Frank Altmayer, MSF, AESF Fellow
AESF Foundation Technical Education Director
Scientific Control Labs, Inc.
3158 Kolin Ave.
Chicago, IL 60623-4889
E-mail: faltmayer@sclweb.com

Die Casting & Plating – Part II

Dear Advice & Counsel,

I would like to be armed with some basic information as to what operational conditions in producing "castings" are related to defects that may cause plating related problems. Our company plates mostly onto aluminum die castings, and a small part of our work is made of cast iron. I know little about the relationship between casting quality and plating quality.

Signed,
Ms. Mucho Porus

Dear Ms. Porus,

Last month, with some assistance from "Metals Handbook" (American Society for Metals or ASM International), I provided a primer on casting technology. This month I would like to share some information on casting flaws and how to deal with them.

Casting flaws

Any casting flaws that effect the surface of the casting require that the polishing-buffing operation remove enough metal to eliminate the flaw (if possible). A normal casting has a relatively dense metal skin but is porous underneath this skin (Fig. 1). Aggressive polishing (called "cutting") to remove surface flaws often cuts through the dense metal layer and reveals surface pores. These pores are often not visible due to metal smears produced by the polishing/buffing operation. However, the cleaning and acid dipping in the plating line removes enough metal to open up these defects. Chemicals that are drawn into surface pores and fissures produce residues that are bridged by the plating. Temperature changes cause shear forces at these defective sites, producing adhesion failures that may be blisters or peeling of the plated deposit. Some plating operations utilize a heavy deposit of acid copper followed by buffing in an attempt to remove surface flaws. Any surface flaws that are large enough to see with the unaided eye are too large to "cure" this way.

Common die casting flaws include cold shuts (subsurface fissures), surface porosity, metal flow lines and heat checks (ridges in the casting produces by minor cracks around sharp corners). These flaws are related to the following casting conditions.

Gating system design

The gating system is a primary factor in the production of acceptable die castings. It includes runners, gate inlets, gates, vents and overflows which are designed to deliver a smooth, uniform flow of molten metal to the die cavity and allow for the air inside to escape efficiently. The optimum fill rate of the die cavity depends on the thickness of the casting, type of metal cast, metal temperature, die temperature and the geometry of the casting. Flow lines may be produced by poor condition of the die cavity, employing too much time between casting cycles or because gates are improperly located.

Die temperature

The correct die temperature for a specific casting is determined by the die section thicknesses and by the type of finish required. The dynamic temperature that the die reaches is a product of the temperature of the casting metal, the size of the shot, time between cycles, die cavity geometry and level of die cooling.

Die temperature is controlled by incorporation of heating and cooling devices. Temperature should be maintained within ±5°C. When the die temperature is too low, the overflows fail to fill and the castings may have excessive internal porosity, cold shuts and flow marks.

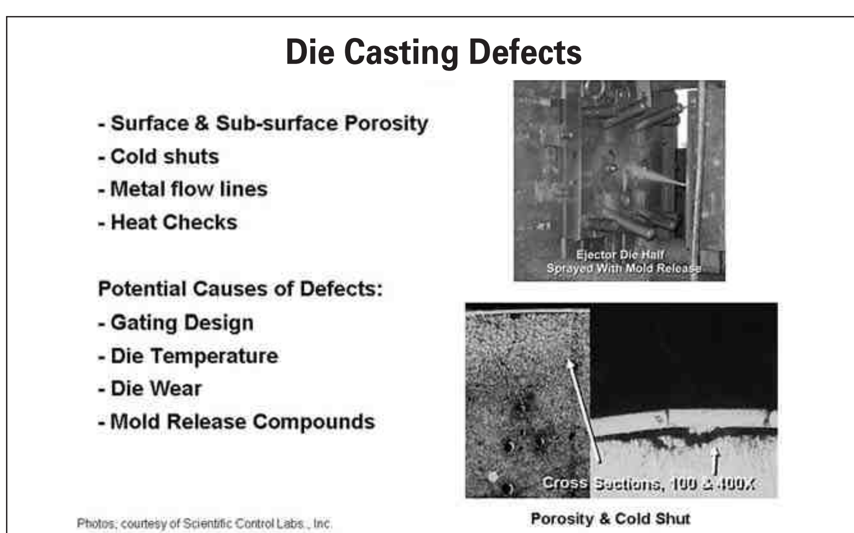

Figure 1—Die casting defects.

When the die temperature is too high, heat checking (small surface fissures in the surface of the die) may occur. Heat checks produce ridges in the casting which require aggressive polishing to remove, resulting in surface pores. Higher than necessary temperatures also shorten the number of shots that can be produced from a given die and can cause poor product ejection (hang-ups).

A raised fin pattern (heat checks) on the casting near the gate indicates the die surface is failing by thermal fatigue. The life of the die can be prolonged by polishing at the first sign of failure. Thermal fatigue can be delayed by suitable preheating of the die.

Shrinkage caused by hot spots may occur when sufficient cooling cannot be provided or cores cannot be built into the die, particularly in heavy sections.

Excessive die wear

Excessive die wear can be the result of casting high silicon content alloys, high die temperature, high temperature of the molten metal and the presence of sharp edges or corners in the die design. Worn dies produce castings with poor surface conditions, requiring more polishing.

Mold release compounds

Mold release agents prevent a casting from "sticking" to the die. They also assist metal to flow into narrow die cavities. Mold release agents must be chosen for the given operation as no one product works well for all die casting operations.

When the molten metal interacts with the release agent, most of it is thermally destroyed (carbonized), producing a solid residue that acts to lubricate the process. Typically, five to six shots of metal can be produced before the release agent must be reapplied, but if the release agent has a carbonizing temperature that is too low, it is essentially used up after each shot and may produce gases that yield porosity.

Mold release compounds incorporating silicones are notorious for causing adhesion problems in electroplating. These should never be used for casting parts destined to be plated. *P&SF*

Test Your Plating I.Q. #426

By Dr. James H. Lindsay

Laboratory equipment

1. What is a pipette and what is it used for?

2. What is a burette and what is it used for?

3. What is the **body** shape of a Florence flask?
   a) spherical b) conical c) cylindrical

4. What is the **body** shape of an Erlenmeyer flask?
   a) spherical b) conical c) cylindrical

5. What is the **body** shape of a Büchner flask?
   a) spherical b) conical c) cylindrical

6. Extra Credit
   What is the **body** shape of a graduate cylinder? !!!!

Answers on page 30.