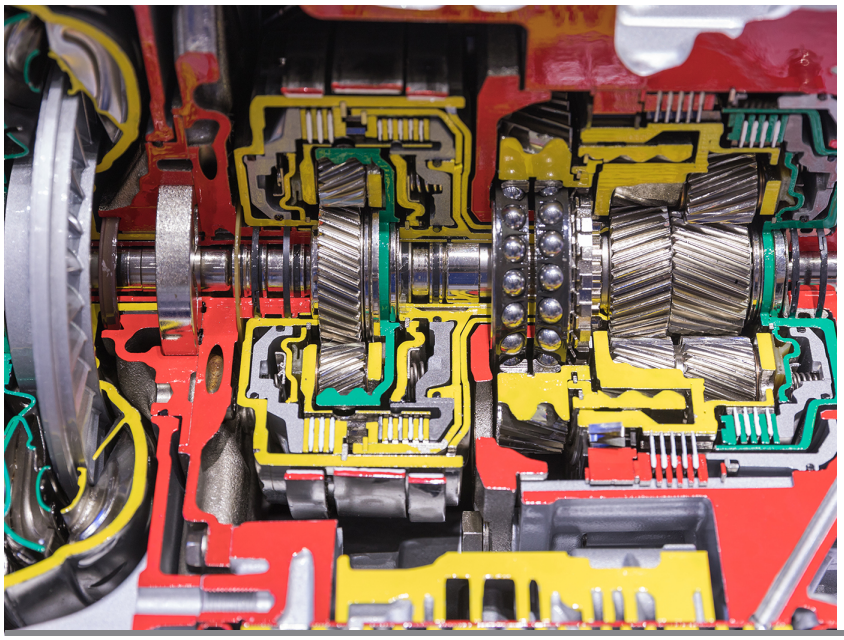

National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Mechanical and Fluid Systems

NiTi Alloy Ball Bearings

Small, high-grade bearings are extremely hard and corrosion-resistant

Innovators at NASA's Glenn Research Center have developed a new method for making small diameter, high-grade Nickel Titanium (NiTi) ball bearings that set a new standard for precision performance in the bearing field. Using non-corrosive NiTi alloy instead of steel is an inexpensive way to increase the load capability and reduce the weight of a ball bearing. It has been difficult, however, to produce balls less than 0.375" in diameter using the standard baseline 60NiTi alloy. To address this challenge, Glenn innovators have created a new, more advanced alloy consisting of NiTi and Hafnium (Hf) that can produce high-quality ball bearings of any size, but most notably less than 0.25" in diameter. Glenn's NiTi-Hf ball bearings are superior to any previously used alloy or steel. They are corrosion-resistant, shockproof, and have been rated at a grade 10 or higher on the Annular Bearing Engineering Committee (ABEC) scale (an industry-accepted tolerance standard for bearings). Thanks to their high strength and Rockwell hardness (HRC 58-60), these customizable ball bearings will facilitate new high-speed precision applications in a broad range of industries, including aerospace, automotive, industrial, medical, and more.

BENEFITS

- High Strength: Utilizes a shockproof alloy that can withstand tremendous loads and stresses without denting or other permanent deformation
- High Hardness: Achieves a Rockwell hardness of HRC 58-60 enabling longer life and faster rotations
- High Quality: Rated at a grade 10 or higher on the ABEC scale
- Corrosion-resistant: Fabricated using a non-magnetic alloy containing no iron, and therefore cannot rust
- Lightweight: Weighs 15-20% less than conventional steel ball bearings

THE TECHNOLOGY

For the very first time, NASA Glenn has successfully produced large quantities of high-grade ball bearings that are less than 0.25" in diameter thanks to the development of a new alloy made of 57.6% Ni, 39.2% Ti and 3.2% Hf. Smaller, shockproof balls improve load capability in conventional steel races, aircraft control surface joints, actuator gearboxes, and more. The production of standard NiTi alloy ball bearings that are smaller than 0.375" in diameter has proven challenging for multiple reasons, the primary being that small parts made from NiTi alloys cool excessively before they can be quenched (an important step in attaining high hardness). NiTi-Hf alloy, on the other hand, does not require such high-rate quenching to achieve high hardness. Consequently, the production of small, extremely durable NiTi ball bearings is now a reality.

The powder metallurgy process by which these high-quality NiTi-Hf ball bearings are manufactured combines many new techniques with several existing ones. First, a high-purity NiTi-Hf powder is created through an atomization process and transformed into long, cylindrical rods through hot isostatic pressing. The rods are then cut into cylinders and machined into spheres somewhat larger than the desired finished ball size. Finally, the spheres are hardened through heat treatment and polished until the desired finished size diameter and surface finish (typically 1 micro-inch root mean square roughness) is achieved. The result is a non-corrosive, very hard, highly elastic yet remarkably strong ball bearing with unbridled potential.

These versatile bearings are useful to a variety of medical equipment such as this centrifuge

These NiTi-Hf balls show no wear after a 10,000-hour continuous test in a steel bearing with grease

APPLICATIONS

The technology has several potential applications:

- Aerospace (engines, actuators, and joints)
- Automotive
- Marine
- Military
- Electronics
- Power
- Valves
- Industrial machinery
- Biomedical (x-ray machines, surgical instruments, medical testing equipment)
- High performance sports (automobile racing, biking)
- Mechanical systems

PUBLICATIONS

Patent No: 11,033,963; 11,517,962

See also LEW-TOPS-144 "High-Strength Superelastic Compounds" DataSheet_LEW-TOPS-129

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

LEW-19725-1, LEW-19725-2, LEW-TOPS-129

More Information

National Aeronautics and Space Administration

Agency Licensing Concierge

Glenn Research Center

21000 Brookpark Road
Cleveland, OH 44135
202-358-7432
Agency-Patent-Licensing@mail.nasa.gov

www.nasa.gov

NP-2018-06-2579 HQ