

Stainless Steels in Sports and Leisure Equipment





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Introduction

Sports are now part of our lives. As more and more people enjoy more leisure and do not exert a physical activity in their professional lives, sports have grown to be the way to keep the body healthy. Sport is recommended for people of all ages, from the young for muscular development, improved coordination and skills to the elderly as a condition for retarding ageing.

Sport fosters effort, courage, teamwork, to name a few of its educational and social benefits, summarised by the old saying “mens sana in corpore sano”*.

It is perhaps quite logical then that sport has become a major provider of entertainment for the world, a huge market... and suffers from its downsides as well.

From a materials point of view, all materials are used in the wide variety of sports practiced today. The purpose of the present publication is to show some prominent uses of stainless steel in sports and leisure equipment.

A choice has been made not to include stainless steel used in fixed equipment, such as arenas, pools, and turnstiles.

**Roman saying: a healthy mind in a healthy body*



Mountaineering

Mountaineering, understood as ascending a complete mountain, uses a variety of skills: ice climbing (shown here), some rock climbing, survival, navigation, endurance etc. ... It is never risk-free. Mountains are known to be treacherous and claim lives every year. At high altitudes the breathing is more difficult, the weather more dangerous, and more equipment must be carried in the backpack. The equipment has to be perfectly reliable in any weather and weigh as little as possible.

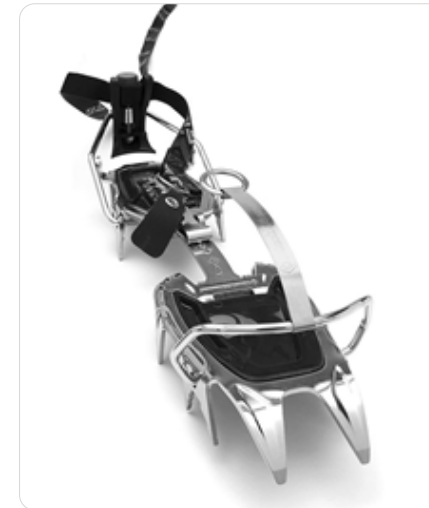
High strength/weight ratio is therefore an important consideration in choosing the equipment (metal components involve fasteners, anchors, ropes, carabiners, descenders, ice axes, etc. ...).

As technical equipment is expensive, it has to be lasting, i.e. not subjected to corrosion that can impair its reliability. In addition, aesthetics and finishes are valued because these products are expected to be attractive to the eye and to feel good when grasped.

Stainless steel offers reliability in any weather, high strength, and good aesthetics. It is used often in combination with Aluminium and/or Titanium alloys.



Ice axe for mountaineering and ice climbing, with a forged stainless steel spike. Spikes are designed to be sharpened like cutting tools. They insure an excellent grip on rock and an efficient penetration into ice. Picture courtesy of Petzl SARL.



Made of stainless steel for a design that won't rust, crampons are lighter weight and durable. Stainless steel resists snow balling. Picture courtesy of Blackdiamond equipment.



Rock Climbing

There are thousands of bolting sport routes available for climbing fans. As this is an unregulated practice, carried out by practitioners who may not have the experience and skill required, accidents may happen, especially if the anchors are corroded and have thereby lost much of their load-bearing capacity. Aggressive environments are to be expected in most places and particularly on rock faces close to the sea in hot and humid tropical climates. Risk mitigation by visual inspection of bolts and anchors on-site is not reliable and replacement requires a lot of time and effort, in addition to the cost involved.

Stainless steel anchors (preferably grade EN 1.4404/AISI 316L or better) provide a maintenance-free, lasting solution and guarantee the best safety conditions.



Stainless steel expansion bolt anchors similar to those used in industry for concrete and rock are very effective, can be used immediately but are suitable only for hard rocks such as granite.

Picture Courtesy of Petzl



Adhesive bolt anchors are recommended for softer rocks, offer an excellent mechanical resistance but they are said to be tricky to set and require at least one day to cure.



EN 1.4401 (AISI 316) Rock hanger with round ring and carabiner.

Picture courtesy of Raumer



Via Ferrata

The via ferrata, invented by the Italian military, is a fixed-aid climbing route, designed to allow non-rock climbers to tackle challenging rock faces using artificial aids which include cables, ladders, iron rungs and pegs or stanchions anchored into the rock. A continuous wire cable runs along the route, making it safe from start to finish as climbers must clip their lanyards onto the cable.

The via ferrata provides high-adrenaline adventure sport without danger.

The best practice is to have all the permanent equipment, steps, anchors and cables made of stainless steel for long, maintenance-free service life. Stainless steel carabiners may also be used to clip the lanyards onto the safety cable.

Pictures are courtesy of Raumer



EN 1.4301 (AISI 304) rebar rung to be anchored into the rock.



EN 1.4301 (AISI 304) Clamp anchors for cable



EN 1.4401 (AISI316) Cable



Hiking

Hiking lets a person experience the beauty of nature in a peaceful, soothing and restoring environment. Hiking trails are found almost everywhere, run over thousands of kilometers in scenic areas and places remote from cities and car traffic. They are given difficulty ratings, from moderate to very strenuous, suitable for people of all ages and physical condition. Backpacks always carry food and water for a day or more. In the recent years, stainless steel has emerged as the best preferred material for food contact, and water containers as it is sustainable and does not release phthalates or any other chemical.



*Stainless foldable pocket knife
Picture courtesy of Opinel SA*



Stainless food jar



Stainless bottle with carabiner . No plastic, no paint, no phthalates, BPA or other chemicals.



Caving

Although caving equipment shares some features with climbing such as harnesses, ropes and carabiners, it differs in using flexible ladders, diving equipment, headlamps and more. As the environment is usually humid, with sometimes water pouring, corrosion resistance is needed besides the usual strength requirement.

Pictures are courtesy of Lyon Equipment



Rope ladders with wire sides made of Stainless Steel offer vastly superior resistance to corrosion and rust than the galvanised versions.



Steel carabiners are tougher than the aluminium types favoured by climbers, and are much better for uses underground.



Caving

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Wire Rope Y Spreaders are made from Stainless Steel for longer life. Ideal for use with Caving Ladders.



8 shaped descender.



Aluminum and stainless steel pulley single prussic.

Pictures are courtesy of International Safety Components.



Pictures courtesy of GoSt-Barefoots Germany.

Jogging

These very innovative chainmail minimalist shoes are made from stainless steel chainmail. The shoes are built for strolling, light hiking, and walking on natural surfaces and in water. For more 'urban' environments, "Multi-Paws", attachable soft sole spots based on animal paws that provide grip on smooth and paved surfaces are also available.



Treetop Adventure parks

Treetop adventure parks are more and more popular to families, and to the young. The zipline course, for instance, allows guests ages 5-91 to traverse cables that make them feel like they are gliding through the air like birds from tree to tree, usually in scenic areas over rivers and valleys. A network of platforms, such as the stainless steel one shown here high in the pine canopy, provides relays from one exciting ride to the next.

This innovative stainless steel platform is suspended in a non-invasive way to the old-growth ponderosa pines, unlike the usual wood platforms. Without need of penetrating the trees with hooks, bolts or screws, it makes it a unique, eco-friendly outdoor adventure as well as a thrilling day long adventure.

The coarser wrap of some cables is how "zipline" got its name, as it emits a loud, "zipping" noise.

This park uses smooth 19-7 reverse-wrap stainless steel cables, unlike the galvanized 7-19 wrap cables used at other zipline courses. The smooth zipline cables are silent and allow guests to enjoy the serenity of the old-growth forest. They will never flake or rust off the lines as galvanized steel does. This type of cable is used in helicopter rescues and "long-lining." Ancillary equipment such as e.g. turnbuckles is also often made of stainless steel.





Aqua treadmill and cycling

In aqua-cycling, aka aquabiking, the bikes are placed in a pool for the riders to pedal against the water resistance, with water up to the waist. An aqua treadmill, an aqua gaiter and other devices work in a similar way. Aqua cycling is a fast developing exercise for fitness, physical rehabilitation, weight loss and cardio training. One of the specific benefits is that it is without risk of damage to the joints, a big advantage for those who cannot practice endurance sports based on running. Races involving aqua cycling plus swimming are now taking place.

Stainless steel is the standard material for this equipment as treated pool water is very corrosive.



Aqua treadmill

Picture courtesy of Hydrorider



Bikes are made of stainless steel, typically grade EN 1.4404/AISI 316L to resist corrosion in thermal springs, sea water and chlorinated water.
Pictures courtesy of Hydrorider.



Picture courtesy of Hydrorider



Hydro bikes are a new form of pedal boats. They are also often made of stainless steel.
Picture courtesy of Hydrorider



Scuba Diving

Scuba diving allows mankind to enjoy the beauty and diversity of the underwater world. The underwater environment is however unfamiliar and hazardous, especially for deep diving. In order to ensure diver safety, procedures must be followed. Most of them are intended to reduce the risk of drowning, and many of the rest reduce the risk of barotrauma and decompression sickness. In some instances, in which getting lost is a serious hazard, specific procedures must be followed. Checking the reliability of the equipment, especially the breathing system is part of the routine. Cutting tools such as knives, line cutters or shears are often carried by divers to cut loose from entanglement in nets or lines

Sea water, especially in warm tropical climates, is very corrosive and stainless steel grades that resist corrosion, typically EN 1.4404/AISI 316 are widely used.



*Backplate
Picture courtesy of Halcyon Inc.*



*Bailout whip
Picture courtesy of American
Diving Supply*



Dual manifold with isolation valve



*Swivel eye snap bolt
Picture courtesy of Halcyon Inc.*



Sailing

No wonder sailing has never failed to attract men and women. The sea has always been seen as a character, a god, a setting for adventure and for discovery, an image touching all the human senses, a metaphor for the unseen world beyond the senses.

“Free man, you will always cherish the sea!
The sea is your mirror; you contemplate your soul
In the infinite unrolling of its billows;
Your mind is an abyss that is no less bitter” .

Charles Baudelaire

Back on day to day reality, huge technical advances have been made but one basic requirement stays, i.e. to resist corrosion and provide a long service life with as little maintenance as possible. Stainless steel enjoys the status of the reference material for the hardware.



Winch



Rigging screw



Sailing

Stainless steel has made this easier, as it is the standard material for most of the hardware.



Anchor



Carabiner snap hook
Picture courtesy of [Wichard SA](#)



Cleat



Cable



Rowing

A very ancient means of transportation, then a sport as well, still practiced for competition, for fitness or for leisure. Rowing is one of the few non-weight bearing sports that exercise all the major muscle groups and not only the arms as it is often thought. Competition rowing is practiced with different boat classes, from an individual shell to an eight-person shell. Fitness rowing, still practiced by those who have the opportunity of a suitable water stretch, can now also be practiced outside the water and has become so popular that it is now a standard feature in fitness gyms.

The design of rowboats varies widely depending on their intended use.

Stainless steel is one of the materials used for the high strength metal parts, along with aluminium.



Oar lock and base



Sliding seat system with grooved rollers sliding on round stainless steel guide rails. Rugged, comfortable and low maintenance design.

Picture courtesy of Puuvenepiste Oy



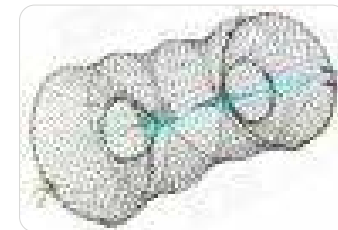
Fishing

In sport fishing, the primary challenge is to find and to catch the fish. Pressure from conservationists, combined with a genuine concern about fish stocks, have caused many sport fishers to begin releasing their catch alive, sometimes after fitting them with identifying tags and recording their details so as to aid fisheries research (known as tag and release). Unlike commercial fishing, which causes a lot of damage, the only equipment used is a hook, a rod and a reel.

Hooks are made of stainless steel and reels and ancillary equipment, mostly for sea fishing, are usually made of stainless steel.



Fishing Spinning Reel.



Fishing Standing keep net.



Trident.



Hook and Wobler



Stainless steel AISI 316 quick release, useful in all situations where you may need to quickly disengage from the attachment point (water skiing, long positioning, etc ...)



Stainless Steel Water Ski Tow Hook / Eye



316 Water Ski Quick Release

Water ski



Cycling

Bicycles are hugely popular and now fashionable, with thousands of kilometres of cycling paths available in cities and in the countryside, as an environment-friendly means of transportation or as leisure. The latter activity has developed into an array of sports, on roads, on all-terrains, for acrobatic events, for racing. For each one, specific bikes are available, with an attractive look and more and more sophisticated technology, some of it derived from the automotive or from aerospace industries.

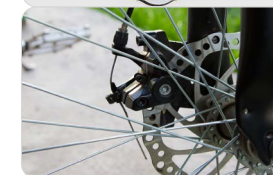
There is a wide variety of designs and of materials used, from the very basic to the highly sophisticated and expensive. Stainless is used in most bikes for cables, fasteners, brake disks and spokes. Less frequently, it is also used for frames, cogs, wheel rims and chain links.



Stainless steel brake and derailleur cables are strong, smooth and lightweight.



Chains with inner links made of stainless steel for longer wear.



Disk brake rotor for Mountain Bike. AISI 410 -EN 1.4006 Stainless Steel



Cogs.



Stainless grade 431 Iron club head for softness and durability.

Golf

There is a well-established use of stainless steel for golf heads.

AISI 431 Grade (EN 1.4057) is a softer stainless steel commonly used in high quality iron heads. It is said to allow the most forgiving and smoothest feeling iron sets available today.

AISI 17-4PH (EN 1.4542) and 15-5PH (UNS15500) grades are harder and found in professional style iron and wood heads. They are less common in iron heads, but popular material for woods.

While the harder material will decrease the soft feel found in grade 431, it makes up for it by creating better ball compression and essentially generating better distance.



*Bright stainless steel ball hitting the ground.
Pictures are courtesy of Boule Obut.*

Petanque

In petanque, the goal is to throw hollow metal balls weighing between 650 and 800g as close as possible to a small wooden ball called a cochonnet (literally "piglet") or jack. Practiced by people of all ages, it is a relaxing sport practiced mostly outdoors during summer vacations.

Steel balls are made of steel, sometimes chromium-plated steel or stainless steel.

Martensitic stainless steels are chosen for top quality sets. Depending upon the hardness, a "soft touch" or a "medium hard" touch are available. Stainless steel provides a longer life and does not require any precaution against corrosion.



Fencing

Fencing has evolved into a sport in the 18th century, with electrical scoring introduced around the mid-20th century. It improves body coordination, agility, balance, strength and cardiovascular endurance. It requires also strategic thinking and excellent focus.



Lame jackets, designed to be electrically conductive and protective (mechanical resistance $800\text{N}/\text{cm}^2$ min), are made using stainless steel fine wire. They are extremely durable and machine washable.

Picture courtesy of Blue Gauntlet Fencing.



Protective and conductive FIE compliant fencing masks are made of stainless steel wire mesh. They must pass a 1600 N punch without failing.

Picture courtesy of Leon Paul.



Indoor fitness

While outdoor fitness is recommended – as long as the environment is not polluted - indoor fitness is well suited to urban, sedentary life. Fitness centres are equipped with an increasing variety of machines and devices designed to exercise every part of the body with more and more sophisticated electronics to monitor calories spent, distance, time, etc. ... Equipment can also be used at home.

Fitness equipment uses a variety of metallic materials, mostly painted carbon steel, Cr-plated carbon steels, cast iron (for weights), aluminium and stainless steel. Stainless steels are likely to be used more often in the future, to eliminate the problem of treating toxic plating waste, to allow a better disinfection of the equipment and to provide more aesthetic designs.



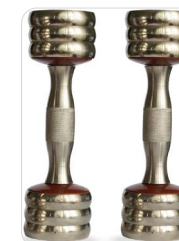
Lifting Bar



Spring chest exerciser



Pushups handles and handgrips



Dumbbells



Outdoor Fitness

Practicing a physical activity outside in clean air and a green landscape, is and has always been a sound advice for staying healthy. Municipalities are encouraging it by installing and maintaining equipment in cities, freely available to anyone. It has become a familiar sight in city parks, in city squares, on beaches, in playgrounds, along jogging paths, on residential building sundecks and near swimming pools. Initially for warm climates, outdoor fitness equipment is now used also in cold as well as hot climates, usually as part of a training circuit.

A wide variety of machines is offered to people of all ages, from toddlers to the elderly: cardio stepper, elliptical trainer, parallel bars, abdominal/leg lift, to name just a few of them.

The equipment must withstand not only all weather conditions, but it must also resist damage and vandalism that may happen in public areas.

Stainless steel is the obvious choice for corrosion resistance, aesthetics and durability in heavy duty service conditions.



All pictures are courtesy of Ijlander

Outdoor Fitness

Fitness equipment is not confined to indoor use. It has become a familiar sight in city parks, in city squares, on beaches, in playgrounds, along jogging paths, on residential building sundecks, near swimming pools... It is used in winter, in summer, in cold as well as hot climates.



All pictures are courtesy of Ijslander





Horseback riding

Although it has been said that “Riding isn’t a sport- the horse does all the work!”, riding is about strength and skill. It is having control over every single muscle of the body and knowing what to do without having to think about it. Even after a short ride, non-riders will notice certain muscles will be quite sore. Riding requires a few muscles that aren’t often used in other sports. The control it takes to use rein, leg and seat aids to influence a horse requires refined body awareness somewhat similar to a gymnast. Memorising dressage tests and jump courses, following trail maps, choosing the safest route on a trail ride, deciding the most effective way to handle a horse that is acting up (that sometimes requires split-second timing) and always being aware of what your horse is thinking, is mental exercise. Riders memorise how they will ride a particular course or cue a horse for a specific move, often within minutes of competing. However, they also need to be mentally flexible enough to change course instantaneously if the horse misbehaves. An old sport, still very well alive! Stainless steel is used for the metal parts of high quality horse tacks. Glue on steel horseshoes requires stainless steel tabs for optimum adhesion to the hoof.



Horse bit.
Picture courtesy of Hilason



Horseshoes.
Picture courtesy of Hanson Farriers



Finn Tack Overcheck Snap
Picture courtesy of Hilason



Stirrups.
Picture courtesy of Hilason



Ice sports

Stainless steel is one of the choice materials for runners for ice sports, as hardness, toughness and aesthetics are essential.

Stainless steel skating blades are usually made of AISI 420C (EN 1.4028) grade. Blades made of AISI 440C (EN 1.4125) grade, the hardest stainless steel is said to hold an edge up to 4 times longer than C-steels.

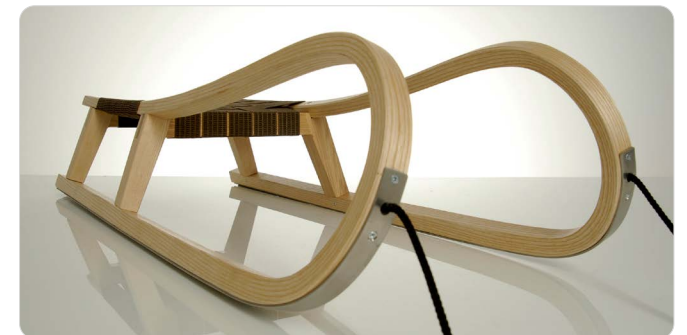
Re-sharpening stainless steel runners is straightforward and does not require any further precaution to prevent any rusting. Stainless steel runners are used for luge skeletons and bobsleigh racing... but details are kept secret.



Figure blades (left) and runners for hockey skates (right).



Stainless steel runners are used for luge skeletons and bobsleigh racing



Ash sleigh runners.
Picture courtesy of Sirch.



Skiing

A company specialized in artisan downhill skis, with the collaboration of CRYOLAB, an interdepartmental laboratory of Politecnico di Milano, designed and patented bottoms for skis completely in modified EN 1.4310 (AISI 301) stainless steel: starting from sheets having a thickness of 0.5 mm, they are obtained through laser cutting and then assembled with the other components of the ski. The better resistance to corrosion and to abrasion are two of the many advantages with stainless steel. Moreover, this material is characterized by high mechanical properties and a great resistance to scratches and impacts: these aspects remarkably reduce the maintenance operations on the skis.

*The bottoms of these skis are made of stainless steel to improve their resistance to corrosion and abrasion.
All pictures courtesy of [Centro Inox](#).*

Miscellaneous

Stainless steels are used, to a lesser extent, in many other sports. Here are some examples:

- In sky diving as the industry is shifting from cadmium plated hardware to stainless steel hardware because the cadmium plating process produces toxic waste
- In fitness boxing to hang the heavy punching bag from the ceiling
- In archery for lasting arrow tips
- In gymnastics equipment for high bars, cables, fasteners, carabiners...
- In water polo for goal posts



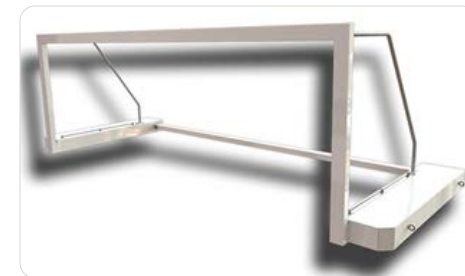
Sky diving safety equipment



High bar anchor point



Fitness boxing Heavy Duty Bag 4 Hook Chain Set and punching ball mount.



Water polo goal post



Arrows with fiberglass shaft and stainless steel tips.

Olympic Symbols

The Olympic symbols themselves have used stainless steel:

- the flower-shaped cauldron for the 1992 Albertville Winter games, still pristine today
- the 16-ton Cauldron of the 2012 London Summer Games was made of 204 copper "petals" while the "stems" were made of stainless steel. It was able to move from a fully open position to an the upright position
- the torches for the 1992 (Albertville) 2000 (Sydney) and 2010 (Vancouver) games



Flower-shaped cauldron for the 1992 Albertville Winter games



Sydney 2000 Olympic Torch in Aluminum and Stainless steel.



Stainless steel tubes centerpiece cauldron that housed the flame throughout the London 2012 Olympics.
Photo courtesy of [Nick Webb](#)



Vancouver 2010 Olympic Torch. Aluminum core, with a stainless steel double-burner system that will keep the flame operational between -50°C to $+40^{\circ}\text{C}$.



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About ISSF

The International Stainless Steel Forum is a non profit association, based in Brussels, which represents the interests of the producers of stainless steel and the Stainless Steel Development Associations (SSDAs) towards end-users, the media, the general public and regulatory authorities. The association has 56 members from all over the world and currently represents approximately 90% of the total production of stainless steel.

More information

For more information about ISSF, please consult our website worldstainless.org.

For more information about stainless steel and sustainability, please consult the sustainablestainless.org website.

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