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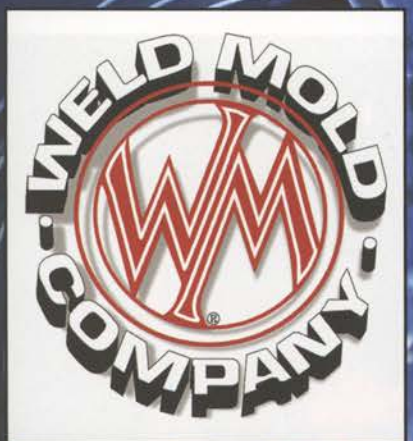

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Die Maintenance in the Forge Shop

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Dies and the forging equipment in which they are installed undergo significant mechanical and thermal stresses as they cycle in and out of production runs. Unless dies are properly heated, aligned, stress-relieved and lubricated, they could fail catastrophically. This results in expensive downtime and lost production and costs more than a properly regulated maintenance program.

Missing wing on lower counter-blow ram was the result of misalignment.

Everyone in the forging industry has learned the value of increasing die life by welding. With the use of special welding alloys to repair particular problems associated with premature failure, cracking, heat checking, wear, etc., many forgers have experienced 50-300% increases in die life. This is accomplished by using the proper welding alloys along with proper procedures and highly trained personnel.

A major cause of die failure occurs in the forge shop itself. Because of increased competitive pressures to produce more forgings at reduced costs, some forgers have become lax in maintaining equipment and have shortcut maintenance procedures to keep output up and costs down. Often in these circumstances, just the opposite occurs, and substandard procedures only result in premature failure of dies and forging components.

Die and Equipment Temperatures

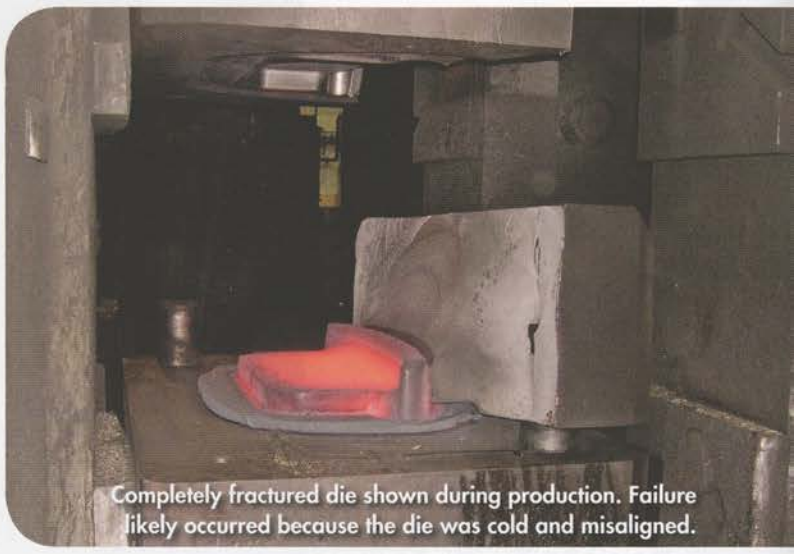
All forgemasters, hammermen and press operators know and respect the necessary temperatures required to forge particular materials. This respect seems to go by the wayside, however, when it comes to dies and forging equipment. Dies are often set up in the hammer cold. After a flame is placed on them for a few hours, forging begins.

A red-hot billet is placed on the lower die. The top die is then impelled downward with tremendous force by means of a mechanical, hydraulic, air or steam force to shape the billet to match the impression in the die. When this cycle occurs to a die that is not properly preheated, the thermal shock to it is immeasurable.

The result can be premature cracking, which is sometimes so severe that the die ends up in two or more pieces. A few hours of preheating with a flame are insufficient to heat the die internally. The proper preheat would be to put the dies in a die heating furnace at 500°F for a period of at least one hour per inch of thickness. This ensures complete preheat throughout the die. After it is put in the hammer, put a flame on it to maintain temperature until forging begins.

In dies with multiple impressions, overheating can occur in areas having bosses or ribs that are isolated from the larger mass of the die block. These areas can become red hot, almost to forging temperatures. Some forging presses offer the benefit of preheating dies in the press and for maintaining the temperature. They may also have a cooling system to keep the dies from overheating from extended contact time with the part being forged. This is not so of hammers. Heat checking, malformation and softening of the die steel results in premature failure. Care should always be taken to not overheat the dies for an extended period of time. In no case should they be quenched.

Anyone who has ever stood in a forge shop when a hammer is running can feel the massive impact the hammer bases, anvils and other components are subjected to. The base and anvil, as is true of the dies, have a temperature at which they should be maintained – a minimum of 100°F. This holds for the entire piece of equipment, since the force of impact is reflected throughout the entire hammer.



Completely fractured die shown during production. Failure likely occurred because the die was cold and misaligned.

Die Maintenance in the Forge Shop

This is especially important in northern climates during the winter, where several infrared heaters around the base will accomplish this. Steam hammers, by their nature, will keep the upper components warm. Any forger that has had a cracked base or anvil can testify to their devastating effect on production, not to mention the wallet.

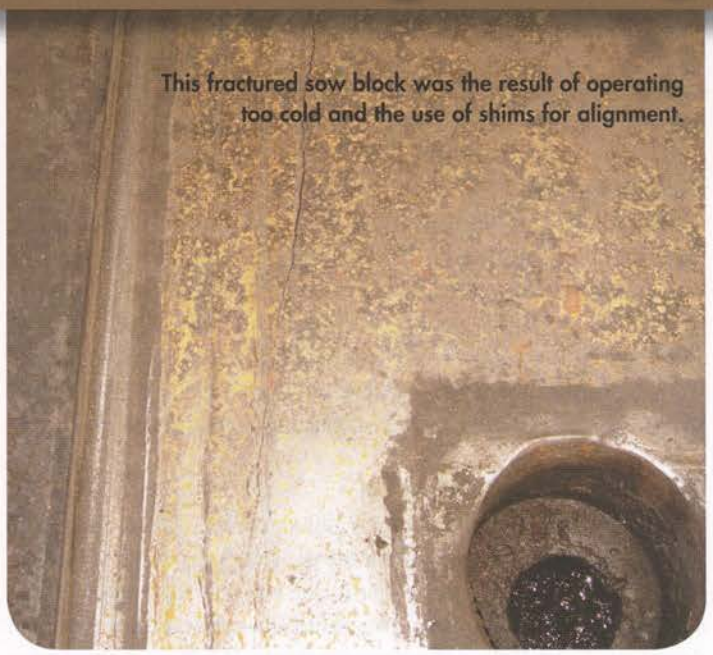
Die Alignment

Another problem in the forge shop is misalignment of equipment. When a new ram and sow block are installed, a set of master dies is employed to properly align them so they hit squarely, center-to-center. This ensures equal impact at all points of the components. In the course of setting up dies for production, it may become necessary to move the ram or sow block to align the top and bottom dies to make a good part. To move the bottom die side to side, shims are installed around the sow block or moved from one side to the other. Most of the time, after a run is completed, these shims are not removed or returned to the original position as they should be. As a result, the ram and sow block lose their alignment.

The top die is adjusted by either shimming the hammer columns or moving the ram guides in or out. As with the sow block, the ram should be brought back to original position. This is a process that requires time and is usually put off until it is more convenient.

So what happens?

New dies are put in and more adjustments are made. After several such cycles, the components are so far out of line that excessive pressure is applied on one side and too little on the other. The result of the dies being impacted off-center is cracked die shanks, cracked rams and sow blocks and broken piston rods. The time it would take (every 5-10 days) to put the master dies in and realign the ram and sow block would far offset the cost of an expensive ram or sow-block repair and the downtime involved for such a repair. It is advisable to maintain an inventory of spare components (rams, sow blocks, etc.) that are in complete repair and ready to be switched out with the damaged components. By maintaining this inventory of spare parts, excessive downtime can be avoided while the damaged part is repaired.



This fractured sow block was the result of operating too cold and the use of shims for alignment.

Die Lubricants

With forgers today having to forge parts from increasingly exotic metals and alloys (such as vanadium, titanium, Waspalloy and Inconel), proper die lubricants play a major role in successfully forging a part while still maintaining die life. Many suppliers of die lubes offer an extensive array of synthetic lubricants that will

This piston rod broke because it was too cold and misaligned.

Broken upper counter-blow ram held together with straps for removal and eventual repair.

maintain and sometimes extend die life. The easier the forgeable material moves in the die, the less impact the die has to experience.

Stress Relief

While the dies are in operation, they are subjected to frequent impact and cyclical heating and cooling conditions. These create tremendous internal stresses that require periodic relief. Even if a die has successfully completed a run without repairs, a stress relief of 1000-1050°F for one hour per inch of thickness is advisable before the next run. At the very least, this will minimize any pre-existing stressful conditions that may contribute to premature die failure.

Preventive Maintenance

With forgers competing in today's global market, almost all have to implement and conform to a quality assurance program, which requires a preventive maintenance routine for their equipment. There are many fine computer programs available to assist the maintenance department in fulfilling these requirements. If followed, these programs will ensure more production time without expensive repairs and downtime. As with any program that is going to be successful, more than lip service has to be made. The time and manpower to perform the preventive maintenance has to be made available.

Avoid Shortcuts

Just as in die welding, if shortcuts are employed using inferior materials or poor, unsound procedures, the desired positive effects will not be achieved. Can we really afford to not follow proper procedures in maintaining the equipment in which we expect these dies to perform? I think not. The relatively small expense incurred by following these maintenance suggestions will no way exceed the losses incurred by scrap parts, expensive repairs and downtime, late deliveries or perhaps even the loss of a customer. The smoothest-running forge is not one that is constantly trying to make emergency repairs to keep production going, but the one that is running with a minimum of repairs.

Author David Fox spent years traveling the globe as welding application director and training manager for Weld Mold Company, Brighton, Mich. Having recently semi-retired to Florida, Fox continues to travel, teaching a new generation of flood welders in the forging industry. Questions about this article may be directed to Fox at: (810) 229-9521 (office); (330) 416-2949 (cell); or info@weldmold.com

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