

Highway Safety Group  
By, Chad Dornsife  
October 20, 2010

**Re: WSDOT Solar Powered Centerline Delineation Test**  
Oso, WA • SR 530 • 2.25 mile segment • MP 32.75 to 35.00

### Post Installation Synopsis Looking Forward

#### Advantages and Observations:

1 A single string of internally illuminated raised, flush or subsurface markers can successfully convey unique bi directional advanced guidance for passing and no passing exclusion zones as well as the nature of the changing terrain and curves ahead, illuminated studs only in Figure 1;



Figure 1: WSDOT - SR 530 – 900 plus feet of no passing zone with undulating terrain; Astucia flush studs milled-in subsurface on 40' centers

2 Improved and sustainable night and adverse weather guidance (fog, rain, ice, skiff of snow etc) when traction materials are present because these studs rely on internal illumination rather than retroreflectivity; and

3 Guidance is maintained during winter months regardless of the condition of the painted markings and they're fully compatible with snow removal operations.

4 The goal for flush studs is to maintain consistent year-around enhanced guidance for the life cycle of the pavement (asphalt 7 years). We're also exploring methodologies to accommodate periodic chip seal operations.

5. Conspicuity and pattern densities. In the UK Astucia set their luminance to 1 candela to provide clear guidance without distraction taking into consideration their pattern densities and spacing. Except for spacing guidance pattern same as WSDOT.



Figure 2: Astucia - clear guidance without distraction.



Figure 3: Brand X - too much luminance and distracting patterns.

**Centerline Intervals:**

*Exclusion Zones (double line)*  
UK 15' (4.5m) (single marker)  
Caltrans 24' (double markers)  
WSDOT 40' (single marker)

*Passing Zones (broken line)*  
20'(curves) to 30' (6-9m) (single)  
48' (single)  
80' (single)



Figure 4;6: Astucia 1 candela white and amber stud conspicuity comparison



WSDOT spacing is MUTCD based but in adverse weather zones (fog etc) a closer spacing regime may be warranted, Additionally, because of our greater spacing and the conspicuity differences between white and amber light, suggest Astucia explore increasing their amber stud's perceived conspicuity to be on par with their white counterparts for North American centerline applications. White studs are visible up to 900m.

## Installation:

Astucia in the UK has employed a waterless milling process that cuts the stud hole to-depth (2") in tarmac surfaces with no additional steps or handwork, which dramatically reduces secondary labor, support equipment and fixant requirements.

A purpose-equipped crew of 3 for temperate zones or 4 for snow zones (milling) would average 2 plus miles a day even with live traffic. Mother supply truck with trailer for 2 purpose modified golf carts\* and the pavement miller for steel bit snowplow zones. Temperate and rubber bit snowplow zones do not need to be milled. \*easy to maneuver and transport platforms

Traffic control additional as required.

Special installation considerations: Astucia flush studs were designed for temperate or snow zones with rubber bit snowplows. The stud optics are only 4mm (0.15") above road surface (Figures 5;6), thereby maintaining site distance and conspicuity while making them impervious to dynamic forces.

In this instance SR 530 is in a snow zone where steel snowplow bits may be used during extreme storms. Therefore we subsurface mounted the studs with 6mm deep milled slots to maintain sight distances.



Figure 7: Milled-in Astucia flush stud

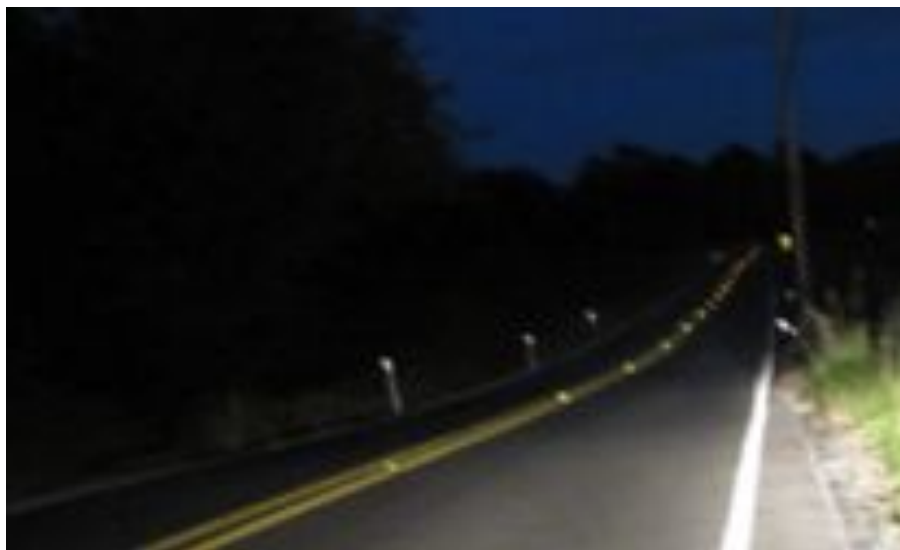


Figure 8: Astucia flush studs milled-in between double yellow lines

Regardless of the depth of the mill we set the top of the stud 1/8 inch below the road surface to maintain continuity in sight distance, we then filled in around the stud (not shown) to protect it and the edges of the holes. With the production configuration this QC would all be done in one pass/step.

### **WSDOT SR 530 Press Coverage:**

WSDOT solar stud press coverage, installation and site photos



Figure 9: Link to Seattle King 5 News Coverage of installation<sup>1</sup>

WSDOT - 2010 - Solar-powered road reflectors may light the way for future safety improvements.<sup>23</sup>

Roads & Bridges: WSDOT to test solar-powered road reflectors<sup>4</sup>

YouTube<sup>5</sup> installation, technology and visibility demonstrations.

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1 <http://www.king5.com/news/local/solar-road-reflectors-101200019.html>

2 [http://www.wsdot.wa.gov/News/2010/08/17\\_SR530SolarStuds.htm](http://www.wsdot.wa.gov/News/2010/08/17_SR530SolarStuds.htm)

3 <http://www.flickr.com/photos/wsdot/sets/72157624622258429/with/4901554539/>

4 <http://www.roadsbridges.com/index.cfm/fuseaction/showNewsItem/newsItemID/21340>

5 <http://www.youtube.com/user/SolarLites>

### **Current Practice and Contiguous SR 530 Site Observations:**

On east end of the SR 530 test site current recessed RPM not visible/apparent in the rain etc and their subsurface mounting causes sight distances to be erratic and foreshortened.



Figure 10: Typical milled-in pavement marker on SR 530 east of test.

The grooves readily fill with water or debris from sanding etc. In weather events headlights reflect off surface of water, thereby eliminating their conspicuity altogether, or they become hidden from view by debris.

Figure 11 is a debilitating debris example, the reflective surface of the stud is well below the road surface and it takes considerable time after a weather event to clear them - again ineffective when needed most.



Figure 11: Caltrans – Highway 89 - studs covered for extended periods

When clear of debris or water the reflective surfaces are short lived, site distances are foreshortened, and despite their subsurface mounting they're only viable during good weather and require frequent replacement.



Figure 12: Caltrans – I5 Grapevine – effectiveness short lived

Adverse weather and conspicuity mitigation: Astucia's flush studs remain visible in rubber plow bit or a temperate zone because their internal light is located above the roadway surface and it has a 10 day power reserve. Having the light source above the pavement is always the best guidance solution if it can be accommodated.

When milled-in Astucia studs are still visible when covered with water and one tire pass clears the water from the shallow groove, and a few passes will clear debris enough to see the raised light source. In addition, Astucia's lenses are made of a material that is polished by tires.

Dynamic loading, high-speeds and lateral forces significantly foreshorten raised pavement marker service life. Likewise, SR 530 has significant truck traffic and the effects of dynamic loading cannot be overstated on these classifications of roadways. WSDOT has about 7,000 miles of roadway to maintain and even with a 2-year cycle, their striping crews have to work hard because of their short maintenance seasons to stay ahead of their 2 lane highway needs.

Universally 2 lane roadways with raised pavement markers begin to have failures within months, and by the time these low volume roads can be serviced again considerable numbers of the markers have been damaged or are missing (Figure 12); sometimes for significant distances or individually in ways that detract from their guidance except as a general centerline demarcation.



Figure 12: Typical 2 lane road missing markers and degradation

Dynamic loading and severe traffic mitigation - Regardless of dynamic loading, lateral forces on curves or wheel hop from the centerline rumble strips the Astucia stud's low profile design (.15 inch above; milled .125 below) is unaffected by these destructive forces. In heavy tire chain zones a .20 subsurface depth may be warranted.

**Considerations:**

On roadways with existing milled in raised pavement markers, replace a few segments with the Astucia solar surface mount studs thereby adding the advantages of the enhanced LED guidance. The improvement in conspicuity and advanced guidance would be readily apparent if a controlled installation-setting regime was also implemented.

Notwithstanding, Astucia's flush studs as used on the SR 530 provide optimum sight distances and consistency because the lens/light source is at or above the roadway, and not below the line of sight.



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