Braided Composite Technologies for Rotorcraft Structures

To reduce weight, noise, and vibration

A&P Technology has developed a braided material approach for fabricating lightweight, high-strength hybrid gears for aerospace drive systems. The conventional metallic web was replaced with a composite element made from A&P's quasi-isotropic braid. The 0°, +/–60° braid architecture was chosen so that inplane stiffness properties and strength would be nearly equal in all directions.

The test results from the Phase I Small Spur Gear program demonstrated satisfactory endurance and strength while providing a 20 percent weight savings. (Greater weight savings is anticipated with structural optimization.) The hybrid gears were subjected to a proof-of-concept test of 1 billion cycles in a gearbox at 10,000 revolutions per minute and 490 in-lb torque with no detectable damage to the gears. After this test the maximum torque capability was also tested, and the static strength capability of the gears was 7x the maximum operating condition. Additional proof-of-concept tests are in progress using a higher oil temperature, and a loss-of-oil test is planned.

The success of Phase I led to a Phase II program to develop, fabricate, and optimize full-scale gears, specifically Bull Gears. The design of these Bull Gears will be refined using topology optimization, and the full-scale Bull Gears will be tested in a full-scale gear rig. The testing will quantify benefits of weight savings, as well as noise and vibration reduction. The expectation is that vibration and noise will be reduced through the introduction of composite material in the vibration transmission path between the contacting gear teeth and the shaft-and-bearing system.

Applications

NASA

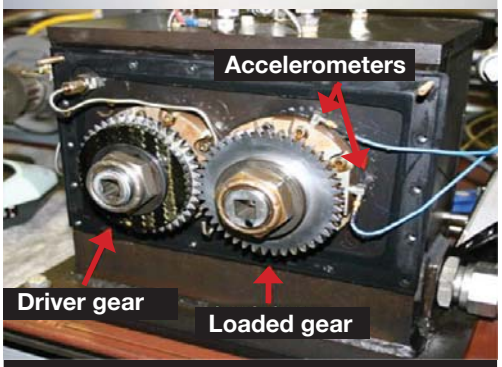
- Rotorcraft systems

Commercial

This technology could be applied to gears across many consumer industries, including:

- Aviation
- Industrial
- Automotive

A&P Technology photos



Phase II Objectives

- Determine operating conditions for a gear in a rotorcraft gearbox
- Develop, fabricate, and optimize full-scale composite/metal hybrid gears for full-scale validation testing
- Evolve analytical tools to enable design optimization

Benefits

- Decreased weight in rotorcraft gearboxes
- Reduced noise and vibration

Firm Contact

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Proposal Number: 11-2: A2.09-8194