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LUCAS HEIGHTS RESEARCH LABORATORIES

OPERATING PROCEDURES FOR THE MANUFACTURE OF RADIOACTIVE SYNROC IN THE ACTINIDE LABORATORY

by

K.F. WESTERN

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ABSTRACT

The purpose of this manual is to acquaint the operator with the procedures required to manufacture SYNROC-containing radioactive materials in the SYNROC actinide laboratory, Building 56, Lucas Heights Research Laboratories. The actinide-doped SYNROC production facility is a series of four interconnected glove boxes and one free-standing glove box located in Building 56. The samples of radioactive SYNROC produced in the actinide laboratory are used to carry out physical testing of the product at various laboratories on site, e.g. leach testing, auto-radiographic examination, electron-microscopic examination, atomic absorption spectrophotometry and analysis.

CONTENTS

PART I
OPERATING PROCEDURES

PART II
PLANT AND EQUIPMENT

PART I

OPERATING PROCEDURES

1. INTRODUCTION

The actinide-doped SYNROC production facility is a series of four interconnected glove boxes and one free-standing glove box located at Lucas Heights Research Laboratories in Building 56 (see figures 1 and 2). Stores requirements and replacement parts and suppliers are listed in Appendices A and B. Plant and equipment numbers issued under NERDDC Grant 25 are listed in Appendix C. Operating procedures are set out in Part I and essential plant and equipment are described in Part II.

2. PROCESS DESCRIPTION

2.1 Glove Box 1

The actinides (radionuclides) are removed from their shipping containers and incorporated into a nitrate solution. A specific quantity of this solution is then combined with the prepared Sandia slurry to which has been added a solution of chemicals which simulates the chemical makeup of the radioactive components of nuclear waste. The resulting slurry is then transferred to glove box 2.

2.2 Glove Box 2

The slurry is pumped into a flash drier where the free water is removed. The resulting product is a friable porous substance which is readily crushed into a powder. This powder is then placed into a calcining vessel and heated in a reducing atmosphere to a temperature at which calcination of the powder takes place. Upon completion of calcination, the powder is removed and transferred to glove box 3.

2.3 Glove Box 3

The powder is weighed to determine the gross product weight and the titanium powder inclusion percentage calculated. After the titanium powder has been added, the product is blended in a mechanical 'Y' blender, before loading into the press for hot pressing. When hot pressing is completed, the sample is removed and reweighed to ascertain the final product weight and to determine the losses, if any, during production operations. The sample is then transferred to glove box 4.

2.4 Glove Box 4

The sample has a number of cores drilled from it. These cores are then mounted in a rotating sample holder and sawn to produce slices of predetermined thickness. These slices, after ultrasonic cleaning, are removed from the glove boxes in which they were produced and placed into the free standing glove box 5.

2.5 Glove Box 5

The density of the sample is determined and the physical dimensions (diameter and thickness) recorded.

The samples are now ready for leach testing under MCC-12 guidelines and any other tests that might be required at locations other than the actinide laboratory.

BEFORE STARTING WORK INSIDE THE GLOVE BOX, MAKE READY ALL MATERIAL AND EQUIPMENT REQUIRED TO UNDERTAKE THE OPERATION PLANNED TO ENSURE THAT TRANSFERS INTO THE GLOVE BOXES ARE KEPT TO A MINIMUM

-**-

DO NOT OPEN BOTH DOORS OF THE TRANSFER PORT AT THE SAME TIME.

-**-

DO NOT MOVE VESSELS OF LIQUID AROUND THE GLOVE BOX WITH THEIR CAPS REMOVED.

-**-

CLEAN UP ALL SPILLS IMMEDIATELY

-**-

ON COMPLETION OF ANY OPERATION IN THE GLOVE BOX, A CLEANUP MUST BE UNDERTAKEN TO ENSURE GOOD HOUSEKEEPING.

OPERATING PROCEDURES
GLOVE BOX 1
DISSOLUTION AND SLURRY PREPARATION

3. GLOVE BOX 1: DISSOLUTION AND SLURRY PREPARATION

3.1 Introduction

As this glove box 1 contains radioactive solutions, extreme care must be taken to prevent its contamination.

3.2 EQUIPMENT Located in Glove Box

[1] Three-jaw chuck (for holding radionuclide shipping container while it is being cut open).

[2] Pipe cutters (for cutting open radionuclide shipping container).

[3] Hot plate (for use during dissolution of radionuclide).

[4] Magnetic stirrer with separating funnels (see figure 3).

[5] A pH meter (to monitor pH of slurry during addition of radionuclide).

[6] Squeeze bottle (for demineralised water).

3.3 MATERIAL for Transfer into Box Before Operation

[1] Plastic bag of Sandia slurry. (The weight of the slurry is determined by ignition loss of moisture from the attrited material supplied.)

[2] Radwaste solutions prepared in plastic bottle(s).

[3] Neutralising solution in a 50 mL bottle.

[4] Facial tissues and disposable lint-free towels (if required).

[5] Check the condition of the magnetic stirring rod and replace if necessary.

[6] Top up demineralised water wash bottle in glove boxes.

3.4 TOPPING UP Wash Bottle with Demineralised Water

[1] Fill the plastic transfer vessel with demineralised water.

[2] Position the wash bottle under the water outlet in glove box.

[3] Fit self-sealing 'quik-connect' coupling into the green labelled bulkhead fitting attached to end of glove box 1 adjacent to glove box 2.

[4] Remove the cap from the top of the transfer vessel and open the stop cock to allow transfer of water from vessel into glove box.

3.5 TRANSFER of Materials and Equipment into Glove Box

[1] Ensure that the filter valve on transfer port is closed.

[2] Open the outer door of the transfer port and place into the port all the items to be transferred into the glove box.

[3] Close and seal the outer door of the transfer port and open the filter valve.

[4] Open the inner door and remove all the items from the port.

[5] Close and seal the inner door.

3.6 PREPARATION of pH Meter

Before use in slurry preparation, the pH meter must be checked for stability.

[1] Remove the pH probe from its storage solution and wash with demineralised water.

[2] Place the probe into the buffer test solution and adjust the pH meter if necessary.

[3] Withdraw the probe from the buffer solution and wash with demineralised water.

[4] After use, rinse the probe with demineralised water and return it to the storage solution.

3.7 SLURRY Preparation

The radionuclide could be added at various stages during this process, as specified in the log sheet.

[1] Load the neutralising solution into the separating funnel marked 'N.S.'

[2] Load the radwaste solution into the separating funnel marked 'R.W.' This radwaste composition will be as specified on the log sheet for the experiment and may contain the radionuclide.

[3] Place the mixing beaker on the magnetic stirrer with the stirring bar in position.

[4] Fit the plastic bag containing the Sandia slurry into the squeeze rollers. Clamp the rollers onto the unused section of the bag.

[5] Holding the pointed end of the bag to the top, carefully cut off the tip of the bag with a pair of scissors.

[6] Place the cut end of the bag into the beaker, taking care not to spill any of the slurry outside the beaker.

[7] Turn the rollers to expel the slurry into the beaker. Care must be taken not to turn the rollers too quickly, as the end of the bag has a tendency to flick.

[8] Adjust the speed of magnetic stirrer until a strong vortex is evident.

[9] Add the radwaste to the slurry at a very slow rate, maintaining the pH of the slurry at the level specified on the log sheet by the addition of neutralising solution.

[10] After all additions have been completed, allow the slurry to stir until the pH has stabilised.

> NOTE
>
> THE RADIONUCLIDES MAY BE ADDED BEFORE, AS PART OF THE RADWASTE, OR AFTER THIS STAGE

OPERATING PROCEDURES
GLOVE BOX 2
FLASH DRYING AND CALCINATION

4. GLOVE BOX 2: FLASH DRYING AND CALCINATION

4.1 Introduction

As this glove box contains equipment which operates at high temperatures and has rotating components (belts, furnace barrel, etc.), extreme care must be taken to prevent a glove from being damaged by contact with hot equipment and/or rotating parts. (See figure 4 for equipment locations and figure 5 for services.)

4.2 EQUIPMENT Located in Glove Box

[1] Magnetic stirrer (for stirring the slurry while it is being pumped into the flash drier).

[2] Peristaltic pump (for pumping slurry into flash drier).

[3] Flash drying vessel (see figure 6).

[4] Heating element (for heating flash drier - see figure 7).

[5] Vibrating vessel holder (electrically powered).

[6] Calcining vessel (see figure 8).

[7] Rotary furnace (for calcining - see figure 9).

[8] Surgical torch (to ascertain whether the calcining vessel is empty).

[9] Condensate catch tank (flash drier).

[10] Condensate catch tank (rotary furnace).

[11] Condenser (attached to the flash drier).

[12] Absolute filter (attached to the vacuum system).

[13] Liquid waste removal hose.

4.3 PRESTART Checklist

[1] Top up the demineralised water wash bottle in glove box (see section 3.4).

[2] Check that the H_2/N_2 gas bottle has sufficient gas to undertake the complete operation.

[3] Check that the thermocouple is in place and not likely to make contact with the wall of the vessel.

[4] Check that the flash drying vessel is clean and in place.

[5] Check that the condensate catch tank (flash drier) is empty.

[6] Check that the off-gas bubbler is full to indicator mark.

[7] Check that the flash drying system is sealed. The gas bubbler attached to the off-gas line should bubble when the gas flowmeter reads 15-20 on the scale. If leaks are apparent, as shown by the lack of bubbles in the bubbler, check the seal and all joints.

[8] Check that the pump supply line to the flash drier is not blocked. (Check by running the pump in reverse and observing air bubbles in the slurry.)

[9] Check that the water chiller is turned on and working.

[10] Check that the water chiller supply valve to and return valve from glove box 2 are open.

[11] Check that the gas flow meter to flash drier has been set at 100 mL/min (see table 1).

[12] Check that the heat shield is in place over flash drier.

4.4 FLASH Drying

[1] Transfer the beaker containing the slurry from glove box 1 and place it on the magnetic stirrer with the pump pickup pipe in position.

[2] Close and seal the transfer port.

[3] Set the speed control on the magnetic mixer to approximately 4. This setting will have to be adjusted during the operation, as the level of the slurry drops, to prevent the slurry from splashing out of the beaker.

[4] Turn on the switch for the plug marked 'mixer' located on the Kambrook switch board inside glove box 2.

[5] Place the glove port bung in position in the glove port in front of the flash drier.

[6] Turn on switch 2 on the outer front face of glove box 2. This supplies power to the Kambrook switch board (see figure 10).

[7] Place the heat shield in position over the flash drier.

[8] Withdraw hands from gloves and ensure that the gloves are not in contact with any equipment inside the glove box.

[9] Set the temperature controller located on the front of the glove box to the temperature specified on the log sheet.

[10] Turn on switch 3 on the outer front face of glove box 2. This activates the heating element.

[11] Monitor the vessel temperature reading.

[12] When the vessel temperature has reached approximately 620°C, start the pump and set the pump rate at 2-. This results in a pump flowrate of 100 mL in approximately 15 minutes.

[13] As the slurry level drops, reset the magnetic stirrer rate to prevent splashing.

NOTE

IF THE TEMPERATURE SUDDENLY DROPS BELOW 500°C, THE PUMP RATE IS TOO HIGH. REDUCE THE PUMP RATE AND ALLOW THE TEMPERATURE TO RISE ABOVE 550°C BEFORE RESETTING THE PUMP RATE TO JUST BELOW THE INITIAL SETTING.

[14] On completion of pumping, wash demineralised water through the beaker and pump line until the pump line is clean. Stop the pump and reverse the pump direction to draw water back into the pump head.

[15] Reduce the control setting to the bake temperature specified on the log sheet and monitor for one (1) hour.

[16] After one (1) hour at the bake temperature, turn off the power to the heating element, using switch 3 on the front face of the glove box, and reduce the control setting to 0000°C.

[17] Monitor the temperature periodically by turning on power switch 3 on the front face of the glove box.

[18] Switch off power switch 3 on the front face of the glove box on completion of each monitoring action.

[19] During cooling, the associated procedures must be carried out at the following temperatures:

300°C Lower the heating element from around the flash drying vessel.

150°C Turn off the water chiller.

100°C Turn off the H_2/N_2 gas supply bottle.

[20] Allow the flash-drying vessel to cool before removing the vessel from the flash-drying rig.

4.5 CALCINATION

[1] Remove the flash-drying vessel from the flash-drying rig by positioning the vibrating vessel holder under the flash-drying vessel and raising it until the vessel holder and vessel make contact. Tighten the vessel clamp before releasing the toggle clamps on the flash drier.

[2] Break up the friable product using the hammer-like tool provided.

[3] Place the cork stopper into the flat end of the calcining vessel.

[4] Place the funnel into the conical end of the calcining vessel.

[5] Turn on switch 2, on the outer front face of glove box 2.

[6] Turn on the switch for the plug marked 'vibrator' on the Kambrook switch board inside glove box 2, and empty the flash-drying vessel into the calcining vessel. Ensure that all of the product is transferred into the calcining vessel.

[7] Place the calcining vessel on the floor of the glove box and roll back and forth a number of times. This will distribute the product evenly along the length of the vessel.

[8] REMOVE the cork stopper from the end of the calcining vessel and place in the cork storage container.

[9] Remove the end cap from the rotary furnace and place the calcining vessel, conical end first, into the rotary furnace. Place the heat shields into the rotary furnace and replace the end cap.

[10] CHECK that the stopper cork is in the storage container.

[11] Turn on the H_2/N_2 purge gas supply bottle.

[12] Set the purge gas flow-meter to 800 mL/min (see table 1).

[13] Turn the furnace purge gas inlet valve off.

[14] Turn on vacuum pump.

[15] Turn the three-way purge gas inlet valve slowly to the vacuum position.

[16] Evacuate the rotary furnace for 20 minutes.

[17] Turn off the vacuum pump and slowly release the vacuum in the rotary furnace by filling the rotary furnace with purge gas using the three-way purge inlet valve.

[18] Shut off the purge gas when the pressure has normalised.

[19] Turn on the switch for the plug marked 'drive' on the Kambrook switch board inside glove box 2.

[20] Repeat steps [14] to [18].

[21] Open the three-way valve to exhaust when the pressure has normalised and check flowrate is 800 mL/min.

[22] Set the temperature controller located on the front face of the glove box to the temperature specified on the log sheet for calcination.

[23] Switch the controller to manual and set the heating rate to 60%.

[24] Monitor the temperature indicator and at 600°C switch the controller to automatic. This should be approximately two (2) hours and 15 minutes after the power is turned on.

[25] Maintain the temperature for 90 minutes after the specified temperature has been reached. At the completion of this time cycle, change the controller setting to 0000°C and set the manual heating rate to 00%.

[26] Monitor the temperature drop periodically until 300°C is reached. At this temperature, reduce the purge gas flow rate to 300 mL/min.

[27] Shut down the water chiller when the temperature reaches 100°C.

[28] Turn off the gas supply bottle.

[29] Turn off the power to the rotary drive.

[30] Remove the calcining vessel from the rotary furnace and place in the vessel holder.

[31] Tare the blender body in glove box 3 and transfer it into glove box 2, ensuring the transfer port doors are then closed and sealed.

[32] Remove the cap from the blender body and fit the funnel into the blender body.

[33] Fit the funnel over the calcining vessel with the blender attached.

[34] Turn on the switch to the plug marked 'vibrator' on the Kambrook switch board, and empty the calcining vessel into the blender body. Ensure the calcining vessel is empty by using the surgical torch to examine its interior.

[35] When all the product has been transferred replace the cap on the blender body.

[36] Replace the calcining vessel in the rotary furnace for storage with the heat shields.

[37] Transfer the blender body into glove box 3.

NOTE

CLEANUP THE GLOVE BOX AND REMOVE THE LIQUID WASTE

OPERATING PROCEDURES
GLOVE BOX 3
BLENDING AND HOT PRESSING

5. GLOVE BOX 3: BLENDING AND HOT PRESSING

5.1 EQUIPMENT Located in the Glove Box

[1] Beam balance, for weighing the calcined product in the blender to calculate the amount of titanium powder to be added to the product.

[2] Vibrating spatula, to measure the titanium powder.

[3] Motorised blender, with removable body (see figure 11).

[4] Cyclone system, to remove the insulating alumina bubble from the induction heating coil.

[5] Hydraulic press with induction heating coil attached (see figure 12).

[6] Carbon die (see figure 13).

5.2 HOT PRESSING Checklist

[1] Turn on the light in glove box 3. This will energise the solenoid valve supplying N_2 to purge the glove box.

[2] Record the Magnahelic gauge reading.

[3] Close the inlet filter valve.

[4] Open the N_2 valve on the end of glove box 3 and adjust flow to match with the reading recorded in step [2] (see figure 14).

[5] Turn on the N_2 purge supply to the die and adjust the flow-meter to 800 mL/minute.

[6] Turn on the water chiller.

[7] Check that the hydraulic pump air supply bottle has sufficient gas to undertake the complete operation.

[8] Turn on the air supply to the hydraulic pump.

[9] Clean loading tray.

[10] Check that ALL alumina bubble has been removed from the induction coil.

5.3 BLENDING

[1] Place the blender body on the scales and calculate the net weight of the product.

[2] Calculate the weight of titanium powder required at 2% of the weight of the product.

[3] Weigh and add the titanium powder to the product in the blender body then mount the blender body in the blender.

[4] Turn on switch 2 on the front panel of glove box 3. Blend for 20 to 30 minutes.

5.4 HOT PRESSING

[1] Place the carbon die on the plastic strap and position in the loading tray.

[2] Place the bottom plug into the die and ensure that it is properly seated at the base of the die.

[3] Remove the cap from the blender body and pour the contents of the blender into the die.

[4] Place the plunger into the die and carefully push the plunger down until a firm resistance is felt.

[5] Carefully lift the carbon die, with the plastic strap holding the bottom plug in position, and place it into the induction heating coil.

[6] Carefully remove the plastic strap from beneath the carbon die.

[7] Align the carbon die with the ram of the press.

[8] Place the carbon cap over the plunger and position the firebrick spacer on top of the cap.

[9] Place the thermocouple in its locating hole in the carbon die.

[10] Position the N_2 purge gas lines inside the induction coil spaced equally around the die.

[11] Remove the stopper from the alumina cyclone drain line and feed the alumina bubble into the induction coil until all the alumina has been distributed over the carbon die.

[12] Place the extra alumina bubble, which is located in the beaker, over the die.

[13] Open the air supply valve to the hydraulic pump.

[14] Open the hydraulic shut-off valve to the press (see figures 15 and 16).

[15] Slowly close the hydraulic by-pass and lower the press ram until 2 mPa is applied to the plunger. At this pressure, simultaneously close the hydraulic shut-off valve and the hydraulic by-pass valve to lock the ram in position.

[16] Turn on the mains (power) switch on the top front of the induction heater.

[17] Release the stop button on the control panel (top left outside corner of glove box 3 - see figure 17).

[18] Press the start button on the control panel and set the power to 30%.

[19] Monitor the temperature until it is within 5°C of the temperature specified on the log sheet. At this point reduce the power to 21%. The power will have to be further reduced in 0.5% decrements every few minutes to prevent the temperature from exceeding the specified temperature by more than 5°C.

[20] Allow the die to stabilise at this temperature for 10 minutes after reaching the specified temperature before applying pressure.

[21] Apply pressure to the plunger by slowly opening the hydraulic shut-off valve. This pressure should be set at 14 mPa and should automatically regulate itself at this pressure.

[22] Monitor the temperature and slowly reduce the power input, in approximately 0.5% steps, to maintain the specified temperature for the next two (2) hours.

[23] At the end of two (2) hours at pressure, shut off the induction heater and reduce the pressure to zero.

[24] Turn off the mains (power) switch on the front face of the induction heater.

[25] Turn off the air supply bottle to the hydraulic pump.

NOTE

(i) THE WATER CHILLER MUST REMAIN ON UNTIL THE TEMPERATURE IS BELOW 150°C

(ii) THE PURGE GAS MUST REMAIN ON UNTIL THE TEMPERATURE IS BELOW 300°C

[26] Allow the carbon die to cool before proceeding.

[27] Turn on the vacuum cleaner (switch 1 on the front of glove box 3) and remove the alumina bubble from the induction heating coil. When the cyclone tank is half full, empty some of the alumina bubble into the beaker.

[28] Remove the carbon die from the induction heating coil and carefully push the plunger into the die, thus removing the hot-pressed pellet of SYNROC containing radionuclides.

[29] Place the SYNROC pellet on the scales and record the weight on the log sheet as the achieved weight.

[30] Transfer the pellet into glove box 4.

NOTE

CLEAN UP THE GLOVE BOX BEFORE PROCEEDING WITH OPERATIONS IN GLOVE BOX 4.

OPERATING PROCEDURES
GLOVE BOX 4
CORE DRILLING AND SAWING

6. GLOVE BOX 4: CORE DRILLING AND SAWING

6.1 EQUIPMENT Located in Glove Box

[1] Drill press with attached lubricating water supply tank and pump (see figure 19).

[2] Diamond saw (see figure 20).

[3] Ultrasonic cleaning bath.

6.2 CORE DRILLING Checklist

[1] Check and top up the water level in the lubricating water supply tank located at the rear of the drill press.

6.3 CORE DRILLING

[1] Position the SYNROC pellet in the coring jig.

[2] Fit the top plate to the coring jig and tighten the wing nuts holding the top plate in position. Ensure that the pellet is firmly held in the jig as the cores will be deformed if the pellet is not held firmly.

[3] Turn on switch 1. This will activate the lubricating pump and supply water to the core drill.

[4] Turn on switch 2, which is also located on the front face of the glove box. This will activate the core drill.

[5] Carefully lower the core drill until contact is made with the pellet. Note the reading on the depth scale located on the right hand side of the drill press.

[6] Carefully continue drilling, keeping in mind the depth at which the core will be completed (reading on depth scale when contact was made with the pellet plus the thickness of the pellet).

[7] Ease off the cutting presure 2 mm before the expected completion depth to prevent the bottom of the pellet from breaking.

[8] Turn off switches 1 and 2.

[9] Using a pair of tweezers, carefully remove the cored sample from the pellet and place it in the container provided.

[10] Slacken the clamp located below the drill jig to allow the jig to be rotated anti-clockwise to the location of the next core.

[11] Rotate the drill jig until the outer edge of the core drill closest to the front of the glove box is just engaged with the previous core hole.

[12] Repeat steps [3] to [12] until all cores have been removed.

6.4 SAWING

[1] Remove the appropriate size collet from the glycol-filled storage container and fit it to the drive head.

[2] Using tweezers place the core into the collet.

[3] Lock the collet head onto the sample. Care must be taken to ensure that the collet is sufficiently tightened to hold the core securely. Do not over tighten, as this will withdraw the core into the collet head and prevent a slice of the required thickness from being attained.

[4] Carefully move the sliding table up to the saw blade and clamp the split nut around the lead screw.

[5] Place the splash shield in position to prevent the lubricant from contaminating the window of the glove box.

[6] Turn on switch 3, making sure that the gloves are not in contact with the saw.

[7] On completion of the cut turn off the saw.

[8] Unclamp the split nut and slide the table away from the saw blade.

[9] Swing the adjustable stop towards the window and remove the slice with a pair of tweezers.

[10] Place the slice into the container of alcohol located in the ultrasonic bath.

[11] Turn on switch 4. This activates the ultrasonic bath to clean the slice.

[12] Unlock the collet head and using the tool provided push the core forward until it is positioned against the stop.

[13] Repeat steps [3] to [12] until the maximum number of slices which can be obtained from the core have been removed.

[14] Turn off switch 4 and remove the slices from the bath.

[15] Place the slices into clean containers for transfer to glove box 5.

NOTE

(i) CLEAN UP THE GLOVE BOX BEFORE PROCEEDING WITH ANY FURTHER OPERATIONS

(ii) THE HEALTH PHYSICS SURVEYORS MUST BE IN ATTENDANCE DURING TRANSFER OF THE SAMPLES TO GLOVE BOX 5.

OPERATING PROCEDURES
GLOVE BOX 5
DENSITY MEASUREMENT AND PHYSICAL DIMENSIONING

7. GLOVE BOX 5: DENSITY MEASUREMENT AND PHYSICAL DIMENSIONING

7.1 EQUIPMENT Located in Glove Box

[1] Balance (electronic) with density measurement attachments.

[2] Vacuum tank.

[3] Dial indicator.

7.2 DENSITY Measurement

[1] Transfer the samples (slices) from glove box 4.

[2] Remove the samples from the transfer container and place on a face tissue to dry the surfaces of each sample.

[3] Place each sample into separate pre-labelled storage containers.

[4] Remove only one sample at a time from its storage container to prevent the samples from being mixed.

[5] Carry out the density measurement in accordance with the method laid down in MCC-12, Test Method For Determining Density Changes In Actinide-Doped Waste Forms.

NOTE

STEP (6) MCC-12 HAS BEEN CHANGED TO :

(6) PLACE THE SPECIMEN IN THE LIQUID AND EVACUATE FOR 10 MINUTES. THEN TRANSFER THE SPECIMEN ONTO THE WEIGHING BASKET. RECORD THE WEIGHT AS Wt.

7.3 PHYSICAL Dimensioning

Physical dimensioning is carried out using the dial indicator to determine the thickness and the diameter of the sample. These readings are recorded against their identifying label in the leach sample log book. These samples are now ready for further testing.

PART II
PLANT AND EQUIPMENT

1. INTRODUCTION

Part II identifies all the essential equipment used in the actinide laboratory radioactive SYNROC glove box production facility. Where possible, the original supplier and the purchase order number are stated. Also, where applicable, the relevant tender action file number is stated.

2. PLANT AND EQUIPMENT

2.1 Glove Box 1

Magnetic Stirrer	Janke and Kunel model KM02. Supplied by John Morris, Sydney. Purchase order: PR31177.
Hotplate	Sybron type 1900, model HPA191.
pH Meter	Analite Catalogue No. 339200; 9 V d.c. Supplied by Selby's Scientific, Sydney. Purchase order: PR31190.
Probe (pH Meter)	Analite Catalogue No. 802077 combined electrode. Supplied by Selby's Scientific, Sydney.

2.2 Glove Box 2

Magnetic Stirrer	Analite model S1. 240 V 50 Hz.
Peristaltic Pump	MasterFlex model 7554-10 c/w Controller. MasterFlex model 7016 pump head. Supplied by Edwards Instruments, Sydney.
Heating Element (flash drier)	This element was developed especially for the SYNROC Project by Thermal Electric Elements, Padstow. Power rating: 2.5 kW (see figure 7). Purchase order: - PR29939.
Laboratory Jack	Metapp Catalogue No. 726; 150x200. Supplied by Lab Supply Pty Ltd, Sydney.

Flash-drying Vessel	Manufactured at the AAEC Research Establishment (see figure 6)
Vibrator Vessel Holder	Systron Electric type V4AC, model C142500, 240 V.
Calcining Vessel	Manufactured at the AAEC Research Establishment(see figure 8).
Gasket (flash drier)	Flexicard seal: 106 mm i.d. x 115 o.d. x 1 mm thick. Supplied by Flexitallic Pty Ltd, Sydney. Purchase Order: MA31217.
Furnace (tube)	Manufactured by Electrochemical Engineering Pty Ltd. Tender action: LH82/874. Purchase Order: RE12101.
Rotating Barrel (Tube Furnace)	Tube only manufactured by Wardrope and Carol Engineering, Sydney. Rotating drive mechanism manufactured at the AAEC Research Establishment (see figure 9).
Surgical Torch	Concept Flexi-Lum, Catalogue No. 3034. Supplied by Medical-Optical Pty Ltd, Sydney. Purchase Order: MX58563.

2.3 Glove Box 3

Blender	Manufactured at the AAEC Research Establishment (see figure 11).
Beam Balance	Ohaus triple beam balance. Capacity: 2610 g. Supplied by Selby's Scientific, Sydney: Part No. 212710. Purchase Order: MX58435.
Press	Manufactured by Chapman Hydraulics. Tender action: LH82/812. Purchase Order: PR27323.
Carbon Die	Manufactured at the AAEC Research Establishment

Induction Heater	Manufactured by InductoHeat Pty Ltd, Sydney. Tender action: LH82/755
Battery Charger	Arlec PS319; 6 V/12 V, 18A surge. Supplied by Arlec, Sydney.
Vacuum Cleaner	National model HC180; 12 V.

2.4 Glove Box 4

Drill Press	5 speed, 0.25 h.p. Supplied by Hare and Forbes, Parramatta.
Suds Pump	Myty; 240 V. Supplied by Hare and Forbes, Parramatta.
Water Swivel	Triefus water swivel, habit shank. Supplied by Triefus Pty Ltd, Sydney.
Diamond Drill	Hycon plated drill, habit shank. Manufactured by Triefus Pty Ltd, Sydney. (see figure 18).
Diamond Saw	Gemmasta model GS6D. Power feed from model GS10. Supplied by Gemmasta, Adelaide. Tender action: LH82/756.
Ultrasonic Bath	Supplied by Jasco, Sydney.

2.5 Glove Box 5

Balance	Mettler model AC100
Dial Indicator	Mercer

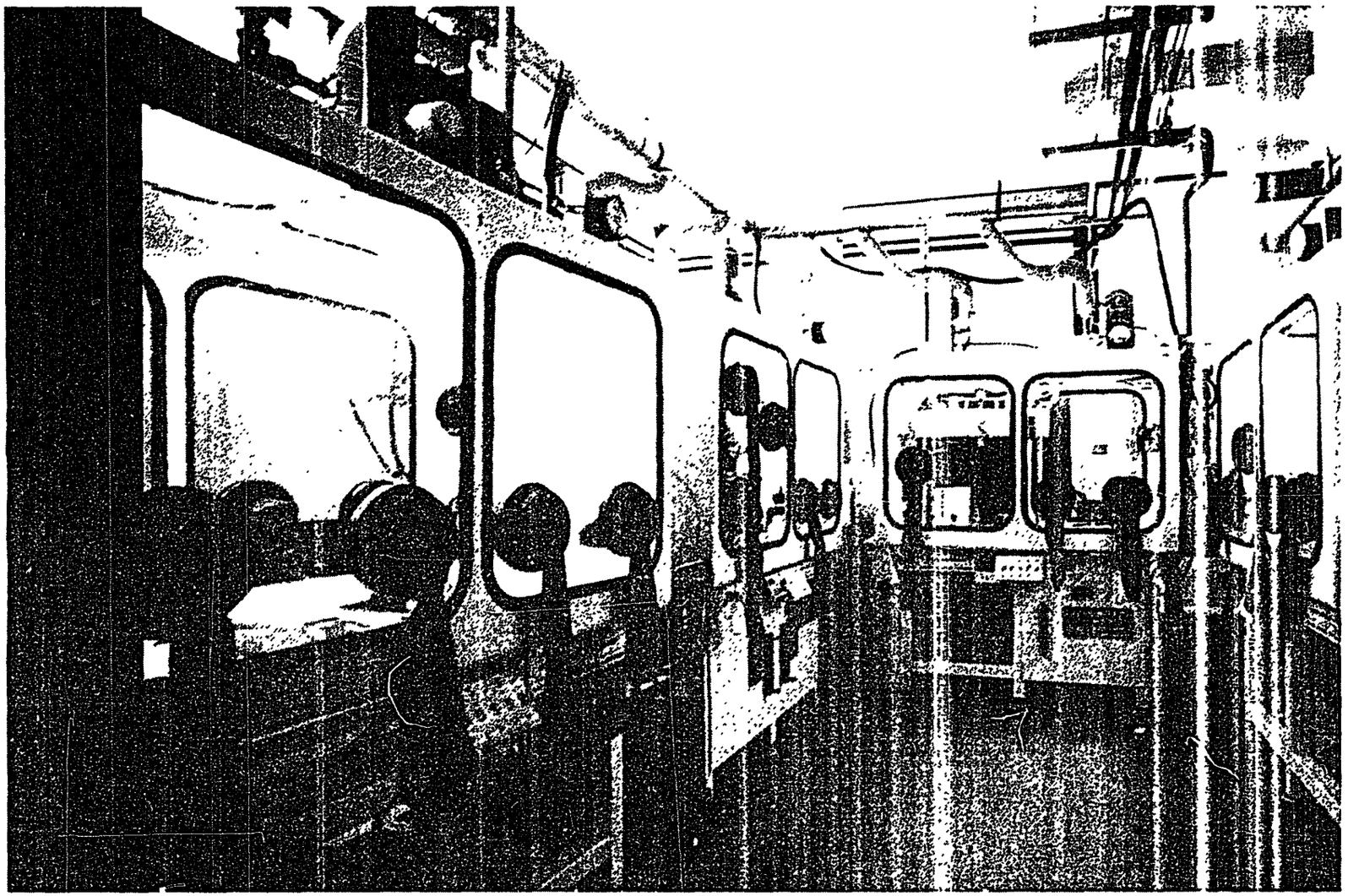


Figure 1 Actinide Laboratory, Building 56, Glove Boxes 1 to 4

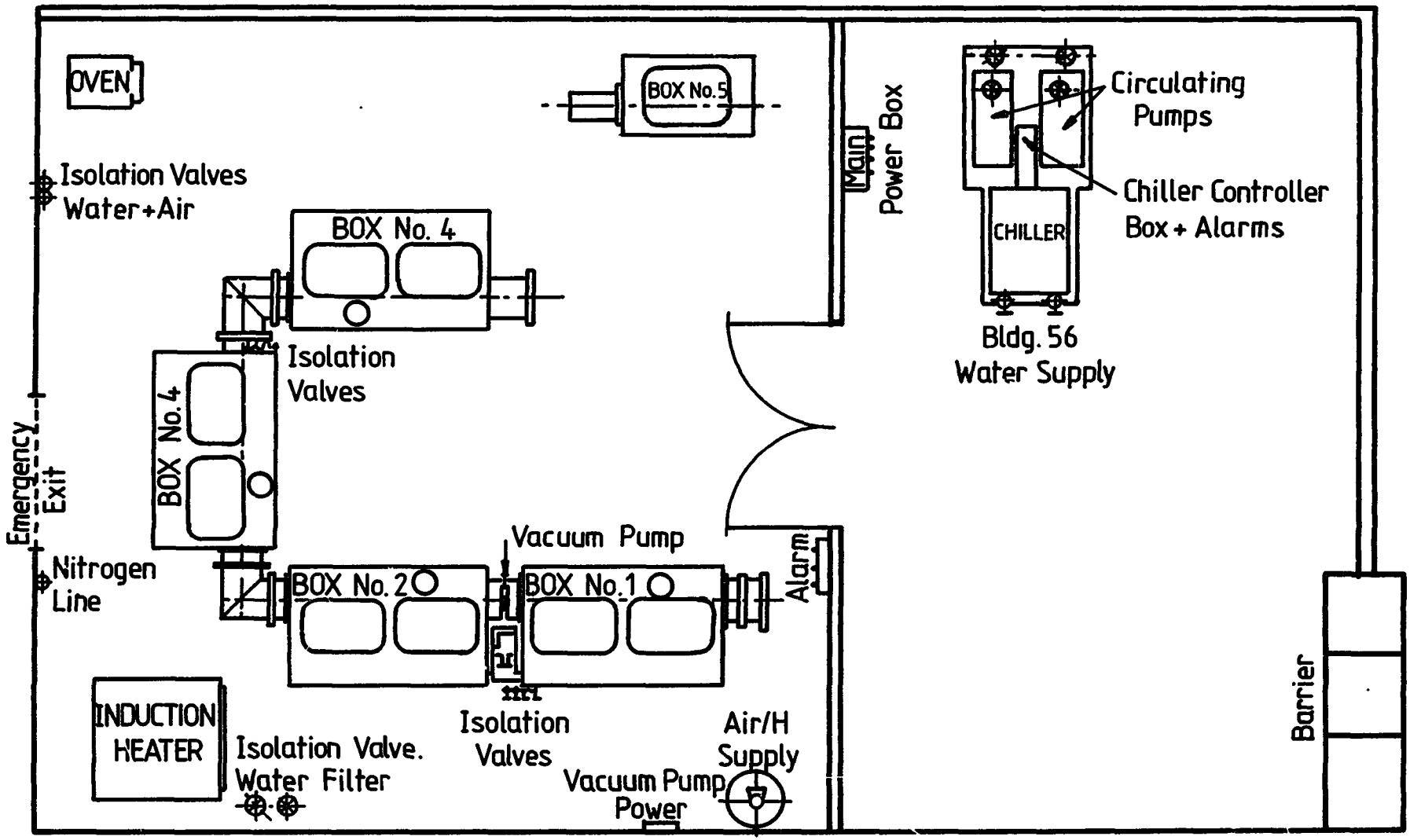


Figure 2 Actinide Laboratory Floor Plan

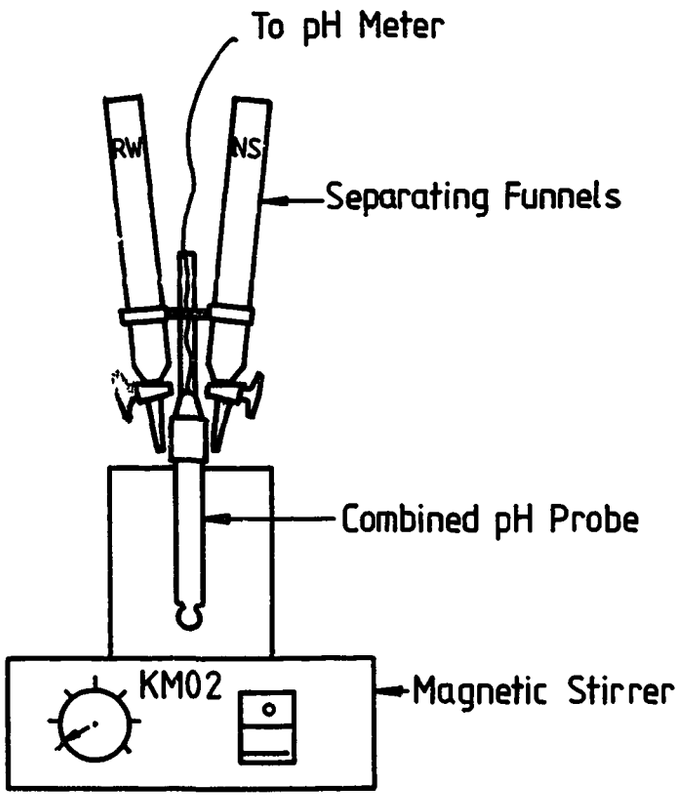


Figure 3 Magnetic Stirrer with Separating Funnels

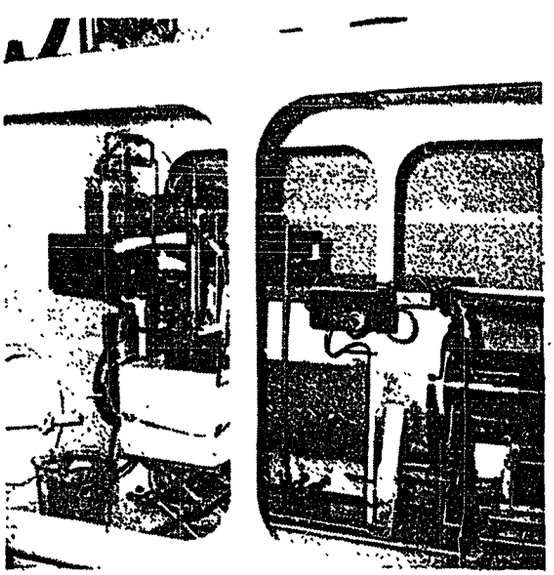


Figure 4 Glove Box 2 Equipment Location

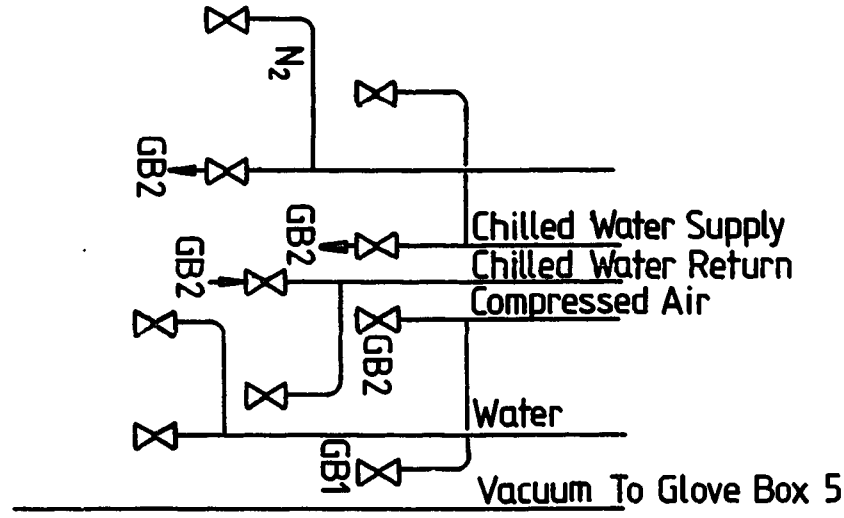
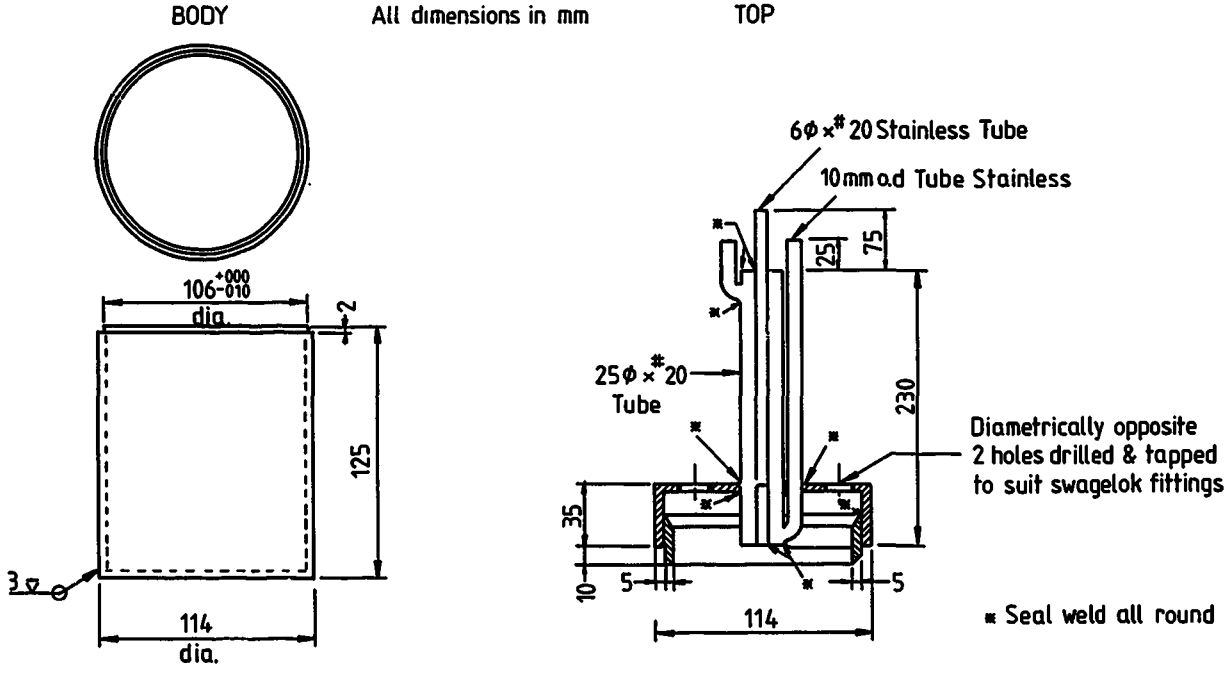


Figure 5 Services to Glove Boxes 1 and 2



Material: 5mm stainless steel. (5mm tube wall acceptable)

Material.: Stainless Steel

Figure 6 Flash Drier

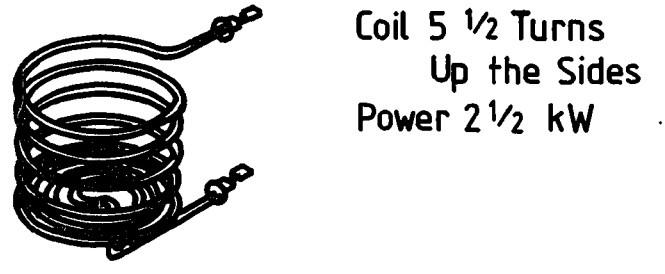


Figure 7 Flash Drier Heating Element

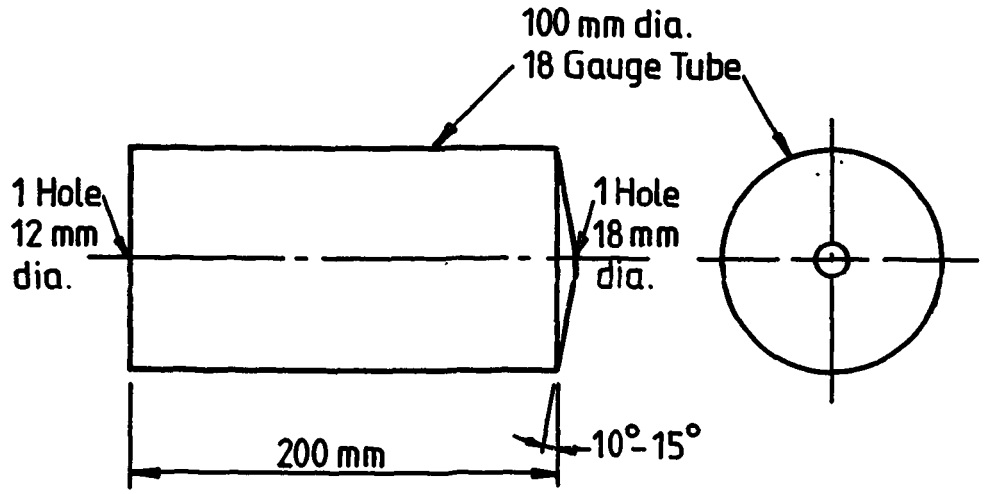


Figure 8 Calcining Vessel

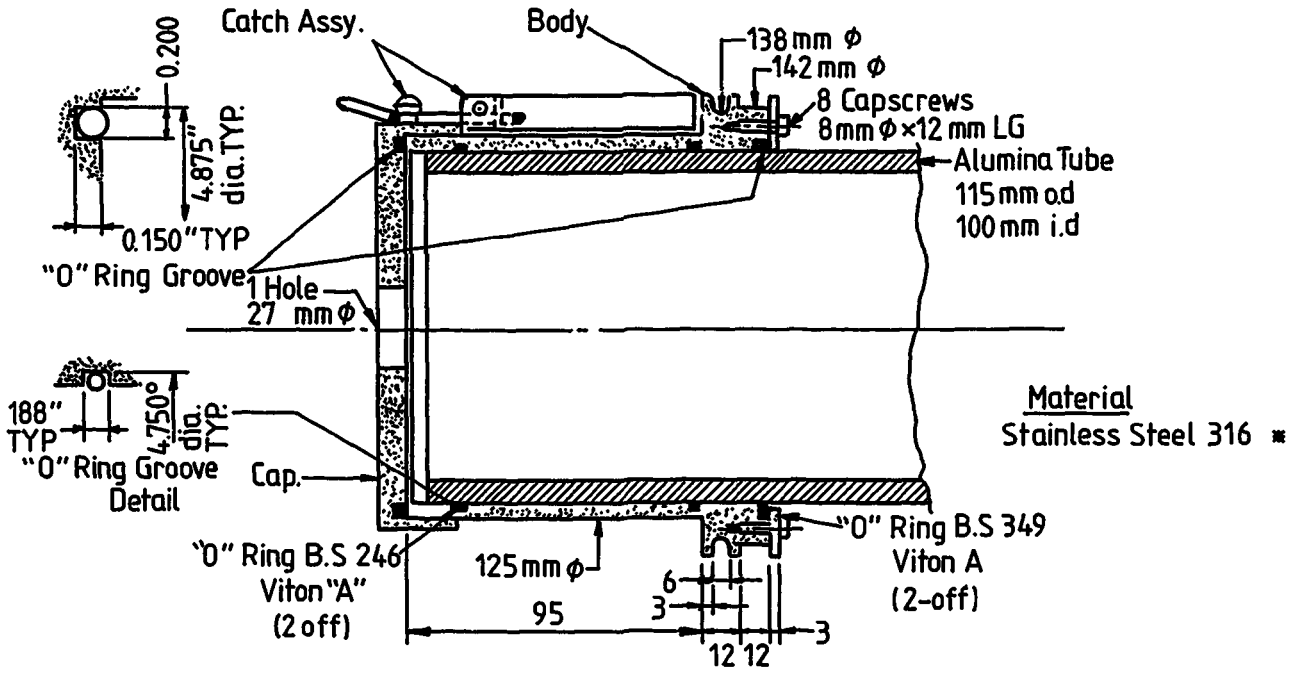


Figure 9 Rotary Furnace End Fittings

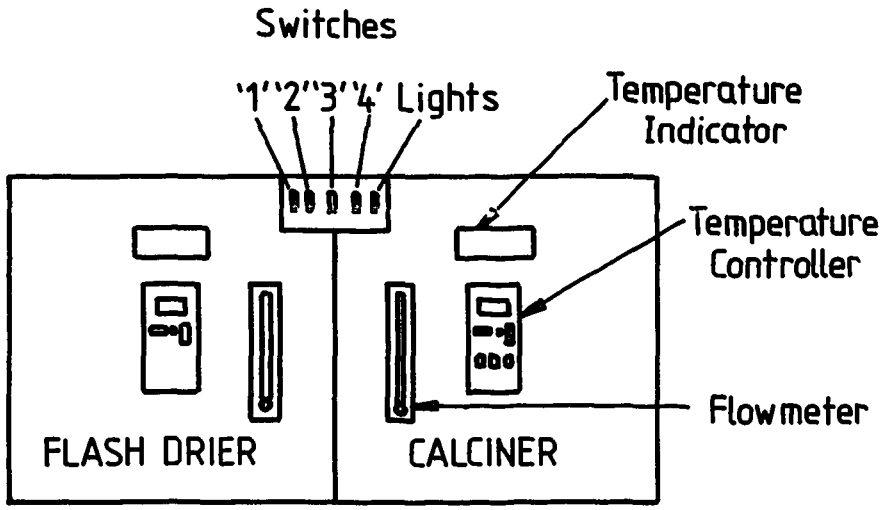


Figure 10 Glove Box 2 Front Panel

Figure 11 Y Blender

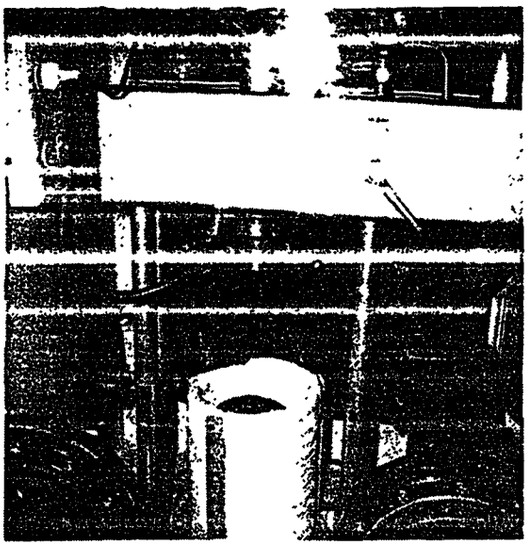


Figure 12 Press in Glove Box with RF Induction Coil and Carbon Die in Position

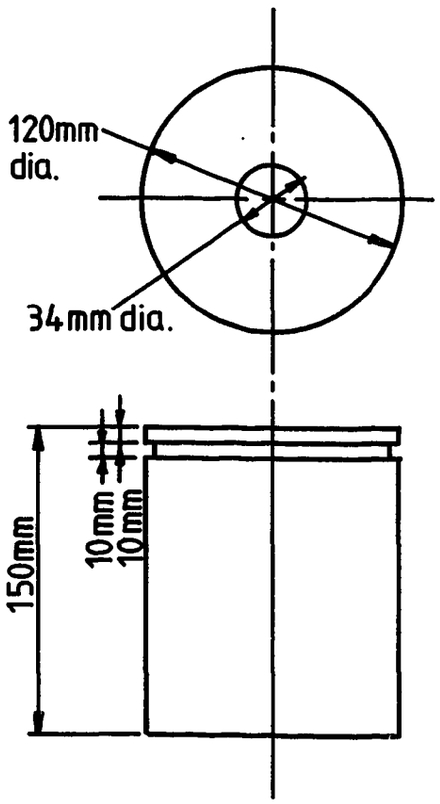


Figure 13 Carbon Die

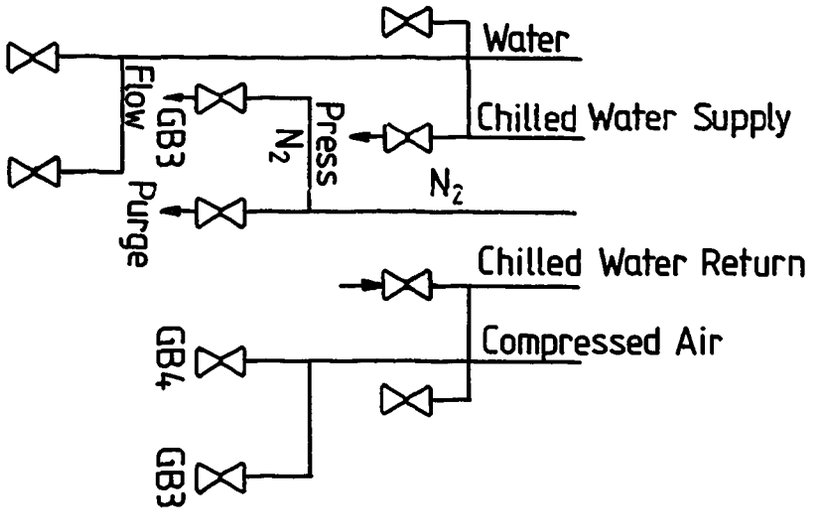


Figure 14 Services to Glove Boxes 3 and 4

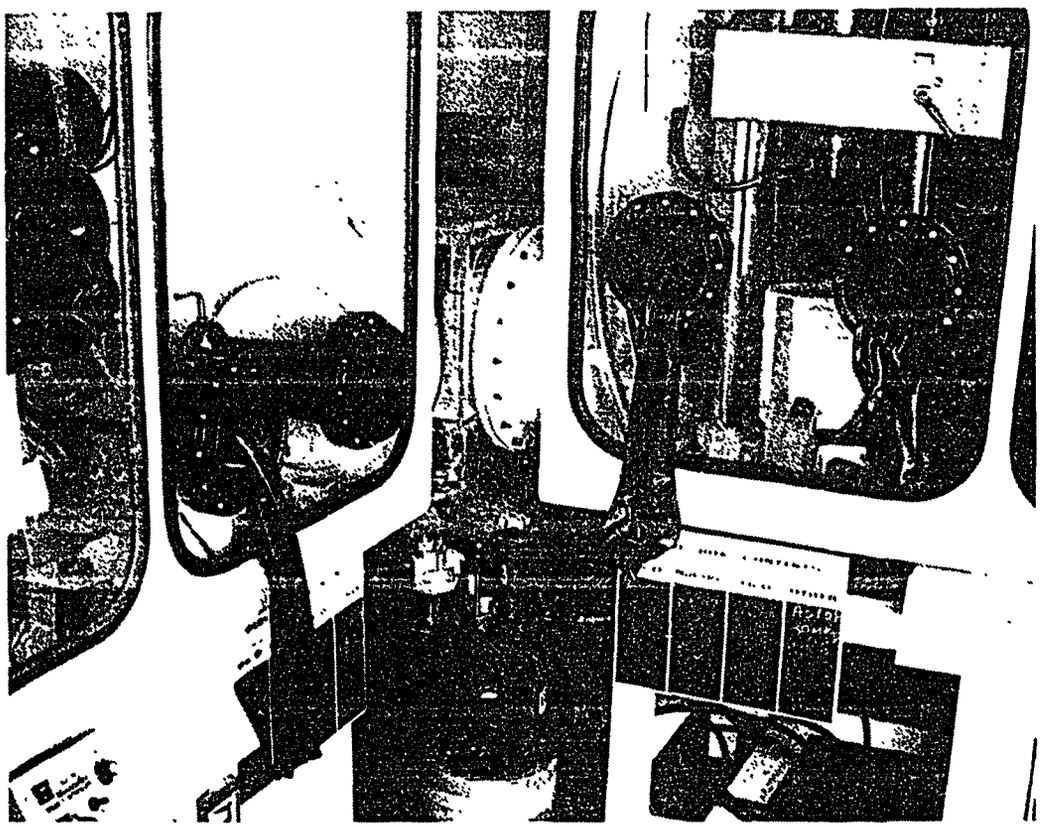


Figure 15 Hydraulic Pump Location

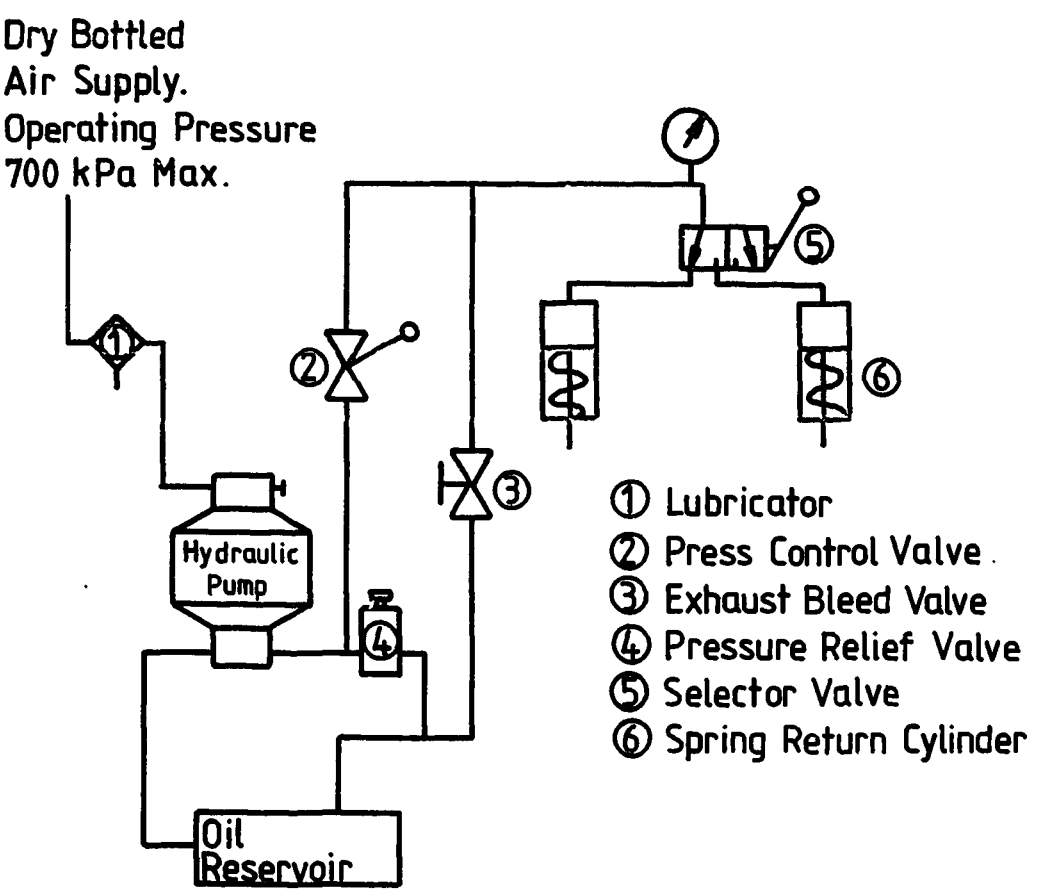


Figure 16 Hydraulic Control Circuit

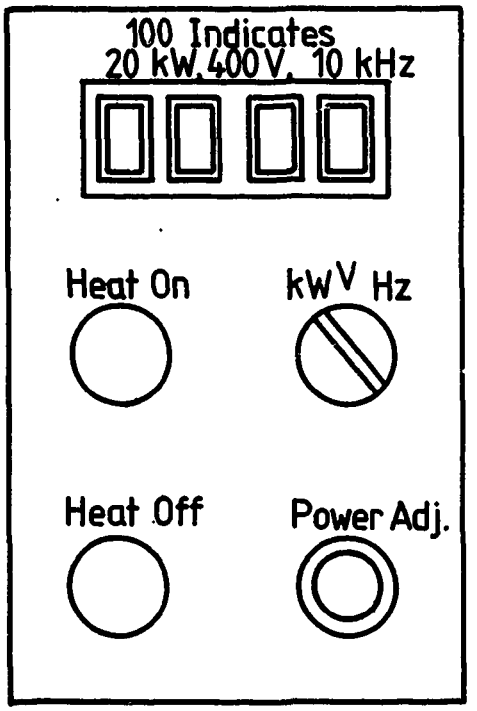


Figure 17 Induction Heater Control Panel

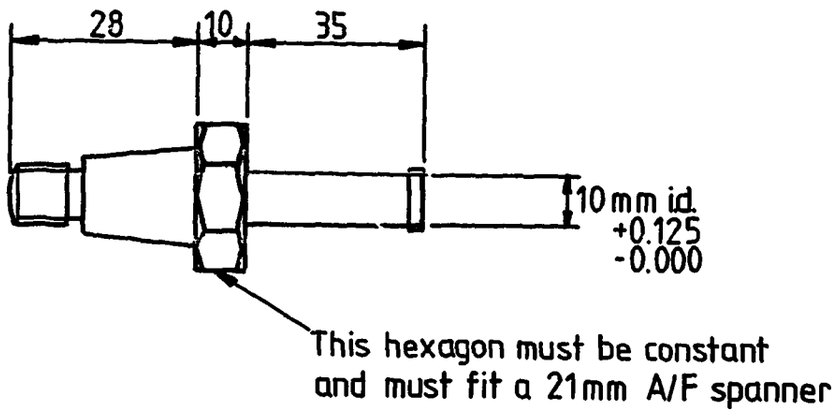


Figure 18 Diamond Core Drill

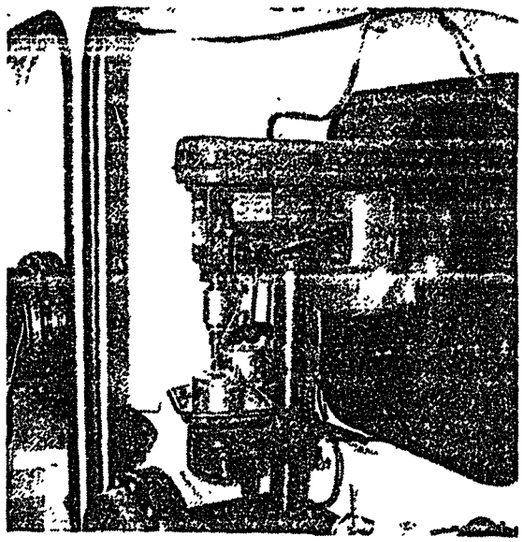


Figure 19 Core Drilling Machine

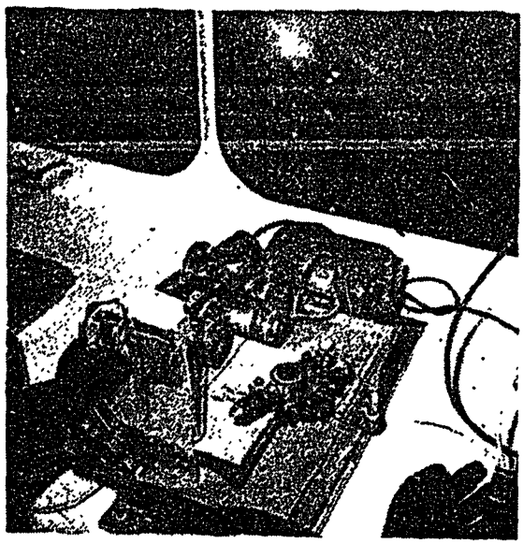


Figure 20 Diamond Saw

APPENDIX A

STORES REQUIREMENTS

The following items are available from stores inventory at the Lucas Heights Research Laboratories and are items required for daily operations.

Item	Description	Vocabulary No.
Bearing,	30 o.d. x 10 i.d. x 10 W saw head and rotating furnace	3110 - 39
Bottle,	counting vial, 10 mL	6640 - 1689
Bottle,	screw cap, 0.5 gal	6640 - 140
Bottle,	screw cap, 50 mL	6640 - 127
Cloth,	disposable lint-free	7920 - 62
Filter,	glove box absolute (Luwa)	6640 - 1822
Gloves,	Travenol	8415 - 76
Gloves,	glove box	8415 - 79
Gloves,	medical cotton	
O-ring,	glove box glove retaining	5330 - 173
O-ring,	glove port bung 6"	5330 - 171
O-ring,	glove port bung 7"	5330 - 178
Tissue,	facial	8540 - 2
Waste clearance certificate		7530 - 705

APPENDIX B

REPLACEMENT PARTS

The following items are replacement parts for equipment purchased primarily for the manufacture of radioactive SYNROC and are not available from the stores inventory.

Diamond Drill	Hycon plated drill (see figure 18). Supplied by Triefus Pty Ltd, Sydney.
Diamond Saw Blade	6" o.d. x 0.625" i.d. Supplied by Gemmasta.
Hydraulic Pump	Haskel model M-36
Electric Motor	Used for the drive motor on the diamond saw head and the rotating furnace tube. Elcoma model 9904 111 06 131, 220 V 50 Hz, 250 rev/min. Supplied by Phillips Electronics, Sydney.
Gearbox (to match the Elcoma Motor)	Used on the diamond saw sample head, blender and the rotating furnace tube. Elcoma model 9904 111 01 19 Supplied by Phillips Electronics, Sydney.
Unimat Collet Attachment	Unimat model 200-050. Supplied by Emco Machine Tools, Sydney.
Collet 10.0 mm	Unimat model 225-100. Supplied by Emco Machine Tools, Sydney.
Collet, 11.0 mm	Unimat model 225-110. Supplied by Emco Machine Tools, Sydney.
Purge Gas N_2 - 3.5% H_2	Supplied by C.I.G., Sydney.
Diamond Saw Drive Belt	Ludowici Catalogue No. 351. Supplied by Ludowici and Son Ltd, Sydney.

APPENDIX C

PLANT AND EQUIPMENT NUMBERS ISSUED UNDER NERDDC GRANT 25

PLANT NUMBER	ITEM	LOCATION
G25/1	Press	B56-AL-GB3
G25/4	Balance	B56-AL-GB5
G25/6	Induction heater	B56-Act.Lab.
G25/7	Water chiller	B56-Act.Lab.
G25/9	Glove box	B56-Act.Lab.
G25/10	Glove box	B56-Act.Lab.
G25/11	Glove box	B56-Act.Lab.
G25/12	Glove box	B56-Act.Lab.
G25/14	Pump, Ajax (water)	B56-Act.Lab.
G25/15	Pump, Ajax (water)	B56-Act.Lab.
G25/23	Air oven	B56-Act.Lab.
2214	Diamond saw	B56-AL-GB4
2186	Peristaltic pump	B56-AL-GB2