

Turbo Wheel Meeting
26th EICF International Conference on Investment Casting
Lugano, Switzerland
Revised August 26, 2014

Wax Room Automation Improves Dimensional Consistency and Balance of Turbo Wheels

Good morning and thank you for inviting me to speak today.

I find this a very interesting venue, not only competing foundries but competing manufacturers all under the same roof, and all with a focus on turbo chargers. It is also very interesting that all of us in this room are consumers, at one level or another, of Turbo Chargers. Whether in our own personal car or the trucks that deliver our products, we are all looking for the benefits that turbo chargers bring to keep performance up and operating costs down while helping the environment. All of us here today are putting pressure on one another as we push the boundaries for more fuel efficient vehicles. It is this constant demand that continues to push the turbo wheel design to require more dimensional consistency as well as improved balance in order for the wheels to be able to perform at higher and higher speeds.

MPI can improve balance and dimensional consistency of a cast wheel, and we can do it from the wax room. If you cannot pass these requirements in the wax room if you cannot make dimensionally consistent, balanced wax patterns you will never make castings that will achieve dimensional consistency and balance.

MPI has a solution to help achieve these goals....Quality Wax, a Quality Die, and a Wax Injector that is in Control.

1. Pattern Wax:
 - a. A quality pattern wax made consistently is imperative. Too many times we see procedures in the wax department that are really patches to an inadequate wax material.
 - b. The wax needs to be manufactured / reclaimed within tight specs from batch to batch.
 - c. The viscosity curves need to match from batch to batch. It is the wax viscosity that controls the waxes flow ability.
 - d. The wax should have good mold release properties. Some of the largest pattern to pattern variation comes from mold release over spray. The less spray required the better.
2. Wax Die:
 - a. The wax dies needs to be accurate enough so that if a metal part was formed directly from the die the wheel would not need to be balanced.
 - b. The die needs to be automated and the slides need to operate smoothly.
 - c. The die needs to have automated pattern ejection.
3. Wax Injector:
 - a. You need to have a wax injection machine that opens and closes the die smoothly.
 - b. The injector needs to be able to maintain the process of wax temperature, wax flow and wax pressure.
 - c. The wax injector needs to be able to inject a paste wax (low temperature wax) consistently. Again Temperature control is critical.

- d. The best flow path for wax into a turbo wheel is vertically up. Vertical up injection allows for the filling of the die to be uniform radially around the hub. It is important that all blades of the wheel fill at the same time
4. Automated Pattern Handling:
- a. It is not possible to handle wax patterns manually without introducing pattern distortion/variation. You need to eliminate the human variation in the process. Any time an operator handles a pattern they are introducing a variation to the pattern.
 - b. Automating the wax injector with a pattern removal device, robotics is imperative to pattern to pattern repeatability.
 - c.
5. Automated Assembly of the patterns to the runner:
- a. It is important to not assemble the patterns before they have been properly cured. They need time to stabilize.
 - b. Again, you need to eliminate the human variation in the process. If the operator is handling the pattern for assembly they are introducing two types of variation.
 - i. Pattern to pattern variation
 - ii. Assembly variation
 - c. Assembly variation causes shell variation, shell variation causes casting variation.
6. Process Control: It is important to realize that you need to control the entire process of pattern making, runner making and pattern assembly. The more the process varies the more the dimensional consistency of the patterns varies and the more likely the wheel will be out of balance. Whatever the quality of the pattern, the runner and the final assembly coming out of the wax room is, this is your starting point. You cannot improve the quality from here you can at best maintain the quality throughout the rest of the process. The reality is, the quality will degrade throughout the rest of the process, and it cannot improve. So whatever goes into the shell room will be the best you can get from the final casting.