

# **Nuclear Gauge Testing Manual**

**Edition 4**

**August 2023**

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## Introduction

### 1 Scope

This manual is applicable to the use of both the nuclear surface moisture-density gauge and the nuclear thin-layer density gauge.

- Nuclear surface moisture-density gauges have been designed specifically to measure the density and/or moisture content of earthen materials (for example, soil or crushed rock) and asphalt. These earthen materials may be unbound or treated with stabilising agents such as cement, foamed bitumen or lime.
- Nuclear thin-layer density gauges have been designed specifically for the density measurement of thin layers of asphalt.

Within this manual, both gauge types, or combinations of these gauge types, are referred to as nuclear gauges.

### 2 Content

The manual contains four parts as follows:

- Part 1: *Introduction*
- Part 2: *Calibration*
- Part 3: *Test methods*, and
- Part 4: *Operating instructions*.

### 3 Definitions

#### 3.1 Standard definitions

The standard definitions listed in Table 3.1 shall apply to the *Nuclear Gauge Testing Manual*.

**Table 3.1 – Standard definitions**

Term	Definition
Plant-mixed stabilisation	Involves the stationary pug mill mixing of a stabilisation agent with an unbound granular material sourced from a quarry or reclaimed construction and demolition waste (usually concrete). The quality of unbound granular pavement material used in plant mixing must conform to an unbound pavement specification.
Sample	The material to be forwarded for examination and/or testing which is representative of a lot. A sample is either a single entity (a spot sample) or, more usually, a representative sample, and derived by combining sample increments of approximately equal quantities from a lot, and thoroughly mixing to provide a single uniform sample and then dividing the sample into a suitable quantity for examination and/or testing.
Test location	The location, described in terms of longitudinal, lateral and, if required, vertical distance from where a single insitu test is performed.
Unbound materials	Quarry materials, natural gravels or recycled materials produced for base and sub-base pavement construction.

### 3.2 Definitions in other publications

Further relevant definitions are contained in the following Austroads publication and Transport and Main Roads [Technical Specifications](#):

- a) [Austroads Glossary of Terms](#)
- b) MRTS01 *Introduction to Technical Specifications*
- c) MRTS04 *General Earthworks*
- d) MRTS05 *Unbound Pavements*
- e) MRTS06 *Reinforced Soil Walls*
- f) MRTS07A *In situ Stabilised Subgrades using Quicklime or Hydrated Lime*
- g) MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blends*
- h) MRTS07C *In situ Stabilised Pavements using Foamed Bitumen*
- i) MRTS08 *Plant-Mixed Heavily Bound (Cemented) Pavements*
- j) MRTS09 *Plant-Mixed Foamed Bitumen Stabilised Pavements*
- k) MRTS10 *Plant-Mixed Lightly Bound Pavements*, and
- l) MRTS30 *Asphalt Pavements*.

### 3.3 Standard abbreviations

The standard abbreviations listed in Table 3.3 shall apply to the *Nuclear Gauge Testing Manual*.

**Table 3.3 – Standard abbreviations**

Abbreviation	Definition
BS	Backscatter
CPN	Campbell Pacific Nuclear

### 3.4 Abbreviations in other publications

Further relevant abbreviations are contained in the *Austroads Glossary of Terms*.

## 4 Referenced documents

### 4.1 Australian Standards

Table 4.1 lists the Australian Standards including Austroads Test Methods referenced in the *Nuclear Gauge Testing Manual*.

**Table 4.1 – Referenced Australian Standards**

Reference	Title
AS 1289.1.4.2	<i>Methods of testing soils for engineering purposes, Method 1.4.2: Sampling and preparation of soils – Selection of sampling or test sites – Stratified random number method</i>
AS 1289.2.1.1	<i>Methods of testing soils for engineering purposes, Method 2.1.1: Soil moisture content tests – Determination of the moisture content of a soil – Oven-drying method (standard method)</i>

Reference	Title
AS 1289.2.1.2	<i>Methods of testing soils for engineering purposes, Method 2.1.2: Soil moisture content tests – Determination of the moisture content of a soil – Sand bath method (subsidiary method)</i>
AS 1289.2.1.4	<i>Methods of testing soils for engineering purposes, Method 2.1.4: Soil moisture content tests – Determination of the moisture content of a soil – Microwave-oven-drying method (subsidiary method)</i>
AS 1289.2.1.5	<i>Methods of testing soils for engineering purposes, Method 2.1.5: Soil moisture content tests – Determination of the moisture content of a soil – Infrared lights method (subsidiary method)</i>
AS 1289.2.1.6	<i>Methods of testing soils for engineering purposes, Method 2.1.6: Soil moisture content tests – Determination of the moisture content of a soil – Hotplate drying method</i>
AS 1289.2.3.1	<i>Methods of testing soils for engineering purposes, Method 2.3.1: Soil moisture content tests – Establishment of correlation – Subsidiary method and the standard method</i>
AS 1289.5.8.4	<i>Methods of testing soils for engineering purposes, Method 5.8.4: Soil compaction and density tests – Nuclear surface moisture-density gauges – Calibration using standard blocks</i>
AS 2891.1.2	<i>Methods of sampling and testing asphalt, Method 1.2: Sampling – Coring method</i>
AS/NZS 2891.9.2	<i>Methods of sampling and testing asphalt, Method 9.2: Determination of bulk density of compacted asphalt – Presaturation method</i>
AS/NZS 2891.14.3	<i>Methods of sampling and testing asphalt, Method 14.3: Field density tests – Calibration of nuclear thin-layer density gauge using standard blocks</i>
AS/NZS 2891.14.4	<i>Methods of sampling and testing asphalt, Method 14.4: Field density tests – Calibration of nuclear surface moisture-density gauge – Backscatter mode</i>

## 5 Principles of measurement

### 5.1 Nuclear gauge components

The essential components of a nuclear gauge comprise a source of gamma radiation for density measurement, a source of neutron radiation for moisture content measurement, detectors of gamma radiation and slow neutron radiation as appropriate, and electronics to convert the detected radiation into measures of density / moisture content.

### 5.2 Density measurement

Nuclear gauges use the emission and detection of gamma radiation for the measurement of the density of a material. Gamma radiation is a form of high-energy radiation which readily penetrates most materials. In the transmission of gamma rays between a source and detector, a proportion of these rays will be absorbed and scattered in accordance with the density of the material between the source and detector. As the density of this material increases, the number of gamma rays absorbed and scattered increases and the number reaching the detector decreases.



A relationship then exists between the detected gamma radiation and the density of the material. This relationship is commonly expressed in the following form:

$$\text{DCR} = A e^{B\rho} - C$$

where    DCR    =    density count ratio  
           $\rho$         =    density of the material  
          A, B, C    =    calibration constants for the nuclear gauge

The electronics of the gauges referenced in this manual use this exponential relationship to display density directly for a given value of count ratio.

An isotope of caesium (Cs - 137) is used as the source of gamma radiation in nuclear gauges for the measurement of density. The quantity of radioactive material used in the gamma source is usually either 0.296 or 0.37 GBq.

### 5.3    **Moisture content measurement**

Nuclear surface moisture-density gauges use the emission and detection of neutron radiation for the measurement of the moisture content of a material. Neutrons are emitted into a material and collisions occur between these neutrons and the nuclei of atoms within the material. These collisions will successively reduce the energy of these neutrons until they are slowed sufficiently to allow them to be detected by a 'slow neutron' detector.

The most effective collision by far in producing slow neutrons is that between a neutron and a nuclei of about the same mass (that is, hydrogen). The number of slow neutrons produced in a material is then proportional to the number of hydrogen atoms in the material. For most soil-type materials where hydrogen is present only in the form of water, the number of slow neutrons detected is directly proportional to the moisture content of the material.

A relationship can then be established between the detected slow neutron radiation and the moisture content of the material. This relationship is commonly expressed in the following form:

$$\text{MCR} = F(W) + E$$

where    MCR    =    moisture count ratio  
          W        =    moisture content of the material  
          E, F     =    calibration constants for the nuclear gauge

The electronics of the gauges referenced in this manual use this equation to display moisture content directly for a given value of count ratio.

An isotope of americium (Am-241) in combination with beryllium (Be) is used as the source of neutrons for nuclear surface moisture-density gauges for the measurement of moisture content. The quantity of radioactive material used in the neutron source is usually either 1.48 or 1.85 GBq.

### 5.4    **Density measurement modes**

Nuclear surface moisture-density gauges are designed to use the emission and detection of gamma radiation for determining density in two measurement modes – direct transmission and backscatter.

The direct transmission method involves placing the source and detector on opposite sides of the material to be measured (that is, detector on the surface and source within the material). The gamma radiation emitted from the source then passes through the material to be measured before it is detected. This method is partially destructive in that it requires a hole to be formed in the material to locate the source; however, it does provide a measure of the average density of the material between the source and detector. Measurement positions are normally provided to 300 mm in increments of 25 mm.

The backscatter method commonly uses one measurement position (for example, BS in Troxler, Humboldt and Instrotek gauges) or two measurement positions (for example, BS and AC in CPN gauges). It involves placing the source and detector on the same side of the material to be measured (that is, on the surface). The gamma radiation emitted from the source is then scattered back towards the detector if it is to be detected. This method is performed rapidly and is truly non-destructive; however, it has restricted measurement depth and its measurements are biased toward the surface of the material with about 80 to 90 percent of its measurement coming from the top 50 mm of material for the BS measurement position. It does not provide a true measure of the average density of the material. The backscatter method is also very sensitive to surface roughness and is less precise than the direct transmission method.

Due to its sensitivity to surface roughness and inferior accuracy and precision, the backscatter method has been excluded from this manual as an option for the density measurement of soil-type materials; however, it has been retained as the preferred option for the density measurement of asphalt where problems associated with surface roughness and measurement depth are reduced, and where its rapid and non-destructive nature compensates for its inferior accuracy and precision.

The nuclear thin-layer density gauge uses two backscatter geometries to provide independent measures of material density. Mathematical computation of responses from the two geometries then allows a reduction in the influence from the underlying layer on density measurement. Use of this gauge is restricted to asphalt having a nominal maximum size not greater than 40 mm and a nominal layer thickness between 25 and 100 mm. This is the only nuclear gauge method allowed for the density measurement of compacted asphalt having a layer thickness between 25 and 50 mm.

For nuclear thin-layer density gauges, a relationship has been developed to combine numerically the independent measures of material density to calculate the overlay density. This relationship is commonly expressed in the following form:

$$\rho_T = \frac{K_2\rho_1 - K_1\rho_2}{K_2 - K_1}$$

where  $\rho_T$  = density of the overlay material  
 $\rho_1$  = system 1 density of the material  
 $\rho_2$  = system 2 density of the material  
 $K_1, K_2$  = values that quantify the influences of the density of the overlay material and of the underlying material on the density measured by the gauge.

The values of  $K_1, K_2$  are calculated using the overlay thickness and depth factor calibration constants determined for each density system in the gauge.

## 5.5 Moisture measurement mode

The emission of neutron radiation and detection of 'slow neutron' radiation for the determination of moisture content is not designed for direct transmission measurement. It is conducted only in a backscatter mode with the source and detector positioned close together to provide a linear relationship between detected radiation and moisture content.

The effective measurement depth for moisture content varies according to the moisture content of the material and decreases with increasing moisture content. For a moisture content range of 0.1 to 0.3 t/m<sup>3</sup>, the measurement depth is about 250 to 200 mm respectively; however, detection of 'slow neutrons' relies on diffusion to the detector and, as such, moisture content measurements are biased towards the surface of the material. This bias will not affect the accuracy of moisture content measurement, provided that the water within the material is evenly distributed.

## 6 Calibration

### 6.1 Standard blocks calibration

Standard blocks calibration is a prerequisite for nuclear gauge measurement of both density and moisture content. It allows the conversion of nuclear gauge count data to measures of density and moisture content. Standard blocks calibration is described in Part 2 of this manual and is performed in accordance with the relevant Australian Standard as follows:

- Nuclear surface moisture-density gauge (direct transmission) AS 1289.5.8.4
- Nuclear thin-layer density gauge AS/NZS 2891.14.3
- Nuclear surface moisture-density gauge (backscatter) AS/NZS 2891.14.4.

The standard blocks calibration determined for a nuclear gauge will vary according to the particular type of standard blocks set chosen and the number, uniformity and composition of the standard blocks within the set. While standard blocks calibration methods allow the use of any one of two types of block sets, it places few conditions on the blocks selected for each set and makes no attempt to align the calibrations obtained from different block sets.

It is accepted that standard blocks calibration of nuclear gauges will not be undertaken by each user and will be restricted to those organisations and laboratories having the appropriate facilities; however, the user is required to arrange for standard blocks calibration and undertake calibration checks in accordance with the procedures and time frames specified in this manual.

### 6.2 Calibration adjustment – material bias

It is recognised that the density and moisture content results obtained from traditional tests (for example, sand replacement, core density) will differ from those results obtained from a nuclear gauge calibrated against standard blocks. The cause of this difference is due to a combination of factors relating to calibration (accuracy, precision), testing (test precision, commonality of tested material), material condition (surface roughness, density / moisture gradients, homogeneity) and material type (chemical composition). The contribution of each of these factors is not easily determined and will vary from job to job.

This difference (traditional test result – nuclear gauge test result) can be either positive or negative but tends to be positive for most materials (that is, nuclear gauge test tends to provide lower density results than those obtained using traditional tests). For many materials, this difference is small and can be ignored; however, for some materials, it is substantial, and adjustment of the standard blocks calibration may be necessary.

The approach adopted within this manual in relation to adjustment of the standard blocks calibration is as follows:

- For moisture content measurement of earthen materials, calibration adjustment is always made via a material bias for soil moisture content as determined from comparative nuclear gauge and oven-drying moisture content results.
- For wet density measurement of earthen materials, calibration adjustment is made via a material bias for soil wet density as determined from comparative nuclear gauge and sand replacement wet density result. For materials used in pavement layers and stabilised materials, calibration adjustment is always made.
- For density measurement of asphalt, calibration adjustment is always made via a material bias for asphalt density as determined from comparative nuclear gauge and core sample compacted density results.

The procedure adopted for calibration adjustment involves determining that value which, when applied to the nuclear gauge result, most closely approximates the traditional test result in the average case. The basic assumption behind this procedure is that the real difference between the nuclear gauge and traditional test results is constant over the property range and that a single adjustment only needs to be applied.

The calibration adjustment procedure also includes certain checks to ensure that the limited data used in adjustment of the standard blocks calibration is not erroneous as follows.

- The nuclear gauge test results are validated by plotting the count ratio and test data from the nuclear gauge to ensure all data points lie on the plot. For thin-layer gauges, the test results are validated by plotting the count ratio and test data for both density systems of the nuclear gauge to ensure all data points lie on the plot.
- The traditional test results used in determining the calibration adjustment are checked by determining their scatter around the adjusted standard blocks calibration in terms of an estimate of the standard error. Analysis of such data reveals that the standard error should not be greater than 0.055 t/m<sup>3</sup> for soil wet density, 0.025 t/m<sup>3</sup> for asphalt density and 0.020 t/m<sup>3</sup> for soil moisture content.
- The calibration adjustment for a material type or condition is checked regularly by obtaining additional calibration data and using these data to upgrade and confirm the adjustment. Minimum requirements are included for the frequency of such checks.

## **7 Test Methods and operating instructions**

Part 3 of this manual contains Test Methods for determining the insitu dry density of soil materials, the insitu density of asphalt and the associated material biases for soil moisture content, soil wet density and asphalt density. Part 4 of this manual contains operating instructions for taking a standard count, performing a statistical count, setting the test parameters and taking a measurement. The operating instructions relate to the makes and models of nuclear gauge listed in Table 2.

The Test Methods and operating instructions are based on specific information contained within the manufacturer's instruction manual for a gauge, together with best practice guidelines developed over four decades of nuclear gauge use within the Department of Transport and Main Roads. In general, standardised procedures have been developed for all nuclear gauge makes / models, particularly in the areas of gauge verification and stability analysis, count periods, gauge orientation and site preparation. Consequently, while there may be some procedural differences from the manufacturer's recommendation for some gauges, such differences will only enhance the accuracy and precision of the nuclear gauge results obtained.

For the testing of soils and crushed rock materials, results are obtained from two orientations of the nuclear gauge at each test site to determine site density and/or moisture content. The use of two orientations at 90° provides a larger testing area with little increase in overall testing time. It also allows a check to be performed on the results obtained from the nuclear gauge. Based on an analysis of data from these two orientations, the difference in dry density results between the two orientations at 90° should be no more than 0.075 t/m<sup>3</sup>. The use of two orientations then provides an improved estimate of the average density / moisture content of the site.

For the testing of asphalts, results are obtained from two orientations of the nuclear gauge at each test site to determine site density. The use of two orientations at 180° provides a larger testing area with little increase in overall testing time. It also allows a check to be performed on the results obtained from the nuclear gauge. Based on an analysis of data from these two orientations, the difference in density results between the two orientations at 180° should be no more than 0.075 t/m<sup>3</sup>. The use of two orientations then provides an improved estimate of the average density of the site.

Various procedures are suggested by nuclear gauge manufacturers to check the performance of nuclear gauges. Standard count checks, gauge function checks and density system consistency checks have been adopted for all gauge makes / models identified within this manual to assess gauge performance. Any variation in the acceptance limits used by the manufacturer and this manual are due to differences in the methods used for data analysis rather than differences in the required levels of performance.

## **8 Safety**

This manual does not attempt to address all safety concerns, if any, associated with its use. It is the responsibility of the user of this manual to establish appropriate occupational health and safety practices that meet statutory regulations.

Nuclear gauges contain radioactive substances which continuously emit gamma and neutron radiation. Although the quantity of radioactive material is small, it is important that the use of nuclear gauges is in accordance with the user's approved Radiation Safety and Protection Plan.

## **9 Notes**

Information contained in sections with the heading 'Notes on method' is for guidance in understanding or clarifying the associated requirement.

## **10 Approved gauges**

The nuclear gauges approved for use on Queensland Department of Transport and Main Roads projects are shown in Table 10.

**Table 10 – Approved gauges**

<b>Troxler</b>	<b>Campbell Pacific Nuclear</b>	<b>Humboldt</b>	<b>InstroTek</b>
3440P	MC3 Elite	5001EZ-2	Xplorer2 3500
3430P	MC1 Elite	5001SD	Xplorer 3500
3440		5001EZ	
3430			
4640B			

## Calibration

### 1 Nuclear gauge calibration

#### 1.1 General

Prior to the use of a nuclear gauge for density and/or moisture content testing, calibration of the density and/or moisture systems of the nuclear gauge shall be performed in accordance with the relevant Australian Standard as follows:

- Nuclear surface moisture-density gauge (direct transmission) AS 1289.5.8.4
- Nuclear thin-layer density gauge AS/NZS 2891.14.3
- Nuclear surface moisture-density gauge (backscatter) AS/NZS 2891.14.4

Additional calibrations of the nuclear gauge shall be undertaken at least once every two years and following any major repair or component replacement.

#### 1.2 Density system consistency check

Density system consistency checks shall be performed at least monthly to confirm the density calibration for each calibrated source rod position. Such checks are performed on a density standard block as described in the relevant Australian Standard or a secondary block of naturally-occurring stone.

A secondary block shall conform with the following:

- minimum dimensions of length 500 mm, width 290 mm and depth not less than 200 mm and at least 50 mm deeper than the greatest depth at which the check will be conducted
- placed in a fixed location, which is at least 1 m from any vertical projection and sufficiently clear of other nuclear gauges or radiation sources to have no effect on nuclear gauge density measurement of the block
- for backscatter measurement, the nuclear gauge base is fully confined within the top surface of the block and clear of any direct transmission access hole, and
- for direct transmission measurement, the block contains an access hole of diameter 30 mm maximum drilled normal to the top surface of the block. The access hole is located to ensure the nuclear gauge base is confined fully within the top surface of the block during both direct transmission and backscatter measurement.

Measurement positions are marked on the block for direct transmission and backscatter measurement (where required) to ensure that all measurements for a nuclear gauge will be made on the same position on the block.

##### 1.2.1 Initial measurement

An initial density measurement of the standard density / secondary block for a nuclear gauge is made prior to its use in the field and within one month of its calibration being determined. The procedure shall be as follows:

- a) Determine a standard count and perform a Standard Count Check in accordance with Clause 5.1 of Test Method N01, N04 or N06 as appropriate (refer to Part 3 of this manual).
- b) Perform a Gauge Function Check – Statistical Performance in accordance with Clause 5.2 of Test Method N01, N04 or N06 as appropriate (refer to Part 3 of this manual).
- c) Position the nuclear gauge within the appropriate marked position on the block.

- d) Move the source rod to the calibrated position to be checked and take eight 1-minute density readings or equivalent combination, in accordance with the appropriate Operating Instruction detailed in Part 4 of the manual.
- e) Record the mean density as the initial gauge density of the block for the calibrated position ( $\rho_i$ ).
- f) Repeat Steps (d) and (e) for each of the remaining calibrated source rod positions (note: for a nuclear thin-layer density gauge, the check is performed for test thicknesses of 25 (25.4) mm, 50 mm, 75 mm and 100 mm).

### 1.2.2 Subsequent measurement

For each calibrated source rod position, further density measurements of the block using the nuclear gauge are made prior to use in the field, at intervals not exceeding one month or if it is suspected that the gauge is malfunctioning. The procedure shall be as follows:

- a) Determine a standard count and perform a Standard Count Check in accordance with Clause 5.1 of Test Method N01, N04 or N06 as appropriate (refer to Part 3 of this manual).
- b) Perform a Gauge Function Check – Statistical Performance in accordance with Clause 5.2 of Test Method N01, N04 or N06 as appropriate (refer to Part 3 of this manual).
- c) Position the nuclear gauge within the appropriate marked position on the block.
- d) Move the source rod to the calibrated position to be checked and take at least four one-minute density readings, or equivalent combination, in accordance with the appropriate Operating Instruction detailed in Part 4 of this manual.
- e) Record the mean density as the current gauge density of the block for the calibrated position ( $\rho_c$ ).
- f) Repeat Steps (d) and (e) for each of the remaining calibrated source rod positions (note: for a nuclear thin-layer density gauge, the check is performed for test thicknesses of 25 (25.4) mm, 50 mm, 75 mm and 100 mm).

### 1.2.3 Gauge acceptance

Accept the density calibration for a particular source rod position, provided that the difference between  $\rho_i$  and  $\rho_c$  is no greater than 0.020 t/m<sup>3</sup> for direct transmission measurements and 0.050 t/m<sup>3</sup> for backscatter measurements. Otherwise, withdraw the gauge from service for the calibrated position until the reason for the fault is determined and the fault rectified. Depending on the type of repair undertaken, the gauge may require recalibration.

### 1.2.4 Gauge relocation

If a gauge is relocated to an area remote from the standard density / secondary block, and a different block will be used for this check, the value(s) of  $\rho_i$  for this block shall be determined as follows:

- a) During the 24-hour period prior to transporting the gauge, determine the final gauge density of the block ( $\rho_f$ ) for each of the calibrated source rod positions in accordance with Steps (a) to (f) of Clause 1.2.1 (note: for a nuclear thin-layer density gauge, the check is performed for test thicknesses of 25 (25.4) mm, 50 mm, 75 mm and 100 mm).
- b) Assess the gauge for acceptance in accordance with Step 1.2.3 using  $\rho_i$  and  $\rho_f$ .



- c) Provided that this check allows acceptance of the density calibration for the gauge, perform an initial density measurement ( $\rho_{i2}$ ) on the new block in accordance with Steps (a) to (f) of Clause 1.2.1, prior to its use in the field and within one month of its arrival at the new location (note: for a nuclear thin-layer density gauge, the check is performed for test thicknesses of 25 (25.4) mm, 50 mm, 75 mm and 100 mm). Adjust the initial density measurement on the new block for movement in the measurements on the initial standard density / secondary block. Calculate the adjusted initial density measurement  $\rho_{i2a} = \rho_{i2} - |\rho_f - \rho_i|$  for each of the calibrated source rod positions on the new block.
- d) Perform subsequent density system consistency checks ( $\rho_{c2}$ ) on the new block for each of the calibrated source rod positions in accordance with Steps (a) to (f) of Clause 1.2.2, prior to its use in the field and at intervals not exceeding one month or if it is suspected that the gauge is malfunctioning.

### **1.2.5 Relocated gauge acceptance**

Accept the density calibration for a particular source rod position, provided that the difference between  $\rho_{i2a}$  and  $\rho_{c2}$  is no greater than 0.020 t/m<sup>3</sup> for direct transmission measurements and 0.050 t/m<sup>3</sup> for backscatter measurements. Otherwise, withdraw the gauge from service for the calibrated position until the reason for the fault is determined and the fault rectified. Depending on the type of repair undertaken, the gauge may require recalibration.

## Test Method N01: Compacted density of soil – nuclear gauge

### 1 Source

This method was developed in-house using techniques evolved through internal departmental research investigations and incorporates information provided by nuclear gauge manufacturers.

### 2 Scope

This method sets out the procedure for the determination of the compacted density of soils and crushed rock materials using a nuclear surface moisture-density gauge in the direct transmission mode. Insitu dry density is determined from measured values of wet density and moisture content.

For wet density measurement, an adjustment is made to the wet density for all materials used in pavements (for example, unbound materials such as quarry materials or natural gravels, insitu stabilised materials or plant-mixed stabilised materials) and for all other stabilised materials. For nuclear gauge moisture content measurement, an adjustment is made to the moisture content as determined from comparative nuclear gauge and oven-drying moisture content results.

Where it is not practical to use a nuclear gauge to measure insitu moisture content, the standard oven-drying method, or a subsidiary method can be used. The use of a subsidiary method is conditional on a correlation established with the oven-drying method in accordance with Test Method AS 1289.2.3.1.

### 3 Apparatus

The following apparatus is required:

- 3.1 Nuclear gauge of an approved make and model as listed in Part 1, Section 6 of the *Nuclear Gauge Testing Manual*, logbook, manufacturer's handbook for the gauge and capable of the following:
  - a) direct transmission measurement in 25 mm increments from 50 mm to 300 mm
  - b) uncertainty of the predicted density at the depth used for the test not exceeding 0.06 t/m<sup>3</sup>, and
  - c) uncertainty of the predicted water content not exceeding 0.07 t/m<sup>3</sup>.
- 3.2 Reference block, as supplied by the manufacturer with the nuclear gauge, traceable to the nuclear gauge and used for the calibration of the gauge.
- 3.3 Drill, a rotary hammer drill or a drill rod and hammer capable of forming a hole at least 16 mm in diameter.
- 3.4 Guide plate, a flat metal template at least the same size as the base of the nuclear gauge, with a hole in one end for the drill rod.
- 3.5 Fines, dry fine sand or dry native fines passing a 0.600 mm test sieve.
- 3.6 Brush.

## **4 Calibration and biasing**

Calibration and biasing shall be performed as follows:

### **4.1 Standard blocks calibration**

Calibrate the nuclear gauge on standard blocks at least once every two years for both wet density measurement and moisture content measurement in accordance with Test Method AS 1289.5.8.4. For wet density measurement, obtain a separate calibration for each test depth. Recalibrate the nuclear gauge following any major repair or component replacement.

### **4.2 Material moisture bias**

4.2.1 Where the insitu moisture content of a material is to be measured using a nuclear gauge, determine a moisture bias for the nuclear gauge and material source (and, if applicable, material type and subtype) in accordance with Test Method N02.

This bias is to be re-determined whenever any of the following apply:

- a) the nominal depth of the layer being tested changes by more than 50 mm
- b) the mean insitu moisture content has changed by more than 2 per cent from the mean value at the time the moisture bias was determined, or
- c) there is a change in the source rock or the source of any fine component.

4.2.2 In addition to the requirements of Step 4.2.1, check the moisture bias in accordance with Test Method N02 as follows:

- a) following the compaction of every 10,000 tonnes of material, or
- b) if the moisture bias has not been used with the nuclear gauge for two months or more.

### **4.3 Material wet density bias**

4.3.1 Determine a wet density bias for the nuclear gauge, material source (and, if applicable, material type and subtype) and test depth in accordance with Test Method N03. This bias is to be re-determined whenever any of the following apply:

- a) there is a change in the source rock or the source of any fine component.

4.3.2 In addition to the requirements of Step 4.3.1, check the wet density bias in accordance with Test Method N03 as follows:

- a) whenever any assigned MDD is re-determined in accordance with Test Method Q144A
- b) following the compaction of not more than 10,000 tonnes of material, or
- c) if the wet density bias has not been used with the nuclear gauge for two months or more.

## **5 Operational checks**

To ensure that the nuclear gauge is operating normally, checks shall be undertaken routinely or following repair as follows:

### **5.1 Standard count check (frequency: each day of use)**

5.1.1 Remove the nuclear gauge and reference block from the store and place the reference block on the designated test location. A location is to be selected which is at least 2 m from any large object and 10 m from any other nuclear gauge. Mark this location and use for all counts associated with operational checks.

5.1.2 Take a standard count in accordance with the appropriate standard count operating instruction in Part 4: *Operating Instructions: Operational Checks of the Nuclear Gauge Testing Manual* and ensure the following:

- a) the nuclear gauge is correctly located on the reference block
- b) the source rod handle is correctly located in the shielded position, and
- c) density standard count and moisture standard count values are recorded.

Keep a record of each gauge to record operational check data (standard count and gauge function check) and the date of measurement (Note 11.1).

5.1.3 Calculate the mean of the previous four recorded and accepted density standard counts and the mean of the previous four recorded and accepted moisture standard counts.

5.1.4 Calculate the limits for density and moisture as follows and record:

$$L = \overline{SC} - 2\sqrt{\frac{SC}{PS}}$$

$$U = \overline{SC} + 2\sqrt{\frac{SC}{PS}}$$

- where  $\overline{SC}$  = mean density standard count (DS) or mean moisture standard count (MS)
- L = lower limit for density ( $L_p$ ) or moisture ( $L_w$ )
- U = limit for density ( $U_p$ ) or moisture ( $U_w$ )
- PS = nuclear gauge prescale factor (refer to Table 1)

5.1.5 If the recorded standard count values lie within the range  $L_p$  to  $U_p$  for density and  $L_w$  to  $U_w$  for moisture, the density or moisture standard count is accepted and the nuclear gauge may be used for testing.

5.1.6 If the recorded standard count value lies outside the range  $L_p$  to  $U_p$  for density or  $L_w$  to  $U_w$  for moisture, repeat Steps 5.1.2 to 5.1.5. If either standard count is again outside the appropriate range, remove the nuclear gauge from service and have it repaired by a licensed service agent (Note 11.2).

## 5.2 Gauge function check – statistical performance (frequency: monthly)

5.2.1 Remove the nuclear gauge and reference block from the store and place the reference block on the designated test location. A location is to be selected which is at least 2 m from any large object and 10 m from any nuclear gauge. Mark this location and use for all counts associated with operational checks.

5.2.2 Take at least 16 density and moisture counts in accordance with the appropriate statistical count operating instruction in Part 4: *Operating Instructions: Operational Checks of the Nuclear Gauge Testing Manual* and ensure the following:

- a) the nuclear gauge is correctly located on the reference block

- b) the source rod handle is correctly located in the shielded position, and
- c) density and moisture count values are recorded.

Keep a record for each gauge to record operational check data (standard count and gauge function check) and the date of measurement.

- 5.2.3 Calculate the mean and standard deviation of the density counts and moisture counts.
- 5.2.4 Calculate the density ratio and moisture ratio using the following formula and record the values in the nuclear gauge logbook:

$$r = \frac{s}{\sqrt{\bar{C}}}$$

where  $r$  = density ratio ( $r_p$ ) or moisture ratio ( $r_w$ )  
 $s$  = standard deviation of the density or moisture counts  
 $\bar{C}$  = mean density count ( $\bar{C}_p$ ) or mean moisture count ( $\bar{C}_w$ )

Where an accepted form of statistical analysis is performed by the microprocessor, it is not necessary to record individual count values. Only record the density and moisture ratio values and omit Steps 5.2.3 and 5.2.4.

- 5.2.5 If the density ratio and moisture ratio lie within the limits given in Table 2, the nuclear gauge is verified to be operating normally and may be used for testing.
- 5.2.6 If either the density ratio or the moisture ratio lies outside the relevant limits given in Table 2, repeat Steps 5.2.2 to 5.2.5. If either ratio is again outside the limits, remove the nuclear gauge from service and have it repaired by a licensed service agent.

### 5.3 Density system consistency check (frequency: monthly)

Perform a density system consistency check in accordance with Part 2 Clause 1.2 of the *Nuclear Gauge Testing Manual*.

## 6 Configuration

On each day of use, configure the nuclear gauge before testing any material by undertaking a standard count and setting or checking test parameters for the material (and, if applicable, material type and subtype) as follows:

### 6.1 Standard count

- 6.1.1 Remove the nuclear gauge and reference block from the transport case and place the reference block on the surface of the material (and, if applicable, material type and subtype) under test. When using the nuclear gauge within 2 m of a large object or in a trench, take a separate standard count at each test site.
- 6.1.2 Take a standard count in accordance with the appropriate standard count operating instruction in Part 4: *Operating Instructions: Operational Checks* of the *Nuclear Gauge Testing Manual* and ensure the following:
  - a) the nuclear gauge is correctly located on the reference block
  - b) the source rod handle is correctly located in the shielded position, and

- c) density and moisture standard count values are recorded with the test data and, where the functionality exists, stored in the nuclear gauge microprocessor.

## 6.2 Test parameters

Check or set user definable test parameters in accordance with the appropriate test parameters operating instruction in Part 4: *Operating Instructions: Testing – Soils* of the *Nuclear Gauge Testing Manual* (Note 11.3).

## 7 Test site selection and preparation

Determination of test locations and preparation of each test site shall be as follows:

- 7.1 Use the stratified random number method for selection of a test site within a test area in accordance with Test Method AS 1289.1.4.2 to determine each test location.
- 7.2 At a designated test location, use the guide plate to define a test site that is flat and free from depressions. The test site is formed by two overlapping rectangles at right angles to each other, with each rectangle being at least the size of the guide plate and the hole being common within the overlapping area as shown in Figure 1. The guide plate may be used to trim the surface of some materials, provided the surface is not de-densified by such action.
- 7.3 Sweep all loose material from the test site and sprinkle fine sand or native fines on the surface. Move the guide plate over the surface until the voids are just filled, ensuring that the sand or fines does not form an added layer.
- 7.4 Place the guide plate on the test site and drill a hole at least 50 mm beyond the specified measurement depth (Note 11.4). Where the measurement depth is not stipulated in the appropriate specification, select a depth in keeping with the following criteria:
  - a) the measurement depth for unbound pavement layers is 15 mm to 39 mm less than the nominal layer thickness where alternative vertical tolerance A is specified, up to the maximum direct transmission measurement depth of 300 mm (Note 11.5)
  - b) the measurement depth for unbound pavement layers is 25 mm to 49 mm less than the nominal layer thickness, where alternative vertical tolerance B is specified, up to the maximum direct transmission measurement depth of 300 mm (Note 11.5)
  - c) the measurement depth for plant-mixed stabilised layers is 15 mm to 39 mm less than the nominal depth of the layer up to the maximum direct transmission measurement depth of 300 mm, or
  - d) the measurement depth for insitu stabilised layers (subgrade or pavement) is 5 mm to 29 mm less than the nominal depth of the layer up to the maximum direct transmission measurement depth of 300 mm.
- 7.5 Remove the guide plate and repair the prepared test site using some additional sand or fines if required.
- 7.6 Use the guide plate to mark the test site to allow the placement of the nuclear gauge over the test site and to align the source rod to the hole (Note 11.6).

## 8 Testing

Testing shall be performed as follows:

- 8.1 Place the nuclear gauge on the marked test site, lower the source rod into the formed hole and move the source rod to the required measurement depth.

- 8.2 Ease the source rod against the hole wall by moving the nuclear gauge in the direction of the source rod handle.
- 8.3 Confirm the firm seating of the nuclear gauge on the test site by rotating the nuclear gauge several degrees left or right if required. Maintain contact between the source rod and the formed hole. If unable to obtain firm seating of the nuclear gauge, prepare a new test site immediately adjacent to the original site.
- 8.4 Take a 1-minute count in accordance with the appropriate measurement operating instruction in Part 4: *Operating Instructions: Testing – Soils of the Nuclear Gauge Testing Manual*. Record relevant density and moisture test data while meeting the requirements of Table 3.
- 8.5 Rotate the nuclear gauge through 90° ensuring that the test site is not disturbed. Repeat Steps 8.2 to 8.4 and then move the source rod to the shielded position (Note 11.6).
- 8.6 Compare the dry density values from the two orientations. If the difference exceeds 0.075 t/m<sup>3</sup>, examine and further prepare the test site as necessary and repeat Steps 8.1 to 8.5.
- 8.7 If the dry density difference again exceeds 0.075 t/m<sup>3</sup>, abandon the test site and select a new site immediately adjacent.
- 8.8 Where the insitu moisture content is to be measured using the standard oven-drying method or a subsidiary method:
  - a) obtain a moisture content sample in accordance with Test Method Q061, and
  - b) determine the oven-dry moisture content of the sample obtained in accordance with Test Method AS 1289.2.1.1 or one of the subsidiary Test Methods AS 1289.2.1.2, AS 1289.2.1.4, AS 1289.2.1.5 or AS 1289.2.1.6 for which a relationship with Test Method AS 1289.2.1.1 has been established in accordance with Test Method AS 1289.2.3.1.

## 9 Calculations

Calculations shall be as follows:

### 9.1 Nuclear gauge density and moisture measurement

- 9.1.1 Determine the mean nuclear gauge dry density for the test site by averaging the dry density values obtained at the 0° and 90° orientations.
- 9.1.2 Where any relevant biases have not been applied via the nuclear gauge microprocessor, adjust the mean nuclear gauge dry density calculated in Step 9.1.1 by applying these biases to calculate the compacted dry density as follows:

$$\rho_d = \overline{\rho_{Gd}} + B_p - B_w$$

- where
- $\rho_d$  = compacted dry density (t/m<sup>3</sup>)
  - $\overline{\rho_{Gd}}$  = mean nuclear gauge dry density (t/m<sup>3</sup>)
  - $B_p$  = wet density bias (t/m<sup>3</sup>)
  - $B_w$  = moisture bias (t/m<sup>3</sup>)

- 9.1.3 Determine the mean nuclear gauge water content for the test site by averaging the measured water content values obtained at the 0° and 90° orientations.
- 9.1.4 Where a moisture bias has not been applied via the nuclear gauge microprocessor, adjust the mean water content calculated in Step 9.1.3 by applying this bias to calculate the insitu moisture content as follows:

$$w = \frac{(\overline{W}_G + B_w)100}{\rho_d}$$

- where  $w$  = insitu moisture content (%)
- $\overline{W}_G$  = mean nuclear gauge water content (t/m<sup>3</sup>)
- $B_w$  = moisture bias (t/m<sup>3</sup>)
- $\rho_d$  = compacted dry density (t/m<sup>3</sup>)

## 9.2 Nuclear gauge density and standard oven drying or subsidiary moisture measurement

- 9.2.1 Determine the mean nuclear gauge wet density for the test site by averaging the wet density values obtained at the 0° and 90° orientations.
- 9.2.2 Where any relevant biases have not been applied via the nuclear gauge microprocessor, adjust the mean nuclear gauge wet density calculated in Step 9.2.1 by applying these biases to calculate the insitu wet density as follows:

$$\rho = \rho_G + B_\rho$$

- where  $\rho$  = insitu wet density (t/m<sup>3</sup>)
- $\rho_G$  = mean nuclear gauge wet density (t/m<sup>3</sup>)
- $B_\rho$  = wet density bias (t/m<sup>3</sup>)

- 9.2.3 Determine the insitu water content for the test site as follows:

$$W = \frac{\rho w}{100 + w}$$

- where  $W$  = insitu water content (t/m<sup>3</sup>)
- $\rho$  = insitu wet density (t/m<sup>3</sup>)
- $w$  = insitu oven dry or subsidiary moisture content (%)

- 9.2.4 Determine the compacted dry density for the test site as follows:

$$\rho_d = \rho - W$$

- where  $\rho_d$  = compacted dry density (t/m<sup>3</sup>)
- $\rho$  = insitu wet density (t/m<sup>3</sup>)
- $W$  = insitu water content (t/m<sup>3</sup>)



## 10 Reporting

The following shall be reported:

- a) compacted dry density or insitu wet density to the nearest 0.01 t/m<sup>3</sup>
- b) insitu moisture content to the nearest 0.1% and the test method used
- c) date tested, depth tested, lot number, test site number, and chainage and offset
- d) source and description of the material together with the layer type and nominal depth of layer
- e) a statement including the wet density bias, to the nearest 0.01 t/m<sup>3</sup>, and identification of the bias report as follows: 'An adjustment of x.xxx t/m<sup>3</sup>, obtained from Report Number <report no>, has been made.'
- f) a statement including the moisture bias, to the nearest 0.01%, and identification of the bias report as follows: 'An adjustment of x.x%, obtained from Report Number <report no>, has been made.', and
- g) the number of this Test Method, that is N01.

## 11 Notes on method

- 11.1 Where there are no previous four standard counts taken within the previous five weeks of the current date or when moving the nuclear gauge to a new operating location and there is a new designated test location, it may be necessary to take four new standard counts in accordance with Steps 5.1.1 to 5.1.2.
- 11.2 It is expected that a standard count value will lie outside the range  $L_p$  to  $U_p$  about once in every 20 standard count checks. To have consecutive values outside this range is expected only once in 400 standard count checks. However, as the return of the gauge for checking and possible repair can be expensive and disruptive, it is acceptable to perform a gauge function check in accordance with sub-section 5.2. If verified that the gauge is not operating normally, remove the nuclear gauge from service and have it repaired by a licensed service agent.
- 11.3 The scope of user definable test parameters is dependent on the make and model of nuclear gauge. Such parameters include:
  - a) counting time, units and measurement mode
  - b) maximum dry density
  - c) density bias, and
  - d) moisture bias.
- 11.4 Where the underlying layer consists of the same material type and subtype as that in the layer under test, select the measurement depth that is closest to the nominal layer thickness. Under these conditions, it is acceptable for the source rod to penetrate into the underlying layer.
- 11.5 The vertical tolerances are found in MRTS05 *Unbound Pavements* Clause 8.4.4.3 and Annexure MRTS05.1 *Unbound Pavements* Clause 3.2.1.

11.6 To improve operator safety, it is recommended that the source rod containing radioactive materials not be extended out of its shielded (SAFE) position prior to placing it into the formed hole. Where possible, align the gauge to allow the placing of the source rod directly into the formed hole from the shielded position. The source rod should be returned to its shielded (SAFE) position at the completion of measurements.

**Table 1 – Nuclear gauge prescale factors**

Nuclear gauge make / model	Prescale factor
CPN / Elite series	8
Troxler / except Model 3450	16
Humboldt / All	16
InstroTek / Xplorer series	16

**Table 2 – Gauge function check – density and moisture ratio limits**

Nuclear gauge make/model	Lower limit	Upper limit
CPN / Elite series	0.25	0.45
Troxler / except Model 3450	0.17	0.33
Humboldt / All	0.60	1.40
InstroTek / Xplorer series	0.18	0.35

**Table 3 – Minimum test data**

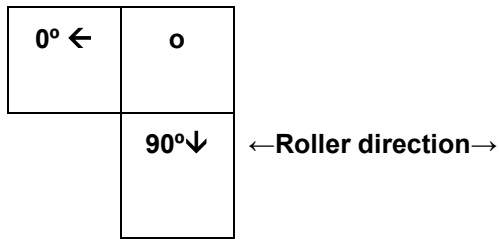
Measurement	Routine test		Material bias or bias check	
	Nuclear gauge density and moisture	Nuclear gauge density and oven dry/ subsidiary moisture	Density	Moisture
density standard count	✓	✓	✓	
moisture standard count	✓			✓
wet density (t/m <sup>3</sup> )		✓	✓	✓
dry density (t/m <sup>3</sup> )	✓	✓*	✓*	✓*
water content (t/m <sup>3</sup> )	✓#			✓
moisture content (%)	✓			
density count	✓	✓	✓	
moisture count	✓			✓
relative compaction	✓^			

\* These values are only recorded as a means of monitoring the validity of the test results (refer to Step 8.6).

# This value is only recorded when the moisture bias is not applied by the microprocessor.

^ This value is only valid when all relevant biases have been applied by the microprocessor.

**Figure 1 – Test site**



## Test Method N02: Soil moisture bias

### 1 Source

This method was developed in-house using techniques evolved through internal departmental research investigations and incorporates information provided by nuclear gauge manufacturers.

### 2 Scope

This method sets out the procedure for the determination of the moisture bias associated with the measurement of insitu moisture content of soils and crushed rock materials using a nuclear gauge. The moisture bias represents the average moisture content difference between the nuclear gauge and oven-drying tests for a particular nuclear gauge and material. Differences in the moisture content values obtained by the nuclear gauge and oven-drying tests are due to differences in the material sampled by both tests, the effect of moisture gradients, the presence of any bound water on nuclear gauge results and any moisture losses from the sample prior to oven-drying.

Included in the method is a procedure for monitoring the applicability of an existing moisture bias and for providing ongoing adjustment of the bias to reflect subtle changes in material composition.

This method makes no provision for concurrent determination of wet density bias and, where both moisture content bias and wet density bias are required, reference Test Method N03.

### 3 Procedure

The procedure shall be as follows:

- 3.1 Select at least six test sites within the lot under consideration using the stratified random number method for selection of a test site within a test area in accordance with Test Method AS 1289.1.4.2 (unless otherwise specified) (Note 7.1). Number each test site and any bias check test site consecutively in chronological order.
- 3.2 At each test site, undertake the following:
  - 3.2.1 Measure the nuclear gauge moisture content, water content, dry density and wet density in accordance with Test Method N01, except that no moisture bias and wet density bias are applied. Record the relevant density and moisture test data while meeting the requirements of Test Method N01 Table 3 for both the 0° and 90° orientations.
  - 3.2.2 Obtain a moisture content sample in accordance with Test Method Q061 from the location shown in Figure 1.
  - 3.2.3 Determine the oven-dry moisture content of the sample obtained in accordance with Test Method AS 1289.2.1.1. For stabilised materials, return moisture content samples to a laboratory and place in drying ovens within the same work shift as the moisture content sampling is undertaken.

### 4 Calculations

Calculations shall be as follows:

#### 4.1 Field test data

- 4.1.1 Determine the mean moisture count, mean nuclear gauge moisture content, mean nuclear gauge water content and mean nuclear gauge wet density for each site by averaging the corresponding measurements for the 0° and 90° orientations.

4.1.2 Calculate the oven-dry water content for each site as follows:

$$W_{ov} = \frac{\rho_G W_{ov}}{100 + w_{ov}}$$

where  $W_{ov}$  = oven-dry water content (t/m<sup>3</sup>)  
 $\rho_G$  = mean nuclear gauge wet density (t/m<sup>3</sup>)  
 $w_{ov}$  = oven-dry moisture content (%)

## 4.2 Data validation

4.2.1 Calculate the moisture count ratio for each site to four significant figures as follows:

$$CR_w = \frac{C_w}{SC_w}$$

where  $CR_w$  = moisture count ratio  
 $C_w$  = mean moisture count  
 $SC_w$  = moisture standard count

4.2.2 Plot the mean nuclear gauge moisture content against the corresponding moisture count ratio using the data from all test sites (Note 7.2).

4.2.3 If any data pair does not lie on the linear plot, reject the nuclear gauge and oven-dry moisture data for this test site.

## 4.3 Data acceptance

Perform data acceptance with the remaining data as follows:

4.3.1 Calculate the mean nuclear gauge water content and mean oven-dry water content for all remaining test sites.

4.3.2 Calculate the moisture standard error as follows:

$$SE_w = \sqrt{\frac{\sum (W_{ov} - W_G - \bar{W}_{ov} + \bar{W}_G)^2}{n - 2}}$$

where  $SE_w$  = moisture standard error (t/m<sup>3</sup>)  
 $W_{ov}$  = oven-dry water content at each test site (t/m<sup>3</sup>)  
 $W_G$  = nuclear gauge water content at each test site (t/m<sup>3</sup>)  
 $\bar{W}_{ov}$  = mean oven-dry water content for all test sites (t/m<sup>3</sup>)  
 $\bar{W}_G$  = mean nuclear gauge water content for all test sites (t/m<sup>3</sup>)  
 $n$  = number of test sites

4.3.3 If the moisture standard error does not exceed 0.020 t/m<sup>3</sup>, accept the data and calculate the moisture bias in accordance with Subsection 4.4.

4.3.4 If the moisture standard error exceeds 0.020 t/m<sup>3</sup>, perform the following:

- a) For each moisture data pair (oven-dry and nuclear gauge), calculate the moisture error as follows:

$$E_W = \left| (W_{ov} - W_G) - (\overline{W}_{ov} - \overline{W}_G) \right|$$

where  $E_W$  = moisture error (t/m<sup>3</sup>)

$W_{ov}$  = oven-dry water content at each test site (t/m<sup>3</sup>)

$W_G$  = nuclear gauge water content at each test site (t/m<sup>3</sup>)

$\overline{W}_{ov}$  = mean oven-dry water content for all test sites (t/m<sup>3</sup>)

$\overline{W}_G$  = mean nuclear gauge water content for all test sites (t/m<sup>3</sup>)

- b) Remove the moisture content data pair (oven-dry and nuclear gauge), with the largest moisture error from the analysis.
- c) Re-analyse the data by repeating Steps 4.3.1 to 4.3.4, except that:
- i. if data from three or more test sites are eliminated, reject all test data and repeat the complete procedure
  - ii. if there are acceptable data from fewer than six test sites, reject all test data and repeat the complete procedure, and/or
  - iii. if all test data are again rejected, it is not appropriate to calculate a single wet density bias for the material.

#### 4.4 Determination of moisture bias

Moisture bias may be calculated directly in t/m<sup>3</sup> or expressed as a K value. There are options for determining the K value, depending on the functionality of the nuclear gauge. The K value can be either calculated external to the nuclear gauge and stored in the microprocessor or calculated internally by the microprocessor using input values of mean oven-dry moisture content and mean nuclear gauge moisture content (Notes 7.3, 7.4 and 7.5).

##### 4.4.1 Moisture bias (t/m<sup>3</sup>)

Calculate the moisture bias using accepted data as follows:

$$B_W = \overline{W}_{ov} - \overline{W}_G$$

where  $B_W$  = moisture bias (t/m<sup>3</sup>)

$\overline{W}_{ov}$  = mean oven-dry water content for all accepted test sites (t/m<sup>3</sup>)

$\overline{W}_G$  = mean nuclear gauge water content for all accepted test sites (t/m<sup>3</sup>)

##### 4.4.2 Moisture bias (K value)

###### a) External calculation

Calculate the moisture bias using accepted data as a K value and record to the nearest 0.01 as follows:

$$K = \frac{\overline{W}_{ov} - \overline{W}_G}{\overline{\rho}_G - \overline{W}_{ov}}$$

- where
- K = K value
  - $\overline{W}_{ov}$  = mean oven-dry water content for all accepted test sites (t/m<sup>3</sup>)
  - $\overline{W}_G$  = mean nuclear gauge water content for all accepted test sites (t/m<sup>3</sup>)
  - $\overline{\rho}_G$  = mean nuclear gauge wet density for all accepted test sites (t/m<sup>3</sup>)

#### b) Internal calculation

- i) Calculate the mean oven-dry moisture content as follows:

$$\overline{w}_{ov} = \frac{100\overline{W}_{ov}}{\overline{\rho}_G - \overline{W}_G}$$

- where
- $\overline{w}_{ov}$  = mean oven-dry moisture content for all accepted test sites (%)
  - $\overline{W}_{ov}$  = mean oven-dry water content for all accepted test sites (t/m<sup>3</sup>)
  - $\overline{W}_G$  = mean nuclear gauge water content for all accepted test sites (t/m<sup>3</sup>)
  - $\overline{\rho}_G$  = mean nuclear gauge wet density for all accepted test sites (t/m<sup>3</sup>)

- ii) Calculate the mean nuclear gauge moisture content as follows:

$$\overline{w}_G = \frac{100\overline{W}_G}{\overline{\rho}_G - \overline{W}_G}$$

- where
- $\overline{w}_G$  = mean nuclear gauge moisture content for all accepted test sites (%)
  - $\overline{W}_G$  = mean nuclear gauge moisture content for all accepted test sites (t/m<sup>3</sup>)
  - $\overline{\rho}_G$  = mean nuclear gauge wet density for all accepted test sites (t/m<sup>3</sup>)

- 4.4.3 Calculate the minimum oven-dry moisture content (%) and maximum oven-dry moisture content (%) for all accepted test sites.

## 5 Bias check

Bias checks shall be performed as follows:

- 5.1 Monitor the moisture bias by performing three additional nuclear gauge moisture and oven-dry moisture content tests following the compaction of not more than 10,000 tonnes of material and perform testing in accordance with Section 3.
- 5.2 Determine and validate the nuclear gauge moisture count and nuclear gauge moisture content data in accordance with Steps 4.1 to 4.2.3.
- 5.3 Add the new moisture data pairs (nuclear gauge and oven-dry) to the previously accepted data while removing three existing and consecutive moisture data pairs commencing at the lowest test site number. When there are only six existing data points, remove only two so that seven data points are available for analysis.

- 5.4 Analyse the revised moisture data for acceptance in accordance with Subsection 4.3, except that no more than one of the new moisture data points may be eliminated.
- 5.5 Calculate an amended moisture bias for the accepted data in accordance with Subsection 4.4.

## 6 Reporting

The following shall be reported:

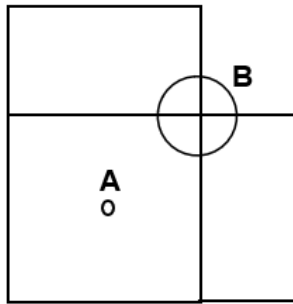
- a) moisture bias as follows:
  - i. to the nearest 0.01 t/m<sup>3</sup>
  - ii. a K value to the nearest 0.01 units, and
  - iii. K value inputs: that is, mean oven-dry moisture content to the nearest 0.1% and mean nuclear gauge moisture content to the nearest 0.1%.
- b) the minimum oven-dry moisture content, mean oven-dry moisture content and maximum oven-dry moisture content to the nearest 0.1%
- c) source and description of the material, together with the layer type and layer depth
- d) a tabulation containing the nuclear gauge and oven-dry moisture data used to determine the bias (including any eliminated data), together with the date tested, depth tested, lot number, test site number, chainage and offset
- e) the date the bias was reported and, in the case of an amended moisture bias, the report number and date for the previous report, and
- f) the number of this Test Method, that is N02.

## 7 Notes on method

- 7.1 To determine a moisture bias that is representative of the lot, distribute sampling locations throughout the lot.
- 7.2 The relationship between nuclear gauge moisture content and moisture count ratio is linear over the expected moisture content range within a lot.
- 7.3 The method calculates and reports moisture bias in different formats. The user will choose the form that is suitable for the nuclear gauge make / model and the method operation; for example, the make and model will determine if the K value is entered directly into the nuclear gauge for biased use. Alternatively, the method of operation will determine if the gauge is used biased onsite, or unbiased with bias applied through the calculation and reporting process.
- 7.4 External calculation of K for direct entry into a nuclear gauge is required for CPN Elite MC-1, CPN Elite MC-3, Humbolt 5001EZ, Humbolt 5001EZ-2, Humbolt 5001SD, InstroTek Xplorer 3500, InstroTek Xplorer 2 3500, Troxler 3430 and Troxler 3430P gauges.
- 7.5 Internal calculation of K requiring entry of values for mean oven-dry moisture content and mean nuclear gauge moisture content is required for Troxler 3440 and Troxler 3440P gauges.



**Figure 1 – Test site and moisture content sampling location**



**A:** probe access hole location (small circle)

**B:** oven dry moisture content sampling location (large circle)

## Test Method N03: Soil wet density bias

### 1 Source

This method was developed in-house using techniques evolved through internal departmental research investigations and incorporates information provided by nuclear gauge manufacturers.

### 2 Scope

This method sets out the procedure for the determination of the wet density bias associated with the measurement of compacted density of soils and crushed rock materials using a nuclear gauge. The wet density bias represents the average wet density difference between the nuclear gauge and sand replacement tests for a particular nuclear gauge, material and test depth. Differences in the wet density values obtained by the nuclear gauge and sand replacement tests are due to differences in the material sampled by both tests, the effect of chemical composition and test site characteristics (for example, density and moisture gradients, surface condition, particle size, homogeneity) on nuclear gauge results and inadequacies in the sand replacement test for some materials.

Included in the method is a procedure for monitoring the applicability of an existing wet density bias and for providing ongoing adjustment of the bias to reflect subtle changes in material composition.

This method also caters for concurrent determination of a moisture bias in accordance with Test Method N02.

### 3 Procedure

The procedure shall be as follows:

- 3.1 Select at least six test sites within the lot under consideration using the stratified random number method for selection of a test site within a test area in accordance with Test Method AS 1289.1.4.2 (unless otherwise specified) (Note 7.1). For stabilised materials, complete work to determine the wet density to a stage where the wet density has been determined within 24 hours after the end of the work shift where stabilisation works were completed for the corresponding lot. Number each test site and any bias check test site consecutively in chronological order.
- 3.2 At each test site, undertake the following:
  - 3.2.1 Measure the nuclear gauge wet density in accordance with Test Method N01, ensuring that no wet density bias is applied. Record the relevant density and moisture test data while meeting the requirements of Test Method N01 Table 3 for both the 0° and 90° orientations.
  - 3.2.2 Where a moisture content bias is required in conjunction with a wet density bias, obtain and record moisture counts and nuclear gauge moisture content values in accordance with Test Method N02.
  - 3.2.3 Select a position for a sand replacement test at either position D for a 150 mm diameter hole or position E for a 200 mm diameter hole as shown in Figure 1.

- 3.2.4 Remove any fine sand or fines from the nuclear gauge test position as selected in Step 3.2.2. Undertake a sand replacement test in accordance with Test Method Q141B and determine the wet density and oven-dry moisture content. Excavate to one of the following depths while avoiding the probe access hole and any associated surface cracking:
- a) the full depth of the layer where the sampled material is from a pavement or earthworks, or
  - b) the depth used in the nuclear gauge measurement of wet density where the sampled material is from earthworks and no layer depth is applicable.
- 3.2.5 For stabilised materials, return moisture content samples to a laboratory and place in drying ovens within the same work shift as the moisture content sampling is undertaken.

## 4 Calculations

Calculations shall be as follows:

### 4.1 Field test data

Determine the mean density count and mean nuclear gauge wet density for each site by averaging the corresponding measurements for the 0° and 90° orientations.

### 4.2 Data validation

- 4.2.1 Calculate the density count ratio for each site to four significant figures as follows:

$$CR_p = \frac{C_p}{SC_p}$$

where  $CR_p$  = density count ratio  
 $C_p$  = mean density count  
 $SC_p$  = density standard count

- 4.2.2 Plot the nuclear gauge wet density against the corresponding density count ratio using the data from all test sites (Note 7.2).
- 4.2.3 If any data point does not lie on the linear plot, reject the nuclear gauge and sand replacement wet density data for this test site.

### 4.3 Data acceptance

Perform data acceptance with the remaining data as follows:

- 4.3.1 Calculate the mean nuclear gauge wet density and mean sand replacement wet density for all remaining test sites.

4.3.2 Calculate the wet density standard error as follows:

$$SE_{\rho} = \sqrt{\frac{\sum (\rho_s - \rho_G - \bar{\rho}_s + \bar{\rho}_G)^2}{n - 2}}$$

- where
- $SE_{\rho}$  = wet density standard error (t/m<sup>3</sup>)
  - $\rho_s$  = sand replacement wet density at each test site (t/m<sup>3</sup>)
  - $\rho_G$  = nuclear gauge wet density at each test site (t/m<sup>3</sup>)
  - $\bar{\rho}_s$  = mean sand replacement wet density for all test sites (t/m<sup>3</sup>)
  - $\bar{\rho}_G$  = mean nuclear gauge wet density for all test sites (t/m<sup>3</sup>)
  - $n$  = number of test sites

4.3.3 If the wet density standard error does not exceed 0.055 t/m<sup>3</sup>, accept the data and calculate the wet density bias in accordance with Subsection 4.4.

4.3.4 If the wet density standard error exceeds 0.055 t/m<sup>3</sup>, perform the following:

- a) For each density data pair (sand replacement and nuclear gauge), calculate the wet density error as follows:

$$E_{\rho} = \left| (\rho_s - \rho_G) - (\bar{\rho}_s - \bar{\rho}_G) \right|$$

- where
- $E_{\rho}$  = wet density error (t/m<sup>3</sup>)
  - $\rho_s$  = sand replacement wet density at each test site (t/m<sup>3</sup>)
  - $\rho_G$  = nuclear gauge wet density at each test site (t/m<sup>3</sup>)
  - $\bar{\rho}_s$  = mean sand replacement wet density for all test sites (t/m<sup>3</sup>)
  - $\bar{\rho}_G$  = mean nuclear gauge wet density for all test sites (t/m<sup>3</sup>)

- b) Remove the wet density data pair (sand replacement and nuclear gauge), with the largest wet density error from the analysis.
- c) Re-analyse the data by repeating Steps 4.3.1 to 4.3.4, except that:
- i. if data from three or more test sites are eliminated, reject all test data, and repeat the complete procedure
  - ii. if there are acceptable data from fewer than six test sites, reject all test data and repeat the complete procedure, and/or
  - iii. if all test data are again rejected, it is not appropriate to calculate a single wet density bias for the material.

#### 4.4 Wet density basis

4.4.1 Calculate the wet density bias using the accepted data as follows:

$$B_{\rho} = \bar{\rho}_s - \bar{\rho}_G$$

- where  $B_p$  = wet density bias ( $t/m^3$ )  
 $\bar{\rho}_s$  = mean sand replacement wet density for all accepted test sites ( $t/m^3$ )  
 $\bar{\rho}_G$  = nuclear gauge wet density for all accepted test sites ( $t/m^3$ )

4.4.2 Calculate the minimum sand replacement wet density and maximum sand replacement wet density for all accepted test sites.

## 5 Bias check

Bias checks shall be performed as follows:

- 5.1 Monitor the wet density bias by performing three additional nuclear gauge wet density and sand replacement wet density tests following the compaction of not more than 10,000 tonnes of material and perform the testing in accordance with Section 3.
- 5.2 Determine and validate the nuclear gauge density count and nuclear gauge wet density data in accordance with Steps 4.1 to 4.2.3.
- 5.3 Add the new wet density data pairs (sand replacement and nuclear gauge) to the previously accepted data while removing three existing and consecutive density data pairs commencing at the lowest test site number. Where there are only six existing data points, remove only two so that seven data points are available for analysis.
- 5.4 Analyse the revised wet density data for acceptance in accordance with Subsection 4.3, except that no more than one of the new density data pairs may be eliminated.
- 5.5 Calculate an amended wet density bias for the accepted data in accordance with Subsection 4.4.

## 6 Reporting

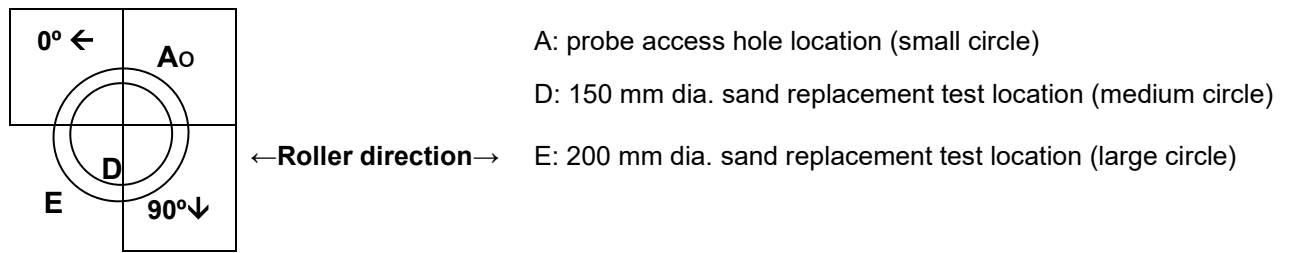
The following shall be reported:

- a) wet density bias to the nearest  $0.01 t/m^3$
- b) minimum sand replacement wet density, mean sand replacement wet density and maximum sand replacement wet density for all accepted test sites to the nearest  $0.01 t/m^3$
- c) source and description of the material together with the layer type and layer depth
- d) a tabulation containing the nuclear gauge and sand replacement wet density data used to determine the bias (including any eliminated data), together with the date tested, depth tested, lot number, test site number, chainage and offset
- e) the date the bias was reported, and
- f) the number of this Test Method, that is N03.

## 7 Notes on method

- 7.1 To determine a wet density bias that is representative of the lot, distribute the sampling locations throughout the lot.
- 7.2 The relationship between nuclear gauge wet density and density count ratio is essentially linear over the expected density range within a lot.

**Figure 1 – Test site and sand replacement location**



## Test Method N04: Compacted density of asphalt – nuclear gauge

### 1 Source

This method was developed in-house using techniques evolved through internal departmental research investigations and incorporates information provided by nuclear gauge manufacturers.

### 2 Scope

This method sets out the procedure for the determination of the compacted density of asphalt using a nuclear gauge. The method is based on the backscatter mode of measurement and records the wet density output from the nuclear gauge as the compacted density of the asphalt.

An adjustment is made to the nuclear gauge wet density calibration as determined from comparative nuclear gauge wet density and core compacted density results.

### 3 Apparatus

The following apparatus is required:

- 3.1 Nuclear gauge of an approved make and model as listed in Part 1 of the *Nuclear Gauge Testing Manual*, logbook, manufacturer's handbook for the gauge and capable of the following:
  - a) backscatter measurement including thin-layer gauges such as the Troxler 4640B, and
  - b) calibration density uncertainty not exceeding 0.08 t/m<sup>3</sup> for gauges used in backscatter mode and for thin-layer gauges such as the Troxler 4640B.
- 3.2 Reference block, as supplied by the manufacturer with the nuclear gauge, traceable to the nuclear gauge and used for the calibration of the gauge.
- 3.3 Guide plate or straightedge.
  - a) Guide plate, a flat metal template at least the same size as the base of the nuclear gauge, or
  - b) Straightedge, a steel straightedge about 300 mm long and 5 mm thick.
- 3.4 Dry fine sand passing a 0.600 mm test sieve.
- 3.5 Broom or brush.

### 4 Calibration and biasing

Calibration and biasing shall be performed as follows:

#### 4.1 Standard blocks calibration

Calibrate the nuclear gauge on standard blocks at least once every two years for density measurement in accordance with the relevant Australian Standard as follows:

- Nuclear thin-layer density gauge AS 2891.14.3
- Nuclear moisture-density gauge (backscatter) AS 2891.14.4

Recalibrate the nuclear gauge following any major repair or component replacement.

## 4.2 Asphalt density bias

- 4.2.1 Determine a density bias for the nuclear gauge, asphalt mix and gauge layer thickness setting (thin-layer gauge only) in accordance with Test Method N05.

This bias is to be re-determined whenever any of the following apply:

- a) there is a change to the mix design, or
- b) there is a change to the gauge layer thickness setting.

- 4.2.2 In addition to the requirements of Steps 4.2.1, check any applied density bias in accordance with Test Method N05 as follows:

- a) whenever there is a change in site conditions (for example, surface roughness, nominal layer thickness, composition of underlying layer, density of underlying layer)
- b) following the compaction of not more than 10,000 tonnes of material, or
- c) if the density bias has not been used with the nuclear gauge for two months or more.

## 5 Operational checks

To ensure that the nuclear gauge is operating normally, checks shall be undertaken routinely or following repair as follows:

### 5.1 Standard count check (frequency: each day of use)

- 5.1.1 Remove the nuclear gauge and reference block from the store and place the reference block on the designated test location. A location is to be selected which is at least 2 m from any large object and 10 m from any other nuclear gauge. Mark this location and use for all counts associated with operational checks.

- 5.1.2 Take a standard count for each density detection system in accordance with the appropriate standard count operating instruction in Part 4: Operating Instructions: Operational Checks of the *Nuclear Gauge Testing Manual* and ensure the following:

- a) the nuclear gauge is correctly located on the reference block
- b) the source rod handle is correctly located in the shielded position, and
- c) the density standard count values are recorded.

A record is to be kept for each gauge to record operational check data (standard count check and gauge function check) and the date of measurement. For nuclear gauges with two detection systems (for example, the nuclear thin-layer density gauge), record the check data for each system separately.

- 5.1.3 Calculate the mean of the previous four recorded and accepted density standard counts (Note 11.1).

- 5.1.4 Calculate the density limits for each density detection system as follows and record the limits (Note 11.3):

$$L_p = \overline{SC} - 2\sqrt{\frac{\overline{SC}}{PS}}$$

$$U_p = \overline{SC} + 2\sqrt{\frac{\overline{SC}}{PS}}$$



- where  $\overline{SC}$  = mean density standard count (DS)  
 $L_\rho$  = lower limit for density  
 $U_\rho$  = upper limit for density  
 PS = nuclear gauge prescale factor (refer to Table 1)

- 5.1.5 If the recorded standard count value for each system lies within the range  $L_\rho$  to  $U_\rho$ , the density standard count is accepted, and the nuclear gauge may be used for testing.
- 5.1.6 If either recorded standard count value lies outside the range  $L_\rho$  to  $U_\rho$  repeat Steps 5.1.2 to 5.1.5. If either standard count is again outside the range, remove the nuclear gauge from service and have it repaired by a licensed service agent (Notes 11.2 and 11.5).

## 5.2 Gauge function check – statistical performance (frequency: monthly)

- 5.2.1 Remove the nuclear gauge and reference block from the store and place the reference block on the designated test location. A location is to be selected which is at least 2 m from any large object and 10 m from any other nuclear gauge. Mark this location and use for all counts associated with operational checks.
- 5.2.2 Take at least 16 density counts for each density detection system in accordance with the appropriate statistical count operating instruction in Part 4: Operating Instructions: Operational Checks of the *Nuclear Gauge Testing Manual* and ensure the following:
- the nuclear gauge is correctly located on the reference block
  - the source rod handle is correctly located in the shielded position, and
  - the density count values are recorded (Note 11.3).
- 5.2.3 Calculate the mean and standard deviation of the density counts.
- 5.2.4 Calculate the density ratio for each density detection system as follows and record the value:

$$r_p = \frac{s}{\sqrt{\overline{C}_\rho}}$$

- where  $r_p$  = density ratio  
 $s$  = standard deviation of the density counts  
 $\overline{C}_\rho$  = mean density count

Where an accepted form of statistical analysis is performed by the microprocessor, it is not necessary to record individual count values. Only record the density and moisture ratio values and omit Steps 5.2.3 and 5.2.4.

- 5.2.5 If the density ratio for each system lies within the limits given in Table 2, the nuclear gauge is verified to be operating normally and may be used for testing.
- 5.2.6 If any density ratio lies outside the relevant limits given in Table 2, repeat Steps 5.2.2 to 5.2.5. If any ratio is again outside the limits, remove the nuclear gauge from service and have it repaired by a licensed service agent.

### **5.3 Density system consistency check (frequency: monthly)**

Perform a density system consistency check in accordance with Part 2, Subsection 1.2 of the *Nuclear Gauge Testing Manual*.

## **6 Configuration**

On each day of use, configure the nuclear gauge before testing by undertaking a standard count and setting or checking test parameters appropriate to the asphalt mix design as follows:

### **6.1 Standard count**

6.1.1 Remove the nuclear gauge and reference block from the transport case and place the reference block on the surface of the particular asphalt mix under test. Where the nuclear gauge is to be used within 2 m of a large object or in a trench, take a separate standard count at each test site.

6.1.2 Take a standard count in accordance with the appropriate standard count operating instruction in Part 4: Operating Instructions: Operational Checks of the *Nuclear Gauge Testing Manual* and ensure the following:

- a) the nuclear gauge is correctly located on the reference block
- b) the source rod handle is correctly located in the shielded position, and
- c) the density standard count value is recorded with the test data and, where the functionality exists, stored in the nuclear gauge microprocessor.

### **6.2 Test parameters**

Check or set user definable test parameters in accordance with the appropriate test parameters operating instruction in Part 4: Operating Instructions: Testing – Asphalt of the *Nuclear Gauge Testing Manual* (Note 11.3).

## **7 Test site selection and preparation**

Determination of test locations and preparation of each test site shall be as follows:

7.1 Use the stratified random number method for selection of a test site within a test area in accordance with Test Method AS 1289.1.4.2 to determine each test location.

7.2 At a designated test location, use the guide plate or straightedge to define a test site which is flat and free from depressions. The test site is formed by a single rectangle being at least the size of the guide plate with the source rod being over the surface of the asphalt at each end of the test area as shown in Figure 1.

7.3 Sweep all loose material from the test site and sprinkle fine sand on the surface. Move the guide plate or straightedge over the surface until the voids are just filled, ensuring that the sand does not form an added layer. Remove the guide plate or straightedge.

## **8 Testing**

Testing shall be performed as follows:

8.1 Place the nuclear gauge on the prepared test site such that the longitudinal axis of the nuclear gauge is parallel to the direction of rolling.

8.2 Confirm that the nuclear gauge is firmly seated without rocking. If the nuclear gauge cannot be firmly seated, prepare a new test site immediately adjacent to the original site. Move the source rod to the backscatter (BS) position.

- 8.3 Take a one-minute count in accordance with the appropriate measurement operating instruction detailed in Part 4: Operating Instructions: Testing – Asphalt of the *Nuclear Gauge Testing Manual*. Record the wet density and the density count data.
- 8.4 Rotate the nuclear gauge through 180°, ensuring that the test site is not disturbed. Repeat Steps 8.2 to 8.3 and then move the source rod to the shielded position.
- 8.5 Compare the wet density values from the two orientations. If the difference exceeds 0.075 t/m<sup>3</sup>, examine and further prepare the test site as necessary and repeat Steps 8.1 to 8.4.
- 8.6 If the wet density difference again exceeds 0.075 t/m<sup>3</sup>, abandon the test site and select a new site immediately adjacent.

## 9 Calculations

Calculations shall be as follows:

- 9.1 Determine the mean nuclear gauge wet density for the test site to the nearest 0.001 t/m<sup>3</sup> by averaging the wet density values obtained at the 0° and 180° orientations.
- 9.2 Where the asphalt density bias has not been applied via the nuclear gauge microprocessor, adjust the compacted density calculated in Step 9.1 by applying this bias to calculate the compacted density as follows:

$$D_c = \rho_G + B_p$$

where  $D_c$  = compacted density (t/m<sup>3</sup>)

$\rho_G$  = mean nuclear gauge wet density (t/m<sup>3</sup>)

$B_p$  = asphalt density bias (t/m<sup>3</sup>)

## 10 Reporting

The following shall be reported:

- a) compacted density to the nearest 0.001 t/m<sup>3</sup>
- b) date tested, test mode, lot number, test site number, and chainage and offset
- c) source and type of the asphalt together with the mix code number and nominal layer depth
- d) for thin-layer gauges (such as Troxler 4640B), the gauge layer thickness setting to the nearest 1 mm
- e) a statement including the density bias, to the nearest 0.001 t/m<sup>3</sup>, and identification of the bias report as follows: 'An adjustment of x.xxx t/m<sup>3</sup>, obtained from Report Number <report no>, has been made.', and
- f) the number of this Test Method, that is N04.

## 11 Notes on method

- 11.1 Where the previous four standard counts have not been taken within the previous five weeks of the current date or the nuclear gauge has been moved to a new operating location and has a new designated test location, it may be necessary to take four new standard counts in accordance with Steps 5.1.1 to 5.1.2.

- 11.2 It is expected that a standard count value will lie outside the range  $L_p$  to  $U_p$  about one in every 20 standard count checks. To have consecutive values outside this range is expected only once in 400 standard count checks; however, as the return of the gauge for checking and possible repair can be expensive and disruptive, it is acceptable to perform a gauge function check in accordance with Subsection 5.2. If the gauge is not verified as operating normally, remove the nuclear gauge from service and have it repaired by a licensed service agent.
- 11.3 The scope of user definable test parameters is dependent on the make and model of nuclear gauge. Such parameters include:
- a) counting time, units and measurement mode
  - b) maximum density
  - c) asphalt density bias, and
  - d) for thin-layer gauges (such as Troxler 4640B), the gauge layer thickness setting.

**Table 1 – Nuclear gauge prescale factors**

Nuclear gauge make / model	Prescale factor
CPN / Elite series	8
Troxler / except Models 3450 and 4640B	16
Troxler / Models 4640B	8
Humboldt / All	16
InstroTek / Xplorer series	16

**Table 2 – Gauge function check – density ratio limits**

Nuclear gauge make / model	Lower limit	Upper limit
CPN / Elite series	0.25	0.45
Troxler / except Models 3450 and 4640B	0.17	0.33
Troxler / Model 4640B	0.25	0.45
Humboldt / All	0.60	1.40
InstroTek / All	0.18	0.35

**Figure 1 – Test site**



Position A is the source rod location for 0° measurement and Position B is the source rod location for 180° measurement.

## Test Method N05: Asphalt density bias

### 1 Source

This method was developed in-house using techniques evolved through internal departmental research investigations and incorporates information provided by nuclear gauge manufacturers.

### 2 Scope

This method sets out the procedure for the determination of the asphalt density bias associated with the measurement of compacted density of asphalt using a nuclear gauge. The asphalt density bias represents the average density difference between nuclear gauge wet density and core compacted density for a particular nuclear gauge, asphalt mix and layer thickness. Differences between nuclear gauge wet density and core compacted density are due to differences in the material sampled by both tests and the effect of chemical composition and test site characteristics (for example, density gradients, surface condition, homogeneity) on nuclear gauge results.

Included in the method is a procedure for monitoring the applicability of an existing asphalt density bias and providing ongoing adjustment of the bias to reflect subtle changes in asphalt mix composition / site conditions.

### 3 Procedure

The procedure shall be as follows:

- 3.1 Select at least 10 test sites within the lot under consideration using the stratified random number method for selection of a test site within a test area in accordance with Test Method AS 1289.1.4.2 (unless otherwise specified) (Note 7.1). Number each test site and any bias check test site consecutively in chronological order.
- 3.2 At each test site, undertake the following:
  - 3.2.1 Measure the nuclear gauge wet density in accordance with Test Method N04, except that no asphalt density bias is applied. For thin-layer gauges, the gauge layer thickness should be set to the nominal thickness of the layer. Record the measured density counts and wet density values to the nearest 0.001 t/m<sup>3</sup>, for both the 0° and 180° orientations.
  - 3.2.2 Obtain a 150 mm diameter core sample centrally within the site in accordance with Test Method AS 2891.1.2.
  - 3.2.3 Measure the compacted density of the core sample in accordance with Test Method AS/NZS 2891.9.2, Q306B or Q306C as appropriate (Note 7.2). For stone mastic asphalt and open graded asphalt, determine the core sample compacted density in accordance with Test Method Q306C. For dense graded asphalt, the core sample may be tested in accordance with Test Method AS/NZS 2891.9.2 or Q306B rather than Test Method Q306C, provided that its air void content is not less than the minimum specified level. Use the same compacted density method for both the bias determination and bias checks.

## 4 Calculations

Calculations shall be as follows:

### 4.1 Field test data

Determine the mean density count and mean nuclear gauge wet density for each site by averaging the corresponding measurements for the 0° and 180° orientations.

### 4.2 Data validation

Validate the density count, density standard count and nuclear gauge wet density data as follows (Note 7.3):

4.2.1 Calculate the density count ratio for each site to four significant figures as follows:

$$CR_p = \frac{C_p}{SC_p}$$

where  $CR_p$  = density count ratio

$C_p$  = mean density count

$SC_p$  = density standard count

4.2.2 Plot the nuclear gauge wet density against the corresponding density count ratio using the data from all test sites.

4.2.3 If any data pair does not lie on the linear plot, reject the nuclear gauge and core compacted density wet density data for this test site.

4.2.4 For thin-layer gauges with two detection systems, validate the density system 1 data (that is density count, density standard count and the standards blocks wet density) in accordance with Steps 4.2.1 to 4.2.3. Then validate the density system 2 data (that is density count, density standard count and the nuclear gauge wet density) in accordance with Steps 4.2.1 to 4.2.3.

### 4.3 Data acceptance

Perform data acceptance with the remaining data as follows:

4.3.1 Calculate the mean nuclear gauge wet density and mean core compacted density for all remaining test sites.

4.3.2 Calculate the density standard error as follows:

$$SE_p = \sqrt{\frac{\sum (D_C - \rho_G - \bar{D}_C + \bar{\rho}_G)^2}{n-2}}$$

- where
- $SE_p$  = density standard error (t/m<sup>3</sup>)
  - $D_C$  = core compacted density at each test site (t/m<sup>3</sup>)
  - $\rho_G$  = nuclear gauge wet density at each test site (t/m<sup>3</sup>)
  - $\bar{D}_C$  = mean core compacted density for all test sites (t/m<sup>3</sup>)
  - $\bar{\rho}_G$  = mean wet density for all test sites (t/m<sup>3</sup>)
  - $n$  = number of test sites

4.3.3 If the density standard error does not exceed 0.025 t/m<sup>3</sup>, accept the data and calculate the asphalt density bias in accordance with Subsection 4.4.

4.3.4 If the density standard error exceeds 0.025 t/m<sup>3</sup>, perform the following:

- a) For each density data pair (core compacted density and nuclear gauge wet density), calculate the density error as follows:

$$E_p = \left| (D_C - \rho_G) - (\bar{D}_C - \bar{\rho}_G) \right|$$

- where
- $E_p$  = density error (t/m<sup>3</sup>)
  - $D_C$  = core compacted density at each test site (t/m<sup>3</sup>)
  - $\rho_G$  = nuclear gauge wet density at each test site (t/m<sup>3</sup>)
  - $\bar{D}_C$  = mean core compacted density for all test sites (t/m<sup>3</sup>)
  - $\bar{\rho}_G$  = mean nuclear gauge wet density for all test sites (t/m<sup>3</sup>)

- b) Remove the density data pair (core compacted density and nuclear gauge wet density) with the largest density error from the analysis.
- c) Re-analyse the data by repeating Steps 4.3.1 to 4.3.4, except that:
- i. if three or more test sites are eliminated, reject all test data, and repeat the complete procedure
  - ii. if there are acceptable data from fewer than eight test sites, reject all test data and repeat the complete procedure, and/or
  - iii. if all test data are again rejected, it is not appropriate to calculate a single asphalt density bias for the material.

#### 4.4 Asphalt density bias

4.4.1 Calculate the asphalt density bias using accepted data to the nearest 0.001 t/m<sup>3</sup> as follows:

$$B_{\rho} = \bar{D}_C - \bar{\rho}_G$$

where  $B_{\rho}$  = asphalt density bias (t/m<sup>3</sup>)

$\bar{D}_C$  = mean core compacted density for all test sites (t/m<sup>3</sup>)

$\bar{\rho}_G$  = mean nuclear gauge wet density for all test sites (t/m<sup>3</sup>)

4.4.2 Calculate the minimum core compacted density and maximum core compacted density for all accepted test sites.

### 5 Bias check

Bias checks shall be performed as follows:

- 5.1 Monitor the asphalt density bias by performing three additional nuclear gauge wet density and core compacted density tests following the compaction of not more than 10,000 tonnes of material and perform testing in accordance with Section 3.
- 5.2 Determine and validate the density count and nuclear gauge wet density data in accordance with Steps 4.1 to 4.2.3.
- 5.3 Add the new density data pairs (core compacted density and nuclear gauge wet density) to the previously accepted data while removing three existing and consecutive density data pairs commencing at the lowest test site number. Where there are only eight existing data points, remove only two so that nine data points are available for analysis.
- 5.4 Analyse the revised density data for acceptance in accordance with Subsection 4.3, except that no more than one of the new density data pairs may be eliminated.
- 5.5 Calculate an amended asphalt density bias for the accepted data in accordance with Subsection 4.4.

### 6 Reporting

The following shall be reported:

- a) asphalt density bias to the nearest 0.001 t/m<sup>3</sup>
- b) minimum core compacted density, mean core compacted density and maximum core compacted density for all accepted test sites to the nearest 0.001 t/m<sup>3</sup>
- c) source and type of the asphalt together with the mix code number and nominal layer depth
- d) a tabulation containing the nuclear gauge wet density and core compacted density data used to determine the bias (including any eliminated data), together with the date tested, lot number, test site number, and chainage and offset
- e) the date the bias was calculated and, in the case of an amended asphalt density bias, the report number and date for the previous report
- f) for thin-layer gauges (such as Troxler 4640B) the gauge layer thickness setting to the nearest 1 mm, and
- g) the number of this test method, that is N05.



## **7 Notes on method**

- 7.1 To determine an asphalt density bias which is representative of the lot, distribute sampling locations throughout the lot.
- 7.2 The relationship between nuclear gauge wet density and density count ratio is essentially linear over the expected density range within a lot.

## Operating Instruction N101: Standard Count Troxler 3440

### 1 Set up

Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press  and the following is displayed:
- ▶ Press  and the following is displayed:
- ▶ Press  and the following is displayed:
- ▶ At the end of the counting period the following is displayed:

Record the following values:

- MS as the **moisture standard count**.
- DS as the **density standard count**.

- ▶ Press  and the display will return to <READY>.


- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N102: Statistical Count Troxler 3440

### 1 Set up






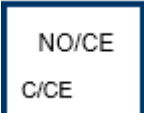
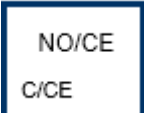


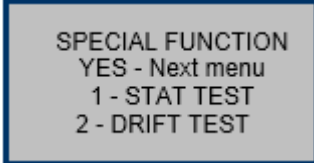

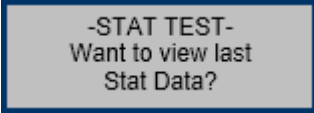

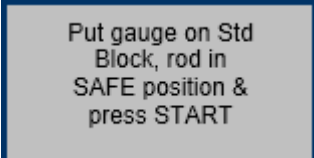

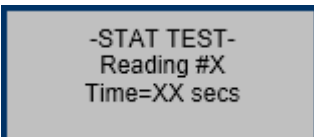

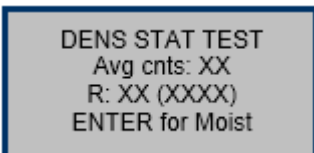
Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.


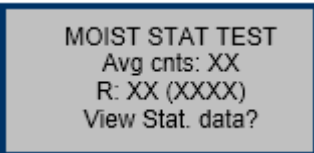
### 2 Measurement

When <READY> is displayed:

- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 


At the end of the counting period, the following will be displayed:

Record R as the **density ratio**.

- ▶ Press  and the following is displayed: 

Record R as the **moisture ratio**.

▶ Press  and display will return to <READY>.

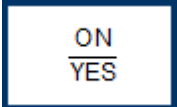
▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N103: Standard Count Troxler 3430

### 1 Set up


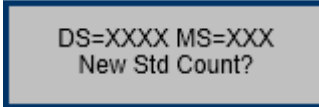
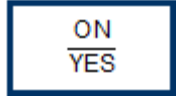
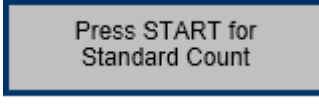
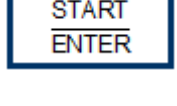
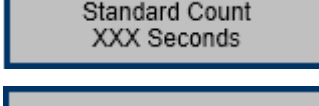
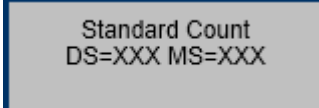
Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

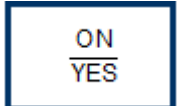
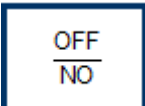
### 2 Measurement

When <READY> is displayed:

- ▶ Press  and the following is displayed: 
  - ▶ Press  and the following is displayed: 
  - ▶ Press  and the following is displayed: 
- At the end of the counting period the following will be displayed: 

Record the following values:

- DS as the **density standard count**.
- MS as the **moisture standard count**.

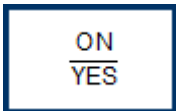
- ▶ Press  and the display will return to <READY>.
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N104: Statistical Count Troxler 3430

### 1 Set up


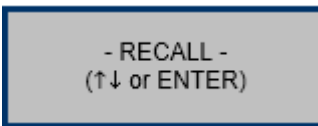
Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.


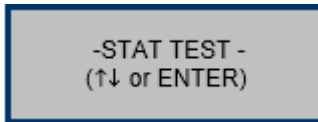
Check the source rod handle is correctly located in the shielded position.

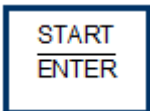
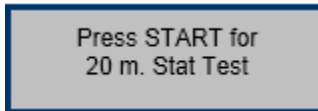
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

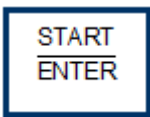
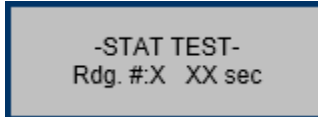
### 2 Measurement

When <READY> is displayed:

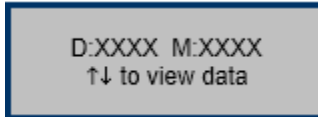
- ▶ Press  and the following is displayed: 


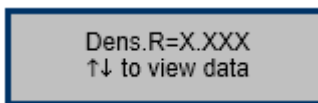
- ▶ Press  repeatedly until the following is displayed: 

- ▶ Press  and the following is displayed: 


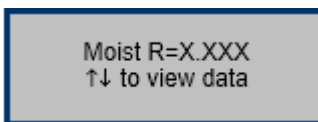
- ▶ Press  and the following is displayed: 

At the end of the counting period the following will be displayed:

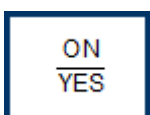


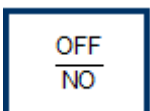
- ▶ Press  and the following is displayed: 

Record Dens. R as the **density ratio**.

- ▶ Press  repeatedly until the following is displayed: 

Record Moist R as the **moisture ratio**.

- ▶ Press  and the display will return to <READY>.


- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N107: Standard Count Troxler 4640B

### 1 Set up

Position the air gap spacer on the reference block. Position the nuclear gauge on the spacer so the handle end rests over the two posts on the spacer.

Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press  and the following will be displayed:

```
-Standard Count-
XXXX XXXX
Take a new
Standard Count?
```

- ▶ Press  and the following will be displayed:

```
Place Gauge on
Spacer & both on
Block, Put Rod in
SAFE, Press ENTER
```

- ▶ Press  and the following will be displayed:


```
Taking
Standard Count.
XX seconds
remaining.
```


At the end of the counting period, the following will be displayed:

```
Std 1 Std 2
XXXX XXXX
X.XX%Z X.XX%Z
Use new Stds?
```

Record the following values:

- Std1 as the **System 1 standard count**.
- Std2 as the **System 2 standard count**.

- ▶ Press  and the display will return to <READY>.


- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N108: Statistical Count Troxler 4640B

### 1 Set up


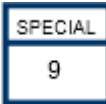
Position the air gap spacer on the reference block. Position the nuclear gauge on the spacer so the handle end rests over the two posts on the spacer.

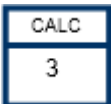
Check the source rod handle is correctly located in the shielded position.


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press   and the following will be displayed:
 



Special Function  
 Yes - Next Menu  
 1 - Surface Voids  
 2 - Recover Erase
  - ▶ Press  and the following will be displayed:
 

Place Gauge on  
 Spacer & both on  
 Block, Put Rod in  
 SAFE, Press ENTER
  - ▶ Press  and the following will be displayed:
 

-STAT TEST-  
 Reading # X  
  
 Time: XX secs.
- At the end of the counting period, the following will be displayed:
- STAT TEST-  
 Avg: XXXX X.XX Z  
 Avg: XXXX X.XX Z  
 View stat data?

Record the second value on the first line of displayed data as the **System 1 density ratio**.

Record the second value on the second line of displayed data as the **System 2 density ratio**.

- ▶ Press  and the display will return to <READY>.
- ▶ Press  if the nuclear gauge is not required for further use.




## Operating Instruction N113: Standard Count Humboldt 5001EZ

### 1 Set-up

Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge closest to the source rod is in contact with the metal plate on the side of the block.


Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.


The following will be displayed:

```
*DATA XX/XX/XX
*SET UP XX:XX:XX
*ENGINEERING
DEPTH=SAF
```

### 2 Measurement


- ▶ Press  and the following will be displayed:

```
*SET UP 2
*SET MEASUREMENT MODES
*SET TRNCH COR.
*SET TARGETS
```


- ▶ Press  and the following will be displayed:

```
MEAS = FAST/NORM/SLOW
STD = 4MIN/16MIN
TYPE = ASPH/SOIL/THIN
DEPTH = AUTO/MANUAL
```

- ▶ Press  repeatedly until "4MIN" flashes.

- ▶ Press  and the following will be displayed:

```
DS = XXXX MM/DD/YY
MS = XXX MM:HH
* TAKE NEW STD
* USE CURRENT STD
```

- ▶ Press  and the following will be displayed:

```
TAKING STANDARD
TIME REMAINING X:XX
DS = X
MS = X DEPTH = SAF
```

- ▶ At the end of the counting period, the following will be displayed:


```
STD TEST RESULTS
DS = XXXX.X
MS = XXX.X
```

or

```
DS = XXXX %ERR = X.X
MS = XXX %ERR = X.X
*REJECT & TAKE NEW STD
*RETAIN THE NEW STD
```


Record the following displayed values if no error message is displayed:

- DS as the **density standard count**.
- MS as the **moisture standard count**.

▶ Press  and the display will return to the main menu.

If an error message is displayed:

▶ Press   and the display will return to the main menu.


▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N114: Statistical Count Humboldt 5001EZ

### 1 Set-up

Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge closest to the source rod is in contact with the metal plate on the side of the block.


Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.


The following will be displayed:

```
*DATA XX/XX/XX
*SET UP XX:XX:XX
*ENGINEERING
DEPTH=SAF
```


### 2 Measurement

- ▶ Press  and the following will be displayed:

```
*SET UP 2
*SET MEASUREMENT MODES
*SET TRNCH COR.
*SET TARGETS
```


- ▶ Press  and the following will be displayed:

```
MEAS = FAST/NORM/SLOW
STD = 4MIN/16MIN
TYPE = ASPH/SOIL/THIN
DEPT = AUTO/MANUAL
```

- ▶ Press  repeatedly until "16MIN" flashes.

- ▶ Press  and the following will be displayed:

```
DS = XXXX          MM/DD/YY
MS = XXX           MM:HH
* TAKE NEW STD
* USE CURRENT STD
```

- ▶ Press  and the following will be displayed:

```
TAKING STATISTICS
TIME REMAINING      X:XX
DS = X
MS = X              DEPTH = SAF
```

- ▶ At the end of the counting period, the following will be displayed:

```
STAT TEST RESULTS
DS = XXXX.X      R = X.XXX
MS = XXX.X       R = X.XXX
```

or


```
DS = XXXX          %ERR = X.X
MS = XXX           %ERR = X.X
*REJECT & TAKE NEW STD
*RETAIN THE NEW STD
```


Record the following displayed values:

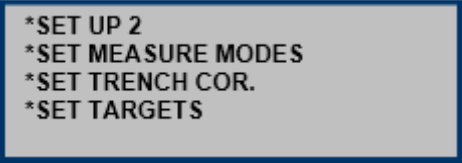
- R in the DS row as the **density ratio**.
- R in the MS row as the **moisture ratio**.

If an error message is displayed:


▶ Press   to take new counts.

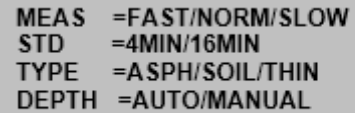
▶ Press  and the display will return to the main menu.

▶ Press  and the following will be displayed:





```
*SET UP 2
*SET MEASURE MODES
*SET TRENCH COR.
*SET TARGETS
```


▶ Press  and the following will be displayed:



```
MEAS =FAST/NORM/SLOW
STD =4MIN/16MIN
TYPE =ASPH/SOIL/THIN
DEPTH =AUTO/MANUAL
```

▶ Press  repeatedly until "4MIN" flashes.

▶ Press  and the display will return to the main menu.

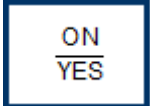
▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N119: Standard Count Instrotek Xplorer 3500

### 1 Set-up



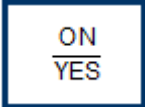


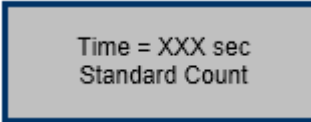
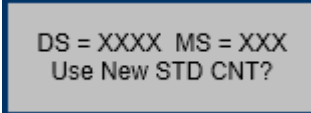
Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

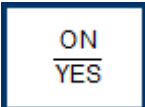
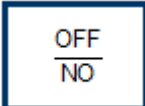
### 2 Measurement

When <READY> is displayed:

- ▶ Press  and the following is displayed: 
  - ▶ Press  and the following is displayed: 
  - ▶ Press  and the time will count down from 240 seconds and display: 
- At the end of the counting period, the following will be displayed: 

Record the following values:

- DS as the **density standard count**.
- MS as the **moisture standard count**.

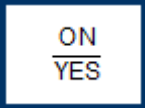
- ▶ Press  and display will return to <READY>.
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N120: Statistical Count Instrrotek Xplorer 3500

### 1 Set-up


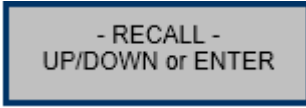

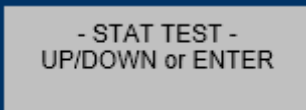
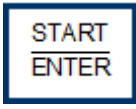
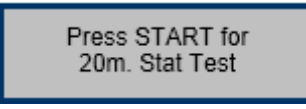
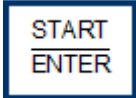
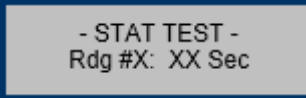
Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.



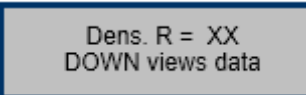
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement


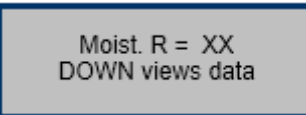
When <READY> is displayed:

- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 

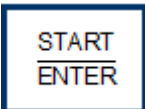
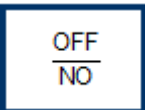
At the end of the counting period, the following is displayed:

- ▶ Press  and the following is displayed:   


Record Dens. R as the **density ratio**.

- ▶ Press  repeatedly until the following is displayed: 

Record Moist R as the **moisture ratio**.

- ▶ Press  and the display will return to <READY>.
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N121: Standard Count Troxler 3440P

### 1 Set-up

Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

▶ Press	STD	repeatedly until the following is displayed:	-Standard Count- DS = XX MS = XX Take new count?
▶ Press	YES	repeatedly until the following is displayed:	Is gauge on Std. Block & Source rod in SAFE pos?
▶ Press	ENTER START	repeatedly until the following is displayed:	Taking Standard Count XX seconds remaining
At the end of the counting period, the following is displayed:			DS = XX XX %P MS = XX XX %P Do you want to use the new STD?

Record the following values:

- MS as the **moisture standard count**.
- DS as the **density standard count**.

▶ Press YES and the display will return to <READY>.

- ▶ Turn the power switch off if the nuclear gauge is not required for further use.

## Operating Instruction N122: Statistical Count Troxler 3440P

### 1 Set-up




Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.


Check the source rod handle is correctly located in the shielded position.


- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press 
- ▶ Press  until stat test appears as an option
- ▶ Press  the following is displayed:
 


1. Take STAT Test  
 2. Review STAT Test  
 3. Print STAT Test  
 <ESC> to Exit
- ▶ Press  the following is displayed:
 

Place Gauge on  
 Std. Block & Source  
 Rod in SAFE Pos.  
 Press <START>
- ▶ Press 

At the end of the counting period, the following will be displayed:

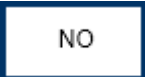

DENS STAT TEST  
 Avg cnts: XXXX  
 R: XX (XXXX)  
 ENTER for Moist

Record R as the **density ratio**.

- ▶ Press  the following is displayed:
 

MOIST STAT TEST  
 Avg cnts: XX  
 R: XX (XXXX)  
 View Stat. data?

Record R as the **moisture ratio**.

- ▶ Press  and display will return to the SETUP menu.
- ▶ Press  to exit.

- ▶ Turn the power switch off if the nuclear gauge is not required for further use.



## Operating Instruction N123: Standard Count Troxler 3430P

### 1 Set-up

Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

▶ Press	STD	repeatedly until the following is displayed:	-Standard Count- DS = XX MS = XX Take new count?
▶ Press	YES	repeatedly until the following is displayed:	Is gauge on Std. Block & Source rod in SAFE pos?
▶ Press	ENTER START	repeatedly until the following is displayed:	Taking Standard Count XX seconds remaining

At the end of the counting period, the following is displayed:

DS = XX XX %P  
 MS = XX XX %P  
 Do you want to use  
 the new STD?

Record the following values:

- MS as the **moisture standard count**.
- DS as the **density standard count**.

▶ Press YES and the display will return to <READY>

- ▶ Turn the power switch off if the nuclear gauge is not required for further use.

## Operating Instruction N124: Statistical Count Troxler 3430P

### 1 Set-up




Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.


Check the source rod handle is correctly located in the shielded position.


- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press 
- ▶ Press  until stat test appears as an option
- ▶ Press  the following is displayed:
 


1. Take STAT Test
  2. Review STAT Test
  3. Print STAT Test  
<ESC> to Exit
- ▶ Press  the following is displayed:
 

Place Gauge on  
Std. Block & Source  
Rod in SAFE Pos.  
Press <START>
- ▶ Press 

At the end of the counting period, the following will be displayed:

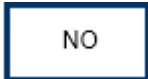

DENS STAT TEST  
Avg cnts: XXXX  
R: XX (XXXX)  
ENTER for Moist

Record R as the **density ratio**.

- ▶ Press  the following is displayed:
 

MOIST STAT TEST  
Avg cnts: XX  
R: XX (XXXX)  
View Stat. data?

Record R as the **moisture ratio**.

- ▶ Press  and display will return to the SETUP menu
- ▶ Press  to exit.

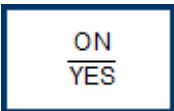
- ▶ Turn the power switch off if the nuclear gauge is not required for further use.

## Operating Instruction N127: Standard Count CPN MC1 and MC3 Elite

### 1 Set-up


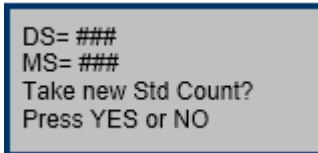
Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

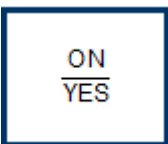

Check the source rod handle is correctly located in the shielded position.

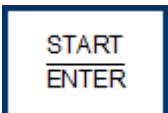
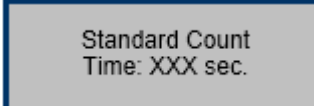
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

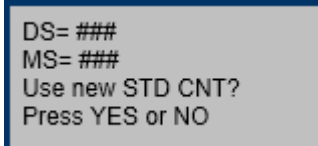
When <READY> is displayed:

- ▶ Press  and the following is displayed: 

- ▶ Press  and the following is displayed: 

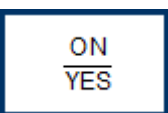
- ▶ Press  and the following is displayed: 

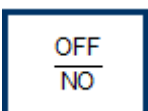
At the end of the counting period, the following will be displayed:



Record the following values:

- DS as the **density standard count**.
- MS as the **moisture standard count**.

- ▶ Press  and the display will return to <READY>.

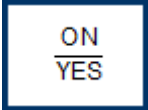
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N128: Statistical Count CPN MC1 and MC3 Elite

### 1 Set-up



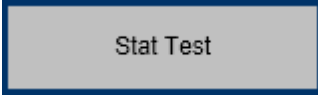
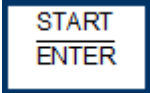
Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press 
- ▶ Press  when the display reads: 
- ▶ Press 

After 20 minutes, the display will show the results of the test, you can scroll through to see each count.

## Operating Instruction N129: Standard Count Humboldt 5001SD

### 1 Set-up

Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge closest to the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.



Press



and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:

MEAS	STD	TYPE	DEPTH
NORM	4MIN	SOIL	AUTO
<b>Working Project (Job)</b>			
1234			
<b>Project results</b>			
WD = XXXX	%M = XX.X	%PR = XX.X	
DD = XXXX	M = XXX	MAXD = XXXX	

## 2 Measurement

▶ Press



The following will be displayed:

Selected Standard Method - [4 MIN STD]		
Date	Density Std	Moisture Std
xx/xx/xxxx xx:xx:xx	XXXX.X	XXX.X
xx/xx/xxxx xx:xx:xx	XXXX.X	XXX.X
xx/xx/xxxx xx:xx:xx	XXXX.X	XXX.X
xx/xx/xxxx xx:xx:xx	XXXX.X	XXX.X

▶ Press



The following will be displayed:

<b>TAKING MEASUREMENT</b>	
<b>TIME REMAINING</b>	<b>XX:XX</b>
DENSITY COUNT = XX.X	
MOISTURE COUNT = X.X	
<b>DEPTH = XX</b>	

► At the end of the counting period, the following will be displayed

Standard Results xx/xx/xxxx xx:xx:xx			
Min	DS	MS	Density Standard
1	4109	467.0	4109 % Error: 0.1 <b>Moisture Standard</b> 467.0 % Error = 0.1


or


Standard Results xx/xx/xxxx xx:xx:xx			
Min	DS	MS	Density Standard
1	4109	467.0	4109 R=0.705
2	4066	466.0	% Error: 0.1
3	4089	464.6	<b>Moisture Standard</b>
4	4093	455.1	467.0 R=0.998
5	4094	469.8	% Error = 1.0
6	4088	472.5	

Record the following displayed values if no error message is displayed:

- DS as the **density standard count**.
- MS as the **moisture standard count**.

► Press  to accept and store the standard count

► Press  and the display will return to the main menu.

► Press  if the nuclear gauge is not required for further use.

## Operating Instruction N130: Statistical Count Humboldt 5001SD

### 1 Set-up

Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge closest to the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

▶ Press

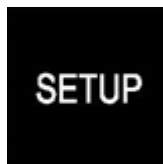


The following will be displayed:

MEAS	STD	TYPE	DEPTH
NORM	4MIN	SOIL	AUTO
<b>Working Project (Job)</b>			
1234			
<b>Project results</b>			
WD = XXXX	%M = XX.X	%PR = XX.X	
DD = XXXX	M = XXX	MAXD = XXXX	

### 2 Measurement

▶ Press



The following will be displayed:

Settings
<b>Set Measure Modes</b>
<b>Set Trench Correction</b>
<b>Standardization</b>



Select '**Set Measure Modes**'.



The following will be displayed:

Measurement Modes			
Measure	Standard	Type	Depth
Fast	4 Min	Asphalt	Auto
Norm	16 Min	Soil	Manual
Slow		Thin Layer	

▶ Press '**16MIN**' Check all other settings are '**Norm**', '**Soil**' and '**Auto**'.



The following will be displayed:

Selected Standard Method - [16 MIN STD]		
Date	Density Std	Moisture Std
xx/xx/xxxx xx:xx:xx	XXXX.X	XXX.X
xx/xx/xxxx xx:xx:xx	XXXX.X	XXX.X
xx/xx/xxxx xx:xx:xx	XXXX.X	XXX.X
xx/xx/xxxx xx:xx:xx	XXXX.X	XXX.X



The following will be displayed:



- ▶ During the counting period, the following display will be updated with counts every one minute:

Standard Results xx/xx/xxxx xx:xx:xx			
Min	DS	MS	Density Standard
1	4109	467.0	4109 % Error: 33.1
			<b>Moisture Standard</b> 467.0 % Error = 33.1

- ▶ At the end of the counting period, the following will be displayed:

Standard Results xx/xx/xxxx xx:xx:xx			
Min	DS	MS	Density Standard
1	4109	467.0	4109 R=0.705
2	4066	466.0	% Error: 0.1
3	4089	464.6	<b>Moisture Standard</b>
4	4093	455.1	467.0 R=0.998
5	4094	469.8	% Error = 1.0
6	4088	472.5	

Record the following displayed values:

- R in the DS row as the **density ratio**.
- R in the MS row as the **moisture ratio**.

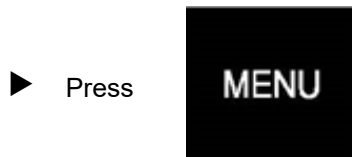
If an error message is displayed:



or



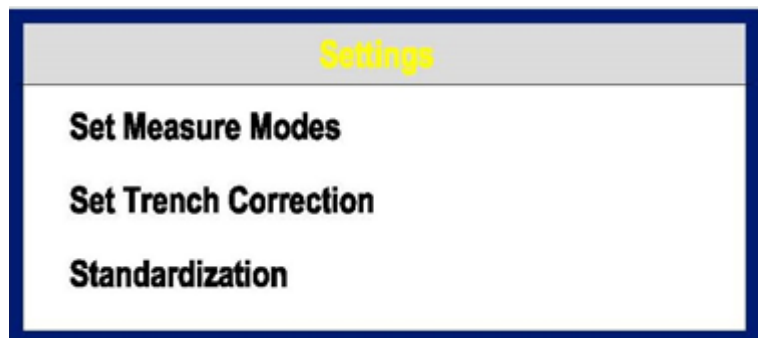
to take new counts.



and the display will return to the main menu.



The following will be displayed:



Select '**Set Measure Modes**'.



The following will be displayed:

Measurement Modes			
Measure	Standard	Type	Depth
Fast	4 Min	Asphalt	Auto
Norm	16 Min	Soil	Manual
Slow		Thin Layer	

▶ Press **'4MIN'**

Check all other settings are **'Norm'**, **'Soil'** and **'Auto'**.

▶ Press



▶ Press



and the display will return to the main menu.

▶ Press




if the nuclear gauge is not required for further use.

## Operating Instruction N131: Standard Count Instratek Xplorer 2 3500

### 1 Set up


Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.


Check the source rod handle is correctly located in the shielded position.


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <GAUGE READY> is displayed:

- ▶ Press  and the following is displayed:
 

DS = XXXX  
 MS = XXX  
 Take New STD Count?  
 Press YES or NO
- ▶ Press  and the following is displayed:
 



Place Gauge on Poly  
 Std. Block in SAFE  
 Position  
 Press Start
- ▶ Press  and the time will count down from 240 seconds and display:
 

Standard Count  
 Count Time: XXXsec.
- ▶ At the end of the counting period the following will be displayed:
 

DS = XXXX  
 MS = XXX  
 Use New STD Count?  
 Press YES or NO

Record the following values:

- DS as the **density standard count**.
- MS as the **moisture standard count**.


- ▶ Press  and the display will return to **<GAUGE READY>**.
  
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N132: Statistical Count Instrotek Xplorer 2 3500

### 1 Set up





Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge furthest from the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <GAUGE READY> is displayed:

▶ Press		and the following is displayed:	1. Recall 2. Offset UP/DOWN for Next Select #, ESC Exit
▶ Press		repeatedly until the following is displayed:	5. Start Test 6. Drift Test UP/DOWN for Next Select #, ESC Exit
▶ Press		and the following is displayed:	Stat Test. Press START for 20 one min counts
▶ Press		and the following is displayed	Stat Test Reading # X Count Time: XX sec.

- ▶ At the end of the counting period the following is displayed:


```
Dens. R:  X.XX P
Dens. Avg: XXXX
Moist R:  X.XX P
Moist Avg: XXX
```

Record Dens. R as the **density ratio**.

Record Moist R MS as the **moisture ratio**.


- ▶ Press  and the following is displayed:

```
#1 D XXXX M XX
#2 D XXXX M XX
#3 D XXXX M XX
#4 D XXXX M XX
```

- ▶ Press  repeatedly to view individual counts and return to the following screen:

```
Dens. R:  X.XX P
Dens. Avg: XXXX
Moist R:  X.XX P
Moist Avg: XXX
```

- ▶ Press  and the display will return to <GAUGE READY>.


- ▶ Press  if the nuclear gauge is not required for further use.



## Operating Instruction N133: Standard Count Humboldt 5001EZ-2

### 1 Set-up

Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge closest to the source rod is in contact with the metal plate on the side of the block. Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:

```
F1 DATA      XX/XX/XXXX
F2 SETUP
F3 ENGINEERING
              DEPTH = SAFE
```

### 2 Measurement

- ▶ Press 

The following will be displayed:

```
F1 SETUP 2
F2 SET MEASURE MODES
F3 SET TRENCH COR.
F4 SET TARGETS
```

- ▶ Press 

The following will be displayed:

```
F1 MEAS FAST / NORM / SLOW
F2 STD      4MIN / 16MIN
F3 TYPE     ASPH / SOIL / THIN
F4 DEPTH    AUTO / MANUAL
```

- ▶ Press  repeatedly until '4MIN' flashes.

- ▶ Press 

The following will be displayed:



▶ Press 

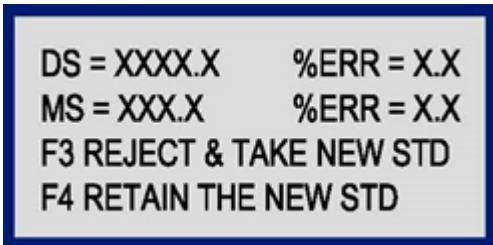
The following will be displayed:



▶ At the end of the counting period, the following will be displayed:




or




Record the following displayed values if no error message is displayed:

- DS as the **density standard count**.
- MS as the **moisture standard count**.

▶ Press  and the display will return to the main menu.

If an error message is displayed:

▶ Press   and the display will return to the main menu.


▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N134: Statistical Count Humboldt 5001EZ-2

### 1 Set-up

Position the nuclear gauge on the reference block between its raised edges, such that the side of the nuclear gauge closest to the source rod is in contact with the metal plate on the side of the block.

Check the source rod handle is correctly located in the shielded position.

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:

```
F1 DATA      XX/XX/XXXX
F2 SETUP
F3 ENGINEERING
              DEPTH = SAFE
```

### 2 Measurement

- ▶ Press 

The following will be displayed:

```
F1 SETUP 2
F2 SET MEASURE MODES
F3 SET TRENCH COR.
F4 SET TARGETS
```

- ▶ Press 

The following will be displayed:

```
F1 MEAS FAST / NORM / SLOW
F2 STD      4MIN / 16MIN
F3 TYPE     ASPH / SOIL / THIN
F4 DEPTH    AUTO / MANUAL
```

- ▶ Press  repeatedly until '**16MIN**' flashes.

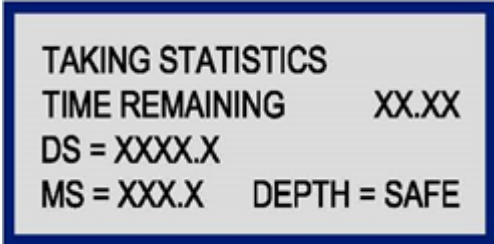
- ▶ Press 

The following will be displayed:

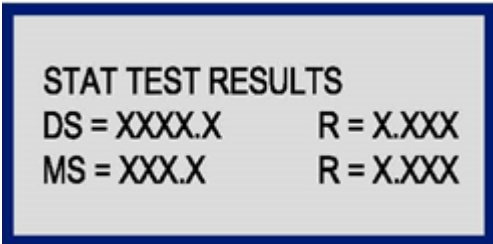


▶ Press 

The following will be displayed:



▶ At the end of the counting period, the following will be displayed:



Record the following displayed values:

- R in the DS row as the **density ratio**.
- R in the MS row as the **moisture ratio**.

If an error message is displayed:

▶ Press 

or



to take new counts.

▶ Press 

and the display will return to the main menu.

▶ Press 

The following will be displayed:


F1 SETUP 2  
F2 SET MEASURE MODES  
F3 SET TRENCH COR.  
F4 SET TARGETS


▶ Press 

The following will be displayed:

F1 MEAS FAST / NORM / SLOW  
F2 STD 4MIN / 16MIN  
F3 TYPE ASPH / SOIL / THIN  
F4 DEPTH AUTO / MANUAL


▶ Press  repeatedly until '4MIN' flashes.

▶ Press  and the display will return to the main menu.

▶ Press  if the nuclear gauge is not required for further use.


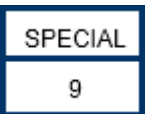
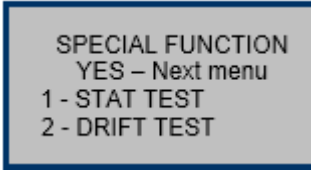
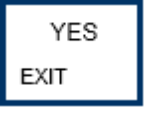
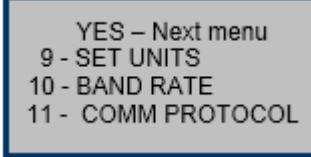
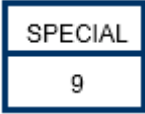
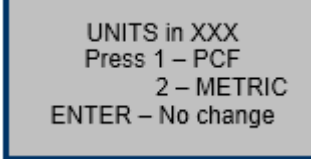
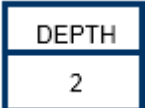

## Operating Instruction N201: Test Parameters (Soils) Troxler 3440

### 1 Set-up

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.


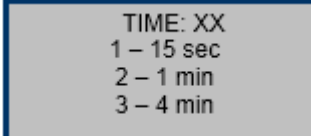
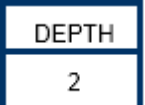
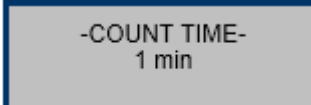
### 2 Units

When <READY> is displayed:

- ▶ Press 
- ▶ Press  and the following is displayed: 
  - SPECIAL FUNCTION
  - YES – Next menu
  - 1 - STAT TEST
  - 2 - DRIFT TEST
- ▶ Press  repeatedly until the following is displayed: 
  - YES – Next menu
  - 9 - SET UNITS
  - 10 - BAND RATE
  - 11 - COMM PROTOCOL
- ▶ Press  and the following is displayed: 
  - UNITS in XXX
  - Press 1 – PCF
  - 2 – METRIC
  - ENTER – No change
- ▶ Press  and the following is displayed: 
  - UNITS IN METRIC

The display will return to <READY>.

### 3 Count time

- ▶ Press  and the following is displayed: 
  - TIME: XX
  - 1 – 15 sec
  - 2 – 1 min
  - 3 – 4 min
- ▶ Press  and the following is displayed: 
  - COUNT TIME-
  - 1 min

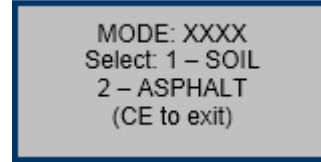
The display will return to <READY>.

#### 4 Soil mode

▶ Press 

▶ Press 

and the following is displayed:




▶ Press 

And the following will be displayed briefly:

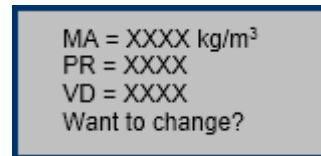


The display will return to <READY>.

#### 5 Maximum dry density

▶ Press 

and the following is displayed:



To retain the value, go to 5.1.

To change the value, go to 5.2.

##### 5.1 Retain the value

▶ Press 

to retain the displayed value of PR.

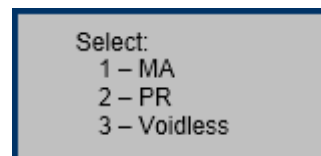
The display will return to <READY>. Go to 6.

##### 5.2 Change the value

▶ Press 

to change the displayed value of PR.

And the following will be displayed:



▶ Press 

DEPTH
2

 and the following is displayed:

Select source of Proctor value: 1 – Stored Value 2 – New Value
--

To enter a new value, go to 5.3.

To select a stored value, go to 5.4.

**5.3 Enter a new value**

▶ Press 

DEPTH
2

 and the following is displayed:

Proctor: XXXX kg/m <sup>3</sup> Press ENTER when completed
---

▶ Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup>.

▶ Press 

START/ ENTER
=

 and the following is displayed:

PR = XXXX kg/m <sup>3</sup> Do you want to save this value for later use?
---

**Note:** It is not necessary to save the displayed value to enable it.

**If the value is not to be saved:**

▶ Press 

NO/CE
C/CE

 and the display will return to <READY>. Go to 6.

**To save the displayed value:**

▶ Press 

YES
EXIT

 and the following is displayed:

Select Proctor Memory Cell: 1:XX2:XX 3:XX4:XX
--

▶ Press the numbered key (1, 2, 3 or 4) to select a memory cell in which to store the value.

And the following will be displayed:

Proctor XXXX kg/m <sup>3</sup> ENABLED! stored in cell X
---

The display will return to <READY>. Go to 6.



### 5.4 Select a stored value

▶ Press 

COUNTS
1

 and the following is displayed:

Select desired  
Proctor:  
1:XX2:XX  
3:XX4:XX

▶ Press the numbered key (1, 2, 3 or 4) to select the required value:

And the following will be displayed:

Proctor  
XXXX kg/m<sup>3</sup>  
ENABLED!

The display will return to <READY>.

## 6 Wet density bias

▶ Press 

OFFSET
MR

 and the following is displayed:

-OFFSET- Select:  
1 – Dens. –ZZZ-  
2 – Moist –ZZZ-  
3 – Trench –ZZZ-

▶ Press 

COUNTS
1

The following will be displayed:

Density Offset  
DISABLED  
Do you want to  
ENABLE?

or

Density Offset  
ENABLED  
Do you want to  
DISABLE?

To disable the wet density bias, go to 6.1.

To enable the wet density bias, go to 6.2.

### 6.1 Disable wet density bias

▶ Press 

NO/CE
C/CE

 to confirm the density offset is to remain disabled or 

YES
EXIT

 to disable the density offset.

And the following will be displayed briefly:

Density Offset  
DISABLED

The display will return to <READY>. Go to 7.

## 6.2 Enable wet density bias

- Press 

YES
EXIT

 to enable the density offset or 

NO/CE
C/CE

 to confirm the density offset is to remain enabled.

The following will be displayed:

-Wet Density- Offset XXXX kg/m <sup>3</sup> Want to change?
--

To retain the value, go to 6.2.1.

To change the value, go to 6.2.2.

### 6.2.1 Retain the value

- Press 

NO/CE
C/CE

 to retain the displayed value of wet density offset.

The following will be displayed briefly:

Density Offset ENABLED!
----------------------------

The display will return to <READY>.

### 6.2.2 Change the value

- Press 

YES
EXIT

 and the following is displayed:

- WD Offset - Select: + or - 1 = + 2 = -
---

- Press 

COUNT
1

 or 

DEPTH
2

 and the following is displayed:

WD Offset Press enter when completed
--

- Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup>.

- Press 


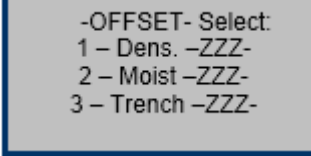
START/ ENTER
=

The following will be displayed:

Density Offset ENABLED!
----------------------------

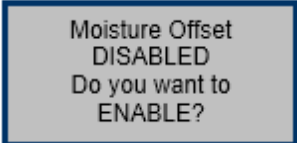
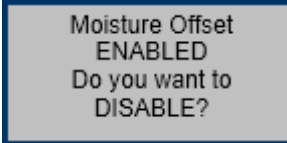
The display will return to <READY>.

## 7 Moisture bias

▶ Press  and the following is displayed: 

▶ Press 

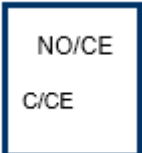

The following will be displayed:

 or 

To disable the moisture bias, go to 7.1.

To enable the moisture bias, go to 7.2.

### 7.1 Disable moisture bias


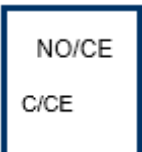
▶ Press  to confirm the moisture offset is to remain disabled or  to disable the moisture offset.

And the following will be displayed briefly:

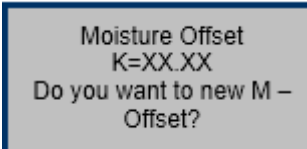


The display will return to <READY>. Go to 8.

### 7.2 Enable moisture bias

▶ Press  to enable the moisture offset or  to confirm the moisture offset is to remain enabled.

And the following will be displayed:



To retain the displayed K value, go to 7.2.1.

To change the displayed K value to a gauge-derived value, go to 7.2.2.

To change the displayed K value to a stored value, go to 7.2.3.

### 7.2.1 Retain the value

- ▶ Press  to retain the displayed K value.

The following will be displayed:

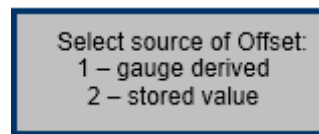


The display will return to <READY>. Go to 8.

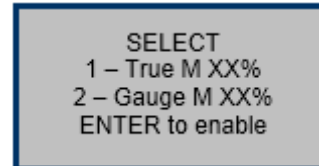
### 7.2.2 Change to a gauge-derived value

To change the moisture bias to a gauge-derived value:

- ▶ Press  and the following is displayed:



- ▶ Press  and the following is displayed:

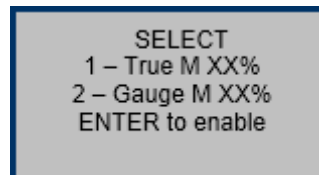



- ▶ Press  and the following is displayed:

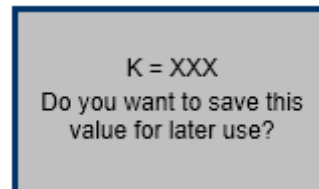


- ▶ Use the numbered keys to enter the mean oven-dry moisture content to the nearest 0.1%.

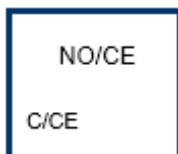
- ▶ Press  and the following is displayed:



- ▶ Press  and the following is displayed:



If the value is not be saved:

- ▶ Press 

And the following will be displayed:

Moisture Offset  
ENABLED  
K = XXXX

The display will return to <READY>. Go to 8.

**To save the displayed value:**

▶ Press 

YES
EXIT

and the following is displayed:

Enter desired  
memory location  
of M – Offset  
(1-4)

▶ Press a numbered key (1, 2, 3 or 4) to select a memory cell in which to store the value.

▶ Press 

START/ ENTER
=

And the following will be displayed:

Moisture K  
SAVED  
K = X.XX  
Location 1

And the following will be displayed briefly:

Moisture Offset  
Enabled  
K = X.XX

The display will return to <READY>. Go to 8.

**7.2.3 Change to a stored value**

▶ Press 

YES
EXIT

and the following is displayed:

Select source of Offset:  
1 – gauge derived  
2 – stored value

▶ Press 

DEPTH
2

and the following is displayed:

Enter desired memory  
location of M – Offset:  
(1-4)

▶ Press a numbered key (1, 2, 3 or 4) to select the required memory location.

▶ Press 


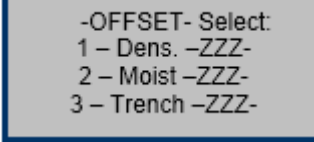
START/ ENTER
=

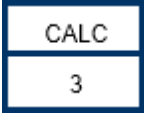

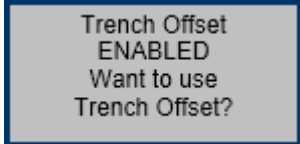
and the following is displayed:

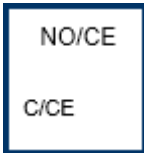
Moisture Offset  
ENABLED  
K = X.XX

The display will return to <READY>.

## 8 Trench offset

▶ Press  and the following is displayed: 


▶ Press  and the following is displayed:  
 or 

▶ Press  to disable the trench offset.

The following will be displayed briefly:




The display will return to <READY>.

▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N202: Measurement (Soils) Troxler 3440

### 1 Set-up

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

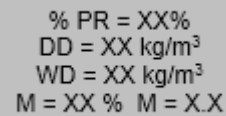
When <READY> is displayed:

- ▶ Press 

In the manual depth mode, the gauge will prompt for the source rod depth.

In the automatic mode, the gauge software reads the depth strip on the source rod to determine the depth.

At the end of the counting period, the following will be displayed:



```
% PR = XX%
DD = XX kg/m³
WD = XX kg/m³
M = XX % M = X.X
```

Record the following values:

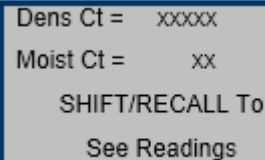
- % PR as the **percent protector** to the nearest 0.1%.
- DD as the **dry density** to the nearest 0.001 t/m<sup>3</sup>.
- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- M as the **water content (t/m<sup>3</sup>)** to the nearest 0.001 t/m<sup>3</sup>.
- % M as the **moisture content (%)** to the nearest 0.1%.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000).

- ▶ Press 

- ▶ Press 


And the following will be displayed:




```
Dens Ct = xxxxx
Moist Ct = xx
SHIFT/RECALL To
See Readings
```

Record the following values as appropriate:

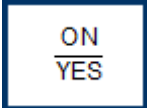
- Dens Ct as the **density count**.
- Moist Ct as the **moisture count**.

- ▶ Press  and the display will return to <READY>.

- ▶ Press  if the nuclear gauge is not required for further use.

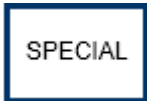
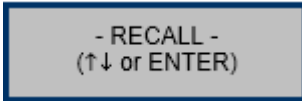

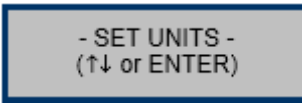
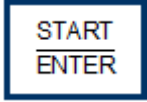
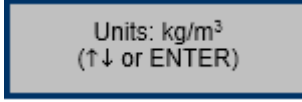


## Operating Instruction N203: Test Parameters (Soils) Troxler 3430

### 1 Set-up


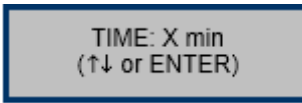


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Units


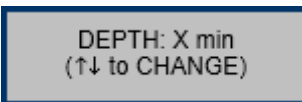

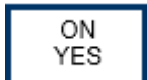
When <READY> is displayed:

- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  to set the desired unit.
- ▶ Press  and the display will return to <READY>.

### 3 Count time

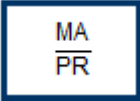



- ▶ Press  and the following is displayed: 
- ▶ Press  to set the desired count time.
- ▶ Press  and the display will return to <READY>.

### 4 Depth

- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the required test depth is displayed.
- ▶ Press  and display will return to <READY>.



## 5 Soil mode and maximum dry density

- ▶ Press  and the following is displayed: 
- ▶ Press  until PR is displayed. 

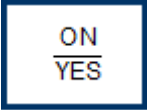
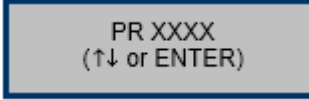

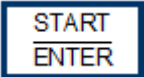
To retain the displayed value, go to 5.1.  
To change the displayed value, go to 5.2.

### 5.1 Retain the value

- ▶ Press  to retain the displayed value of PR.


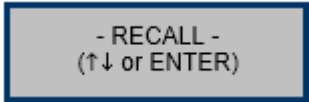


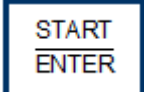
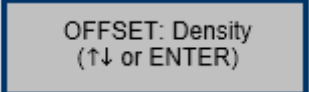
The display will return to <READY>. Go to 6.

### 5.2 Change the value

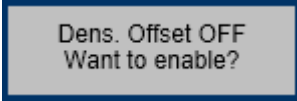
- ▶ Press  to change the displayed value of PR.
- The following is displayed: 
- For each digit:
- ▶ Press  repeatedly until the required number is displayed.
  - ▶ Press  to confirm each number.

The display will return to <READY>.

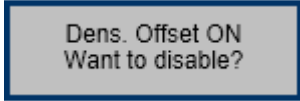
## 6 Wet density bias

- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 

► Press  and the following is displayed:



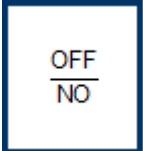
or



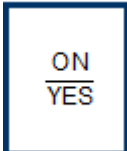
To disable the wet density bias, go to 6.1.

To enable the wet density bias, go to 6.2.


### 6.1 Disable wet density bias

► Press  to confirm the density offset is to remain disabled

or

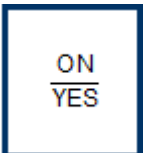
 to disable the density offset.

And the following will be displayed:

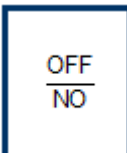


The display will return to <READY>. Go to 7.

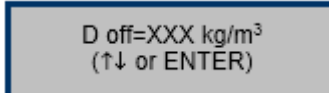
### 6.2 Enable wet density bias

► Press  to enable the density offset

or

 to confirm the density offset is to remain enabled.

And the following will be displayed:



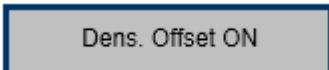
To retain the displayed value, go to 6.2.1.

To change the displayed value, go to 6.2.2.

#### 6.2.1 Retain the value

► Press 

The following will be displayed briefly:




The display will return to <READY>. Go to 7.



#### 6.2.2 Change the value

► Press  to enter a negative or wet density bias.

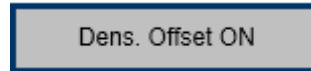
or

 to enter a positive wet density bias.

For each digit:

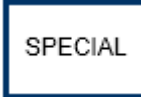
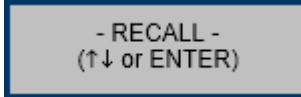

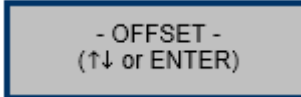

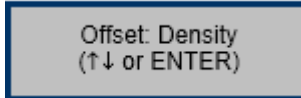

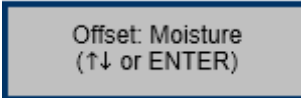
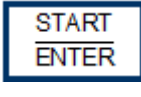
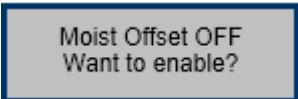
- ▶ Press  until the required number is displayed.
- ▶ Press  to confirm each number.

And the following will be displayed:

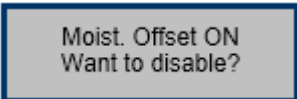


The display will return to <READY>.

## 7 Moisture bias

- ▶ Press  and the following is displayed: 
  - ▶ Press  and the following is displayed: 
  - ▶ Press  and the following is displayed: 
  - ▶ Press  and the following is displayed: 
  - ▶ Press  and the following is displayed:
- 

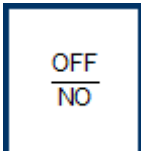
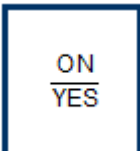
or



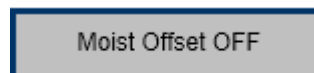
To disable the moisture bias, go to 7.1.

To enable the moisture bias, go to 7.2.

### 7.1 Disable moisture bias

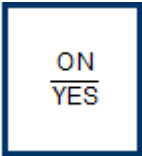
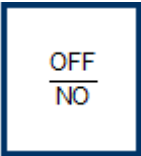
- ▶ Press  to confirm the moisture offset is to remain disabled or  to disable the moisture offset.

And the following will be displayed:

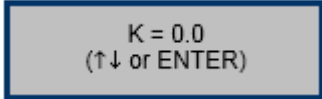




The display will return to <READY>. Go to 8.

### 7.2 Enable the moisture bias


- ▶ Press  to enable the moisture offset or  to confirm the moisture offset is to remain enabled.

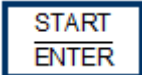
And the following will be displayed:



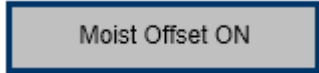
- ▶ Press  to enter a negative K value or  to enter a positive K value

For each digit:

- ▶ Press  until the required number is displayed.

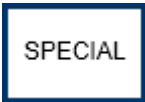
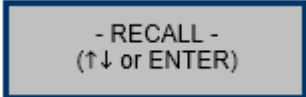

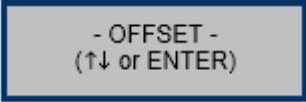
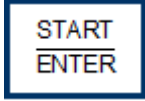
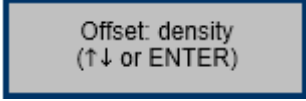

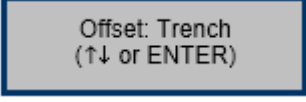
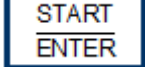
- ▶ Press  to confirm each number.

And the following will be displayed:

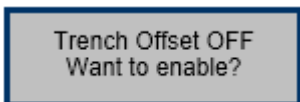
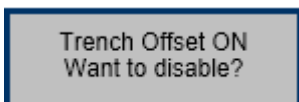


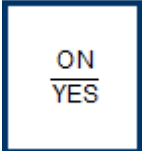
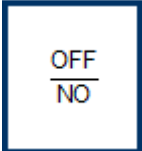
The display will return to <READY>.

### 8 Trench offset

- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the following is displayed: 
- ▶ Press 

The following will be displayed:

 or 

► Press  to confirm the trench offset is to remain disabled or  to disable the trench offset.

And the following will be displayed briefly:

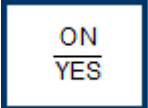


Trench Offset  
DISABLED

The display will return to <**READY**>.

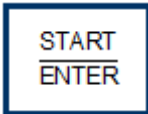
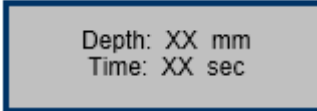
## Operating Instruction N204: Measurement (Soils) Troxler 3430

### 1 Set-up


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press  and the following is displayed: 

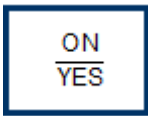
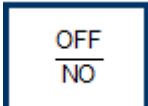
At the end of the counting period:

- ▶ Press  repeatedly until the required values are displayed.

Record the following values:


- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- DD as the **dry density** to the nearest 0.001 t/m<sup>3</sup>.
- % PR as the **relative compaction** to the nearest 0.1%.
- Moist as the **water content (t/m<sup>3</sup>)** to the nearest 0.001 t/m<sup>3</sup>.
- % Moist as the **moisture content (%)** to the nearest 0.1%.
- M Count as the **moisture count**.
- D Count as the **density count**.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000.)

- ▶ Press  and the display will return to <READY>.
- ▶ Press  if the nuclear gauge is not required for further use.


## Operating Instruction N211: Test Parameters (Soils) Humboldt 5001EZ

### 1 Start-up

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:

```
*DATA      XX/XX/XX
*SET UP    XX:XX:XX
*ENGINEERING
          DEPTH=SAF
```

- ▶ Press  and the following will be displayed:


```
*SET UP 2
*SET MEASUREMENT MODES
*SET TRNCH COR.
*SET TARGETS
```

### 2 Measurement units


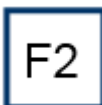
- ▶ Press  and the following will be displayed:

```
*SET DATE
*SET TIME
*UNITS = PCF/SI
```

- ▶ Press  repeatedly until 'SI' flashes.


- ▶ Press  and the display will return to the main menu.

### 3 Count time

- ▶ Press  

The following will be displayed:



```
MEAS = FAST/NORM/SLOW
STD  = 4MIN/16MIN
TYPE = ASPH/SOIL/THIN
DEPTH = AUTO/MANUAL
```

- ▶ Press  repeatedly until 'NORM' flashes.


#### 4 Soil mode

- ▶ Press  repeatedly until 'SOIL' flashes.



#### 5 Depth

- ▶ Press  repeatedly until 'AUTO' flashes.
- ▶ Press  and the display will return to the main menu.

#### 6 Maximum dry density


- ▶ Press  and the following will be displayed:

MAXD = XXXX  
\*INCREASE  
\*DECREASE

- ▶ Press  OR 

to increase or decrease the displayed value until the required value (within the range 900 kg/m<sup>3</sup> to 3000 kg/m<sup>3</sup>) is obtained.

(To convert from t/m<sup>3</sup> to kg/m<sup>3</sup>, multiply the maximum dry density by 1000.)

- ▶ Press  and the display will return to the main menu.


#### 7 Wet density bias

There is no facility to set a wet density bias using the keypad.

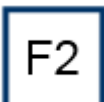
#### 8 Moisture bias

- ▶ Press  and the following will be displayed:

\*SET UP 2  
\*SET MEASURE MODES  
\*SET TRENCH COR.  
\*SET TARGETS

- ▶ Press  and the following will be displayed:

MAXD= XXXX    LWD = XXXX  
KVAL = X.XXX    SPG = X.XXX  
\*INCREASE  
\*DECREASE

- ▶ Press  repeatedly until the 'KVAL' value flashes.



- ▶ Press **F3** OR **F4** to increase or decrease the displayed value until the required K value is obtained.


A maximum value of 0.20 (in increments of 0.10) and a minimum value of -0.10 (in increments of 0.01) may be set.

To disable the moisture bias, set a value of **"0.0"**.

- ▶ Press **MAIN MENU** and the display will return to the main menu.
- ▶ Press **PWR** if the nuclear gauge is not required for further use.

## Operating Instruction N212: Measurement (Soils) Humboldt 5001EZ

### 1 Start-up

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.

### 2 Measurement

- ▶ Press  and the following will be displayed:

```
TAKING MEASUREMENT
TIME REMAINING  X.XX
DC = X
MC = X          DEPTH=XXX
```


At the end of the counting period, the following will be displayed:

```
DD = XXXX.X   %M   = XX.X
WD = XXXX.X   M     = XXX.X
%PR = XXX.X   MAXD  = XXXX
*NEXT          MDEPTH = XXX
```

Record the following values as appropriate:

- DD as the **dry density** to the nearest 0.001 t/m<sup>3</sup>.
- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- % PR as the **relative compaction** to the nearest 0.1%.
- % M as the **moisture content** to the nearest 0.1%.
- M as the **water content** to the nearest 0.001 t/m<sup>3</sup>.


To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000.)


- ▶ Press  and the following will be displayed:

```
DC = XXXX.X   DS     = XXXX.X
MC = XX.X     MS     = XXX.X
VR = XX.XX    %AV    = X.XX
*LAST          MDEPTH = XXX
```

Record the following values as appropriate:

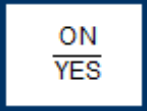
- DC as the **density count**.
- MC as the **moisture count**.

- ▶ Press  and the display will return to the main menu.

- ▶ Press  if the nuclear gauge is not required for further use.


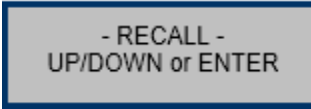

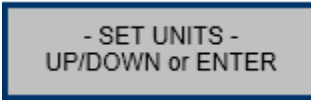

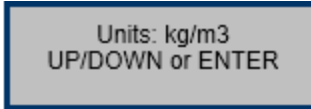

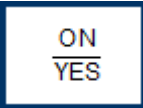
## Operating Instruction N217: Test Parameters (Soils) Instrotek Xplorer 3500

### 1 Set-up


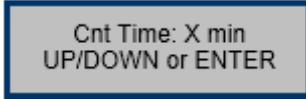

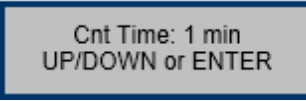
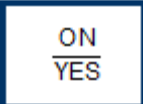
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Units


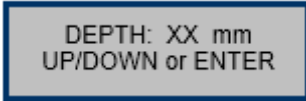

When <READY> is displayed:

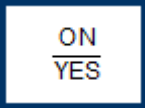
- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  to set the desired unit.
- ▶ Press  and the display will return to <READY>.

### 3 Count time

- ▶ Press  and the following is displayed: 
- ▶ Press  to set the desired count time. 
- ▶ Press  and the display will return to <READY>.

### 4 Depth

- ▶ Press  the following is displayed: 
- ▶ Press  repeatedly until the required test depth is displayed.

- ▶ Press  and display will return to <READY>.

## 5 Soil mode and maximum dry density

- ▶ Press  and the following is displayed:

ENTER selects PR  
DOWN selects MA

- ▶ Press  and the following is displayed:

PR: XXXXX  
Change value?

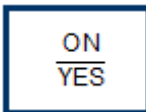
To retain the displayed value, go to 5.1.  
To change the displayed value, go to 5.2.

### 5.1 Retain value

- ▶ Press  to retain the displayed value.

The display will return to the <READY> screen. Go to 6.



### 5.2 Change the value

- ▶ Press  to change the displayed value of PR.

The following is displayed:

PR: XXXXX  
UP/DOWN or ENTER

For each digit:

- ▶ Press  repeatedly until the required number is displayed.
- ▶ Press  to confirm each number.

The display will return to <READY>. Go to 6.


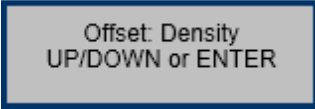

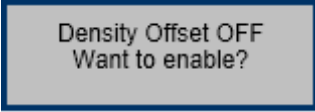
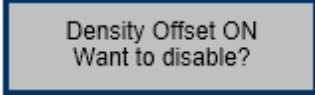
## 6 Wet density bias

- ▶ Press  and the following is displayed:

- RECALL -  
UP/DOWN or ENTER

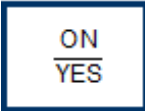
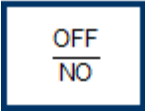

- ▶ Press  and the following is displayed:

- OFFSET -  
UP/DOWN or ENTER

- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed:  or 

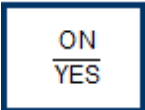
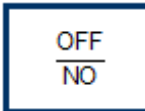
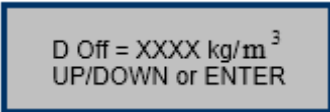
To disable the wet density bias, go to 6.1.  
 To enable the wet density bias, go to 6.2.

**6.1 Disable wet density bias**

- ▶ Press  to disable the density offset.
  - or
  - ▶ Press  to confirm the density offset is to remain disabled.
- The following will be displayed briefly: 

The display will return to <READY>. Go to 7.

**6.2 Enable wet density bias**

- ▶ Press  to enable the density offset.
  - or
  - ▶ Press  to confirm the density offset is to remain enabled.
- And the following will be displayed: 

To retain the displayed value, go to 6.2.1.  
 To change the displayed value, go to 6.2.2.

### 6.2.1 Retain the value

- ▶ Press  and the following will be displayed:

Density Offset Enabled

The display will return to <READY>. Go to 7.


### 6.2.2 Change the value

- ▶ Press  for a positive value.

or

- ▶ Press  for a negative value.

For each digit:

- ▶ Press  until the desired number is displayed.

- ▶ Press  to confirm each number.

And the following will be displayed:

Density Offset Enabled

The display will return to <READY>.

## 7 Moisture bias

- ▶ Press  and the following is displayed:

- RECALL -  
UP/DOWN or ENTER

- ▶ Press  and the following is displayed:


- OFFSET -  
UP/DOWN or ENTER

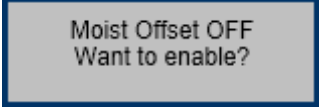
- ▶ Press  and the following is displayed:

Offset: Density  
UP/DOWN or ENTER

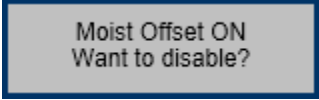
- ▶ Press  and the following is displayed:

Offset: Moisture  
UP/DOWN or ENTER

▶ Press  and the following is displayed:

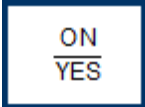


or

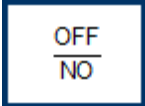


To disable the moisture bias, go to 7.1.  
To enable the moisture bias, go to 7.2.


### 7.1 Disable the moisture bias

▶ Press  to disable the moisture offset.

or

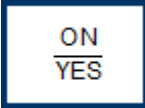
▶ Press  to confirm the moisture offset is to remain disabled.

The following will be displayed:

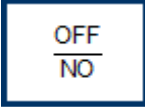


The display will return to <READY>. Go to 8.

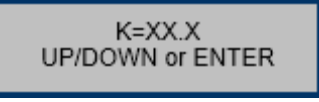
### 7.2 Enable the moisture bias

▶ Press  to enable the moisture offset.

or

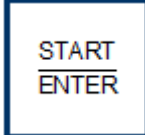
▶ Press  to confirm the moisture offset is to remain enabled.


The following will be displayed:



To retain the displayed value, go to 7.2.1.  
To change the displayed value, go to 7.2.2.


#### 7.2.1 Retain the value

▶ Press  and the following is displayed:




The display will return to <READY>. Go to 8.

### 7.2.2 Change the value

▶ Press  for a positive value.  
or


▶ Press  for a negative value.

For each digit:

▶ Press  until the required number is displayed.

▶ Press  to confirm each number.

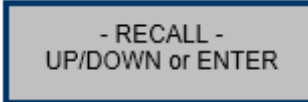
And the following will be displayed:



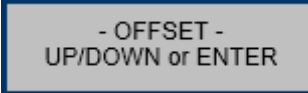
The display will return to <READY>.

## 8 Trench offset

▶ Press  and the following is displayed:



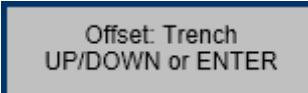
▶ Press  and the following is displayed:



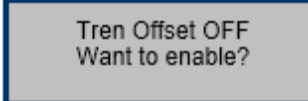
▶ Press  and the following is displayed:



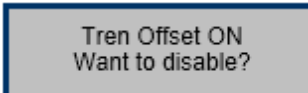
▶ Press  repeatedly until the following is displayed:

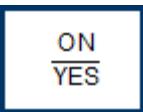


▶ Press  and the following is displayed:

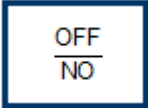


or



▶ Press  to disable the trench offset.  
or



▶ Press  to confirm the trench offset is to remain disabled.

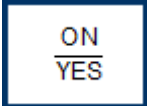
The following will be displayed:



The display will return to <READY>.


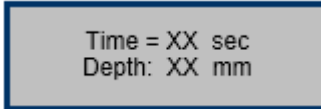
## Operating Instruction N218: Measurement (Soils) Instrotek Xplorer 3500

### 1 Set-up


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press  and the following is displayed: 

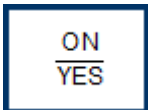
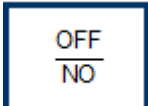
At the end of the counting period:

- ▶ Press  repeatedly until the required values are displayed.

Record the following values as appropriate:

- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- DD as the **dry density** to the nearest 0.001 t/m<sup>3</sup>.
- % PR as the **relative compaction** to the nearest 0.1%.
- Moist as the **water content (t/m<sup>3</sup>)** to the nearest 0.001 t/m<sup>3</sup>.
- % M as the **moisture content (%)** to the nearest 0.1%.
- M Count as the **moisture count**.
- D Count as the **density count**.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000.)

- ▶ Press  and the display will return to <READY>.
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N219: Test Parameters (Soils) Troxler 3440P

### 1 Start up

- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

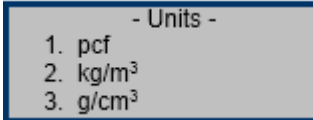
### 2 Measurement units

When <READY> is displayed:

- ▶ Press 

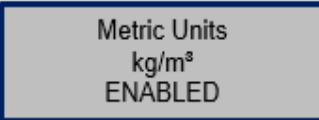
- ▶ Press 

The following will be displayed:



- ▶ Press 

The following will be displayed:

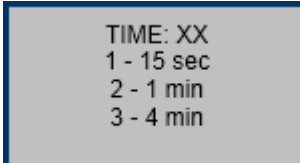


The display will return to <SETUP>.

### 3 Count time

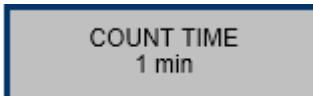
- ▶ Press 

- ▶ Press  and the following is displayed:



- ▶ Press 

The following will be briefly displayed:



The display will return to <READY>.

#### 4 Soil mode

▶ Press MODE

The following will be displayed:

MODE: XXXX  
Select: 1 - ASPHALT  
2 - SOIL  
Press # to Select

▶ Press 2

The following will be displayed briefly:

Soil Mode  
ENABLED

The display will return to <READY>.

#### 5 Wet density bias

▶ Press OFFSET the following is displayed:

-OFFSET-  
1 - Dens. -OFF-  
2 - Moist -OFF-  
3 - Trench -OFF-

▶ Press 1

The following will be displayed:

Density Offset  
Xx kg/m<sup>3</sup>  
1. Enable 2. Disable  
3. Change Offset

To disable the wet density bias, go to Step 5.1.

To enable the wet density bias, go to Step 5.2.

To change the wet density bias, go to Step 5.3.

##### 5.1 Disable wet density bias

▶ Press 2

The following will be displayed briefly:

Density Offset  
DISABLED

The display will return to <READY>. Go to 7.

**5.2 Enable wet density bias**

▶ Press 1

The following will be displayed:

Density Offset  
ENABLED

**5.3 Change wet density bias**

▶ Press 3 the following is displayed:

Density Offset  
xx kg/m<sup>3</sup>  
Select (+/-)  
Input and <ENTER>

▶ Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup>.  
(To convert from t/m<sup>3</sup> to kg/m<sup>3</sup>, multiply the wet density bias by 1000.)

▶ Press ENTER  
START

The following will be displayed briefly:

Density Offset  
ENABLED

The display will return to <READY>.

**6 Moisture bias**

▶ Press OFFSET the following is displayed:

-OFFSET--Select:  
1 - Dens. -OFF-  
2 - Moist. -OFF-  
3 - Trench -OFF-

▶ Press 2

The following will be displayed:

Moisture Offset  
1. xxxx 2. xxxx  
3. xxxx 4. xxxx  
5. New 6. Disable

**6.1 Disable moisture bias**

▶ Press 6

The following will be displayed:

Moisture Offset  
DISABLED

The display will return to <READY>. Go to Step 8.

### 6.2 Enable the moisture bias

- ▶ Press the number corresponding to any of the stored values.

### 6.3 Change a moisture bias value

▶ Press 5 the following is displayed:

Select Offset Source  
 1. Manual Entry  
 2. Gauge Derived

**For manual entry:**

▶ Press 1 the following is displayed:

True Moisture %  
 x.xx  
 Press <ENTER>

Use the numbered keys to enter the mean oven-dry moisture content to the nearest 0.01%.

▶ Press ENTER  
START the following is displayed:

Gauge Moisture %  
 0.00%  
 Press <ENTER>

Use the numbered keys to enter the mean nuclear gauge moisture content to the nearest 0.01%.

▶ Press ENTER  
START the following is displayed:

K = xxxx  
 Do you want to save  
 this value for later use ?

To save the displayed value:

▶ Press YES the following is displayed:

Select Memory Cell  
 1.            2.  
 3.            4.  
 Press # to Select

- ▶ Press a numbered key (1, 2, 3 or 4) to select a memory location in which to save the value.

The following will be displayed briefly:

K x.xx  
 ENABLED

If the value is not to be displayed:

▶ Press NO

The display will return to <READY>.

**For gauge derived:**

▶ Press 2 the following is displayed:

True Moisture %  
 x.xx  
 Press <ENTER>

Use the numbered keys to enter the true moisture content to the nearest 0.01%.

▶ Press **ENTER  
START** the following is displayed:

Place gauge on soil,  
Lower rod and  
Press any key

Place the gauge on the measurement site and press any key.

At the completion of the counting period, the following will be displayed:

K: ###  
Save This Value for  
Later Use ?

To save the value:

▶ Press **YES**

To enable the value without storing:

▶ Press **NO**

## 7 Trench offset

▶ Press **OFFSET** the following is displayed:

-OFFSET-  
1 - Dens. -OFF-  
2 - Moist. -OFF-  
3 - Trench -OFF-

▶ Press **3** the following is displayed:

Trench Offset  
M: 0 D: 0  
1. Enable 2. Disable  
3. Change Offset

To enable the trench offset:

▶ Press **1**

The following is displayed:

Trench Offset  
ENABLED

To disable the trench offset:

▶ Press **2**

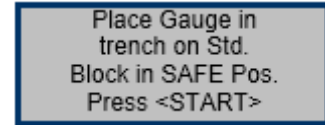
The following is displayed:

Trench Offset  
DISABLED

To change the trench offset:

▶ Press 

The following is displayed:



Place Gauge in  
trench on Std.  
Block in SAFE Pos.  
Press <START>

▶ Press 

At the end of the counting period, the display will return to <READY>.

▶ Turn the power switch off if the nuclear gauge is not required for further use.




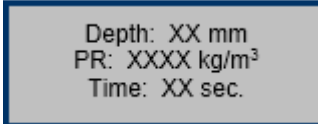
## Operating Instruction N220: Measurement (Soils) Troxler 3440P

### 1 Start up

- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

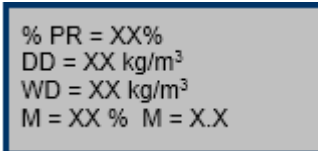
### 2 Measurement

When <READY> is displayed:

- ▶ Press  the following is displayed: 

In the manual depth mode, the gauge will prompt for the source rod depth. In automatic mode, the gauge software reads the depth strip on the source rod to determine the depth.




At the end of the counting period, the following will be displayed:



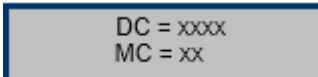
Record the following values as appropriate:

- % PR as the **relative compaction** to the nearest 0.1%.
- DD as the **dry density** to the nearest 0.001 t/m<sup>3</sup>.
- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- M as the **water content (t/m<sup>3</sup>)** to the nearest 0.001 t/m<sup>3</sup>.
- % M as the **moisture content (%)** to the nearest 0.1%.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000.)

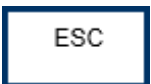
- ▶ Press 
- ▶ Press 
- ▶ Press 

The following will be displayed:



Record the following values as appropriate:

- DC as the **density count**.
- MC as the **moisture count**.

- ▶ Press  and the display will return to <READY>.
- ▶ Turn the power switch off if the nuclear gauge is not required for further use.

## Operating Instruction N221: Test Parameters (Soils) Troxler 3430P

### 1 Start up

- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement units

When <READY> is displayed:

▶ Press SETUP

▶ Press 2

The following will be displayed:

- Units -

1. pcf  
2. kg/m<sup>3</sup>  
3. g/cm<sup>3</sup>

▶ Press 2

The following will be displayed briefly:

Metric Units  
kg/m<sup>3</sup>  
ENABLED

The display will return to <SETUP>.

### 3 Count time

▶ Press SETUP

▶ Press 1 and the following is displayed:

TIME: XX  
1 - 15 sec  
2 - 1 min  
3 - 4 min

▶ Press 2

The following will be displayed briefly:

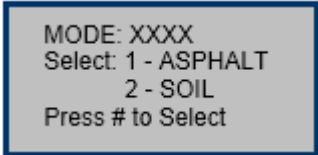
COUNT TIME  
1 min

The display will return to <READY>.

#### 4 Soil mode

▶ Press 

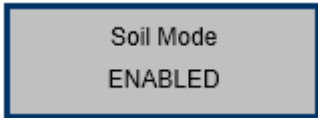
The following will be displayed:



MODE: XXXX  
Select: 1 - ASPHALT  
2 - SOIL  
Press # to Select

▶ Press 

The following will be displayed briefly:

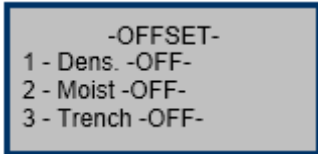


Soil Mode  
ENABLED

The display will return to <READY>.

#### 5 Wet density bias

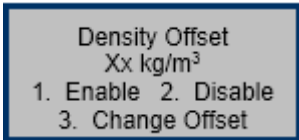
▶ Press  the following is displayed:



-OFFSET-  
1 - Dens. -OFF-  
2 - Moist -OFF-  
3 - Trench -OFF-

▶ Press 

The following will be displayed:



Density Offset  
Xx kg/m<sup>3</sup>  
1. Enable 2. Disable  
3. Change Offset

To disable the wet density bias, go to Step 5.1.

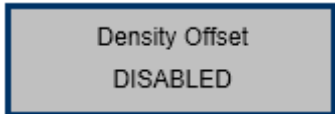
To enable the wet density bias, go to Step 5.2.

To change the wet density bias, go to Step 5.3.

##### 5.1 Disable wet density bias

▶ Press 

The following will be displayed briefly:



Density Offset  
DISABLED

The display will return to <READY>. Go to 7.

### 5.2 Enable wet density bias

▶ Press 1

The following will be displayed:

Density Offset  
ENABLED

### 5.3 Change wet density bias

▶ Press 3 the following is displayed:

Density Offset  
xx kg/m<sup>3</sup>  
Select (+/-)  
Input and <ENTER>

▶ Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup>.  
(To convert from t/m<sup>3</sup> to kg/m<sup>3</sup>, multiply the wet density bias by 1000.)

▶ Press ENTER  
START

The following will be displayed briefly:

Density Offset  
ENABLED

The display will return to <READY>.

## 6 Moisture bias

▶ Press OFFSET the following is displayed:

-OFFSET--Select:  
1 - Dens. -OFF-  
2 - Moist. -OFF-  
3 - Trench -OFF-

▶ Press 2

The following will be displayed:

Moisture Offset  
1. xxxx 2. xxxx  
3. xxxx 4. xxxx  
5. New 6. Disable

### 6.1 Disable moisture bias

▶ Press 6

The following will be displayed:

Moisture Offset  
DISABLED

The display will return to <READY>. Go to Step 8.

**6.2 Enable the moisture bias**

- ▶ Press the number corresponding to any the stored values.

**6.3 Change a moisture bias value**

▶ Press 5 the following is displayed:

Select Offset Source  
 1. Manual Entry  
 2. Gauge Derived

**For manual entry:**

▶ Press 1 the following is displayed:

True Moisture %  
 x.xx  
 Press <ENTER>

Use the numbered keys to enter the mean oven-dry moisture content to the nearest 0.01%.

▶ Press ENTER  
START the following is displayed:

Gauge Moisture %  
 0.00%  
 Press <ENTER>

Use the numbered keys to enter the mean nuclear gauge moisture content to the nearest 0.01%.

**For gauge derived:**

▶ Press 2 the following is displayed:

True Moisture %  
 x.xx  
 Press <ENTER>

Use the numbered keys to enter the true moisture content to the nearest 0.01%.

▶ Press ENTER  
START the following is displayed:

Place gauge on soil,  
 Lower rod and  
 Press any key

Place the gauge on the measurement site and press any key.

At the completion of the counting period, the following will be displayed:

K: ##.##  
 Save This Value for  
 Later Use ?

To save the value:

▶ Press YES

To enable the value without storing:

▶ Press NO

## 7 Trench offset

▶ Press OFFSET the following is displayed:

-OFFSET-

1 - Dens. -OFF-

2 - Moist. -OFF-

3 - Trench -OFF-

▶ Press 3 the following is displayed:

Trench Offset

M: 0 D: 0

1. Enable 2. Disable

3. Change Offset

To enable the trench offset:

▶ Press 1

The following is displayed:

Trench Offset  
ENABLED

To disable the trench offset:

▶ Press 2

The following is displayed:

Trench Offset  
DISABLED

To change the trench offset:

▶ Press 3

The following is displayed:

Place Gauge in  
trench on Std.  
Block in SAFE Pos.  
Press <START>

▶ Press ENTER  
START

At the end of the counting period, the display will return to <READY>.

- ▶ Turn the power switch off if the nuclear gauge is not required for further use.


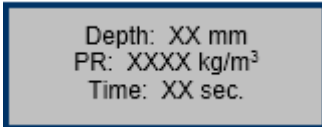
## Operating Instruction N222: Measurement (Soils) Troxler 3430P

### 1 Start up

- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

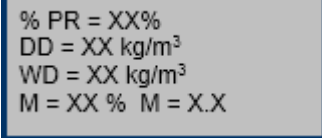
### 2 Measurement

When <READY> is displayed:

- ▶ Press  the following is displayed: 

In the manual depth mode, the gauge will prompt for the source rod depth. In automatic mode, the gauge software reads the depth strip on the source rod to determine the depth.




At the end of the counting period, the following will be displayed:



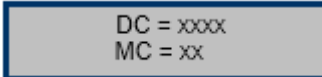
Record the following values as appropriate:

- % PR as the **relative compaction** to the nearest 0.1%.
- DD as the **dry density** to the nearest 0.001 t/m<sup>3</sup>.
- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- M as the **water content (t/m<sup>3</sup>)** to the nearest 0.001 t/m<sup>3</sup>.
- % M as the **moisture content (%)** to the nearest 0.1%.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000.)


- ▶ Press 
- ▶ Press 
- ▶ Press 

The following will be displayed:



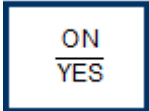
Record the following values as appropriate:

- DC as the **density count**.
- MC as the **moisture count**.


- ▶ Press  and the display will return to <READY>.
- ▶ Turn the power switch off if the nuclear gauge is not required for further use.

## Operating Instruction N225: Test Parameters (Soils) CPN MC1 and MC3 Elite


### 1 Set-up

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.


### 2 Units

- ▶ Press  the first screen will be:
 

1. Recall  
2. Set depth  
UP/DOWN for next  
Select #, ESC exit

- ▶ Press  the following is displayed:
 


11. Auto scroll  
12. Set units  
UP/DOWN for next  
Select #, ESC exit

- ▶ Press  (button 1, then 2)
 

1. PCF  
2. kg/m<sup>3</sup>  
3. GCC  
Select #, ESC exit


- ▶ After selecting the unit of measurement, the gauge returns to the menu screen.
 

11. Auto scroll  
12. Set units  
UP/DOWN for next  
Select #, ESC exit

- ▶ Press  returns to the ready screen
 


GAUGE READY  
COUNT TIME: # min  
Depth: ### Offset: N  
<date> <time>

### 3 Count time

- ▶ Press  and the following is displayed:
 

Cnt Time: ## min.  
UP/DOWN TO CHANGE  
YES to Accept  
ESC to Exit

- ▶ Press UP and DOWN to set the desired count time.

- ▶ Press  returns to the ready screen
 

GAUGE READY  
COUNT TIME: # min  
Depth: ### Offset: N  
<date> <time>



#### 4 Depth

The Elite gauge is equipped with an automatic non-magnetic depth indicator. The depth is automatically read as you lower the source into the measure position and the appropriate constants are selected to calculate the density.

The gauge can be placed into manual depth mode by disabling the Automatic depth mode from the MENU functions.

#### 5 Soil mode and maximum dry density

▶ Press	MA PR	and the following is displayed:	1. Proctor 2. Max. Dens Select #, ESC exit
▶ Press	1	for Proctor.	PR: #### PCF Change value? Press YES or NO ESC to Exit
▶ Press	YES		Enter value for Proctor: ### PCF ENTER to accept ESC to Exit

Use the number buttons to change the value. Once you have entered the PR value, the gauge will return to ready screen.

#### 6 Offset

There are three offset options for the gauge: density, moisture, and trench.

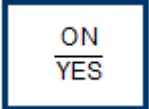
To use the offset mode:

- ▶ Press MENU
- ▶ Press 6
- ▶ Scroll **UP** and **DOWN** to select the offset you want to enable.
- ▶ For entering a negative number, use the **DOWN** button; for a positive number, use the **UP** button.

Note: When an offset is enabled, a **Y** on the gauge ready screen will appear next to the offset.

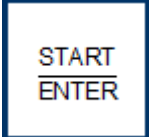
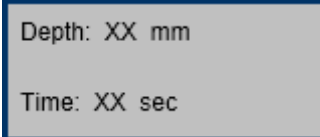
## Operating Instruction N226: Measurement (Soils) CPN MC1 and MC3 Elite

### 1 Set-up

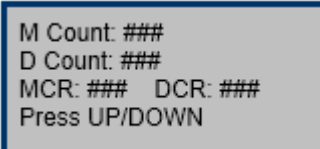
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

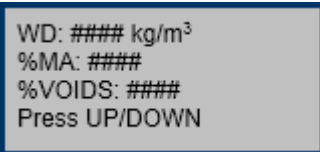
### 2 Measurement

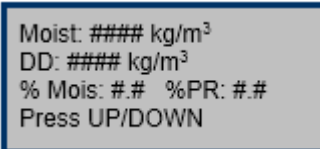
When the ready screen is displayed:

- ▶ Press  and the following is displayed. 

At the end of the counting period, the gauge will display:

- ▶ 

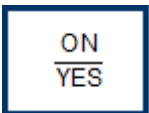
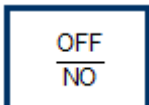
- ▶ 

- ▶ 

Record the following values:

- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- DD as the **dry density** to the nearest 0.001 t/m<sup>3</sup>.
- % PR as the **relative compaction** to the nearest 0.1%.
- Moist as the **water content (t/m<sup>3</sup>)** to the nearest 0.001 t/m<sup>3</sup>.
- % Moist as the **moisture content (%)** to the nearest 0.1%.
- M Count as the **moisture count**.
- D Count as the **density count**.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000.)

- ▶ Press  and the display will return to the ready screen.
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N227: Test Parameters (Soils) Humboldt 5001SD

### 1 Start-up



Press



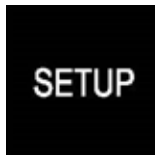
and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:

MEAS	STD	TYPE	DEPTH
NORM	4MIN	SOIL	AUTO
<b>Working Project (Job)</b>			
1234			
<b>Project results</b>			
WD = XXXX	%M = XX.X	%PR = XX.X	
DD = XXXX	M = XXX	MAXD = XXXX	



Press



The following will be displayed:

Settings
<b>Set Measure Modes</b>
<b>Set Trench Correction</b>
<b>Standardization</b>

## 2 Measurement units

▶ Press



or



until the following is displayed:



Select '**System Units**'.

▶ Press




The following will be displayed:



Select '**Metric**'.

▶ Press



▶ Press  and the display will return to the main menu.

### 3 Count time

▶ Press 

The following will be displayed:

Settings
<b>Set Measure Modes</b>
<b>Set Trench Correction</b>
<b>Standardization</b>

Select '**Set Measure Modes**'.

▶ Press 

The following will be displayed:

Measurement Modes			
Measure	Standard	Type	Depth
Fast	4 Min	Asphalt	Auto
Norm	16 Min	Soil	Manual
Slow		Thin Layer	

Select '**Norm**'.

### 4 Soil mode

Select '**Soil**'.

## 5 Depth

Select '**Auto**'.

▶ Press



and the display will return to the main menu.

## 6 Maximum dry density

▶ Press



Enter the value by using the displayed keyboard.

(To convert from  $t/m^3$  to  $kg/m^3$ , multiply the maximum dry density by 1000).

▶ Press



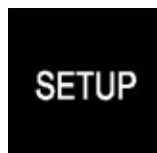
and the display will return to the main menu.

## 7 Wet density bias

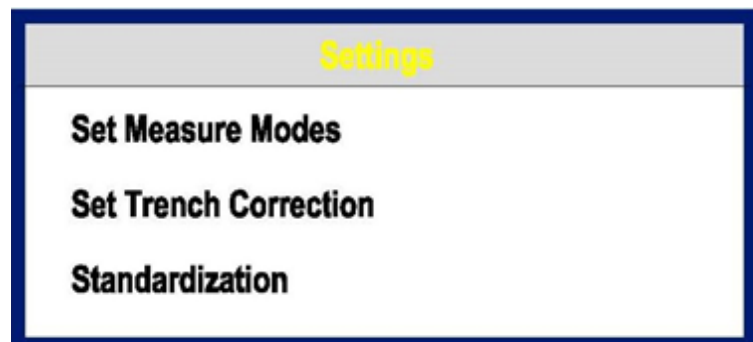
There is no facility to set a wet density bias using the keyboard.

## 8 Moisture bias

▶ Press



The following will be displayed:



Select '**Set Default Targets**'.

▶ Press



The following will be displayed:

Default Targets	
Maximum Density	Low Density
2480	2360
K Value	Specific Gravity
0.0	2.7

Select '**K Value**'.

Enter the value by using the displayed keyboard.

To disable the moisture bias, set a value of '**0.0**'.

▶ Press



and the display will return to the main menu.

▶ Press



if the nuclear gauge is not required for further use.

## Operating Instruction N228: Measurement (Soils) Humboldt 5001SD

### 1 Start-up

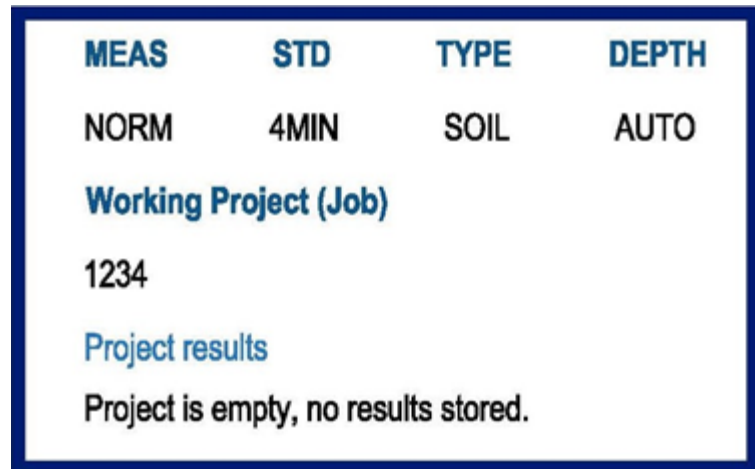


Press



and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:



### 2 Measurement



Press



The following will be displayed:





At the end of the counting period, the following will be displayed:

Project abcd Test Results		
Dry Density	xxxx	(kg/m <sup>3</sup> )
Moisture	x.xx	(%)
Wet Density	xxxx	(kg/m <sup>3</sup> )
Moisture	xxx	
Compaction	xx.x	(%)
Maximum Density	xxxx	(kg/m <sup>3</sup> )
Depth = XX		

Record the following values as appropriate:

- **Dry Density** to the nearest 0.001 t/m<sup>3</sup>.
- **Wet Density** to the nearest 0.001 t/m<sup>3</sup>.
- Compaction as **relative compaction** to the nearest 0.1%.
- Moisture as the **moisture content** to the nearest 0.1%.
- Moisture as the **water content** to the nearest 0.001 t/m<sup>3</sup>.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000.)

► Press



or



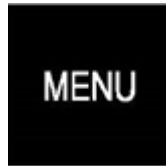
The following will be displayed:

Project abcd Test Results		
Density Count	xxxx.x	
Density Standard	xxxx.x	
Moisture Count	xxx.x	
Moisture Standard	xxx.x	
Voids Ratio	x.x	
Air Voids	xx.x	(%)
Depth = BS		

Record the following values as appropriate:

- **Density count.**
- **Moisture count.**

▶ Press



and the display will return to the main menu.


▶ Press



if the nuclear gauge is not required for further use.


## Operating Instruction N229: Test Parameter (Soils) Instrotek Xplorer 2 3500


### 1 Set up

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Units


When <GAUGE READY> is displayed:

- ▶ Press  and the following is displayed:
 


1. Recall  
 2. Offset  
 UP/DOWN for Next  
 Select #, ESC Exit
- ▶ Press  repeatedly until the following is displayed:
 

11. Set Units  
 12. Standard Mode  
 UP/DOWN for Next  
 Select#, ESC Exit
- ▶ Press **11** and the following is displayed:
 


1. PCF  
 2. kg/m3  
 3. GCC  
 Select #, ESC Exit
- ▶ Press **2** and the following is displayed:
 

11. Set Units  
 12. Standard Mode  
 UP/DOWN for Next  
 Select#, ESC Exit
- ▶ Press  and the display will return to <GAUGE READY>.


### 3 Count time

▶ Press  and the following is displayed:

Count Time: X min  
UP/DOWN to Change  
YES to Accept  
ESC to Exit

▶ Press  to set the desired count time, 1 minute.


Count Time: 1 min.  
UP/DOWN TO CHANGE  
YES to Accept  
ESC to Exit

▶ Press  and the display will return to <GAUGE READY>.

### 4 Depth

The Xplorer 2 gauge is designed and equipped with an automatic non-contact depth indicator. The depth is automatically sensed as you lower the source rod into a measurement position and the appropriate calibration constants are selected for calculation of density.

### 5 Soil mode and maximum dry density

▶ Press  and the following is displayed:

1. Proctor  
2. MAX DENS  
Select #. ESC Exit

▶ Press **1** and the following is displayed:

PR: XXXX kg/m3  
Change Value?  
Press YES or NO  
ESC to Exit

To retain the displayed value, go to 5.1.  
To change the displayed value, go to 5.2.

### 5.1 Retain value

- ▶ Press  to retain the displayed value.

The display will return to <GAUGE READY>. Go to 6.

### 5.2 Change the value

- ▶ Press  and the following is displayed: 

- ▶ Use the numbered keys to enter the required value to the nearest 1 km/m<sup>3</sup>

- ▶ Press 

The display will return to <GAUGE READY>.

## 6 Wet density bias

- ▶ Press  and the following is displayed: 

- ▶ Press **2** and the following is displayed: 

- ▶ Press **1** and the following is displayed:


Density Offset OFF  
Want to Enable?  
Press YES or NO

To disable the wet density bias, go to 6.1.  
To enable the wet density bias, go to 6.2.

**6.1 Disable wet density bias**

- ▶ Press  to disable the density offset.

or

- ▶ Press  to confirm the density offset is to remain disabled.

The following will be displayed:


Density Offset Disabled

The display will return to <GAUGE READY>.

**6.2 Enable wet density bias**

- ▶ Press  to enable the density offset.

or

- ▶ Press  to confirm the density offset is to remain enabled.

The following will be displayed:

Enter Density  
Offset: XXX kg/m3  
ENTER to Accept  
ESC to Exit

To retain the displayed value, go to 6.2.1.

To change the displayed value, go to 6.2.2.

### 6.2.1 Retain the value

▶ Press



and the following  
will be displayed:

Density Offset Enabled

The display will return to <GAUGE READY>.

### 6.2.2 Change the value

▶ Press



and the following  
will be displayed  
briefly:

Density Offset Enabled

The display will return to <GAUGE READY>.

## 7 Moisture bias

▶ Press



and the following  
is displayed:

1. Recall  
2. Offset  
UP/DOWN for Next  
Select #, ESC Exit

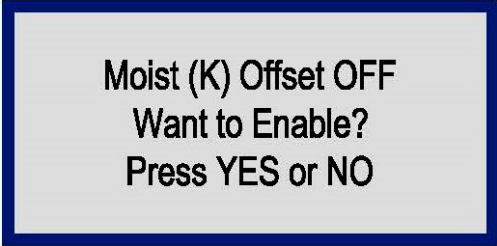
▶ Press

2

and the following  
is displayed:


1. Density  
2. Moisture  
3. Trench  
Select #, ESC Exit

- ▶ Press **1** and the following is displayed:




To disable the moisture bias, go to 7.1.  
To enable the moisture bias, go to 7.2.

### 7.1 Disable the moisture bias

- ▶ Press  to disable the moisture offset.

or

- ▶ Press  to confirm the moisture offset is to remain disabled.

The following will be displayed:




The display will return to <GAUGE READY>. Go to 8.

### 7.2 Enable the moisture bias

- ▶ Press  to enable the moisture offset.

or

- ▶ Press  to confirm the moisture offset is to remain enabled.



The following will be displayed:



To disable the displayed value, go to 7.2.1.  
To change the displayed value, go to 7.2.2.

### 7.2.1 Retain the value

▶ Press



and the following is displayed:



The display will return to <GAUGE READY>. Go to 8.

### 7.2.2 Change the value

▶ Use the numbered keys to enter the required value to the nearest 0.01%.

▶ Press



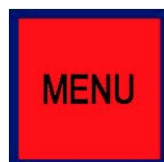
and the following will be displayed briefly:



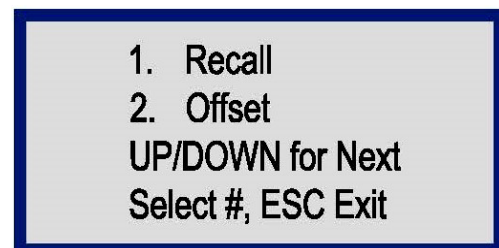
The display will return to <GAUGE READY>.

## 8 Trench offset

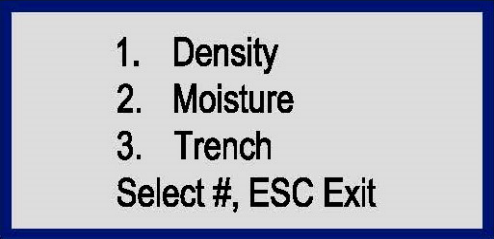
▶ Press



and the following is displayed:



▶ Press **2** and the following is displayed:



▶ Press **3** and the following is displayed:




To disable the trench offset, go to 8.1.  
To enable the trench offset, go to 8.2.

### 8.1 Disable trench offset

▶ Press  to disable the trench offset.

or

▶ Press  to confirm the trench offset is to remain disabled.

The following will be displayed:




The display will return to <GAUGE READY>.

### 8.2 Enable trench offset

▶ Press  to enable the trench offset.

or

- ▶ Press  to confirm the trench offset is to remain enabled.

The following will be displayed:



To disable the displayed value, go to 8.2.1.  
To change the displayed value, go to 8.2.2.

### 8.2.1 Retain the value

- ▶ Press  and the following is displayed:



The display will return to <GAUGE READY>.

### 8.2.2 Change the value

- ▶ Use the numbered keys to enter the required value to the nearest 1 k/m<sup>3</sup> for a positive value.


- ▶ Press  and the following will be displayed briefly:



The display will return to <GAUGE READY>.

## Operating Instruction N230: Measurement (Soils) Instrotek Xplorer 2 3500

### 1 Set up


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <GAUGE READY> is displayed:

- ▶ Press  and the following is displayed: 


At the end of the counting period:


- ▶ Press  repeatedly until the required values are displayed.

Record the following values as appropriate:

- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- DD as the **dry density** to the nearest 0.001 t/m<sup>3</sup>.
- % PR as the **relative compaction** to the nearest 0.1%.
- Moist as the **water content (t/m<sup>3</sup>)** to the nearest 0.001 t/m<sup>3</sup>.
- % MOIS as the **moisture content (%)** to the nearest 0.1%.
- M Count as the **moisture count**.
- D Count as the **density count**.

To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000).

- ▶ Press  and the display will return to <GAUGE READY>.

- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N231: Test Parameters (Soils) Humboldt 5001EZ-2

### 1 Start-up

- ▶ Press **POWER** and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:

```
F1 DATA      XX/XX/XXXX
F2 SETUP
F3 ENGINEERING
              DEPTH = SAFE
```

- ▶ Press **F2**

The following will be displayed:

```
F1 SETUP 2
F2 SET MEASURE MODES
F3 SET TRENCH COR.
F4 SET TARGETS
```

### 2 Measurement units

- ▶ Press **F1**

The following will be displayed:

```
F1 SETUP 4
F2 UNITS      PCF / SI
F2 SOUND     OFF / ON
F4 TIMEOUTS
```

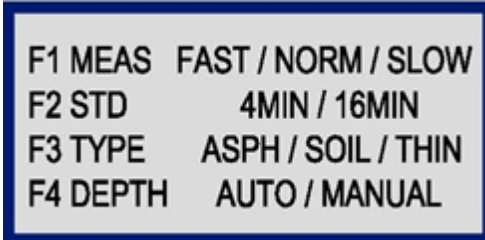
- ▶ Press **F2** repeatedly until 'SI' flashes.

- ▶ Press **MAIN MENU** and the display will return to the main menu.

### 3 Count time

▶ Press  

The following will be displayed:



```
F1 MEAS  FAST / NORM / SLOW
F2 STD    4MIN / 16MIN
F3 TYPE   ASPH / SOIL / THIN
F4 DEPTH  AUTO / MANUAL
```


▶ Press  repeatedly until **'NORM'** flashes.

### 4 Soil mode

▶ Press  repeatedly until **'SOIL'** flashes.

### 5 Depth

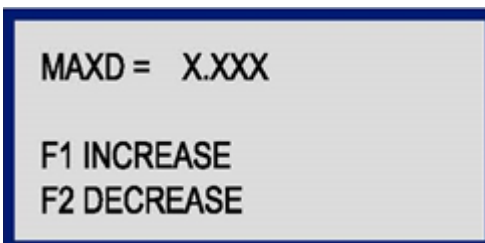
▶ Press  repeatedly until **'AUTO'** flashes.

▶ Press  and the display will return to the main menu.

### 6 Maximum dry density

▶ Press 

The following will be displayed:



```
MAXD =  X.XXX

F1 INCREASE
F2 DECREASE
```

▶ Press 

or



to increase or decrease the displayed value until the required value (within the range 900 kg/m<sup>3</sup> to 3000 kg/m<sup>3</sup>) is obtained.

(To convert from t/m<sup>3</sup> to kg/m<sup>3</sup>, multiply the maximum dry density by 1000).

▶ Press 

and the display will return to the main menu.

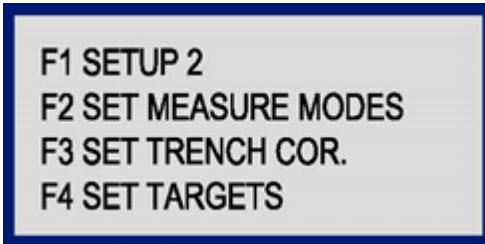
## 7 Wet density bias

There is no facility to set a wet density bias using the keypad.

## 8 Moisture bias

▶ Press 

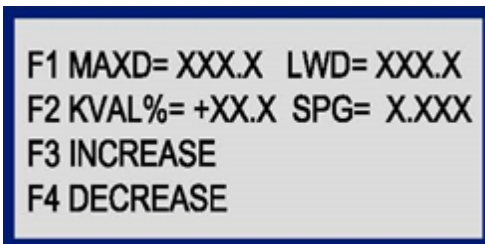
The following will be displayed:



```
F1 SETUP 2
F2 SET MEASURE MODES
F3 SET TRENCH COR.
F4 SET TARGETS
```

▶ Press 

The following will be displayed:



```
F1 MAXD= XXX.X LWD= XXX.X
F2 KVAL%= +XX.X SPG= X.XXX
F3 INCREASE
F4 DECREASE
```

▶ Press 

repeatedly until the '**KVAL**' value flashes.

▶ Press 

or



to increase or decrease the displayed value until the required K value is obtained.

A maximum value of 0.20 (in increments of 0.10) and a minimum value of -0.10 (in increments of 0.01) may be set.

To disable the moisture bias, set a value of **'0.0'**.

▶ Press 

and the display will return to the main menu.


▶ Press 

if the nuclear gauge is not required for further use.



## Operating Instruction N232: Measurement (Soils) Humboldt 5001EZ-2

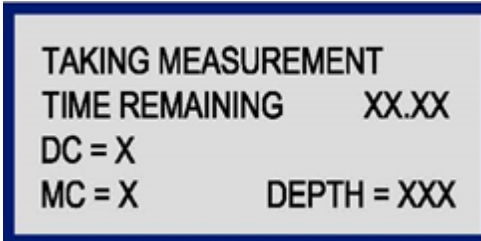
### 1 Start-up

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.

### 2 Measurement

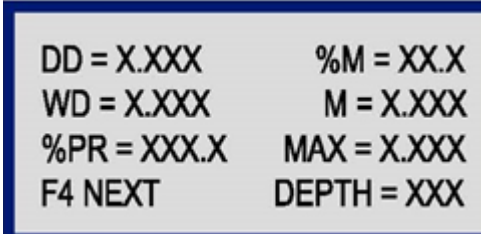
- ▶ Press 

The following will be displayed:



```
TAKING MEASUREMENT
TIME REMAINING   XX.XX
DC = X
MC = X           DEPTH = XXX
```

At the end of the counting period, the following will be displayed:



```
DD = X.XXX      %M = XX.X
WD = X.XXX      M = X.XXX
%PR = XXX.X     MAX = X.XXX
F4 NEXT        DEPTH = XXX
```

Record the following values as appropriate:

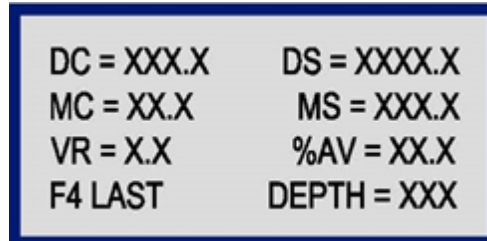
- DD as the **dry density** to the nearest 0.001 t/m<sup>3</sup>.
- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- % PR as the **relative compaction** to the nearest 0.1%.
- % M as the **moisture content** to the nearest 0.1%.
- M as the **water content** to the nearest 0.001 t/m<sup>3</sup>.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000.)

▶ Press



The following will be displayed:



Record the following values as appropriate:

- DC as the **density count**.
- MC as the **moisture count**.

▶ Press



and the display will return to the main menu.


▶ Press



if the nuclear gauge is not required for further use.


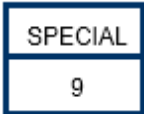
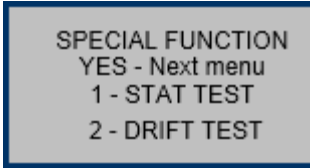
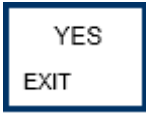
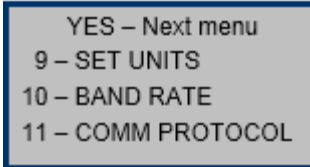
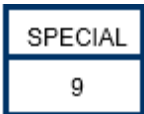
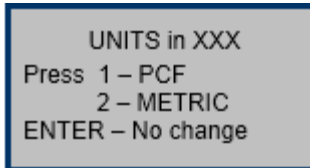
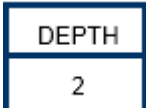

## Operating Instruction N301: Test Parameters (Asphalt) Troxler 3440

### 1 Set-up

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.


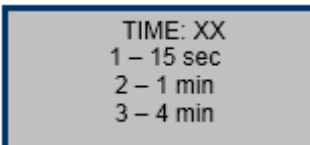
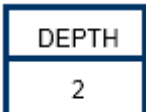
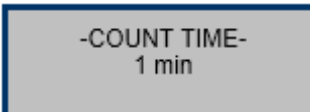
### 2 Units

When <READY> is displayed:

- ▶ Press 
- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 

The display will return to <READY>.

### 3 Count time

- ▶ Press  and the following is displayed: 
- ▶ Press  and the following is displayed: 

The display will return to <READY>.

#### 4 Asphalt mode

▶ Press	SHIFT X		
▶ Press	MODE 8	and the following is displayed:	MODE: XXXX Select: 1 – SOIL 2 – ASPHALT (CE to exit)
▶ Press	DEPTH 2	and the following is displayed:	ASPHALT: XXXX Select: 1 – % MA 2 – 100% - % MA
▶ Press	COUNT 1	and the following is displayed:	ASPHALT: % MA Do you want to enable % voids also?
▶ Press	YES EXIT	and the following is displayed:	ASPHALT: % MA % VOIDS
	or		
	NO/CE C/CE	and the following is displayed:	ASPHALT: % MA
The display will return to <READY>.			
▶ Press	SHIFT X		
▶ Press	MODE 8	and the following is displayed:	MODE: XXXX Select: 1 – SOIL 2 – ASPHALT (CE to exit)
▶ Press	DEPTH 2	and the following is displayed:	ASPHALT: XXXX Select: 1 – % MA 2 – 100% - % MA
▶ Press	DEPTH 2	and the following is displayed:	ASPHALT: 100% MA Do you want to enable % voids?

► Press 

YES
EXIT

 and the following is displayed: 

ASPHALT: 100% MA % VOIDS
-----------------------------

or

► Press 

NO/CE
C/CE

 and the following is displayed: 

ASPHALT: 100% MA
------------------

The display will return to <READY>.

## 5 Maximum density

► Press 

PROCTOR/ MARSHALL
+

 and the following is displayed: 

MA = XXXX kg/m <sup>3</sup> PR = XXXX VD = XXXX Want to change?
--

To retain value, go to 5.1.

To change value, go to 5.2.

### 5.1 Retain the value

► Press 

NO/CE
C/CE

 to retain the displayed value of MA.

The display will return to <READY>. Go to 6.

### 5.2 Change the value

► Press 

YES
EXIT

 to change the displayed value of MA.

And the following will be displayed:

Select: 1 – MA 2 – PR 3 – Voidless
---

► Press 

COUNT
1

 and the following is displayed:

Select source of Marshall value: 1 – Stored Value 2 – New Value
--

To enter a new value, go to 5.3.

To select a stored value, go to 5.4

### 5.3 Enter a new value


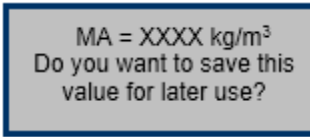
► Press 

DEPTH
2

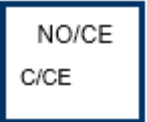
 and the following is displayed: 

Marshall: XXXX kg/m <sup>3</sup> Press ENTER when completed
--

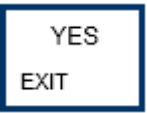
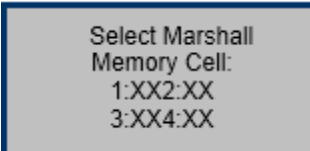
- ▶ Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup>.

▶ Press  and the following is displayed: 

**If the value is not to be saved:**

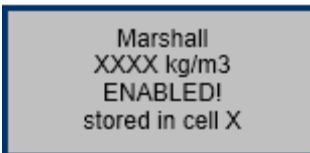
▶ Press  and the display will return to <READY>. Go to 6.

**To save the displayed value:**

▶ Press  and the following is displayed: 


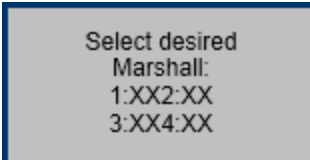
- ▶ Press the numbered key (1, 2, 3 or 4) to select a memory cell in which to store the value.

And the following will be displayed:



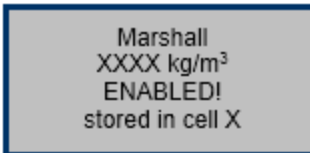
The display will return to <READY>. Go to 6.

#### 5.4 Select a stored value

▶ Press  and the following is displayed: 


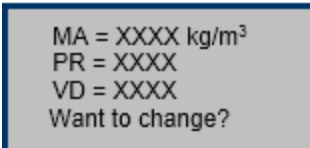
- ▶ Press the numbered key (1, 2, 3 or 4) to select the required value:

And the following will be displayed:



The display will return to <READY>.

#### 6 Voidless density

▶ Press  and the following is displayed: 

- ▶ Press 

YES
EXIT

 and the following is displayed: 

SELECT: 1 – MA 2 – PR 3 - VOIDLESS
---
  
- ▶ Press 

CALC
3

 and the following is displayed: 

Voidless Density XXXX kg/m <sup>3</sup> Press enter when complete
--
  
- ▶ Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup>.
  
- ▶ Press 

START/ ENTER
=

And the display will return to <READY>.

## 7 Asphalt density bias

- ▶ Press 

OFFSET
MR

 and the following is displayed: 

-OFFSET- Select: 1 – Dens. -ZZZ- 2 – Moist -ZZZ- 3 – Trench -ZZZ-
--
  
- ▶ Press 

COUNTS
1

The following will be displayed:

<table border="1" style="margin: auto;"><tr><td>Density Offset DISABLED Do you want to ENABLE?</td></tr></table>	Density Offset DISABLED Do you want to ENABLE?	or	<table border="1" style="margin: auto;"><tr><td>Density Offset ENABLED Do you want to DISABLE?</td></tr></table>	Density Offset ENABLED Do you want to DISABLE?
Density Offset DISABLED Do you want to ENABLE?				
Density Offset ENABLED Do you want to DISABLE?				

To disable the asphalt density bias, go to 7.1.

To enable the asphalt density bias, go to 7.2

### 7.1 Disable asphalt density bias

- ▶ Press 

NO/CE
C/CE

 to confirm the density offset is to remain disabled. or 

YES
EXIT

 to disable the density offset.

And the following will be displayed briefly:

Density Offset DISABLED
----------------------------

The display will return to <READY>.

## 7.2 Enable asphalt density bias

- ▶ Press 

YES
EXIT

 to enable the density offset. or 

NO/CE
C/CE

 to confirm the density offset is to remain enabled.

The following will be displayed:

-Wet Density-Offset XXXX kg/m <sup>3</sup> Want to change?
--

To retain the value, go to 7.2.1.  
To change the value, go to 7.2.2.

### 7.2.1 Retain the value

- ▶ Press 

NO/CE
C/CE

 to retain the displayed value of Wet Density Offset.

The following will be displayed briefly:

Density Offset ENABLED!
----------------------------

The display will return to <READY>.

### 7.2.2 Change the value

- ▶ Press 

YES
EXIT

 and the following is displayed:

- WD Offset - Select: + or - 1 = + 2 = -
---

- ▶ Press 

COUNT
1

 or 

DEPTH
2

 and the following is displayed:

WD Offset Press enter when completed
--

- ▶ Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup>.

- ▶ Press 

START/ ENTER
=

The following will be displayed:


Density Offset ENABLED!
----------------------------

The display will return to <READY>.




## Operating Instruction N302: Measurement (Asphalt) Troxler 3440

### 1 Set-up

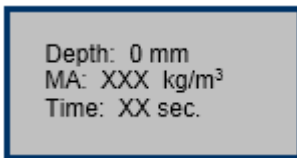
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

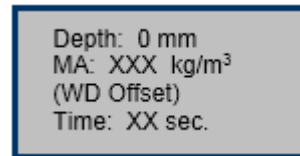
- ▶ Press 

The following will be displayed:



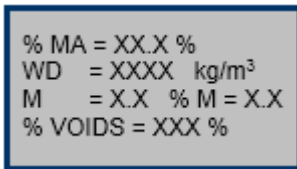
(asphalt density bias labelled)

or



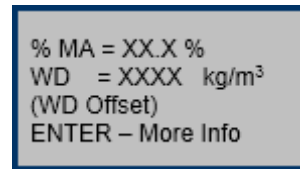
(asphalt density bias enabled)

At the end of the counting period, the following will be displayed:




(asphalt density bias disabled)

or

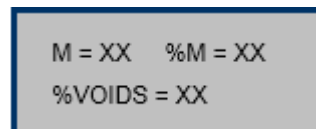


(asphalt density bias enabled)

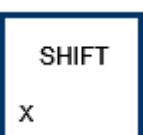
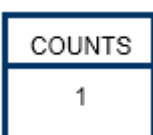
If more information is required:

- ▶ Press 

And following will be displayed:



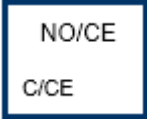

Record WD as the **wet density**.

- ▶ Press  

And following will be displayed:

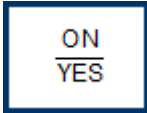
Dens ct. = XXXX  
Moist ct. = XX  
SHIFT/RECALL to  
see Readings

Record Dens Ct as the **density count**.

- ▶ Press  and the display will return to <READY>.
- ▶ Press  if the nuclear gauge is not required for further use.

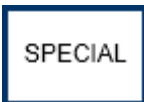
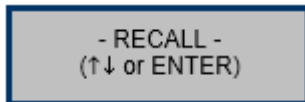

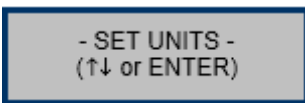
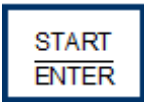
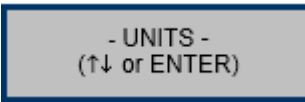

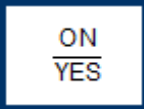
## Operating Instruction N303: Test Parameters (Asphalt) Troxler 3430

### 1 Set-up


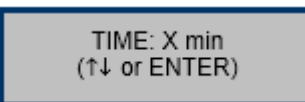

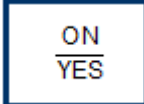
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Units


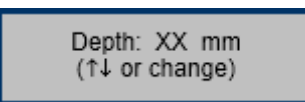

When <READY> is displayed:

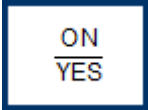
- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  to set the desired unit.
- ▶ Press  and the display will return to <READY>.

### 3 Count time

- ▶ Press  and the following is displayed: 
- ▶ Press  to set the desired count time.
- ▶ Press  and the display will return to <READY>.

### 4 Depth

- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the required test depth is displayed.

- ▶ Press  and the display will return to <READY>.

## 5 Asphalt mode and maximum density

- ▶ Press  and the following is displayed:

ZZ: XXXX (↑↓)  
Change ZZ value?

- ▶ Press  until "MA" is displayed.

MA: XXXX (↑↓)  
Change MA value?

To retain the displayed value, go to 5.1.  
To change the displayed value, go to 5.2

### 5.1 Retain the value

- ▶ Press  to retain the displayed value.

The display will return to <READY>. Go to 6.


### 5.2 Change the value

- ▶ Press  to change the display value of MA

The following will be displayed:

MA: XXXX  
(↑↓ or ENTER)

For each digit:

- ▶ Press  repeatedly until the required number is displayed.

- ▶ Press  to confirm each number.

The display will return to <READY>.


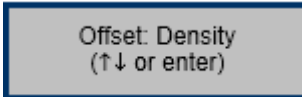
## 6 Asphalt density bias

- ▶ Press  and the following is displayed:

- RECALL -  
(↑↓ or ENTER)

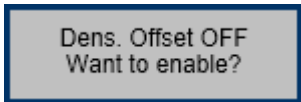
- ▶ Press  repeatedly until the following is displayed:

- OFFSET -  
(↑↓ or ENTER)

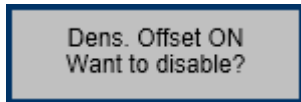
▶ Press  and the following is displayed: 

▶ Press 

The following will be displayed:



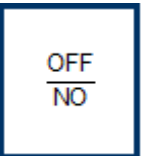
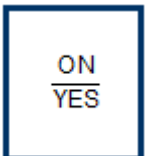
or



To disable the asphalt density bias, go to 6.1

To enable the asphalt density bias, go to 6.2.

### 6.1 Disable asphalt density bias

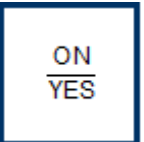
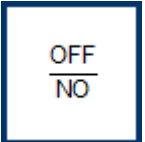
▶ Press  to confirm the density offset is to remain disabled or  to disable the density offset.

The following will be displayed briefly:

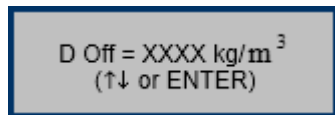


The display will return to <READY>. Go to 7.

### 6.2 Enable asphalt density bias

▶ Press  to disable the density offset or  to confirm the density offset is to remain disabled.

And the following will be displayed:



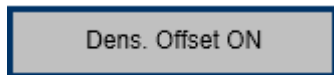
To retain the display, go to 6.2.1.

To change the display, go to 6.2.2.

#### 6.2.1 Retain the value



▶ Press 

The following will be displayed:


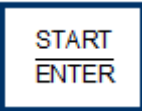


The display will return to <READY>. Go to 7.

### 6.2.2 Change the value

- ▶ Press  to enter a positive asphalt density bias or  to enter a negative asphalt density bias.

For each digit:

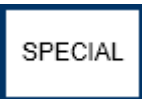
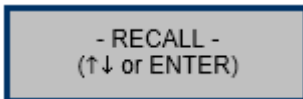

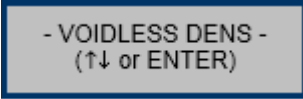

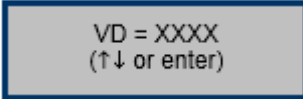
- ▶ Press  until the required number is displayed.
- ▶ Press  to confirm each number.

The following will be displayed briefly:


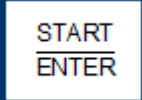
Dens. Offset ON

The display will return to <READY>.

## 7 Asphalt voidless density

- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the following is displayed: 
- ▶ Press  and the following is displayed: 

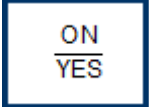
For each digit:

- ▶ Press  until the required number is displayed.
- ▶ Press  to confirm each number.

The display will return to <READY>.


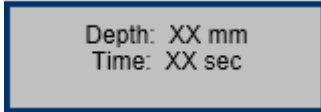
## Operating Instruction N304: Measurement (Asphalt) Troxler 3430

### 1 Set-up


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press  and the following is displayed: 

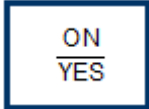
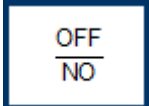
At the end of the counting period:

- ▶ Press  repeatedly until the required values are displayed.

Record the following values as appropriate:


- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- D as the **density count**.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000).

- ▶ Press  and the display will return to <READY>.
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N307: Test Parameters Troxler 4640B


### 1 Start-up

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.


### 2 Measurement units

- ▶ Press   and the following will be displayed:


SPECIAL FUNCTION  
YES - next menu  
1 - Surface Voids  
2 - Recover Erase

- ▶ Press  and the following will be displayed:

Units in ZZZ  
Press: 1 - US  
2 - METRIC  
ENTER - no change

- ▶ Press  and the following will be displayed:

Density in kg/m<sup>3</sup>  
Select: 1 - kg/m<sup>3</sup>  
2 - g/cm<sup>3</sup>  
Enter - no change


- ▶ Press  and the following will be displayed:

UNITS - METRIC  
Density in g/cm<sup>3</sup>


(Units of g/cm<sup>3</sup> are equivalent to t/m<sup>3</sup>).

The display will return to <READY>.


### 3 Count time

- ▶ Press  and the following will be displayed:

-Count Time-  
XX min.  
Do you want  
to change?

- ▶ Press  and the following will be displayed:

Sel: 1- 0.5 min.  
2- 1 min.  
3- 2 min.  
4- 3 min.


- ▶ Press  and the following will be displayed:

-Count Time-  
1 minutes!

The display will return to <READY>.




#### 4 Layer thickness

- ▶ Press  and the following will be displayed:

Layer Thickness:  
X.XX cm.  
Input and  
Press ENTER


- ▶ Use the numbered keys to enter the layer thickness to the nearest 0.1 cm.  
(The minimum value that can be set is 2.54 cm).

- ▶ Press  and the following will be displayed briefly:

Layer Thickness:  
X.XX cm.

The display will return to <READY>.

#### 5 Marshall and maximum (voidless) density


- ▶ Press  and the following will be displayed:

MA: X.XXX g/cm<sup>3</sup>  
VD: X.XXX g/cm<sup>3</sup>  
Do you want  
to change?

If MA and VD values of “0.000 g/cm<sup>3</sup>” are displayed:


- ▶ Press 

If values other than “0.000 g/cm<sup>3</sup>” are displayed:

- ▶ Press  and the following will be displayed:


MARSHALL  
X.XXX g/cm<sup>3</sup>  
Input and  
Press ENTER

- ▶ Press 

- ▶ Press  and the following will be displayed:

VOIDLESS DENSITY  
X.XXX g/cm<sup>3</sup>  
Input and  
Press ENTER

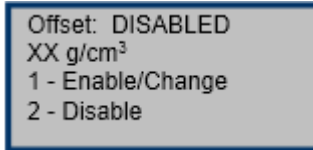
- ▶ Press 

- ▶ Press  and the display will return to <READY>.

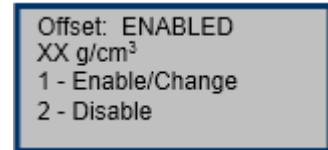
## 6 Asphalt density bias



The following will be displayed:



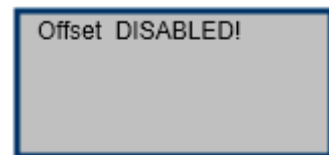
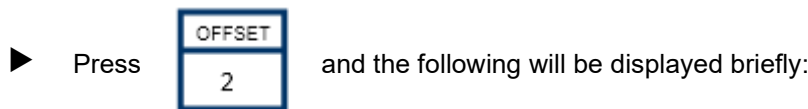
or



To disable the asphalt density bias, go to Step 6.1.

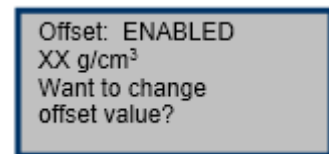
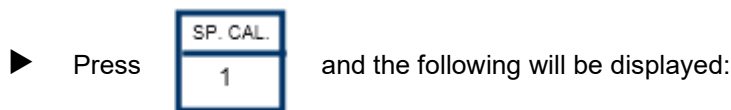
To enable the asphalt density bias, go to Step 6.2.

### 6.1 Disable asphalt density bias



The display will return to <READY>.

### 6.2 Enable asphalt density bias



To retain the displayed value, go to Step 6.2.1.

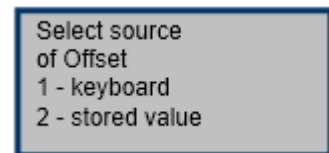
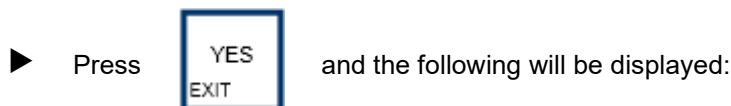
To change the displayed value, go to Step 6.2.2.

#### 6.2.1 Retain the value



The display will return to <READY>.


#### 6.2.2 Change the value





To enter a new value, go to Step 6.2.2.1.

To select a stored value, go to Step 6.2.2.2.

### 6.2.2.1 Enter a new value

▶ Press  and the following will be displayed:


Offset value:  
 --- g/cm<sup>3</sup>  
 Select 1 = +  
 2 = -

▶ Press  to enter a positive bias. or  to enter a negative bias.

The following will be displayed:

Offset value:  
 x --- g/cm<sup>3</sup>  
 Input and  
 press ENTER


▶ Use the numbered keys to enter the asphalt density bias to the nearest 0.001 g/cm<sup>3</sup>.

▶ Press  and the following will be displayed:


Offset: ENABLED  
 XXXXg/cm<sup>3</sup>  
 Do you want to  
 save this value?

**Note:** It is not necessary to save the displayed value to enable it.

**If the value is not to be saved:**

▶ Press  and the display will return to <READY>.


**To save the displayed value:**

▶ Press  and the following will be displayed:

Enter permanent  
 Memory location  
 to save Offset:  
 (1 – 12)? --

▶ Use the numbered keys to enter the memory location.


**Note:** Record the memory location and bias to facilitate subsequent retrieval of saved values.

▶ Press  and the following will be displayed briefly:

Offset: ENABLED  
 x XX g/cm<sup>3</sup>  
 Saved in memory  
 location X

The display will return to <READY>.

### 6.2.2.2 Select a stored value

▶ Press  and the following will be displayed:

Offset: # X -  
 XX g/cm<sup>3</sup>  
 1 – to select  
 2 – for next

▶ Press 

OFFSET
2

 repeatedly until the required memory location and value is displayed.

▶ Press 

SP. CAL.
1

 and the following will be displayed briefly:

Offset: ENABLED XX g/cm <sup>3</sup>
---

The display will return to <READY>.


▶ Press 

OFF
-----

 if the nuclear gauge is not required for further use.

## Operating Instruction N308: Measurement (Asphalt) Troxler 4640B

### 1 Start-up

- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press 

The following will be displayed:

```
MA: XXXX g/cm³
Thick: XX.XX cm
Avg: XX
Time: XX secs
```

(asphalt density bias disabled)

or

```
MA: XXXX g/cm³
Thick: XX.XX cm
Avg: XX, Offset
Time: XX secs.
```

(asphalt density bias enabled)

At the end of the counting period, the following will be displayed:


```
Dens: XXXX kg/m³
%MA: XX.XX%
100-%MA: XXX.XX%
%VOID: X.XX%
```


Record Dens as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.

- ▶ Press   and the following will be displayed:

```
Dens: XXX.X kg/m³
%MA: XX.XX%
%VOID: X.XX%
Cnts XXXX XXXX
```


Record Cnts as the **density count** values for System 1 and System 2.

- ▶ Press  and the display will return to <READY>.

- ▶ Press  if the nuclear gauge is not required for further use.


## Operating Instruction N313: Test Parameters (Asphalt) Humboldt 5001EZ

### 1 Start-up

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.


The following will be displayed:

```
*DATA   XX/XX/XX
*SETUP  XX:XX:XX
*ENGINEERING
                                DEPTH=SAF
```

- ▶ Press  and the following will be displayed:


```
*SET UP 2
*SET MEASUREMENT MODES
*SET TRNCH COR.
*SET TARGETS
```

### 2 Measurement units



- ▶ Press  and the following will be displayed:

```
*SET DATE
*SET TIME
*UNITS = PCF/SI
```

- ▶ Press  repeatedly until 'SI' flashes.


- ▶ Press  and the display will return to the main menu.

### 3 Count time

- ▶ Press  

The following will be displayed:



```
MEAS   =FAST/NORM/SLOW
STD     =4MIN/16MIN
TYPE    =ASPH/SOIL/THIN
DEPTH   =AUTO/MANUAL
```

- ▶ Press  repeatedly until 'NORM' flashes.


### 4 Asphalt mode



- ▶ Press  repeatedly until 'ASPH' flashes.

## 5 Depth

- ▶ Press  repeatedly until 'AUTO' flashes.
- ▶ Press  and the display will return to the main menu.

## 6 Maximum density


- ▶ Press  and the following will be displayed:
 


MAXD =                    XXXX  
 \*INCREASE  
 \*DECREASE
- ▶ Press  to decrease the displayed value until a value of 900 kg/m<sup>3</sup> is obtained.
- ▶ Press  and the display will return to the main menu.





## 7 Asphalt density bias

There is no facility to set an asphalt density bias using the keypad.

## 8 Moisture bias


- ▶ Press  and the following will be displayed:
 

\*SET UP 2  
 \*SET MEASURE MODES  
 \*SET TRENCH COR.  
 \*SET TARGET S
- ▶ Press  and the following will be displayed:
 

MAXD = XXXX            LWD= XXXX  
 KVAL = X.XXX            SPG=X.XXX  
 \*INCREASE  
 \*DECREASE
- ▶ Press  repeatedly until the **KVAL** value flashes.
- ▶ Press  repeatedly until a displayed value of '0.0' is obtained.
- ▶ Press  and the display will return to the main menu.
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N314: Measurement (Asphalt) Humboldt 5001EZ

### 1 Start-up

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.

### 2 Measurement

- ▶ Press  and the following will be displayed:

```
TAKING MEASUREMENT
TIME REMAINING   X:XX
DC = X
MC = X           DEPTH=BAC
```

At the end of the counting period, the following will be displayed:

```
MEASURE ASPH RESULTS
WD = XXXX.X%    %MA = XXX.X
AC = X.X        MAXD = XXXX
*NEXTM         DEPTH=BAC
```



Record WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000).

- ▶ Press  and the following will be displayed:

```
DC = XXXX.X    DS = XXXX.X
MC = XX.X      MS = XXX.X
VR = XX.XX     %AV = X.XX
*LAST          MDEPTH=BAC
```

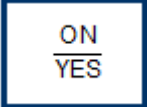
Record DC as the **density count**.

- ▶ Press  and the display will return to the main menu.
- ▶ Press  if the nuclear gauge is not required for further use.




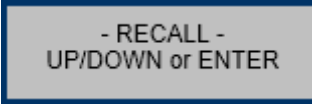

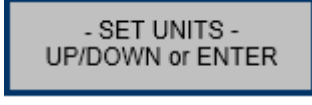
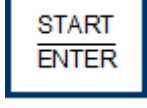
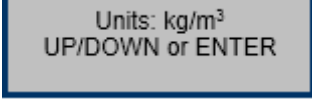

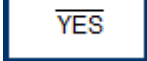
## Operating Instruction N319: Test Parameters (Asphalt) Instrotek Xplorer 3500

### 1 Start-up


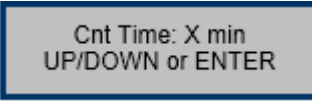

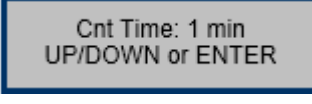
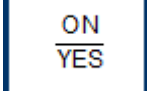
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Units


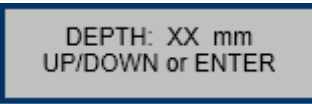

When <READY> is displayed:

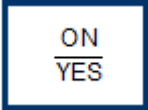
- ▶ Press  and the following is displayed: 
- ▶ Press  repeatedly until the following is displayed: 
- ▶ Press  and the following is displayed: 
- ▶ Press  to set the desired unit.
- ▶ Press  and the display will return to <READY>.

### 3 Count time

- ▶ Press  and the following is displayed: 
- ▶ Press  to set the desired count time. 
- ▶ Press  and the display will return to <READY>.

### 4 Depth

- ▶ Press  the following is displayed: 
- ▶ Press  repeatedly until the required test depth is displayed.

- ▶ Press  and the display will return to <READY>.

## 5 Asphalt mode and maximum density

- ▶ Press  and the following is displayed:

ENTER selects PR  
DOWN selects MA

- ▶ Press  and the following is displayed:

MA: XXXXX  
Change value?

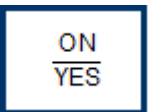
To retain the displayed value, go to 5.1.  
To change the displayed value, go to 5.2

### 5.1 Retain value

- ▶ Press  to retain the displayed value.

The display will return to <READY>. Go to 6.


### 5.2 Change the value

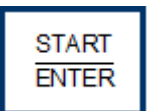
- ▶ Press  to change the displayed value of MA.

The following is displayed:

MA: XXXXX  
UP/DOWN or ENTER

For each digit:

- ▶ Press  repeatedly until the required number is displayed.

- ▶ Press  to confirm each number.

The display will return to <READY>.


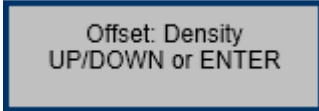

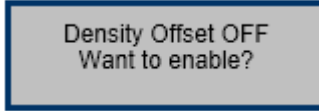

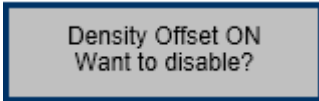
## 6 Asphalt density bias

- ▶ Press  and the following is displayed:

- RECALL -  
UP/DOWN or ENTER

- ▶ Press  and the following is displayed:

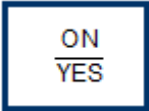
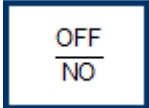
- OFFSET -  
UP/DOWN or ENTER

- ▶ Press  and the following is displayed: 
  - ▶ Press  and the following is displayed: 
- or
- ▶ Press  and the following is displayed: 


To disable the asphalt density bias, go to 6.1.

To enable the asphalt density bias, go to 6.2

### 6.1 Disable asphalt density bias

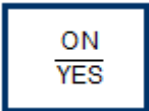
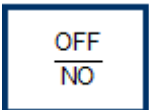
- ▶ Press  to disable the density offset.
- or
- ▶ Press  to confirm the density offset is to remain disabled.

The following will be displayed:

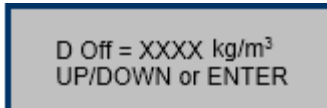


The display will return to <READY>.

### 6.2 Enable asphalt density bias

- ▶ Press  to disable the density offset.
- or
- ▶ Press  to confirm the density offset is to remain enabled.

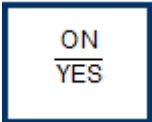
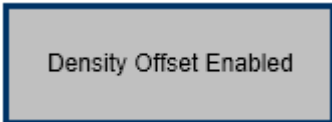
The following will be displayed:



To retain the displayed value, go to 6.2.1.



To change the displayed value, go to 6.2.2.

### 6.2.1 Retain the value


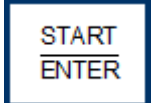
- ▶ Press  and the following will be displayed: 

The display will return to <**READY**>.

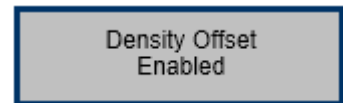
### 6.2.2 Change the value

- ▶ Press  for a positive value.
- or
- ▶ Press  for a negative value.

For each digit:

- ▶ Press  until the required number is displayed.
- ▶ Press  to confirm each number.

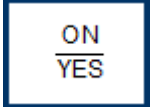
The following will be displayed briefly:



The display will return to <**READY**>.


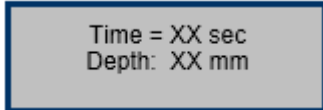
## Operating Instruction N320: Measurement (Asphalt) Instrotek Xplorer 3500

### 1 Start-up


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <READY> is displayed:

- ▶ Press  and the following is displayed: 

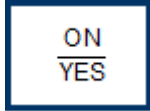
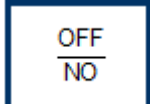
At the end of the counting period:

- ▶ Press  repeatedly until the required values are displayed.

Record the following values as appropriate:

- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- D Count as the **density count**.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000).

- ▶ Press  and the display will return to <READY>.
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N321: Test Parameters (Asphalt) Troxler 3440P

### 1 Start up

- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

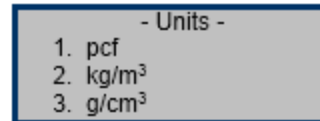
### 2 Measurement units

When <READY> is displayed:

- ▶ Press 

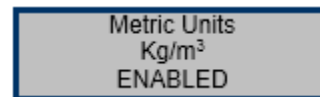
- ▶ Press 

The following will be displayed:



- ▶ Press 

The following will be displayed briefly:

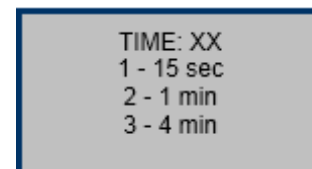


The display will return to <SETUP>.

### 3 Count time

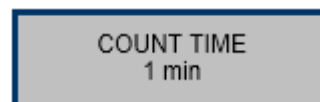
- ▶ Press 

- ▶ Press  and the following is displayed:



- ▶ Press 

The following will be briefly displayed:

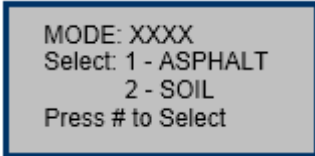


The display will return to <READY>.

#### 4 Asphalt mode

▶ Press 

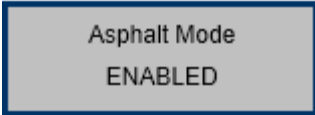
The following will be displayed:



MODE: XXXX  
Select: 1 - ASPHALT  
2 - SOIL  
Press # to Select

▶ Press 

The following will be displayed briefly:

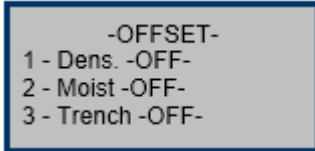


Asphalt Mode  
ENABLED

The display will return to <READY>.

#### 5 Asphalt density bias

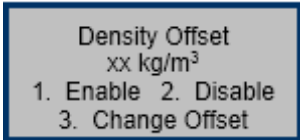
▶ Press  the following is displayed:



-OFFSET-  
1 - Dens. -OFF-  
2 - Moist -OFF-  
3 - Trench -OFF-

▶ Press 

The following will be displayed:



Density Offset  
xx kg/m<sup>3</sup>  
1. Enable 2. Disable  
3. Change Offset

To disable the asphalt density bias, go to Step 5.1.

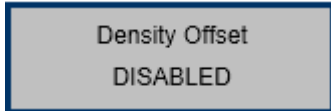
To enable the asphalt density bias, go to Step 5.2.

To change the asphalt density bias, go to Step 5.3.

##### 5.1 Disable asphalt density bias

▶ Press 

The following will be displayed briefly:



Density Offset  
DISABLED

The display will return to <READY>. Go to 7.

### 5.2 Enable asphalt density bias

▶ Press 1

The following will be displayed:

Density Offset  
ENABLED

### 5.3 Change asphalt density bias

▶ Press 3 the following is displayed:

Density Offset  
xx kg/m<sup>3</sup>  
Select (+/-)  
Input and <ENTER>

▶ Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup>.  
(To convert from t/m<sup>3</sup> to kg/m<sup>3</sup>, multiply the asphalt density bias by 1000.)

▶ Press ENTER  
START

The following will be displayed briefly:

Density Offset  
ENABLED

The display will return to <READY>.

## 6 Moisture bias

▶ Press OFFSET the following is displayed:

-OFFSET--Select:  
1 - Dens. -OFF-  
2 - Moist. -OFF-  
3 - Trench -OFF-

▶ Press 2

The following will be displayed:

Moisture Offset  
1. xxxx 2. xxxx  
3. xxxx 4. xxxx  
5. New 6. Disable

### 6.1 Disable moisture bias

▶ Press 6



The following will be displayed:



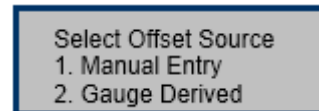
The display will return to <READY>. Go to Step 8.

**6.2 Enable the moisture bias**

- ▶ Press the number corresponding to any of the stored values.

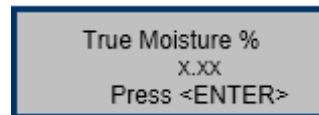
**6.3 Change a moisture bias value**

- ▶ Press  the following is displayed:



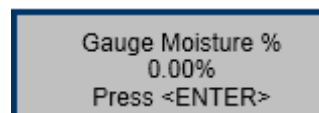
**For manual entry:**

- ▶ Press  the following is displayed:



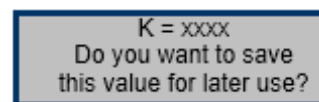
Use the numbered keys to enter the mean oven-dry moisture content to the nearest 0.01%

- ▶ Press  the following is displayed:



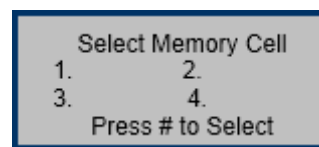
Use the numbered keys to enter the mean nuclear gauge moisture content to the nearest 0.01%.

- ▶ Press  the following is displayed:



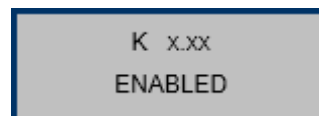
To save the displayed value:

- ▶ Press  the following is displayed:



- ▶ Press a numbered key (1, 2, 3 or 4) to select a memory location in which to save the value.

The following will be displayed briefly:



If the value is not to be displayed:

- ▶ Press

The display will return to <READY>.

**For gauge derived:**

▶ Press  the following is displayed:

True Moisture %  
x.xx  
Press <ENTER>

Use the numbered keys to enter the true moisture content to the nearest 0.01%.

▶ Press  the following is displayed:

Place gauge on soil,  
Lower rod and  
Press any key

Place the gauge on the measurement site and press any key.

At the completion of the counting period, the following will be displayed:

K: ##.##  
Save This Value for  
Later Use ?

To save the value:

▶ Press

To enable the value without storing:

▶ Press

**7 Trench offset**

▶ Press  the following is displayed:

-OFFSET-  
1 - Dens. -OFF-  
2 - Moist. -OFF-  
3 - Trench -OFF-

▶ Press  the following is displayed:

Trench Offset  
M: 0 D: 0  
1. Enable 2. Disable  
3. Change Offset

To enable the trench offset:

▶ Press

The following is displayed:

Trench Offset  
ENABLED

To disable the trench offset:

▶ Press 

The following is displayed:

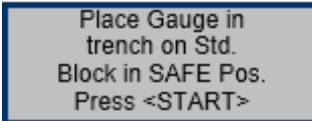


Trench Offset  
DISABLED

To change the trench offset:

▶ Press 

The following is displayed:



Place Gauge in  
trench on Std.  
Block in SAFE Pos.  
Press <START>

▶ Press 

At the end of the counting period, the display will return to <READY>.

▶ Turn the power switch off if the nuclear gauge is not required for further use.


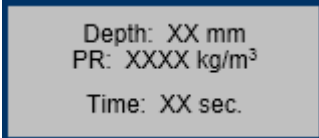
## Operating Instruction N322: Measurement (Asphalt) Troxler 3440P

### 1 Start up

- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

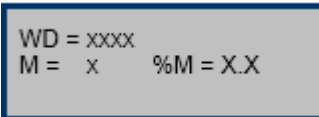
### 2 Measurement

When <READY> is displayed.




- ▶ Press  the following is displayed: 

In the manual depth mode, the gauge will prompt for the source rod depth. In automatic mode, the gauge software reads the depth strip on the source rod to determine the depth.

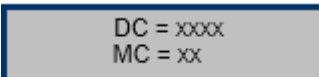
At the end of the counting period, the following will be displayed:



Record WD as the **wet density**:


- ▶ Press 
- ▶ Press 
- ▶ Press 

The following will be displayed:



Record the following values as appropriate:

- DC as the **density count**.
- MC as the **moisture count**.

- ▶ Press  and the display will return to <READY>.
- ▶ Turn the power switch off if the nuclear gauge is not required for further use.



## Operating Instruction N323: Test Parameters (Asphalt) Troxler 3430P

### 1 Start-up

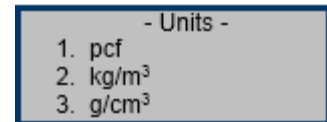
- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement units

When <READY> is displayed:

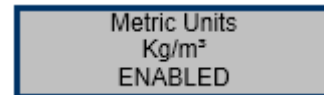
- ▶ Press 
- ▶ Press 

The following will be displayed:






- ▶ Press 

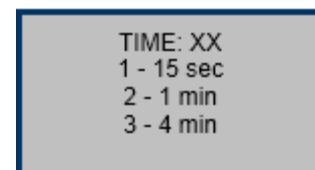
The following will be displayed briefly:



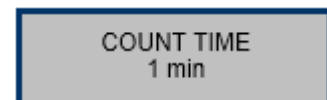
The display will return to <SETUP>.

### 3 Count time

- ▶ Press 
- ▶ Press  and the following is displayed:
- ▶ Press 




And the following will be briefly displayed:

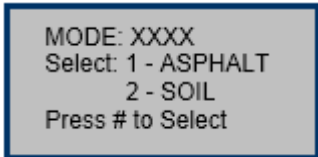


The display will return to <READY>.

#### 4 Asphalt mode

▶ Press 

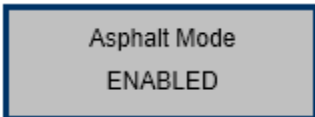
The following will be displayed:



MODE: XXXX  
Select: 1 - ASPHALT  
2 - SOIL  
Press # to Select

▶ Press 

The following will be displayed briefly:

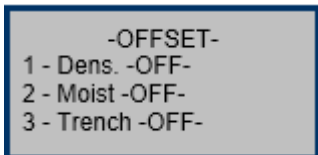


Asphalt Mode  
ENABLED

The display will return to <READY>.

#### 5 Wet density bias

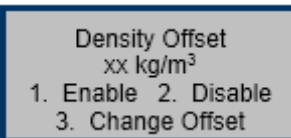
▶ Press  the following is displayed:



-OFFSET-  
1 - Dens. -OFF-  
2 - Moist -OFF-  
3 - Trench -OFF-

▶ Press 

The following will be displayed:



Density Offset  
xx kg/m<sup>3</sup>  
1. Enable 2. Disable  
3. Change Offset

To disable the wet density bias, go to Step 5.1.

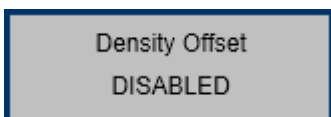
To enable the wet density bias, go to Step 5.2.

To change the wet density bias, go to Step 5.3

##### 5.1 Disable wet density bias

▶ Press 

The following will be displayed briefly:



Density Offset  
DISABLED

The display will return to <READY>. Go to 7.

### 5.2 Enable wet density bias

▶ Press 1

The following will be displayed:

Density Offset  
ENABLED

### 5.3 Change wet density bias

▶ Press 3 the following will be displayed:

Density Offset  
xx kg/m<sup>3</sup>  
Select (+/-)  
Input and <ENTER>

▶ Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup>.  
(To convert from t/m<sup>3</sup> to kg/m<sup>3</sup>, multiply the wet density bias by 1000.)

▶ Press ENTER  
START

The following will be displayed briefly:

Density Offset  
ENABLED

The display will return to <READY>.

## 6 Moisture bias

▶ Press OFFSET the following will be displayed:

-OFFSET--Select:  
1 - Dens. -OFF-  
2 - Moist. -OFF-  
3 - Trench -OFF-

▶ Press 2

The following will be displayed:

Moisture Offset  
1. xxxx 2. xxxx  
3. xxxx 4. xxxx  
5. New 6. Disable

### 6.1 Disable moisture bias

▶ Press 6

The following will be displayed:

Moisture Offset  
DISABLED

The display will return to <READY>. Go to Step 8.

**6.2 Enable the moisture bias**

- ▶ Press the number corresponding to any of the stored values.

**6.3 Change a moisture bias value**

▶ Press 5 the following will be displayed:

Select Offset Source  
 1. Manual Entry  
 2. Gauge Derived

**For manual entry:**

▶ Press 1 the following will be displayed:

True Moisture %  
 x.xx  
 Press <ENTER>

Use the numbered keys to enter the mean oven dry moisture content to the nearest 0.01%.

▶ Press ENTER  
START the following will be displayed:

Gauge Moisture %  
 0.00%  
 Press <ENTER>

Use the numbered keys to enter the mean nuclear gauge moisture content to the nearest 0.01%.

▶ Press ENTER  
START the following will be displayed:

K = xxxx  
 Do you want to save  
 this value for later use ?

To save the displayed value:

▶ Press YES the following will be displayed:

Select Memory Cell  
 1.           2.  
 3.           4.  
 Press # to Select

- ▶ Press a numbered key (1, 2, 3 or 4) to select a memory location in which to save the value.

The following will be displayed briefly:

K x.xx  
 ENABLED

If the value is not to be displayed:

▶ Press NO

The display will return to <READY>.

**For gauge derived:**

▶ Press 2 the following is displayed:

True Moisture %  
 x.xx  
 Press <ENTER>



Use the numbered keys to enter the true moisture content to the nearest 0.01%.

▶ Press ENTER  
START the following is displayed:

Place gauge on soil,  
Lower rod and  
Press any key

Place the gauge on the measurement site and press any key.

At the completion of the counting period, the following will be displayed:

K: ##.##  
Save This Value for  
Later Use ?

To save the value:

▶ Press YES

To enable the value without storing:

▶ Press NO

## 7 Trench offset

▶ Press OFFSET the following is displayed:

-OFFSET-  
1 - Dens. -OFF-  
2 - Moist. -OFF-  
3 - Trench -OFF-

▶ Press 3 the following is displayed:

Trench Offset  
M: 0 D: 0  
1. Enable 2. Disable  
3. Change Offset

To enable the trench offset:

▶ Press 1

The following is displayed:

Trench Offset  
ENABLED

To disable the trench offset:

▶ Press 2

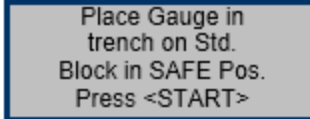
The following is displayed:

Trench Offset  
DISABLED

To change the trench offset:

- ▶ Press 

The following is displayed:



Place Gauge in  
trench on Std.  
Block in SAFE Pos.  
Press <START>

- ▶ Press 

At the end of the counting period, the display will return to <READY>.

- ▶ Turn the power switch off if the nuclear gauge is not required for further use.


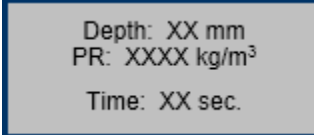
## Operating Instruction N324: Measurement (Asphalt) Troxler 3430P

### 1 Start up

- ▶ Turn the power switch on and allow the nuclear gauge to complete the self-test routine.

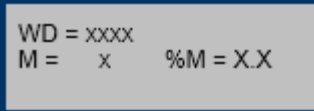
### 2 Measurement

When <READY> is displayed:




- ▶ Press  the following is displayed: 

In the manual depth mode, the gauge will prompt for the source rod depth. In automatic mode, the gauge software reads the depth strip on the source rod to determine the depth.

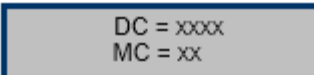
At the end of the counting period, the following will be displayed:



Record WD as the **wet density**:


- ▶ Press 
- ▶ Press 
- ▶ Press 

The following will be displayed:



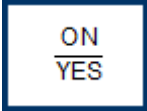
Record the following values as appropriate:

- DC as the **density count**.
- MC as the **moisture count**.


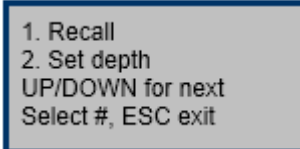
- ▶ Press  and the display will return to <READY>.
- ▶ Turn the power switch off if the nuclear gauge is not required for further use.


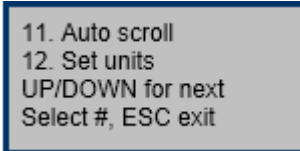
**Operating Instruction N327: Test Parameters (Asphalt) CPN MC1 and MC3 Elite**


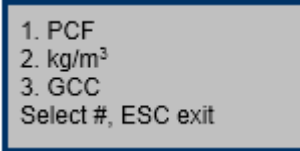
**1 Set-up**

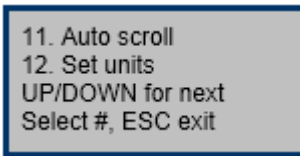
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.


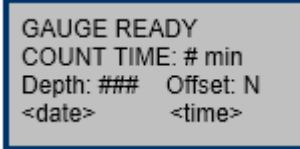
**2 Units**

- ▶ Press  the first screen will be: 


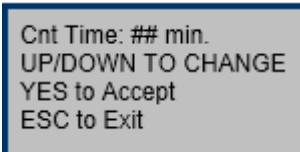
- ▶ Press  the following is displayed: 

- ▶ Press  (button 1, then 2) 


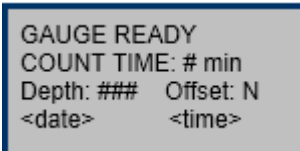
- ▶ After selecting the unit of measurement, the gauge returns to the menu screen. 

- ▶ Press  returns to ready screen 

**3 Count time**

- ▶ Press  and the following is displayed: 

- ▶ Press UP and DOWN to set the desired count time.

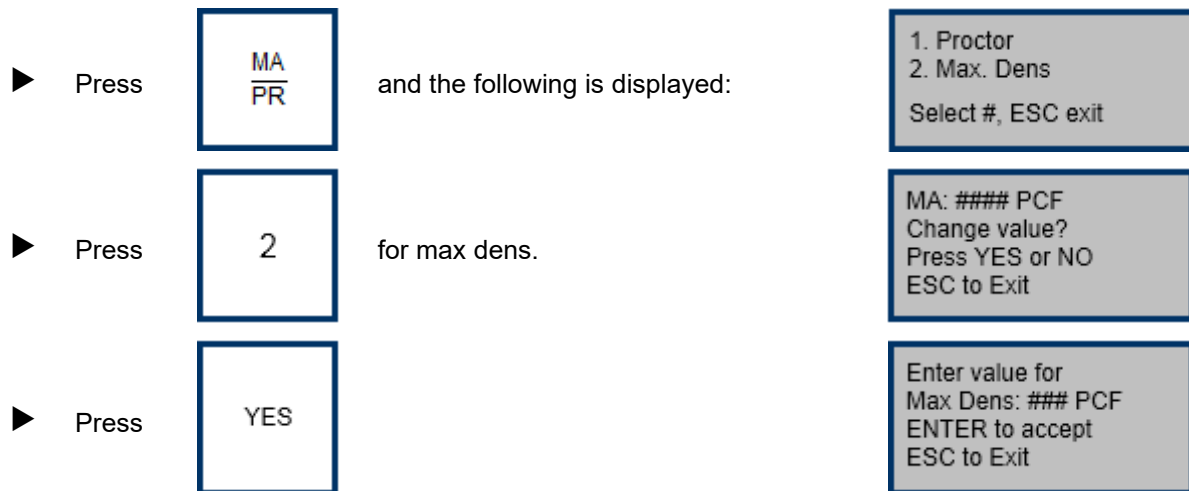
- ▶ Press  returns to ready screen 

#### 4 Depth

The Elite gauge is equipped with an automatic non-magnetic depth indicator. The depth is automatically read as you lower the source into the measure position and the appropriate constraints are selected to calculate the density.

The gauge can be placed into manual depth mode by disabling the automatic depth mode from the MENU functions.

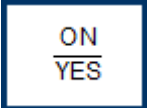
#### 5 Asphalt mode and maximum density



Use the number buttons to change the value. Once you have entered the PR value, the gauge will return to ready screen.


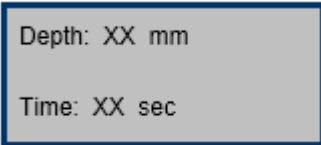
## Operating Instruction N328: Measurement (Asphalt) CPN MC1 and MC3 Elite

### 1 Set-up

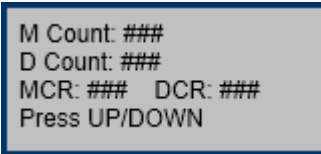
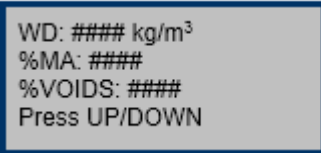
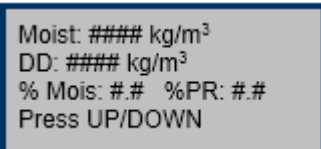
- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When the ready screen is displayed:

- ▶ Press  and the following is displayed: 

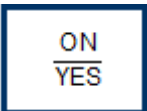
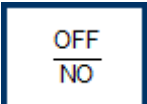
At the end of the counting period, the gauge will display:

- ▶ 
- ▶ 
- ▶ 

Record the following values:

- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- D Count as the **density count**.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000.)

- ▶ Press  and the display will return to the ready screen.
- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N329: Test Parameters (Asphalt) Humboldt 5001SD

### 1 Start-up



Press



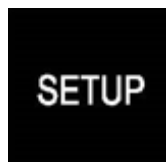
and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:

MEAS	STD	TYPE	DEPTH
NORM	4MIN	SOIL	AUTO
<b>Working Project (Job)</b>			
1234			
<b>Project results</b>			
WD = XXXX	%M = XX.X	%PR = XX.X	
DD = XXXX	M = XXX	MAXD = XXXX	



Press



The following will be displayed:

Settings
<b>Set Measure Modes</b>
<b>Set Trench Correction</b>
<b>Standardization</b>

## 2 Measurement units

▶ Press



or



until the following is displayed:



Select '**System Units**'.

▶ Press



The following will be displayed:




Select '**Metric**'.

▶ Press

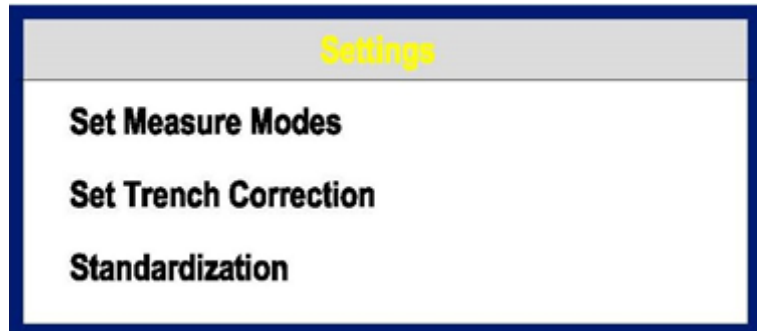




▶ Press  and the display will return to the main menu.

### 3 Count time

▶ Press 



Select '**Set Measure Modes**'.

▶ Press 

The following will be displayed:

Measurement Modes			
Measure	Standard	Type	Depth
Fast	4 Min	Asphalt	Auto
Norm	16 Min	Soil	Manual
Slow		Thin Layer	

Select '**Norm**'.

### 4 Soil mode

Select '**Asphalt**'.

## 5 Depth

Select '**Auto**'.



Press



and the display will return to the main menu.

## 6 Maximum dry density



Press

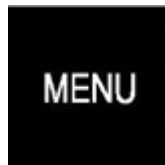


Enter the value by using the displayed keyboard.

(To convert from  $t/m^3$  to  $kg/m^3$ , multiply the maximum dry density by 1000).



Press



and the display will return to the main menu.

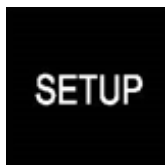
## 7 Asphalt density bias

There is no facility to set an asphalt density bias using the keypad.

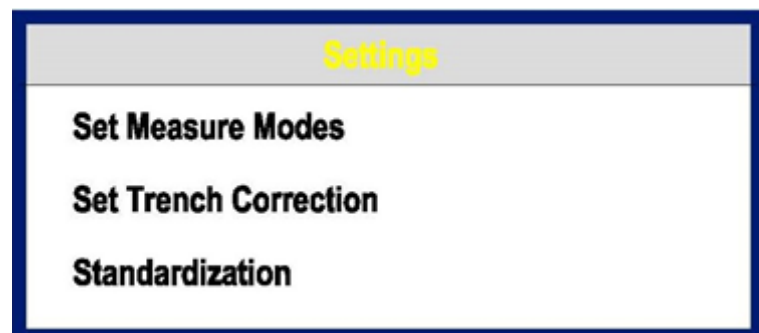
## 8 Asphalt bias



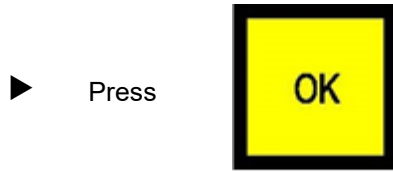
Press



The following will be displayed:



Select '**Set Default Targets**'.



The following will be displayed:

Default Targets	
Maximum Density	Low Density
2480	2360
K Value	Specific Gravity
0.0	2.7

Select '**K Value**'.

Enter the value of '**0.0**' to disable the moisture bias.



and the display will return to the main menu.



if the nuclear gauge is not required for further use.

## Operating Instruction N330: Measurement (Asphalt) Humboldt 5001SD

### 1 Start-up



Press



and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:

MEAS	STD	TYPE	DEPTH
NORM	4MIN	ASPHALT	AUTO
<b>Working Project (Job)</b>			
1234			
<b>Project results</b>			
COMP = XX.X	WD = XXXX	%M	XX
MAXD = XXXX	DD = XXXX	M	XX

### 2 Measurement



Press



The following will be displayed:

<b>TAKING MEASUREMENT</b>	
<b>TIME REMAINING</b>	<b>XX:XX</b>
DENSITY COUNT = XX.X	
MOISTURE COUNT = X.X	
<b>DEPTH = BS</b>	

At the end of the counting period, the following will be displayed:

Project abcd Test Results		
Wet Density	xxxx	(kg/m <sup>3</sup> )
Compaction	xxx	(%)
Asphalt Content	xx	
Maximum Density	xxxx	(kg/m <sup>3</sup> )
Density Count	xxxx.x	
Density Standard	xxxx .x	
Depth = BS		

Record the following values as appropriate:

- **Wet Density** to the nearest 0.001 t/m<sup>3</sup>.
- Compaction as **relative compaction** to the nearest 0.1%.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000).

▶ Press



or



The following will be displayed:

Project abcd Test Results		
Density Count	xxxx.x	
Density Standard	xxxx.x	
Moisture Count	xxx.x	
Moisture Standard	xxx.x	
Voids Ratio	x.x	
Air Voids	xx.x	(%)
Depth = BS		

Record the following values as appropriate:

- **Density count.**
- **Moisture count.**

▶ Press



and the display will return to the main menu.


▶ Press



if the nuclear gauge is not required for further use.


## Operating Instruction N331: Test Parameters (Asphalt) Instrotek Xplorer 2 3500

### 1 Set up


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Units

When <GAUGE READY> is displayed:

- ▶ Press  and the following is displayed:
 

1. Recall
  2. Offset

UP/DOWN for Next  
Select #, ESC Exit
- ▶ Press  repeatedly until the following is displayed:
 


11. Set Units
  12. Standard Mode

UP/DOWN for Next  
Select#, ESC Exit
- ▶ Press **11** and the following is displayed:
 

1. PCF
  2. kg/m3
  3. GCC

Select #, ESC Exit
- ▶ Press **2** and the following is displayed:
 

11. Set Units
  12. Standard Mode

UP/DOWN for Next  
Select#, ESC Exit
- ▶ Press  and the display will return to <GAUGE READY>.

### 3 Count time

▶ Press **TIME** and the following is displayed:

Count Time: X min  
UP/DOWN to Change  
YES to Accept  
ESC to Exit

▶ Press **DOWN** to set the desired count time, 1 minute.

Count Time: 1 min.  
UP/DOWN TO CHANGE  
YES to Accept  
ESC to Exit

▶ Press **YES ON** and the display will return to <GAUGE READY>.

### 4 Depth

The Xplore 2 gauge is designed and equipped with an automatic non-contact depth indicator. The depth is automatically sensed as you lower the source rod into a measurement position and the appropriate calibration constants are selected for calculation of density.

### 5 Asphalt mode and maximum density

▶ Press **MAX PR** and the following is displayed:

1. Proctor  
2. MAX DENS  
Select #. ESC Exit

▶ Press **2** and the following is displayed:

MAX: XXXX kg/m3  
Change Value?  
Press YES or NO  
ESC to Exit

To retain the displayed value, go to 5.1.  
To change the displayed value, go to 5.2.



### 5.1 Retain value

- ▶ Press  to retain the displayed value.

The display will return to <GAUGE READY>. Go to 6.

### 5.2 Change the value

- ▶ Press  and the following is displayed: 

- ▶ Use the numbered keys to enter the required value to the nearest 1 km/m<sup>3</sup>.

- ▶ Press 

The display will return to <GAUGE READY>.

## 6 Asphalt density bias

- ▶ Press  and the following is displayed: 

- ▶ Press **2** and the following is displayed: 

- ▶ Press **1** and the following is displayed:




- ▶ To disable the asphalt density bias, go to 6.1.
- ▶ To enable the asphalt density bias, go to 6.2.

### 6.1 Disable asphalt density bias

- ▶ Press  to disable the density offset.

or

- ▶ Press  to confirm the density offset is to remain disabled.

The following will be displayed:




The display will return to <GAUGE READY>.

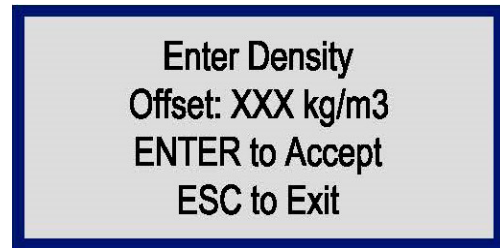
### 6.2 Enable asphalt density bias

- ▶ Press  to enable the density offset.

or

- ▶ Press  to confirm the density offset is to remain enabled.

The following will be displayed:

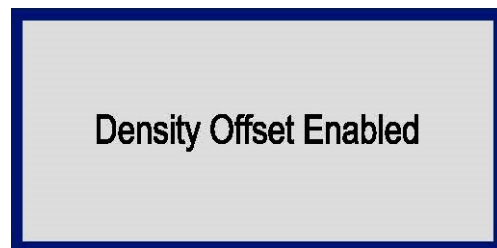


To retain the displayed value, go to 6.2.1.

To change the displayed value, go to 6.2.2.

#### 6.2.1 Retain the value

► Press  and the following is displayed:



The display will return to <GAUGE READY>.

#### 6.2.2 Change the value

Use the numbered keys to enter the required value to the nearest 1 kg/m<sup>3</sup> for a positive value.


► Press  and the following is displayed:



The display will return to <GAUGE READY>.

## Operating Instruction N332: Measurement (Asphalt) Instrotek Xplorer 2 3500

### 1 Start up


- ▶ Press  and allow the nuclear gauge to complete the self-test routine.

### 2 Measurement

When <GAUGE READY> is displayed:

- ▶ Press  and the following is displayed: 


At the end of the counting period:


- ▶ Press  repeatedly until the required values are displayed.

Record the following values as appropriate:

- WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.
- D Count as the **density count**.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000).

- ▶ Press  and the display will return to <GAUGE READY>.

- ▶ Press  if the nuclear gauge is not required for further use.

## Operating Instruction N333: Test Parameters (Asphalt) Humboldt 5001EZ-2

### 1 Start-up

- ▶ Press **POWER** and allow the nuclear gauge to complete the initialising routine.

The following will be displayed:

```
F1 DATA      XX/XX/XXXX
F2 SETUP
F3 ENGINEERING
              DEPTH = SAFE
```

- ▶ Press **F2**

The following will be displayed:

```
F1 SETUP 2
F2 SET MEASURE MODES
F3 SET TRENCH COR.
F4 SET TARGETS
```

### 2 Measurement units

- ▶ Press **F1**

The following will be displayed:

```
F1 SETUP 4
F2 UNITS      PCF / SI
F2 SOUND     OFF / ON
F4 TIMEOUTS
```

- ▶ Press **F2** repeatedly until 'SI' flashes.

- ▶ Press **MAIN MENU** and the display will return to the main menu.

### 3 Count time

▶ Press  

The following will be displayed:

F1 MEAS	FAST / NORM / SLOW
F2 STD	4MIN / 16MIN
F3 TYPE	ASPH / SOIL / THIN
F4 DEPTH	AUTO / MANUAL


▶ Press  repeatedly until '**NORM**' flashes.

### 4 Asphalt mode

▶ Press  repeatedly until '**ASPH**' flashes.

### 5 Depth

▶ Press  repeatedly until '**AUTO**' flashes.


▶ Press  and the display will return to the main menu.


### 6 Maximum density

▶ Press 

The following will be displayed:

MAXD =	X.XXX
F1	INCREASE
F2	DECREASE

▶ Press  to decrease the displayed value until a value of 900 kg/m<sup>3</sup> is obtained.

▶ Press  and the display will return to the main menu.

## 7 Asphalt density bias

There is no facility to set an asphalt density bias using the keypad.

## 8 Moisture bias

▶ Press

F2

The following will be displayed:

```
F1 SETUP 2
F2 SET MEASURE MODES
F3 SET TRENCH COR.
F4 SET TARGETS
```

▶ Press

F4

The following will be displayed:

```
F1 MAXD= XXX.X LWD= XXX.X
F2 KVAL%= +XX.X SPG= X.XXX
F3 INCREASE
F4 DECREASE
```

▶ Press

F2

repeatedly until the 'KVAL' value flashes.

▶ Press

F4

repeatedly until a displayed value of '0.0' is obtained.

▶ Press

MAIN MENU

and the display will return to the main menu.

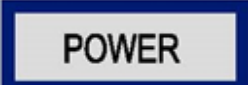
▶ Press

POWER

if the nuclear gauge is not required for further use.

## Operating Instruction N334: Measurement (Asphalt) Humboldt 5001EZ-2

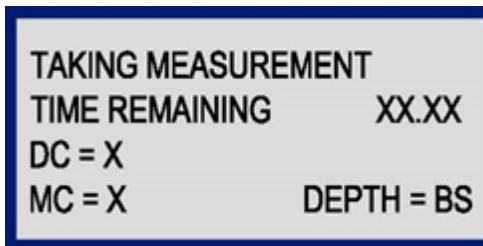
### 1 Start-up

- ▶ Press  and allow the nuclear gauge to complete the initialising routine.

### 2 Measurement

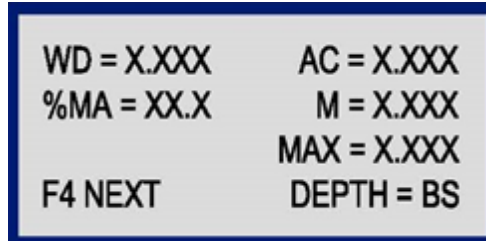
- ▶ Press 

The following will be displayed:



TAKING MEASUREMENT  
TIME REMAINING XX.XX  
DC = X  
MC = X DEPTH = BS

At the end of the counting period, the following will be displayed:



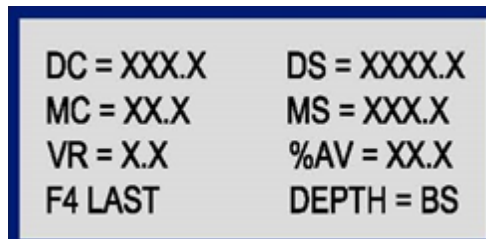
WD = X.XXX AC = X.XXX  
%MA = XX.X M = X.XXX  
MAX = X.XXX  
F4 NEXT DEPTH = BS

Record WD as the **wet density** to the nearest 0.001 t/m<sup>3</sup>.

(To convert from kg/m<sup>3</sup> to t/m<sup>3</sup>, divide the displayed value by 1000).


- ▶ Press 

The following will be displayed:



DC = XXX.X DS = XXXX.X  
MC = XX.X MS = XXX.X  
VR = X.X %AV = XX.X  
F4 LAST DEPTH = BS

Record DC as the **density count**.

- ▶ Press  and the display will return to the main menu.



▶ Press



if the nuclear gauge is not required for further use.