

# Wearing moly gets trendy

In pockets, on noses, wrists and ears, even at the end of a dog lead, molybdenum-containing alloys are part of modern life. This article describes their use in objects designed to entertain, connect, inform, alert, identify, or simply make us stand out!

These days, almost everywhere you look, people can be seen with heads down, hands tapping or held to their ears, moving like zombies, talking to invisible beings, some sporting improbable metal accessories pierced through their skin. These scenes incorporate all sorts of portable, useful or decorative, simple or ultra-sophisticated products, often made of alloys in which molybdenum plays an essential role.

## Eyeglasses – robust customizable frames

Eyeglasses are an ideal application for Type 316L stainless steel containing 2–3% molybdenum because it is a tough, corrosion resistant, and hypoallergenic material. Thanks to these characteristics it is used in eyeglass frames, bridges, hinges, and temples. It is easy to manufacture by stamping, a process which avoids welding. It also offers improved mechanical strength compared to other methods, and produces a wide range of shapes and styles.



Stainless steel hinges, bridges and temples offer a wide choice of shapes and styles with high mechanical strength. © Bliss-Eye

## Smartphones, cameras and camcorders – intensive handling

The smartphone must meet demanding specifications for performance, ergonomics, ruggedness, and aesthetics in a small package. Constant use subjects these devices to acids and alkalines contained in skin oils, salty perspiration and both indoor and outdoor atmospheres. They must survive collisions and shocks when they are mishandled or dropped. Their high visibility requires that they retain their immaculate appearance through all of these travails. As a result, 316L stainless steel is a material of choice for smartphone inner and outer frames. Aesthetics are important to fashion design, so the many surface finishes available on stainless steels make them even more attractive.

Manufacturers of other products also appreciate these stainless attributes. Some smartphone cases and many portable USB battery chargers have a 316L frame that protects them against

### Type 316L passed the transit drop shock test for smartphones

Recently, a Korean smartphone model was certified compliant with the MIL-STD-810G Method 516.6, Procedure IV Transit Drop shock test, thanks to its molded Type 316L stainless steel case. It survived 26 successive drops from 1.22 meters (4 feet) onto concrete with no deformation or damage on the surface or edges!

premature failure due to wear and tear. For still and video cameras where the competition among plastic, aluminum and stainless steel is ongoing, 316L has an advantage for camera bodies because it has the highest shock and dent resistance.

Other materials are frequently used in these applications. However, the fragility of plastics, the high cost of carbon-fiber composites, and the softness of aluminum make them somewhat less attractive. Often, molybdenum-containing stainless steel is simply the best choice!

## Headphones, headsets, earphones and microphones – easy wear and better sound quality

Headphones, headsets, earphones and microphones allow people to listen to their “tunes” without bothering others and use their phones wherever they go. Molybdenum-containing stainless steel is an important contributor to all of these devices.

Headset headbands can be equipped with a flexible, ultra-light Type 316 wire ➤



The modern human carries molybdenum around every day, mostly in the form of stainless steel, be it in watches, jewelry or electronics. © iStockphoto/LaraBelova

frame covered with foam and enclosed in a removable colored plastic sheath for durability and comfort. In high-end over-the-ear headsets, 316L stainless steel wire mesh reduces acoustic noise from the environment and permits exceptional sound rendition. The one-piece frame of an integrated earphone-microphone unit, equipped with removable plastic covers for access to inner components, can be formed from 316L. A 316L mesh effectively protects the membrane of a handheld microphone from oral spray and provides better resistance to corrosion than alternative materials. An ultrafine (0.1 mm diam.) mesh provides the same protection for a simple earpiece, a microphone connected to an earpiece, or a wireless lapel microphone.



High-end headsets use stainless steel wire mesh for excellent sound rendition. © Sennheiser

### Body piercings – beautiful, hypoallergenic and hygienic

Humans have worn jewelry for at least 35,000 years. Jewelry is meant to decorate, ascribe power and status, attract attention, and beautify and personalize the wearer. The long-established practice of body piercing has become more popular in recent years. The fashion industry now offers a wide assortment of studs, rings and other items that pierce the ears, nose, mouth, and other areas of the body. They are produced in a plethora of materials, designs and shapes using a variety of processes. The constant intimate contact of these accessories with the skin or mucous membrane, and the near-surgical act necessary to insert them, creates a



“Surgical” Type 316 stainless steel is the preferred material for body piercing jewelry.  
© iStockphoto/Kolidzei

significant risk of infection. Thus, these materials must be corrosion resistant, hypoallergenic, sturdy and require a minimal need for maintenance and care.

The molybdenum containing “surgical implant stainless steels” (Types 316, 316L) provide an excellent cost-effective

solution to the potential problem of allergic reactions and dermatitis. The inert chromium oxide surface layer on these alloys protects the skin against such reactions. Molybdenum improves localized corrosion resistance, minimizing the release of potential allergens. Other metals (e.g. gold, titanium) can serve as well;

however, not only are they expensive, but they themselves have occasionally been associated with skin problems. Stainless steels with lower chromium content and without molybdenum should be avoided in these applications because they have a higher probability of causing allergic reactions.

### Watches – ruggedness, elegance and accuracy

Watches are utilitarian and individual objects that may be among the best examples of the combination of metallurgical, mechanical and digital technologies with artistic creativity. From their simplest models to limited-series timepieces, watchmakers use 316 and 316L stainless steels to protect their creations from corrosion and the shocks of daily life.

Hardness, corrosion resistance and hypoallergenic properties are all important factors in selecting materials for watches. Stainless steels provide these characteristics and more. They ➤

#### Molybdenum for wearables

Application	Use	Grades	Benefits
Smartphones	Frames, inner frames, cases	316, 316L (2.00–3.00% Mo)	Corrosion resistance, ruggedness, deformation resistance, aesthetics
Cameras	Bodies		
Headphones, headsets, ear-phones, microphones	Head bands, microphones, ear-phones, ultra-thin noise-cancelling mesh, frames		
Watches	Bracelets, cases, springs, pinions, fasteners	316, 316L	Hardness, corrosion resistance, ruggedness, elegance, machinability, non-magnetic
		440C (<0.75% Mo)	Hardness, ruggedness, less expensive than other corrosion-resistant grades
		904L (4.00–5.00 Mo)	Highly corrosion resistant to chemicals and hydrocarbons
	Springs	SPRON®510 (~10% Mo), SPRON®610	High elasticity, superior resistance to rotating bending fatigue, non-magnetic
Body piercings		316L	Corrosion resistant, hypoallergenic, strong, surgical quality
		316LVM (Low Carbon Vacuum Melt)	Greatly reduced inclusion count allows finer polished finishes and improved resistance to pitting corrosion



### Molybdenum guarantees accuracy

The metallic components of a high-precision watch must be protected against magnetic fields that can reduce its accuracy. Molybdenum additions up to 10% play a key role in the very high-strength, non-magnetic cobalt-based Co-Ni-Mo-Fe SPRON® type alloys (see table) found in components such as springs. Molybdenum enhances the alloy's strength and corrosion resistance while preserving its nonmagnetic character. The watch's spring accumulates energy either from manual winding in mechanical watches or from wrist movements in automatic watches, and drives the hands via gearing. The most sophisticated springs can store energy for up to 72 hours without additional winding. Molybdenum-containing alloys are also present in precision parts like pinions, fasteners, and winding stems where hardness is essential.

are suitable for a wide range of manufacturing processes and many different surface finishes can be applied (e.g. gloss, satin, brushed, guilloché, engraved, to name a few). The most common applications are wristbands and cases. High-end watches employ molybdenum-containing specialty alloys for certain parts to avoid the effects of magnetic fields on their accuracy. Components close to the crown, where moisture may ingress, are also usually made of 316L stainless steel. Additionally, this grade is especially valued for its superior machinability and cold formability. Cold-formed, work-hardened material is used for internal parts that require a high hardness for wear- and deformation-resistance.

While Type 440C stainless steel (0.75% max. Mo) is less commonly used in watches, it is still appreciated for its hardness. It is less resistant to seawater and more easily magnetizable than 316 or 316L, but it offers a much less expensive alternative and is often used for inexpensive luxury watch reproductions.

Molybdenum-containing materials have even become design features that are emphasized by marketers. Apple, for example, highlights in its advertisement the use of 316L stainless steel in the breakthrough Apple Watch®. And Rolex heavily promotes the excellent corrosion resistance of its divers' watches thanks to 904L (4.5% Mo) stainless steel cases and bands. This grade is a highly corrosion-resistant stainless steel commonly found in marine applications and in industrial process equipment.



Luxury watch cases and bands are often made of Type 316L stainless steel. © Patek Philippe

### Animal accessories – rugged and corrosion resistant

Even when it comes to pets, stainless steel is essential. Metal collars and identity tags are exposed to the environment and the ring to which the leash is attached has to be strong when Fido suddenly spots a cat. In some cases the collars are a fashion statement and stainless steel contributes to the beautiful design. Like humans, pets can suffer from allergic reactions and need protection. A wide range of accessories is available for them as well as their masters and 316L stainless steel makes up the lion's share!

Molybdenum stainless steels and special alloys are found in the things we wear and carry, no matter whether they are utilitarian or beautiful or both. That is because these materials keep their attractive finish, do not cause allergic reactions and keep sensitive electronic devices safe from damage. They can add beauty and increase longevity and safety to these objects. Molybdenum is an important component in these materials, allowing designers and manufacturers to let their imaginations run free for ever more alluring and useful creations. (Thierry Pierard)



Type 316L stainless steel is strong and durable - necessary to restrain some dogs... © Fotolia/Stieber