Why Doesn't My Machine Work?

By Robert Wax, Associated Pacific Machine Corporation

This is a call our customer service person receives on a regular basis. Sometimes the answer is simple and sometimes it is a seminar in the principles of die-cutting. To answer the question, we need to collect a bit of information about the problem.

First, we would need to establish what kind of machine the customer has that is presenting the problem. We sell many types of machines for different applications. For the purpose of this article, let's assume it is a hydraulic die-cutting press.

Next, we ask the customer if the press is running. If the answer is no, questions are asked about the power supply. Is the machine receiving power? Is the power on, and is the circuit breaker properly set? Is there a blown fuse? Is the disconnect switch closed, an emergency stop switch on the machine pressed or a guard on the machine open? Power is not the problem, the machine is running and goes down and up without a die.

This is a good start - the machine is supposed to go down and up. All presses are designed to work within a certain set of parameters. They have a fixed daylight, which is the maximum distance between the bed of the press and the bottom of the upper platen. When in its top position, you have your cutting stroke, which is the distance the moving platen will travel. The last element, not including press size, is cutting force. The force of a press is calculated by taking the surface area of the cylinder times the line pressure of the hydraulic fluid. This is either kilogram per square cementer or pounds per square inch. No press has unlimited power!

The next question is what did the press do or not do without going into electrical or mechanical issues? Why the press did not cut will be the focus of our attention. The first thing to find out: does the press have enough force to do the job? There is more than one way to check for pressure. One method is with the machine's manometer gauge (see Diagram 1).

The machines we sell come with a manometer gauge that will read the pressure in the system at the time of cutting. Every machine has a chart that will interpret the maximum cutting force the press can develop. The benefit of having a manometer in a machine is the ability to check what cutting force it takes to diecut against a particular surface. This information can be very useful in determining how large a die can be made.

The second way to find out if the machine has enough power to execute the job it is being asked to do is by listening to the machine. If the machine starts to groan, the motor slows down and the press slows down, it is being overloaded.

After some questions and answers with the customer, it was determined that the press was working to factory specs. However, the problem did not go away, and the material was not being cut or was being cut incompletely. Now that the machine was eliminated as the problem, a whole new set of issues needed to be looked at.

Next, we will try to determine if the die requires more pressure than the press can deliver. If that is the case, what can be done about the problem? First, we find out how many inches of rule are in the die. Is any part of the die congested? Is the die flat and sharp? To check whether the die is too big, examine how much

cutting blade is in the die. There is a rule of thumb to see if you are in the ballpark: it takes 400 to 500 pounds (181 to 227kb) of force to cut one linear inch (25.4mm) of cutting rule.

Based on the rule of thumb, in our example, the die does not have too much rule. The most common problem at this point is too much ejection material in the die. Just as it takes a certain amount of pressure to cut an inch of knife, it takes pressure to compress ejection material. There should only be enough material to push the part out of the die. When ejection material covers the die, it is usually too much (see Diagrams 2 and 3).

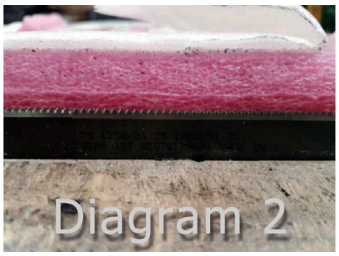
Diagram 2


Diagram 3

We have looked at some of the simple things that affect the performance of a press. The next group of reasons must be looked at together: the material being cut, the cutting rule and the cutting surface.

The properties of the material being cut are important in cutting rule, die design and cutting surface. Whether the material is hard or soft, thick, or thin is important to know in making choices.

Another rule of thumb is that the cutting surface should be harder than the material being cut. In many cases the material is compressed between the edge or the knife and the cutting surface. If the cutting surface is soft, the material will be pushed into it. This will result in a poor quality or incomplete cut. The cutting surface will also deteriorate quickly. When a cut line crosses a groove in these conditions, the result may be a poorly cut part (see Diagram 4).

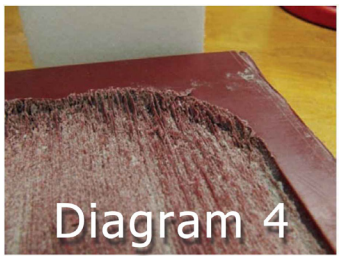
Diagram 4

It is very important that the space inside the die is large enough to hold the ejection material and the material to be cut. The cutting press needs to compress the material to be cut so the edge of the cutting blade can reach the cutting surface. This will increase the cutting force requirements to the point that a cut cannot be made. The compression of foam can take the cutting force requirements off the charts. With proper die-making, these problems can be taken off the table.

Most die-cutting is done with flat edge rule, either skived or ground. Both of these rules, and even slightly serrated rule, will cut against the standard polypropylene cutting pad. If the material to be cut is particularly hard, or has nylon threads, it may be necessary to move up to a nylon pad. If Kevlar® is being cut, it is necessary to make a Kevlar® cutting surface. The harder the cutting surface, the flatter the cutting rule must be.

So, what cutting surface is the correct one to use? What is available?

Materials used for cutting surfaces have ranged from paper, like newspaper and craft paper, to hardened and ground steel plates. Obviously, the range is very wide, and the question is how to narrow it down.

The elements influencing the choice are the materials to be cut, the type of die to be used and the machine to apply the pressure. The first rule, and probably the most important, is that the cutting surface needs to be harder than the material being cut.

The next element to consider is the cutting die and edge profile. Cutting a serrated edge against a hard surface is not a good idea. It will dull the die and increase the cutting force requirements drastically. On the other hand, a flat edge will work better on a harder surface, especially when the material is being pinched as it is being cut.

What is the dividing line between hard and soft cutting surfaces? Based on the many materials that we diecut, the type of dies and rules that are used, 68 to 70 Shore D is the dividing line. For the purpose of engineering and classification, cutting pad materials have hardness scales. The one used for rubber and plastic are the Shore A and C scales.

What role does hardness have in the cutting process? The die-cutting process is an into process and not an onto process unless you are cutting against steel. The harder the surface to cut against, the more pressure it takes to cut. The cutting presses come in a full range of pressure or cutting force. The more pressure a press can deliver, the more it costs; usually one does not want to buy more press than they need. A hard pad will take the edge off the die more quickly than a softer cutting surface.

What happens when the material is diecut? Not always the same thing, as the material reacts to the cutting process. Some materials will compress as the blade approaches the cutting surface. Some materials will separate; as the blade penetrates the cutting surface, the material is pinched off and separated. On harder materials, the blade will enter the material and it will fracture ahead of the blade. This may give a ragged appearance on the lower portion of the cut. Some material will cut as the blade goes into it. This is usually with a serrated edge.

Cutting surfaces can be pads, plates, or belts. This is mostly machine or cutting system dependent. The rule for choosing a cutting surface is to get the least expensive that will do the job. This can come into play when choosing a machine with a pad or a belt. This decision will be influenced by how the material will feed through the machine.

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