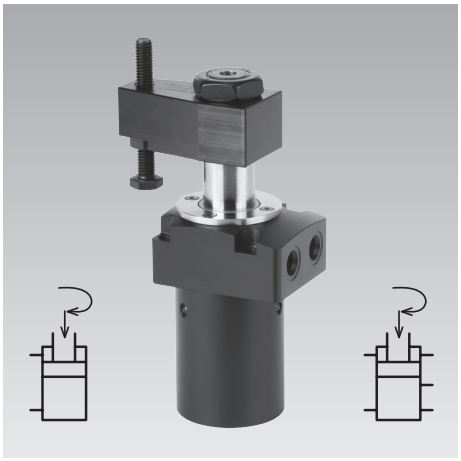
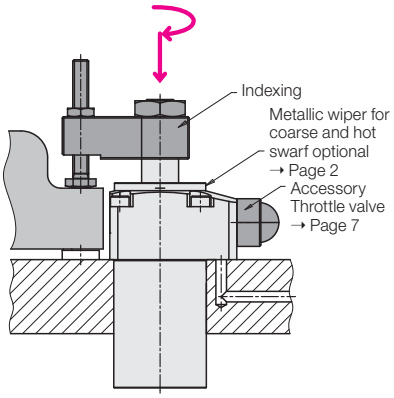
Swing clamp with reinforced swing mechanism

Position monitoring optional: pneumatically integrated/electrically attachable
Top flange type, double acting, operating pressure 70 bar/max. 120 bar



Advantages

- 4 sizes available
- Compact design partially recessible
- High clamping force already at 70 bar
- Extremely short clamping and unclamping times
- Accessory throttle valve, screw-in
- Indexing of clamping arm
- Standard FKM wiper
- Metallic wiper optional
- Pneumatic position monitoring integrated for type 185XP, standard
- Electrical position monitoring for type 185XQ, available as accessory
- Mounting position: any



Application

Hydraulic swing clamps are used for clamping of workpieces, when it is essential to keep the clamping area free of straps and clamping components for unrestricted workpiece loading and unloading.
This series obtains very high clamping forces even at 70 bar and can directly be connected to the low-pressure hydraulics of the machine tools.
With the reinforced swing mechanism and the optional position monitorings these swing clamps are particularly suitable for:

- Automatic manufacturing systems with very short cycle times
- Clamping fixtures with workpiece loading by handling systems
- Transfer lines and assembly lines
- Test systems for motors, gears and axes
- Assembly lines
- Special machine tools

Description

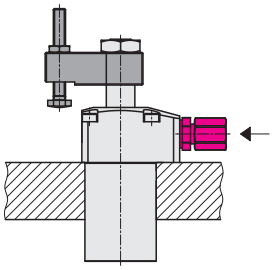
The hydraulic swing clamp is a pull-type cylinder where a part of the total stroke is used to swing the piston.
The reinforced swing mechanism ensures that the angle position of the clamping arm remains the same even if a slight collision with the workpiece during loading and unloading or during clamping occurs.
The angle position of the clamping arm is fixed with a dowel pin.
The FKM wiper at the piston rod can be protected against coarse and hot swarf by an optionally available metallic wiper (see page 2).
The version with extended switch rod is provided for mounting electrical position monitoring (accessory).

Important notes see page 2

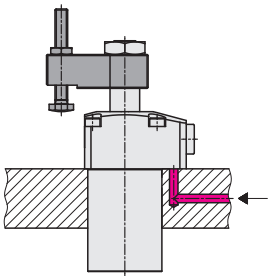
Installation and connecting possibilities

Pipe thread

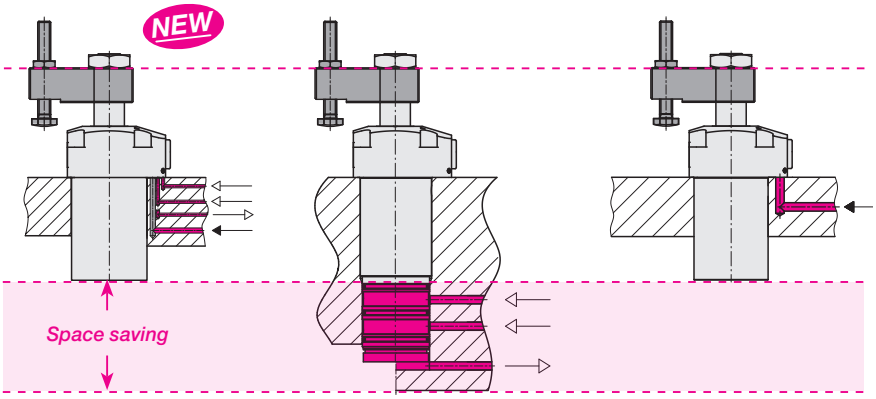
without position monitoring
185XT → Page 2



Drilled channels



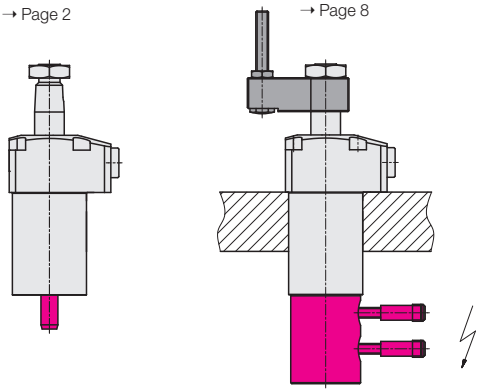
with integrated pneumatic position control
185XP → Page 4



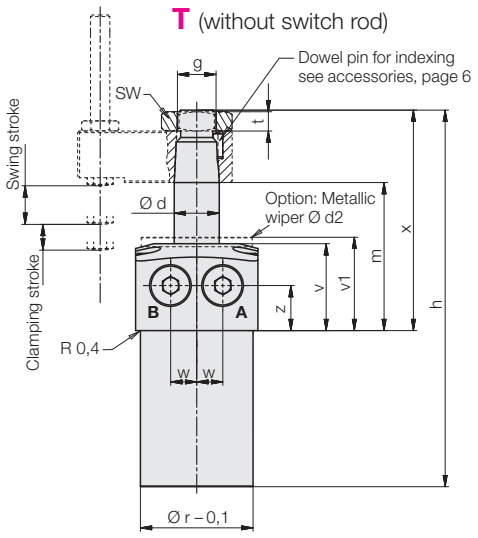
Pneumatic position monitoring at the bottom
available on request

without position monitoring

with switch rod for electrical position monitoring (see accessories)
185XQ → Page 2 → Page 8

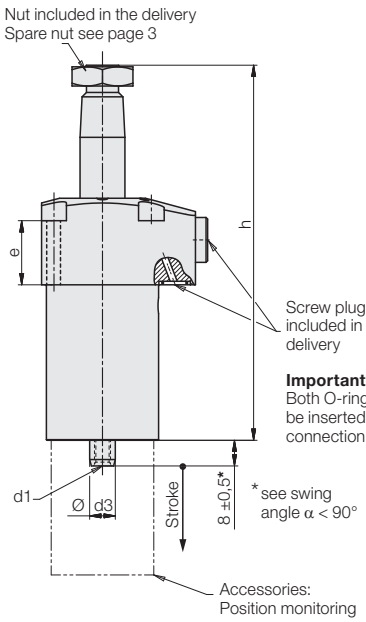


T (without switch rod)

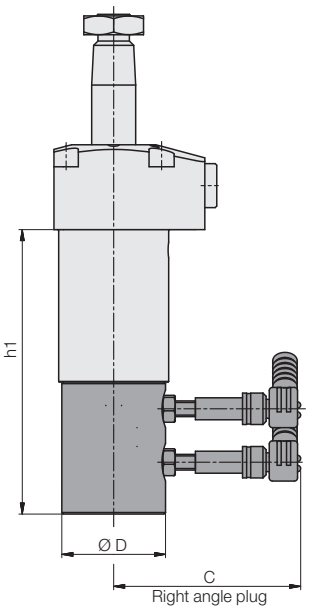


A = Clamping
B = Unclamping

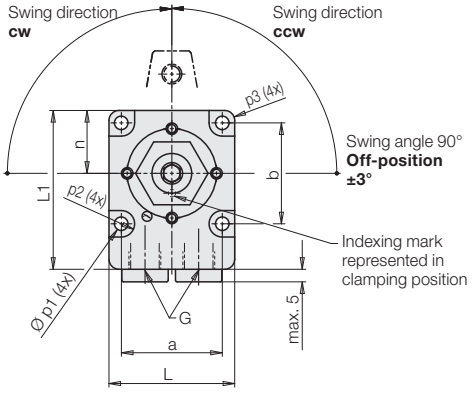
Q (with switch rod)



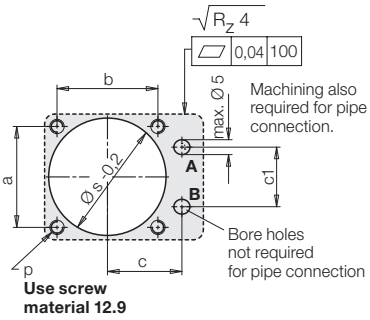
Electrical position monitoring (→ page 8)



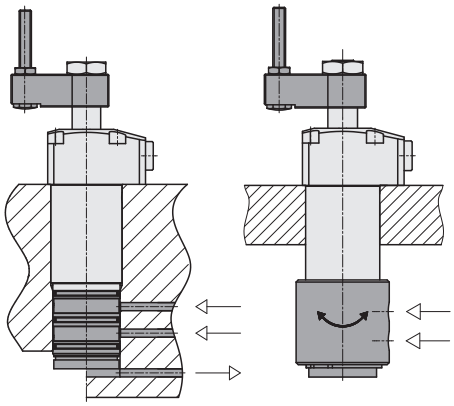
Clamping position ±1°



Connecting scheme



Pneumatic position monitorings
available on request



Cartridge type Pipe thread connection

Swing angle

1. Swing angle 90° and 0° (standard)

	Part no.
90° cw	**185X X090 RXX**
90° ccw	**185X X090 LXX**
0°	**185X X000 0XX**

2. Swing angle α < 90°

α = 15° to 75° in gradation of 5°

By insertion of a distance plate the return stroke of the piston is reduced and thus the swing angle is reduced.
Clamping stroke and clamping position remain the same. The swing stroke and the dimensions h, m and x are reduced by y:

y = (90° – α°) * k (k see chart page 3)

Dimension 8 ±0.5 is lengthened by the value y.

Example:

Swing clamp	1856T090L27
Desired swing angle	**45° ccw**
Part no.	**1856T045L27**

Shortening:
y = (90° – 45°) * 0.125 mm/° = 5.625 mm

3. Swing angle > 90°

Available on request!

Important notes

Swing clamps must only be used for clamping of workpieces in industrial applications and may only be operated with hydraulic oil. They can generate very high forces. The workpiece, the fixture or the machine must be in the position to compensate these forces.
In the effective area of piston rod and clamping arm, there is the danger of crushing.
The manufacturer of the fixture or the machine is obliged to provide effective protection devices. The swing clamp has no overload protection device. When mounting the clamping arm, the clamping arm or the hexagon socket in the piston have to be backed up for tightening or untightening the fixing nut.
During loading and unloading of the fixture and during clamping a collision with the clamping arm has to be avoided.
Remedy: Mount position adaptor.

Wiper system

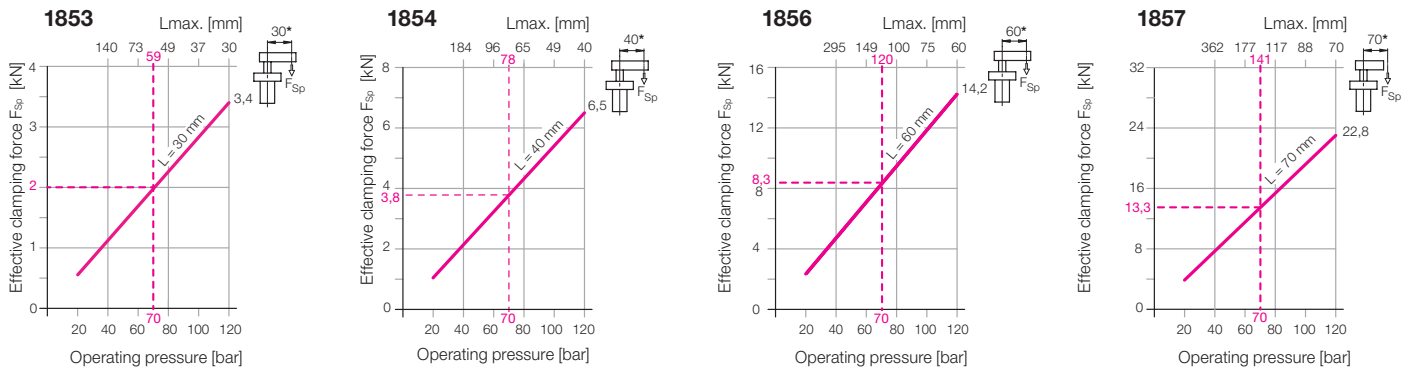
The standard FKM wiper has a high chemical resistance against most cooling and cutting fluids.
The optional metallic wiper protects the FKM wiper against mechanical damage due to big or hot swarf.
It consists of a radially floating wiping disk and a retaining disk.
The metallic wiper can be delivered already mounted ("**M**") or as an accessory for retrofitting (part no. see page 7).

Attention!
The metallic wiper is not suitable for dry machining or minimum quantity lubrication. Also in applications with very little grinding swarf, the standard FKM wiper has a better protection effect.
If there is any danger that small particles stick to the piston rod, the metallic wiper disk can also be replaced by a hard plastic disk.

Swing clamps			**1853**	**1854**	**1856**	**1857**
Max. pulling force (70 bar)		[kN]	2.35	4.46	9.9	16.1
Max. pulling force (120 bar)		[kN]	4,04	7,65	17	27,6
Effective clamping force		[kN]	see diagram or calculation of the clamping force on page 6			
Clamping stroke		[mm]	8	8	10	10
Swing stroke		[mm]	8	13	17	19
Total stroke		[mm]	16	21	27	29
Min. operating pressure		[bar]	20	20	20	20
Max. flow rate	Clamping	[cm^3/s]	13.5	33.5	96	167
	Unclamping	[cm^3/s]	20	53.5	145	255
Piston area	Clamping	[cm^2]	3.36	6.37	14.16	23
	Unclamping	[cm^2]	4.9	10.17	21.23	33.18
Oil volume / stroke		[cm^3]	5.4	13.4	38.3	66.7
Oil volume / return stroke		[cm^3]	7.9	21.4	57.4	102
Piston Ø		[mm]	25	36	52	65
a		[mm]	30.5	40	56	68
b		[mm]	30.5	40	56	68
c		[mm]	22.5	28	36	42
c1		[mm]	18	24	36	45
Ø d		[mm]	14	22	30	36
Ø d1		[mm]	M5x14.5 deep	M6 x 11.5 deep	M8x16.0 deep	M8x16.0 deep
Ø d2		[mm]	34.5	44.5	52.5	58.5
Ø d3 f7		[mm]	8	10	12	12
e		[mm]	20	19.5	19	23.5
SW		[mm]	SW 19	SW 27	SW 36	SW 46
g		[mm]	M12	M18 x 1.5	M24x1.5	M30x1.5
G			G 1/8	G 1/8	G 1/4	G 1/4
h		[mm]	117	149	178.5	203.5
h1		[mm]	90.5	110	132	141
k		[mm/°]	0.056	0.095	0.125	0.125
L		[mm]	38	50	70	86
L1		[mm]	48	60	82	96
m		[mm]	46	54	64.5	72.5
n		[mm]	19	25	35	43
p		[mm]	M4 (10.9)	M5 (10.9)	M8 (10.9)	M10 (10.9)
Ø p1		[mm]	4.3	5.5	9	11
p2		[mm]	4	5	7	9
p3		[mm]	3	3	6	7
Ø r –0.1		[mm]	35	47	63	78
Ø s –0.2		[mm]	36	48	64	79
t		[mm]	6	9	10	12
v		[mm]	27	29.5	34.5	39
v1		[mm]	29	31.5	36.5	41
w		[mm]	8.1	11	15	19
x		[mm]	68.5	88	101.5	119.5
z		[mm]	14	13.5	15.5	15.5
Weight, approx.		[kg]	0.7	1.5	3.0	5.0
Part no.	Swing direction 90° cw		**1853X090R16M**	**1854X090R21M**	**1856X090R27M**	**1857X090R29M**
	Swing direction 90° ccw		**1853X090L16M**	**1854X090L21M**	**1856X090L27M**	**1857X090L29M**
	0 degree		**1853X000016M**	**1854X000021M**	**1856X000027M**	**1857X000029M**
Spare O-ring		[mm]	7x1.5	7x1.5	8x1.5	8x1.5
Part no.			**3000342**	**3000342**	**3000343**	**3000343**
Spare nut DIN 936			M12	M18 x 1.5	M24x1.5	M30x1.5
Tightening torque		[Nm]	12	30	62	110
Part no.			**3302115**	**3301663**	**3302104**	**3302139**

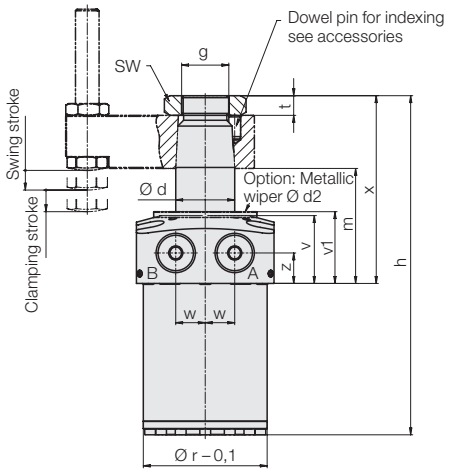
Code letter **X** see page 2
Metallic wiper **M** = option (see page 2)

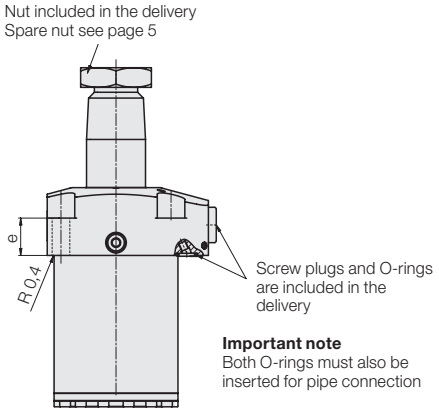
Effective clamping force with accessory clamping arm as a function of the oil pressure

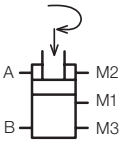


* Clamping force for other lengths see page 6

P (with integrated pneumatic position monitoring)

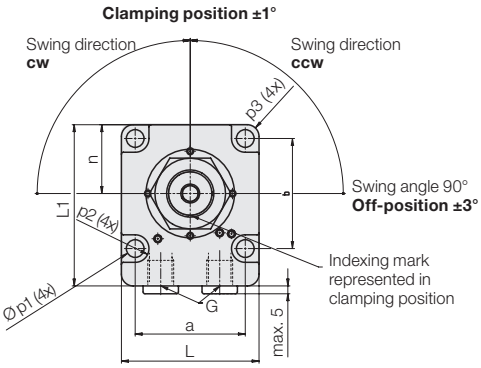


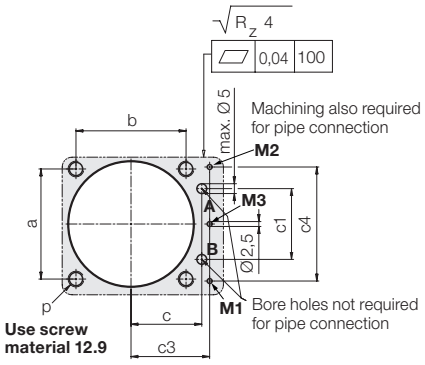




A = Clamping
B = Unclamping
M1 = Clamped (pneumatic)
M2 = Unclamped (pneumatic)
M3 = Outlet air (pneumatic)

Connecting scheme





Pneumatic position monitoring

Application

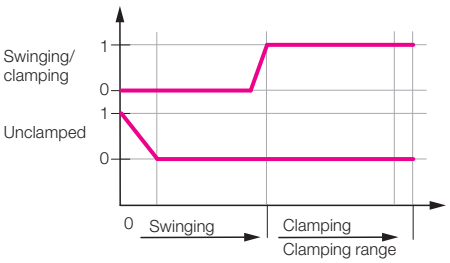
The pneumatic position monitoring signals the following conditions by closing two bore holes:

1. Piston extended and clamping arm in off-position.
2. Piston in clamping area and clamping arm in clamping position.

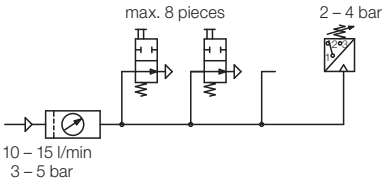
For each control function, a pneumatic line has to be provided at the clamping fixture.

Pneumatic diagram

0 = Passage
1 = No passage/closed



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 position monitorings can be monitored.
Note that reliable functioning of pneumatic monitoring is only guaranteed if the throttled air pressure and air flow rate are throttled.

Technical data

Port	Drilled channels
Nominal diameter	2 mm
Max. air pressure	10 bar
Range of operating pressure	3–5 bar
Differential pressure*) at 3 – 5 bar system pressure	min. 1.5 bar
Air flow rate	10– 15 l/min

*) Minimum pressure difference, if one or several position monitorings are not operated

Swing clamps			1853P	1854P	1856P	1857P
Max. pulling force (70 bar)		[kN]	2.35	4.46	9.9	16.1
Max. pulling force (120 bar)		[kN]	4,04	7,65	17	27,6
Effective clamping force		[kN]	see diagram or calculation of the clamping force on page 6			
Clamping stroke		[mm]	8	8	10	10
Swing stroke		[mm]	8	9	11	15
Total stroke		[mm]	16	17	21	25
Min. operating pressure		[bar]	20	20	20	20
Min. clamping and unclamping times		[s]	0.5	0.5	0.5	0.5
Max. flow rate	Clamping	[cm^3/s]	10.8	21.6	60	115
	Unclamping	[cm^3/s]	15.8	34.6	89.2	166
Piston area	Clamping	[cm^2]	3.36	6.37	14.16	23
	Unclamping	[cm^2]	4.9	10.17	21.23	33.18
Oil volume / stroke		[cm^3]	5.4	10.8	29.8	57.5
Oil volume / return stroke		[cm^3]	7.9	17.3	44.6	83
Piston Ø		[mm]	25	36	52	65
a		[mm]	30.5	40	56	68
b		[mm]	30.5	40	56	68
c		[mm]	22.5	28	36	42
c1		[mm]	18	24	36	45
c3		[mm]	21	28	40	44.5
c4		[mm]	31.8	41	58	67
Ø d		[mm]	14	22	30	36
Ø d2		[mm]	34.5	44.5	52.5	58.5
e		[mm]	20	19.5	19	23.5
SW		[mm]	SW 19	SW 27	SW 36	SW 46
g		[mm]	M12	M18x1.5	M24x1.5	M30x1.5
G			G 1/8	G 1/8	G 1/4	G 1/4
h		[mm]	116.5	145	172.5	199.5
L		[mm]	38	50	70	86
L1		[mm]	48	60	82	96
m		[mm]	45.5	50	59	68.5
n		[mm]	19	25	35	43
p		[mm]	M4 (10.9)	M5 (10.9)	M8 (10.9)	M10 (10.9)
Ø p1		[mm]	4.3	5.5	9	11
Ø p2		[mm]	4	5	7	9
p3		[mm]	3	3	6	7
Ø r –0.1		[mm]	35	47	63	78
Ø s –0.2		[mm]	36	48	64	79
t		[mm]	6	9	10	12
v		[mm]	27	29.5	34.5	39
v1		[mm]	29	31.5	36.5	41
w		[mm]	8	11	15	19
x		[mm]	68	84	95.5	115.5
z		[mm]	14	13.5	15.5	15.5
Weight, approx.		[kg]	0.7	1.5	3.2	5.1
Part no.	Swing direction cw		**1853PXXR16**	**1854PXXR17**	**1856PXXR21**	**1857PXXR25**
	Swing direction ccw		**1853PXXL16**	**1854PXXL17**	**1856PXXL21**	**1857PXXL25**
	0°		**1853P00016**	**1854P00017**	**1856P00021**	**1857P00025**
Spare O-ring	2 x hydraulics	[mm]	5x1.5	7x1.5	8x1.5	8x1.5
Part no.			**3000340**	**3000342**	**3000343**	**3000343**
Spare O-ring	3 x pneumatics	[mm]	3x1	3x1	2.9x1.78	2.9x1.78
Part no.			**3001758**	**3001758**	**3000019**	**3000019**
Spare nut DIN 936			M12	M18x1.5	M24x1.5	M30x1.5
Tightening torque		[Nm]	12	30	62	110
Part no.			**3302115**	**3301663**	**3302104**	**3302139**

Length correction value for h, m, x, total stroke and swing stroke

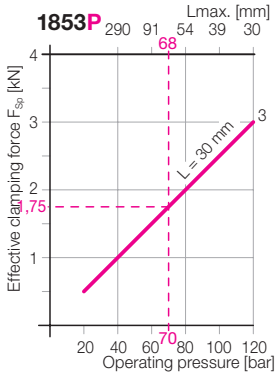
Swing angle	Part no.	1853P	1854P	1856P	1857P
90°	**185XP90XXX**	0	0	0	0
60°	**185XP60XXX**	–3.5	–3.7	–4.9	–6.3
45°	**185XP45XXX**	–4.5	–4.7	–6.2	–8.2
0°	**185XP000XX**	0	0	0	0
With metallic wiper [1]	**185XPXXXXXM**				

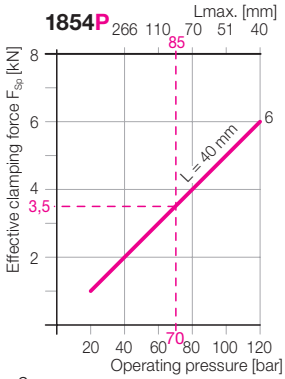
[1] Wiper system, see page 2

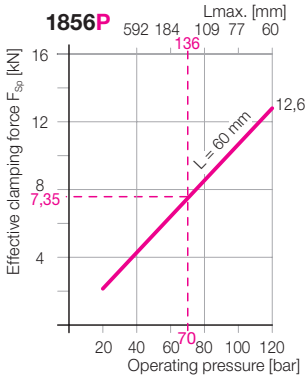
Example: **1854P45R17**

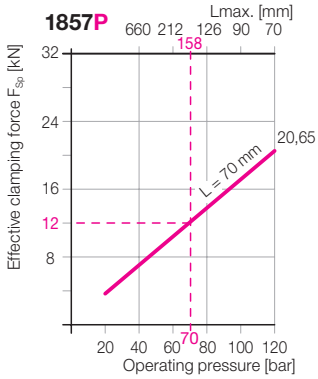
h	145	–4.7 = 140.3
m	50	–4.7 = 45.3
x	84	–4.7 = 79.3
Total stroke	17	–4.7 = 12.3
Swing stroke	9	–4.7 = 4.3

Effective clamping force with accessory clamping arm as a function of the oil pressure









* Clamping force for other lengths see page 6

Admissible flow rate

With the accessory clamping arm and the admissible flow rate as per the chart, the shortest clamping time is approx. 0.5 seconds.
Longer special clamping arms have a higher torque of inertia. To avoid an overload of the swing mechanism, the flow rate has to be reduced:

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

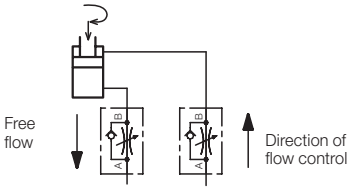
Q_e = Flow rate as per chart
Q_L = Flow rate with special clamping arm
J_e = Torque of inertia accessory clamping arm
J_L = Torque of inertia special clamping arm

If the torques of inertia are not known, the admissible flow rate can be determined according to the following example:
Conditions: The special clamping arm is longer, has however the form (cross section) of the accessory clamping arm, as shown on page 6.

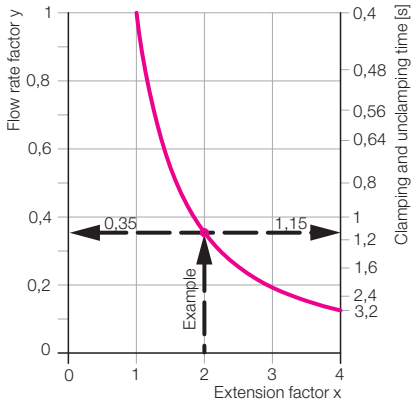
Example: Swing clamp 1853T090R16
L = 60 mm
e = 30 mm as per above chart
Q_e = 13.5 cm³/s

1. Extension factor $x = \frac{L}{e} = \frac{60\text{ mm}}{30\text{ mm}} = 2$
2. Flow rate factor as per diagram → y = 0.35
3. Max. flow rate $Q_L = y * Q_e = 0.35 * 13.5\text{ cm}^3/\text{s} = 4.7\text{ cm}^3/\text{s}$
4. Min. clamping time as per diagram → approx. 1.15 s

Throttling of the flow rate



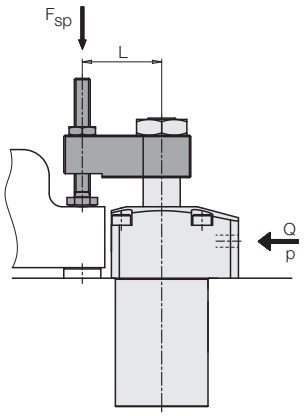
Adm. flow rate and clamping time as a function of the clamping arm extension



Clamping force calculation

The clamping force diagram shows the effective clamping force with accessory clamping arm (L = e).
Versions **T** and **Q**: see page 3
Version **P**: see page 5

With longer clamping arms (L > e) the degree of efficiency is reduced. This is considered in the following calculation.
The constants (A–E) for the 4 sizes are shown in the following charts.



Versions T and Q

Constant	1853	1854	1856	1857
A	29.68	15.68	7.06	4.35
B	0.177	0.069	0.023	0.013
C	102.9	260.5	853.8	1596
D	3053	4087	6026	6939
E	18.2	17.86	19.55	20.86

Version P

Constant	1853	1854	1856	1857
A	29.68	15.68	7.06	4.35
B	0.343	0.108	0.041	0.021
C	90	240	756	1442
D	2671	3763	5335	6270
E	30.8	25.9	31	30.5

Effective clamping force

$$F_{Sp} = \frac{p}{A + (B * L)} \le F_{adm.} \quad [\text{kN}]$$

Admissible clamping force*)

$$F_{adm.} = \frac{C}{L} \quad [\text{kN}]$$

Admissible operating pressure

$$p_{adm.} = \frac{D}{L} + E \le 70 \quad [\text{bar}]$$

L = special length [mm] p = pressure [bar]

*) With a desired clamping arm length L the clamping force must not exceed the admissible value.

Example 1: Swing clamp 1853T090R16
Special clamping arm L = 60 mm

1. Admissible clamping force*)
$F_{adm.} = \frac{C}{L} = \frac{102{,}9}{60} = 1{,}71\text{ kN}$
2. Admissible operating pressure
$p_{adm.} = \frac{D}{L} + E = \frac{3053}{60} + 18{,}2 = 69\text{ bar} < 70$
3. Effective clamping force
$F_{Sp} = \frac{p}{A + (B * L)} = \frac{69}{29{,}68 + (0{,}177 * 60)} = 1{,}71\text{ kN}$

Example 2: Swing clamp 1853P090R16
Special clamping arm L = 70 mm

1. Admissible clamping force*)
$F_{adm.} = \frac{C}{L} = \frac{90}{70} = 1{,}29\text{ kN}$
2. Admissible operating pressure
$p_{adm.} = \frac{D}{L} + E = \frac{2671}{70} + 30{,}8 = 69\text{ bar} < 70$
3. Effective clamping force
$F_{Sp} = \frac{p}{A + (B * L)} = \frac{69}{29{,}68 + (0{,}343 * 70)} = 1{,}29\text{ kN}$

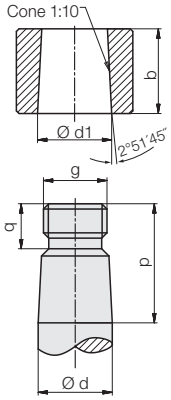
Example 3: Swing clamp 1853T090R16
Special clamping arm L = 60 mm

1. Admissible clamping force*)
$F_{adm.} = \frac{C}{L} = \frac{102{,}9}{60} = 1{,}71\text{ kN}$
2. Admissible operating pressure
$p_{adm.} = \frac{D}{L} + E = \frac{3053}{60} + 18{,}2 = 69\text{ bar} < 120$
3. Effective clamping force
$F_{Sp} = \frac{p}{A + (B * L)} = \frac{69}{29{,}68 + (0{,}177 * 60)} = 1{,}71\text{ kN}$

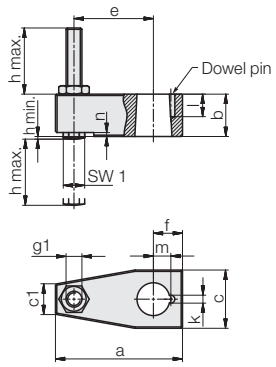
Example 4: Swing clamp 1853P090R16
Special clamping arm L = 60 mm

1. Admissible clamping force*)
$F_{adm.} = \frac{C}{L} = \frac{90}{60} = 1{,}5\text{ kN}$
2. Admissible operating pressure
$p_{adm.} = \frac{D}{L} + E = \frac{2671}{60} + 30{,}8 = 75{,}3\text{ bar} < 120$
3. Effective clamping force
$F_{Sp} = \frac{p}{A + (B * L)} = \frac{75{,}3}{29{,}68 + (0{,}343 * 60)} = 1{,}5\text{ kN}$

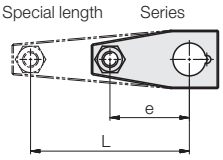
Dimensions for special clamping arms



Clamping arm with contact bolt



Special clamping arm



Flow rate and clamping force calculation, see page 6

Swing clamps		**1853**	**1854**	**1856**	**1857**
a	[mm]	48	65	96	114
b	[mm]	16	25	27	35
c	[mm]	22	34	52	60
c1	[mm]	12	19	31	36
Ø d	[mm]	14	22	30	36
Ø d1 –0.05	[mm]	14	22	30	36
e	[mm]	30	40	60	70
f	[mm]	11	17	25	30
g	[mm]	M12	M18 x 1.5	M24 x 1.5	M30 x 1.5
g1	[mm]	M6	M8	M12	M16
h min.	[mm]	1	1	1	1
h max.	[mm]	40	46	54	63
Ø k +0.1	[mm]	3	3	6	6
l +0.5	[mm]	8.5	8.5	12.5	12.5
m ±0.05	[mm]	6.6	10.3	15	18.1
n	[mm]	1.5	2.5	6	8
p	[mm]	22.5	34	37	47
q	[mm]	8.5	11.5	12.5	15.5
SW 1	[mm]	8	10	18	24
Moment of inertia of J_e	[kg mm²]	44	230	1284	3247
Part no.					
Clamping arm with contact bolt and dowel pin		**0354243**	**0354249**	**0354254**	**0354256**
Dowel pin		3 m 6x8	3 m 6x8	6 m 6x12	6 m 6x12
		3301854	**3301854**	**3300325**	**3300325**
Metallic wiper		**0341227**	**0341228**	**0341229**	**0341230**

Accessory
Throttle valve

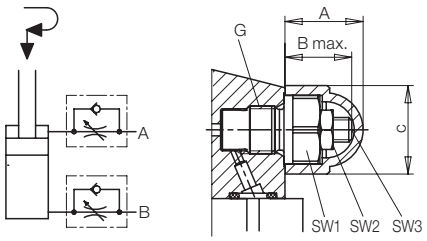
Throttle valves are used
- in order to reduce the swing speed of the clamping arm
- in order to improve the synchronism of several swing clamps

This application is only possible for manifold-mounting connection through drilled channels.

Important note

If throttling is too strong, the back pressure can trigger premature switching of pressure switches and sequence valves.

Hydraulic symbol



Swing clamps		**1853 1854**	**1856 1857**
A	[mm]	16	21
B max.	[mm]	13.5	17.5
C	[mm]	18	23.6
G		G 1/8	G 1/4
SW1	[mm]	14	19
Tightening torque	[Nm]	18	35
SW2	[mm]	8	8
SW3	[mm]	2.5	2.5
Weight	[kg]	0.025	0.036
Part no.		**2957209**	**2957210**

Application

The electrical position monitoring signals the following conditions due to damping of two inductive proximity switches:

1. Piston extended, clamping arm in off-position.
2. Piston in clamping area, clamping arm in clamping position.

For each control function, an electrical line has to be provided at the clamping fixture.

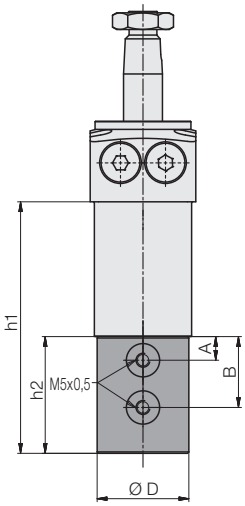
Description

The electrical position monitoring can be easily retrofitted at all swing clamps with switch rod (185X**Q**0XX).

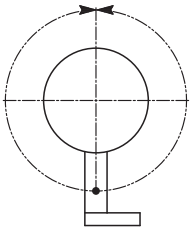
Included in our delivery are:

1 Signal sleeve with screw
1 Adapter with 4 countersunk screws
1 Control housing with 3 set screws
2 Inductive proximity switches with right angle plug (if ordered)

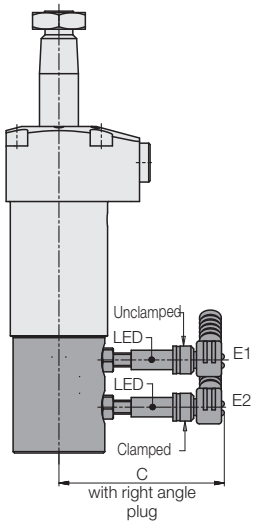
The signal sleeve is screwed onto the switch rod. The adapter is mounted with 4 countersunk screws on the bottom cover.
The control housing can be put onto the adapter in any angular position and locked with 3 set screws.
For information on adjustment of proximity switches, see operating manual.



360° adjustable



Possible position of the proximity switches



Important notes

Inductive position monitorings are not suitable for the use in coolant and swarf areas. According to the corresponding application conditions, safety measures have to be planned and checked later on.

Swing clamps		**1853Q0XX**	**1854Q0XX**	**1856Q0XX**	**1857Q0XX**
A	[mm]	8.5	8.5	8.5	8.5
B	[mm]	25.5	30.5	37.5	39.5
C approx.	[mm]	59.5	61	62	62
Ø D	[mm]	33	42	45	45
h1	[mm]	90.5	110	132	141
h2	[mm]	42	49	55	57

Technical data	
Operating voltage	10–30 V DC
Max. residual ripple	10 %
Max. constant current	100 mA
Switching function	interlock
Output	PNP
Material of housing	stainless steel
Thread	M 5 x 0.5
Code class	IP 67
Ambient temperature	–25 to +70 °C
LED function display	Yes
Protected against short circuits	Yes
Type of connection	Connector
Length of cable	5 m

Part no. swing angle 0° or 90°				
with switch and plug	**0353920**	**0353926**	**0353930**	**0353943**
without switch and plug	**0353923**	**0353927**	**0353931**	**0353944**
Part no. 15° to 75° = XX*)				
with switch and plug	**03539200XX**	**03539260XX**	**03539300XX**	**03539430XX**
without switch and plug	**03539230XX**	**03539270XX**	**03539310XX**	**03539440XX**
Part no. spare parts				
Inductive proximity switch	**3829198**	**3829198**	**3829198**	**3829198**
Right angle plug 5 m	**3829099**	**3829099**	**3829099**	**3829099**

*) in gradation of 5° (see page 2, "swing angle α < 90°")

Function chart