



## Graphite Composite Panel Polishing Fixture

**Composite fixture eliminates problems that may be caused by those made from aluminum.**

*Goddard Space Flight Center, Greenbelt, Maryland*

The use of high-strength, lightweight composites for the fixture is the novel feature of this innovation. The main advantage is the light weight and high stiffness-to-mass ratio relative to aluminum.

Meter-class optics require support during the grinding/polishing process with large tools. The use of aluminum as a polishing fixture is standard, with pitch providing a compliant layer to allow support without deformation. Unfortunately, with meter-scale optics, a meter-scale fixture weighs over 120 lb ( $\approx 55$  kg) and may distort the optics being fabricated by loading the mirror and/or tool used in fabrication. The use of composite structures that are lightweight yet stiff allows standard techniques to be used while providing for a decrease in fixture weight by almost 70 percent.

Mounts classically used to support large mirrors during fabrication are especially heavy and difficult to handle. The mount must be especially stiff to avoid deformation during the optical fabrication process, where a very large and heavy lap often can distort the mount and optic being fabricated. If the optic is placed on top of the lapping tool, the weight of the optic and the fixture can distort the lap. Fixtures to support the mirror during fabrication are often very large plates of aluminum, often 2 in. ( $\approx 5$  cm) or more in thickness and weight upwards of 150 lb ( $\approx 68$  kg). With the addition of a backing material such as pitch and the mirror itself, the assembly can often weigh over 250 lb ( $\approx 113$  kg) for a meter-class optic.

This innovation is the use of a lightweight graphite panel with an aluminum honeycomb core for use as the polishing fixture. These materials have been used

in the aerospace industry as structural members due to their light weight and high stiffness. The grinding polishing fixture consists of the graphite composite panel, fittings, and fixtures to allow interface to the polishing machine, and introduction of pitch buttons to support the optic under fabrication. In its operation, the grinding polishing fixture acts as a reaction structure to the polishing tool. It must be stiff enough to avoid imparting a distorted shape to the optic under fabrication and light enough to avoid self-deflection. The fixture must also withstand significant tangential loads from the polishing machine during operations.

*This work was done by John Hagopian, Carl Strojny, and Jason Budinoff of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15911-1*

## Material Gradients in Oxygen System Components Improve Safety

*Lyndon B. Johnson Space Center, Houston, Texas*

Oxygen system components fabricated by Laser Engineered Net Shaping™ (LENS™) could result in improved safety and performance. LENS™ is a near-net shape manufacturing process fusing powdered materials injected into a laser beam. Parts can be fabricated with a variety of elemental metals, alloys, and nonmetallic materials without the use of a mold. The LENS™

process allows the injected materials to be varied throughout a single workpiece. Hence, surfaces exposed to oxygen could be constructed of an oxygen-compatible material while the remainder of the part could be one chosen for strength or reduced weight. Unlike conventional coating applications, a compositional gradient would exist between the two materials, so no abrupt

material boundary exists. Without an interface between dissimilar materials, there is less tendency for chipping or cracking associated with thermal-expansion mismatches.

*This work was done by Bradley S. Forsyth of Honeywell Technology Solutions, Inc., for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-23166-1*

## Ridge Waveguide Structures in Magnesium-Doped Lithium Niobate

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This work proposes to establish the feasibility of fabricating isolated ridge waveguides in 5% MgO:LN. Ridge waveguides in MgO:LN will significantly improve power handling and conversion ef-

iciency, increase photonic component integration, and be well suited to space-based applications. The key innovation in this effort is to combine recently available large, high-photorefractive-damage-

threshold, z-cut 5% MgO:LN with novel ridge fabrication techniques to achieve high-optical power, low-cost, high-volume manufacturing of frequency conversion structures. The proposed ridge