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Date:	September 7 , 2011	Refer to:	L1100202-v1
Subject:	Hybrid fabrication of ACB using black glass and oxidized polished stainless steel		
To:	SLC Group		
From:	Michael Smith		

Introduction

The 57deg louver surface, the bent apex, and the leading edge of the center plate determine the scattering of the Arm Cavity Baffle (ACB); the other surfaces provide the trapping of the light that reflects from the louver surface, but contribute less to the total scattering noise.
A hybrid structure for the ACB is proposed, in which the entire baffle is fabricated using oxidized polished stainless steel, with black glass inserts for the 57 deg louver surface and the center plate.

In the following, the scattered light displacement noise is calculated for three cases: 1) all oxidized polished stainless steel surfaces, 2) the hybrid structure as described above, and 3) another hybrid, in which the center plate is made of oxidized polished stainless steel.

All Oxidized Polished Stainless Steel ACB

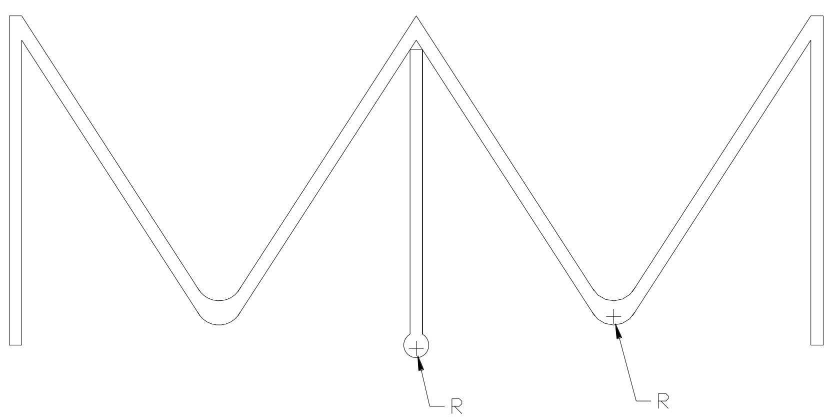

Figure 1: All Oxidized Polished Stainless Steel Surfaces, top View; Stray Light is Incident from Lower Side in this View

The measured BRDF for oxidized polished stainless steel as a function of the angle away from the specular direction is shown below.

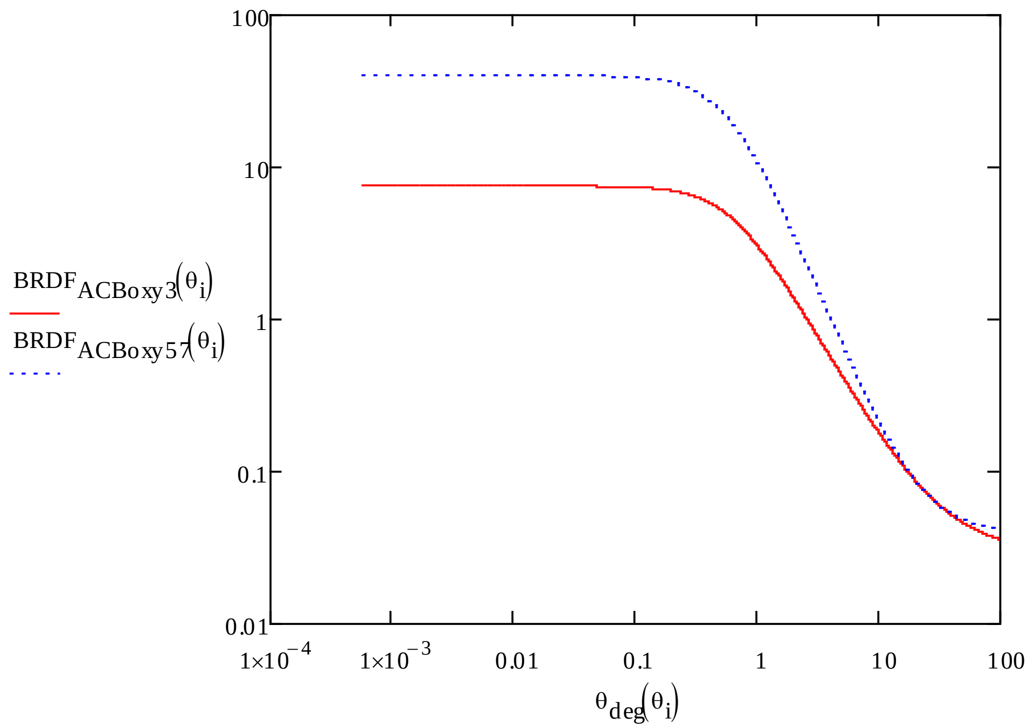

Figure 2: BRDF of Oxidized Polished Stainless Steel around the Specular Direction

The scattered light displacement noise is due to scattering from three areas of the ACB: 1) the leading edge of the vertical plate, 2) the frontal area of the bend region, and 3) the surface of the 57 deg louver. The scattering is a function of the radius of the bent surface and the leading edge, as well as the vertical tilt angle of the entire baffle assembly, which mitigates the specular reflection from the leading edge and the bend region.

The results of the scattered light calculation is shown below, with a 2mm radius on the leading edge and bent surface, as a function of vertical tilt angle of the baffle assembly.

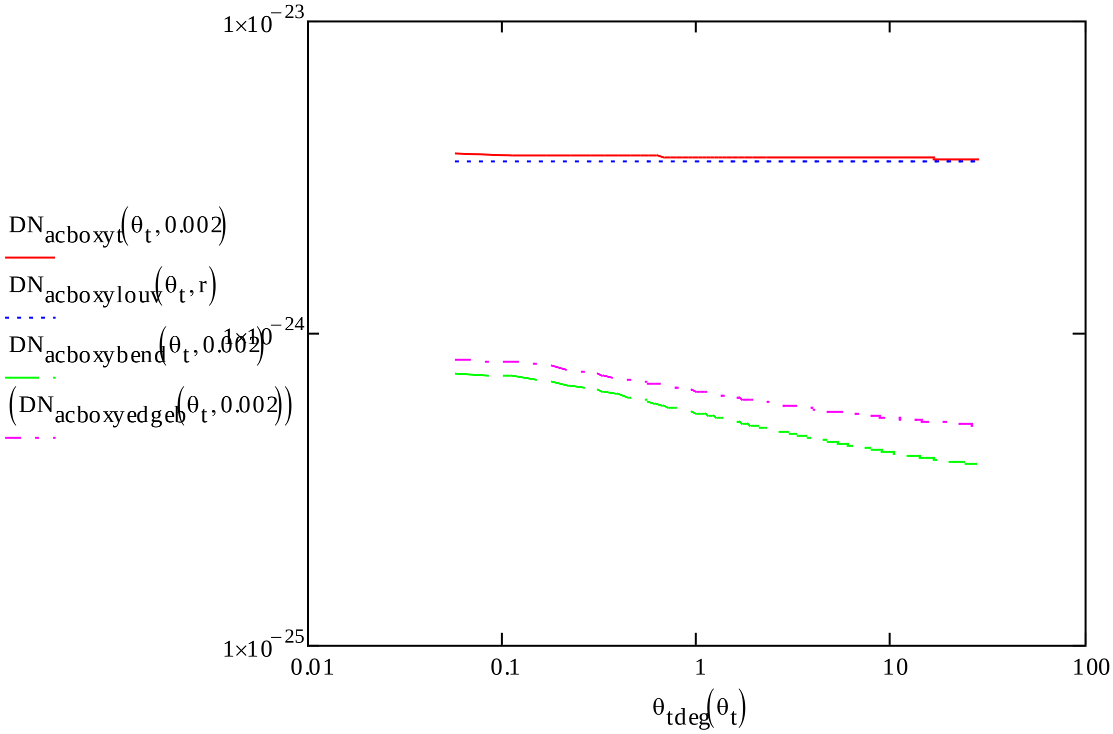

Figure 3: Scattered Light Displacement Noise for ACB, all Oxidized Polished Stainless Steel

The displacement noise is dominated by back-scatter from the large surface area of the louver portion of the baffle.

Hybrid Oxidized Polished Stainless Steel ACB with Black Glass Inserts

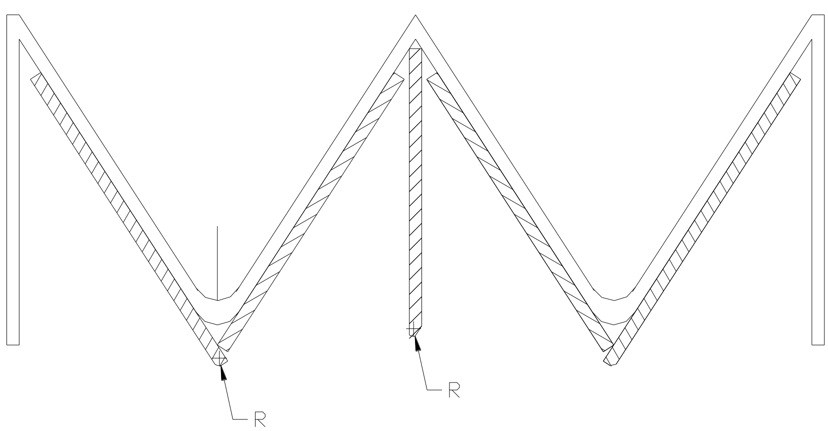

Figure 4: Hybrid Oxidized Polished Stainless Steel with Black Glass Plates, top View; Stray Light is Incident from Lower Side in this View

The BRDF for black glass as a function of the angle away from the specular direction has not been measured. However; the large angle BRDF was measured; it is 5E-6 sr^-1, and is constant beyond 5 degrees from incidence; the maximum BRDF at the specular reflection must lie between the value of a superpolished mirror, 1000, and that of porcelainized steel, approximately 40. We will assume the hypothetical BRDF curve as shown below for the calculations; in any case, the effect of the specular reflection is mitigated by tilting the baffle by 3 deg.

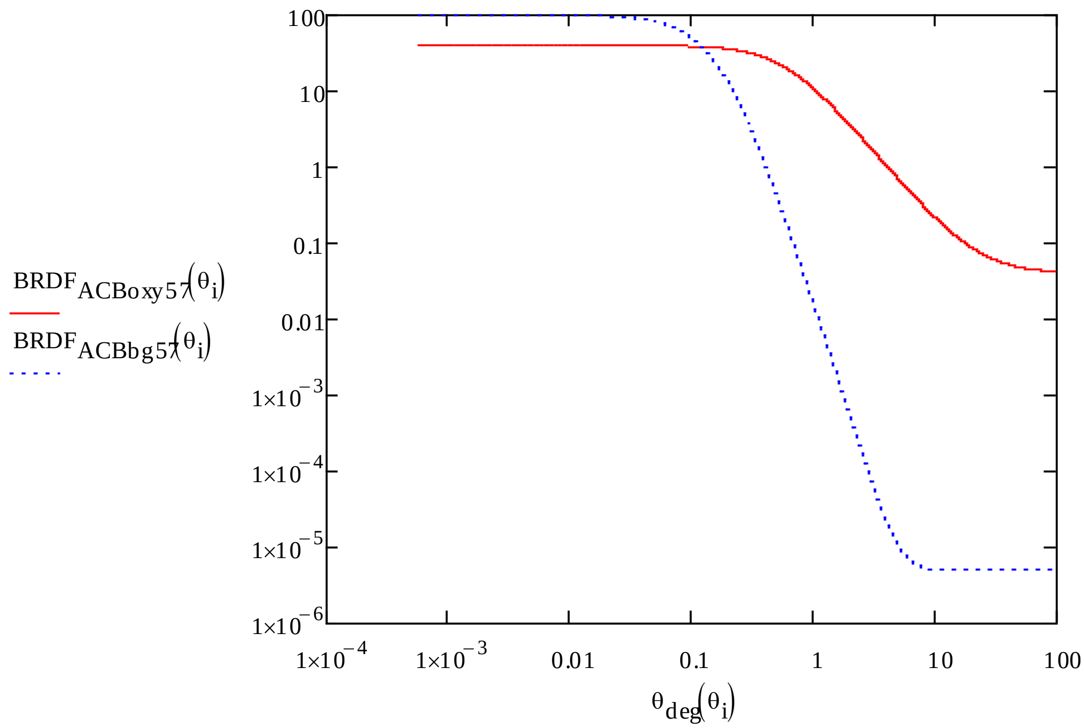

Figure 5: Hypothetical BRDF of Black Glass, compared with Oxidized Polished Stainless Steel around the Specular Direction

The results of the scattered light calculation are shown below.

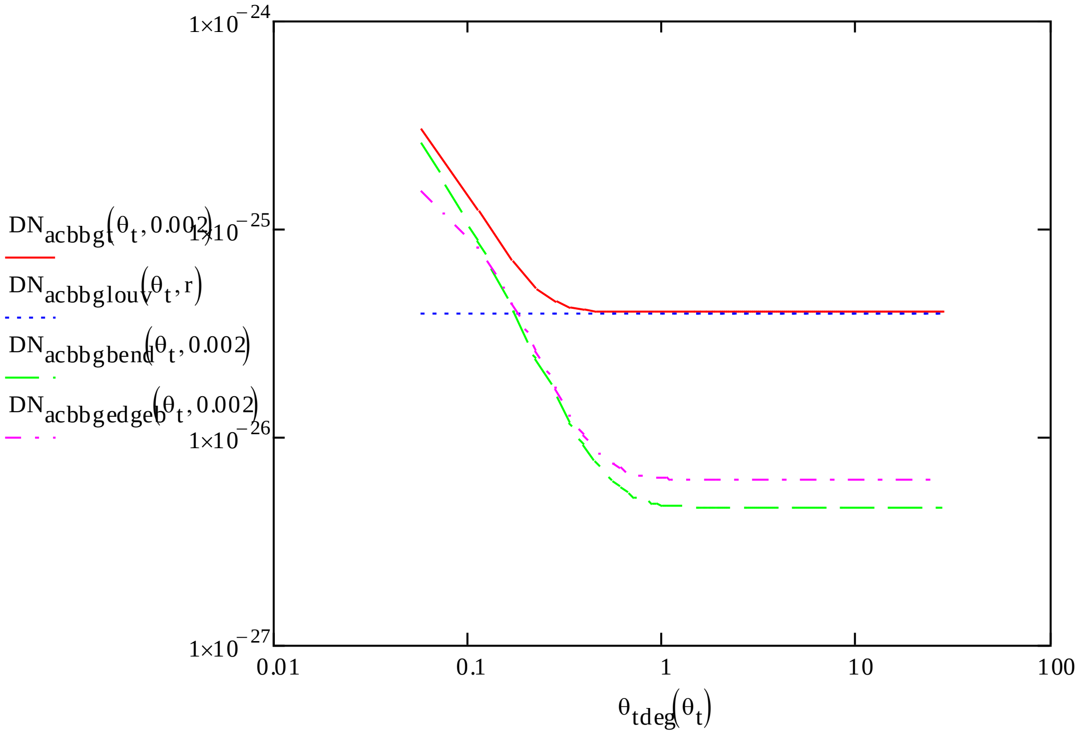

Figure 6: Scattered Light Displacement Noise for ACB, all Oxidized Polished Stainless Steel

The noise due to specular reflection from the bend and the leading edge of the plate is mitigated by tilting the baffle 3 deg; the resulting displacement noise is dominated by back-scatter from the large surface area of the louver portion of the baffle.

Hybrid Oxidized Polished Stainless Steel ACB Center Plate with Black Glass Louver

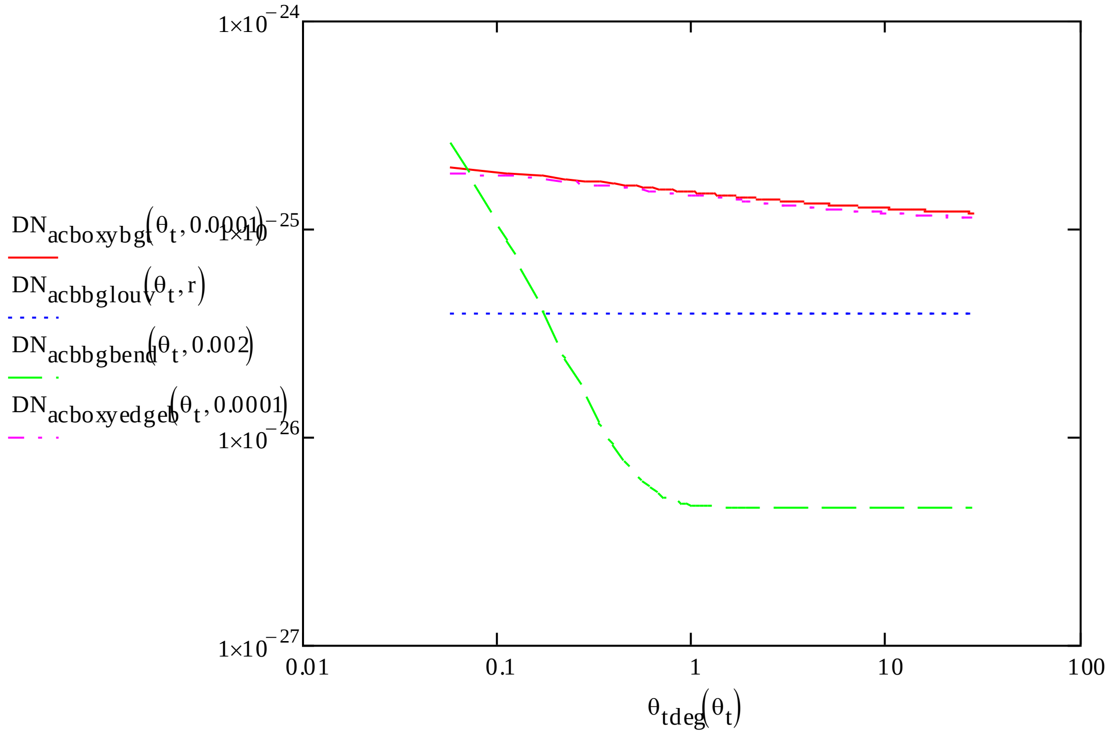

Figure 7: Scattered Light Displacement Noise for ACB, Oxidized Polished Stainless Steel Plate with Black Glass Louver

The oxidized polished stainless steel center plate leading edge dominates the scatter, and it must have a radius < 0.1 mm in order to approach the scattering noise from the black glass louver.

Summary of Scattered Light Displacement noise of ACB using Different Materials

A summary comparison of the scattering from the three construction cases described above are compared in the figure.

$\theta_t := 0, 0.001 .. 0.5$

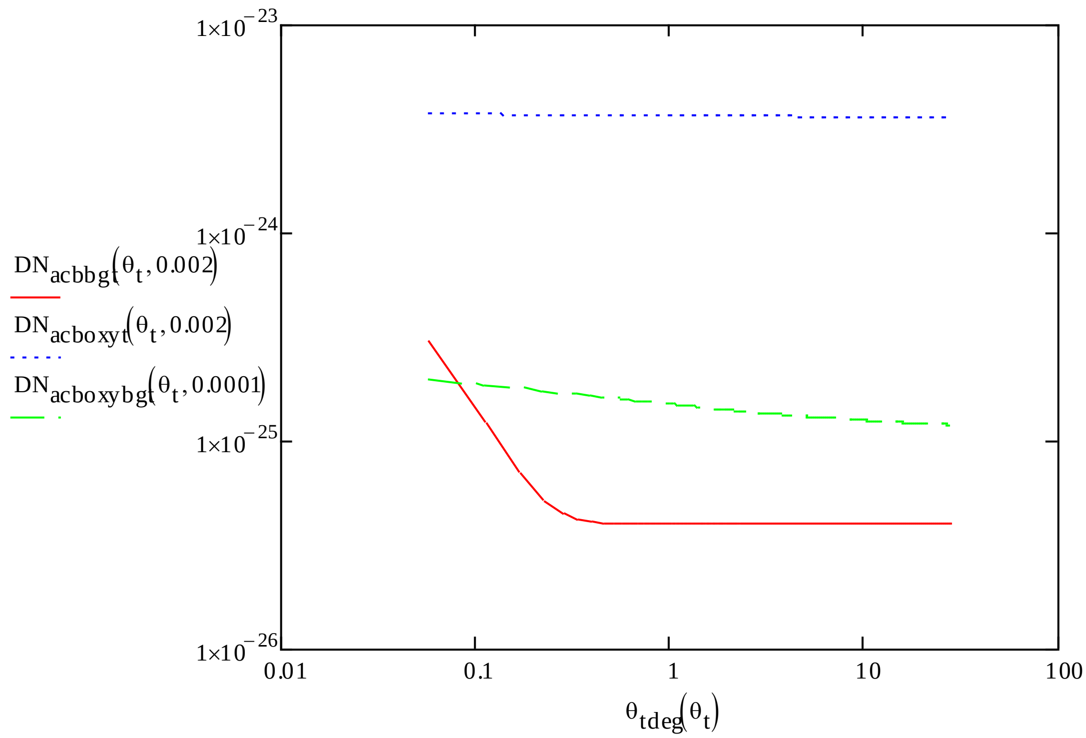

Figure 8: Comparison of Scattered Light Displacement Noise using various Materials for the ACB

Conclusion

It appears that a significant reduction of Scattered Light Displacement Noise from the ACB can be obtained by mounting black glass plates to the 57 deg louver surfaces. In addition, making the center plate from black glass will further reduce the scattered light noise.
The exposed edges of the black glass must either be polished to a bevel, or cut and then flame polished; the edge radius of the flame-polished black glass can be as large as a few mm.
If the center plate is made of oxidized polished stainless steel, the leading edge must be < 0.1 mm to approach the scattering level of the black glass louver plates.