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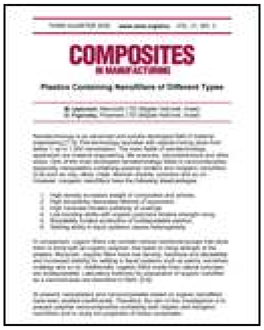

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COMPOSITES IN MANUFACTURING

Development of Elastic Memory Composite Stiffeners for a Flexible Precision Reflector

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Large, deployable, radio frequency (RF) reflector technologies can generally be categorized as either moderate-precision or high-precision technologies [1]. Moderate-precision reflectors typically involve mesh surface, lightweight designs and are capable of operating at frequencies up to 40 GHz [2]. High-precision reflectors typically involve solid-surface, higher-mass and more mechanically complex designs, but are capable of operating at frequencies in excess of 40 GHz. Unfortunately, there are currently no flight-qualified, large-aperture reflectors, capable of operating beyond 40 GHz, that are mechanically simple and cost effective. One advanced reflector concept that shows great promise, the flexible precision reflector (FPR), has been developed by the **Harris Corp.** (Melbourne, Fla.) under funding from NASA Langley Research Center. The FPR is a solid-surface, lightweight, mechanically simple design that is capable of operating at frequencies in excess of 40 GHz. A key component to this design could be a series of TEMBO® elastic memory composite (EMC) stiffeners.

Existing Moderate-Precision Deployable Reflectors

Mesh Reflectors. Mesh antennas have become the industry workhorse and are distinguished by the lightweight, pliable mesh making up the antenna reflective surface (*Figure 1*). This mesh surface has allowed the industry to develop highly mass-efficient deployable reflectors, which have been flown with much success. The compliancy of the mesh allows stowage in a small volume for launch and results in system designs with minimal stored strain energy and minimal resistance to deployment. Thus, mesh reflectors are typically known for their well-controlled, low-shock and highly predictable deployments. Drawbacks to these types of reflectors include limitations on deployed surface accuracy of the reflective mesh surface and the limited ability of the porous mesh surface to reflect RF communications at shorter wavelengths. This class of reflectors operates at or below 40 GHz.

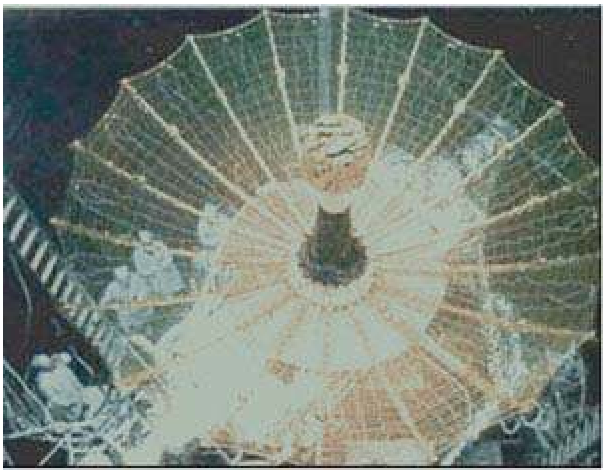


Figure 1. *Five meter TDRS mesh reflector (Photo courtesy Harris Corp.).*

Taco Shell Reflector. Another type of deployable moderate-precision reflector is the “SpringBack” or “Taco Shell” reflector (shown in *Figure 2*). The surface of this reflector is a thin, open-weave carbon-fiber/epoxy laminate that has a secondary lattice of ribs and struts that provide deployed stiffness and precision. For launch, the reflector is furled by pulling the opposite sides into a cylindrical shape, and then launch-restraint devices are used to constrain the strain energy of the system. Once on orbit, the launch restraints are released, allowing the system to self-deploy. The system is mechanically simple with no moving parts or assemblies. However, design limitations/drawbacks to this type of reflector include:

- A low packaging efficiency when compared to open-mesh reflector systems of comparable size
- Strain limitations of the composite laminates
- Deployment shock due to the sudden release of stored strain energy
- Sensitivity of the deployed shape to thermal stability of the materials

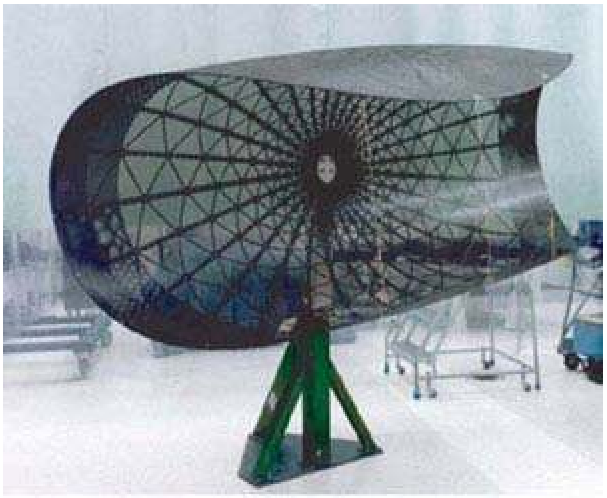


Figure 2. *TDRS-H "Taco Shell" reflector (Photo courtesy The Boeing Co.).*

Further, the reflector has minimal structural depth, which results in a relatively low deployed stiffness. To address this problem, Tan and Pellegrino have proposed the use of a circumferential collapsible stiffener around the outer perimeter of the reflector [3]. Preliminary studies have shown that a deployed perimeter stiffener would significantly increase the deployed stiffness and precision of the reflector, without an increase to the mechanical complexity of the system. However, little has been done to address many of the other drawbacks inherent to this reflector, therefore limiting the use of such a design.

Existing High-Precision Deployable Reflectors

High-precision deployable reflector designs utilize solid, low-loss, reflecting surfaces, which have been developed for high-frequency, high-data-rate RF signals. Typical solid-surface, high-precision deployable reflectors have been fabricated using a central hub that is surrounded by a series of deployable rigid "petals." Often, these petals are made of carbon-fiber face sheets over aluminum honeycomb core and are supported on a deployable metering structure [4]. Such reflectors require a high degree of mechanical complexity to stow and deploy to the required accuracy (*Figure 3*). Thermal distortions due to the coefficient of thermal expansion (CTE) of the reflector surface, and of the mechanical components used in the deployment of the reflector segments, create an additional complication to the system design.

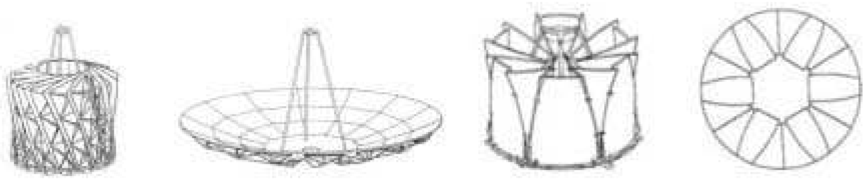


Figure 3. *High-precision reflector with rigid "petals" that form the reflector surface.*

The high complexity of these rigid-petal, deployable reflector concepts leads to an increased risk of component malfunction, as well as an increased cost for the design, assembly and testing required before launch of such a system. Thus, most high-precision, solid-surface reflectors that are flown are nondeployable designs.

Flexible Precision Reflector (FPR)

All existing antenna technologies have inherent weaknesses that limit either their aperture size or operational frequency capability. Thus, there is much interest in advancing deployable reflector technologies capable of large aperture and high-frequency operation [5]. To address this need, Harris Corp. has recently developed a novel concept called the flexible precision reflector, shown in *Figure 4* [6]. The FPR includes a thin-composite reflector surface that is furled in a pleated fashion, similar to the pleats in a coffee filter or an umbrella. The thin composite structure is deployed and constrained by a metering structure similar to the backup structures for mesh antennas.

Figure 4. *Harris Corp.'s flexible precision reflector (FPR).*

Very large-diameter versions of the FPR concept have been developed in which the reflector surface is divided into multiple circumferential "panels" that nest within one another during packaging (a two-panel reflector is shown in *Figure 4*). The key features of the FPR design are: (1) a very low areal-density design, (2) a very low packaged volume, (3) operational frequencies in excess of 40 GHz and (4) potential deployed diameters in excess of 25 m.

The FPR concept is able to attain high-operational frequency bands (in excess of 40 GHz) through the use of a solid reflective surface, which is not transparent to higher RF bands. Additionally, the solid FPR reflecting surface is a doubly curved parabolic shape that is held to a high level of deployed surface accuracy. To achieve the desired FPR system surface accuracy, Harris Corp. has determined the need to incorporate a series of integral, pop-out, circumferential stiffeners on the back of the reflector surface. Early analyses indicate that regions on the reflector membrane interfacing the pop-out stiffeners could be difficult to manufacture if conventional composite materials are used, due to strain limitations, and the possibility of creep (such as permanent set) in the launch package.

To address this problem, Harris Corp. requested that CTD develop designs for the FPR stiffeners that use TEMBO EMC materials, as they have been shown to accommodate much higher levels of packaging strain, without exhibiting creep, than traditional composites are capable of attaining [7].

The present program was based on a point design for a 25 m diameter FPR antenna that could be used as an Earth-Mars communications relay satellite for future NASA missions to Mars. This point design is for a high-precision, four-segmented, FPR antenna and defines design requirements for the reflector surface and stiffener elements, such as the deployed laminate modulus, in-plane laminate CTE, laminate thicknesses (affecting system mass and moments of inertia) and the cross-sectional geometry of the circumferential stiffeners.

Additionally, the point design includes a packaged geometry design, which identifies the minimum bend radius that the FPR membrane would need to achieve to meet the system packaging efficiency goals for this mission (see *Figure 5*). The results from this point design were used to motivate the work discussed herein. For instance, first-order stress and strain levels were calculated within the furled reflector by coupling the FPR laminate requirements and the predicted packaged geometry of the reflector. These stress and strain levels were then used as the design targets for the Breadboard reflector.

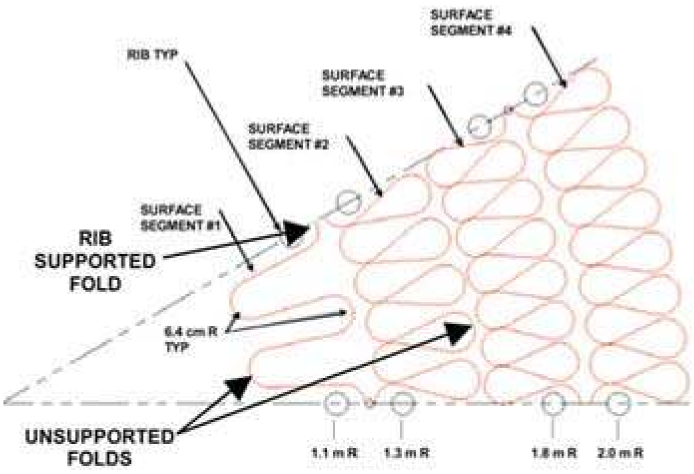


Figure 5. *Edge-on view of a furled, 25 m diameter, four-segmented FPR.*

Additionally, these values, along with the predicted thermal behaviors of the deployed reflector, drove the material selection and qualification effort.

Design of TEMBO EMC FPR

TEMBO EMC FPR Design Concept and Development Plan. TEMBO EMC materials exhibit many favorable qualities for deployable space structures. Of particular interest to Harris Corp. were the abilities of TEMBO EMC materials to attain high packaging strains without exhibiting creep and to control the release of packaging strain energy, and avoid high shock events at the end of deployment. Effectively, the goals of including TEMBO EMC materials within a FPR system are to contain the strain energy of the flexible reflector surface in the launch package, while enabling a substantial increase to the deployed stiffness and precision of the reflective surface.

Under the present program, CTD has developed a concept for incorporating TEMBO EMC materials into the FPR system. This concept was to manufacture the FPR circumferential stiffeners out of TEMBO EMC materials and to manufacture the reflector surface out of a traditional (such as non-EMC) composite material. This design was selected over an all-EMC design as it would require 60% less power during the reflector deployment (*Figure 6*).

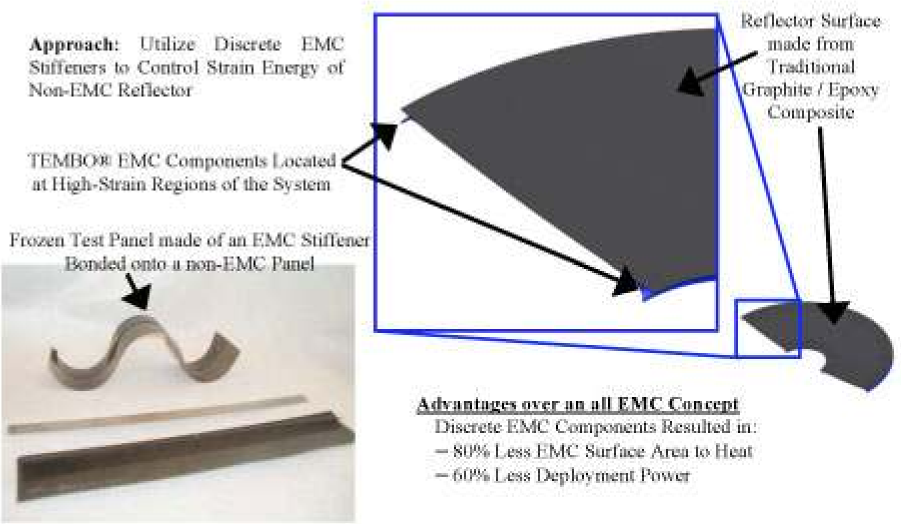


Figure 6. *TEMBO EMC FPR design concept.*

Preliminary analyses and coupon-level tests were performed to assess the increased strain capacity of the system, as well as the internal strain storage/damping made available from the discrete use of TEMBO materials. These early results indicated that a substantial increase would in fact be made to the upper strain threshold of the FPR laminates. Additionally, the use of TEMBO EMC materials for the circumferential stiffeners would provide ample strain-energy-storing capacity for internally restraining the furled FPR system, reducing the need for expensive launch lock devices and deployment dampers. Based on these findings, the proposed design concept was selected for further development. Subsequent efforts then focused on: the manufacture and testing of TEMBO EMC coupons for qualifying and validating concept feasibility, and designing, fabricating and testing a self-deploying 0.9 m foldable FPR Breadboard demonstration model with integral stiffeners made of TEMBO EMC materials.

Material Selection and Qualification

TEMBO Material Down-Select. Based on the requirements from the point design of the 25 m Earth-Mars FPR relay antenna, candidate TEMBO EMC materials were selected for coupon validation and qualification. These candidate systems were chosen from the existing array of TEMBO materials and selected based on the operational thermal environment that had been predicted in the point design and the need to minimize the actuation temperature, and thus power, required for deployment. The list of candidate TEMBO materials was further reduced by considering the modulus requirements of the deployed laminate. Finally, the remaining TEMBO systems were evaluated for minimum bend radius and strain energy storing capabilities (*Figure 7*).

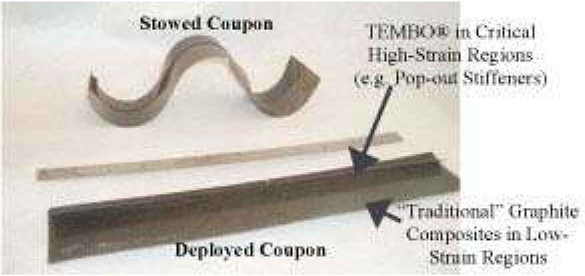


Figure 7. *Coupon validating strain energy storage of a TEMBO pop-out stiffener bonded onto a non-EMC flat panel.*

Although each system had previously accumulated such data, further testing was conducted to demonstrate direct traceability with potential FPR flight laminate architectures (for example, similar fiber orientations and number of plies).

Deployment Recovery. After the baseline stiffener material had been selected, deployment repeatability, or recovery of the shape of the reflector on deployment, was investigated. Initial deployment recovery testing was conducted at the coupon level.

To carry out these tests, three representative specimens were fabricated, and photogrammetry techniques were used to capture the initial, as-fabricated, shape of the specimens. Next, these specimens were bent and stored at a strain level and period of time traceable to the requirements defined by the 25 m FPR point design. Finally, the samples were recovered, and photogrammetry was again employed to capture shape changes indicative of creep exhibited by the specimens (see *Figure 8*).

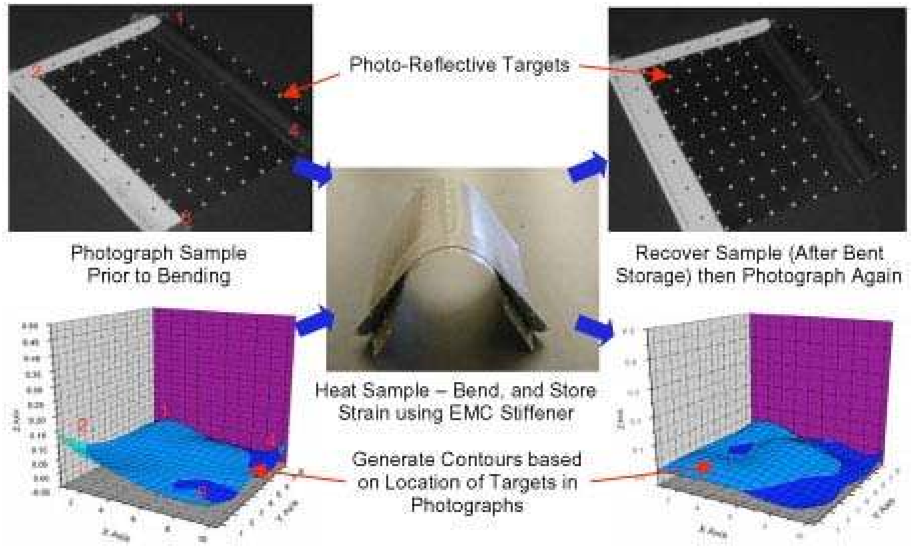


Figure 8. *Photogrammetry technique used to capture creep/deployment recovery data.*

Of the three samples fabricated, two were tested for material creep, while the third sample became a control. The control was bent and immediately recovered without spending significant storage time in the bent configuration.

Results from this series of tests can be seen in *Figure 9*. These tests were able to measure the shape, and hence deployment recovery of the samples, to a resolution of approximately 0.004 in. (0.0102 cm). All three of the flat samples were found to recover to a flatness equal to, or flatter than, the shape that had been generated from the initial images. Hence, no permanent “creep” or lack of recovery was resolved in these tests.

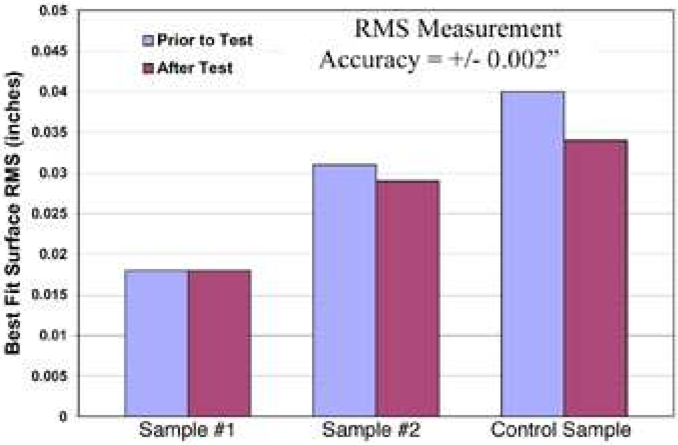
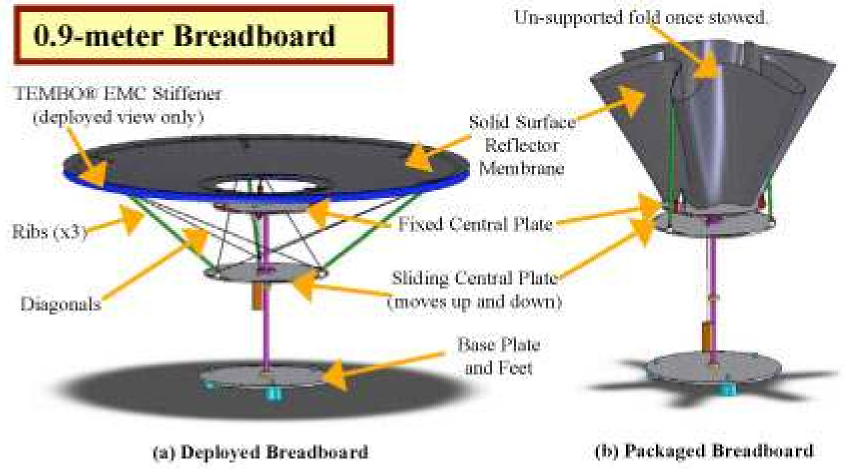


Figure 9. *Deployment recovery results from single-ply fabric, flat-panel, material-creep specimens.*

It was further concluded that thermal stresses were introduced in the system when the non-EMC composite flat panels were adhesively bonded to TEMBO EMC stiffeners. These thermal stresses were significant, as both components had originally been fabricated at different cure temperatures prior to the bonding process. Relaxation of these residual thermal stresses could attribute to the improvements witnessed in the flatness of each sample. This relaxation occurred as each sample underwent thermal cycling, which occurred during the bend and release of the test specimens, and thus reduced the RMS of the assembly.

Improvements to this test would be to minimize the residual thermal stresses induced within the assembly, fabricate test specimens with more inherent stiffness than single-ply flat panels (used in this test) and to improve the processing controls on the materials. However, the resolution of this test was sufficient for this point in the program, and future system-level testing, which was to be conducted to a higher fidelity, would capture the effects of folding and storing a doubly curved stiffener and reflector laminate.

0.9 m Breadboard Development. The next goal of the program was to design and fabricate a 0.9 m TEMBO FPR Breadboard technology demonstration model, and to perform packaging and deployment tests on this model to assess the performance of the TEMBO EMC stiffeners within the integrated FPR reflector system. *Figure 10* is a CAD image showing some of the key components within the Breadboard structure and defining nomenclature used in the following Breadboard discussion.



(a) Deployed Breadboard (b) Packaged Breadboard

Figure 10. *Important features from the 0.9 m Breadboard.*

Breadboard Reflector Design. Key design parameters from the full-scale flight system were identified so that design traceability between the 0.9 m Breadboard model and the 25 m, four-segmented, FPR point design could be maintained. Two key design parameters emerged as driving the design of the Breadboard model. They were:

1. Maintain packaging strain traceability (operating the Breadboard packaging strain equivalent to, or greater than, the strain levels expected in the flight system).
2. Demonstrate the ability of TEMBO stiffeners to control the packaging strain energy from a reflector stowed in a similar fashion as the 25 m point design. That packaging design has ribs, which stow vertically (to allow an efficient stowed envelope), and unsupported folds that do not have ribs attached (see flight packaging scheme in *Figure 5*).

With these parameters in mind, the 0.9 m Breadboard demonstration reflector was designed. Scaling of the FPR reflector was constrained by the use of full-thickness laminates for both the reflector and the TEMBO EMC stiffeners. The other key constraint was the use of existing circumferential stiffener tooling. This tooling had been fabricated under a separate program, and the geometry had not been optimized for shape memory performance. A twelve-fold (six inner fold and six outer fold) reflector packaging design was selected for the Breadboard (see *Figure 11*). This twelve-fold design achieves the packaging goal, as it allows for unsupported folds, similar to the 25 m flight version. *Table 1* compares some of the key dimensions and parameters of the Breadboard reflector and the 25 m point design.

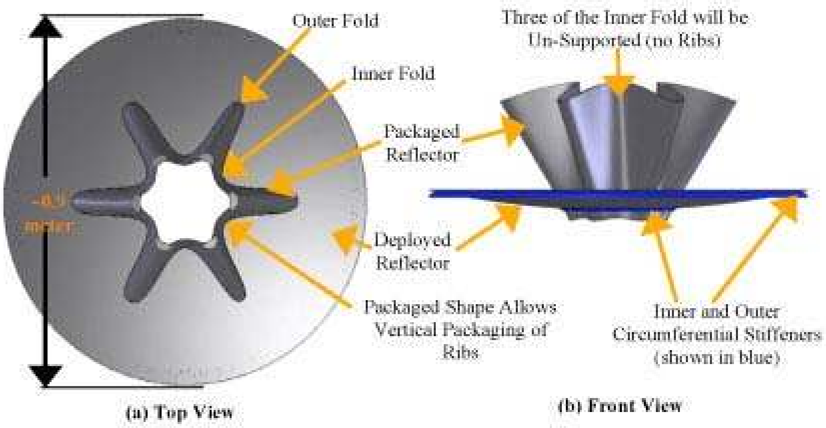


Figure 11. *Stowed image of Breadboard reflector superimposed on top of the deployed image.*

	Breadboard (0.9 m)	25 m FPR Point Design	Remarks
Circumferential bend radii	1.25 in. (3.2 cm)	2.5 in. (6.4 cm)	Breadboard minimum bend radius half that of flight (twice as aggressive)
Ratio of surface area reflector : stiffener	6 : 1	~13 : 1	Constrained by Breadboard tooling dimensions
Reflector thickness	0.006 in. (0.015 cm)	0.006 in. (0.015 cm)	One-ply of fabric (difficult to scale)
Stiffener thickness	0.012 in. (0.030 cm)	0.006 in. (0.015 cm)	TEMBO's high strain capability allows thicker laminates to be used for the stiffeners

Table 1. *Comparison of Breadboard reflector to 25 m flight reflector.*

Apparent in *Table 1* is the increase in stiffener laminate thickness afforded by the discrete use of TEMBO EMC materials. The geometric packaging requirements for the 25 m FPR point design had dictated that a minimum bend radius of 2.5 in. (6.4 cm) be used for the point design packaging scheme. This requirement, as well as the allowable strain (such as the strain where nil creep was expected) had limited the point design stiffener laminate thickness to 0.006 in. (0.015 cm). The inclusion of TEMBO EMC materials in the design of the FPR antenna has dramatically increased the allowable thickness at the critical juncture between the circumferential stiffener and reflective membrane. Raising this strain threshold allows for thicker, stiffer, circumferential stiffener laminates to be used, substantially improving the deployed stiffness and operational surface accuracy, of the FPR antenna.

Breadboard Backup Structure Design. In general, the function of the backup structure in the FPR system is to provide deployed depth (and hence stiffness) to the system, and also to provide a means for coordinating the deployment. However, one goal for the Breadboard was to demonstrate the capability of the TEMBO materials to control the deployment of the reflector in a coordinated fashion. Thus, it was decided to develop a very simple mechanical backup structure for the Breadboard (*Figure 12*). Essentially, the backup structure consists of a set of inner pivots that connect the inside edge of the reflector to a fixed central plate and a set of ribs that connect the outer edge of the reflector to a sliding central plate. During deployment, the sliding central plate slides down a central rod and allows the ribs to rotate outward as the reflector surface unfurls.

A key feature that was included in the mechanical design of the Breadboard backup structure was a gravity off-load device (seen in *Figure 12*). This feature prevented the weight from the sliding central plate and attached hardware from "pulling" the reflector out during deployment. By off-loading gravity, a more accurate assessment of EMC's deployment coordination capabilities was able to be made.

Breadboard Fabrication and Testing. After completing the system design, the next step was to fabricate the 0.9 m Breadboard model, and validate the concept through a modest test campaign, showing feasibility for larger flight systems. *Figure 13* shows a packaged and deployed image of the Breadboard that was fabricated, including the TEMBO EMC pop-out circumferential stiffeners, the non-EMC FPR reflector membrane and the mechanical backup structure.

(a) Packaged (b) Deployed

Figure 13. *The final, fabricated 0.9 m Breadboard model.*

One important system design challenge that was addressed as the Breadboard model was being built was the development of tooling and procedures for packaging of the reflector. The Breadboard packaging concept utilized the backup structure to locate folds and sequence the stowage of the reflector. Bend mandrels were used to control the radii of curvature at the inside of the bends. This packaging concept is potentially scalable to flight antennas, as a single degree-of-freedom Harris backup structure could be the mechanism used to coordinate the packaging of a flight reflector.

The testing goals for the Breadboard model were to investigate the shape recovery after storage (such as identify signs of creep at a system level), life cycle testing and to demonstrate the controlled storage and deployment of the FPR membrane strain energy via the TEMBO circumferential stiffeners. System creep testing was conducted by populating the Breadboard reflector with an array of retroreflective targets, and then using photogrammetry techniques to measure the surface shapes before and after packaging and deployment (*Figure 14*). During this test, the Breadboard was packaged and stored for 100 hr. The shapes of the reflector surface, before and after storage, were compared, and a difference contour plot was generated (*Figure 14*). This plot demonstrates no signs of the six-lobe undulations (six high regions and six low regions) that would have been apparent if the reflector had retained any of the packaged shape. Based on this plot, and a pre and post-test surface accuracy measurement of 0.013 in. (0.033 cm) and 0.014 in. (0.036 cm) root mean square (RMS), no detectable signs of creep were evident at the resolution level of this test.

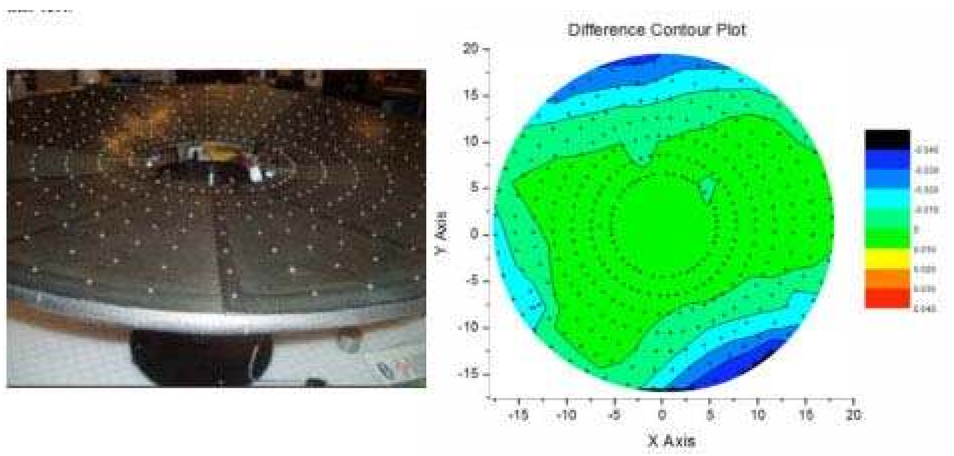


Figure 14. *Breadboard photogrammetry testing and results.*

Life cycle testing included eight successful packaging and deployment cycles. These tests were used to validate the material performance of a TEMBO FPR system, as well as to qualify the packaging concept under repeated use. Before and after each cycle, the reflector and stiffeners were visually inspected for damage. Additionally, the embedded heater wires were inspected for electrical continuity to identify any damage within the heaters. Upon completion of these tests, the existing packaging procedures and tools were deemed sufficient for repeatedly furling a TEMBO FPR without inducing damage into the materials. Additionally, these tests successfully demonstrate the ability of the TEMBO EMC to freeze the stored strain energy from an entire FPR system. During deployment, heating the stiffeners above the actuation temperature resulted in a gradual, controlled, deployment of the reflector, proving that TEMBO materials were capable of controlling the strain energy from the furled FPR system (see *Figure 15*).

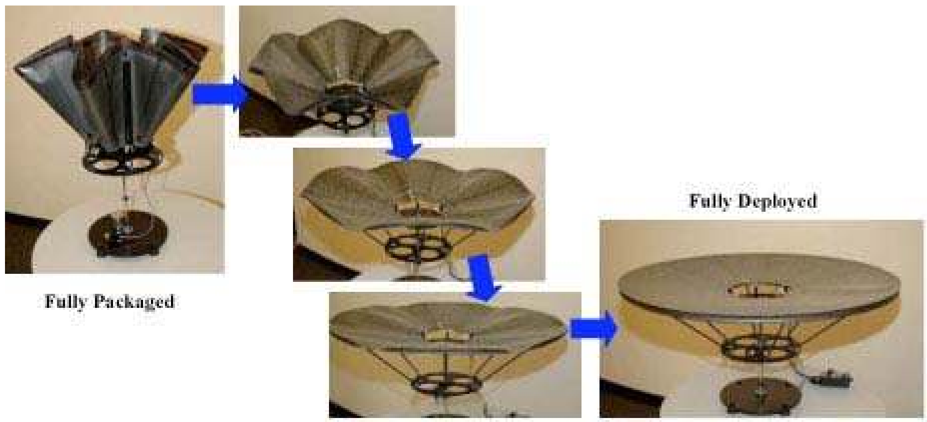


Figure 15. *Stages of Breadboard deployment.*

Conclusion

The flexible precision reflector (FPR) is an advanced antenna concept that has been developed by the Harris Corp., and is a solid-surface, lightweight, mechanically simple design that is capable of operating at frequencies in excess of 40 GHz. A key component to this design could be a series of TEMBO elastic memory composite (EMC) stiffeners that are designed to contain and control the release of the strain energy of the reflector surface during deployment, and provide stiffness to the deployed reflector surface. Under the present program, TEMBO EMC coupons were manufactured and tested to qualify a stiffener design. Additionally, a self-deploying 0.9 m foldable FPR Breadboard demonstration model with integral TEMBO EMC stiffeners was designed, fabricated and tested to prove system feasibility.

The preliminary material qualification process has identified a baseline TEMBO EMC system, which should be capable of meeting a future, potential, large-aperture, high-precision FPR requirements. Further, the 0.9 m Breadboard feasibility model successfully demonstrated the advantages of a TEMBO FPR system, providing a foundation from which future flight programs can build upon. Based on the success of the program, it is recommended that the development of a TEMBO FPR system be advanced to flight quality and scale. These developments should include refined deployment recovery testing, taking advantage of higher (flight) quality laminates and test specimens. Further, the manufacturing challenges associated with scaling to a larger system should be investigated. Technical challenges that must be addressed will include the incorporation of a Harris backup structure, optimizing the geometry of the circumferential stiffeners for shape memory performance and refining the packaging procedures to enable the furling of larger, segmented reflectors.

Acknowledgments

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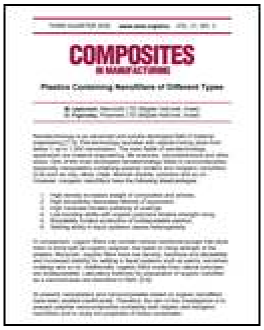

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NEWSLINE

Abrasive Grinding Wheel

A new, all-purpose flexible mesh abrasive wheel for the grinding and light standing of fiberglass tanks, vessels, hulls and composite structures has been introduced by **Rex-cut Products Inc.** (Fall River, Mass.). Sigma-Screen™ multipurpose discs are depressed-center Type 27 abrasive wheels that feature a blend of zirconia-ceramic abrasive grains bonded to a flexible mesh and come in coarse, medium, fine and very-fine grades. Ideal for grinding, blending and light sanding of fiberglass and composites, these mesh abrasive wheels are chatter free and will not clog. Faster and cooler on fiberglass than solid resin fiber discs, Sigma-Screen multipurpose discs are offered in test kits featuring two-each of coarse, medium-fine and very-fine to let fabricators evaluate them. These 4.5 in. (11.43 cm) diameter wheels can be stacked on a grinder for longer life. They are also effective for stainless steel, metals, aluminum and wood. The kit is priced at $18.74. Individual discs are $1.99 each, supplied in boxes of 10 or 50 discs, with quantity discounts available.

New Piezoelectric Composite Components

Morgan Electro Ceramics (Eindhoven, The Netherlands) introduces its new piezoelectric composites components. Components manufactured with piezocomposite materials offer improvements over traditional transducer materials, which result in increased acoustic performance for medical applications, including medical imaging and Doppler blood flow equipment. MEC's piezoelectric composite materials reduce the cross-coupling that typically occurs between different modes in the ceramic of conventional transducers, enabling medical components to respond in a more precise and predictable manner. Additionally, components manufactured with ME's piezoelectric composite materials reduce spurious activity, offering higher transmit and receive efficiency. Piezocomposite components also provide lower acoustic impedance and improved transducer bandwidth than that of conventional piezoelectric ceramics alone. MEC offers the piezoelectric composites in both 1-3 and 2-2 orientations, in sizes up to 1.5 in. sq (0.000968 m sq) and frequencies from 100 kHz to 12 MHz. In addition, piezoelectric volume fractions can be tailored for any application to enhance transmit and receive response rates.

Components Delivered for First Airbus A400M

EADS Socata (Tarbes, Frances) has delivered its subassemblies for the first Airbus A400M to representatives of the industrial partners of Airbus Military, EADS CASA and Airbus France. As part of the Component Design & Build Team for the Airbus A400M sponsons, the main landing gear fairings, EADS Socata has been involved in this European program from the preliminary study phase. The sponsons are two, 14 m fairs on either side of the preliminary study phase. The sponsons are two, 14 m fairings on either side of the fuselage housing the main landing gear of six sturdy wheels fitted with low-pressure tires specially designed for operating on short and rudimentary runways. The sponsons are of mixed construction, a metal frame covered with composite (hybrid glass/carbon and carbon) panels on the fore and aft parts, to both limit the weight of the structure and make it able to withstand the impact of projectiles thrown up from unmetalled runways. To comply with new safety regulations in the event of a burst tire, the central section has been redesigned with metal panels. Each sponson weighs around 900 kg. They are delivered to EADS CASA fully equipped with electric, hydraulic and fuel circuits installed. The four-nose landing gear doors are made of composite material (sandwich carbon fiber). They incorporate a hinging system developed by the design office, which allows weight reduction without lessening performance. Each door weighs 90 kg. They are delivered to Airbus France's St. Nazaire factory.

Commercially Available Smart Composite Structures

IPTRADE (Newton, Mass.) has completed the development phase of first commercially available smart composite structure. The design and manufacturing effort for the patent-pending smart composite lasted for 18 months and was successfully completed with the help of the company's manufacturing partner, ARC Technologies ( ). The smart composite structure incorporates multiple layers of piezoceramic (PZT) wafers, enabling it to be at once a high-fidelity strain sensor and a high-precision strain actuator. According to IPTRADE, key technological breakthroughs include full compatibility with commonly accepted manufacturing practices for glass/epoxy and graphite/epoxy composites. The primary uses of the smart composite are expected to be nondestructive testing (NDT) and structural health monitoring, as well as precision control of elastic vibration.

Owens Corning to Sell Composite Manufacturing Plants

Owens Corning (Toledo, Ohio) announced the planned sale of two glass-fiber reinforcement manufacturing facilities in Battice, Belgium, and Birkeland, Norway. The sale is intended to address regulatory concerns associated with the proposed formation of a joint venture between Saint-Gobain's Reinforcement and Composites business (a part of Saint-Gobain known as Vetrotex) and Owens Corning's Reinforcement business. Owens Corning also announced that the company is in active discussions with Saint-Gobain regarding the potential conversion of the proposed joint venture into an outright acquisition by Owens Corning of Saint-Gobain's Vetrotex business. Should such conversion occur, it is expected that the planned sale of the two manufacturing facilities would go forward to address regulatory concerns associated with the acquisition transaction.

Structural Parts Made by Laser Sintering

Besides the numerous nonstructural parts made by Windform XT that can be found in the Ilmore engine, the 2007 innovation project is a real turning point in the creation of racing engines. If this project is successful, the future of the engine and frame production will have the green light toward really new and interesting delivery times, costs and performances. The new challenge is the optimization of the camshaft cover for the newest Ilmor engine. The camshaft cover is the structural part that supports the bearing of the camshaft, directly applied on the four-stroke, 800 cc engine head. Inside there is also the lubricant oil. The average working temperature of this part is between 130°C and 140°C. The most critical aspects of the motorcycle engine camshaft cover are the centering and maintenance of its position on the seats and the oil capacity. Its performance is fundamental as far as the reduction of the weight, time and cost is concerned. This part is usually CNC machined or cast and then machined: its limit is the unquestionably long lead time. The aim is to extend plastic laser sintering technology and application to new components, combining it with traditional metals, which enables creating a composite sintering metal. The advantages of this new innovative method are principally the versatility and the speed, while its limits could be the mechanical characteristics of plastic that are inferior to some metallic alloys or to laminated carbon. Around a mainframe in metal-ceramic matrix (aluminum MMC0, a shell made by carbon-fiber-filled resin (Windform XT) was created. The shell is therefore the result of powder sintering using high-performing CRP-developed material, directly from a mathematic model in a few hours. The main areas of the part (camshaft seats) are made by a series of simple cutting and welding processes, while the prototype shell has the complex shape. The seats were realized in MMC (metal-matrix composites) to offer further weight savings, increased stiffness and exceptional strength and fatigue resistance. Windform XT is a versatile material that can be CNC machined directly from "HIPped" billets forged or formed by using extrusion or rolling techniques. Contact **CRP Technology** (Modena, Italy) to learn more.

Premium Pneumatic Cylinder Testing

BA Ultra is a premium pneumatic cylinder tubing that offers 300°F (149°C) operating temperature and a very low coefficient of thermal expansion. BA Ultra provides a smooth, self-lubricating wear surface that prevents pistons from sticking. BA Ultra can be used to replace honed and chromed steel, stainless steel and aluminum tubing with no additional machining required. For more information, contact **Amalga Composites Inc.** (West Allis, Wisc.).

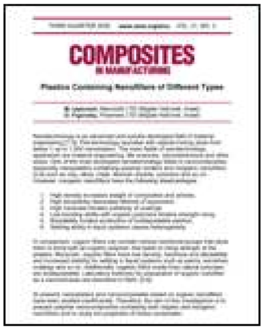
New Series of Pneumatic Nutrunners

Ingersoll Rand (Annandale, N.J.) has extended its nutrunner product line again to include the new AQ^ series pneumatic nutrunners. Engineered for industrial and assembly professionals, the AQ6 series has a torque range of 15 to 90 Nm and is ideal for critical fastening applications that require precise torque control. Like the AQ4 series, QA6 series nutrunners can be used on hard or soft joints, including plastics, composites or metals. The new nutrunners feature ergonomic grips that provide operators with greater comfort during periods of extended usage. Additionally, QA6 series nutrunners utilize externally adjustable shutoff clutches and conveniently located reverse rings for easier operation. The nutrunners have maximum torque outputs of 90 Nm and run off lube-free motors. They are easy to maintain and service, which means less downtime, and are fully customizable to the operator's application in both straight and angle configurations. The third and final addition to the QA family of nutrunners — the AQ8 nutrunner — is scheduled for release in late summer and will have a maximum torque output of 225 Nm.

Aloca Wins Prestigious R&D Award

A team of research scientists are engineers from **Alcoa** (Pittsburgh) has received an R&D 100 Award for the development of a new generation of aluminum-lithium alloys for the aerospace industry. The R&D 100 Awards are given annually in recognition of the world's most significant technological innovations. The award-winning product, aluminum alloy 2099, has characteristics that have played a pivotal role in helping the aerospace industry meet the increasingly stringent mission requirements for structural efficiency, weight reduction, sustainability and cost. Since its commercial arrival in 2006, aluminum alloy 2099 products are creating significant benefits for aerospace industry stakeholders, our environment and air travelers by enabling increased fuel efficiency and producing less CO_2 emissions; reducing the cost of ownership and use; and improving the durability, reliability and safety performance of aircraft. The commercialization of aluminum alloy 2099 required coordination between Alcoa's global technology organization and Alcoa's production facilities to meet aggressive customer timelines, demonstrating Alcoa's ability to take technology from the lab through operating plants to deliver a product to the customer.

COMPOSITES
IN MANUFACTURING



AUTHOR GUIDE

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CALENDAR OF EVENTS

CANCOM 2007
August 14-17, 2007 (Winnipeg, Manitoba, Canada)
Canadian Association for Composite Structures and Materials

The International Conference on Structural Analysis of Advanced Materials ICSAM 2007
September 2-6, 2007 (Patras, Greece)
The University of Patras

Nanocomposites 2007

September 5-7, 2007 (Las Vegas)
Executive Conference Management

7th Annual Automotive Composites Conference and Exhibition
September 11-13, 2007 (Troy, Mich.)
Society of Plastics Engineers

Materials Science & Technology 2007 Conference and Exhibition
September 16-20, 2007 (Detroit)
American Ceramic Society

GREAT LAKES 2007 Exposition & Conference
September 18-20, 2007 (Grand Rapids, Mich.)
SME Motorsports Charlotte
October 2-4, 2007 (Charlotte, N.C.)
Collaborate 2007
October 17-18, 2007 (Fort Worth, Texas)
Society of Manufacturing Engineers

Fibre Reinforced Composites Conference 2007
December 9-12, 2007 (Nelson Mandela Bay, South Africa)
Council for Scientific and Industrial Research

WESTEC 2008 Exposition & Conference
March 31-April 3, 2008 (Los Angeles)
Society of Manufacturing Engineers