

Specification for handheld Retroreflectometer for determining the coefficient of retroreflected luminance (R_A) of road traffic signs, high visibility clothing, license plates and reflective tapes

1. MEASUREMENT PARAMETERS:

1.1. The measurement: The instrument shall measure the coefficient of retroreflected luminance (R_A) of road traffic signs, high visibility clothing, license plates and reflective tapes.

1.2. Geometry and standards: The retroreflectometer must comply with, among others, the following international geometries and standards:

1.2.1. Road traffic signs: EN 12899, ASTM E 1709, ASTM E 2540

1.2.2. High visibility clothing: EN 20471, ASTM E 1809

1.2.3. License plates: No EN and ASTM standards available

1.2.4. Reflective tapes: No EN and ASTM standards available

1.3. Illumination and Observation: The retroreflectometer instrument should be constructed to meet the following geometries.

1.3.1. Illumination / entrance angles of -4° , $+5^\circ$, $+10^\circ$, $+20^\circ$, $+30^\circ$, $+40^\circ$, $+45^\circ$. The illumination / entrance angles are provided as front adapter allowing measurement of one angle at a time. The instrument automatically detect and inform in the display the type of attachment

1.3.2. Three observation angles as a selection from the following angles: 0.2° , 0.33° , 0.5° , 0.7° , 1.0° , 1.5° , 2.0° measured simultaneously

1.3.3. Light source should be CIE illuminant type A, ASTM E 1709 section 6.4.2

1.3.4. Light source and receptor angular aperture of 0.1°

1.3.5. Light must be collimated

1.3.5. Measurement area $\varnothing$ 25 mm / 1 inch

1.4. Working Range: The instrument shall have a working range of 0 to $2000 \text{ cd} \cdot \text{lx}^{-1} \cdot \text{m}^{-2}$.

1.5. Measurement: The instrument shall be able to sequentially measure R_A of three of the observations angles 0.2° , 0.33° , 0.5° , 0.7° , 1.0° , 1.5° , 2.0° in a single measurement.

1.6. Color Correction: The instrument shall be built in accordance to ASTM E 1709 section 6.4 to allow retroreflection measurement of various colors and type of reflective sign sheeting and tapes including fluorescence types. Recalibration shall not be necessary for individual colors, sheeting or tape type.

1.7. Point Aperture Measurement: The instrument shall utilize ASTM standard point aperture geometry, enabling the user to determine if microprismatic sheeting material has been applied with the correct orientation (datum mark).

1.8. Stray Light Compensation: The instrument shall detect for and compensate for the actual level of ambient light present as part of each retroreflectivity measurement.

- 1.9. Positioning Data: The instrument shall have a built-in GPS (optional).
- 1.9.1. The accuracy of the GPS data under optimal conditions shall be 6.6 ft. / 2.0m CEP or better.
 - 1.9.2. The accuracy of each GPS fix shall appear on the instrument display and be included in the data storage.

2. INSTRUMENT FEATURES:

- 2.1 Sign Identification Data: The instrument shall have a built-in barcode and QR code reader (optional) for recording of sign identification data. The instrument shall have the option of manually entering of sign related data either as a template entry covering a family of signs or as a single measurement specific entry.
- 2.2 User Identification Data: The instrument shall have the option of entering user identification data
- 2.3 Picture of sign: The instrument shall have a built-in digital camera (optional) for making a picture of the sign measured.
- 2.4 Color recognition and contrast: The instrument shall be able to identify colors and provide the contrast between background and legend. If the color is not correctly identified the user will have the option of manually adjusting the color recorded by the instrument.
- 2.5 GPS & mapping: The instrument shall have a built-in GPS (optional) unit for identification of the location of the sign and for use in mapping of the measurement results.
- 2.6 Standard data transfer: The instrument shall come with the option of data transfer via USB to a PC.
- 2.7 Wireless transfer Data: The instrument shall have built-in wireless communication (optional) for transfer of data to an iPad via an App (optional)
- 2.8 Instrument rotation and tilt: The instrument shall have a built-in function (optional) to identify rotation and tilt of the instrument.
- 2.9 Sign face direction: The instrument shall have a built-in compass (optional) to identify the facing of the measured sign.
- 2.10 Sign library, pass / fail function: The instrument shall have a built-in sign library (optional) to allow for immediate pass / fail function. The initial library offered will be according to MUTCD.
- 2.11 Extension pole: The instrument can be delivered with an extension pole (optional) for measurement of high placed signs. The pole will allow for extension of 1.5-2.7 m / 4.9-8.9 feet

3. CALIBRATION:

2.1. Calibration reference: The instrument shall be supplied with a single white reflection reference mounted at the back of the front adapter. The white reflection reference shall be traceable to an accredited national standards laboratory through an ISO 17025 certified calibration and testing laboratory.

2.2. Calibration procedure. The instrument calibration shall be done in two ways: a) by entering into the calibration page of the instrument the calibration reference values for the 7 observation angles stated at the back of the front adapter. b) by scanning the calibration reference values via the QR code located same at the back of the front adapter.

4. CONSTRUCTION:

3.1. Basic Construction The instrument shall be rigidly constructed for field use. The instrument housing is made of ABS polymer

3.2. Portability: The instrument shall be self-contained, portable and be supplied with a foam-lined carrying case.

3.3. Dimensions: The instrument's physical dimensions shall be a maximum 260 x 285 x 110 mm / 10.2 x 11.2 x 4.3 inch. The instrument shall weigh less than 1.9 kg / 4.2 lbs.

3.4. Power Source: The instrument shall be powered by a commercially available, replaceable Li-Ion 10.8V 2,0 Ah easy changeable and rechargeable battery.

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

5. USE AND CONTROL:

4.1. Operation of the instrument: Operation of the instrument shall be through the use of a LED color touch display with backlight.

4.2. Preparing measurement program: A measurement program can be prepared directly on the instrument using the touch display or can be prepared on a tabletPC(optional App) in advance and uploaded to the instrument. A measurement program with uniform sign parameters can use a template for fast creation of individual measurements.

4.2. Data Storage: The instrument shall utilize internal non-volatile memory for storing measurement data. The instrument shall be capable of storing minimum 2 mio. measurements without pictures and minimum 2,000 measurement with pictures. Each measurement shall consist of the coefficient(s) of retroreflected luminance (R_A) of the measured entrance and observations angles and all other data mentioned under paragraph 1.10 and data mentioned under section 2 (paragraph 2.1 to 2.10)

4.3. Data Output: The instrument shall be equipped with a USB computer interface and wireless communication for tabletPC data exchange to allow for data output, pre-programming, extended control and diagnostics.

4.4. Internal Error Detection: The instrument shall indicate to the user on the display whenever a measurement may contain excess stray light. The instrument shall also indicate on the display whenever other detected errors exist such as incorrect calibration or low battery.

4.5. Averaging function: The instrument shall display a running average of measurement results. The instrument is able to average 2 to 10 measurement per background and legend color.

6. EQUIPMENT:

5.1. The instrument shall be equipped complete with an instrument user's manual, quick guide, battery, battery charger, carrying case, calibration reference mounted on a front attachment with written calibration values and QR code for scanning of calibration values.

5.2. The instrument shall have a temperature operating range of +32°F to +140°F / 0°C to +60°C and a temperature storage range of +14°F to +140°F / -10°C to +60°C (recommended +32°F to +86°F / 0°C to +30°C).

7. REGULATORY COMPLIANCE:

EU

The equipment shall comply with the following directives of the European Parliament and of the Council:

Directive 1999/5/EC of 9 March 1999 on radio equipment and telecommunications terminal equipment.

Directive 2011/65/EU of 8 June 2011 on restriction of the use of certain hazardous substances (RoHS).

Directive 2002/96/EC of 27 January 2003 on waste electrical and electronic equipment (WEEE).

The equipment is tested to the following standards:

R&TTE article 3.1a (health & safety):

EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011

R&TTE article 3.1b (electromagnetic compatibility):

EN 301489-1 V1.8.1:2008

EN 301489-3 V1.4.1:2002

R&TTE article 3.2 (radio parameters):

EN 300440-2 V1.4.1:2010

RetroSign GRX-3



USA

The equipment complies with the following rule part of the Federal Communications Committee:

FCC CFR 47 Part 15 Subpart B, Class A.

The equipment incorporates a separately certified Bluetooth radio module, FCC ID: S7APARANIESD200

The equipment complies with the following safety specification:

IEC 60950-1:2005 (2nd Edition); Am 1:2009

8. WARRANTY:

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

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