

ExoTAC Report on Starshade S5 Milestone #7C Review

January 30, 2020

A telecon review of the Milestone #7C Final Report for the Starshade Technology to TRL 5 Activity (S5) was held on January 28, 2020. All of the ExoTAC members were able to participate in the telecon.

Milestone #7C requires demonstrating that the inner disk subsystem (IDS) with the critical deployment features can be reproducibly deployed and stowed with a full-scale test item, with the IDS deployed configuration achieving a total positional accuracy of +/- 300 microns. As Milestones #7A and #7B, which involve the Truss Bay, also contribute to the total positional accuracy, the goal for Milestones #7C and #7D combined is to achieve +/- 150 microns in the radial (random) direction and +/- 120 microns in the tangential (random) direction. Milestone #7D goes beyond #7C by requiring that this accuracy be achieved with all features attached to the IDS, not just the critical deployment features.

The full-scale test article, fabricated and tested at a private facility in Colorado, has 28 petals, a deployed diameter of 10.6 m, and a stowed diameter of 2.3 m, consistent with the WFIRST Starshade Rendezvous Mission (SRM) concept. Testing was done in air with the IDS suspended from the ceiling by a gravity offload system at 140 points on the IDS. The test article was constructed of carbon-fiber-reinforced-plastic (CFRP), with flight-like stiffness, and an aluminum center beam, though Invar will be used for the flight article. The structural hub was also made of aluminum, though CFRP will be used for flight. The optical shield was two Kapton layers with an intermediate foam separator with aluminum ribs. A laser tracker, with uncertainties between 3 and 30 microns, was used to measure the positional accuracy of the spherically mounted retroreflectors (SMR) located on the IDS at 34 petal interface points.

22 deployment cycles were tested, with stow states ranging from being nearly fully stowed (96%) to only about 8% stowed. The 3 sigma positional accuracies met the goal values, with +/- 121 microns in the radial (random) direction and +/- 91 microns in the tangential (random) direction. The radial bias error of +/- 26 microns also met the goal of +/- 35 microns, but showed a dependence on the ambient humidity. Milestone #7D will be pursued next, given the successful conclusion of #7C.

The ExoTAC agrees that Milestone #7C has been met and congratulates the entire team on their efforts to advance the technology readiness levels of the elements in the S5 activity. We suggest that the Milestone #7D testing should include full 100% stow testing, which would require installation of MGSE surrogate launch locks for holding the 100% stow starting point. We will look forward to learning about the results of the thermal cycling of the deployed Truss Bay assembly in Milestones #7A and #7B.

We thank Manan Arya, David Webb, Doug Lisman, Phil Willems, and the other S5 team members for their presentations and comments during the review.

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