Part 5:
Retroreflectivity Data Requirements and Analysis

(35–40 minutes)

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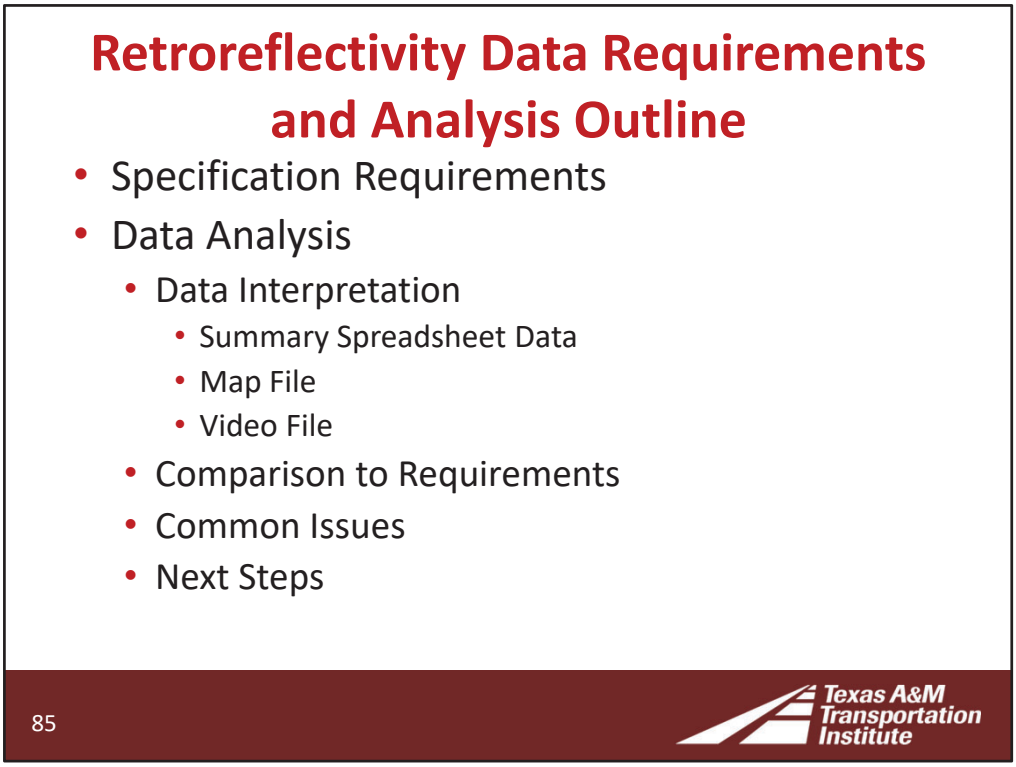
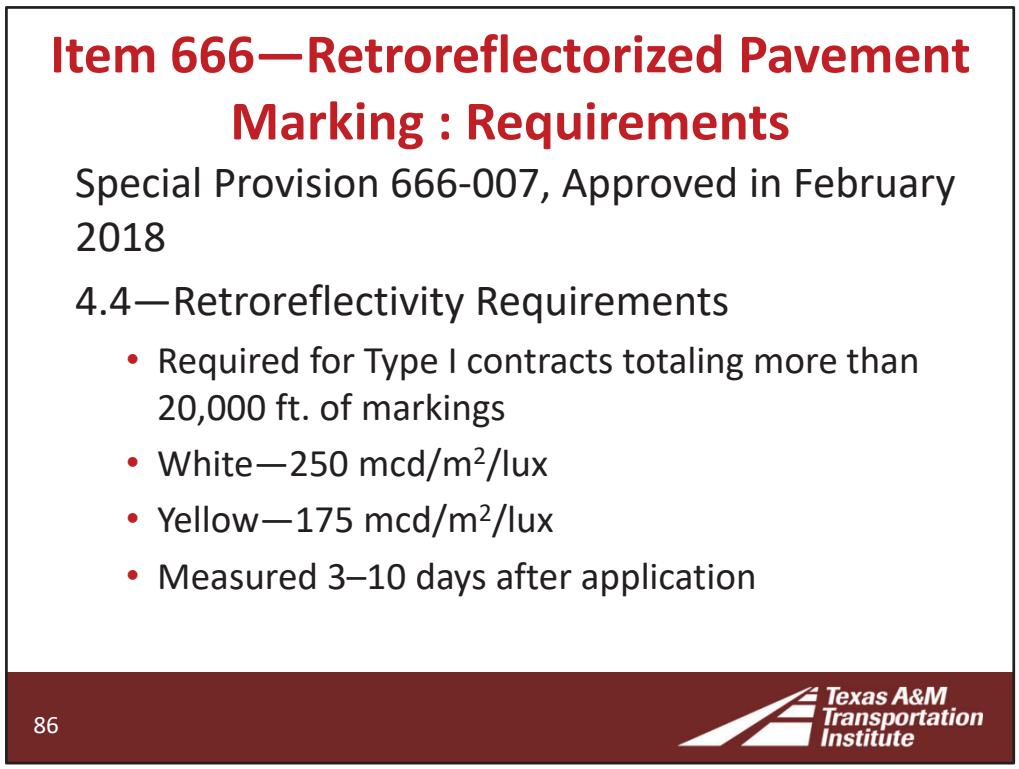


We are going to focus on mobile retroreflectivity requirements and analysis in this part of the guidance presentation. Portable requirements have been described in other parts of the presentation. The analysis of portable measurements is similar to that of the mobile data, but there is a lot less data to evaluate, and the data may not be organized as well.

Some of these topics have been covered in other parts of the presentation. Part 2 of the guidance presentation covered the specification requirements in depth. Part 4 of the guidance presentation included information on data output. Part 3 included some information on comparing the data to requirements. This part of the guidance presentation will cover some of these areas in more detail. Where areas have been summarized, the part of the guidance presentation to reference for additional information will be mentioned.



Detailed information on the specification requirements was covered in Part 2 of the guidance presentation. Specification information in this section is summarized.

Updated special provision required starting for May 2018 letting.

Contracts with total pavement marking quantities below 20,000 ft. are not subject to the minimum retroreflectivity requirements, unless shown on the plans. Callout work is not subject to the minimum retroreflectivity requirements unless shown on the plans.

Retroreflectivity requirements are 250 for white markings, whether they are solid or broken, and 175 for yellow markings, whether they are solid or broken. Yellow markings must meet requirements in both directions of travel when serving as a centerline.

Providers should evaluate the markings 3–10 days after application. This allows the markings to get some traffic to remove loose and excess beads. Readings after 10 days can still be accepted, but there should not be any leeway on the required retroreflectivity level.

Item 666—Retroreflectorized Pavement Marking : Requirements

- Mobile retroreflectivity measurements are required for Contracts totaling more than 50,000 ft. of pavement markings
- For Contracts with 20,000–50,000 ft. of pavement markings, mobile or portable retroreflectometers may be used at the Provider's discretion
- Coordinate with and obtain authorization from the Engineer before starting any retroreflectivity data collection

87

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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. Unless specified on the plans, contracts with less than 20,000 feet of markings do not require retroreflectivity readings.

Providers should obtain authorization from the Engineer before starting any retroreflectivity data collection.

Item 666—Retroreflectorized Pavement Marking : Requirements

- Provide mobile measurement averages for every 0.1 miles unless otherwise specified or approved.
- Take measurements on each section of roadway for each series of markings (i.e., edgeline, center skip line, each line of a double line, etc.) and for each direction of traffic flow. Measure each line in both directions for centerlines on two-way roadways (i.e., measure both double solid lines in both directions and measure all center skip lines in both directions).
- Furnish measurements in compliance with Special Specification "Mobile Retroreflectivity Data Collection for Pavement Markings," unless otherwise approved. Currently SS 6291.
- Inform the Engineer at least 24 hr. before taking any measurements.*

All longitudinal markings must be evaluated. 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.

References Special Specification 6291.

Engineer must be informed 24 hours prior to taking measurements.
*SS 6291 requires that TTI be informed as well.

Item 666—Retroreflectorized Pavement Marking : Requirements

- A marking meets the retroreflectivity requirements if:
  - the combined average retroreflectivity measurement for a 1-mile segment meets the minimum retroreflectivity values specified, and
  - no more than 30% of the retroreflectivity measurement values are below the minimum retroreflectivity requirements value within the 1-mile segment.
- The Engineer may accept failing 1-mile segments if no more than 20% of the retroreflectivity measurements within that mile segment are below the minimum retroreflectivity requirement value.
- Centerlines with two stripes (either solid or broken) will result in 2 miles of data for each mile segment. Each centerline stripe must be tested for compliance as a stand-alone stripe.

89

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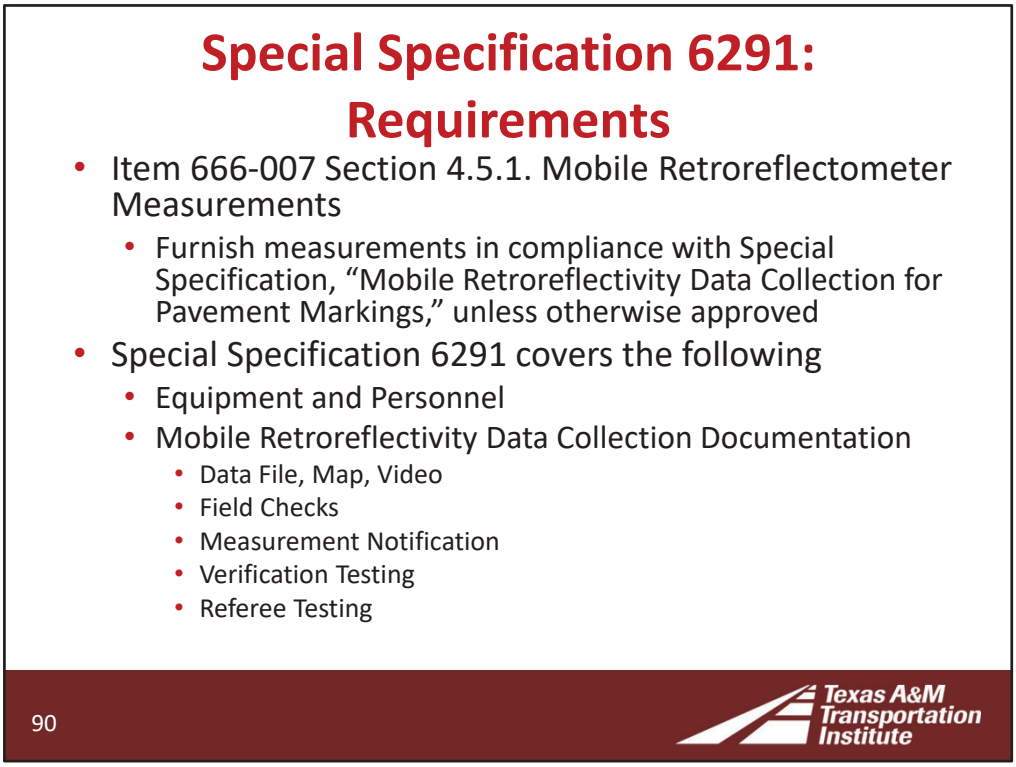
Analysis requirements are provided in this section. Data are to be analyzed in 1-mile segments. The average over the mile needs to exceed the required values (250 white, 175 yellow), and no more than three of the ten, 0.1-mile segments can be below the required value.

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.

Information on restriping failed sections is provided in the specification. Those paragraphs are described later in Part 5 of the guidance presentation, during the Next Steps discussion.



Item 666 references the Special Specification by title, not number, since it may be revised. The current version is Special Specification 6291 and is required starting with May 2018 letting.

Many of the topics that Special Specification 6291 covers have been described in previous parts of this presentation.

- Verification and referee testing was covered in depth in Part 3.
- Specification requirements were covered in depth in Part 2.
- Data, map, and video output were covered in general in Part 4.

This part of the guidance presentation will summarize the information on the specification requirements and go more in depth on the data output, how to interpret it, and how to compare to Item 666 requirements.

Special Specification 6291: Marking Requirements

- Mobile Retroreflectometer—Certified by the TTI Mobile Retroreflectometer Certification Program
- Operating Personnel for Mobile Retroreflectometer—Certified by the TTI Mobile Retroreflectometer Certification Program to conduct MRDC with the certified mobile retroreflectometer provided
- https://groups.tti.tamu.edu/visibility/programs-and-guidance/mobile-retro-certification/certified-providers/

91

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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.

MRCD = Mobile retroreflectivity data collection

The certification list is updated frequently and should be checked prior to allowing work on any new jobs.

Special Specification 6291: Marking Requirements

- Preliminary Documentation Sample—A sample data file, video, and map of MRDC data in the required format should be submitted for TxDOT review 10 working days prior to beginning any work. The format must meet specification and be approved by the Engineer before any work may begin.
- Initial Documentation Review and Approval—The Department will review documentation submitted for the first day of MRDC, and if it does not meet specification requirements, will not allow further MRDC until deficiencies are corrected. The Department will inform the Provider no later than 3 working days after submittal if the first day of MRDC does not meet specification requirements.

92

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For the most part, providers are not submitting 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.

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.

Special Specification 6291: Marking Requirements

- Measurement Notification—Provide notification via email to Mobileretro@tamu.edu a minimum of 24 hours prior to mobile retroreflectivity data collection to allow for scheduling verification testing when needed.
- Data Submission—All collected data should be submitted to the Department and to the TTI Mobile Retroreflectometer Certification Program no later than 3 working days after the day the data is collected. Submit all raw data collected in addition to all other data submitted.

93

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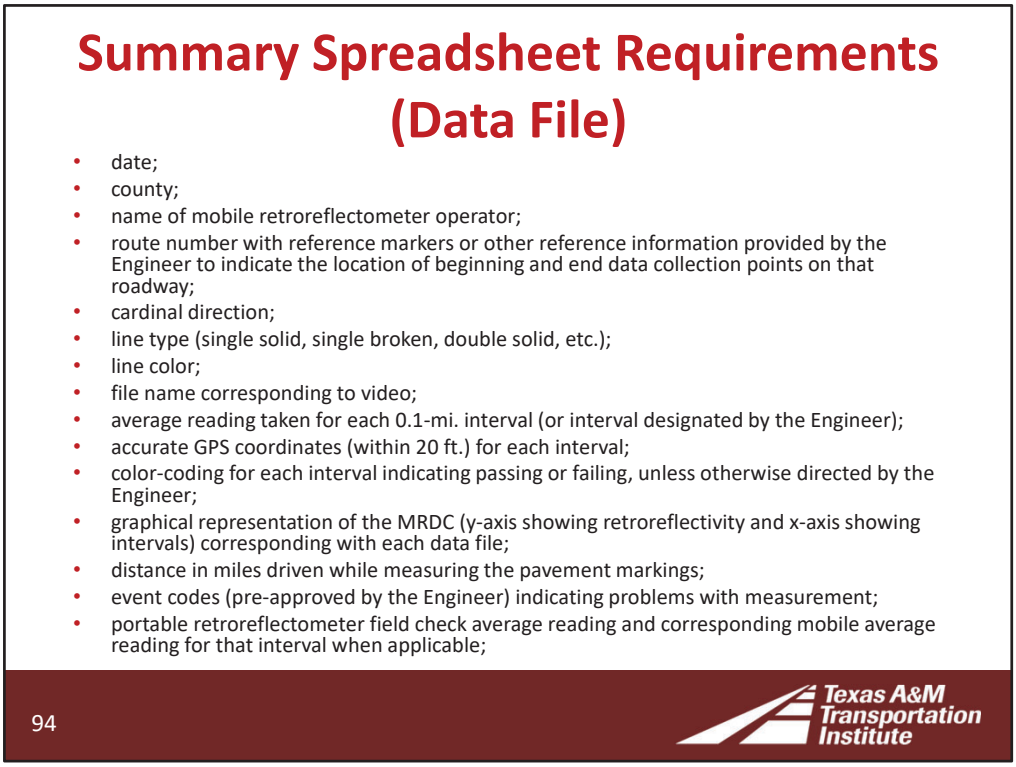
Item 666 requires that the engineer be notified at least 24 hours in advance, and Special Specification 6291 requires that TTI be notified as well. Notification of TTI is a new addition to the specification. TTI needs to be notified for all projects.

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.

Data submission: It is necessary to get the data 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 increase the difference between the data sets.



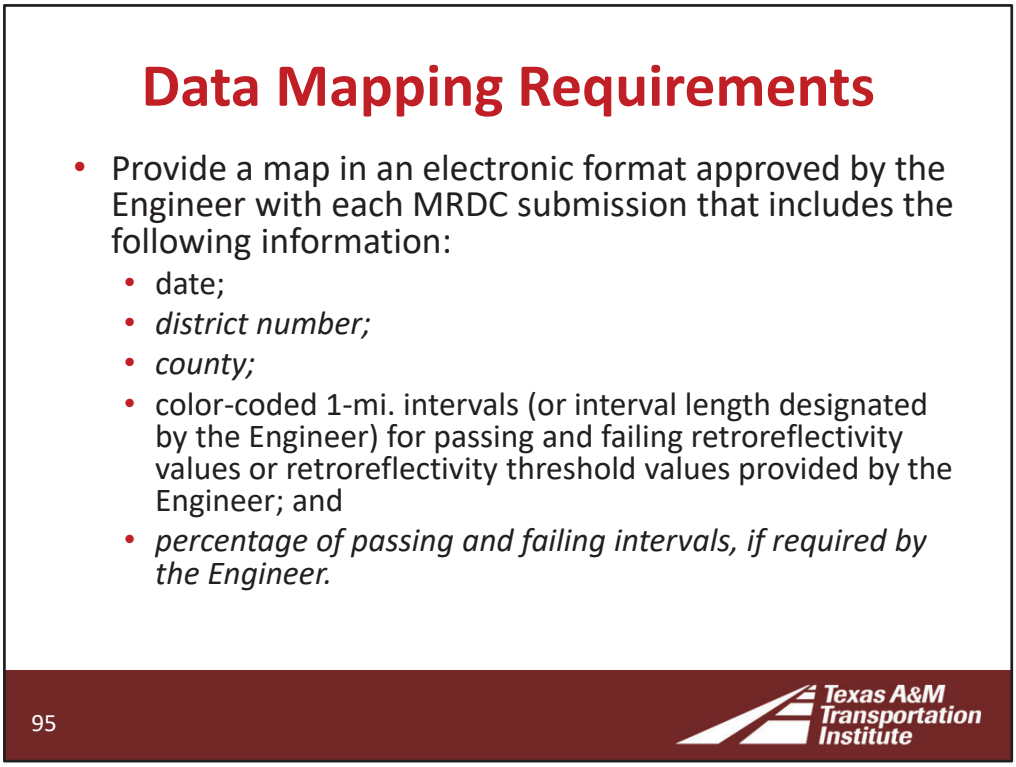
Special Specification 6291 outlines the specific requirements for the summary data file.

- The summary data file should be in an electronic file in spreadsheet format.
- The summary data file should have the accompanying raw data used to produce the summary data file.

Part 2 of the guidance presentation and the Special Specification itself outline all of the requirements of the data file. The list presented here highlights some of the more important information.

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.



Each of these items should be provided on the map file.

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 manufacturers 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).

The italicized bullets are not really necessary for data organization or evaluation purposes.

Information on percent intervals passing or failing is not necessarily needed on the map files, since it is part of the data file.

Each of these items should be provided on the video file. The specification indicates a DVD, but electronic files are preferred. The new equipment provides electronic files that are simple to transfer and of good video quality.

Part 2 of the guidance presentation and the Special Specification itself outline all of the requirements of the data file. The list presented here highlights some of the more important information.

Generally, the video file name will indicate the route, start and end points, direction of travel, and project number.

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 manufacturers to try to get the data in alignment with the specifications.

Data Interpretation

- Summary Spreadsheet
- Data Map File
- Video File

97

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In this section, we will discuss interpretation of the submitted data. This was covered briefly in Part 4 of the guidance presentation but will be covered more in depth here.

Each of the three forms of submitted data will be explored.

Summary Spreadsheet Information

- File name should clearly indicate what data are being presented
- The spreadsheet should have at least two tabs:
  - One tab should have the raw unedited data that were collected
  - One tab should have the required summarized data based on SS 6291
- A chart showing the data should be presented to allow easy visual analysis of the data

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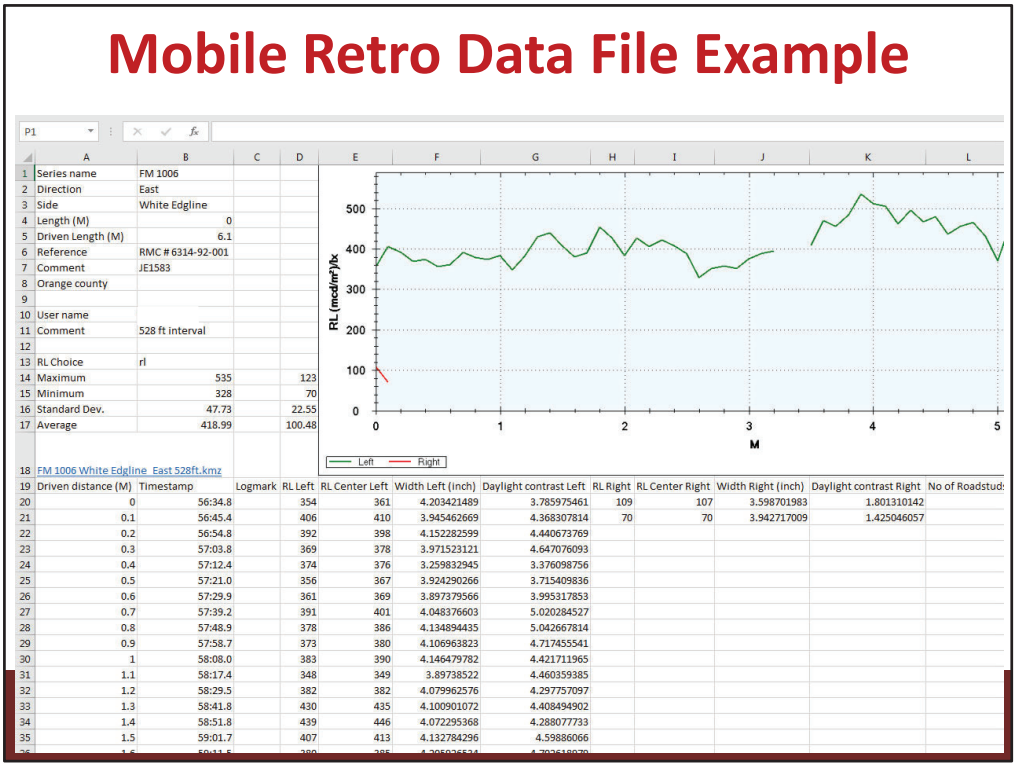
These are the basic components of the data sheet. Some systems and contractors add to the raw data sheet to meet the requirements. In this case, a single tab is sufficient per marking. Within the data sheet, the data should be summarized to meet the requirements of Special Specification 6291. The chart should show the retroreflectivity values along the entire length of the marking being evaluated.

Mobile Retro Data File Example



	A	B	C	D
1	Series name	FM 1006		
2	Direction	East		
3	Side	White Edgline		
4	Length (M)	0		
5	Driven Length (M)	6.1		
6	Reference	RMC # 6314-92-001		
7	Comment	JE1583		
8	Orange county			
9				
10	User name			
11	Comment	528 ft interval		
12				
13	RL Choice	rl		
14	Maximum	535		123
15	Minimum	328		70
16	Standard Dev.	47.73		22.55
17	Average	418.99		100.48
18	FM 1006 White Edgline East 528ft.kmz			

19	Driven distance (M)	Timestamp	Logmark	RL Left	RL Center Left	Width Left (inch)	Daylight contrast Left	RL Right	RL Center Right	Width Right (inch)	Daylight contrast Right	No of Roadstud
20	0	56:34.8		354	361	4.203421489	3.785975461	109	107	3.598701983	1.801310142	
21	0.1	56:45.4		406	410	3.945462669	4.368307814	70	70	3.942717009	1.425046057	
22	0.2	56:54.8		392	398	4.152282599	4.440673769					
23	0.3	57:03.8		369	378	3.971523121	4.647076093					
24	0.4	57:12.4		374	376	3.259832945	3.376098756					
25	0.5	57:21.0		356	367	3.924290266	3.715409836					
26	0.6	57:29.9		361	369	3.897379566	3.995317853					
27	0.7	57:39.2		391	401	4.048376603	5.020284527					
28	0.8	57:48.9		378	386	4.134894435	5.042667814					
29	0.9	57:58.7		373	380	4.106963823	4.717455541					
30	1	58:08.0		383	390	4.146479782	4.421711965					
31	1.1	58:17.4		348	349	3.89738522	4.460359385					
32	1.2	58:29.5		382	382	4.079962576	4.297757097					
33	1.3	58:41.8		430	435	4.100901072	4.408494902					
34	1.4	58:51.8		439	446	4.072295368	4.288077733					
35	1.5	59:01.7		407	413	4.132784296	4.59886066					

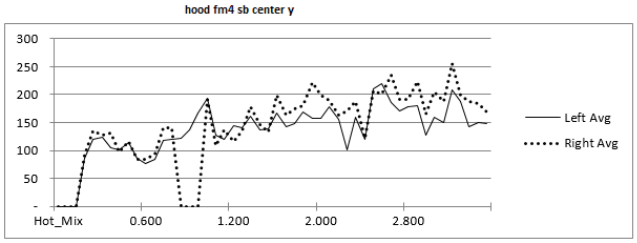
This is an example of a summary data file. Much of the required project information is in Columns A and B rows 1 through 11. This information provides location, marking type, and job details. An overall summary of the data is provided in Rows 14 through 17. Row 18 indicates the file name of the associated map file. Rows 19 through the bottom of the file provide the retroreflectivity data. Column A indicates the distance driven, Column B has the time with imbedded data, and Column C provides any log markings if the operator made any notes in the data during data collection. These log marks are associated with the entire 0.1-mile long segment, even if they may have only lasted a short distance with that span. Columns D and E provide the retroreflectivity values for the left pavement marking (if two were present). Column D is the retro value across the whole width of the marking, and Column E is the retro value across the middle 2 inches of the marking. Columns F and G provide additional information that is not required on marking width and daylight contrast. These values have not been well studied to judge their accuracy. Columns H through K provide the same marking information but for the right line, if there were two adjacent lines. Column L provides a count of RRPMs; this value has not been studied to determine its accuracy. GPS information is provided in columns to the right of what is displayed.

A plot of the retroreflectivity vs. distance driven is provided. The green line indicates the left marking, and a red line indicate the right marking. This is a white edge line marking, so the readings meet the minimum retroreflectivity level of 250. The spreadsheet does not show the percent passing and failing the minimum value. The spreadsheet is also not using color to indicate passing or failing of the average values. Since all the data are passing, this is not a big issue. If the data were a mix of passing and failing, the colored values would

make it easier to visually see the areas with passing and failing readings.

Mobile Retro Data File Example

Company	
Date	#VALUE!
Length	3.7 Miles
District #:	2
County:	hood
Road:	fm4
Direction:	sb
Line Type:	center
Color:	y
Readings:	48
Int. Pass:	14
Int. Fail:	34
Left Avg	144.7
Right Avg	162.5



Retro Requirements	
w	250
y	175

FILTER OUT ZEROS

Interval	Stripe Type	Points	Left Avg	Right Avg	Stripe Avg	CPU Time	Long	Lat	Event Code
Hot_Mix	0	-	-	-		0:00:00	0	0	
Odometer	StripeType	#VALUE!	tro_Left_Averzro_Right_Aver			Time	Longitude	Latitude	Road_Conditions
0.000	Double_Solid	-	-	-		10:33:32	-98.042847	32.517643	
0.100	Double_Solid	1,273.00	85.80	92.30	89.05	10:33:38	-98.04187	32.517075	
0.100	Skip_Right	1,020.00	119.80	134.90	127.35	10:33:40	-98.041489	32.516769	
0.200	Skip_Right	3,374.00	123.30	126.90	125.10	10:33:48	-98.040329	32.515678	
0.300	Skip_Right	506.00	104.80	130.60	117.70	10:33:49	-98.040138	32.515507	
0.300	Double_Solid	2,290.00	100.80	97.70	99.25	10:33:55	-98.039185	32.514614	
0.400	Double_Solid	2,676.00	113.80	116.00	114.90	10:34:02	-98.037994	32.513527	
0.500	Double_Solid	2,441.00	86.90	83.50	85.20	10:34:09	-98.036636	32.512711	
0.600	Double_Solid	746.00	76.50	83.80	80.15	10:34:13	-98.03569	32.512562	
0.600	Skip_Right	1,072.00	85.00	93.30	89.15	10:34:17	-98.034897	32.512558	
0.700	Skip_Right	2,975.00	118.50	141.40	129.95	10:34:23	-98.03318	32.51255	
0.800	Skip_Right	1,095.00	120.00	140.10	130.05	10:34:26	-98.032433	32.512543	
0.800	Single_Skip	293.00	121.30	-	121.30	10:34:29	-98.031502	32.512539	
0.900	Single_Skip	477.00	137.10	-	137.10	10:34:34	-98.0298	32.512539	
1.000	Single_Skip	112.00	167.40	-	167.40	10:34:36	-98.029373	32.512531	
1.000	Skip_Left	1,544.00	192.50	190.90	191.70	10:34:40	-98.028038	32.51252	
1.100	Skip_Left	1,778.00	127.70	108.70	118.20	10:34:45	-98.026573	32.512512	
1.100	Skip_Right	290.00	119.70	137.70	128.70	10:34:46	-98.026352	32.512512	

100

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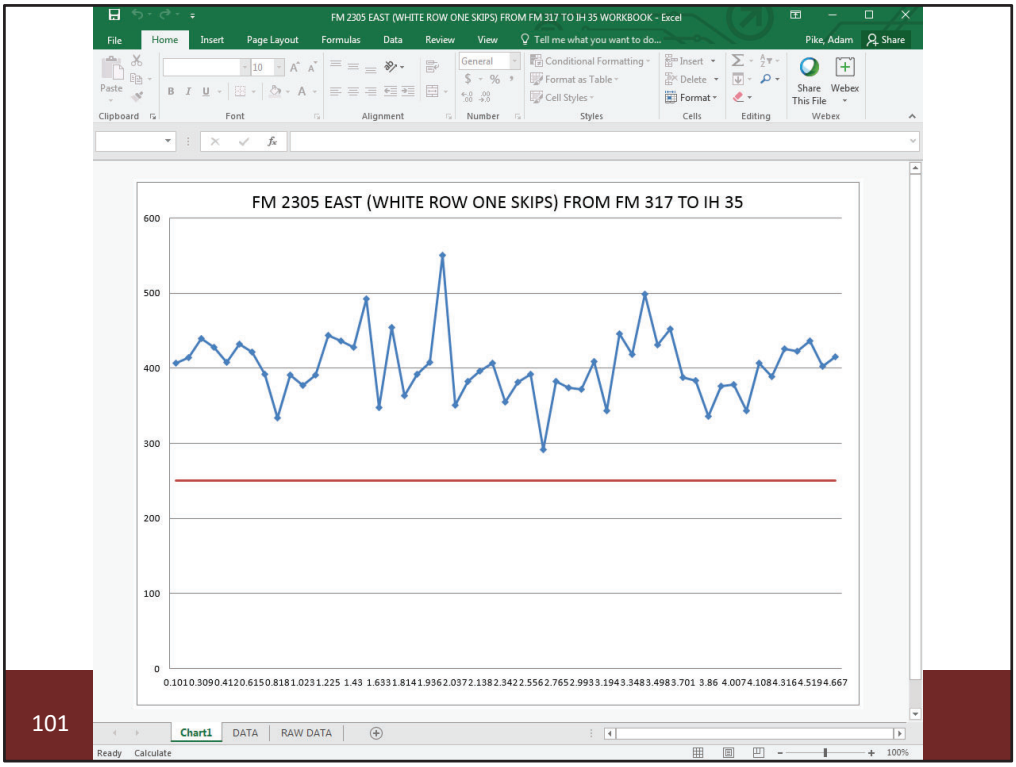
This is another example of a summary data file. This example is similar to the previous one, except that it is for a double line, and a different mobile retroreflectometer system was used, so the data output is a little different. The location, marking type, and job information are provided in the upper left portion of the table. The retroreflectivity data are provided in the bottom half of the spreadsheet. The interval column indicates the distance driven. The stripe type column indicates the type of double marking (double solid, skip right, skip left, or single skip). The points column indicates the number of readings recorded per segment. The left and right average values are the average retro values for the left and right markings for each segment. The stripe average column is the average of the two average values. The time and GPS coordinates are provided. The event code column indicates any notes the operator made during the data collection.

A plot of the retroreflectivity vs. distance driven is provided. The solid line indicates the left average value, and the dashed line indicates the right average value. The spreadsheet is not using color to indicate passing or failing readings, though the retro requirements are noted in the upper right portion of the spreadsheet.

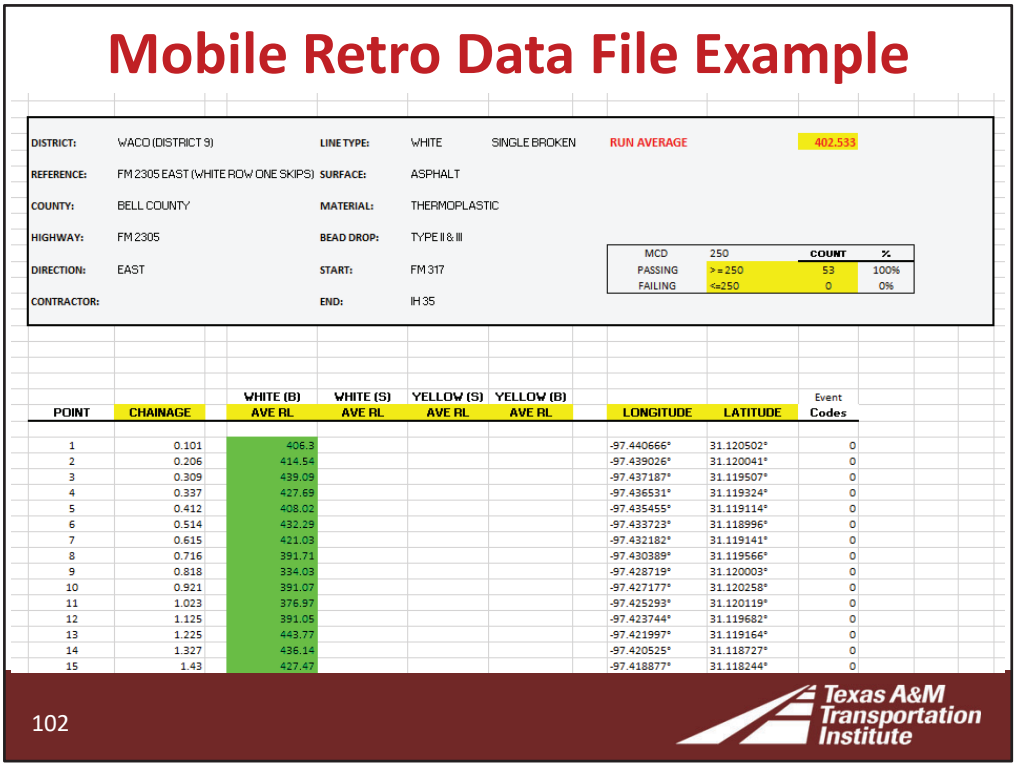
These data are clearly not all passing, so the color-coordinated values would be beneficial in visually analyzing the data. The majority of the data appear to be failing. Ways to analyze the results are provided later in this portion of the presentation .



101

This slide shows a chart associated with a summary data file. The spreadsheet has a chart tab, a data tab (summary data), and a raw data tab. The chart has a horizontal line drawn at 250 indicating the required retro level. All the data are clearly passing on this white skip line.

Mobile Retro Data File Example



DISTRICT:	WACO (DISTRICT 9)	LINE TYPE:	WHITE	SINGLE BROKEN	RUN AVERAGE	402.533
REFERENCE:	FM 2305 EAST (WHITE ROW ONE SKIPS)	SURFACE:	ASPHALT			
COUNTY:	BELL COUNTY	MATERIAL:	THERMOPLASTIC			
HIGHWAY:	FM 2305	BEAD DROP:	TYPE II & III			
DIRECTION:	EAST	START:	FM 317			
CONTRACTOR:		END:	IH 35			

MCD	250	COUNT	%
PASSING	>= 250	53	100%
FAILING	<=250	0	0%

POINT	CHAINAGE	WHITE (B) AVE RL	WHITE (S) AVE RL	YELLOW (S) AVE RL	YELLOW (B) AVE RL	LONGITUDE	LATITUDE	Event Codes
1	0.101	406.3				-97.440666°	31.120502°	0
2	0.206	414.54				-97.439026°	31.120041°	0
3	0.309	439.09				-97.437187°	31.119507°	0
4	0.337	427.69				-97.436531°	31.119324°	0
5	0.412	408.02				-97.435455°	31.119114°	0
6	0.514	432.29				-97.433723°	31.118996°	0
7	0.615	421.03				-97.432182°	31.119141°	0
8	0.716	391.71				-97.430389°	31.119566°	0
9	0.818	334.03				-97.428719°	31.120003°	0
10	0.921	391.07				-97.427177°	31.120258°	0
11	1.023	376.97				-97.425293°	31.120119°	0
12	1.125	391.05				-97.423744°	31.119682°	0
13	1.225	443.77				-97.421997°	31.119164°	0
14	1.327	436.14				-97.420525°	31.118727°	0
15	1.43	427.47				-97.418877°	31.118244°	0

This is the second tab, the data tab, from the previous slide. This tab contains the summarized data and project information.

The chainage column indicates the distance driven. The center columns are separated for the different line types: white broken, white solid, yellow solid, yellow broken. The average value for the marking is provided. The GPS information and event codes are also provided. This chart indicates the percent passing and failing the minimum retroreflectivity level. The green highlighted values indicate passing retroreflectivity levels.

The raw data tab contains additional information that is automatically output by the retroreflectometer software. That information is not really needed for the evaluation of this marking.

Map Information

- File name should clearly indicate what data are being presented.
- The map provides a visual tool to analyze the quality of the striping.
- Most maps are provided in Google Earth format. Multiple maps can be displayed at once.

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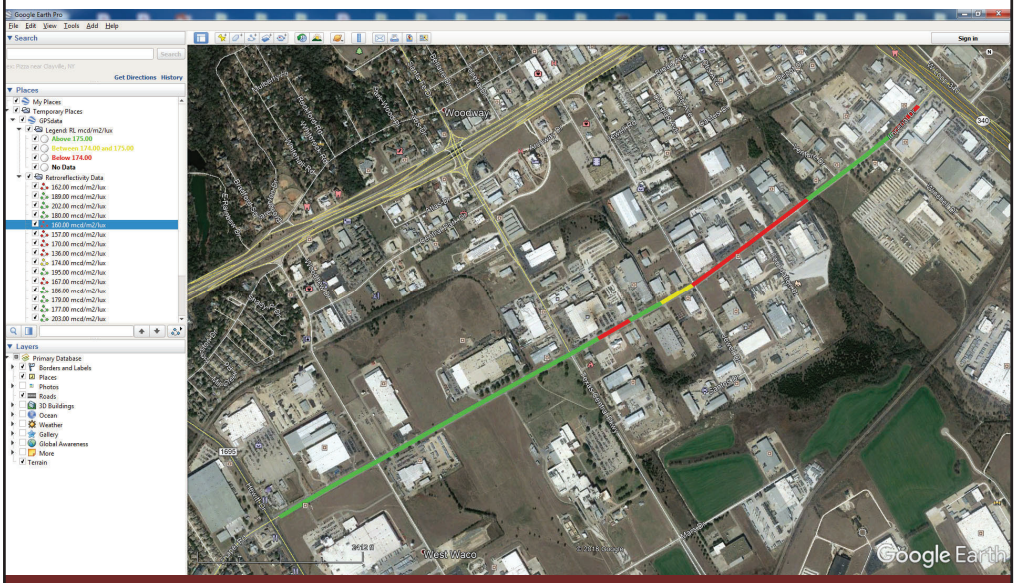
Not much information needs to be in the maps. If the file name is adequate, the map itself can just display the data with appropriate color for passing and failing data.

In Google Earth, multiple .kmz or .kml files can be opened at once and displayed at the same time. This will be described in more depth later in this section.

Mobile Retro Map File Example



The newer mobile retroreflectometers directly output Google Earth files; these are .kml or .kmz files. These files can be viewed directly in the free Google Earth software.
The map file here has been opened and fully displayed in Google Earth. The data presented are for one of the yellow centerline markings on the road. Yellow centerlines that contain two lines will be displayed in separate maps with the output from this system. The other system produces a single map.

Green indicates greater than 175, yellow is 174–175 and red is less than 174.

The data are presented in 0.1-mile segments, which is the distance over which the data were aggregated. Individual segments can be selected to display the actual values, which are listed on the left hand side of the screen.

These data have mixed results with a portion of the markings falling below the required level of 175. This area would need further evaluation, by looking at the summary spreadsheet, to determine if restriping is necessary. Evaluating the data will be described later in the presentation.

This map displays the map data output from the other major manufacturer of the mobile retroreflectivity equipment. Again, Google Earth is used.

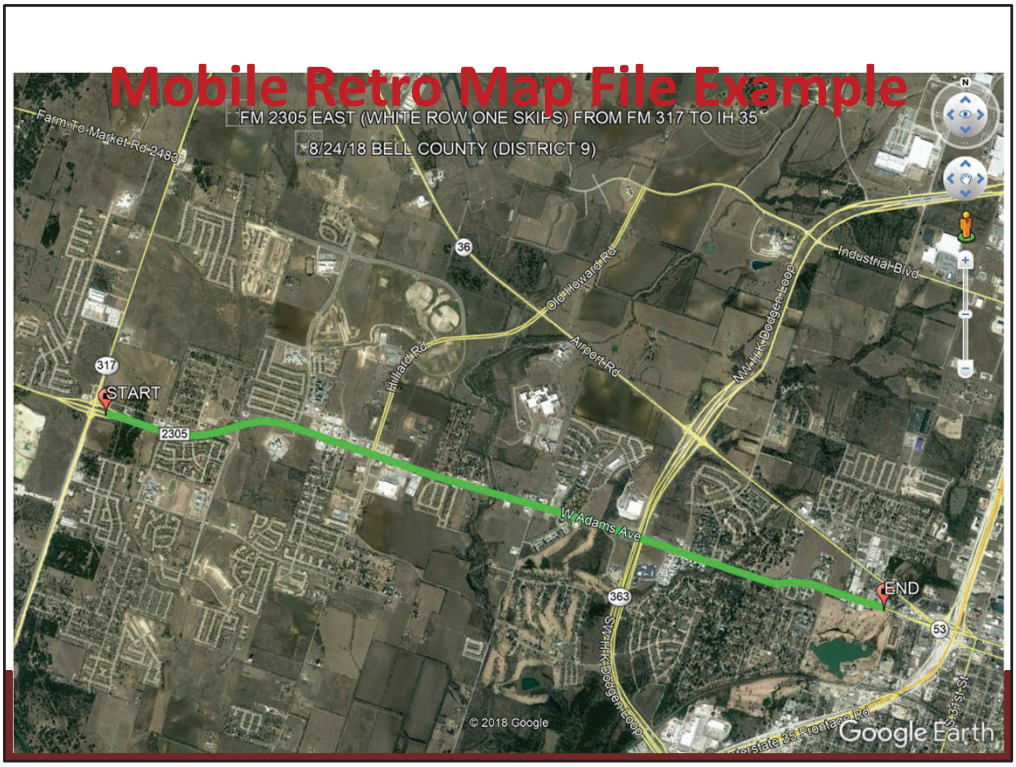
This instrument plots the left and right retro values for doubles lines on the same map (see the dividing line in the circles where the system picked up a second stripe). The other retroreflectometers plot them in separate map files. This instrument also uses circles at the midpoint of the test segments instead of a continuous line between test segments.

These data are for a white edge line. Green indicates data 250 mcd/m^2/lux or more. Red indicates data under 250 mcd/m^2/lux.

This section had some failing and passing areas. The areas with failing readings were all the locations where a second line was detected. These are likely errant readings near intersections and were not actual readings of the new pavement markings.

Individual data points can be selected, as shown (white callout box), to display the retroreflectivity value and much of the other information that can be found in the summary spreadsheet.

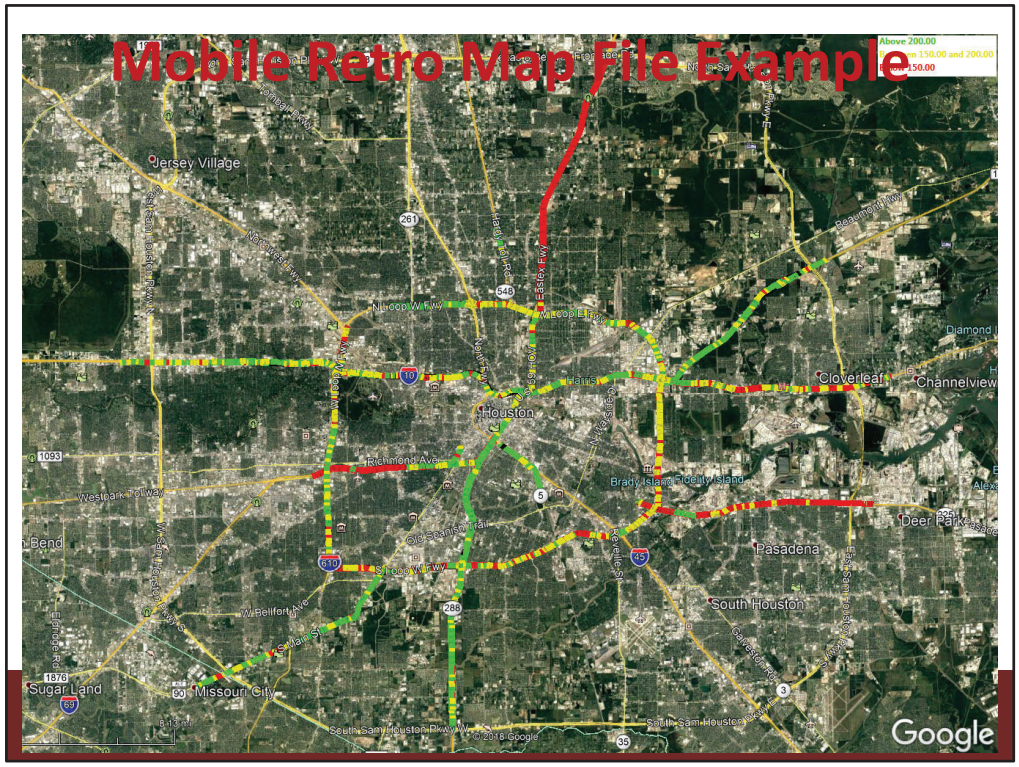
The white dots indicate 0.1-mile segments in which no markings were detected.



Instead of submitting a google map file, this provider took a screen capture of the google map. The provider overlaid project information, the white text at the top, onto the file.

The data are for a white skip line marking, passing retro levels. Green indicates values over 250.

Data submitted like this meets specification and may be easier for TxDOT in some ways, but it also limits some of the flexibility of having the actual Google Earth file.



As previously mentioned, multiple Google Earth files can be displayed at once.

This map displays data TTI collected on in-service markings around Houston. The map displays the white edge line markings on the main lanes for the evaluated roads.

- Green >200
- Yellow 150–200
- Red <150

Displaying multiple roads together can help determine which roads may need to be restriped based on retroreflectivity levels.

Video Information

- File name should clearly indicate what data are being presented
- The video provides a visual tool to review if issues with the data arise
- Most videos are provided in typical video file formats

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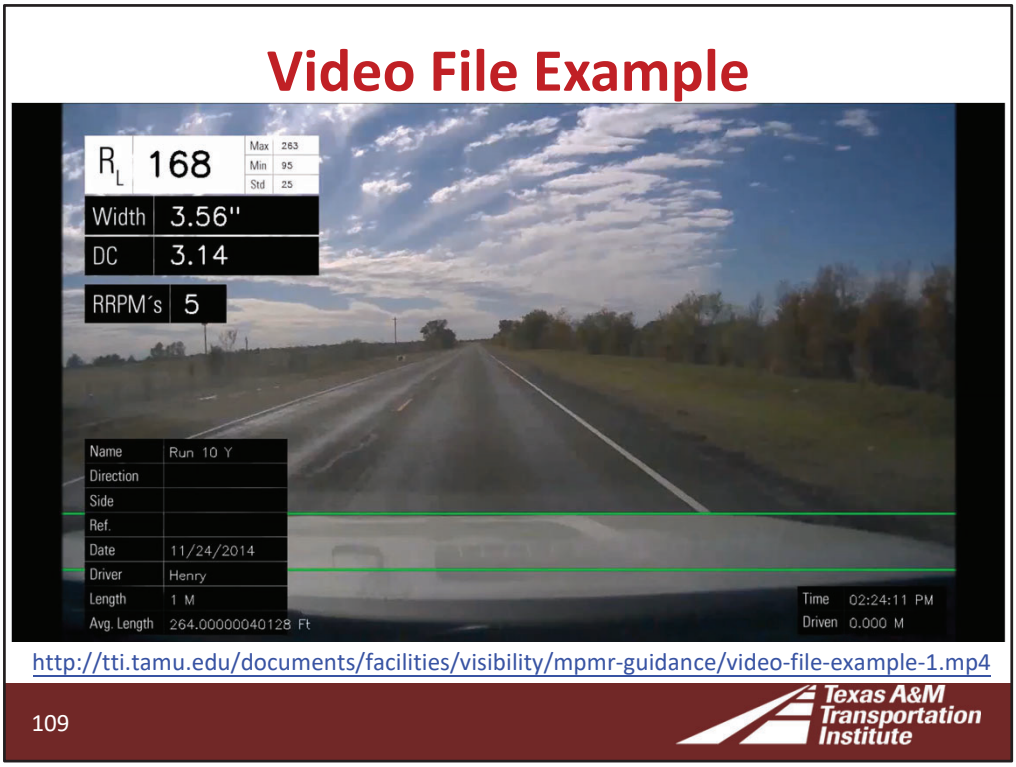
Not much information needs to be in the videos. If the file name is adequate, the video itself can just display the retro, GPS, and mileage data.



The quality of these videos can be increased on the newer systems. They can take up a lot of space, so a balance between quality and video size needs to be made.

The videos in this presentation have had the quality reduced some to reduce the size of the presentation.

The various information boxes present the data associated with the data collection. This type of information is not adjustable, but the content inside the user entry areas can be changed.

- Retro value, width, day contrast value, and count of RRPMs are all in the upper left.
- File name, measurement direction, side of measurement, reference number, date, operator, total section length, and segment length over which the data are aggregated are at the bottom left.
- Time and distance driven are at the bottom right.

The horizontal green lines are provided to indicate the distance at which the measurements are being made.

A link to download or view the video is provided under the video image.

Video File Example

http://tti.tamu.edu/documents/facilities/visibility/mpmr-guidance/video-file-example-2.mp4

110

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This video is from a different retroreflectometer manufacturer. There is not as much descriptive information.

Date, time, file name, GPS location, retro values, and chainage data are provided in the text at the top.

This video would be of better quality if the operator did not have the white paper on the dash, which is reflecting on the windshield.

This video also shows the operator passing a vehicle that pulled out in front of him/her. The retro values stopped when the vehicle passed because the operator paused the data. When the operator got back to the edge line he/she unpaused the data, and collection resumes. In the data spreadsheet, there will not be any data collected for the 0.1-mile segment during the pass. The video can be used to determine why there is missing data or to verify notes the operators make during data collection.

A link to download or view the video is provided under the video image.

Video File Example

http://tti.tamu.edu/documents/facilities/visibility/mpmr-guidance/video-file-example-3.mp4

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This video is from the older style retroreflectometer.

The video file shows description; GPS location; chainage data; speed; operating temperature; retro values with max, min, and average; and counts.

A link to download or view the video is provided under the video image.

Comparing Data to Requirements

- **Retroreflectivity Requirements:**
  - White markings: 250 mcd/m^2/lx
  - Yellow markings: 175 mcd/m^2/lx
- A marking meets the retroreflectivity requirements if:
  - the combined average retroreflectivity measurement for a 1-mile segment meets the minimum retroreflectivity values specified, and
  - no more than 30% of the retroreflectivity measurement values are below the minimum retroreflectivity requirements value within the 1-mile segment
- The Engineer may accept failing 1-mile segments if no more than 20% of the retroreflectivity measurements within that mile segment are below the minimum retroreflectivity requirement value

112

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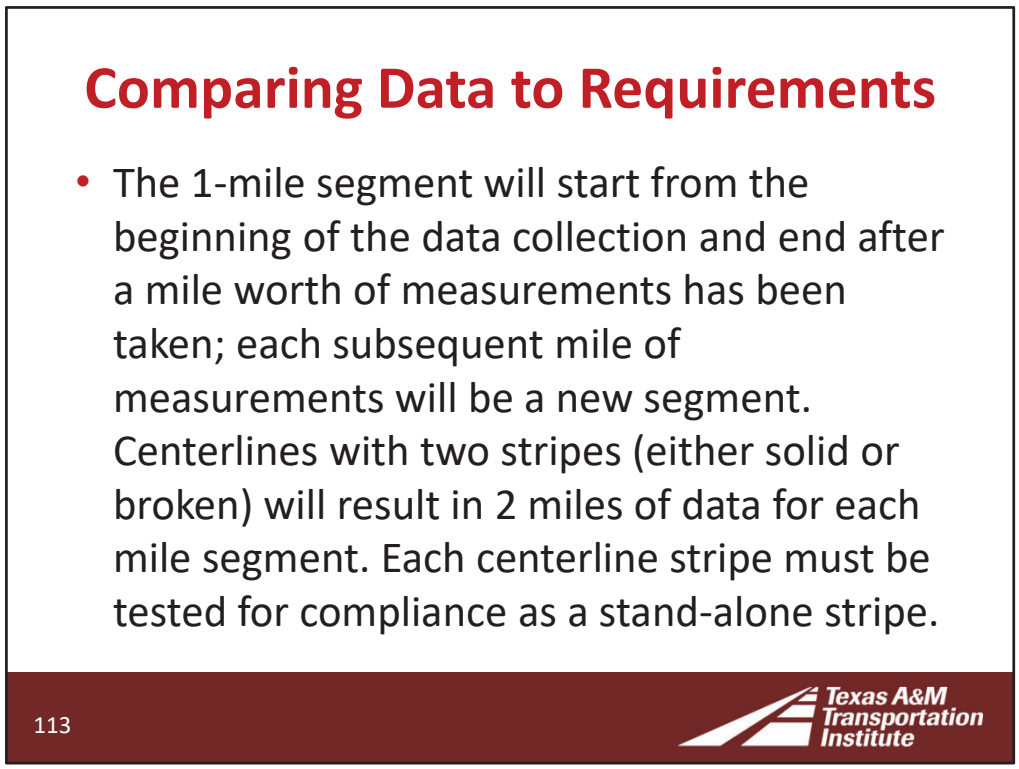
The retroreflectivity requirements and what constitutes meeting the requirements are in Item 666.

Each line has to meet the requirements. Yellow centerlines need to be evaluated separately.

In summary, a 1-mile segment will meet requirements if the average retroreflectivity value over that mile meets or exceeds the required values, and no more than 30% of the values are below the minimum value. That means seven of the ten, 0.1-mile segments need to meet or exceed the minimum value, and the average for the whole mile needs to meet or exceed the minimum value. Alternatively, if the average for the mile does not meet the minimum required value, but only two of the 0.1-mile segments are below the required value, then the mile section can pass requirements.

The mile segments and some data are discussed on the next few slides.



This information is directly from Item 666. Data are to be analyzed in 1-mile segments. This portion of the specification clearly indicates that yellow centerlines need to be evaluated separately.

Generally, all data are collected in 0.1-mile increments. Unfortunately, the data are not always perfect because there are not always ten segments per mile. When evaluating yellow centerlines and the line type changes from one type to another, the software will create a new line of data when the operator changes the line type (for some equipment types). This will result in some segments shorter than 0.1 miles and more than ten segments per mile. If these areas are near the minimum retroreflectivity level, then additional effort is required to properly evaluate them. An example is provided during the data analysis on the next slides.

Information on restriping failed sections is provided in the specification and will be described during the Next Steps discussion later in this section.

Yellow Edge Line		
Driven distance (M)	RL Center Left	Averages
4	169	175
4.1	165	
4.2	174	
4.3	180	
4.4	179	
4.5	181	
4.6	180	
4.7	178	
4.8	168	
4.9	172	
5	181	185
5.1	184	
5.2	188	
5.3	188	
5.4	185	
5.5	191	
5.6	192	
5.7	195	
5.8	183	
5.9	161	
6	165	182
6.1	181	
6.2	192	
6.3	200	
6.4	183	
6.5	191	
6.6	174	
6.7	180	
6.8	182	
6.9	167	

White Edge Line		
Driven distance (M)	RL Center Left	Averages
0	139	286
0.1	176	
0.2	253	
0.3	316	
0.4	216	
0.5	291	
0.6	367	
0.7	381	
0.8	383	
0.9	334	
1	260	248
1.1	269	
1.2	271	
1.3	272	
1.4	268	
1.5	175	
1.6	184	
1.7	259	
1.8	261	
1.9	265	
2	377	386
2.1	431	
2.2	389	
2.3	411	
2.4	360	
2.5	380	
2.6	361	
2.7	374	
2.8	384	
2.9	389	

114

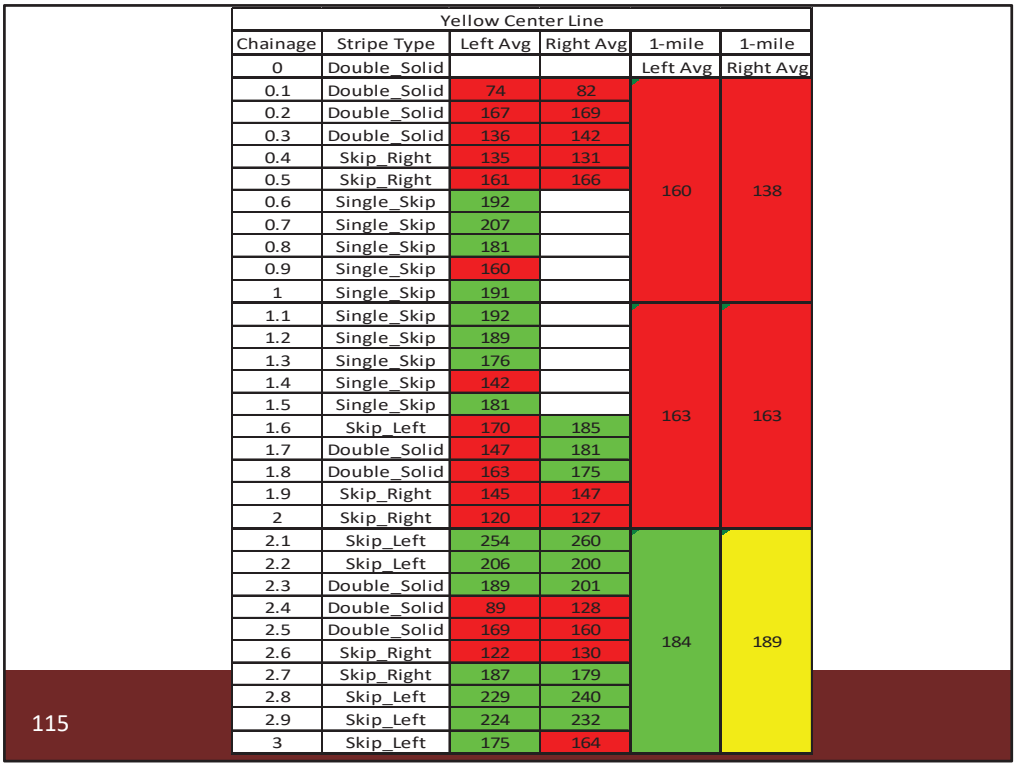
Presented on this slide are two sets of data: One for a yellow edge line marking and one for a white edge line marking.

Both sets of data contain 3 miles of retroreflectivity data. The data are broken down by the mile and averaged in the column on the right. The individual 0.1-mile segments have been color coded green for above 175 or 250, passing, and red for below, failing. The 1-mile averages have been color-coded for passing requirements, green, and failing requirements, red.

The first mile of the yellow data has an average of 175 but has five segments failing so the whole mile fails. The other 2 miles of yellow pass because they have an average of at least 175 and three or fewer failing segments.

The 3 miles of white data are all passing because each is at 250 or above and contains no more than three failing segments or has fewer than two 0.1-mile segments failing.

Analysis like this should be conducted for each mile of each data set. For some markings that easily meet the minimum, in-depth analysis is not needed. Visually, the 1-mile segments could be observed on the graphical representation of the data, or the rows of data could be looked at and determined to pass or fail without calculating out each mile average. If markings look like they may fail, it is a good idea to determine the averages to support your position.



Yellow Center Line					
Chainage	Stripe Type	Left Avg	Right Avg	1-mile	1-mile
0	Double_Solid			Left Avg	Right Avg
0.1	Double_Solid	74	82	160	138
0.2	Double_Solid	167	169		
0.3	Double_Solid	136	142		
0.4	Skip_Right	135	131		
0.5	Skip_Right	161	166		
0.6	Single_Skip	192			
0.7	Single_Skip	207			
0.8	Single_Skip	181			
0.9	Single_Skip	160			
1	Single_Skip	191			
1.1	Single_Skip	192		163	163
1.2	Single_Skip	189			
1.3	Single_Skip	176			
1.4	Single_Skip	142			
1.5	Single_Skip	181			
1.6	Skip_Left	170	185		
1.7	Double_Solid	147	181		
1.8	Double_Solid	163	175		
1.9	Skip_Right	145	147		
2	Skip_Right	120	127		
2.1	Skip_Left	254	260	184	189
2.2	Skip_Left	206	200		
2.3	Double_Solid	189	201		
2.4	Double_Solid	89	128		
2.5	Double_Solid	169	160		
2.6	Skip_Right	122	130		
2.7	Skip_Right	187	179		
2.8	Skip_Left	229	240		
2.9	Skip_Left	224	232		
3	Skip_Left	175	164		

Presented on this slide are data for a yellow centerline marking. Each line of a yellow centerline needs to be evaluated separately and for each direction of travel. Only one direction of travel is shown here.

Like the previous slide, all of the data has been color-coded for ease of analysis. Both lines for the first 2 miles fail. The averages are not high enough, and there are too many failed segments. One issue that will occur with yellow centerline markings is not having full sets of data for both lines all the time. In this data set there is a single skip line for a portion of each of the first 2 miles. For cases such as these the average still needs to occur in the 1-mile segments from the start of the project. This may result in less than 1 mile of marking being averaged; in this case, both sections are about 0.5 miles. Their average still needs to meet or exceed 175, and no more than 30% of the individual segments (1 or 2 segments) can fail for the section to be accepted. If there are very few sections and the average value is close, engineering judgment can be used to determine if restriping is needed. For double lines, if one line passes and the other line is close, then the marking may be acceptable. The measurements in the opposite direction along that same section may be the determining factor.

The third mile of data indicate that the left line passes and the right line is close. The right line is close because the average exceeds the requirement, but four segments are failing, which is one more than allowable. Engineering judgement can be used in this circumstance. If this is an isolated instance of lower retroreflectivity values, then it can be accepted. If there are frequent instances of low retroreflectivity and many other areas are

requiring restriping, then requiring restriping may be advisable.

Yellow Center Line					
Odometer	StripeType	Valid_Scans_Left	Retro_Left_Average	Valid_Scans_Right	Retro_Right_Average
0	Double_Solid				
0.1	Double_Solid	2925	409	2996	384
0.1	Double_Solid	2165	436	1946	330
0.2	Skip_Left	201	254	631	344
0.2	Skip_Left	839	364	1924	378
0.3	Double_Solid	873	356	896	345
0.4	Double_Solid	2783	364	2775	328
0.5	Double_Solid	2597	299	2538	334
0.6	Double_Solid	2303	364	2636	391
0.7	Double_Solid	2433	351	2608	369
0.8	Double_Solid	2232	395	2450	416
0.9	Double_Solid	2617	373	2608	353
1	Double_Solid	2635	323	2722	311
1.1	Double_Solid	2487	377	2576	350
1.2	Double_Solid	2071	391	2228	387
1.3	Double_Solid	2251	389	2570	401
1.4	Double_Solid	2617	402	2720	378
1.5	Double_Solid	3006	365	3047	343
1.6	Double_Solid	2777	302	2873	264
1.7	Double_Solid	2420	402	2562	376
1.7	Double_Solid	1526	374	1144	384
1.8	Skip_Right	959	374	258	348
1.9	Skip_Right	2394	419	577	348
1.9	Skip_Right	842	353	672	353
2	Skip_Left	417	381	1567	383

116

Presented on this slide are data for a yellow centerline marking. Another issue when analyzing yellow centerline markings is uneven segment sizes. The retroreflectivity of these markings clearly exceeds the requirements, so segment size differences is not a big concern with these data, but it makes analysis more complicated if the data were closer to the requirements.

In the odometer readings, some of the values are repeated. This generally occurs when the pavement marking pattern type changes, and the operator notes it in the data. Sometimes values in between the tenth of a mile length are listed (i.e. 0.13). This can add more detail to the data set but results in uneven segment lengths. Accompanying the odometer and retroreflectivity readings are the number of valid scans. This is how many retroreflectivity readings are being averaged in each segment. Skip lines will have fewer readings than solid lines due to less marking being on the road. The left and right counts may not always be even due to stripe configuration, vehicle wander, and the system losing some readings on the left marking if the crown of the road is sharp. Generally, the data default to the left, so with double lines, the left line will typically have more unless the center of the road has a steep crest.

With uneven segment lengths, the markings still need to be evaluated in 1-mile segments. There will just be more than 10 segments per mile. It may be necessary to combine the partial segments based on the number of scans to properly account for quantity measured if the retroreflectivity levels are different between the segments.

Only one manufacturer of the mobile equipment allows for line type selection for centerline markings, so unequal segment size does not occur with data from the other manufacturer.

Yellow Center Line							
Chainage	Stripe Type	Left Points	Left Peak Average	Right Points	Right Peak Average	Right Peak Standard Deviation	Two-Stripe Average
11.026	Single Skip	31	171	4	83	25	127
11.132	Single Skip	31	155	3	104	25	129
11.237	Single Skip	33	154	3	72	17	113
11.342	Single Skip	26	150	2	80	31	115
11.449	Single Skip	39	123	3	115	25	119
11.522	Left Skip / Right Solid	5	73	24	122	69	98
11.556	Left Skip / Right Solid	2	61	11	140	51	100
11.657	Left Skip / Right Solid	18	191	50	184	125	187
11.746	Left Solid / Right Skip	46	165	14	144	112	154
11.761	Left Solid / Right Skip	3	105				105
11.868	Left Solid / Right Skip	54	154	18	148	60	151
11.969	Left Solid / Right Skip	71	171	30	169	83	170
12	Single Skip	17	99	5	127	59	113
12.063	Left Skip / Right Solid	2	98	22	152	91	125
12.071	Left Skip / Right Solid	2	146	6	148	29	147
12.174	Left Skip / Right Solid	31	163	64	132	48	148
12.275	Left Skip / Right Solid	21	204	51	165	82	184
12.282	Double Solid	8	172	6	181	30	176
12.339	Left Solid / Right Skip	46	218	36	169	64	193
12.38	Left Solid / Right Skip	25	208	7	131	46	169
12.487	Left Solid / Right Skip	64	134	17	157	78	145
12.557	Single Skip	45	116	11	138	56	127
12.592	Single Skip	9	105				105
12.699	Single Skip	25	134				134
12.802	Single Skip	34	113	2	28	17	70
12.908	Single Skip	22	159				159

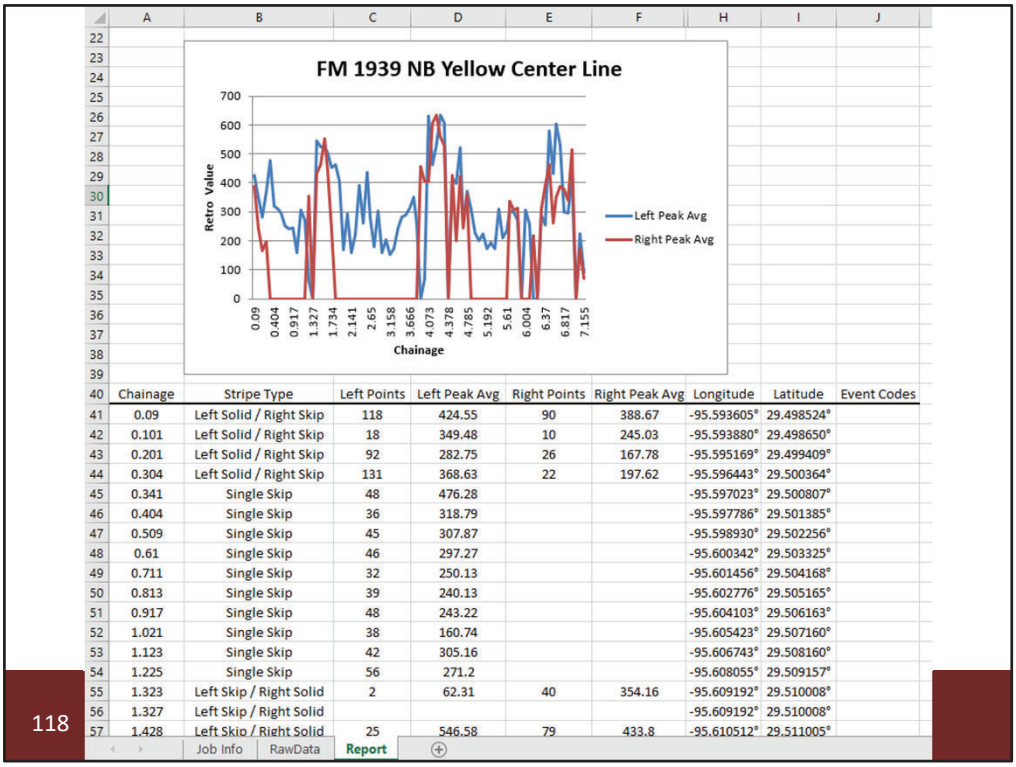
117

Similar to the last slide, the data presented on this slide are for a yellow centerline marking. Again, the centerline line type is changed resulting in unequal segment sizes. The retroreflectivity of these markings is fairly poor, so further analysis is not necessary, but if the data were closer to the requirements, the data analysis would be a little more complicated.

The odometer readings in this data set show that the values are not in even 0.1-mile intervals. The segments are starting at whatever chainage the odometer is at when the stripe type is changed. Again, accompanying the chainage and retroreflectivity readings is the number of valid scans (left and right points). This is how many retroreflectivity readings are being averaged in each segment. The left and right counts may not always be even due to stripe configuration, vehicle wander, and the system losing some readings on the left marking if the crown of the road is sharp. In some cases in the data, there are right points for single skip lines; sometimes this occurs when evaluating edge lines as well. The system picks up a few readings from rumble strips, markers, or other reflections, and the data get recorded. The operators should remove this extraneous data when creating the summary spreadsheet.

With uneven segment lengths, the markings still need to be evaluated in 1-mile segments. There will just be more than 10 segments per mile. It may be necessary to combine the partial segments based on the number of scans to properly account for quantity measured if the retroreflectivity levels are different between the segments.

These data are from the older retroreflectometer system; the number of data points collected is around 10% the number of data points collected by the newer system. That means the newer system is getting much better coverage of the pavement markings (i.e. more readings along the length of the marking).



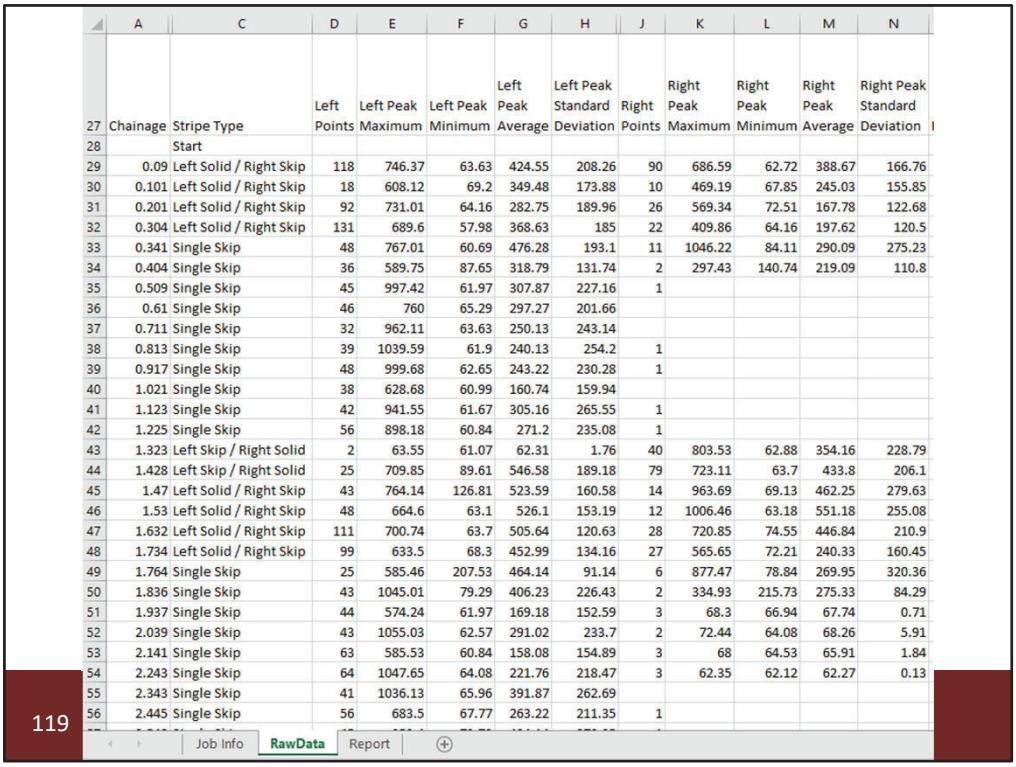
Chainage	Stripe Type	Left Points	Left Peak Avg	Right Points	Right Peak Avg	Longitude	Latitude	Event Codes
0.09	Left Solid / Right Skip	118	424.55	90	388.67	-95.593605°	29.498524°	
0.101	Left Solid / Right Skip	18	349.48	10	245.03	-95.593880°	29.498650°	
0.201	Left Solid / Right Skip	92	282.75	26	167.78	-95.595169°	29.499409°	
0.304	Left Solid / Right Skip	131	368.63	22	197.62	-95.596443°	29.500364°	
0.341	Single Skip	48	476.28			-95.597023°	29.500807°	
0.404	Single Skip	36	318.79			-95.597786°	29.501385°	
0.509	Single Skip	45	307.87			-95.598930°	29.502256°	
0.61	Single Skip	46	297.27			-95.600342°	29.503325°	
0.711	Single Skip	32	250.13			-95.601456°	29.504168°	
0.813	Single Skip	39	240.13			-95.602776°	29.505165°	
0.917	Single Skip	48	243.22			-95.604103°	29.506163°	
1.021	Single Skip	38	160.74			-95.605423°	29.507160°	
1.123	Single Skip	42	305.16			-95.606743°	29.508160°	
1.225	Single Skip	56	271.2			-95.608055°	29.509157°	
1.323	Left Skip / Right Solid	2	62.31	40	354.16	-95.609192°	29.510008°	
1.327	Left Skip / Right Solid					-95.609192°	29.510008°	
1.428	Left Skip / Right Solid	25	546.58	79	433.8	-95.610512°	29.511005°	

Job Info | RawData | Report

This summary data sheet provides data for a yellow centerline marking. The blue line in the graph is the left average, and the red line is the right average. In the graph, the variability of the data is apparent, with large swings up and down. This is typically not a good sign for the quality of the data collection or the quality of the marking. Some of the large drops to zero are because the data that were missing on the single skip areas where there was only a single line were plotted as zeros. This is incorrect; the zero data should not have been plotted. The line would not be continuous, but it wouldn't spike down to zero when there was actually no reading to plot.

If just looking at the average of the data, it looks good. However, there are two apparent issues that require further exploration. Outside of the plotting of the missing data, the average values are still highly variable, and the average values for yellow thermoplastic are abnormally high. Typical yellow thermoplastic will range between 150 and 300. Readings over 300 are not too common. For white markings, the expectation is typically 350 to about 450.

The next slide will look at the raw data tab to try to explain some of the issues with these data.



	A	C	D	E	F	G	H	J	K	L	M	N
27	Chainage	Stripe Type	Left Points	Left Peak Maximum	Left Peak Minimum	Left Peak Average	Left Peak Standard Deviation	Right Points	Right Peak Maximum	Right Peak Minimum	Right Peak Average	Right Peak Standard Deviation
28		Start										
29	0.09	Left Solid / Right Skip	118	746.37	63.63	424.55	208.26	90	686.59	62.72	388.67	166.76
30	0.101	Left Solid / Right Skip	18	608.12	69.2	349.48	173.88	10	469.19	67.85	245.03	155.85
31	0.201	Left Solid / Right Skip	92	731.01	64.16	282.75	189.96	26	569.34	72.51	167.78	122.68
32	0.304	Left Solid / Right Skip	131	689.6	57.98	368.63	185	22	409.86	64.16	197.62	120.5
33	0.341	Single Skip	48	767.01	60.69	476.28	193.1	11	1046.22	84.11	290.09	275.23
34	0.404	Single Skip	36	589.75	87.65	318.79	131.74	2	297.43	140.74	219.09	110.8
35	0.509	Single Skip	45	997.42	61.97	307.87	227.16	1				
36	0.61	Single Skip	46	760	65.29	297.27	201.66					
37	0.711	Single Skip	32	962.11	63.63	250.13	243.14					
38	0.813	Single Skip	39	1039.59	61.9	240.13	254.2	1				
39	0.917	Single Skip	48	999.68	62.65	243.22	230.28	1				
40	1.021	Single Skip	38	628.68	60.99	160.74	159.94					
41	1.123	Single Skip	42	941.55	61.67	305.16	265.55	1				
42	1.225	Single Skip	56	898.18	60.84	271.2	235.08	1				
43	1.323	Left Skip / Right Solid	2	63.55	61.07	62.31	1.76	40	803.53	62.88	354.16	228.79
44	1.428	Left Skip / Right Solid	25	709.85	89.61	546.58	189.18	79	723.11	63.7	433.8	206.1
45	1.47	Left Solid / Right Skip	43	764.14	126.81	523.59	160.58	14	963.69	69.13	462.25	279.63
46	1.53	Left Solid / Right Skip	48	664.6	63.1	526.1	153.19	12	1006.46	63.18	551.18	255.08
47	1.632	Left Solid / Right Skip	111	700.74	63.7	505.64	120.63	28	720.85	74.55	446.84	210.9
48	1.734	Left Solid / Right Skip	99	633.5	68.3	452.99	134.16	27	565.65	72.21	240.33	160.45
49	1.764	Single Skip	25	585.46	207.53	464.14	91.14	6	877.47	78.84	269.95	320.36
50	1.836	Single Skip	43	1045.01	79.29	406.23	226.43	2	334.93	215.73	275.33	84.29
51	1.937	Single Skip	44	574.24	61.97	169.18	152.59	3	68.3	66.94	67.74	0.71
52	2.039	Single Skip	43	1055.03	62.57	291.02	233.7	2	72.44	64.08	68.26	5.91
53	2.141	Single Skip	63	585.53	60.84	158.08	154.89	3	68	64.53	65.91	1.84
54	2.243	Single Skip	64	1047.65	64.08	221.76	218.47	3	62.35	62.12	62.27	0.13
55	2.343	Single Skip	41	1036.13	65.96	391.87	262.69					
56	2.445	Single Skip	56	683.5	67.77	263.22	211.35	1				

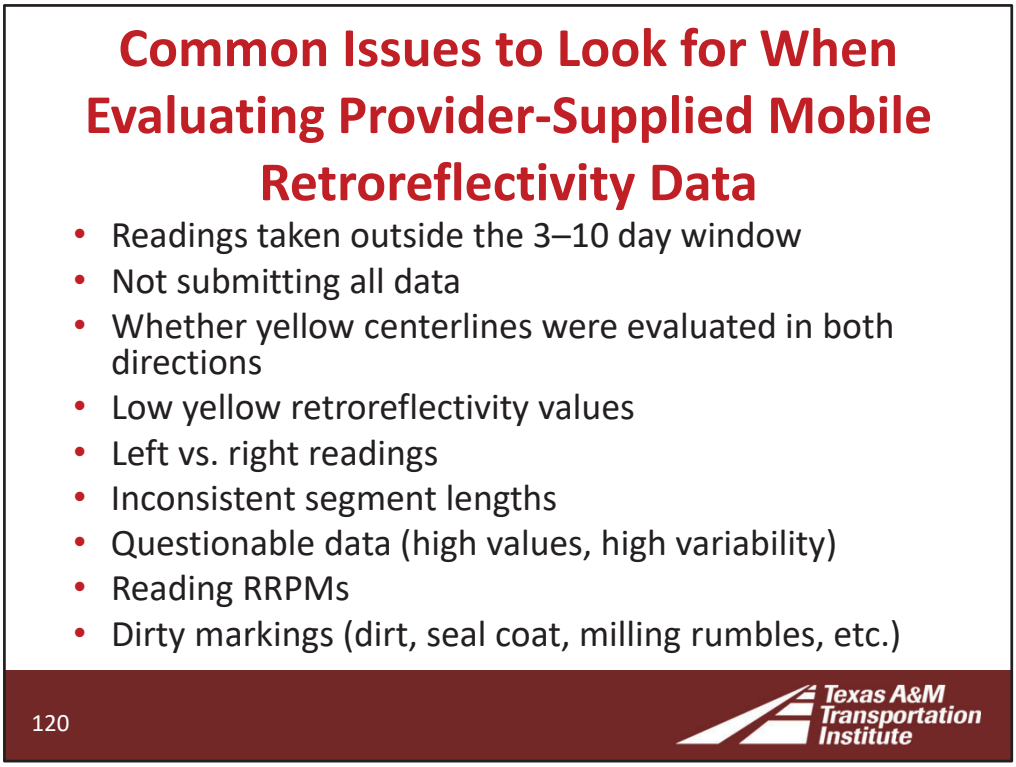
Job Info | RawData | Report

119

This is the raw data tab that was used to create the summary table and chart from the previous slide. The number of points (Column D and J) and the average values (Column G and M) were provided on the previous slide. In addition to the average retro data, we now have the left and right line max and min values along with their standard deviations. The standard deviation provides a measurement of how variable each of the average values is. This variability is influenced by the min and max values. Having a large range between the min and max values, coupled with a large standard deviation, means that the data are spread out. A good pavement marking should be relatively consistent, and good data collection should not negatively influence that consistency.

The very high maximum values likely indicate that RRPMs were not properly filtered out of the data. This will result in artificially high retro values, high maximum values, and high standard deviation values. The consistently very low minimum values likely indicate that the settings were not optimized to filter out background noise or that the markings were very poor. The variation between the maximum values in the different rows of data show there were some issue with the data collection. If you look at the rows that had the lower maximum values (values closer to where you would expect yellow markings to be), the average value for these sections are somewhat more reasonable.

Not all of the mobile retroreflectometers output the maximum, minimum, and standard deviation values. This may limit the ability to do this more in-depth analysis for the data for some systems. The system that does not include these values does not have user adjustable settings; therefore it typically does not have this issue.



Readings taken outside the 3–10 day window: There are several reasons why readings may be taken after the 3–10 day window; for example weather delays, other projects, equipment issues, etc. may delay readings. This doesn't mean they do not need to be taken, nor does it change the required retroreflectivity levels. Markings that are read after 10 days are more likely to have been subjected to more wear, and thus it is typically not an advantage for the provider to delay readings. Therefore later readings should be allowed, and if the measurements pass, then the markings can be accepted. If readings are taken before the third day, the markings are likely to have seen minimal wear and have a higher retroreflectivity value than if they were evaluated during the specified time period.

Not submitting all data: The specification requirements have been discussed in multiple parts of this guidance presentation. Part of the requirement is to submit example data prior to starting work. At this time, the data should be reviewed to make sure the required information is being submitted. If it is not, the provider needs to be made aware so it can submit the correct data. Providers should submit the raw data in addition to the summarized data. All markings need to be evaluated.

Yellow both ways: Providers are required to evaluate yellow centerlines in both directions. Both directions need to meet the retroreflectivity requirements. Left edge lines, and two-way left-turn lanes only need to be measured in the direction of the through lane. It is typical that the retroreflectivity values for yellow centerlines are lower when evaluated in the opposite direction of the application. This is especially true for seal coat roadways. The large profile of the seal coat aggregate and the forward velocity of the striping operation

typically result in the thermoplastic and beads hitting the front side of the aggregate but less hitting the back side since it is somewhat shadowed from the aggregate vertical profile. This issue is made worse if contractors are going too fast and/or are not applying enough thermoplastic and beads.

Low yellow retroreflectivity values: Typically, yellow markings are not as reflective as white markings. The most difficult marking to install is a yellow centerline marking on a new seal coat roadway. The retroreflectivity readings are commonly low unless the providers are using quality materials and do a good installation job. If materials are not of good quality and/or the installation quality is not good, then the retroreflectivity levels will be low, especially in the direction opposite of the installation direction (see yellow both ways). Just because it may be more difficult to install yellow centerline markings on seal coat surfaces does not mean that the retroreflectivity requirements should be relaxed or ignored.

Left vs. right readings: This point was recently discussed when analyzing the yellow centerlines. The old equipment defaulted all readings to the left position; thus, when evaluating double lines, the left line would always have more readings. The newer equipment is much better at properly assigning data to the right or left. The systems also gather much more data, so any differences are not a big factor overall. When markings are broken left and solid right, the right will have more readings. In some instances, the systems will pick up measurement noise or retroreflectivity off things that are not markings and record data that should be disregarded. These data to disregard are typically much less than the average retroreflectivity value being recorded.

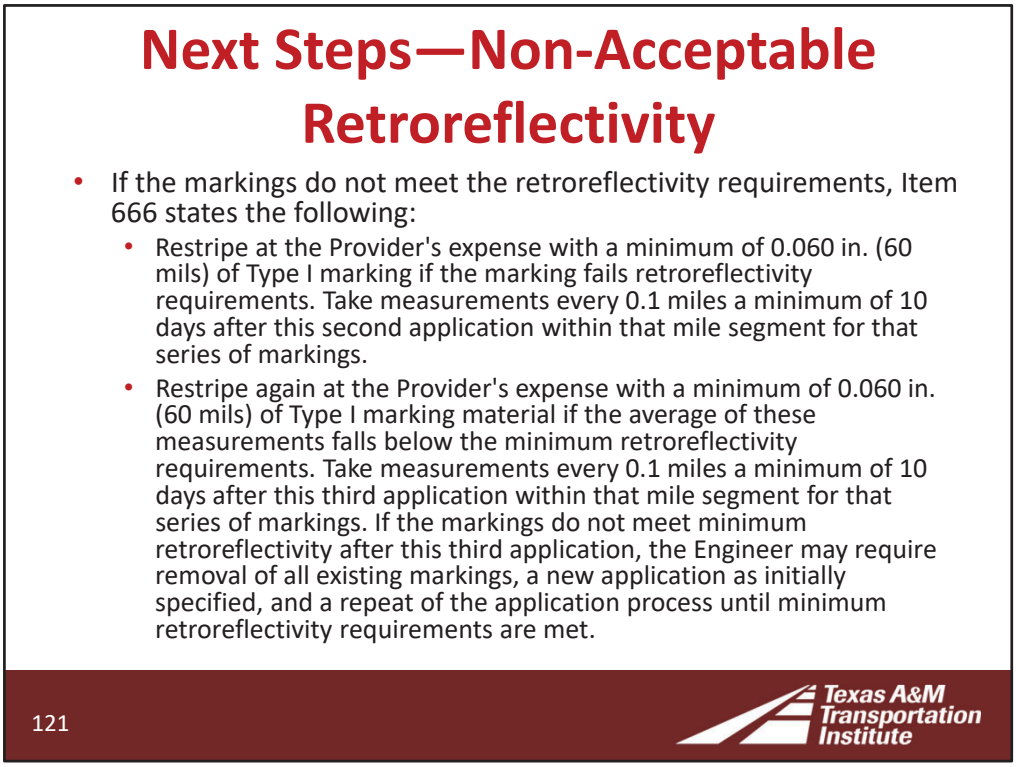
Inconsistent segment lengths: This point was recently discussed when analyzing the yellow centerlines. Files with inconsistent segments need a little more attention when analyzing whether the data meet the requirements. The inconsistent length is due to new lines of data being started when the centerline type changes.

Questionable data: If the data seem questionable and you cannot determine a reason why, please ask TTI to look at the data. We can quickly review the data and determine if there are inconsistencies with typical data or if the provider needs to improve its operations. If there are issues with the provider or questionable data, request that TTI do a verification check on the provider's work. The district can conduct its own field checks using portable retroreflectometers. Spot checks on segments with questionable data can be used to verify if the data are reasonably accurate. The spot checks should be conducted in as close proximity time wise to the provider's mobile retroreflectivity readings as possible. When looking at the data, the most noticeable indicators of questionable data are high variability in the data and inclusions of RRPMs in the data.

Reading RRPMs: Readings RRPMs will create high standard deviation and false high average readings. Yellow centerlines and white skip lines will generally have RRPMs in place. The mobile retroreflectometers either automatically filter the RRPMs or the operator has to set a level at which the RRPMs will be filtered. The opposite to reading RRPMs is recording

readings on the pavement between skip line markings. If the equipment and software are not operated properly, low retroreflectivity levels may be recorded in the gaps between skip line markings. This will create false low readings. This is detrimental to the provider because the markings are more likely to not meet minimum retroreflectivity requirements if this occurs.

Dirty markings (dirt, seal coat, milling rumbles, etc.): Depending on when readings are taken, there are many factors outside the control of the provider that may negatively influence the retroreflectivity readings. The providers should note these issues when collecting data, and they should be considered when determining whether to pass or fail markings due to retroreflectivity requirements. Dirt tracked onto markings, seal coat asphalt tracking onto markings, and damage to markings due to construction activities are common and not the fault of the striping provider. Some of these issues may be visible in the video file, or they may require a field inspection to verify.



Failing 1-mile segments need to be restriped at the provider's expense until the retroreflectivity readings meet the minimum requirements. TTxDOT needs to hold the providers accountable to the specification requirements. This creates an even playing field for all providers and will result in higher-quality pavement markings that are more visible at night.

Some providers are proactive and restripe short deficient sections prior to submitting data to TxDOT. This results in full mile segments that meet the requirements, reduces TxDOT's need to critically analyze the data, reduces TxDOT's need to require restripes, and reduces the provider's costs for restriping whole sections or calling back equipment it may have moved on to other jobs. The end result is markings that meet the new stripe minimum retroreflectivity levels.

Next Steps—Acceptable Retroreflectivity

- If the markings meet the retroreflectivity requirements, the project can be approved.
- Effective May 1, 2020, new requirements have been added to SiteManager to capture receipt and review of the retroreflectivity data.

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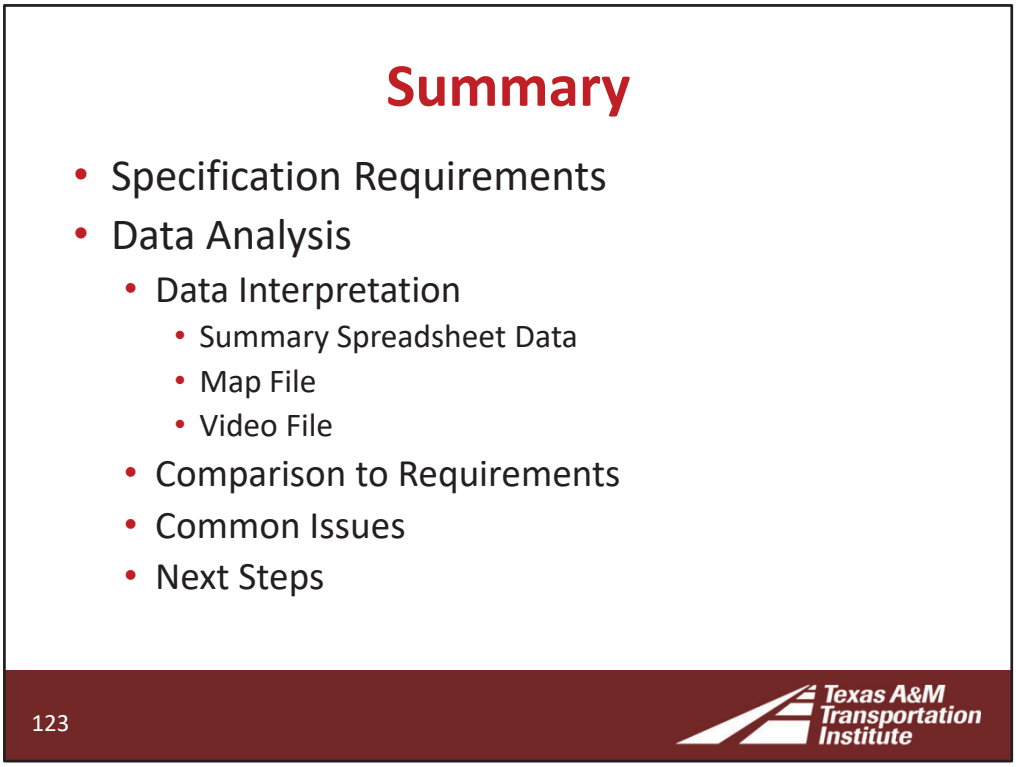
Passing markings can be approved. There is a new SiteManager requirement effective May 1, 2020. It requires the engineer to create a sample and attach a SiteManager test report to show that he/she has received and reviewed the retroreflectivity data from the Provider.

Please contact Kristina Santos (Kristina.Santos@txdot.gov) at (512) 506-5870 with any questions regarding these new requirements.

Additional information on the SiteManager requirements will be provided in future versions of this guidance presentation and in the FAQ section of the Programs and Guidance website.

https://groups.tti.tamu.edu/visibility/programs-and-guidance/frequently-asked-questions/



This part of the guidance presentation covered a summary of the specification requirements and data analysis for mobile retroreflectivity.

The data analysis included discussion on the data in the spreadsheets and how to analyze them to meet specification requirements. The discussion included common issues to look for and how to identify these issues in the summary and raw data files. The use and benefit of the map and video files were also discussed.

The specifications have specific retroreflectivity values that need to be met. There are conditions and situations that will require engineering judgment to fairly determine if the markings are acceptable or not. There are many factors outside of the pavement marking contractors' control that may impact their retroreflectivity values. Equitable analysis from job to job and contractor to contractor is key.

When markings have been determined to not be acceptable, the markings should be restriped. If they are acceptable, the engineer needs to create a sample report and submit to SiteManager.

This concludes the discussion of the retroreflectivity data requirements and analysis.