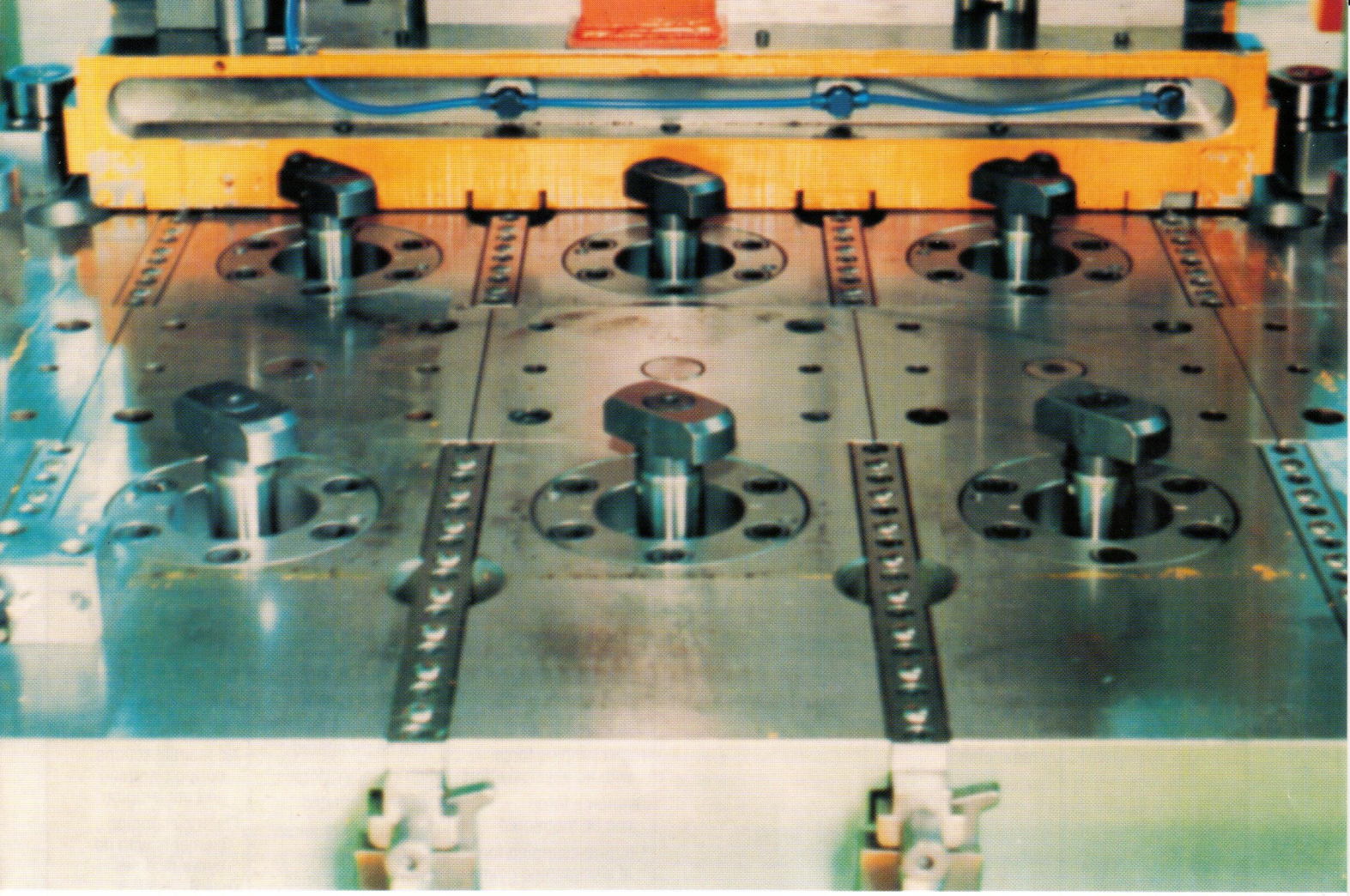

Versatile Clamps Cut Die Change Times

By combining the right clamps with well-planned installation, shops can benefit from increased productivity.

Just-in-time manufacturing has placed increasing demands on die change operations for faster and more frequent changeovers that effectively handle evolving production requirements. Correct choices of clamps and accessories are required to achieve the greatest gains in efficiency. Both die change frequency, and press and die design are important concerns. The support equipment, accessories and automation system for the press also must be taken into consideration to optimize production time.

Generally, clamping and unclamping can represent a significant time element in the changeover process. Careful clamp selection can result in several fundamental manufacturing benefits.

- Efficiency—Die clamps decrease setup times for runs of all sizes. More efficient production, in turn, allows lower levels of inventory. Machine operators can perform the simplified die change, which frees

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Versatile Clamps

Overview of clamping devices for dies on stamping presses

Clamping Method	Conventional	Mechanical	Hydraulic	Integrated	Automatic
Clamping device	T bolt and nut Strap clamp	Clamping screw or clamping nut with mechanical advantage Spring-loaded clamping cylinder	Hollow piston cylinder Sliding clamp Angular (or rocker) type clamp Ledge clamp Internal wedge clamp External wedge clamp Wedge-type clamping bar	Swing-sink clamp Swing clamp Pull cylinder Tilt-and-pull clamp Double-T clamping bar Turn-and-pull clamp Wedge-type rocker clamp	Sliding with hydraulic or electric clamps Electric rocker clamp Electric turn-and-pull clamp
Purchasing costs	Low	Attractive	Medium	High	High
Installation costs	None	None	Medium	High	High
Clamping and unclamping times	Long, per screw = 26 sec.	Medium, per clamp = 15 sec.	Short, per clamping circuit = 15 sec.	Short, per clamping circuit = 10 sec.	Short, per clamping circuit = 10 sec.
Advantages	Economically priced Space-saving Small space requirement	Low costs Equal clamping force	Short clamping and unclamping times Can be automated High clamping force with no physical effort Clamping force can be monitored Uniform clamping force at all clamping points	Bolster top clear for the die change Clamp force & position can be monitored High clamping forces Can be automated Operator not required to move clamp Rigid hydraulic lines Low space requirement No physical effort during clamping and unclamping Uniform clamping force at all clamping points	Can be fully automated Various die sizes can be clamped No manual actions during clamping and unclamping Electric clamping elements with no hydraulic lines High flexibility Uniform clamping force at all clamping points
Disadvantages	Long clamping and unclamping times Loose components High physical effort for low clamping force Time-consuming alignment and setup Cannot be automated	Force cannot be monitored Medium clamping and unclamping times Manual actions during clamping and unclamping Cannot be automated Medium clamping forces	High costs Pump unit needed Manual actions during clamping & unclamping Flexible hydraulic lines	High costs Pump unit needed	High costs Pump unit needed when using hydraulic clamps

more specialized personnel for other tasks. Also, since worn or damaged dies are easily replaced, production downtime is minimized.

Further gains in function and maintenance are available. Die clamps' high clamping forces mean fewer individual clamps are required for a given application. Moreover, clamps maintain their positions, keeping upper and lower dies aligned and located. Run-in periods are reduced, and tools deliver increased output by requiring fewer repairs.

• Automation—Power-operated clamps, and their automated controls, provide shortened clamping cycles. Monitoring devices for hydraulic pressure, clamping bolt position and other elements enhance clamping in harsh environments like forging shops or where sprays and lubricants are used. Operator and equipment safety is assured through the integration of these monitoring and control functions.

• Easier Operation—Die clamps deliver consistent, high clamping forces. Optimum selections of clamping positions—even in hard-to-reach areas—can be made according to press conditions and feed systems. Since the clamping procedure is highly repeatable, die change is possible by less-skilled workers. Clamping also is possible under unfavorable conditions, as in the presence of high temperatures and sprays.

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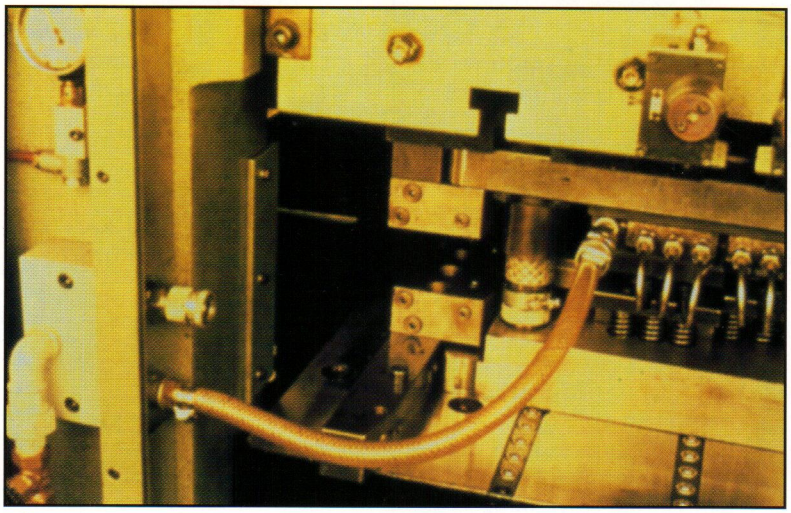


If the dies are the same size, fixed hydraulic ledge clamps are the simplest solution.

• Increased productivity—The short setup and trial periods significantly expand press capacity. Rework due to worn or broken tools is reduced, resulting in less production downtime.

• Improved quality—Repeatable clamping forces and accurate die positioning improve quality. Clamping remains consistent through long runs and frequent die changes.

• Less wear—Uniform clamping with no die movement cuts wear and lengthens tool life. Clamping forces remain constant despite die expansion and contraction resulting from temperature changes.

Manual vs. Automated Die Change: The Quick Change Payoff

Manual clamping with T-bolts and nuts has clamping force limitations, and is time consuming, as well. Manually clamping a T-bolt on a machine bed requires up to 40 sec., along with another 20 sec. if strap clamps are used. Add up to 20 sec. more for clamping on the slide, and additional time if the clamping components are not standardized and positioned at the correct height.

Die clamps are faster (with total cycle times as short as one sec.), more secure and more consistent than manual clamping. Further benefits include less press downtime, better capital utilization and improved product quality. But how do you determine if automation truly is a more profitable choice than the manual approach to clamping?

Use the following formula to estimate the cost benefits of an automated system. Costs include the initial purchase of the clamps, power unit and controls; and the costs of installation hardware and associated labor expenses to integrate the clamp system to the press controls.

Additional costs relating to the modification of the press and dies also must be factored in, as indicated in the following formula:

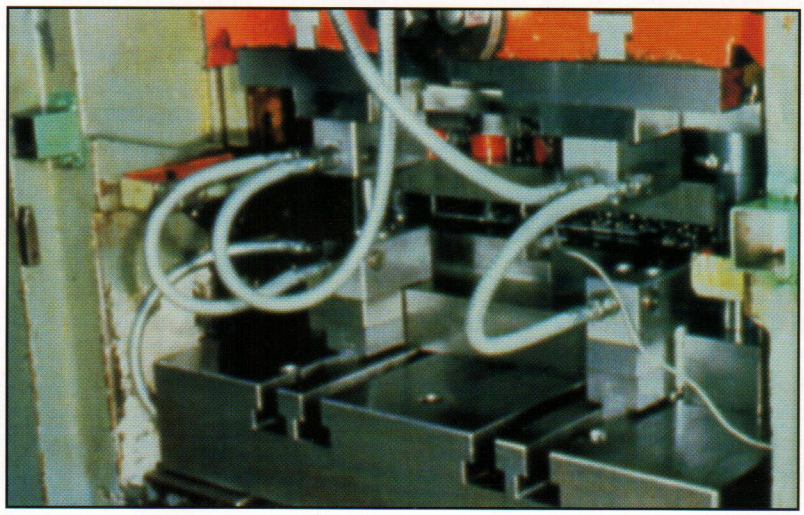
$$A = \frac{C}{N} = \frac{(C_s + C_m + C_w)}{(N_s \times M \times W)}$$

A—amortization
C—cost
N—benefit
C_s—cost of clamping system
C_m—cost of machine modification
C_w—cost of die modification
N_s—reduction of clamping and unclamping time
M—hourly rate of machine
W—changeover frequency

Clamp System Features Also Increase Safety

Power units supply hydraulic pressure for die clamps. Based on clamp circuit configuration and hydraulic flow rate, clamp/unclamp times run from 1 to 30 sec. in duration. For safety, clamping circuits generally include pressure switches that stop press operation when hydraulic pressure falls below normal operating values. Zero-leakage directional control valves further ensure a safe clamp system.

For further safety, key-operated switches are used at control stations to initiate clamping and unclamping. Clamps also can be connected to two hydraulic circuits; if the first fails, the die stays clamped via the second. Pilot-operated check valves located in clamps or adjacent hy-



Sliding clamps, which move in T-slots, handle dies on subplates with a maximum of 22,500 lbs. clamping force. With four sliding clamps on a circuit, a one to two second clamp time can be achieved.

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draulic manifolds maintain circuit pressure if a single unit fails. Proximity switches indicating clamp/unclamp position also can be used to shut down the press in an emergency.

Standardize for Faster Changeovers

Clamping times will not drop without some preparation. Standardized clamping edge heights and locations are an essential part of more efficient clamping. To minimize expenses, establish a base height equal to that of your highest clamping edge. Add spacer plates to dies with lower edges to bring them up to your new mark. Standardization of the front-to-back and left-to-right dimensions of the die is not necessary if manually or automatically positioned clamps are used.

Varied Clamp Solutions

For standardized dies, simple ledge clamps mounted on the sides of the press bolster and slide use locating pins to quickly position dies. Once actuated, 10-in. ledge clamps can provide a clamping force of 26,000 lbs. during a clamp/unclamp time of one or two seconds.

Sliding clamps, which move in T-slots, handle dies on subplates with a maximum 22,500 lbs. clamping force. With four sliding clamps on a circuit, a similar clamp and unclamp time can be achieved.

Hollow piston cylinders clamp dies with U-slots. After height positioning via T-bolts, hollow piston cylinders are located in T-slots for clamping. Motorized options using chain, lead screw or belt drives can automate the positioning operation. Clamping force up to 24,000 lbs. can be achieved with manual positioning, and even higher force when automatically positioned. Clamping time: as little as two seconds.

For very high clamping forces in a compact area, wedge clamps and automatic block clamps are a good choice. They deliver up to 225,000 lbs. force. These sturdy types of clamps provide clamping and unclamping times from five to 30 sec., even under harsh conditions of dirt and high temperature. They also can be configured with position monitoring for greater clamping control and security.

Electrically operated clamps are available with clamp/unclamp times from two to 10 sec. Such clamps offer clamping forces between 16,000 and 56,000 lbs.

Additional Options

It may be hard to locate clamps that hold the die to the bolster when using automatic rolling bolsters. High-pressure clamping nuts manually located through the T-slot in the bolster can be used in such situations. Since the clamping nuts multiply the torque applied, a small torque wrench is sufficient to build up a clamping force of 36,000 lbs. These setups allow clamping and unclamping times of about 15 sec.

For installations where external clamping is impossible, or when the bolster must remain clear for die change, internal retractable clamps are the answer. With swing sink clamps, the piston's T-nut extends through the die and rotates 45 deg., then retracts as it turns 45 deg. further. Clamp/unclamp times for swing sink clamps range from 15 to 30 sec. Very high clamping forces—more than 100,000 lbs.—can be achieved using these versatile units.

Right Clamp, Right System

The clamps referred to in this article represent some of the more commonly used types. Many other clamps have been customized and built for specific applications, meeting the changing needs of shops and plants the world over. Clamps, however, are just one part of the die change equation.

To provide the most efficient quick die change, the various facets of each press, its dies and ancillary equipment must be taken into account. All these factors must be thoroughly planned and organized for the greatest returns. By reorganization of the die change process and providing the appropiate equipment, it is possible to slash die change time and increase your company's competitive edge. **MF**