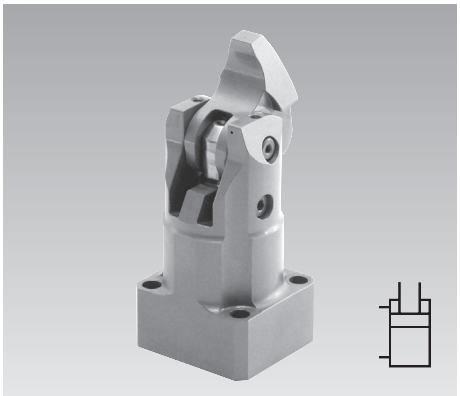
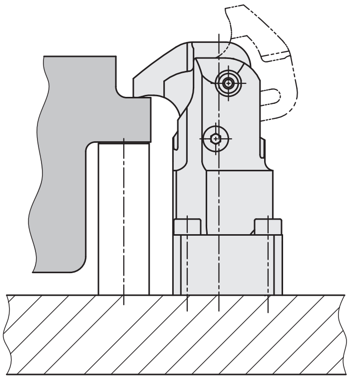
Compact Clamps

Manifold-mounting type, pneumatic position monitoring optional, double acting, max. operating pressure 250 bar



Advantages

- Minimum dimensions
- Mounting without pipes
- Metallic wiper edge for piston rod
- Clamping lever can be swivelled into small recesses
- Workpiece clamping without any side loads
- Unimpeded loading and unloading of the clamping fixture
- Long clamping lever adaptable to the workpiece
- Universal lever for adapting customised clamping levers
- Mounting position: any



Application

Compact clamps are designed for application in hydraulic clamping fixtures where oil supply is effected through drilled channels in the fixture body.

Due to the minimum space required, the compact clamp is especially suitable for clamping fixtures with little space for the installation of hydraulic clamping elements.

A clamping recess in the workpiece a little bit wider than the clamping lever is sufficient as clamping surface. Typical applications are:

- Rotary indexing fixtures in horizontal and vertical machining centres
- Clamping fixtures for machining of several sides and complete machining
- Multiple clamping fixtures with many workpieces that are closely arranged
- Test systems for motors, gears, etc.
- Assembly lines

Description

The hydraulic compact clamp is a double-acting pull-type cylinder where a part of the linear stroke is used to swing the clamping lever onto the workpiece.

Available versions

1. **With pneumatic clamping monitoring** **180X2XX**
   The clamping monitoring signals:
   "The clamping lever is within the usable clamping range and the workpiece is clamped with minimum clamping force (min. 70 bar)."

2. **With pneumatic unclamping monitoring** **180X2XXA**
   The unclamping monitoring signals:
   "The clamping lever is within the unclamping range, starting approx. 10° before the final position."

3. **Without position monitoring** **180X2XXB**

4. **With pneumatic clamping and unclamping monitoring** **180X2XXC**

Pneumatic position monitoring see page 6.

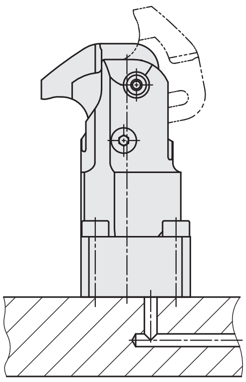
Important notes

(see page 5)

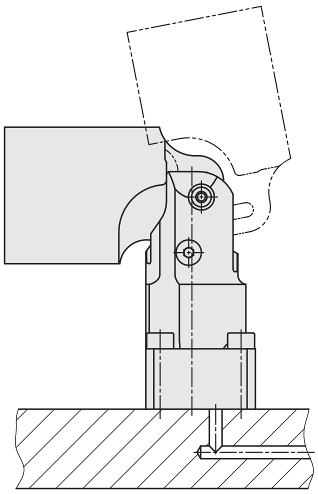
Installation and connecting possibilities

Drilled channels

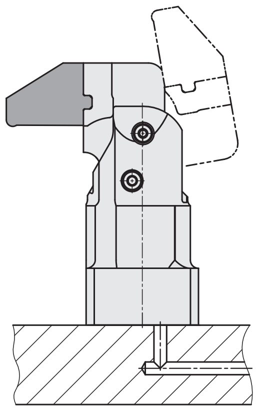
with short clamping lever



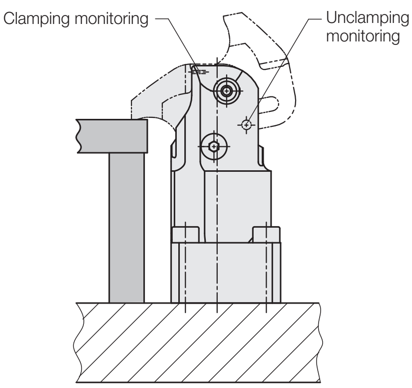
with long clamping lever (blank)



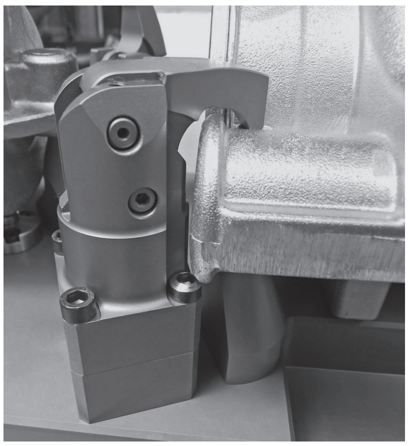
Universal lever



Pneumatic position monitoring

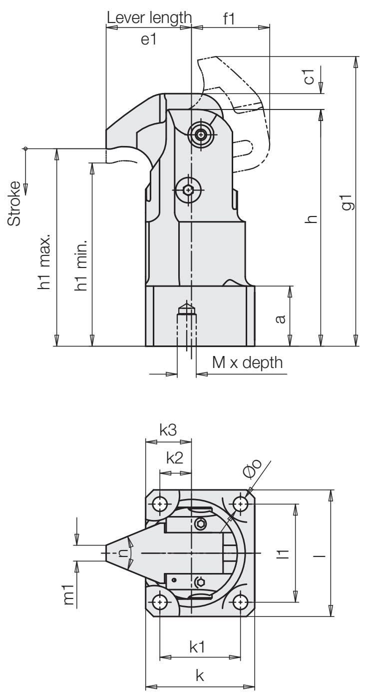


Application example

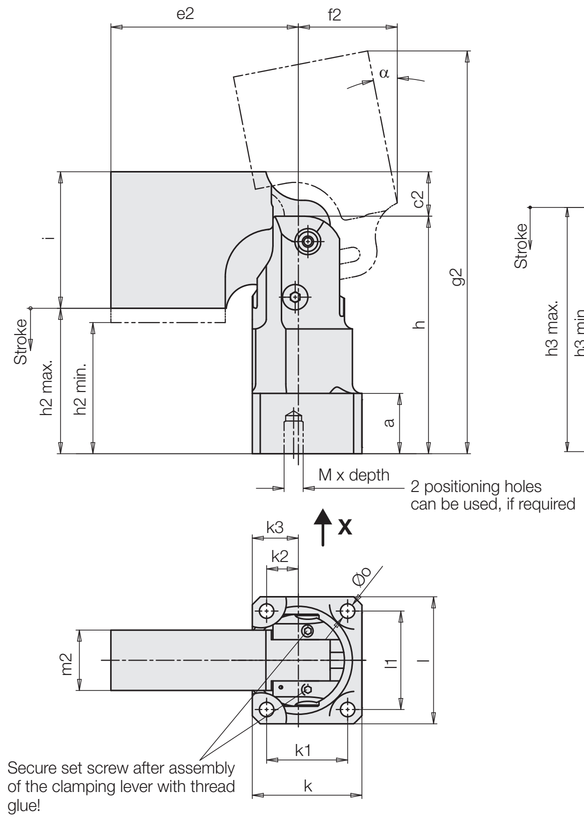


Clamping of a cast part with special clamping lever

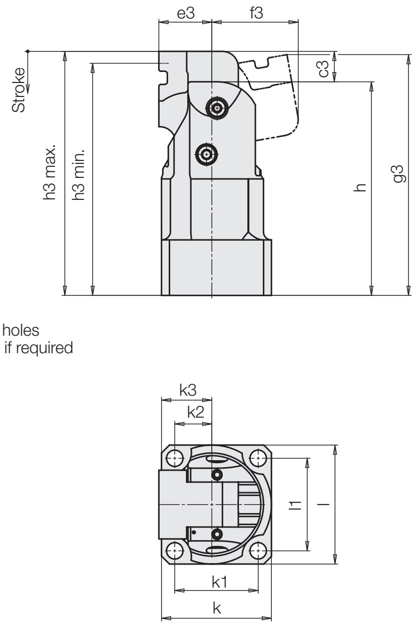
Short clamping lever 180X210



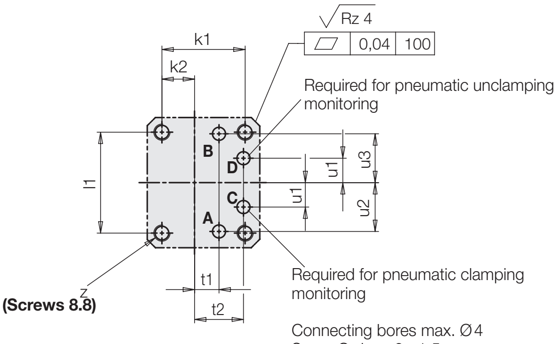
Long clamping lever (blank) 180X230



Universal lever 180X250

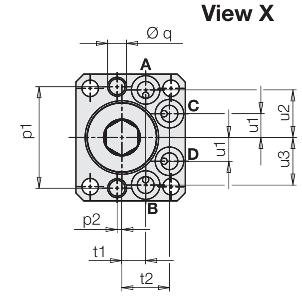


Connecting scheme



Connecting bores max. Ø4
Spare O-rings 6 x 1.5
Part no. 3000313

View X



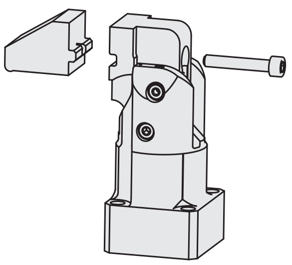
A = Clamping
B = Unclamping
C = Clamping monitoring
D = Unclamping monitoring

Pneumatic position monitoring see page 4.

Materials

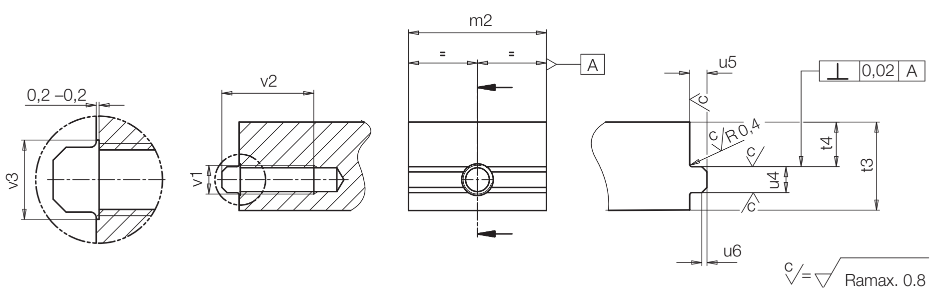
Body:	hardened, stainless
Clamping lever:	
short	HRc 48 – 55, stainless
long (blank)	X37 Cr Mo V5-1 hardened and tempered HRc 40 and nitrated
Seals:	NBR and PUR (max. 80°)

Universal lever



The compact clamp with universal lever and integrated swing mechanism enables the fixing of customised clamping levers, which are relatively easy to manufacture.
The fixing screw 12.9 included in our delivery. Tightening torque see chart page 3.

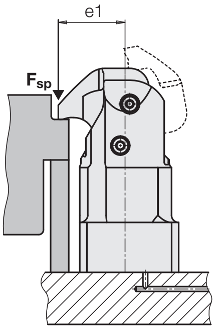
Connecting dimensions to the flange of the universal lever



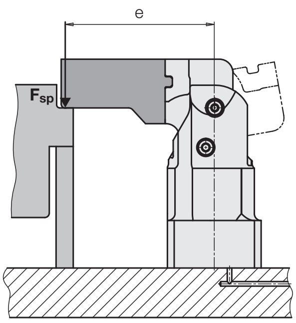
Size		1	2	3	4
Clamping force at 250 bar (short clamping lever)	[kN]	3.2	4.5	7.5	11.5
Max. stroke	[mm]	5	5	7	8.5
Clamping stroke, usable	[mm]	4.5	4.5	6.5	8
Piston Ø	[mm]	18	22	28	33
Rod Ø	[mm]	11	14	17	19
Oil volume clamping	[cm^3]	2.3	3.2	6.4	10.5
Oil volume unclamping	[cm^3]	3.6	5.4	10.2	15.7
Max. flow rate	[cm^3/s]	8	11	22	35
Min. operating pressure					
without clamping monitoring	[bar]	20	20	20	20
with clamping monitoring	[bar]	70	70	70	70
Min. air pressure	[bar]	3	3	3	3
α ±1	[°]	13.5	10.5	14	16
a	[mm]	19	21	24	24
c1	[mm]	5	5	7	8.5
c2	[mm]	14	12	7	8.5
c3	[mm]	14	16	16	22.5
e1	[mm]	27	28	36.5	36.5
e2	[mm]	59	60	67.5	67.5
e3	[mm]	17	20	22	22
f1	[mm]	25	26	32	34
f2	[mm]	31	31	32	34
f3	[mm]	34.5	37	41	48.5
g1 max.*	[mm]	92.5	95.4	115.9	117.5
g2 min. / max.*	[mm]	128.3/129.8	131.5/134	150.9/152	153.5/155.6
g3	[mm]	87.5	93	109.5	115
h	[mm]	74.8	80.8	95.4	98.6
h1 min. / h1 max.	[mm]	57.8 / 62.3	59.8 / 64.3	67.9 / 74.4	68.1 / 76.1
h2 min. / h2 max.	[mm]	41.3 / 45.8	42.3 / 46.8	51.4 / 57.9	51.6 / 59.6
h3 min. / h3 max.	[mm]	84.3 / 88.8	92.3 / 96.8	104.9 / 111.4	113.1 / 121.1
i	[mm]	43	46	44.5	47.5
k	[mm]	34.5	41.5	52	54
k1	[mm]	25.5	31.5	38	41
k2	[mm]	10	14	16	18
k3	[mm]	14.5	19	23	24.5
l	[mm]	40	45	58	59
l1	[mm]	31	35	44	46
m1	[mm]	5	6	8	8
m2	[mm]	21	26	32	35
n	[°]	50.4	55.8	56.1	62
Ø o	[mm]	5.2	6.2	8.2	8.2
p1 ±0.02	[mm]	32	35	44	48
p2 ±0.1	[mm]	1.5	0	0	3
Ø q +0.05 x depth	[mm]	6x9	6x9	8x17	8x17
t1	[mm]	7.5	8.5	10	11
t2	[mm]	15	16.7	21.5	21.2
t3	[mm]	20	23	23	29
t4	[mm]	8.5	12	10	17
u1	[mm]	7.5	9.2	12.5	13.5
u2	[mm]	15	16.8	20	23
u3	[mm]	15	16.8	20	22
u4 −0,05	[mm]	4	5	6	6
u5	[mm]	2	3	4	4
u6	[mm]	0.9 x 45°	1 x 45°	1.3 x 45°	1.3 x 45°
v1 x v2	[mm]	M5 x 10	M5 x 10	M8 x 17	M8 x 17
Ø v3	[mm]	5.5	5.5	8.5	8.5
z	[mm]	M5	M6	M8	M8
With pneumatic clamping monitoring					
Part no. - short clamping lever		**1801 210**	**1802 210**	**1803 210**	**1804 210**
Weight, approx.	[kg]	0.46	0.69	1.29	1.42
Part no. - long clamping lever (blank)		**1801 230**	**1802 230**	**1803 230**	**1804 230**
Weight, approx.	[kg]	0.74	1.05	1.77	1.93
Part no. - universal lever		**1801 250**	**1802 250**	**1803 250**	**1804 250**
Weight, approx.	[kg]	0.46	0.73	1.27	1.44
With pneumatic unclamping monitoring					
Part no. (version see above)		**1801 2XXA**	**1802 2XXA**	**1803 2XXA**	**1804 2XXA**
Without position monitoring					
Part no. (version see above)		**1801 2XXB**	**1802 2XXB**	**1803 2XXB**	**1804 2XXB**
With clamping and unclamping monitoring					
Part no. (version see above)		**1801 2XXC**	**1802 2XXC**	**1803 2XXC**	**1804 2XXC**
Accessories					
Part no. - short clamping lever		**3548 1121**	**3548 1122**	**3548 1123**	**3548 1124**
Part no. - long clamping lever (blank)		**3548 1071**	**3548 1072**	**3548 1073**	**3548 1074**
Part no. - universal lever		**3548 4111**	**3548 4112**	**3548 4113**	**3548 4114**
Screw for universal lever	[mm]	M5x30 −12.9	M5x30 −12.9	M8x35 −12.9	M8x35 −12.9
Tightening torque	[Nm]	10	10	42	42
Part no.		**3301 1019**	**3301 1019**	**3301 468**	**3301 468**

* min. = height in unclamping position as presented. max. = max. height for swing in

Short clamping lever



Universal clamping lever



Calculation of the clamping force

1. Clamping lever length e is known

1.1 Admissible clamping force as a function of the clamping lever length e

$$F_{adm} = \frac{A}{e - B} \quad [kN]$$

1.2 Admissible operating pressure

$$p_{adm} = \frac{F_{adm} * 100}{C} \left(\frac{e - B}{D} + 1 \right) \quad [bar]$$

1.3 Effective clamping force at other pressure p

1.3.1 F_{adm} = and p_{adm} are known

$$F_{sp} = F_{adm} \frac{p}{p_{adm}} \leq F_{adm} \quad [kN]$$

1.3.2 In general:

$$F_{sp} = \frac{C}{\left(\frac{e-B}{D} + 1\right) * 100} * p \leq F_{adm} \quad [kN]$$

2. Maximum clamping lever length depending on the existing operating pressure

$$e_{max} = \frac{A}{(C * 0.01 * p) - E} + B \quad [mm]$$

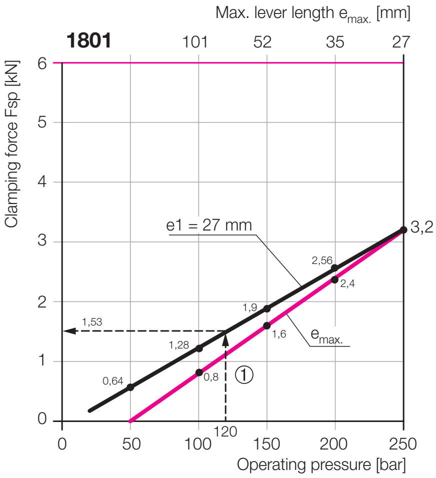
F_{sp}, $F_{adm.}$	= Clamping force	[kN]
e, e1, $e_{max.}$	= Clamping lever length	[mm]
p, $p_{adm.}$	= Operating pressure	[bar]
A…E	= Constants as per chart	

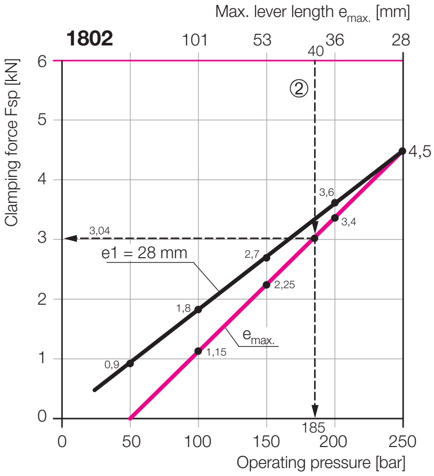
Enter the variables in the above units into the formulas

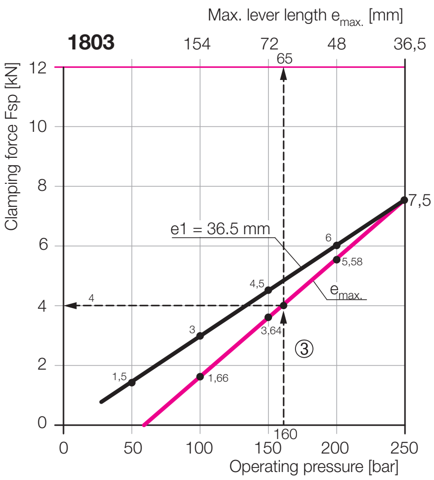
Constants

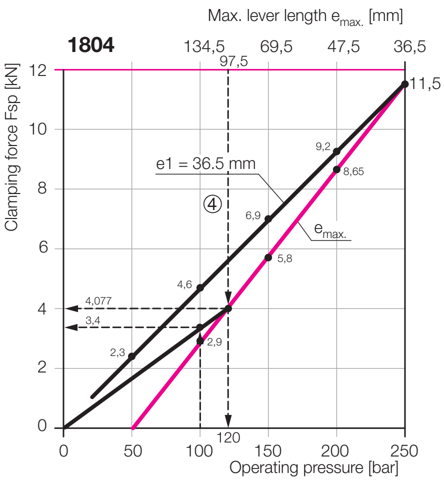
Size	1801	1802	1803	1804
A	80	112.5	251.3	385.3
B	2	3	3	3
C	1.594	2.262	3.888	5.718
D	101.7	97.62	113	138.1
E	0.787	1.152	2.224	2.789

Clamping force diagrams









Example ① Compact clamp 1801 210
Series clamping lever e1 = 27 mm
F_{adm} = 3.2 kN at p_{adm} = 250 bar
Operating pressure p = 120 bar

Effective clamping force

$$F_{Sp} = F_{adm} \frac{P}{p_{adm}} = 3.2 \frac{120}{250} = 1.536 \text{ kN}$$

alternative

$$F_{Sp} = \frac{C}{\left(\frac{e-B}{D} + 1\right) * 100} * p$$

$$F_{Sp} = \frac{1.594}{\left(\frac{27-2}{101{,}7} + 1\right) * 100} * 120$$

$$F_{Sp} = 1.535 \text{ kN}$$

Example ② Compact clamp 1802 210
Series clamping lever e = 40 mm

Admissible clamping force

$$F_{adm} = \frac{A}{e - B} = \frac{112.5}{40 - 3} = 3.04 \text{ kN}$$

Admissible operating pressure

$$p_{adm} = \frac{F_{adm} * 100}{C} * \left(\frac{e - B}{D} + 1 \right)$$

$$p_{adm} = \frac{3.04 * 100}{2.262} * \left(\frac{40 - 3}{97.62} + 1 \right)$$

$$p_{adm} = 185 \text{ bar}$$

Example ③ Compact clamp 1803 210
Operating pressure p = 160 bar
Special clamping lever

Maximum clamping lever length

$$e_{max} = \frac{A}{(C * 0.01 * p) - E} + B$$

$$e_{max} = \frac{251.3}{(3.888 * 0.01 * 160) - 2.224} + 3$$

$$e_{max} = 65.875 \text{ mm} \rightarrow 65 \text{ mm}$$

Maximum clamping force

$$F_{Sp} = \frac{C}{\left(\frac{e-B}{D} + 1\right) * 100} * p$$

$$F_{Sp} = \frac{3.888}{\left(\frac{65-3}{113} + 1\right) * 100} * 160$$

$$F_{Sp} = 4 \text{ kN}$$

Example ④ Compact clamp 1804 210
Special clamping lever e = 97.5 mm

Admissible clamping force

$$F_{adm} = \frac{A}{e - B} = \frac{385.3}{97.5 - 3} = 4.077 \text{ kN}$$

Admissible operating pressure

$$p_{adm} = \frac{F_{adm} * 100}{C} * \left(\frac{e - B}{D} + 1 \right)$$

$$p_{adm} = \frac{4.077 * 100}{5.718} * \left(\frac{97.5 - 3}{138.1} + 1 \right)$$

$$p_{adm} = 120 \text{ bar}$$

Effective clamping force at 100 bar

$$F_{Sp} = \frac{C}{\left(\frac{e-B}{D} + 1\right) * 100} * p$$

$$F_{Sp} = \frac{5.718}{\left(\frac{97{,}5-3}{138{,}1} + 1\right) * 100} * 100$$

$$F_{Sp} = 3.4 \text{ kN}$$

Admissible flow rate

The admissible flow rate as per the chart on page 3 refers to the "short" clamping lever. Thus the clamping time is approx. 0.6 seconds and the unclamping time approx. 1 second.
Longer clamping levers with larger mass moments of inertia cause higher loads on the swing mechanism, which results in higher wear. The end stop during unclamping is also critical. Therefore, the flow rate should be reduced with longer clamping levers according to the following formula:

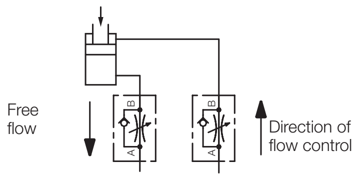
$$Q_L = Q_k * \sqrt{\frac{J_k}{J_L}} \ \text{cm}^3/\text{s}$$

Q_L = Adm. flow rate with longer special clamping lever
Q_K = Adm. flow rate with "short" clamping lever as per the chart on page 3
J_K = Moment of inertia of the "short" clamping lever (see chart)
J_L = Moment of inertia of the special clamping lever

$$\text{Clamping time } t_{Sp} = \frac{\text{Oil volume clamping [cm}^3\text{]}}{\text{Adm. flow rate } \frac{[\text{cm}^3]}{\text{s}}} \ [\text{s}]$$

Throttling of the flow rate

A flow rate throttling has to be effected in the supply line to the compact clamp. This avoids a pressure intensification and thereby pressures exceeding 250 bar.

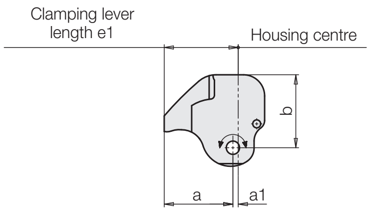


Determine the moment of inertia

Due to the complicated shape of the clamping levers, the mass moment of inertia can only be determined with the help of a CAD model in the computer.
Attention! The clamping lever length e always starts from the centre of the housing. As the examples show, the swing axis for determining the moment of inertia is offset by 1-2 mm. The exact position of the swing axis can be determined with the coordinates a and b.

Short clamping lever

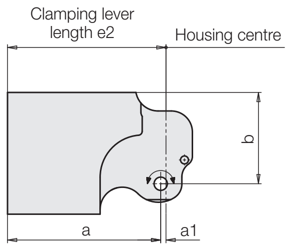
The moment of inertia in the chart is the starting point for the maximum flow rate and the shortest possible clamping time.



Size		1	2	3	4
e1	[mm]	27	28	36.5	36.5
a	[mm]	26	26	34.5	34.5
a1	[mm]	1	2	2	2
b	[mm]	25.5	27.5	33	36
Moment of inertia J_K	[kgmm²]	22	34	98	125

Long clamping lever (blank)

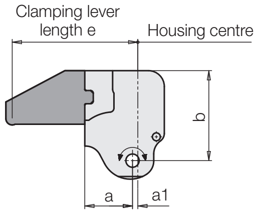
The blank is not a finished clamping lever. The value in the chart shows how high the maximum moment of inertia can rise.



Size		1	2	3	4
e2	[mm]	59	60	67.5	67.5
a	[mm]	58	58	65.5	65.5
a1	[mm]	1	2	2	2
b	[mm]	34.5	34.5	33	36
Moment of inertia J_L	[kgmm²]	576	756	1234	1477

Universal clamping lever

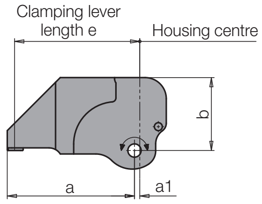
The universal clamping lever is supplemented by clamping arm provided by the customer and the fixing screw. A CAD model should be created in the assembled state to determine the moment of inertia.



Size		1	2	3	4
e	[mm]	Customer request			
a	[mm]	16	18	20	20
a1	[mm]	1	2	2	2
b	[mm]	34.5	38.5	42	50
Moment of inertia J_{L1}	[kgmm²]	Universal lever 35	63	146	220
+ extension J_{L2}	[kgmm²]	Determine with CAD model			

One-piece special clamping lever

A one-piece special clamping lever can only be manufactured at Römheld because exact contours are required for the swing mechanism and the pneumatic position monitoring.



Size		1	2	3	4
e	[mm]	Customer request			
a	[mm]	Customer request			
a1	[mm]	1	2	2	2
b	[mm]	25.5	27.5	33	36
Moment of inertia J_L	[kgmm²]	Determine with CAD model			

Important notes!

The compact clamps are designed exclusively for clamping of workpieces in industrial applications.
Hydraulic clamping elements can generate considerable forces. The workpiece, the fixture or the machine must be in the position to compensate these forces.
In the effective area of clamping lever there is the danger of crushing. The manufacturer of the fixture or the machine is obliged to provide effective protection devices.
During loading and unloading of the fixture a collision with the clamping lever has to be avoided. Remedy: Mount position adaptor.
The height of the flange surface of the compact clamp and the height of the clamping surface on the workpiece should be matched so that the clamping height is approximately in the middle of the usable clamping stroke.

The compact clamp has to be checked regularly on contamination by swarf and has to be cleaned.
For dry machining, minimum quantity lubrication and in case of accumulation of very small swarf or particles, regular disassembly, cleaning and lubrication of the lever mechanism as per operating manual is required.

Operating conditions, tolerances and other data see data sheet A 0.100 and A 0.130.

Pneumatic position monitoring

1. Pneumatic clamping monitoring

In the clamping area, the clamping lever slides downwards at two hardened surfaces of the body. In one of the surfaces there is the bore hole for the pneumatic clamping monitoring.
The clamping lever overruns the bore hole, but does not completely close it. Only when the workpiece is really clamped, the clamping lever supports itself on the sliding surface and the bore hole will be firmly closed.

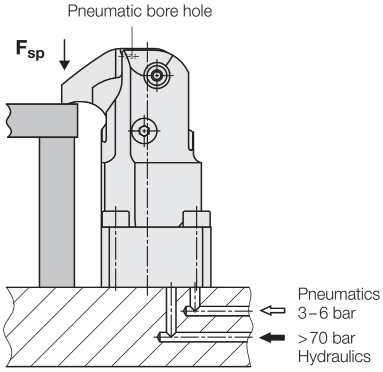
The clamping monitoring signals:
- The clamping lever is in the usable clamping range and
- a workpiece is clamped.

Important note

Required minimum pressures for clamping monitoring:

Hydraulics 70 bar
Pneumatics 3 bar

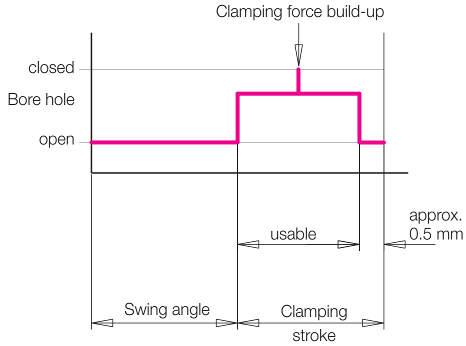
Clamping monitoring

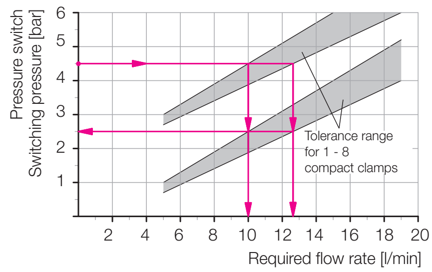


Example for clamping position
Required switching pressure 4.5 bar
Pressure drop, if 1 compact clamp is not clamped approx. 2 bar

As per diagram:
Required flow rate approx. 10-13 l/min (depending on the number of connected compact clamps)

Function chart



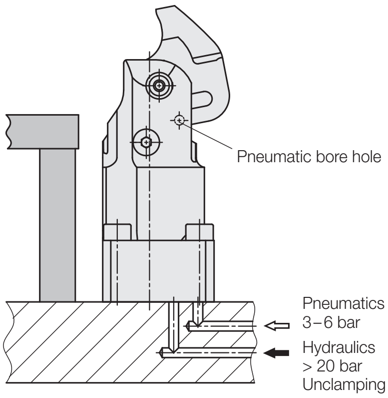


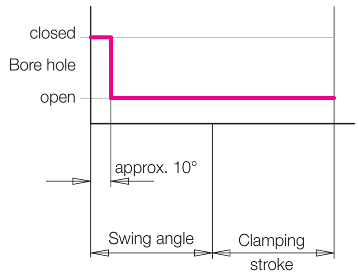
Required flow rate depending on the switching pressure of the pneumatic pressure switch for a pressure drop Δp 2 bar

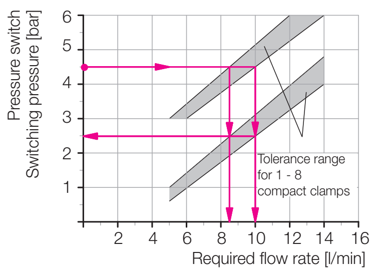
2. Pneumatic unclamping monitoring

A disk which is pre-stressed by a spring element is mounted at the side of the clamping lever. This disk closes a pneumatic bore hole in unclamping position.

Unclamping monitoring







Example for unclamping position
Required switching pressure 4.5 bar
Pressure drop, if 1 compact clamp is not unclamped approx. 2 bar

As per diagram:
Required flow rate approx. 8.5–10 l/min (depending on the number of connected compact clamps)

Required flow rate depending on the switching pressure of the pneumatic pressure switch for a pressure drop Δp 2 bar

Monitoring by pneumatic pressure switch

For the evaluation of the pneumatic pressure increase standard pneumatic pressure switches can be used.
With one pressure switch up to 8 compact clamps can be controlled.

Important note

Pneumatic position monitorings are only process-safe, when air pressure and air volume are precisely adjusted.
For measuring the air volume, appropriate devices are available. Please contact us.