# 10 WORST PRACTICES BY LIGHT METAL DIE CASTERS

## and their impact on productivity

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### Poor Practice Checklist

- ☐ 1. Plunger and shot sleeve not perfectly aligned.
- ☐ 2. Die, shot sleeve, and plunger tip not properly preheated.
- ☐ 3. Clearances uncontrolled between sleeve and platen, and sleeve and die.
- ☐ 4. Gate runner in the shot sleeve instead of in the die.
- ☐ 5. Shot sleeves are not always designed for maximum efficiency.
- ☐ 6. Inadequate cooling allows too much plunger tip expansion.
- ☐ 7. Improper tip and sleeve lubrication.
- ☐ 8. Inadequate venting.
- ☐ 9. Increased pressure simply masks process problems.
- ☐ 10. Plunger tip and shot sleeve considered separately instead of together.

### The Most Common Counter-productive Die Casting Practice?

The market for light metal die castings continues to increase. Customers now want larger and more complex castings, and the castings must satisfy much tighter specifications than ever before. The actual process of cold chamber die casting, however, remains basically unchanged. How can this changing demand be met? The only solution is, "Better die casting."

The checklist above is in no particular order, as it is impossible to estimate the real cost to the die caster of any one of these flawed practices. The actual total cost must include scrap, shortened operating life of components, increased downtime, late deliveries, customer dissatisfaction, etc. The list is simply 10 quite common examples of poor practice in the production of light metal castings. Few die casters can honestly say that they have none of these poor practices in their plants.

Arguably, the single worst practice, that is unfortunately common to many light metal die casters, is failing to take advantage of the opportunities to increase productivity by improving the efficiency of their shot end components.

Anything that can be measured can be improved. Even a small improvement in several of the problem areas listed will have a considerable cumulative effect that is guaranteed to immediately increase productivity and profit.

### 1. Plunger & Shot Sleeve Not Perfectly Aligned

Any misalignment between the plunger rod and the shot sleeve will immediately cause excessive wear. Alignment must be exact. There is no acceptable minimum deviation. When any misalignment is found, the life of both the plunger tip and the shot sleeve has already been shortened. Alignment should be checked weekly, preferably with a laser. The aim should always be prevention, not correction.

### 2. Die and Shot Sleeve Not Properly Preheated

Both the die and the shot sleeve should be preheated to a uniform operating temperature, taking care to avoid overheating.

The best way to preheat the shot sleeve is with hot oil. Many die casters, however, simply fill the sleeve with alloy then push it out when it has hardened. This is a fairly safe and practical method. But too often, the die caster preheats the die with a torch, relying on the expertise of the operator to heat it uniformly and without hot spots.

H13 tool steel will begin to over-temper and soften at about 1085°F, and an uncontrolled open flame can reach temperatures of 5,000°F or more. The problem is that the die caster is usually unaware that parts of his die may have been overheated and softened. Die life will be shortened because of structural and cosmetic damage to the mould.

### 3. Clearances Uncontrolled Between Sleeve and Platen, and Sleeve and Die

The clearances between both the shot sleeve and the platen, and the shot sleeve and the die should remain between .005" and .015", depending on diameter and temperature.

If the space between the shot sleeve and the platen is too great, heat will be retained. When this happens, hot spots will occur, and the sleeve will expand at these locations. If the clearance between the shot sleeve and the platen is too small, the platen will draw heat from the sleeve. Cold spots will develop in the sleeve, and it will contract. It may then interfere with the plunger tip and cause inconsistent shot velocity.

If the clearance between the shot sleeve and the die is too small, the expansion at the end of the sleeve will be constrained at the point where the expansion of the plunger tip is greatest. Interference is almost inevitable.

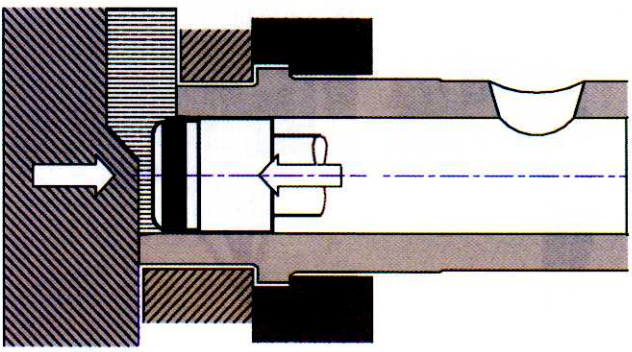
The amount of thermal expansion and contraction of shot end components is much greater than most die casters realize.

## 4. Gate Runner in the Shot Sleeve Instead of in the Die

If the gate runner is cut into the end of the sleeve, where expansion and contraction are greatest, even though the corners are radiused, cracks may develop here.

Also, if the biscuit is shorter than the gate runner, e.g. if the gate runner extends into the sleeve for 3" and the biscuit is only 1" thick, at the end of the injection stroke the metal has an opening to pass the face of the plunger tip. Worming will begin. For maximum performance, it is important that the biscuit extends back past the gate runner, and the front of the plunger never passes it.

This problem is easily avoided by putting the gate runner in the die instead of the shot sleeve. Many die casters, however, make little effort to properly manage the biscuit.



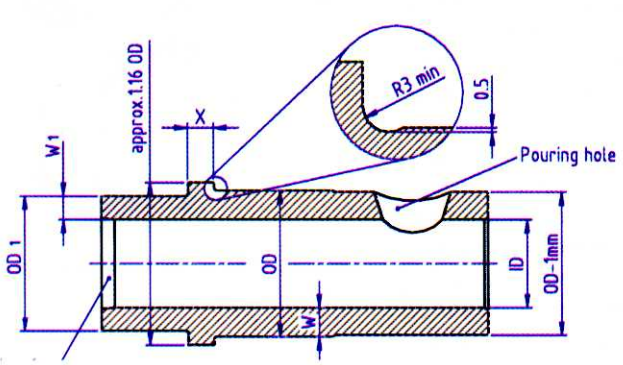
*Plunger can enter gate runner when in sleeve.*

## 5. Shot Sleeves Not Always Designed for Maximum Efficiency

Experience has proven that there are ideal dimensional ratios for shot sleeves that will allow maximum performance and operating life.

The ideal wall thickness is ⅓ of the ID of the shot sleeve. If the wall is too thin, hot spots will develop, and unequal expansion will cause ovality of the sleeve, and result in excessive wear by both the shot sleeve and the plunger tip. If the wall of the sleeve is too thick, however, the sleeve will retain too much heat and the entire sleeve will overheat. Excessive thermal expansion then may cause the gap between sleeve and plunger tip to increase too much and blowby will result.

The diameter of the pour hole should be no more than 70 percent of the ID of the sleeve. If the pour hole is too large, the shot sleeve will become deformed. Ovality will result.




*Recommended shot sleeve proportions.*

| Type | H1.5 | H2.5 | H3.0 | H3.5 | H4.0 |
|---|---|---|---|---|---|
| Plunger Diameter | 2.00 - 2.25 | 2.375 - 2.75 | 2.75 - 3.125 | 3.125 - 3.625 | 3.5 - 4.25 |
| GPM at Outlet | 2.00 - 2.75 | 2.75 - 3.50 | 3.50 - 4.00 | 3.50 - 4.00 | 4.00 - 5.00 |

| Type | H4.5 | H5.0 | H6.0 | H7.0 | H8.0 |
|---|---|---|---|---|---|
| Plunger Diameter | 4.375 - 5.00 | 5.25 - 6.00 | 5.75 - 6.50 | 6.50 - 7.50 | 7.375 - 7.875 |
| GPM at Outlet | 5.00 - 5.50 | 5.50 - 6.75 | 6.75 - 9.00 | 9.00 - 12.00 | 13.00 - 16.00 |

*Recommended water flow to stabilize plunger.*

## 6. Inadequate Cooling Allows Too Much Plunger Tip Expansion

Most plunger tips are cooled with water. Especially in larger machines, if the plunger tip is not adequately cooled, the crucial gap between the plunger tip and the shot sleeve can disappear. This problem can often be resolved by simply increasing the flow of water. A good flow of coolant through the shot rod is essential. The rate of flow of cooling water is easily measured, and should be monitored frequently. Rate of flow is more critical than the temperature of the cooling water.

Unless both plunger tip and shot sleeve are thermally, and therefore dimensionally stabilized throughout the stroke, the critical gap between them can no longer be maintained.

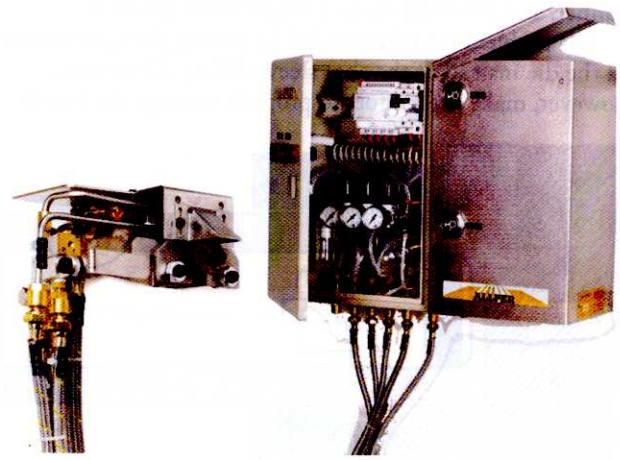
The casting machine should, of course, never be started unless the plunger tip coolant is adequate and flowing freely.

*Dimensionally stable plunger with effective cooling system.*

## 7. Improper Tip and Sleeve Lubrication

Effective lubrication of the shot sleeve is necessary for maximum production. Insufficient lubrication will result in inconsistent shot velocity, premature sleeve and plunger tip wear, and unnecessary scrap. An excessive amount of lubrication is often mistakenly used in an attempt to seal the gap between the plunger tip and the shot sleeve. This will increase porosity and scrap. The only valid purpose of lubrication in die casting is to reduce the friction between the tip and the sleeve.

For a short shot sleeve, 30" long or less, it is usually only necessary to apply lubrication to the front edge of the plunger tip. If the sleeve is more than 30" long, it is necessary to apply lubricant the complete length of sleeve. With a 50" sleeve, for example, if only the plunger tip is lubricated, the lubricant will never reach the die end of the sleeve.



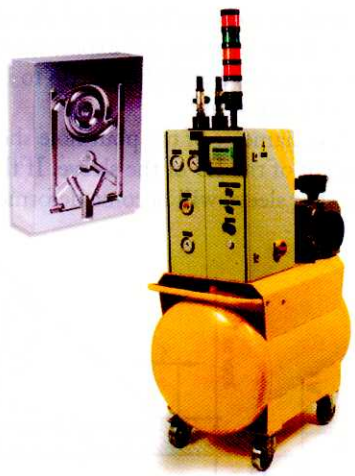
*Lube-spray system for longer shot sleeves*

## 8. Inadequate Venting

A major cause of scrap in die casting is porosity. Porosity in castings can often be minimized by the use of an effective vacuum system. Frequently, less clamping force is required when vacuum is used, and larger and thinner castings can be made by smaller machines.

Some die casters believe that venting alone is adequate, and vacuum is unnecessary. The reality is that with the level of quality now being demanded in today's market, to remain competitive the use of vacuum is often required.

Some die casters use vacuum systems that are no longer adequate for the level of quality required. They may be unaware of the level of performance that is now possible from a contemporary vacuum system. In the past few years, the average performance has risen considerably. For example, valve preventive maintenance is now often not required until after at least 25,000 shots.



*Typhoon runner (left) and multi-vac controller (right).*

## 9. Increased Pressure Masks Process Problems

Some problems in die casting production frequently appear to be solved simply by increasing shot cylinder tonnage. For example, if there is some restriction between the plunger tip and the shot sleeve that is causing the stroke to be inconsistent, it can often be overcome by increasing the shot pressure.

The problem, however, has not been resolved, it has merely been hidden by the increased pressure, and both plunger tip and shot sleeve are wearing unnecessarily.

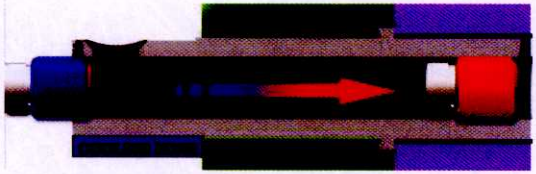
## 10. Plunger Tip and Shot Sleeve Considered Separately

One of the most critical interactions in the die casting production process is between the plunger tip and the shot sleeve. Unless each is working at close to maximum efficiency, the operating life of both will be compromised. The problem for the die caster is to maintain a gap of less than 0.004" between them.

During the shot, if the gap becomes much more than .004", the metal will likely penetrate the space. Flash or blowby will occur. The abrasiveness of the alloy will soon cause excessive wear on both sleeve and tip.

If the gap becomes close to disappearing, however, there is a danger of interference, and inconsistent shot velocity. This will, of course, result in scrap.

The gap must be constantly controlled. This can only be done by controlling the temperature, and therefore the expansion, of both the shot sleeve and the plunger



*Thermally aligned shot end system.*

tip. Since they interact so closely, they should always be considered together.

## Better Die Casting

Better die casting is not necessarily done by the die caster who invests the most money in new equipment, but by the one who makes the best use of existing equipment. In short, better die casting is done by better die casters... die casters who believe that their productivity and their profit can always be improved, and who are sincerely committed to ongoing improvement. Much of this opportunity for improvement can often be found in the shot end tooling, and by applying sound engineering principles to everyday operations.


### About the Author

*Paul Robbins is well known in the die casting community for his work with NADCA, also for a number of technical papers and articles advocating better die casting. He is general manager of Castool Tooling Systems, a leading supplier to the light metal die casting industry. To learn more about Castool, visit their website at www.castool.com*