

Colorado Procedure – Laboratory 5304-15

Standard Method of Test for

Calibration of CDOT Nuclear Thin Layer Density Gauges

1. SCOPE

- 1.1 It is the intent of these procedures to describe the calibration of a nuclear thin layer density (TLD) gauge. These procedures will apply only to CDOT TLD gauges.
- 1.2 The CDOT Staff Materials - Nuclear Lab has a calibration bay designed to eliminate external influences in the calibration process. No new TLD gauge will be placed into operation on a Colorado state project until it has been calibrated within this controlled environment.
- 1.3 All CDOT TLD gauges will be re-calibrated annually. Any TLD gauge that has undergone major repair; that is, the replacement of detection tubes or the scaler will be re-calibrated regardless of when the calibration was performed last.
- 1.4 The validity of the test results obtained by the TLD gauge in the field are only as good as the gauge itself. Daily Reference Standard Counts are an essential element in the determination of a gauge's reliability and repeatability, often providing advance information of deteriorating components.

2. PRE-CALIBRATION INSPECTION

- 2.1 Inspect the gauge's U.S. DOT Type "A" carrying case to ensure that all requirements such as physical integrity and labeling are met. Clean the carrying case, make any repairs, and replace either of the required two "RADIOACTIVE YELLOW II" labels or the "DOT TYPE "A" RADIOACTIVE" label if necessary.
- 2.2 Inspect the gauge's reference standard block for any contamination. Reference standard blocks are not interchangeable; therefore, ensure that it is assigned the same identification number as the gauge.
- 2.3 Inspect the TLD gauge for damage or non-compliance with required radioactive source labels. If the label on the source rod handle is in any way illegible it shall be replaced. Clean the shell and the base plate of the gauge of any asphalt contamination, being careful to direct the base away from anyone in the immediate area. The Radiation Safety Officer should remove the base plate so that proper cleaning and lubrication can be performed. Remove the sliding shield and the shield spring. Clean the old grease and dirt out of the cavity and off all of the parts. The source rod should be extended quickly, to reduce exposure to radiation, and inspected for any damage as well as to be cleaned. Lubricate the bearings and the sliding shield. Install the sliding shield and spring into the cavity and re-attach the base plate.

Remove the scaler and inspect both the scaler and the inside of the gauge body. Verify that the electronics are clean, dry, and undamaged. If all electronic connections are solid re-attach the scaler.

- 2.4 The TLD gauge should be sufficiently charged to allow for three hours of continuous operation. Do not charge the gauge unless it has indicated that it needs a charge. However, if in doubt let the batteries run down and then apply a full 14 hour charge.
- 2.5 If the Pre-Calibration Inspection has been completed and all necessary repairs have been accomplished, the calibration can begin.

3. APPARATUS

- 3.1 CDOT Calibration Bay located at Staff Materials - Nuclear Lab.
- 3.2 Calibration blocks of: Magnesium (Mag), Magnesium/Aluminum (Mag/Alum), and Aluminum (Alum).
- 3.3 TLD gauge, Air Gap Spacer, and Reference Standard Block that have passed the pre-calibration inspection.
- 3.4 Operator must wear a personnel dosimeter, have the gauge binder with all of the required documentation, and a Weigh-Tronix Printer.

4. CALIBRATION PROCEDURE

- 4.1 A TROXLER TLD GAUGE PROMPTS THE OPERATOR THROUGH THE COMPLETE CALIBRATION PROCEDURE. THE STEP BY STEP INSTRUCTIONS LISTED HERE ARE BOTH DOCUMENTARY AND TO EXPEDITE THE DECISION PROCESS.
- 4.2 Key Gauge On. The gauge runs a 5 minute RAM Test.
- 4.3 Key SHIFT SPECIAL. Enter number 19.
- 4.4 EXTENDED FUNCTIONS
Enter code 528_
and Press ENTER
- 4.5 6 - Gauge Calib
- 4.6 -CALIBRATION-
Enter Code 528_
and Press ENTER
- 4.7 -4640B Recalib.-
2 - Three Block
- 4.8 -4640B Recalib.-
1 - New Recalib.
- 4.9 -4640B Calib.-
Bay #? 1

4.10 -4640B Calib.-
Tech #? 1

4.11 Dens Mg blk?
0.00 PCF
Input and
Press ENTER
111.50

4.12 Dens Mg/Al blk?
0.00 PCF
Input and
Press ENTER
137.50

4.13 Dens Al blk?
0.00 PCF
Input and
Press ENTER
168.80

4.14 Gauge on spacer,
Mg Ref, & Mg/Al.
Rod -> SAFE.
Press START

Note 1: On the Mag/Alum block place the Mag reference block flush with the leading edge of the block. Center the spacer and place the gauge on the spacer between the guides. Handle to the rear as indicated on the spacer. Before pressing START, the gauge should have been on for 30 minutes to allow the electronics time to warm-up.

4.15 **-STAT TEST-**
Reading #1 through Reading #20

4.16 **-STAT TEST-**
Avg: _____.____ P or F (Pass or Fail)
Avg: _____.____ P or F

Note 2: This standard deviation is compared to a theoretical value. Ideally this ratio should be one; however, the gauge prescales (or divides) the counts by 8, resulting in an ideal ratio of (0.35). The acceptable limits for the ratio are from (0.25) to (0.45). The gauge is considered to be unstable if the ratio is outside these limits.

4.17 Gauge on Mg
Rod -> Measure.
Press START for
20 min. count

- 4.18 Gauge on Mg
Rod -> Measure.
Time: _____ secs
- 4.19 Gauge on Mg
S1: _____
S2: _____
Press ENTER
- 4.20 Gauge on Mg/Al
Rod -> Measure
Press START for
20 min. count
- 4.21 Gauge on Mg/Al
Rod -> Measure
Time: _____ secs
- 4.22 Gauge on Mg/Al
S1: _____
S2: _____
Press ENTER
- 4.23 Gauge on Al
Rod -> Measure
Press START for
20 min. count
- 4.24 Gauge on Al
Rod -> Measure
Time: _____ secs
- 4.25 Gauge on Al
S1: _____
S2: _____
Press ENTER
- 4.26 Gauge on spacer,
Mg Ref, & Mg/Al.
Rod -> SAFE.
Press START
- Note 3:** TLD gauge placement should be as specified in Subsection 4.14.
- 4.27 **-DRIFT TEST-**
Reading #1 through #5

4.28 Avg: _____
Drift A: __.____% P or F
Drift B: __.____% P or F

View DRIFT data?

* The Pass/Fail tolerance is
0.50 % for System 1 &
0.80 % for System 2.

4.29 Standard count
Std 1: _____
Std 2: _____

4.30 -WORKING-
Calculations
A1, B1 and C1

A2, B2 and C2

4.31 Connect Weigh-Tronix Printer

4.32 Calib. complete.
Would you like
a hardcopy ? YES

4.33 -DOWN LOADING-
to printer.

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*****
Troxler Electronic Labs, Inc.
4640B Calibration 7/05/00
*****

Gauge serial #: 1113
Bay # 1 Tech # 1
Start Time: 12:38 PM
End Time: 3:23 PM

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Ready

Calibration Block Densities:

Mag - 111.50 PCF
Mag/Alu - 137.50 PCF
Alu - 168.80 PCF

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Ready

>>>>> Gauge Count Data <<<<<<

Stability test (20 1-min. cnts)

-----
Ready
Count # System 1 System 2
-----
1 5268 1605
2 5296 1597
3 5300 1584
4 5284 1622
5 5285 1624
6 5251 1597
7 5272 1597
8 5233 1610
9 5269 1621
10 5256 1608
11 5283 1625
12 5250 1599
13 5326 1650
14 5284 1626
15 5317 1615
16 5300 1619
17 5285 1632
18 5264 1624
19 5277 1624
20 5322 1638

Avg cnts: 5281 1616
Ratio: 0.34P 0.40P

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Ready
    
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20-minute Count
System 1 System 2
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Mag - 12311 2775
Mag/Alu - 10373 1778
Alu - 8531 1228

-----
Ready

Drift test (5 4-min. cnts)

-----
Count # System 1 System 2
-----
1 5291 1617
2 5290 1614
3 5307 1610
4 5283 1619
5 5294 1621

Avg cnts: 5293 1616
Drift: 0.23% P 0.00%P

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Ready

>>>>> Gauge Parameters <<<<<<
System 1

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Ready
A1 -23.54962591
B1 -0.00056181
C1 -27.37905323
A11 1.56861680
A12 1.96563623
A13 0.00498418
Prec: 0.47

System 2

-----
Ready
A2 15.03950386
B2 0.02112661
C2 -0.25003971
A21 1.17626667
A22 0.94040558
A23 0.00503772
Prec: 0.54

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Thickness DT Precision
-----
1.00 1.01
1.50 0.68
2.00 0.56
2.50 0.50
3.00 0.46
3.50 0.43
4.00 0.40

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Standard count - System 1 5293
System 2 1616
*****
x
    
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