Bulletin 4230 B-15.1

Engineering Report
On
Ferrule Design-Suparcase®

Instrumentation tube fittings were on the market for only a short time when manufacturers realized that a pure compression 316 stainless steel fitting, single or double ferrule, while working well with fluids would not effectively seal gases. Nor would stainless steel compression ferrules hold to the working pressure of the many tube wall thicknesses being specified. Also compression ferrules would not effectively seal gases on stainless steel tubing with surface imperfections. It became evident that it would be necessary to harden the surface of the ferrule to improve service performance. All fitting manufacturers began to harden the leading edge of the ferrules to solve this problem.

Parker's Instrumentation Connectors Division was not alone in recognizing the application problems associated with pure compression stainless steel fittings. But, as often happens with engineering trade-offs, chemical hardening, while a solution to the problem at hand, affected and changed the chemistry of the 316 stainless material.

Chemical hardening of the ferrule reduced its resistance to corrosion. The race was on to find a new way to maintain the benefits of chemical hardening without changing the base chemistry of the 316 stainless material. Parker has taken the lead in the development of the chemical hardening process ideal for ferrules designed to grip and seal stainless steel tubing. The process, a technological breakthrough, is called **Suparcase**.

Suparcase is a **proprietary** chemical process for the treatment of ASTM 316 stainless steel ferrules that imparts a unique set of physical characteristics that greatly enhances the corrosion resistance and hardness of ASTM 316 stainless steel. The **Parker Suparcase** ferrules offer several important advantages over untreated ASTM 316 stainless steel.

The first important advantage lies in performance in corrosive environments. When compared to **untreated** ASTM 316 stainless steel, **Suparcase** offers at least equivalent or better performance in the following corrosive environments:

50% sulfuric acid solution at 25°C
50% nitric acid solution at 25°C
30% acetic acid solution at 25°C
5% sodium hypochlorite at 25°C
Type II simulated black liquor at 25°C (TAPPI TIS 0402-09)

Standard stress corrosion cracking tests have been performed on **Suparcased** ASTM 316 stainless steel, and untreated ASTM 316 stainless steel. The tests were conducted on U-bend specimens and on standard tensile specimens in chloride, hydroxide, and sulfide solutions. These tests have shown that the **Suparcase** is at least equivalent or better in performance in resistant to stress corrosion cracking as compared to untreated ASTM 316 stainless steel.

Also, the **Suparcase** ferrule has a surface hardness exceeding that of untreated ASTM 316 stainless steel enabling the Suparcase ferrule to grip and seal ASTM 316 stainless steel tubing.

Over the past several years, ICD has made dramatic product quality improvements. Improvements have been made in forging quality, body seats and tube bore surfaces, pipe threads, nut quality, I.D. surface finishes, overall improved tolerances and now **Suparcase**, the ultimate product advantage.

The **Parker Suparcase** ferrule is a new breakthrough as a result of technology transfer from extensive research into super-corrosion resistant austenitic stainless steel by Parker's Research and Development Group. The **Suparcase** ferrule has been developed to greatly enhance the corrosion resistance and hardness of ASTM type 316 stainless steel. Due to the **Suparcase** ferrule's unique set of physical characteristics, it is ideal for instrumentation fitting ferrules which must seal and grip on commercial stainless steel tubing.

The **Parker Suparcase** ferrule has the following features, advantages and benefits to the user: 1. Superior or equal to ASTM type 316 stainless steel in a broad range of corrosive applications. 2. Not affected by the standard working temperatures of ASTM type 316 stainless steel. 3. Superior resistance to pitting compared to ASTM 316. 4. Superior to ASTM 316 in stress corrosion tests. 5. A high surface hardness that prevents galling and increases remakes. 6. Proven in field applications throughout the world.

Typical Sample of Corrosion Resistance Corrosion Environment Environment **Suparcase** Ferrule compared to Untreated ASTM 316 Acetic Acid Superior Boiling Nitric Acid Equivalent Hydrochloric Acid Equivalent ASTM Salt Spray Test #B117 Equivalent Sulfuric Acid Superior SO_2 Atmosphere Equivalent 34% $MgCL_2$ Stress Corrosion Test Superior **Elevated Temperature Test** The upper temperature limit for the use of ASTM 316 stainless steel in tube fittings is established by the potential formation of carbide precipitates. The **Suparcase** ferrules are fully functional at these temperatures.

Stress Corrosion Stress corrosion tests confirming the superiority of the **Suparcase** ferrule have been carried out in 34% Magnesium Chloride solution under pure bending conditions with constant load. The Tensile stress in the specimens is 29,000 lbs. in ^{2} that are about 80% of the 0.2% yield stress.

The first tests were carried out with ground specimens of ASTM 316 at a temperature of 158 degrees F. The results are shown in the following table. Time to rupture in hours of ground ASTM 316 specimen is shown below. Temperature of 158 Degrees F Untreated ASTM 316 Supercase Ferrule Failure at 262 hrs. No failure at 3,000+ hrs. Failure at 339 hrs. No failure at 3,000+hrs. Failure at 333 hrs. No failure at 3,000+ hrs. Failure at 304 hrs. No failure at 3,000+ hrs.

Surface Hardness The **Suparcase** ferrule has a surface hardness greater than a ferrule produced from untreated ASTM 316. This means that the **Suparcase** ferrule will seal on welded and redrawn as well as seamless ASTM stainless steel tubing and hold it to its burst pressure.

Infusion into the Surface of the Ferrule The hard surface of the **Suparcase** ferrule, because of the complete infusion into the surface, creates no dimensional changes. The **Suparcase** ferrule integrity is unaffected by initial or repeated remakes.