



### Introduction

These guidelines are provided based on Dyson's wealth of experience in supplying zirconia crucibles to numerous industrial sectors. The following information is not intended to be used as a set of rules that must be obeyed, but as guidelines based on how our customers have used our products in the past. Feedback on this document will be well received as it will only help increase our knowledge base, provide a better service and ultimately help Dyson adapt our crucibles to suit the casting processes of more of our customers.

### Recommended Sizes

Crucibles must be supported during melting cycles. Therefore it is imperative that the correct size crucible is chosen.

- There must be an appropriate gap between the coil and the outside of the crucible. This is to allow the installation of backing material to correctly support the crucible
- The inside base of the crucible should not be placed below the coil
- The top of the crucible should protrude out of the furnace body, as little as possible to minimise thermal shock
- There should be a minimum of 25mm (1") between the base of the furnace and the bottom of the crucible.

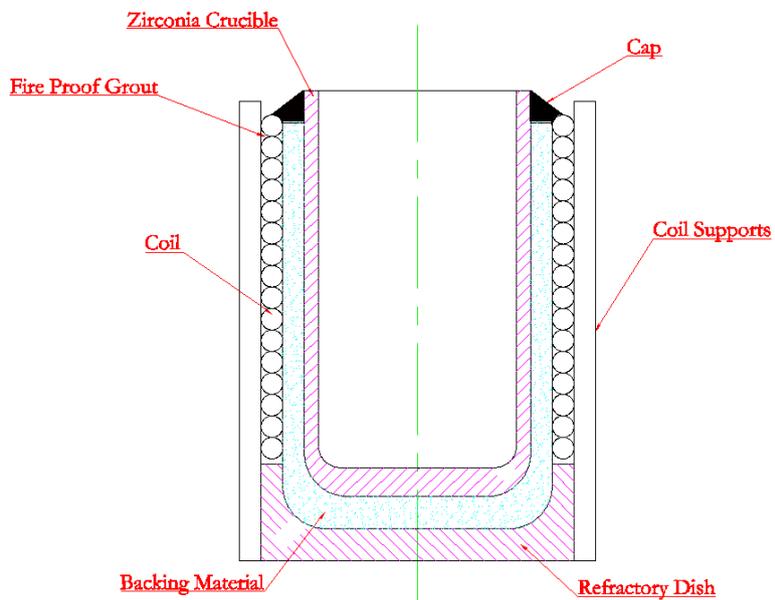
### Backing/Ramming of the Crucible

It is imperative that an appropriate and compatible backing material is used with your crucible. Dyson highly recommend using a Dyson Dypack backing material. Around the sides of the crucible there should be a minimum of 12mm (1/2") ramming material used for small crucibles and up to 50mm (2") for larger crucibles. A minimum of 25mm (1"), when packed should be used between the base of the crucible and the bottom of the furnace.

When ramming, a vibration tool or a ramming rod can be used. However the appropriate size rod must be used and care must be taken not to strike the crucible, when ramming.

### Installation of a Dyson crucible

- 1 To avoid any cracking on heat up, the crucible needs to be completely dry prior to installation. To achieve this, the crucible should be dried inside a drying oven for a minimum of 24 hours.
- 2 Check the coil and coil grout for damage. If there is damage to the grout then this must be repaired prior to the installation of the crucible. In addition the refractory base of the furnace must also be inspected for damage and must be capable of holding the crucible, backing material and the charge at temperature.
- 3 Check the crucible for any damage or defects.
- 4 Fill the bottom of the furnace to allow enough backing material to raise the crucible to the desired level. A good technique (especially for round bottom crucibles) is to rotate the crucible to ensure the backing material is properly packed. If the crucible sits too low add more backing material. If you are using a crucible with a round base, add more backing material to ensure an adequate amount of backing material surrounds the base.
- 5 Now add backing material between the outside wall of the crucible and the inside wall of the coil lining. A jig may be used to ensure the crucible is centred during this process. The backing material should be added in small increments and the material should be packed with a blunt ramming tool or a vibrating device, while this process is taking place. The backing material should reach a level of 12.5mm (1/2") below the top of the furnace box.
- 6 Ensure the backing material is evenly packed around the entire crucible.
- 7 Fill the remaining space between the top of the backing material and the top of the crucible with high temperature ceramic fibre or wool. Apply a seal ring on top of the ceramic fibre, if needed.
- 8 The inside of the crucible should now be cleaned with compressed air or a vacuum cleaner.



BASLOW ROAD, TOTLEY, SHEFFIELD. S17 3BL. UNITED KINGDOM  
 TEL: +44 (0) 114 2356060 FAX: +44 (0) 114 2356010

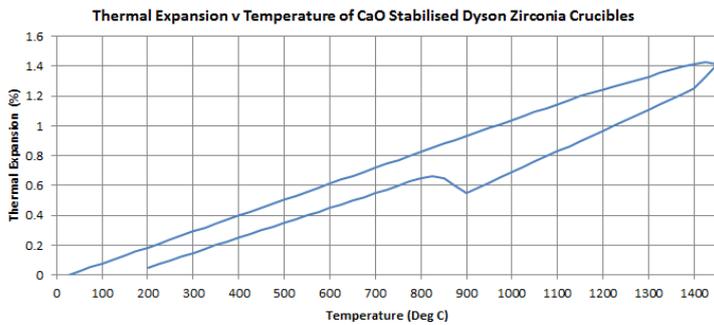
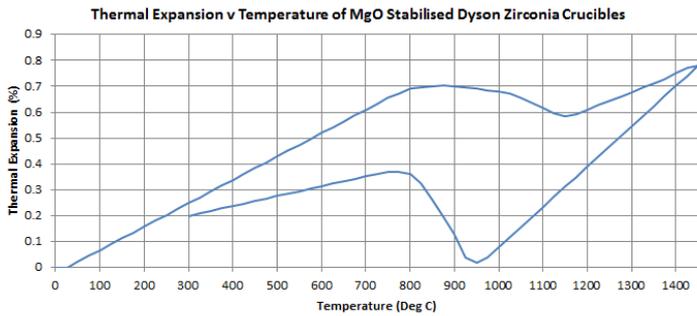
EMAIL: [enq@dysontc.com](mailto:enq@dysontc.com) WEB: [www.dysontc.com](http://www.dysontc.com)



A correctly rammed crucible will ensure the crucible is adequately supported in compression and stays in place throughout the melting process. This will ensure that the melt will not leak through into the crucible lining should a minor crack occur.

*Please note: These are guidelines for crucible installation and should not be considered as definitive instructions. It is envisaged that your own techniques will develop from these guidelines and Dyson appreciates all feedback received in order to improve upon these guidelines.*

## Thermal Expansion Graphs of Dyson's Crucible Materials



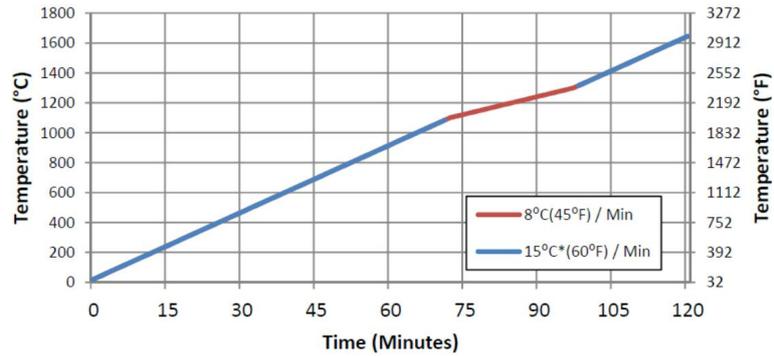
## Heat up Cycle and Thermal Expansion Considerations

To avoid problems associated with thermal expansion during heating, along with problems relating to dimensional hysteresis upon cooling, Dyson provides the following heating recommendations:

- Do not rapidly heat the crucible from room temperature. An acceptable heating rate is approximately 15°C (60°F)/minute up to a temperature of 1100°C (2010°F).
- Between 1100°C and 1300°C (2010°F and 2370°F) we recommend a slower heating rate of 8°C (45°F)/minute.
- Once the temperature of the crucible reaches 1300°C (2370°F), every effort should be made to prevent the crucible from cooling below this point.
- Above 1300°C (2370°F) the crucible can be heated up at approximately 15°C (60°F)/minute.

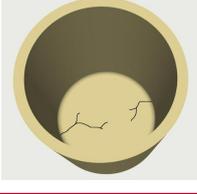
Dyson Technical Ceramics recommends against practices that involve cooling the crucible to room temperature between melts. If an extended period of time between these melts is unavoidable it is recommended that a system of maintaining temperature is used to avoid excessive thermal stress.

## DysonTC Zirconia Crucibles - Recommended Heat-up Cycle



## Troubleshooting

Dyson's crucibles are designed to be very resilient to all casting environments. However despite this, problems may still occur that can easily be resolved. Below is a list of crucible failures and the potential causes.

| Types of Crucible Failure   | Potential Causes of Failure  |
|---|--|
| <b>Horizontal Cracks</b><br>                             | <ul style="list-style-type: none"> <li>Insufficient amount of backing material near the area of the crack</li> <li>Rapid heating during preheat of the crucible</li> <li>The crucible is not heated/cooled equally throughout the crucible</li> </ul>  |
| <b>Vertical Cracks</b><br>                              | <ul style="list-style-type: none"> <li>Insufficient amount/no insulation near the top of the crucible</li> <li>Lack of backing material</li> <li>Unsuitable quality of backing material</li> <li>Excessive thermal cycling</li> </ul>  |
| <b>Large "spalls" on the inside of the crucible</b><br> | <ul style="list-style-type: none"> <li>The charge striking the crucible during heating</li> <li>Extreme cases of thermal shock</li> </ul>  |
| <b>Cracking in the bottom of the crucibles</b><br>      | <ul style="list-style-type: none"> <li>The crucible is allowed to cool excessively between pours</li> <li>Incorrect/in-adequate amount of backing material</li> <li>The charge striking the crucible bottom during heating</li> <li>The bottom of the crucible is lacking adequate support at temperature</li> </ul> |



BASLOW ROAD, TOTLEY, SHEFFIELD. S17 3BL. UNITED KINGDOM  
 TEL: +44 (0) 114 2356060 FAX: +44 (0) 114 2356010

EMAIL: [enq@dysontc.com](mailto:enq@dysontc.com) WEB: [www.dysontc.com](http://www.dysontc.com)

