



FMF-OM-922 Coating Molds and Crucibles

November 1986

Changing the World's Energy Future

C.W. Wilkes



INL is a U.S. Department of Energy National Laboratory operated by Battelle Energy Alliance, LLC

DISCLAIMER

This information was prepared as an account of work sponsored by an agency of the U.S. Government. Neither the U.S. Government nor any agency thereof, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness, of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. References herein to any specific commercial product, process, or service by trade name, trade mark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. Government or any agency thereof.

FMF-OM-922 Coating Molds and Crucibles

C.W. Wilkes

November 1986

**Idaho National Laboratory
Idaho Falls, Idaho 83415**

<http://www.inl.gov>

**Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517**

EBR-II FUEL MANUFACTURING FACILITY OPERATIONS MANUAL

REVIEW AND APPROVAL

REV. BUL. NO. 769 DATE 11/14/86

SECTION FMF-OM-922

TITLE COATING MOLDS & CRUCIBLES

REVIEW

mcj 11-18-86
11-19-86
SIGNATURE *D. F. Gallagher* *see notes* DATE *11/19/86*
QUALITY ENGINEER/QQA
SIGNATURE *C. E. Holton* *see note p. 2* DATE *12/23/86*
RADIATION, FIRE AND SAFETY ENGINEERING

APPROVAL

SIGNATURE *Robert L. P. P.* DATE *12-17-86*
EBR-II DIVISION QUALITY ENGINEER
SIGNATURE *Donald J. Briggs* DATE *1-8-86*
SUPERVISOR
SIGNATURE *W. Wickes* DATE *1-9-86*
FABRICATION DEVELOPMENT MANAGER
SIGNATURE *D. B. Tracy* *for K. J. Longue* DATE *1/13-87*
FUEL MANUFACTURING MANAGER

CONTENTS

	<u>Page</u>
1. INTRODUCTION	2
2. EQUIPMENT AND MATERIALS	2
3. COATING GRAPHITE CRUCIBLES	2
4. COATING MOLDS	3

1. INTRODUCTION

Graphite crucibles are coated with an inert material, such as yttrium oxide (Y_2O_3) paint, to prevent the molten uranium alloy from reacting destructively with them.

The molds used for injection casting are either Vycor or quartz glass. Because silica is reduced by uranium alloy, the molds are protected by an inert material that is not wetted by the molten uranium. The coating is zirconium oxide or yttrium oxide mixed with ethyl alcohol or water. The internal surface is swabbed with a pipe cleaner attached to a rigid tube. The bottom 2 in. of the outside of the molds is painted with the coating.

2. EQUIPMENT AND MATERIALS

2.1 Crucibles

Four sizes of crucibles may be used, standard 10 Kg or 17 Kg and oversize 10 Kg or 17 Kg. The oversize crucibles are larger in diameter and used to remelt a solidified charge which would fit too tightly in a standard crucible.

2.2 Drying Oven

The drying oven is a standard commercial product. It is used to dry molds and crucibles after they are coated.

3. COATING GRAPHITE CRUCIBLES

3.1 Precautions

3.1.1 Follow the FMF Emergency Procedures.

3.1.2 Protective clothing shall be worn while coating crucibles (lab coat, gloves, safety glasses, and when needed, high temperature gloves).

3.2 Lay yellow plastic on the work table and coat the crucibles on the plastic.

3.3 If the crucible has been used for a melt, ensure all of the uranium has been removed. (Uranium is removed with the crucible in a hood.)

3.4 Wipe the crucibles with a clean cloth wetted with ethyl alcohol to remove dust or oxide. (If the crucible is contaminated with uranium dust, this step must be performed in a hood.)

3.5 Place the crucibles in the drying oven and heat to 100°C.

CAUTION: When the crucibles are removed from the oven, high temperature gloves must be worn.

3.6 Remove the crucibles from the drying oven and place them on the work table.

3.7 Put thermocouple wells in place.

3.8 Using a paint brush, apply Y_2O_3 coating evenly to the inside and outside of the crucibles and thermocouple wells.

3.9 Place the crucibles in the drying oven at 150°C for one hour.

3.10 Repeat step 3.8.

3.11 Place the crucibles in the drying oven at 500°C for two hours. After heating the crucibles are stored in the oven.

3.12 Store the unused Y_2O_3 solution in a tightly stoppered bottle.

3.13 Dispose of any alcohol and cloths used for cleaning the crucibles.

3.14 Update the crucible inventory.

4. COATING MOLDS

4.1 Precautions

4.1.1 Follow the FMF Emergency Procedures.

4.1.2 Protective clothing shall be worn while coating molds (lab coat, safety glasses, and gloves).

4.2 Obtain the required molds from storage and update the inventory.

4.3 Inspect each mold for badly chipped or broken ends, cracks, and internal and external contamination.

4.4 Make swabs for coating the insides of the molds as follows:

4.4.1 Insert a 4 in. section of 4 mm pipe cleaner about 2 in. into a 24 in. x 1/8 in. stainless steel tube.

4.4.2 Crimp the tube as close to the end as possible with a crimping tool.

NOTE: Both ends of the tube can be used.

4.5 If ZrO_2 is to be used mix the ZrO_2 (1 to 4 micron) solution in a 4000 ml beaker until consistent. The Y_2O_3 is premixed with ethyl alcohol.

4.5.1 Use 520 g of zirconium oxide.

4.5.2 Use 750 ml of ethyl alcohol.

4.6 Wet the swab in the ZrO_2 or Y_2O_3 solution and insert it to end of the mold.

4.7 Rotate the mold to coat the end.

4.8 Withdraw the swab without rotation so a straight line coating of the inner surface is achieved.

4.9 Inspect the mold for any uncoated areas. Repeat steps 4.6 through 4.8, if necessary.

4.10 Coat the outside of the mold by painting the bottom 2 in. with ZrO_2 or Y_2O_3 solution.

4.11 Lay the mold in a clean plastic pan.

4.12 Repeat steps 4.6 through 4.11 for all the molds.

4.13 Place the molds in the rack in the drying oven and bake at $150^{\circ}C$ for a minimum of 12 hours.

4.14 Save the used swabs and excess ZrO_2 or Y_2O_3 solution in plastic bottles for later use.