

How to Become a Plastics Guru: What You Need to Know (Part 1 of 3)

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There are those who are good at what they do, and then there are those who are the absolute best. The gurus. The late NASCAR legend, Dale Earnhardt is a great example of one such guru. He was so good, in fact, that it's thought that he could see the air moving around the car to better understand what move he should make next.

If you've had the honor of meeting a plastics guru, you'd know how brilliant they are. How are they so good? What do you need to know to be on that higher level?

Over the next three segments, we're going to review several of the often overlooked technical arenas that are vital to understand in order to become a plastics guru. In this segment, we will review mechanical and electrical knowledge.

Mechanical

There are many areas that require a deep understanding of mechanical in the industry. We will graze the surface of what you need to know about the machine, the intensification ratio, and the mold.

1. The Machine

Did you know that 80% of the energy required to melt the material comes from mechanical friction? The first step is understanding the Length to Diameter Ratio (L/D) (a comparison of its flighted length to diameter) in conjunction with the compression ratio (the reduction in depth of the space between the root diameter and outside diameter of the screw).

Figure 1 helps to understand if the design is efficient enough to melt the pellets before they are injected into the mold. Imagine rubbing your hands together on a cold day to generate heat. The faster your hands are rubbed together, the greater the heat. If they are pressed together firmly, the heat generated increases yet again. The reciprocating screw design works the same way. If a screw design is too aggressive, it can cause degradation. If it isn't aggressive enough, it won't

work the way it needs to. So it's vital to find the right balance.



Figure 1: Screw showing L/D and Compression Ratio

2. The Intensification Ratio

The next type of mechanical advantage that must be understood on the molding machine is the intensification ratio. This ratio determines the amount of work, or power, the injection unit can deliver during the filling and packing phase.

Hydraulic machines generally have large diameter cylinders in small diameter screws (shown in Figure 2). If we compare the area of the hydraulic cylinder to the area of the screw, the intensification ratio can be calculated. If this step is overlooked, the molded part may require more power than the machine can deliver, yielding an inconsistent process.

For example, if we apply 500 PSIf hydraulic pressure to a 10:1 ratio, the result is 5,000 PSIf. When the same pressure is applied to a machine with an intensification ratio of 15:1, the result becomes 7,500 PSIf. Think of it like a magnifying glass.

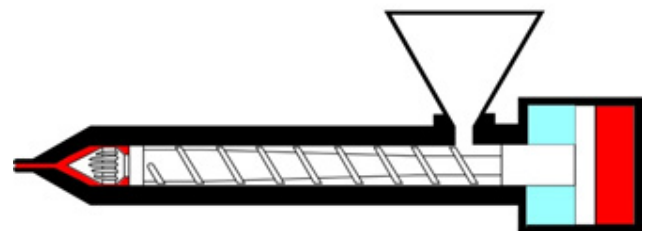


Figure 2: Note large injection cylinder and small reciprocating screw

3. The Mold

Now let's center our attention on the mold and its mechanics. Many parts today are designed

with undercut features that require movement of components, such as slides or lifters. It's important to understand minimum and maximum angles for either to ensure the steel can be disengaged from the molded part. If the angle is too steep, there could be galling between the metal components. If it's too shallow, the distance of travel required to release the part could negatively impact the mold size or place excessive stress on the lifter rod or cam pin (shown in Figure 3).

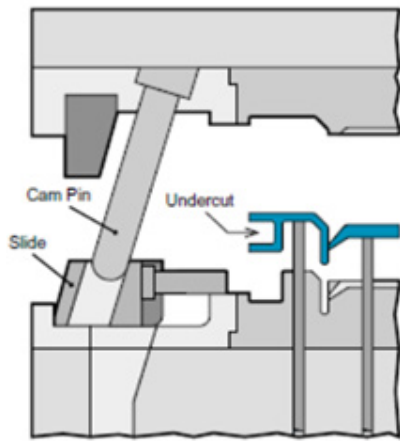


Figure 3: Slide detail showing Cam Pin angle

Electrical

To a certain extent, a plastics guru needs to have an understanding of how electricity is used in the machine as well as in the mold.

First, you should know that machines with hot runners have heaters (pretty obvious, right?). The heaters are used to preheat the screw and barrel assembly before screw rotation can occur. If the heater bands are not properly sized, it can take a long time before production can begin. The heater bands also provide a small amount of energy to melt the plastic material. Understanding how to size the heater and how to verify the proper function can go a long way in making sure the machine is performing appropriately, increasing the opportunity for quality parts each cycle.

Now for a moment, let's focus on the heaters inside the mold. Hot runners have many heaters to maintain the temperature of the melt from cycle to cycle. Think of them as an extension of the barrel, only smaller. If the heater is not functioning properly, it can cause the temperature to drop

and the injection to increase, causing fulgurations in the process. When the temperature runs too hot from either an improper set point or pinched thermocouple wire the material inside the system can be degraded.

Next Time...

In the next segment, we will review what you need to know about fluid dynamics and thermodynamics to be the next plastics guru.

About the Author:



Jeremy Williams has over 17 years of experience in the plastics industry serving the medical, automotive, furniture, and appliance industries. He previously worked as a Principal Engineer, taking projects from design concept to saleable products.

Jeremy earned his Master Molder II qualification in 2011, became an RJG Qualified Trainer in 2012, and started at RJG in 2015. In addition to his extensive manufacturing background, he holds degrees in plastics and business. Currently Jeremy is a Consultant/Trainer with TZERO®.