



## Measurement practise for road markings

A hands-on guide for LTL 2000 series, LTL-X and LTL-XL

### Measuring retroreflection from road markings with a handheld retroreflectometer

Measuring retroreflection from road markings is important to make sure that the markings perform according to specification and thus support safe driving. But how do you compose a measuring program to provide a good overview of the condition of a road marking? What do you have to be aware of when planning and conducting the measurements?

#### The retroreflectometer

The retroreflectometer must be checked and calibrated before measurements are started to make sure it measures correctly. You need to check the following on a daily basis, e.g. when you start measuring in the morning.

- The calibration unit of the instrument must be clean and without scratches.
- The mirror underneath the instrument is clean and without scratches or moisture on the surface.
- Calibrate the instrument to ensure that the instrument measures correctly (check the instrument Quick Guide or User Manual for details).

If the mirror and/or the calibration unit cannot be cleaned properly, has scratches or is otherwise damaged it needs to be changed. Please contact your local dealer (see contact details on [www.roadsensors.com](http://www.roadsensors.com)) or DELTA for assistance.

DELTA recommends that the calibration unit is re-calibrated or changed at regular intervals. These intervals are typically every 1-2 years depending on the use pattern and storage conditions of the calibration unit. Please contact your local dealer or DELTA for assistance. DELTA recommends that the instrument is being serviced at regular intervals depending on the use pattern and storage conditions of the instrument. Please contact your local dealer or DELTA for assistance.

DELTA's retroreflectometers LTL 2000 series, LTL-X and LTL-XL will operate perfectly within 0 – 45° C / 32 – 114° F and under non-condensing conditions (relative humidity below 90 – 95%).

### Measurement practise

To be able to provide a proper overview of the state of road markings you can consider applying the following measurement program:

- If the markings generally look fine make spot measurement to confirm that the markings clearly meet the minimum requirement. A spot check can be 1-2 measurements per km.
- If the markings get close to the minimum requirement use 5-10 measuring points per km road, i.e. measure every 100 – 200 m if the marking is in uniform condition.
- For each measuring point make 3-4 measurements and use the average value as the result.
- If the marking is not uniform (e.g. when the road turns, on rumble stripes, on stop markings and alike or when the marking is otherwise uneven in quality) more frequent measurements should be taken.



LTL-XL

DELTA's retroreflectometers LTL 200 series, LTL-X and LTL-XL will be able to automatically calculate the average value, if set to do so.

Make sure that you measure in the driving direction of the cars to ensure correct correlation to what the driver sees.

## The results, $R_l$ and Qd

Retroreflection of road markings is measured in  $\text{mcd} / \text{lx} / \text{m}^2$

$\text{mcd}$  = milli candela = the luminous intensity

$\text{lx}$  = lux = the luminous flux incident on a surface per unit area

$\text{m}^2$  = square meter = the surface unit area used in the calculation

The value read by the retroreflectometer represents the amount of retroreflected light being seen by a driver in a passenger car at night- or daytime.

$R_l$  or the "Coefficient of Retroreflected Luminance" is the measure for the retroreflection level at nighttime. The light source is the head light of a car.

Qd or the "Luminance Coefficient under Diffuse Illumination" is the measure for the retroreflection level at daytime. The light source is the sun or street light.

## Minimum retroreflection levels

What should the minimum retroreflection level be? Among others this depends on:

- the particular national standard applied
- the type or class of road
- if night or day visibility is measured
- if the pavement marking is dry or wet.



### LTL-X

In other words, there are no uniform global guidelines. For the European Union (EU) the CEN standards using 30 m geometry provide directions. The standard also includes recommended minimum retroreflection values on different types

of roads and under different driving conditions. The relevant standard is called:

- EN 1436 "Road marking materials – Road marking performance for road users"

The US ASTM standard is based also on 30 m geometry and is called:

- E 1710 "Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry using a Portable Retroreflectometer"

In the US the minimum requirements of retroreflection are laid out in the so called MUTCD. Currently there is only a MUTCD for traffic signs, "National Standards for Traffic Control Devices; the Manual on Uniform Traffic Control Devices for Streets and Highways; Maintaining Traffic Sign Retroreflectivity". A similar MUTCD is currently being worked on for pavement markings and is expected introduced during 2011.

## Measurement intervals

There are no uniform guidelines in EU and USA about measurement intervals. A typical measurement schedule could be:

- Confirm that the agreed performance level has been met when new markings are delivered by the contractor. This measurement is typically taking place within the first two weeks after delivery.
- Check the retroreflection level during the lifetime of the markings. These checks can be to confirm the marking performance vis-à-vis the performance contract or to let the road owner know the condition of the markings for taking road management decisions. Measurements are typically taken every 1-2 years on evenly worn roads and possibly more often at critical road spots.
- Check the performance at the end of the performance contract period, typically 2 – 4 years after delivery.

The overall purpose of measuring the retroreflection level is to ensure first of all compliance with the minimum retroreflection levels (if any) and secondly to confirm that the road owner received the performance level agreed upon. And not to forget – to make sure the road is safe to drive on also during nighttime and during adverse weather conditions.

## Conditions to watch when measuring

When you measure retroreflection from road markings there are a number of conditions to be aware of, if you want representative measurement results. The main conditions are listed below:

- Place the instrument evenly on the marking, if tilted you may get wrong readings (the instrument measures a compacted 30 m geometry).
- Make sure the marking is dry from moisture if you want to measure comparable results.
- Make sure the marking is clean from gravel, dirt and loose glass beads.
- Make sure the measured areas are representative of the marking to be measured.
- When measuring profiled markings it is especially important to calculate the average of several measurements at different locations.
- Do not measure within 1 m of a strong reflective material like cateyes /RRPM's.

When measuring new markings

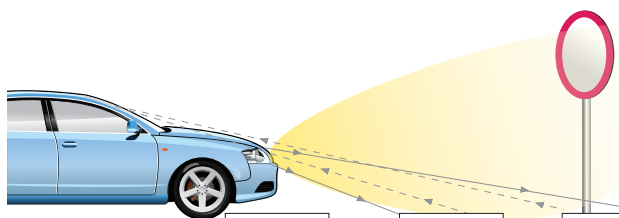
- Make sure the markings are dry after application.
- Make sure loose glass beads have been removed (to avoid giving false readings).

DELTA's instruments are capable of measuring dry and wet markings (LTL-X can even measure continuous rain conditions, see the User Manual for details). If you decide to measure wet markings expect results to vary, even if you repeat measurements on the same spot, see below for details.

### Other conditions to be aware of

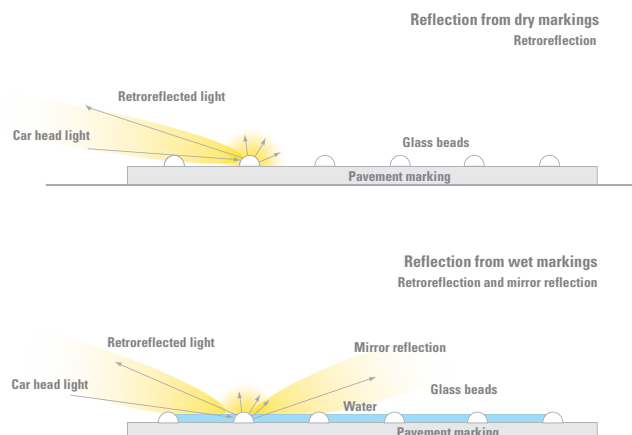
Retroreflection of light from a car's headlight being returned by a road marking is helping the driver to see the road and thus limiting the risk of accidents.

Retroreflection is caused mainly by the glass beads imbedded in the road markings. Depending on the quality and amount of glass beads a retroreflection level  $> 500$  mcd/lux/sqm may be reached. A white marking without glass beads will provide limited retroreflection levels.



Retroreflection levels are significantly lower during nighttime driving on wet roads compared to dry roads. Moisture on markings will partly or fully cover for the light, so they will not reach the glass beads and thereby reduce retroreflection. Be-

sides, water on markings will cause mirror reflection resulting in further loss of light.



DELTA's retroreflectometers will measure white and yellow markings without any adjustment to the instrument. DELTA retroreflectometers will measure any marking design.