

Procedure: Creep Test at SNL

Version: Date:
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Form Completed By: Lanni

1 Test Description

| Parameters | Value |
|---|--|
| Test Name | UNM-WP-HY-175-04 |
| Salt Presence (Circle One) | Avery Island <u>(WP)</u> |
| Test Type (Circle One) | <u>Hydrostatic</u> / Shear |
| Salt Can Label | <u>4E</u> |
| Water Added to Salt (Circle One) | Yes / <u>No</u> |
| Target/Actual Acid Water Content | 12 = <u>Standardized as</u> Mass |
| Temperature [°C / °F] | <u>175°C</u> |
| Pressure [MPa / psi] | |
| Jacketing Components (Circle All) | <u>Outer Lead</u> <u>Outer Viton</u> <u>Outer Lead</u> <u>Inner Copper</u> |
| Tested In (Circle One) | Frame 2 / Frame 3 |
| Test Target (permeability / fractional density / etc) | |

Table 1: Description of Test

2 Pre-Test Measurements

2.1 Height of components:

| Components | Count | Component Label | Recorded Height (mm) |
|---------------------------------|-------|-----------------|----------------------|
| Placers | 1 | <u>C3</u> | <u>37.03</u> |
| | 2 | <u>C5</u> | <u>37.67</u> |
| Chamber Discs | 1 | <u>CP4</u> | <u>8.48</u> |
| | 2 | <u>CP6</u> | <u>8.35</u> |
| Mesh Discs | 1 | NA | <u>1.18</u> |
| | 2 | NA | <u>1.14</u> |
| Cumulative Height of Components | | | <u>93.85</u> mm |

Table 2: Itemized List of Components for Height Measurements (No Salt)

2.2 Jacket Dimensions

2.2.1 Height of Outer Jacket

This value will vary depending on which placers (steel or aluminum) and chamber pieces are used, in general:

- Outer Jacket: 10.125 inches (257.17 mm) to 10.5 inches (266.7 mm);
- INNER SHELL: 12.0 INCHES (304.8 MM) -> THIS IS FOR BOTH A1 AND A2;
- Spectator Clearance: 1.875 inches (47.62 mm) to 1.5 inches (38.1 mm);

NOTE: the maximum height inside Frame 2 and 3 is 12 inches (304.8 mm)

If the upper internal part of the shell is plugged, the available height is decreased to 11.75 inches (298.45 mm)

| Jacket Description | Height | No. of Jackets Used |
|-----------------------------|------------|---------------------|
| Outer Lead Jacket (mm) | <u>216</u> | <u>1</u> |
| Outer Viton Jacket (mm) | | |
| Inner Lead Jacket (mm) | <u>130</u> | <u>1</u> |
| Inner Copper Jacket (mm) | <u>134</u> | <u>1</u> |
| Height of Total Sample (mm) | | |

Table 3: Height of Jacketing Components (If jacket not used, write "NA")

$$218.84 - 3 = 215.84$$

$$217.96 - 2 = 215.96$$

2.2.2 Checklist of Jacketing Materials

| Components | Count | Verification Checkmark (and Component Label is Applicable) |
|---|-------|--|
| Platens | 2 | ✓ |
| Platen O-rings | 4 | ✓ |
| Platen Screws (0.25 inch 30 rpd) | 2 | ✓ |
| Screw-In Nipples | 2 | ✓ |
| Nipple O-rings | 8 | ✓ |
| Nipple Adapter (HHP HP4 connection) | 2 | ✓ |
| Nipple Flaps (HHP HP4 plug) | 2 | ✓ |
| Chamber Discs | 2 | ✓ |
| Mesh Discs | 2 | ✓ |
| Inner Copper Jacket (indicate No. used) | 1 | Thickness of 1 Sheet of Copper (mm) |
| Inner Lead Jacket | 1 | Jacket Thickness (mm) |
| Outer Lead Jacket | 1 | Jacket Thickness (mm) |
| External Hose Clamps | 4 | ✓ |

Table 4: Itemized List of Components for Mass and Volume Measurements (No Salt)

2.2.3 Volume and Mass of Components (No Salt)

| Measured Value | Value | Units | Comments |
|---|----------|--------------|-------------------------------|
| Prior to Dunk: Water Level Reading on Burette | 53.45 | ml (burette) | |
| After Dunk: Water Level Reading on Burette | 48.2 | ml (burette) | |
| Volume of Components (No Salt) | 1048.604 | ml | |
| Mass of Components (No Salt) | 4.9624 | kg | adjusted for clamp cut pieces |
| Approximate Outside Diameter of Sample | | mm | |

Dunk Tank Volume Factor: 114.078 mL/Burette Unit

Table 5: Measurements of All Components (No Salt)

adjusted for hose clamp volume.

2.3 Measured Mass of Salt

2.3.1 Date

| Parameters | Value |
|---|-----------|
| Salt Can Label | |
| Before Making Sample: Mass of Salt and Can (with lid) | 1.9228 kg |
| After Sample is Made: Remaining Mass of Salt and Can (with lid) | 0.3562 kg |
| Bulk Mass of Salt Used for Sample | 1.5666 kg |
| Cumulative Mass of Components and Salt | 6.5289 kg |

Table 6: Mass of Salt Before Preconsolidation

3 Pre-consolidation Measurements

3.0.2 Date

3.0.3 Data Sample Rate

| Volume Displayed on GUI | Volume [mL] | Pressure [psi] | Time [h:mm] |
|---|-------------|----------------|-------------|
| Initial Reading: prior to consolidation | 507.52 | 10Psi | 12:00:00 |
| Reading: When at pre-consolidation pressure | 255 | 2900 | 12:05 |
| Final Reading: after pre consolidation | 350 | 10 | 12:11 |

Table 7: Pre-consolidation Details

| Parameter | Value | Units |
|--|---------|--------------|
| Prior to Dunk: Mass of Specimen (with all components) | 6.5340 | kg |
| Prior to Dunk: Water Level Reading on Burette | 59.4 | ml (burette) |
| After Dunk: Water Level Reading on Burette | 42.5 | ml (burette) |
| Preconsolidated Specimen (all components listed above plus salt) | 1435.01 | ml |
| After Dunk: Mass of Specimen (with all components) | | kg |
| Average Height of Specimen | 209.19 | mm |
| Average Outside Diameter of Specimen | 103.77 | mm |
| Bulk Salt Volume (Salt and added water) | | ml |

Dunk Tank Volume Factor: 114.078 mL/Burette Unit

Table 8: Measurements Made After Preconsolidation of Specimen

- 59.4
42.6
- ← circumference
- ① avg diameter = 326 mm; Dia = 103.77 mm after preconsolidation
- ② avg ht = 209.19 mm

Volume calculation for these clamp cut pieces;

Initial water level = 37

Final water level = $\frac{47.5}{10.5 \text{ ml}}$

Circumference = 340 mm
 $D = 108.28 \text{ mm}$

| Parameter | Values | Units |
|--|--------|-------------------|
| Salt Only - Volume: $V_{salt}^{(0)} = V_{salt}^{(0)} \cdot (1 - u)$ | | mL |
| Salt Only - Mass: $m_{salt}^{(0)} = m_{salt}^{(0)} \cdot (1 - u)$ | | kg |
| Salt Only - Density: $\rho_{salt}^{(0)} = m_{salt}^{(0)} / V_{salt}^{(0)}$ | | kg/m ³ |
| Salt Only - Fractional Density: $\beta = \rho_{salt}^{(0)} / 2160$ | | |

Table 9: Post-Consolidation Density Calculations

4 Application of Heat to Obtain Test Temperature

4.0.4 Data Sample Rate: 1000/sec

| Event | Date | Time | Confining Pressure [psi] | Expelled Silicone Oil Volume [mL] |
|----------------------------|------|-------|--------------------------|-----------------------------------|
| Start Temperature Increase | 8/11 | 10:40 | 2 psi | 0 |
| End Temperature Increase | 8/13 | 2:55 | 3.1 | 2480 mL |

Table 10: Dates of Details of Temperature Increase

5 Creep Test

5.0.5 Date (Start Test): 8/13 3:00

5.0.6 Data Sample Rate: 10 sec

| Event | Value | Comment |
|--|------------|---------|
| ISCO Pump Volume (Pre Pressure Increase) | 507.4 | |
| ISCO Pump Pressure (Pre Pressure Increase) | 0 | |
| Begin Pressure Increase | Time: 3:02 | |
| End Pressure Increase | Time: 3:07 | |
| ISCO Pump Volume (Post to Pressure Increase) | 265.38 | |
| ISCO Pump Pressure (Post Pressure Increase) | 2900 | |
| ISCO Pump Flow Rate (Post Pressure Increase) | 3.8 | |

Table 11: Details of Test Initiation

5.0.7 Date (End Test): 8/31/15 21:00 AM

4/1

| Parameters | Values | Units |
|--|---------|-------------------|
| Final Mass of Specimen | 6.5440 | kg |
| Initial - Dunk Tank Values | 59.9 | mL (burette) |
| Final - Dunk Tank Values | 43.8 | mL (burette) |
| Volume of Specimen | 1843.41 | mL |
| Average Height of Specimen | 205.87 | mm |
| Average Outside Diameter of Specimen | 100.02 | mm |
| Density of Salt only | | kg/m ³ |
| Dunk Tank Volume Factor: 114.073 mL/Burette Unit | | |

Table 12: Post Test Measurements

| Parameter | Values | Units |
|--|--------|-------------------|
| Salt Only - Volume: $V_{salt}^{(0)} = V_{salt}^{(0)} \cdot (1 - u)$ | | mL |
| Salt Only - Mass: $m_{salt}^{(0)} = m_{salt}^{(0)} \cdot (1 - u)$ | | kg |
| Salt Only - Density: $\rho_{salt}^{(0)} = m_{salt}^{(0)} / V_{salt}^{(0)}$ | | kg/m ³ |
| Salt Only - Fractional Density: $\beta = \rho_{salt}^{(0)} / 2160$ | 0.91 | |

Table 13: Post Test Density Calculations

Begin Heating
8/12 10:56 ConfP
8/12 3:49 pm ConfP
1.9 psi

On Laptop

445 mL expelled 155.6°C

Left overnight
8/13 2:55

480 mL expelled 171.0°C

Post Consolidation

| <u>D (mm)</u> |
|-------------------------------|
| 1) 100.1 |
| 2) 99.31 |
| 3) 100.94 |
| 4) 99.72 |
| Average 100.02 mm |
| 91.42 |
| $A_{av} = 65.64 \text{ cm}^2$ |

| <u>h (mm)</u> |
|---------------------------------|
| 1) 205.39 |
| 2) 206.56 |
| 3) 205.75 |
| 4) 205.78 |
| Average 205.87 mm |
| - 93.85 |
| = 112.37 |
| $V_{av} = 737.547 \text{ cm}^3$ |

$$p = 2123.79 \frac{\text{kg}}{\text{m}^3}$$

$$FD = 0.98$$