LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
SPECIFICATIONS

SURFACE MOISTURE & DENSITY GAUGE

DESCRIPTION:

The surface moisture and density gauge to be purchased under these specifications shall be the manufacturer's current production model and design. The unit described by these specifications must be furnished complete with standard accessories and transport case as described herein. **PROTOTYPES WILL NOT BE ACCEPTED.**

REQUIREMENTS:

Mechanical

Gauge	Colored Polycarbonate Top Shell with Aluminum Base
Vibration Test	0.1 in. (2.5 mm) at 12.5 Hz
Drop Test	300 mm on 25 mm Diameter Steel Ball
Operating Temperature:	
Ambient	14 to 158 F (-10 to 70 C)
Surface	350 F (175 C)
Storage Temperature	-70 to 185 F (-55 to 85 C)

The gauge sources, detectors, and electronics are to be housed in a machined or permanent mold aluminum base that is heat-treated and annealed to provide a rugged structure that is immune to physical damage except for major accidents. There must be no openings from the bottom surface to the interior which would allow ground water or soil to enter the instrument. All topside openings must be gasketed to maintain a clean environment.
The surface moisture and density gauge must sustain repeated drops from 12 inches (300 mm) on a 1-inch (25 mm) steel ball placed on any unyielding surface without damage or alteration of calibration.

The source rod shall be constructed of stainless steel and hardened to 45-55 Rockwell C to reduce wear and insure proper indexing of the measurement geometry. The indexing mechanism is to be made from hardened aluminum and be Teflon coated or steel hardened to 45 Rockwell C so that any wear is produced on parts that are easily replaceable. All interior mechanical parts shall be either anodized aluminum or stainless steel to prevent corrosion.

The index rod, source rod, and indexing mechanism shall be open so that visual inspection, cleaning, and lubrication may be performed without disassembly. Enclosures are not acceptable due to binding of the indexing mechanism that could be caused by damage to any enclosure. Source rod must return to a safe (or stored) position when transported by the carrying handle.

Gauge must be capable of automatic depth and manual depth indication.

Radiological

Gamma Source	CS-137, Must have between 8- 10 mCi
Neutron Source	AM241:Be, Must have between 40 - 44 mCi
Source Housing	Double encapsulated infusion-welded stainless steel capsules
Shielding	Tungsten, Lead and/or Cadmium
Surface Dose Rates	20 MREM/HR Max., Neutron and Gamma
Source Rod Material	Stainless Steel
Shipping Case	DOT 7A, Type A, Yellow II Label 0.6 or less Transport Index
Source Seal Approval for Domestic and International Shipment	CS-137, Special Form AM241:Be, Special Form

The instrument shall contain two (2) separate sealed sources so that moisture and density tests may be performed simultaneously in all measurement modes.

All biological shielding to be constructed of tungsten or cast lead. Cast lead shall be mounted in such a manner to negate cold flow and loss of shielding properties due to melting.

Battery Pack

The gauge shall operate on a rechargeable nickel-cadmium battery pack or on alkaline batteries. The device shall automatically power down the instrument to prevent measurement errors or destruction of the batteries due to deep discharge.

Must have low battery alarm and auto shutoff for low and dead batteries displayed on an LCD.

Full NiCad recharge must be made within 16 hours by means of a 110/220 Volt ac 50-60 Hz or a 12 Volt DC charger.

Electrical

Timer Stability	0.01% or Better
Stored Power Approximate	30 Watt-Hours
Battery Recharge Time	16 Hours (Automatic Cutoff)
Charge Source	110/220 V, 50 - 60 Hz and 12 V DC
Readout	4 X 16 Or 4 Line X 20 Alpha-Numeric Backlit LCD

Approximate Measurement (PCF)

	15 SEC.	1 MIN.	4MIN.
Direct Transmission Density, 6 inches:			
Precision at 120 PCF	0.42	0.21	0.11
Composition Error at 120 PCF	1.25	1.25	1.25
Surface Error (0.05 inch, 100% Void)	0.87	0.87	0.87
Backscatter Density (98%), 4 Inches:			
Precision at 120 PCF	1.00	0.50	0.25
Composition Error at 120 PCF	2.50	2.50	2.50
Surface Error (0.05 inch, 100% Void)	3.43	3.43	3.43
Moisture:			
Precision at 15 PCF	0.64	0.32	0.16
Surface Error (0.05 Inch, 100% Void)	1.12	1.12	1.12

Calibration

Gauges must be calibrated in accordance with the method required by ASTM D7759.

The density of the standards required by ASTM D7759 must be determined to an accuracy of 0.5% or better. The moisture standard must be calibrated to an accuracy of 2.0% or better.

Calibration Range: 70 - 170 PCF Density
0 - 40 PCF Moisture

Method: Computer Reduction of Count Rate Data based on U. S. National Bureau of Standards Photon Cross Sections, Neutron Cross Sections and Absorption Coefficients. Data is reduced to the form $D = (1/B) LN (A/ (CR + C))$ for density and $M = (CR-E)/F$ for moisture where A, B, C, E, and F are constants and CR is Count Ratio. The algorithm corrects for hydrogen photon scattering coefficients and provides means for offsetting non-water hydrogen. Direct calibration data entry by keypad.

Two (2) high temperature platinum lined geiger-muller detectors shall be provided for density measurements and one Helium-3 detector for the moisture measurements. The Helium-3 detector shall be totally insensitive to gamma radiation below 1 MeV to insure no interaction from the cesium-137 source.

No mechanical switches are allowed for interaction with gauge or for gauge operation. A minimum of three (3) measurement periods (15 second, 1 minute, and 4 minutes) will be provided.

Gauge must have capability of storing at least 320 complete test (32K of RAM) station records and a means to transfer this data via USB.

Gauge must contain a microprocessor providing direct reading in both SI and U.S. customary units for wet density, dry density, moisture content and percent moisture. (If the optimum density has been preset by the operator, the microprocessor can compute % of Marshall or % of Proctor and % Voids.)

SPECIAL FUNCTIONS TO BE FURNISHED:

1) Automatic standard count comparison and storage
2) Field offsets of density and moisture data
3) Field calibration for special soil types
4) Nomograph method for measurement of asphalt overlays
5) Method to negate for measurement of asphalt overlays
6) Automatic depth indicator with manual override
7) Self-test and service programs:
    a) Display, keypad, and ram test
    b) Statistical stability and drift test
    c) Gauge identification program
8) Neutron moisture measurement test mode
9) Backscatter density test mode
10) Direct transmission test mode capable of testing to 12 inches at 2 inch increments

SOFTWARE AND ACCESSORIES:

Gauge must come complete with the following:

1) One (1) software program for gauge calibration
2) One (1) sturdy, lockable transport case capable of storing all accessories furnished with the gauge as specified on page two of this specification
3) One (1) drill rod
4) One (1) drill rod removal tool
5) One (1) scraper plate
6) One (1) reference block
7) One (1) 110/220 Volt 50 - 60 Hz charger
8) One (1) 12 Volt DC charger
9) Alkaline battery pack cases, if applicable
10) One (1) operators manual
11) A mobile application for data transfer to a smartphone or tablet
12) GPS locations for measurements
13) A USB port for data transfer

WARRANTY:

Gauge must include a minimum one (1) year warranty.

APPROVED BRANDS/MODELS:

Troxler, Model 3440; Humboldt, Model HS-5001 EZ; Instrotek, Model 3500

Product must be one of the DEQ brands and models listed above and be listed on the

Louisiana Department of Transportation and Development's radiation license.