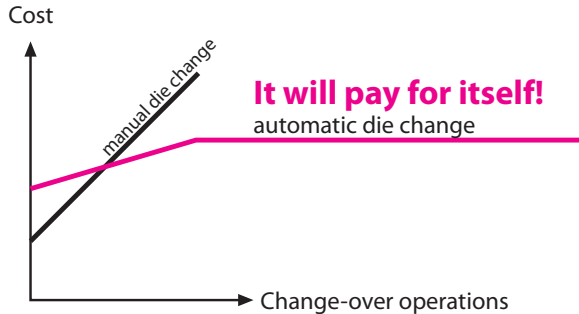






## Why die clamping systems?



Innovative technology and many years of experience are the basis for our range of die clamping and changing systems.

Rationalize your operation by using automatic die changing systems.

## Improved productivity

- **More capacity**  
thanks to **reduced set-up times**
- **Less downtime**  
e.g. due to tool breakage or reworking of dies
- Short test period

## Operating facility

- Operate under extreme **circumstances**  
(high temperature, spray)
- Die clamping in barely **accessible** positions
- Clamping using **high clamping forces**
- Dies may be changed by relatively **unskilled workers**
- **Repeatable** die changing process

## Automation

- **Power operated** elements
- **Monitoring devices**, in particular for pressure and position
- **Short cycles** thanks to automatic triggering of functions
- Integration with **process monitoring and control**

## Economy

- Short **set-up times** even for small batches, smaller stock of parts
- **Simplified** die change, can be carried out by the machine operator
- Fewer **jigs and fixtures required**
- Enhanced **tool life** as a result of less wear
- Reduced **run-in period** for tools and dies, fewer test pieces and less time needed

## Improved quality

- **Consistent quality**
- **Repeatability** of die position
- **Low-distortion clamping**

## Reduced rate of wear

- **Uniform and low-distortion clamping, high clamping forces**
- **Compensating clamping force** (elasticity)
- **Repeatable** positioning and clamping operation
- Optimum **selection of clamping points**



---

|   |                      |
|---|----------------------|
| <b>Clamping principles</b><br><b>T-slots in the press bed and slide</b> | <b>Pages 14 - 15</b> |
| <b>Clamping force</b><br><b>Clamping time</b>                           | <b>Pages 16 - 17</b> |
| <b>Efficiency analysis</b><br><b>Calculation of payback period</b>      | <b>Pages 18 - 21</b> |
| <b>Hydraulic parameters</b><br><b>Symbols of clamping hydraulics</b>    | <b>Pages 22 - 23</b> |
| <b>Safety stages</b><br><b>Power units</b>                              | <b>Pages 24 - 25</b> |



| Clamping principles | Examples of clamping | Clamping element   | Product group                                    |
|---------------------|----------------------|--|--|
|                     |                      | Sliding clamp, angular clamps<br>Clamping bars, hollow piston cylinder<br>Wedge clamps with a flat clamping edge<br>Spring clamping cylinders<br>Extending clamps<br>Clamping screws | <b>2 + 3</b><br><br><br><br><br><br><br><b>6</b> |
|                     |                      | Pivot and pull clamp<br>Wedge swing clamp<br>Electromechanical clamping elements   | <b>2 + 5</b>                                     |
|                     |                      | Rapid clamping system<br>with pusher chain<br>Hollow piston cylinder<br>Angular clamp, electromechanical   | <b>3</b><br><br><br><b>5</b>                     |
|                     |                      | Wedge clamp for dies<br>with a tapered clamping edge   | <b>2</b>   |
|                     |                      | Double-T clamping bars<br>Pull clamping element  | <b>2 + 4</b>                                     |
|                     |                      | Swivel and pull clamps, hydraulic<br>Swivel and pull clamps, electrical<br>Swing-sink clamping element<br>Swing clamping element   | <b>4 + 5</b>                                     |
|                     |                      | Pull clamping element with T-slot  | <b>4</b>   |

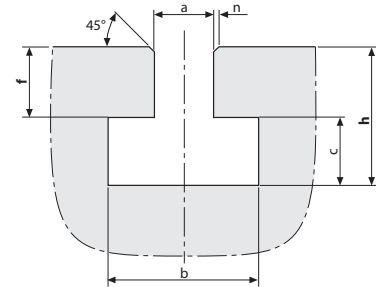
# T-slot dimensions according to DIN 650



## T-slot dimensions according to DIN 650

Dimensions and tolerances for T-slots according to DIN 650. Applicable to machine beds, pallets or die clamping devices on presses.

| a (mm)      | 18 H8     | 22 H8     | 28 H8     | 36 H8     | a (in)      | $\frac{13}{16}$                 | $1\text{-}\frac{1}{16}$         |
|-------------|-----------|-----------|-----------|-----------|-------------|---------------------------------|---------------------------------|
| f min. (mm) | 16        | 20        | 26        | 33        | f min. (in) | $\frac{9}{16}$                  | $\frac{3}{4}$                   |
| f max. (mm) | 24        | 29        | 36        | 46        | f max. (in) | $1\text{-}\frac{1}{16}$         | $1\text{-}\frac{1}{4}$          |
| b (mm)      | $30^{+2}$ | $37^{+3}$ | $46^{+4}$ | $56^{+4}$ | b (in)      | $1\text{-}\frac{3}{8}^{+0.094}$ | $1\text{-}\frac{3}{4}^{+0.094}$ |
| c (mm)      | $12^{+2}$ | $16^{+2}$ | $20^{+2}$ | $25^{+3}$ | c (in)      | $\frac{19}{32}^{+0.031}$        | $\frac{25}{32}^{+0.047}$        |
| h min. (mm) | 30        | 38        | 48        | 61        | h min. (in) | $1\text{-}\frac{5}{32}$         | $1\text{-}\frac{17}{32}$        |
| h max. (mm) | 36        | 45        | 56        | 71        | h max. (in) | $1\text{-}\frac{11}{16}$        | $2\text{-}\frac{5}{64}$         |
| n max. (mm) | 1,6       | 1,6       | 1,6       | 2,5       | n max. (in) |                                 |                                 |



The **slot depth h** and the **web height f** must be exactly measured and checked for possible tolerances. If your T-slot is not within the specified tolerance range, customized solutions are also possible.

## Recommended clamping forces for T-slots acc. to DIN 650

| T-slot | Clamping force max. |
|--------|---------------------|
| 18 mm  | 40 kN               |
| 22 mm  | 60 kN               |
| 28 mm  | 100 kN              |
| 36 mm  | 160 kN              |

If the above clamping forces are exceeded, permanent deformation of the T-slot may be caused.

## Conversion factors

Temperature

|    | K               | °C           | °F                |
|----|-----------------|--------------|-------------------|
| K  | 1               | °C +273,15   | (°F-459,67) x 5/9 |
| °C | K-273,15        | 1            | (°F-32) x 5/9     |
| °F | K x 9/5 +459,67 | °C x 9/5 +32 | 1                 |

K = Kelvin  
°C = Degrees centigrade  
°F = Degrees Fahrenheit

Pressure

|       | 1 MPa   | 1 bar  | 1 PSI  |
|-------|---------|--------|--------|
| 1 MPa | 1       | 10     | 145,04 |
| 1 bar | 0,1     | 1      | 14,504 |
| 1 PSI | 0,00689 | 0,0689 | 1      |

MPa = Mega-Pascal  
PSI = Imperial pound per square inch

Length

|        | mm     | inch   |
|--------|--------|--------|
| 1 inch | 25,399 | 1      |
| 1 mm   | 1      | 0,0393 |

inch = Imperial unit of length



## Clamping force

| Thread, property class 8.8  | M6   | M8   | M10  | M12   | M14  | M16                        | M20   | M24                        | M30                        | M36  | M42                         | M48                         |
|---|--|------|------|---|------|----------------------------|---|----------------------------|----------------------------|--|-----------------------------|-----------------------------|
| Permissible test load to DIN 267 sheet 3 (kN)                                   | 12   | 21   | 34   | 49  | 67   | 91                         | 143   | 205                        | 326                        | 478  | 652                         | 856                         |
| Max. permissible preload (utilising 2/3 of the yield point) (kN)                | 8  | 14   | 23   | 32  | 45   | 60                         | 95  | 136                        | 217                        | 318  | 434                         | 570                         |
| Required tightening torque (Nm)   | 9  | 22   | 44   | 76  | 120  | 190                        | 380   | 620                        | 1200                       | 2100   | 3400                        | 5000                        |
| Maximum manual clamping force* (kN)   | 8  | 14   | 23   | 32  | 45   | 56                         | 67  | 70                         | 70                         | 70   | 70                          | 70                          |
| Clamping force using a clamping arm (leverage = 2:1) (kN)                       | 5  | 9    | 15   | 21  | 30   | 37                         | 44  | 46                         | 46                         | 46   | 46                          | 46                          |
| Number x piston Ø for obtaining the preload specified in line 3 at 400 bar (mm) | 1x16   | 1x20 | 1x25 | 1x32  | 1x40 | 1 x 44<br>2 x 32<br>3 x 25 | 1 x 55<br>2 x 40<br>3 x 32  | 1 x 63<br>2 x 50<br>3 x 40 | 1 x 80<br>3 x 50<br>4 x 40 | 1 x 100<br>4 x 50<br>6 x 40  | 1 x 120<br>2 x 80<br>6 x 50 | 1 x 140<br>3 x 80<br>8 x 50 |
| Mechanical clamping and unclamping time per clamping point** (s)                | 11   | 12   | 13   | 15  | 17   | 18                         | 22  | 26                         | 36                         | (50)   | (70)                        | (100)                       |
| Hydraulic clamping and unclamping time per clamping point*** (s)                | 0,8  | 0,9  | 1,0  | 1,1   | 1,2  | 1,3                        | 1,5   | 1,8                        | 2,2                        | 3,0  | 4,0                         | 5,0                         |
| <b>Recommendations</b>  | <b>If there are several clamping points, hydraulic clamping is recommended</b> |      |      | <b>Transition from manual to hydraulic clamping</b> |      |                            | <b>Max. permissible clamping force cannot be achieved manually; hydraulic clamping is preferred</b> |                            |                            | <b>Manual clamping is no longer appropriate; hydraulic clamping only</b> |                             |                             |

\* Clamping force that can be achieved manually using a wrench to DIN 894, by applying a manual force of 150N and a coefficient of friction of 0.14.

\*\* Total time required in case of mechanical clamping and unclamping to obtain the clamping force specified in line 5, without taking account of time required for providing single components. Clamping stroke = 6 mm

When **working overhead** or when using **clamping claws**, the clamping and unclamping time must be increased by about 50%.

\*\*\* Total time required for hydraulic clamping and unclamping to obtain the clamping force specified in line 3. Electric power unit with solenoid valves. Pump delivery 40 cm<sup>3</sup>/s at 400 bar. Clamping stroke = 6 mm.

## Clamping time ... ... for other clamping strokes

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

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

t = Clamping time specified in lines 8 and 9  
h = Clamping stroke (mm)  
m = Stroke factor 0.8 for stroke >6 mm  
Stroke factor 1.2 for stroke <6 mm

## Calculations

$$\text{Clamping time, } t = \frac{q \times s \times z}{16 \times Q} \text{ [s]}$$

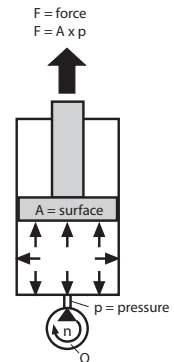
$$\text{Piston velocity, } v = \frac{160 \times Q}{A \times z} \text{ [mm/s]}$$

$$\text{Pump delivery, } Q = \frac{q \times s \times z}{16 \times t} \text{ [l/min]}$$

$$\text{Motor power on continuous duty, } P = 2,7 \times n \times V \times p \text{ [W]}$$

$$\text{Pressure loss in pipes, } \Delta p = \frac{1 \times L}{4 \times d} \times v^2 \text{ [bar]}$$

t = Clamping time [sec]  
q = Oil required per 1 mm piston stroke acc. to catalogue [cm<sup>3</sup>/mm]  
s = Clamping stroke [mm]  
z = Number of clamping cylinders  
Q = Pump delivery [l/min]  
A = Piston area [cm<sup>2</sup>]  
n = Motor speed [rpm]  
V = Pump delivery (l/min.)  
p = Operating pressure [bar]  
Assumed: λ = 0,055, p = 700 Ns<sup>2</sup>/m<sup>4</sup>, volumetric efficiency 0.96, motor efficiency 0.88  
L = Pipe length [m] (straight, smooth pipe)  
d = Pipe inner diameter [mm]  
v = Flow velocity [m/s]  
v<sub>max.</sub> = 6 m/s for pressure pipes, 2 m/s for return pipes





The clamping force to be applied for upper and lower die depends on:

- the **stripping force** on the slide
- the **ejection force**
- the **acceleration force**
- the **die weight**

The total clamping force to be produced by the clamping elements must be higher **than the greatest of all forces acting in a specific case. In general, the following approximate value may be assumed as the total clamping force for the upper or the lower die**

**Total clamping force = 10 % - 20 % of the pressing force**

Based on the total clamping force, the required number of clamping elements is determined taking account of their clamping force and local conditions (symmetry, clearance, etc.)

### Stripping force on the slide

This is the force acting on the die's clamping points after deduction of losses due to friction and acceleration. In the case of die casting machines, this force is referred to as the opening force. In a specific case it must be checked whether this force has to be taken into consideration when designing the clamping elements. Under normal operating conditions, the full machine potential is not utilized. Often it only becomes evident when the die halves have become stuck. The clamping elements must be designed in such a way that they are not damaged or broken in such cases of emergency. (Approximate values as per VDI guidelines 3145, see below.)

### Ejection force

If ejectors are used, the maximum ejection force must be taken into account. The ejection 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. (Approximate values as per VDI guidelines 3145, see below.)

### Approximate values as per VDI guidelines 3145

- Stripping force on the slide: 5 % – 20 % of the pressing force
- Ejection force in the bed: 5 % – 20 % of the pressing force
- Ejection force in the slide: 1 % – 10 % of the pressing force

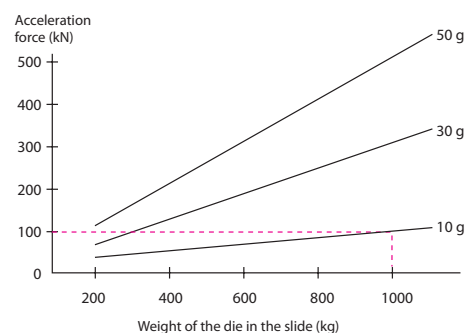
### Acceleration force

The acceleration force must be taken into consideration when using very heavy dies and/or in case of high slide acceleration. The acceleration depends on the press drive, on the mechanical properties (elasticity, rigidity) of the press frame and on the operations being carried out.

The following approx. values may be assumed:

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

For determining the occurring acceleration force, the die weight must be known. The interrelation is shown in the diagram below:



### Example of calculation

Hydraulic double-column press, without drawing operation, max. stripping force 400 kN; weight of upper and lower dies: 1000 kg each.

Approximate value for the total clamping force per die half:  
Determination on the basis of the acceleration force:

20% of the pressing force = approx. 400 kN.  
with an acceleration of 10 g and a weight of 1000 kg, the acceleration force (as per diagram) is approx. 100 kN.

In view of the low acceleration force, the clamping force is determined on the basis of the stripping force.

**Thus, the required total clamping force is 400 kN.**



**Assistance in reaching a decision  
'When does an investment pay for itself?'**

The subject of quick die changing on forming presses and injection moulding machines should not be interpreted too closely. The term 'clamping' includes the complete part of the process which is capable of being automated, i.e. feeding to and positioning in the machine, clamping and transporting outside the machine and, in a broader sense, also storage of dies.

Hilma-Römheld offers system solutions which are suitable for adaptation to customers' specific needs. There may be many reasons for automation, the degree being dependent of the criteria prevailing in a company with respect to production and to the workplace.

**A decision for automation may be influenced by the following criteria:**

- improving productivity
- minimizing set-up times
- increasing flexibility
- rationalization measures
- humanization of work
- safety

This means that the decision for an automation of the die changing process is not only taken on the basis of a cost-benefit analysis but it is also influenced by workplace-related optimizing approaches.

In order to approach a solution by taking account of both quantity- and quality-related aspects, the so-called **efficiency analysis** may be applied.

This method for an alternative assessment offers the possibility of including also those criteria which cannot be expressed in units of money.

In addition to the fixed and variable costs of an investment, quality-related features such as—

- guaranteed conditions
- availability of spare parts
- safety
- service life
- advice and training
- ease of operation
- compatibility with the environment, etc.

can also be taken into account.

For each criterion included an **evaluation** is determined which reflects the importance of the criterion concerned. In the second step, each alternative relevant for the decision is assigned a mark, based on its **compliance with the various criteria**.

By multiplying these dimensionless figures, a partial efficiency is obtained for each criterion. Addition of the partial efficiency obtained for the alternative under consideration will give the overall efficiency.

In the example, two alternative solutions for press automation are at choice. Using this model of an analysis of the efficiency (**scoring model**) decisions can also be made taking account of quality criteria.

| Criterion                 | Evaluation % | Die changing system A              |             | Die changing system B |             |
|---------------------------|--------------|------------------------------------|-------------|-----------------------|-------------|
|                           |              | Degree of compliance <sup>2)</sup> | Efficiency  | Degree of compliance  | Efficiency  |
| Acquisition costs         | 25           | 8                                  | 2,00        | 3                     | 0,75        |
| Maintenance               | 20           | 4                                  | 0,80        | 6                     | 1,20        |
| Safety                    | 30           | 5                                  | 1,50        | 9                     | 2,70        |
| Operation                 | 15           | 2                                  | 0,30        | 10                    | 1,50        |
| Spare parts               | 8            | 5                                  | 0,40        | 9                     | 0,72        |
| Training                  | 2            | 3                                  | 0,06        | 9                     | 0,18        |
| <b>Overall efficiency</b> | <b>100</b>   | –                                  | <b>5,06</b> | –                     | <b>7,05</b> |

2) The degree of compliance is expressed in marks between 1 and 10, 10 being the best.

Although the price of die changing system B does not meet with expectations (assigned degree of compliance = 3), this alternative has a higher overall efficiency. For more details, we recommend reference to examples on the Internet, catchword: Analysis of efficiency.

When simply comparing costs, only the investment costs of two or more alternatives are compared with the anticipated benefit.





## Calculation of payback period

In this method, the acquisition costs (purchase price, calculatory depreciation and interest), the operating costs (energy, maintenance, expenses for the room where the machine is installed, follow-up costs for dies) as well as wage costs (set-up times, run-in period after die change) are calculated and, related to the planned die changing frequency, compared with the savings in time and costs.

## Example of calculation

Using the example of an existing press, two alternative proposals for die changing are compared. The production conditions are as follows:

- 2-shift operation, 810 min./day
- one die change per shift
- the dies are being used in the press
- roller bars and support consoles for loading the die are already fitted to the press

### Example A

Die change is carried out using ten M24 mechanical clamping screws on the slide and six M24 clamping screws on the bed.

The acquisition costs are negligible compared with alternative B.

### Example B

On the slide, die change is carried out using quick clamping systems from product group 3, i.e. hollow piston cylinders type HILMA 8.2135.2802 (8x). On the bed, die change is carried out using clamping bars of product group 2 type HILMA 2095-120 (4x).



Clamping bar



Hollow piston cylinder



**Comparison of costs**

|                                  |        | <b>Example A</b> | <b>Example B</b> |
|----------------------------------|--------|------------------|------------------|
| <b>General data</b>              |        |                  |                  |
| Transfer press (existing)        | number | 1                | 1                |
| Existing dies                    | number | 5                | 5                |
| Planned dies                     | number | 3                | 3                |
| <b>Die changing system</b>       |        |                  |                  |
| Clamping elements on the slide   | €      | 0                | 3.200            |
| Clamping elements on the bed     | €      | 0                | 1.600            |
| Power unit (including controls)  | €      | 0                | 4.300            |
| Installation / Commissioning     | €      | 0                | 4.700            |
| Rework of existing dies          | €      | 0                | 16.900           |
| Costs of the die changing system | €      | <b>0</b>         | <b>30.700</b>    |

|                                  |        |               |               |
|----------------------------------|--------|---------------|---------------|
| <b>Set-up times</b>              |        |               |               |
| Die clamping on the slide        | min.   | 6,5           | 0,5           |
| Die clamping on the bed          | min.   | 3,9           | 0,5           |
| Die unclamping on the slide      | min.   | 6,5           | 0,5           |
| Die unclamping on the bed        | min.   | 3,9           | 0,5           |
| Die transport                    | min.   | 4,0           | 4,0           |
| Die set-up times                 | min.   | <b>24,8</b>   | <b>6,0</b>    |
| <b>Die changing</b>              |        |               |               |
| Die changes / shift              | number | 1             | 1             |
| Manpower / number of die changes | number | 1             | 1             |
| <b>Set-up time / month</b>       | h      | <b>17,3</b>   | <b>4,2</b>    |
| Hourly machine rate              | €/h    | 280           | 280           |
| Set-up costs / month             | €      | 4.844         | 1.176         |
| <b>Set-up costs / year</b>       | €/year | <b>58.128</b> | <b>14.112</b> |
| Hourly wage                      | €/h    | 25,56         | 25,56         |
| <b>Wage costs / year</b>         | €      | <b>5.306</b>  | <b>1.288</b>  |
| <b>Calculatory depreciation</b>  | years  | 10            | 10            |
|                                  | €/year | <b>0</b>      | <b>3.070</b>  |
| <b>Calculated interests</b>      | €/year | <b>0</b>      | <b>767</b>    |
| <b>Sum of costs</b>              | €/year | <b>63.434</b> | <b>19.237</b> |

If die change is carried out once per shift, about 500 die changes are carried out per year.

|  |             |        |       |
|--|-------------|--------|-------|
| <b>Die change</b>  | Number/year | 500*   | 500   |
| <b>Costs / change</b>  | €           | 126,87 | 38,47 |
| <b>Cost advantage</b>  | €/change    |        | 88,40 |
| Amortisation of die change ~ 347 die changes (€ 30.700 / 88,40)<br>this corresponds to approx. 8,33 months |             |        |       |

\* 500 die changes/year = 2 die changes/day x 250 working days

Under the given marginal conditions, an investment of € 30,700 quoted as an example in alternative B will have paid off after approx. 8.33 months or 347 die changes. The production time gained by the reduction in the set-up times has not been taken into account.



## Rough calculation

As a first approach, the following formula can be used for determining the payback period with sufficient accuracy:

$$\text{Payback period} = \frac{\text{costs}}{\text{benefit}} = \frac{\text{investment (quick die clamping)} - \text{investment (conventional)}}{\text{saving of time} \times \text{hourly machine rate} \times \text{die change}}$$

Parameters:

Investment costs (quick die clamping/changing system B) [€]

Investment costs (conventional clamping/changing system A) [€]

Saving of time = quick die clamping [min] - conventional clamping [min]

Hourly machine rate [€/min]

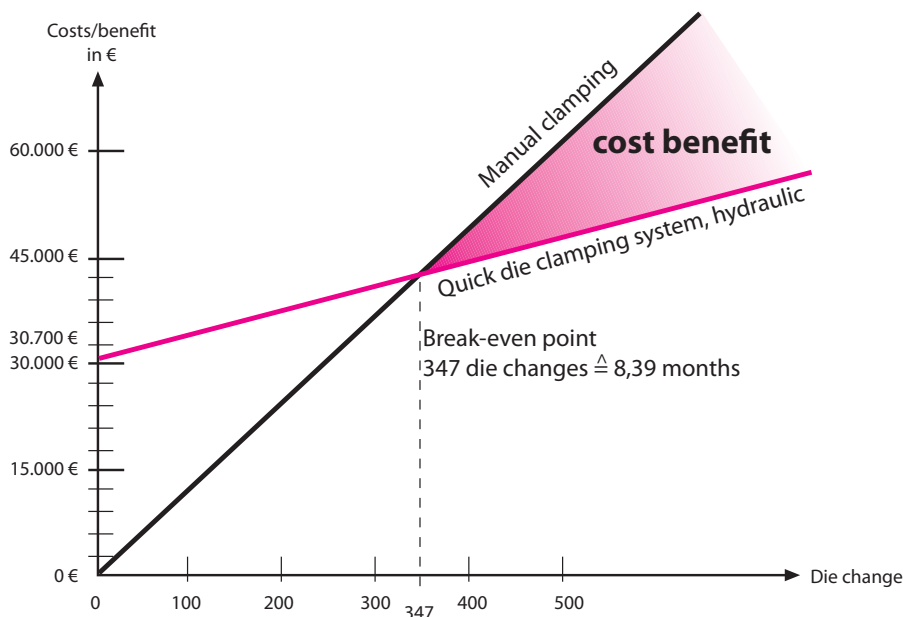
Die change [changes/month]

Payback period [months]

For the above example, a rough calculation gives the following results:

$$\begin{aligned} \text{Payback period} &= \frac{(30.700 - 0)}{(24,8 - 6) \times (280/60) \times (500/12)} \\ &= \mathbf{8,39 \text{ months}} \end{aligned}$$

The payback period of 8.39 months determined by this method is almost identical with the payback period determined by way of calculation and thus is sufficiently accurate.





## Hydraulic parameters and recommendations

**Data contained in the catalog:**

All parameters are quoted in accordance with the VDI Guidelines 3267 to 3284. Designations and symbols according to ISO 1219.

Dimensions in SI units, according to DIN 1301.

Dimensions without tolerance indication: DIN 7168, medium.

**Clamping elements:**

- Constant working pressure: see catalog sheets  
 Ambient temperature: -10°C to 70°C  
 (other temperatures on request)  
 Mounting position: any, unless otherwise stated  
 Piston velocity: 0.01 to 0.25 m/s  
 Oil leakage rate: at 400 bar 20°C  
 hydraulic oil HLP 32  
 - dynamic: 0.0001 g per double stroke  
 (Ø = 32, stroke = 40,  
 V = 0.1 m/s)  
 0.0003 g per double stroke  
 (Ø = 40, stroke = 40,  
 V = 0.1 m/s)  
 - static: 0.03 g in 24 hours

**Oil recommendation:**

| Oil temperature (°C) | Designation acc. to DIN 51524 | Viscosity acc. to DIN 51519 |
|----------------------|-------------------------------|-----------------------------|
| 0 - 40               | HLP 22                        | ISOVG 22                    |
| 10 - 50              | HLP 32                        | ISOVG 32                    |
| 20 - 60              | HLP 46                        | ISOVG 46                    |

(Other hydraulic fluids are available on request)

**Influence of temperature**

Fluids expand differently under the influence of increasing temperatures. If no space is available for expansion, the change results in a pressure increase. Since the clamping system is a closed system, there will be a pressure increase. Conversely, a decrease in temperature results in a decrease in pressure.

As a rule of thumb one can say that a 10°C increase in temperature results in a 100 bar increase in pressure. In the case of a significant decrease in temperature, e.g. during the night in unheated workshops, the pressure will decrease accordingly. It is therefore recommended that systems which are isolated from the pressure generator are fitted with a pressure accumulator, in order to reduce any decrease in pressure.

**Pipe fittings:**

According to DIN 2353, screwed plugs type B to DIN 3852, sheet 2 (sealing by sealing edge) should be used. Do not use additional sealing materials such as Teflon tape!

**Connecting threads:**

Whitworth pipe threads type X to DIN 3852, sheet 2 (for cylindrical screwed plugs).

**Piping:**

Seamless, plain ended steel pipes as per DIN 2391 NBK. Preferably:

| Outer Ø (mm) | Wall thickness (mm) | Hydraulic pressure (bar) | Fitting |
|--------------|---------------------|--------------------------|---------|
| 8            | 1,5                 | 400                      | G 1/4   |
| 8            | 2,0                 | 500                      | G 1/4   |
| 12           | 2,5                 | 400                      | G 3/8   |
| 12           | 3,0                 | 500                      | G 3/8   |
| 16           | 3,0                 | 400                      | G 1/2   |
| (inch)       | (inch)              | (psi)                    |         |
| 1/4          | 0.049               | 6,650                    | G 1/4   |
| 3/8          | 0.065               | 5,900                    | G 3/8   |

Pipe runs should be as short as possible. The length of pipes for single-acting cylinders with a spring return should not exceed 5 m, pipes for double-acting cylinders may be longer. Make sure that pipes are installed with a large bending radius.

**Hose connections:**

For connection of the clamping elements we recommend high-pressure hoses with 4 x safety factor at an operating pressure of 500 bar. Special designs should be used for hoses subject to constant movement, e.g. hoses for oil supply to the slide. Observe the minimum radius bends.

**Starting the system, Maintenance:**

Read the operating instructions before starting the system. Use clean and fresh oil. Bleed the complete system by operating the pump at low pressure (~20 bar) until the oil which emerges at the highest point is free from bubbles (rinsing). Since hydraulic valves are very sensitive to dirt, make sure that no impurities are carried into the hydraulic oil. A change of oil should be carried out once a year.

**Dynamic pressure in the hydraulic system:**

Due to friction in pipes, screw fittings, valves and cylinders a pressure of 1 – 2 bar is necessary for proper oil circulation. The retracting springs in cylinders with a spring return are designed for a maximum dynamic pressure of 2 bar. If the cylinders move slowly, or if they do not retract properly, the dynamic pressure must be reduced (larger pipe diameter, shorter pipes, fewer screw fittings, connection in parallel rather than in series, reduced 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 from the piston side must flow back to the oil reservoir through narrow pipes and valves.

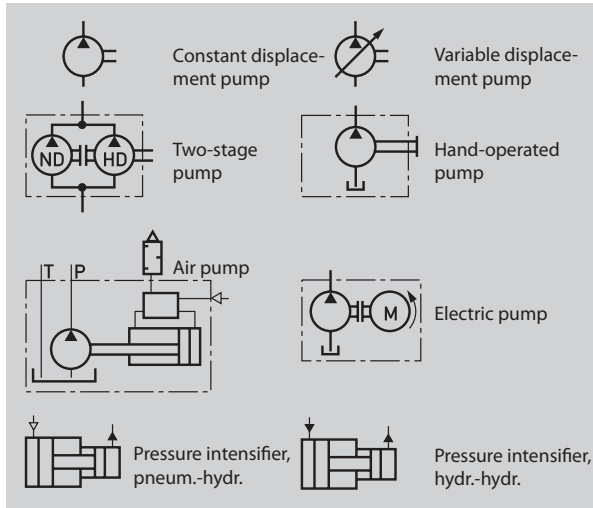
Normally, dynamic pressure has no negative effect. However, if in applications with swing clamps and swing sink clamps the drop is in excess of 50 bar, this may cause premature wear of the swing mechanism and result in a malfunction (see catalog sheets).

# Symbols and designations used in hydraulic clamping systems

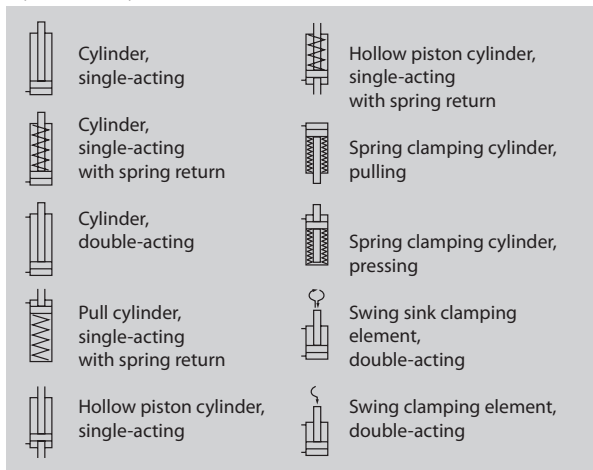


**ROEMHELD**  
HILMA ■ STARK

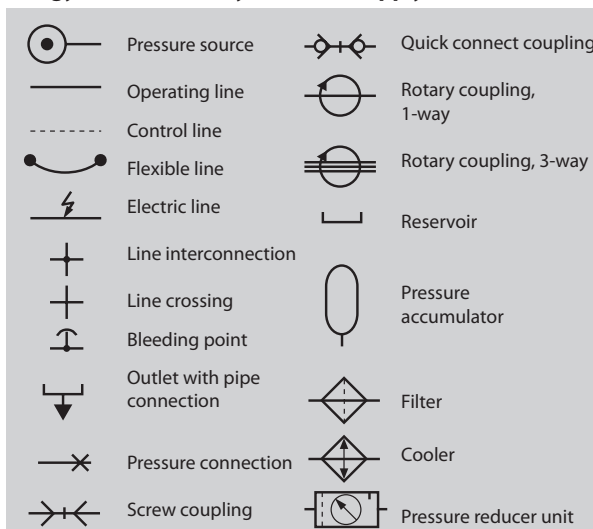
## Pressure generators



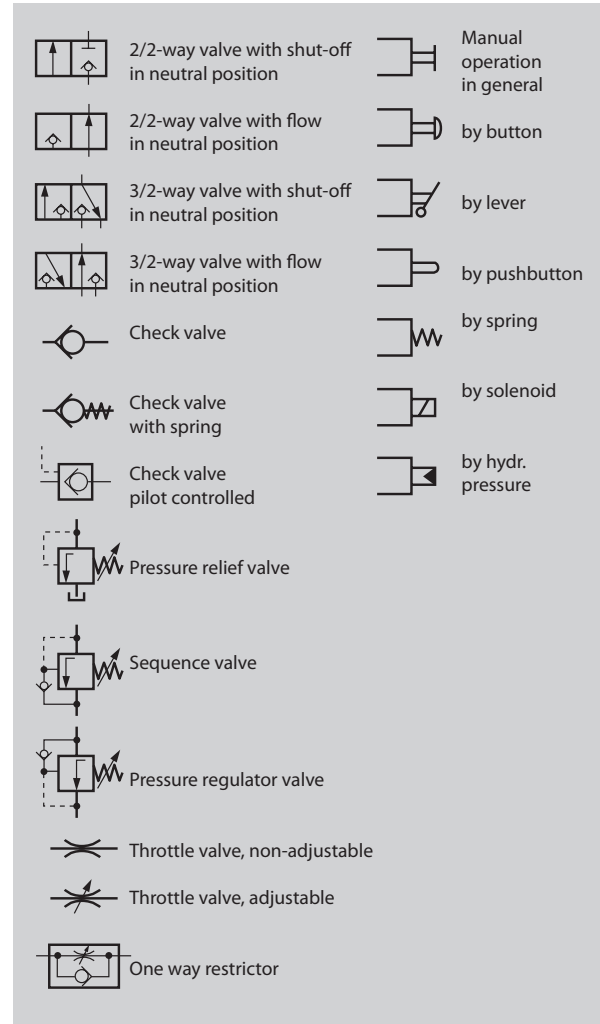
## Hydraulic cylinders



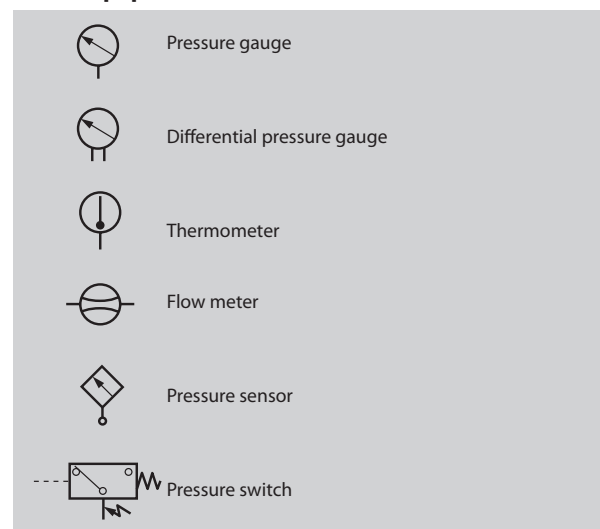
## Energy transmission Hydraulic oil supply and accessories



## Valves



## Other equipment



Excerpt from ISO 1219, DIN 24300



Safety levels are determined by different safety requirements and manufacturing technologies. Based on the state of technical development, hydraulic die clamping systems can be classified into one of three safety levels.

**Safety level no. 1:**

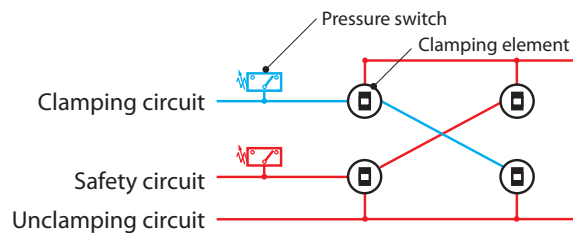
Preferably for presses with column-guided dies:

Pressure switches in every clamping circuit for controlling the clamping force, used for machine safety.

Two independent hydraulic circuits.

- Clamping circuit = 50% of the clamping elements in bed and slide
- Safety circuit = 50% of the clamping elements in bed and slide

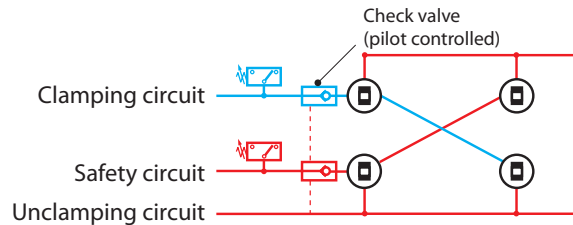
If one circuit fails, the upper or lower die is still clamped with 50% of the total clamping power.



**Safety level no. 2:**

For presses with dies which are not column-guided

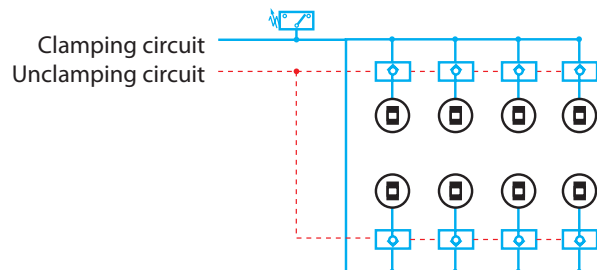
A check valve (pilot controlled) maintains pressure in the clamping and safety circuits even when the pressure drops in the remaining system.



**Safety level no. 3:**

For power presses and car body presses with dies which are not column-guided.

All clamping elements are secured by pilot controlled check valves. If pressure drops by more than 20% of the operating pressure, the pressure switch stops the press. The check valves maintain the clamping force for many days.

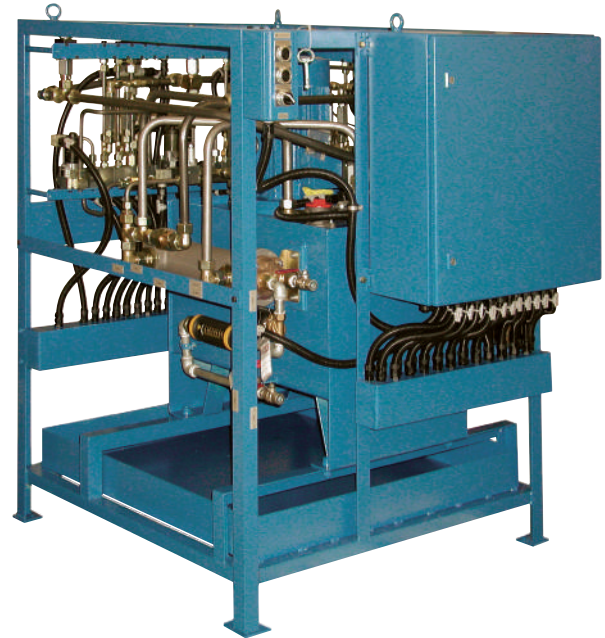




Hydraulic power units used for clamping applications need low oil volumes but high pressures, other than those used for applications involving motion.

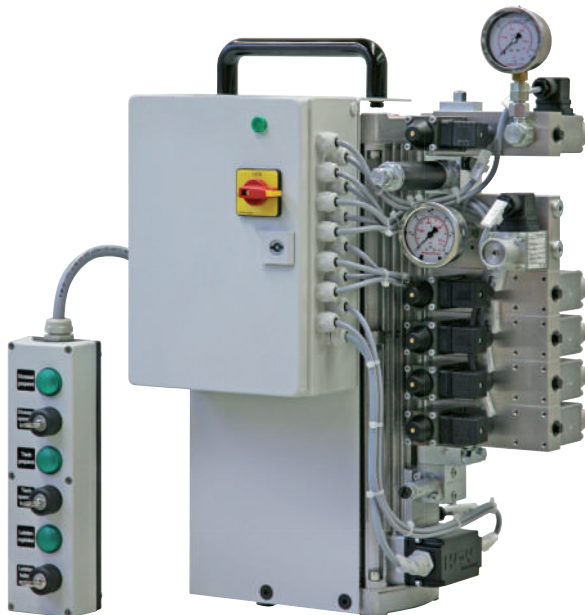
The power unit operates intermittently under automatic pressure control, i.e. when the set pressure of 400 bar is reached the motor is automatically switched off. If the pressure drops below 360 bar, the pressure switch causes the motor to start again. The valves used are of the seat-valve type. This ensures that oil loss in each clamping circuit is restricted to a minimum.

The solenoids of the valves are designed for a 24V DC supply and for continuous duty. They are idle when the clamping elements are clamped. In addition to a high service life, this ensures that even in the case of power failure the clamping force is maintained. For power units of this design only small oil reservoirs are required, since the oil is only slightly heated up. The energy balance is very favorable.

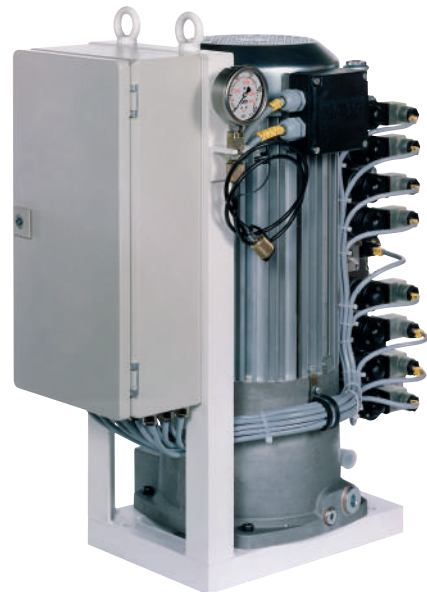


Frame-type unit for 3 forging presses:  
12 clamping circuits with pressure reduction for compensation of temperature  
high-pressure 4.2 l/min., 400 bar  
cooling return 45 l/min., 10 bar

## “Modular system enables individual solutions”



Power unit, series 7: 2.8 l/min., max. 400 bar



Power unit, 4.2 l/min., max. 400 bar  
ready for connection and immediate use

**For more technical information on power units, please refer to product group 7**



# QUICK DIE CHANGE

## Automatic or Manual



*Manual  
Clamping Nut*  
**See Section 6**

Hilma has been safely clamping dies for more than 50 years. We work with you to develop an automatic or manual die change system to suit your needs.

We provide the products and support to keep you competitive in today's manufacturing environment.



*New Automatic  
Flexline Traveling  
Clamp*  
**See Section 3**