Part 2:
Pavement Marking Specifications Concerning Mobile Retroreflectivity

(20–25 minutes)

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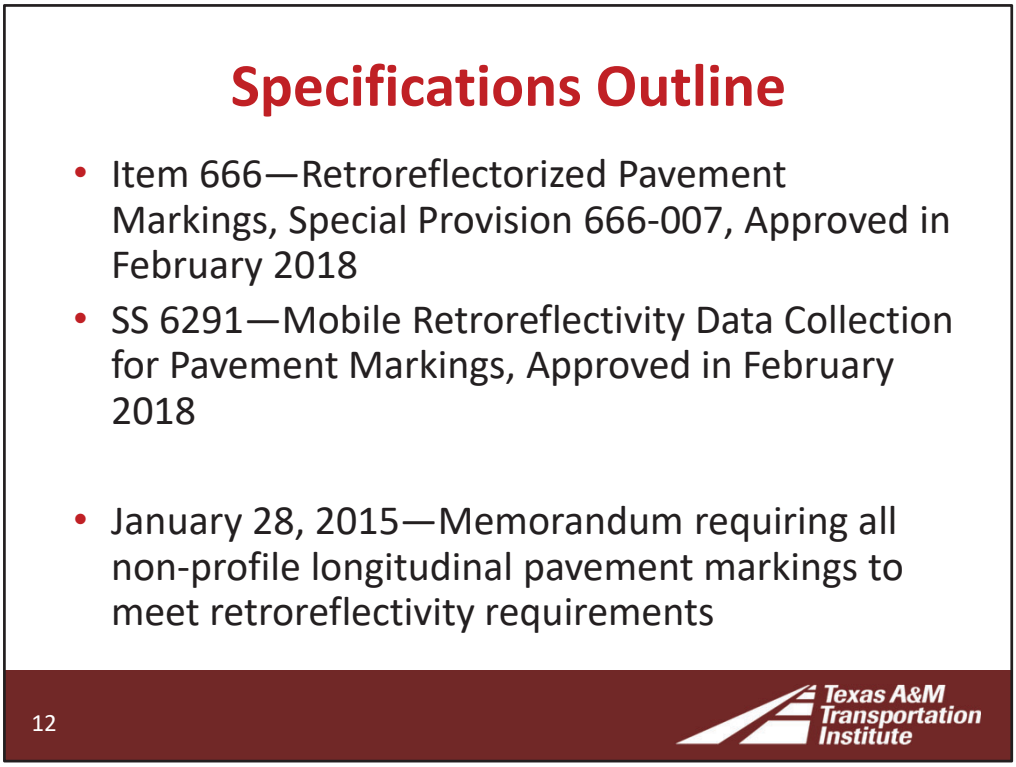
This portion of the presentation covers the specifications that call for and control the mobile retroreflectivity data collection. There is a lot of text in this part of the guidance presentation since specific material in each specification is covered.



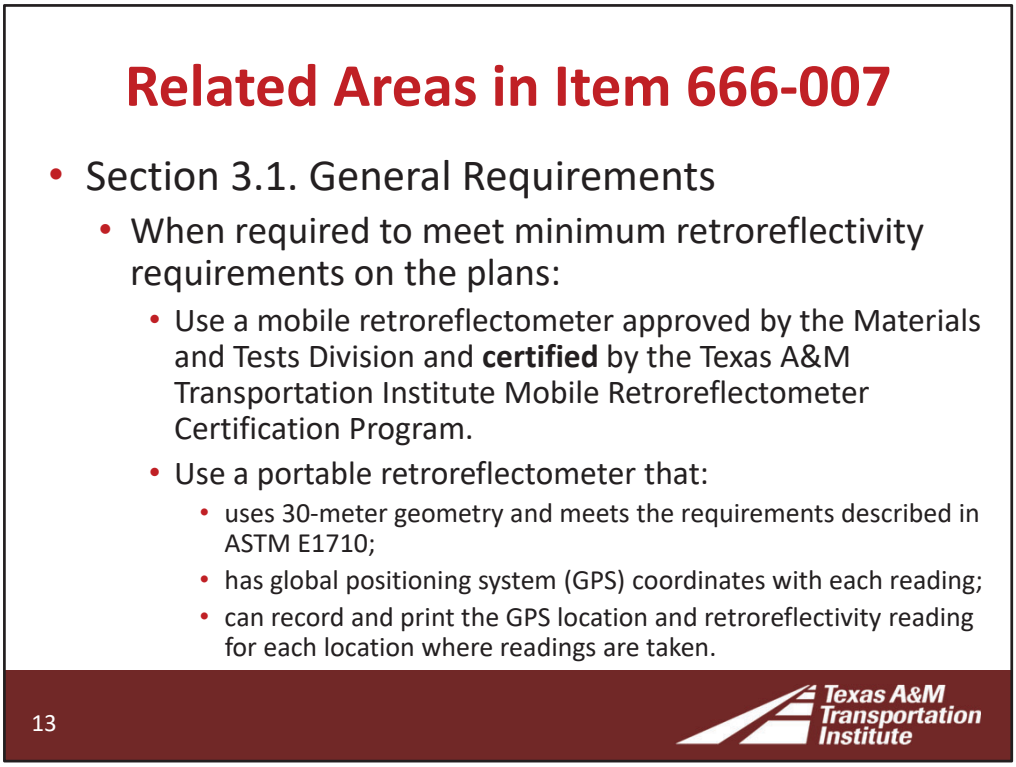
Item 666 was updated in February 2018 by Special Provision 007. The main areas of change included in the special provision related to the required retroreflectivity measurements.

Special Specification 6291 was approved to replace the previous Special Specification in February 2018. The areas of change included changes to the measurement notification and inclusion of verification and referee testing.

The memorandum distributed in 2015 was created to obtain uniformity of practice throughout the state.

Parts of these specifications will be discussed in other parts of the guidance presentation. The discussion in this part of the guidance presentation will not look at every part of the specifications, only those relevant to the discussion of mobile retroreflectivity.

It would be useful to have these documents available for reference during the presentation. Both of these specifications are undergoing review and modification. This presentation will be updated as newer versions are approved.

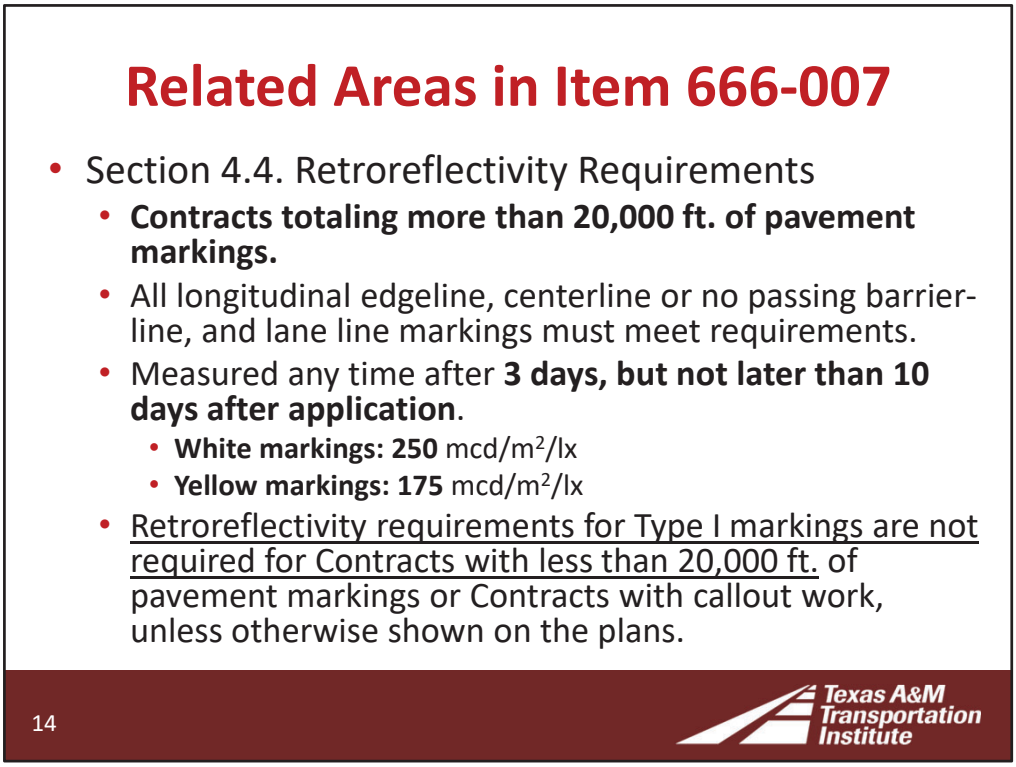


Updated specification required on all new jobs starting with May 2018 letting.

Mobile retroreflectometers need to be certified by TTI.

Portable retroreflectometers do not require certification but should be checked for calibration and accuracy. They are to be used to perform checks of the mobile retroreflectivity data and for small pavement marking jobs where retroreflectivity is required but the job size is not large enough to require mobile retroreflectivity.
Both mobile and portable retroreflectometers evaluate the markings at the standard 30-meter geometry. They just evaluate at a different scale. When both measurements are properly conducted, the results should be very similar.

Previously, the retroreflectometers were approved by the Construction Division; the specifications are being updated to reflect the change to the Materials and Tests Division (MTD).

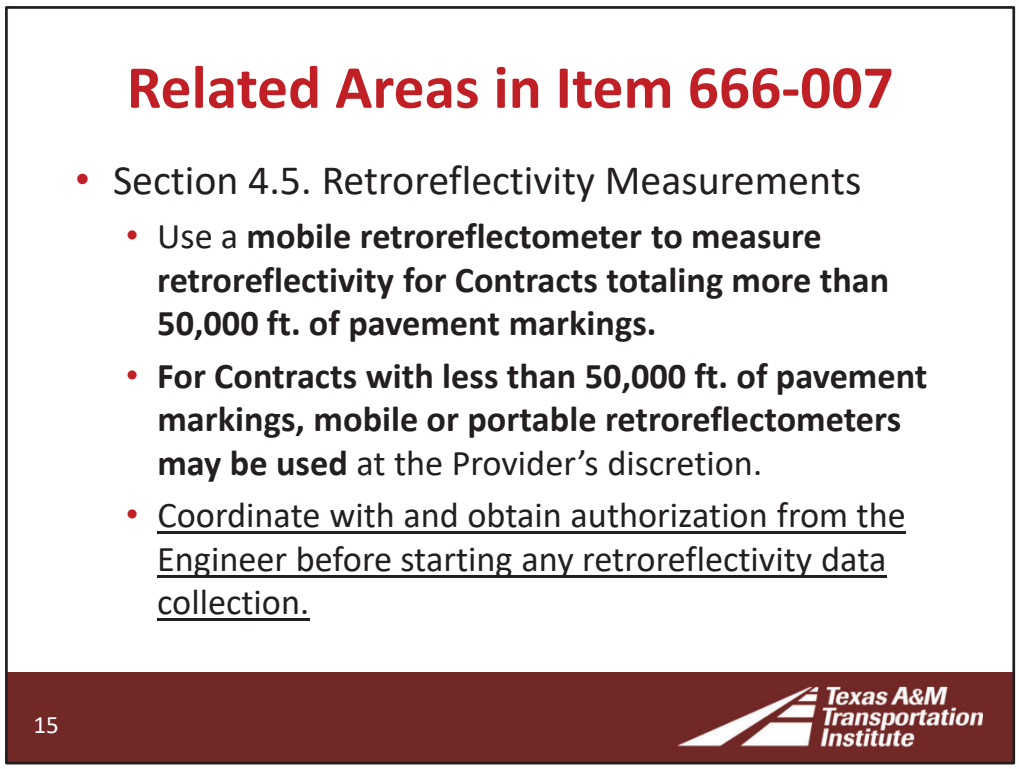


Section 4.4. was completely modified in Special Provision 007.

Bold and underline were added to call out specific areas of interest.

Markings must meet retroreflectivity requirements for all contracts with over 20,000 ft (total) of markings. Contracts with less than 20,000 ft of markings do not need to be evaluated for retroreflectivity unless shown on plans. Callout work does not have retroreflectivity requirements. Markings that do not have retroreflectivity requirements must still be retroreflective, but the retroreflectivity level is not evaluated.

The retroreflectivity values are for dry retroreflectivity. There are special specifications that have wet retroreflectivity requirements for pavement markings.

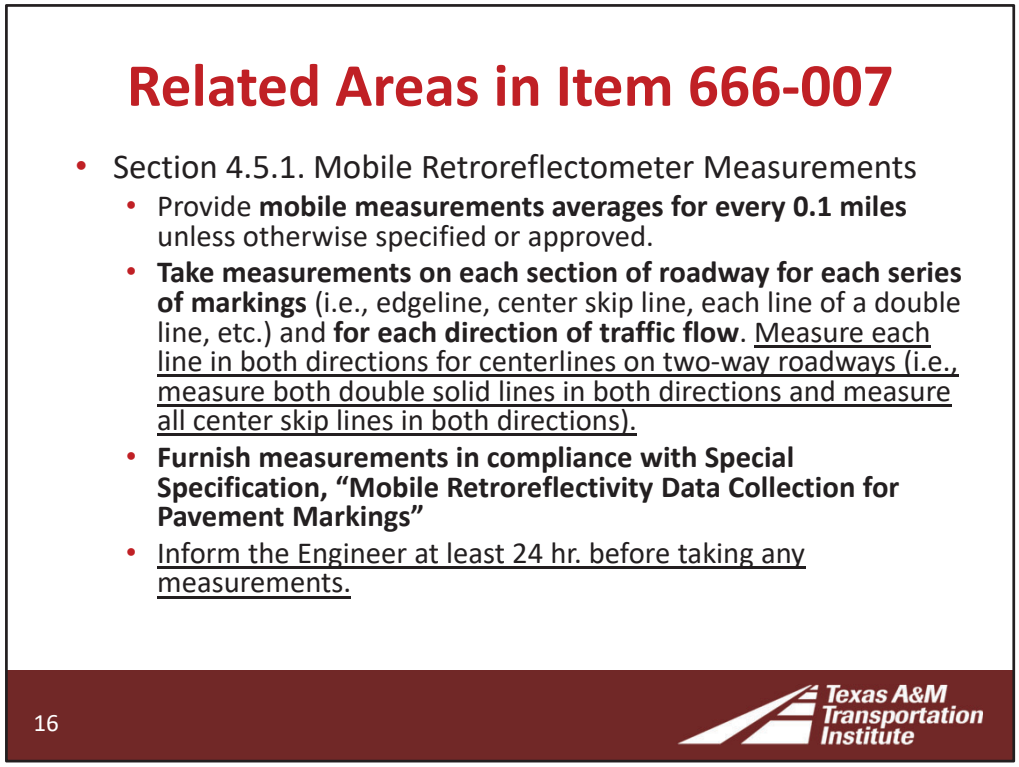


Section 4.5. was completely modified in Special Provision 007.

Bold and underline were added to call out specific areas of interest.

Mobile measurements must be used for all contracts with over 50,000 ft of markings. Contracts with less than 50,000 ft of markings may be evaluated with either mobile or portable retroreflectometers. Remember that contracts with less than 20,000 ft of markings do not have retroreflectivity requirements that must be met, but the markings must still be retroreflective.

Providers are supposed to obtain authorization from the Engineer before starting any retroreflectivity data collection.

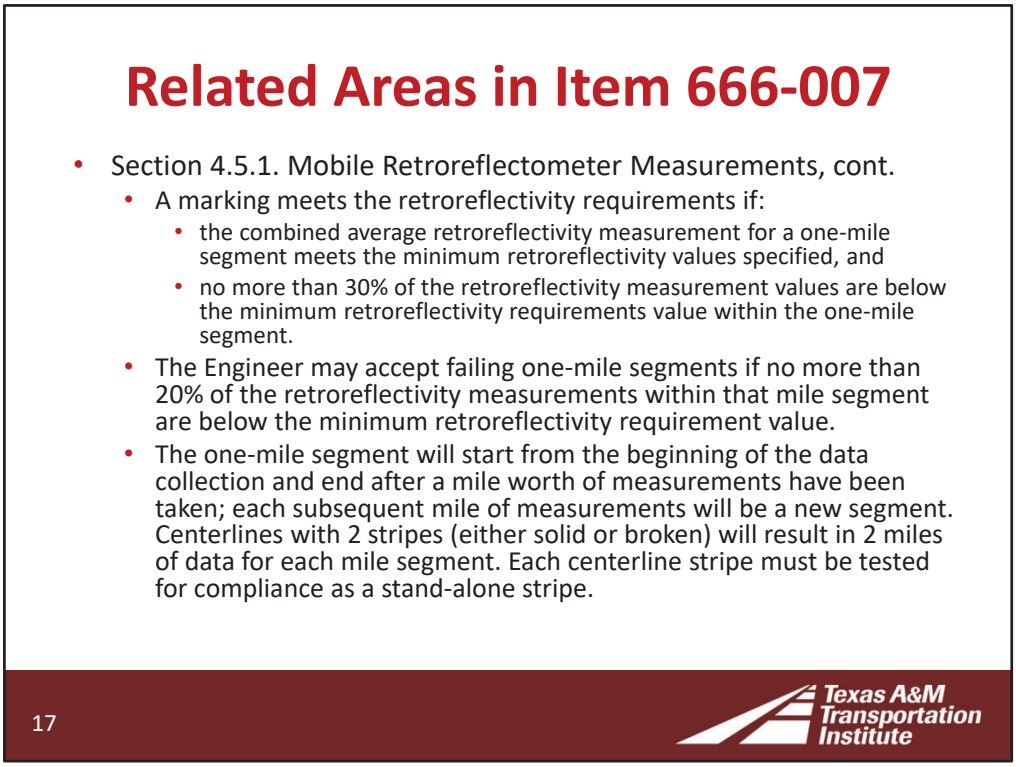


Bold and were underline added to call out specific areas of interest.

All longitudinal markings must be evaluated. The typical averaging distance is 0.1 miles. The mobile retroreflectometer collects a continuous stream of data and is averaged at the user-specified interval distance. Yellow centerline markings on two-way roadways must be evaluated in both directions. For double yellow and broken/solid marking configurations, each marking must be evaluated separately. This means each edge line and lane line will each have a single set of data along its length. Yellow centerline data will have two sets of data, one for each direction of travel. Within these sets of data, there need to be separate sets of data for the right and left yellow markings.

Item 666 references the Special Specification "Mobile Retroreflectivity Data Collection for Pavement Markings."

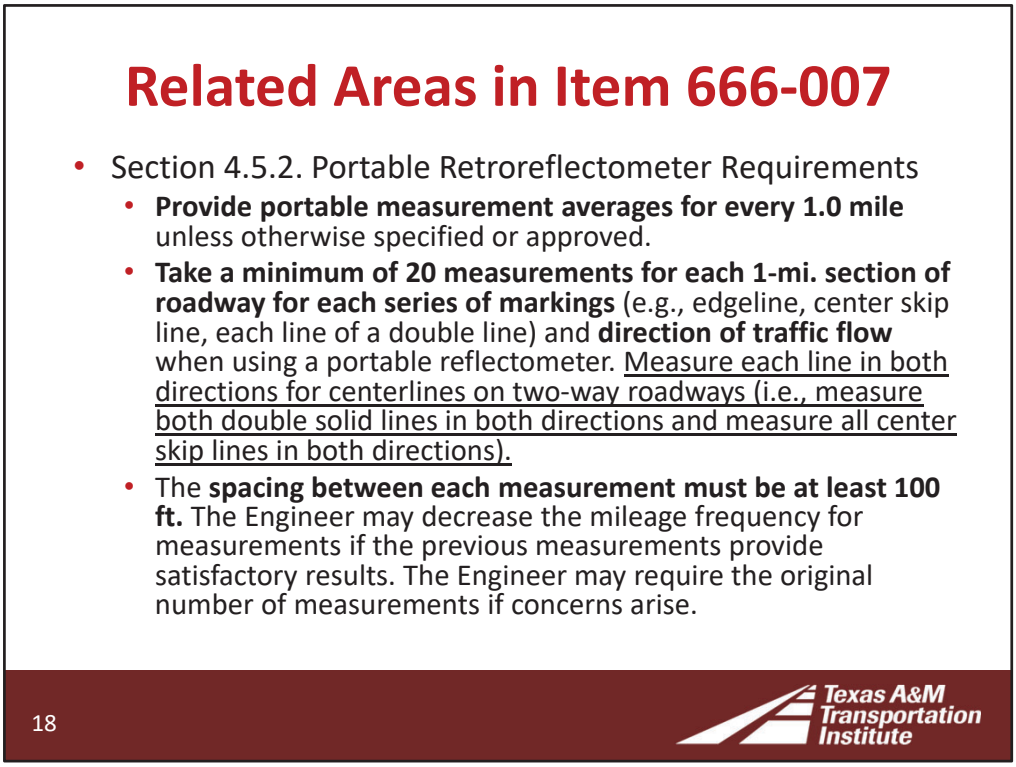
Providers must notify the engineer 24 hours prior to taking measurements. The special specification requires that TTI be notified as well (for verification testing purposes—described in Part 3 of the presentation).



Analysis requirements are provided in this section of the specification. Data are to be analyzed in 1-mile segments. The average over the mile needs to exceed the required values (250 white, 175 yellow), and no more than three of the ten 0.1-mile segments can be below the required value.

There is an exception; an overall 1-mile average that is below the required value may be accepted if only two, 0.1-mile segments are failing. This is to allow some leeway for short areas where the marking has possibly worn due to increased traffic, such as access points or near turning areas. Yellow centerline markings need to meet or exceed the retroreflectivity requirements for both directions of travel.

Information on restriping failed sections is provided in the specification (not provided in this portion of the guidance presentation). Those paragraphs are described later in the presentation, Part 5, during the Next Steps discussion.



Section 4.5.2. was completely modified in Special Provision 007.

Like the mobile measurements, all markings need to be evaluated. The portable measurements will result in much less data than can be gathered with a mobile unit. The portable measurements are time consuming and may require additional traffic control, unlike mobile measurements. Yellow centerline markings are again evaluated in both directions and evaluated separately. Unless the job is really small, most providers will use mobile measurements when there is an option between the two methods.

Information on restriping failed sections is provided in the specification (not provided in this portion of the guidance presentation). That information is described later in the presentation, Part 5, during the Next Steps discussion.

Related Areas in Item 666-007

- Section 4.6. Performance Period
  - **All longitudinal markings must meet the minimum retroreflectivity requirements within the time frame specified.** All markings must meet all other performance requirements of this specification for at least 30 calendar days after installation. Unless otherwise directed, remove pavement markings that fail to meet requirements, and replace at the Provider's expense. Replace failing markings within 30 days of notification. All replacement markings must also meet all requirements of this Item for a minimum of 30 calendar days after installation.

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The first sentence of Section 4.6. was modified in Special Provision 007.

The time frame for the retroreflectivity requirements is 3–10 days.

If markings fail for any reason, the reapplied markings must meet all requirements, including retroreflectivity.

This covers the information in Item 666 that pertains to the retroreflectivity evaluation of the pavement markings.

The Special Specification "Mobile Retroreflectivity Data Collection for Pavement Markings" is called out in Item 666.

The special specification covers the data collection requirements and what data are required to be submitted.

The updated special specification (6291) is required starting with May 2018 letting.

Each of the items described in the special specification will be discussed in this section.

MRDC = mobile retroreflectivity data collection.

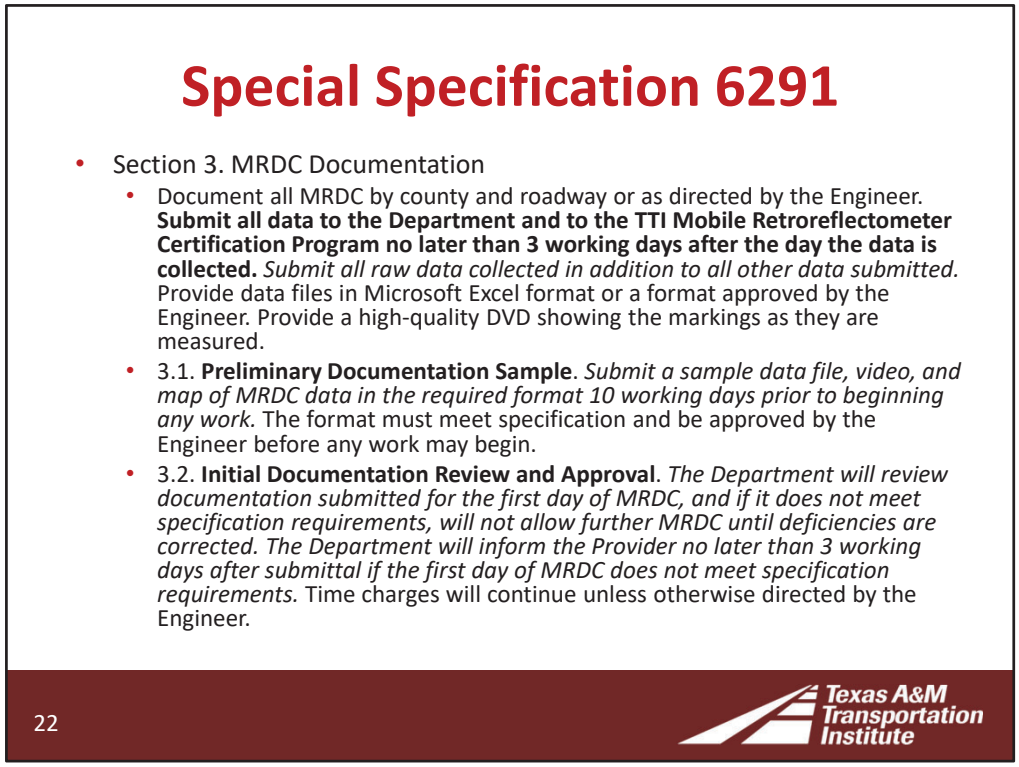
Equipment and personnel must be certified by TTI.

During the certification process, TTI will check any available portable retroreflectometers for accuracy at no additional charge.

TTI maintains the list of certified providers on the mobile certification website. The website is updated when changes to the list are required. In the past, physical certificates were distributed. Physical certificates are no longer distributed. Please contact the Program Coordinator (Adam Pike) if there are questions about the status of a provider, operator, or equipment.

https://groups.tti.tamu.edu/visibility/programs-and-guidance/mobile-retro-certification/certified-providers/

Adam Pike
a-pike@tti.tamu.edu
979-317-2136



Section 3 of the special specification describes the data requirements. Parts 4 and 5 of this guidance presentation look at the data output from the systems, data the providers are required to turn in, and how to analyze the data.

It is necessary to receive the data from the provider within 3 days so that retroreflectivity values can be verified if needed. If the provider delays submitting the data, there will be a longer time span between provider-collected data and verification/referee testing. This longer time span may result in changes to the retroreflectivity and may increase the difference between the data sets.

Section 3.1—Providers often do not submit the preliminary data, and districts are not requesting preliminary documentation. This is not a new addition to the specification. Districts should request this information to make sure the providers are going to submit data in the proper format. Not all districts request all information contained in this specification, and providers may assume they do not need to deliver it all when working with a new district.

Section 3.1—Districts need to review the initial documentation submission to make sure it fits their needs. If it does not, the provider needs to be notified as soon as possible so that they can modify the documentation as needed.

Each of these items should be provided on the summary data file. Examples of data files are provided in Parts 4 and 5 of this guidance presentation.

Providers format their data files in different ways. There is not a standard format that providers must follow. The files should contain the information listed unless not required by the district.

There are some differences between mobile retroreflectometers, their software, and their output data that may affect some of the above required items. These differences are described in Parts 4 and 5 of the presentation.

As noted in Section 3 of the special specification, the raw data should be submitted in addition to the required summary data as described in Section 3.3. The summary data provide a good overview of the information collected and if the markings pass or fail the retroreflectivity requirements. Looking at the summary data, an observer can sometimes judge the quality of the data. If the accuracy of the data looks questionable, the raw data can be reviewed to see if there may be some issues with the data.

Special Specification 6291

- **Section 3.4. Map**. Provide a map in an electronic format approved by the Engineer with each MRDC submission that includes the following information:
  - date;
  - district number;
  - county;
  - color-coded 1-mi. intervals (or interval length designated by the Engineer) for passing and failing retroreflectivity values or retroreflectivity threshold values provided by the Engineer; and
  - percentage of passing and failing intervals, if required by the Engineer.

24

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Each of these items should be provided on the map file. Examples of map files are provided in Parts 4 and 5 of this guidance presentation.

Providers format their map files in different ways. There is not a standard format that providers must follow. The files should contain the information listed unless not required by the district.

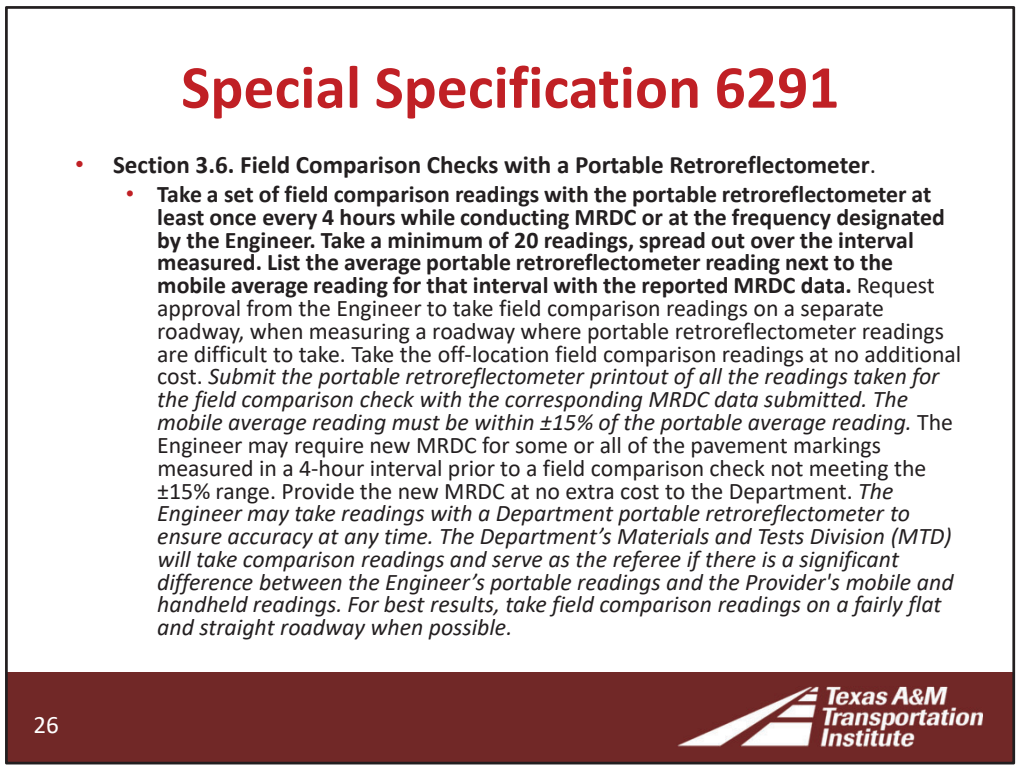
There are some differences between mobile retroreflectometers, their software, and their output data that may affect some of the above required items. Most of the providers are submitting map files generated directly by the software provided with their mobile retroreflectometer. There is not much room to change these files. TTI has worked with the equipment manufacture's to try to get the data in alignment with the specifications. Most map files have the data color-coded by the length of the data acquisition interval (i.e. typically 0.1-mile segments). Percent intervals passing or failing is not necessarily needed on the map files, since it is part of the data file. Google Earth files should be requested from the providers.

The map files are useful to get a visual representation of the retroreflectivity values along the length of the section. Multiple files can be combined and layered to show a broader overview of the retroreflectivity quality of the markings. Using a satellite image can help identify why there may be drops in retroreflectivity along certain parts of a roadway (access points/turning movements).

Each of these items should be provided on the video file. The specification indicates a DVD, but electronic files are preferred. A pending update to the special specification has modified this to indicate an electronic file. The new equipment provides electronic files that are simple to transfer and of good video quality. Examples of video files are provided in Parts 4 and 5 of this guidance presentation.

Providers format their video files in different ways. There is not a standard format that providers must follow. The files should contain the information listed unless not required by the district.

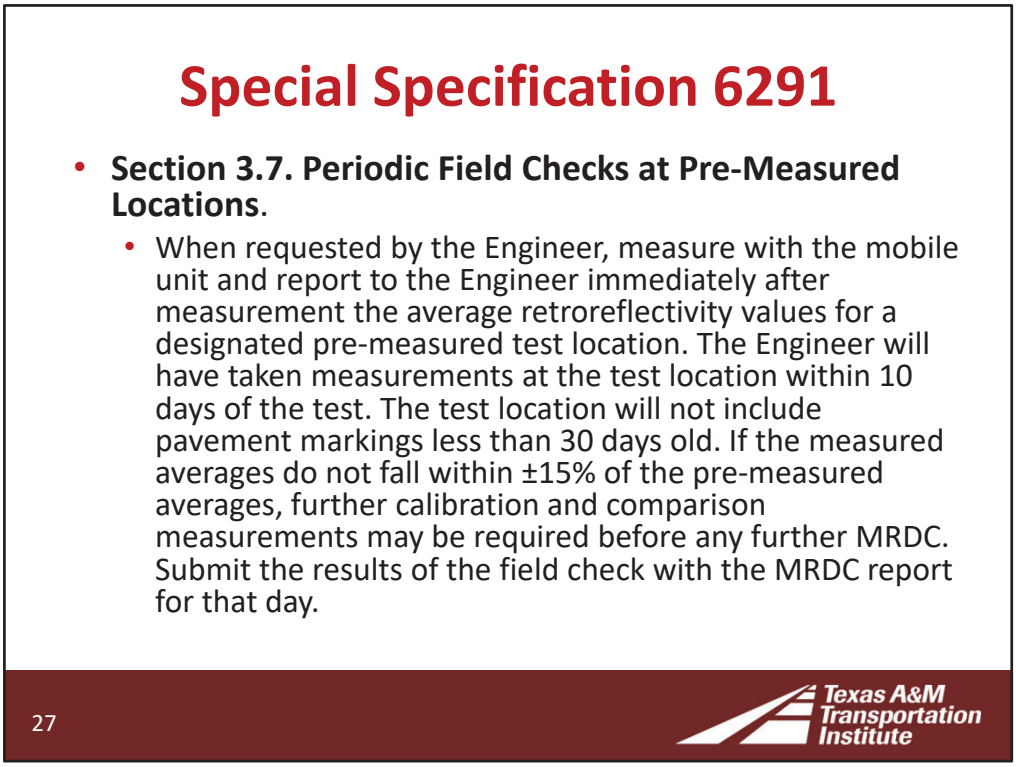
There are some differences between mobile retroreflectometers, their software, and their output data that may affect some of the above required items. Most of the providers are submitting video files generated directly by the software provided with their mobile retroreflectometer. There is not much room to change these files. TTI has worked with the equipment manufacture's to try to get the data in alignment with the specifications.



Most providers are not submitting these field comparison checks, and most districts are not requesting these measurements be taken. This is not a new addition to the specification.

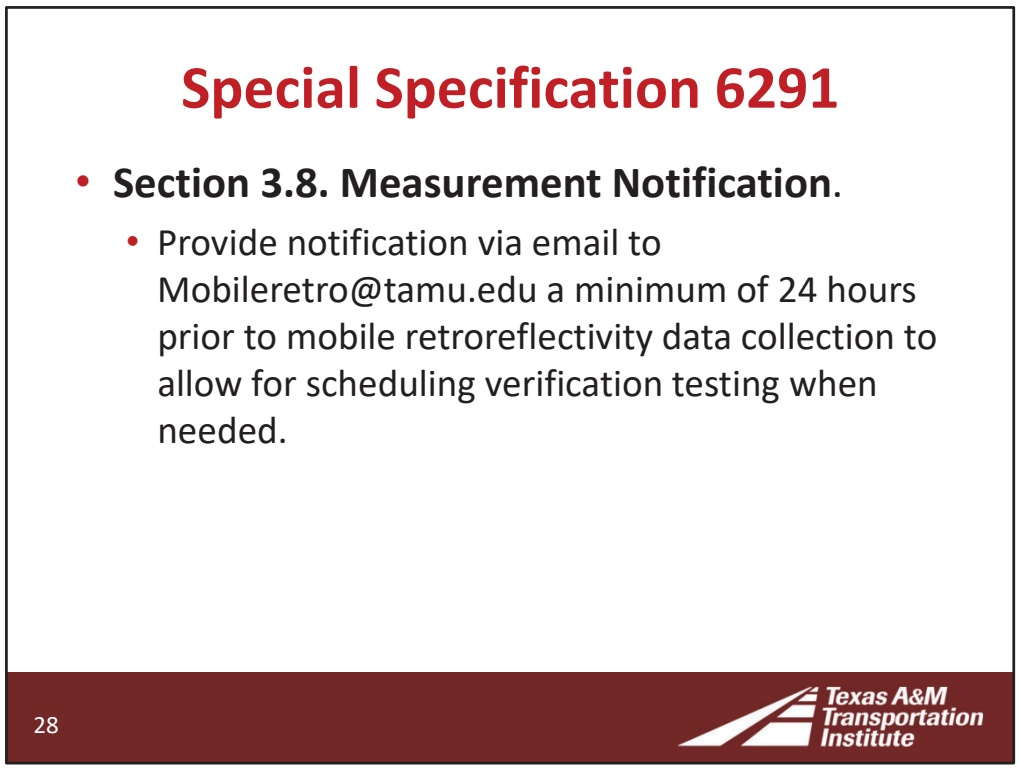
Periodic comparison of the mobile data to a portable system will help ensure accurate readings are being collected. Providers do not want to do this because it takes time and is a safety issue. Safety is important, and these portable readings should not be requested on high-volume roads. Early in a contract, an unfamiliar provider, or past experience, should dictate the rate at which portable comparisons are required/requested. The district should try to check readings as often as possible to make sure accurate data are being collected until they are comfortable with the provider. Spot retroreflectivity readings can help give an idea as to the quality of the marking for quality assurance purposes.

Twenty readings over a tenth of a mile section is a sufficient number to be confident in the average value collected. Twenty readings will provide more than 95% confidence that the average value is within one half of a standard deviation of the data set. i.e. if the 20 readings average 350 with a standard deviation of 40, you can be 95% confident that the average value is 350 ± 20.



This is an old method some districts had used to make sure operators were collecting accurate retroreflectivity data. It is a good method but requires effort from the district to establish these comparison test areas. It also requires the provider to possibly go out of its way to evaluate these specific field check locations.
This type of field check is more useful when a provider is reading many roads in a relatively small area (i.e., seal coat striping, restriping, or maintenance-level readings).

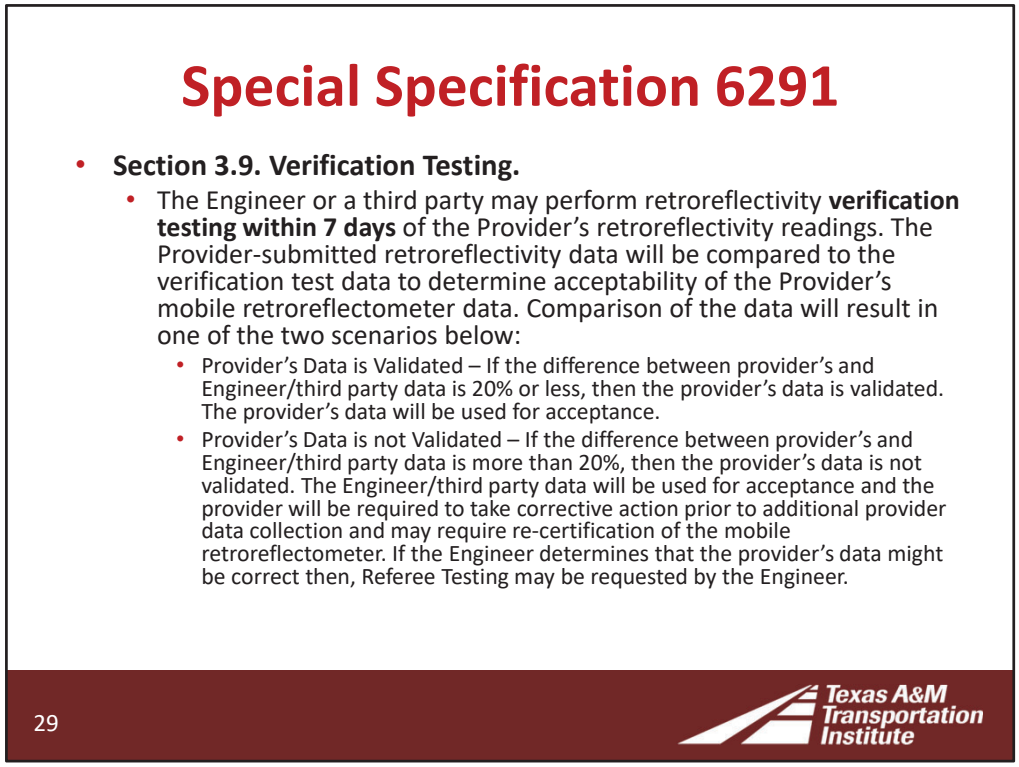
This type of field check may be useful for new providers or providers who have previously submitted questionable or inaccurate data.



Item 666 requires that the engineer be notified at least 24 hours in advance; Special Specification 6291 requires that TTI be notified as well. Notification of TTI is a new addition to the specification. TTI needs to be notified for **all projects**.
Districts are also welcome to notify TTI if they are having issues or would like a provider checked.

From TTI's perspective, it would be ideal if providers submitted weekly work plans on Monday instead of daily plans every day. This weekly work plan would indicate which roads they are planning to read, what job those readings are part of, and when those roads were striped. There is an understanding that these plans may change some due to delays or weather. The 3–10 day window still needs to be met; any delays beyond that are on the provider and cannot be used as an excuse for failing readings.

Many providers are currently providing adequate notification to TTI, but some are not. Those who do not provide adequate notification will be removed from the certified providers list until they come into compliance with the notification requirements.



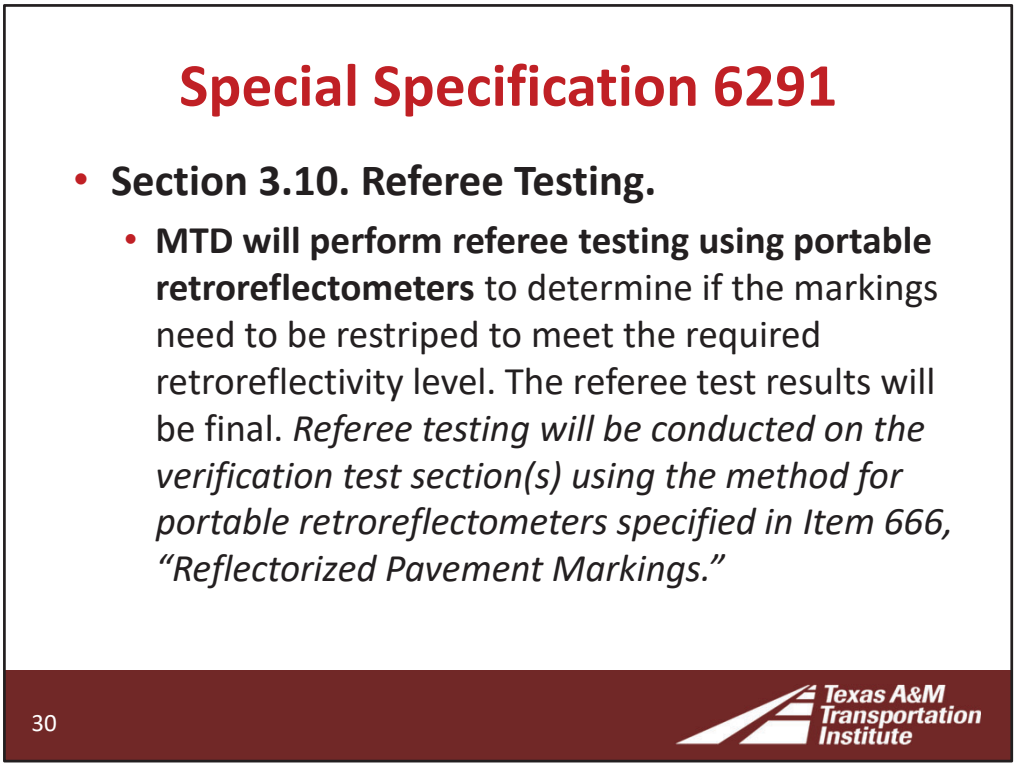
TTI or the district can perform verification testing on the provider. The TTI verification testing program will be described in Part 3 of this guidance presentation.

The goal of the verification testing is to collect an accurate set of data in as close a time frame as possible to when the provider collected its data. These two data sets are compared to check the quality of the provider's data.

Providers whose data are less than 20% different from the verification data will be notified of the validated results.

Providers whose data exceed 20% difference from the verification data set will be provided with the results and information concerning corrective actions to improve future data collection. Repeated non-validation of data will result in loss of certification, described in Part 3 of this presentation.

If the data are not verified and both data sets indicate data that exceed the minimum retroreflectivity requirements, then the engineer can accept the job. If there is conflict between the data sets, where one indicates passing markings and the other does not, the engineer can request referee testing.



TxDOT MTD will perform the referee testing. Referee testing should occur as soon as possible after conflicting measurements are found and cannot be resolved. Delays in performing referee testing may result in data that are not as easy to compare due to the impact of time on the degradation of marking retroreflectivity.

Referee testing can occur with or without TTI verification testing. If the district checks the provider's work and the provider disputes the results, referee testing can be conducted to resolve the dispute.

Special Specification 6291

- **Section 4. FINAL REPORT**
  - Submit a final report in the format specified by the Engineer to the Department's Traffic Engineering representative within 1 calendar week after the service is complete. The final report must contain a list of all problems encountered (pre-approved event codes) and the locations where problems occurred during MRDC.

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If a final report is to be submitted, it must be submitted within 1 week after the service is complete.

The final report is in addition to the individual data (Excel, map, video) submissions. TTI is not aware of final reports being regularly submitted by the providers or the frequency of use by TxDOT.

The pavement marking retroreflectivity requirements, especially the mobile retroreflectivity requirements, from these two specifications were described. Each specification outlines certain criteria and requirements that need to be followed. The providers and TxDOT need to understand and follow the specifications to make sure markings are meeting the minimum initial retroreflectivity requirements.

This concludes the discussion of the specifications concerning mobile pavement marking retroreflectivity.