



## Specification for Retroreflectometer for determining the coefficient of retroreflected luminance of pavement markings

### 1. MEASUREMENT PARAMETERS:

1.1. **Geometry:** The retroreflectometer (instrument) shall be constructed to simulate the driver observation angle found at a 30-meter distance from the marking and in accordance with ASTM E 1710.

- 1.1.1. Entrance angle of 88.76 degrees
- 1.1.2. Observation angle of 1.05 degrees

and in accordance with EN 1436

- 1.1.3. Entrance angle of 1.24 degrees
- 1.1.4. Observation angle of 2.29 degrees

1.2. **Working Range:** The instrument shall measure retroreflection of road markings and shall have a working range of 0 to 4.000  $\text{mcd}\cdot\text{lx}^{-1}\cdot\text{m}^{-2}$  for  $R_L$  and 0 to 318  $\text{mcd}\cdot\text{lx}^{-1}\cdot\text{m}^{-2}$  for  $Q_d$ .

1.3. **Nighttime Color Coordinates (x,y):** The instrument shall be able to measure nighttime retroreflected color – CIE chromaticity for white and yellow markings according to EN1436 and ASTM D6628

1.4. **Marking Types & Conditions:** The instrument shall be capable of measuring retroreflectivity on planar (flat) and profiled (textured) markings under dry and wet conditions. The instrument shall be capable of automatic compensating for stray light allowing for full daylight measurements.

1.5. **Depth Ability - Profile Markings:** The instrument shall have a depth ability which enables the instrument to accurately measure profiled road / pavement markings in accordance with  $R_L$  profile height / depth of up to 0.6 inch / 15 mm.

1.6. **Measurement Fields:** The instrument shall utilize an illumination field that is wholly contained within the observation field. The instrument shall measure the retroreflectance  $R_I$  of an area of 7.5 inch / 190 mm in length by 1.95 inch / 50 mm in width.

1.7. **Measurement:** The instrument measurement shall include the following data: Retroreflectivity ( $R_L$  &  $Q_d$ ,  $Q_d$  optional); date and time; series ID; user ID; GPS coordinates of measurement location (optional).

1.8. **Illumination and Detection:** The instrument shall utilize a system response illuminant type 'A' and CIE observer sensitivity according to ASTM E 1710.

1.9. **Positioning Data:** The instrument shall include the following as a minimum to qualify itself as GNSS capable (GPS, Galileo, GLONASS, BeiDou satellite systems, optional):

- 1.9.1. The coordinates of the location of the instrument shall be recorded with each measurement of retroreflection.
- 1.9.2. The instrument will measure, display, and record, along with the position coordinates, the number of satellites used to determine such coordinates for each reading and the horizontal dilution of precision.
- 1.9.3. The GNSS receiver must receive all operational power from an internal supply source.
- 1.9.4. The GNSS receiver shall be contained wholly within the retroreflectometer housing.



1.9.5. The accuracy of the GNSS data under optimal conditions shall be 6.5 ft. / 2.0m CEP.

## 2. CALIBRATION / ACCURACY:

The instrument shall be supplied with a calibration standard as described below.

- 2.1. Traceable Calibration: The instrument shall be supplied with a RI master calibration assembly, which is made up of a plate and a calibrated reflection standard. The calibrated reflection standard must be traceable to an accredited national standards laboratory through an ISO17025 certified testing and calibration laboratory. A DANAK accredited calibration certificate shall be supplied with the traceable calibration reflection standard.
- 2.2. Calibration Standards RI: The reflection standard shall be made of a durable diffuse reflector without glass beads that is uniform and consistent across the whole reflector face.
- 2.3. Stray Light Compensation: The instrument shall actively detect for and compensate for the normal level of stray light present as part of each retroreflectivity measurement.
- 2.4. Color Correction: The instrument shall be internally color corrected to allow measurement of white and yellow markings without requiring recalibration using colored reflection standards.
- 2.5. Repeatability: The repeatability of measurements taken with the instrument shall be within +/- 2%.
- 2.6. Reproducibility: The reproducibility of measurements taken with the instrument or other like instruments shall be within +/- 5%.

## 3. CONSTRUCTION:

- 3.1. Basic Construction: The instrument shall be constructed with an internal metal frame to which the illumination and observation sources shall be mounted in order to maintain a fixed geometry. The instrument shall have an external shell made of impact resistant plastic.
- 3.2. Portability: The instrument shall be completely self-contained with no external battery packs or electronic components.
- 3.3. Dimensions: The instrument's physical dimensions shall be 16.5 inch / 420 mm long; 5.9 inch / 150 mm wide; 11.8 inch / 300 mm high.
- 3.4. Power Source: The instrument must be powered by a rechargeable and replaceable Li-Ion battery. The instrument shall standard be powered by a 12 V / 3.0 Ah professional Bosch battery.
- 3.5. Display: The instrument shall come with a high brightness color touch display, which is clearly visible in daylight and during sunshine. The display functions shall be supported by 3 rugged buttons.
- 3.6. Operating and storage range, humidity: The instrument shall be able to function within the following temperature range:
  - Operation: 0°C to +60°C / +32°F to +140°F
  - Storage: -10°C to +60°C / +14°F to +140°F



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It is recommended that the instrument is being stored below +30°C / +86°F to conserve the battery best possible.

It is recommended to operate the instrument at relative humidity levels below 85% to ensure there is no condensation on the window underneath the instrument where light passes during measurement.

3.7. Electronics Shielding: The instrument shall comply with FCC-CFR47 part 15B (class B) to be fully shielded to eliminate external electromagnetic interference with its performance and block internal electromagnetic radiation.

3.8. Optics: The optics of the instrument shall be fixed within the aluminum frame, totally enclosed and protected by a sealed glass window.

3.9. Display Shield: The instrument shall be provided with a retractable shield that will protect the display when the unit is not in use. The shield shall be fabricated from polymer in such a manner as to cover the display into its furthest extent.

#### 4. USE AND CONTROL:

4.1. Keyboard Panel: Use of the instrument shall be through the use of color touch display and three control buttons / navigation buttons.

4.2. Multi-lingual: The instrument shall have the self-contained ability to output display menus and readings initially in English. Additional languages will be added over time like but not limited to: French, German, Italian, Polish, Russian and Spanish,

4.3. Timing: The instrument shall be able to take combined  $R_L$  and  $Q_d$  measurements in less than 1 second.

4.4. Data Storage: The instrument shall utilize internal non-volatile 8 GB memory for storing measurement data. The GPS data (optional) shall be stored internally along with each retroreflectivity measurement. Each stored measurement must be identifiable by way of a series identifier and a user identifier.

4.5. Data Output: The instrument shall be equipped with a USB port to allow for easy measurement data and diagnostics. The GPS data (optional) shall be shown on the display screen and linked to the individual measurements. Measurement data shall be presented in Excel.

4.6. Internal Error Detection: The instrument must indicate on the display and data log whenever detectable errors exist, such as excessive stray light, low battery or incorrect calibration.

4.7. GPS Fix (optional): The instrument shall during normal use advise the operator if the GPS fails to have a fix when a reading is taken. The operator shall be given the options of a) taking the measurement anyway, b) not taking the measurement, or c) turning off the GPS function.

#### 5. EQUIPMENT:

5.1. Standard Accessories: The instrument shall be delivered complete with quick guide, battery charger, battery, carrying case, calibrated master reflection standard and USB memory stick for data transfer. User manual and other support material shall be available via [www.roadsensor.com](http://www.roadsensor.com)

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5.2. Optional Accessories: The instrument will come as a base unit model able to measure R1 and which can be added one or more of the following options: Build-in GNSS, Nighttime color coordinates and Qd measurement.

## 6. TECHNICAL SUPPORT & SERVICE:

6.1. Training: The manufacturer and/or authorized representative shall provide training and/or technical service as required by the purchaser or his appointed representative.

6.2. Factory Services: The instrument must have a factory certified maintenance program available for regular service checks to verify instrument performance and reference standard condition.

## 7. REGULATORY COMPLIANCE:

### **EU:**

Radio: EN 303-413 V1.1.1:2017

EMC: EN 301-489-19 V2.1.1 (2019-04)

Safety: IEC 61010-1:2010, AMD1:2016; EN 61010-1:2010+A1:2019

### **USA:**

FCC: 47 CFR Part 15B (class B)

### **Canada:**

ICES-003:2016 (Class B)

## 8. WARRANTY:

8.1. The instrument shall be warranted for a period of two years against defective parts and workmanship.