NRDCA 300 – "PROCEDURES TO DETERMINE THE ACCURACY OF MATERIAL MEASURING EQUIPMENT FOR LIGHTWEIGHT INSULATING CONCRETE"

I. Scope

Lightweight insulating concrete is field produced with specialized mixing equipment. A conveying system transfers measured raw materials into the mixing equipment. The accuracy of the measuring equipment determines the consistency of the insulating concrete and whether the concrete meets manufacturer's specifications. This document establishes methods to determine the accuracy of the raw material measuring equipment. Repair and re-calibrate equipment before continued use in making insulating concrete, should it not meet the required accuracy limits established in this document.

This document includes the methods of determining the accuracy and establishes accuracy limits for:

Load Cell
Water Meter
Cast Density Scale
Cast Density Calibrated Container

II. Reference Documents

A. Following are documents referenced in this document or that reference this document.

1. NRDCA 100 – "Guideline for Field Application of Aggregate Insulating Concrete Roof Deck Systems".

2. **NRDCA 175 – "Guideline for Field Application of Cellular Insulating Concrete Roof Deck Systems".**

3. **NRDCA 250– "Field Quality Control Procedures for Application of Insulating Concrete Roof Deck Systems".**

4. **NRDCA 400 - "Guideline for Field Application of Lightweight Insulating Concrete Reroofing / Recover Systems".**

III. Load Cell

A. General: The load cell may be either a mechanical or electromechanical device to weigh the cement for the insulating concrete mix. A load cell may also measure the weight of the mixer and its components after all raw materials have been added.

B. Frequency of Determining Accuracy and Accuracy Limits: The load cell must be checked for accuracy each time it is moved and set up in a new equipment site. The load cell may require accuracy testing more frequently if it shows erratic readings during normal operation.

Should the average of three accuracy measurements show the load cell readings to be greater than 10% in error, it must be repaired and re-calibrated before continued use.

C. Accuracy Procedure: This procedure requires the use of calibrated weights or a similar device shown in Attachment 1 and the following accuracy measuring steps.

1. Attach either a calibrated weight or the device shown in Attachment 1 to the load cell. Either device should apply a calibrated weight to the load cell approximately equal to 500 pounds. Load cell may be checked by a given volume of water for mixer weighing systems.

2. Record the scale reading in pounds and subtract the scale reading from the calibrated weight. If the difference is greater than 50 pounds, the load cell must be returned to a laboratory providing calibration service for repair and re-calibration. When continuing to use the current load cell for cement weight, increase or decrease the cement batch weight by the percent difference to complete the current project.

IV. Water Meter

A. General: The water meter is a mechanical device that measures the volume of water that flows through the meter.

B. Frequency of Determining Accuracy and Accuracy Limits: The water meter must be checked once every month to ensure the volume of water and the meter reading are in agreement.
Should the meter reading be more than 5% different than a known volume, the meter should be repaired and re-calibrated.

C. Accuracy Procedure: This procedure uses a container of known volume filled with water to compare to the water meter reading. Use either the water surge tank on the mixer or a 55-gallon drum to determine water meter accuracy.

1. Determine the volume of the calibrating container by measuring the inside diameter (inches) and inside length (inches) of the surge tank or 55-gallon drum. When using a surge tank, measure the inside diameter of the pipe from the tank to the dump valve and the length of the pipe.

2 Calculate the volume of the container in cubic inches using the formula below:

$$\text{Volume} = \frac{\Pi D^2}{4} \times L$$

Where: Π = 3.14
D = Diameter in inches of tank or pipe
L = Length in inches of tank or pipe

3. Divide the result by 231cubic inches/gallon to convert the calculated number in Section III. C. 2. from cubic inches to gallons.

4. Fill the calibrating tank three times and record the water meter reading each time. Average the three water meter readings. Calculate the difference between the average water meter reading and the calibrated tank volume. Determine the percent difference. If the average is more than 5% different than the know volume, have the meter repaired and re-calibrated. During the current water meter set up, the gallons of water required per batch can be increased or decreased by the calculated percent difference or another calibrated water meter can be installed to complete the current project.

5. Example of Calculating the Volume of a Surge Tank with Pipe:

Tank outside dimensions: 24" diameter, 48 5/16" long
Inside diameter of drain pipe: 5"

Length of pipe from tank to center of valve: 4 7/8"

Inside dimensions of tank are approximately ¼" smaller than outside dimensions. Therefore, the inside dimensions of the tank are 23 ¾" diameter and 48 1/16" long.

Volume of Tank: $\frac{3.1416\ (23.75)^2}{4}$ **x 48.06 = 21,291.29 cubic inches**

Volume of Pipe: $\frac{3.1416\ (5)^2}{4}$ **x 4.88 = 95.82 cubic inches**

Total Volume of Tank with Pipe = 21,387.11 cubic inches

Converted Gallons of Water = $\frac{21{,}387.11 \text{ cubic inches}}{231 \text{ cubic inches/gallon}}$ **= 92.6 gallons**

V. Cast Density Scale

A. General: The pound scale used to measure the cast density of insulating concrete may be either a platform scale or a hanging spring scale with a minimum weight capacity of 50 pounds or a capacity practical for the calibrated container.

B. Frequency of Determining Accuracy and Accuracy Limits: The scale must be checked weekly.

Repair and re-calibrate the scale should the scale accuracy measurements be greater than +/- 5.0%.

C. Accuracy Procedure: Use a known calibrated weight of at least 25 pounds to calibrate the scale.

1. **The calibrated weight must be attached to the scale or placed on the scale a minimum of three times. Record the scale reading for each weighing.**

2. **Calculate an average of the three scale readings. Subtract the average of the scale readings from the calibration weight. Calculate the percent difference between the two numbers. If the difference is greater than 5.0%, replace the scale or have it repaired before continuing to make cast density measurements.**

VI. Cast Density Calibrated Container

A. General: The volume of the cast density measurement container is critical to determining the cast density of the insulating concrete being placed. The cast density measurement container must be of solid construction in order to maintain its volume characteristics. Should the volume change because it is flexible when loaded with insulating concrete, the cast density measurement will not be accurate. A galvanized steel minimum 10-quart pail is recommended.

B. Frequency of Determining Accuracy and Accuracy Limits: The container calibration factor should be measured once a month. If the pail volume changes due to bending of the container or leaving dried concrete inside the container, re-calibrate the container or use a new container that has been calibrated.

Should the container calibration factor change by more than 3%, the container must be replaced with a new container that has been calibrated.

C. Accuracy Procedure: This procedure requires a scale with a minimum weighing capacity of 50 pounds and a cast density container.

1. Weigh the empty container in pounds.

2 Fill the container to the top with water.

3 Weigh the water filled container.

4. Subtract the empty container weight from the water filled container.

5. Divide the weight of water determined in Step 4 into 62.4 pounds/cubic foot. The resulting number is the calibration factor used in determining the concrete cast density.

D. Example of Determining Calibration Factor

A 10 quart metal container will be used in measuring the cast density of insulating concrete. What is the container calibration factor?

1. Using a calibrated scale, the container empty weight = 2.00 Pounds.

2. The weight of the water filled container is = 23.50 Pounds

3. The net weight of water is (23.5-2.0) = 21.50 Pounds

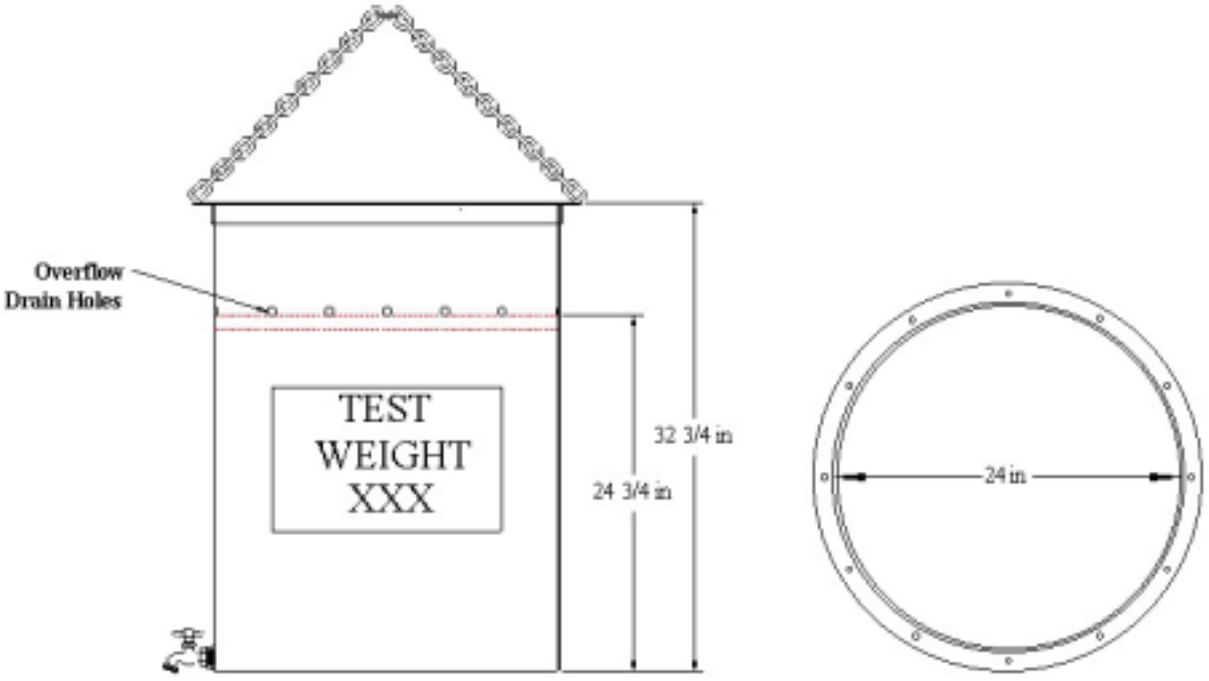
4. The Container Calibration Factor is (62.4/21.5) = 2.90 Pails/ cubic feet

(or by volume: 21.5/62.4 = 0.34 cubic feet)

Attachment 1: - Cement Load Cell Accuracy Measurement Using Water Weight

I. The device shown below, when filled with water to the indicated level will result in a calibrated weight of approximately 500 pounds. The actual calibrated test weight for the unit filled with water is on the unit label. The device will hang directly from the load cell and has a valve installed to release the water after the calibration procedure is completed. This device provides a portable but accurate method to create the dead load required in Section III, Load Cell Accuracy Procedure.

II. Design and Construction Details



NOTES:

1. EACH UNIT TO BE FILLED WITH WATER, WEIGHED AND MARKED AS TEST WEIGHT ON UNIT LABEL.
2. UNIT MUST BE KEPT CLEAN OF DEBRIS AND FILLED ONLY WITH WATER.
3. PERIODIC VERIFICATION OF ACTUAL WEIGHT REQUIRED FOR CONTINUED ACCURACY.