

GETTING THE BEST OUT OF YOUR CRUCIBLE. MORGANMMS'S TOP TEN RECOMMENDATIONS.

By Mirco Pavoni, Technology Director, Morgan Molten Metal Systems.

Sometimes the difference between a crucible that consistently performs well and one that fails to meet even minimal standards may have nothing to do with the crucible itself. Rather, the performance difference may have everything to do with how the crucible is handled, operated and maintained at the foundry. For example, if some crucibles provide a long service life while other identical crucibles fail after a couple of heats, those premature failures typically are caused by operating conditions at the foundry. Often, following some basic operational procedures will eliminate early crucible failures. Here is a countdown list of the top ten ways to help you maximize your crucibles' service life.

Select a Tip from the list to go to our Recommendation.

1. Check your crucible for cracks and damage when received. Be sure to handle and store it properly.
2. Install your crucible according to the manufacturer's instructions.
3. Prevent thermal shock with proper preheating.
4. Never exceed the crucible's maximum temperature limits and never let metal freeze in the crucible.
5. Avoid physical damage by charging correctly and carefully.
6. Guard against chemical attack by minimizing flux usage and adding flux only after metal is fully molten.
7. Prevent oxidation of the crucible by insuring burners and seals are properly operating.
8. Control dross build-up by cleaning regularly.
9. Maintain a careful log of crucible use, inspect the crucible often and replace it when worn or damaged.
10. Select the right crucible for your operations and processes.

Check out our recommendations below to improve the life of your crucibles.

10. Check your crucible for cracks and damage when received. Be sure to handle and store it properly.

Crucibles are easily damaged by improper handling. When a new crucible arrives at your location, inspect it carefully for chips, cracks and abrasions and never put a damaged crucible into service. Also, in moving crucibles to a furnace or into storage, never roll them because this damages the protective glaze. And never stack crucibles one inside the other because they will crack. Finally, never sit them directly on a concrete surface because they will absorb water on the bottom.



Fig. 1 – Stacking crucibles, one inside the other, will damage the crucibles.

9. Install your crucible according to the manufacturer's instructions.

While installing a crucible is quick and easy, care must be taken to follow the instructions regarding base size, clearances between the crucible and the furnace and the initial preheating of the crucible. Too small a base may fail to provide sufficient support and the wrong base height in a fuel-fired furnace may cause the burner flame to create an overheated and oxidized area on the crucible. Insufficient clearances between the crucible and the furnace sides and top may cause cracking when the heated crucible expands. Also, insufficient initial heating may result in crucible failure on first use.

8. Prevent thermal shock with proper preheating.

While some types of crucibles are designed to resist damage from rapid heating, all crucibles require careful preheating if allowed to cool between melts. Thermal shock causes cracking in crucibles heated too quickly. Follow specified preheating recommendations.

7. Never exceed the crucible's maximum temperature limits and never let metal freeze in the crucible.

Every crucible has a maximum temperature limit. If you exceed that limit the crucible will be damaged and may fail. Keep close control of crucible temperatures. Allowing molten metal to solidify in the crucible also may damage the crucible when that metal is reheated for pouring.

6. Avoid physical damage by charging correctly and carefully.

Dropping a heavy casting or ingot into a furnace crucible may chip or crack the crucible leading to failure. Follow proper charging practice of first loading small charge materials and then care- fully lowering heavier materials on top of cushioning base. It also is important not to tightly pack charge materials into the furnace. When wedged material is heated, it expands and can crack the crucible.



Fig. 3 – Cone shaped fracture caused by the impact of charge materials dropped into the inside of the crucible.



Fig. 2 – Typical Y shaped crack.
This crucible cracked because the charge materials were packed so tightly that there was no space for their expansion when heated

5. Guard against chemical attack by minimizing flux usage and adding flux only after metal is fully molten.

All crucibles, even those designed to resist chemical attack, can be damaged flux additives. The most effective way to minimize this damage is to add flux only after the bath is fully molten and able to dilute the material. Adding flux with the solid charge allows the concentrated flux to attack the crucible surface during the melting process. It is also important to use the minimum amount of flux that is required.



Fig. 3 – Metal with a high flux concentration was allowed to overflow these crucibles, eating away the exterior surface.



Fig. 3a – Metal with a high flux concentration caused Corrosion of lower internal wall of this crucible

4. Prevent oxidation of the crucible by insuring burners and seals are properly operating.

In a fuel-fired furnace, operating the burner with excess air and direct flame impingement on the crucible surface will produce damaging oxidation of the crucible. In all furnaces, placing ceramic fibre between the crucible and its base or wedging ceramic fibre against the top edge of the crucible also will cause oxidation and cracking in those areas. Finally, allowing a metal bath to be held at a minimal temperature for a lengthy period of time will accelerate crucible oxidation.



Fig. 4 – Direct contact with a burner flame caused this oxidation damage. The base block holding the crucible was not the proper height

3. Control dross build-up by cleaning regularly.

Dross or slag build-up is bad in several ways. It has low thermal conductivity necessitating higher furnace temperatures. It absorbs flux and accelerates chemical attack on the crucible. And its high expansion rate causes internal pressure on the crucible that can damage it. Follow a consistent program of frequent and thorough dross and slag removal, using a scraping tool that matches the curve of the crucible's interior surface to avoid gouging.



Fig. 5 – Dross accumulation in this crucible caused the crucible to fail because of expansion cracking

2. Maintain a careful log of crucible use, inspect the crucible often and replace it when worn or damaged.

Keeping an accurate log of crucible use is essential to the effective and safe operation of crucibles. It enables you to create a history that will reveal what crucible service life you should anticipate in normal operations. With this information, you can set up a program of routine crucible replacement that will minimize downtime. However, such a program is not a substitute for frequent crucible inspections that may reveal wear or damage that requires immediate crucible replacement.

1. Select the right crucible for your operations and processes.

Selecting the right tool for the job is essential for most tasks and crucibles are no exception. The most important way to maximize crucible service life is to begin by selecting the right crucible match for your application. You must consider the full range of metals and alloys you melt or hold, the type and size of the melting or holding furnace you use, the temperature ranges the crucible will experience, the rate of temperature change the crucible must sustain, the fluxes or additives to be used, your operating schedule, how the crucible will be charged and emptied, how the crucible will be handled and how it will be maintained. With this information in hand, talk with your crucible supplier for his or her recommendations. New crucible types with enhanced performance characteristics are becoming available at increasingly frequent intervals and your crucible supplier will be able to keep you up to date with this information.