Portable Nuclear Moisture- Density Gauges

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TROXLER®
The Leader in Construction Testing Equipment

Outline

- Compaction of Soil and Asphalt during Construction
- Portable Nuclear Gauges for Testing Compaction
- Radiological Properties of Portable Nuclear Gauges
- Safety & Security of Portable Nuclear Gauges

Compaction of Soil and Asphalt Layers

Compaction during construction is essential to increase the load bearing capacity of roads, airfields, building sites, embankments, parking lots, …

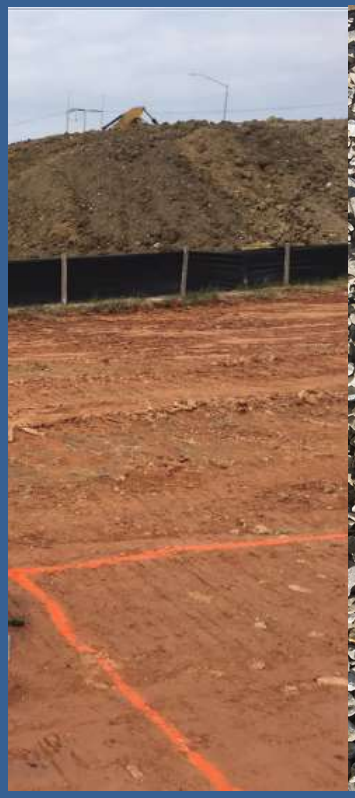
For Soil Layers:

For a given compaction effort, the degree of compaction depends on moisture content.

Compaction of Soil and Asphalt Layers

Density (= mass/volume) is a measure of Compaction.

Density and moisture measurements are used for QC/QA during construction.



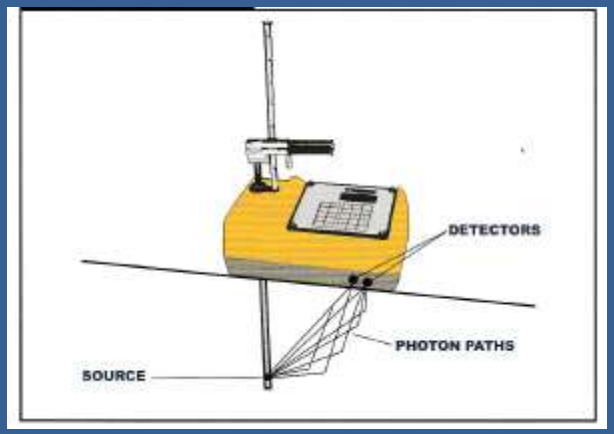
Measuring Density and Moisture in soils and asphalts is challenging because of the ***heterogeneity*** of the material.

- *Use of **large sample volumes*** give better density and moisture estimates

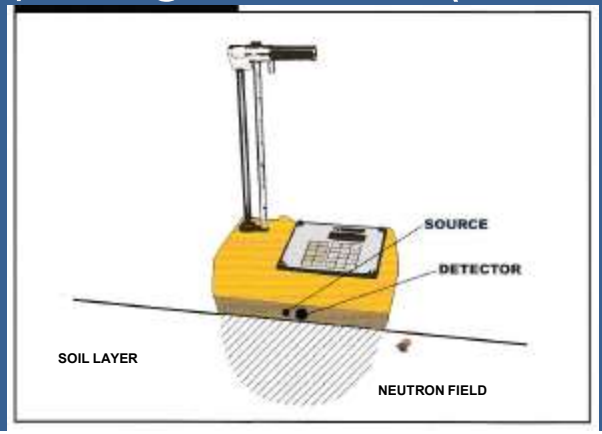
Portable Nuclear Gauges for Testing Compaction (Density & Moisture)

Nuclear gauges use radiation from sealed radioactive sources to scan ***large sample*** **volumes** and measure density and moisture.

- Density by using Gamma-rays (Cs-137)



- Moisture by using Neutrons (Am-241/Be)



Troxler Portable Nuclear Moisture-Density Gauges

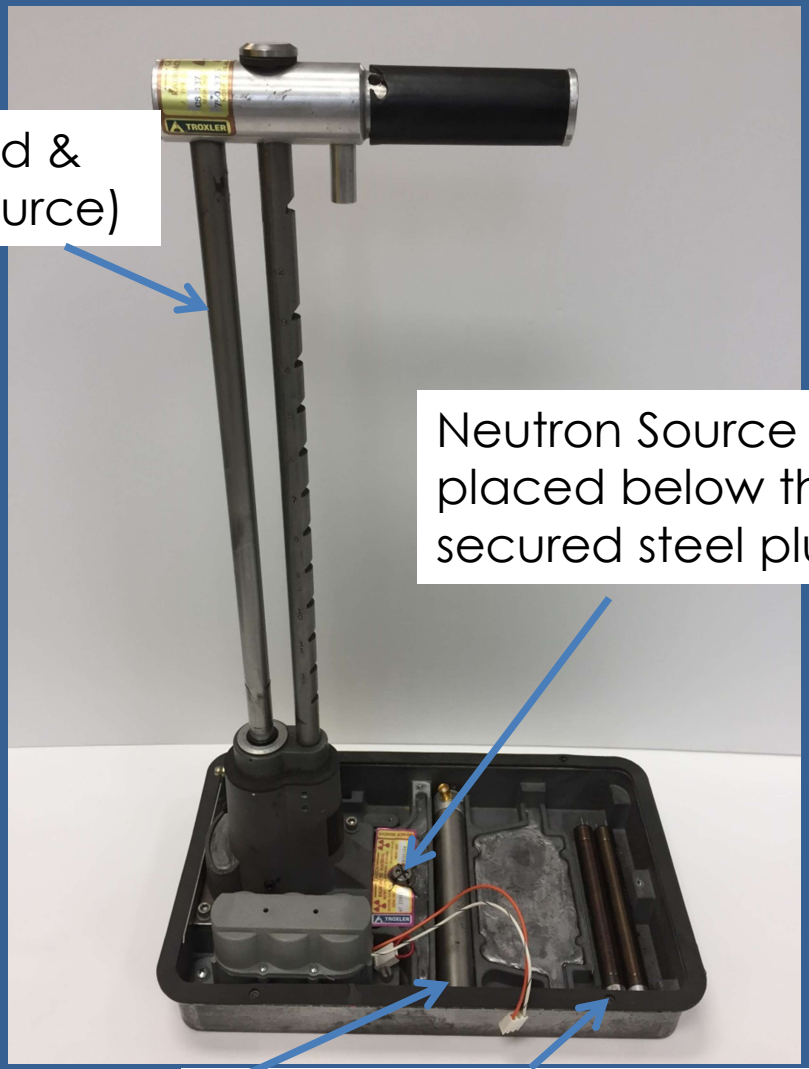
Radiological Specification

Model	3430 & 3440	3430 PLUS & 3440 PLUS
Gamma Source Activity Cs-137 ($T_{1/2}$ = 30.2 Yrs.)	8 mCi (0.3 GBq)	8 mCi (0.3 GBq)
Neutron Source Activity Am-241/Be ($T_{1/2}$= 432.2 Yrs.)	40 mCi (1.48 GBq)	40 mCi (1.48 GBq)
Maximum Dose at Surface	21 mrem/hr (0.21 mSv/hr)	31 mrem/hr (0.31 mSv/hr)
Released Year	1986	2006
US Licensing Type	Specific	Specific

Gauge Safety & Security: M3430 / M3440

Extendable Steel Rod & Handle (Gamma Source)

Gamma Source is placed inside the steel rod close to the tip.



Neutron Source is placed below the secured steel plug.

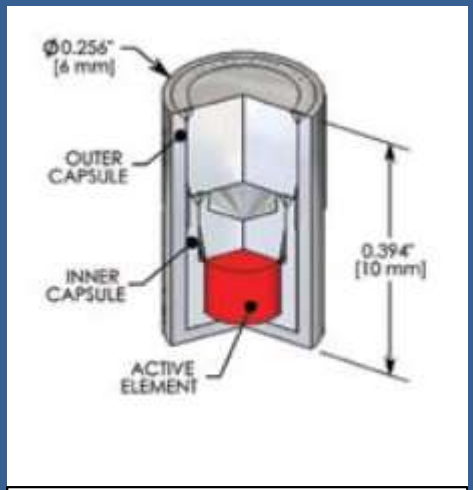
G-M Detector for Gamma

He-3 Detector for Neutron

Gauge Safety & Security: M3430 / M3440

Sealed-Sources

Gamma Source Nominal Activity	Cs-137 8 mCi (0.3 GBq)
Neutron Source Nominal Activity	Am-241/Be 40 mCi (1.48 GBq)
Source Type	Sealed Source Special Form IAEA Category 4 C66535 for Cs-137 C66545 for Am-241/Be
Source Housing	Doubly encapsulated Stainless steel



Source Capsule†

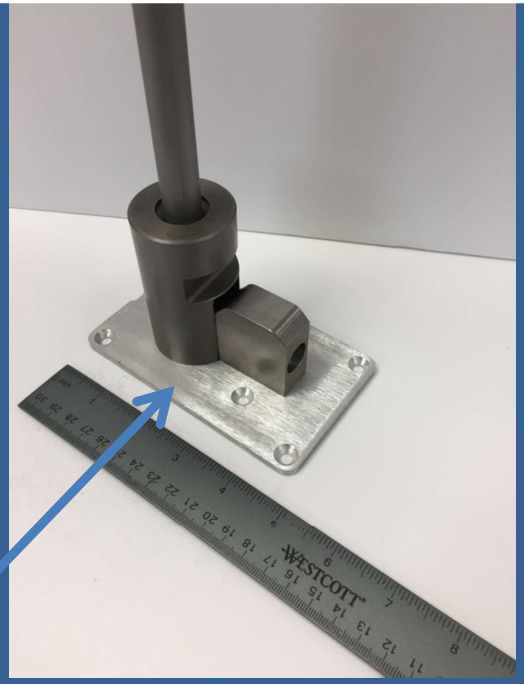
Source Rod

Source Rod showing the placement of the source capsule

† From Eckert & Ziegler Industrial Radiation Sources Catalog

Gauge Safety & Security: M3430 / M3440

Tungsten Bio-Shield & Shutter



Tungsten Bio-Shield and Shutter (sliding block) system is used to keep the Gamma Source shielded in SAFE position.

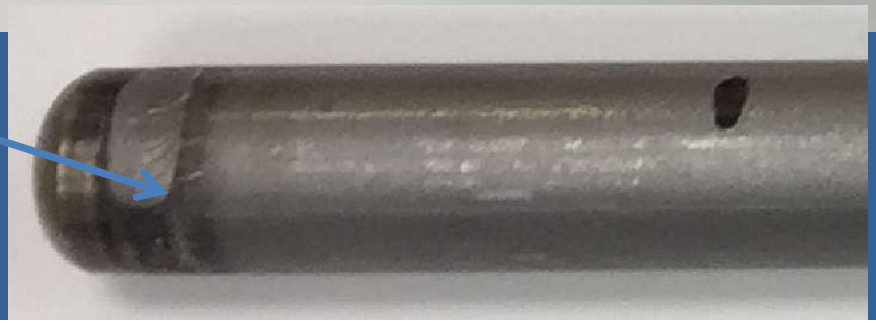
Bottom View: Tungsten Shutter (sliding block) in CLOSED position.

Gauge Safety & Security: M3430 / M3440

Source Rod Inspection

New Gauges: Source Rod Weld Inspection
-One source rod welded without a sealed source per month
This rod is inspected by Radiation Safety Officer and Quality Officer
-Every year, pick two such source rods randomly and send for metallurgical study to verify the quality of the weld

Old gauges coming for repair / service/ and calibration
-Source rod weld is inspected
-Shutter mechanism (sliding block) is inspected
-Source rod motion (for binding/jamming) checked and serviced



Gauge Safety & Security: M3430 / M3440

Prototype Gauge Testing

ANSI N43.8: Classification of
Industrial Ionizing Radiation Gauging Devices

Gauges Tested for mechanical, structural,
And radiological integrity.

Tests include:
- Temperature Extremes
- Vibration
- Drop Test

Highest dose rates

➢ at the surface of the gauge	~ 21 mrem/hr	(0.21 mSv/hr)
➢ at 1 m from the gauge	~ 0.7 mrem/hr	(0.007 mSv/hr)

Gauge Safety & Security: M3430 / M3440

US Regulatory Requirements

- License to own & operate
- Operator training
- Maintaining RAD safety program
- Monitor operator exposure to radiation
- Radioactivity leak testing
- Annual fees for regulatory agencies
- Multi state usage - Reciprocity
- HAZMAT training
- Type A certified shipping container
- Shipping papers

Portable Nuclear Gauges to Measure Density & Moisture

- Accurate- meets industry requirements (50+ years)
- Fast- Measurements in 1 to 4 minutes
- Test large sample volumes
- Safe to operate
  Security against radiation exposure to public
  (Gauge design &Regulatory restrictions)

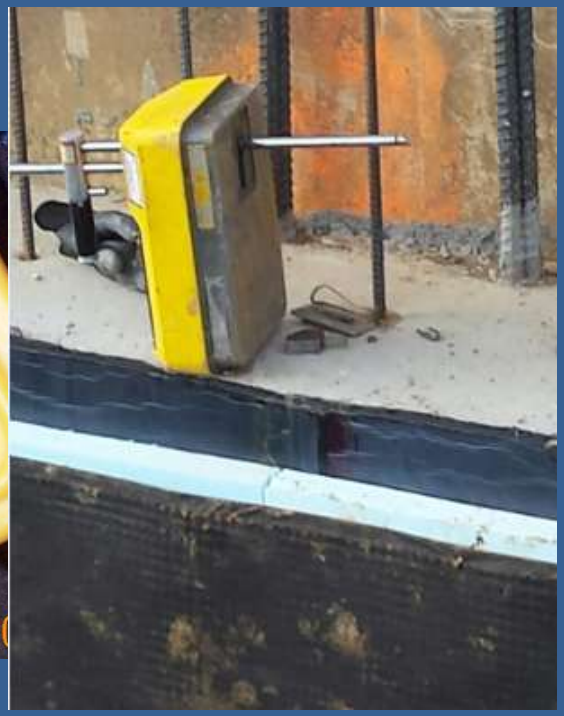
Model 3430 PLUS

Accidents, Negligence & Mishandling

Gauge in a Fire

Gauge ran over

Operator Mishandling



No radioactive material was released from any of the Source Capsules.

50+ Years of use of these gauges in real field conditions,
none of the Source Capsules have been found to be breached.