

WORK INSTRUCTION

Measure Bulk Density

Change History

Section(s)	Effectivity	Change Authorization	Summary
2,3	8/29/06	R. H. Moore	Iss E: Added instructions to steps 18 and 21 concerning the wire basket and added new section 3.4 for visual inspection.

TRAINING REQUIRED BASED ON THIS ISSUE

R. H. Moore	8/29/06	No approval needed for issue E	
R. H. Moore, Org 2454 Process Engineer Author	Date	D. M. Goy, Org 2454 Product Eng.	Date
R. B. Trujillo	8/29/06		
R. B. Trujillo, Org 12343 Quality Engineer Authorizing Signature	Date		

1.0 INTRODUCTION

1.1 Scope

This procedure covers the Density Measurement of PZT slugs used for voltage bar fabrication

2.0 PREREQUISITES

2.1 References

Document No.	Description
OP 01-14100-0001	ES&H Operating Procedure (OP) for PZT Processing in Building 878, Room Y715
OA-PST-001	Operation of Measurement Equipment for Slug Density
GP-AC0007	Nonconforming Material Procedure for Active Ceramics Production

2.2 Equipment and Materials

Personal Protective Equipment		
Qty.	Equip. ID	Description
AR		Gloves
AR		Safety glasses
AR		Tyvek lab coat or overalls

Equipment		
Qty.	Equip. ID	Description
1		Caliper
1		Mettler balance
AR		Tray
1		Wire basket with 28 AWG, or smaller, wire
1		Large container
1		Small container
1		Rotary vane vacuum pump
1		Bell jar with flask

Materials		
	Dwg./Part Number	Description
AR		High Fired PZT slugs

Shop Supplies		
	Dwg./Part Number	Description
AR		Shop towels

2.3 Records

Document No.	Description
DF-PST-026	High Fire Bulk Density Summary

3.0 PROCEDURE

3.1 Geometric Density

- [1] Verify that the Lot number, TSP number, quantity of slugs, and the WI issue are consistent with the job documentation (Traveler or Oracle routing).
- [2] Referring to OA-PST-001, measure and record the dimensions and the weight of each slug on the Excel density spreadsheet. Label workbook with High Fire and TSP number.
- [3] Calculate and record the geometric density of each slug on the Excel density spreadsheet.
- [4] As necessary, record notes explaining any unexpected changes in dry weight.
- [5] Place slugs in labeled tray.

3.2 Bulk Density

- [6] Referring to OA-PST-001, weigh all dry slugs and record as dry weight
- [7] Place slugs in suitable container not touching each other or the walls.
- [8] Place container in bell jar and cover with lid, and verify that the vacuum hose is connected from the vacuum pump to the bell jar.
- [9] Close the vacuum release valve, open the valve to the vacuum pump, and close the stopcock below the flask.
- [10] Turn the vacuum pump on and allow to pump for 30 minutes, minimum.
- [11] Check the resistivity of the DI water. Verify the resistivity meter is set on 16 megohms. Run the DI water until the meter reads at least 16 megohms before filling the flask with ~800 cc of DI.
- [12] After 30 minutes of vacuum, close the vacuum pump valve and turn off the vacuum pump.
- [13] Open the stopcock and partially fill the container with DI water until the water covers the slugs. Close the stopcock before the flask is empty.

- [14] Allow the slugs to absorb water for 5 minutes, minimum, then slowly open the vacuum release valve.
- [15] Remove container with slugs from bell jar.
- [16] Leave slugs under DI water.
- [17] Verify that the wire basket is hanging under the balance, and that the small container is filled with DI water
- [18] Place the container under balance with the wire basket in DI water. Verify that the wire basket is fully submerged (including the knot), with only the 28 AWG wire breaking the surface of the water.
- [19] Insuring there are no air bubbles on wire basket and basket is not touching the container sides, tare balance.

Note:

If DI water volume is altered in the container, the balance must be tared again.

Balance should be checked at least every fifth measurement for re-zeroing and tared if necessary.

- [20] Remove DI water container and place a slug in wire basket.
- [21] Place the container under balance with slug in the basket under DI water. Verify that the wire basket and slug are fully submerged (including the knot), with only the 28 AWG wire breaking the surface of the water
- [22] Record weight as suspended weight on the Excel density spreadsheet.
- [23] Place the slug back into the large container under DI water.
- [24] Repeat for all slugs in the high fire and record the suspended weights for all of the slugs on the Excel density spreadsheet.
- [25] Remove the suspended wire basket and tare the balance.
- [26] Using a damp towel, remove all surface water from a slug, weigh, and record the weight as the saturated weight on the Excel density spreadsheet.
- [27] Repeat for all slugs in the high fire and record the saturated weight for all of the slugs on the Excel density spreadsheet.
- [28] Use the spreadsheet to calculate bulk density and open porosity for all of the slugs.

3.3 Verify Spreadsheet Calculations

- [29] To verify the bulk density and open porosity calculations performed by the spreadsheet, select one slug and calculate its bulk density and open porosity using a hand calculator and the following formulas:

$$BD = \frac{W_{dry}}{(W_{Saturated} - W_{Suspended})}$$

$$\%OP = 100 \times \frac{(W_{Saturated} - W_{Dry})}{(W_{Saturated} - W_{Suspended})}$$

3.4 Visual Inspection

- [30] Select approximately 10% of the slugs from the high fire and visually inspect them at 10 – 30X for cracks and spots.
- [31] Send the spreadsheet to the process engineer for data review and completion of DF-PST-026. Also include any observations from the slug visual inspections.

4.0 APPENDICES

APPENDIX A, CHANGE HISTORY

Section(s)	Effectivity	Authorization	Description
2,3	8/29/06	R. H. Moore	Iss E: Added instructions to steps 18 and 21 concerning the wire basket and added new section 3.4 for visual inspection.
2,3	2/15/06	R. H. Moore	Iss D: Added new section 3.3 to verify spreadsheet calculations.
All	12/17/03	R. H. Moore	Iss C: Bell jar was modified to add a flask for the DI. Steps 8 through 16 were changed to reflect the new procedure for evacuating and adding DI.
All	11/10/03	R. H. Moore	Iss B: Switched from house vac to rotary vane vac pump, increased vac time to 30 min and added 5 min hold after water added.
All	2/5/03	R. H. Moore	Iss A: initial release