Troubleshooting Your Way to Success

by:
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***Troubleshoot:* "To isolate the source of a problem and fix it, typically through a process of elimination whereby possible sources of the problem are investigated and eliminated beginning with the most obvious or easiest problem to fix."** — **Webopedia**

For manufacturers, the scene is familiar—a request for quotation arrives via facsimile and the print proceeds through feasibility review. Troubleshooting is germane when preparing an estimate for a customer. Taking exception to a dimensional tolerance during the quotation stage for example is more acceptable than addressing the issue after the receipt of an order.

Upon determining manufacturing capabilities, a selling price is tendered with the hope of receiving a contract. Troubleshooting begins prior to receipt of an order and continues throughout the entire process. Customer relationships are ever more fragile and every work order poses an opportunity to exceed customer expectations.

Why Is Troubleshooting Necessary?

Truss head-style rivets can be a classic example of when a deviation for increased tolerance is necessary. A truss head is characterized by a large diameter relative to a small head height as seen in **Figure 1**. The longer the part, the more difficult the part is to kick out of the die. Therefore, oil is necessary for lubrication of the die and knock-out assembly.

Cold-heading machines typically operate using an oil system with the cutoff and transfer mechanisms. A drop of oil left on a cutoff blank can become trapped in the punch and cause a "flat spot" on the truss head of the fastener and ultimately an undersized head height. An oversized head diameter is also of consequence. Trapped oil can prevent the material from filling the entire cavity of the punch, which moves forward to upset the head. The deforming material must go somewhere resulting in a "flash" around the head diameter as seen in **Figure 2**.

Part configuration dictates the machine type and tool selection. Completion of both the progression and tool design leads to the next step in the manufacturing process, which is machine setup. Work instructions detail how job changeovers should be performed. Fasteners are part-specific, which makes each setup unique. The ability to troubleshoot throughout the setup can mean the difference between a quick changeover or a prolonged setup process. For instance, part of the setup includes running the cold heading machine at full speed after the wire is loaded, the tooling is installed and the clearances are set. Allowing the machine to "warm up" renders a more accurate reading of the rivet's dimensions than measuring a headed fastener that was produced by "jogging" the punch during setup to upset the part.

Experiencing die breakage within minutes of operation leaves the operator to contemplate the root cause of the failure (**Figure 3**). Is the interference fit between the insert and die

Fig. 1 — Truss head rivet with large diameter relative to a small head height.

Fig. 2 — Deformed material results in a "flash" around the head diameter.

Fig. 3 — Die breakage within minutes of the operation enables the operator to determine the root cause of the failure.

case correct? Is the chosen tool steel for the die insert appropriate for this application? If the fastener has been produced in the past without incident, perhaps the carbon content of the raw material is towards the top of the specification. The coil of wire can also be poorly coated.

Past experience indicates that the quick occurrence of die breakage is indicative of the punch traveling too close to the face of the die. A simple check can be accomplished by placing a piece of paper against the front of the die and "jog" the punch over the current punch displacement. If the paper tears (as in **Figure 4**), the punch needs to be backed away from the die face to alleviate the heading force on the insert. Interestingly, practical techniques still serve a purpose in our technologically advanced marketplace.

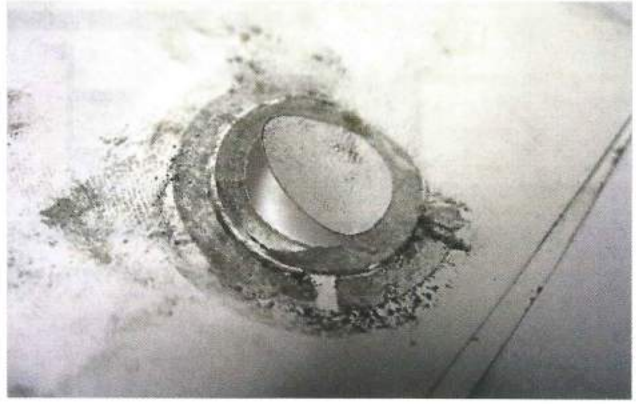

Fig. 4 — Paper used in checking die and punch positioning.

The Benefits of Good Troubleshooting

Troubleshooting techniques improve machine efficiency and the development of operator skills. Take for example the operator who experiences die knockout pin failure during fastener manufacturing. The operator must put on a detective cap and determine possible variables of the die pin breakage. Is the part long in relation to the length of the die case? If so, the die pin must be retracted far away from the die leaving much of the pin unsupported to experience the force required to head a part and knock the part out of the die (**Figure 5**). One remedy may be the use of a telescoping sleeve, which provides supplementary support to the pin assembly (**Figure 6**).

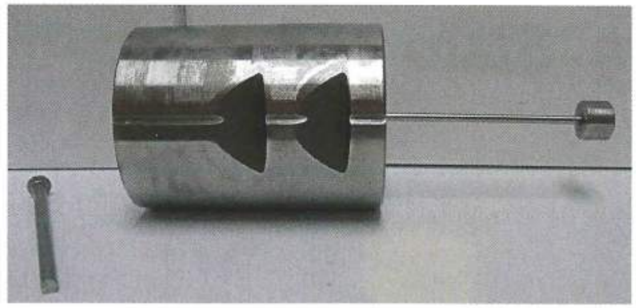

Fig. 5 — Pin retracted from die leaving it unsupported.

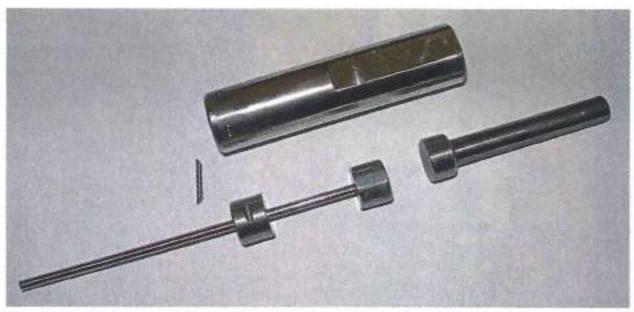

Fig. 6 — Telescoping sleeve provides extra pin support.

Forming sequences can also provide evidence as to the cause of the pin fracture. One case study showed that after part upset, the metal was visibly shiny around the bottom of the shoulder diameter. Further investigation revealed that the die insert used to form the shoulder contained a taper. The insert had a smaller diameter at the area around the face of the die. During the manufacturing process, the fastener formed a larger diameter at the bottom of the shoulder and a smaller diameter at the top, which resulted in excessive pressure on the die pin to kick the part out of the die. The die pin had to force material 0.315" (8 mm) diameter out of an insert that tapered to 0.312" (7.9 mm) diameter at the die face. The cause of pin failure was determined by disassembling the die into its components. Pin gages were then used to check the shoulder insert diameter. A 0.315" (8 mm) pin gage was unable to pass through the entire length of the die insert.

Subsequent inspection showed a 0.312" (7.9 mm) pin gage slid through the insert with ease (**Figure 7**). Replacing the insert eliminated the die pin failure and the order was successfully completed.

Fig. 7 — Die insert shown with 0.315" (8 mm) and 0.312" (7.9 mm) pin gages.

Conclusion

Fastener manufacturing demands the ability to troubleshoot. The emergence of these skills occurs only with time. Experienced machine operators frequently mentor new personnel in the functional methods of troubleshooting. Often in this industry, when someone leaves, his or her knowledge is lost. Having a troubleshooting guide in place to document difficult job set-ups not only catalogs operator know-how, but saves valuable time on repeat production orders. Knowledge gained from the shop floor can ultimately filter throughout all departments, i.e., quoting, engineering, tool room, quality.

The goal is to have every division of the company collaborate with a synergetic effect in all facets of fastener manufacture. FTI

*Company & Author Profiles...***Brainard Rivet Company** *is an employee-owned ISO 9001:2000 certified manufacturer of small rivets, large rivets, shoulder rivets, drilled products (clevis pins), knurled pins, grooved pins and special shaved fasteners for the general metalworking, distributor, farm, railroad and auto/truck industries.* ***www.brainardrivet.com***

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