

“Synergistic” Coatings for Titanium and Titanium Alloys Prevent Hydrogen Absorption

- ▶ Superior non-stick properties resist adhesion
- ▶ Prevent hydrogen “pick-up” (absorption)
- ▶ Wear resistance can be matched to application
- ▶ Offer superior heat transfer properties
- ▶ Superior resistance to friction, galling, and seizing
- ▶ Low coefficient of friction
- ▶ Will not scratch, chip, flake, or rub off
- ▶ Improve titanium’s inherent corrosion resistance
- ▶ Increase part performance
- ▶ Temp range: –200°F (–129°C) to +1200°F (+649°C)

Recognizing that titanium is highly susceptible to hydrogen pickup or embrittlement, metallurgical engineers at General Magnaplate created a series of coating processes that would preclude any hydrogen absorption. Called CANADIZE, these “synergistic” coatings were originally developed to prevent galling at the joints and in the drive shaft of titanium core-sample drill tubes used in NASA’s exploration of the moon. The coatings also prevented contamination of moon rock samples by titanium or other foreign materials.

Since their initial use in the space program, CANADIZE coatings have been successfully employed to solve wear, friction, galling, seizing, moisture and corrosion problems in a broad spectrum of “down to earth” applications involving titanium and its alloys.

The CANADIZE process begins with a proprietary cleaning process. The part is then enhanced to the desired thickness in a proprietary solution.



Titanium gland nuts used in aircraft are protected against freeze-up, abrasive wear and corrosion by a CANADIZE surface treatment. The dry-lubrication of the coating also permits faster maintenance procedures.

Through predetermined time and current control, a hard ceramic surface is formed. In instances where permanent dry lubrication is desired, one or more carefully selected engineering materials are infused into the surface, i.e. fluorocarbons, polymers, molybdenum disulfides, graphites, or combinations of these well known dry lubricants.

Application Spotlight

- ▶ A variety of metal parts used in the manufacture of sealed reagent kits for chemical testing were coated with CANADIZE to provide chemical resistance and increase the service life of the manufacturing equipment.
- ▶ Galling and seizing compromised valves in pressure vessels and piping systems controlling the flow of LP gas and anhydrous ammonia. CANADIZE anti-galling/anti-seize coating solved the problem and eliminated a potentially dangerous situation.

Versatility

With few exceptions, CANADIZE coatings can be applied to parts of any configuration, and virtually any size or thickness. Precise control of the coating thickness permits use on machine threads and similar close-tolerance parts.

Engineering Data and Performance Characteristics

Hardness/wear and abrasion resistance

Abrasion resistance and wear life are substantially improved. The CANADIZE process produces an augmented surface hardness (Rc 45) on the titanium part or assembly. Additional enhanced properties include high fatigue strength and fracture toughness superior to steel.

Permanent lubricity

The CANADIZE process provides an extremely hard, permanently dry-lubricated surface over the entire part, thus eliminating galling, binding and seizing.

Friction

The coefficient of friction, as coated, is 0.15 against most materials (4-8 RMS), but with an additional top layer of specially selected polymers or dry lubricants, this can be reduced to as low as 0.04. The CANADIZE process is also available with molybdenum disulfide which can be combined with various other engineering polymers to meet specific requirements. Its lubricity reduces surface friction significantly, allowing the free flow of liquids while resisting the adhesion of contaminants over a broad temperature range.

Temperature

Without top coating, the usable operating temperature range is -200°F (-129°C) to $+1200^{\circ}\text{F}$ ($+649^{\circ}\text{C}$). With another added surface coating, the maximum becomes $+550^{\circ}\text{F}$ ($+285^{\circ}\text{C}$) when using engineering

polymers, and $+800^{\circ}\text{F}$ ($+427^{\circ}\text{C}$) with specially selected proprietary dry lubricants.

Chemical protection

Titanium is very susceptible to chemical attack from halides and particularly chlorides. Special engineering polymers are applied to the surface to offer complete corrosion protection against most chemicals, including washdown solutions.

Corrosion resistance

Titanium's natural resistance to corrosion is greatly augmented by the CANADIZE process. As a result of the enhanced ceramic film created on the metal part, the new surface becomes almost impervious to corrosion, making it especially useful wherever galvanic, seawater immersion or atmospheric corrosion is encountered.

Thickness

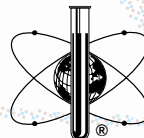
CANADIZE coating thickness range can be provided from 0.0001" to 0.0005". Titanium 6AL 4V produces the best ceramic coating — other alloys will not permit more than a thin film. Color can be produced in the lower thickness range. General Magnaplate's engineers are available for consultation regarding optimum thickness recommendations.



CANADIZE treatment on both the inside and outside of the titanium core-sample drill tubes used in NASA's exploration of the moon's surface prevented galling at the joints and in the drive shaft. It also eliminated the danger of contamination of moon rocks samples by titanium particles or other foreign materials.

Typical applications

- ▶ Aerospace
- ▶ Aircraft components
- ▶ Manufacturing equipment
- ▶ Packaging equipment
- ▶ Desalinization tubing
- ▶ Food Contact
- ▶ Valves
- ▶ Torpedoes
- ▶ Ordnance
- ▶ Rapid-Fire weaponry
- ▶ Undersea crafts
- ▶ Construction
- ▶ Power tools



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