HILMA

Information

General information

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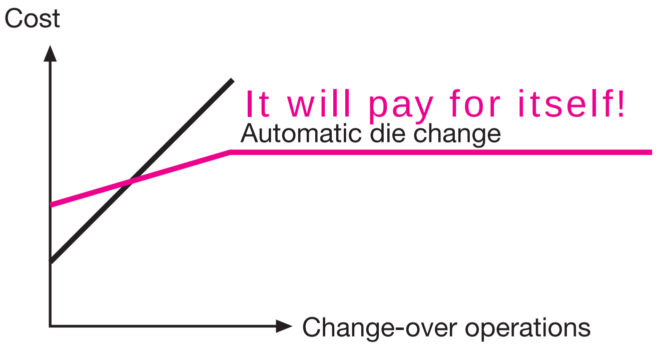
Why die clamping systems?



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

Rationalise 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
- **Easy** 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 **break-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**

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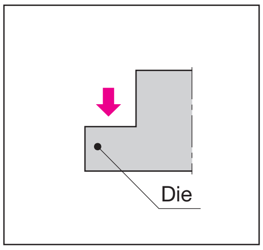
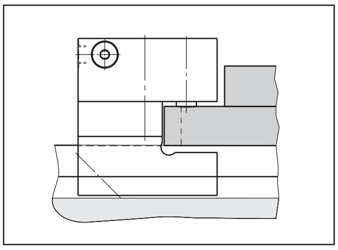
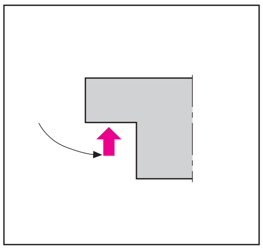
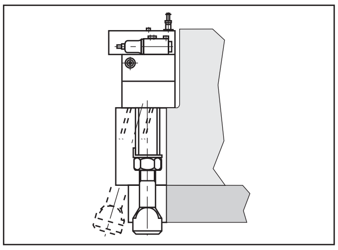
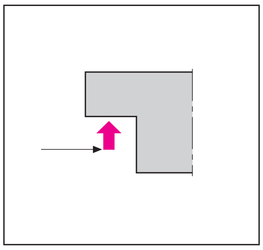
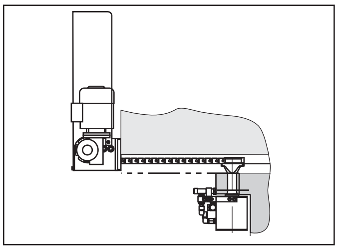
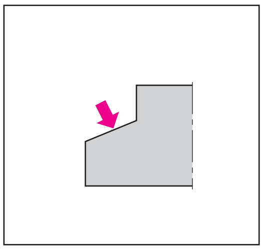
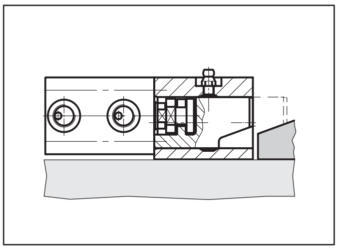
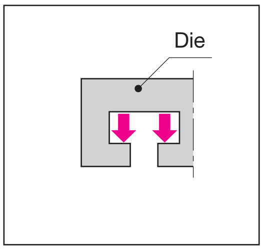
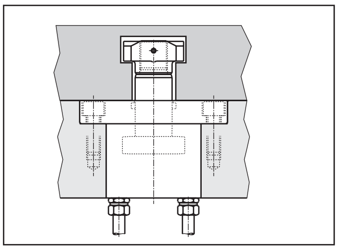
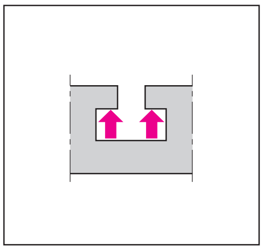
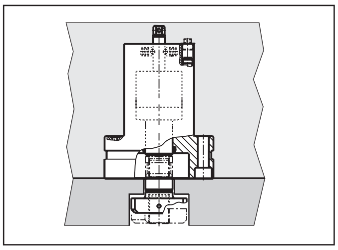
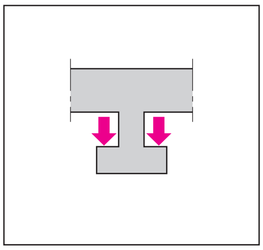
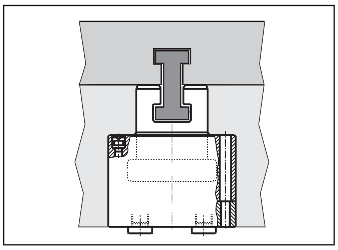
Clamping principle	Examples of clamping	Clamping element	Product group
		Sliding clamp, angular clamp, clamping bar, hollow piston cylinder, wedge clamps with flat clamping edge spring clamping cylinder, extending clamp, clamping screws	2 + 3 6
		Pivot and pull clamp, wedge swing clamp electromechanical clamping elements	2 + 5
		Rapid clamping system with pusher chain Hollow piston cylinder Angular clamp, electromechanical	3 5
		Wedge clamp for dies with tapered clamping edge	2
		Double-T clamping bars Pull clamping element	2 + 4
		Swivel and pull clamps, hydraulic Swivel and pull clamps, electrical Swing-sink clamping element Swing clamping element	4 + 5
		Pull clamping element with T-slot	4

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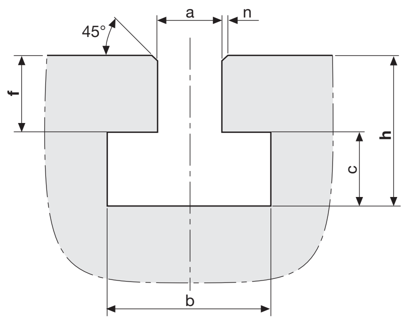
T-slot dimensions according to DIN 650

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	**f**		b	c	**h**		n
	min.	max.			min.	max.	max.
14 H8	12	19	23^{+2}	9^{+2}	23	28	1,6
18 H8	16	24	30^{+2}	12^{+2}	30	36	1,6
22 H8	20	29	37^{+3}	16^{+2}	38	45	1,6
28 H8	26	36	46^{+4}	20^{+2}	48	56	1,6
36 H8	33	46	56^{+4}	25^{+3}	61	71	2,5

Dimensions in mm

The **slot depth h** and the **web height** f must be exactly measured and checked whether within tolerance. If your T-slot is not within the specified tolerance range, customised 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

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Clamping force

Thread size 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 (mm)	1x16	1x20	1x25	1x32	1x40	1x44	1x55	1x63	1x80	1x100	1x120	1x140
the preload specified in line 3						2x32	2x40	2x50	3x50	4x 50	2x 80	3x 80
at 400 bar						3x25	3x32	3x40	4x40	6x 40	6x50	8x50
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
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 is preferred**			**Manual clamping is not advisable; hydraulic clamping only**		

* 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 prepared single components. Clamping stroke = 6 mm
When **working overhead** or when using **clamping claws**, increase the clamping and unclamping time 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 at 400 bar. Clamping stroke = 6 mm.

Clamping time ...

... for other clamping strokes

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

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

... for several clamping points

Time for mechanical clamping = $t \times n$ (s)

Time for hydraulic clamping = $t \times n - 0{,}8\,(n-1)\,\sqrt{t}$ (s)

t = Clamping time specified in lines 8 and 9
n = Number of clamping points

Calculations

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

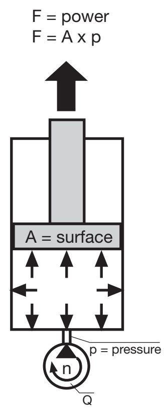
Piston velocity, v: $v = \frac{160 \times Q}{A \times z}$ [mm/s]

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

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

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

t = Clamping time [sec]
q = Oil required per 1 mm piston stroke acc. to catalogue [cm^3/mm]
s = Clamping stroke [mm]
z = Number of clamping cylinders
Q = Pump delivery [l/min]
A = Piston area [cm^2]
n = Motor speed [rpm]
V = Pump delivery (l/revolution)
p = Operating pressure [bar]
Assumed: l λ = 0,055, p = 700 Ns^2/m^4, 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]
$v_{max.}$ = 6 m/s for pressure pipes, 2 m/s for return pipes



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

- the **stripping force** on the slide
- the **ejection force**
- the **acceleration power**
- 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 local conditions in relation to clamping (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 pressure 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 utilised. Often it only becomes evident when the die has 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)

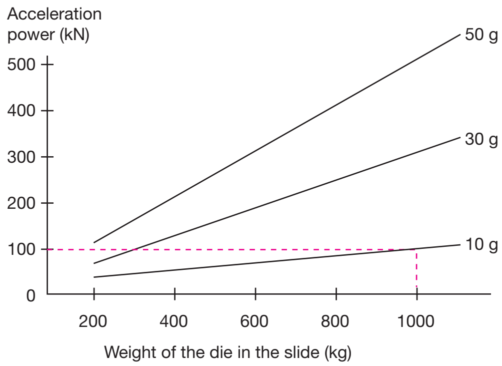
Ejection force
If ejectors are used, the maximum ejection force must be taken into account. The ejection force acts on the die, if the ejector cylinders do not move against their own stops but when the die is used as stop. Thus, ejection forces must be considered in any case. (Approximate values as per VDI guidelines 3145, see below)

Approximate values as per VDI-guidlines 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 power
The acceleration power 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 body 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 power, 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: 20% of the pressing force = approx. 400 kN. Determination on the basis of the acceleration power: with an acceleration of 10 g and a weight of 1000 kg, the acceleration power (as per diagram) is approx. 100 kN.
In view of the low acceleration power, the clamping force is determined on the basis of the stripping force.
Thus, the required total clamping force is 400 kN.

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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 offers systems 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
- minimising set-up times
- increasing flexibility
- rationalisation measures
- better conditions for workforce
- safety

This means that the decision for an automation of the die changing process is not only taken on the basis of a cost-effectiveness analysis but it is also influenced by workplace-related optimising approaches.
In order to approach a solution by taking account of both quantity- and quality-related aspects, the so-called **analysis of economic value** 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
- operating facility
- 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 economic value is obtained for each criterion. Addition of the partial economic values obtained for the alternative under consideration will give the overall economic value.

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

		Die changing system A		Die changing system B	
Criterion	Evaluation %	Degree of compliance 2)	Economic value	Degree of compliance	Economic value
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
Overall economic value	**100**	**-----**	**5,06**	**-----**	**7,05**

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 economic value. For more details, we recommend reference to examples on the Internet, catchword: Analysis of economic value.

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

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Calculation of amortisation
In this method, the acquisition costs (purchase price, calculated depreciation and interest), the operating costs (energy, maintenance, expenses for the room where the machine is installed, resulting costs for dies) as well as wage costs (set-up times, running-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, type HILMA 2095-120 (4x).

Clamping bar

Hollow piston cylinder

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Comparison of costs

		Example A	Example B
General data			
Transfer press (existing)	number	1	1
Existing dies	number	5	5
Planned dies	number	3	3
Die changing system			
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	€	**0**	**30.700**
Set-up times			
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.	**24,8**	**6,0**
Die changing			
Die changes / shift	number	1	1
Personnel / die change	number	1	1
Set-up time / month	h.	**17,3**	**4,2**
Hourly machine rate	€/h	280	280
Set-up costs / month	€	4.844	1.176
Set-up costs / year	€/year	**58.128**	**14.112**
Hourly wage	€/h	25,56	25,56
Wage costs / year	€	**5.306**	**1.288**
Calculated depreciation	years	10	10
	€/year	**0**	**3.070**
Calculated interests	€/year	**0**	**767**
Sum of costs	**€/year**	**63.434**	**19.237**

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

Die change	Number/year	500*		500
Costs / change	€	126,87 →		← 38,47
Cost advantage	€/change		88,40	
Amortisation of die change	~ 347 die changes (€ 30.700 / 88,40) 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.

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Rough calculation

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

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

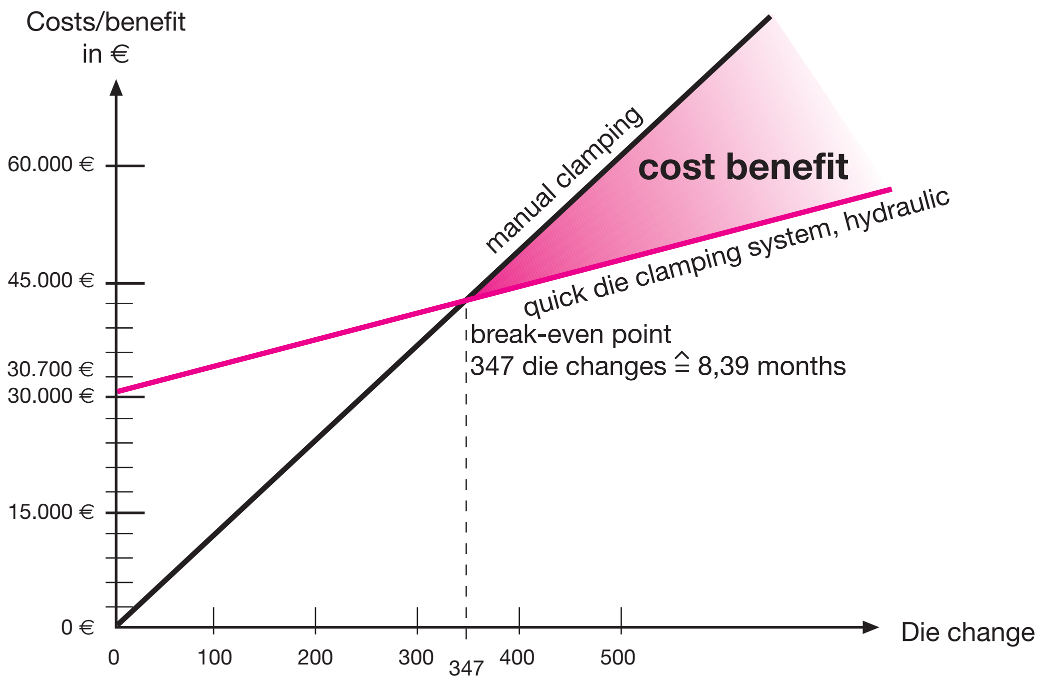
Where:
Investment costs (quick die clamping/changing system B) [€]
Investment costs (conventional clamping/changing system A) [€]
Saving of time = quick die clamping [min] - conventional clamping [min]
Hourly machine rate [€/min]
Die change [changes/month]
Amortisation time [months]

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

$$\textbf{Amortisation time} = \frac{(30.700 - 0)}{(24{,}8 - 6) \times (280/60) \times (500/12)}$$

$$= \textbf{8,39 months}$$

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



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Data contained in the catalogue:
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 tolerances: DIN 7168, medium.

Clamping elements:
Constant working pressure: see catalogue 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, 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

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 at least 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 the stroke is not fully extended, 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 catalogue sheets).

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Symbols and designations used in hydraulic clamping systems

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Pressure generators

- Constant displacement pump
- Variable displacement pump
- Two-stage pump (ND, HD)
- Hand-operated pump
- Air pump (T, P)
- Electric pump (M)
- Pressure intensifier, pneum.-hydr.
- Pressure intensifier, hydr.-hydr.

Hydraulic cylinders

- Cylinder, single-acting
- Hollow piston cylinder, single-acting with spring return
- Cylinder, single-acting with spring return
- Spring clamping cylinder, pulling
- Cylinder, double-acting
- Spring clamping cylinder, pressing
- Pull cylinder, single-acting with spring return
- Swing sink clamping element, double-acting
- Hollow piston cylinder, single-acting
- Swing clamping element, double-acting

Energy transmission Hydraulic oil supply and accessories

- Pressure source
- Quick connect coupling
- Operating line
- Rotary coupling, 1-way
- Control line
- Rotary coupling, 3-way
- Flexible line
- Electric line
- Reservoir
- Line interconnection
- Line crossing
- Pressure accumulator
- Bleeding point
- Outlet with pipe connection
- Filter
- Pressure connection
- Cooler
- Screw coupling
- Pressure reducer unit

Valves

- 2/2-way valve with shut-off in neutral position
- Manual operation in general
- 2/2-way valve with flow in neutral position
- by button
- 3/2-way valve with shut-off in neutral position
- by lever
- 3/2-way valve with flow in neutral position
- by push-button
- Check valve
- by spring
- Check valve with spring
- by solenoid
- Check valve pilot controlled
- by hyd. pressure
- Pressure relief valve
- Sequence valve
- Pressure regulator valve
- Throttle valve non-adjustable
- Throttle valve adjustable
- One way restrictor

Other equipment

- Pressure gauge
- Differential pressure gauge
- Thermometer
- Flow meter
- Pressure sensor
- Pressure switch

Excerpt from ISO 1219, DIN 24300

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

Safety level no. 1:

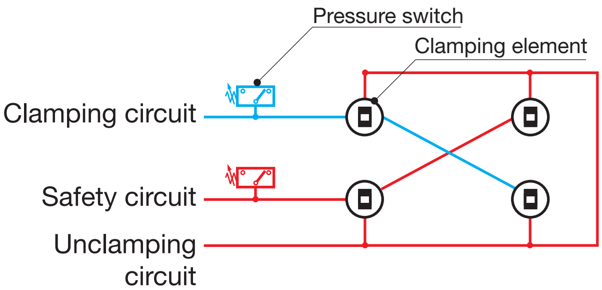
Preferably for presses with column-guided dies:

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

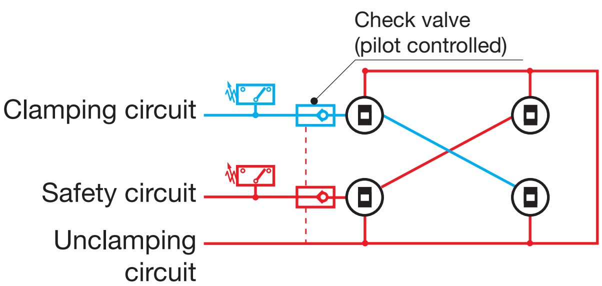
If one circuit fails, the upper or lower die is still clamped with 50% of the total clamping power.



Safety level no. 2:

For presses with dies which are not column-guided

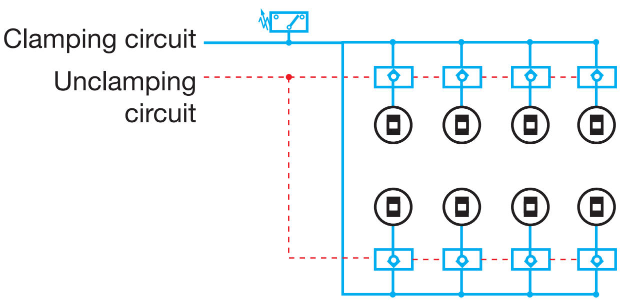
A check valve (pilot controlled) maintains pressure in the clamping and safety circuits even when the pressure drops in the remaining systems



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.



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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. In most cases, 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 favourable.

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 schemes"

Power unit, series 5: 2.5 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

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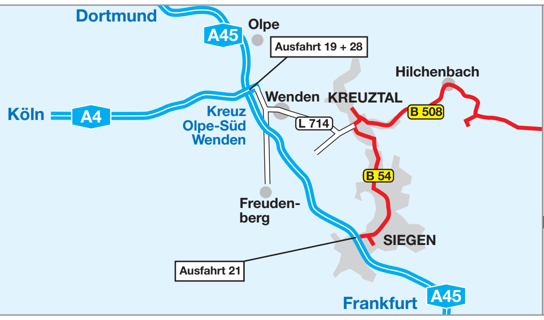

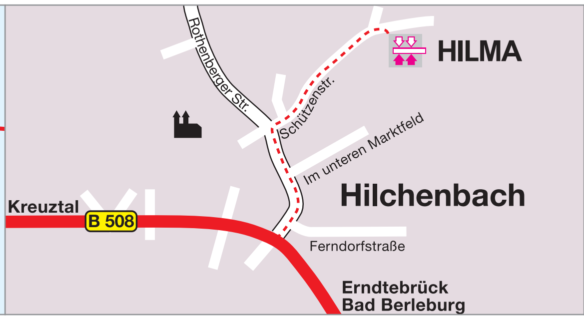

Flexible clamping systems
Machine vices
Die clamping systems
Magnetic clamping technique

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