2024 Qualified Pavement Markings Inspection Technician

Brandi R. Mitchell
Division of Materials
Brandi.Mitchell@ky.gov
502.782.8382

BelKunwar
Division of Materials
Bele.Kunwar@ky.gov
502.782.8386

COURSE SCHEDULE

DAY 1

8:30 – 9:30am	Introduction and Welcome
	KM64-001 Qualification Program for Technicians
	Specifications
	District Wide Striping Contract
9:30 – 9:45am	**BREAK**
9:45 – 10:45am	District Wide Durable Striping Contract
	Materials Handling
	Kentucky Methods
10:45 – 11:30am	LTL 3500 Overview
11:30 – 1:00pm	**LUNCH**
1:00 – 4:00pm	Workshops

DAY 2

8:30 – 9:00am	Review
9:00 – UNTIL	Written and Practical Exam

*Between the written and practical exam, participants will have an opportunity to take a break and practice for the second part of the exam.

Websites

Division of Materials
https://transportation.ky.gov/Materials/Pages/default.aspx

Kentucky Methods 201, 202 , 203
https://transportation.ky.gov/Organizational-Resources/Policy%20Manuals%20Library/Kentucky%20Methods.pdf

Kentucky Standard Specifications
https://transportation.ky.gov/Construction/Pages/Kentucky-Standard-Specifications.aspx

List of Approved Materials
https://transportation.ky.gov/Materials/pages/List-Of-Approved-Materials.aspx

Sampling Manual
https://transportation.ky.gov/Materials/Pages/Sampling-Manual.aspx

Daily Paint Striping Report/Daily Long-Line Thermoplastic Report
https://transportation.ky.gov/Materials/pages/Chemistry.aspx

QUALIFIED

PAVEMENT MARKING

TECHNICIAN

TRAINING

INTRODUCTION & WELCOME

1. Visitor Check-In & Out
2. Restrooms & Concessions

REASON FOR THE COURSE

KM 64-001

According to the Federal Highway Administration Policy all acceptance sampling and testing must be performed by "Qualified Personnel." In response to the federal policy, the state Qualification Program for Technicians was developed.

Kentucky Method 64-001-08 covers qualification and disqualification procedures for inspectors. This method states that to qualify you must attend training and pass both a written test and a practical test. Disqualification is the result of one of the following reasons:

1. Failure to pass re-qualification class
2. Found to be guilty of falsifying test results, records, and/or reports.
3. Improper performance of tests

As of 2016 the Qualified Pavement Markings Inspection Technician course qualification is good for five (5) years (as opposed to only three years in the past).

OVERVIEW OF THE COURSE

DAY 1

This course will begin by discussing the Specifications that cover striping. Then we will review the district wide striping contract followed by a short break. After the break we will go over the Materials testing and finish with the Kentucky Methods. Finally, we will finish the morning with an overview of the handheld retroreflectometer. Following lunch, we will have workshops that include hands on practice with the handheld retroreflectometer.

All participants must attend both the morning presentations AND the workshops in order to be eligible to take the exam.

DAY 2

At the start of the day we will have a brief **question and answer session** followed by an open book written exam. After the **written exam**, there is a **practical test.** <u>For the practical exam the manuals are not allowed</u>. Also, the practical will include written questions.

NO RETEST

TIPS

1. Follow along during the class so that you are familiar with your manual.
2. Practice with the retroreflectometer until you are comfortable.

Kentucky Method 64-001-17
Revised 02/22/17
Supersedes KM 64-001-08
Dated 04/02/08

KENTUCKY TRANSPORTATION CABINET
QUALIFICATION PROGRAM FOR TECHNICIANS

1. SCOPE:

   1.1. According to Title 23, Part 637, Code of Federal Regulations (23 CFR 637), FHWA's "Quality Assurance Procedures for Construction", all acceptance and verification sampling and testing must be performed by "qualified personnel".

   1.2. As defined in the Quality Assurance Program for Materials Testing and Acceptance, the Kentucky Department of Highways has established a Quality Assurance (QA) program to ensure that materials and workmanship incorporated into any highway construction project are in reasonable conformity with the requirements of the approved plans and specifications, including any approved changes. This QA program allows for the use of validated, contractor-performed, quality control (QC) test results as part of an acceptance decision. It also allows for the use of test results obtained by commercial laboratories in the Independent Assurance (IA) program as well as in acceptance decisions.

2. REFERENCED DOCUMENTS: Kentucky Department of Highways Quality Assurance Program for Materials Testing and Acceptance

3. QUALIFICATION PROGRAM STEERING COMMITTEE (QPSC): The Qualification Program is overseen by a Steering Committee consisting of the following representatives:

   State Highway Engineer

   Deputy State Highway Engineer for Project Delivery

   Director, Division of Construction

   Director, Division of Materials

   Director, Division of Employee Support

   Division of Materials Qualification Coordinator

   Representative, Federal Highway Administration

   Representative, Kentucky Concrete Association (KCA)

   Representative, Kentucky Association of Highway Contractors (KAHC)

   Representative, Kentucky Crushed Stone Association (KCSA)

   Representative, Plantmix Asphalt Industry of Kentucky (PAIKY)

4. QUALIFICATION POLICIES:

4.1. Required qualifications are primarily: 1) sample and test oriented or 2) demonstration of knowledge or expertise for a specific discipline.

4.1.1. Qualifications required for sampling and testing as part of a QA program. These qualifications are required, as applicable, for the QC effort, acceptance, verification, or IAS program. To qualify, an individual must successfully perform the specific tests and necessary calculations required for each qualification type in the presence of an authorized evaluator. Successful performance is defined as demonstrating the ability to properly perform the key elements for each test method. If the individual fails to demonstrate the ability to perform a test, the individual may be allowed one retest per test method at the evaluator's discretion.

4.1.2. Qualifications required for demonstration of knowledge or expertise associated with items of work. These qualifications are required, as applicable, for project oversight when specific items of work are being performed.

4.2. The individual must pass a written examination administered by an authorized evaluator. An individual failing the written examination may request a retest. The individual may be allowed one retest at the evaluator's discretion. The retest must be requested, scheduled and administered within 30 days of the notification of failure. Failure to pass the second written examination shall be considered as failing the entire qualification.

4.3. Qualification of an individual is valid for not more than five years. After that time, the individual must qualify again. Under the requirements of the QA program, interim evaluations will be permitted when appropriately justified.

4.4. Test questions and other examination data used to administer this qualification program are subject to reuse and are considered confidential and exempt from public records inspection.

5. EXAMINATION METHODS AND POLICIES:

5.1. A standard set of examinations for each qualification will be used statewide. With the exception of national qualifications, the examinations will be developed by a committee composed of personnel from some or all of the following: Division of Materials, Division of Construction, and appropriate industry representatives.

5.2. In addition, the individual may be required to participate in proficiency sample testing administered by the qualification authority to validate the qualification. The result of the proficiency samples will be evaluated for compliance with acceptable tolerance limits. If the comparison of test results does not comply with the tolerances, an engineering review of the test procedures and equipment shall be performed immediately to determine the source of the discrepancy. Corrective actions must be identified, and incorporated as appropriate, prior to the individual performing additional testing on that test method.

6. DISQUALIFICATION PROCEDURES: A qualified individual can be disqualified for any of the following reasons:

6.1. Failure to pass requalification requirements and/or provide payment of fees, initial or requalification.

6.2. Found to be guilty of falsifying test results, records, and/or reports or any willful departure from approved policy/procedure. Allegations of falsification or willful departure will be made to the QPSC in writing. The allegations will contain the name, address, and signature of the individual(s) making the allegation. The allegations will be investigated by the QPSC. The accused and the individual(s) making the allegation will be given the opportunity to appear before the QPSC. All involved parties will be notified in writing of the findings by the QPSC. Any warranted actions will be imposed according to the guidance contained herein. Decisions regarding allegations may be appealed in writing to the QPSC which will consider such written appeals and take such action considered appropriate.

6.2.1. First offense would result in a 12-month revocation of qualification status in all qualification types. Prior to reinstatement, the individual shall again successfully complete qualification classes.

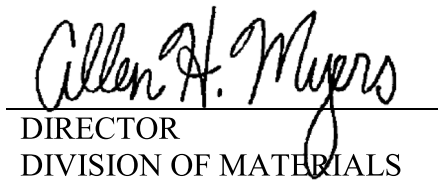
6.2.2. Second offense would result in a permanent loss of qualification status in all qualification types.

6.3. Found to be guilty of improperly performing tests, failing to perform tests, or being incapable of performing tests and documented by a qualified technician. The documentation ("Report of Violation" form, copy attached) must include the date(s), time(s), location(s), occurrence(s) of non-conformance, and signature of the qualified technician reporting the incident.

6.3.1. First offense would result in a letter of reprimand from the QPSC.

6.3.2. Second offense would result in a 30-day revocation of qualification status.

6.3.3. Third offense would result in a revocation of qualification status. The individual may obtain qualification again after a six-month period and successfully completing the appropriate qualification class(es).

APPROVED 

DIRECTOR
DIVISION OF MATERIALS

DATE 02/22/17

Kentucky Method 64-001-17
Revised 02/22/17
Supersedes KM 64-001-08
Dated 04/02/08

SPECIFICATIONS


2024
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Brandj.Mitchell@ky.gov
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Pavement Marking Inspection
•TEMPORARY STRIPING
•PERMANENT PAVEMENT STRIPING
•DURABLE PAVEMENT STRIPING
•INTERSECTION MARKINGS
ONLY
sdstriper 2002

2


Standard Specifications for Temporary Striping
Section 112.03.11: Temporary Striping with Paint or Tape

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Section 112.03.11: Temporary Striping

- **Striping expected to be in place less than 120 days**
  - Visual Acceptance
  - Maintained Retroreflectivity Readings
  - Manufacturer's Certification
  - Temporary Tape: Ensure the product is on the List of Approved Materials
- **Striping expected to be in place greater than 120 days**
  - Initial Retroreflectivity Readings
  - Maintained Retroreflectivity readings
  - Manufacturer's Certification
  - Paint: Collect a sample to be sent to Central Office Materials
  - Temporary Tape: Ensure the product is on the List of Approved Materials

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Section 112.03.11: Initial Evaluation of Temporary Stripe

- **Less than 120 days**
  - Initial evaluation = Visual Evaluation
- **Greater than 120 days**
  - Initial Evaluation = Retroreflectivity within 5 days of application
    - White: 300 mcd/m^2/lux
    - Yellow: 225 mcd/m^2/lux

Readings taken in accordance with KM202 or KM203

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Section 112.03.11:Temporary Striping Minimum Maintained Retroreflectivity

- **Minimum retroreflectivity maintained as long as the temporary stripe is in place**
  - **Stripe in place less than 120 days**
    - Requested at any time by the Engineer
  - **Stripe in place greater than 120 days**
    - Requested any time after initial evaluation by the Engineer

White: 175 mcd/m^2/lux
Yellow: 150 mcd/m^2/lux

Readings taken in accordance with KM202 or KM203.

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Section 112.03.11: Temporary Striping Visual Acceptance Guidelines

- **Suitable and uniform color**
- **Crisp edges and clean cutoffs**
- **Adhere to pavement**
- **Sufficient retroreflectivity – visible daytime and nighttime**

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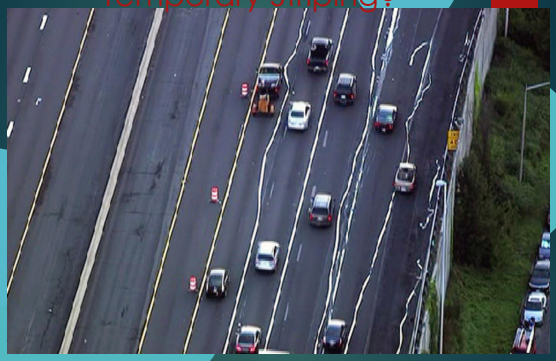
Temporary Striping?



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Section 112.03.11: Corrective Work for Temporary Stripe

- **Unacceptable initial evaluation**
  - Corrective work completed within 24 hours
- **Damaged or missing stripe during the course of the contract**
  - ~~Replace within 3 days~~ Within 24 hours

*Change made to the 2019 spec book

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Section 112.03.11: Temporary Stripe Review Questions

- If the temporary stripe is only expected to be in place for two months, what type of initial evaluation do you need to perform?
- If the temporary stripe is expected to be in place for 6 months, what type of initial evaluation should you perform?

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Section 112.03.11: Temporary Stripe Review Questions

- A temporary stripe has been in place for 90 days but at night the line is barely visible. What minimum values should the line be?
- If the line is below these values, how long does the contractor have to replace the temporary stripe?

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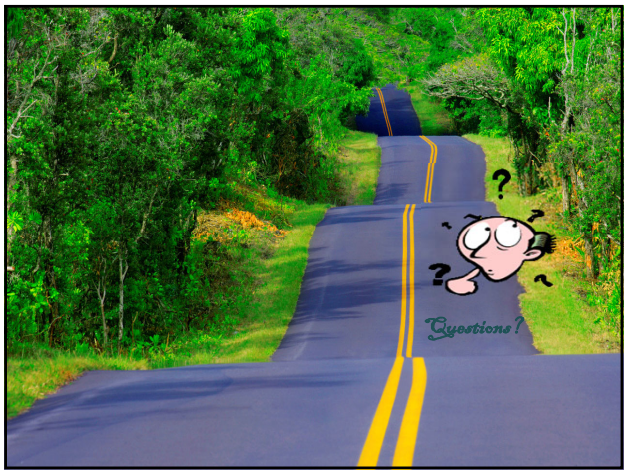

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Standard Specifications

Section 713: Permanent Pavement Striping

Section 714: Durable Pavement Striping

Section 717: Thermoplastic Intersection Markings

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Section 713

Permanent Pavement Marking Paints

On

Resurfacing, Restoration and Rehabilitation Contracts

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Section 713:Perment Striping Materials

- **Waterborne Traffic Paint**
  - Conform to Section 842
- **Durable Waterborne Traffic Paint**
  - Conform to Section 846

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Section 713:Permanent Striping Minimum Application Rates

4" Waterborne Paint – 16.5 gallons/mile

4" Durable Waterborne Paint – 24 gal/mile

6" Waterborne Paint – 24.8 gallons/mile

6" Durable Waterborne Paint – 36 gallons/mile

Glass Beads – 6 pounds/gallon

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Section 713: Permanent Striping 2019 Spec Book Change

- Do not apply pavement marking materials to reflectors
- Provide a maximum gap in the marked line of 18 inches at each marker
- Remove pavement marking material applied to a prismatic reflector surface that same workday. Restore the reflector's brightness to its prior condition.

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Section 713: Permanent Striping 2019 Spec Book Change

On new concrete, remove the curing compound from the pavement surface before applying the pavement marking material

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Section 713:Permanent Striping Proving Period

- **Proving period – facility open to traffic**
- **Readings to be taken 30-60 days after proving period begins**
- **Minimum retroreflectivity requirements**

White: 300 mcd/m²/lux
Yellow: 225 mcd/m²/lux

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Section 713: Permanent Striping Pass/Fail Decisions

- **KM202**
  - 80% of the readings in each segment must pass
- **KM203**
  - 80% of the segments in each section must pass
- **Acceptance with Deduction**
  - Use if all other work is in conformity except retroreflectivity
  - Weather conditions prohibit corrective work
  - Sliding scale

	White
	301
	315
	325
	432
	363
	299
	312
	313
	338
	287
	278
	304
	317
	291
	319
	325
	303
	314
	293
	326
Average	317.75

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Section 713: Permanent Striping Acceptance Pay Schedule

Pay Value	White (mcd/m²/lux)	Yellow (mcd/m²/lux)
1.00	≥ 300	≥ 225
0.50	251 – 299	176 – 224
0.25	226 – 250	151 – 175
0.00	200 – 225	125 – 150
Remove and Replace	< 200	< 125

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Section 713: Permanent Striping Marking Removal

- Use ultra-high pressure water to remove markings
- Markings removal totaling less than 1,000 linear feet may be removed by an abrasive method
- Do not paint markings made in error or not in conformance with asphalt binder or other material
- Do not damage pavement in any way while removing markings and protect all joint seals

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Section 714

Durable Striping

Type I Tape
&
Thermoplastic

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Section 714: Durable Striping Type I Tape

- Use for markings on bridge decks, JPC pavement and JPC intersection
- Do not use thermoplastic on ~~bridge decks~~, JPC pavement and JPC intersections

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Section 714: Durable Striping Type I Tape

- **Materials Requirements (Section 836)**
  - **Manufacturer's Certification**
  - **Must meet the minimum retroreflectivity requirements**
    - White = 500 mcd/m²/lux
    - Yellow = 500 mcd/m²/lux

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Section 714: Durable Striping Proving Period for Type I Tape

- Blistering
- Excessive cracking
- Bleeding
- Staining
- Discoloration
- Oil content from pavement markings
- Chipping
- Spalling
- Loss of Retroreflectivity
- Vehicular damage

- Deterioration due:
  - Grease deposits
  - Oil
  - Diesel fuel
  - Gasoline

- Adequate bonding to the pavement

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Section 714: Durable Striping Nighttime Visual Acceptance

- **Retroreflectivity readings are not necessary if**
  - Material shows no sign of failure
  - Adequately bonded to the pavement
- **Acceptance**
  - Nighttime visual evaluation
  - Manufacturer's certification

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Section 714: Durable Striping
Extruded Thermoplastic

- **Minimum application rate**
  - 90 mil line
- **1 foot gap every 20 feet**

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Section 714: Durable Striping
Equipment Requirements for Thermoplastic

- DO NOT use a spray or ribbon gun applicator
- Extrusion die deposits and shapes lines
- Maintain continuous and uniform heating between 400 and 440°F
- Kettle capable of continuous agitation
- Motorized and capable of applying line at a rate of 3 mph
- Cut off device to provide clean, square ends
- Automated bead dispenser

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Section 714: Durable Striping
Perform Bond Checks

- Check 60 to 120 seconds after application of stripe
- Cut 6 inch strip
- Bonding has successfully occurred if asphalt clings to the removed strip and the pavement surface is shiny and black

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Section 714: Restriction

DO NOT APPLY IF

- **Air and Pavement Temperature < 50^{0}F**

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Section 714: Durable Striping Thermoplastic Proving Period

- **180 Days**
- **Minimum retroreflectivity requirements**
  - White: 300 mcd/m^2/lux
  - Yellow: 225 mcd/m^2/lux
- **Readings taken 150-210 days after the start of the proving period**
  - KM202 – Portable readings (LTL-X)
  - KM203 – Mobile Readings (Mobile Van)

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Section 714: Durable Striping Proving Period for Thermoplastic

- Blistering
- Excessive cracking
- Bleeding
- Staining
- Discoloration
- Oil content from pavement markings
- Smearing or spreading under heat
- Chipping
- Spalling
- Loss of retroreflectivity
- Vehicular damage
- Deterioration due:
  - Grease deposits
  - Oil
  - Diesel fuel
  - Gasoline

- Adequate bonding to the pavement

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Section 714: Durable Striping Acceptance Pay Schedule

Pay Value	White (mcd/m²/lux)	Yellow (mcd/m²/lux)
1.00	≥ 300	≥ 225
0.50	251 – 299	176 – 224
0.25	226 – 250	151 – 175
0.00	200 – 225	125 – 150
Remove and Replace	< 200	< 125

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Section 717

Intersection Markings

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Section 717: Intersection Markings

- **Preformed Thermoplastic**
  - List of approved materials
  - 125 mil minimum thickness
- **Extruded Thermoplastic**
  - **90 mil line**
- **Type I Tape**

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Section 717: Intersection Markings Equipment Requirements

- DO NOT use a spray or ribbon gun applicator
- Extrusion die deposits and shapes lines
- Maintain continuous and uniform heating between 400 and 440^{0}F
- Kettle capable of continuous agitation
- Motorized and capable of applying line at a rate of 3 mph
- Cut off device to provide clean, square ends
- Automated bead dispenser

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Section 717: Intersection Markings Restrictions

- **DO NOT APPLY IF**
  - Air and Pavement Temperature < 50^{0}F

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Section 717: Intersection Markings Proving Period

- **Proving period – 180 days**
- **Minimum retroreflectivity requirements**
  - White = 300 mcd/m^2/lux
  - Yellow = 225 mcd/m^2/lux
- **Take readings 15-45 days after the start of the proving period**
  - Readings taken according to KM201

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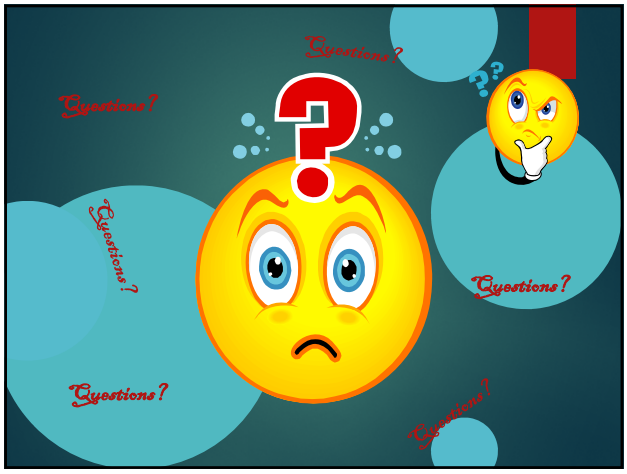
Section 717: Acceptance Pay Schedule for Intersection Markings

Pay Value	White (mcd/m²/lux)	Yellow (mcd/m²/lux)
1.00	≥ 300	≥ 225
0.50	251 – 299	176 – 224
0.25	226 – 250	151 – 175
0.00	200 – 225	125 – 150
Remove and Replace	< 200	< 125

40



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EXCERPT FROM SECTION 112- MAINTENANCE AND CONTROL OF TRAFFIC DURING CONSTRUCTION

112.03.10 Removal of Permanent Pavement Markings. Remove all permanent markings and raised pavement markers that do not conform to the traffic operation in use. Remove striping according to Section 713.03.04. Remove raised pavement markers according to Subsection 403.03.02.

When the marker's casting will conform to the final marking scheme but does not conform to the current traffic operation, the Department may allow lens removal in place of removing the entire marker. Additionally, when weather would prohibit patching for marker removal within 24 hours, the Department may allow lens removal until such time weather permits patching.

112.03.11 Temporary Pavement Markings.

A) **Placement and Removal of Temporary Raised Pavement Markers.** Place and remove temporary raised pavement markers when the Contract specifies. Install temporary pavement markers according to the manufacturer's recommendations. Replace missing or damaged temporary markers within 3 calendar days. After completion of the work, remove the markers from the job site, including the primer and adhesive. Take ownership of the temporary markers at the end of the project.

B) **Placement and Removal of Temporary Striping.** Place temporary striping on new construction, resurfacing, pavement restoration, pavement rehabilitation and other projects that have existing pavement markings as the Contract specifies. On interstates and parkways, and other roadways approved by the State Highway Engineer, install pavement striping that is 6 inches in width. On other routes, install pavement striping that is 4 inches in width. Ensure that all lines have clean edges with a width tolerance of plus 1/2 inch.

Except on new construction or where markings do not exist, prepare and keep a written record, striping log, of the existing pavement markings locations, and furnish a copy to the Engineer at least 15 days prior to removing, covering, or obliterating the markings.

Apply temporary striping when any course of a new pavement is to be driven over by the public, including patching, milling, leveling, and wedging courses, except when existing centerline markings are plainly visible and not obscured. Install the pavement marking material for centerlines and lane lines every day before sunset that day. The Department will defer installation of edgeline markings until all shoulder paving is complete, except on Interstate and Parkway roads or when the Contract specifies otherwise. When rain or other unavoidable occurrences prevent marking before sunset, mark the pavement as soon as conditions permit. Locate no passing zones as the Engineer directs.

1) Removable Striping. Use removable striping tape when different phases of construction will require the relocation of striping to different positions on the same pavement. Relocate lane lines, edgelines, and other pavement markings as the Standard Drawings and the Contract specify. Do not use removable material as a permanent marking unless the Engineer directs.
2) Non-removable striping material. Use either tape or paint where the striping is to be covered by subsequent paving courses and for temporary paved facilities which will be removed before completing the project. Apply paint according to Section 713.

Maintain the following minimum retroreflectivity requirements at all times:

White:	175 mcd/lux/square meter
Yellow:	150 mcd/lux/square meter

Additionally, when temporary striping that is to remain in use for more than 120 days, provide striping with the following minimum initial retroreflectivity readings:

White:	300 mcd/lux/square meter
Yellow:	225 mcd/lux/square meter

The Engineer may visually accept the markings intended for less than 120 days use but may obtain retroreflectivity readings at any time conformance to the minimum retroreflectivity readings are in doubt. When striping that is to remain in use for more than 120 days, the Department will obtain retroreflectivity readings within five days of application of temporary striping using an approved 30 meter geometry handheld or mobile retroreflectometer. The Department will determine acceptance of the temporary striping in accordance with KM-202 or KM-203 as applicable. When the Department determines the striping is not acceptable, complete corrective work within 24 hours.

Maintain all markings throughout the duration of the project. Replace missing or damaged stripes or tape within 24 hours. Remove all markings placed in error or markings that do not conform to the traffic scheme in use within 24 hours. Liquidated damages will be assessed according to 112.03.15.A for any failure to address any striping issue within the times specified above unless a greater damage is specified elsewhere in the contract.

SECTION 713 — PERMANENT PAVEMENT STRIPING

713.01 DESCRIPTION. Furnish and apply waterborne striping paint to provide lane lines, edgelines, and gore markings as specified in the Contract.

713.02 MATERIALS AND EQUIPMENT.

713.02.01 Paint. Conform to Section 842 and Section 846.

713.02.02 Drop On Glass Beads. Use beads that will ensure the pavement marking material will meet retroreflectivity requirements. The Department will evaluate the beads as part of the marking system through retroreflectivity readings.

713.02.03 Application Equipment. Use a self-propelled striper capable of heating the paint to provide uniform flow. Ensure that the striper has a guide boom or optical pointer to attain smooth and straight lines. Ensure that the equipment maintains proper application pressures for paint and beads at all times. Provide equipment capable of applying a single line or parallel lines of the specified width and in any combination of a skip line and a solid line in one pass.

Provide equipment with a paint cutoff device to provide clean, square marking ends of the paint lines.

Equip the paint pots or tanks with an agitator that will keep the paint thoroughly mixed.

Provide equipment with bead dispensers, minimum of one for each paint spray gun, placed such that the beads are applied to the paint almost instantly as the paint is being placed on the roadway surface. Design and align the bead dispensers so that beads are applied under air pressure uniformly to the entire surface of the paint lines. Equip the bead dispensers with cutoff controls synchronized with the cutoff controls for the paint spray guns.

713.03 CONSTRUCTION. Provide yellow centerline markings, which are defined as those separating traffic moving in opposite directions. Provide white lane line markings, which are defined as those separating traffic moving in the same direction. Ensure that these markings are skip lines and solid lines as required by Part 3 of the MUTCD. Ensure that edge lines are solid lines, and determine the color from Part 3 of the MUTCD.

On interstates and parkways, and other routes approved by the State Highway Engineer, install pavement striping that is 6 inches in width. On other routes, install pavement striping that is 4 inches in width. When centerline markings consist of a double yellow line (either a one-direction or two-direction no passing zone marking), the spacing between the two lines shall be the same as the width of one line marking. Ensure that all lines have clean edges with a width tolerance of plus 1/2 inch. The Engineer may waive the tolerances when deviations are caused by undulation in the pavement surface.

Construct skip lines with a stripe-to-gap ratio of a 10-foot paint stripe to a 30-foot gap. Ensure that the length of the stripe is between 10 and 10 1/2 feet. Ensure that the stripe-gap cycle is between 40 and 40 1/2 feet. Offset longitudinal lines at least 2 inches from longitudinal pavement construction joints. Offset longitudinal lane lines on multi-lane highways 2 inches towards the median.

On resurfacing, pavement restoration, and pavement rehabilitation projects, reinstall the recorded existing pavement markings as modified by the Engineer. On new construction, place the markings as the Contract specifies or as the Engineer directs.

Do not apply pavement marking materials to the reflector of a plowable pavement marker. Interrupt the application of the pavement marking line at each pavement marker where marking material would otherwise be applied to the marker's prismatic reflector. Provide a maximum gap in the marked line of 18 inches at each marker. Remove pavement marking material applied to a prismatic reflector surface, or replace the reflector that same workday. If material must be removed from the reflector, restore the reflector's brightness to its prior condition.

713.03.01 Records. On resurfacing, pavement restoration, and pavement rehabilitation projects, prepare and keep a written record of the locations of existing pavement markings, and furnish a copy to the Engineer at least 15 days before removing or obliterating the markings.

713.03.02 Pavement Surface Preparation. Clean grease, oil, mud, dust, dirt, grass, loose gravel, or other deleterious material from the surface where pavement markings are to be applied. On new concrete pavement surfaces, remove the curing compound from the pavement surface before applying the pavement marking material. Use only Engineer approved cleaning methods.

713.03.03 Paint Application. Apply permanent striping to new pavements when the final surface course has been placed and subsequent paving operations will not adversely impact the permanent striping. When subsequent paving operations will adversely impact the permanent striping, apply temporary striping according to Section 112.03.11 and apply the permanent striping as soon as conditions permit. Apply striping before sunset on new pavement that is to be driven over by the public.

Comply with the following application rates.

Material	Paint Application Rate	Glass Bead Application Rate
4 inch waterborne paint	Min. of 16.5 gallons/mile	Min. of 6 pounds/gallon
4 inch durable waterborne paint	Min. 24 gal/mile	Min. of 6 pounds/gallon
6 in waterborne paint	Min. of 24.8 gallons/mile	Min. of 6 pounds/gallon
6 inch durable waterborne paint	Min. of 36 gallons/mile	Min. of 6 pounds/gallon

713.03.04 Marking Removal. Remove all markings made in error or not conforming to the traffic operation in use. Do not paint with asphalt binder or other material to obliterate the markings. Remove pavement striping, temporary or permanent, from asphalt or concrete pavement using ultra-high pressure water. Marking removal totaling 1,000 linear feet or less may be removed by an abrasive method to the satisfaction of the Engineer. Vacuum all marking material and removal debris concurrently with the marking removal operation.

Do not damage the pavement in any way and protect all joint seals. If damage is observed, stop the removal process until the operation can provide an acceptable marking removal. Repair any damage to the pavement as a result of the marking removal. Removal of marking will not be measured for payment.

Waterblast to remove temporary or permanent striping completely as the Engineer directs.

713.03.05 Proving Period. A proving period will follow the application of the permanent pavement striping. During this period, the Engineer will make such observations as are necessary to determine if the markings are acceptable. The proving period begins when the facility is opened to traffic.

A) Requirements. The minimum retroreflectivity requirements at the end of the proving period, as measured with a Department approved 30 meter geometry handheld or mobile retroreflectometer, are as follows:

White: 300 mcd/lux/square meter
Yellow: 225 mcd/lux/square meter

The Department will take these measurements between 30 and 60 days after the start of the proving period, with acceptance based on KM 202 or KM 203 as

applicable. If the Department determines that the markings are acceptable, the installation of the markings will be considered complete.

B) Failure. For any one-mile section and each gore area during the proving period, the Department will consider the section defective when the retroreflectivity falls below the minimum required. The Department will consider each edge line, centerline, lane line and gore area marking separately.

C) Corrective Work. If a line is found to be defective, repair or remove and replace the line. Perform pavement marking replacement according to the requirements specified in this subsection for the initial application. The corrective work will be subject to a proving period as listed above.

713.03.06 Acceptance of Non-Specification Markings. If weather conditions allow, perform corrective work to bring striping retroreflectivity into conformance. If corrective work has been performed and the work meets all requirements except for minimum retroreflectivity, the Department may accept the work according to Subsection 105.04. When the Engineer determines that the markings may be left in place, the Department will accept them at a reduction in the Contract unit bid price according to the Acceptance Pay Schedule. Additionally, the Engineer may remove the striping crew for the remainder of the project according to Subsection 108.06 Part A).

The Engineer may also apply this section when corrective work cannot be performed due to weather.

ACCEPTANCE PAY SCHEDULE FOR PERMANENT STRIPING		
Pay Value	White mcd/lux/square meter	Yellow mcd/lux/square meter
1.00	≥300	≥225
0.50	251-299	176-224
0.25	226-250	151-175
0.00	200-225	125-150
Remove and Replace	< 200	< 125

713.04 MEASUREMENT.

713.04.01 Pavement Striping. The Department will measure the quantity in linear feet. When a bid item is not included for gore markings, the Department will measure the quantity by converting the actual length and width of line installed to an equivalent length of the normal width line on that section of roadway. The Department will measure temporary striping according to 112.04.07 when subsequent paving operations will adversely impact the permanent striping.

713.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
06514-06517	Pavement Striping - Permanent Paint, Width	Linear Foot
24189ER	Durable Waterborne Marking – 6 IN W	Linear Foot
24190ER	Durable Waterborne Marking – 6 IN Y	Linear Foot
24191ER	Durable Waterborne Marking – 12 IN W	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 714 — DURABLE PAVEMENT STRIPING

714.01 DESCRIPTION. Furnish and install durable marking materials, thermoplastic or Type I tape, to provide lane lines, edgelines, and gore markings as specified in the Contract.

714.02 MATERIALS AND EQUIPMENT.

714.02.01 Thermoplastic. Conform to Section 837.

714.02.02 Type I Tape. Conform to Section 836.

714.02.03 Binder. Furnish a binder that the manufacturer of the pavement marking material recommends and the Engineer approves. Provide a binder that forms a continuous film that dries rapidly and adheres to the pavement. Provide a material that does not discolor or cause any noticeable change in the appearance of the pavement outside of the finished pavement marking. Submit the material and method of application to the Engineer and obtain written approval from the Engineer and the manufacturer of the pavement marking material before applying.

714.02.04 Drop On Glass Beads. Use beads that will ensure the pavement marking material will meet retroreflectivity requirements. The Department will evaluate the beads as part of the marking system through retroreflectivity readings.

714.02.05 Thermoplastic Application Equipment. Provide equipment with an extrusion die that simultaneously deposits and shapes lines at a minimum thickness of 90 mils on the pavement surface. Do not use spray and ribbon gun applicators.

Ensure the application equipment conforms to the following:

1) Capable of providing continuous and uniform heat to maintain the material between 400 and 440 °F throughout the mixing, conveying, and dispensing.
2) The kettle is capable of continuous agitation during mixing and heated storage and is equipped with an automatic thermostat control device and material thermometer.
3) Motorized and capable of applying a uniform line at a rate of 3 mph.
4) Equipped with a cutoff device that provides clean, square stripe ends.
5) Equipped with an automatic bead dispenser.

714.03 CONSTRUCTION. Provide yellow centerline markings, which are defined as those separating traffic moving in opposite directions. Provide white lane line markings, which are defined as those separating traffic moving in the same direction. Ensure that these markings are skip lines and solid lines as required by Part 3 of the MUTCD. Ensure that edge lines are solid lines, and determine the color from Part 3 of the MUTCD.

Install pavement striping at the width specified in the Contract. Ensure that all lines have clean edges with a width tolerance of plus 1/2 inch. The Engineer may waive the tolerances when deviations are caused by undulation in the pavement surface.

Construct skip lines with a stripe-to-gap ratio of a 10-foot stripe to a 30-foot gap. Ensure that the length of the stripe is between 10 and 10.5 feet. Ensure that the stripe-gap cycle is between 40 and 40.5 feet.

Use Type I Tape for markings on bridge decks, JPC pavement and JPC intersections. Do not use thermoplastic materials on JPC pavement and JPC intersections.

714.03.01 Layout. Install all pavement markings according to Part 3 of the MUTCD and the following requirements.

Make the width of lane lines and edgelines as specified in the Plans or as the Engineer directs. Make lines for gore area markings twice the normal width line for that section of roadway.

Unless striping plans are included in the proposal or otherwise directed by the Engineer, install gore area markings as shown in Figures 3B-8 and 3B-9 of the MUTCD. Do not use the optional markings shown (transverse lines in the neutral area and dotted extension of the right edgeline).

Due to the possibility that water may be retained on the roadway by the thermoplastic edgelines, place a one foot gap every 20 feet in all thermoplastic edgelines. Do not install gaps for taped edgelines.

Offset longitudinal lines at least 2 inches from longitudinal pavement construction joints. Offset longitudinal lane lines on multi-lane highways 2 inches towards the median.

On resurfacing, pavement restoration, and pavement rehabilitation projects, prepare and keep a written record of the locations of existing pavement markings, and furnish a copy to the Engineer at least 15 days before removing or obliterating the markings. The Engineer will notify you of any changes to the existing markings.

Before applying the pavement marking material, pre-mark the pavement surface and obtain the Engineer's approval of the proposed location, alignment, and control guides.

714.03.02 Surface Preparation.

1) Remove existing pavement markings and clean grease, oil, mud, dust, dirt, grass, loose gravel, or other deleterious material from the surface where pavement markings are to be applied, as directed by, and by methods acceptable to, the Engineer.
2) Remove the existing pavement markings until a minimum of 90 percent of the pavement surface is uniformly exposed throughout. Ensure that the pavement surface is in proper condition for successful bonding of the pavement markings and provides a neat appearance. Do not leave any loose or flaking existing pavement markings.
3) When removing the existing pavement markings, ensure that the finished pavement surface is not damaged or left in a condition that may mislead or misdirect the motorist. Repair any damage to the pavement, pavement joint materials, or the pavement surface caused by the removal of the existing pavement markings in a manner acceptable to the Engineer. After completing these operations, use compressed air to blow clean the pavement surface of residue and debris resulting from the removal of existing pavement markings.
4) When removal of existing pavement markings and objectionable materials obscures existing pavement markings of a lane occupied by public traffic, immediately remove the residue, including dust, from the surface being treated. Obtain the Engineer's approval of the removal methods.
5) Place the final pavement markings on the same day that the existing pavement markings are removed.
6) On concrete surfaces and as the Engineer directs on older asphalt pavements, apply binder to the area where placing pavement marking material.
7) On new concrete pavement surfaces, remove the curing compound from the pavement surface before applying the binder and the pavement marking material.

714.03.03 Application.

A) Type I Tape. Apply according to the manufacturer's recommendations. When applied to concrete, cut the tape at all joints.

B) Thermoplastic. Rather than installing thermoplastic pavement markings on fresh asphalt, the Department will allow temporary striping with paint. Temporary striping is incidental to the permanent marking. The Department will not require removal of the interim pavement marking paint, as referenced in 714.03.02, before applying the thermoplastic pavement markings when completed within 30 calendar days of placement of the interim pavement markings.

Install the thermoplastic material at a minimum thickness of 90 mils on the pavement surface in a melted state at a temperature from 400 and 440 °F.

Apply additional glass beads by drop-on or pressure spray methods in sufficient quantities to obtain the retroreflectivity requirements specified in Subsection 714.03.06.

Verify the adhesion of the thermoplastic to asphalt pavements by performing bond checks, at least 4 per mile of line, as follows. Approximately 60 to 120 seconds after applying a thermoplastic line to the roadway surface, cut and lift approximately a 6-inch section of thermoplastic. The thermoplastic is successfully bonding to the pavement surface if a layer of asphalt clings to the removed thermoplastic stripe and the pavement surface under the removed stripe is shiny and black.

Provide finished markings that are continuous and uniform in shape, having clear and sharp dimensions. Ensure that all lines have well-defined edges.

714.03.04 Restrictions. Do not apply the pavement marking material when air and pavement temperatures are below 50 °F.

Do not apply the pavement marking material when the surface of the pavement contains evidence of moisture in amounts significant enough to prevent the pavement marking material from bonding to the pavement. Significant amounts of moisture can be caused by heavy dew or very humid nights as well as from rainfall.

If encountering significant amounts of moisture while applying the thermoplastic, the Contractor, at his own risk, may attempt to apply thermoplastic subject to the following restrictions. Heat the thermoplastic material to the upper temperature limit specified by the manufacturer, and apply a test line on the pavement. Perform a bond check according to Subsection 714.03.03. If the thermoplastic successfully bonds to the pavement continue to apply thermoplastic lines, provided there is evidence that the moisture is escaping through the surface of the line, as indicated by very small pin holes. If there is excessive moisture, as indicated by larger sized holes or bubbles on the surface of the line, do not apply thermoplastic until the moisture can be effectively dealt with. Perform a sufficient number of bond checks to ensure that the thermoplastic is bonding to the pavement.

714.03.05 Project Conflicts. When other construction projects are in progress within the limits of the designated work areas, install no pavement markings that will be removed or damaged by immediate subsequent construction. The Engineer will give notification of all conflicting construction projects. Schedule the installation of pavement markings after completion of the conflicting construction. When scheduling is impossible or creates an undue hardship, the Engineer will delete the intersection from this project.

714.03.06 Proving Period for Durable Markings. A 180 day proving period will follow the application of the durable markings. During this period, the Engineer will make such observations as are necessary to determine if the markings are acceptable. The proving period begins when the facility is opened to traffic.

A) Requirements.

1) Type I Tape. During the proving period, ensure that the pavement marking material shows no signs of failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, chipping, spalling, poor adhesion to the pavement, loss of retroreflectivity, vehicular damage, and normal wear. Type I Tape is manufactured off site and warranted by the manufacturer to meet certain retroreflective requirements. As long as the material is adequately bonded to the surface and shows no sign of failure due to the other items listed in Subsection 714.03.06 A) 1), retroreflectivity readings will not be required. In the absence of readings, the Department will accept tape based on a nighttime visual observation.

2) Thermoplastic. During the proving period, ensure that the thermoplastic pavement marking material shows no signs of failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, smearing or spreading under heat, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, chipping, spalling, poor adhesion to the pavement materials, loss of retroreflectivity, vehicular damage and normal wear.

The minimum retroreflectivity requirements at the end of the proving period, as measured with a Department approved 30 meter geometry handheld or mobile retroreflectometer, are as follows:

White:	300 mcd/lux/square meter
Yellow:	225 mcd/lux/square meter

The Department will take these measurements between 150 and 210 days after the start of the proving period, with acceptance based on KM 202 or KM 203 as applicable. If the Department determines that the markings are acceptable, the installation of the markings will be considered complete.

B) Failure. During the proving period, the Department will consider markings defective when the retroreflectivity falls below the minimum required or the material fails to meet the other requirements of A) above. Additionally, when more than 10 percent of any one-mile section or individual gore area is defective, the Department will consider the entire section defective. The Department will consider each edge line, centerline, lane line and gore area marking separately.

C) Corrective Work. If a line is found to be defective, repair or remove and replace the line. Perform pavement marking replacement according to the requirements specified in this subsection for the initial application. The corrective work will be subject to a proving period as listed above.

714.03.07 Marking Removal. Remove all markings made in error or not conforming to the traffic operation in use. Do not paint with asphalt binder or other material to obliterate the markings. Remove pavement striping, temporary or permanent, from asphalt or concrete pavement using ultra-high pressure water. Marking removal totaling 1,000 linear feet or less may be removed by an abrasive method to the satisfaction of the Engineer. Vacuum all marking material and removal debris concurrently with the marking removal operation.

Do not damage the pavement in any way and protect all joint seals. If damage is observed, stop the removal process until the operation can provide an acceptable marking removal. Repair any damage to the pavement as a result of the marking removal. Removal of marking will not be measured for payment.

714.03.08 Acceptance of Non-Specification Thermoplastic Markings. When reasonably acceptable work has been produced but retroreflectivity requirements are not met, the Department may accept the work according to Subsection 105.04. When the Engineer determines that the markings may be left in place, the Department will accept them at a reduction in the Contract unit bid price according to Acceptance Pay Schedule for Thermoplastic.

714.04 MEASUREMENT. When a bid item is not included for gore markings, the Department will measure the quantity by converting the actual length and width of line installed to an equivalent length of the normal width line on that section of roadway.

714.04.01 Thermoplastic Pavement Markings. The Department will measure for payment by the units listed in the Quantity Summary. The Department will not measure sampling, testing, surface preparation, pre-marking, interim marking, and binder application for payment and will consider them incidental to the thermoplastic bid items. The Department will not measure corrective work for payment.

714.04.02 Durable Pavement Markings, Type I. The Department will measure for payment by the units listed in the Quantity Summary. The Department will not measure sampling, testing, surface preparation, pre-marking, and binder application for payment and will consider them incidental to the pavement marking bid items. Corrective work will not be measured for payment.

714.04.03 Pavement Striping Removal. When listed as a bid item, the Department will measure for payment by the units listed in the Quantity Summary. The Department will not measure for payment the removal of existing pavement markings that have not been authorized by the Engineer. When the Contract does not list a bid item, the Department will consider existing pavement marking removal incidental to the other pavement marking bid items. The Department will not measure for payment any corrective work required due to the removal work.

714.05 PAYMENT. The Department will make payment upon completion of the work. If after the proving period the markings do not meet minimum retroreflectivity requirements, the Department will adjust the payment or require corrective work according to the following:

ACCEPTANCE PAY SCHEDULE FOR THERMOPLASTIC		
Pay Value	White mcd/lux/square meter	Yellow mcd/lux/square meter
1.00	≥300	≥225
0.50	251-299	176-224
0.25	226-250	151-175
0.00	200-225	125-150
Remove and Replace	< 200	< 125

Code	Pay Item	Pay Unit
06540-06547	Pavement Striping - Thermoplastic, width, color	Linear Foot
06554-06561	Pavement Striping - Durable Type I Tape, width, color	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 717 — INTERSECTION MARKINGS

717.01 DESCRIPTION. Furnish and install thermoplastic or Type I tape intersection markings (Stop Bars, Crosswalks, Turn Arrows, etc.) by either a machine applied, screed extrusion process or by applying preformed thermoplastic intersection marking material.

717.02 MATERIALS AND EQUIPMENT.

717.02.01 Preformed Thermoplastic Intersection Marking Material. Select from the Department's List of Approved Materials.

717.02.02 Extruded Thermoplastic Pavement Marking Material. Conform to Section 837.

717.02.03 Binder. Conform to Subsection 714.02.03

717.02.04 Drop On Glass Beads. Use beads that will ensure the pavement marking material will meet retroreflectivity requirements. The Department will evaluate the beads as part of the marking system through retroreflectivity readings.

717.02.05 Extruded Thermoplastic Application Equipment. Provide equipment with a shaping die that simultaneously deposits and shapes lines at a minimum thickness of 90 mils on the pavement surface. Do not use spray and ribbon gun applicators.

Ensure the application equipment conforms to the following:

1) Capable of providing continuous and uniform heat to maintain the material between 400 and 440 °F throughout the mixing, conveying, and dispensing.
2) The kettle is capable of continuous agitation during mixing and heated storage and is equipped with an automatic thermostat control device and material thermometer.
3) Equipped with a cutoff device that provides clean, square stripe ends.
4) Equipped with an automatic bead dispenser.

717.02.06 Type I Tape. Conform to Section 836.

717.03 CONSTRUCTION.

717.03.01 Layout. On resurfacing, pavement restoration, and pavement rehabilitation projects, prepare and keep a written record of the locations of existing pavement markings, and furnish a copy to the Engineer at least 15 days before removing or obliterating the markings. The Engineer will notify you of any changes to the existing markings.

On new construction, the Department will provide more detailed information for each intersection prior to beginning work. This information will consist of plans, a drawing of each intersection, or an inspector to work with each crew to layout the markings in the field.

Before applying the pavement marking material, pre-mark the pavement surface and obtain the Engineer's approval of the proposed location, alignment, and control guides.

717.03.02 Surface Preparation. Clean all grease, oil, mud, dust, dirt, grass, loose gravel, or other deleterious material from the surface where pavement markings are to be applied as directed by, and by methods acceptable to, the Engineer.

On concrete surfaces and as the Engineer directs on older asphalt pavements, apply binder to the area where placing pavement marking material. Ensure that all solvents have evaporated from the binder before applying the marking material. On new concrete pavement surfaces, remove the curing compound from the pavement surface before applying the binder and the pavement marking material.

717.03.03 Application.

A) Thermoplastic. Install extruded thermoplastic at a minimum thickness of 90 mils on the pavement surface in a melted state at a temperature from 400 and 440 °F. Install preformed thermoplastic according to manufacturer's instructions at a minimum thickness of 125 mils. Apply additional glass beads by a drop-on method at a rate that satisfies the retroreflectivity requirements of Subsection 717.03.05.

When installing symbols and legends (turn arrows, the word "ONLY" etc.) by the extrusion process, ensure that the finished markings conform to the standard size and shape in the Manual on Uniform Traffic Control Devices.

Verify the adhesion of the thermoplastic to asphalt pavements by performing bond checks as follows. Approximately 60 to 120 seconds after applying the thermoplastic material cut and lift approximately a 6-inch section. The thermoplastic is successfully bonding to the pavement surface if a layer of asphalt clings to the removed thermoplastic and the pavement surface under the removed section is shiny and black.

Ensure that finished markings are continuous and uniform in shape having clear and sharp edges with uniform bead distribution across the entire width and length of the line, symbol, or legend.

B) Type I Tape. Apply according to the manufacturer's recommendations. Cut all tape at pavement joints when applied to concrete surfaces.

717.03.04 Restrictions. Do not apply the pavement marking material when air and pavement temperatures are below 50 °F.

Do not apply the pavement marking material when the surface of the pavement contains evidence of moisture in amounts significant enough to prevent the pavement marking material from bonding to the pavement. Significant amounts of moisture can be caused by heavy dew or very humid nights as well as from rainfall.

If encountering significant amounts of moisture while applying the thermoplastic, the Contractor, at his own risk, may attempt to apply the thermoplastic material subject to the following restrictions. Heat the thermoplastic material to the upper temperature limit specified by the manufacturer, and apply a test line on the pavement. Perform a bond check according to Subsection 717.03.03. If the thermoplastic successfully bonds to the pavement continue to apply thermoplastic material, provided there is evidence that the moisture is escaping through the surface of the material, as indicated by very small pinholes. If there is excessive moisture, as indicated by larger sized holes or bubbles on the surface of the material, do not apply thermoplastic until the moisture can be effectively dealt with. Perform a sufficient number of bond checks to ensure that the thermoplastic is bonding to the pavement.

717.03.05 Proving Period. A proving period of 180 days will follow the application of the durable markings. During this period, the Engineer will make such observations as are necessary to determine if the markings are acceptable. The proving period begins when the facility is opened to traffic.

A) Requirements.

1) Thermoplastic. During the proving period, ensure that the material shows no signs of failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, smearing or spreading under heat, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, chipping, spalling, poor adhesion to the pavement materials, loss of retroreflectivity, vehicular damage and normal wear.

The minimum retroreflectivity requirements at the end of the proving period, as measured with a Department approved 30 meter geometry handheld retroreflectometer, are as follows:

White: 300 mcd/lux/square meter
Yellow: 225 mcd/lux/square meter

The Department will take these measurements between 15 and 45 days after the start of the proving period, with acceptance based on KM 201. If the Department determines that the markings are acceptable, the installation of the markings will be considered complete.

2) **Type I Tape.** During the proving period, ensure that the pavement marking material shows no signs of failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, drippings, chipping, spalling, poor adhesion to the pavement, loss of retroreflectivity, vehicular damage, and normal wear. Type I Tape is manufactured off site and warranted by the manufacturer to meet certain retroreflective requirements. As long as the material is adequately bonded to the surface and shows no signs of failure due to the other items listed in Subsection 714.03.06 A) 1), retroreflectivity readings will not be required. In the absence of readings, the Department will accept tape based on a nighttime visual observation.

B) Failure. The Department will consider any marking defective when the readings for that marking do not satisfy the retroreflectivity requirements or more than 10 percent of the material fails to meet the other requirements of A) above. The Department will consider each marking separately.

C) Corrective Work. If any marking is found to be defective, repair or remove and replace the marking. Perform pavement marking replacement according to the requirements specified in this subsection for the initial application. The corrective work will be subject to a proving period as listed above.

717.03.06 Marking Removal. Remove all markings made in error or not conforming to the traffic operation in use. Remove markings by water blasting process to the satisfaction of the Engineer. Vacuum all marking material and removal debris concurrently with the removal operation. Do not paint with asphalt binder or other material to obliterate the markings.

A) Waterblast Stripe Removal. Conform to subsection 713.03.04.

717.03.07 Acceptance of Non-Specification Markings. When reasonably acceptable work has been produced but retroreflectivity requirements are not met, the Department may accept the work according to Subsection 105.04. When the Engineer determines that the markings may be left in place, the Department will accept them at a reduction in the Contract unit bid price according to Acceptance Pay Schedule for Thermoplastic. The Department will not consider these procedures a means to continue accepting non-specification markings.

717.04 MEASUREMENT. The Department will measure the intersection markings on a per unit basis for items listed in the Quantity Summary.

The Department will not measure the removal of existing markings, layout, surface preparation, binder, glass beads, or testing for payment and will consider them incidental to the installation of the new marking. The Department will exclude the gaps when measuring dotted lane line extensions.

717.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

ACCEPTANCE PAY SCHEDULE FOR THERMOPLASTIC		
Pay Value	White mcd/lux/square meter	Yellow mcd/lux/square meter
1.00	≥300	≥225
0.50	251-299	176-224
0.25	226-250	151-175
0.00	200-225	125-150
Remove and Replace	< 200	< 125

Code	Pay Item	Pay Unit
06565, 06566	Pavement Marking, Thermoplastic X-Walk, Size	Linear Foot
06567, 06568	Pavement Marking, Thermoplastic Stop Bar, Size	Linear Foot
06569	Pavement Marking, Thermoplastic Cross Hatch	Square Foot
06572	Pavement Marking, Dotted Lane Extension	Linear Foot
06573-06575, 06578	Pavement Marking, Thermoplastic Arrow, Type	Each
06576	Pavement Marking, Thermoplastic "ONLY"	Each
06577	Pavement Marking, Thermoplastic "SCHOOL"	Each
06563	Pave Marking – R/R X Bucks 16 IN	Linear Foot
20782NS714	Pave Marking Thermo – Bike	Each
23251ES717	Pave Mark TY I Tape X-Walk, Size	Linear Foot
23264ES717		
23252ES717	Pave Mark TY I Tape Stop Bar, Size	Linear Foot
23265ES717		
23253ES717	Pave Mark TY I Tape Cross Hatch	Square Foot
23254ES717	Pave Mark TY I Tape Dotted Lane Extension	Linear Foot
23255ES717	Pave Mark TY I Tape Arrow, Type	Each
23268ES717-23270ES717		
23256ES717	Pave Mark TY I Tape- ONLY	Each
23257ES717	Pave Mark TY I Tape- SCHOOL	Each
23266ES717	Pave Mark TY 1 Tape R/R X Bucks-16 IN	Linear Foot
23267ES717	Pave Mark TY 1 Tape-Bike	Each

The Department will consider payment as full compensation for all work required under this section.

PART 3
MARKINGS

CHAPTER 3A. GENERAL

Section 3A.01 Standardization of Application

Support:

01 Markings are used to supplement other traffic control devices such as signs, signals, and other markings. In other instances, markings are used alone to effectively convey regulations, warnings, or guidance in ways not obtainable by the use of other devices.

02 Markings can take many forms including road surface markings, curb markings, delineators, colored pavements, and channelizing devices.

Standard:

03 **Each standard marking shall be used only to convey the meaning prescribed for that marking in this Manual, including when used for applications not described in this Manual.**

04 **Except as provided in Chapter 3H, markings that must be visible at night shall be retroreflective unless the markings are adequately visible under street or highway lighting. All markings on Interstate highways shall be retroreflective.**

05 **Markings that are no longer applicable for roadway conditions or restrictions and that might cause confusion for the road user shall be removed or obliterated to be unidentifiable as a marking as soon as practicable.**

Option:

06 Until they can be removed or obliterated, markings that are no longer applicable for roadway conditions or restrictions may be temporarily masked with non-reflective, preformed tape that is approximately the same color as the pavement surface.

Section 3A.02 Materials

Guidance:

01 *The materials used for markings should provide the specified color throughout their useful life.*

02 *Consideration should be given to selecting pavement marking materials that will minimize tripping or loss of traction for road users, including pedestrians, bicyclists, and motorcyclists.*

Option:

03 Marking systems that consist of clumps or droplets of material with visible open spaces of bare pavement between the material droplets, which can function in a manner that is similar to the marking systems that completely cover the pavement surface, may be used as pavement markings if they meet the other pavement marking requirements of the highway agency.

Section 3A.03 Colors

Standard:

01 **Markings shall be yellow, white, red, blue, or purple. The colors for markings shall conform to the standard highway colors.**

Option:

02 Black markings may be used in combination with the colors mentioned in Paragraph 1 of this Section to enhance the contrast with a light-colored pavement.

Standard:

03 **When used, yellow markings for longitudinal lines shall delineate:**

- **A. The separation of traffic traveling in opposite directions,**
- **B. The left-hand edge of the roadways of divided highways and one-way streets or ramps, or**
- **C. The separation of two-way left-turn lanes and reversible lanes from other lanes.**

04 **When used, white markings for longitudinal lines shall delineate:**

- **A. The separation of traffic flows in the same direction,**
- **B. The right-hand edge of the roadway, or**
- **C. Both the right-hand edge and left-hand edge of a reversible roadway.**

05 **When used, red raised pavement markers or delineators shall delineate:**

A. Truck escape ramps, or
B. One-way roadways, ramps, or travel lanes that shall not be entered or used in the direction from which the markers are visible.

06 **When used, blue markings shall supplement white markings for parking spaces for persons with disabilities.**

07 **When used, purple markings shall be in accordance with the provisions of Chapter 3F to identify toll plaza approach lanes restricted to use only by vehicles with registered electronic toll collection accounts.**

08 **When pavement markings that simulate route signs are used (see Section 3B.22), the colors shall be the same as those that are used for the route signs (see Section 2D.11).**

Support:

09 Provisions regarding colored pavements are contained in Chapter 3H.

Section 3A.04 Functions, Widths, and Patterns of Longitudinal Pavement Markings

Standard:

01 **The general functions of longitudinal lines shall be as follows:**

A. A double line indicates maximum or special restrictions.
B. A solid line discourages or prohibits crossing (depending on the specific application).
C. A broken line indicates a permissive condition.
D. A dotted lane line provides warning of a downstream change in lane function.
E. A dotted line used as a lane line or edge line extension guides vehicles through an intersection, a taper area, or an interchange ramp area.

02 **The widths and patterns of longitudinal lines shall be as follows:**

A. Normal line—4 to 6 inches wide.
B. Wide line—at least twice the width of a normal line.
C. Double line—two parallel lines separated by a discernible space. The pavement surface shall be visible between the lines in the same way that it is visible outside the lines, except where contrast markings are used in combination with the double line (see Section 3A.03).
D. Broken line—normal width line segments separated by gaps.
E. Dotted line—noticeably shorter line segments separated by shorter gaps than used for a broken line. The width of a dotted line extension shall be at least the same as the width of the line it extends.

Guidance:

03 *To be recognized as a double line rather than two separate, disassociated single lines, the discernible space separating the parallel lines of a double line should not exceed two times the line width of a single line.*

Support:

04 The width of the line indicates the degree of emphasis.

05 Increasing edge line width from 4 inches to 6 inches has been shown to be a beneficial countermeasure to enhance safety at locations with a history of run-off-the-road crashes (see Section 3B.09). Wider normal lines with a 6-inch width instead of the minimum 4-inch width can be beneficial to both human drivers and driving automation systems (see Section 5B.02).

Guidance:

06 *Broken lines should consist of 10-foot line segments and 30-foot gaps, or dimensions in a similar ratio of line segments to gaps as appropriate for traffic speeds and the need for delineation.*

07 *A dotted line used as a lane line (see Section 3B.07) should consist of 3-foot line segments and 9-foot gaps. A dotted line for line extensions within an intersection, taper area, or interchange ramp area (see Section 3B.11) should consist of 2-foot line segments and 2-foot to 6-foot gaps.*

Support:

08 Section 5B.02 contains information on pavement marking considerations for driving automation systems.

Section 3A.05 Maintaining Minimum Pavement Marking Retroreflectivity

Standard:

01 **Except as provided in Paragraph 5 of this Section, a method designed to maintain retroreflectivity at or above 50 mcd/m^2/lx under dry conditions shall be used for longitudinal markings on roadways with speed limits of 35 mph or greater.**

Guidance:

02 *Except as provided in Paragraph 5 of this Section, a method designed to maintain retroreflectivity at or above 100 mcd/m^2/lx under dry conditions should be used for longitudinal markings on roadways with speed limits of 70 mph or greater.*

03 *The method used to maintain retroreflectivity should be one or more of those described in "Methods for Maintaining Pavement Marking Retroreflectivity" (FHWA-SA-22-028), 2022 Edition, FHWA or developed from an engineering study based on the values in Paragraphs 1 and 2 of this Section.*

Support:

04 Retroreflectivity levels for pavement markings are measured with an entrance angle of 88.76 degrees and an observation angle of 1.05 degrees. This geometry is also referred to as 30-meter geometry. The units of pavement marking retroreflectivity are reported in mcd/m^2/lx, which means millicandelas per square meter per lux.

Option:

05 The following markings may be excluded from the provisions established in Paragraphs 1 and 2 of this Section:

A. Markings where ambient illumination assures that the markings are adequately visible;
B. Markings on streets or highways that have an ADT of less than 6,000 vehicles per day;
C. Dotted extension lines that extend a longitudinal line through an intersection, major driveway, or interchange area (see Section 3B.11);
D. Curb markings;
E. Parking space markings; and
F. Shared-use path markings.

Support:

06 The provisions of this Section do not apply to non-longitudinal pavement markings including, but not limited to, the following:

A. Transverse markings;
B. Word, symbol, and arrow markings;
C. Crosswalk markings; and
D. Chevron, diagonal, and crosshatch markings.

07 Special circumstances will periodically cause pavement marking retroreflectivity to be below the minimum levels. These circumstances include, but are not limited to, the following:

A. Isolated locations of abnormal degradation;
B. Periods preceding imminent resurfacing or reconstruction;
C. Unanticipated events such as equipment breakdowns, material shortages, and contracting problems; and
D. Loss of retroreflectivity resulting from snow maintenance operations.

08 When such circumstances occur, compliance with Paragraphs 1 and 2 of this Section is still considered to be achieved if a reasonable course of action is taken to resume maintenance of minimum retroreflectivity in a timely manner according to the maintaining agency's method(s), policies, and procedures.

DISTRICT WIDE STRIPING CONTRACTS

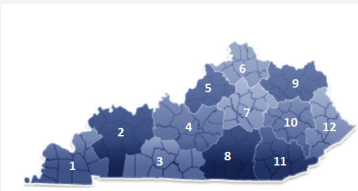
DISTRICT WIDE STRIPING

WATERBORNE TRAFFIC PAINT

1

DISTRICT WIDE STRIPING

Maintenance striping – one contractor stripes routes for the entire district as specified in the pre-construction meeting



2

DISTRICT WIDE STRIPING TOPICS

- Marking Removal
- Application of Striping
- Equipment and Surface Preparation
- Scheduling
- Dispute Resolution
- Retroreflectivity Requirements
- Measurement and Payment
- Quality Control/ Quality Assurance

3

EQUIPMENT AND SURFACE PREPARATION

- **Electrical counter**
  - Tabulate the amount of footage applied by each striping gun
- **Data logger system – recorded in 1 mile increments**
  - Gallons of paint per mile
  - Average wet film thickness
  - Pounds of beads per gallon of paint
  - Ambient temperature
  - Pavement temperature
  - Paint temperature
  - Store the calibration parameters
  - Remote cab mounted display indicating parameters in real time

4

EQUIPMENT AND SURFACE PREPARATION

- Data Access
  - Provide access to stored data on a secure password protected website
- Contractor should provide KYTC inspector the same form of direct communication with the paint striping crew as that used by the paint striping crew (CB Radio, 2-Way Radio, etc.)
  - Items will be returned to the Contractor upon completion of the contract

5

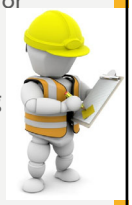
EQUIPMENT AND SURFACE PREPARATION

- **Sweeping Unit**
  - Remove dirt and debris
  - Shall not be a part of the striper
  - Broom must maintain contact with the roadway

6

EQUIPMENT AND SURFACE PREPARATION

- KM 64-267
  - Stripers available at a central location for inspection
  - Stripers pre-approved prior to striping
  - Random field verifications



7

QC/QA REQUIREMENTS

- **Quality Control Coordinator (QCC)**
  - Designated by the contractor
  - Performs Quality Control (QC) Inspection
- **Quality Control Plan (QCP)**
  - Furnished and approved prior to the start of work
- **Quality Assurance Inspector (QA)**
  - Designated by the state
  - Performs QA Inspection

8

QCC COORDINATOR

- Hold qualification as a Pavement Marking Inspection Technician
- Oversee contractor's evaluation of applied lines
- Notify Engineer of changes to the striping application process
- Submit Daily Striping Reports to Engineer the next calendar day

9

QCC COORDINATOR CONT.

Ensure the Data Logger System (DLS) manufacturer makes available to the Engineer electronic DLS raw data from the secure server at any time.

"Provide GPS mapping system that is capable of real time (within 20 minutes) tracking of material application rates, film thickness, beads pounds per gallon, vehicle speed time, date, project numbers, operator manual data, and color coded alarms for film thickness. Film thickness must have a tolerance of ±0.5mils."

10

QCC COORDINATOR (CONT.)

- Inform/mobilize crews to complete restriping or corrective work
- Supply certifications at the time of sampling
- Track quantities of materials
- Meet with the Engineer to conduct field reviews

- Coordinate and review/perform KM202 and provide electronic test reports to the Engineer within one (1) working day
  - **Failure to provide printouts: section not accepted and corrective work must be performed**

11

QUALITY CONTROL PLAN

- **Identifies QC Coordinator and other Pavement Marking Inspection Technicians**
  - Names and addresses
  - Phone and fax numbers

- **Work Plan**
  - Starting and completion dates
  - Number of crews
  - General description of how the project will be completed

12

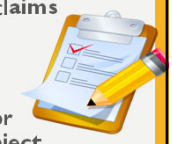
QUALITY CONTROL PLAN (CONT.)

- **Description of striping equipment**
  - Make and model of each striper
  - Minimum and maximum operating speeds
  - Instruments used to calibrated flow of paint and beads
- **Frequency and method of monitoring application rates and quality of line**
- **Materials list**
  - List of paint and beads
  - Manufacturer's recommendations for application

13

QUALITY CONTROL PLAN (CONT.)

- **Contact person for paint on vehicle claims**
  - Email
  - Phone and fax numbers
- **Description and product literature for reflectometers to be used on the project**
- **Submit manufacturer's sampling procedure for sampling from tote**



14

QA INSPECTOR

- **Perform testing on at least one segment of each section for verification of QC testing**
  - Provide QCC with randomly selected zones on the day QC testing is to be performed
  - Randomly select at least one segment for QA verification testing
  - Test in accordance with KM202
  - QA should perform verification testing within the 30-60 calendar days of application or within two weeks of receiving QC report

15

DISPUTE RESOLUTION

Base payment on QCC's results if QC and QA mean values differ by less than 10%

16

DISPUTE RESOLUTION

1. **Do the QC and QA results differ by more than 10% within a segment and indicate a change in pay?**
   - Additional readings are required
   - Discard original QC and QA test results for the section
   - QA will randomly establish 3 new zones in each segment of the section
   - QC and QA will jointly evaluate each new zone within the section
   - ➢ Accept QC test results if the mean values differ by less than 10%

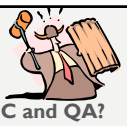
17

DISPUTE RESOLUTION

2. **Do the QC and QA results differ by more than 10% but there is no change in pay?**
   - Additional Readings will not be required
   - Accept the QC test results
   - Determine the cause of the discrepancy
   - Document resolution to the discrepancy

18

DISPUTE RESOLUTION



3. **Can a resolution not be achieved by the QC and QA?**
   - Additional testing within 2 weeks of written request
   - Three (3) new zones in each segment of the section
   - Calibrate QC, QA and CO instruments
   - ➢ Accept QC: QC < 10% to CO
   - ➢ Accept QA:QC > 10% to CO and QA < 10% to CO
   - ➢ Accept CO:QC and QA > 10% to CO

19

DISPUTE RESOLUTION

- Contractor will incur all costs associated with dispute resolution that does not results in use of QC test data for payment
- Department reserves the right to take over the QC portion of testing; the contractor will incur the cost of testing performed by the Department

20

DISPUTE RESOLUTION

- **Vendor evaluating markings by KM203 must demonstrate compliance to quality control procedures**

  - – Department will select test site
  - – Joint evaluations conducted for both white and yellow markings
  - – Vendor deemed compliant if mean averages differ by less than 10% for each marking
  - ➢ Payment for evaluation by KM203 will be based solely on the Department's approved vendor

21

APPLICATION OF STRIPING

- Paint must be applied in a single pass at an application rate in accordance with Section 713.03.03
- No bead application rate
- Contractor responsible for protecting paint line

22

APPLICATION OF STRIPING

- Complete all striping in a county for each type of paint before striping in another county
  - 4" Yellow
  - 4" White
  - 6" Yellow
  - 6" White
- All striping in a section must be completed within one week

23

APPLICATION OF STRIPING

- **Engineer may stop the striping operation for unsatisfactory quality including but not limited to**
  - Retroreflectivity
  - Bead distribution
  - Paint thickness
  - Overspray
  - Accuracy of retracing
  - Line width
  - Consistency
  - Tracking

24

CLEANING OF APPLIED STRIPE

- May clean prior to QC testing
- Cleaning – single pass using a broom truck
- Notify the Engineer 48 hours prior to performing cleaning operations

25

MARKING REMOVAL

- Water blasting only
- Begin corrective within 5 working days and work continuously

26

RETROREFLECTIVITY REQUIREMENTS

- **Section 713**
  - White: 300 mcd/m^2/lux
  - Yellow: 225 mcd/m^2/lux

27

SCHEDULING DEADLINES (~~EXCEPT DISTRICT 5~~)

- Priority routes– June 1, 2025
- Additional routes added by– July 1, 2025
- Scheduled routes–August 15, 2025
- Re-Striping– October 15, 2025
- Continue re-striping – spring of 2026 until June 1, 2026
- Liquidated damages shall accrue until October 15, 2026

28

RE-STRIPE

- Re-stripe -completed within 15 calendar days of notification by the Engineer after that it will accrue liquidated damages until restriping is completed or October 15, 2025
- The Engineer can require that re-stripe not completed by October 15, 2025 be completed as a priority route in the following spring by June 1, 2025
- Re-stripe not completed June 1, 2026 will accrue liquidated damages until October 15, 2026.
- If a section is not accepted, the entire section must be re-striped

29

ADDITIONAL TESTING COSTS

- Cost of re-testing by KM203 shall be reimbursed to the Department by the contractor
- Costs associated with additional testing for dispute resolution shall be incurred by the contractor if the QC results are not used for payment

30

MEASUREMENT AND PAYMENT

- **Initial payment**
  - 50% upon application of stripe
- **Final payment**
  - Section is accepted – 50%
  - Section is not accepted – required restripe

31

TRAFFIC CONTROL PLAN – CONTRACT CHANGES

If approved in advance by the Engineer, the contractor may use rolling road blocks to stripe intersections, not to exceed five (5) minutes duration, allowing the paint truck and broom to back up and paint the entire intersection

When painting the center lines release traffic at least every two (2) miles

32

CALL NO. 325

CONTRACT ID. 252001

VARIOUS COUNTIES

FED/STATE PROJECT NUMBER FE01 121 DW25 0010000

DESCRIPTION VARIOUS ROUTES IN DISTRICT 1

WORK TYPE WATERBOURNE PAINT STRIPING

PRIMARY COMPLETION DATE 8/15/2025

LETTING DATE: January 23,2025

Sealed Bids will be received electronically through the Bid Express bidding service until 10:00 AM EASTERN STANDARD TIME January 23,2025. Bids will be publicly announced at 10:00 AM EASTERN STANDARD TIME.

NO PLANS ASSOCIATED WITH THIS PROJECT.

REQUIRED BID PROPOSAL GUARANTY: Not less than 5% of the total bid.

TABLE OF CONTENTS

PART I

SCOPE OF WORK

ADMINISTRATIVE DISTRICT - 01

CONTRACT ID - 252001

FE01 121 DW25 0010000

COUNTY - VARIOUS

PCN - MP12100002501
FE01 121 DW25 0010000

VARIOUS ROUTES IN DISTRICT 1 VARIOUS ROUTES IN DISTRICT 1WATERBOURNE PAINT STRIPING
GEOGRAPHIC COORDINATES LATITUDE 36:52:16.00 LONGITUDE 88:29:13.00
ADT

COMPLETION DATE(S):

COMPLETED BY 08/15/2025	SPECIFIED COMPLETION DATE - ALL ITEMS IN CONTRACT
COMPLETED BY 06/01/2025	SPECIFIED COMPLETION DATE - PRIORITY ROUTES
5 WORKING Days	REMOVE STRIPIG ERRORS AND SPILLS
15 WORKING Days	RESTRIPING ROUTES WITH FAILED RETROREFLECTIVITY

CONTRACT NOTES

INSURANCE

Refer to Kentucky Standard Specifications for Road and Bridge Construction, current edition.

PROPOSAL ADDENDA

All addenda to this proposal must be applied when calculating bid and certified in the bid packet submitted to the Kentucky Department of Highways. Failure to use the correct and most recent addenda may result in the bid being rejected.

BID SUBMITTAL

Bidder must use the Department's electronic bidding software. The Bidder must download the bid file located on the Bid Express website (www.bidx.com) to prepare a bid packet for submission to the Department. The bidder must submit electronically using Bid Express.

JOINT VENTURE BIDDING

Joint venture bidding is permissible. All companies in the joint venture must be prequalified in one of the work types in the Qualifications for Bidders for the project. The bidders must get a vendor ID for the joint venture from the Division of Construction Procurement and register the joint venture as a bidder on the project. Also, the joint venture must obtain a digital ID from Bid Express to submit a bid. A joint bid bond of 5% may be submitted for both companies or each company may submit a separate bond of 5%.

UNDERGROUND FACILITY DAMAGE PROTECTION

The contractor shall make every effort to protect underground facilities from damage as prescribed in the Underground Facility Damage Protection Act of 1994, Kentucky Revised Statute KRS 367.4901 to 367.4917. It is the contractor's responsibility to determine and take steps necessary to be in compliance with federal and state damage prevention directives. When prescribed in said directives, the contractor shall submit Excavation Locate Requests to the Kentucky Contact Center (KY811) via web ticket entry. The submission of this request does not relieve the contractor from the responsibility of contacting non-member facility owners, whom shall be contacted through their individual Protection Notification Center. Non-compliance with these directives can result in the enforcement of penalties.

REGISTRATION WITH THE SECRETARY OF STATE BY A FOREIGN ENTITY

Pursuant to KRS 176.085(1)(b), an agency, department, office, or political subdivision of the Commonwealth of Kentucky shall not award a state contract to a person that is a foreign entity required by KRS 14A.9-010 to obtain a certificate of authority to transact business in the Commonwealth ("certificate") from the Secretary of State under KRS 14A.9-030 unless the person produces the certificate within fourteen (14) days of the bid or proposal opening. If the

foreign entity is not required to obtain a certificate as provided in KRS 14A.9-010, the foreign entity should identify the applicable exception. Foreign entity is defined within KRS 14A.1-070.

For all foreign entities required to obtain a certificate of authority to transact business in the Commonwealth, if a copy of the certificate is not received by the contracting agency within the time frame identified above, the foreign entity's solicitation response shall be deemed non-responsive or the awarded contract shall be cancelled.

Businesses can register with the Secretary of State at https://secure.kentucky.gov/sos/ftbr/welcome.aspx .

SPECIAL NOTE FOR PROJECT QUESTIONS DURING ADVERTISEMENT

Questions about projects during the advertisement should be submitted in writing to the Division of Construction Procurement. This may be done by email to kytc.projectquestions@ky.gov. The Department will attempt to answer all submitted questions. The Department reserves the right not to answer if the question is not pertinent or does not aid in clarifying the project intent.

The deadline for posting answers will be 3:00 pm Eastern Daylight Time, the day preceding the Letting. Questions may be submitted until this deadline with the understanding that the later a question is submitted, the less likely an answer will be able to be provided.

The questions and answers will be posted for each Letting under the heading "Questions & Answers" on the Construction Procurement website (www.transportation.ky.gov/construction-procurement). The answers provided shall be considered part of this Special Note and, in case of a discrepancy, will govern over all other bidding documents.

HARDWOOD REMOVAL RESTRICTIONS

The US Department of Agriculture has imposed a quarantine in Kentucky and several surrounding states, to prevent the spread of an invasive insect, the emerald ash borer. Hardwood cut in conjunction with the project may not be removed from the state. Chipping or burning on site is the preferred method of disposal.

INSTRUCTIONS FOR EXCESS MATERIAL SITES AND BORROW SITES

Identification of excess material sites and borrow sites shall be the responsibility of the Contractor. The Contractor shall be responsible for compliance with all applicable state and federal laws and may wish to consult with the US Fish and Wildlife Service to seek protection under Section 10 of the Endangered Species Act for these activities.

ACCESS TO RECORDS

The state agency certifies that it is in compliance with the provisions of KRS 45A.150, "Access to contractor's books, documents, papers, records, or other evidence directly pertinent to the contract." The Contractor, as defined in KRS 45A.030, agrees that the contracting agency, the

Finance and Administration Cabinet, the Auditor of Public Accounts, and the Legislative Research Commission, or their duly authorized representatives, shall have access to any books, documents, papers, records, or other evidence, which are directly pertinent to this agreement for the purpose of financial audit or program review. The Contractor also recognizes that any books, documents, papers, records, or other evidence, received during a financial audit or program review shall be subject to the Kentucky Open Records Act, KRS 61.870 to 61.884. Records and other prequalification information confidentially disclosed as part of the bid process shall not be deemed as directly pertinent to the agreement and shall be exempt from disclosure as provided in KRS 61.878(1)(c).

BOYCOTT PROVISIONS

If applicable, the contractor represents that, pursuant to KRS 45A.607, they are not currently engaged in, and will not for the duration of the contract engage in, the boycott of a person or an entity based in or doing business with a jurisdiction with which Kentucky can enjoy open trade. **Note:** The term Boycott does not include actions taken for bona fide business or economic reasons, or actions specifically required by federal or state law.

If applicable, the contractor verifies that, pursuant to KRS 41.480, they do not engage in, and will not for the duration of the contract engage in, in energy company boycotts as defined by KRS 41.472.

LOBBYING PROHIBITIONS

The contractor represents that they, and any subcontractor performing work under the contract, have not violated the agency restrictions contained in KRS 11A.236 during the previous ten (10) years, and pledges to abide by the restrictions set forth in such statute for the duration of the contract awarded.

The contractor further represents that, pursuant to KRS 45A.328, they have not procured an original, subsequent, or similar contract while employing an executive agency lobbyist who was convicted of a crime related to the original, subsequent, or similar contract within five (5) years of the conviction of the lobbyist.

SPECIAL NOTE – BUY AMERICA REQUIREMENTS AND BUILD AMERICA, BUY AMERICA (BABA) ACT 10/26/2023

1.0 BUY AMERICA REQUIREMENT.

Follow the "Buy America" provisions as required by 23 U.S.C. § 313 and 23 C.F.R. § 635.410. Except as expressly provided herein all manufacturing processes of steel or iron materials including but not limited to structural steel, guardrail materials, corrugated steel, culvert pipe, structural plate, prestressing strands, and steel reinforcing bars shall occur in the United States of America, including the application of:

- Coating,
- Galvanizing,
- Painting, and
- Other coating that protects or enhances the value of steel or iron products.

The following are exempt, unless processed or refined to include substantial amounts of steel or iron material, and may be used regardless of source in the domestic manufacturing process for steel or iron material:

- Pig iron,
- Processed, pelletized, and reduced iron ore material, or
- Processed alloys.

The Contractor shall submit a certification stating that all manufacturing processes involved with the production of steel or iron materials occurred in the United States.

Produce, mill, fabricate, and manufacture in the United States of America all aluminum components of bridges, tunnels, and large sign support systems, for which either shop fabrication, shop inspection, or certified mill test reports are required as the basis of acceptance by the Department.

Use foreign materials only under the following conditions:

1) When the materials are not permanently incorporated into the project; or
2) When the delivered cost of such materials used does not exceed 0.1 percent of the total Contract amount or $2,500.00, whichever is greater.

The Contractor shall submit to the Engineer the origin and value of any foreign material used.

2.0 – BUILD AMERICA, BUY AMERICA (BABA)

Contractor shall comply with the Federal Highway Administration (FHWA) Buy America Requirement in 23 C.F.R. § 635.410 and all relevant provisions of the Build America, Buy America Act (BABA), contained within the Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, §§ 70901-52 enacted November 15, 2021. The BABA requires iron, steel, manufactured products, and construction materials used in infrastructure projects funded by federal financial assistance to be produced in the United States. Comply with 2 C.F.R § 184.

BABA permits FHWA participation in the Contract only if domestic steel and iron will be used on the Project. To be considered domestic, all steel and iron used, and all products manufactured from steel and iron must be produced in the United States and all manufacturing processes, including application of a coating, for these materials must occur in the United States. Coating includes all processes that protect or enhance the value of the material to which the coating is applied. This requirement does not preclude a minimal use of foreign steel and iron materials, provided the cost of such materials does not exceed 0.1% of the total contract amount under the Contract or $2,500.00 whichever is greater.

BABA permits FHWA participation in the Contract only if all "construction materials" as defined in the Act are made in the United States. The Buy America preference applies to the following construction materials

incorporated into infrastructure projects: non-ferrous metals; plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables); glass (including optic glass); Fiber optic cable; optical fiber; lumber; engineered wood; and drywall. Contractor will be required to use construction materials produced in the United States on this Project. The Contractor shall submit a certification stating that all construction materials are certified to be BABA compliant.

Finally, BABA permits the continuation of FHWA's current general applicability waivers for manufactured products, raw materials, and ferryboat parts, but these waivers are subject to reevaluation, specifically the general applicability waiver for manufactured products.

The Contractor has completed and submitted, or shall complete and submit, to the Cabinet a Buy America/ Build America, Buy America Certificate prior to the Cabinet issuing the notice to proceed, in the format below. After submittal, the Contractor is bound by its original certification.

A false certification is a criminal act in violation of 18 U.S.C. § 1001. The Contractor has the burden of proof to establish that it is in compliance.

At the Contractor's request, the Cabinet may, but is not obligated to, seek a waiver of Buy America requirements if grounds for the waiver exist under 23 C.F.R. § 635.410(c) or will comply with the applicable Buy America requirements if a waiver of those requirements is not available or not pursued by the Cabinet.

Please refer to the Federal Highway Administration's Buy America webpage for more information.

Buy America - Construction Program Guide - Contract Administration - Construction - Federal Highway Administration (dot.gov)

BUY AMERICA / BUILD AMERICA, BUY AMERICA (ACT) MATERIALS CERTIFICATE OF COMPLIANCE

The Contractor hereby certifies that it will comply with all relevant provisions of the Build America, Buy America Act, contained within the Infrastructure Investment and Jobs Act, Pub. L. NO. 117-58, §§ 70901-52, the requirements of 23 U.S.C. § 313, 23 C.F.R. § 635.410 and 2 C.F.R § 184.

Date Submitted:_____

Contractor:_____

Signature:_____

Printed Name:_____

Title:_____

NOTE: THIS CERTIFICATION IS IN ADDITION TO ANY AND ALL REQUIREMENTS OUTLINED IN THE CURRENT EDITION OF THE STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION AND/OR SPECIAL NOTES CONTAINED IN THE PROJECT PROPOSAL.

SPECIAL NOTE FOR RECIPROCAL PREFERENCE

RECIPROCAL PREFERENCE TO BE GIVEN BY PUBLIC AGENCIES TO RESIDENT BIDDERS

By reference, KRS 45A.490 to 45A.494 are incorporated herein and in compliance regarding the bidders residency. Bidders who want to claim resident bidder status should complete the Affidavit for Claiming Resident Bidder Status along with their bid in the electronic bidding software. Submittal of the Affidavit should be done along the bid in Bid Express.

April 30, 2018

NATIONAL HIGHWAY

Be advised this project is on the NATIONAL HIGHWAY SYSTEM.

SPECIAL NOTES FOR WATERBORNE PAINT STRIPING AND DURABLE WATERBORNE PAINT STRIPING 2025 DISTRICT WIDE CONTRACT – DISTRICT 1

DESCRIPTION

Except as specified herein, perform all work according to the Commonwealth of Kentucky, Transportation Cabinet, Department of Highways' 2019 Standard Specifications for Road and Bridge Construction; Supplemental Specifications; applicable Standard and Sepia Drawings; applicable Special Notes and Special Provisions; and Kentucky Methods; current editions. Section references are to the Standard Specifications.

SCOPE OF WORK

Furnish and apply durable waterborne striping paint for 6 inch lines on Interstate and Parkway Routes and waterborne striping paint for 4 inch and 6 inch lines on other routes, reflectorized with glass beads, to the sections of roadway provided in this Contract with an updated listing provided at the pre-construction meeting. This Contract is for the installation of centerlines, lane lines, edgelines, ramp lines, dotted lines and gore lines only. Gore line materials shall be the same as the mainline of the roadway. Special markings such as stop bars, crosswalks, cross-hatching, chevrons, railroad markings, etc. are not to be installed under this Contract.

Intersection approach markings such as the edgelines of large painted islands or edgelines on mountable medians may be included at the discretion of the Engineer provided they can be painted by the striping truck. Markings that would require application by equipment other than the striping truck are not to be installed under this Contract.

Retrace existing lines on the listed routes. The Department will pre-mark any section of roadway where there are no existing markings, old markings are no longer visible, or where the existing markings are to be changed. Do not place edge lines on any section of roadway where edgelines do not currently exist without written authorization from the Chief District Engineer. Use only one paint crew per route per county.

MATERIALS FOR WATERBORNE AND DURABLE WATERBORNE PAINT STRIPING

PAINT: Furnish paint materials for this project to meet the performance requirements detailed in Sections 842 and 846 of the Standard Specifications.

Submit initial samples for each paint formulation for approval prior to initiation of the striping operations. The Contractor's paint manufacturer may submit the initial sample directly to the Department. The Department will obtain subsequent samples of paint in accordance with the Materials Field Sampling Manual when striping operations are in progress. A minimum of one sample will be obtained per color, per truck, per week and shall represent the quantity of striping applied per week. Deductions for application of non-specification paint shall be assessed to the quantity of striping represented by the sample.

BEADS: Use sufficient beads to ensure the pavement marking material meets retroreflectivity requirements. The Department will evaluate beads as part of the installed pavement marking in accordance with Kentucky Method 202 or 203 as applicable. Testing of the coatings, gradation and quality of the product applied shall be the responsibility of the Contractor.

MATERIALS SAMPLING AND ACCEPTANCE

If two or more random samples obtained during striping operations fail to meet minimum compositional requirements, striping operations shall be discontinued at the discretion of the Engineer. In the event striping operations are discontinued, the Department will randomly sample and test each batch of paint the Contractor has in stock at the storage location.

For batches of paint that fail to meet the minimum compositional criteria, the stock material will be rejected. The Contractor will be required to remove all failing paint from his central storage location. Batches that are tested and found to be in compliance with the compositional requirements may be used. After the Department has sampled all of the material at the central storage area, sampling and testing will resume according to the Materials Field Sampling Manual as soon as striping operations resume.

A deduction in payment will be made for any paint used that fails to meet material requirements according to Sections 842 and 846 as applicable.

EQUIPMENT

Each striper shall be equipped with electrical foot counters. The counters shall individually tabulate the amount of footage applied by each striping gun on the carriage, whether solid or dashed. The counters shall be capable of measuring up to six digits and shall have a reset feature. The counters shall be calibrated in the presence of a Department representative to ensure an accurate measurement of the paint applied. Perform the calibration prior to starting striping operations and as necessary thereafter. When done, the Department's representative will record the calibrations on the Engineer's Daily Work Report (DWR).

Each striper shall be equipped with an accurate dashing mechanism, capable of being adjusted to retrace existing lane line, dotted lines, or centerline markings as directed by the Engineer. The striper shall also be equipped with a detection device that will automatically cutoff the paint guns when a raised or recessed pavement marker is detected in the pavement. The Contractor, at his own expense, shall replace any pavement marker lens painted over; **DO NOT** attempt to clean.

Equip each striper with a Data Logging System (DLS) that will record operational details during striping operations, store data, and generate and export reports on a daily basis to the manufacturer's secure server. Provide only DLS equipment certified by the manufacturer. Ensure the data is in Microsoft Excel format, or a comma or spaces delimited text file adequate for insertion into a computerized spreadsheet. The DLS shall monitor and report the quantities of paint and beads consumed in line and calculate, in real time, the gallons of paint per mile, average wet film thickness, and pounds of beads per gallon of paint for each line application. The DLS shall monitor and report the ambient temperature, pavement temperature, and paint temperature, and record the data at the beginning of each line application and at a minimum of one (1) mile increments during application. The DLS shall be capable of storing and supplying the necessary scaling and calibration parameters to the flow meters, and shall provide a means of adjusting the scaling factor as necessary. The DLS shall include a remote cab mounted display, which shall indicate in real time, pavement temperature, application rate of paint in gallons per mile, paint film thickness in mils, and application rate of beads in pounds per gallon. In addition, the Contractor's striper shall also be equipped with a calibrated measuring device for monitoring quantities of paint and beads consumed in line.

Export to the secure server a DLS report as raw data, and as an Excel spreadsheet containing the following information: route; the beginning and ending mile points; the beginning and ending coordinates determined by a Global Positioning System receiver with a 16 foot accuracy, and the direction of travel; line type, indicated as CL (Yellow Center Line Double-Solid, Mono- directional passing, or Bi-directional passing); EL (White Edge Line on all roads or Yellow Edge Line on Solid Median Multi-Lane Highways and Interstates); LL (Solid Yellow or White Lane Line to define turn or merge lanes); SK (Dashed Yellow or White Line 10'stripe/30'gap); GM (Gore Marking installed at 2x the Edge Line Width); DTLE (Dashed Yellow or White Line Extension 3'stripe/9'gap); line width; line color; direction of application (this must be indicated for each direction travelled i.e. must include a separate entry for both the North and South directions, cannot be one entry that says direction was North/South); weight of paint applied in pounds or number of strokes counted, appropriate scaling factors; paint film thickness in mils; paint application rate in gallons per mile; bead application rate in pounds per gallon; paint temperature obtained immediately after the heat exchanger; ambient temperature; pavement temperature; and vehicle speed in miles per hour. Report application and temperature data in one-mile increments for each line applied. Provide GPS mapping system that is capable of real time (within 20 minutes) tracking of material application rates, film thickness, beads pounds per gallon, vehicle speed, time, date, project numbers, operator manual data, and color coded alarms for film thickness. Film thickness alarms must have a tolerance of ±0.5 mils.

Provide access to stored data on a secure password protected website. The Department reserves the right to obtain any and all raw data recorded by the DLS at any time during this Contract. The Engineer may require field verification of the DLS operation and calibration at any time to ensure the accuracy of the DLS data and output. If field personnel suspect that the DLS data and/or output are not accurate, the Engineer may direct additional checks be performed. The secure server shall allow the Department to be able to create a Daily Striping Report which automatically fills from the DLS's data. It shall auto-populate all fields shown on the attached DSR except for Route Type, Mobile, and Corrective Re-stripe. These fields will be drop downs to be chosen by the user. The route length shall be calculated from the GPS data and not the manually entered milepoints. The DSR shall compute the total striped line length in "Totals Summary" once the user picks the "Route Type."

Prior to starting striping operations, make all stripers available at a central location within Kentucky designated by the Department for inspection by the Department for compliance to Kentucky Method 64-267 and DLS requirements. Striping trucks that can fulfill the requirements of this method and these notes will be approved for use on this Contract. Striping trucks that have not been approved for use by Department personnel will not be allowed to stripe as part of this Contract. The Department reserves the right to perform random field verifications of striping equipment during this Contract.

The Engineer may require the Contractor to provide detailed operating instructions from the manufacturer of the striping equipment and/or the DLS if quality or reporting issues arise at any time during the Contract. The Contractor shall then be required to operate the striping equipment within the suggested operating guidelines of the manufacturer, with particular emphasis on the speed of the striping operation, or make other adjustments until the quality of the striping is satisfactory to the Engineer.

The Contractor shall provide a separate sweeping unit powerful enough to remove normal highway dirt and debris. This unit shall not be a part of the striper.

Provide the KYTC inspector the same form of direct communication with the paint striping crew as that used by the paint striping crew (CB Radio, 2-Way Radio, etc.). The Department will return the item to the Contractor upon completion of the Contract.

SURFACE PREPARATION

Prepare the pavement surface for the striping operation in accordance with Section 713.03.02. Sweep all pavement surfaces prior to striping and maintain the cleaning operation far enough in advance of the striping operation to prevent any dust from the cleaning operation from mixing with the paint. The sweeper must maintain contact with the roadway. When the Engineer determines abnormal amounts of debris or other material have accumulated beyond the capability of the required sweeping unit which will require shoveling or other means to remove, the Engineer will make arrangements,

prior to painting, to have the material removed by the Department or that section of roadway will be deleted from the Contract.

CONSTRUCTION

Except as specified herein, apply all striping according to Section 713.

QUALITY CONTROL (QC) and QUALITY ASSURANCE (QA)

The Contractor shall designate a Quality Control Coordinator (QCC) for the project who will be the contact person for any questions or concerns regarding the quality of the work performed under this Contract. The QCC shall:

- Hold current qualification from the Department as a Pavement Marking Inspection Technician;
- Plan and oversee the Contractor's evaluation of the lines applied on the project;
- Complete and submit Daily Striping Reports to the Engineer within 24 hours of completion of that days striping;
- Ensure that the DLS manufacturer submits electronic DLS raw data and Excel spreadsheets from the secure server by e-mail, at the e-mail addresses provided at the preconstruction meeting, to designated field personnel no later than the first working day following application of the pavement markings;
- Verify the electronic records are completed and received by the Engineer prior to the records being removed from the pavement marking equipment;
- Coordinate and review or Perform KM-202, for each section of striping and provide completed test reports (electronic copy) along with printouts from the handheld retroreflectometer to the Engineer within one (1) working day of completion (failure to provide the printouts will cause the Department to not accept that section and require corrective work in order to be eligible for the final 50% payment);
- Document all adjustments made to the application process to consistently produce the quality of line desired;
- Notify the Engineer of any changes in the striping work plan that are determined necessary;
- Inform and mobilize crews to complete restriping or corrective work (after notification by the Department);
- Supply the appropriate certifications for paint and the DLS to the Engineer assigned to the particular project at the time of sampling;
- Track the quantities of materials supplied by the Contractor's vendors and applied by the painting crew;
- Meet with the Engineer to discuss and/or conduct field reviews on the project throughout the execution of the Contract;
- Perform QC testing in accordance with KM-202 for each section of striping on zones selected by the Department based on KM-64-113 The Department will **NOT** provide advanced notice of the randomly selected zones to the Contractor

prior to the striping being placed, but will only provide the locations for each randomly selected zone on the day of the test. The Department's QA inspector will coordinate the date of the test with the Contractor's QCC.

At the Pre-construction Conference, the Contractor shall furnish the Department for approval a Quality Control Plan (QCP) that covers in detail the following items:

- The name, address, phone and fax numbers for the QCC;
- The names of individuals other than the QCC taking readings in accordance with KM-202 (these people shall hold qualification from the Department as Pavement Marking Inspection Technicians);
- An overall work plan which states the estimated starting and completion dates for the entire project, the number of crews to be used on the project and a general description of how the project will be completed;
- A description of the striping equipment to be used on the project, including make and model of each striper, minimum and maximum operating speeds, and type of instruments to be used to calibrate the flow of paint and beads;
- The frequency and method to be used to monitor application rates and quality of the line (specifically with regard to retroreflectivity, width, thickness, bead distribution, tracing accuracy, etc.);
- A list of paint(s) and bead(s) to be used in this Contract along with a statement from the paint manufacturer that indicates the recommended minimum and maximum application temperatures for ambient temperature, pavement temperature, paint temperature, and guidelines for any other environmental factors that would adversely affect the successful performance of the paint;
- The contact person, phone, e-mail and fax numbers for reporting claims for paint on vehicles;
- A description and product literature of the reflectometer to be used by the Contractor;
- A description, product literature, and manufacturer's certification of the DLS to be used by the Contractor;
- The manufacturer's sampling procedure for sampling paint from the tote.

Obtain the Engineer's acceptance of the Contractor's QCP prior to the start of work. The Department reserves the right to require the Contractor to make changes in the QCP to obtain the quality specified in the Contract.

After acceptance by the Department, the Contractor shall notify the Engineer in writing of any proposed change(s) to the QCP. Proposed changes are subject to acceptance by the Department.

The Department will perform Quality Assurance (QA) testing on (at least) one segment of each section of striping completed by the Contractor. QA testing is intended to verify the Contractor's QC test data. Upon receipt of the Contractor's QC test reports for each section, the QA Inspector will randomly select (at least) one segment for QA evaluation. The Department will **NOT** provide advance notice to the Contractor of the selected

segment. The Department will perform the test in accordance with KM-202 with the exception that QA testing will be conducted within the later of 30-60 calendar days after the striping application or 2 weeks of receipt of the Contractor's QC report.

The Department will base payment for each section evaluated in accordance with KM-202 on the Contractor's QC test results if the QC and QA mean values for each segment selected for QA testing differ by less than 10% of the QA mean value.

If a dispute should arise regarding the acceptability of the Contractor's QC test results the dispute resolution shall be conducted as follows:

1. If the retroreflectivity values obtained during the QA testing within a segment indicate a change in pay quantities (i.e. QC readings are passing and QA readings are failing) and the mean values differ by more than 10% of the QA mean value; additional testing will be required. Discard the original QC and QA test results for the section in question. The QA will randomly establish three new zones, in accordance with KM-113, in each segment within the section in question. The QC and QA will jointly evaluate each new zone within the section in accordance with KM-202 (with the exception of the evaluation period if greater than 60 days). The QC test results for each segment will be used for evaluation of the section if the QC and QA mean values for each segment differ by less than 10% of the QA mean value.

2. If the variance between QC and QA testing does not indicate a change in the pay quantities for the section (i.e. QC and QA readings are both passing) however, the QC mean values differ by more than 10% of the QA mean value, additional readings will not be required. Accept the QC test results for evaluation of the section. However, additional testing within the section in question should be conducted as soon as possible to determine the cause of the discrepancy. The Contractor and the Engineer shall document the resolution to the discrepancy.

3. If resolution to a dispute or variance of QC and QA test results cannot be achieved by the QC and QA, additional testing will be required. Discard the QC and QA test results for the section in question. Additional testing will be conducted by the QC, QA, and representatives of Central Office Division of Materials. Additional testing will be conducted within two weeks of receipt of a written request from the Engineer to the Division of Materials for each section in question. Three new zones, randomly selected in accordance with KM-113, will be established by the QA for each segment of the section in question. Each instrument to be used for testing will be calibrated in the presence of Central Office representatives prior to initiation of testing. The QC, QA and Central Office representatives will obtain readings for each new zone in accordance with KM-202 (with the exception of the evaluation period if greater than 60 days). The QC test results for each segment will be used for evaluation of the section if the QC mean values for each segment differ by less than 10% to the mean value obtained by Central Office. The QA test results for each segment will be used for evaluation of the section if the QC mean

values differ by more than 10% to the mean value obtained by Central Office and the QA mean value differs by less than 10% to the Central Office mean value. If neither the QC nor QA mean values meet these requirements, the Central Office mean value for each segment will be used to evaluate the section in question. These results will be final and the basis of payment for the section in question.

The Contractor shall incur all costs associated with additional testing performed by Department personnel for dispute resolution that does not result in the use of QC test data as the basis of payment. These costs will include the cost to maintain and control traffic.

The Department reserves the right to take over the QC portion of testing. In the event that the Department exercises this option, the Contractor will incur the cost of testing performed by the Department.

The Department reserves the right to evaluate retroreflectivity on designated routes, in whole or in part, in accordance with KM-203. The Department will identify routes or portions of routes to be evaluated in accordance with KM-203. The evaluation of a section in accordance with KM-203 will be conducted at the Departments expense.

The Department will require the Department's approved vendor performing retroreflectivity evaluation in accordance with KM-203 to successfully demonstrate compliance to his/her quality control procedures prior to collection of data for this Contract. The Department will select an appropriate test site for demonstration purposes and conduct joint evaluations of both yellow and white longitudinal markings within the test site using approved 30M geometry handheld instruments. The demonstration will be deemed successful if the mean average obtained by the approved vendor differs by less than 10% to the mean average obtained by the Department for each marking evaluated within the test site.

The Department will base payment for each section evaluated in accordance with KM-203 solely on the test results obtained by the Department's approved vendor. Completed test results submitted by the Department's approved vendor will be considered final and are not subject to dispute.

The Department will furnish the Contractor with a blank electronic copy of the Contractors Daily Striping Report (DSR). The Contractor shall complete and furnish this standard DSR to the Engineer's office the next calendar day for each crew for each color and width of line applied. The information on the DSR shall reflect the milepoints and quantities for striping completed for that day and for that crew. The Contractor shall also include with the DSR the certification for the paint used on that day's striping according to Section 842.05 and 846.05, as applicable.

Export DLS reports each calendar day to the manufacturer's secure server. Ensure that the DLS manufacturer submits electronic DLS raw data and Excel spreadsheets from the secure server by e-mail, at the e-mail addresses provided at the preconstruction meeting, to the designated field personnel no later than the first working day following application

of the pavement markings. Verify the electronic records are completed and received by the Engineer prior to the records being removed from the pavement marking equipment.

APPLICATION OF STRIPING

Roadways shall be marked with 4", 6", 8" and 12" lines as indicated in the summaries and/or as directed by the Engineer. The four-inch line shall be not less than four inches nor more than five inches in width. The six-inch line shall be not less than six inches nor more than seven inches in width. The eight-inch line shall be not less than eight inches nor more than nine inches in width. The twelve-inch line shall be not less than twelve inches nor more than thirteen inches in width. The centerline of all newly applied lines shall be within one inch of the centerline of the existing stripe. Mark all Interstate and Parkway Routes with six (6) inch striping using Durable Waterborne Paint meeting the requirements of Section 846, except as specified herein. Mark all other routes using Waterborne Paint meeting the requirements of Section 842, except as specified herein. Apply gore lines at twice the width of the normal line width on that portion of roadway. **DO NOT APPLY PAINT OVER EXISTING THERMOPLASTIC STRIPING.** All lines shall have distinct, clean edges with proper bead distribution across the entire width and length of the line.

Passing zones and lane lines shall be installed as a 10’ segment of paint with a 30’ gap. The length of the 10’ segment shall not be less than 10’ nor longer than 10 feet 6 inches. The stripe- gap cycle shall be not less than 39 feet 6 inches and no longer than 40 feet 6 inches.

Apply paint, in a single pass, in accordance with the application rates in Section 713.03.03. Contrary to Section 713.03.03, the Contractor may apply beads at any application rate that meets the retroreflectivity requirements of Section 713.03.05.

The Contractor shall be responsible for protecting the painted line from traffic until dry in order to eliminate tracking. Retroreflectivity readings will be taken on zones with substantial amounts of tracking and the readings will be used in the calculation of payment. If the Engineer directs or the Contractor elects to use additional traffic control devices beyond what is specified in the TRAFFIC CONTROL PLAN, or other methods to control tracking, the additional cost shall be incidental to the bid item “Maintain and Control Traffic”.

If the Engineer determines that the quality of the striping applied by the Contractor is unsatisfactory with regard to retroreflectivity, bead distribution, paint thickness, overspray, accuracy of retracing, line width, consistency, tracking, etc., the Engineer may stop the striping operation immediately until the Contractor can demonstrate that the problem has been corrected. If it is determined by the Engineer that the striping is not applied at the specified application rate, restriping will be required.

CLEANING OF APPLIED STRIPING

The Contractor has the option to clean accumulated debris from affected route prior to performing QC testing. Cleaning is defined as a single pass using the broom truck to remove accumulated debris from the affected striping. Notify the Engineer 48 hours prior to performing the cleaning operations.

MARKING REMOVAL

The Contractor shall be responsible for all necessary cleanup of any paint or other material that is spilled onto the pavement or elsewhere as a result of his operations and for correcting any striping error (including tracking and rain damage) that the Engineer determines removal to be required. Contrary to Section 713.03.04, remove all striping errors or paint spills by water blasting only (see attached note) at no additional cost to the Department. This removal process shall be performed in a manner that shall not be detrimental to the pavement. Upon notification of a striping error or paint spill by the Engineer, the Contractor shall be required to begin the process of correcting the striping error or paint spill within five (5) working days and shall work continuously to complete the corrective work prior to striping any other section of roadway included in this Contract.

Prior to retracing, the Engineer will notify the Contractor if existing striping errors need to be removed. Contrary to Section 713.03.04, remove all existing striping errors by water blasting only (see attached note). The Department will measure and pay for water blasting removal of existing stripes directed by the Engineer in linear feet.

PAINT ON VEHICLES

The Contractor shall be responsible for addressing disputes with the public regarding paint on vehicles that occur as a result of his operations. All complaints from the public shall be addressed in a timely manner and the Contractor must demonstrate a “good faith” attempt to resolve disputes to the satisfaction of the citizen. However, the Contractor shall have the right to dispute fault and refuse settlement in cases where the Contractor feels that paint on the vehicle was a result of negligence on the part of the citizen. Unresolved disputes involving paint on vehicles shall be handled through the legal system. The Department shall not be held responsible for paint on vehicles under any circumstances.

RETROREFLECTIVITY REQUIREMENTS

The minimum retroreflectivity requirements shall be in accordance with Section 713.03.05A of the Standard Specifications.

Restriping will be required for striping that fails to meet to meet the minimum retroreflectivity requirements. The provisions for restriping are described in the section of the Contract entitled MEASUREMENT AND PAYMENT. Complete the restriping within 15 calendar days after notification by the Engineer except that restriping will be suspended after **October 15, 2025** until the following spring at the discretion of the Engineer. All restriping not completed by **October 15, 2025** will be restriped at the Engineer's discretion as a priority route in the spring of 2026 and completed by **June 1, 2026**. All aspects of this specification shall apply to lines that are repainted due to failure to meet the requirements of the specifications, including the retroreflectivity requirements.

SCHEDULING

At the Pre-construction conference, the Engineer may provide the Contractor with a list of Priority Routes (not to exceed 10 percent of the total project estimate) which are to be striped prior to **June 1, 2025**. The painting of all scheduled routes shall be completed by **August 15, 2025**.

The Contractor shall coordinate the daily striping schedule, one week in advance, with the Engineer. Unless approved by the Engineer, complete all striping in a county, for that type of paint, before starting striping for that type of paint in another county (for this Contract there are 4 types of paint striping: 4" yellow, 4" white" 6" yellow, and 6" white). The Contractor shall ensure that once striping begins on a section that all striping on that section must be completed within two (2) weeks. Failure to comply with this requirement will result in withholding of pay estimates.

The Engineer may eliminate any route from the schedule at any time prior to striping if it is determined that the route does not require retracing. Also, the Engineer may add additional routes to be striped. The Contractor shall be notified of added routes prior to July 1, 2025.

CONTRACT COMPLETION AND LIQUIDATED DAMAGES

All priority routes shall be striped by **June 1, 2025**. Contrary to the Standard Specifications, no time extension will be granted for failure to complete striping of these priority routes by the **June 1, 2025** milestone completion date. Liquidated damages in the amount specified in Section 108.09 of the Standard Specifications will be assessed for each day that any priority route remains unstriped after **June 1, 2025**.

Sections that are required to be re-striped due to failure to meet retroreflectivity requirements must be completed within 15 calendar days after notification by the Engineer. The Department will assess Liquidated Damages in the amount specified in Section 108.09 of the Standard Specifications for each day beyond the 15 calendar days that the restriping is not completed and shall accrue until **October 15, 2025**. Failure to

complete all necessary corrective work by the **October 15, 2025** deadline will result in no additional payment for the stripe beyond the 50% that was initially paid for the installation of the stripe and payment will be based upon the Payment Schedule. At the Engineer's discretion, necessary corrective work not completed by the **October 15, 2025** deadline may be required to be restriped in the spring of **2026** as a priority route with a completion date of **June 1, 2026**. Any re-stripe required by the Engineer that is not completed by **June 1, 2026** shall accrue liquidated damages until **October 15, 2026**.

All routes that are required to be striped under this Contract shall be completed by **August 15, 2025**. Contrary to the Standard Specifications, no time extension will be granted. Liquidated damages will apply in accordance with Section 108.09 of the Standard Specifications for failure to complete the striping by **August 15, 2025**. Liquidated damages will accrue until **October 15, 2025**; no striping shall be performed after this date.

Remove all striping errors and spills within five (5) working days after notification by the Engineer. Liquidated damages, in the amount specified in Section 108.09 of the Standard Specifications, shall apply for each day beyond the five (5) working days that the Contractor has not begun to correct the striping error/spill or continuously work to complete the corrective work.

The Department will apply all Liquidated Damages accumulatively.

RE-TESTING OF FAILURES

The Department's costs associated with re-testing of striping failures for Kentucky Method 203 shall be reimbursed to the Department by the Contractor. The reimbursement shall include mobilization of the Department's mobile striping vendor's mobile testing machine as well as the current per mile rate for the mobile striping according to the Cabinet's Master Agreement.

MEASUREMENT AND PAYMENT

STRIPING: The Department will measure the paint striping of each type in linear miles of paint stripe. The Department will measure the quantity at twice the rate for a 4-inch line when an 8- inch line is applied or twice the rate for a 6-inch line when a 12-inch line is applied.

The Department will pay 50% of the Contract Unit Bid price for the applicable bid items after application of all striping to a particular section of roadway. Contrary to Section 104.02.02, the overrun and underrun formula shall not apply to this Contract. The remaining payment will be made based upon the following procedure and the Payment Schedule:

1. Each section of striping will be evaluated in accordance with KM-202 or KM-203, as applicable, and the QC/QA testing specified herein, for the purpose of evaluating retroreflectivity.

2. If a Section is accepted in accordance with the appropriate Kentucky Methods, the Department will make final payment according to the Payment Schedule listed below.

3. If a section is not accepted in accordance with the appropriate Kentucky Methods, restripe the entire section within fifteen (15) calendar days after notification by the Engineer subject to the same requirements as the original striping at no additional cost to the Department. If the restriped Section is accepted in accordance with the appropriate Kentucky Methods, the Department will make final payment according to the following Payment Schedule. If the section is not restriped by **October 15, 2025**, the Department will not make final payment and restriping may be required in the spring of **2026** where the corrective will become a priority route and re-striping must be completed by **June 1, 2026**. If the Engineer does not require re-striping to be completed in the spring of **2026**, the Contractor shall accept the deduction in payment for the section that has been determined to be unacceptable.

Payment Schedule

	Initial Payment	Final Payment	Total Payment
Section is Accepted	50%	50%	100%
Section is Not Accepted	50%	0%	50%

QUALITY CONTROL: The Department will measure and pay the quantity as one lump sum. The Department will not measure the QCP, the DLS, any actions and personnel required to carry out the QCP, any testing, any testing equipment, or any other work necessary to perform the specified QC/QA procedures for payment, but will consider them incidental to this item of work.

MAINTAIN AND CONTROL TRAFFIC: See Traffic Control Plan.

LAW ENFORCEMENT OFFICER: See Traffic Control Plan.

WATER BLASTING EXISTING STRIPE: See Special Note for Water Blasting Existing Stripe.

SPECIAL NOTE FOR CENTERLINE & EDGELINE RUMBLE STRIPES

Be advised there may be some centerline and edgeline rumble stripes to be retraced. Place centerline and edgeline rumble stripes according to Standard Drawings TPR-100 through TPR-130. Notify the Engineer if questions arise regarding the striping patterns. If necessary, the Engineer will obtain guidance from the District Traffic Engineer and/or the Division of Traffic.

SPECIAL NOTE FOR WATER BLASTING EXISTING STRIPE

This Special Note will apply where indicated on the plans or in the proposal. Section references herein are to the Department's 2012 Standard Specifications for Road and Bridge Construction.

1.0 DESCRIPTION. Remove pavement striping, temporary or permanent, from asphalt or concrete pavement using ultra-high pressure water.

2.0 MATERIALS AND EQUIPMENT.

2.1 Truck Mounted Ultra-high Pressure Pump and Water Tank. Use a truck having a separate hydrostatic transmission capable of speed increments of ±1 foot per minute at operator's discretion. Use a pump capable of delivering a minimum of 30,000 psi to a bumper mounted deck containing an operator controlled rotating manifold that is speed variable up to at least 3,000 rpm and accepts interchangeable waterjet nozzles. Provide all necessary waterjet nozzle setups and patterns to ensure clean sufficient removal. Ensure the deck's discharge directs the water and removal material in a manner that is not hazardous to vehicles or pedestrians.

2.2 Water. Conform to Section 803.

3.0 CONSTRUCTION. Before starting work, provide the Engineer with a contractor work history of 2 projects where striping removal was completed acceptably for a similar type of pavement. If no history is available, complete 1,000 linear feet of striping removal and obtain the Engineer's approval before continuing.

Conduct striping removal under lane closures meeting the conditions of the MUTCD and Kentucky Standard Drawings and Specifications. Waterblast to remove temporary or permanent striping completely as the Engineer directs. Do not damage the pavement in any way and protect all joint seals. If damage is observed, stop the removal process until the operator can make changes and demonstrate acceptable striping removal. Repair any damage to the pavement. Vacuum all marking material and removal debris concurrently with the blasting operation.

4.0 MEASUREMENT. The Department will measure the quantity in linear feet. When the removal area's width exceeds 8 inches and a second pass is required, the Department will measure the length of the additional pass for Payment. The Department will not measure for payment additional passes for widths of 8 inches or less or passes to further eradicate markings. The Department will not measure repair of damaged pavement for payment and will consider it incidental to this item of work.

5.0 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
22664EN	Water Blasting Existing Stripe	Linear Foot

The Department will consider payment as full compensation for all work required under this note.

October 30, 2012

SPECIAL NOTE FOR PROJECTS TO BE RESTRIPED IN 2024 & 2025

Be advised that some projects listed herein may be scheduled for resurfacing in 2025. The Engineer may delete the striping on these routes from this Contract.

Be advised that some projects not listed herein were scheduled for resurfacing or restriping in 2024, but may have been canceled or postponed. The Engineer may add the striping on canceled routes to this Contract.

COORDINATION OF WORK WITH OTHERS

Be advised, the Department may issue permits for work on the Department's right of way adjacent to or within the limits of this project. See Sections 107.06 and 107.14. The Engineer will coordinate the work of the Contractor and the permit holders.

Be advised, there may be an active project(s) adjacent to or within this project. The Engineer will coordinate the work of the Contractors. See Section 105.06.

Be advised the Department may be performing work adjacent to or within this project. The Engineer will coordinate the Department's operations with the Contractor's work. See Section 105.11.

The Department will not grant any time extension or monetary consideration, and will not consider any claims if the Contractor's forces are delayed in their operations.

TRAFFIC CONTROL PLAN
DURABLE WATERBORNE AND WATERBORNE PAINT STRIPING

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1. Maintain and Control Traffic in accordance with the Standard Specifications for Road and Bridge Construction, Supplemental Specification, Standard and Sepia Drawings, and the MUTCD, current editions.

2. Contrary to Section 112, include all items necessary to maintain and control traffic in the lump sum bid item "Maintain and Control Traffic". The Department will measure and pay only the bid items listed; consider all other work and necessary items to be incidental to the listed bid items. The Department will measure and pay "Maintain and Control Traffic" as one lump sum.

3. Maintain possession of all temporary traffic control items, devices, materials, and incidentals, unless otherwise specified in the proposal, when no longer needed.

4. If the Contractor desires to deviate from the traffic control scheme outlined in the Standard Drawings, prepare an alternate plan and present it in writing to the Engineer. Do not use the alternate plan until reviewed and approved by the District Engineer and the Divisions of Construction, Maintenance, and Traffic Operations.

5. Provide for the Contractor's vehicles to always move with and not across or against the flow of traffic. Do not allow vehicles to make U-turns at any location. Do not allow the striper to stop and back down the road or ramps to stripe gore lines and turn lanes. Require vehicles to enter or leave work areas in a manner that will not be hazardous to, or interfere with, normal traffic flow. If approved in advance by the Engineer, the contractor may use rolling road blocks to stripe intersections, not to exceed five (5) minutes duration, allowing the paint truck and broom to back up and paint the entire intersection. Do not allow vehicles to park or stop within the right-of-way except within work areas designated by the Engineer. Do not allow personal vehicles to park within the right-of-way except in specific areas designated by the Engineer.

6. Do not allow the paint supply truck to operate as one of the traffic control vehicles shown on the Standard Drawings. If one of the required traffic control vehicles experiences mechanical problems or for some other reason is not available to remain in position as shown in the traffic control scheme, cease the striping operation until all required vehicles are in place.

7. Do not perform striping operations on any roadway during the peak times of the day, holiday periods, or special events as determined by the Engineer.

8. On two-lane, two-way highways, make provisions to the satisfaction of the Engineer to periodically allow traffic to safely pass the train of vehicles in the striping operation. When painting center lines release traffic at least every two (2) miles.

9. In low speed, urban situations, the Engineer may permit the Contractor to delete the intermediate trail vehicle between the striper and the final trail vehicle shown on the Standard Drawings.

10. If requested by the Contractor, the Engineer may approve Law Enforcement Officer Police Support on Interstate highways when striping operations are taking place. If the Contractor requests Law Enforcement Officer Police Support on other than Interstate Highways, provide written justification for the Engineer's approval. If approved, provide two (2) police support units for each lane closure, each unit consisting of an off-duty law enforcement officer from any police agency having lawful jurisdiction and a police car equipped with externally mounted flashing blue lights. Place the police support unit at locations determined by the Engineer. The Department will measure and pay for each approved individual police support unit on a per hour basis for the officer with the police vehicle.

CONTRACT COMPLETION DATE AND LIQUIDATED DAMAGES

All priority routes shall be stripped by **June 1, 2025**. Contrary to the Standard Specifications, no time extension will be granted for failure to complete stripping of these priority routes by the **June 1, 2025** milestone completion date. Liquidated damages in the amount specified in Section 108.09 of the Standard Specifications will be assessed for each day that any priority route remains unstriped after **June 1, 2025**.

Sections that are required to be re-striped due to failure to meet retroreflectivity requirements must be completed within 15 calendar days after notification by the Engineer. The Department will assess Liquidated Damages in the amount specified in Section 108.09 of the Standard Specifications for each day beyond the 15 calendar days that the restriping is not completed and shall accrue until **October 15, 2025**. Failure to complete all necessary corrective work by the **October 15, 2025** deadline will result in no additional payment for the stripe beyond the 50% that was initially paid for the installation of the stripe and payment will be based upon the Payment Schedule. At the Engineer's discretion, necessary corrective work not completed by the **October 15, 2025** deadline may be required to be restriped in the spring of 2026 as a priority route with a completion date of **June 1, 2026**. Any re-stripe required by the Engineer that is not completed by **June 1, 2026** shall accrue liquidated damages until **October 15, 2026**.

All routes that are required to be striped under this Contract shall be completed by **August 15, 2025**. Contrary to the Standard Specifications, no time extension will be granted. Liquidated damages will apply in accordance with Section 108.09 of the Standard Specifications for failure to complete the striping by **August 15, 2025**. Liquidated damages will accrue until **October 15, 2025**; no striping shall be performed after this date.

Remove all striping errors and spills within five (5) working days after notification by the Engineer. Liquidated damages, in the amount specified in Section 108.09 of the Standard Specifications, shall apply for each day beyond the five (5) working days that the Contractor has not begun to correct the striping error/spill or continuously work to complete the corrective work.

The Department will apply all Liquidated Damages accumulatively.

STANDARD SPECIFICATIONS

Any reference in the plans or proposal to previous editions of the *Standard Specifications for Road and Bridge Construction* and *Standard Drawings* are superseded by *Standard Specifications for Road and Bridge Construction, Edition of 2019* and *Standard Drawings, Edition of 2020.*

SUPPLEMENTAL SPECIFICATIONS

The contractor shall use the Supplemental Specifications that are effective at the time of letting. The Supplemental Specifications can be found at the following link:
http://transportation.ky.gov/Construction/Pages/Kentucky-Standard-Specifications.aspx

Kentucky Equal Employment Opportunity Act of 1978

The requirements of the Kentucky Equal Employment Opportunity Act of 1978 (KRS 45.560-45.640) shall apply to this Contract. The apparent low Bidder will be required to submit EEO forms to the Division of Construction Procurement, which will then forward to the Finance and Administration Cabinet for review and approval. No award will become effective until all forms are submitted and EEO/CC has certified compliance. The required EEO forms are as follows:

- EEO-1: Employer Information Report
- Affidavit of Intent to Comply
- Employee Data Sheet
- Subcontractor Report

These forms are available on the Finance and Administration's web page under ***Vendor Information, Standard Attachments and General Terms*** at the following address: **https://www.eProcurement.ky.gov**.

Bidders currently certified as being in compliance by the Finance and Administration Cabinet may submit a copy of their approval letter in lieu of the referenced EEO forms.

For questions or assistance please contact the Finance and Administration Cabinet by email at **finance.contractcompliance@ky.gov** or by phone at 502-564-2874.

DISTRICT WIDE
DURABLE STRIPING
CONTRACTS

DURABLE STRIPING CONTRACTS

*Information is subject to change per special note or specifications

INSTALLATION OF SPRAY APPLIED 6" THERMOPLASTIC

- Install according to Section 714 with the following exception
  - Existing stripe on asphalt will not be removed prior to installation of spray thermoplastic stripe

INSTALLATION OF DURABLE TYPE I TAPE 6”

- Install according to Section 714
- Type I Tape is to be used on concrete surfaces only
- Waterblast existing stripe prior to installation

MARKING REMOVAL

In the event of a striping error or paint spill,

The contractors shall begin corrective work within five (5) working days

and work continuously to complete the corrective work prior to striping

and other section of roadway.

SPECIAL NOTE FOR SPRAY THERMOPLASTIC

Composition (Percentage by Weight)		
Component	**White**	**Yellow**
Binder	26.0 min	26.0 min
Glass Beads (Premixed)	30-40	30.40
Titanium Dioxide	10.0 min	-------
Calcium Carbonate & Inert Fillers	42.0 max	50.0 max
Heavy Metals Content	Comply with 40 CFR 261	Comply with 40 CFR 261
Daytime Color	6.0 ΔE* max	6.0 ΔE* max
Nighttime Color	6.0 ΔE* max	6.0 ΔE* max

SPECIAL NOTE FOR SPRAY THERMOPLASTIC

- Install thermoplastic materials at a minimum thickness as specified in the note (usually between 30-60 mils)
- Ensure the material temperature is maintained between 350°F and 400°F
- Do not allow the material temperature to exceed 400°F
- Removal of existing stripe on asphalt is not required

CHANGE ORDERS

- If a contract calls for a spray thermoplastic and any other material is used, that material will not be approved without a change order

- If a contract calls for extruded thermoplastic and any other material is used, that material will not be approved without a change order

KENTUCKY METHODS

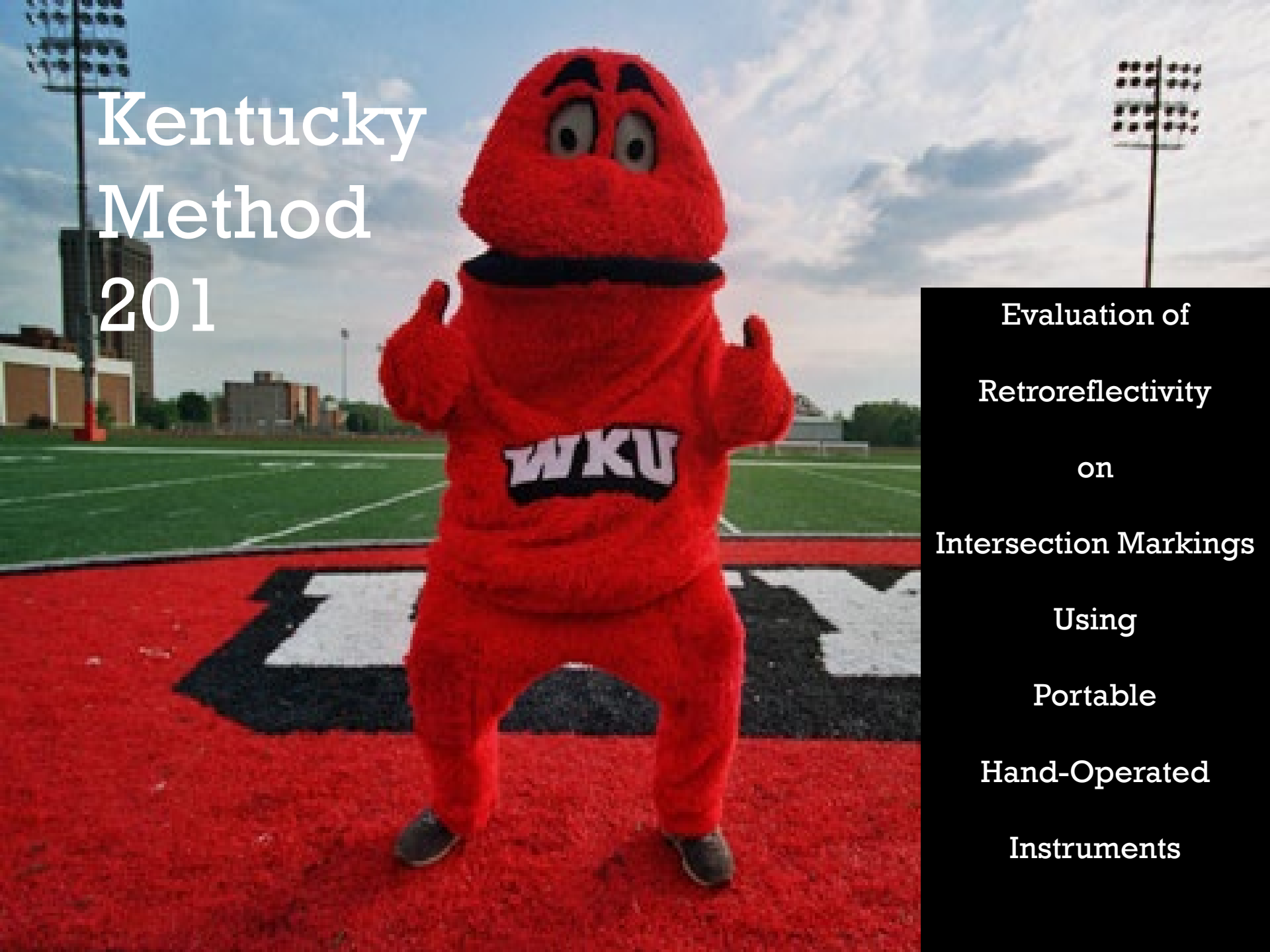

KENTUCKY
METHODS

Kentucky Methods

KM 201: Handheld Inspection of Intersection Markings

KM202: Handheld Inspection of Pavement Markings

KM 203: Mobile Inspection of Pavement Markings



Kentucky Method 201

Evaluation of

Retroreflectivity

on

Intersection Markings

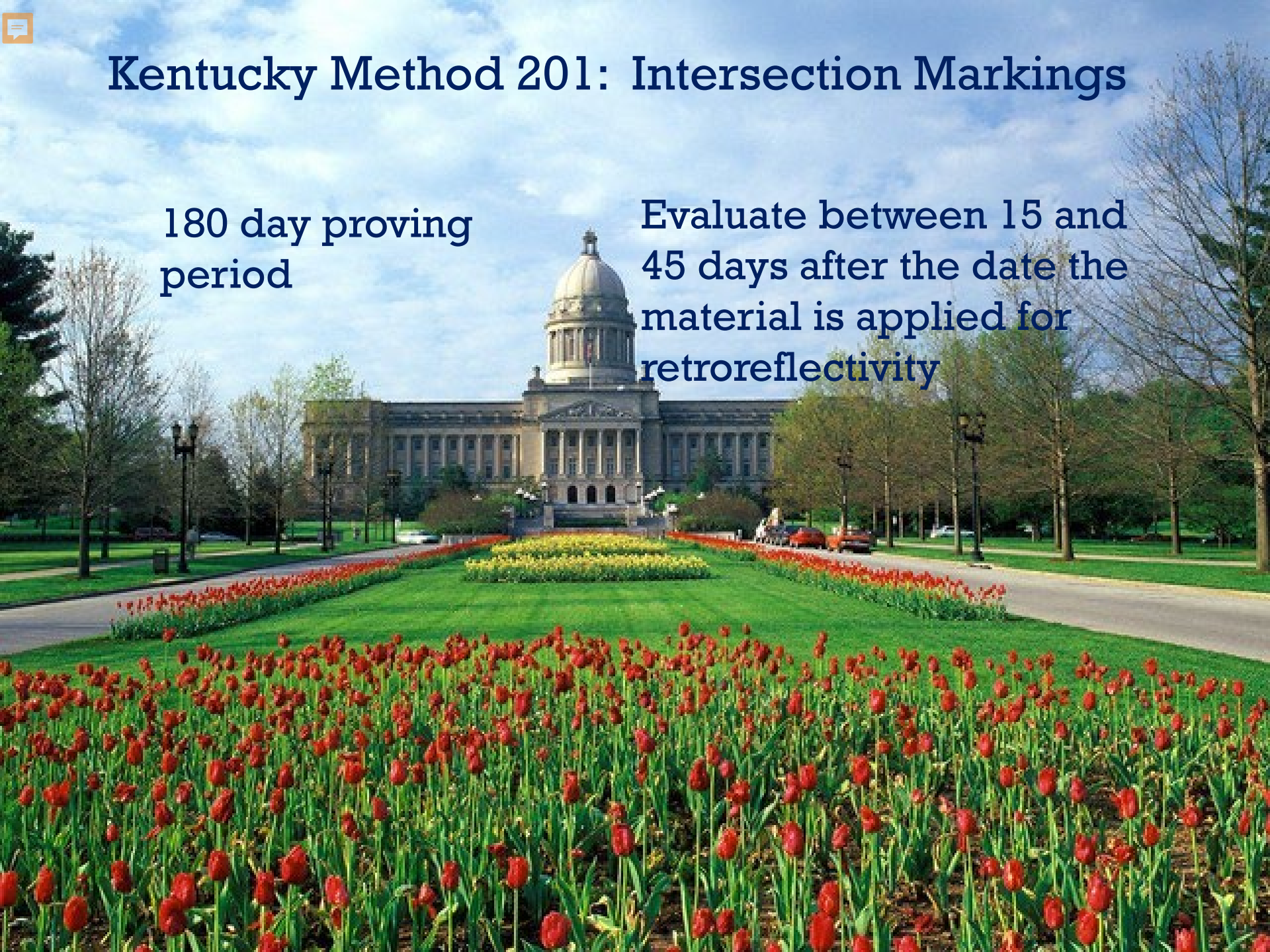
Using

Portable

Hand-Operated

Instruments

Kentucky Method 201: Intersection Markings



180 day proving period

Evaluate between 15 and 45 days after the date the material is applied for retroreflectivity

Kentucky Method 201: Intersection Markings

- Each marking is considered separately
- Evaluate two markings per intersection
- Take two readings on each marking

KM201: Intersection Markings

Performance Requirements

If all readings meet or exceed the minimum requirements markings are accepted

White = 300 mcd/m^2/lux
Yellow = 225 mcd/m^2/lux

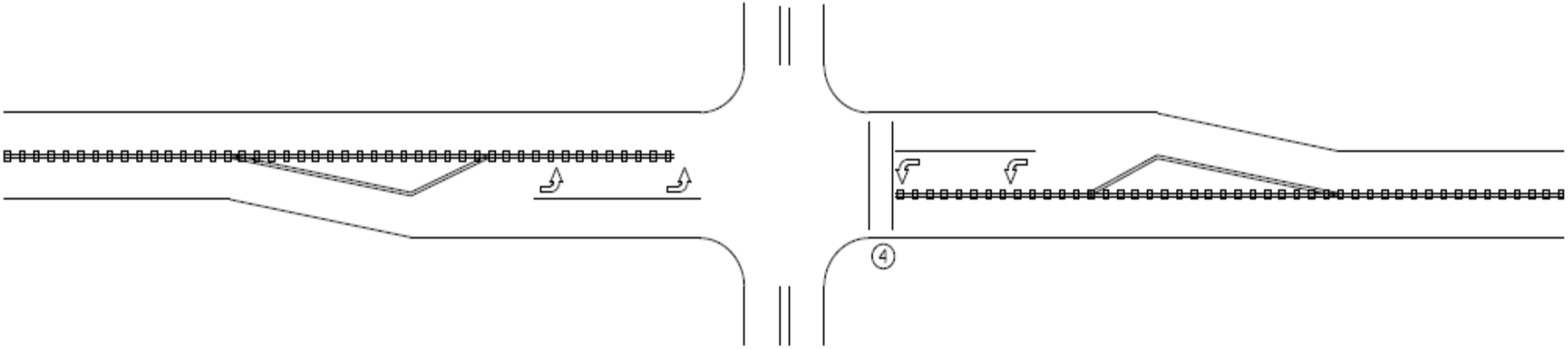
If any reading fails to meet the minimum requirements additional readings will be taken.

KM 201: Additional Readings

Additional readings are taken to assess which markings need to be repaired or replaced.

1. Visually inspect markings
2. Bond checks

3. Select two markings
   Ex. Left turn arrow and stop bar



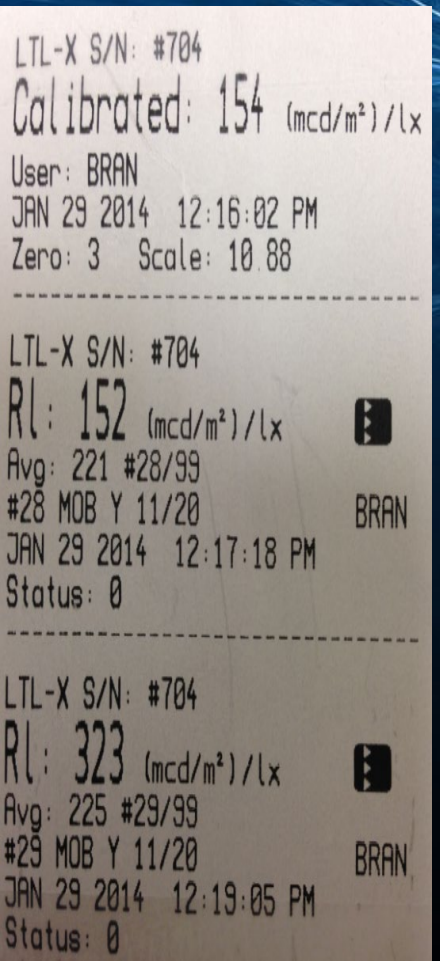
INTERSECTION WITH LEFT-TURN LANES

4. Take two readings on each markings
Ex. Two readings on the left turn arrow
Two readings on the stop bar

5. Additional readings if any of the original readings fail
Ex. If the left turn arrow selected fails, take retroreflectivity readings on the other left turn arrows

KM201: Intersection Markings

Reporting



- Printout
- Date and time of application of the pavement markings (from contractor's DSR)
- Location (County, Intersection and marking

KM201 Update

The readings shall be printed from either the on-board printer or an on-site printer linked directly to the hand operated instrument.

Evaluation of Retroreflectivity on Pavement Markings Using Portable Hand-Operated Instruments

Kentucky Method 202: Definitions

Moonbow

Section: Portion of striping completed For a single color per line width by one crew in one shift

Segment: Portion equal to one fifth (or more) of a section

Zone: Location within a segment where one begins taking readings

Kentucky Method 202:
Definitions Continued

- Crew
  - Group of two or more people identified by the striper and the driver
- Shift
  - Period of time where a single crew works continuously stopping for legally required breaks

Kentucky Method 202: Handheld Inspection of Pavement Striping

Divide each section according to the striping completed

Section	Number of Segments Required
≥ 30 Miles	5 Segments
≥ 10 Miles and < 30 Miles	3 Segments
< 10 Miles	1 Segment

KM 202: Handheld Inspection of Pavement Markings

Establishing the Zone

KM202: Handheld Inspection of Pavement Markings
Establishing the Zone

- Randomly generate the starting point of a zone within each segment
  - Mark the beginning of each zone with spray paint
- Start each zone for the section at the same distance into each segment
- The starting point of the first zone is used to establish the location of the next zone within the next segment

KM202: Handheld Inspection of Pavement Markings

Retroreflectivity Readings

- Retroreflectivity readings are to be taken in the direction the striper applied the line
  - Take readings in both directions
  - Whichever direction gives you the higher reading, is the way the striper was headed when the line was applied

KM 202:Handheld Inspection of Pavement Markings

Readings Within the Zone

- Obtain 20 readings in each zone
  - Take the first reading at the beginning of the zone
  - Take subsequent readings at 15 foot intervals
  - For centerlines, alternate readings between the solid lines or on the combination of solid and skip lines
    - Measure each skip at two evenly spaced locations

KM 202: Handheld Inspection of Pavement Markings

Moving the Zone

Kentucky State Fruit: Blackberry
Credit: United States Department of Agriculture (USDA)

- Move the zone if any portion is unsafe
- Change in starting point of one zone should not change the starting point for the next zone
- Move ahead within the zone if readings cannot be taken due to
  - Potholes
  - Grass
  - Break in pavement
  - Debris

KM 202: Handheld Inspection of Pavement Markings

Pass/Fail Segments

If 80% or more of the readings within a zone pass, the segment passes

If less than 80% of the readings pass, additional readings must be taken

	White
	301
	315
	325
	432
	363
	299
	312
	313
	338
	287
	278
	304
	317
	291
	319
	325
	303
	314
	293
	326
Average	317.75

Bibb lettuce, America's first gourmet lettuce, developed by John Bibb of Frankfort, KY

KM202: Handheld Inspection of Pavement Markings

Additional Readings

Happy birthday to you,
Happy birthday to you,
Happy birthday dear
[Pavement Markings Inspection Technician participants]
Happy birthday to you.

By Patty and Mildred Hill of Louisville, KY

- Establish two additional zones within the segment
- Take twenty readings in each of the two additional zones
- If 80% or more of all readings in the segment pass, the segment passes

KM 202: Exception

If 13 or more of the readings in the first zone in a segment fail, additional readings are unnecessary

The segment fails

KM202: Handheld Inspection of Pavement Markings
Pass/Fail Section

- 3 segments fail (section > 30 miles)
  - The section is not accepted
- 1 segment fails (section < 30 miles)
  - The section is not accepted

KM 202: Handheld Inspection of Pavement Markings

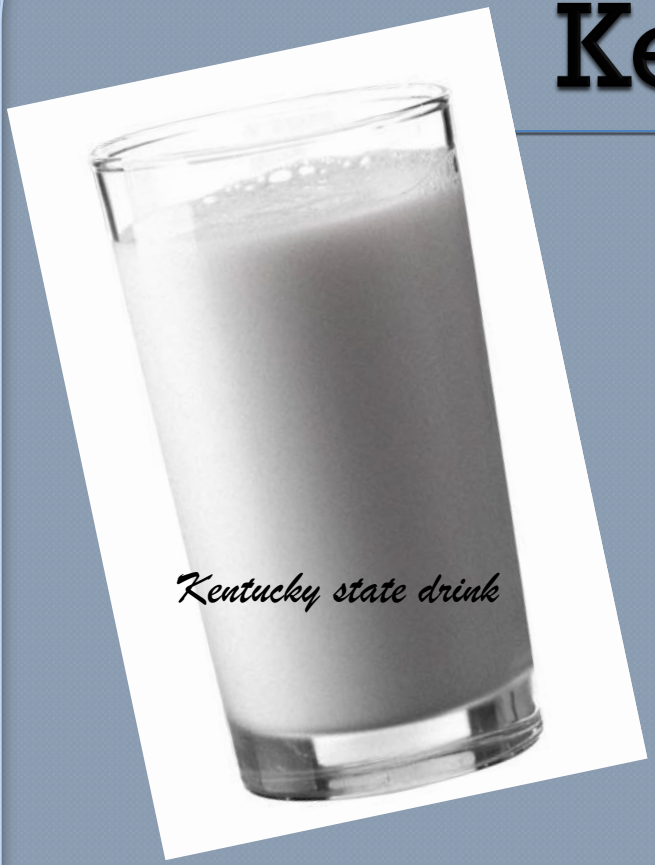
Reporting

- Printout
- Date and Time of Application
- Location of Test

KM 202 Update

The readings shall be printed from either the on-board printer or an on-site printer linked directly to the hand operated instrument.

Kentucky Method 203



Evaluation of Retroreflectivity on Permanent Markings Using Mobile 30 Meter Geometry Instruments

KM 203: Mobile Evaluation of Pavement Markings

Definitions

- Section
  - Portion of striping completed for a single color per line width by one striping crew in one shift
- Segment
  - Portion equal to one-tenth of a mile of a section
    - Segment is 528 feet

KM 203: Mobile Evaluation of Pavement Markings
Definitions Cont.

- Crew
  - Two or more people identified by the truck and driver applying pavement markings
- Shift
  - Period of time where a single crew works continuously

KM 203: Mobile Inspection of Pavement Markings

Evaluation

- At least 50% of all segments in each section will be evaluated by the mobile
- The mobile will pass/fail sections
- Readings will be taken in the direction the striper applied the line

KM 203: Mobile Evaluation of Pavement Markings

Pass/Fail Criteria

- If
  - 80% or more of the segments for a section pass, the section passes
- If
  - Less than 80% of the segments pass, the section will not be accepted

KM 203: Mobile Evaluation of Pavement Markings
Reporting

- Mobile Readings
  - Date and time of test
  - Calibration Information
  - % Passing
- Date and Time of Application
  - From mobile request form
- Location of Test

Daily Striping Report

User Instructions | Clear Route Information | Add More Rows to Route Information

Contractor & District Information

DISTRICT	1	CONTRACTOR	[Name]
CONTACT			[Mailing Address]
PROJECT TYPE:	Rehabilitation / Resurfacing		[City, ST ZIP CODE]
FUNDING STRIP:			[Phone]
CONTRACT ID:			[Fax]
APPLICATION DATE:	1/12/2011		[E-Mail Address]
APPLICATION TYPE:	Temporary		[Crew Name / No.]
FIRST DAY TO TEST:	2/11/2011		[Driver]
LAST DAY TO TEST:	3/13/2011		[Striping Truck]
SECTION STATUS:	ACCEPT AT 100% PAY		[Comment]

Route Information

County	Route	Direction	Color	Width	Line Type	Starting Milepoint	Ending Milepoint	Striped Line Length (Feet)	Route Length (Feet)	Route Type	Mobile (KM 203)?	Corrective Re-stripe?

Materials	Comments
Yellow WB Traffic Paint	
White WB Traffic Paint	
Beads	

Totals Summary

Striped Line Length (Feet)	MP 4" W	MP 4" Y	MP 6" W	MP 6" Y		RS 4" W	RS 4" Y	

To request measurement of retroreflectivity in accordance with KM203, please email all correspondence to brandi.mitchell@ky.gov. Please notify Central Office at least two (2) weeks in advance of when mobile testing is needed.

Kentucky Method Questions


5116
5116

Kentucky Method 64-201-23
Dated 02/22/23
Supersedes KM 64-201-08
Dated 02/04/08

EVALUATION OF RETROREFLECTIVITY ON INTERSECTION PAVEMENT MARKINGS USING PORTABLE HAND-OPERATED INSTRUMENTS

1. SCOPE:

   1.1. This method covers the evaluation of retroreflectivity on pavement markings using portable hand-operated instruments.

   1.2. It is intended to provide standards of intersection pavement markings to assure that adequate retroreflectivity for the driver is provided by newly applied markings.

   1.3. Thermoplastic intersection pavement markings will be evaluated in a period of not less than 15 to no more than 45 days after the date the materials are applied.

2. TERMINOLOGY: Retroreflectivity: a standard of measure for pavement markings. The units for these readings are millicandelas per square meter per lux ($mcd/m^2/lx$).

3. SUMMARY OF SPECIFICATION:

   3.1. Perform a visual inspection and bond checks for each marking.

   3.2. Perform retroreflectivity tests at each intersection on at least 2 markings.

   3.3. For the purpose of evaluating retroreflectivity, each marking will be considered separately with 2 readings taken on each marking evaluated. Readings will not be taken on portions of the marking that are in the wheel track or where build up of road debris such as oil, grease, etc. would provide readings not representative of the quality of the work.

4. PERFORMANCE REQUIREMENTS:

   4.1. Retroreflectivity: The pavement marking will be evaluated for acceptance within the time period detailed in section 1.3.

   4.2. If all four readings taken in an intersection meet or exceed the required minimum retroreflectivity values established for the materials that are being measured, the intersection markings that are being evaluated will be accepted.

   4.3. If any of the readings taken in an intersection are below the required minimum retroreflectivity values established for the materials that are being measured, additional readings will be taken within the intersection that is being evaluated.

   4.4. Taking additional readings: At the discretion of the engineer, additional readings may be taken to assess which markings within an intersection need to be replaced or repaired.

5. REPORTING:

5.1. Include the following in the inspection report:

5.1.1. Printout of the readings taken with the hand-operated instrument (which should show date and time of test and zero reading and calibration). The readings shall be printed from either the on-board printout on the hand-operated instrument or an on-site printer linked directly to the hand-operated instrument.

5.1.2. Date and time of application of the pavement marking from the Contractors Daily Report.

5.1.3. Location (County, intersection, marking tested and any special information).

5.2. Readings shall be recorded in millicandelas per square meter per lux ($mcd/m^2/lx$).

5.3. Measurement shall be reported for each intersection of markings per day.

APPROVED Allen H. Myers

DIRECTOR
DIVISION OF MATERIALS

DATE 02/22/23

Kentucky Method 64-201-23
Dated 02/22/23
Supersedes KM 64-201-08
Dated 02/04/08

Kentucky Method 64-202-23
Revised 02/22/23
Supersedes KM 64-202-12
Dated 01/20/12

EVALUATION OF RETROREFLECTIVITY ON PAVEMENT MARKINGS USING PORTABLE HAND-OPERATED INSTRUMENTS

1. SCOPE:

1.1. This method covers the evaluation of retroreflectivity on pavement markings using portable hand-operated 30-meter geometry instruments.

1.2. It is intended to provide standards of horizontal pavement markings to assure that adequate retroreflectivity for the driver is provided by newly applied markings.

1.3. Waterborne and durable waterborne pavement markings will be evaluated in a period of not less than 30 to no more than 60 days after the date the materials are applied.

1.4. Durable pavement markings such as Thermoplastic, Permanent Pavement Tapes, and Epoxies will be evaluated in a period of time not less than 150 days to no more than 210 days after the date the materials are applied.

2. TERMINOLOGY:

2.1. Section: a portion of striping completed for a single color per line width by one striping crew in one shift.

2.2. Segment: a portion equal to one fifth (or more) of a section.

2.3. Zone: a location in each segment where one begins taking retroreflectivity readings.

2.4. Retroreflectivity: a standard of measure for pavement markings. The units for these readings are millicandelas per square meter per lux ($mcd/m^2/lx$).

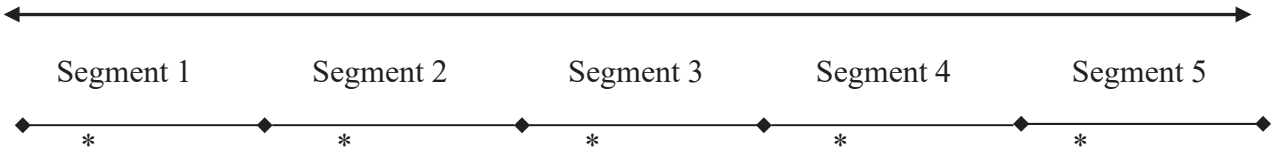
2.5 Crew: a group of two or more people identified by the striper and the driver of the striper applying pavement markings.

2.6 Shift: a period of time whereby a single crew works continuously stopping only for legally required breaks

3. SUMMARY OF SPECIFICATION:

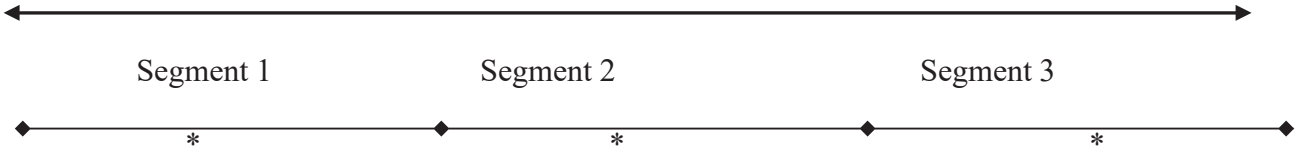
3.1. For the purpose of evaluating retroreflectivity, each section will be evaluated separately. Divide each section into segments containing a zone (as shown in Figure 1A, Figure 1B, Figure 1C, and as described in Step 3.2). Establish five segments to collect readings to represent a day's striping if the total day's striping is >30 miles. Establish three segments to collect readings to represent a day's striping if the total day's striping is >10 miles and <30 miles. If the total day's striping is <10 miles the day will be considered one segment.

Figure 1A. Striping Day (> 30 miles)



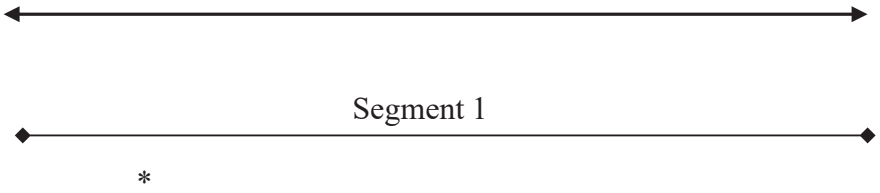
*Marks beginning of the Zone in each Segment

Figure 1B. Striping Day (> 10 miles and < 30 miles)



*Marks beginning of the Zone in each Segment

Figure 1C. Striping Day (< 10 miles)



*Marks beginning of Zone in the Segment

3.2. As stated in Step 3.1, divide the number of miles striped in a day to establish the length of each segment. In the first segment, randomly generate a milepoint (to the nearest tenth of a mile) to begin taking readings in the first zone. The distance from the beginning of the segment to the beginning of the zone (distance **a***), in the first zone, will be used to establish the location of each successive zone within successive segments (See Figure 2)

Figure 2.

NOTE: **a***=distance each time, from beginning of each segment, to beginning of zone.

3.3. Mark the beginning and ending point of each zone with spray paint. Make sure the calibration transfer is not more than one week old. Perform a daily calibration on the hand-operated instrument according to the manufacturer's instructions. Print the calibration readings at the beginning of each days work. Recalibrate the instrument every 2 hours when taking continuous readings or before taking readings if the instrument has not been used for 30 minutes or more. Print the calibration readings each time these operations are performed.

3.4. Take 20 readings in each of the zones in the direction the striper applied the traffic markings. Take the first reading exactly at the beginning of the zone. Take subsequent readings at approximately 15-foot intervals (5 paces). If any portion of the zone is unsafe for taking readings, move forward to the first point which can be inspected safely and begin the zone there. Do not move the zone simply for convenience. A change in the starting point of one zone should not change the starting points of any subsequent zones. Also, if a valid reading is not attainable at a location within the zone due to a pothole, grass, occasional tracking, etc., move forward in the zone to the first available location for a valid reading, then resume the subsequent readings within that zone in the incremental procedure described above. However, readings will be taken in areas with substantial amounts of tracking.

3.5. For readings taken on centerlines, take alternating readings between solid lines or on the combination of solid and skip lines.

3.6. When a zone contains only skip lines for evaluation, measure each skip line at two evenly spaced locations on the line. Continue measuring within the established zone in this manner until 20 readings are obtained.

3.7 When a zone contains multiple line types of the same color and width, i.e. edgeline and lane line, obtain measurements representative of the quantities of line types.

4. PERFORMANCE REQUIREMENTS:

4.1. Retroreflectivity: The pavement marking will be evaluated for acceptance within the time period detailed in sections 1.3 and 1.4.

4.2. If 80% (16 or more) of the readings in a zone meet or exceed the required minimum retroreflectivity values established for the materials that are being measured, the segment that is being evaluated will be accepted.

4.3. If less than 80% (less than 16) of the readings in a zone meet the required minimum retroreflectivity values established for the materials that are being measured, additional readings will be taken within the segment that is being evaluated.

4.4. Taking additional readings - Randomly establish two (2) new zones within the segment in question using the procedure detailed in section 3.2. Obtain readings for each of these zones as described in 3.2 –3.4. These readings will be combined with the initial readings for evaluation of the segment. If less than 80% of the 60 readings (20 in each of three zones) taken within a segment meet the minimum retroreflectivity requirements established

for the materials that are being measured, the segment is not accepted. Alternatively, if 13 or more of the first 20 readings taken within a segment fail to meet the minimum retroreflectivity requirements established for the materials that are being measured, the segment is not accepted and additional testing within that segment is not required.

4.5. If three of five segments are not accepted on a section of striping that is ζ 30 miles in length, the entire section of striping will not be accepted. If one segment is not accepted on a section of striping that is <30 miles in length, the entire section of striping will not be accepted.

5. REPORTING:

5.1. Include the following in the inspection report:

5.1.1. Printout of the readings taken with the hand-operated instrument (which should show date and time of test and zero reading and calibration). The readings shall be printed from either the on-board printer of the hand-operated instrument or an on-site printer linked directly to the hand operated instrument.

5.1.2. Date and time of application of the pavement marking from the Contractors Daily Striping Report

5.1.3. Location (County, route, milepoint, intersection, direction of travel, color of line, line type and any special information)

5.2. Record readings in millicandelas per square meter per lux ($mcd/m^2/lx$).

5.3. Report measurements for each section of striping per color per line width per shift.

APPROVED Allen H. Myers

DIRECTOR
DIVISION OF MATERIALS

DATE 02/22/23

Kentucky Method 64-202-23
Revised 02/22/23
Supersedes KM 64-202-12
Dated 01/20/12

Kentucky Method 64-203-12
Revised 01/20/12
Supersedes KM 64-203-10
Dated 01/15/10

EVALUATION OF RETROREFLECTIVITY ON PERMANENT PAVEMENT MARKINGS USING MOBILE 30 METER GEOMETRY INSTRUMENTS

1. SCOPE:

1.1. This method covers the evaluation of retroreflectivity on permanent pavement markings using mobile 30-meter geometry instruments.

1.2. It is intended to provide standards of horizontal pavement markings to assure that adequate retroreflectivity for the driver is provided by newly applied markings.

1.3. Waterborne and durable waterborne pavement markings will be evaluated in a period of not less than 30 to no more than 60 days after the date the materials are applied.

1.4. Durable pavement markings such as Thermoplastic, Permanent Pavement Tapes, and Epoxies will be evaluated in a period of time not less than 150 days to no more than 210 days after the date the materials are applied.

2. TERMINOLOGY:

2.1. Section: a portion of striping completed for a single color per line width by one striping crew in one shift.

2.2. Segment: a portion equal to one-tenth of a mile of a section.

2.3. Retroreflectivity: a standard of measure for pavement markings. The units for these readings are millicandelas per square meter per lux ($mcd/m^2/lx$).

2.4. Crew: a group of two or more people identified by the striper and the driver of the striper applying pavement markings.

2.5. Shift: a period of time whereby a single crew works continuously stopping only for legally required breaks.

3. SUMMARY OF SPECIFICATION:

3.1. For the purpose of evaluating retroreflectivity, data obtained through evaluation according to KM 64-203 will be collected and evaluated separately for each section.

3.2. Calibrate the mobile instrument. Record calibration measurements at the beginning of the day's work. Recalibrate the instrument as necessary when taking readings. Provide the calibration measurements in the retroreflectivity report, each time these operations are performed.

3.3. The Department will provide the Contractor operating the mobile retroreflectometer with routes for evaluation. The routes evaluated will represent at least 50% of the segments completed in a section of striping. Data shall be collected in the direction the striper applied the traffic markings.

4. PERFORMANCE REQUIREMENTS:

4.1. Retroreflectivity: The pavement marking will be evaluated for acceptance within the time periods detailed in sections 1.3. and 1.4.

4.2. If 80% or more of the segments evaluated in a section meet or exceed the required minimum retroreflectivity values established for the materials that are being measured, the section will be accepted.

4.3. If less than 80% of the segments evaluated in a section meet the required minimum retroreflectivity values established for the materials that are being measured, the section will not be accepted.

5. REPORTING:

5.1. Include the following in the inspection report:

5.1.1. Calibration information for the mobile retroreflectometer.

5.1.2. Average of the readings taken for each segment evaluated by the mobile retroreflectometer (which should show date of test, total number of segments, passing segments, % passing segments, failing segments and % failing segments).

5.1.3. Date of application of the pavement marking.

5.1.4. Location (District, county, route, starting milepoint, ending milepoint, line type, direction of travel, color of line, and any special information).

5.2. Readings shall be recorded in millicandelas per square meter per lux ($mcd/m^2/lx$).

5.3. Measurement shall be reported for each section of striping per color per line width per shift.

APPROVED Allen A. Myers

DIRECTOR
DIVISION OF MATERIALS

DATE 01/24/12

Kentucky Method 64-203-12
Revised 01/20/12
Supersedes KM 64-203-10
Dated 01/15/10

MATERIALS HANDLING

Materials Handling

1

Temporary Striping Materials

Permanent Striping Materials

- Resurfacing, rehabilitation & restoration
- District wide striping

Ben Creech, Chemist (Structural Coatings and Epoxies)

2

Temporary Striping

TEMPORARY PAINT

TEMPORARY TAPE

3

Temporary Paint Materials Requirement

- LESS THAN 120 DAYS – NO SAMPLE
- GREATER THAN 120 DAYS – SEND SAMPLES
  - Conform to Section 842 and 846
  - Manufacturer's Certification
  - Do not sample glass beads

Pranab Nandy, Chemist (Traffic Paint, Fasteners)

4

Temporary Tape Materials Requirement

CONFORM TO SECTION 831: CONSTRUCTION ZONE TEMPORARY MARKING TAPES

MANUFACTURER'S CERTIFICATION

LIST OF APPROVED MATERIALS

Bel Kunwar (Trans Engr Technologist III

5

Resurfacing, Rehabilitation and Restoration Contracts

WATERBORNE AND DURABLE WATERBORNE TRAFFIC PAINT

EXTRUDED, SPRAY AND RIBBON THERMOPLASTIC

TYPE I TAPE

DO NOT SAMPLE GLASS BEADS

6

Waterborne & Durable Waterborne Paint (Resurfacing Rehabilitation & Restoration Contracts)

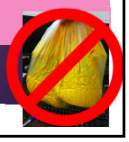
CONFORM TO SECTION 842 & 846

MANUFACTURER'S CERTIFICATION

RANDOMLY SAMPLE PAINT FROM STRIPER

Minimum of one per color per project
Paint samples should be taken from the striper

SITE MANAGER SAMPLE RECORD FORM



7

Extruded Thermoplastic

(Resurfacing, Rehabilitation & Restoration Contracts)

THERMOPLASTIC MUST MEET THE REQUIREMENTS OF SECTION 837

MANUFACTURER'S CERTIFICATION

SITE MANAGER SAMPLE RECORD FORM

MOLTEN SAMPLE FROM THE STRIPER'S GUN IN A 9-IN BY 12-IN DISPOSABLE ALUMINUM PAN

Habiba Dowla, Instrumental Analysis, Senior Chemist

8

Sampling Extruded Thermoplastic

(Resurfacing, Rehabilitation & Restoration Contracts)

SMALL QUANTITIES < 250 POUNDS

Manufacturer's Certification

QUANTITIES > 250 POUNDS

Manufacturer's Certification

Obtain samples in accordance with MS-507 Thermoplastic in the Sampling Manual

9

Type I Tape

(Resurfacing, Rehabilitation & Restoration Contracts)

MEET THE REQUIREMENTS OF SECTION 836 OF THE STANDARD SPECIFICATIONS

Manufacturer's Certification

Minimum retroreflectivity requirements

White: 500 mcd/m²/lux

Yellow: 500 mcd/m²/lux

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Waterborne & Durable Waterborne Paint

(District Wide Striping Contracts)

CONFORM TO SECTION 842 & 846

Deduction shall apply to color from 4.1 to 6.0 (also for Resurf.)

No paint accepted with color deviation > 6.0 (also for Resurf.)

Minimum contrast ratio for white 0.990 and yellow is 0.980

MANUFACTURER'S CERTIFICATION

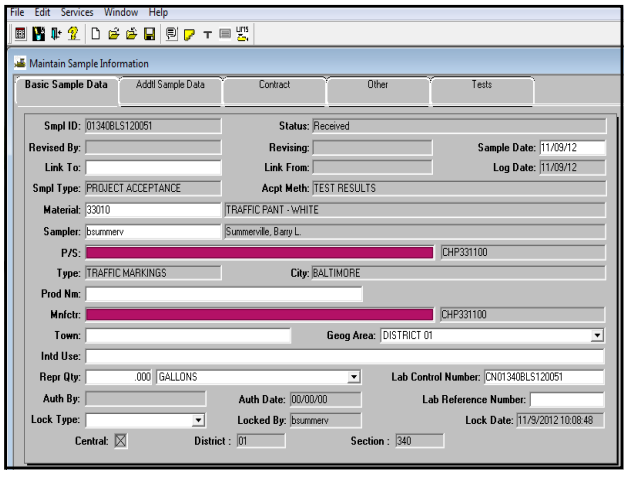
SAMPLES

Minimum of one per color per truck per week

Paint samples should be taken from the striper

SITE MANAGER SAMPLE RECORD FORM

11



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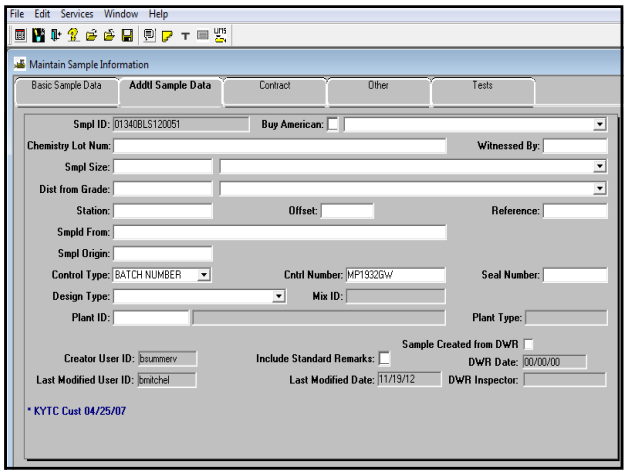
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Other
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Witnessed By:
Smpl Size:
Dist from Grade:
Station:
Offset:
Reference:
Smpld From:
Smpl Origin:
Control Type: BATCH NUMBER
Cntrl Number: MP1932GW
Seal Number:
Design Type:
Mix ID:
Plant ID:
Plant Type:
Sample Created from DWR
Creator User ID: bsummerv
Include Standard Remarks:
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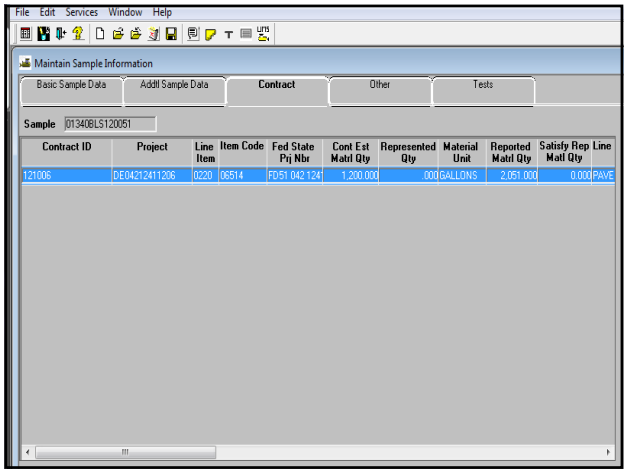
Last Modified User ID: bmitchel
Last Modified Date: 11/19/12
DWR Inspector:
* KYTC Cust 04/25/07

13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Project
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Item Code
Fed State Prj Nbr
Cont Est Matl Qty
Represented Qty
Material Unit
Reported Matl Qty
Satisfy Rep Line Matl Qty
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0220
06514
FD51 042 124
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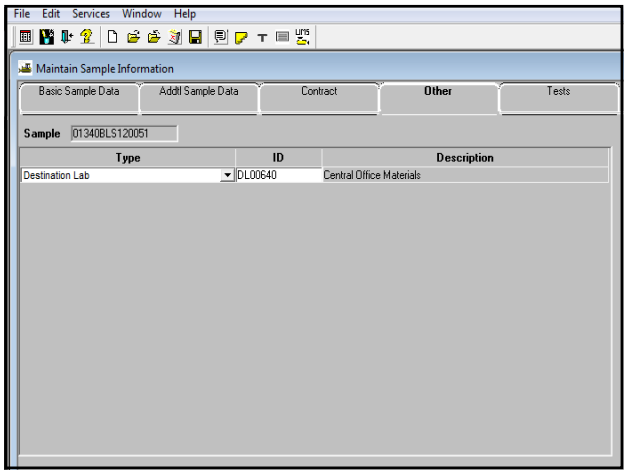
GALLONS
2,051.000
0.000
PAVE

14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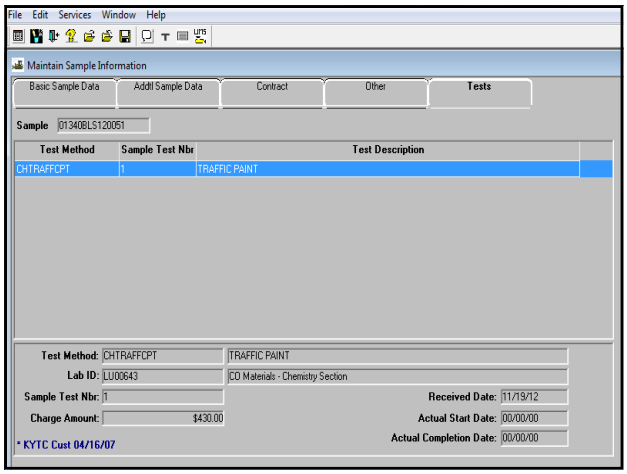
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Test Method
Sample Test Nbr
Test Description
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1
TRAFFIC PAINT
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TRAFFIC PAINT
Lab ID: LU00643
CO Materials - Chemistry Section
Sample Test Nbr: 1
Received Date: 11/19/12
Charge Amount: $430.00
Actual Start Date: 00/00/00
Actual Completion Date: 00/00/00
* KYTC Cust 04/16/07

16


FIRE EXTINGUISHER
Questions?

17

SECTION 831 — CONSTRUCTION ZONE TEMPORARY MARKING TAPES

831.01 DESCRIPTION. This section covers pavement marking material designed to provide reflective delineation in construction zones. This section covers the following types of marking material:

A) Type A. Non-removable Pavement Marking Tape.
B) Type B. Removable Pavement Marking Tape.

831.02 GENERAL.

831.02.01 Manufacture. Use a material consisting of a weather and traffic-resistant reflective film on a backing precoated with a pressure-sensitive adhesive.

831.02.02 Adhesive. Use a precoated pressure-sensitive adhesive that does not require a liner or activation.

831.02.03 Application Properties. Ensure that the material adheres to asphalt and concrete surfaces, when applied according to the manufacturer's recommendations, at or above surface temperatures of 40 °F. Ensure that the material does not require any protective devices such as traffic cones or barricades after application. Do not allow re-use of previously installed material.

831.02.04 Conformability and Thickness. Use material that is thin, flexible, formable, and remains conformed to the texture of the pavement surface following application. Ensure that the thickness of the material furnished is within 2 mils of the thickness of the material submitted for approval. Use tape with a minimum width of 4 inches.

831.02.05 Miscellaneous Requirements. Ensure that the supplied material is of good appearance, free from cracks, with edges true, straight, and unbroken. Make the material available in rolls with no more than 3 splices per 50 yards of length. Package the material according to accepted commercial standards. Ensure that the supplied material is capable of being stored at temperatures up to 100 °F for a period of one year after purchase without adversely affecting the physical properties stated in this section.

831.03 APPROVAL. The Department will approve temporary marking tapes based on conformance to KM 64-207 and the requirements of this section. The Department may remove temporary marking tapes from the Department's List of Approved Materials for poor field performance in Kentucky.

831.04 CERTIFICATION. Submit manufacturer's certification stating conformance to the requirements of this section for each shipment of approved temporary marking tapes delivered for use on projects. Clearly state the manufacturer, product name, product code and color as listed in the Department's List of Approved Materials. Identify the lot number(s), expiration date and quantity delivered.

831.05 ACCEPTANCE. The Department will accept temporary marking tapes based on verification of inclusion on the Department's List of Approved Materials, compliance of the manufacturer's certification, verification the expiration date will not be exceeded, and visual inspection of the temporary marking tape installation. The Department reserves the right to sample and test temporary marking tape, at the discretion of the Engineer, in accordance with the Department's Field Sampling and Testing Manual.

SECTION 836 - DURABLE PREFORMED PAVEMENT MARKINGS TYPE I TAPE

836.01 GENERAL. Use preformed pavement marking material consisting of white or yellow films with retroreflective optics incorporated to provide immediate and continuing retroreflection.

Use preformed pavement marking material capable of adhering to new dense and open graded asphalt surfaces, during the paving operation, or portland cement concrete by a pre-coated pressure sensitive adhesive. The Engineer may require a primer to precondition the pavement surface. Ensure that the markings conform to pavement contours by the action of traffic. Ensure that, after application, the markings are immediately ready for traffic.

Ensure that these markings provide long term reflectivity, as determined in the following performance requirements, when applied according to the manufacturer's instructions.

Ensure that the preformed markings are suitable for use one year after the date of receipt when stored according to the manufacturer's recommendations.

836.02 REQUIREMENTS.

836.02.01 Composition. Use retroreflective preformed pavement markings consisting of a mixture of high quality polymeric materials, pigments, and retroreflective optics distributed throughout its base cross sectional area.

836.02.02 Reflectance. Ensure that the white and yellow markings have the following minimum reflectance values as measured according to the testing procedures of ASTME 1701. Measure the coefficient of retroreflective luminance and express the value as millicandelas per square meter per lux [$(mcd/m^2)lx^{-1}$].

MINIMUM REFLECTANCE			
Color	Entrance Angle	Observation Angle	Minimum Reflectance
White	88.76º	1.05º	500 minimum
Yellow	88.76º	1.05º	500 minimum

836.02.03 Skid Resistance. Ensure that the surface of the retroreflective material provides an initial minimum skid resistance value of 45 BPN when tested according to ASTM E 303.

836.02.04 Patchability. Ensure that the pavement marking material is capable of use for patching worn areas of the same type according to the manufacturer's recommendations.

836.02.05 Material Quality. Replace any material used as longitudinal or intersection markings that fails minimum reflectivity values or fails due to loss of adhesion or complete wear through. Minimum replacement zone is 300 feet of roadway length or one intersection marking.

836.03 APPROVAL. The Department will approve Type I pavement marking tape based on conformance to KM 64-207 and this section.

836.04 CERTFICATION. Submit manufacturer's certification stating conformance to the requirements of this section for each shipment of approved Type I pavement marking tape for use on projects. Clearly state the manufacturer, product name and product code and color as listed in the Department's List of Approved Materials. Identify the lot number(s), expiration date, and quantity delivered.

836.05 ACCEPTANCE. The Department will accept Type I pavement marking tape based on verification of inclusion on the Department's List of Approved Materials, compliance of the manufacturer's certification, and visual inspection of the installation of the Type I pavement marking tape.

SECTION 837 - EXTRUDED THERMOPLASTIC PAVEMENT MARKING MATERIALS

837.01 GENERAL. This section covers extruded thermoplastic pavement marking materials for permanent applications.

837.02 DROP ON BEADS. Use beads that will ensure the pavement marking material will meet retroreflectivity requirements. The Department will evaluate the beads as part of the marking system through retroreflectivity readings.

837.03 APPROVAL. Select materials that conform to the composition and physical characteristic requirements below when evaluated in accordance with KM 64-268 or other test methods as cited. The Department will obtain samples of thermoplastic material for compliance testing to the requirements of this sections in accordance with the Department's Materials Field Sampling Manual.

837.03.01 Composition. Use a maleic-modified glycerol ester resin (alkyd binder) to formulate the thermoplastic material. Ensure the pigment, pre-mix beads, and filler are uniformly dispersed in the resin. Use material that is free from all dirt and foreign material. Annually provide independent analysis data and certification for each formulation stating the total concentration of each heavy metal present, the test method used for each determination, and compliance to 40 CFR 261 for leachable heavy metals content. Manufacturers are to produce extruded thermoplastic in compliance with the values listed in Table 1.

837.03.02 Table 1.

COMPOSITION (Percentage by Weight)		
Component	White	Yellow
Binder, [1]	18.0 min.	18.0 min.
Glass Beads (Premixed)	30 - 40	30 - 40
Titanium Dioxide	10.0 min.	—
Calcium Carbonate & Inert Fillers [2]	42.0 max.	50.0 max.
Heavy Metals Content	Comply with 40 CFR 261	Comply with 40 CFR 261

[1]Use a binder that consists of a mixture of synthetic resins, at least one being solid at room temperature, and high boiling point plasticizers. Ensure that at least one-third of the binder composition is solid maleic-modified glycerol ester resin and is not less than 8 percent by weight of the entire material formulation. Do not use alkyd binder that contains petroleum based hydrocarbon resins.

[2]The manufacturer may choose the amount of calcium carbonate and inert fillers, providing all other requirements of this section are met.

837.03.03 Physical Characteristics. For thermoplastic material heated for 4 hours at 425ºF under agitation, conform to the following requirements.

A) Color. As determined with a spectrophotometer using D65 illuminant with a 45 degree entrance angle and 0 degree observation angle geometry.

Deleted: AASHTO T-250

Deleted: . The Department will sample and evaluate for approval each lot of thermoplastic material delivered for use per contract prior to installation of the thermoplastic material

Deleted: The Department will sample and evaluate for approval each shipment of each lot of thermoplastic material delivered for user per contract prior to installation of the thermoplastic material. Do not allow the installation of thermoplastic material until it has been approved by the Division of Materials. Allow the Department a minimum of 10 working days to evaluate and approve thermoplastic material from the date received by the Division of Materials.

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CIELAB Color Coordinates		
	Yellow	White
Daytime Color (CIELAB) Spectrophotometer using illuminant D65 at 45º illumination and 0º viewing with a 2º observer	L* 81.76 a* 19.79 b* 89.89 Maximum allowable variation 6.0ΔE*	L* 93.51 a* -1.01 b* 0.70 Maximum allowable variation 6.0ΔE*
Nighttime Color (CIELAB) Spectrophotometer using illuminant A at 45º illumination and 0º viewing with a 2º observer	L* 86.90 a* 24.80 b* 95.45 Maximum allowable variation 6.0ΔE*	L* 93.45 a* -0.79 b* 0.43 Maximum allowable variation 6.0ΔE*

B) Flowability. Ensure that the white thermoplastic material has a maximum residue of 18 percent and the yellow thermoplastic material has a maximum residue of 21 percent.

C) Set Time. Use material that, when applied at a temperature range of 415 ± 15 ºF and thickness of 40 to 120 mils, sets to bear traffic in not more than 2 minutes when the air and road surface temperature is approximately ≥ 50 ± 3 ºF, and not more than 10 minutes when the air and road surface temperature is approximately < 50 ± 3 ºF.

C) Softening Point. Ensure that the thermoplastic material has a softening point of 215 ± 15 ºF.

C) Bond Strength. Ensure that the bond strength of the thermoplastic material to concrete exceeds 180 psi.

C) Cracking Resistance at Low Temperature. Ensure that the thermoplastic material shows no cracks when observed from a distance exceeding one foot.

C) Impact Resistance. Ensure the impact resistance of the thermoplastic material is a minimum of 1.13 joules.

C) Flash Point. Use thermoplastic material that has a flash point not less than 475 °F.

837.04 PACKAGING. Package thermoplastic material in suitable 50 pound containers to which the material shall not adhere during shipment or storage. Include a label stating that the thermoplastic material is to be maintained with a temperature range of 400 – 440ºF during application. Provide the thermoplastic material in either block or granular form.

837.05 SHELF LIFE. Ensure that the thermoplastic material conforms to this section for a period of one year. Replace any thermoplastic material not conforming to the above requirements.

837.06 MANUFACTURER'S TESTING. Perform testing in accordance with KM 64-268 on a minimum of one composite sample per 10,000 pounds, or portion thereof, per lot of thermoplastic produced.

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837.07 CERTIFICATION. Submit manufacturer's certification stating conformance to the requirements of this section for each lot of extruded thermoplastic delivered for use on projects. Clearly state the manufacture, formulation identification, product name, color, date of manufacturer, lot number (s), expiration date, total quantity of lot produced, actual quantity of thermoplastic material represented, sampling method utilized to obtain the samples, and required manufacturer's testing data for each composite sample tested to represent each lot produced.

837.08 ACCEPTANCE. The Department will accept extruded thermoplastic based on compliance of the manufacturer's certification and conformance of test results obtained by the Department to the requirements of this section.

837.09 ACCEPTANCE OF NON-SPECIFICATION COMPLIANT THERMOPLASTIC

The Department may accept thermoplastic found to be in non-conformance to the Specification Acceptance Range at a reduction in pay, see Table 2. Thermoplastic with analytical test results not conforming to the Specification Acceptance Range but within the Acceptance Range with Deduction may be accepted for incorporation into the project with applicable reductions in pay. Deductions are cumulative to a maximum of 60% reduction in pay applied to the contract unit bid price for the thermoplastic. Thermoplastic with three (3) or more analytical tests resulting in non-conformance to the Specification Acceptance Range or any analytical test result exceeding the Acceptance Range with Deduction will be rejected and removed from the project. Do not allow transfer of thermoplastic materials between projects that have analytical test results in the Acceptance Range with Deduction.

837.10 Table 2.

THERMOPLASTIC PRICE ADJUSTMENT SCHEDULE			
Analytical Test	Specification Acceptance Range	Acceptance Range with Deduction	Deduction Applied to Unit Cost
Binder, %	18.0 min.	16.0 -17.9	50%
Glass Beads % (Premixed)	30-40	28-30	20%
Titanium Dioxide, % for white	10.0 min.	9.0 -9.9	20%
Calcium Carbonate and Inert Fillers for white,	42.0 max.		
Calcium Carbonate and Inert Fillers for Yellow,	50.0 max.		
Heavy Metals Content	Comply with 40 CFR 261		
Color	6.0 ΔE*	6.0 ΔE*- 8.0 ΔE*	10%

SECTION 842 - PAVEMENT STRIPING PAINT

2.01 DESCRIPTION. This section covers quick-drying waterborne acrylic pavement striping paint for permanent applications.

842.02 GENERAL. Select waterborne acrylic paint that conforms to the composition requirements below. Annually provide independent analysis data and certification for each formulation stating the total concentration of each heavy metal present, the test method used for each determination, and compliance to 40 CFR 261 for leachable heavy metals content. Submit initial samples per formulation for approval before beginning striping operations on a yearly basis. The initial sample may be sent from the manufacturer of the paint.

PAINT COMPOSITION		
Property and Test Method	Yellow	White
Daytime Color (CIELAB) Spectrophotometer using illuminant D65 at 45º illumination and 0º viewing with a 2º observer	L* 81.76 a* 19.79 b* 89.89 Maximum allowable variation 4.0ΔE*	L* 93.51 a* -1.01 b* 0.70 Maximum allowable variation 4.0ΔE*
Nighttime Color (CIELAB) Spectrophotometer using illuminant A at 45º illumination and 0º viewing with a 2º observer	L* 86.90 a* 24.80 b* 95.45 Maximum allowable variation 4.0ΔE*	L* 93.45 a* -0.79 b* 0.43 Maximum allowable variation 4.0ΔE*
Heavy Metals Content	Comply with 40 CFR 261	Comply with 40 CFR 261
TiO_2 ASTM D 4764	NA	10% by wt. of pigment min.
VOC ASTM D 2369 and D 4017	1.25-lb/gal max.	1.25-lb/gal max.
Contrast Ratio (at 15 mils wft.)	0.98	0.99

842.03 MANUFACTURER'S TESTING. Perform testing for Daytime and Nighttime Color, Contrast Ratio, Titanium Dioxide (white paints) and Volatile Organic Content (VOC) on each lot of waterborne acrylic paint to be delivered for use on projects.

842.04 SAMPLING. The Department will obtain samples of waterborne acrylic paint for compliance testing to the requirements of this section in accordance with the Department's Materials Field Sampling Manual.

842.05 CERTIFICATION. Submit manufacturer's certification stating conformance to the requirements of this section for each shipment of waterborne acrylic paint delivered for use on projects. Clearly state the manufacturer, product name, product code, lot number(s), expiration date, color, sampling method, test results of manufacturer required testing, and quantity delivered.

842.06 ACCEPTANCE. The Department will accept waterborne acrylic paint based on compliance of the manufacturer's certification and conformance of test results obtained by the Department to the requirements of this section.

842.07 ACCEPTANCE PROCEDURES FOR NON-SPECIFICATION PAVEMENT STRIPING PAINT. When non-specification paint is inadvertently incorporated into the work the Department will accept the material with a reduction in pay. The percentage deduction is cumulative based on its compositional properties, but will not exceed 60 percent. The Department will calculate the payment reduction on the unit bid

price for the routes where the non-specification paint was used. Do not accept waterborne acrylic paint with a Daytime or Nighttime color variation greater than 6.0ΔE* or if the cumulative deduction exceeds 60 percent.

PAVEMENT STRIPING PAINT REDUCTION SCHEDULE					
Non-conforming Property	Color 4.1ΔE* to 6.0ΔE*	Heavy Metals	Ti O_2	VOC	Contrast
Reduction Rate	10%	60%	10 %	60%	10%

SECTION 846 - DURABLE WATERBORNE PAINT

846.01 DESCRIPTION. This section covers quick-drying durable waterborne acrylic pavement striping paint for permanent applications. The paint shall be ready-mixed, one-component, 100% waterborne acrylic striping paint suitable for application on such traffic-bearing surfaces as Portland cement concrete, bituminous cement concrete, asphalt, tar, and previously painted areas of these surfaces.

846.02 GENERAL. Select durable waterborne acrylic paint that conforms to the composition requirements below. Annually provide independent analysis data and certification for each formulation stating the total concentration of each heavy metal present, the test method used for each determination, and compliance to 40 CFR 261 for leachable heavy metals content. Submit initial samples per formulation for approval before beginning striping operations on a yearly basis. The initial sample may be sent from the manufacturer of the paint.

The non-volatile portion of the vehicle shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. The acrylic resin used shall be a 100% cross-linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm-1 with intensities equal to those produced by an acrylic resin known to be 100% cross-linking.

PAINT COMPOSITION		
Property and Test Method	Yellow	White
Daytime Color (CIELAB) Spectrophotometer using illuminant D65 at 45º illumination and 0º viewing with a 2º observer	L* 81.76 a* 19.79 b* 89.89 Maximum allowable variation 4.0ΔE*	L* 93.51 a* -1.01 b* 0.70 Maximum allowable variation 4.0ΔE*
Nighttime Color (CIELAB) Spectrophotometer using illuminant A at 45º illumination and 0º viewing with a 2º observer	L* 86.90 a* 24.80 b* 95.45 Maximum allowable variation 4.0ΔE*	L* 93.45 a* -0.79 b* 0.43 Maximum allowable variation 4.0ΔE*
Heavy Metals Content	Comply with 40 CFR 261	Comply with 40 CFR 261
Titanium Dioxide ASTM D 4764	NA	10% by weight of pigment min.
VOC ASTM D 2369 and D 4017	1.25 lb/gal max.	1.25 lb/gal max.
Contrast Ratio (at 15 mils wft)	0.98	0.99

846.03 MANUFACTURER'S TESTING. Perform testing for Daytime and Nighttime Color, Contrast Ratio, Titanium Dioxide (white paints) and Volatile Organic Content (VOC) on each lot of durable waterborne acrylic paint to be delivered for use on projects.

846.04 SAMPLING. The Department will obtain samples of durable waterborne acrylic paint for compliance testing to the requirements of this section in accordance with the Department's Field Sampling and Testing Manual.

846.05 CERTIFICATION. Submit manufacturer's certification stating conformance to the requirements of this section for each shipment of durable waterborne acrylic paint deliverer for use on projects. Clearly state the manufacturer, product name, product code, color, sampling method, test results of manufacturer required testing, and quantity

delivered.

846.06 ACCEPTANCE. The Department will accept durable waterborne acrylic paint based on compliance of the manufacturer's certification and conformance of test results obtained by the Department to the requirements of this section.

846.07 ACCEPTANCE PROCEDURES FOR NON-SPECIFICATION DURABLE WATERBORNE PAVEMENT STRIPING PAINT. When non-specification paint is inadvertently incorporated into the work the Department will accept the material with a reduction in pay. The percentage deduction is cumulative based on its compositional properties, but will not exceed 60 percent. The Department will calculate the payment reduction on the unit bid price for the routes where the non-specification paint was used. Do not accept waterborne acrylic paint with a Daytime or Nighttime color variation greater than 6.0ΔE*.

DURABLE WATERBORNE PAVEMENT STRIPING PAINT REDUCTION SCHEDULE						
Non-conforming Property	Resin	Color 4.1ΔE* to 6.0ΔE*	Contrast	TiO_2	VOC	Heavy Metals Content
Reduction Rate	60%	10%	10%	10%	60%	60%

LTL 3500

OVERVIEW AND

HANDS ON

DEMONSTRATION

LTL3500 Retroreflectometer

Retroreflection Measurement of Pavement Markings

A New Generation of Retroreflectometer Instruments

Forbes – "Most Dangerous Time to Drive" by Hanna Elliot"

A PART OF FORCE TECHNOLOGY

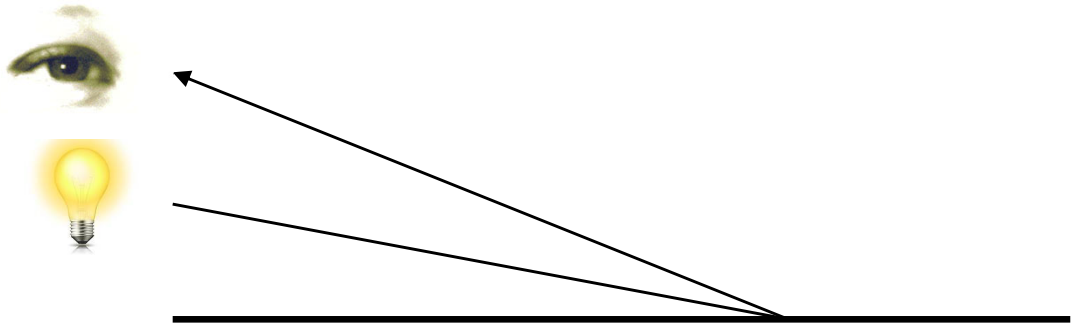
- *"Time of day plays an important role in evaluation fatal crashes, in no small part because other dangerous factors are compounded at night."*
  - *Increase drunk driving*
  - *Increase speeding*
  - *Increase Driving without a safety belt*
- *"Nationwide, 49% of fatal crashes happen at night, with a fatality rate per mile of travel about three times as high as daytime hours."*

MUTCD 11th Edition

- ***Minimum Pavement Marking Retroreflectivity***
  - *Standard*
    - Maintain above 50 mcd/m^2/lux under dry conditions for longitudinal markings on roadways with speed limits of 35 mph or greater
  - *Guidance*
    - Maintain above 100 mcd/m^2/lux under dry conditions for longitudinal markings on roadways with speed limits of 70 mph or greater
  - *Exceptions*
    - Sufficient ambient illumination
    - ADT less than 6,000 vehicles per day
    - Dotted extension lines through an intersection
    - Curb Markings/Parking space markings/Shared used path markings

Retroreflection

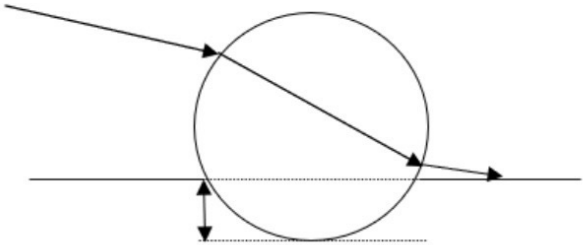
Retroreflectivity is when the light hits the markings and bounces back to the driver's eye



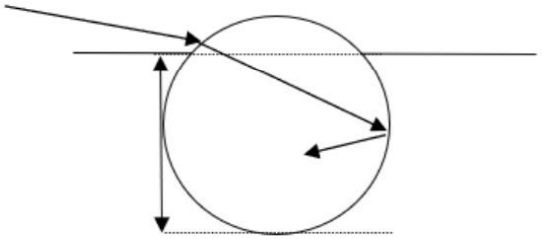
Marking Performance is Affected by

- *Quality of material and application*
- *Embedment of glass beads*
- *Water on roadway*
- *Driver's eyesight*
- *Position and quality of headlamps*
- *Design of marking (profiled)*
- *Color of Marking*
- *Marking profile*
- *Road surface and debris*

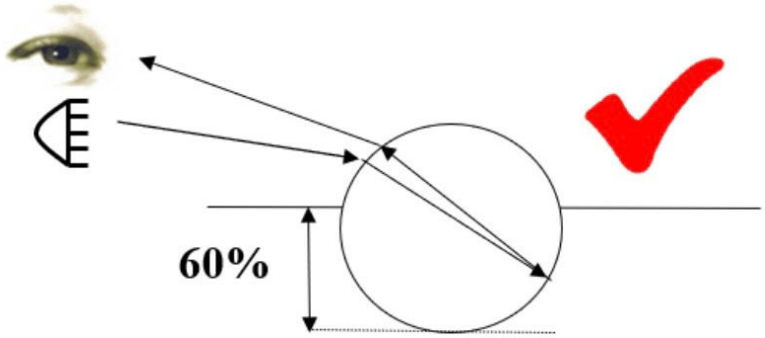
Glass Bead Embedment



High Embedment, Poor



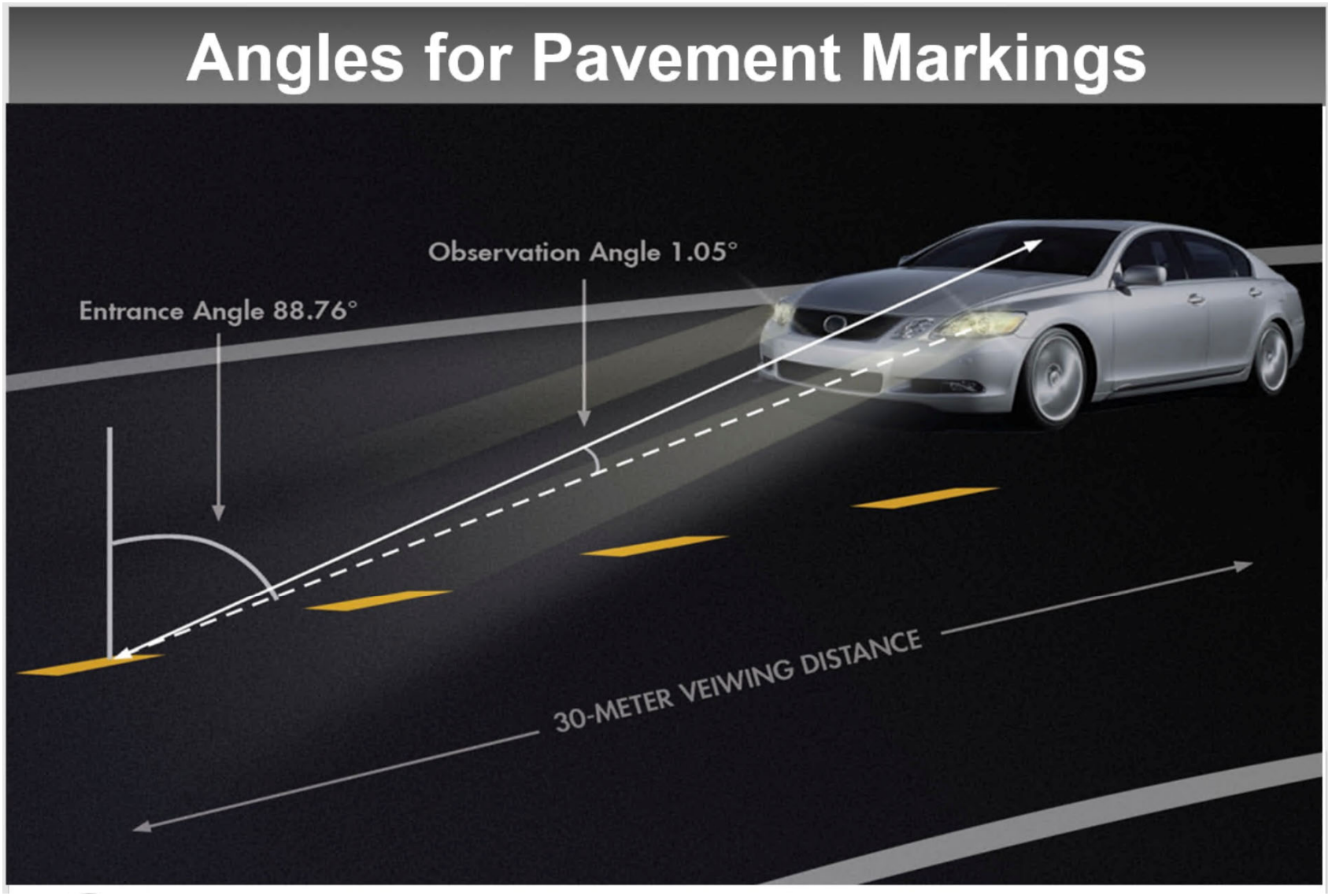
Low Embedment, Poor



60% Embedment, Good

30 Meter Geometry

A PART OF FORCE TECHNOLOGY



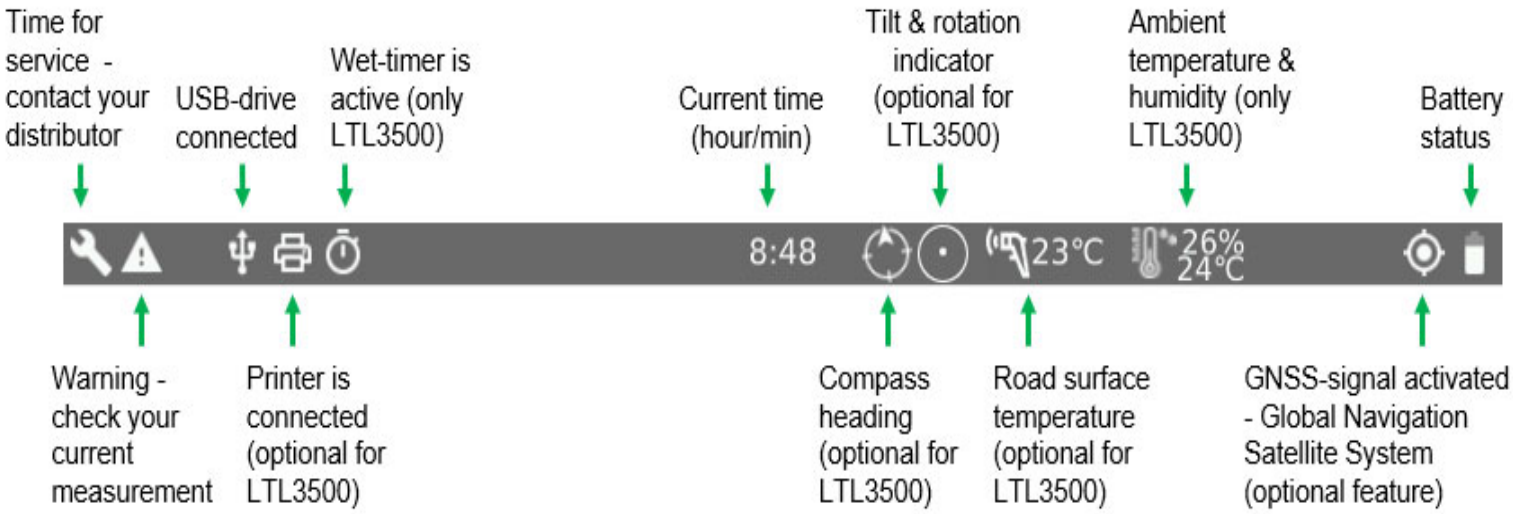
LTL3500 General Instrument Features

- Comply with EU (EN 1436) and US (E1710, E2177, E2302 & E2367) & CIE 1931 standards
- Small size & low weight (5.6 kg / 12.3 lbs)
- R_L (nighttime visibility), measurement range 0 - 4.000 mcd/lux/sqm
- Qd (daytime visibility, *optional*) measurement range 0 – 318 mcd/lux/sqm
- Nighttime chromaticity coordinates (x,y), white & yellow (*optional*)
- Show and store date, time, temperature, relative humidity and marking temperature
- Show and store user ID, road ID, 3rd party data and other measurement related data
- Average calculation
- Measures for RL profiled markings up to 15 mm / 0.6 inch
- Fast measurement time <1 sec (RL and Qd measurement simultaneous)
- GNSS positioning (GPS, GLONASS, BeiDou & Galileo, *optional*)
- Easy one-step calibration procedure
- High visibility color touch LED display supported by 3 activity buttons
- Long-lifetime light sources
- Multi-lingual user menu
- Operating temperature 0 – 60 deg. C / 32 to 140 deg. F
- Powered by professional standard Bosch battery, removable (charging time ~1 hour 15 minutes)

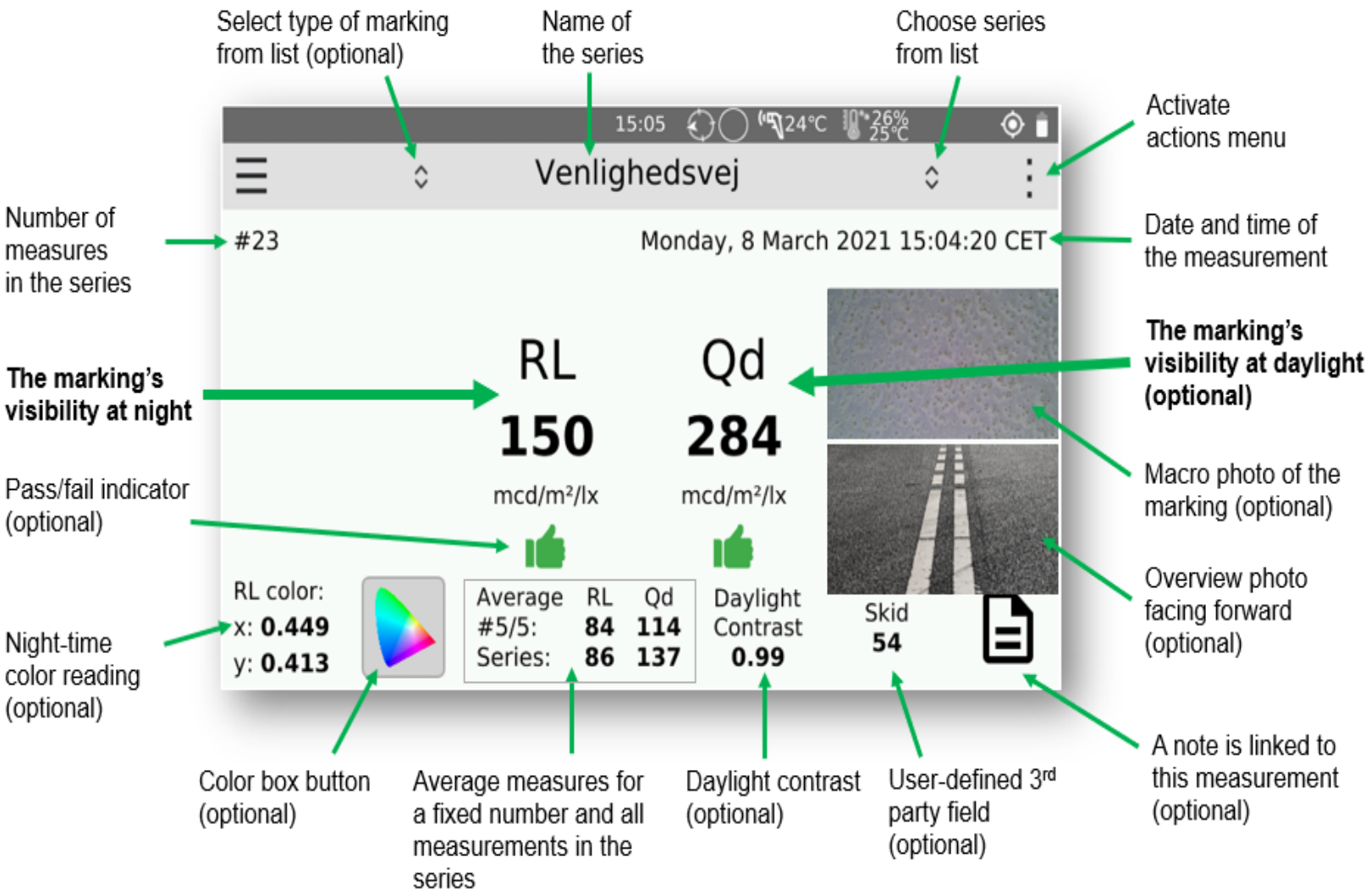
LTL3500 – Optional Features

- Global Navigation Satellite System (GNSS)
- Nighttime chromaticity coordinates (x,y)
- Daytime contrast
- Macro camera & overhead camera
- Orientation (compass, instrument tilt & rotation)
- Advanced data pack
- External printer

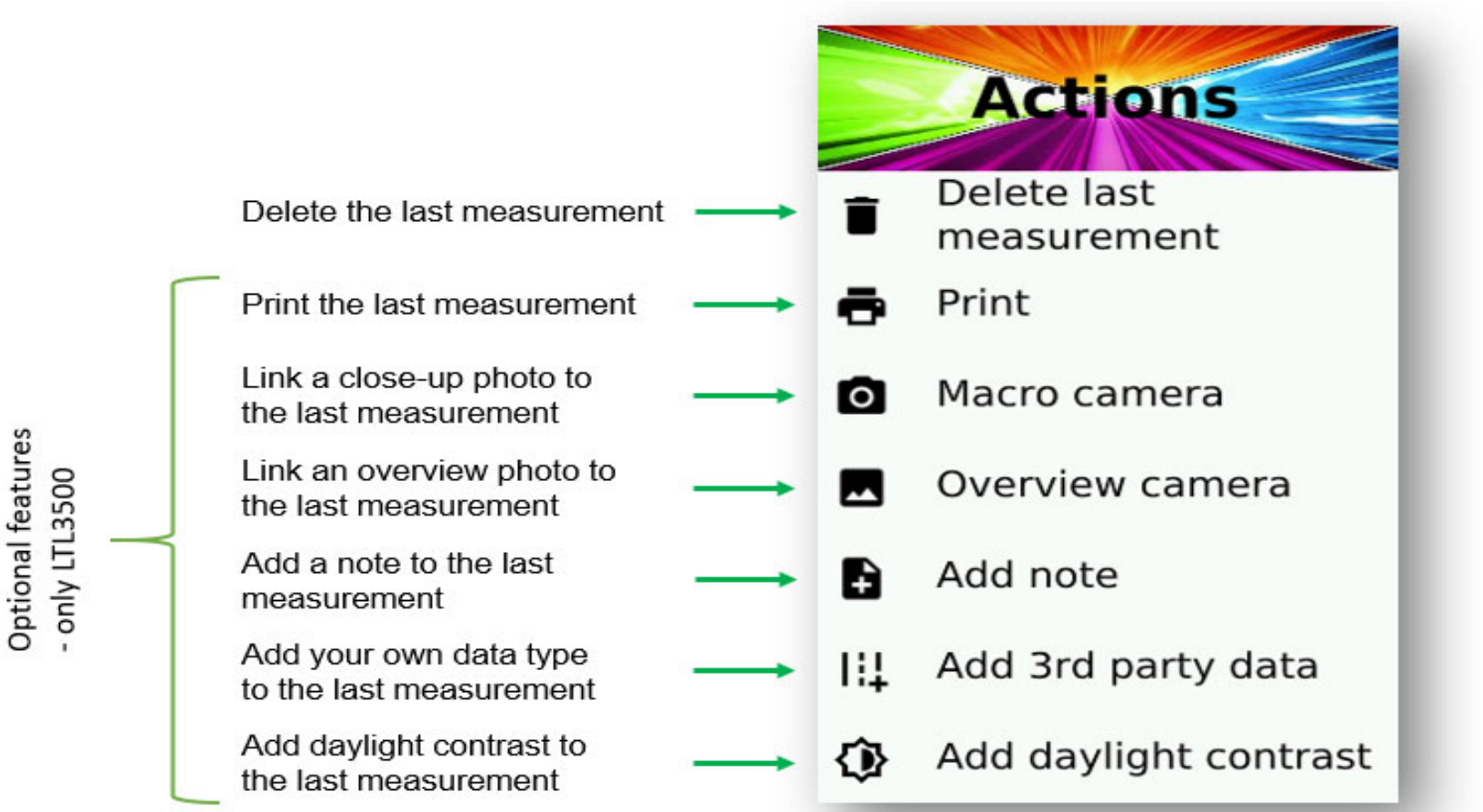
LTL3500 – Icons



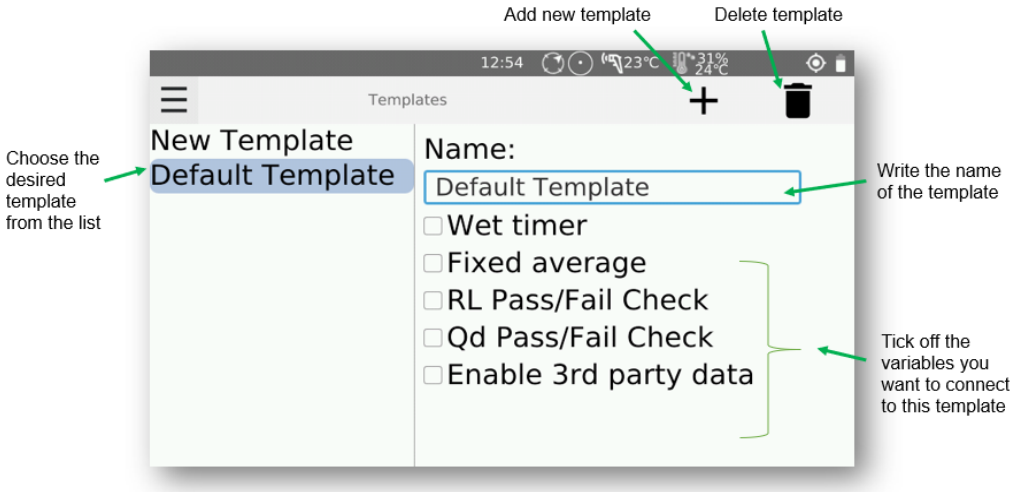
LTL3500 – Display

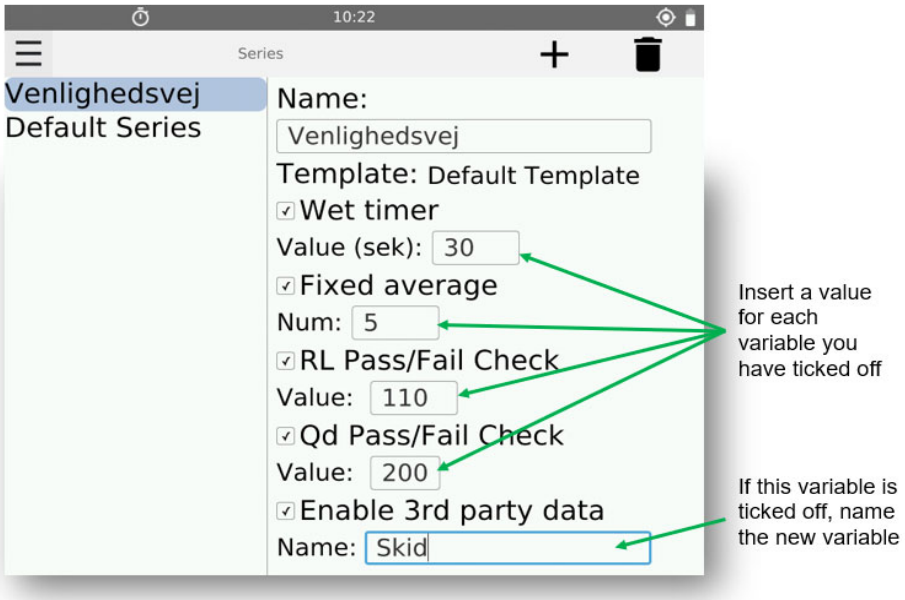


LTL3500 – Action menu

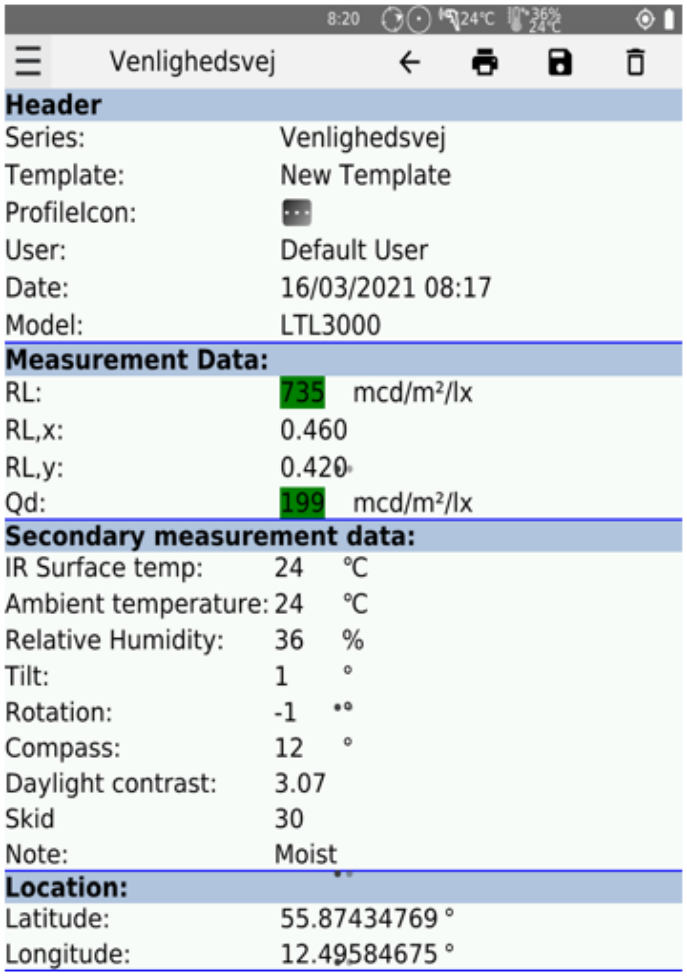


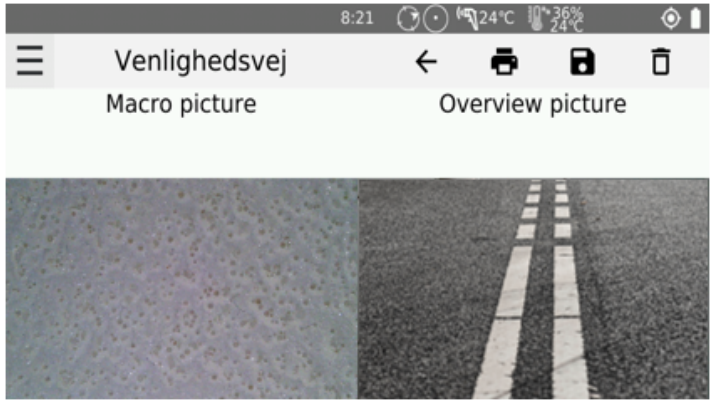
LTL3500 – Template

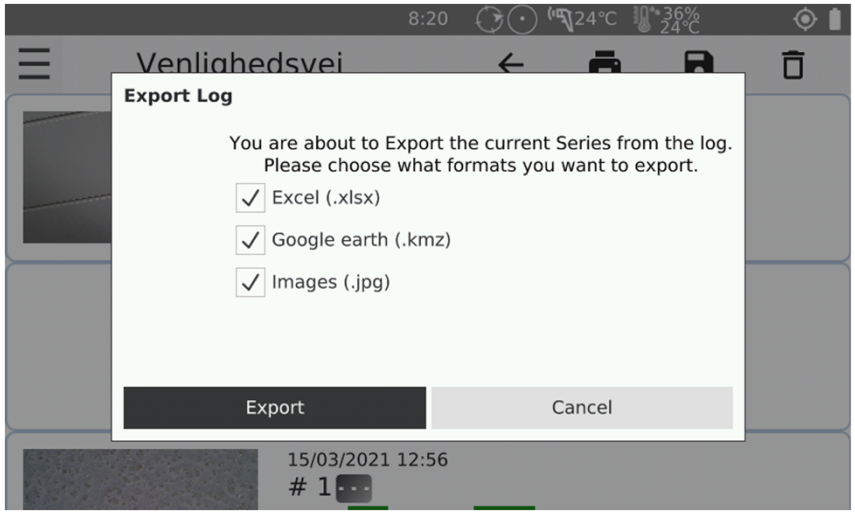




LTL3500 – Log

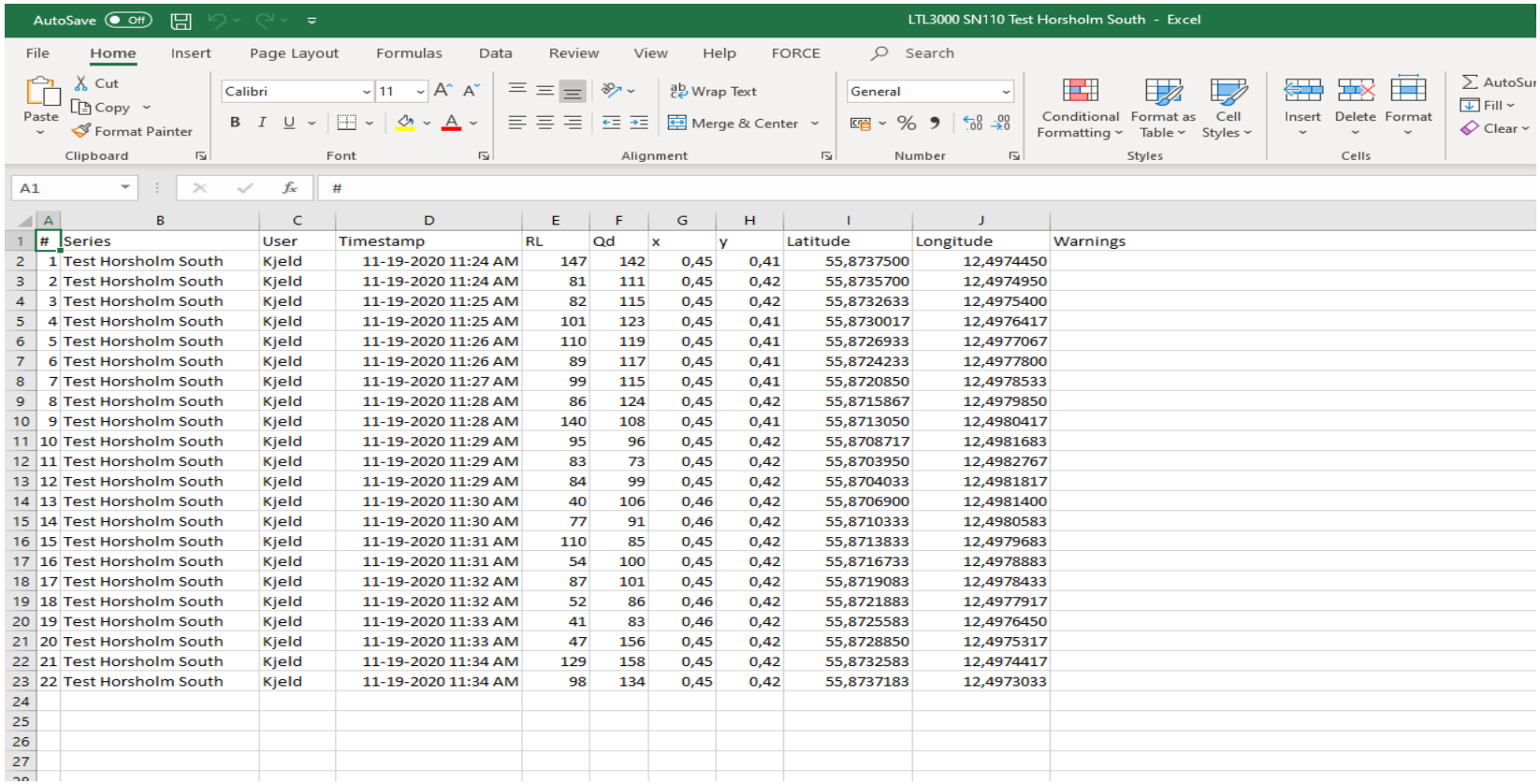

8:20
24°C
36%
24°C
Venlighedsvej
Header
Series: Venlighedsvej
Template: New Template
ProfileIcon:
User: Default User
Date: 16/03/2021 08:17
Model: LTL3000
Measurement Data:
RL: 735 mcd/m²/lx
RL,x: 0.460
RL,y: 0.420
Qd: 199 mcd/m²/lx
Secondary measurement data:
IR Surface temp: 24 °C
Ambient temperature: 24 °C
Relative Humidity: 36 %
Tilt: 1 °
Rotation: -1 °
Compass: 12 °
Daylight contrast: 3.07
Skid 30
Note: Moist
Location:
Latitude: 55.87434769 °
Longitude: 12.49584675 °


8:21
24°C
36%
24°C
Venlighedsvej
Macro picture
Overview picture


8:20
24°C
36%
24°C
Venlighedsvej
Export Log
You are about to Export the current Series from the log.
Please choose what formats you want to export.
Excel (.xlsx)
Google earth (.kmz)
Images (.jpg)
Export
Cancel
15/03/2021 12:56
1

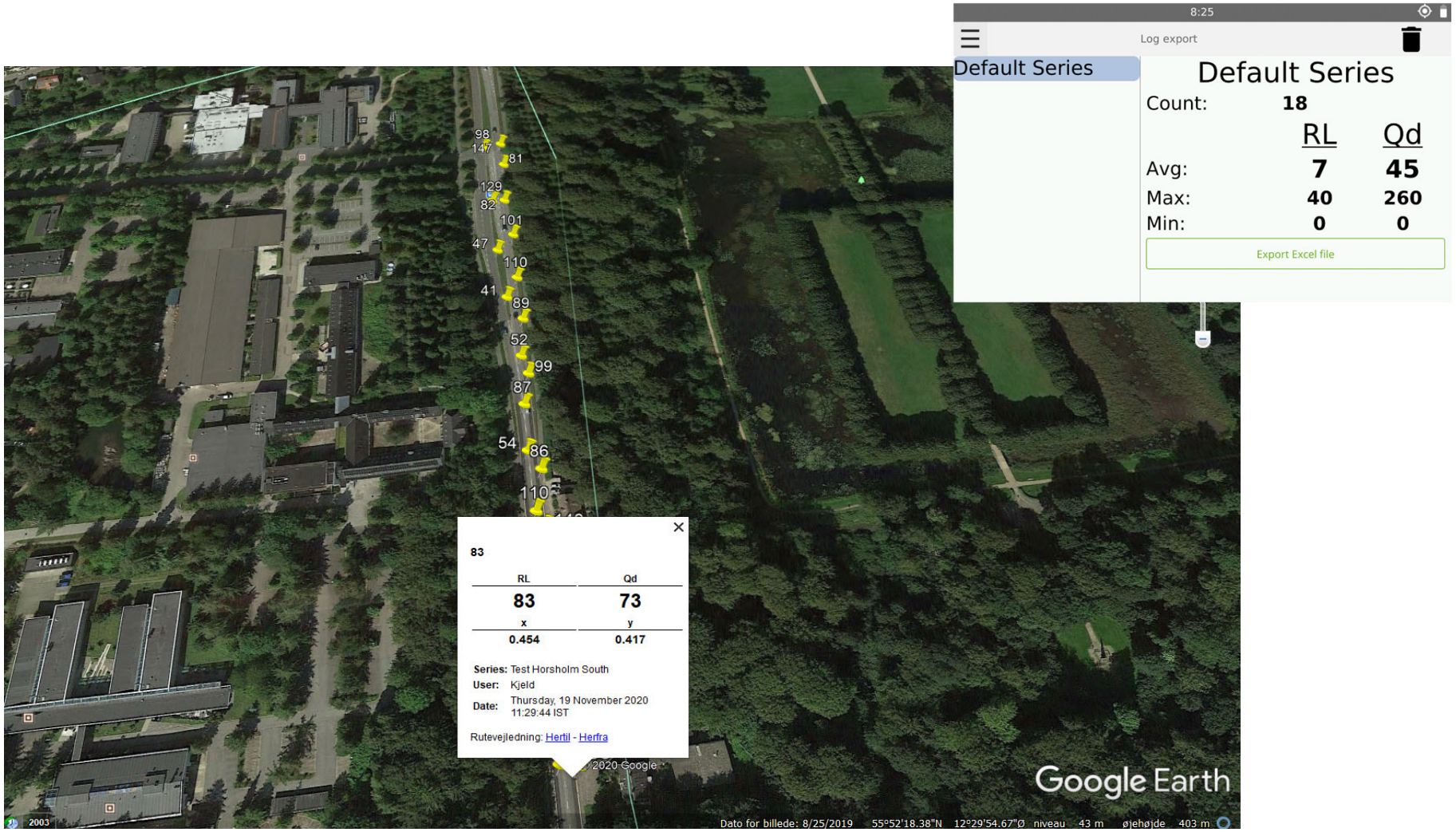
LTL3500 - Data Related Features

- Memory 8GB
- Data transfer by USB Memory stick, WiFi
- Entering of Road ID and User ID
- Show and stores day and time
- Data processing in Excel
- Data presentation in Google Earth (with GNSS)



#	Series	User	Timestamp	RL	Qd	x	y	Latitude	Longitude	Warnings
1	Test Horsholm South	Kjeld	11-19-2020 11:24 AM	147	142	0,45	0,41	55,8737500	12,4974450	
2	Test Horsholm South	Kjeld	11-19-2020 11:24 AM	81	111	0,45	0,42	55,8735700	12,4974950	
3	Test Horsholm South	Kjeld	11-19-2020 11:25 AM	82	115	0,45	0,42	55,8732633	12,4975400	
4	Test Horsholm South	Kjeld	11-19-2020 11:25 AM	101	123	0,45	0,41	55,8730017	12,4976417	
5	Test Horsholm South	Kjeld	11-19-2020 11:26 AM	110	119	0,45	0,41	55,8726933	12,4977067	
6	Test Horsholm South	Kjeld	11-19-2020 11:26 AM	89	117	0,45	0,41	55,8724233	12,4977800	
7	Test Horsholm South	Kjeld	11-19-2020 11:27 AM	99	115	0,45	0,41	55,8720850	12,4978533	
8	Test Horsholm South	Kjeld	11-19-2020 11:28 AM	86	124	0,45	0,42	55,8715867	12,4979850	
9	Test Horsholm South	Kjeld	11-19-2020 11:28 AM	140	108	0,45	0,41	55,8713050	12,4980417	
10	Test Horsholm South	Kjeld	11-19-2020 11:29 AM	95	96	0,45	0,42	55,8708717	12,4981683	
11	Test Horsholm South	Kjeld	11-19-2020 11:29 AM	83	73	0,45	0,42	55,8703950	12,4982767	
12	Test Horsholm South	Kjeld	11-19-2020 11:29 AM	84	99	0,45	0,42	55,8704033	12,4981817	
13	Test Horsholm South	Kjeld	11-19-2020 11:30 AM	40	106	0,46	0,42	55,8706900	12,4981400	
14	Test Horsholm South	Kjeld	11-19-2020 11:30 AM	77	91	0,46	0,42	55,8710333	12,4980583	
15	Test Horsholm South	Kjeld	11-19-2020 11:31 AM	110	85	0,45	0,42	55,8713833	12,4979683	
16	Test Horsholm South	Kjeld	11-19-2020 11:31 AM	54	100	0,45	0,42	55,8716733	12,4978883	
17	Test Horsholm South	Kjeld	11-19-2020 11:32 AM	87	101	0,45	0,42	55,8719083	12,4978433	
18	Test Horsholm South	Kjeld	11-19-2020 11:32 AM	52	86	0,46	0,42	55,8721883	12,4977917	
19	Test Horsholm South	Kjeld	11-19-2020 11:33 AM	41	83	0,46	0,42	55,8725583	12,4976450	
20	Test Horsholm South	Kjeld	11-19-2020 11:33 AM	47	156	0,45	0,42	55,8728850	12,4975317	
21	Test Horsholm South	Kjeld	11-19-2020 11:34 AM	129	158	0,45	0,42	55,8732583	12,4974417	
22	Test Horsholm South	Kjeld	11-19-2020 11:34 AM	98	134	0,45	0,42	55,8737183	12,4973033	

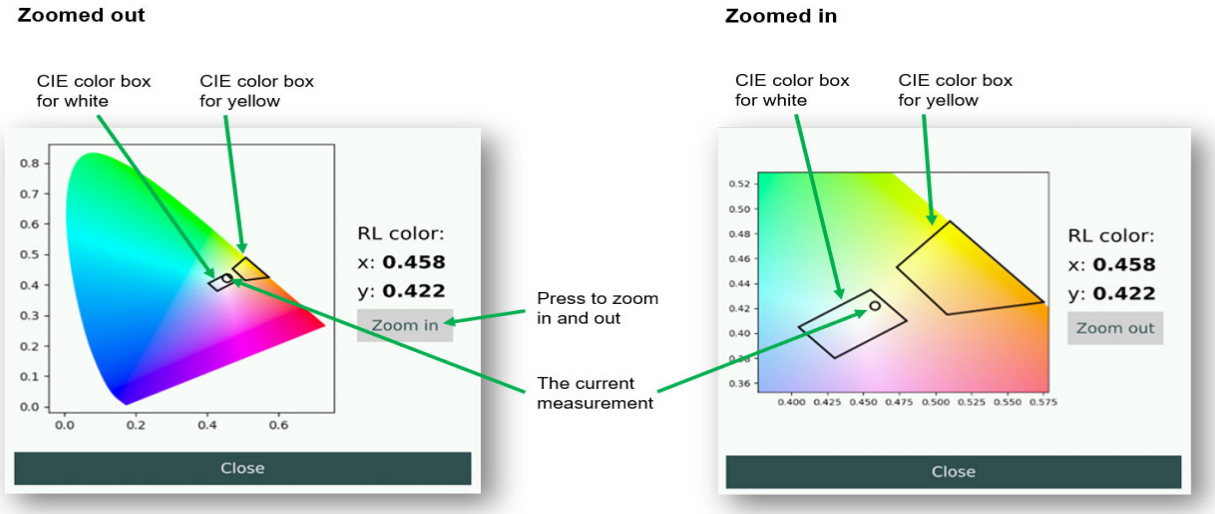
LTL3500 - Data Related Features



LTL3500 – Chromaticity Coordinates (x,y)

- LTL3500 measures the nighttime chromaticity coordinates (x,y) of white and yellow markings according to CIE 1931
- The retrorefleted light from the road marking is analysed in the LTL-3500's light receiver consisting of 3 types of detectors matching the human eyes tristimulus color sensitivity functions X,Y and Z as defined by CIE (CIE standard 1931).
- The three signals X,Y and Z from the 3 detectors are used to calculate the chromaticity coordinates:

  x= X/X+Y+Z and y=Y/X+Y+Z CIE = International Commission on Illumination



LTL3000-series: Standard Delivery

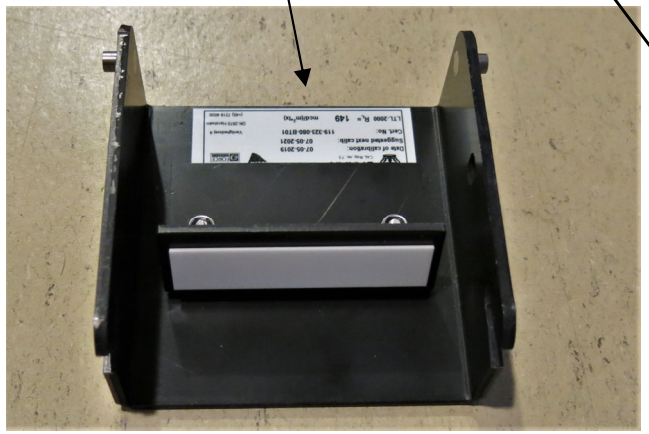
- LTL3500 unit
- Hard shell transportation box
- Calibration standard
- USB Memory stick (data transfer)
- Battery charger & spare battery
- 2-page Quick guide

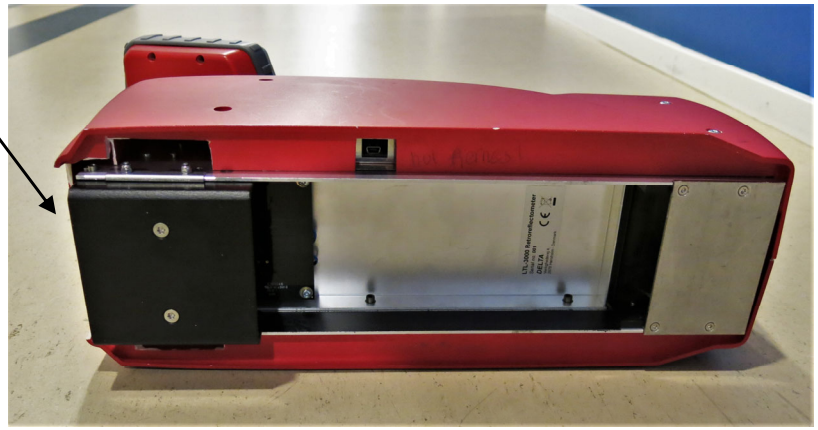
Accessed on web-page:

- User manual
- Video user instruction (to come)

Calibration of LTL3500 - RL

- Calibration of LTL3500 is similar to the LTL-XL and LTL-X Mark II calibration process for RL using a plate which can only be mounted in one way.
- The calibration plate is mounted underneath the instrument.

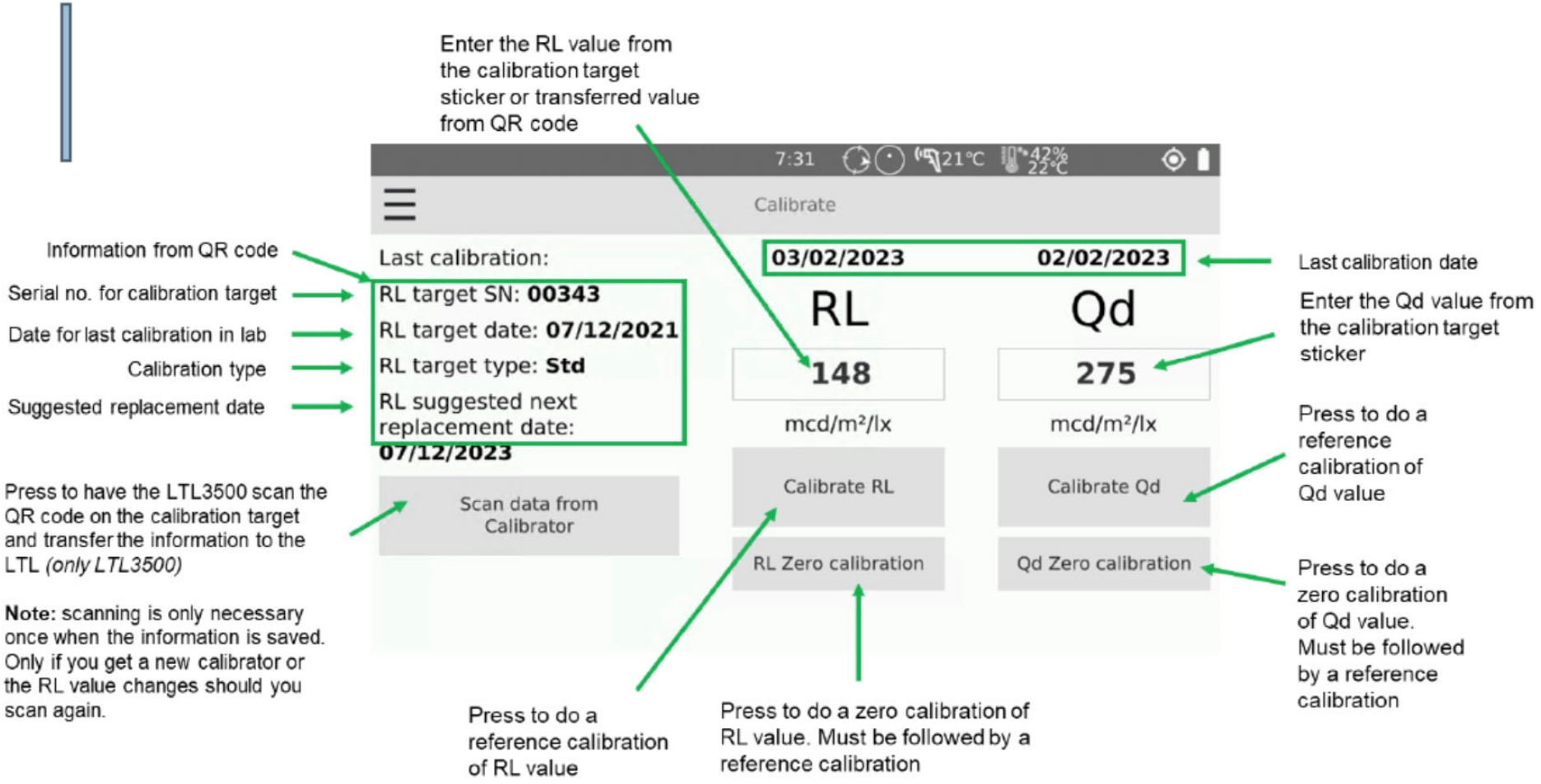




One-step calibration, takes maximum 30 seconds.

Calibration LTL3500 Overview

Calibration screen overview:



Zero Calibration LTL3500

- *Make sure the window under the instrument is clean*
- *Select 'Calibrate' from the main menu*
- *Press 'RL Zero calibration' on the screen*
- *Tilt the instrument backwards and make sure it is not pointing at anything within several meters (especially reflective materials like lights, RPMs, etc.)*
- *Press OK and wait for success confirmation*

RL Calibration Block for LTL 3500

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Reference RL calibration

RL calibration can be done without performing a *Zero RL calibration* first, but it is recommended to do the *Zero RL calibration* also, at least at regular intervals e.g., once a week.

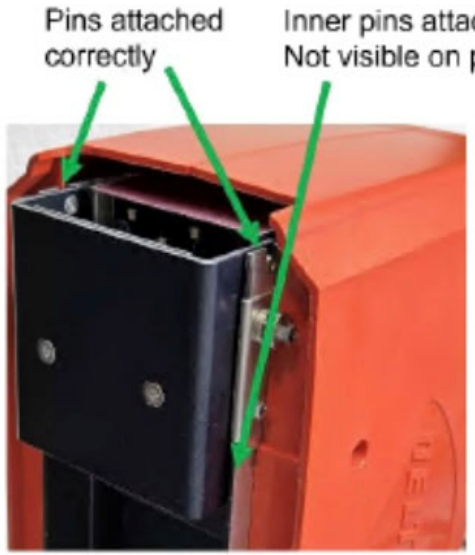
To calibrate the LTL3000/LTL3500 use the RL calibration target delivered with the instrument:

RL calibration target.

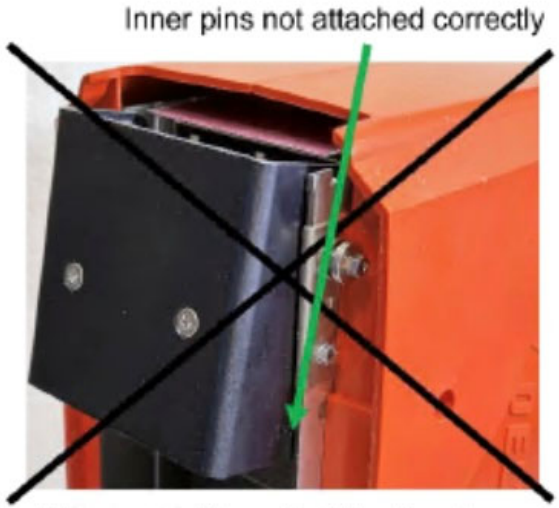
RL Calibration Procedure for LTL 3500

Calibrate the RL by following these steps:

- Make sure the protection window underneath the instrument is clean. If necessary, clean it following the instruction described in section 'Maintenance'.
- Select 'Calibrate' from the main menu.
- Type in the RL-calibration value printed on the calibration target sticker or scan the QR code on the calibration target by pressing 'Scan from Calibrator' (only LTL3500).
- Place the calibration target under the LTL3000/LTL3500 (in the front) and press 'Calibrate RL' on the screen.



Correct position of calibration target



Wrong position of calibration target

Note: the pins on the calibration target must fit into the slots underneath the instrument.

Measurement LTL 3500

- Place the LTL 3500 instrument on the marking straight down making sure that the instrument covers the marking as much as possible

- Move the LTL 3500 by lifting the unit straight up and moving it to the next position to take a reading. Do not slide the unit, this can cause damage to the optic window

- Press the Green Button to take measurements

- ***DO NOT*** *take measurements on wet or damp markings*
- *Operating Temperature is 32°F to 140°F*

(Recommended storage is 32°F to 86°F due to lifetime considerations of the battery)

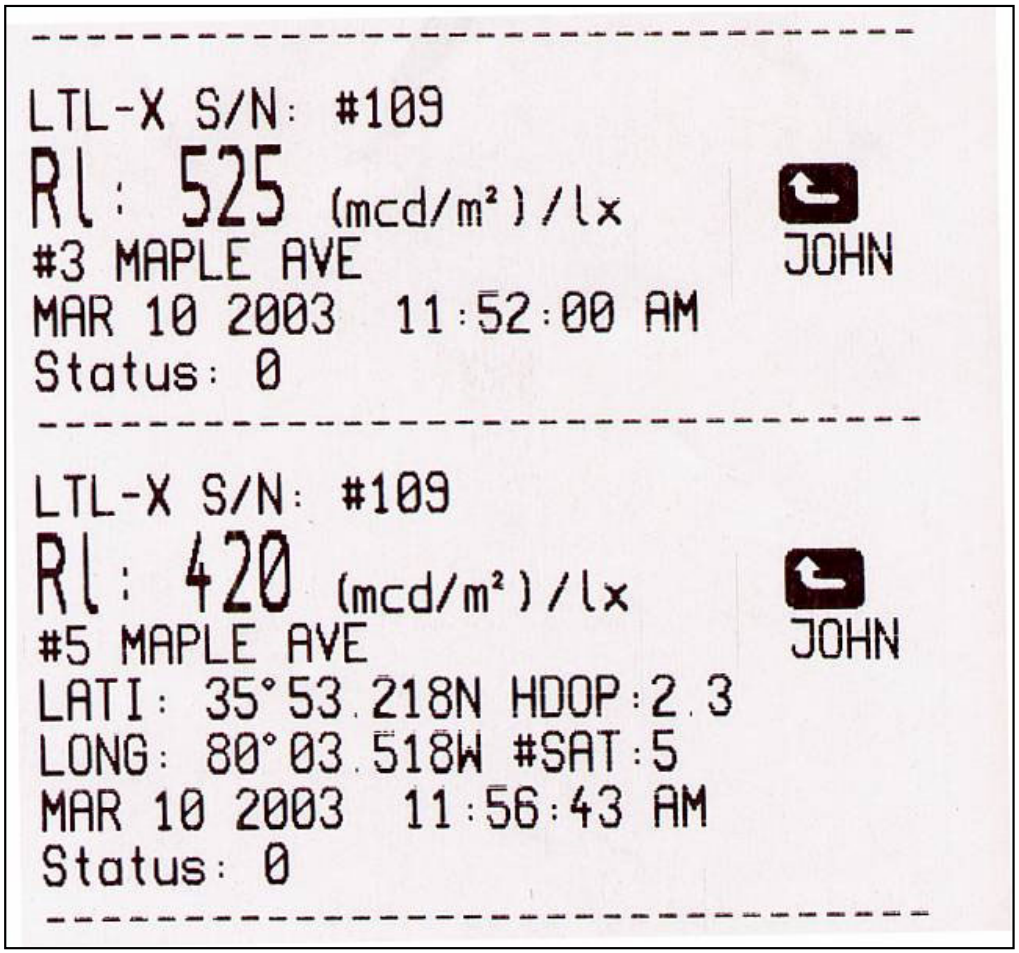
Cleaning the LTL3500

- **DO NOT clean the calibration block.**
  - It is your traceable standard.

- Clean the window under the instrument per the instructions in the manual.

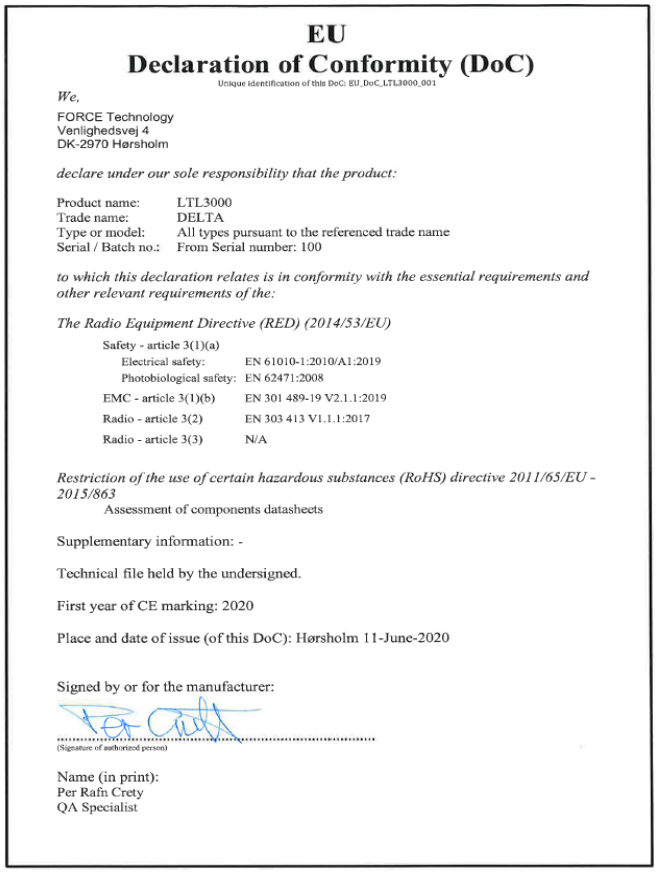
Printer

- *On Site Printer*
  - *Bluetooth*
  - *Print in the field*



Safety & Certification

All DELTA's instruments are certified to European and US standards when it comes to users safety and EMC emission.



EU
Declaration of Conformity (DoC)

Unique identification of this DoC: EU_DoC_LTL3000_001

We,

FORCE Technology
Venlighedsvej 4
DK-2970 Hørsholm

declare under our sole responsibility that the product:

Product name: LTL3000
Trade name: DELTA
Type or model: All types pursuant to the referenced trade name
Serial / Batch no.: From Serial number: 100

to which this declaration relates is in conformity with the essential requirements and other relevant requirements of the:

The Radio Equipment Directive (RED) (2014/53/EU)

Safety - article 3(1)(a)	
Electrical safety:	EN 61010-1:2010/A1:2019
Photobiological safety:	EN 62471:2008
EMC - article 3(1)(b)	EN 301 489-19 V2.1.1:2019
Radio - article 3(2)	EN 303 413 V1.1.1:2017
Radio - article 3(3)	N/A

Restriction of the use of certain hazardous substances (RoHS) directive 2011/65/EU - 2015/863
Assessment of components datasheets

Supplementary information: -

Technical file held by the undersigned.

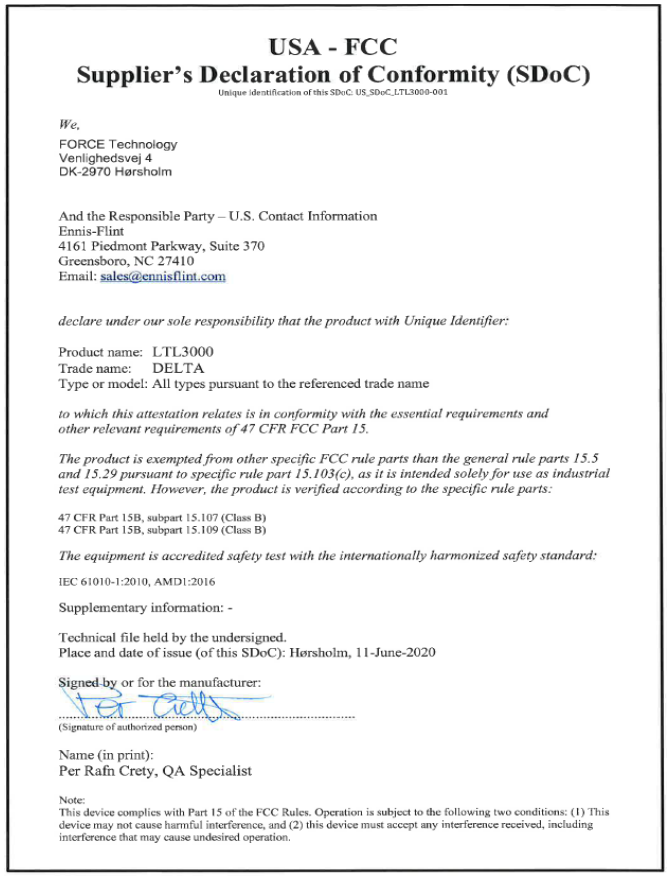
First year of CE marking: 2020

Place and date of issue (of this DoC): Hørsholm 11-June-2020

Signed by or for the manufacturer:

.....
(Signature of authorized person)

Name (in print):
Per Rafn Crety
QA Specialist



USA - FCC
Supplier's Declaration of Conformity (SDoC)

Unique identification of this SDoC: US_SDoC_LTL3000-001

We,

FORCE Technology
Venlighedsvej 4
DK-2970 Hørsholm

And the Responsible Party – U.S. Contact Information
Ennis-Flint
4161 Piedmont Parkway, Suite 370
Greensboro, NC 27410
Email: sales@ennisflint.com

declare under our sole responsibility that the product with Unique Identifier:

Product name: LTL3000
Trade name: DELTA
Type or model: All types pursuant to the referenced trade name

to which this attestation relates is in conformity with the essential requirements and other relevant requirements of 47 CFR FCC Part 15.

The product is exempted from other specific FCC rule parts than the general rule parts 15.5 and 15.29 pursuant to specific rule part 15.103(c), as it is intended solely for use as industrial test equipment. However, the product is verified according to the specific rule parts:

47 CFR Part 15B, subpart 15.107 (Class B)
47 CFR Part 15B, subpart 15.109 (Class B)

The equipment is accredited safety test with the internationally harmonized safety standard:

IEC 61010-1:2010, AMD1:2016

Supplementary information: -

Technical file held by the undersigned.
Place and date of issue (of this SDoC): Hørsholm, 11-June-2020

Signed by or for the manufacturer:

.....
(Signature of authorized person)

Name (in print):
Per Rafn Crety, QA Specialist

Note:
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

LTL 3500 MANUAL

LTL3000 and LTL3500 Retroreflectometer

User Manual

February 2023 – English language version

DELTA – a part of FORCE Technology
Venlighedsvej 4 - DK-2970 Hørsholm - Denmark - Tel. (+45) 43 25 14 00 - roadsensors@forcetechnology.com

USA Statement

Note:

LTL3000 and LTL3500 have been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada Statement

Note:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

Declaration of Conformity for EU, USA and Canada.

See FORCE website – LTL3000: https://roadsensors.com/products/ltl3000/#certification

See FORCE website – LTL3500: https://roadsensors.com/products/ltl3500/#certification

Disclaimer

The information contained in this document is subject to change without notice.

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LTL3000 AND LTL3500 ARE BUILT ON GENERAL PUBLIC LICENSE COMPONENTS. THE SOURCE CODE IS AVAILABLE UPON REQUEST.

Intended use/purpose

LTL3000 and LTL3500 retroreflectometer are portable field instruments used for on-site inspection and quality control of retroreflection properties of road markings.

Important Safety and Handling Information

Caution
Changes/modifications not approved by the responsible party could void the user's authority to operate the equipment.

Use the unit only in the way described in this manual. Failure to follow the guidelines and instructions in this manual may be dangerous and illegal.

 LTL3000 and LTL3500 may not be used with other batteries than those supplied with the product.

Disposal and Recycling Information

Please ask your appointed dealer concerning disposal of LTL3000 / LTL3500 in your country.

Visit our website: https://roadsensors.com/

Table of Contents

Introduction

The LTL3000 and LTL3500 retroreflectometers are portable field instruments intended for measuring the retroreflection and reflection properties of road markings. This manual covers both instruments. Throughout the manual it is indicated in the text if a topic or feature applies to both instruments (LTL3000/LTL3500) or only applies to one of the instrument types (e.g., LTL3500).

What does the instrument measure?

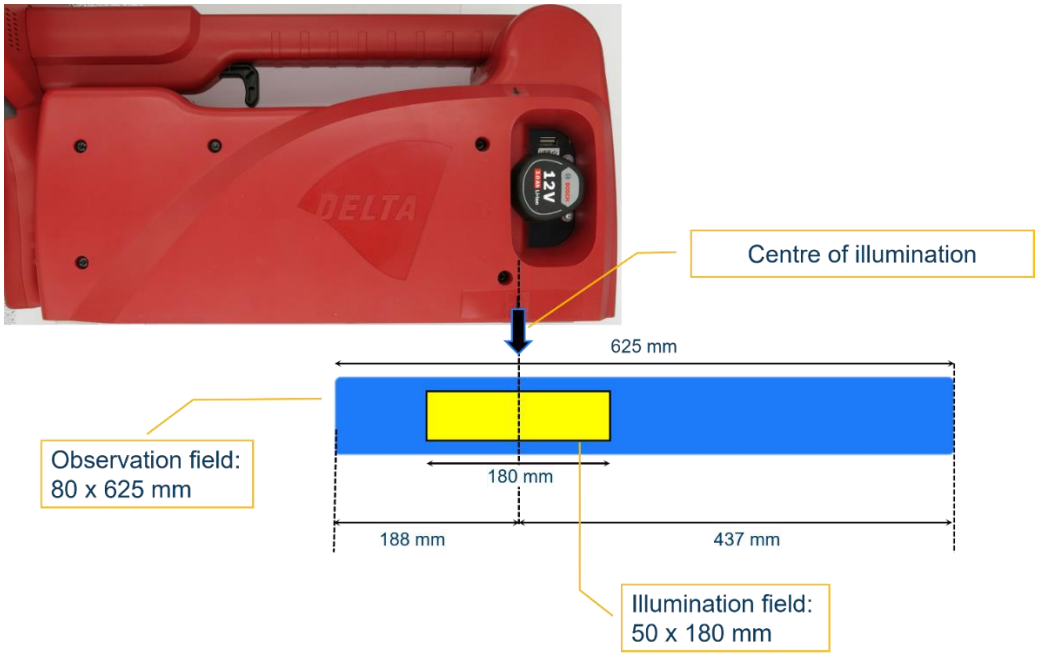
LTL3000/LTL3500 measures the RL value (coefficient of retroreflected luminance at night / in darkness) and the Qd value (day light visibility). RL is a measure of the road marking's brightness as seen by drivers of motorized vehicles with headlights turned on. For RL, the road is illuminated at an angle of 1.24°, whereas the illumination for Qd (daylight) is diffuse.

The reflected light for both RL and Qd is measured at an angle of 2.29°, which corresponds to an observation distance of 30 meters - i.e., a motorist's viewing situation under normal conditions. Further information about measuring principles and standards can be found on https://roadsensors.com/.

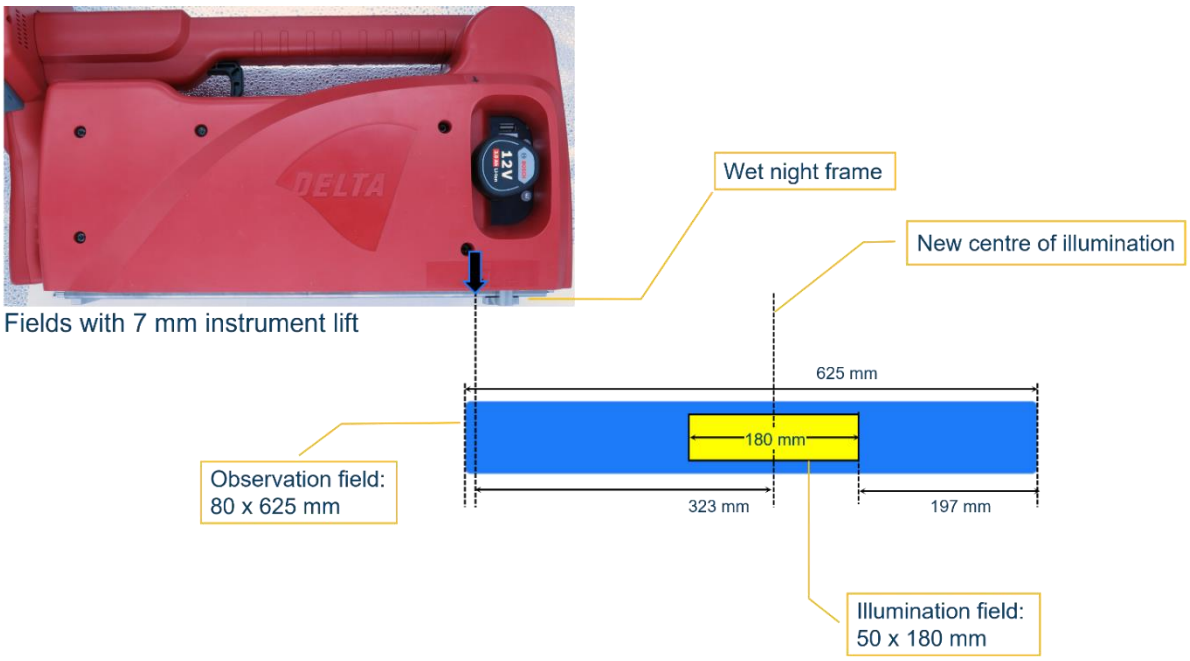
Measurement fields

The center of the illumination field length (180 mm / 7.1 inch) is marked with a black arrow on the body of the instrument (see picture below). The width of the measurement field (50 mm / 2 inch) is centered.

The figures below show the placement of the fields for normal and continuous wetting operations.



For continuous wetting measurements the instrument is raised 7 mm by mounting the wet night frame.



Note: Ensure that reflective objects such as RPM, shoes and similar are not in the instrument's field of view as this can affect the measurement.
Objects within 1 m / 39.37 inch can affect the measurement. With wet night frame the distance is approx. 1.5 m / 59 inch.

LTL3000/LTL3500 measures:

- RL (nighttime visibility) of markings under dry and wet conditions. RL range: 0 to 4000 mcd·m^{-2}·lx^{-1}
- Qd (daytime visibility) of markings under dry and wet conditions. Qd range: 0 to 318 mcd·m^{-2}·lx^{-1}
- Nighttime chromaticity coordinates (x, y).

LTL3000/LTL3500 has automatic ambient light compensation. Thus, daylight and other outside light sources will not affect the accuracy of the measurements.

Overview of LTL3000 and LTL3500

The LTL3000/LTL3500 retroreflectometer is easy to operate and requires a minimum of instructions.

The measurement results are presented on the instrument's touch screen. Each measurement can be linked to a user/operator name and a series name.

The instrument provides a warning message or sound in case of unreliable measurement.

Most action buttons on the instrument are accessible via the touch screen. The physical buttons and features on the instrument are shown below.

Front and side of the LTL3000/LTL3500:

The LTL3000/LTL3500 is equipped with a USB port on the side of the instrument for data export via a memory stick.

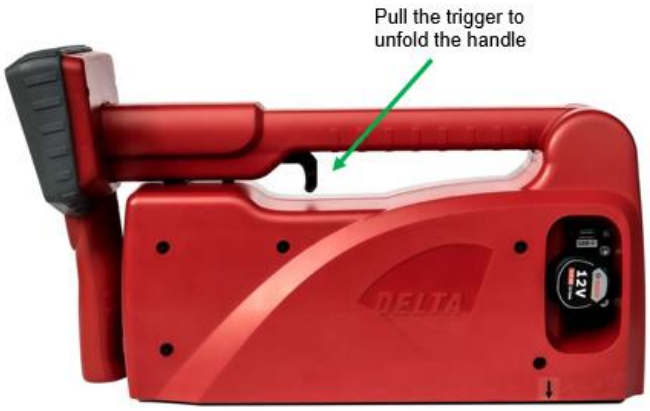
The instrument is powered by a rechargeable battery, offering many hours of measurement capacity. A mains powered battery charger is supplied with the instrument as standard delivery.

Extractable handle *(only LTL3500)*

The LTL3500 is featured with an extractable handle enabling the user to operate the instrument and view the instrument display from an upright working position.

The handle can be adjusted in various lengths (high/low) by pushing the black trigger on the handle.

For easy transportation when the instrument is not in use, the extractable handle can be folded down. Pull the black trigger unfold the handle again.



Getting started

Insert battery: before using the LTL3000/LTL3500 instrument make sure that the battery is charged and inserted in the battery slot on the side of the instrument.

Turn on: press the green button on the handle of the instrument. After 10-15 seconds, the system has booted, and the instrument is ready for use.

Standby: the instrument automatically switches to **standby mode** if the instrument has not been used for a specific amount of time. From stand-by mode the instrument is instantly ready when pressing the green button on the handle.

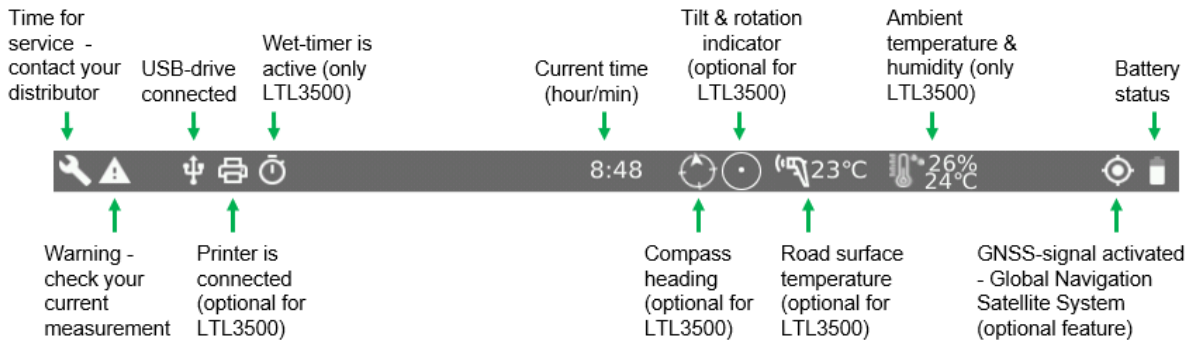
Calibrate: to ensure high quality of data we recommend that you perform an RL calibration of the instrument every day the instrument is in use, typically in the morning before commencing the measurements (see how in the section named 'Calibration' in this manual).

The Qd (optional feature) measurement system is factory calibrated and calibration can be done occasionally.

Switch off: press the X-button on the handle of the instrument and then press 'Shutdown' in the menu on the touch screen, and the instrument will switch off.
Note: The instrument automatically turns off when it has not been used for an extended amount of time.

Icons

The icons in the status bar at the top of the display screen give you information about the instrument status and operational mode:



Icon explanation:

	It is time for service on your instrument. Please contact your local distributor
	Warning signal for your current measurement
	USB drive is connected and accepted
	Printer is connected and accepted
	Wet timer is active (only LTL3500)
	The current time (hour/min)
	Compass heading (optional feature - only LTL3500)
	Tilt and rotation indicator (optional feature - only LTL3500)
	Road surface temperature (optional feature - only LTL3500)
	Ambient temperature & humidity (only LTL3500)
	GNSS-signal is activated e.g., Global Navigation Satellite System (optional feature)
	Battery status

Main menu

The various instrument actions can be accessed via the main menu on the display screen:

You can activate the main menu in 3 ways:

- press ☰ at the top left corner of the display screen to access the main menu,
- or press **X** on the instrument handle.

If you want to close the menu again, just touch the display or press X on the instrument handle.

The main menu consists of these elements:

Icon	Function	Explanation
	Measure	Perform an inspection
	Series	Select, add, edit, or delete series of measurements
	Templates (only LTL3500)	Select, add, edit, or delete a template
	Users	Select, add, edit, or delete a user
	Log	Export measurement series to USB stick or delete data
	Calibrate	Calibrate the LTL3000/LTL3500
	Settings	Adjust settings (language, time, date etc.)
	Shutdown	Power off the instrument

Note: all information you enter or alter under the individual menu items is automatically stored in the instrument.

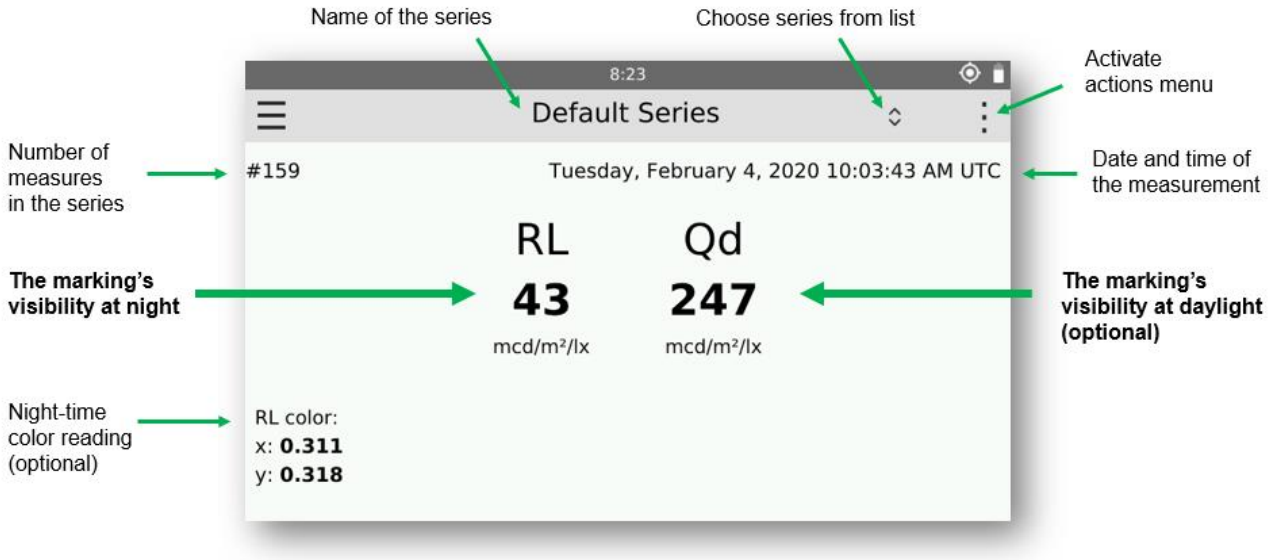
Perform a measurement

Select ‘Measure’ from the main menu, and the instrument is now ready to perform a measurement.

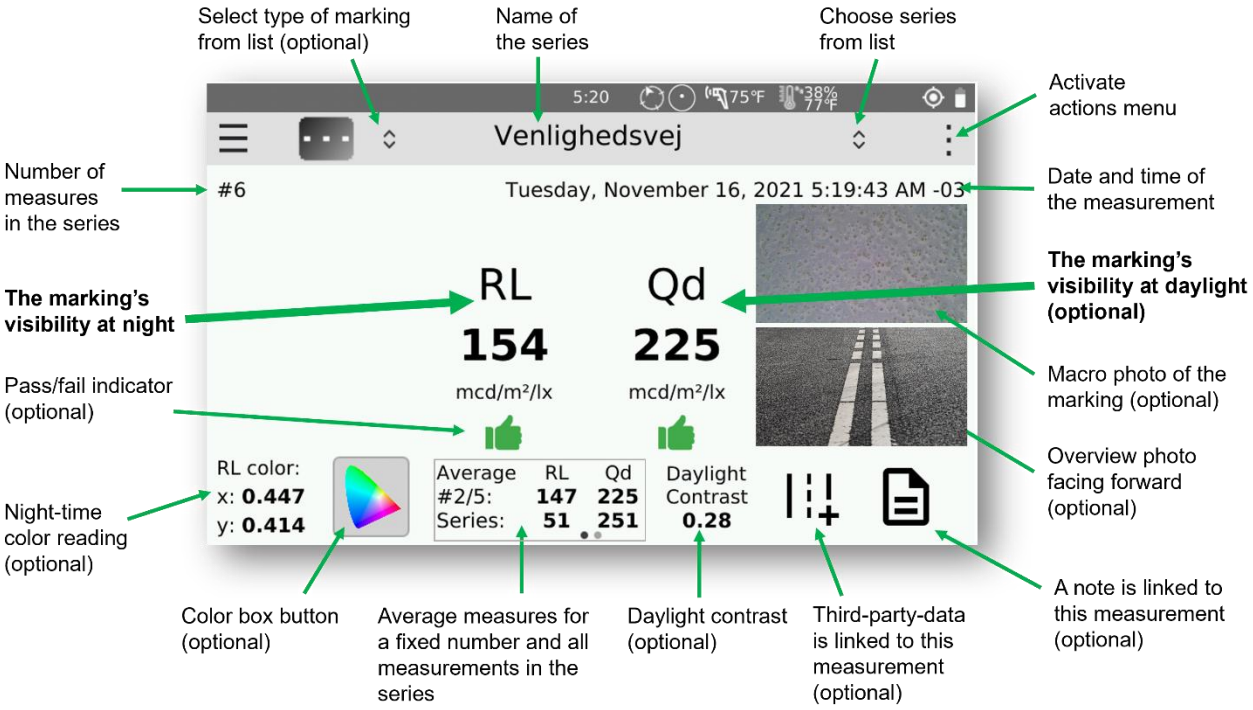
Place the instrument on top of the specific road marking you want to measure and press the green button on the instrument handle.

Wait a second until the reading is shown on the display.

LTL3000 display:



LTL3500 display:



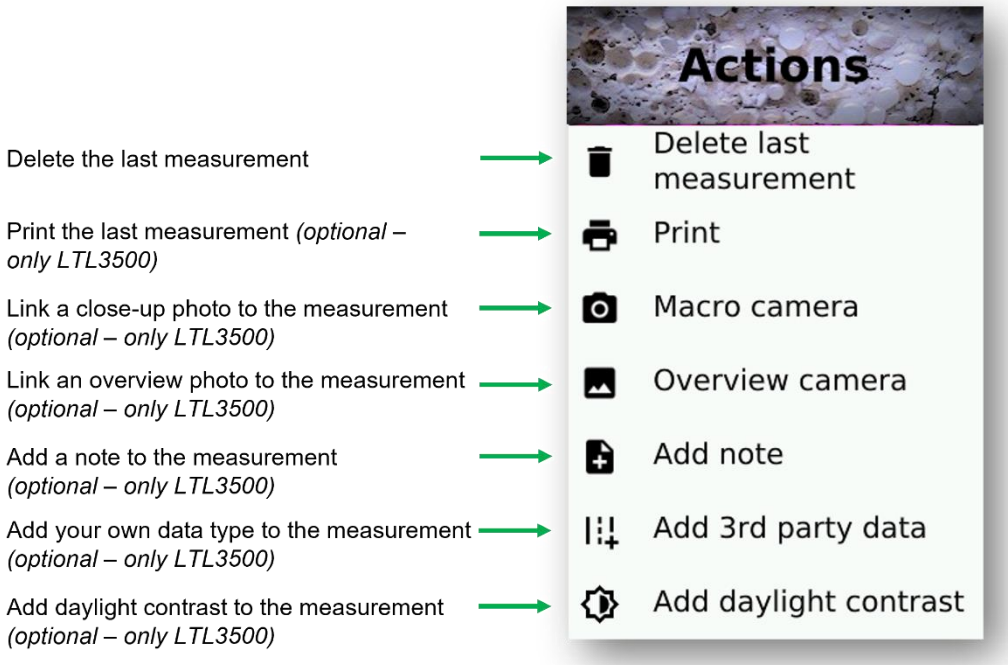
The measurement data is automatically saved by the instrument. You can now continue to conduct another measurement.

If you want to switch to another series, pressing ⇕ and choose the relevant series from the drop-down menu (or select it in the Series menu) and continue with your measurements.

Actions

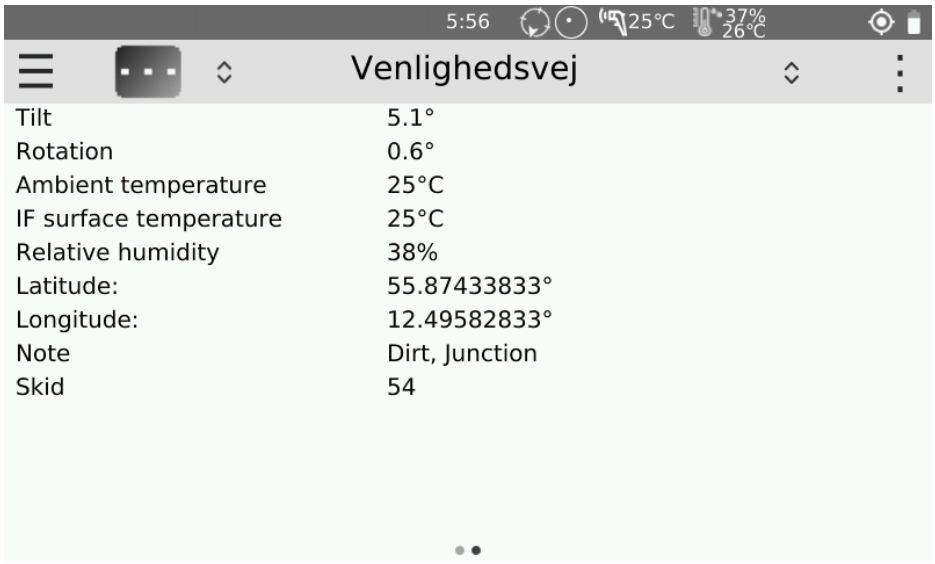
There are various actions you can do with your current measurement. Activate the actions menu by pressing ⋮ at the top right corner on the screen.

Elements in the actions menu:



The elements in the actions menu are explained in detail in section ‘Actions Menu’ later in this manual.

Swiping from right to left on the measure screen lets you see auxiliary data which are attached to the current measurement.



Working with series and templates

It is very easy to use the instrument to conduct measurements, and the instrument helps you organize the data:

- Your measurements are stored in series. A **series** is defined as all the collected data and measurements for a specific work assignment.
- Your series are based on a template (only LTL3500). A **template** defines which settings should be applied to a series. The template specifies the data fields to be captured during an inspection e.g., wet timer, RL pass/fail check.

You can add, select, edit, or delete series of measurements. Likewise, you can add, select, edit, or delete templates.

In practice, when you add a new series you must decide which template to use for your series before you conduct the measurements. If you select an existing series from your list, then a template is already linked to the series.

Templates *(only LTL3500)*

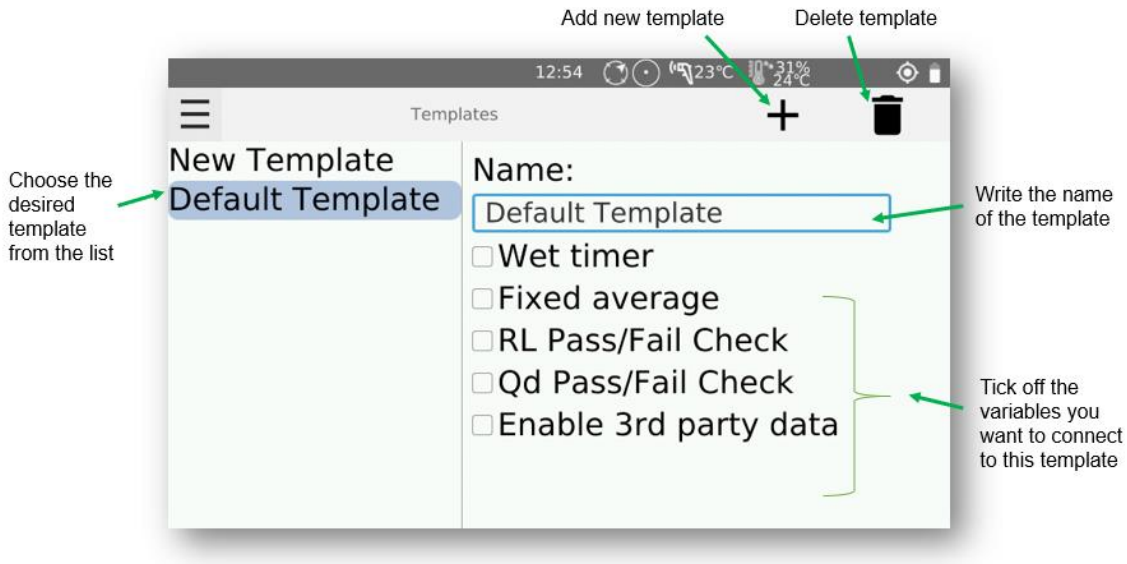
Start by selecting 'Templates' from the main menu. On the display, all your templates are now listed on the left side of the screen.

Select a template: Press the template on the list, you want to use – the template is now selected. Tick off the template variables you want to activate. Add user defined variables by ticking off 'Enable 3rd party data'. You can now continue selecting a series for your measurements (switch to 'Series' in the main menu).

Add a new template: Press + on the top bar to add a new template and write a name in the 'Name' field for your new template (use the keyboard on the touch screen). Tick off the variables you want connected to this template. The template is now added, and you can continue selecting at series for your measurements (switch to 'Series' in the main menu).

Edit a template: From the template list, select the template you want to edit and type the new name of the template in the 'Name' field. Select or deselect variables from the variable list. When finished press return arrow, and the new name of the template is saved.

Delete a template: Press the template on the list that you want to delete, then press  on the top bar. The template is now deleted.
Note: It is required that at least one template exists, thus it is impossible to delete the last template.



Explanation to the individual template variables:

Wet timer: Introducing a delay from pressing the measurement button until the actual measurement is taken e.g., 30 second's delay.

Fixed average: Calculates an average of a user-defined number of measurements e.g., 5 measurements.

RL Pass/Fail Check: Set a pass/fail threshold for the RL value. If the RL value of your measurement is above this threshold, then a green thumps-up symbol is visible on the display, but if the RL value is below then a red thumps-down symbol appears on the display.

Pass: 

Fail: 

Qd Pass/Fail Check: Set a pass/fail threshold for the Qd value. If the Qd value of your measurement is above this threshold then a green thumps-up symbol is visible on the display, but if the Qd value is below then a red thumps-down symbol appears on the display.

Enable 3rd party data: Option of collecting 3rd party data, which will be added to your log file. Remember to name the 3rd party data e.g., 'Skid Resistance' or 'Marking Thickness'.

Series

First, start by selecting 'Series' from the main menu. On the display, all your series are now listed on the left side of the screen.

Select a series: Press the series on the list, you want to use – the series is now selected. For LTL3500 a specific template is linked to the series: Tick off the template variables you want to activate and write a value for each of them in the box next to the variable.

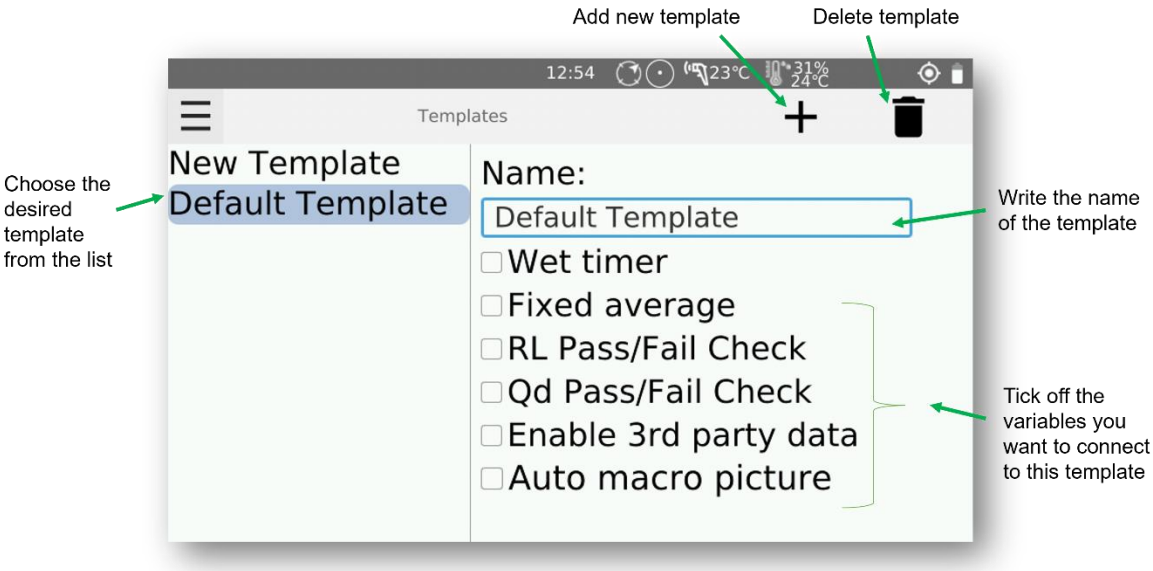
You can now continue with your measurements (switch to 'Measure' from the main menu) and the data will be linked to the chosen series.

Add a new series: Press + on the top bar to add a new series and write a name in the 'Name' field for your new series (use the keyboard on the touch screen). For LTL3500 you will be asked which template to use for this series: Select the relevant template and tick off the variables you want to activate. Write a value for each of the variables.

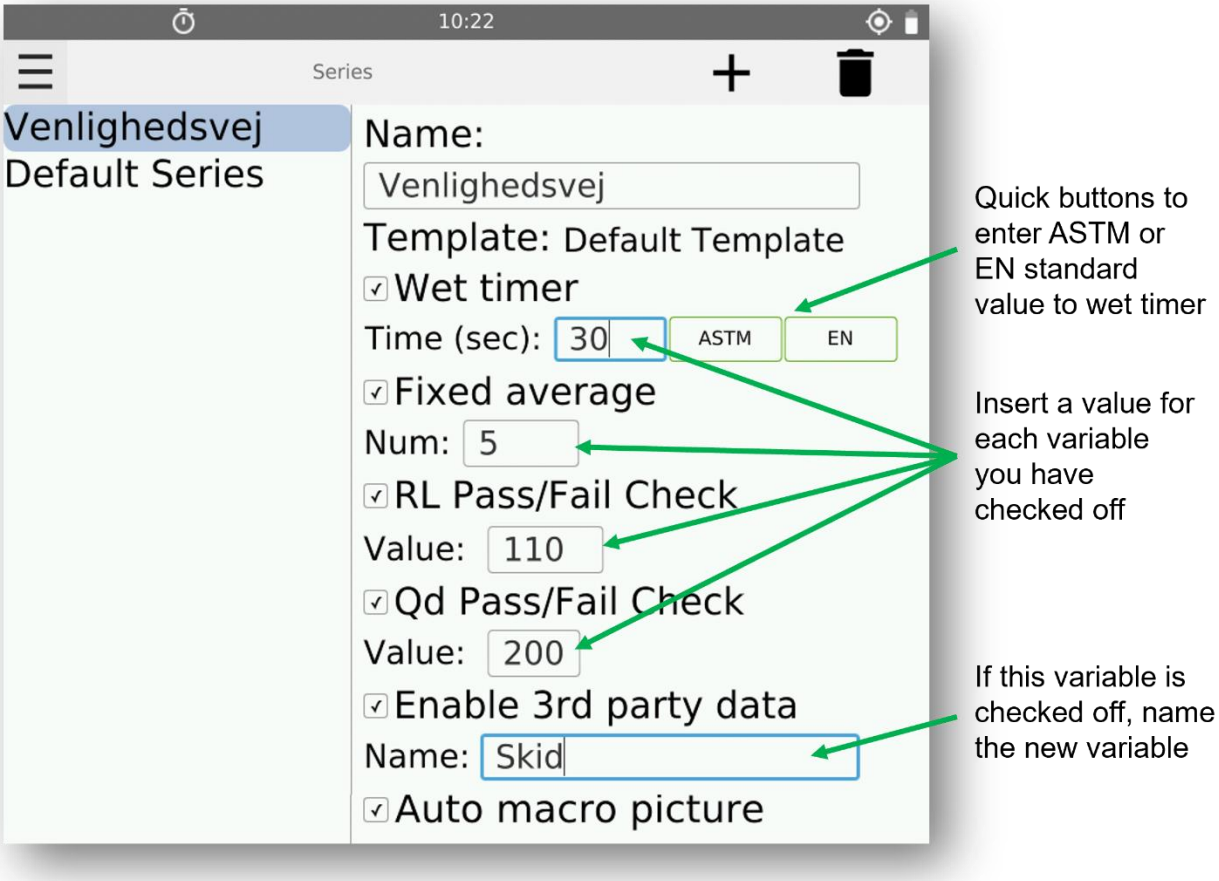
The series is now added, and you can continue with your measurements (switch to 'Measure' from the main menu) and the data will be linked to the new series.

Edit a series: From the series list, select the series you want to edit and type the new name of the series in the 'Name' field. When finished press return arrow, and the new name of the series is saved.

Delete a series: Press the series on the list you want to delete, then press 🗑 on the top bar. The series and associated measurement data are now deleted.
Note: It is required that at least one series exists, thus it is impossible to delete the last series.



For LTL3500: Insert an appropriate value for each template variable you have ticked off. If you have ticked off '3rd party data', then remember name this new variable e.g., "Skid Resistance' or "Marking Thickness":



Users

It is possible to link the measurements to a specific person. It could be relevant in cases where the instrument is used by different staff, and you want to identify which measurements have been conducted by whom.

You can select, add, edit, or delete users. First, start by selecting ‘Users’ from the main menu. On the display, all your users are now listed on the left side of the screen.

Select a user: Press the user on the list, you want to use – the user is now selected. You can now continue with your measurements (switch to ‘Measure’ in the main menu) and the user will be linked to the data.

Add a new user: Press + on the top bar to add a new user. Type the name of the new user in the ‘Name’ field by using the keyboard on the touch screen. Press the return arrow to finish. The user is now added, and you can continue with your measurements (switch to ‘Measure’ from the main menu) and the user will be linked to the data.

Edit an existing user: Select the user on the list and rename the user profile (using the keyboard on the screen and press the return arrow to finish.). The user is now renamed, and you can continue with your measurements.

Delete a user: On the list select the user you want to delete. Press 🗑 on the top bar. The user and the related measurements are now deleted.

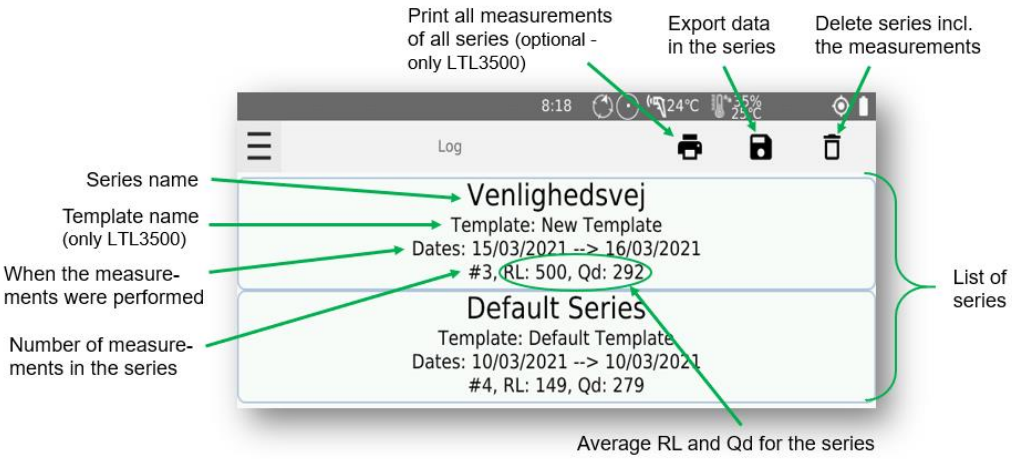
Note: it is required that at least one user exists, in other words it is impossible to delete the last user.

Log

The LTL3000/LTL3500s keep a log of all the measurements conducted. In the log you can see the data for each series and export the data.

View list of series

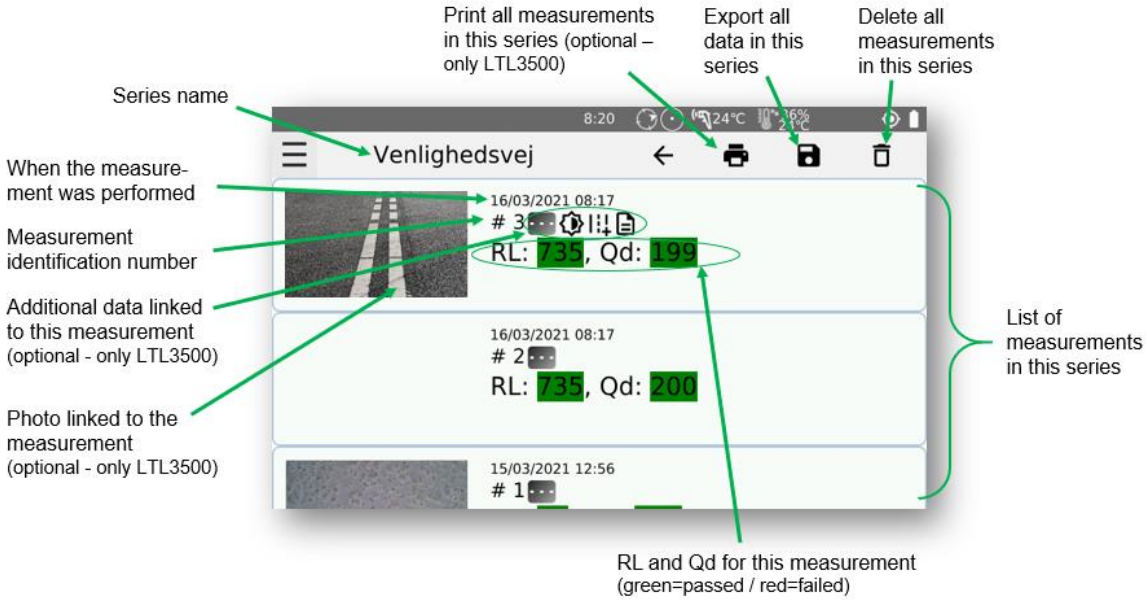
Start by selecting 'Log' from the main menu. Series containing measurement data are now displayed in a list on the screen.



Press the symbols at the top of the screen to print (optional feature), export, or delete all the series including the associated measurements and data. You can also see the measurements in a series by selecting the series.

View list of measurements in a series

From the log list, press the series you are interested in. A list of all the measurements in this series are now shown on the screen.

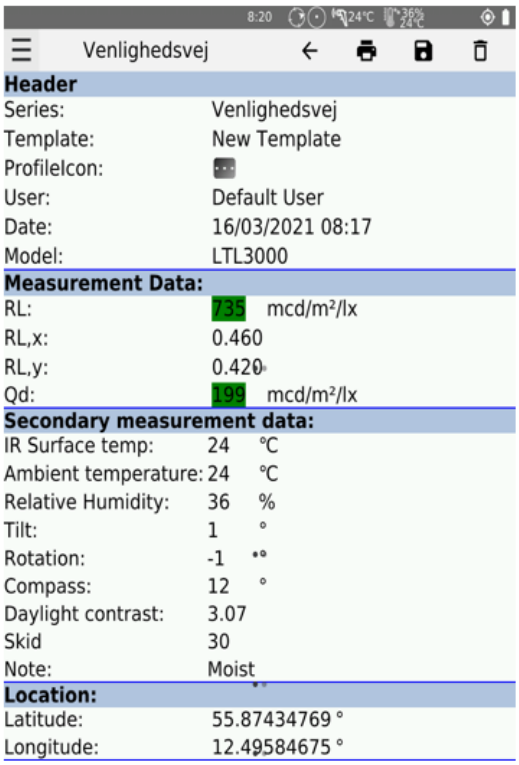


Press the symbols at the top of the screen to print (optional feature), export, or delete all the measurements in the series (including the associated data).

You can also see the measurement data in full detail by selecting the measurement.

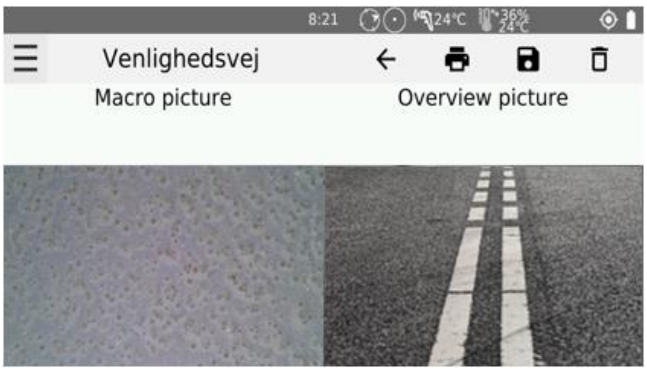
View all data for a measurement

From the log list of measurements, press the particular measurement you want to see details for. Now you can see all the measurement data in details:



Press the symbols at the top of the screen to print (optional feature), export, or delete all the data in this measurement.

Swipe to the left to see macro and overview pictures (optional feature – only LTL3500):

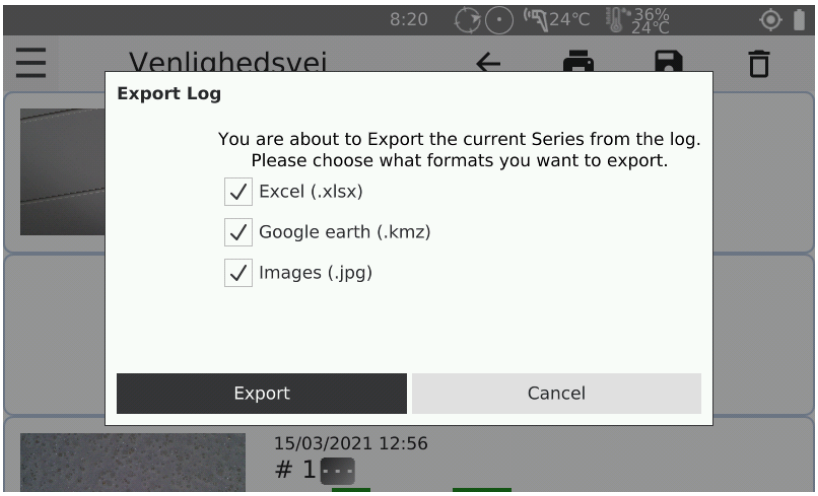


Export measurement data

Series and measurement data can easily be exported to a USB stick for further analysis.

How to transfer data:

- Choose the relevant series or measurement
- Press  at the top of the screen. If pressed while viewing all series, all series will be exported.
- In the dialog box, tick the formats you want to export and press ‘Export’.



The data is now transferred to the USB stick. Google Earth files will only be available if the instrument is equipped with GNSS and if there is valid GNSS data recorded. Likewise, images will only be available if the instrument is equipped with macro/overview camera (optional feature for LTL3500 only) and if one or more pictures are captured.

Note: remember to insert a FAT32-formated USB memory stick in the USB port before you transfer the data.

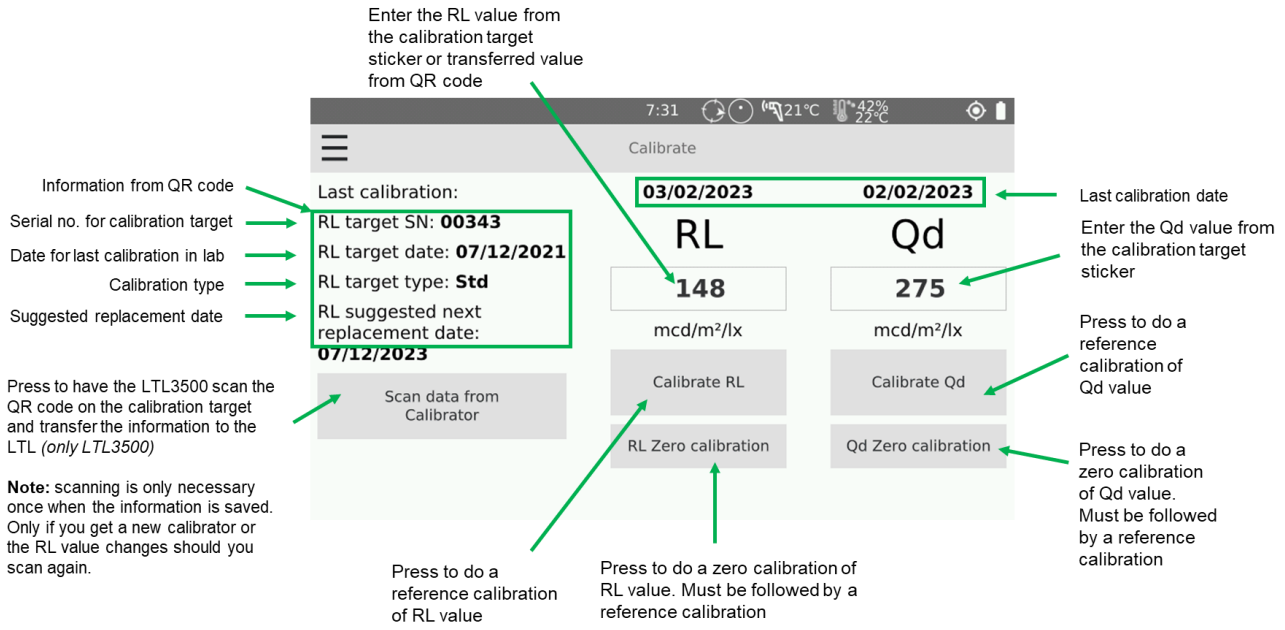
Calibration

To ensure high quality of the measurement data, DELTA recommends that you calibrate the LTL3000/LTL3500 daily.

Each day you use the instrument - typically in the morning before commencing your measurements you should perform a ***Zero calibration*** followed by a ***Reference RL calibration*** *and a* ***Reference Qd calibration*** (optional).

The calibration process automatically compensates for instrument offsets etc.

Calibration screen overview:



RL calibration

Zero RL calibration

To do a zero calibration follow these steps:

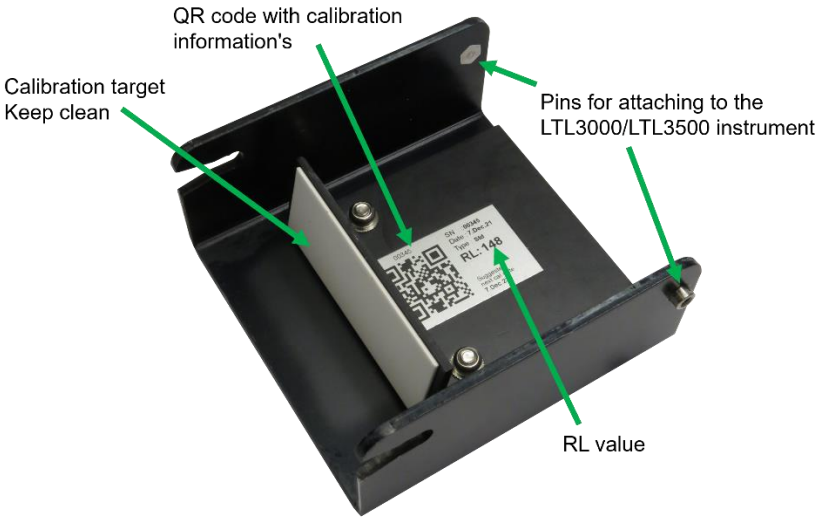
- Make sure the protection window underneath the instrument is clean. If necessary, clean it following the instruction described in section ‘Maintenance’.
- Select ‘Calibrate’ from the main menu.
- Press ‘RL Zero calibration’ on the screen.
- Tilt the instrument backwards and make sure it is not pointing at anything within several meters. **Note: Especially reflective materials e.g., from lamps will affect the calibration.**
- Press OK and wait for success confirmation.

Important: Zero calibration must be followed by a Reference RL calibration

Reference RL calibration

RL calibration can be done without performing a *Zero RL calibration* first, but it is recommended to do the *Zero RL calibration* also, at least at regular intervals e.g., once a week.

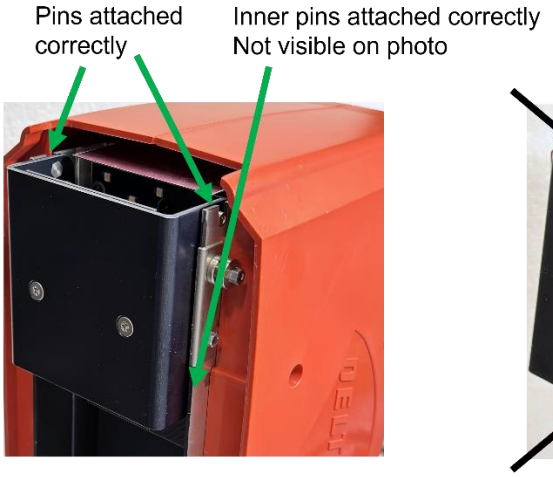
To calibrate the LTL3000/LTL3500 use the RL calibration target delivered with the instrument:



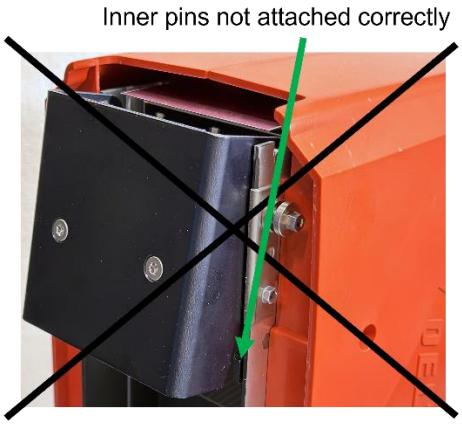
RL calibration target.

Calibrate the RL by following these steps:

- Make sure the protection window underneath the instrument is clean. If necessary, clean it following the instruction described in section ‘Maintenance’.
- Select ‘Calibrate’ from the main menu.
- Type in the RL-calibration value printed on the calibration target sticker or scan the QR code on the calibration target by pressing ‘Scan from Calibrator’ (only LTL3500).
- Place the calibration target under the LTL3000/LTL3500 (in the front) and press ‘Calibrate RL’ on the screen.



Correct position of calibration target



Wrong position of calibration target

Note: the pins on the calibration target must fit into the slots underneath the instrument.

- Wait for success confirmation.

RL calibration is now done.

Qd calibration

Zero Qd calibration

Normally, it is sufficient to make a reference calibration of the instrument prior to conducting measurements. However, if the instrument in rare occasions measures incorrectly it is recommended to do a zero calibration.

To do a zero calibration follow these steps:

- Make sure the protection window underneath the instrument is clean. If necessary, clean it following the instruction described in section ‘Maintenance’.
- Select ‘Calibrate’ from the main menu.
- Press ‘Qd Zero calibration’ on the screen.
- Tilt the instrument backwards and make sure it is not pointing at anything within a few meters.
- Press OK and wait for success confirmation.

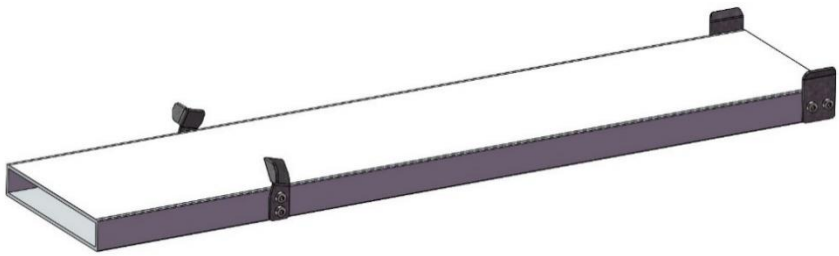
Important: Zero calibration must be followed by a Reference Qd calibration

Reference Qd calibration

Qd calibration can be done without performing a *Zero Qd calibration* first, but it is recommended to do the *Zero Qd calibration* also, at least at regular intervals e.g., once a week.

The calibration can be verified by performing a Qd measurement on the Qd calibration target. If the reading is within a few values compared to the Qd value on the Qd calibrator, calibration is not required.

Qd calibration requires the Qd calibration target. The instrument will warn about this fact before calibration.

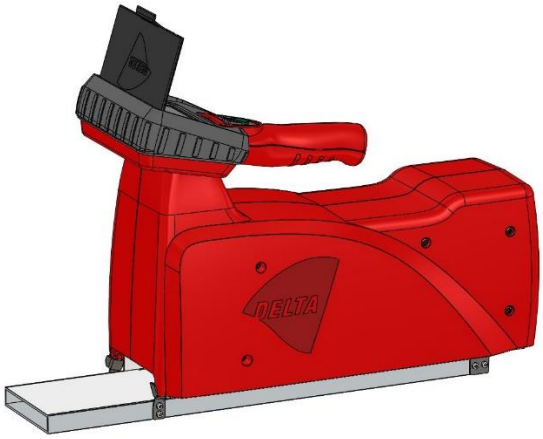


Qd calibration target.

To calibrate the Qd follow these steps:

- Make sure the protection window underneath the instrument is clean. If necessary, clean it following the instruction described in section ‘Maintenance’.
- Select ‘Calibrate’ from the main menu.
- Type in the Qd calibration value printed on the calibration target sticker.

- Place the LTL3000/LTL3500 fully back on the Qd calibration target, facing in the direction indicated.



- Press ‘Calibrate Qd’ on the screen.
- Wait for success confirmation.

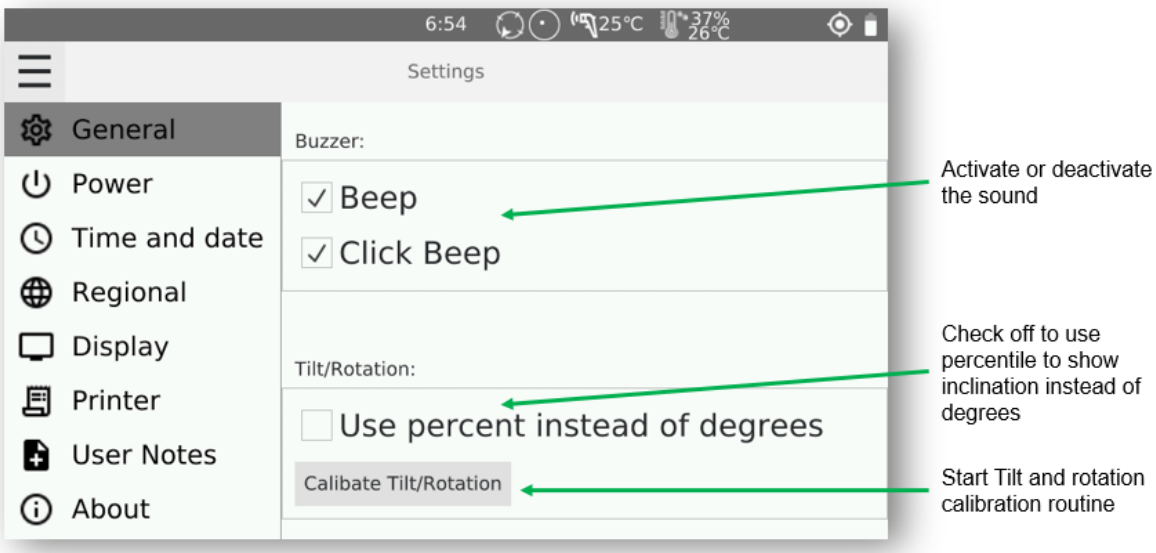
Qd calibration is now done.

Settings

Select ‘Settings’ from the main menu to adjust various instrument settings from the list below.

General

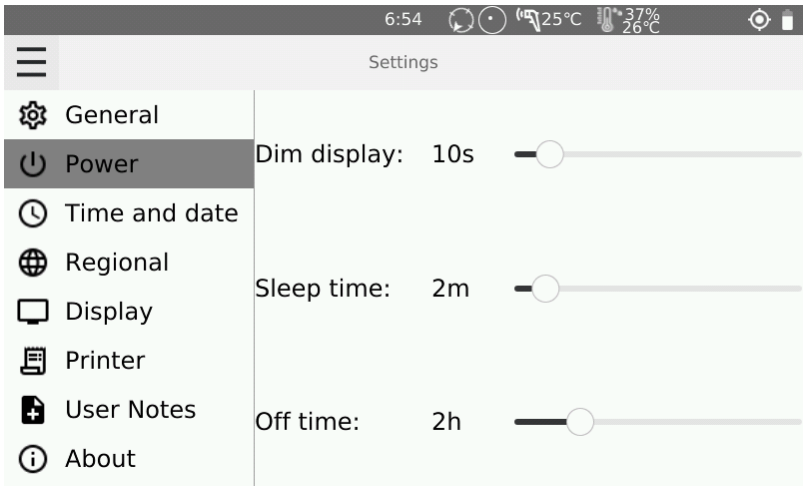
The instrument will send out a short beep when a new measurement is done, and a long beep if there is an error. To turn the sound on or off just check the “Beep” box. If you also want the instrument to make a short sound as feedback to the touch display, check the box “Click Beep”



Power

You can adjust certain power elements to save battery power:

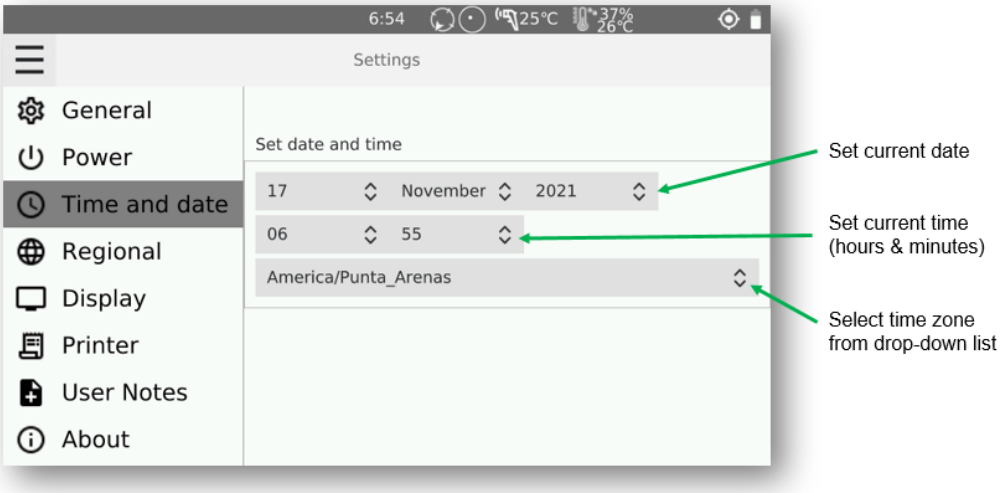
- **Dim display:** set timer for when the display light should dim (e.g., after 20 seconds)
- **Sleep time:** set timer for when the instrument should switch to stand-by mode (e.g., after 2 minutes)
- **Off time:** set timer for when the instrument should turn off automatically if not in use (e.g., after 2 hours).



Note: drag the curser all the way to the left to turn the function off.

Time and date

Adjust time and date linked to the measurements.



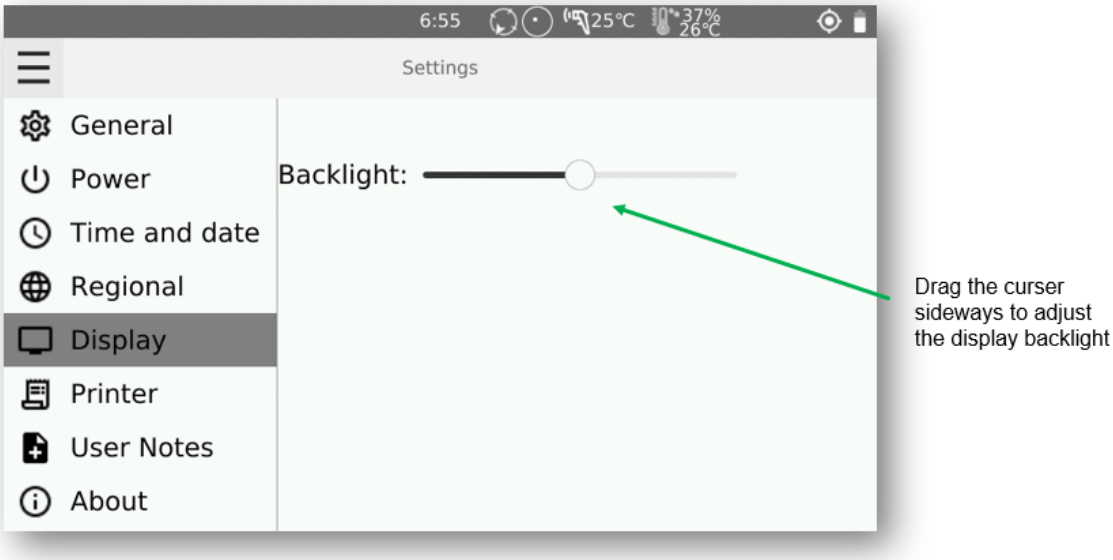
Note: If the GLSS feature is activated on your instrument, time and date are automatically updated according to the selected time zone.

Regional

You can adjust the format for how the instrument shows e.g., dates, numbers, temperature, and language. Select the relevant regional settings from the drop-down menu.

Display

Adjusting the light of the display by dragging the curser sideways.
Note: it may drain the battery faster if the backlight is set high intensity.

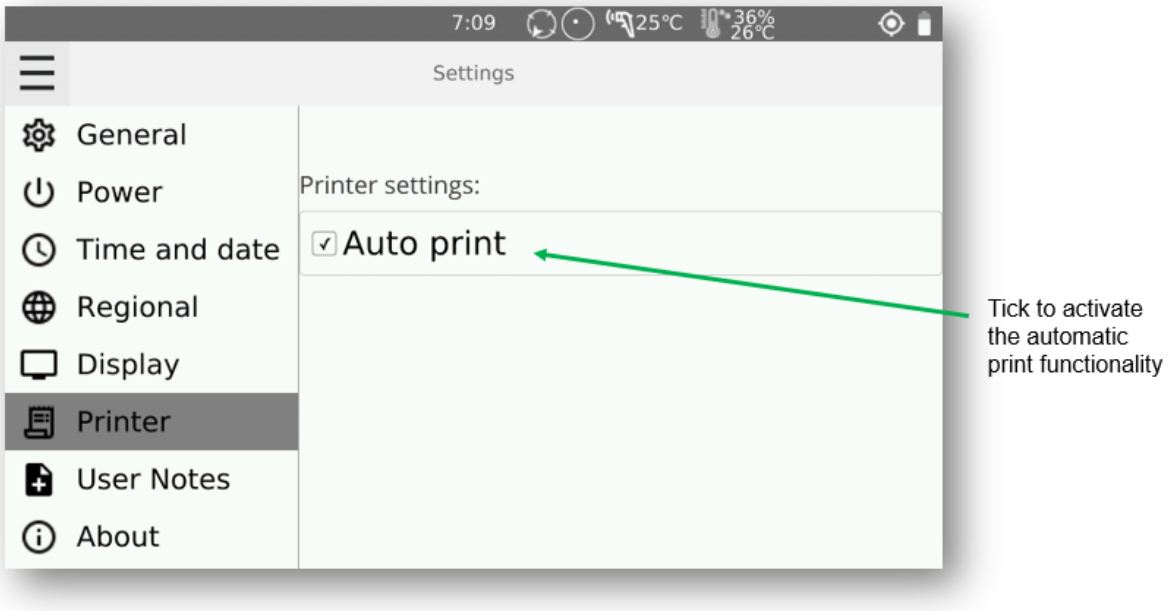


Printer

Activate or deactivate the automatic print functionality.

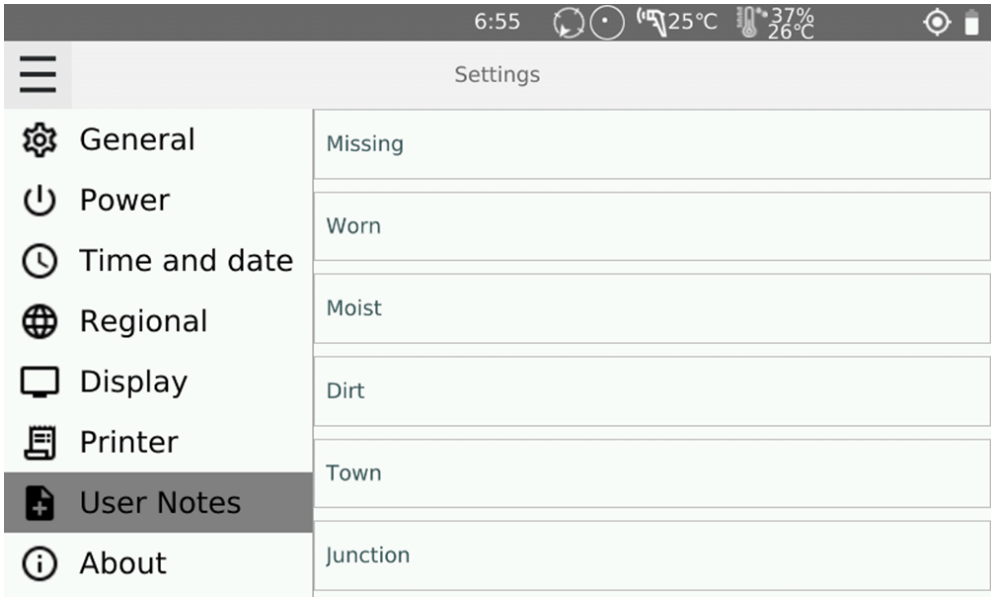
If activated the instrument will automatically print out data after each measurement. Remember to turn the printer on and press ‘Connect printer’ in the instrument display in the actions menu (see Actions Menu section).

If deactivated, the automatic printing is turned off. It is still possible to make ad-hoc prints of measurement data by selecting ‘Print’ in the Actions menu.



User notes

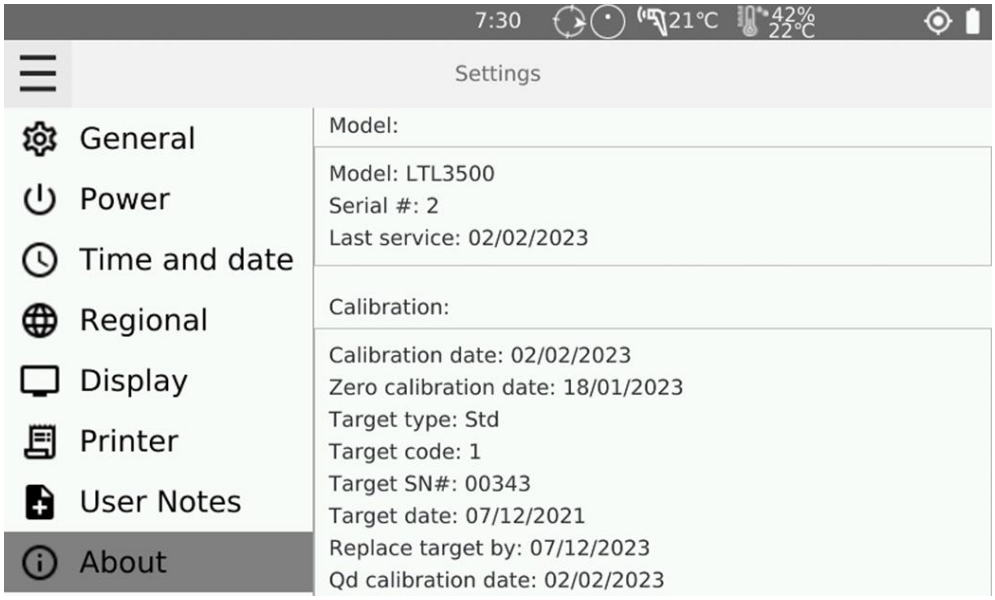
Customize the six quick notes that are available in the “Add note” screen.



About

Information about your instrument e.g., instrument model, serial number, version number, most recent service date, date of last calibration.

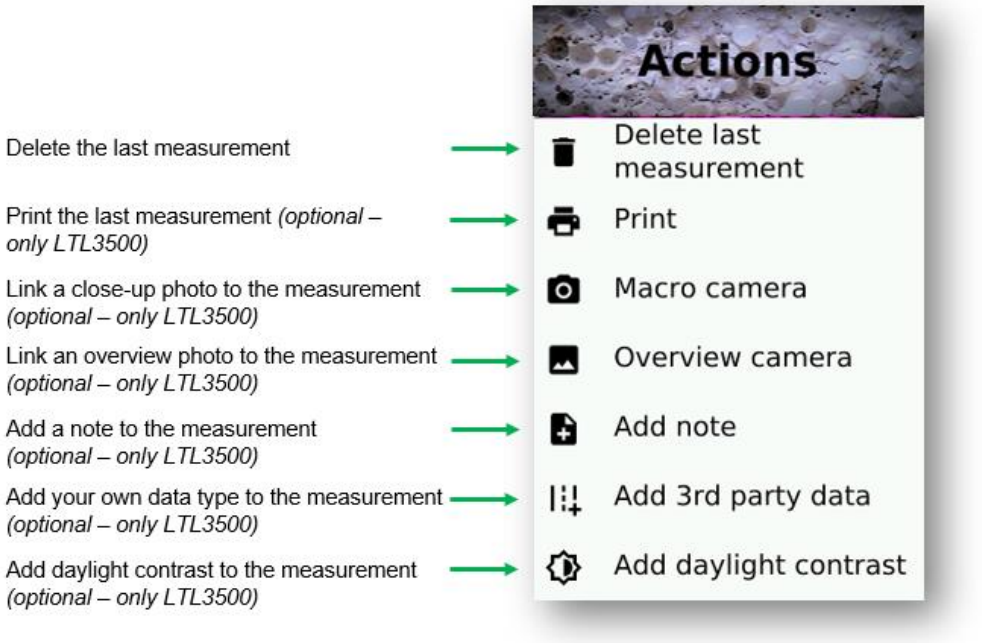
Swipe down to see more informations.



Actions menu

When you have performed a measurement there are various actions you can do with the measurement. These are explained in this section.

To activate the actions menu (after you have performed a measurement) press ⋮ at the top right corner on the screen (or press ○ on the instrument handle), and this menu appears:



Note: you can only use the actions in this menu <u>after</u> you have performed a measurement.

Delete last measurement

This action deletes the last measurement performed with the instrument.

Print (optional feature – only LTL3500)

This print action enables you to print data from the last measurement.

If the printer is already connected to the instrument press 'Print' to print the measurement data.

If the printer is not already connected to the instrument:

- Turn the printer on
- Press 'Connect printer' in the actions menu
- Wait for the printer icon to turn on in the top status bar
- Press 'Print' to print the measurement data

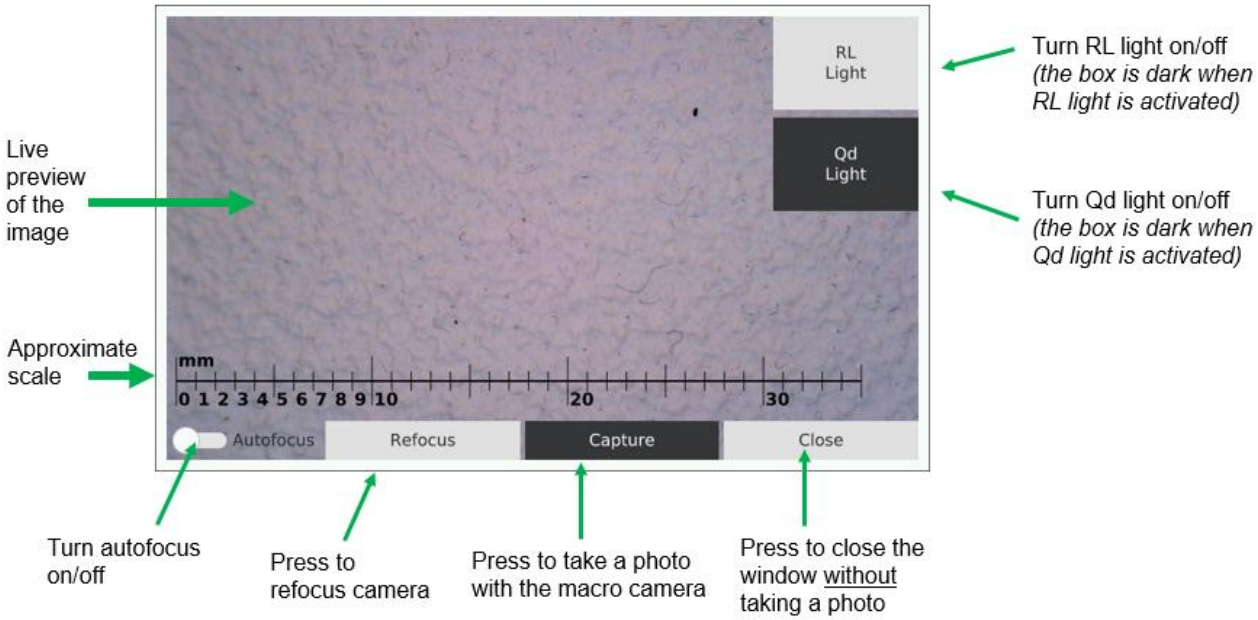
Macro camera (optional feature – only LTL3500)

This action enables you to take a close-up photo of the markings. The size of the photo is:

- Normal: width 27.5 mm / 1.08", height 15.5 mm / 0.61"
- With wet night frame: width 33 mm / 1.30", height 18.5 mm / 0.73"

How to take a photo:

- Place the LTL3500 on top of the road marking
- Turn the light on (press either RL or Qd or both on the screen)
- Activate or deactivate autofocus (or tap on the screen where you want the autofocus point to be)
- Pinch to zoom and drag to reframe the image (Optional)
- Pinch to zoom and drag to reframe the image (Optional)
- Press 'Capture' to take the photo
- The photo is now added to your measurement.

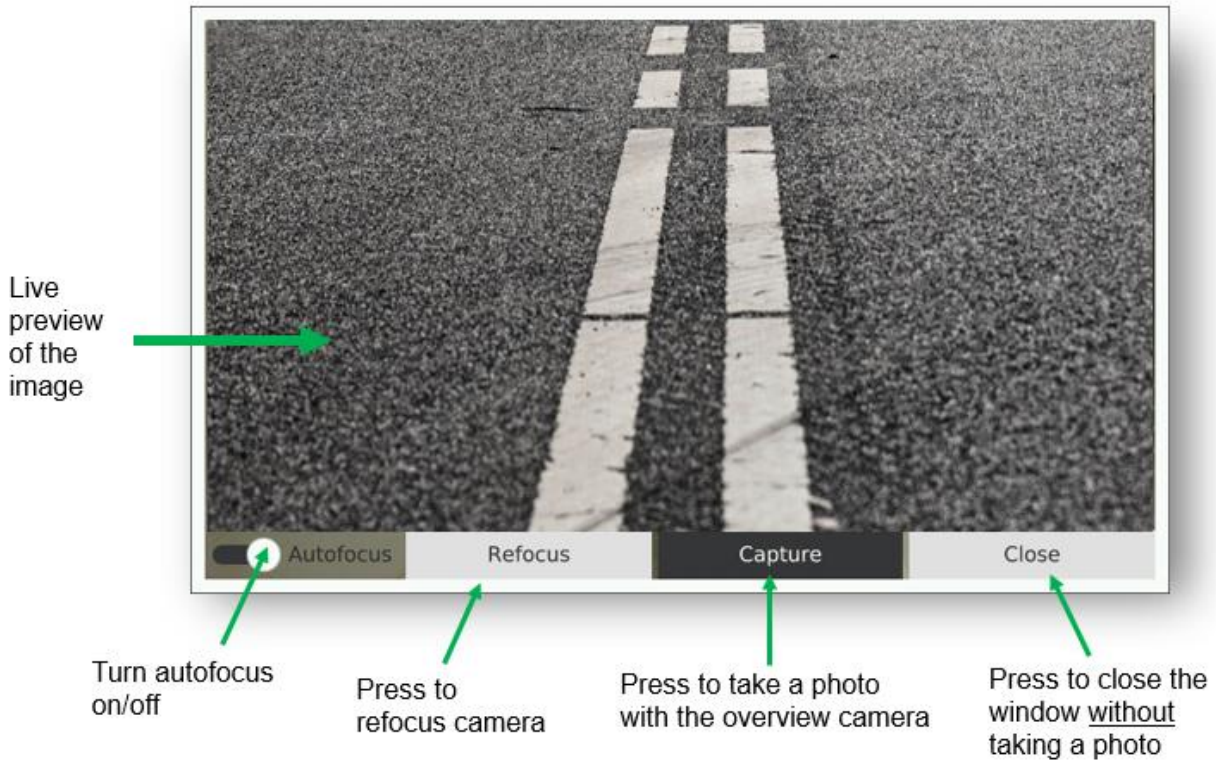


Overview camera (optional feature – only LTL3500)

This action enables you to take an overview photo of the surrounding area by the marking.

How to:

- Place the LTL3500 in the desired direction
- Activate or deactivate autofocus (or tap on the screen where you want the autofocus point to be)
- Pinch to zoom and drag to reframe the image (Optional)
- Press ‘Capture’ to take the photo
- The photo is now added to your measurement.

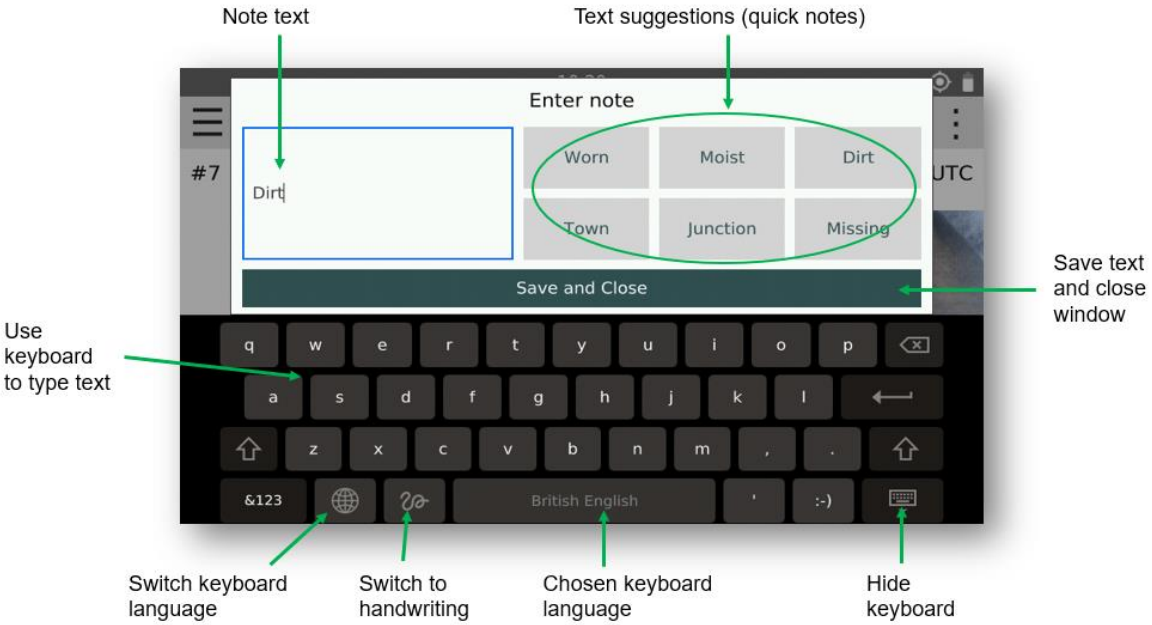


Add note (optional feature – only LTL3500)

This action enables you to add a note to your measurement e.g., a comment about the condition of the marking or an explanation as to why the measurement value turned out as it did.

How to:

- Type the text of your note either by using the keyboard on the screen or choose one of the six predefined quick notes. The quick notes can be edited in settings.
- Press ‘Save and close’ to finish and close the window. The text is now added as a note to your measurement and a note icon is visible on the measurement display.

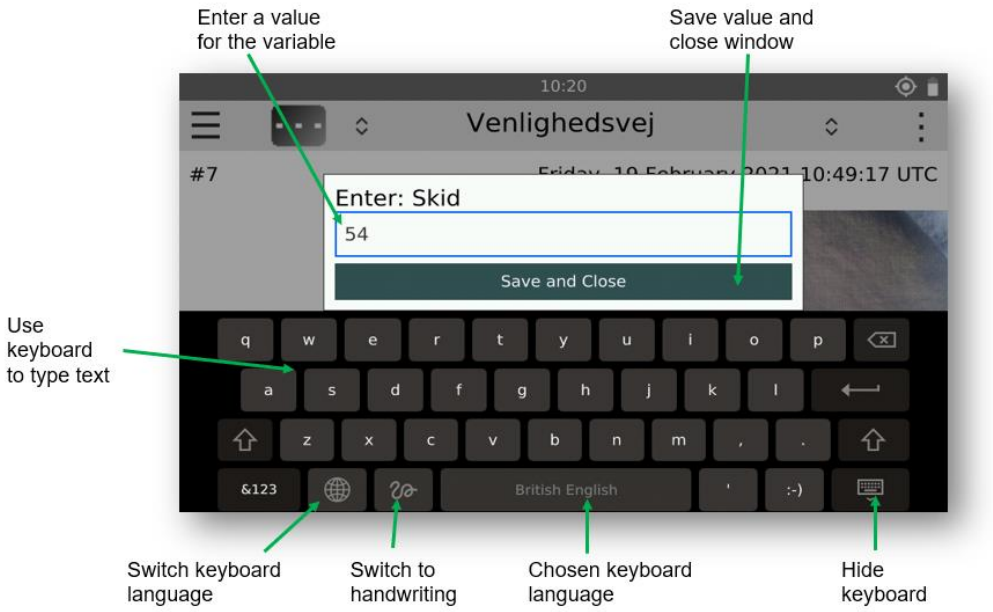


Add 3rd party data (optional feature – only LTL3500)

This action enables you to add a value for the 3rd party e.g., ‘skid resistance’ or ‘marking thickness’.

How to:

- Type a value (text and/or numbers) for the 3rd party variable.
- Press ‘Save and close’ to finish and close window. The entered value will automatically be added to the measurement’s logfile.



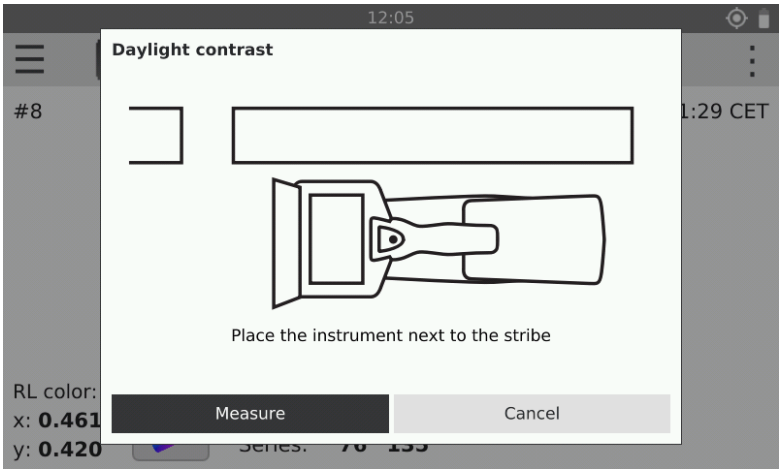
Add daylight contrast (optional feature – only LTL3500)

With this action you can add a measurement of the surface next to the marking, for the instrument to calculate a daylight contrast value.

Daylight contrast is an indication of the marking's visibility at daylight compared to the surface's visibility.

How to:

- Place the LTL3500 instrument on the surface right next to the marking.
- Press 'Measure'.
- The instrument will now automatically calculate the daylight contrast value and added the data to your measurement.



GNSS (optional feature)

If your LTL3000/LTL3500 is equipped with GNSS (Global Navigation Satellite System) it will show the measurement locations. GNSS make use of 4 satellite systems: BeiDou, Galileo, GLONASS and GPS.

The measurement locations with measurement results can be viewed on Google Earth after downloading data to a computer.

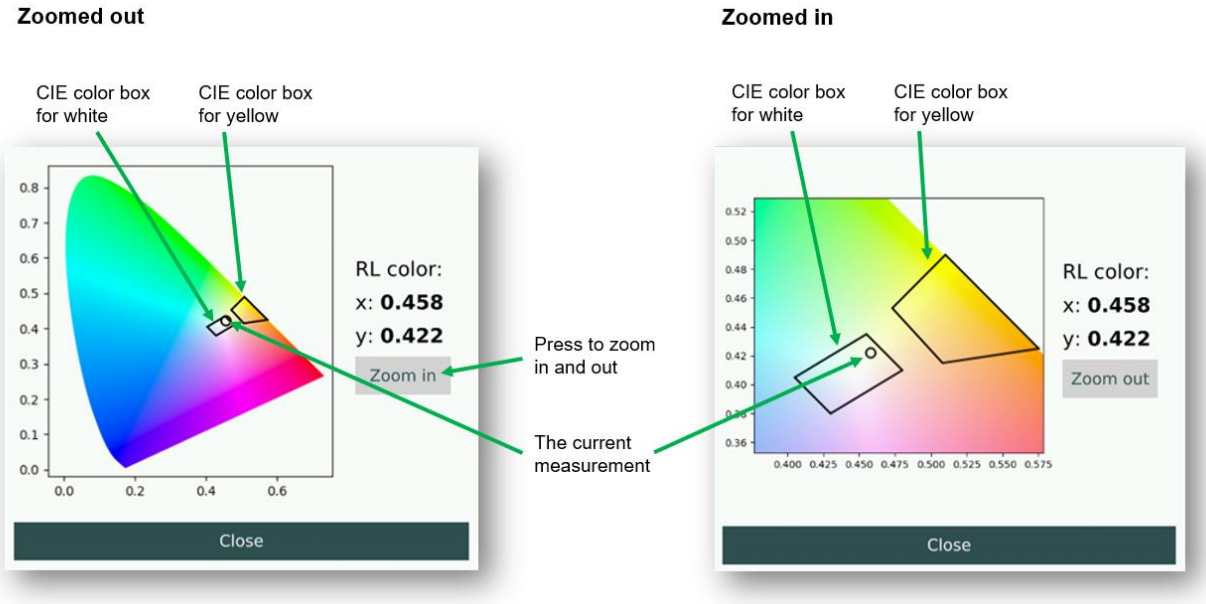
Note: GNSS cannot be expected to work indoors

Nighttime retroreflected color (x,y) *(optional feature)*

LTL3000/LTL3500 measure **nighttime retroreflected color** – CIE chromaticity - for white and yellow markings according to EN1436 and ASTM D6628.

With this feature installed nighttime reflected color will automatically be measured and recorded in the log file for each measurement.

When pressing  on the measurement screen (only available on LTL3500) then the graphic illustration below appears on the screen, showing where your measurement is situated on the color scale. This way you can detect if the road marking has the correct color at nighttime when retroreflected.



Note: LTL3000 provides data for RL color but without the graphic illustration.

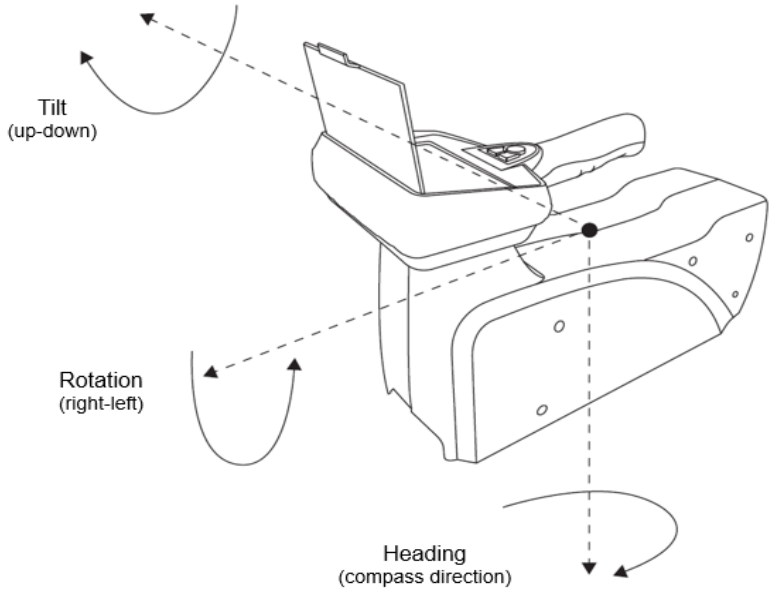
Sensors and cameras *(only LTL3500)*

The LTL3500 instrument is equipped with various sensors and cameras.

Temperature and humidity sensor: sensor that registers temperature and humidity in the surrounding environment. This data will automatically be linked to the measurement.

IR surface sensor (optional feature): an infrared sensor placed underneath the instrument. The sensor registers the road surface temperature, and this data will automatically be linked to the measurement.
Note: if the measurement is conducted on a surface with extra high reflection (e.g., water or broken glasses) the reading might be incorrect.

Orientation sensors (optional feature): sensors that register the physical orientation of the instrument i.e. tilt (up/down), rotation (right/left), and heading (compass direction). This data will automatically be linked to the measurement.



Macro camera (optional feature): an image sensor that is placed next to the Qd light source underneath the LTL3500 instrument. The camera can be activated/deactivated from the actions menu (see section 'Actions menu').

Overview camera (optional feature): an image sensor that is placed on the LTL3500 handle facing forward. The camera can be activated/deactivated from the actions menu (see section 'Actions menu').

Wet Night Frame *(optional feature)*

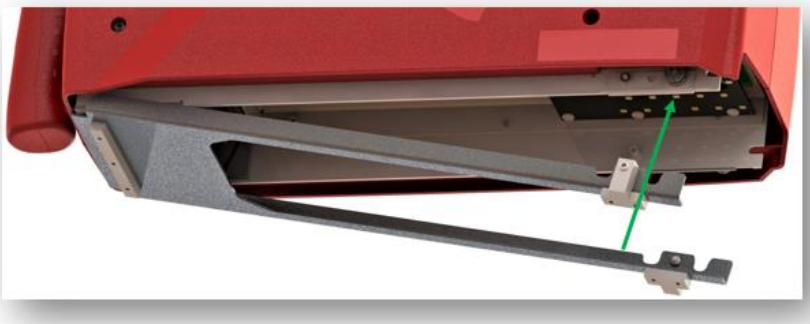
The Wet Night Frame is an optional feature that enables you to perform measurements when it rains and capture the rain's effect on the marking's retroreflection.

Wet Night Frame

The wet night frame is mounted underneath the instrument in order to move the measurement field outside the horizontal base cover during continuous wet measurements - this elevates the instrument, and the measurement field is moved forward.

How to mount the wet night frame:

- Place the end of the wet night frame under the instrument and push the 'legs' up to fixate.
- The wet night frame is now ready for use.



- After use, dismount the wet night frame by reversing the above operations.

Battery

The instrument is powered by a Li-Ion battery, which under normal use requires no maintenance. The battery is a standard Bosch Li-Ion battery model GBA 12V 3.0Ah. Rated 12 Vdc, 3.0Ah.

Bosch Li-Ion battery delivered with the LTL3000/LTL3500.

The battery is equipped with a thermal sensor that only allows charging within a range between 0ºC and 45ºC (32ºF and 113ºF). This ensures long battery life.

A substantial drop in obtainable measurements on a fully charged battery indicates that the battery is worn out and must be replaced.

Insert the rechargeable battery on the side of the LTL3000/LTL3500.

For your safety
Do not expose the battery to heat or flames: **Danger of explosion.** Do not place the battery on a heater or expose to direct sunlight for long periods.

The battery can be stored within a temperature range between -10°C to +60°C (14°F to 140°F), but we recommend storage between 0°C to +30°C (32°F to 86°F), due to lifetime considerations of the battery.

Allow a warm battery to cool before charging.

When handling or storing the battery take special care to avoid possible short circuiting the battery contacts.

Do not insert the battery in the charger if the battery is cracked. Using a damaged battery may result in electric shock or fire.

See further details in the battery user guide.

Sa  ecautions:

- The battery should be protected against impact. Do not open the battery.
- Store the battery in a dry and clean place.
- Due to environmental protection do not dispose the battery with household waste.

Battery charger

A battery charger is provided as a standard accessory for charging the battery from the mains. The battery charger comes in two models:

- Bosch AL1130CV, 230V AC, 50/60 Hz
- Bosch BC330 Fast Charger, 120V AC, 60 Hz

The battery will be fully charged in approx. 1hour and 15 minutes (3Ah battery).

Due to the intelligent charging method, the charging condition of the battery is automatically detected, and the battery is charged with the optimum charging current, depending on battery temperature and voltage.

To recharge the battery, first make sure that the LTL3000/LTL3500 is turned off, remove the battery from the handle and insert it in the charger. Make sure the battery and battery charger are clean and dry before and during charging takes place.

The battery charger will during charging give the following information:

Charger AL1130CV

- If the **green** indicator light is '*on*', the charger is plugged in, but the battery is not inserted, or the battery is fully charged and is being trickle charged.
- If the **green** indicator light is *'flashing'*, the battery is being fast charged. Fast-charging will automatically stop when the battery is fully charged.
  Note: The rapid-charging procedure is only possible when the battery temperature is within the allowable charging temperature range (see below).
- If the **red** indicator light is *'flashing'*, the battery cannot accept a charge. The battery may be defect or the contacts of the charger or battery are contaminated. Clean the contacts of the charger or battery and check. Change the battery is no solution can be found.
- If the **red** indicator light is '*on*', the temperature of the battery is not within the allowable charging temperature range. As soon as the allowable charging temperature range is reached, the battery charger automatically switches to rapid charging.

Charger BC330

- If the **green** indicator light is '*off*', the charger is not receiving power from power supply outlet.
- If the **green** indicator light is '*on*', the charger is plugged in, but the battery is not inserted, or the battery is fully charged, or the battery is too hot or cold for fast charging. The charger will automatically switch to fast charging once a suitable temperature is reached.

- If the **green** indicator light is '*flashing*', the battery is being fast charged. Fast charging will automatically stop when the battery is fully charged.

For your safety
Read all instructions. Failure to follow all instructions listed below may result in electrical shock, fire and/or serious injury.

- The battery and the charger are specifically designed for use in conjunction with one another. Charging should be done only with the charger delivered with the instrument.
- Protect the battery from rain and moisture. The penetration of water in a battery charger increases the risk of electric shock.
- Do not insert battery pack in charger if battery is cracked. Using damaged battery may result in electric shock or fire.
- Do not disassemble charger or operate the charger if it has received a sharp blow, been dropped or otherwise damaged in anyway. Incorrect reassembly or damage may result in electric shock or fire.
- Keep the battery charger clean. Contamination may cause the danger of electric shock.
- Check the battery charger, cable and plug each time before using. Do not use the battery charger when defects are detected. Do not open the battery charger yourself and have it repaired only by qualified personnel using original spare parts. Damaged battery chargers, cables and plugs increase the risk of electric shock.
- Do not operate the battery charger on easily inflammable surfaces (e.g. paper, textiles, etc.) or combustible environments. There is danger of fire due to the heating of the battery charger during charging.
- Do not store battery in charger. Storing the battery in the charger over a long period of time could lead to battery damage and fire.
- See further details in the charger user guide.

Practical advice
With continuous or repetitive charging cycles without interruption, the charger can warm up. This is of no consideration and does not indicate a technical defect of the unit.

USB connection

The LTL3000/LTL3500 is featured with an USB port for connection to a USB memory stick when you want to transfer measurement data. The USB port is placed on the side of the instrument above the battery slot.

Only use a FAT32-formated USB memory stick. Other file formats are not supported. If your USB stick is not working, reformat it and select 'FAT32' as file system.

Maintenance

Service:

Regular service every 24 months is recommended. The instrument's last service date can be seen in the 'About' section in the settings menu. A spanner icon  will appear in the top status bar when it is time for service.

Service on the LTL3000/LTL3500 instrument must be done by DELTA or DELTA trained personal. All spare parts (except for battery and charger) must be supplied only by DELTA.

General care:

The LTL3000/LTL3500 is constructed for outdoor use in fair weather conditions. The retroreflectometer can withstand moist weather, but caution must be taken against rain or splashes and dirt from traffic. Even though it is a robust instrument, it is also an optical instrument and must be handled with care:

- Avoid exposing the instrument to high mechanical shocks and vibrations.
- Avoid exposing the instrument to rapidly changing temperatures.
- When not in use, store the instrument in its case in a clean and dry environment.

When the instrument is not in use, turn off the instrument and fold the screen cover down to protect the touch screen. If the battery is not properly turned off, it will deplete the battery during storage.

You may clean the LTL3000/LTL3500 instrument and the touch screen using a soft, clean linen cloth with mild detergent.

Protection window:

The protection window is accessible from underneath of the instrument. The protection window is coated with a high-efficiency anti-reflection coating. Take care not to damage this coating when cleaning. Compressed air or a fine brush can be used for removing loose particles/dust. If this is not sufficient the window should by cleaned using a soft paper tissue or cloth and some window cleaning liquid.

Battery:

A substantial drop in obtainable measurements on a fully charged battery indicates that the battery is worn out and must be renewed.

For your safety:
Do not expose the battery to heat or flames: **Danger of explosion.** Do not place the battery on a heater or expose to direct sunlight for long periods.

The battery can be stored within a temperature range between -10°C to +60°C (14°F to 140°F), but we recommend storage between 0°C to +30°C (32°F to 86°F), due to lifetime considerations of the battery.

Allow a warm battery to cool before charging. When handling or storing the battery take special care to avoid possible short circuiting the battery contacts.

See further details in the battery user guide.

Safety precautions:

- The battery should be protected against impact. Do not open the battery.
- Store the battery in a dry and clean place.
- Due to environmental protection do not dispose the battery with household waste.

Battery charger:

Keep the battery charger clean by blowing compressed air on charger vents and wiping the charger housing with a damp cloth. Contamination may result in electric shock or fire. Make sure the battery charger is unplugged before cleaning it.

Calibration target:

To make sure that the calibration of the retroreflectometer is correct it is important that the surface on the calibration target is clean and undamaged. Be careful not to touch the calibration target (white side).

When not in use, keep the calibration target protected in the box, in which it has been delivered.

If the surface is stained, scratched, or broken the calibration target must be replaced. A replacement calibration reference can be purchased from DELTA.

In general, DELTA recommends changing the calibration target every two years to ensure that the target always provide correct calibrations.

Appendix A: Specifications

General characteristics

Measurement geometry and optical characteristics

Illumination angle 1.24º

Observation angle 2.29º

Equivalent observer distance ..... 30 m

Observation angular spread ..... ±0.17º

Type 30m CEN

Illumination angular spread horizontal 0.33º

Illumination angular spread vertical 0.17º

Field of measurement:

Width ..... 50 mm (2 inch)

Length (typ.) ..... 180 mm (7.1 inch)

RL range (mcd·m^{-2}·lx^{-1}) 0-4000

Qd range (mcd·m^{-2}·lx^{-1}) - optional 0-318

Nighttime chromaticity coordinates (x,y) according to - optional .....ASTM E 2367 and CIE 1931

Location position system (GNSS)

Latitude / Longitude Format ..... Decimal degrees

Datum .....WGS 84

Electrical characteristics

Pollution Degree: 2

Overvoltage Category: I

Battery supply: ..... Rechargeable and replaceable 12V/3Ah Li-ion

Supply current, full load: 1A

External charger: ..... Mains voltage 230 V/50 Hz or 120V/60Hz

Charge time (3Ah battery): ..... approx. 1 hour 15 minutes

Other

Data memory: ..... 8 GB
Data transfer ..... USB memory stick

Environmental specifications

Operation temperature: ..... 0°C to +60°C / 32°F to 140°F

Storage temperature: ..... -10°C to +60°C / 14°F to 140°F

Recommended storage (due to lifetime considerations of the battery): ..... 0°C to +30°C / 32°F to 86°F

Relative Humidity: ..... 20% - 85%, Non-condensing

Altitude: ..... 4,000 m / 13,000 feet

Instrument dimensions

LTL3000 Length: ..... 420 mm / 16.5 inch

LTL3500 Length: ..... 420 mm / 16.5 inch

Width: ..... 150 mm / 5.9 inch

LTL3000 Height: ..... 300 mm / 11.8 inch

LTL3500 Height: ..... 280 mm / 11 inch

LTL3000 Weight: ..... 4.7 kg / 10.4 lbs.

LTL3500 Weight: ..... 5.6 kg / 12.3 lbs.

Regulatory compliance

EU:

EMC (LTL-3000): ..... EN 301 489-19 V2.1.1 (2019)

Radio (LTL-3000): ..... EN 303 413 V1.1.1:2017

EMC (LTL-3500): ..... EN 301 489-19 V2.1.1:2019; EN 301 489-17 V3.2.4:2020

Radio (LTL-3500): ..... EN 303 413 V1.1.1:2017; EN 300 328 V2.2.2:2019

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

USA:

EMC: ..... FCC 47 CFR Part 15B (class B). Contains FCC ID 2AIG4-MOD1

Canada:

EMC: ..... ICES 003:2016 (Class B). Contains IC 21541-MOD1

Appendix B: Safety symbols and model identification

Below are explanations of symbols related to safety which are used on the LTL3000/LTL3500 equipment:

CE	CE mark – indicates conformance with the essential requirements of the directive
	Dispose of the instrument in compliance with local regulations for the disposal of electronic equipment. Do not put in domestic waste.
	Attention, see the instructions for use
	Universal Serial Bus (USB), port/plug

Label/marking for model identification:

Appendix C: Delivery

The LTL3000 instrument is delivered with the below items:

1. Carrying case
2. LTL3000 instrument including battery
3. Battery charger
4. Spare battery
5. Qd calibration reference (optional)
6. RL calibration reference
7. DANAK accredited calibration certificate (not shown)

The LTL3000 user manual can be located on the following weblink:
https://roadsensors.madebydelta.com/products/ltl3000

The LTL3500 instrument is delivered with the below items:

1. Carrying case
2. LTL3500 instrument including battery
3. Battery charger
4. Spare battery
5. Printer (optional)
6. Qd calibration reference (optional)
7. Wet night frame (optional)
8. RL calibration reference
9. DANAK accredited calibration certificate (not shown)

The LTL3500 user manual can be located on the following weblink:
https://roadsensors.madebpydelta.com/products/ltl3500