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NATIONAL RESEARCH CORPORATION  
70 Memorial Drive  
Cambridge 42, Massachusetts

MA.10

July 23, 1948

326-68A-588

Box #100

Folder # 42

Mallinckrodt Chem.

Company NCR 1948-1949

Dr. Charles D. Harrington  
Mallinckrodt Chemical Works  
Second and Mallinckrodt Streets  
St. Louis 7, Missouri

Dear Dr. Harrington:

During your visit to National Research Corporation on July 16, 1948, you requested that we submit a proposal for preparing 12 ingots of x-metal to be used in the study of casting techniques. We propose the following program:

Purpose of Work

Twelve 25-pound ingots are to be prepared by vacuum melting and casting of charge material supplied by Mallinckrodt Chemical Works for the purpose of determining the effects of variation in operating pressure on yield, purity, and certain properties. In addition to the ingots, National Research will deliver all scrap and remnants along with a material balance and will furnish metallographic and gas analysis data.

Apparatus to Be Used

National Research will modify an existing research vacuum melting furnace with respect to pumping and gauging systems, mechanical handling assemblies, and mold. In order that any question as to quality of the refractories may be eliminated, Mallinckrodt Chemical Works will furnish a crucible, stopper rod, pouring tube, and mold of the required dimensions.

Experimental Technique

The main purpose in this work has been stated to be the determination of the effect of pressure on the product. Every effort will be taken, therefore, to fix the temperature and time of soak for all melts. Since there is a secondary question as to the effect

of pressure on charge material of varying initial quality, the derby sections to be used for melt charges will be selected with such an evaluation in mind. Three melts are to be made at each of four pressures. If a single charge consists of a quarter section of a derby, then a single derby will furnish melts at all four pressures. Two more derbies will be similarly used as charge components at four different pressures. If these three derbies are selected by Mallinckrodt Chemical Works as representative of quality variation, the most complete use of data will appear to have been made.

Each melt will be made in accordance with established practice as to temperature and soak, with the pressure during the molten phase to be varied by means of a controlled rate of leak in the furnace tank above the melt. The four pressures are to be uniformly spaced between the lowest consistently attainable pressure and 100 microns. The melts will be poured into a 2 inch diameter graphite ingot mold to be cooled at the bottom and insulated at the top. Allowance has been made in estimating costs for a reasonable number of exploratory and unsuccessful melts.

A complete material balance will be maintained for each charge. It will include all scrap in any form, including residue and cutting scrap. The different forms of scrap are to be stored in separate containers.

#### Data to Be Reported

National Research Corporation will furnish complete melt data, to include temperature and pressure curves.

Each ingot will be cut according to the sketch made by Dr. Harrington and Mr. Oppold, with observance of standard cutting practice for the material. From the slices thus taken, samples will be taken for metallographic examination and vacuum fusion gas analysis for oxygen, nitrogen, hydrogen, and carbon. Metallographic and analytical reports will be made.

The remaining ingots, together with all forms of scrap, will be delivered to Mallinckrodt Chemical Works for final testing.

Cost of Work

For undertaking this work and supplying ingots and technical information as described above, we have determined a price of \$450 per ingot on the following basis:

Materials and Equipment Modification	\$1,650
Labor, to include the services of a furnace operator, metallurgist, metallographer, and analyst.	1,500
Overhead at 150% of Labor	<u>2,250</u>
Total for 12 Satisfactory Ingots	\$5,400

We are eager to assist you by undertaking this work and shall look forward to receiving your order.

Very truly yours,

NATIONAL RESEARCH CORPORATION

Sgd.  
Robert A. Stauffer  
Assistant Director of Research

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