction R (clockwise)

Stroke end





CTX32-□T only

- Clamp arm, positioning pin and mounting screws are not included.

mm

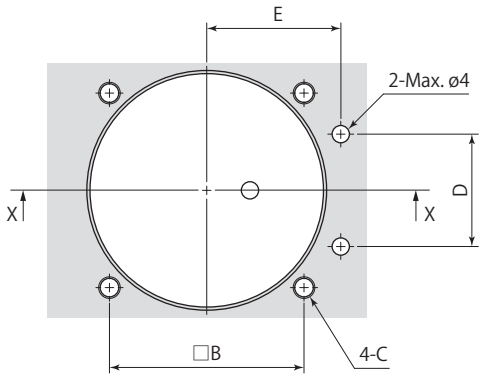
Model		CTX32-□T	CTX40-□T	CTX50-□T	CTX63-□T
A		127.3	134.3	159.2	181.7
B		50	56	66	78
C		60	66	80	91
D		35	38	47	52
E		25	28	33	39
F		39	45	53	65
øG		46 $^{-0.025}_{-0.050}$	54 $^{-0.030}_{-0.060}$	64 $^{-0.030}_{-0.060}$	77 $^{-0.030}_{-0.060}$
øGG		45.6	53.6	63.6	76.6
øH		14	16	20	25
J		78.8	83.3	100.2	110.7
K		48.5	51	59	71
KK		44.5	46.5	49.5	57.5
L		27	27	32	32
M		22.5	24	28	31.5
N (arm thickness)		19	22	27	32
P		10.3	10.3	13.2	15.2
R1		11	11	12.5	12.5
R2		20	26	30	40
R3		28	31	36	41
T		M8×1.25 length 16	M8×1.25 length 16	M10×1.5 length 20	M12×1.75 length 25
V		14	14	17	16
øW		5.5	5.5	6.8	6.8
W1		M6×1	M6×1	M8×1.25	M8×1.25
øX		9.5	9.5	11	11
Y1		G1/8	G1/8	G1/4	G1/4
Y2		3.8	3.8	4.8	4.8
øY3		14	14	19	19
Z		R5	R5	R6	R6
Z1		15°	15°	14°	13°
Z2		20	27	34	42
øAA (pin groove diameter)		4 $^{+0.018}_{0}$	4 $^{+0.018}_{0}$	5 $^{+0.018}_{0}$	5 $^{+0.018}_{0}$
AC		10.5	10.5	12.5	12.5
Positioning pin (dowel pin)		ø4(h8)×10	ø4(h8)×10	ø5(h8)×12	ø5(h8)×12
O-ring FA (fluorocarbon hardness Hs90)		P6	P6	P6	P6
O-ring FB (fluorocarbon hardness Hs70)		AS568-030	AS568-033	AS568-036	AS568-040
Taper sleeve		CTH32-XS	CTH40-XS	CTH50-XS	CTH63-XS
Speed controller*	Meter-in	VCL01-I	VCL01-I	VCL02-I	VCL02-I
	Meter-out	VCL01-O	VCL01-O	VCL02-O	VCL02-O

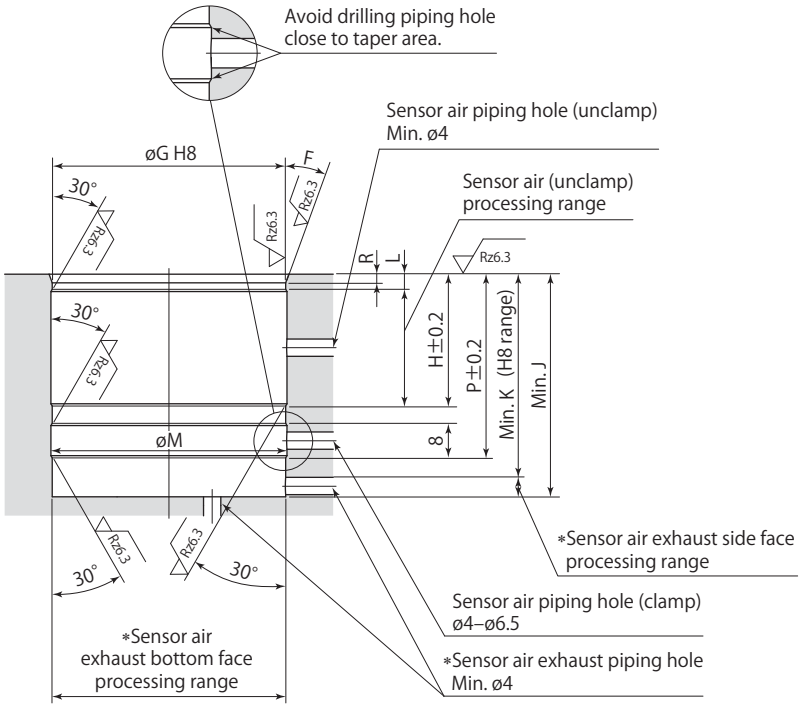
∗: Select the right model of VCL according to the size of the clamp.

Refer to each page for the details of options.

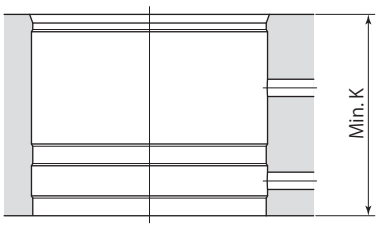
● Taper sleeve **page →22** ● Speed controller **page →56**

Mounting details





In blind hole X-X

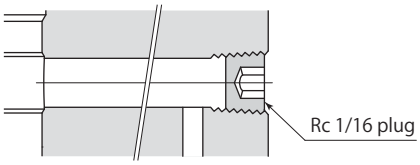


In through hole X-X

*: 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.
- No sensor air piping hole (unclamp) is needed unless unclamp sensor is used. Contact Pascal for the details.
- The sensor air piping hole can be used for a pilot hole of Rc 1/16 plug.



Mounting details

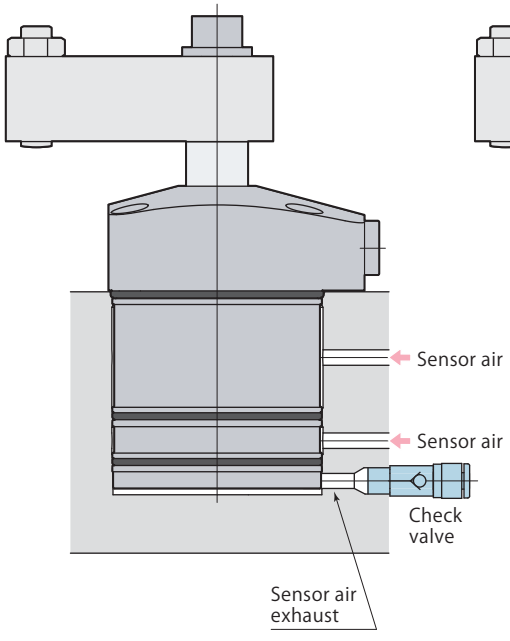
mm

Model	CTX32-□T	CTX40-□T	CTX50-□T	CTX63-□T
B	39	45	53	65
C	M5	M5	M6	M6
D	20	26	30	40
E	28	31	36	41
F	20°	20°	20°	30°
øG	$46^{+0.039}_{0}$	$54^{+0.046}_{0}$	$64^{+0.046}_{0}$	$77^{+0.046}_{0}$
H	28.5	30.5	33.5	41.5
J	52.5	51.5	59.5	71.5
K	44.5	46.5	49.5	57.5
L	3.5	3.5	3.5	8±0.2
øM	46.6	54.6	64.6	77.6
P	40.5	42.5	45.5	53.5
R	2	2	2	1

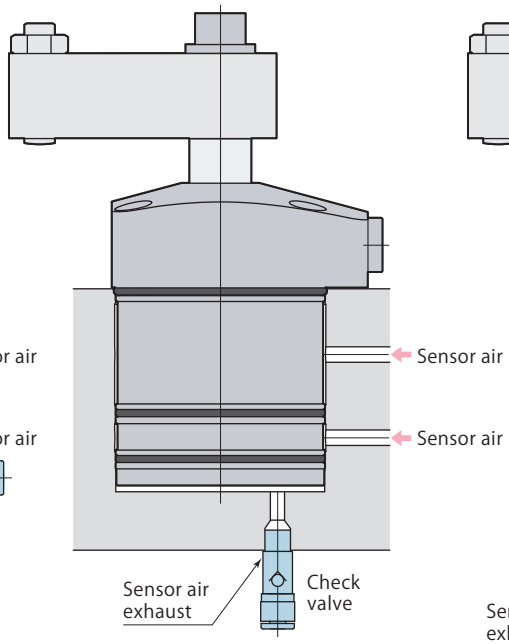
Caution for piping

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

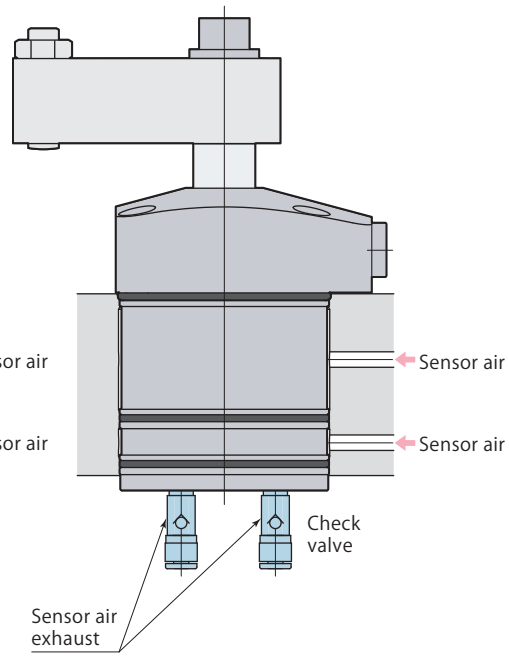
Mounting in blind hole
(Sensor air exhaust：side face)



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



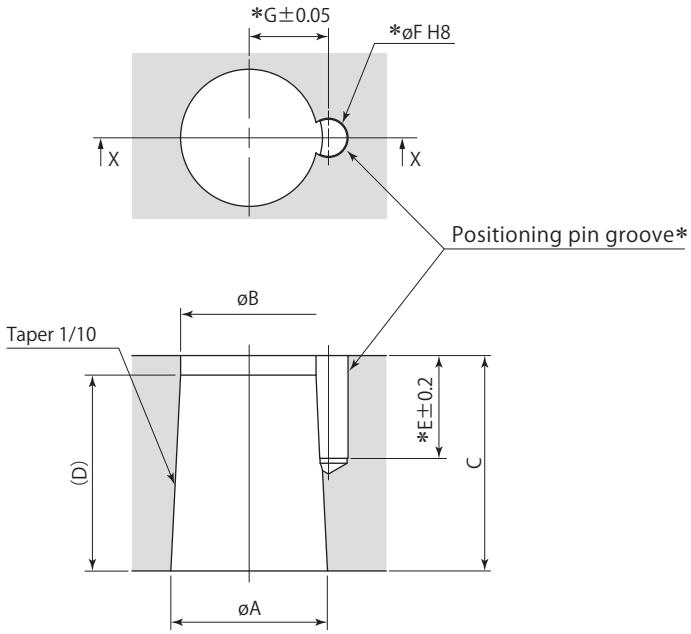
Mounting in through hole



● 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 arm mounting details

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



X-X

*: 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.

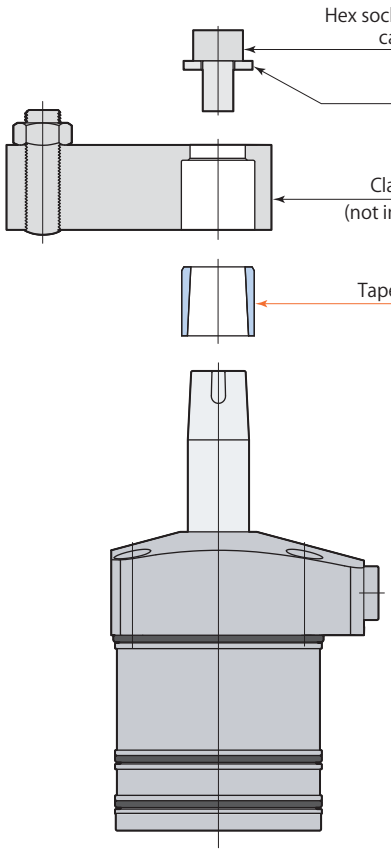
mm

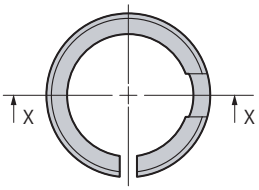
Swing clamp	CTX32-□T	CTX40-□T	CTX50-□T	CTX63-□T
øA	$14^{-0.016}_{-0.034}$	$16^{-0.016}_{-0.034}$	$20^{-0.020}_{-0.041}$	$25^{-0.020}_{-0.041}$
øB	12.6	14	17.8	22.4
C	19	22	27	32
D	14	20	22	26
E	10.5	10.5	12.5	12.5
øF (pin groove diameter)	$4^{+0.018}_{0}$	$4^{+0.018}_{0}$	$5^{+0.018}_{0}$	$5^{+0.018}_{0}$
G	7.1	8.1	10.1	12.6

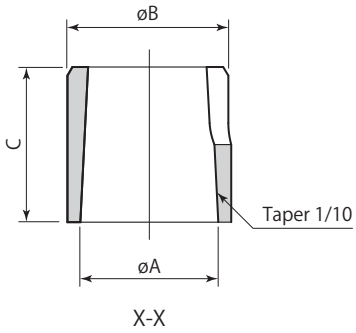
Taper sleeve

Size

CTH 32 / 40 / 50 / 63 — **XS** : Taper sleeve







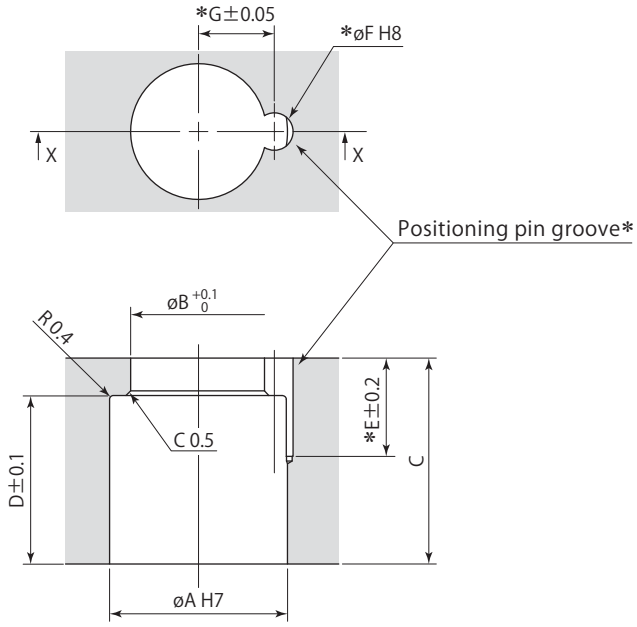
mm

Taper sleeve	CTH32-XS	CTH40-XS	CTH50-XS	CTH63-XS
Applicable swing clamp	CTX32-□T	CTX40-□T	CTX50-□T	CTX63-□T
øA	14	16	20	25
øB	17	19	24	29
C	14	18	22	26

Clamp arm mounting details

(Using taper sleeve)

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



X-X

∗: 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	CTH32-XS	CTH40-XS	CTH50-XS	CTH63-XS
Applicable swing clamp	CTX32-□T	CTX40-□T	CTX50-□T	CTX63-□T
øA	17 +0.018 0	19 +0.021 0	24 +0.021 0	29 +0.021 0
øB	13	14.5	18.5	23
C	19	22	27	32
D	14	18	22	26
E	10.5	10.5	12.5	12.5
øF (pin groove diameter)	4 +0.018 0	4 +0.018 0	5 +0.018 0	5 +0.018 0
G	7.1	8.1	10.1	12.6