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Tapping into the Power of a Traffic Sign Inventory to Meet the New Retroreflectivity Requirements

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Abstract. On January 22, 2008, new language was officially adopted into the Manual On Uniform Traffic Control Devices (MUTCD) that requires agencies in charge of streets and highways to use an assessment or management method to maintain the retroreflectivity of traffic sign at or above established thresholds.

At least one of five different assessment or management methods is recommended to maintain the suggested minimum levels. These methods were developed to provide agencies with added flexibility in complying with the new guidelines.

Which method or combination of methods works best for a local agency? Nighttime inspections? Expected sign life? Measuring? Blanket replacement or using a control sample?

A county in Washington State found that its sign inventory was a powerful tool that could be used to streamline the use of any of the assessment or management methods. Using the inventory system as the foundation, a combination of more than one method ultimately worked most effectively with a minimal amount of additional workload or system administration.

A pilot test of the selected approach showed that in most cases existing high intensity signs several years old had retroreflectivity levels comfortably above the recommended thresholds. It also showed that while some types of engineer grade signs were marginal, other engineer grade signs still met the guidelines. The County now has some very useful and insightful data on which it can now use to plan, prioritize and budget for sign replacement to comply with the new guidelines.

INTRODUCTION

The second revision of the 2003 MUTCD, which became effective on January 22, 2008, includes a new standard in Section 2A.09 which states, "Public agencies or officials having jurisdiction shall use an assessment or management method that is designed to maintain traffic sign retroreflectivity at or above the minimum levels in Table 2A-3." See Table 1 for these levels.

New guidance is also included which states, "…one of more of the following assessment or management methods should be used to maintain sign retroreflectivity." Those methods are listed as:

A. Visual Nighttime Inspection
B. Measured Sign Retroreflectivity
C. Expected Sign Life
D. Blanket Replacement
E. Control Signs
F. Other methods based on engineering studies

Table 1 – MUTCD Minimum Sign Retroreflectivity Levels

<table>
<tr><th colspan="7">Table 2A-3. Minimum Maintained Retroreflectivity Levels[1]</th></tr>
<tr><th rowspan="3">Sign Color</th><th colspan="4">Sheeting Type (ASTM D4956-04)</th><th rowspan="3">Additional Criteria</th></tr>
<tr><th colspan="3">Beaded Sheeting</th><th>Prismatic Sheeting</th></tr>
<tr><th>I</th><th>II</th><th>III</th><th>III, IV, VI, VII, VIII, IX, X</th></tr>
<tr><td rowspan="2">White on Green</td><td>W*; G ≥ 7</td><td>W*; G ≥ 15</td><td>W*; G ≥ 25</td><td>W ≥ 250; G ≥ 25</td><td>Overhead</td></tr>
<tr><td>W*; G ≥ 7</td><td colspan="3">W ≥ 120; G ≥ 15</td><td>Ground-mounted</td></tr>
<tr><td rowspan="2">Black on Yellow or Black on Orange</td><td>Y*; O*</td><td colspan="3">Y ≥ 50; O ≥ 50</td><td>2</td></tr>
<tr><td>Y*; O*</td><td colspan="3">Y ≥ 75; O ≥ 75</td><td>3</td></tr>
<tr><td>White on Red</td><td colspan="4">W ≥ 35; R ≥ 7</td><td>4</td></tr>
<tr><td>Black on White</td><td colspan="4">W ≥ 50</td><td>—</td></tr>
</table>

Notes:
[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°.
[2] For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs
[3] For text and fine symbol signs measuring less than 1200 mm (48 in)
[4] Minimum Sign Contrast Ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity)
* This sheeting type should not be used for this color for this application.

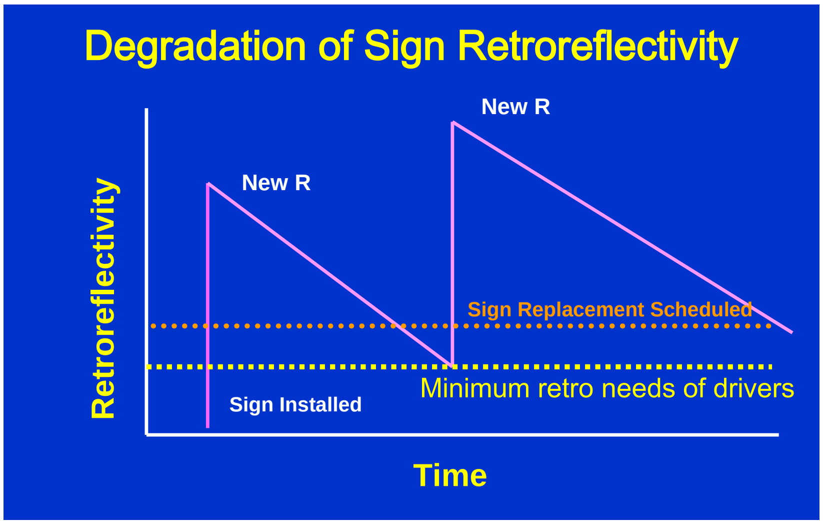
Agencies have until January 22, 2012 to implement a sign assessment or management method to comply with the new standard. The compliance date for regulatory, warning, and ground-mounted guide signs is January 22, 2015, while overhead guide signs have a January 22, 2018 compliance date.

Pierce County is the second most populated county in the state of Washington. It is located in the Puget Sound/Tacoma area south of Seattle and King County. Pierce County Public Works and Utilities is responsible for over 1,500 centerline miles of county roads. At the time of this analysis, the County road system had a total 24,530 traffic signs, of which there were 2,967 Stop and Yield signs, 6,761 warning signs, 3,117 Speed Limit signs, and 8,345 street name signs.

The Pierce County Traffic Division initiated this analysis in 2007 as a means of assessing the overall existing condition of its traffic signs using the new recommended minimum retroreflectivity values as a baseline, and to guide its on-going purchasing and sign sheeting selection decisions when ordering replacement stock. County staff wanted to ensure that any new signs that were being used to replace vandalized signs, as well as any new signs being added to the road system, would have a long-lasting cost effective life cycle as defined by the new retroreflectivity minimums, rather than having their retroreflectivity values dip below the minimums in a relatively short period of time.

Figure 1 graphically represents the desired goal of recognizing the normal degradation process of a traffic sign and replacing it before its retroreflectivity dips below the minimum retroreflectivity needs of drivers. Replacing the sign too soon, while being compliant with the MUTCD, widens the gap between the sign replacement line and the minimum retro driver need line on the graph. Narrowing that gap between the two lines maximizes life cycle costs and valuable resources, as viewed through effective asset management.

Figure 1 – Sign Replacement Due to Retroreflectivity



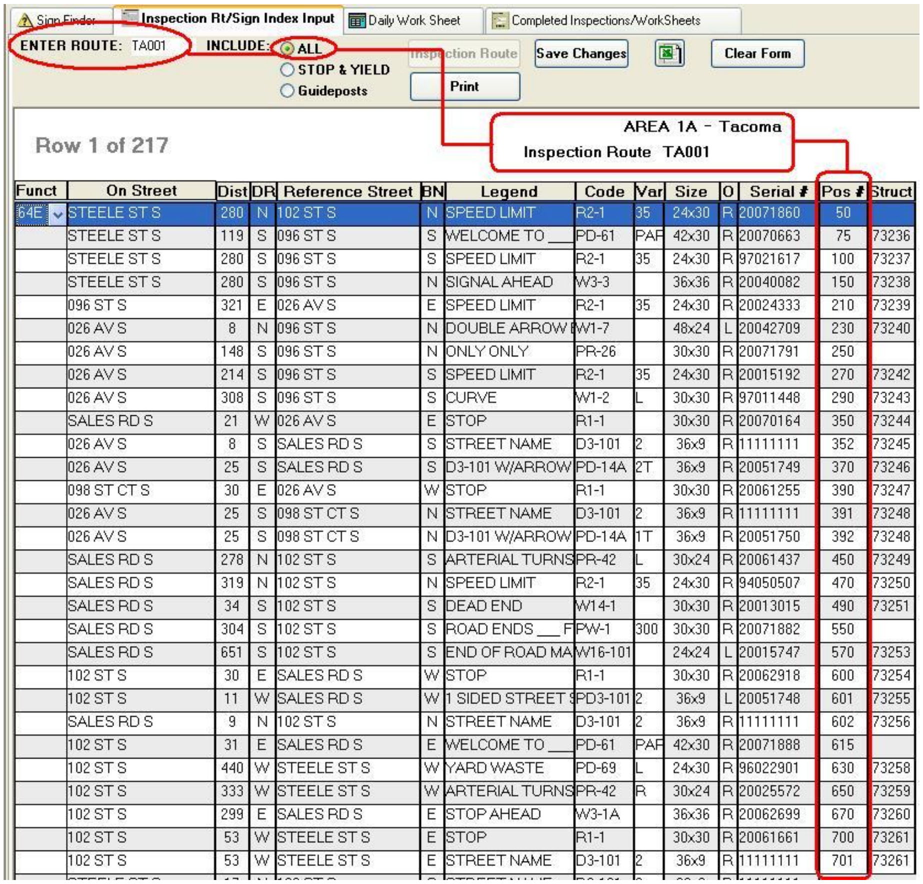
Ultimately, this analysis sought to answer these questions: Which assessment or management method is best for the County? What is the best way to optimize use of the available labor, equipment, and materials, (i.e., managing its assets), to comply with the new MUTCD rule? The County's traffic sign inventory became a powerful tool that helped guide staff to the best answer for Pierce County.

THE PIERCE COUNTY SIGN INVENTORY

The Pierce County traffic sign inventory, initiated in the mid-1980s, was developed on the premise it would be used as a primary foundation and driver for sign maintenance activities. In addition to providing important location and sign type information, the inventory also grouped signs into individual sign inspection routes that could be driven by the sign technician in a most efficient manner to minimize driving time and backtracking. To make this possible, a unique identifier was assigned for each sign in the inventory using its sign inspection route number and its designated position number along that route.

Under this system, all of the signs on a particular inspection route can easily be printed out (or viewed on a laptop computer screen) in the sequence that the sign technician will view them in the field, which facilitates the assigning of the work as well as the documentation of the actual work in the field. All signs in the county are inspected during regular working hours on a routine, periodic basis, which is particularly effective due to the notable amount of vandalism that occurs. Stop and Yield signs are inspected on more frequent intervals. Figure 2 shows an example of a sign inspection route listed in the sequence in which the sign technician will view and document the inspection, and if necessary, any needed repairs.

Figure 2 – Traffic Sign Inspection Route



Funct	On Street	Dist	DR	Reference Street	BN	Legend	Code	Var	Size	O	Serial #	Pos #	Struct
64E	STEELE ST S	280	N	102 ST S	N	SPEED LIMIT	R2-1	35	24x30	R	20071860	50	
	STEELE ST S	119	S	096 ST S	S	WELCOME TO ___	PD-61	PAR	42x30	R	20070663	75	73236
	STEELE ST S	280	S	096 ST S	S	SPEED LIMIT	R2-1	35	24x30	R	97021617	100	73237
	STEELE ST S	280	S	096 ST S	N	SIGNAL AHEAD	W3-3		36x36	R	20040082	150	73238
	096 ST S	321	E	026 AV S	E	SPEED LIMIT	R2-1	35	24x30	R	20024333	210	73239
	026 AV S	8	N	096 ST S	N	DOUBLE ARROW	W1-7		48x24	L	20042709	230	73240
	026 AV S	148	S	096 ST S	N	ONLY ONLY	PR-26		30x30	R	20071791	250	
	026 AV S	214	S	096 ST S	S	SPEED LIMIT	R2-1	35	24x30	R	20015192	270	73242
	026 AV S	308	S	096 ST S	S	CURVE	W1-2	L	30x30	R	97011448	290	73243
	SALES RD S	21	W	026 AV S	E	STOP	R1-1		30x30	R	20070164	350	73244
	026 AV S	8	S	SALES RD S	S	STREET NAME	D3-101	2	36x9	R	11111111	352	73245
	026 AV S	25	S	SALES RD S	S	D3-101 W/ARROW	PD-14A	2T	36x9	R	20051749	370	73246
	098 ST CT S	30	E	026 AV S	W	STOP	R1-1		30x30	R	20061255	390	73247
	026 AV S	25	S	098 ST CT S	N	STREET NAME	D3-101	2	36x9	R	11111111	391	73248
	026 AV S	25	S	098 ST CT S	N	D3-101 W/ARROW	PD-14A	1T	36x9	R	20051750	392	73248
	SALES RD S	278	N	102 ST S	S	ARTERIAL TURNS	PR-42	L	30x24	R	20061437	450	73249
	SALES RD S	319	N	102 ST S	N	SPEED LIMIT	R2-1	35	24x30	R	94050507	470	73250
	SALES RD S	34	S	102 ST S	S	DEAD END	W14-1		30x30	R	20013015	490	73251
	SALES RD S	304	S	102 ST S	S	ROAD ENDS ___ F	PW-1	300	30x30	R	20071882	550	
	SALES RD S	651	S	102 ST S	S	END OF ROAD MA	W16-101		24x24	L	20015747	570	73253
	102 ST S	30	E	SALES RD S	W	STOP	R1-1		30x30	R	20062918	600	73254
	102 ST S	11	W	SALES RD S	W	1 SIDED STREET S	PD3-101	2	36x9	L	20051748	601	73255
	SALES RD S	9	N	102 ST S	N	STREET NAME	D3-101	2	36x9	R	11111111	602	73256
	102 ST S	31	E	SALES RD S	E	WELCOME TO ___	PD-61	PAR	42x30	R	20071888	615	
	102 ST S	440	W	STEELE ST S	W	YARD WASTE	PD-69	L	24x30	R	96022901	630	73258
	102 ST S	333	W	STEELE ST S	W	ARTERIAL TURNS	PR-42	R	30x24	R	20025572	650	73259
	102 ST S	299	E	SALES RD S	E	STOP AHEAD	W3-1A		36x36	R	20062699	670	73260
	102 ST S	53	W	STEELE ST S	E	STOP	R1-1		30x30	R	20061661	700	73261
	102 ST S	53	W	STEELE ST S	E	STREET NAME	D3-101	2	36x9	R	11111111	701	73261

METHOD A: VISUAL NIGHTTIME INSPECTION

With the County's sign inventory built to facilitate sign inspections, use of the Visual Nighttime Inspection method was considered. Its possible implementation, however, raised several points of discussion:

- Adequately training the inspectors for nighttime assessments
- Assignment of overtime, shift differential, or a combination
- Use of two person sign crews at night instead of one person crews during the day

- Inspecting the signs at night and returning during the day to repair (i.e., two trips) versus repairing during the daytime inspection (i.e., one trip).
- Would the nighttime inspections result in more signs being replaced even though they might be comfortably above the minimum levels?

A sample of older signs that were replaced through daytime inspections were assembled in the sign shop yard for viewing by the sign technicians at night so that they could begin to become familiar with lower sign retroreflectivity levels (see Figure 3). Although the County did not implement the Visual Nighttime Inspection, its sign technicians do respond on a 24/7 on-call basis for Stop and Yield sign concerns, and do visually note the retroreflectivity of the signs they see at night while responding on these calls.

Figure 3 – Older Signs Assembled in Sign Maintenance Shop Yard

Figure 4 – Retroreflectivity Measurements

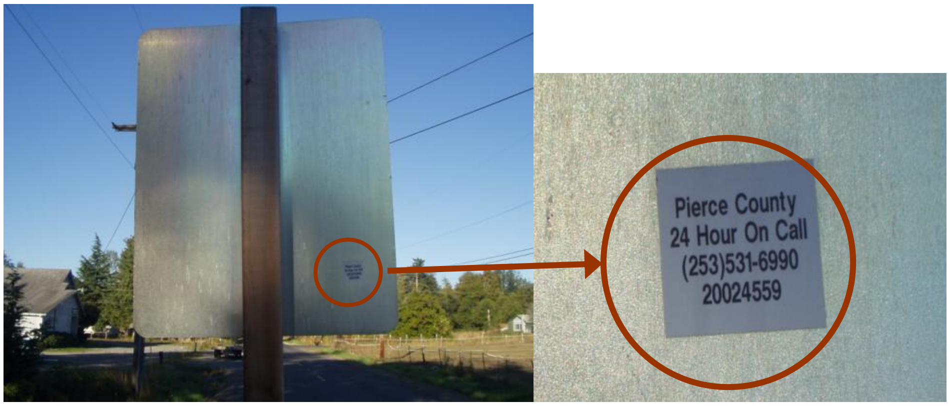
METHOD B: MEASURED RETROREFLECTIVITY

The County purchased a hand-held sign retroreflectometer to conduct spot measurements of selected signs, and most importantly, to gain a sense of what the minimum values in Table 2A-3 represent for actual signs in the field. It is also used to monitor and test new signs that are purchased rather than fabricated in-house. Implementation of the Measured Retroreflectivity method was possible with the purchase of the retroreflectometer and being able to arrange for each sign to be visited and measured via the sign inspection routes. However, considering how labor-intensive it would be, this method was not seriously considered.

METHOD C: EXPECTED LIFE

As a part of the County's sign inventory system, each sign is also typically tagged with a unique serial number, as shown on Figure 5. The County's ownership and a phone number that can be used to report a sign that has been knocked down or stolen is also incorporated into the layout of the tag. The first few digits of the serial number are used to designate the year in which the sign was fabricated, as a means of date stamping. For example, the sign shown in Figure 5 was fabricated in 2002.

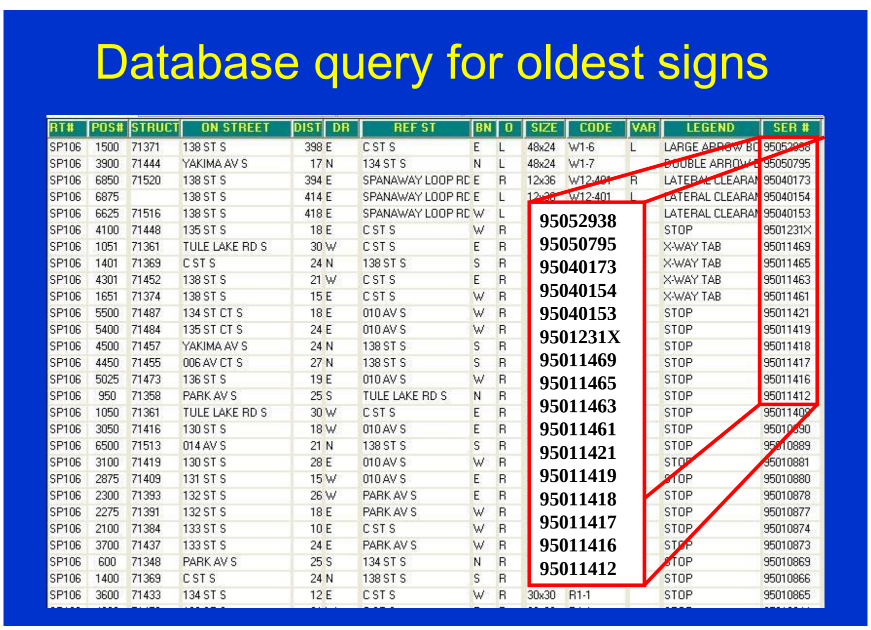
Figure 5 – Serial Number Tagging and Date Stamping



The serial number is particularly useful when a sign is stolen and then dumped along the roadside away from its original location. Upon finding the dumped sign, a responding sign technician can easily query the inventory database by inputting the serial number, viewing the inventory information, and then promptly reinstalling it at its proper location.

From a maintenance management perspective, the database can also be easily queried to develop a list of the oldest signs being used in the field. Figure 6 shows an example of a list of signs fabricated in 1995 and still in use.

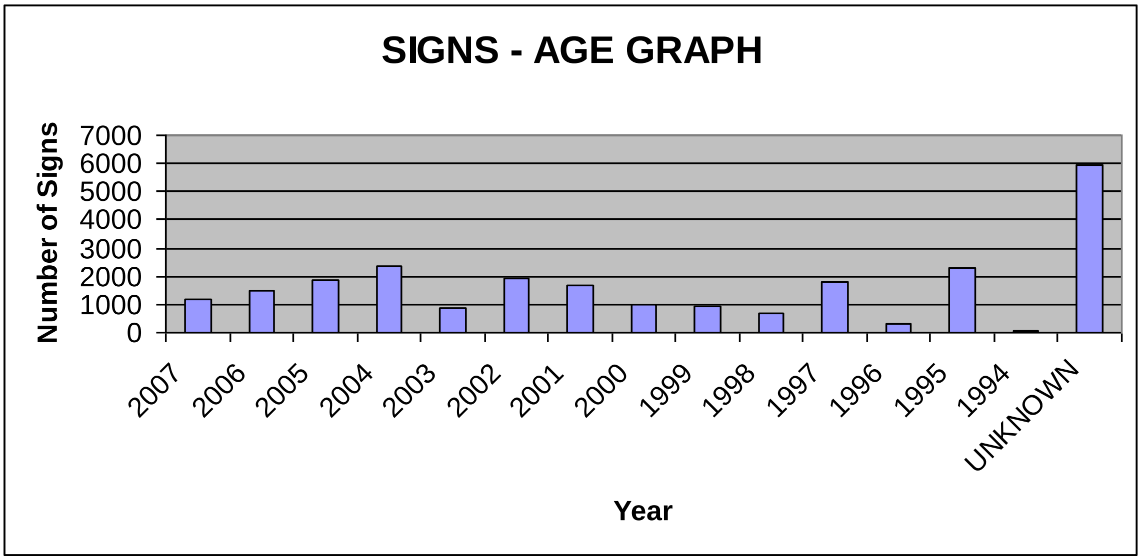
Figure 6 – Database Query Results Using Sign Serial Numbers



RT#	POS#	STRUCT	ON STREET	DIST	DR	REF ST	BN	O	SIZE	CODE	VAR	LEGEND	SER #
SP106	1500	71371	138 ST S	398	E	C ST S	E	L	48x24	W1-6	L	LARGE ARROW BD	[illegible]
SP106	3900	71444	YAKIMA AV S	17	N	134 ST S	N	L	48x24	W1-7		DOUBLE ARROW B	95050795
SP106	6850	71520	138 ST S	394	E	SPANAWAY LOOP RD	E	R	12x36	W12-401	R	LATERAL CLEARAN	95040173
SP106	6875		138 ST S	414	E	SPANAWAY LOOP RD	E	L	12x36	W12-401	L	LATERAL CLEARAN	95040154
SP106	6625	71516	138 ST S	418	E	SPANAWAY LOOP RD	W	L				LATERAL CLEARAN	95040153
SP106	4100	71448	135 ST S	18	E	C ST S	W	R				STOP	9501231X
SP106	1051	71361	TULE LAKE RD S	30	W	C ST S	E	R				X-WAY TAB	95011469
SP106	1401	71369	C ST S	24	N	138 ST S	S	R				X-WAY TAB	95011465
SP106	4301	71452	138 ST S	21	W	C ST S	E	R				X-WAY TAB	95011463
SP106	1651	71374	138 ST S	15	E	C ST S	W	R				X-WAY TAB	95011461
SP106	5500	71487	134 ST CT S	18	E	010 AV S	W	R				STOP	95011421
SP106	5400	71484	135 ST CT S	24	E	010 AV S	W	R				STOP	95011419
SP106	4500	71457	YAKIMA AV S	24	N	138 ST S	S	R				STOP	95011418
SP106	4450	71455	006 AV CT S	27	N	138 ST S	S	R				STOP	95011417
SP106	5025	71473	136 ST S	19	E	010 AV S	W	R				STOP	95011416
SP106	950	71358	PARK AV S	25	S	TULE LAKE RD S	N	R				STOP	95011412
SP106	1050	71361	TULE LAKE RD S	30	W	C ST S	E	R				STOP	95011409
SP106	3050	71416	130 ST S	18	W	010 AV S	E	R				STOP	95010890
SP106	6500	71513	014 AV S	21	N	138 ST S	S	R				STOP	95010889
SP106	3100	71419	130 ST S	28	E	010 AV S	W	R				STOP	95010881
SP106	2875	71409	131 ST S	15	W	010 AV S	E	R				STOP	95010880
SP106	2300	71393	132 ST S	26	W	PARK AV S	E	R				STOP	95010878
SP106	2275	71391	132 ST S	18	E	PARK AV S	W	R				STOP	95010877
SP106	2100	71384	133 ST S	10	E	C ST S	W	R				STOP	95010874
SP106	3700	71437	133 ST S	24	E	PARK AV S	W	R				STOP	95010873
SP106	600	71348	PARK AV S	25	S	134 ST S	N	R				STOP	95010869
SP106	1400	71369	C ST S	24	N	138 ST S	S	R				STOP	95010866
SP106	3600	71433	134 ST S	12	E	C ST S	W	R	30x30	R1-1		STOP	95010865

The date stamping feature within the serial numbering provides the opportunity to implement the Expected Life method. In fact, prior to the MUTCD rule on retroreflectivity, the County utilized this process to replace its oldest signs, albeit in the absence of any detailed support data other than being aware of the sign sheeting warranty and using subjective visual observations. Figure 7 illustrates the age of the County's traffic signs. The oldest group of signs dates back to 1995, when the County initiated its first sheeting upgrade, from Engineer grade to high intensity, for Stop, Yield, and Do Not Enter signs.

Figure 7 – Active Pierce County Signs Grouped By Year of Fabrication



The large number of signs in the "Unknown" age group represent double-sided street name signs. The County was reluctant to place serial number tags on the sign face due to aesthetics, possible driver distraction, and possibly encouraging unauthorized placing of stickers by others.

Initial retroreflectivity measurements of the County's oldest signs indicated that many signs still had adequate retroreflectivity levels past their warranty. It was decided to identify a representative group of the oldest signs of each color type and conduct additional measurements.

METHOD E: CONTROL SIGNS

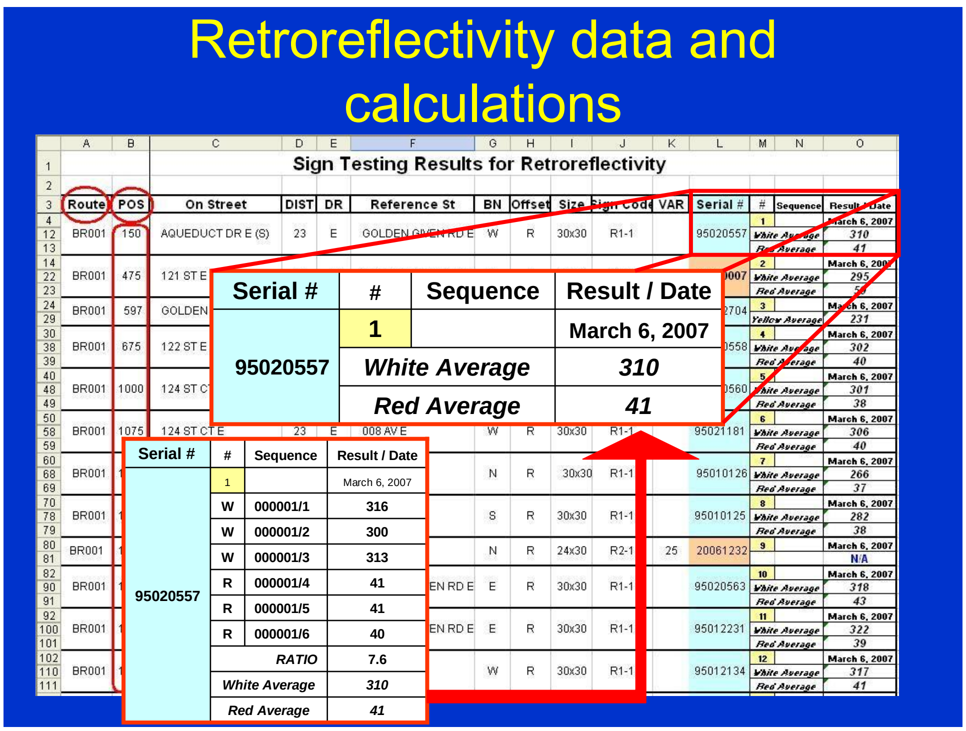
A subset of the oldest group of each color type (Red-series, Yellow/Warning, Black/Regulatory, Green/Street Name) was identified for individual retroreflectivity measurements. In addition to their age and color, the signs were selected based on their proximity to each other (to minimize driving time), their area of the county, and their directional orientation (a variety of north, south, east, west exposures). For example, a four-way stop intersection of two arterials having older signs provided the opportunity to measure several signs with various orientations all within a short distance of each other (e.g., Stop, All-Way, Street Name, Speed Limit, Stop Ahead, etc.).

Table 2 - Number of Control Signs Tested

Red Series	Year: 1995	Stop, Yield, Do Not Enter	106 signs
Black on Yellow	Years: 1995-97	Warning (W-series)	116 signs
Black on White	Years: 1995-97	Speed Limit	39 signs
White on Green	(various years)	Street Name, Directional Guide	50 signs

Using the sign inventory, the control signs were listed by their sign inspection route and position number, thereby creating a route for the sign technician to travel in the most efficient manner when collecting the retroreflectivity measurements. The collected data was then brought back to the maintenance office, where it was entered into a spreadsheet to compute and summarize the measurements. An example is shown in Figure 8.

Figure 8 – Summary of Retroreflectivity Measurements For an Active 1995 STOP Sign



In addition to computing averages of the measurements for each color, the contrast ratio of the White average to the Red average was also calculated for Stop, Yield, and Do Not Enter signs. Similar computations were also conducted for the retroreflectivity data collected for the Yellow/Warning, White/Speed Limit, and Green/Street Name sign control groups.

The results of the control sign measurements are summarized for each control group in Tables 3, 4, and 5. The range of retroreflectivity values for each color are shown with respect to the recommended MUTCD Table 2A-3 minimums.

As shown in Tables 3 and 4, Type III high intensity Red-series and Yellow/Warning signs at or past their warranty periods had retroreflectivity levels comfortably above the minimums. These ten to 12 year old signs appear to have noticeable remaining service life and justify continued monitoring through annual retroreflectivity measurements.

Table 4 shows that ten to 12 year old Type I Engineer grade Speed Limit signs were still noticeably above the minimums. However, Table 5 indicates that Type I Engineer grade street name and guide signs should be replaced, consistent with the MUTCD recommendations.

Table 3 – Control Sign Measurements – Range of Values (cd/lux/m^2)
Red Series (Stop, Yield, Do Not Enter) High Intensity

	Minimum	Maximum	MUTCD Minimum
Red measurements	20	59	7
White measurements	258	325	35
Contrast ratio (W/R)	5:1	9:1	3:1

Table 4 – Control Sign Measurements – Range of Values (cd/lux/m^2)
Black on Yellow (Warning W-series) High Intensity
Black on White (Speed Limit) Engineer Grade

	Minimum	Maximum	MUTCD Minimum
Black on Yellow measurements	117	248	50 (bold or > 48” 75 (fine or < 48”
Black on White measurements	74	111	50

Table 5 – Control Sign Measurements – Range of Values (cd/lux/m^2)
White on Green (Street Name, Destination Guide)

	Color	Minimum	Maximum	MUTCD Minimum
Screen on High Intensity measurements	White Green	194 44	332 63	120 15
Green EC film on High Intensity measurements	White Green	277 52	327 59	120 15
White Engineer on Green Engineer measurements	White Green	70 15	101 18	Not recommended 7
Screened on Engineer Measurements	White Green	44 5	114 24	Not recommended 7

SELECTED ASSESSMENT/MANAGEMENT METHOD

Ultimately, the County selected an approach to assess the retroreflectivity of its signs using elements of Measured Retroreflectivity (measuring using a retroreflectometer), Expected Life (tracking sign age), and primarily, the Control Signs method. The MUTCD describes the Control Signs method as such: "Replacement of signs in the field is based on the performance of a sample of control signs….. The control signs are monitored to determine the end of the retroreflective life for the associated signs. All field signs represented by the control sample should be replaced before the retroreflectivity levels of the control sample reach the minimum levels."

Although not considered by this analysis, Method D, Blanket Replacement, is yet another option, particularly for agencies that may not have a traffic sign inventory. Under this method, all signs in an area or corridor, or signs of a specific type, are replaced at specific intervals based on the expected life of the sheeting. It is not necessary to track individual signs.

A benefit of having the five different alternative methods is that it provides each responsible agency with the flexibility to determine which method is best suited for its own available resources and in-house expertise in order to comply with the new guidelines. For Pierce County, staff found that by using its sign inventory, it was possible to implement any of the methods, but that the Control Signs method as augmented by retroreflectivity measurements and sign age was the best fit and most efficient and cost effective approach for the agency.

This is not to say that the County's approach can guarantee that every sign in the field has a maintained retroreflectivity level above the minimums at all times. In fact, arguably, none of the assessment or management methods can ensure this. Rather, it is important to note that the MUTCD states, *"Compliance… is achieved by having a method in place and using the method to maintain the minimum levels established in Table 2A-3… even if there are some individual signs that do not meet the minimum retroreflectivity levels at a particular point in time."*

FINDINGS

- Replacing signs at the end of their warranty period may result in discarding signs significantly before the end of their useful life. The County analysis found:
    - ✓ 12-Year old Type III high intensity Stop and Yield signs were above the recommended retroreflectivity minimums.
    - ✓ 10 to 12-year old Type III high intensity Yellow/Warning signs were well above the minimums.
    - ✓ 10 to 12-year old Type I Engineer grade Speed Limit signs were above minimums.

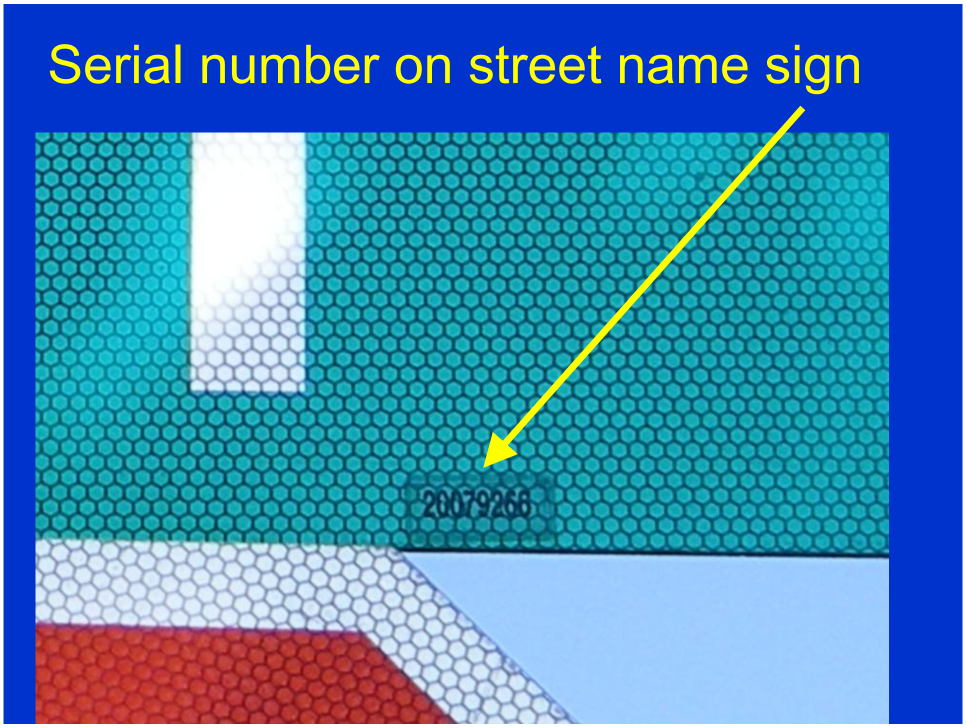
It should be noted that the above results reflect Pierce County conditions only, which can be characterized as having a moderate, temperate climate compared to many other parts of the country or even other parts of Washington state. Useful retroreflectivity life and sign performance could certainly be expected to vary under more extreme ranges of temperature, humidity, and exposure to sun and ultraviolet rays.

- Type III or IV high intensity sheeting appears to be a logical choice for ground-mounted street name or directional guide signs.
  - ✓ Type I Engineer grade white on green signs do not comply with the new retroreflectivity guidelines and should be scheduled for replacement.
  - ✓ There was no appreciable difference in meeting the minimums using either of the County's two fabrication methods: Screened White on Green high intensity, or Applying Green EC film over a White high intensity sign blank.

- Selection of the Control Signs method using in-field sample groups was efficient when combined with the County's sign inventory program.
  - ✓ The oldest signs in the field were easily identified and monitored through the formation of control sign groups by using date-stamped serial numbers.
  - ✓ Use of established sign inspection routes provided measuring efficiencies by minimizing driving time and facilitating the scheduling and documentation of the work.
  - ✓ Using a two-person crew, as many as 100 signs a day could be measured.
  - ✓ A follow-up statistical analysis concluded that increasing the control sample sizes to approximately 150 signs per control group could further enhance the reliability of the data up to a 95% confidence level.

- Based on the analysis results, the County is able to set its first priorities in complying with the MUTCD sign retroreflectivity guidelines.
  - ✓ All new ground-mounted street name and guide signs will utilize Type III or IV sheeting, and existing Type I Engineer grade ground-mounted street name and guide signs will be scheduled for replacement.
  - ✓ The importance of having date-stamped serial numbers on all signs was underscored by the analysis. Serial number tags are now being placed on street name sign faces by printing the number on a clear material, applying it to the white high intensity face of the sign, and then covering it with green EC film.

Figure 9 – Application of Date-Stamped Serial Number Tag for Street Name Sign Fabricated in 2007 (Magnified View)



The street name sign shown in the above figure is shown mounted above a STOP sign on the same post.

ACKNOWLEDGMENTS

The author is indebted to Thomas G. Ballard, P.E., who developed the original Pierce County traffic sign inventory system that has withstood the test of time and continues to be such a valuable and effective cornerstone of the County's sign maintenance and management program, once again proven now by its application to the retroreflectivity guidelines some 22 years later. Special thanks to the dedicated traffic sign technicians of Pierce County, their supervisors Rick Butner and Steve Martin, and spreadsheet marvel Patricia James, for their expertise, suggestions, ideas, guidance, and enthusiasm for making this program a success.

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