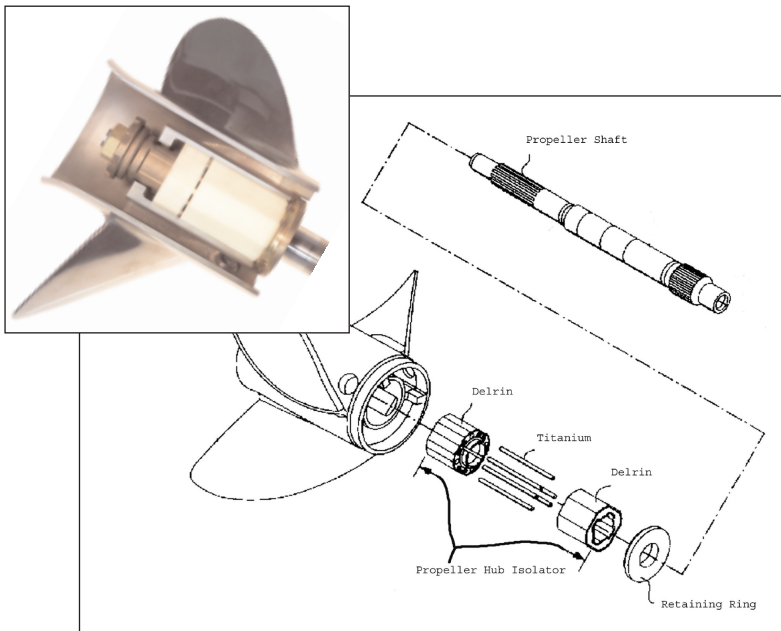


Metal-Plastic Hybrid Combats 'Shift Clunk' in Marine Engines

Mercury Marine over-molds DuPont™ Delrin® acetal onto titanium rods to make an innovative torque spring that damps vibration and shock loads when shifting from neutral into gear.



The torque spring, called the Flo-Torq® IV hub isolator, consists of two ring-shaped plastics parts that are over-molded onto eight titanium rods. It is mounted on a sleeve that mates with the propeller shaft. When the engine is shifted into gear, the isolator absorbs the difference in rotational energy between the shaft of the propeller, which at the instant of shifting is turning lazily in the water, and the engine's drive gears, which are spinning at 264 rpm.

Energy is absorbed as the titanium rods fixed within the acetal parts are deformed by up to 15° of arc as the acetal part nearest the drive gears turns faster than the acetal part at the propeller end. The combination of Delrin® with titanium rods performs functions neither the plastic nor metal could do alone.

Benefits Gained

No shift clunk. The hub isolator eliminates noise, vibration and harshness effects when shifting the engine from neutral into gear.

Drive train protection. The parts made of Delrin® have mold-in races designed to shear under severe loads. This protects other drive train components against damage in the case of a hard propeller impact.

Corrosion resistance. The parts made of Delrin® provide corrosion isolation of the titanium rods from other metal elements of the drive system.

Technical assistance. DuPont specialists provided valuable assistance during development, including finite element analysis. The FEA provided vital data for part design and simulation of non-linear force deflection curves of the interaction between the plastic and titanium parts during operation.

Material Selected, and Why

Delrin® 150 fulfills this application's requirements for strength, toughness, stiffness and resistance to seawater and freshwater.

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CAUTION: Do not use in medical applications involving permanent implantation in the human body. For other medical applications, see "DuPont Medical Caution Statement," H-50102.

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