

Why Die Clamping Systems?

B

Automation

- power operated elements
- monitoring elements, especially for pressure and position
- short cycles thanks to automatic release of functions
- integration in process monitoring and control

Increased productivity

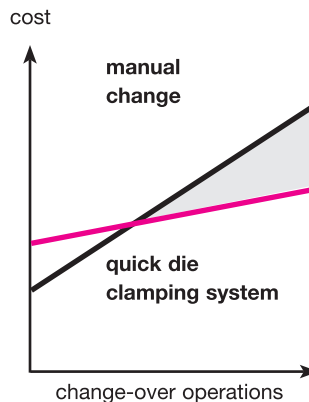
- more capacity thanks to short set-up times
- less downtime e.g. due to tool breakage or reworking dies
- short tryout period

Easier operation

- even in case of unfavorable ambient conditions (temperature, sprays)
- clamping at hard-to-get-to points
- clamping by applying high clamping forces
- die change also possible for less skilled workers

Improved quality

- consistent quality
- repeatability of positioning and clamping
- low-distortion clamping

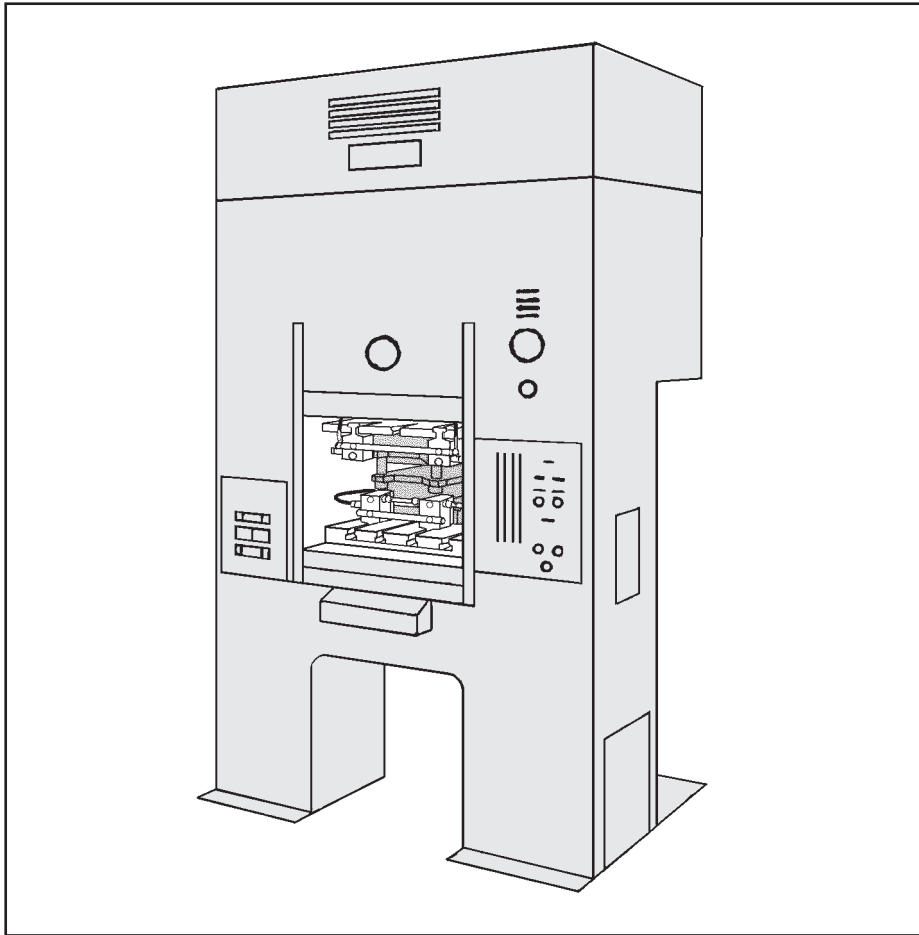

Quick payback

Efficiency

- short set-up time even with small lot sizes, consequently lower inventory levels
- easier die change; can be carried out by the machine operator
- reduced number of clamping devices
- increased tool life quantity
- of tools and dies, i.e. less test pieces

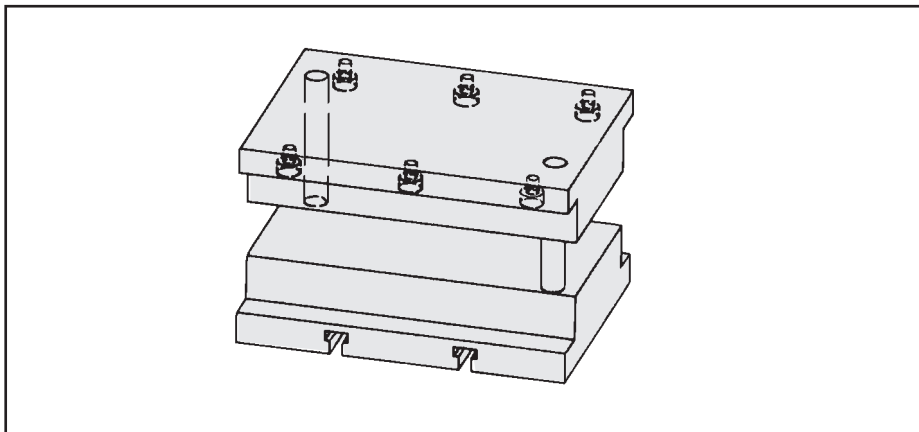
Less wear and tear

- uniform and low-distortion clamping
- consistent clamping forces
- repeatability of positioning and clamping operation, especially with regard to material feed and discharge equipment
- optimum selection of clamping positions



Presses

- Type
- Press tonnage
- Stripping force
- Shut height
- Working stroke
- Strokes per minute
- Dimensions of mounting surfaces
- T-slots
size and layout
- Ejectors
- Die cushion
- Feed guides
- Positioning



Dies

- Weight
- Die or mold dimensions
- Die height
- Clamping edge height
- Ejectors
- Feeder pass height
- Possible clamping positions
- Die handling and transport
- Disconnects for auxiliary energy for monitoring

Component parts of quick die clamping systems?

- Clamping elements suitable for dies and presses
- Energy supply unit
 - pump unit
 - machine hydraulics
- Control and operating panel
- Monitoring system linked with the press controls
- Accessories such as hoses and tubing
- Mounting of the elements onto the machine

Quick die clamping systems require standardization

Regarding:

- Clamping edge height
- Clamping edge depth
- Lateral dimensions
- Clamping points in/on the die, etc.

Characteristics of Tool Clamping Systems, Recommendations

Clamping elements

Constant working pressure: See data sheets
 Ambient temperature: 158° F (70°C) maximum (other temperatures upon request)
 Mounting position: any, unless otherwise stated
 Piston velocity: .4—10 in/sec
 Leakage rate: at 6000 psi, 68°F Hydraulic oil (HPL 32)
 —dynamic: (0.0001g) 0.00004 Oz per double stroke
 (ø = 1.25 in, stroke 1.57 in, V = 4 in/sec)
 (0.0003g) .00012 oz per double stroke
 (ø = 1.57 in, stroke 1.57 in, V = 4 in/sec)
 —static: (0.03g) 0.001 oz in 24 hours

Oil recommendation

Always use absolutely clean, fresh hydraulic fluid. Fill fluid under absolutely clean conditions. Almost all service problems are caused by dirty contaminated fluid.

Oil temperature (F°)	(DIN 51-524)	Designation (DIN 515 19)	Viscosity (2 Gallon)	CLR P/N	Shell
32-104	HLP 22	ISO VG 22		Mobil	Tellus 22
50-122	HLP 32	ISO VG 32	CLR-2-FL	DTE 24	
68-140	HLP 46	ISO VG 46		DTE 25	
Other hydraulic fluids upon request					

Fittings

- According to SAE straight thread (J1926) UN/UNF-2A.
- According to DIN 2353, screwed plugs type B to DIN 3852 sheet 2 (BSPP type, designated, i.e., G¹/₄) When products are furnished with BSPP parts, fittings are supplied to adapt to SAE J514, 37° flared fitting.
- Do not use additional sealing materials such as Teflon tape.

Tubing

Seamless, low carbon steel tubing per SAE J524.

Outside diameter (in)	Wall thickness (in)	Hyd. pressure (psi)	Thread SAE (in)	Fitting DIN (BSPP)
¼	.049	6,650	7/16-20	G ¼
5/16 (8mm)	.065	7,050	½-20	G ¼
¾	.065	5,900	9/16-18	G ¾

Tubes should be dimensioned as short as possible. Tubes for single-acting spring return cylinders should not exceed 16 feet, tubes for double-acting cylinders may be longer. Make sure tubes are installed with large radius bends.

Hose connections

For connection of the clamping elements we recommend high-pressure hoses with 4x safety factor at the maximum operating pressure. Special designs should be used for hoses subject to constant movement, e.g. hoses for oil supply to the slide. Use large radius bends and prevent the hoses from chafing. Please contact us for advice.

Starting the system, Maintenance

Read operating instructions before starting the system. Use clean and new oil. Bleed the complete system by operating the pump at low pressure (300 psi), until the oil which comes out at the highest point is free from bubbles. Since hydraulic valves are very sensitive to dirt, make sure that no impurities are carried into the hydraulic oil. Oil change should be made at least once a year.

Dynamic pressure in the hydraulic system

Due to friction in tubes, screw fittings, valves and cylinders a pressure of 15-30 psi is necessary for proper oil circulation. The retracting springs in cylinders with spring return is designed for a maximum dynamic pressure of 30 psi. If the cylinders move slowly, or if the stroke is not fully extended, the dynamic pressure must be reduced (larger tube diameter, shorter tubes, less screw fittings, connection in parallel and not in series, less weight on the piston).

In applications with double-acting cylinders dynamic pressure is likely to occur, when pressure is applied to the rod side and the larger oil volume of the piston side must flow back to the reservoir through narrow tubes and valves.

Normally, dynamic pressure has no negative effect. However, if in applications with swing clamps and swing sink clamps 725 psi are exceeded, this may cause premature wear of the swing mechanism and result in malfunction (see catalog sheets).

Thread size	M6	M8	M10	M12	M14	M16	M20	M24	M30	M36	M42	M48
Property class 8.8 (between SAE grades 5 and 8)	(.24)	(.32)	(.39)	(.47)	(.55)	(.63)	(.79)	(.95)	(1.18)	(1.42)	(1.65)	(1.89)
Permissible test load to DIN 267 sheet 3 (lb)	2,700	4,700	7,700	11,000	15,100	20,500	32,000	46,000	73,000	108,000	147,000	193,000
Max. permissible preload (utilizing 2/3 of the yield point) (lb)	1,800	3,200	5,200	7,200	10,100	13,500	21,400	30,600	44,000	72,000	98,000	128,000
Required tightening torque (ft-lb)	7	16	33	55	90	140	280	460	890	1,550	2,500	3,700
Maximum manual clamping force* (lb)	1,800	3,200	5,200	7,200	10,100	12,600	15,100	15,800	15,800	15,800	15,800	15,800
Clamping force by using strap clamp (leverage = 2:1) (lb)	1,100	2,000	3,400	4,700	6,700	8,300	9,900	10,400	10,400	10,400	10,400	10,400
Number x piston Ø for obtaining the preload specified in line 3, at 6000 psi (in)	1x.63	1x.787	1x.984	1x1.260	1x1.575	1x1.732 2x1.260 3x.984	1x2.165	1x2.480	1x3.150 2x1.575 2x1.969 3x1.969 3x1.260 3x1.575 4x1.575	1x3.937	1x4.724	1x5.512 4x1.969 2x3.150 3x3.150 6x1.575 6x1.969 8x1.969
Mechanical clamping and unclamping (sec) time per clamping point**	11	12	13	15	17	18	22	26	36	(50)	(70)	(100)
Hydraulic clamping and unclamping (sec) time per clamping point***	0.8	0.9	1.0	1.1	1.2	1.3	1.5	1.8	2.2	3.0	4.0	5.0
Recommendations	If there are several clamping points, hydraulic clamping is recommended			Transition from manual to hydraulic clamping			Max. permissible clamping force cannot be achieved manually; hydraulic clamping preferred			Manual clamping not advisable; hydraulic clamping only		

* Clamping force that can be achieved manually by using a wrench to DIN 894 and by applying a manual force of 34 Lbs coefficient of friction 0.14.

** Total time required in case of mechanical clamping and unclamping to obtain the clamping force specified in line 5, regardless of preparation time. Clamping stroke = .236. When using clamping arm, multiply values by 1.4.

*** Total time required in case of hydraulic clamping and unclamping to obtain the clamping force specified in line 3. Electric power unit with electrovalves. Pump delivery 146 in³/min at 6000 psi. Clamping stroke .236.

Clamping time

for other clamping strokes

$$\text{Time for mechanical clamping} = \frac{t \cdot h}{6} \text{ (s)}$$

$$\text{Time for hydraulic clamping} = \frac{t \cdot h \cdot m}{6} \text{ (s)}$$

t = Clamping time specified in lines 8 and 9

h = Clamping stroke (in)

m = Stroke factor 0.8 for stroke > .236 in

Stroke factor 1.2 for stroke < .236 in

Clamping time

for several clamping points

$$\text{Time for mechanical clamping} = t \cdot n \text{ (s)}$$

$$\text{Time for hydraulic clamping} = t \cdot n \cdot 0.8 (n-1) \sqrt{t} \text{ (s)}$$

t = Clamping time specified in lines 8 and 9

n = Number of clamping points

B

Clamping time, t

$$t = \frac{60q \cdot s \cdot z}{Q} \quad [\text{sec}]$$

Piston velocity, V

$$V = \frac{Q}{60 \cdot A \cdot z} \quad [\text{in/sec}]$$

Pump delivery, Q

$$Q = \frac{60q \cdot s \cdot z}{t} \quad [\text{in}^3/\text{min}]$$

Motor Power Input with continuous duty

$$HP_{IN} = \frac{p \cdot Q}{396,000 \cdot E} = \frac{p \cdot Q}{333,000}$$

t = Clamping time [sec]
q = Oil required per in of piston stroke acc. to catalogue [in³/inch]
s = Clamping stroke [in]
z = Number of clamping cylinders
Q = Pump delivery [in³/min]
A = Piston area [in²]
n = Motor speed [rpm]
p = Operating pressure [pounds/in²]
E = Overall efficiency = Volumetric Eff x Mechanical Eff
= 0.96 x 0.88
= .84

Determination of clamping force

The clamping force for upper and lower die depends on:

- die weight
- accelerated power
- stripping force on the side
- additional forces, e.g. due to ejector
- adherence of workpieces

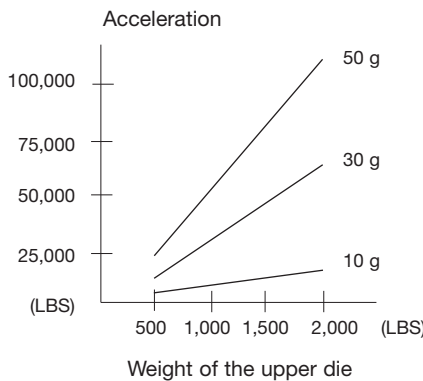
Acceleration power

The acceleration is dependent on the press drive, on the mechanical properties (elasticity, rigidity) of the press body and on the operations being carried out. The highest acceleration rates occur in punching operations during snap-through. The following values must be taken into account:

- approx. 50 g for high-speed automatic punching machines
- 30 g for open-front presses
- 6 g for car body presses

For determination of the acceleration power it is necessary to know the die weight.

The following graph shows the relation.



Net stripping force

This is the force acting on the die's clamping points after deduction of losses due to friction and acceleration. In case of pressure die casting machines this force is referred to as opening force. In a particular case it is necessary to check whether this force must be taken into account when designing the clamping elements. Under normal operating conditions the full machine force is not utilized. Often it only becomes evident when the die has got stuck. The clamping elements must be properly designed to avoid fracture or damage in such cases of emergency.

Ejector force

The ejector force acts on the die, if the ejector cylinders do not move against their own stops but when the die is used as stop. Thus, ejection forces must be considered in any case.

Example

Hydraulic straight side press 112 ton without drawing operation, max. stripping force 22.5 tons.

Both upper die and lower die have a weight of approx. 1,100 pounds each.

Both upper and lower die have a clamping force of approx. 22,000 to 45,000 pounds each.

Acceleration power (for upper die only): mass approx. 1,100 pounds, acceleration approx. 10 g, thus, acceleration power approx. 11,250 pounds (see graph).

Since the acceleration power is generally lower than the stripping force, the clamping force is determined according to the stripping force.

The clamping force is 45,000 pounds.

Safety requirements are defined by safety regulations and manufacturing technology.

In accordance with up-to-date practice, hydraulic die clamping systems are divided into 3 safety levels.

1st safety level:

Preferably used in connection with post-guided dies.

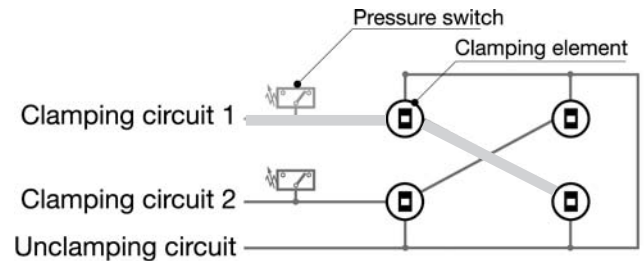
Pressure switches in each clamping circuit for clamping force control as machine safety.

Two hydraulic circuits independent of each other.

Clamping circuit 1 = 50% of the clamping elements in the bed and the slide, respectively

Clamping circuit 2 = 50% of the clamping elements in the bed and the slide, respectively

If one circuit fails, the upper or lower die is still clamped with 50% of the total clamping force. Thus, the 2nd clamping circuit becomes a safety circuit.

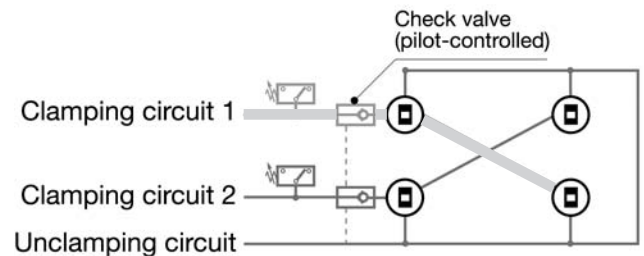


2nd safety level:

Used in connection with dies that are not post-guided.

A check valve (pilot-controlled) keeps pressure in the clamping and safety circuit when pressure drops in the remaining system.

See connection block in Section J for further information.

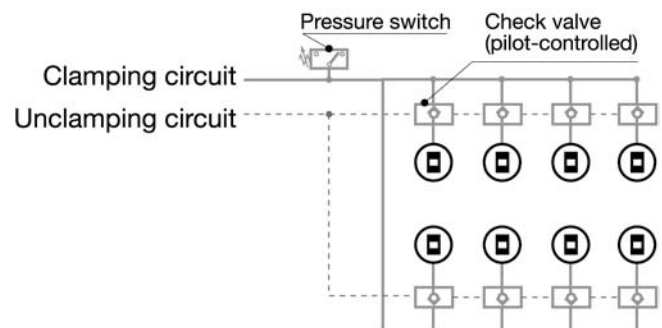


3rd safety level:

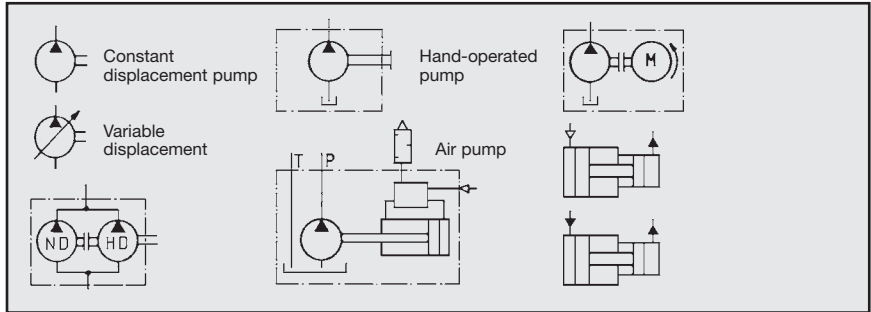
Used in connection with dies on power presses and car body presses that are not post-guided.

All clamping elements are secured by pilot-controlled check valves. In the event of pressure drop >20% of the operating pressure, the press is switched off by a pressure switch. The check valves ensure that the clamping force is maintained over many days.

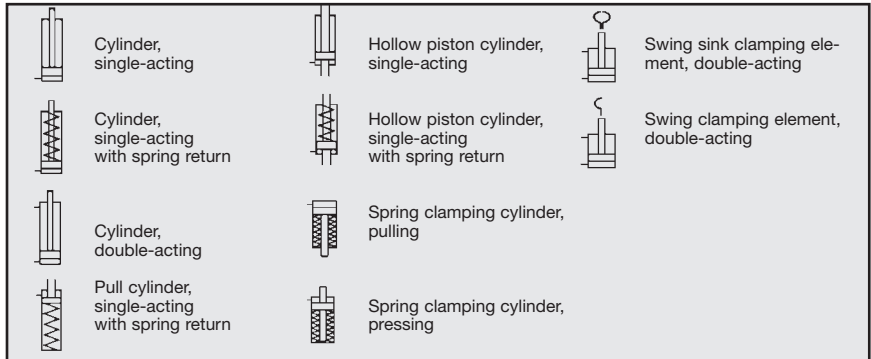
For this safety level, wedge clamps with locking bolts and valve sequence controls are used. Maximum safety by standard wedge clamps.



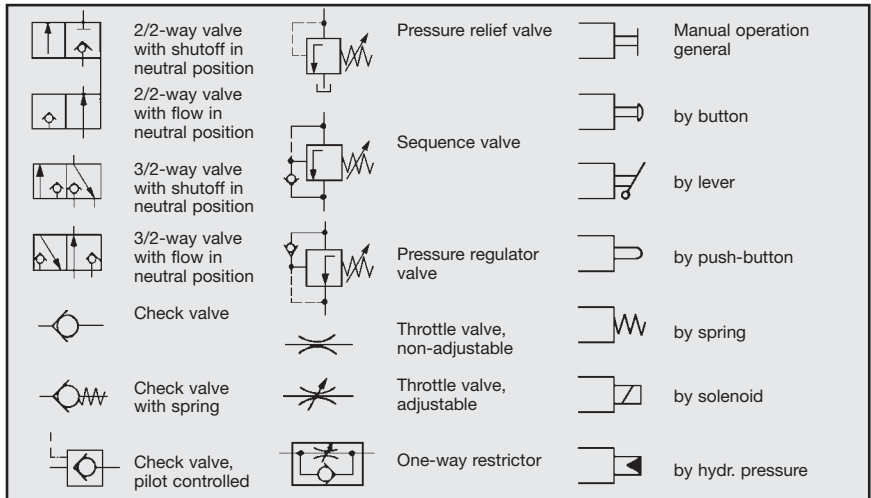
PRESSURE GENERATORS



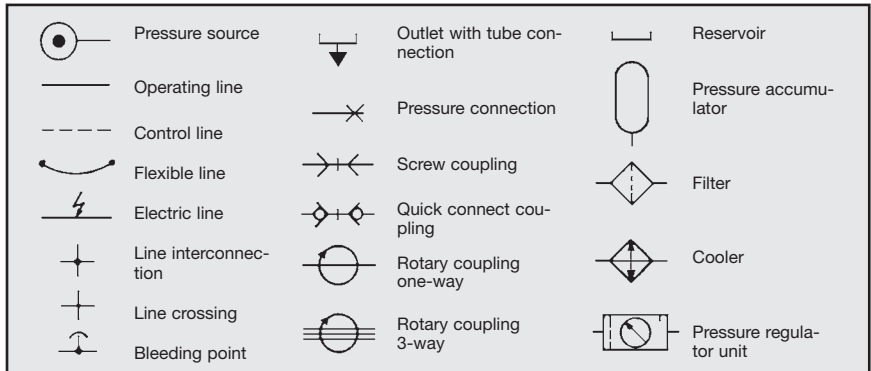
HYDRAULIC CYLINDERS



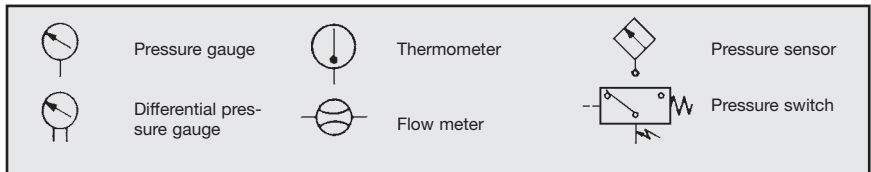
VALVES

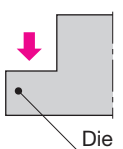
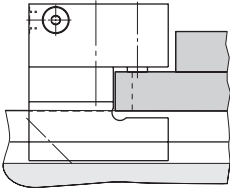
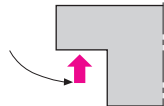
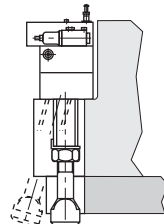
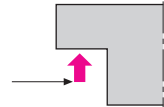
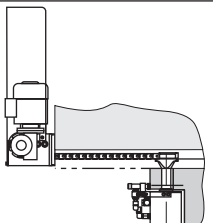
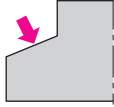
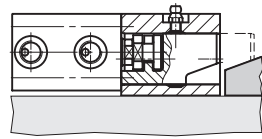
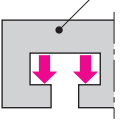
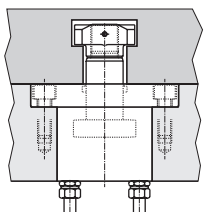
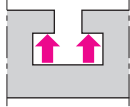
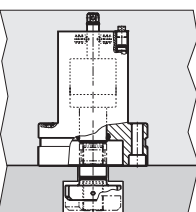
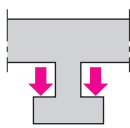
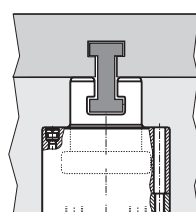


ENERGY TRANSMISSION HYDRAULIC OIL SUPPLY AND ACCESSORIES



OTHER EQUIPMENT



Clamping principles	Examples of clamping	CLAMPING ELEMENT	Catalog Section
 <p>Die</p>		Sliding clamp, angular clamp, clamping bar, hollow piston cylinder, wedge clamps with flat clamping edge spring clamping cylinder, extending clamp, mechanical clamps	C, D
		Pivot and pull clamp, wedge swing clamp electromechanical clamping elements	D, G
		Rapid clamping system with pusher chain Hollow piston cylinder Angular clamp, electromechanical	F, G
		Wedge clamp for dies with tapered clamping edge	D
 <p>Die</p>		Double-T clamping bars Pull clamping element	E
		Swivel and pull clamps, hydraulic Swivel and pull clamps, electrical Swing-sink clamping element Swing clamping element	E, G
		Pull clamping element with T-slot	E

B