

DIE MAINTENANCE DOCUMENTATION AND TRACKING

Responsible automobile owners realize that periodic maintenance and good recordkeeping is essential to assure dependable transportation. Like a car, a stamping die should be expected to produce good parts without abnormal delay, when placed in the press.

A die, like an automobile, must be designed correctly. Both dies and cars are assembled from parts that must work together correctly. Dependable, safe performance begins with good design. Careless operation and poor maintenance will cause great difficulty for both cars and dies in spite of the designer's best efforts. A few cars and dies have design problems that must be corrected in order to assure correct operation.

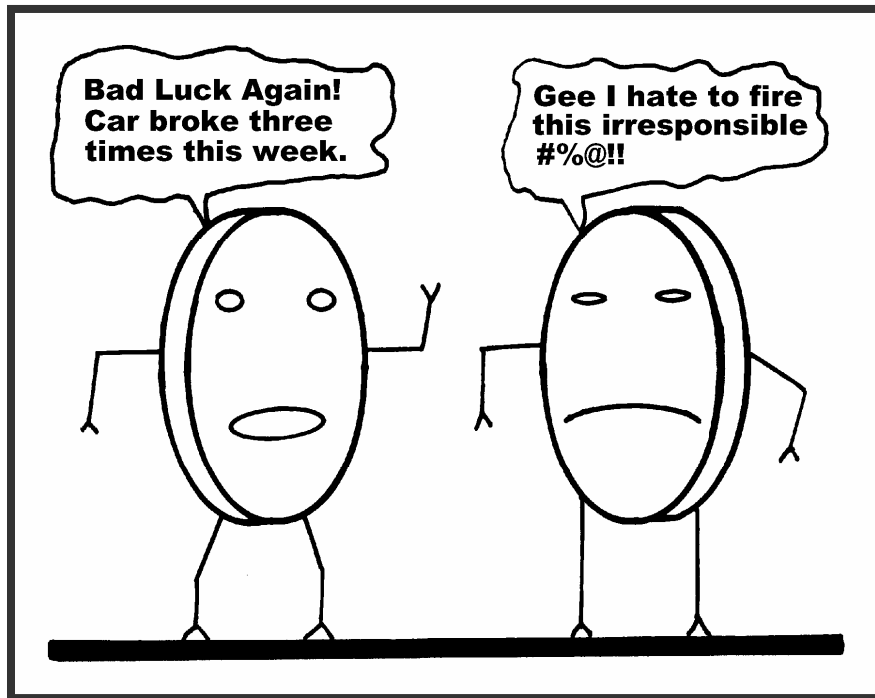


Figure 1. Repeated excuses for tardiness are not acceptable. An employee with this difficulty needs help if he or she is to remain on the team. *Smith & Associates*

Figure 1 is a cartoon showing that frequent excuses for employee tardiness are unacceptable. The same attitude should apply to dies that do not function correctly. Some new automobiles have design problems that must be corrected. Likewise, some new dies have design problems that must be fixed to assure safe dependable operation.

Accepting Responsibility as a Team

Today, pressroom employees and management must work together as a team and be actively involved in solving problems to avoid smashed dies. The metal stamping industry has undergone profound changes. The greatest asset that an employee can bring to the workplace is their knowledge and willingness to contribute to progress.

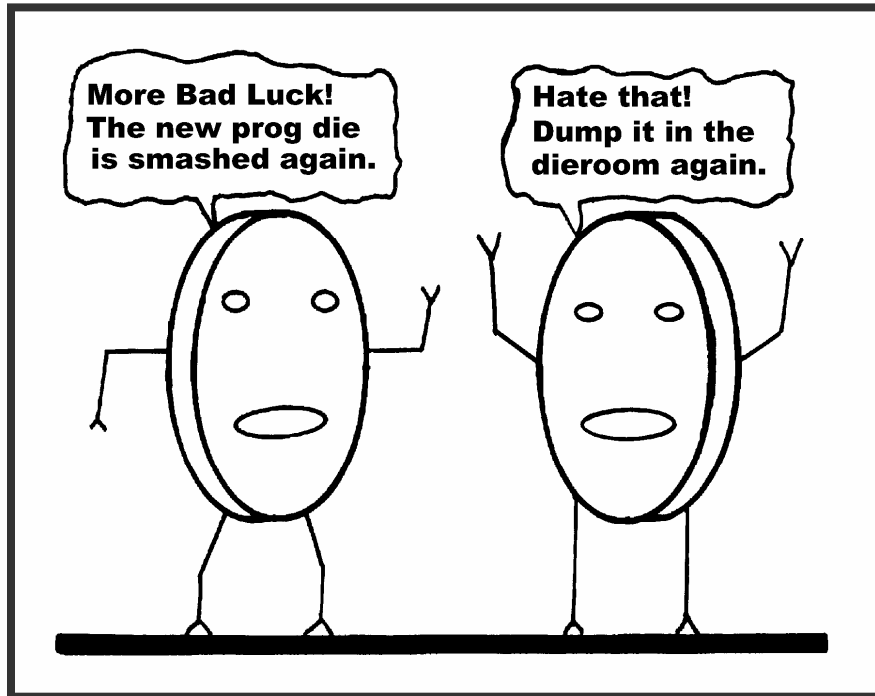


Figure 2. A non-team oriented pressroom reaction to a broken die problem. The cartoon indicates a lack of communication between the pressroom and die repair facility.

Smith & Associates

Figure 2 is a cartoon of a foolish pressroom reaction to a die problem. A car that frequently breaks down is either repaired or replaced. Dies that fail in service require solutions. Well-managed shops expect employee responsibility to accurately communicate tooling problems.

Adopt a Systematic Die Maintenance System

Simply stated, shops that do not maximize human resources probably will not survive in a free market economy. The competition in the industry for high quality, dependable delivery and cost reduction does not permit the luxury of poor communication and inefficient shop organization. Clear concise communication is an essential factor in efficient die maintenance documentation and tracking. A simple systematic approach to problem identification and communication is required.

Figure 3 shows a typical die room response to a die being dropped off without a workorder. The essential element in a system for efficient die maintenance documentation and tracking is communication. A workorder system should be part of a closed repeating cycle in order to correct problems. This includes eliminating their root causes. An organized systematic system is needed.



Figure 3. Dies sent to the die room without details of problem to be corrected usually do not get attention. *Smith & Associates*

Using a Step-by-Step Die Repair Workcycle

Figure 4 shows a six-step die maintenance workcycle. Maintaining any machine tends to be a repetitive activity. Both dies and automobiles need regular maintenance. Dies can develop problems that require keen troubleshooting skills. Everyone associated with the process should understand the basic theory of the stamping processes. The operator should understand the basic functioning of the die, press and auxiliary equipment.

Training is essential at all skill levels. Ongoing training for everyone from the operator to the tooling engineer and even top manufacturing management will increase their skills. Everyone should be able, willing and encouraged to provide input into solving tooling process problems.

Step 1—Identify Problem

The first step is to identify the problem and originate a workorder for the needed correction. The following are some of the ways used to identify problems.

Step-by-Step Die Repair Workcycle

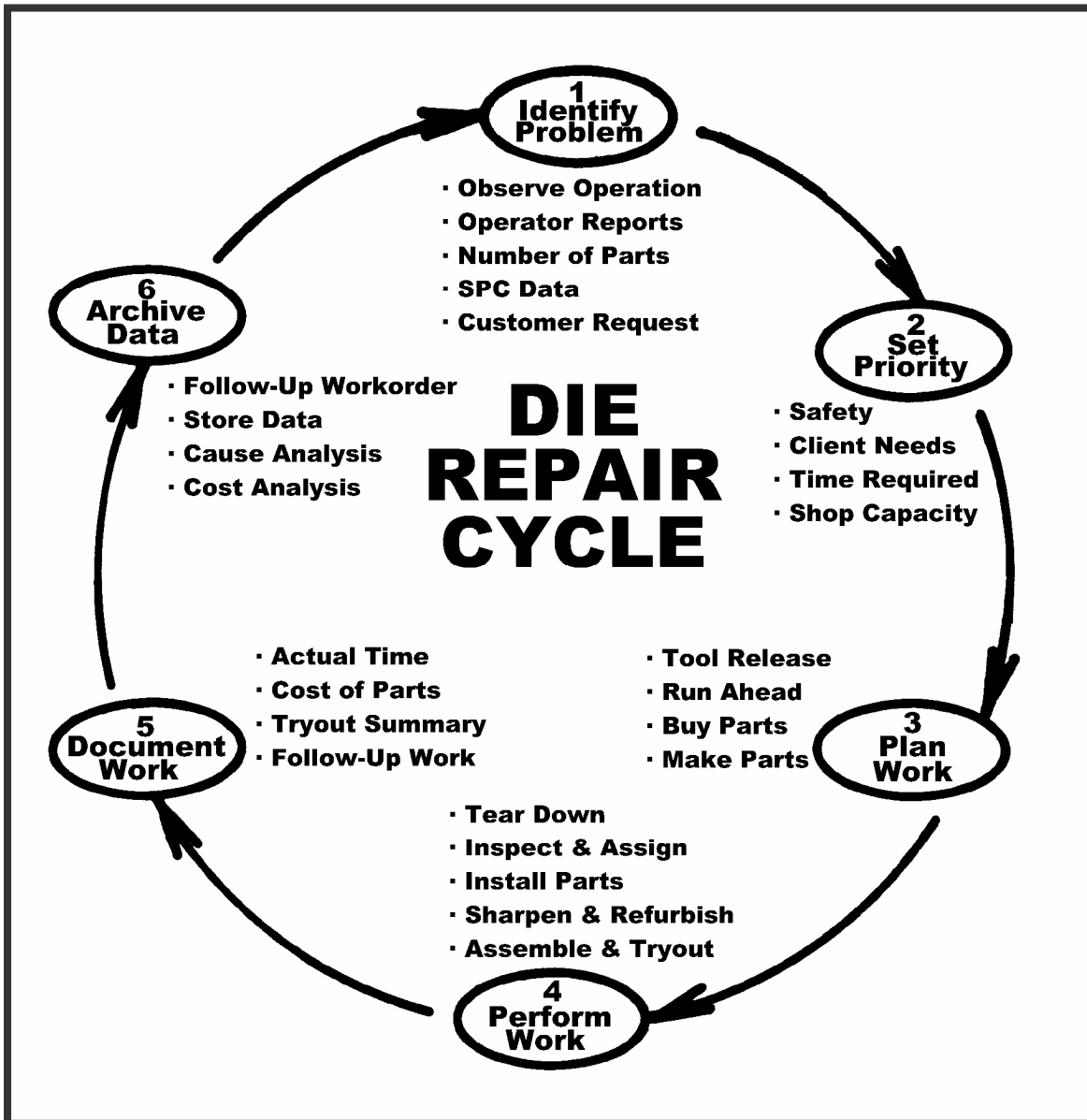


Figure 4. Six essential steps in a die repair work-cycle. *Smith & Associates*

Observation

First, observing the operation and checking the parts produced is the most common method. The operator is in the best position to make long-term observations. His or her opinions are invaluable to the diesetters, tool and die technicians, engineers and management. Ongoing operator training in the stamping process is essential to insure skillful operation and observation.

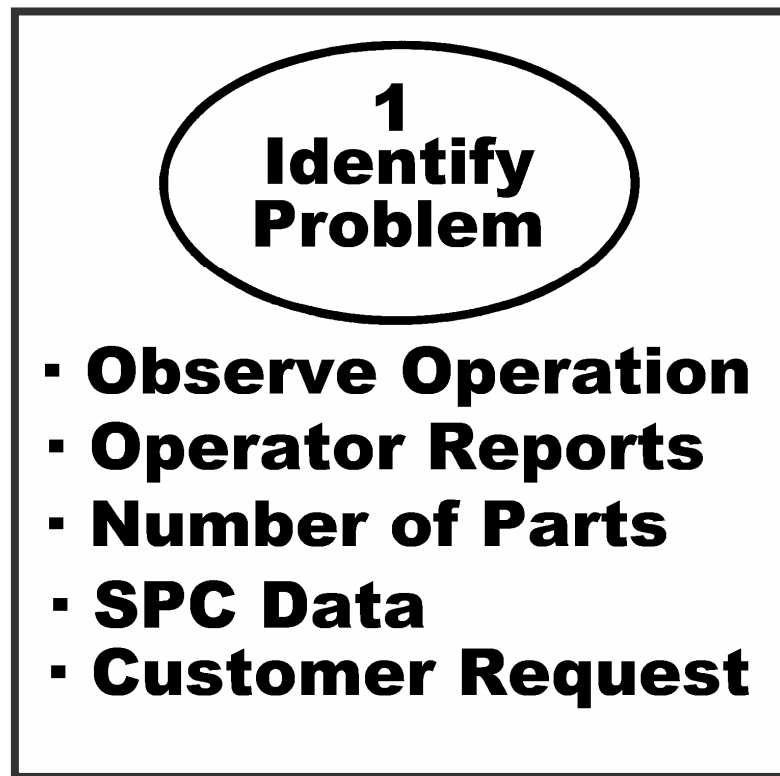


Figure 5. Some simple die problem identification methods. *Smith & Associates*

Number of parts or hits

Like the example of maintaining a motor vehicle, dies require periodic shop maintenance based on the number of hits made. Frequency of maintenance based on the number of parts produced requires fine-tuning based on experience with the die or similar dies. If the die is subjected to misfeeds or multiple hits, it should be examined by a tool and die technician to check for damage—AT ONCE!

SPC Data

Statistical Process Control (SPC) data can guide the observation process. If the process control charts indicate that control points are drifting, something is going wrong with the process. It may be the press, material or the die.

Customer Requests

Finally, customer quality or functionality issues require immediate attention. Here, fast clear communication to determine what has changed and the needed correction. A customer request may involve an engineering change to the part. This usually requires die modification. All die work requires planning and the origination of a formal workorder.

Step 2—Set Priorities

After identifying the work required, initiate a workorder. Some shops use a paperless computer entry system for workorders. A clear workorder defining the scope of work is essential to scheduling the work. Following is a partial list of the considerations that define maintenance priorities.



Figure 6. Set priority for Essential Items. *Smith & Associates*

Safety First

Safety problems are the highest priority. Loose die parts; broken cam return springs and misalignment are several examples of problems that require immediate correction. Die component interference can send pieces flying at high velocity throughout the pressroom. Figures 7 and 8 are humorous illustrations of this problem.

What the Customer Needs

Customer needs are the next highest priority. These needs simply mean “If we don’t fix it soon, we can’t make parts for our customer”. A die process failure sets the ultimate priority—you correct the problem or you cannot make product.

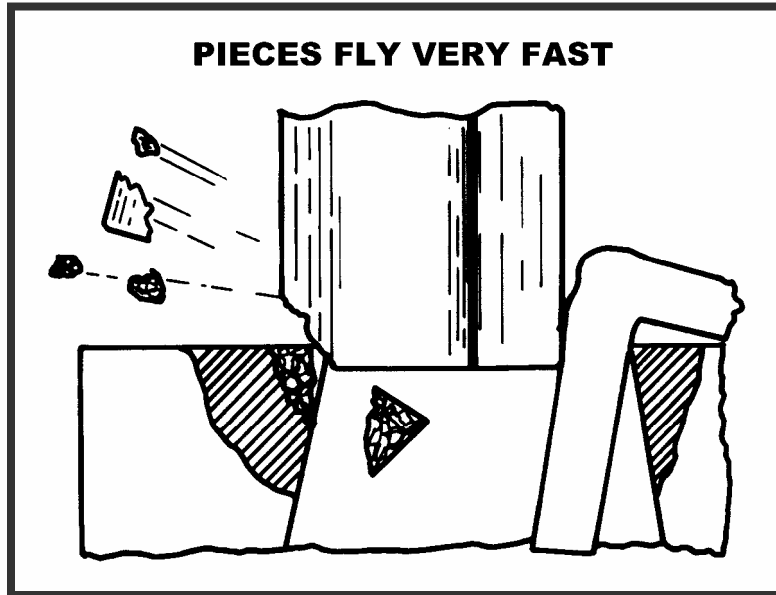


Figure 7. Shattered tool steel is a serious safety concern—it can fly at high velocity causing severe injury. Safety is the highest priority. *Smith & Associates*

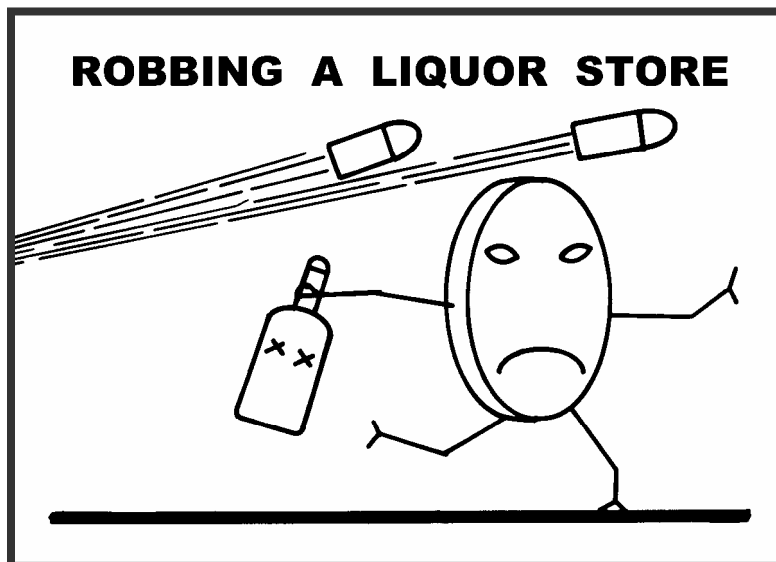


Figure 8. Shattered tool steel is a serious safety concern—it can fly at high velocity causing severe injury. Safety is the highest priority. A little humor enlivens employee training. *Smith & Associates*

Repair Time Required

Determining required maintenance time is important for a number of reasons. Time is a finite resource. Production parts must be shipped meet customer requirements. In this case, it is essential to make an accurate estimate of the time required.

Dieroom Capacity to do the Work

The ability of the dieroom to accomplish the work is essential. Overtime work may be required to repair the die. The dieroom schedule may require overtime accommodate the work if it is an emergency involving safety or quality production. In some cases, a repair capacity shortfall requires the help of a contract die shop.

Step 3—Plan Work

When this third step is completed, we will be ready to work on the die in an efficient way. There are times when a smash-up or breakdown will decide when we work on a die. This should be a rare exception—never the typical situation. The following is a partial list of the actions that should occur before working on the die.



Figure 9. Careful planning is essential to assure that the die repair work will proceed smoothly. *Smith & Associates*

Tool Release and Run Ahead Approved by Production Scheduling

Getting a tool release from the production scheduling activity is essential. Scheduling must work with production control to be sure that sufficient parts are on hand. Stampings must be available to cover the time needed to rework the die. An advance run requires stock, production time and storage for the stampings.

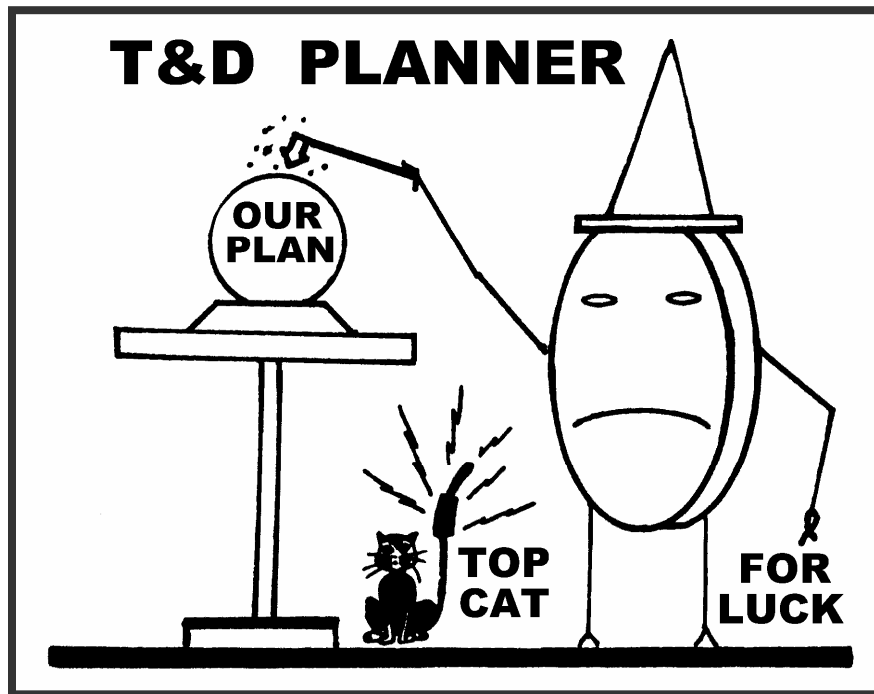


Figure 10. Planning die maintenance is not a black art. A planner may be required to verify that a good plan is in place for all work. A team approach and full cooperation of everyone ensures consistent success. *Smith & Associates*

Make Special Parts in Advance

Planning the work includes determining required die parts or details. Some parts such as springs and punches are standard items available from vendors on short notice. All special parts should be ordered prior to commencing work. Parts made by CNC machining will require cutter path data. Usually tool steel requires heat treating—often followed by finish machining. The production of special die details may require from several days to a week or more.

Avoid a “Black Art” Approach to Planning

Planning is a cooperative effort—never a black art. Figure 10 illustrates that hoping for good luck is not enough. A team approach that provides cooperation is essential. The alternative to planning is confusion, inefficiency and failure to meet the goal of orderly economic repairs.

Step 4—Perform Work

Step 4 is past the halfway point in workcycle. If the first three steps, clearly identifying the problem, properly prioritizing the work and planning the repair and/or modification needed are done properly, the job should go smoothly.

Sample parts and progression strips must be sent to the dieroom with the die. A diemaker can read the progression strip and estimate the required correction needed before opening the die in the dieroom. Once a plan is agreed upon, the die is taken to the dieroom for the required work. A typical sequence of work is as follows.

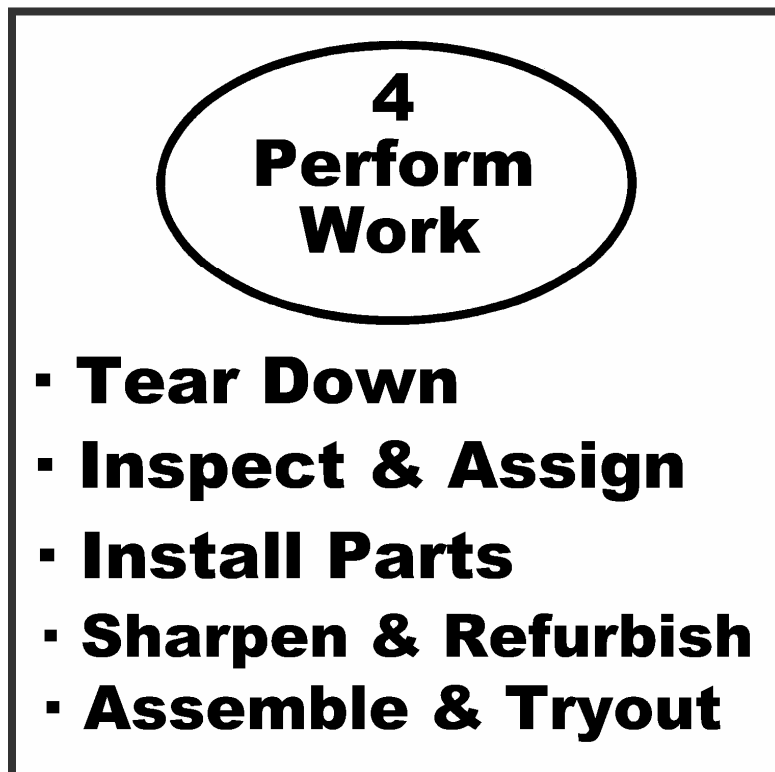


Figure 11. Performing die repair requires disassembly, inspection and assignment of tasks quickly. *Smith & Associates*

Disassemble and Inspect Die

The diemaker carefully opens and examines the die. The condition of the die alignment system consisting of guide pins and/or heel blocks is examined for wear. As this die is disassembled, all evidence of wear and interference is noted.

Inspect and Assign Work

A written record of findings is made and the repair plan finalized. Additional help is assigned as needed and a plan to defer any corrections that cannot be made in the allotted time is documented so a follow-up workorder is originated.

Sharpen and Refurbish as Needed

Good die repair skills are essential to repair and refurbish the die. This may involve some additional work than that anticipated based on the planning and workorder generation process.

Assemble and Tryout in Press

After the parts are reworked and new details installed as needed, the die is tried out. This may be done in a dedicated tryout press in the dieroom. An alternative is to use the designated primary production press. A record of tryout and actual production results is an essential part of building die history. This data is essential to find ways to reduce the cost of die maintenance by improving die maintenance documentation and tracking.

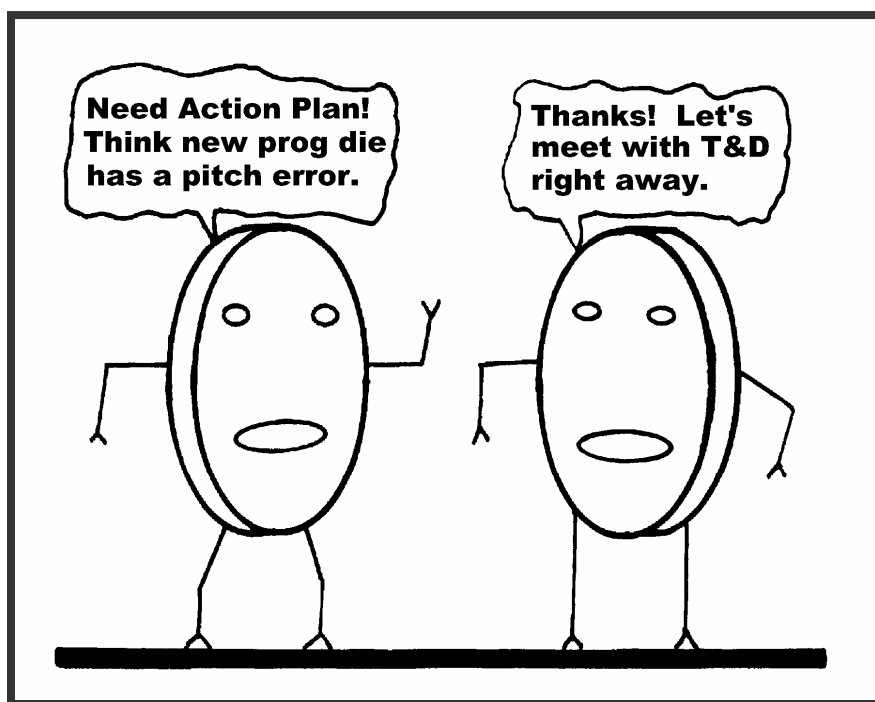


Figure 12. A trained progressive die operator has found part variation and feeding problems with a new die. Reporting this problem initiates step 1 of the six-step die repair workcycle. *Smith & Associates*

Pressroom Employees Can Add Essential Input

Figure 12 illustrates how training operators in basic press and die operation can bring about prompt resolution of problems. Progressive die stamping variations are often due to pitch changes that are difficult to predict exactly in the design stage. Moving and redoweling die stations in the dieroom can correct pitch errors. Left uncorrected, the die will always have part uniformity problems and may not feed smoothly.

Step 5—Document Work

The fifth step is to document the work done. The following is a list of the items that require documentation for archival as die history.

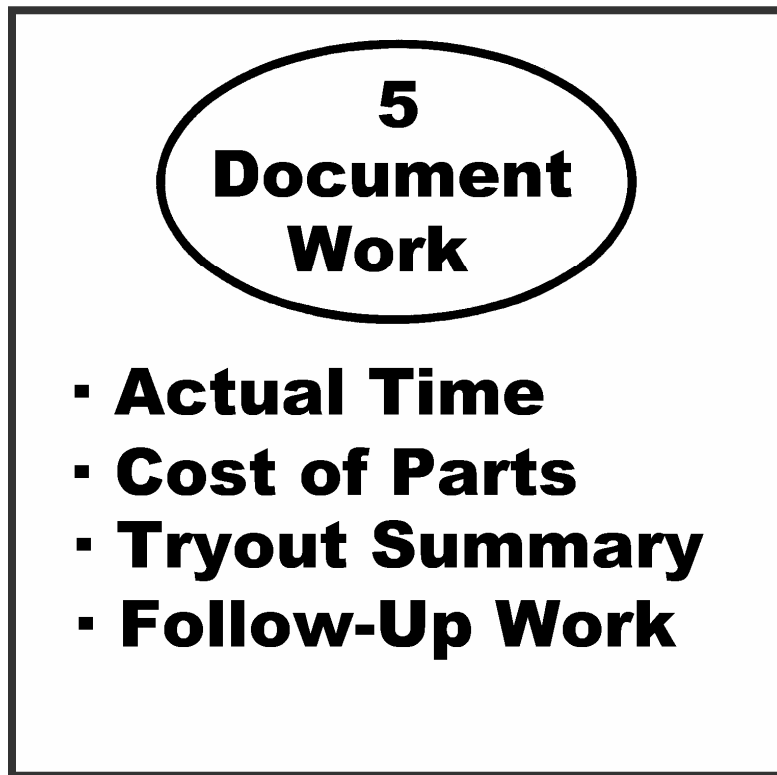


Figure 13. As the six-step workcycle nears completion, the work accomplished and results obtained are documented. *Smith & Associates*

Actual Time, Cost of Parts and Tryout Summary is Documented

The actual cost of the work in terms of time expended and the cost of parts required are listed in detail and as a total cost figure. A summary of the die tryout results should list the improvement or change in the die operation and part produced that has resulted.

Follow Work Often Needed

Follow-up work is often required. Continuous improvement has always been a cornerstone of process-based industries. When the die returns to production, items may be noted that can be improved.

Step 6—Archive Data

Data can be archived in a number of ways. Historically file card, file folder or die notebook systems have been used. Increasingly, computerized databases are used to store die history and perform cost analysis. When the data listing the results of a repair workcycle is archived the following steps should be followed.

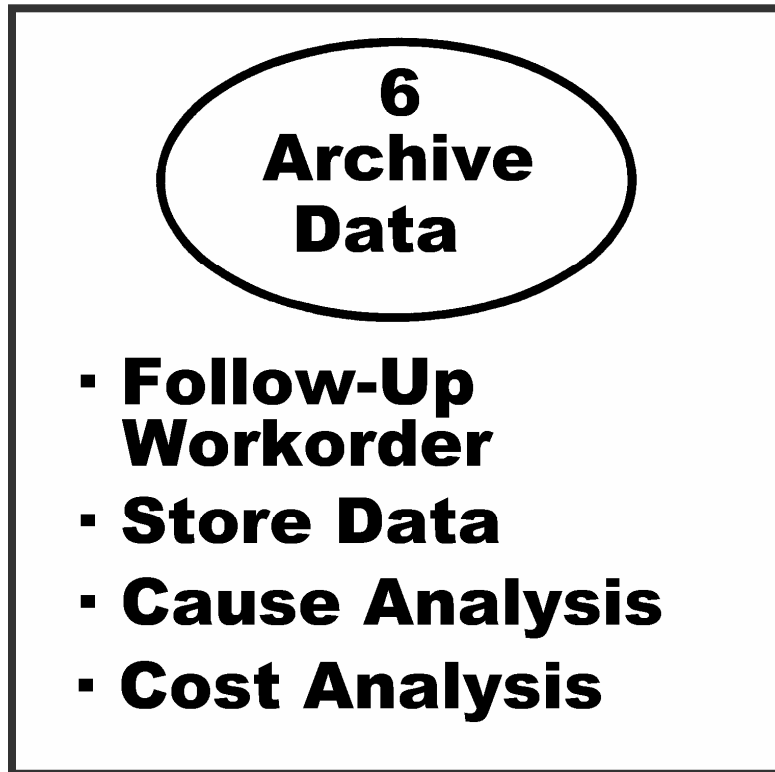


Figure 14. Essential items for archival and analysis to accomplish continuous process improvement. This step completes a workcycle. *Smith & Associates*

Follow-up work is often required. Continuous improvement has always been a cornerstone of process-based industries. When the die returns to production, items must be noted that can be improved.

Originate Follow-up Workorder if Needed

When a follow-up workorder is originated, the cycle is actually started over to further improve the die and process. The die repair cycle is a circle indicating a continuous process. Dies require periodic maintenance that is mirrored in the workcycle.

Store Data in a Secure Way

The die work history needs to be stored securely. Simple paper based systems depend on written forms. These systems are simple to implement and low in cost. Changes in the paper forms are easily made. Duplicate copies of records can be made and stored in a safe location. This insures that duplicate information is available in case the file for a die should be misplaced.

Using Paper Workorders for Computerized Database Conversion

If a computerized die-maintenance system is adopted in the future, the paper workorder and die-history system can work in parallel with it until everyone is comfortable with computerized data storage. This makes the conversion to a computerized system easy to implement. Computer records must be backed up as duplicate files and stored off-site. Good back-up procedures insure against loss of data.

Perform Root Cause Analysis

Achieving continuous improvement proceeds more rapidly if the available resources are directed to solving the most costly problems. First, agreed upon cause factors must be assigned to the types of process failures that occur. Normally, a limited number of problems cause the majority of difficulty. These causes are placed on Pareto charts and the most effort directed toward minimizing these problems. As progress is made, what were minor problems will become the most troublesome. This helps insure that the available problem solving resources are directed toward the most costly problems.

Analyze the Cost Vs Benefit of the Work

Finally, the cost versus benefit of the maintenance program should be documented. If confusion prevails in the workplace, it is very difficult to assign real cost figures to the problems that occur every day. The workorder system and the six-step die repair workcycle are good ways to bring order and increase profitability to the stamping shop.

Designing a Request for Maintenance Form

A die maintenance request form should reflect the procedure followed in the die repair and cost accounting process in sequential order. Today it is practical to use paperless data entry system using data terminals that tie in with the plant mainframe computer. In some cases, a department may have a local area network (LAN) for this function. However, paper forms having two or three carbonless copies remain popular for a number of important reasons.

Advantages of Paper Forms

Familiarity with the paper tracking system is an important consideration. The form minus the part(s) used for entry into the maintenance management computer remains with the die to provide instant information as to the die repair requirements and status. There are many advantages to using a multi-copy paper form rather than direct computer terminal entry. One advantage of the paper form is that the necessary approvals and signatures can be obtained before inputting the maintenance request into the computer system.

Design Elements of a Good Form for a Manual System

A good form starts with basic information entered into the upper left-hand corner and ends with the results of the correction in the lower right hand corner. In this way, the form follows the function of the maintenance process. In small shops, reasonably good record keeping can be accomplished with manual record keeping and cost accounting. However, if more than 15 to 20 maintenance technicians are involved, a computerized system is advised to run in parallel with the paperwork tracking system to assure accurate die history and cost accounting.

Typical Form and Function

Most forms are made from three or more sheets of carbonless paper. This permits tearing out and sending a copy for computer data entry when the work order is generated. Another copy with the information about the work performed during the repair process will be sent for data entry when the work is complete.

The Mazda (now Ford/Mazda Auto Alliance) integrated stamping and assembly plant in Flat Rock, Michigan depends upon a team approach to solving die problems relating to quality and productivity. Team interaction is the key to the success of the system. The stamping shop started with a total of five-transfer press lines, an OBI line and a blanker. Every die is assigned a home line whenever possible.

However, pressroom expansion at Auto Alliance solved throughput shortfall problem and the need for spare press capacity. This helps avoid shutting the adjacent assembly plant down in case of an unforeseen press failure. Auto Alliance, like many plants, has had problems with press failures due to diesetting errors as well as metal fatigue under sustained usage.

Dealing with Paperwork Tracking Limitations

When Mazda, Now Auto Alliance Flat Rock, Michigan Facility was built in the late 1980s, the pressroom was divided into several areas limited to 15 to 20 maintenance technicians each. This was necessary in order to cope with the limitations of a paperwork tracking system. This number of maintenance technicians in a team is considered the upper size limit of a group of maintenance technicians for a manual paperwork tracking system to remain workable.

DIE MAINTENANCE REQUEST		INSPECTION / REPAIR / IMPROVEMENT	
		PART 1	
Part Number		①	
Part Name			
Press Number			
Die Number			
Defective Process			
Today's Date & Time			
Sample Blank & Part Status			
Unit Leader		Originator	②
		Deadline for Modification	↑
Unit Leader Must Contact Planning Dept. for Dates			
DIE MAINTENANCE REQUEST		PART 2	
Die Correction Date		Corrective Action	CHECK THE FOLLOWING INSPECTION ITEMS
Die Correction Time Required			Has Die Been Properly Cleaned?
Tryout Date			Are All Die Parts Secure?
Tryout Time Required			No Foreign Objects On or In Die
Die Maintenance Member	③		Is Die Properly Lubricated?
Unit Leader			Proper Working Clearances?
Tryout Area			Springs and Nitrogen OK?
Production Date			Part Lifters and Automation OK?
Unit Leader			In Die Sensors OK?
Operation			Has All Work Been Completed?
			If Not, Follow-up Request Made?
			④
After Correction, Die Maintenance Member Must Check These Items			
PRODUCTION		PART 3	
Required Production Date		⑤	
Unit Leader			
Operation			
		Results of Correction	
White Copy: INFORMATION TO LINE AFTER CORRECTION			
VERIFY AND FILE WITH DIE HISTORY (Line Die Maintenance Must Check Results)			

Figure 15. A generic version of the form discussed in the text reproduced in full-page format. It can serve as a starting point for developing your maintenance tracking form.
 Smith & Associates

Making a Maintenance Request Using the Paper Form

The three-part Die Maintenance Request form shown in Figure 15 is usually initiated by the transfer press or OBI line production team leader who sketches a description of the problem in space (1) on the form. After signing the form in space (2), the person then takes the form to the tool and die team leader for approval.

Team Leader Review

The team leader reviews the problem with the production team leader and other persons having knowledge of the problem as needed. It is the leader's responsibility to plan the required maintenance. The tool and die team leader must determine the cause(s) of the problem and identify all dies that will require corrective action. The amount of time required to make the correction must be determined.

Tracking and Prioritizing Requests

Only a two-day supply of any given part is usually produced at a time. Production of more than the usual run of parts may be needed to provide additional release time. The tool and die team leader coordinates the required release with the production-planning department. When the plan is complete, the tool and die team leader co-signs the form in the blank space. (3).

One of the three copies is posted on a corkboard at the home line and the other two copies are inserted into a pipe attached to the die for that purpose. The production team leader ships the required number of sample parts needed for evaluation and tryout to the dieroom together with the die(s). The parts are identified and stored in a designated area.

Review Outstanding Maintenance Requests

At the start and near the end of each shift, both the production team leader and the tool and die team leader meet to review problems including a review of all outstanding maintenance requests posted on the line's cork board. The outstanding requests are prioritized based upon the extent to which quality and production are affected. There are times when the entire correction needed cannot be made due to the size of the job and urgency of other requests. In such a case, the plan may be reduced to a partial correction, with a complete correction scheduled for a later date.

Correction and Follow-up

The diemaker making the repairs records the corrective action on the middle part of the form (4) and fills out the list of inspection items. After the correction is completed, the second copy of the die maintenance request is filed in the die room records for that die and the first copy placed in the pipe attached to the die. When the die is returned to the press line, the first copy is placed in a plastic sleeve attached to the corkboard.

The lower space on the form (5) is filled out by the production team leader and line team leader after the success of the repair has been evaluated during a production run. The white copy is then retained in the die repair area as a part of the die's maintenance history.

Cooperation Required

Any good system of manufacturing places great emphasis upon each individual being part of a team responsible for quality and productivity. This maintenance system depends upon the cooperation of all employees.¹

Conclusion

Simple paper forms can be useful to determine the history of problems with individual dies. However, report generation for cost accounting purposes requires time consuming and error prone manual data tabulation.

The same maintenance intervals and cost control measures applied to metal stamping dies ant that required maintaining plastic molds so the software for the maintenance management program is similar. The computer design methods used to make plastic part designs and metal part designs are similar.

Plastic molding programs can simulate the filling of the mold, gas venting etc. Likewise, the sheet metal forming process can be simulated and many problems solved before the tool is built.

After the mold or stamping die is in service, we wish to reduce the maintenance cost to the lowest value per part over the useful life of the investment. For example, you would want to strip and re chrome plate the molding die parts before erosion into the base metal occurred even though it was making good parts. Likewise, excessive parting flash should be avoided. Some stamping and plastics mold dies are machine and material dependent as regards the maintenance interval required. For example non-uniform clamping force will result in both excess machine and mold wear. Likewise stamping press alignment is critical to good die life.

Tooling can have "accidents" that must be reported, so these enter into the maintenance schedule. It is quite similar—the key is documentation of normal wear requiring periodic maintenance and other factors such as “accidents” and quality issues requiring tooling corrections.

Most industries rely extensively on computer integration of the manufacturing process for most aspects of their operations. These include inventory control, payroll generation and government report accountability just to name several categories of essential data that must be managed and reported in a readily understood form. Simple paper forms alone can be useful to determine the history of problems with individual dies. However, report

¹ D. Smith, *Quick Die Change*, Chapter 16, Maintenance Requirements for Quick Die Change, Teams, The Society of Manufacturing Engineers, Dearborn, Michigan, © 1991. This chapter covers the reference from The SME Die Design Handbook © 1990 Chapter 24 in detail.

generation for cost accounting purposes requires time consuming and error prone manual data tabulation.

Today, most industries rely extensively on computer integration of the manufacturing process for most aspects of their operations. These include inventory control, payroll generation and government report accountability just to name several categories of essential data that must be managed and reported in a readily understood form.

The old Mazda paper based die repair tracking system has been abandoned. It has been replaced with a computerized maintenance management and tracking system. Simply stated, the facility is too large for the paper-based system to work effectively.

Paper Die Maintenance Tracking Forms are not obsolete

However, a simple paperwork maintenance tracking system is a good way for a shop relying on verbal orders to improve performance. It can always run in parallel with a computerized maintenance management and tracking system. Many good computerized maintenance management systems rely on paper forms for initial data entry and tracking of the repair process.

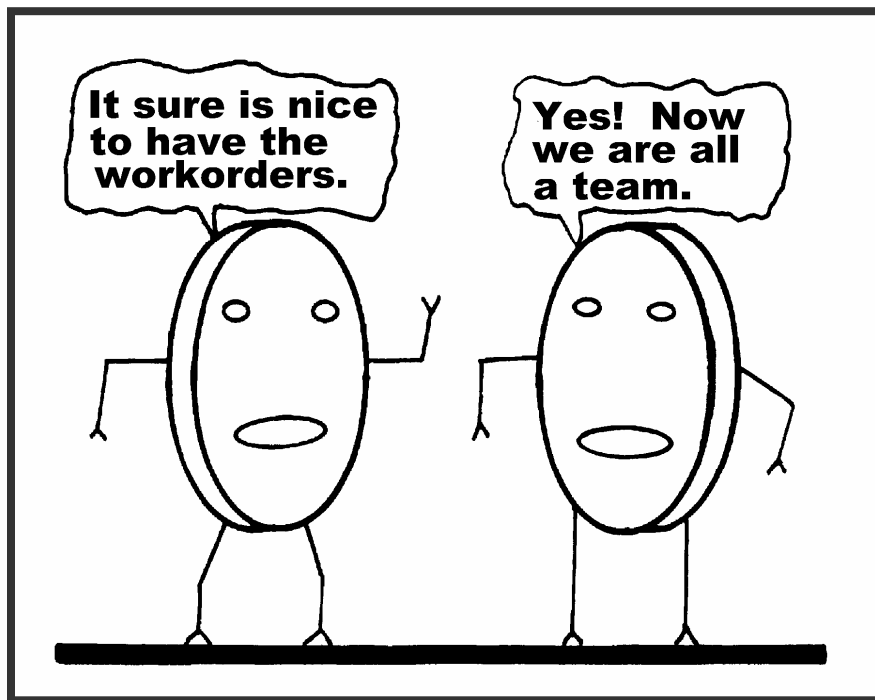


Figure 16. Nearly all employees like being part of a team. Work is much more enjoyable if you know that your efforts are appreciated and your ideas contribute to the progress of the company. *Smith & Associates*

Continuous Tooling Improvements

Tooling design improvements coupled with maintenance cost control is a frequently overlooked area for continuous improvement. Through effective database development and report generation, opportunities for continuous improvement in die design and maintenance issues can be identified and corrected.

Training is Essential

Training is essential at all skill levels. Training opportunities must be provided for everyone from the operator to the tooling engineer and even top manufacturing management to increase their skills. Everyone should be able, willing and encouraged to provide input into solving tooling process problems. Problem solving requires a systematic team oriented approach. This is illustrated in Figure 16.

Further Information

This paper is a brief overview of the topic of die maintenance documentation and tracking. If references that are more detailed and additional information are desired, it is suggested that you contact shops scheduling work with resources similar to your own to obtain advice on their maintenance management tracking procedures.

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