Traffic Sign Life Expectancy

Investigation LAB943

Project Tap Meeting #1

02/19/2013

<u>Project Team</u>

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Agenda

- Introductions
- Project review
- Literature review on other state studies
- Survey of local agencies & states
- MnROAD test decks – vertical and 45 degree rack
  - Select sign material types, colors, sample size, direction, ages
  - Color evaluation
- Next Steps

Project Goals and Objectives

- Develop Sign Life Expectancies
  - Improve Sign Management
  - Enable adoption of sign replacement policy
  - Provide an acceptable management method per federal requirements
  - Understand what drives sign replacements
  - Reduce costs for managing and replacing signs

Task 1: Survey of Practice

- Survey local agencies, other states
  - Types, colors and fabrication method of sheeting
  - Known, quantifiable drivers of sign replacements
  - Agencies with sign management data that could be used
  - All information that can be used from state studies, evaluations and databases
  - List of sign replacement projects scheduled that can provide signs for test deck
  - Potential set of in-field control signs for ongoing measurements

Jan 1, 2013 – April 30, 2013

Task 2: Test Deck & Data Collection Plan

- Identify in-service signs that will be measured
  - Single point
  - Continuing Control Sign
- Select or Develop Spreadsheet Database
- Develop how-to video
- Determine need for additional equipment
- Develop test deck plan for MnROAD
  - Types, colors, number of samples

May 1, 2013 – June 30, 2013

Task 3: MnROAD Data Collection

- Construct vertical and 45^0 accelerated decks
- Populate with sign materials
- Collect retroreflectivity and color annually
- Share Data on Website

July 1, 2013 – Nov, 2016

Anticipate continuation by MnDOT

Task 4: System Data Collection

- Provide Training at MnDOT Lab
- Coordinate shared retroreflectometers
- Provide stickers for field control signs
- Annually calibrate purchased equipment
- Review data, collate into database, prepare results, summarize on webpage

May 1, 2013 – Dec 30, 2013

Task 5:Data Analysis, Recommendations, Report

- Synthesize all information
- Form Expert Panel: TAP + Legal
- Recommend Expected Life for Sign Materials
- Develop Technical Memorandum
  - Document analysis, decision process, results, data,
  - Guideline for sign life, maintenance policies

Jan 1, 2014 – Mar 30, 2014

Project Schedule

Tasks	2013												2014		
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
1. Survey of Practice		T		*											
2. Develop test deck & data collection plan				T		*									
3. MnROAD test deck				T							*				
4. System Data Collection					T					T		*			
5. Data Analysis and Recommendations													E	E	* T

* Task Complete
E Expert Panel Meeting
T TAP Meeting

Literature Review of Sign Retroreflectivity Studies

FHWA (1991)

- Type 1 and III (Engineering Grade, HI)
- 5,700 signs across the U.S.
- Findings:
  - Sign orientation, solar radiation not strong predictors
  - Signs 1-2 years old have high variability in retroreflectivity
  - Developed predictive equations

Purdue(2001) & Indiana (2010)

- 1,341 Type III red, white, yellow signs, 10-11 years old
- Findings:
  - No significant correlation between retro and orientation
  - south facing red signs had increased variability
  - 4% failure
- 2010 – 211 signs, 72 north, 72 south, 15 were over 16 years
  - All green passed, 4% white, 4% red, 12% yellow failed
  - Using 18 year expected life Type III
  - Moving to Type IV

Utah State U/UDOT

- Collected data on 1716 signs in 2011 (age unknown)
- Developed a custom mobile application that incorporates GPS, pictures and data
- 93% passed retro but, 23% of the passing were damaged
  - Elevation: higher=more damage (plow spray)
  - Temperature swing: greater=more damage (more remote)
  - Geography: remote=more damage (more shot)
    - Solution: install a target below the sign

North Carolina State U (2005-6)

- 1,047 Type I and III white, yellow, red, green
- 192 of the original signs were replace in ‘06
- Included analysis of national data
- Findings
  - Typically replacement is 6% :
    - About half from low retro/natural damage
    - Half from vandalism
  - Linear regression fits best

Vermont (2008)

- 398 Type III
- 220 Type IX fluorescent yellow and yellow-green
- Type IX signs in service for 6 years max
- Findings:
  - No significant correlation to orientation or offset
    - North facing higher retro than south
    - Avery outperformed 3M (but small Avery sample, may be skewed)
  - Linear deterioration curve for Type III, Non-Linear for Type IX (but only 6 years of data)
  - Study recommended 15 for red, 15-20 for rest
  - Use 15 year expected life for small signs, control for large ?

Texas TTI (2009)

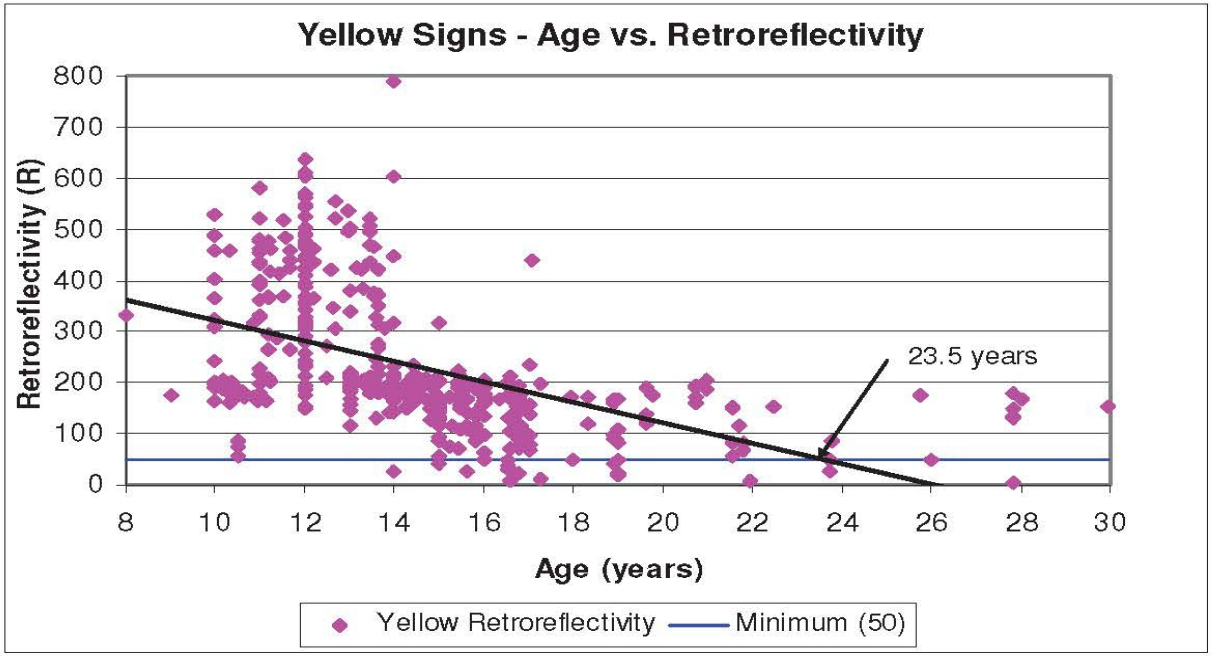
- 859 Type III white yellow and red across Texas:
  - 99% retroreflectivity compliance :
    - 2% failure rate for signs 10-12
    - 8% for signs 12-15
  - No strong correlation between orientation and retro
- Accelerated weathering for all types (10 years= 20 years)
  - Color fading is a significant issue
    - Maintenance crews report direction does impact life, but is it retro or color?

Penn DOT (2012)

- 1,007 Type III and IV, 10+ years old, yellow, white, green, red, black and white
- Findings:
  - No regional differences
  - 28 signs below minimum (2.8%) at an average age of 14
  - Expected sign life value of 15 for Type III yellow, white, green and red signs

Penn DOT Type III , IV Yellow

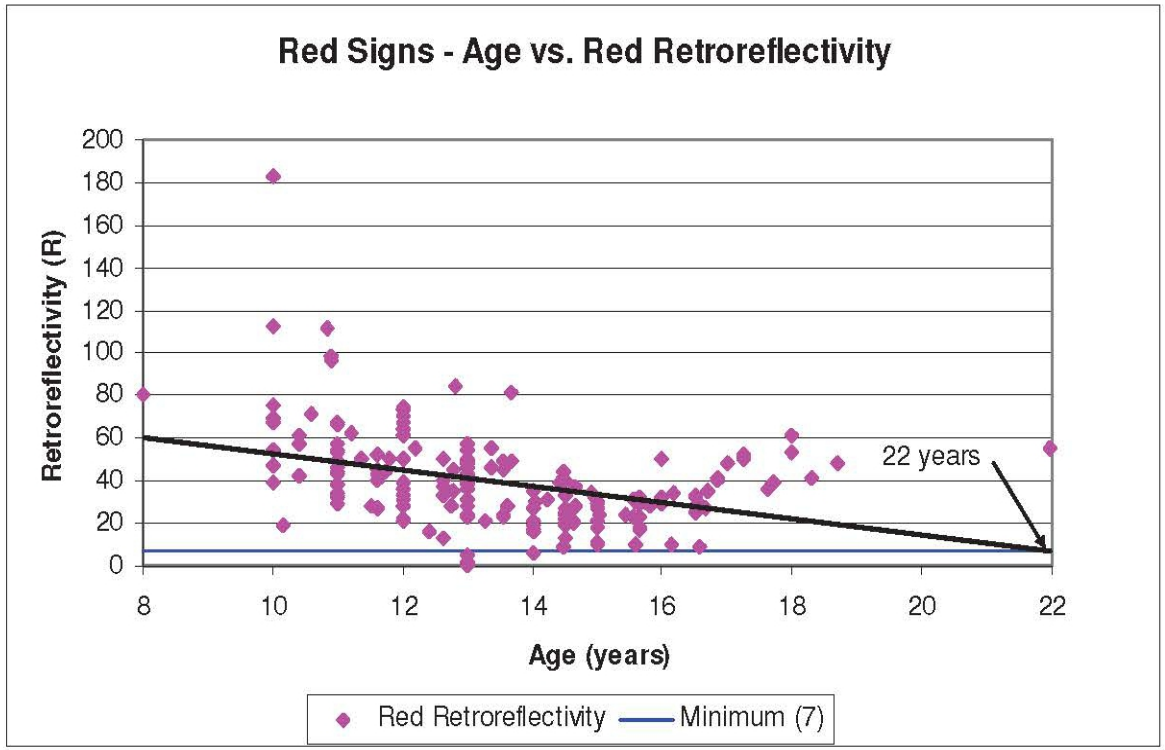
Figure 2: Age versus Retroreflectivity for Yellow Signs (all counties combined)



$y = -20.24x + 523.53$ $R^2 = 0.2533$

Penn DOT Type III, IV Red

Figure 3: Age versus Retroreflectivity for Red Signs (Red) (all counties combined)



y = -

y = 4.0818x + 94.055 R^2 = 0.1537

Survey of Minnesota Agencies

(Minnesota survey will close this week, a survey of other state DOTs is planned)

We asked Minnesota Agencies;

(preliminary results as of 02/19/2013)

- Who collects retro data & how is retro maintained/verified?
- Possible participants for this study?
- Who has an inventory? & what is tracked?
- What sheeting types are installed? & what types are currently specified?

Survey of Minnesota Agencies

(a survey of other states is planned)

Minnesota Agencies – preliminary results as of 02/19/2013

1. Please enter the information about yourself.

		Response Percent	Response Count
Transportation Agency:		**100.0%**	**60**
Person(s) replying to questionnaire:		**100.0%**	**60**
Contact phone number:		98.3%	59
Contact e-mail:		96.7%	58
	answered question		**60**
	skipped question		**3**

Survey of Minnesota Agencies

Minnesota Agencies – preliminary results as of 02/19/2013

2. What method does your agency use for maintaining minimum retroreflectivity of traffic signs? (select all that apply)

	Response Percent	Response Count
Nighttime Visual Inspection	34.5%	19
Measured Sign Retroreflectivity	7.3%	4
Expected Sign Life	**54.5%**	**30**
Blanket Replacement	30.9%	17
Control Signs	5.5%	3
Combination of Methods	36.4%	20
Agency established sign service life	5.5%	3
Other (please specify)		6
answered question		**55**
skipped question		**8**

Survey of Minnesota Agencies

Minnesota Agencies – preliminary results as of 02/19/2013

3. Would you be interested in collecting retroreflectivity data on some of your signs if the equipment and training was provided?

		Response Percent	Response Count
Yes		65.5%	36
No		34.5%	19
		answered question	55
		skipped question	8

Survey of Minnesota Agencies

Minnesota Agencies – preliminary results as of 02/19/2013

4. Do you have a sign inventory that tracks:

	Yes	No	Rating Count
Sign Age	**87.0% (47)**	13.0% (7)	54
Sheeting material type	**88.7% (47)**	11.3% (6)	53
Sheeting material manufacturer	32.7% (16)	**67.3% (33)**	49
Fabrication method	12.2% (6)	**89.8% (44)**	49
Measured Retroreflectivity	18.0% (9)	**84.0% (42)**	50
Cause of replacement (accident, damage, color/retro,etc)	**70.4% (38)**	29.6% (16)	54
		answered question	**54**
		skipped question	**9**

Survey of Minnesota Agencies

Minnesota Agencies – preliminary results as of 02/19/2013

5. What sign sheeting materials are now inplace on your existing traffic signs? Please type in approximate percentage of each.

	Response Percent	Response Count
ASTM Type I - Engineering grade?	**75.0%**	**39**
ASTM Type III-High Intensity?	73.1%	38
ASTM Type IV-High intensity Prismatic?	71.2%	37
ASTM Type IX -VIP prismatic?	55.8%	29
ASTM Type XI-DG3 prismatic?	73.1%	38
answered question		**52**
skipped question		**11**

Survey of Minnesota Agencies

Minnesota Agencies – preliminary results as of 02/19/2013

6. What sign sheeting materials do you currently specify for new traffic signs? Choose one or more by checking box(s)

	Response Percent	Response Count
ASTM Type I - Engineering grade?	7.4%	4
ASTM Type III-High intensity?	16.7%	9
ASTM Type IV-High intensity Prismatic?	38.9%	21
ASTM Type IX -VIP prismatic?	11.1%	6
ASTM Type XI-DG3 prismatic?	**57.4%**	**31**
Other (please specify)		1
answered question		**54**
skipped question		**9**

MnROAD Sign Test Deck

Proposed Location and Configuration (for Task 2)

Sign Test Deck Proposed > Location at MnROAD

Proposed Sign Structure Locations

- 25± Structures, Approximately 20 feet Apart.
- 45 degree deck at south end in the middle

Questions for MnROAD Test Deck

Discussion/Input

- Salvage Vs. New Panels?
- Colors? (planning only those requiring retro – and will test for color)
- Face directions? (planning for NC type “box” formation of all 4 directions)
- Fabrication Methods? (any method and fabricator)
- Sheeting Materials Manufacture? (3M or others too?)
- Sheeting Materials Type(s)?

New MUTCD Table 2A.3
Minimum Maintained Retroreflectivity Levels

Sign Color	Sheeting Type (ASTM D4956-04) ①				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
White on Green	W* G ≥ 7	W* G ≥ 15	W* G ≥ 25	W ≥ 250; G ≥ 25	Overhead
	W* G ≥ 7	W ≥ 120; G ≥ 15			Ground-mounted
Black on Yellow or Black on Orange	Y*; O*	Y ≥ 50; O ≥ 50			②
	Y*; O*	Y ≥ 75; O ≥ 75			③
White on Red	W ≥ 35; R ≥ 7				④
Black on White	W ≥ 50				—

① The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m^2 measured at an observation angle of 0.2° and an entrance angle of -4.0°.
②For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs
③For text and fine symbol signs measuring less than 1200 mm (48 in)
④Minimum Sign Contrast Ratio ≥ 3:1 (white retroreflectivity red retroreflectivity)
* This sheeting type should not be used for this color for this application.

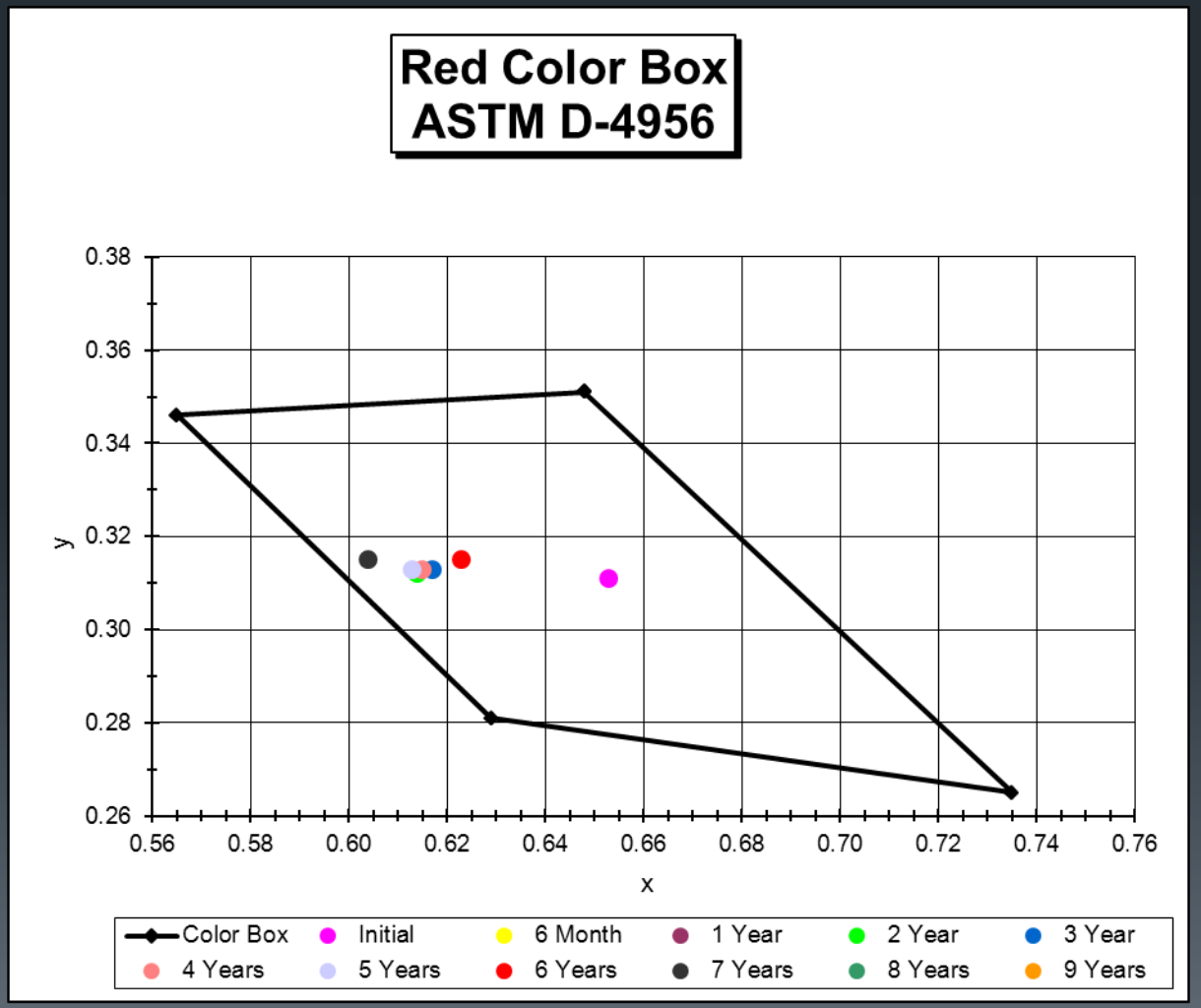
NTPEP Outdoor Weathering Fence Maplewood Lab

Portable Retro

Light Tunnel

AASHTO-NTPEP Sign Sheeting Testing MnDOT Location

- Retroreflection
  - Lab and Field
- Color
  - Lab and Field
  - Color coordinates, x,y
- Visual Evaluation
  - Shrinkage, blistering etc.
- Frequency
  - Initial, 1,2 and 3 years

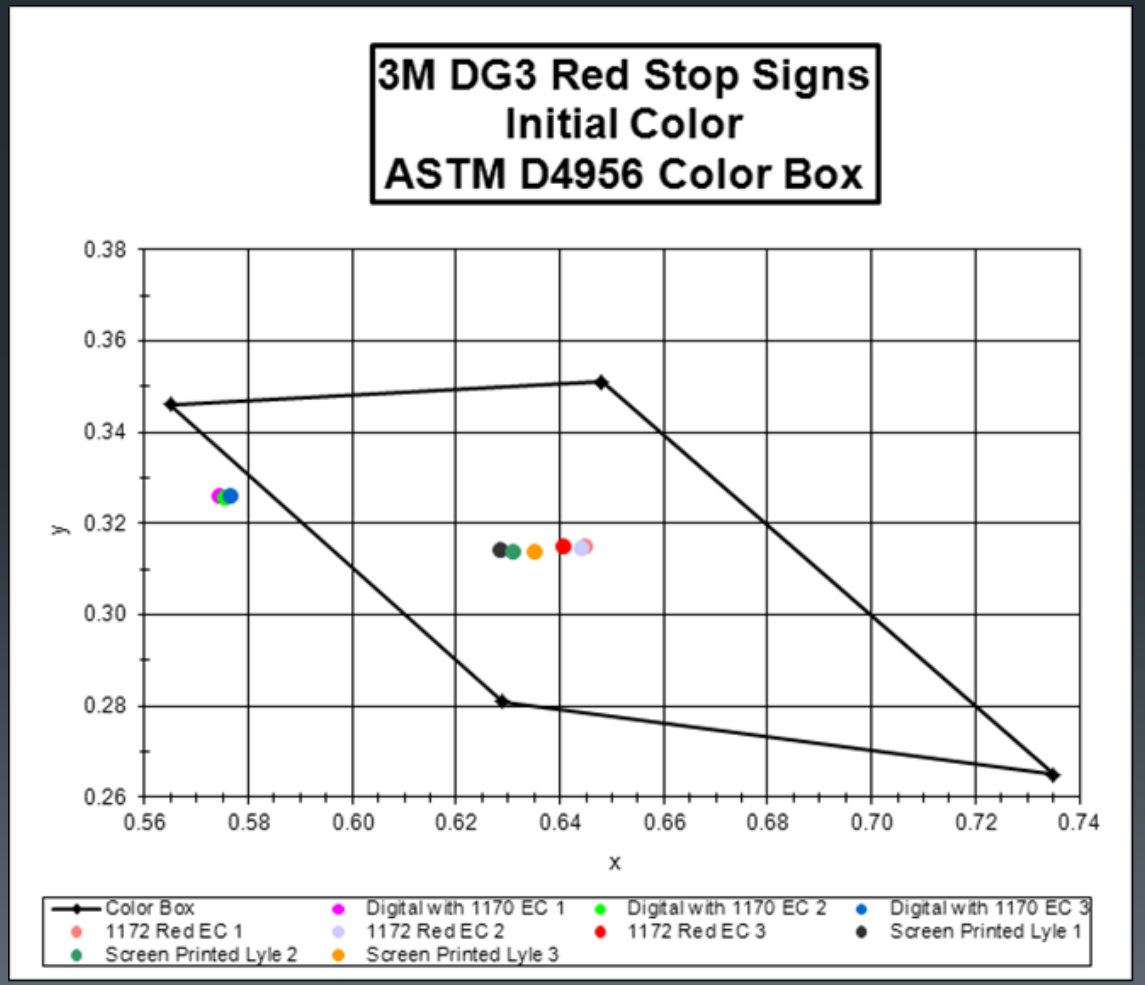


3M DG3 Stop Sign Evaluation Fabrication Method

Initial Retro Readings

- Digital Printed with EC film - 131.
- Red EC film signs - 168.
- Screened signs - 64.

Initial Color Reading



Next Steps

-Retro measurement ‘how-to’ video

-Data collection on in-service signs

-TAP meeting in late April to cover Tasks 2 and 3

Questions?

Thank You