20 YEARS

ISSF INTERNATIONAL STAINLESS STEEL FORUM

BOOK OF NEW APPLICATIONS 2016

INDEX

Introduction

John Rowe

Secretary-General

International Stainless Steel Forum

Brussels

The International Stainless Steel Forum (ISSF) this year celebrates its 20th Anniversary. When it was first proposed, the primary objectives, apart from providing a regular networking forum for its members, were to combine the resources of its members for the compilation of reliable statistical reports related to the stainless steel industry; to ensure greater progress was made in the areas of health, safety and the environment; and to focus joint efforts on the development of new markets for stainless steel.

The ISSF has an extensive extranet and website with a broad range of economic and statistical data covering all aspects of the stainless steel industry. It is also active in disseminating reports of safety related incidents within the steel industry, both from the ISSF and from World Steel, so that members may learn from accidents in other plants, and in promoting matters related to sustainability and environmental awareness and protection. There is a significant focus on market development, including flat rolled and long products, which is coordinated and managed by two very energetic committees, with the help of the staff and fellows at the ISSF. And there is also an ongoing research into the principal raw materials which are used to make stainless steel. On top of this, the ISSF is the external voice of the industry, providing information about stainless steel to a wide-ranging audience, which includes governments, regulatory agencies, other industry associations, the media and the general public. One such project has been an Education Course aimed at students of architecture, to improve awareness of the value which stainless steel can add to the building and construction sectors.

The ISSF has combined its resources with those of the associations which represent the nickel, ferrochrome and molybdenum industries, as well as Eurofer, EuroInox and the International Nickel Study Group to promote projects which are designed to increase market development, to defend existing markets and to engage in joint research into areas which will enhance the image and reputation of stainless steel.

It is appropriate that this anniversary should be commemorated by recording a collection of examples from around the world which illustrate efforts made to promote and develop new markets for stainless steel. In 1996, when the ISSF was formed, global stainless steel production was 15 million metric tons. For 2016 that figure is expected to reach 43 million tons. It is therefore of vital importance for the industry that new opportunities should be found to increase the consumption of this important material.

This book presents a wide cross section of new ideas which we have collected from around the world. Some focus on the sheer beauty of stainless steel in its various forms; others are more focused on its practicality; but all are focused on the primary benefits which stainless steel offers to consumers – an ability to resist corrosion, coupled with an inherent mechanical strength.

In many of these applications, stainless steel is a material of choice; in some of them it is an irreplaceable selection. It provides a unique solution to the combined requirements of hygiene, strength, durability, aesthetic appearance, corrosion resistance, and a capability to be formed with relative ease into a multitude of different shapes. With proven life cycle advantages and the ability to be completely re-cycled at the end of its useful life, the examples illustrated in this book suggest that the only limit to the development of new applications is the scope of the user's imagination.

I hope that this collection of ideas provides inspiration for renewed marketing energy. Stainless steel is a versatile product and we have not yet started to test the limits of its functional capabilities.

This book is the culmination of a joint effort among the producers of stainless steel around the world and the Stainless Steel Development Associations (SSDAs) and the collaboration of the staff and fellows of the ISSF, whose co-operation and readiness to respond are gratefully acknowledged. I would like, in particular to record my appreciation for the special contributions made by Thomas Pauly, the former Managing Director of Euro Inox, whose experience and wealth of information was invaluable; by the ISSF Fellows, particularly Takeo Tomita and Jun Ishikawa (Nisshin Steel), Dr. Wei Zhang (Baosteel) and Hyun-Seok Cho (POSCO); by the tireless Jo Claes, for whom nothing was too much trouble; and by Chiara Lamacchia and her team at our designers, double-id, whose advice, and especially patience, were very helpful.

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The Four Types of Stainless Steel

Austenitic

Austenitic stainless steels contain a significant amount of chromium, and sufficient nickel or manganese to stabilise the austenite microstructure that gives these steels good formability and ductility (and makes them non-magnetic). A typical composition is 18% chromium and 8% nickel, as found in the popular AISI 304 grade. (AISI is an abbreviation of American Iron and Steel Institute and is commonly used as a grade designation.) Austenitic grades can be highly durable and corrosion resistant and have high ductility, low yield stress, relatively high tensile strength and good weldability. They have a very wide range of uses.

Ferritic

Ferritic stainless steels have properties similar to those of mild steel but show better corrosion resistance. Most common are 11% and 16% chromium containing grades – the former used mostly in vehicle exhaust systems and the latter mostly in cooking utensils, washing machines and Indoor architecture.

Austenitic-Ferritic (Duplex)

These stainless steels, which contain high chromium and some nickel, have a microstructure that is roughly 50% ferritic and 50% austenitic. They are mostly used in the process industry and in seawater applications.

Martensitic

Like ferritic grades, martensitic grades contain 12 to 16% chromium. However, they have higher carbon content and are subjected to specific heat treatments during production, making them very hard and strong. They are used in applications such as turbine blades, cutlery and razor blades.

Surfaces

Surface finishing treatments applied to stainless steels can take many forms. The main finishes are described below. Ferritic surface finishes are the same as those for austenitic and other grades.

Description	ASTM	EN 10088-2	Notes
Hot rolled	1	1E/1D	A comparatively rough, dull surface produced by hot rolling to the specified thickness, followed by annealing and descaling.
Cold rolled	2D	2D	A dull, cold rolled finish produced by cold rolling to the specified thickness, followed by annealing and descaling. May also be achieved by a final light pass on dull rolls.
Cold rolled	2B	2B	A bright, cold rolled finish commonly produced in the same way as No. 2D finish, except that the annealed and descaled sheet receives a final cold roll pass on polished rolls. This is a general-purpose cold rolled finish and is more readily polished than No. 1 or No. 2D.
Bright Annealed	BA	2R	BA finish produced by performing bright annealing in an inert atmosphere after cold rolling. Smoother and brighter than No. 2B.
Brushed or polished	No. 4	1J/2J	A general-purpose bright polished finish obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives.
Satin polished (matt)	No. 6	1K/2K	A soft satin finish having lower reflectivity than brushed finish. It is produced by using a medium abrasive.
Bright polished (mirror)	No. 8	1P/2P	The most reflective finish commonly produced. It is obtained by polishing with successively finer abrasives then buffing with a very fine buffing compound.
Electropolished	-	-	This surface is produced by electrolysis in an electrolytic solution. This electrochemical process improves the surface finish.

2D

2B

BA

no. 4

no.6

(Pictures courtesy of POSCO)

Ferritic Stainless Steel Tubes for Floor Heating

Fabrication process	Tube making, press-fitting
Grade/surface	444 (EN 1.4521)
Dimensions	22 mm Ø, 0.8 mm wall thickness
Manufacturer	Tecnofar Spa., Delebio (SO), Italy
Source of information	Centro Inox, Milan, Italy

Contrary to classic radiators, floor heating requires relatively low temperatures (about 35 °C) and therefore ideally combines with "green" sources of heating energy like solar panels or heat pumps. Traditionally, slings of polymer tubes are embedded in the floor. The idea of using stainless steel for this purpose, is new. The molybdenum-alloyed ferritic grade 444 (EN 1.4521) has boosted the application of stainless steel in household plumbing. It was a natural extension of this idea to use this type of stainless steel for floor heating, where tubes with an outer diameter of 22 mm and a wall thickness of 0.8 mm are used. Ferritic stainless steel has economic and technical benefits. Firstly, its alloying composition makes it rather price-stable. Secondly, it has higher thermal conductivity than austenitic stainless steel, which is an obvious advantage when efficient heat transfer is critically important. The clever combination of the inherent physical properties of the material with a proven joining technique opens up new opportunities in the quickly growing market of energy-efficient floor heating.

Architecture, Building and Construction

Ceramic Tile Suspension System

Location	Barcelona
Environment	Outdoor
Fabrication process	Wire drawing, weaving
Grade/surface	316 (EN 1.4401)
Manufacturer	Techidos Metálicos Estruch
Material supplier	Inoxfil, Acerinox Group
Source of information	Cedinox Magazine

Ceramic tiles are a traditional material for roofs and façades in the sunny and hot climate of Spain. They buffer heat, absorb humidity during the night and evaporate it again during the day, producing a cooling effect. A new façade system called Flexbrick involves ceramic tiles which have tubular channels to reduce their weight and enhance their temperature-regulating capability. Lateral grooves make it possible to insert them into a grid of woven stainless steel. The staggered arrangement leaves 50% of the surface open which is an ideal proportion to allow air and daylight in but keep excessive heat out. Potentially high wind loads and demanding durability requirements call for an intrinsically corrosion resistant material like stainless steel. The coastal atmosphere made higher-alloyed grade 316 the most appropriate option. This is another example of stainless steel bringing out the best in partner building materials.

Picture courtesy of Flexbric

Architecture, Building and Construction

Three-Dimensional Façade Panels

Environment	Urban
Fabrication process	Proprietary hydro-mechanical forming technique
Grade/surface	316L, perforated, polished grit 240
Main thickness or diameter	1 mm
Date of completion	2014
Manufacturer	Fielitz GmbH Leichtbauelemente, Ingolstadt, Germany
Material supplier	ThyssenKrupp Materials Services

The headquarters of ThyssenKrupp AG in Essen, Germany, includes a kindergarten building. The architects, a consortium of JSWD Architekten, Cologne, and Chaix & Morel et Associés, Paris, designed a metallic façade which has the appearance of a rough shell from a distance while ensuring soft and almost seamless transitions between the individual elements. The solution was provided by a hydro-mechanical forming process that had not been used previously in building and construction. A three-dimensional surface pattern, which is computer-generated to the architects' specifications, is transferred to a metal sheet using oil pressure within a closed system. This modern alternative to deep-drawing requires only a one-faced tool and is therefore cost-effective even in a smaller series. The panels are 650 mm by 1,300 mm in size. The façade has four areas arranged so that the overlapping parts fit snugly, resulting in a homogeneously undulating surface. The stiffening effect of the pattern makes it possible to use very thin sheet of only 1 mm, thus minimizing weight. Because of its ductility, stainless steel is a particularly suitable material for this process. It eliminates the risk of drawing marks forming on the visible face. The technique, which is applicable to sheets of up to 4,000 mm x 2,000 mm, won first prize in the 2015 Steel Innovation Award by the German Steel Federation, Wirtschaftsvereinigung Stahl. As the undulation adds stiffness to the panels, lightweight perforated sheet only 1 mm thick can be used.

Photo courtesy of Thomas Lewandowski

Acoustic Insulation in Building Fasteners

Fabrication process: Wire, bar, sheet

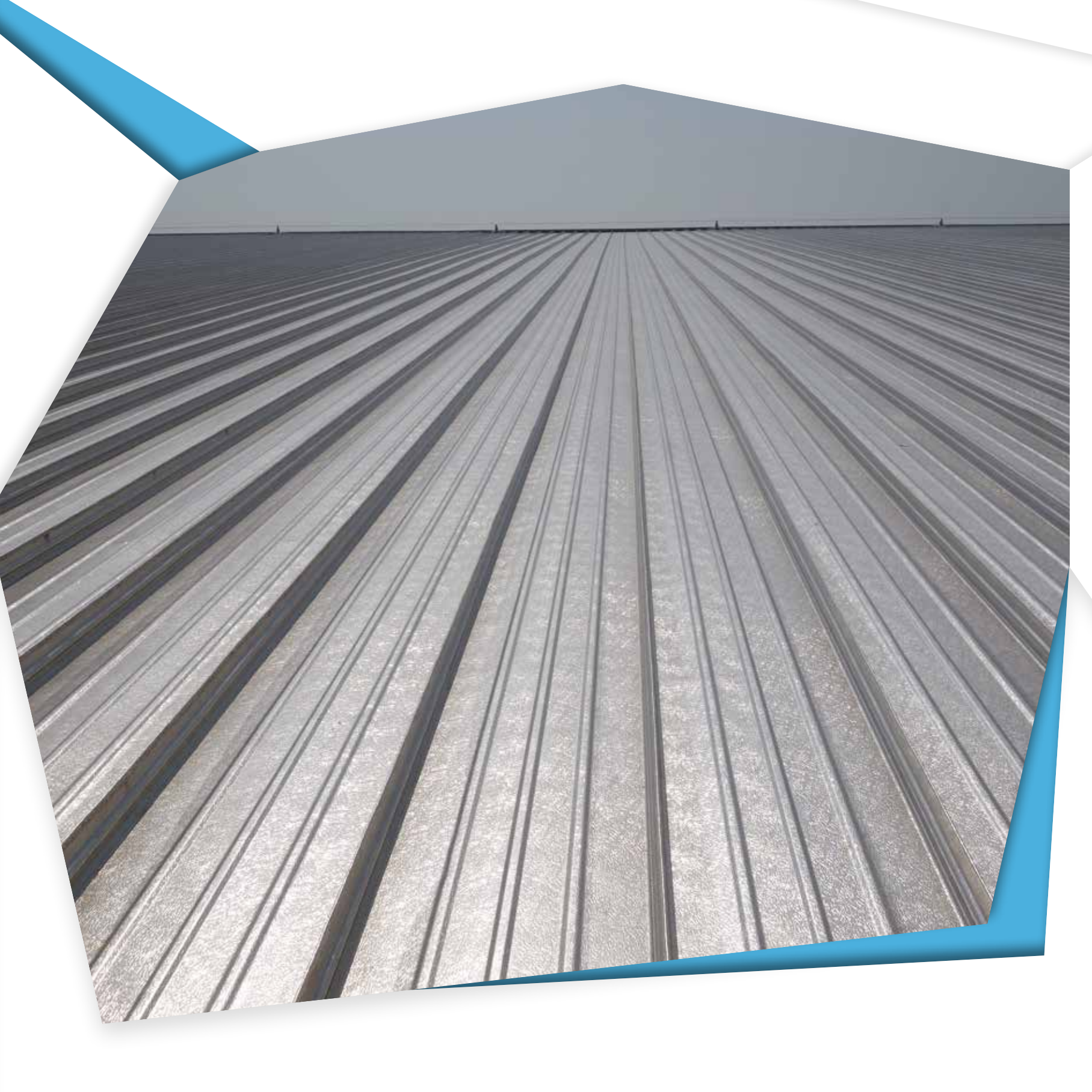
Manufacturer: Ancon, Sheffield, UK

When the thermal insulation of buildings became common in those parts of the world which are exposed to cold winters, stainless steel was quickly identified as an ideal material to make fasteners for wall ties and other construction items. Its long-term corrosion resistance is critically important for components that are hidden and less accessible for inspection and repair. Compared with other metallic materials, austenitic stainless steel grades also have exceptionally low thermal conductivity and are able to penetrate layers of insulation material without compromising their overall energy-saving effect. Yet another dimension has recently been added to its list of assets: acoustic insulation. A novel series of cavity wall ties and shear load dowels features pre-compressed acoustic insulation elements. Originally designed for recording studios and cinemas, where airborne noise can be a problem, they are increasingly being used in residential buildings. These acoustic insulation components, provide an obvious advantage in multiple occupancy buildings such as apartment blocks or hotels where unwanted noise can be a nuisance.

Stainless Steel Rebar for Magnetic Shielding

Location	Cambridge and Cramlington (UK)
Environment	Indoor
Grade/surface	EN 1.4311 (304LN)
Material supplier	Outokumpu

Low magnetic permeability stainless steel was used to reinforce the concrete structure of the new building of the Cambridge University Chemical Engineering and Biotechnology department. It forms an efficient Faraday cage which excludes stray magnetic fields from the sensitive electronic equipment which is used in research. A low carbon grade of stainless steel with an added nitrogen content of 0.12 to 0.22%, EN 1.4311, was used. It is ideally suited for applications in which, an elevated level of mechanical strength is required. Further market potential for this material lies in hospitals. The recently opened Specialist Emergency Care Hospital at Cramlington, is another case in point. The Magnetic Resonance Imaging (MRI) technique requires the equipment to be protected from external electromagnetic fields.



Roll-Formed Stainless Steel Roofing Panels

Location	Macau, China
Environment	Subtropical coastal
Fabrication process	Roll-forming
Grade/surface	316, 2D, embossed
Dimensions	0.5 mm
Manufacturer	P&L Building Materials (Macau) Co., Ltd.
Date of completion	2014
Material supplier	Yieh United Steel Corporation
Source of information	Macau Society of Metal Structures, www.msmsmacau.org

For the regulatory periodical vehicle inspection, The Land, Public Works and Transport Bureau of Macau built a new Technical and Administrative Centre with a floor space of over 28,000 m². The architects, PAL Asiaconsult Ltd. and Arquitectos Associados LAD, specified stainless steel for the 6,713 m² section of the roof that spans the vehicle testing hall. The elevated chloride content in the subtropical coastal climate of Macau and the frequency of typhoons had to be considered. The roof was tested to simulate 14 hours of exposure to a real typhoon. For this purpose, a roofing technique was applied that relies on tray-shaped roofing elements, which are roll-formed from coil material on site and can therefore be tailor-made for the building without the restrictions in length that road-transport would otherwise entail. Stainless steel sheet 0.5 mm thick was formed into trays of up to 47.7 m in length. The system embosses the metal to provide extra strength and stiffness. Together with the original moderately reflective 2D surface, the final surface pattern helps to reduce glare. The trays are fastened to their supports by stainless steel clips and mechanically interlocked. Unlike welded seams, this method of fastening allows for longitudinal movement to account for thermal expansion. Previously this roof laying technique had mainly been applied to light metals. Extending its use into stainless steel, this high-quality material which is otherwise mainly found in prestigious visual applications, becomes part of an affordable functional solution for technical buildings.

Architecture, Building and Construction

Stainless Steel Safety Screens

Location	Taiwan, China
Environment	Outdoor
Grade/surface	316
Main thickness or diameter	1.65 mm
Manufacturer	Tang Sheng Technology
Material supplier	YUSCO
Source of information	YUSCO

This type of safety screen has been designed for use in apartment balconies as a preventive measure against accidents for young children. It can be easily dismantled in case there is a need for an emergency evacuation and it can also be connected to a "smart" alarm system to provide additional security against intruders. The attractive design features make it possible to see through the screen while having the benefits of a secure protection system, and the corrosion resistance of stainless steel means that it will continue to look good throughout its useful life.


BAOSTEEL

Architecture, Building and Construction

Stainless Steel for Curtain Wall Applications

Location	Shanghai/Guangzhou, China
Environment	Outdoor
Fabrication process	cut, bend, drill
Grade/surface	316L/Linen 25
Main thickness or diameter	2 mm
Manufacturer	Yuanda, MSC
Material supplier	Shanghai Krupp Stainless
Source of information	Shanghai Krupp Stainless and Baosteel Stainless Steel

Shanghai Krupp Stainless supplies cold rolled coils with a rolled-on, Linen Finish, in 2 mm gauge to a specialist Curtain Wall manufacturer, Yuanda MSC, which cuts the coils to the required dimensions using laser technology, folds the edges and drills the necessary holes for the fasteners, before assembling the stainless steel panels to an aluminium frame to form curtain wall units. The units are then fixed to the walls of building. As these buildings are typically constructed in extremely aggressive coastal environments, the extra resistance to corrosion provided by highly alloyed stainless steel grade 316L was specified.


MOSAICOS

Fractal
Stainless Steel Tiles

Location	San Luis Potosí, Mexico
Environment	Indoor
Grade/surface	AISI 430/polished
Manufacturer	Outokumpu Mexinox
Source of information	IMINOX

Fractal is the trade name for a new range of "do it yourself (DIY)" stainless steel tiles. The Fractal design provides designers, builders and home decorators with an easy to use and efficient method of installing stainless steel wall decorations through its modular system. Fractal can easily be applied to smooth walls in any building structure, including homes, offices, hotels, hospitals, restaurants, sports centers, gardens, walls, kitchens, bathrooms, elevators, laboratories, spas, schools, fireplaces, etc. achieving a contemporary and sophisticated effect. Fractal allows decorators the freedom to use their own personal designs, achieving different effects by changing the direction of the polished surface on the stainless steel. The tiles are fixed to the wall with glue. This system includes a tool to bend and cut the tile without the need for complicated equipment, this making it accessible to and easy to use by the general public. Because the tiles are generally used indoors where the environment is less aggressive, ferritic grade 430 has been specified in order to provide a more stable cost basis.


z m b

Free-Formed, Self-Supporting Architectural Façades*

Designers Institut für Bildsame Formgebung und Lehrstuhl für Tragkonstruktionen, RWTH, Aachen, Germany

Architects are turning to more and more geometrical diversity. For free-form structures, expensive customized solutions have been inevitable, but a new technology combines tessellation with folding to create self-supporting façade elements which do not need a separate substructure. Stainless steel is particularly suitable for this technique, because austenitic grades are exceptionally malleable. Furthermore, because stainless steel work-hardens during the forming process, this adds to the structural strength of the fabrication. The possibility to reduce wall thickness, weight and material cost, together with the absence of a separate supporting structure, make the most daring architectural shapes affordable for a wider range of applications.

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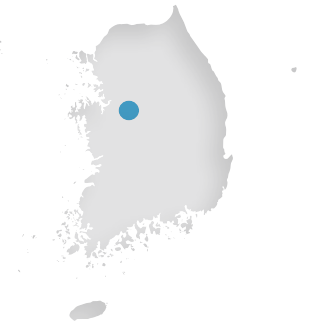
HU-SIEN
25x15

Stainless Steel Pipe Connector

Location	Republic of Korea
Environment	Indoor
Grade/surface	STS304 or STS316
Manufacturer	HI-STEN
Source of information	Korea Iron & Steel Association

This product is a stainless steel pipe connector which also acts as a sprinkler valve as a fire control measure in case of emergencies. The product can be quickly and easily installed in existing stainless steel water supply pipes, and its mechanical properties lend higher strength to its corrosion resistance.

Stainless Steel Hot-Water Reticulation Pipes



Fabrication process	Republic of Korea
Environment	Indoor
Grade/surface	STS304
Manufacturer	DASUNGTECH Co. LTD
Source of information	KOSA

A wide range of heating systems, from household units to industrial variants, operate with hot-water reticulation. The pipes which circulate the water have typically been manufactured from copper, brass or bronze. The Dasung Tech Company, of South Korea, has introduced a system which uses austenitic grade 304 stainless steel, which provides an extended life cycle, with increased strength and corrosion resistance.

Stainless Heat Exchangers

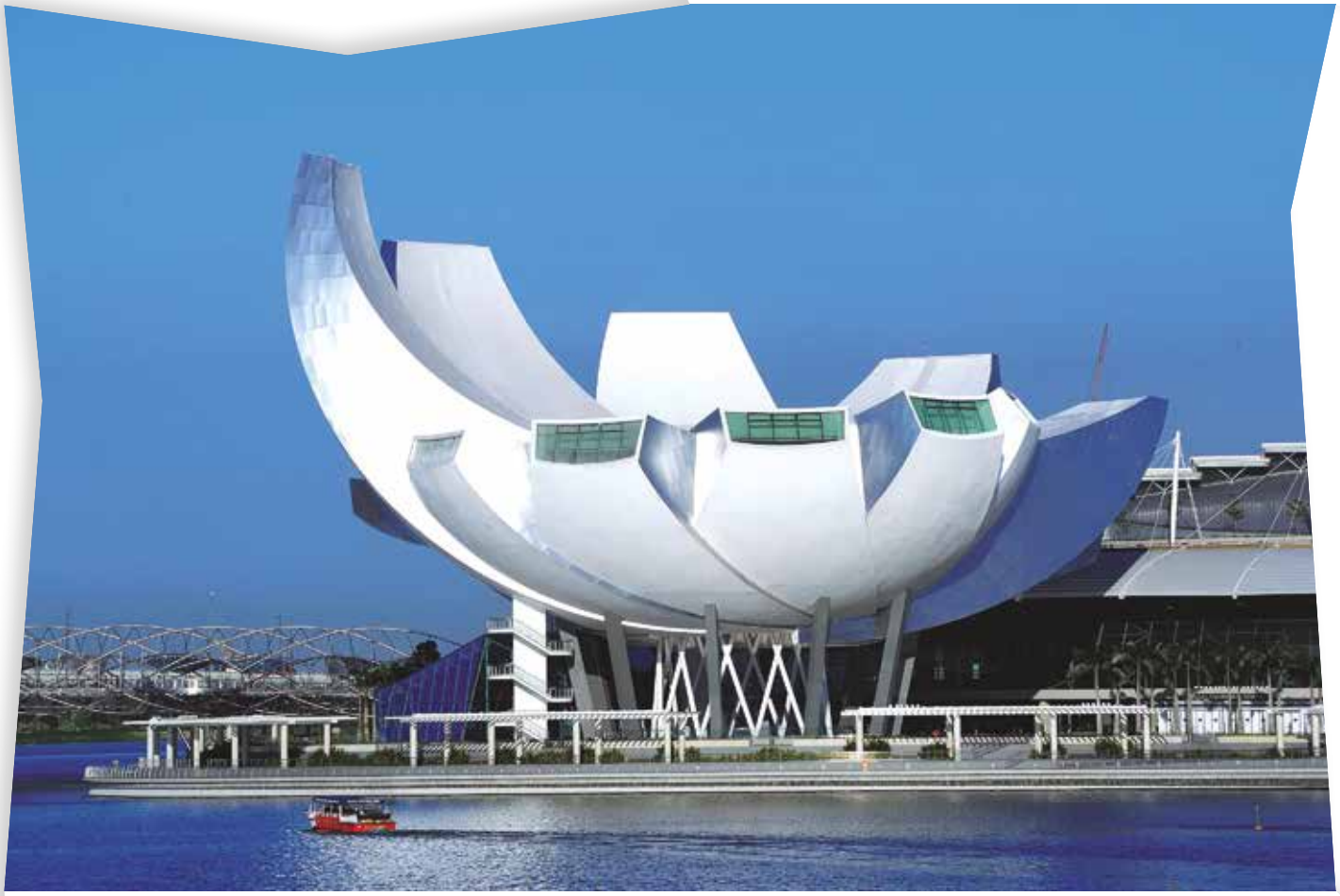
Location	Republic of Korea
Environment	Indoor
Grade/surface	STS430J1L, STS304CuWL, STS316L
Manufacturer	KyungDong Everon
Source of information	KOSA

The latest generation of heat exchangers is being manufactured from stainless steel, with advantages in extended life, durability and corrosion resistance. This example, from Kyung Dong Everon in South Korea, uses a combination of ferritic grade 430 and austenitic grades 304 and 316L for a more stable cost structure.

Stainless Steel Gabions

Fabrication process	Wire drawing, spot welding
Grade/surface	304, 316
Dimensions	Typically 5 mm
Manufacturer	Zanettin, Cembra (TN), Italy
Source of information	Centro Inox, Milan, Italy

Gabions are fencing structures, made from wire, but filled with rocks, concrete or soil, to form practically solid walls. Their original use was in civil engineering, road building and erosion control, but garden and interior architects are increasingly discovering the aesthetic qualities of gabions and suggesting them as an alternative to separators, fences and plant supports. The use of stainless steel wire for gabions is a new idea. The wire, typically 5 mm in diameter, is spot-welded to form the containment. The size and geometry can be customized to the designer's specific functional and aesthetic requirements. The welded joints are equal in corrosion resistance to the base material, thus contributing to the longevity of the product. The extension of the well-known gabion principle to stainless steel opens up a new high-end market sector. It can also be adapted to infrastructural applications, where corrosion resistance requirements are higher than usual and replacement would be difficult and expensive.



Art Science Museum, Marina Bay Sands, Singapore

Location	Singapore
Environment	Outdoor
Grade/surface	316, 304
Manufacturer	Mitsubishi Plastics, Inc.
Material supplier	Nisshin Steel
Source of information	JSSA

Marina Bay Sands is located in the center of the business district of Singapore and is a major Asian destination for business, tourism and entertainment. The Art Science Museum at the Marina Bay Sands has been designed to resemble a lotus flower and is a world famous exhibition center. The outer panels of the Museum are made from a composite of Alpolic from Mitsubishi Plastics, with a non-flammable inorganic filler and grade 316 stainless steel for the surface material. Using these composite sheets, interesting designs and high corrosion resistance have been possible together with significant weight savings. The attractive appearance and superb functionality of the Museum work to emphasize the advantages of stainless steel. The combination of plastics and stainless steel helps to reduce weight which makes handling, transport and assembly easier and cheaper.

The Chapel at the Miho Art School

Location	Shiga, Japan
Environment	Outdoor
Grade/surface	SUS304
Manufacturer	Kikukawa Kogyo Co.,Ltd.
Material supplier	Nippon Steel and Sumikin Stainless Corporation
Source of information	JSSA

The Miho Museum was built in the 1990s, close to the Shumei temple in the Shiga Mountains, by Mihoko Koyama, the heiress to the Toyobo textile business and one of the wealthiest women in Japan. She commissioned the world famous architect, I.M. Pei, who designed, amongst many iconic buildings, the Grand Reception Hall at the Louvre in Paris and the Bank of China Building in Hong Kong, to design a Chapel in 2012. The Chapel building has outer panels made from trapezoid-shaped stainless steel sheets in austenitic grade 304, 18.5 meters long and 5 mm thick. Each piece is twisted uniquely and the surface has a shot-blasted finish resulting in a very sophisticated design. Each curve was created using three-dimensional CAD. When considering material selection a number of challenges had to be addressed: achieving a uniform surface finish; levelling long sheets; laser cutting the trapezoid shapes; and transport logistics. Several companies worked together to develop tooling and shot-blasting techniques for the required finish. Specially designed transport was required to deliver the processed sheets to the site. Thanks to the innovative work of the architect, the Chapel presents a unique appearance with the beauty of stainless steel fully displayed.

Architecture, Building and Construction

The Planetarium at Nagoya City Science Museum

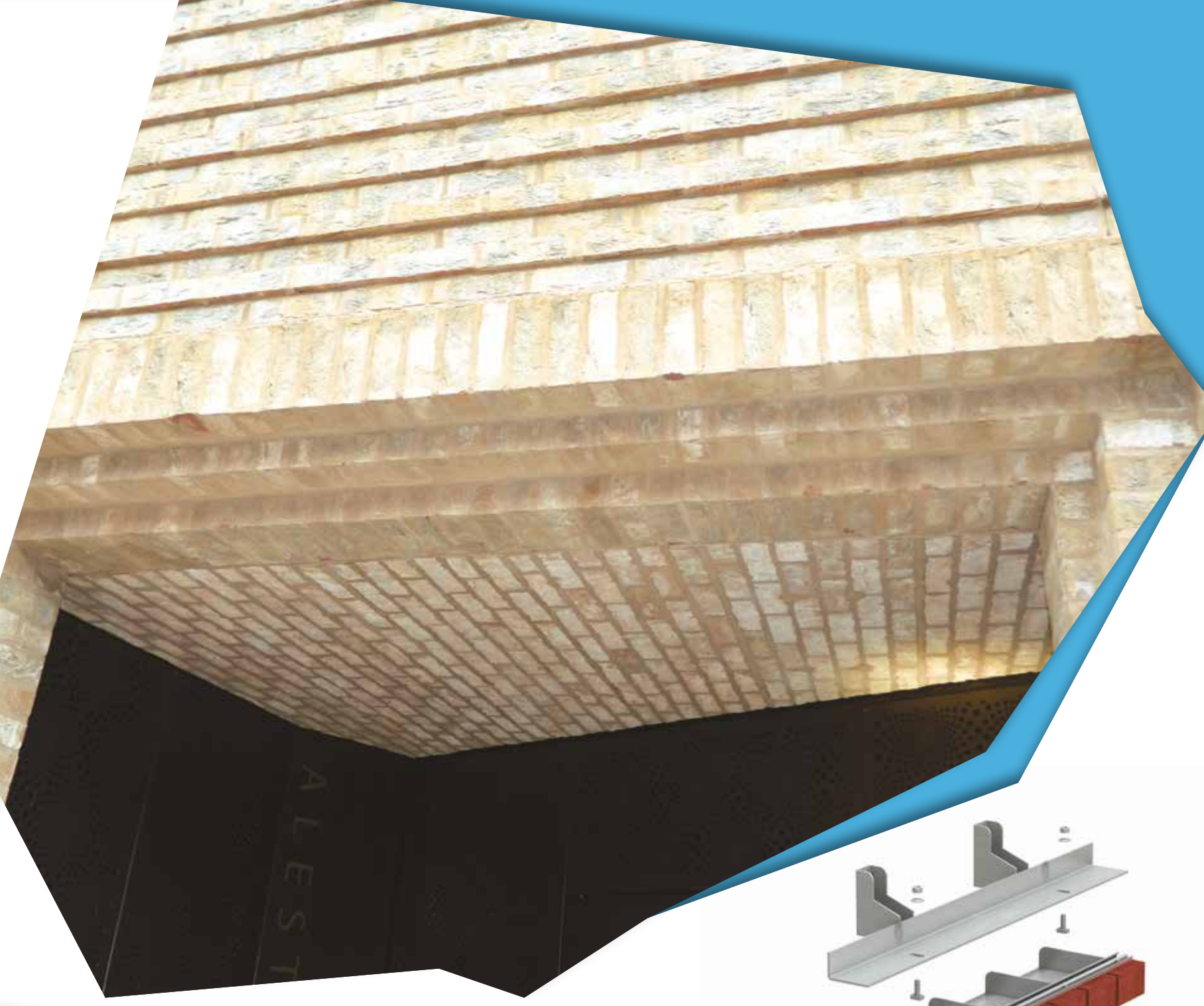
Location	Nagoya, Japan
Environment	Outdoor
Grade/surface	SUS445J1
Manufacturer	Nikken Sekkei Ltd., Nagoya City, and other supporting entities
Material supplier	Nippon Metal Industry
Source of information	JSSA

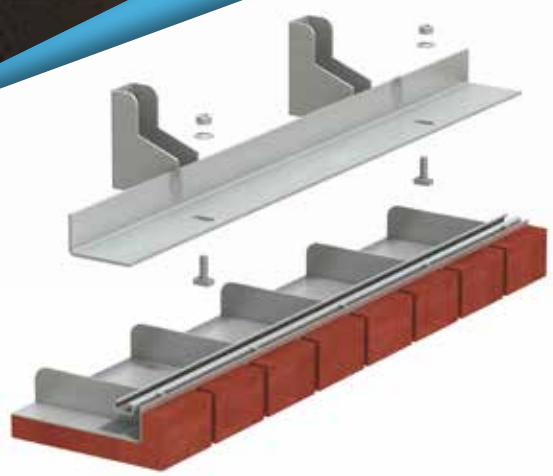
A ferritic stainless steel grade with high strength and excellent resistance to corrosion, type SUS445J1 was specified for the symbolic spherical outer wall of the world's largest planetarium, at Nagoya City Science Museum. The size and surface area of the sphere required a material, which is capable of withstanding seismic shocks while maintaining a pleasing aesthetic appearance over the planned design life of the building. This structure is a good advertisement for the use of stainless steel in the architectural, building and construction sectors.

Stainless Steel Supports for Lintels

Manufacturer Ancon, Sheffield, UK

Bricks are a traditional façade material in many parts of the world. Their use requires builders to use a variety of lintels for structural support. These can either be made from pre-cast concrete or produced manually by a mason, which requires considerable expertise and skills. To simplify this essential building technique, a fabricator of stainless steel building products and a brick producer have jointly developed a lightweight brick-faced structural support system. It combines easy handling together with maximum adjustability for easy alignment on site. The weight is less than half that of comparable cast concrete units, thus dispensing with the time and cost of special lifting equipment. Pre-fabricated off-site in a range of dimensions, they can be fastened to a proven stainless steel brick support system without any on-site cutting or drilling operations. The stainless steel may not be visible, but it provides a simple alternative to a traditional building technique.





Roof of the Kinpozan Enpukuji Temple

Location	Fukushima, Japan
Environment	Outdoor
Grade/surface	SUS304
Manufacturer	Douichi Metal Industry Ltd.
Material supplier	Nisshin Steel
Source of information	JSSA

Conventional materials for roofs of shrines and temples are tiles, copper sheets and prepainted steel sheets. More recently, however, requirements for alternate materials have risen which are lighter in weight, more capable of resisting the impact of possible earthquakes and more resistant to corrosion. Coated stainless steels have been known for some time to be a possible alternative material but because of the hardness of stainless steel it was not considered to be a good roofing material for shrines and temples where the roofs need extensive bending and curving work. To address this problem, a new roofing material was developed by colouring a softer and easier-to-process equivalent of grade SUS304, which helped to combine formability, corrosion resistance and light weight. The strength of the material adds resistance to earthquake damage, but it also allows for thinner gauges to be specified, thus reducing the weight of the roof. New technologies allow a range of colours for the stainless steel surface. The material can be easily installed, thus promoting stainless steel for roofing applications for these religious structures and contribute to preserving an important part of Japanese culture.

The Roof of the International Terminal at Haneda Airport, Tokyo

Location	Haneda Airport, Japan
Environment	Outdoor
Grade/surface	SUS445J2
Manufacturer	PTB Design/Management JV for Haneda International Airport and other supporting joint ventures and entities
Material supplier	Nippon Metal Industry
Source of information	JSSA

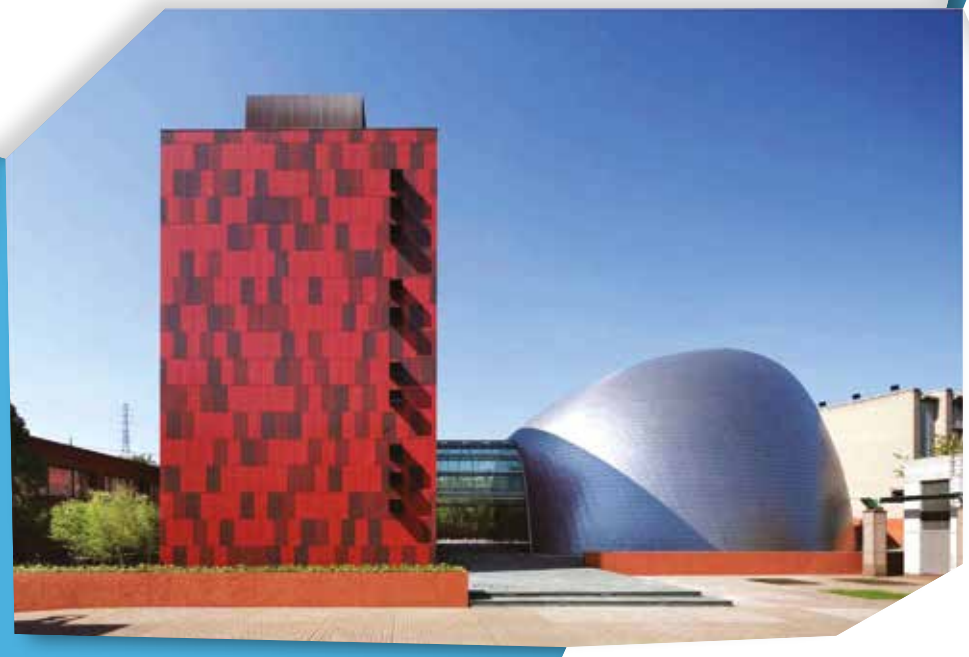
Haneda, also known as Tokyo International Airport, is one of the busiest airports in the world. The East Passenger Terminal was extensively expanded and re-modelled in the early 2000s to promote the airport as a hub for domestic air travel. The Departures Concourse was designed by the world renowned architects, Pelli Clarke Pelli, and features a stainless steel roof with skylights to provide natural light to the terminal. Ferritic stainless steel grade SUS445J2 was specified for the roof because of its excellent corrosion resistance in a relatively aggressive coastal environment and its high strength, which made it ideal for covering such a large surface area. The roof is clearly visible to all airport users and it was therefore important to specify a material which would retain an attractive appearance throughout the useful life of the building.

Architecture, Building and Construction

Sasashima Komeno Bridge

Manufacturer	Nagoya, Japan
Environment	Indoor
Grade/surface	SUS329J4L and SUS304
Manufacturer	Rintatsu Co.,Ltd.
Material supplier	Nippon Yakin Kogyo
Source of information	JSSA

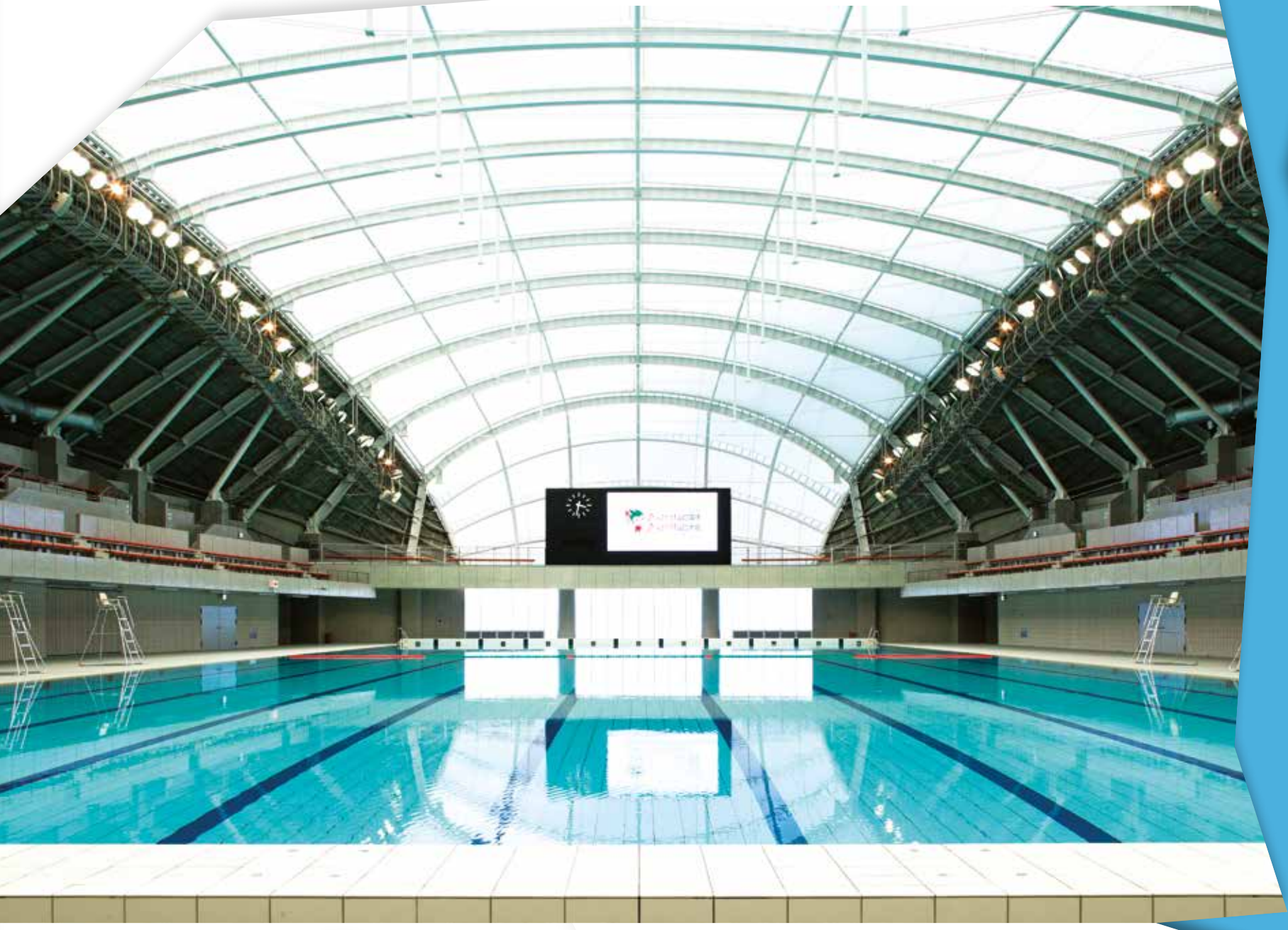
During the course of a land re-adjustment project in Nagoya City, a footbridge was built to connect areas of the City which had been divided into smaller sections with limited rail links. The location of the footbridge (above the railways) makes regular maintenance difficult and the overall length of 156 meters made it necessary to optimise the weight of the structure. With these factors to be considered, SUS329J4L, a duplex stainless steel which has high strength properties and is particularly corrosion-resistant, was adopted for decorative panels inside and outside the girders.



Senzoku Gakuen College of Music Silver Mountain E-Cube

Location	Kawasaki, Japan
Environment	Outdoor
Grade/surface	SUS445J2
Designer/architect	K/o design studio + KAJIMA DESIGN
Material supplier	Nippon Metal Industry
Source of information	JSSA

Senzoku Gakuen is a private institution in Kawasaki, Japan, which operates a school of music, a junior college, primary and secondary schools, and a kindergarten. The school of music was established in 1967, but adopted its present name in 2003, and offers under-graduate and graduate courses. The photograph depicts the rehearsal studios, a bulbous, free-form structure, built with a concrete base, covered with ferritic grade SUS445J2 stainless steel. The designers, K/o Design Studio and Kajima Design used the latest 3D programming technologies which made it possible to construct the free-form structure, utilizing the optimal fit for the 8,000 pieces of stainless steel cut to irregular sized sheets. A characteristic of the structure, known as the "Silver Mountain" is the moderate luster of transparent-coated ferritic stainless steel and the beautiful scale-like twisted patterns on the surface. This new application for stainless steel is expected to have a great potential in the future. At night-time, RGB colour lighting (RGB is an additive colour model in which red, green, and blue light are added together in various ways to reproduce a broad array of colours) gives the structure a fantastic, ever-changing, appearance, quite different from the way it looks during the daytime, and it has become a new attraction of for the college. A new area of expression has been opened through a computer-aided innovative way of utilizing stainless steel, which has previously been better known as an industrial product.

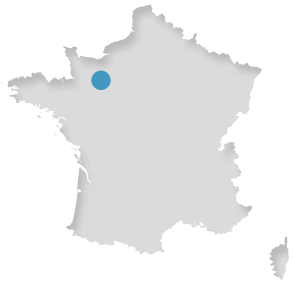


Architecture, Building and Construction

Yamaguchi-Kirara Expo Park Swimming Pool

Location	Yamaguchi, Japan
Environment	Indoor and outdoor
Grade/surface	SUS445J1 for the roof and SUS304 for the floor
Manufacturer	JV of construction companies
Material supplier	Nisshin Steel
Source of information	JSSA

The Yamaguchi-Kirara Exposition Park Swimming Pool is the Yamaguchi Prefecture's first official 50-meter Indoor swimming pool. It was built for the National Athletic Championships which were held in the Prefecture. Stainless steel was specified for the roof and the movable floor of the pool. The harmonious use of stainless steel has created a three-dimensional curved roof with a unique design. After the National Championships, the structure has been kept in place as a symbolic facility and it is now used socially by the local citizens. Being very close to the Seto Inland Sea, grade SUS445J1 with good corrosion resistance was adopted for the roof and grade 304 for the light weight channels of the structural frames.



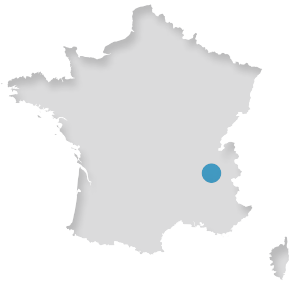
Tidal Sluice Gates at Mont Saint-Michel

Location	Normandy, France
Environment	Marine
Grade/surface	UR 2205+ (UNS S32205, EN 1.4462)
Engineering	BRL ingénierie - Luc Weizmann Architecte - SPRETEC - ANTEA - Bertrand Lanctuit, paysagiste
Fabricator	CM Paimboeuf
Material supplier	Industeel, ArcelorMittal Group, Le Creusot
Source of information	Industeel

Located in Normandy, Mont Saint-Michel is an island, 100 hectares in size. Accessible during the low tide and easy to defend during high tide, the island is known to have been inhabited since the 8th century. 400 years later, monks constructed an abbey and eventually a cathedral was built which attracted increasing numbers of pilgrims. In the late 19th century, with the beginning of modern tourism, a tidal causeway was built to facilitate access. The closed structure of this causeway interfered with the natural flow of water, which caused the bay to silt up gradually. To solve this problem, the construction of a hydraulic dam was initiated in 2006, to allow the water of the nearby Couesnon River to flush away the accumulated silt. With the completion of this project in 2015, the original character of Mont Saint-Michel was restored, without the need for a more conventional bridge. The gates that swing into position to regulate the exchange of water between the Couesnon estuary and the sea include duplex stainless steel floodgate plates with a carbon steel supporting structure. The exposed surface is resistant to the abrasive effect of the sand and is capable of withstanding the high water pressures where the bay opens to the Channel, with a tidal range of up to 14 meters. A tidal barrage regulates the water exchange between the Couesnon estuary and the bay of Mont Saint-Michel. High levels of abrasive stress require a material whose corrosion resistance does not depend on applied surface layers. The duplex stainless steel plates of the floodgates are welded to a carbon steel structure.

Photo courtesy of © Daniel Fondimare

Architecture, Building and Construction



Stainless Steel Cladding for Musée des Confluences

Location	Lyon, France
Environment	Outdoor
Fabrication process	Slitting
Grade/surface	EN 1.4404 (316L)/2B
Main thickness or diameter	3 mm
Manufacturer	Design Factory (Germany) - SMAC (France)
Material supplier	Aperam Stainless Europe
Remarks	Musée des Confluences, Lyon, France - COOP HIMMELB(L)AU © Duccio Malagamba
Source of information	Aperam

The Musée des Confluences is a science centre and anthropology museum opened in 2014 in Lyon, France. It is a stunning example of the beauty and agility of stainless steel. This already iconic building, designed by Austrian architects, Coop Himmelb(l)au, represents a union of glass and stainless steel. To complete this project, Aperam delivered 600 tonnes of 316L in a 3 mm thickness to the German company, Design Factory, who performed micro-bead blasting. Micro-bead blasting of a Uginox Matt base created a uniform satin effect that offers a particularly contemporary look. Over 17,000 stainless steel tiles in 37 different formats covered the 20,000 m² coating, including the underside of the building and the interior of the lobby and corridors. Beauty and agility at work, this combination of cladding, along with the stark shape of the building gives Musée des Confluences its stealthy appearance that may be accentuated under its shell or diluted in the light, creating the impression of a solid behemoth or a soft cloud.

Family Apartments Clad in Ferritic Stainless Steel

Location	Montreuil, France
Environment	Outdoor
Fabrication process	Bending
Grade/surface	EN 1.4526 (K36)/BA
Main thickness or diameter	0.8 mm
Material supplier	Aperam Stainless Europe
Source of information	Aperam
Remarks	Family Apartments, Montreuil, France - archi5 © Sergio Grazia

The Family Apartment (Familistère) is an exercise in highlighting the capabilities of five partners from the architectural practice, archi5, who rose to a challenge to build their own homes together in Montreuil, France adjacent to their offices. It also beautifully showcases how stainless steel, most often used in public buildings, can also be a versatile material of choice for private buildings. The architectural approach was to design a building with a light touch to avoid an overpowering visual impact. KARA (ferritic 1.4526 grade) stainless steel was archi5's choice of material to achieve the building's façade – lightly fluted with shallow waves adapted to suit the scale of the building – reflecting sunlight to surrounding buildings during the day and reflecting street lights at night. The Uginox® Bright covering, with its brilliant finish, takes on all the colours of the seasons. The result is a dynamic façade with a genuine sense of motion. Stainless steel has a harmonious application and the façades were entirely laid out based on the measurements of the sheets used, which meant that the window modules could be inserted at regular and precise intervals. The sheets were fitted to a primary frame structure and attached using visible stainless steel hexagonal screws. A hollow 5 mm joint is inserted between each sheet. Edging on the building is also made from stainless steel. Ferritic stainless steels have a more stable price structure than austenitic grades, providing a big advantage to the construction sector where project costing and economic design are key management elements. The Familistère project took two years from funding, conception, design and construction.

Architecture, Building and Construction

Condensing Gas Boiler Exchangers

Location	Europe, USA
Environment	Outdoor
Fabrication process	Tube Forming and Welding
Grade/surface	EN 1.4509 (K41)/2B-2R
Main thickness or diameter	from 0.8 to 1 mm
Manufacturer	Exchangers manufacturers
Material supplier	Aperam Stainless Europe
Source of information	Aperam

1.4509 (K41) is a Niobium & Titanium stabilised ferritic grade of stainless steel, containing 18 % chromium, which has been approved for use in the automotive exhaust industry for many years. Aperam has capitalised on this experience for a new application for heat exchangers in condensing gas boilers that makes them more resistant to corrosion and easier to maintain. Stainless steel is a green material par excellence: it is infinitely recyclable, environmentally neutral, and, when in contact with water, there is no leaching of its constituent metals which could alter their composition. There are many advantages from using of this grade of stainless steel for the manufacture of gas boiler exchangers. The addition of Niobium enables continued high temperature oxidation resistance, thermal fatigue resistance and creep resistance. Stainless steel oxidises lower than other commonly used materials, resulting in a longer life for the exchanger. The material also allows thinner gauges to be specified, which provides a reduction in weight for the exchanger, and, by extension, for the boiler. Its resistance to aggressive boiler condensates is better than other commonly used materials and as with all ferritic grades, it is not susceptible to stress corrosion. The dual stabilisation with titanium and niobium affords it excellent resistance to intergranular corrosion. An added advantage is that ferritic stainless steels have a more stable price structure than austenitic grades.

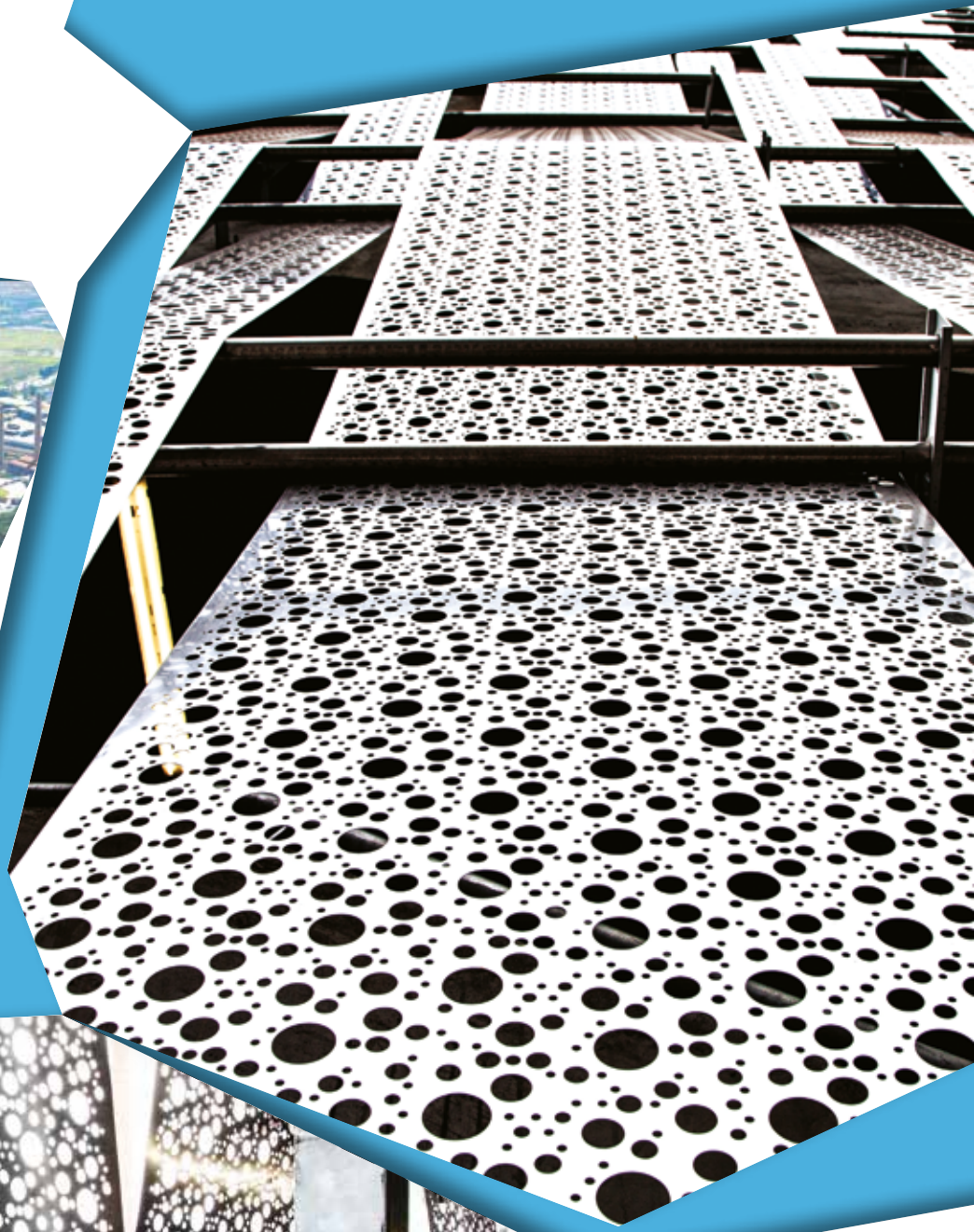
Architecture, Building and Construction

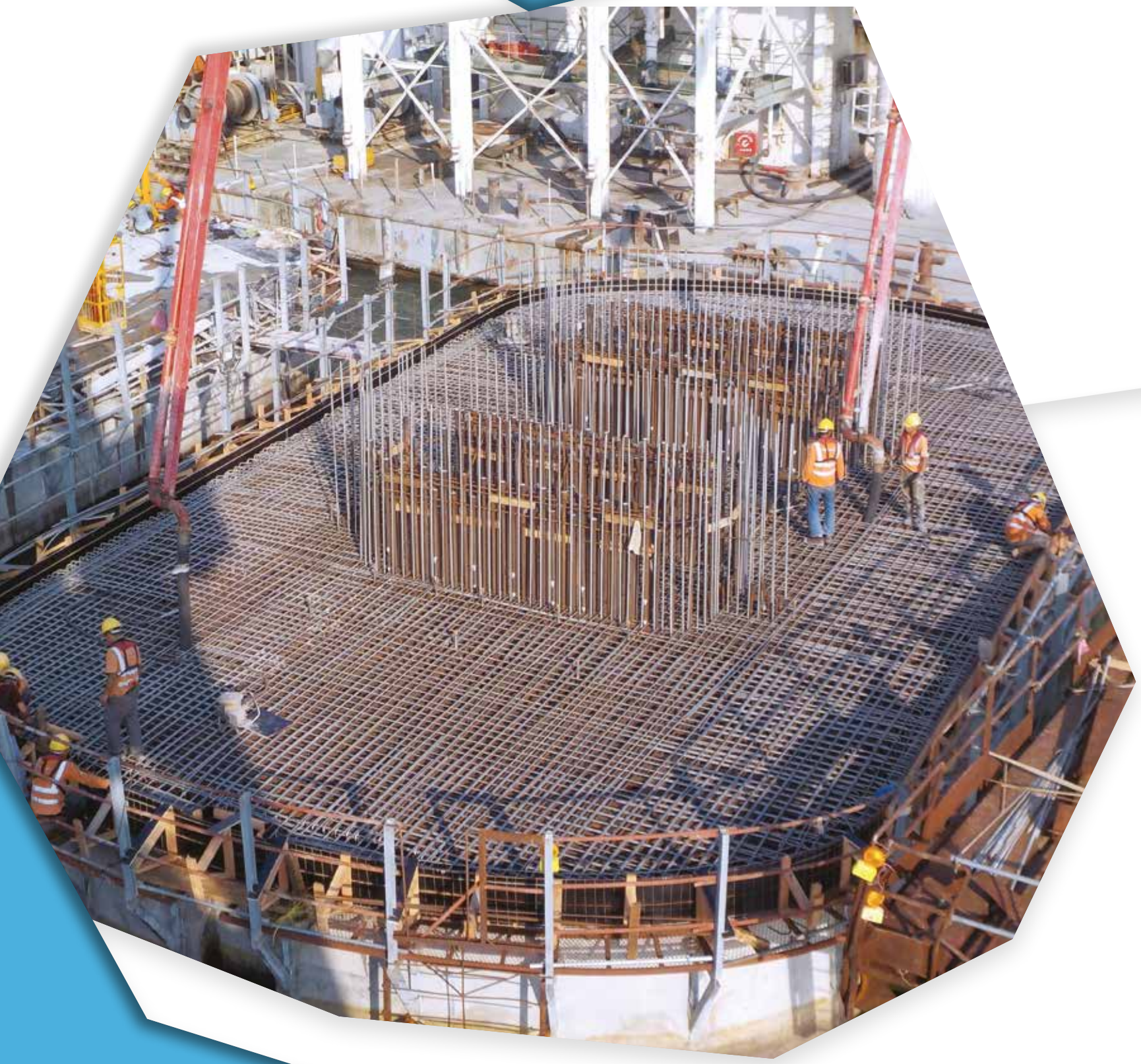
Allianz Parque

Location	São Paulo, Brazil
Environment	Outdoor
Grade/surface	444 /2B
Manufacturing companies	WTorre (contractor), Permetal (perforated sheet) and Hunter Douglas (façade)
Material supplier	Aperam South America
Source of information	Aperam South America

Allianz Parque, also known as the Palestra Itália Arena, is a multipurpose stadium in São Paulo, Brazil, which was built in anticipation of the 2014 FIFA World Cup, is capable of hosting football matches for a capacity of 44,000 fans and also concerts and corporate events and is owned by Palmeira. The stadium is one of the most modern multipurpose event arenas in the country, and meets FIFA's standards as well as being accredited for other sports tournaments. The stadium was designed by the architect Edo Rocha and built by WTorre Properties and was completed in November 2014. The structure required some 280 metric tons of super ferritic grade 444 (produced by Aperam South America under its registered brand name K44) which was delivered in cold rolled form with a standard 2B finish, and as coils and tubes in several dimensions to suit the structural form devised by the design. Stainless steel was chosen for the complex structure of the roof framework as well as the cladding for the stadium walls and its roof because of its pleasing aesthetic appearance as well as its ease of cleaning and its durability. The appearance is striking. This stadium will be available to provide entertainment for many hundreds of thousands of enthusiastic fans for the next generations.


Allianz





Hong Kong to Macau Bridge

Location	Hong Kong, Macau, China
Environment	Marine
Structural engineers	HPDI (China Highway Planning and Design Institute)
Owner/developer	China Government
Fabricator	Arminox and others
Stainless steel grade	EN 1.4362
Product type	Rebar
Dimension	10 mm to 32 mm
Surface finish	Ribbed
Producer or supplier	Roldan (Acerinox group) and others
Source of information	Cedinox Magazine

The Hong Kong–Zhuhai–Macau Bridge is an ongoing construction project which consists of a series of bridges and tunnels that will connect three major cities on the Pearl River Delta in China. The proposed 50 km link is expected to cost US$10.6 billion. The longest bridge section will be 29.6 km and include three cable-stayed spans between 280 and 460 m. Construction began on 15 December 2009 and the bridge is due for completion in late 2016. As corrosion damage would be impractical to repair at a later point in time, duplex stainless steel grade EN 1.4362 was selected for the outer parts of the reinforcement which may be exposed to elevated chloride levels.

Photo courtesy of Arminox

Architecture, Building and Construction

Road Bridge Renewal

Location	Allt Chonoglais, Scotland (UK)
Structural engineers	Scotland Transerv, Glasgow
Owner/developer	Transport Scotland, Glasgow
Fabricator	Morrison Construction Ltd.
Stainless steel grade	2304 (EN1.4362)
Product type	Reinforcement bar
Dimension	Diameters 10, 16 and 25 mm
Producer or supplier	Outokumpu
Source of information	Outokumpu

The existing A82 Allt Chonoglais Bridge in Scotland was identified as being understrength to carry future traffic loads. To repair was deemed uneconomic and in August 2012 work started to demolish and replace the existing bridge with a new stronger reinforced concrete structure, incorporating stainless steel rebar. In order to create a durable and economic bridge over the full design life period it was decided that stainless steel rebar should be used in the areas which are at greater risk from chloride induced reinforcement corrosion due to the application of de-icing salts during the winter months. This included the bridge deck, abutments, wing walls and bearing plinths. The original specification called for grade 304 stainless steel rebar, but after further research, steel EN 1.4362 (2304) was accepted as an alternative. Tests show that this grade has a Critical Chloride Threshold Level (CCTL) over 4 % per mass of cement at room temperature, which is over ten times the figure usually associated with rebar and beyond the levels normally expected at typical rebar depths of cover, concrete quality, and for a 120 year design life, even in the most severe of chloride environments. All of the stainless steel rebar was cut and bent to shape on machinery designed and used solely for stainless steel.

Concrete Bridge Reinforcement

Location	Ottawa, Ontario, Canada
Environment	Urban
Owner/developer	Ministry of Transportation, Ontario
Stainless steel grade	2205 (EN 1.4462) for rebar, 316 (EN 1.4401) for connectors
Product type	Rebar
Producer or supplier	Valbruna
Source of information	IMOA

The Canadian capital is exposed to a climate that is characterized by extremely cold winters which require large quantities of deicing salt to be used. Concrete is porous and cracks are difficult to avoid. Over time, salt-containing water penetrates the concrete and corrodes the steel reinforcement. The resulting rust increases the bar's volume which accelerate concrete degradation. Over a decade ago, the Province of Ontario compared the behaviour of galvanized and epoxy-coated steel rebar with its stainless steel counterparts. The results confirmed the superior durability of stainless steel. Besides the direct cost of corrosion repair, the authorities also took into account the indirect cost resulting from traffic disruptions caused by bridge repair. In a memorandum, they stipulated that for bridges used by more than 100,000 verhicles per day only stainless steel rebar should be specified. This policy was implemented in the Hurdman Bridge, finished in 2014. It is part of one of the country's busiest Highway and duplex stainless steel reinforcing bars were selected for the deck and barrier walls. For tie wires, which keep the rebar in place when the concrete is poured, austenitic alloy 316 was used and also the rebar couplers were made from stainless steel. The decision for the stainless steel option is an indicator of the responsible use of taxpayers' money and motorists' time. (Adapted from MolyReview 1/2015, courtesy of IMoA).

Photo courtesy of Frank Smith

Tension Rods in a Road Bridge

Location	Jemeppe-sur-Sambre, Belgium
Environment	Urban
Owner/developer	Infrabel
Fabricator	GTM, Denain, France
Stainless steel grade	UGI 4462 (EN 1.4462)
Product type	Bar
Dimension	80 mm
Surface finish	Work hardened
Producer or supplier	Ugitech
Source of information	Ugitech

When renewing a road bridge over a railway line, the Belgian public infrastructure management company Infrabel selected duplex stainless steel grade 1.4462 for the tension bars. Its long-term durability was an advantage in an environment where deicing salt is regularly used in winter.

Maintenance Cradle for a Suspension Bridge

Location	Hardanger, Norway
Environment	Coastal
Structural engineers	Public Roads Administration
Fabricator	Vistal, Gdynia, Poland
Product type	Grade 316L (EN 1.4404) as
Grade	Sheet : 1 mm to 5 mm
Dimension	Rod : 40 mm to 100 mm
Surface	Circular hollow sections, 42.4 mm x 2 mm
	L sections : 40 mm x 40 mm
Producer or supplier	Grade 316 Ti (EN 1.4571) 1D and 1B
Source of information	Outokumpu, MTL, Nova Trading Vistal

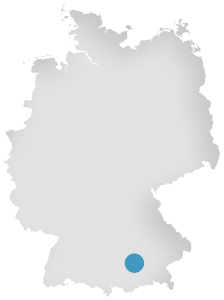
The mountainous Norwegian coastline with its fjords makes the building and subsequent maintenance of bridges an exceptionally complex operation. At Hardanger, a bridge measuring 1,350 meters replaced a ferry connection and considerably shortened the travel time between the capital Oslo and the well-known tourist destination Bergen. Opened in 2012, it is the longest tunnel-to-tunnel suspension bridge in the world. Given the sailing height of 55 meters, strong winds and the long, harsh winters in Scandinavia, the service cradle involves closed side walls to protect the workers. As the bridge is directly connected to tunnels at both ends, future painting and repair of the cradle itself would be complex and costly. The designers therefore selected molybdenum-containing stainless steels of the 316 family for the structurally relevant parts.

Photo courtesy of Vistal Gdynia S.A., Gdynia, Poland

Press-Fit Tube As Cable Channels

Location	Milan
Environment	Urban
Fabrication process	Tube making, press-fitting
Grade/surface	304 (tube), 316L (fittings)
Dimensions	Tube 108 and 74.1 mm; wall thickness 2 mm
Manufacturer	Eurotubi Europa Spa, Nova Milanese (MB), Italy
Date of completion	2015
Material Supplier	Aperam Stainless Services and Solutions Tubes Europe, Ancerville, France
Source of information	Centro Inox, Milan, Italy

Stainless steel press-fitting systems have a long history of successful use for industrial and domestic plumbing, heating and gas installations. However, there is more use for them than conveying liquids or gas. In the construction of a temporary footbridge used by thousands of visitors as the main access route to the 2015 World Exhibition in Milan, they were used as cable channels. In total, 7,000 m of stainless steel tubes manufactured from type 304 were installed, requiring 2,100 press-fit joints, which were interconnected by fittings of grade 316L stainless steel. The rigid metallic design requires fewer anchor points than classic plastic cable channels. The elasticity of stainless steel and a series of expansion joints gave the installation the necessary flexibility to absorb the lateral movement of the 520 m-long steel structure, which could be up to 4 cm, depending on the load. Stainless steel tubes, in combination with the proven press-fit fitting technique, provide a practical and aesthetically pleasing solution wherever cables need to be protected mechanically against accidental damage and vandalism.



Coloured Sol-Gel Coatings

Manufacturer Poligrat, Munich, Germany

Date of completion 2015

Several proven colouring techniques are available for stainless steel but some of them have limitations: organic coloured coatings are usually opaque and remove the metallic look; electrochemical coatings are UV resistant but not particularly abrasion resistant and difficult to reproduce precisely; physical vapour deposition (PVD) coatings can be quite hard, but the range of colours is limited. A new colouring technique, Verospectral, avoids these limitations. It is a sol-gel coating, with a very thin layer that is applied in liquid form to a surface and then cured. Once hardened, it is glass-like and hydrophobic - water runs off easily, without leaving traces. It is an inorganic substance, which is not susceptible to ageing or degradation by UV radiation. The technology required for clear coatings is proven and has been used in anti-fingerprint treatments of stainless steel for years. The new Verospectral process now makes it possible to colour these clear coatings. The pigments used are also inorganic and therefore long-term UV resistant. The specific nature of the process ensures that the layer is fully uniform, unlike some earlier experiments with coloured so-gel coatings. A wide range of colours is available in several saturations. The colours can be reproduced precisely even years after the delivery of the original batch, making it easy to replace, for instance, damaged façade panels. The new process makes stainless steel a candidate material for applications in which colour is requested and the traditional techniques are impractical.

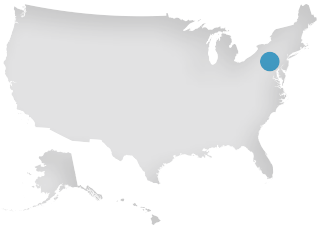

Olympia-Einkaufszentrum
Olympia-Einkaufszentrum

Len Lye Museum

Location	New Plymouth, New Zealand
Environment	Outdoor
Grade/surface	316L, No. 8 finish
Designer/architect	Patterson Architects
Source of information	NZSSDA

A strikingly different use of stainless steel in architectural applications can be found in the city of New Plymouth, New Zealand, where the award winning Len Lye Center is to be found at the Govett-Brewster Art Gallery. This inspirational building has a mirror-like façade manufactured from approximately 32 metric tons of austenitic 316L stainless steel sheets, beautifully polished to a No. 8 finish, which have been hung in vertical inter-locking panels which exhibit an apparently seamless appearance while reflecting the images of the immediate surrounds. The effect is stunningly beautiful and has already made the building an attraction for visitors to the city. The building was designed by Patterson Architects, who used stainless steel because it had been a medium for a number of Len Lye's sculptures over many years. The highly alloyed grade 316L, containing nickel, chrome and molybdenum is particularly well suited for external façades of buildings in coastal environments because of its robust resistance to corrosion.

Photo courtesy of Patterson Architects, and taken by Patrick Reynolds.



Architecture, Building and Construction

Stainless Steel in the New World Trade Center Transit Terminal

Location	New York, USA
Environment	Outdoor
Grade/surface	LDX 2101® duplex grade
Fabricator	Cimolai Spa
Material supplier	Outokumpu
Source of information	Outokumpu

The new World Trade Center Transit Terminal, named Oculus, is one part of the total Ground Zero reconstruction plans on the site of the original Twin Towers of the World Trade Center in New York City. Outokumpu has supplied approximately 340 tons of stainless steel plates made from high strength LDX 2101® duplex grade, which enables the designer to specify thinner gauge and more cost efficient material for the construction. The material was delivered to Cimolai Spa of Italy, which is one of the main steel fabricators for the Oculus project and is responsible for the fabrication of the lower supporting structure. The plates were produced at Outokumpu's Degerfors plant in Sweden. The stainless steel plates will be welded between carbon steel components and act as a thermal barrier to prevent excessive length expansion and tension in the lower supporting part of the structure. In general, the use of duplex stainless steel plates in demanding construction projects is increasing in popularity. The excellent corrosion resistance and high strength of duplex grades offer considerable material weight savings and also lower overall life cycle costs to the building and construction sector.


WORLD TRADE CENTER
TRANSPORTATION

Stainless Steel Containment Solution for Chernobyl

Location	Chernobyl, Ukraine
Environment	Outdoor
Grade/surface	316L
Material supplier	Aperam
Source of information	MolyReview

In a catastrophic failure in 1986, the nuclear reactor at Chernobyl suffered a meltdown which resulted in a wide-spread distribution of radio-active contamination. The risk of further contamination was initially limited by the construction of a large concrete enclosure around the reactor, but after thirty years the combination of time and weather had begun to degrade the concrete structure and a fresh solution became critical. With a design life of 100 years (to allow for the development of new technologies to provide a long term solution) and the required capability to withstand severe temperature ranges, a class 3 tornado and an earthquake up to class 6 on the MSK64 scale, the new structure had to be erected on-site. To meet the indicated design criteria, the engineers specified grade 316L stainless steel. The final structure stands 108 meters high by 162 meters long and has a width of 257 meters, giving a final volume of 3 million cubic meters, equal in size to the O2 Arena in London, but the walls are 12 meters thick. The total weight of the materials is 31,000 metric tons. Stainless steel was a natural material of choice because of its durability, high corrosion resistance and mechanical strength. The stainless steel was delivered by Aperam. It is difficult to imagine a more demanding application than this new enclosure for the aftermath of the Chernobyl meltdown and it is noteworthy that molybdenum containing stainless steel has been selected as a solution.

Story and picture courtesy of the MolyReview.

Cladding of the Underside of a Road Bridge

Location	Turku, Finland
Environment	Coastal, urban
Architects and Structural Engineers	WSP Finland, Helsinki
Owner/developer	City of Turku
Fabricator	Hermann's Finland Oy, Raiso, Finland
Stainless steel grade	2205 (EN 1.4462)
Product type	Cold-rolled sheet
Dimension	4 mm, 2000 mm wide
Surface Finish	2G (ground)
Producer or supplier	Outokumpu
Source of information	Outokumpu

Located in Turku, the original Myllysilta bridge, made from concrete developed serious structural problems and was demolished in 2010 after only 35 years of service. It was replaced by a steel construction with a concrete deck, which allowed cables and pipes to be accommodated. To achieve an aesthetically pleasing solution, the designers clad the underside with 320 stainless steel panels, which reflected the LED lighting. Due to the brackish water of the Aura river, the cladding had to be highly corrosion resistant. Besides the coastal location, de-icing salt used on the bridge during the winter months created a corrosive environment. Despite its decorative nature, the requirement for the surface was to remain bright and shiny with minimal maintenance. An austenitic-ferritic stainless steel, grade 2205 (EN 1.4462), was used which had a track record of performing well in comparable environments. This type of stainless steel is mainly found in heavy structures, which are made from hot-rolled material and consequently have a matt surface. The Myllysilta bridge showed that duplex stainless steel as a cold-rolled sheet material can be as glossy as its austenitic counterparts. (For full reference, please see: imoa.info)

Picture courtesy of WSP Finland / Esko Keski


TCA

Fire-Resistant Cable Fasteners

Fabrication process	Stamping, bending
Grade	430 (EN 1.4016)
Manufacturer	Source Engineering and Manufacturing, Plympton, Devon, UK
Date of completion	2015

Major improvements in the safety of buildings are often triggered by catastrophic events. A recent example is a case of fire fighters becoming entangled in a collapsed wiring system. This tragedy resulted in two casualties and led to an amendment to the British building codes. Since mid-2015, wiring systems in escape routes must be supported by metal fixings or held by metal containment instead of plastic, which can melt and fail. UK suppliers, Source Engineering and Manufacturing, selected stainless steel for their new metallic fastening system. As cables are often found in enclosed or permanently humid locations, stainless steel eliminates the corrosion risks. Ferritic stainless steel was found to have the most suitable profile in terms of cost-effectiveness and technical performance.

Pedestrian and Cycling Bridge

Location	Sölvesborg, Sweden
Environment	Coastal
Bridge designer	Ronny Södergren, Sölvesborg, Sweden
Owner/developer	Municipality of Sölvesborg
Fabricator	Stål & Rörmontage, Sölvesborg, Sweden
Stainless steel grade	LDX 2101 (EN 1.4162)
Product type	Plate
Dimensions	5 mm - 30 mm
Surface Finish	1D
Producer or supplier	Outokumpu
Source of information	Outokumpu

When designing a pedestrian and cycling bridge between the city centre and a newly developed residential district, the town of Sölvesborg in Sweden looked for a material that would last for an extended lifetime with minimal maintenance. Duplex stainless steel provided the solution. As the salinity of the nearby Baltic Sea is lower than that of, for instance, the North Sea, lean duplex stainless steel was adequate technically and economically. It is no longer necessary to provide for regular re-painting, which saves considerable maintenance costs during the life time of the bridge. The nearby bird conservation area will also benefit because the noise and pollution associated with the sand blasting of conventional steel structures will be avoided. At 756 m, this is currently the longest pedestrian bridge in Sweden. The extra weight saving which is made possibly by the high-strength properties of duplex stainless steel was an additional advantage in the design of the attractive and uniquely shaped arch.

This iconic bridge is one of the subjects of a new series of Postage Stamps, which have been issued in Sweden. Picture of the stamp is courtesy of PostNord Frimärken.


SVERIGE
BREV
SÖLVESBORGSBRON

UFA Public Conveniences

Location	Rio de Janeiro, Brazil
Environment	Outdoor
Grade/surface	316L
Material supplier	Aperam South America
Source of information	Aperam South America

In response to the needs of thousands of participants and spectators at the Annual Carnival in Rio de Janeiro, and in an effort to avoid hygienic hazards and to preserve public decency, the Prefeiture do Rio de Janeiro developed an ingenious type of public convenience which is safely connected to the city's sanitary drainage system. To make the units more attractive, but also to ensure that they are durable in very aggressive service conditions as well as in the harsh coastal environment, austenitic grade 316L stainless steel with a polished finish was used. The result is a construction which is easy to install and to clean, attractive and provides a very practical solution to what was an urgent problem. Stainless steel public conveniences are not new – indeed the Euroinox website contains a feature on this type of unit. But the Rio de Janeiro example illustrates how stainless steel can provide a rapid solution to a pressing need.


UFA
UFA

Parlak Water Feature

Location	Pretoria, South Africa
Environment	Indoor
Grade/surface	304
Designer/architectMore	Bilal Parlak
Source of information	Columbus Stainless

This innovative water feature can be seen in the Menlyn Park Shopping Mall, in Pretoria, South Africa. Designed by Bilal Parlak, using austenitic grade 304 stainless steel with a Scotch Brite surface finish, supplied by Columbus Stainless, the feature is 9 meters high and has a continuous flow of water to resemble a water fall. Because of the continuous curtain of water in front of the stainless steel, it was essential to have material which was perfectly flat. The frame was also constructed from 304 stainless steel. The result is an unusual and eye-catching sculpture.

Information and photographs courtesy of Jacob Mouw and Columbus Stainless, and Mr. Bilal Parlak.

Stainless Steel Mosque Pedestal

Location	South Africa
Environment	Indoor
Grade/surface	Cromanite
Designer/architect	Bilal Parlak
Source of information	Columbus Stainless

This example was designed by Bilal Parlak in South Africa and fabricated using Cromanite stainless steel produced by Columbus Stainless. Cromanite is a high nitrogen austenitic stainless steel containing 19% chromium, 10% manganese and 0.5% nitrogen, which has a good combination of strength, toughness, ductility, work hardenability and corrosion resistance. This grade of stainless steel performs exceptionally well in industrial applications where there is wet sliding abrasion and high impact abrasion and in a variety of high strength applications even at elevated temperatures. It is a weldable stainless steel that can be easily be cut, machined and formed. Mr. Patel has specified this grade for his pedestal for its highly durable and corrosion resistant properties. The result is an attractive unit which may well last for a hundred years!

Information and picture from Jacob Mouw and Columbus Stainless and from Mr. Bilal Parlak.

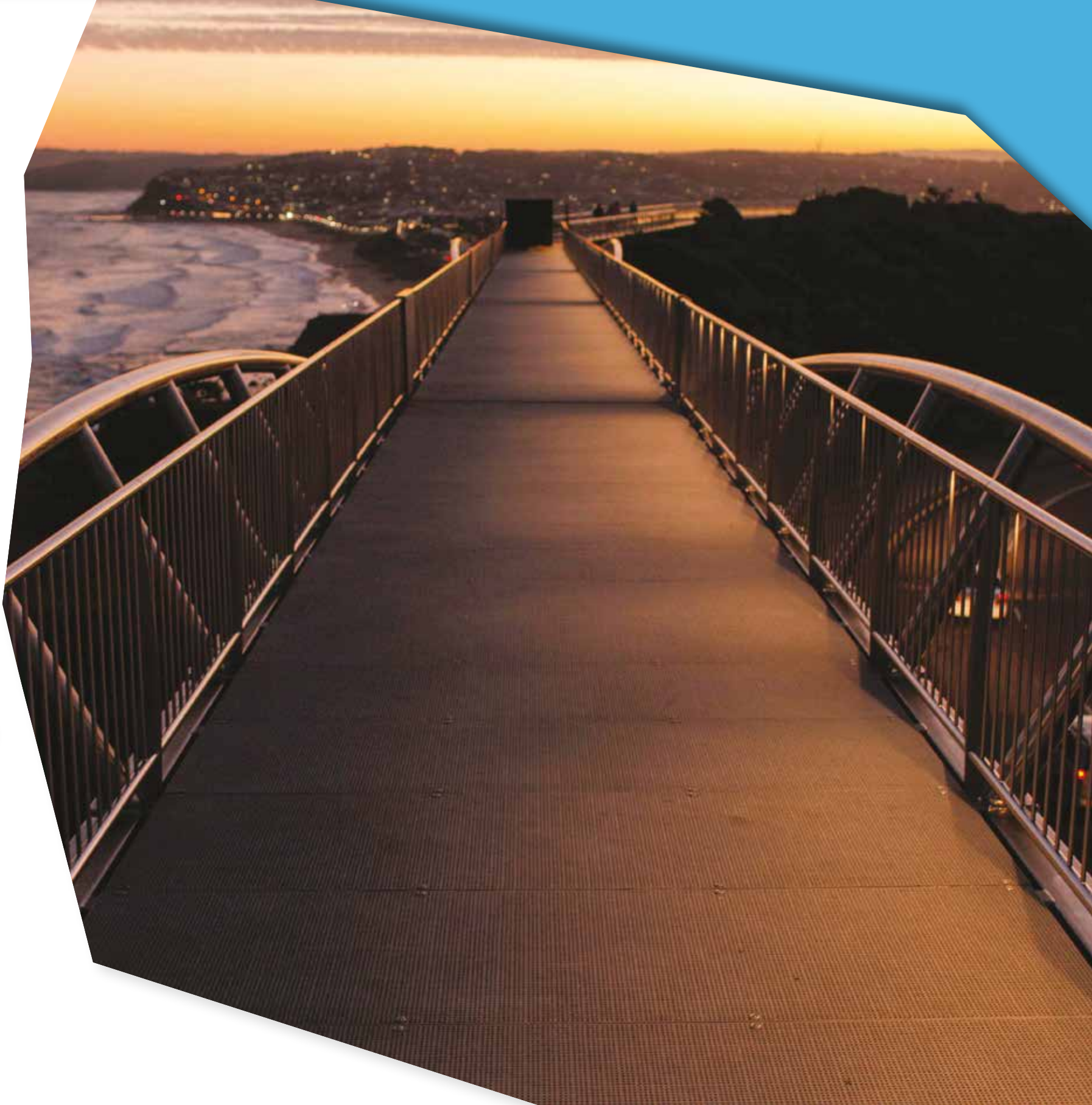
Art and Street Furniture

A Stainless Steel Walk to Remember

Location	Newcastle, Australia
Environment	Outdoor
Grade/surface	316L
Designer/architect	EJE Architecture
Builder	Waeger Construction
Engineering	Northrop Engineers
Source of information	ASSDA

Combining the breath-taking natural beauty of Australia's eastern coastline with the timeless beauty of stainless steel, a new walkway has been constructed around the cliffs of Newcastle, linking Strzelecki Lookout and Bar Beach. Named the Newcastle Memorial Walk to commemorate the Anzac Centenary, the walkway was opened on 24 April 2015. With a total length of 450 meters, and built at a cost of $4.5 million, the project was designed by EJE Architecture and built by Waeger Construction, with engineering by Northrop Engineers. As the design life was required to be not less than 70 years, austenitic grade 316L was selected for its proven strength, corrosion resistance and durability. The construction required 64 metric tons of stainless steel in the forms of hollow sections, bridge section frames, round bars and tubes for handrails. The pre-construction fabrication work of the bridge was done by SGM Construction and Fabrication and it was delivered in 8 single span sections 20 meters in length. Seven Y shaped precast concrete pylons, up to 8.8 meters high and 3.4 meters wide, support the bridge sections. The handrails and vertical balustrades were electro-polished by Australian Pickling and Passivation Service. Newcastle's beaches receive more than 2 million visitors every year and the Newcastle Memorial Walk has already positioned itself as a major tourist attraction. But one should never forget that it also stands as a fitting monument to all Australian and New Zealand service men and women who served and died in all wars, conflicts, and peacekeeping operations and to the contribution and suffering of all those who have served.

Information provided by Richard Matheson and Lissel Port of ASSDA. Pictures courtesy of Thomas Bryce.



Art and Street Furniture

Stainless Steel Under the Sun

Location	Victoria, Australia
Environment	Outdoor
Grade/surface	316
Artists	Robert Owen and Joanna Buckley
Source of information	ASSDA

According to Ecclesiastes 1:9, "What has been is what will be, and what has been done is what will be done, and there is nothing new under the sun". Well, now, thanks to the imaginative design of Melbourne artists, Robert Owen and Joanna Buckley, there is a new sculpture entitled "Under the Sun" at the entrance to Stockland's Point Cook Centre, in Victoria, Australia. This mesmerising art form is a 1300 kg stainless steel sculpture with a diameter of 6.5 meters, suspended above the entrance as to resemble the moon floating over the earth. The piece was commissioned as part of a $20 million revamp and was completed in 2014. Engineering work was carried out by Anthony Snyders of Adams Consulting Engineers and the fabrication by the artists themselves, in conjunction with Jeph Neale of Artery Cooperative and Luke Adams of Eco Electrics. The detail work was laser cut by Arrow Laser. The artists specified 316 stainless steel for the sculpture and the supporting mast and cables, for its excellent corrosion resistance, especially having regard to the harsh environment of coastal cities. The production was aided by 3D modelling in consultation with Ronstan Tensile Architecture General Manager, Rowan Murray. The surfaces of the structure were polished done by MME Surface Finishing. The final result of this complex collaborative effort is a piece of unique art-work bringing together the elements for which stainless steel is justifiably famous – pleasing aesthetics, excellent corrosion resistance, durability and formability. For the architectural, building and construction sectors, the only limitation on the use of stainless steel is the scope of the imagination.

Information and the photographs have been supplied by ASSDA and we gratefully acknowledge the cooperation of Richard Matheson and Lissel Port. Pictures courtesy of John Gollings.


CHOCOLATE

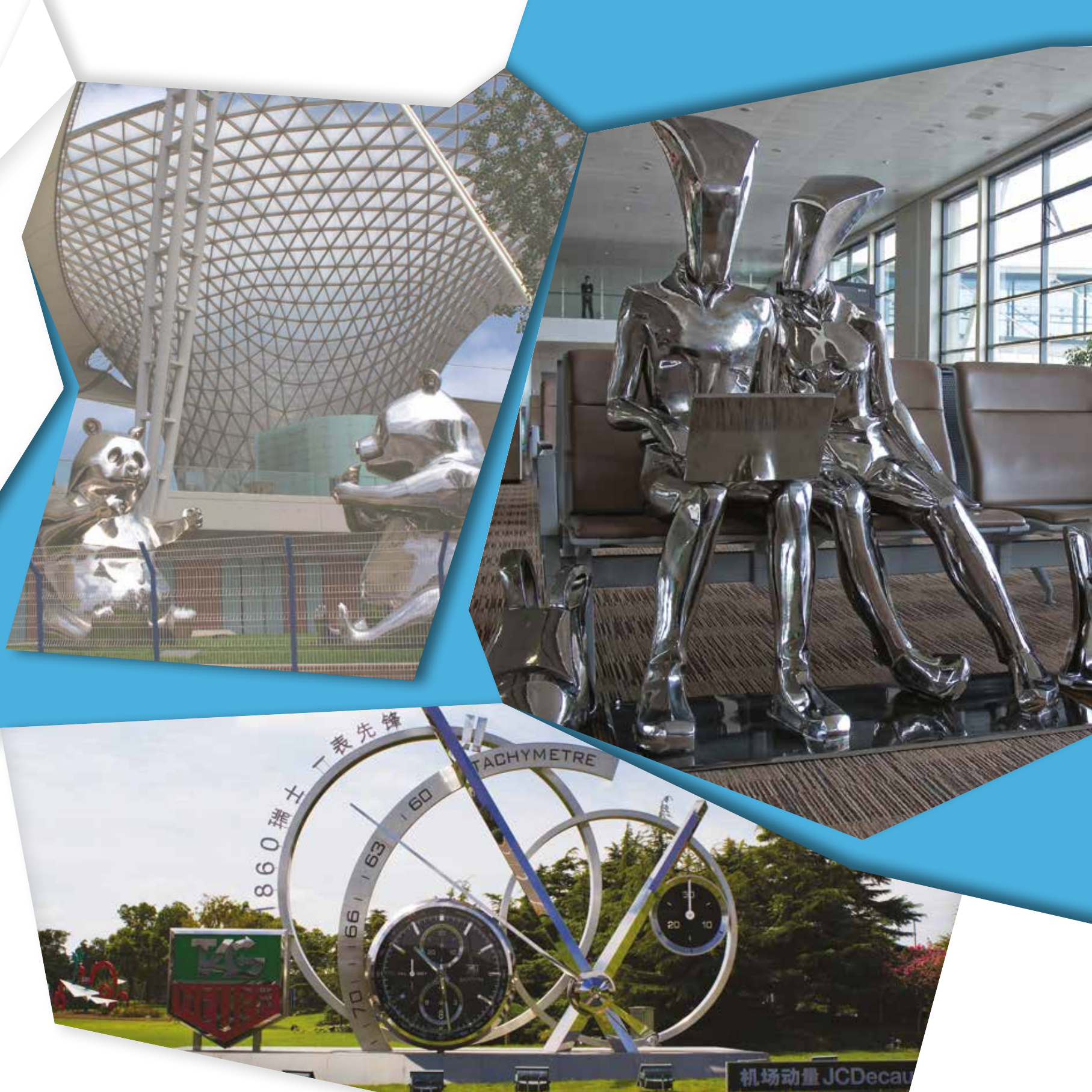
Art and Street Furniture

Art in Shanghai

Location Shanghai, China
Environment Indoor and Outdoor
Source of information Shanghai Krupp Stainless

Stainless steel has been a popular material for street furniture and city sculptures all over the world because its excellent resistance to corrosion gives the art-work a longer life expectancy, particularly in coastal cities. Shanghai has a wonderful variety of stainless steel art-works situated widely across the city. Brightening the landscape of the city and providing enjoyment for citizens and visitors alike. These three examples have been beautifully captured on film by Mr. Chen Shang Shen. The first depicts the artist's fascination with time and is a sculpture which has been placed at the entrance to Pudong International Airport in Shanghai. The second depicts the animal which is best associated with China, the beloved Panda. In this sculpture a pair of Pandas are shown seated near the entrance to the site of the Shanghai World Expo which was held in 2010. Finally, there is a sculpture of a couple sitting at the Domestic Terminal of Pudong Airport, reading a laptop, with their luggage on the ground next to them. In each case local artists have been used and the stainless steel was sourced from local producers.

Photographer: Chen Shang Shen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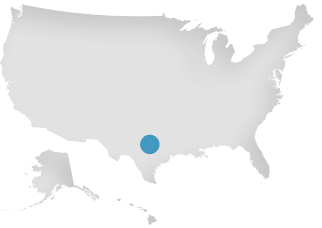
Art and Street Furniture

Stainless Steel Canoe Sculptures

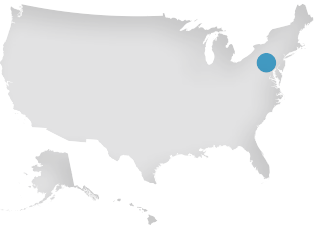


Location	Houston, Texas, USA
Environment	Outdoor
Designer/architect	John Carroll Runnels
Source of information	Houston Chronicle

An artist and sculptor based in Houston, Texas, John Runnels, has made 16 sculptures of boats which he has placed along the Buffalo Bayou in Houston. His latest work has been placed at the Bayou's Crosby Outfall, west of Sabine Street near Allen Parkway and depicts a stainless steel canoe nestled on supports above the Bayou. The artist is a co-founder of MotherDogStudios, and he told the Houston Chronicle that he considers the Buffalo Bayou to be Houston's "birth canal". Among his other sculptures on the Bayou is a boat at Allen's Landing, at Fannin and Commerce streets, where the city's founders landed in 1836. Most of his canoe sculptures are along the Sabine promenade, between Sabine and Bagby streets. Four are on the Sabine Street Bridge, two on either side. They are suspended upside down, as though providing an arched gateway to the Bayou. The atmosphere in Houston is relatively aggressive, bring extremely hot and humid and summer and somewhat cold in winter. Add to this the influence of a salty environment from the coastal region and it becomes clear why the sculptor settled on the use of stainless steel for his art work.

Pictures courtesy of John Carroll Runnels

The Budd BB-1 Pioneer



Location Philadelphia, USA
Environment Outdoor
Source of information Joseph May: Travel for Aircraft

Leonardo Da Vinci made very convincing early drawings of prototype flying machines. Man's fascination with the idea of machines which would enable him to fly like a bird continued in various forms until the Wright Brothers became the first to complete a powered flight, at Kittyhawk, in 1903. But the fascination did not stop there – in fact it was only the beginning of an incredible journey which took man from a landmark first flight of 37 meters at a speed of 10.9 km/hr in 1903 to the supersonic Concorde, which flew for the first time in March 1969 and was capable of flying from London To New York at Mach 2.04 (twice the speed of sound, or 2180 km/hr). Anyone visiting the Aerospace Museum at the Smithsonian Institute in Washington will be well rewarded by an extensive exhibition depicting the history of flight. But there are examples everywhere of models and art-work devoted to the history of this incredible achievement. At the Franklin Institute in Philadelphia there is a rare Budd BB-1 Pioneer sea-plane on display in the front grounds. The Budd Company's unique characteristic is a construction design which used stainless steel. As an amphibious seaplane it was important to the designers to use a highly corrosion resistant material, noting that the aircraft would be operating from a sea-base. The design is inspired by Savoia-Marchetti as well as Sikorsky seaplanes. Power was provided by a 210 horsepower, 5-cylinder, Kinner C-5 radial reciprocating engine, mounted on the top wing. The Pioneer first flew in 1931 and was relegated to display status in 1934 at the Franklin Institute which is also in the Budd Company's home town of Philadelphia PA.

Pictures courtesy of Joseph May: Travel for Aircraft. https://travelforaircraft.wordpress.com

Automotive

Engine Cradles for Passenger Cars

Fabrication process	Hydroforming
Grade/surface	Forta H500, H800 and H1000, 2B
Material supplier	Outokumpu
Source of information	Outokumpu

Materials for structural parts of passenger cars must fulfil requirements which may seem contradictory: on the one hand, they must provide high-strength properties that can be used to design stiff structures; while on the other hand, dedicated parts of the car body must be able to deform in order to absorb crash energy. In addition, fabricated parts must be as light as possible to save fuel. A range of proprietary low-nickel austenitic stainless steels has been optimized for work-hardening which has two effects. Firstly, the cold-rolling process is controlled to achieve defined levels of strength from the outset. Secondly, in the event of a crash, the crumpling of the material locally increases strength in the deformed areas and makes the component absorb energy. The stronger and faster the deformation, the higher the strength increase. This intrinsic property of the material adds to passive safety. But the material retains excellent forming properties, for which the elongation after fracture is an indicator. Forta H500, for instance, reaches a value of over 50 %, which is to say that a standardized sample can be stretched by more than half its original length before it breaks. Proven forming techniques, such as hydroforming, can be applied to achieve exceptionally complex shapes, as demonstrated in an engine cradle. Protective zinc layers are redundant because of the corrosion resistance of the material, but the usual cataphoresis treatment of car bodies can be applied without restrictions. Dedicated material engineering makes stainless steel suitable for volume applications in safer and lighter passenger cars.

Automotive

Lightweight Fuel Tank

Fabrication process	Hydroforming
Grade/surface	HyTens
Material supplier	Outokumpu
Source of information	Outokumpu

During the course of their development, fuel tanks for passenger cars have progressed from aluminized steel to polymers, generally in search of weight reduction and ease of formability. High strength austenitic stainless steels now provide an opportunity to make fuel tanks lighter and safer while retaining their inherent strength. A proprietary grade with a fully austenitic structure has been developed which has a more stable price structure, providing an obvious advantage for the automotive industry, which has to specify materials several years ahead of their use. Compared to the current generation of multi-layer polymer counterparts, stainless steel fuel tanks can significantly reduce the wall thickness. Thus, for the same external dimensions, up to three litres of additional fuel capacity can be gained, while the dry weight of the unit can be reduced by up to 3.5 kg. Carefully balanced material engineering, encompassing alloying composition, rolling and heat treatment, ensures a level of formability that is quite exceptional for the strength of the material. Stainless steel fuel tanks can have shapes, which are just as complex as those of their plastic counterparts, so that even the smallest spaces in the bodywork can be used. Furthermore, stainless steel does not permit permeation of fuel and the re-cycling process adds a positive environmental and economic value.

Automotive

Stainless Fuel Filler Neck

Location	Europe, USA
Environment	Outdoor
Grade/surface	EN 1.4301 (304DDQ)/2B
Main tickness or diameter	0.8 mm
Manufacturer	European & American automotive sub-suppliers
Material supplier	Aperam Stainless Europe
Source of information	Aperam

The range of products Aperam has developed for the automotive industry includes new stainless steel solutions for the Fuel Filler Neck. This type of component in stainless steel is a response to the increasingly stringent European and American standards for hydrocarbon emissions which seek to limit evaporation emissions from fuel tanks. In addition to being resistant to corrosion and friction, stainless steel ensures a tighter seal than other materials. The stainless steel Fuel Filler Neck is also shear-tolerant and cut-resistant. The Fuel Filler Neck developed in stainless steel is an example of how the material can contribute to environmental safety.

Automotive

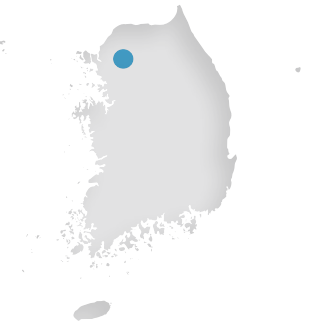
One-Body Construction of Fuel Inlet Pipes Using Ferritic Stainless Steel

Location	USA, Canada, Europe
Environment	Outdoor
Grade/surface	NSSC436S-T(SUS436L)/Cathodic Electrodeposition Painting
Manufacturer	FUTABA INDUSTRIAL CO.,LTD, BESTEX Kyoei CO., Ltd., UNIPRES CORPORATION, FTS CO., LTD
Source of information	Nippon Steel & Sumikin Stainless Steel Corporation

The use of ferritic stainless steel welded pipes was limited in the past because of its low expansion rate. Recent developments have made it possible to increase the expansion rate to more than 200 % following improvements in workability and mechanical properties, thus enabling fabrication of one-body fuel inlet pipes. Furthermore, other developments also led to the use of high efficiency electric resistance welding. With these new developments, it is now possible to fabricate highly durable stainless steel fuel inlet pipes which satisfy the emissions control regulations in California (LEV II: requiring a guaranteed life of 15 years or 150,000 miles), which came into effect in 2003. These regulations are currently used in nearly all the cars being sold by Japanese car manufacturers in North America (approximately 6 million units per year).


FAN CAUTION

Stainless Steel Floor Panels for Refrigerated Trucks



Location	Seoul, Republic of Korea
Environment	Outdoor
Fabrication process	Stamping
Grade/surface	PosSD (KS STS329FLD, ASTM S82013)/2B900 t
Main thickness or diameter	1.0 mm
Manufacturer	Otech
Material supplier	POSCO
Source of information	POSCO

Modern transport logistics make more use of refrigerated vehicles to keep food-stuffs fresh across short and long range delivery zones. Repeated use by handlers, whose primary objective is speed of loading and unloading, carries an ever present risk of damage due to wear and tear. The damp conditions inside the units also carry a risk of corrosion. Stainless steel is both resistant to corrosion and tougher than comparable materials and provides an ideal solution for this application. POSCO produces a lean duplex grade, PosSD, which has similar corrosion resistant properties to the austenitic grade 304, but offers twice the strength. Utilising this type of material allows the manufacturer to reduce the gauge significantly, bringing savings in material costs and as well as reducing the weight of the trucks, and therefore allowing for increased pay-loads.

Automotive

Exhaust Gas Recirculation Coolers for Gasoline Engines

Location	Japan
Environment	Outdoor
Grade/surface	SUS430J1 and SUS444
Manufacturer	Maruyasu Industries Co.,Ltd.
Material supplier	Nippon Steel and Sumikin Stainless Co., Nisshin Steel, JFE Steel
Source of information	JSSA

The Exhaust Gas Recirculation Cooler for gasoline engines has been developed to improve fuel efficiency. By cooling exhaust gases and recycling a large volume of the gas, this unit reduces pumping loss in the low-load region and improves the knocking limit in the high-load region, which improves the compression ratio. The traditional material of choice for EGR coolers has been austenitic stainless steel, but for this particular type, a ferritic grade of stainless steel has been adopted for the first time, considering the performance demands made by high-temperature exhaust gases, as well as the need to stabilise cost and reduce weight. This type of product will be adopted in a number of gasoline vehicles in the future in order to respond to every tightening fuel emission regulations.

Automotive

A New Stainless Steel Grade for EGR Cooler Applications

Location	Europe, USA
Environment	Outdoor
Fabrication process	Drawing and brazing
Grade/surface	EN 1.4521 (K44X)/2D
Main thickness or diameter	From 0.15 to 1.5 mm
Manufacturer	European & American automotive sub-suppliers
Material supplier	Aperam Stainless Europe
Source of information	Aperam

The Exhaust Gas Recirculation (EGR) Cooler is an air-to-liquid heat exchanger device that uses engine coolant to reduce the temperature of exhaust gases prior to recirculating them through the engine's intake system. EGR reduces engine combustion temperature, which prevents the formation of nitrous oxide (NOx). The material used for this type of application must be capable of tolerating very high temperatures and very corrosive conditions. The new 1.4521 (K44X) ferritic stainless steel developed by Aperam fully meets these requirements. This material is a high chromium molybdenum niobium stabilised ferritic grade which offers excellent high temperature properties (cyclic oxidation, creep and thermal fatigue resistance), a low thermal expansion coefficient and very good brazability and formability. Furthermore, the molybdenum content provides a high corrosion resistance. This stainless steel grade offers an optimized solution for the different EGR cooler parts such as thin wall tubes, gas exchange plates and diffusers. An added advantage is that the high mechanical properties contribute to weight savings. Aperam is developing solutions for future EGR coolers both for the diesel low pressure EGR systems (severe corrosion conditions) and the high pressure gasoline cooled EGR (higher temperatures compared to diesel EGR).

Automotive

Stainless Steel Core for Automobile Fuel Pumps

Location	São Paulo, Brazil
Environment	Outdoor
Fabrication process	Drawing
Grade/surface	DIN 1.4512 - UNS S40920/2D
Main tickness or diameter	0.50 mm
Manufacturer	Bosch
Material supplier	Aperam South America
Source of information	Aperam South America

Ferritic grade 1.4512 (equivalent to 409) stainless steel is now being used to manufacture the core of fuel pumps which have historically been made from tin plated steel. The advantage of using stainless steel is that the fuel pump cores no longer need the extra surface treatment that was necessary when using tin plated steel, resulting in a saving of time, logistics and cost. Being a ferritic stainless steel, the cost structure is relatively stable.

PHYTHERM® Nickel Alloys - for Induction Cookware

Location	Europe
Environment	Indoor
Fabrication process	Plating or added a PHYTHERM® disk on the bottom of the pan/frying pan
Grade/surface	PHYTHERM Ni50Fe30Cr
Main thickness or diameter	0.6 X 165/185/205 mm
Manufacturer	Aperam Alloys Imphy
Source of information	Aperam
Remarks	www.phytherm.com

Phytherm is a trade mark of Aperam for a range of high nickel and chrome alloys which are used in pots and pans to make them suitable for induction cookers. In order to stabilise the heat, pot and pan manufacturers apply a layer of this material to the underside of the utensil. In simple terms, as a specific temperature – known as The Curie Point (Tc) – approaches, this nickel alloy base stops getting hotter (practically zero permeability). The material, with its Curie point set at the ideal level, allows for precision temperature control. Furthermore, its patented chemical composition makes it possible to limit the mechanical constraints imposed by the expansion of the other materials used in the utensil. The result is a safe and convenient method of cooking food with a product that is long lasting.

Cookware, Holloware and Cutlery

Roccbox

Location	Christchurch, United Kingdom
Environment	Outdoor
Grade/surface	304
Source of information	roccbox.com

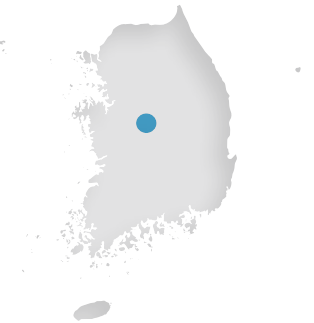
The Roccbox is an exciting new development for the home entertainment market. It is a portable, lightweight, wood and gas fired stone floor oven which can cook beautiful Neapolitan pizzas in under 90 seconds as well as your favourite meat, fish and vegetable dishes. Roccbox brings authentic wood and gas fired cooking into an affordable budget range. Whether using wood or gas, the burner attaches to the underside of Roccbox's body. Once it is lit, all of the thermal elements (dome insulation, stone floor and under floor insulation deck) begin to store and radiate heat, saturating it evenly throughout the oven, creating a unique, consistent cooking environment closely mirroring that of a traditional stone bake oven. Roccbox's wood burner was the most challenging part of the design. It is constructed of three layers of stainless steel, the outer layer being perforated to prevent intense heat build-up. The entire burner has been designed to draw air through its body, creating an intense flame with a secondary combustion. Austenitic grade 304 stainless steel has been used throughout the construction of the Roccbox, with the exception of the bottle opener, Pizza slider and serial number plate.

Pictures are courtesy of Roccbox


ROCCBOX

Electrical Machinery and Equipment

Stainless Steel Heat Exchanger Fin Tubes for Chillers

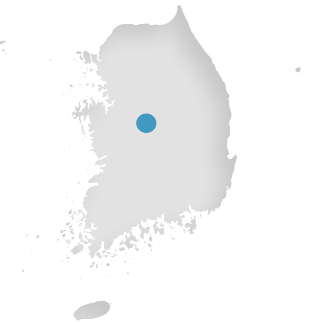


Location	Republic of Korea
Environment	Indoor
Fabrication process	welding
Grade/surface	430J1L /BA
Main thickness or diameter	0.5 mm
Manufacturer	LG Electronics
Material supplier	POSCO
Source of information	POSCO

POSCO has developed a ferritic grade 430J1L for the manufacture of heat exchanger fin tubes for industrial absorption chillers. The liquids used in the fin tubes may cause pitting corrosion and stress corrosion cracking, but this material has been found to be particularly well suited to resisting these forms of corrosion. Welding and annealing conditions have been optimized to make it easier to form the fins on the surface of the tubes. Being a ferritic grade, the material has a relatively stable price structure.

Electrical Machinery and Equipment

Stainless Steel Washing Machine Drum



Location	Republic of Korea
Environment	Indoor
Fabrication process	welding
Grade/surface	430RE /No. 2B
Main thickness or diameter	0.5 mm
Manufacturer	LG Electronics
Material supplier	POSCO
Source of information	POSCO

Stainless steel has been associated with washing machine drums for many years. Although they were originally manufactured from austenitic 304 material, the continuing quest for price stability has moved the industry towards ferritic grades. At first, because of difficulties associated with continuous welding, 430 grade drums were manufactured using mechanical joining techniques, such as a seam-locking structure. POSCO has developed a weldable material, grade 430 RE, which can be welded using laser welding, improving productivity. Furthermore, this grade 430 RE features enhanced ridging endurance and better formability with a combination of higher elongation and lower strength.

Electrical Machinery and Equipment

Lithium Secondary Battery and Electric Double-layer Capacitor

Location	Japan
Environment	Indoor
Grade/surface	SUS329J4L
Manufacturer	Seiko Instruments Inc
Material supplier	Nippon Yakin Kogyo
Source of information	JSSA

Seiko Instruments has developed lithium secondary batteries (rechargeable batteries) and the supercapacitors (electric double-layer capacitors) for time indicators of mobile phones and digital cameras. The development involves pressing austenitic grade 329J4L stainless steel into coin-shaped components which house the electronic components. The stainless steel is constantly exposed to a combination of electrolytic solutions and high voltages and must be corrosion-resistant and capable of withstanding the vapor pressure of the electrolytic solution. The material selected is a highly corrosion-resistant and hard duplex stainless steel grade SUS329J4L. This is an application with a strong demand growth.


LESCO
LESCO

Stainless Steel Electrical Socket Covers

Location	South Africa
Environment	Indoor
Grade/surface	441/No. 4 finish
Manufacturer	Lesco
Source of information	Columbus Stainless

Lesco, a manufacturer of building products in South Africa, has introduced a very innovative range of stainless steel covers for electric plug sockets. They have used the ferritic grade 441 stainless steel, which is perfectly suitable for Indoor applications. The polished, No. 4 finish surface provides an attractive finish which is easy to keep clean and the cover will last a life time. The covers are simply packaged and marketed in DIY (Do it Yourself) building supply shops throughout South Africa and are available in standard sizes which can fit any household electrical socket.

Story and photograph courtesy of Jacob Mouw and Columbus Stainless.

Stainless Steel Security Cameras

Location Worldwide

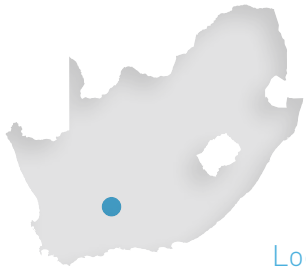
Environment Outdoor

Grade/surface Marine grade stainless steel

In this day and age Closed Circuit Television systems (CCTV) seem to have become part of daily life in many shops, parking garages, industrial sites and indeed cities around the world. In the longstanding debate over whether privacy should prevail over security, it seems that for the time being security has become a priority. The Axis Dome Network Camera system is encased in nitrogen-pressurized stainless steel casings and is ideally suited for surveillance and remote monitoring applications in a wide range of outdoor facilities. These cameras are capable of resisting the corrosive effect of sea water and cleaning chemicals, and can also withstand high-pressure steam cleaning. Pressurized nitrogen prevents internal condensation. Axis has three outdoor-ready, marine-grade stainless steel cameras that enable 360° coverage of wide areas in resolutions up to HDTV 1080p and great zoomed-in detail with up to 36x optical zoom. These cameras provide excellent video surveillance and high durability for reliable performance in demanding indoor and outdoor environments. Manufactured from austenitic grade 316L stainless steel, with a nylon clear dome cover, they can operate in a temperature range from -30 °C to 50 °C and they offer protection against dust, rain, high pressure steam-jet cleaning, snow, ice and salt fog. Stainless steel mounting accessories are also available. This is a good example of applications where the life of the relatively high cost internal equipment of a unit can be prolonged by using the more robust external protection provided by the strength and corrosion resistance of a stainless steel casing.

Pictures courtesy of Axis Communications

Food and Beverage



Stainless Steel for Vineyard Supports

Location	Western Cape, South Africa
Environment	Outdoor
Grade/surface	AISI 304/Polished
Source of information	SASSDA

The Western Cape region of South Africa is a well-known wine producing area with many internationally renowned brands. As in any farming enterprise, the vineyard owners face ongoing budgetary pressures and any cost savings which can be achieved can have a significant impact on the competitiveness of the product and the profitability of the enterprise. Vines have traditionally been supported in this region by a trellis structure, using wooden posts for vertical support and wire strands for horizontal support. Apart from the high labour cost associated with assembling the posts and wires, cost and sustainability issues began to emerge around the sourcing of wood en posts in a country with a scarce water supply. Metal posts offered a practical alternative, but standard steel profiles had a limited life span in an environment where fertilizers and pesticides are routinely mixed with irrigation water resulting in a relatively harsh environment. Furthermore, steel posts tend to be heavy, which adds cost to transport and installation. Thin gauge stainless steel profiles provided superior strength which allowed for thinner gauges, and superior and corrosion resistance together with a lighter weight. The cold rolled profiles are simply driven into the soil with a hammer. The design incorporates angled slots on the sides, which allow the installation teams to simply hook the horizontal wires onto the post before tightening the strands from both ends. The product is complemented with a full set of connectors, end braces and tightening mechanisms, which offer the vineyard a modular and flexible fencing support system.

Food and Beverage

Stainless Steel Food Trucks

Location	Brazil
Environment	Outdoor
Fabrication process	Drawing, Welding
Grade/surface	439/Polished
Main thickness or diameter	0.50 mm and above
Manufacturer	Aços Macom
Material supplier	Aperam South America
Source of information	Aperam South America

Stainless steel has become the material of choice for the interiors of food trucks. In these examples we show the use of ferritic grade 439 with highly polished surfaces in industrial and professional fittings for mobile street kitchens. Stainless steel has been used to manufacture the plates, ovens, fryers, hoods and refrigerator units. These specialty fittings use very precise design specifications, to prevent units or appliances moving or opening when the vehicle is in motion. As food trucks require very demanding standards of hygiene, the relative ease with which stainless steel may be cleaned and sterilized provides one if its prime advantages for this application. Another important point of differentiation is that stainless steel has been independently proved to be safe for use in food applications and does not taint or in any way interfere with the taste of the food. Stainless steel is also used for manufacturing the structural accessories such as awnings and doors for the trucks because its high mechanical strength and durability contributes to a longer design life and a reduction of maintenance costs. The trucks look good, they look clean, they are hygienic and they will last a long time - an imaginative use of stainless steel to serve our daily lives. One often sees photographs of gleaming stainless steel kitchens in up-market restaurants and hotels - and you can get the same effect from a street vendor.


ATENÇÃ

Food and Beverage

Baby Bottles

Location	Calgary, Canada
Environment	Indoor
Grade/surface	AISI 304
Designer/architect	OrganicKidz
Source of information	OrganicKidz

OrganicKidz is a Canadian company, based in Calgary, which specialises in the production and distribution of stainless steel baby and infant bottles and cups to markets throughout North America and internationally. Founded in 2008 by a Canadian mother, Jane Walter, who was looking for an alternative to existing baby bottles which would be safe and hygienic, but also indestructible and durable, the company decided on stainless steel as their material of choice because it ticked all of their boxes. Their website advertises stainless steel as being safe, green, healthy, durable and versatile. Stainless steel is certainly easy to clean; it is completely recyclable; its mechanical properties impart a strength which makes it virtually indestructible in the hands of children; and it lends itself to a multitude of design and colour options. The OrganicKidz range of bottles are manufactured from austenitic grade 304, which is the same grade of stainless steel that is used to make high quality pots and pans and cutlery. With this range of products now children can enjoy the same benefits as adults! Jane's line of baby bottles won an award as Top Baby Product from NBC's The Today Show in 2012.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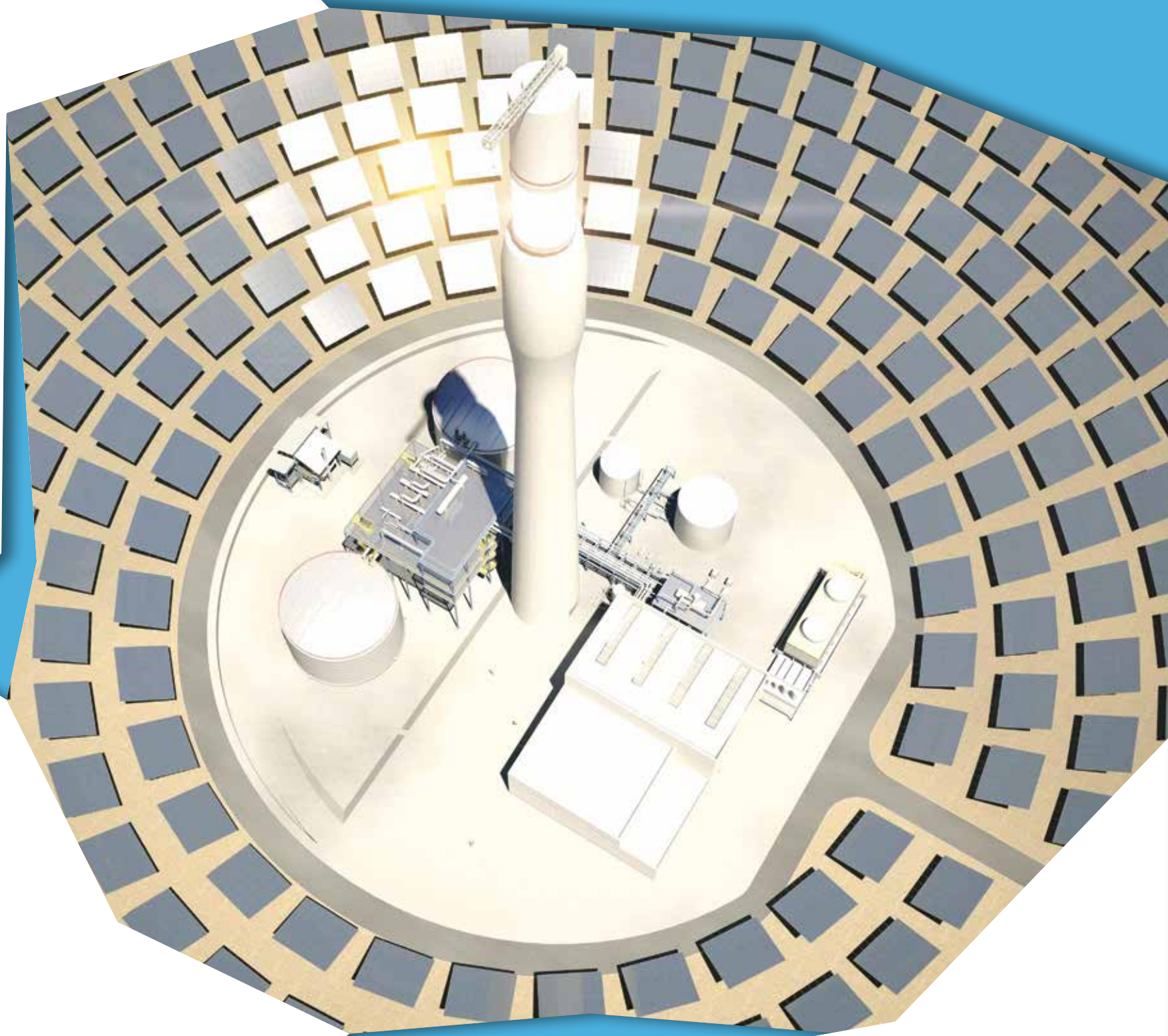
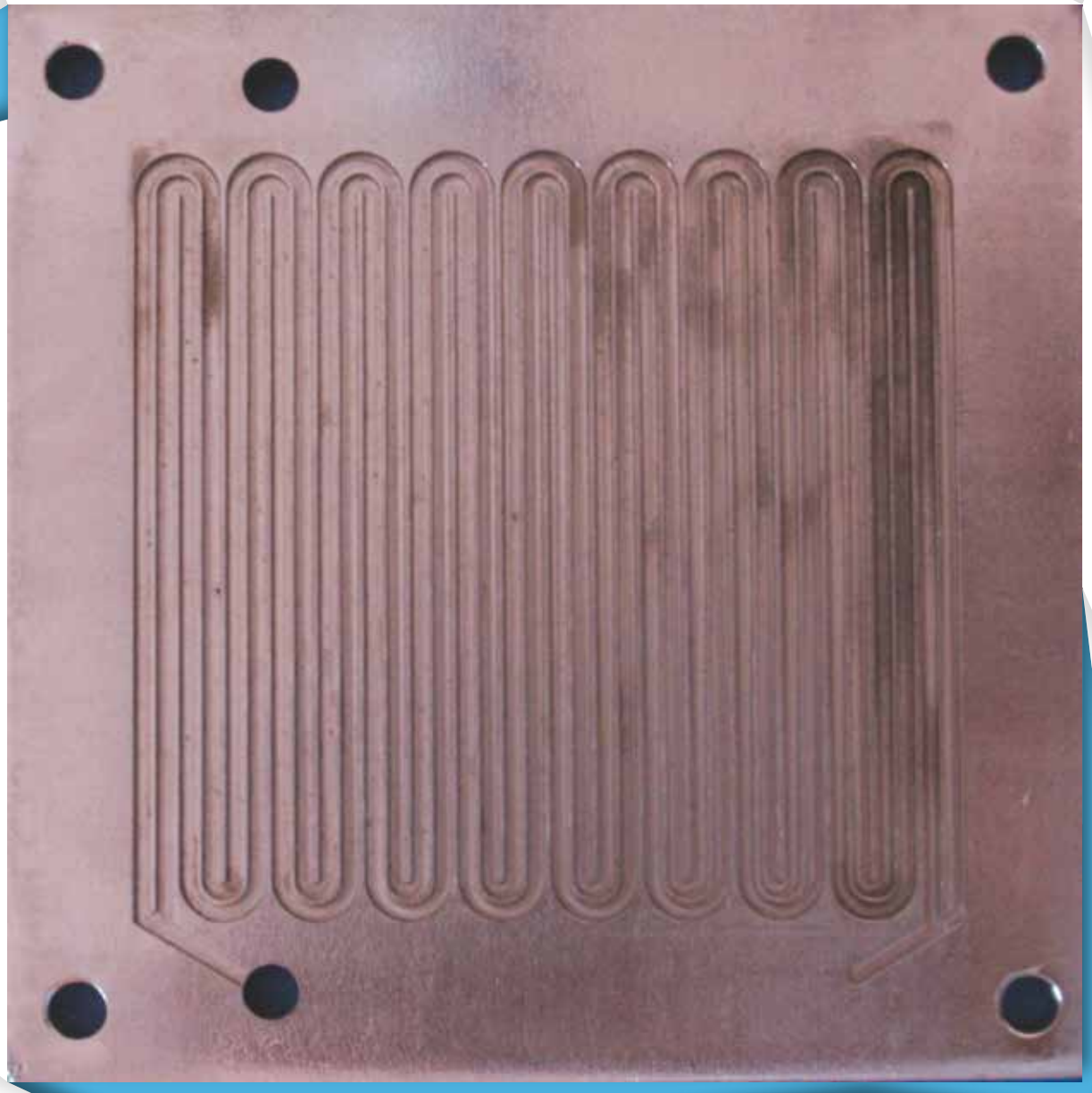
Green Energy

Gemasolar Concentrating Solar Power Plant

Location	Fuentes de Andalucía, Spain
Environment	Outdoor
Grade/surface	Therma 347H/4550 (EN 1.4550, UNS S34709)
Developer	Torresol Energy
Product type	Quarto plate
Dimension	23 meters in diameter and 14 meters high
Quantity	190 tons
Fabricator	Emypro
Material supplier	Outokumpu
Source of information	Outokumpu

The obvious challenge of solar power generation is the fact that whilst energy is available in abundance, it is generally only during the daylight hours. At the Gemasolar plant a practical solution has been found and applied on an industrial scale. 2,650 mirrors focus the heat on a central receiver through which liquid molten salt is piped. It is fed into the receivers at 290 °C and typically comes out at 565 °C. 6.25 tons of molten sodium and potassium nitrates store enough thermal energy to ensure steam production for up to 15 hours. This principle has made Gemasolar the first base load solar power plant when it became operational in 2011. To ensure long-term reliable service under these severe conditions, materials must fulfil three requirements at elevated operating temperatures: they must withstand corrosion, be resistant to creep and maintain their structural properties. The austenitic, niobium-stabilized stainless steel alloy Therma 347H/4550 has been designed for high-temperature applications and provides a cost-effective solution to this application.





Green Energy

Bi-Polar Plates for Fuel Cells

Location	San Luis Potosí, Mexico
Environment	Outdoor
Grade/surface	444 2B
Quantity	250 gr per unit of 9.5 x 9.5 cm
Manufacturer	CIATEQ
Source of information	IMINOX

Fuel cells will need to become cheaper to produce if they are to become commercially successful. The Proton Exchange Membrane (PEM) fuel cell stack consists of a membrane electrode assembly, a bi-polar plate, seal and end plate. Among these components, the bi-polar plate is one of the most costly and problematic in the fuel cell stack. The bi-polar plate is a multi-functional component within a PEM fuel cell stack, whose primary function is to supply reactant gases to the gas diffusion electrodes (GDEs) through flow channels in the plate. The ferritic stainless steel grade 444 is an excellent material for manufacturing these plates. It is comparable to the austenitic grade 316 in corrosion resistance but it has a more stable price structure. Stainless steel bi-polar plates are coated with protective layers which increase corrosion resistance and have good interfacial contact resistance. Research has shown that both austenitic grade 316 and ferritic grade 444 work very well for the performance of these fuel cells.

Green Energy

Super Ferritic Stainless Steel Tubes for Power Plant Condensor

Location	Xingda Power Plant, Taiwan, China
Environment	Outdoor
Fabrication process	Welding
Grade/surface	B446/2B
Main thickness or diameter	0.7 mm
Material supplier	Baosteel
Source of information	Baosteel

Baosteel have supplied the ferritic grade B446 (with 28% Chrome and 3% Molybdenum), with excellent corrosion resistance and good weldability, to manufacture condenser tubes in the Taiwan Xingda Power Plant to replace Titanium and Copper alloys. This material is also suitable for use in condenser tubes and heat exchanger tubes in the petrochemical industry, de-salination plants, roofing and wall panelling for buildings in coastal environments, caustic soda plants, manufacturing plants for organic acid (such as acetic acid and lactic acid) and other industrial applications requiring high corrosion resistance.

Green Energy

Metal Attachments for Solar Panels

Location	Japan
Environment	Outdoor
Grade/surface	SUS409L, SUS410L
Manufacturer	Caname Co., Ltd. and Nippon Teppan Co., Ltd.
Material supplier	Nisshin Steel
Source of information	JSSA

Metal attachments were developed to fix solar panels onto metal roofs. Because the solar panels have a usable life span of more than 20 years, it became imperative to develop attachments which are made from materials with a similar durability to avoid additional maintenance or replacement due to corrosion. Against this background, Caname Company and Nippon Teppan, together with Alstar Stainless, developed metal attachments made from ferritic stainless steel grades 409L and 410L (containing 11 % chrome) for industrial solar panels. Tests conducted onsite in the Okinawa Prefecture have demonstrated the durability of this product. The stainless steel is aluminized because this grade of stainless steel has the required strength and corrosion resistance, but displays a certain level of surface discolouration over time and the aluminium coating maintains an attractive finish. These attachments have been patented and have gained in popularity. With the current surge in demand for solar power systems, these attachments are expected to contribute to further growth in the future.

Green Energy

Metal Frames for Solar Panels

Location	Japan
Environment	Outdoor
Grade/surface	Duplex (21Cr-2Ni-N)
Manufacturer	Co-max Co.,Ltd.
Material supplier	Nippon Steel and Sumikin Stainless Corporation
Source of information	JSSA

Until recently, the principal materials for frames and mounts for solar panels have been pre-painted or coated carbon steels. The use of austenitic grade 304 stainless steel in this area has been limited for price reasons. But carbon steel frames and mounts are susceptible to corrosion, especially in coastal environments. Even coated or painted surfaces can exhibit signs of corrosion if the surface is scratched or damaged. Against this background, a grade of duplex stainless steel has been developed for this application, providing the strength and durability to withstand corrosive attack, even in harsh environments. The strength of the material has allowed designers to select much thinner gauges, thus saving on material weight, which in turn has led to more efficient handling and reduced costs. In addition, efficiency in construction and installation has been increased and transportation charges have been lowered. Using a proprietary processing technology, coils are cut and processed to the required sizes, minimizing material loss and contributing to reasonably-priced stainless steel frames and mounts. This product is experiencing significant growth in this very competitive market.

Green Energy

Solar Panel System with Stainless Steel Mounts

Location	Japan
Environment	Outdoor
Grade/surface	SUS443J1/2B
Manufacturer	Kohnanyoko Co.,Ltd.
Material supplier	JFE Steel
Source of information	JSSA

The Premium SUS Solar System, is a solar panel installation that does not require holes to be made in the roof, thus avoiding problems associated with leaks. It can be quickly and easily installed using stainless steel mounts. The principle behind this system is supporting the weight of the solar panels not on particular points but on the entire face of the mount so as to spread the load burden across the surface of the roof. Furthermore, the system allows for power generation even from the underside of the panels, using the reflection of scattering light. With a number of features which optimise the advantages of stainless steel as a construction material, significant cost reductions have been achieved. To extend the life of the system, the mounts are made entirely from stainless steel, thus eliminating deterioration associated with corrosion, particularly in aggressive coastal environments. A ferritic grade was selected in order to manage the distortion problems commonly linked to long spans and a 2B finish was specified to raise the reflection efficiency of the underside of the panels. Enhanced strength at lighter weights was achieved through corrugating the stainless sheets and welding was omitted in favour of the use of stainless steel fasteners. With the increasing demand for solar power generation, this stainless steel unit brings advantages in the form of sustainable resources and a longer, maintenance-free service life.

Home and Office Appliances

Solar Energy Water Heater

Location	Taiwan, China
Fabrication process	Forming
Environment	Outdoor
Grade/surface	Exterior: SUS304, Water tank: SUS444
Main thickness or diameter	Exterior: 0.6 mm, Water tank: 0.6 mm
Manufacturer	Yu Feng Mold Manufacture Company
Material supplier	YUSCO
Source of information	YUSCO

Solar Energy Water Heaters are very popular in Taiwan and many residences have such units installed on the roofs of their buildings. This product has been designed with a heat collection plate in order to reduce heat energy lost during circulation. Together with the solar energy panel, the unit has a water tank which is manufactured from the ferritic grade 444 stainless steel which is resistant to changes in the pH level of the water as well as to chlorine additions in the water. The unit is supplied with an austenitic grade 304 stainless steel frame which is resistant to corrosion and provides a longer service life.


FOG
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URB
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Home and Office Appliances

Urban Bonfire

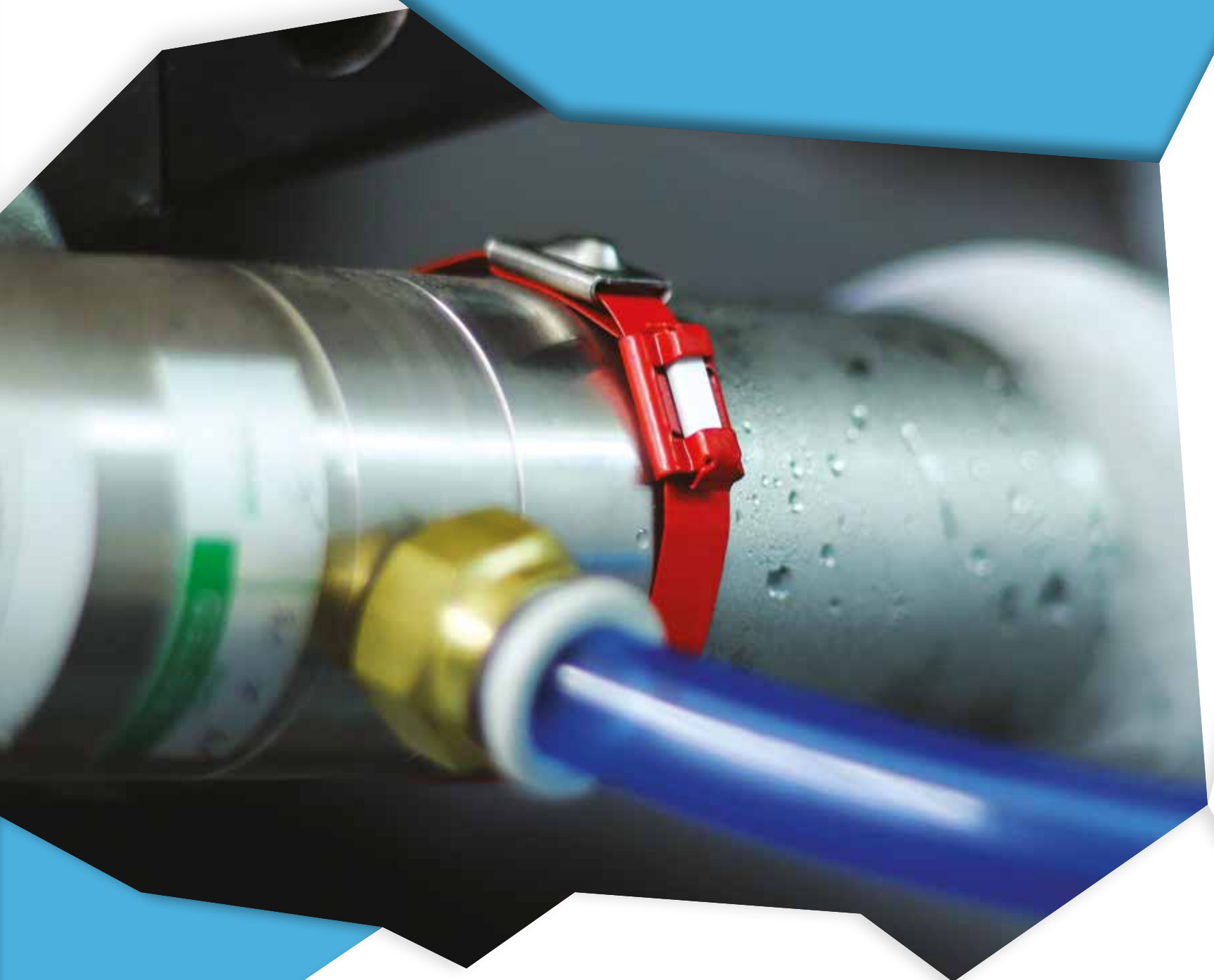
Location	San Luis Potosí
Environment	Indoor
Grade/surface	AISI 304/Polished (tubing and pipe)
Manufacturer	Carlos Glatt
Source of information	IMINOX

The "Urban Bonfire" is a creative design for a new type of decorative home lamp, made from stainless steel. This product won the IMINOX Impulse Contest, in Mexico, which was arranged in 2012 to commemorate the 100th Anniversary of the discovery of stainless steel. The "Urban Bonfire" is a playful and fun product that warms as it illuminates, reminiscent of the "plasma lamps" of the 1960's where globules of plasma moved up and down as the liquid in the lamp was heated, providing a psychedelic effect. This provides a warm and cosy environment, with complete safety. The unit is manufactured from austenitic grade 304 stainless steel tubes with a polished finish.

Care for an Aging Society

Location	Japan
Environment	Indoor
Grade/surface	SUS431J, SUS430
Manufacturer	Yazaki Kako Corporation
Material supplier	JFE Steel
Source of information	JSSA

In an era where societies are aging, the demand for materials and tools to provide care for the elderly is increasing. Basic tools such as handrails require more attention as the combined needs of extended life cycles and enhanced hygiene become primary considerations. Stainless steel has become a material of choice in this sector of the market, where it provides a combination of high strength, good corrosion resistance and good formability to manufacture long lasting products with hygienic, easy-to-clean, surfaces. The example shows a stainless steel stand manufactured from ferritic grades which are magnetic, with anti-slip magnetic mats which enable the users to take them off for easier maintenance. The mounts are made in two layers fastened with screws. For the upper part where higher corrosion resistance is required, grade SUS443J1 is used, and for the lower part, SUS430, which was a measure to reduce the costs.



Industrial Machinery and Equipment

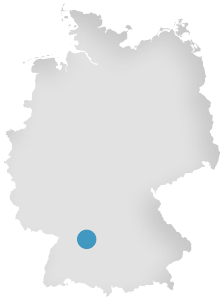
Radio Frequency Identification Tags

Environment	Marine
Grade/surface	316, polyester powder coated
Main thickness or diameter	Precision strip 0.27 mm - Carrier 0.5 mm
Manufacturer	Source Engineering and Manufacturing, Plympton, Devon, UK

Stainless steel holders and cable ties serve as carriers for radio frequency identification (RFID) tags. Tens of thousands of them are used for the remote identification of cables, pipes, valves and other infrastructure in the offshore oil and gas industry. Small electronic chips are encoded with serial numbers and other information required for asset management. When exposed to interrogating radio waves, they act as passive transponders and allow cables and their interconnections to be identified accurately. Unlike a barcode, the tag does not need to be within line of sight of the reader, which makes their use faster and more reliable. The fasteners must be resistant to splash seawater, a wide range of ambient temperatures and strong mechanical loads. Austenitic stainless steel precision strip has the required mechanical and corrosion resistant properties. The additional coating provides a strong colour that makes the tiny electronic chips and their carriers easily visible.

Industrial Machinery and Equipment

Spiral Tank Construction



Fabrication process	Mechanical folding or, alternatively, welding
Grade/surface	316L (EN 1.4404), 316Ti (EN 1.4571), 904L (EN 1.4539) or others upon request
Main thickness or diameter	Up to 6 mm, depending on customer specification
Manufacturer	Lipp, Tannhausen, Germany

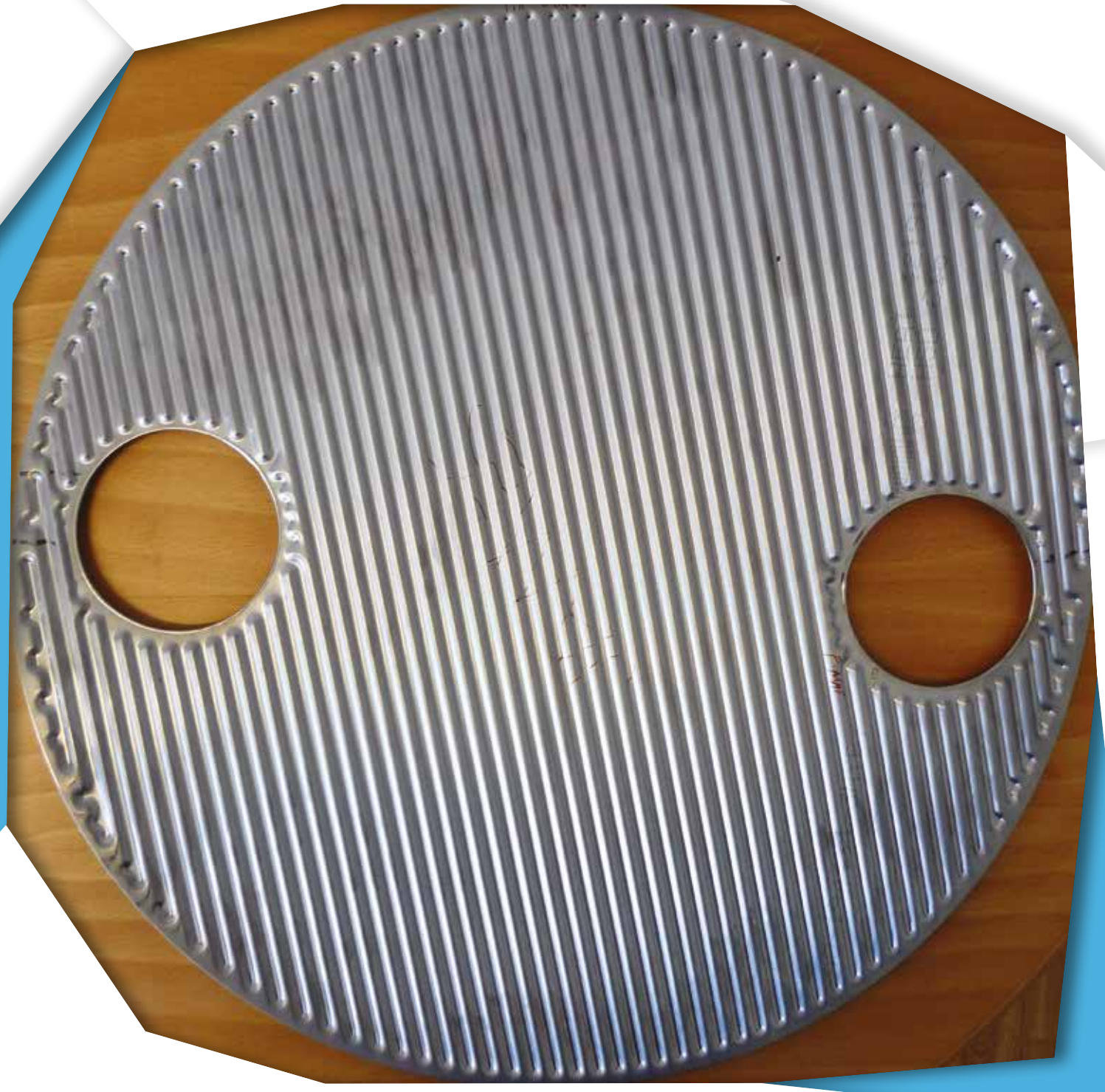
Transporting large-diameter tanks can be a logistical challenge. Lipp System tanks, have been designed to be erected on site and are flexible in terms of tank height and diameter. The sheet metal is taken to the site in coil form. A combined feeding and joining unit unrolls the material from the coil and creates a continuous seam that is fully gas and liquid tight. Two alternative variants are available: welded joints or folded double seams. The process makes the tank progressively spiral up to the requested height. The cover is installed while the tank is still low and is then lifted automatically while the tank grows. The tank material is selected to match the corrosive nature of the solids or fluids to be stored. The system is frequently used in, for instance, biogas production, where stainless steels of the 316 family are a standard option. Other applications include water reservoirs or the storage of solid and liquid foodstuffs. Wall thicknesses can be up to 6 mm. A composite solution called Verinox is available that combines galvanized steel on the outside with stainless steel sheet on the inside. A separation layer is placed between the two materials to avoid galvanic interaction. The three layers made up of galvanized steel, a separator and stainless steel are then mechanically interlocked by a double folded seam. This principle makes it economical to use high-alloyed grades like 904L (EN 1.4539) for the inner surface of tanks that might otherwise have been made of polymers or coated concrete.

Industrial Machinery and Equipment

Using FDX Grade for Plate Heat Exchanger

Location	Finland
Environment	Indoor
Grade/surface	1.4637/2E-FDX™
Manufacturer	Vahterus Oy
Source of information	Outokumpu

Market requirements have created a need for a Formable Duplex grade of stainless steel and Outokumpu has recently introduced such a grade under the trade name FDX™. The 1.4637 FDX™ range of materials with different Pitting Corrosion Resistance (PRE) values is almost as easily formable as standard austenitic stainless steels and as durable as a high-strength steel grade. Moreover, the new product family provides a solution to the limited formability of other duplex grades. The demand to use high strength stainless steel as a base plate material for the manufacturing of Plate Heat Exchangers (PHEs) is increasing. Commonly, standard austenitic grades with good formability have been used for this product, but one limitation has been the relatively insufficient, pressure capability of PHEs made from these grades. In order to enhance the serviceability of the product, in cooperation with Vahterus Oy, Plate & Shell® Heat Exchangers (PSHEs) were produced using the FDX 27™ grade. Corrugated FDX plates were produced by a mass volume manufacturing tool designed for the existing baseline material (4404). The test has identified a number of general advantages from using the FDX™ grade: no additional tool design adaptations or adjustments were required; no tendency towards wear or tool damage was observed; the final strength of the assembled product was increased by 40 %; and a satisfactory level of repeatability in properties and a stable forming process was achieved. In conclusion, the FDX™ concept exhibits four unique attributes - high corrosion resistance, high strength, high ductility and price stable alloying.



Industrial Machinery and Equipment

Stainless Steel Segments for Water Retention Ducts

Location	Japan
Grade/surface	SUS304A
Manufacturer	Alloy Co.,Ltd.
Material supplier	Nippon Steel and Sumikin Stainless Steel Corporation
Source of information	JSSA

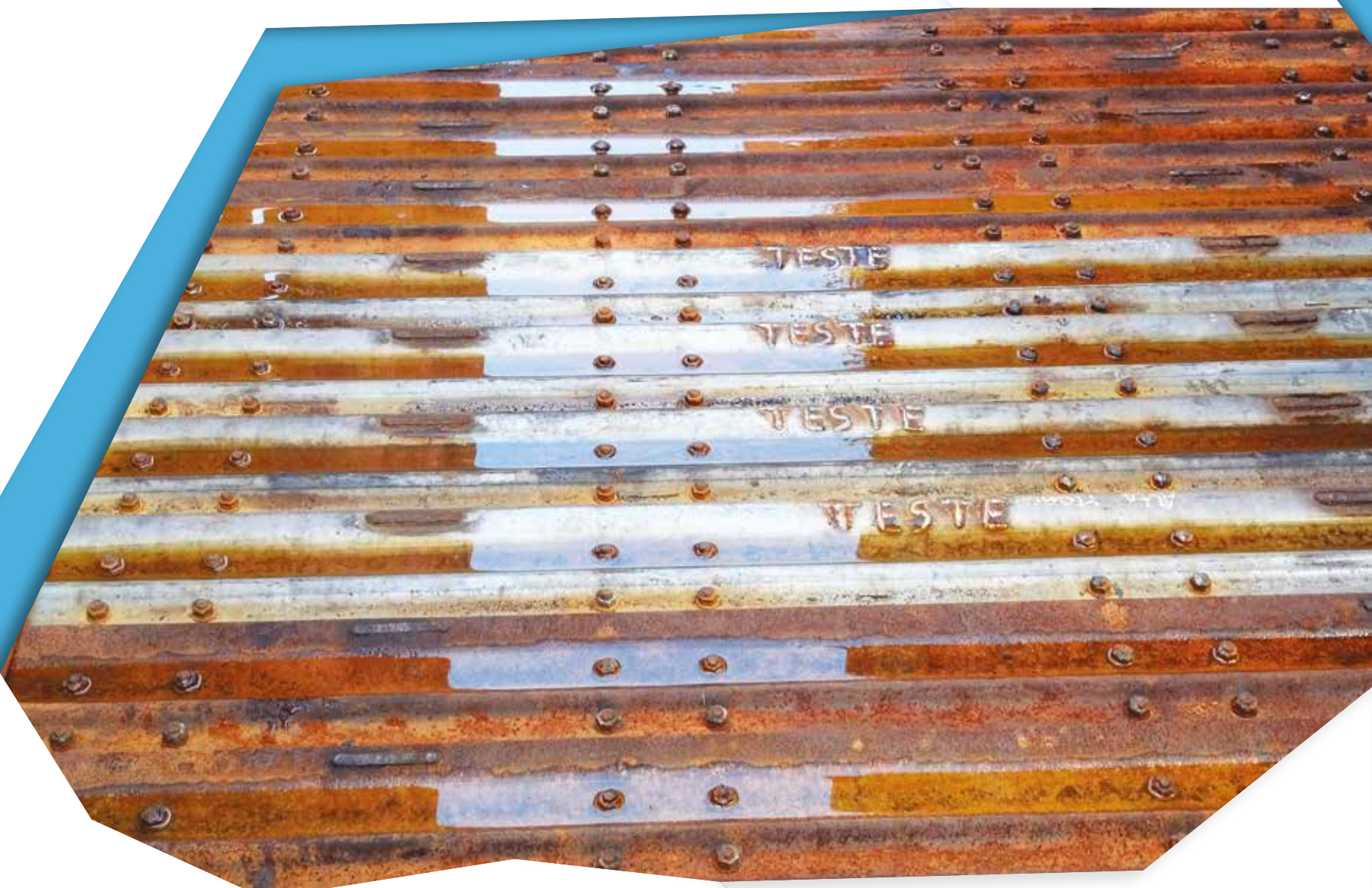
The Water and Sewer Authority of Kyoto City was in need of a new material as they launched a project to construct segments of water retention ducts for one of their combined sewage systems. The area involved is renowned for its production of sake (Japan's traditional alcoholic beverage) and maintaining good quality underground water is very important for the local economy. Other materials which are commonly used for such segments, were deemed unsuitable for the project due to possible bio-elution into the water. As a solution, the Authority decided to use stainless steel because it is highly corrosion-resistant, has high strength, helps to reduce the segment weight and is easy to process. It has also been independently proved to have a metal release rate that is well below established safety limits. This is the first project to apply stainless for such use in Japan, which, along with its novelty and news value, is expected to make an important social contribution. The on-site installation of the segment, was smoothly carried out with high levels of technical skill and product quality. The specified material is grade SUS304A certified under JIS G4321 (stainless steel for building structures). This project is a significant achievement of having the stainless steel grades which are suitable for building structures incorporated into JIS standards and can pave the way for its increased use in civil engineering works in the future.

Industrial Machinery and Equipment

Stainless Steel Cane Carrier Slats

Location	São Joaquim da Barra, Brazil
Environment	Outdoor
Fabrication process	Cut, forming
Grade/surface	DIN WS 1.4003 (K03 APERAM)/#1
Main thickness or diameter	4.5 mm
Manufacturer	General Chains
Material supplier	Aperam South America
Source of information	Aperam South America

Slats are an important component of cane carriers which are used to transport sugar cane from the farm to the mill for processing. These cane carrier slats are formed in rectangular pieces which form a part of the metal tracks that transport the sugar cane. The size of each track varies according to the size of the mill. Each track uses an average of 250 to 300 slats and each slat weighs approximately 30 kg. The slats have traditionally been made from other forms of steel with thickness of around 6.35 mm, but the development of ferritic grade 1.4003 (Aperam K03) stainless steel, by Aperam South America, in conjunction with General Chains, has provided a stronger, more corrosion resistant, alternative, which, because of its higher strength, enables the manufacturer to reduce the gauge to 4.5 mm, with a significant saving in the weight of the manufactured units. This provides a double advantage - lower life cycle costs for the materials and lower handling and transport costs for the finished units. The discolouration of the surface in the photograph is not rust - it is a surfac patina which is typical of lower chrome stainless and can easily be removed.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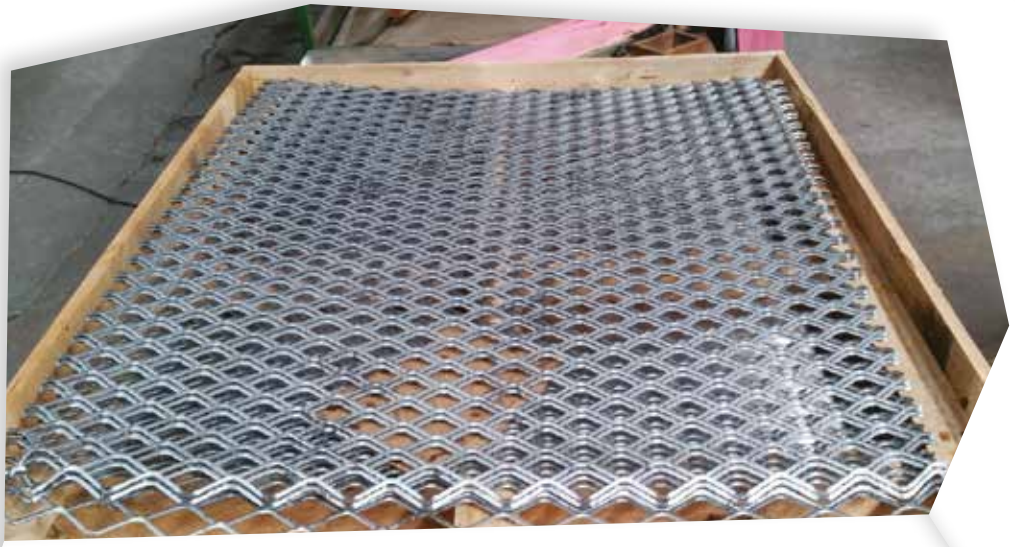


Industrial Machinery and Equipment

Expanded Metal Mesh

Location	Minas Gerais, Brazil
Environment	Outdoor
Grade/surface	1.4003 and 304
Manufacturer	Jati Inox
Material supplier	Aperam South America
Source of information	Aperam South America

Expanded Metal is a simple, cost-effective and efficient form of fencing or enclosure which is produced from solid sheets of metals, including stainless steel. Because it is manufactured from a solid sheet, without weaving or welding, the woven finish can never unravel and the resultant sheet is more secure. The expanded metal is produced by simultaneously partially slitting and stretching the sheet, which expands the cuts into diamond shaped holes of a uniform size and shape. Because there is no metal loss in the manufacturing process, this form of fencing or enclosure is very cost effective and saves significantly on raw materials. Jati Inox, of Catas Altas in Minas Gerais, Brazil, working in conjunction with Aperam South America, has used 5 mm sheets of ferritic grade 1.4003 and austenitic grade 304 to produce expanded metal fences and enclosures for Brazil's very active mining industry, where its increased strength and corrosion resistance give it a greater durability in the particularly aggressive conditions, which are experienced in underground mining. The result is a clean structure that is secure and relatively simple to install.

Industrial Machinery and Equipment

Underground Rescue Chamber

Location	Finland
Environment	Outdoor
Grade/surface	Outokumpu 4622
Manufacturer	HEAT-IT
Material supplier	Outukumpu
Source of information	Outokumpu

HEAT-IT Oy from Rovaniemi, Finland has selected the new high-chromium ferritic stainless steel Outokumpu 4622 as the material for their RESPETRA rescue chamber. The RESPETRA rescue chamber is a stainless steel cabin used in underground mines and other underground working environments, which can provide initial protection for up to four days for underground workers in the event of emergencies, such as fires. The chamber is already in use in mines and underground construction sites in Finland. Stainless steel is a natural choice for this application because it is practically maintenance free, which makes it a relatively low cost product across a usable life. In addition to good corrosion and heat resistance, weldability and deep-drawability, ferritic grade 4622 has a lower cost than austenitic stainless steel grades. The stainless steel surface does not require any coating which reduces the risk of pollutants for the air in the rescue chamber. The stainless steel provides a good combination of strength and toughness, making it well suited in an environment which could experience extremes of pressure. The walls of the rescue chamber have been curved to provide additional protection against pressure and gases. The rescue chamber has been tested in a mine, near the blasting area, and has performed very well. Outokumpu 4622 steel grade is a competitive alternative to austenitic stainless steels. The material can be used in a broad range of applications from home appliances, to exhaust systems, process equipment and cladding panels.


RESCUE

Other

Stainless Steel Paper Burners

Location	Changhua county, Taiwan, China
Environment	Outdoor
Fabrication process	Forming
Grade/surface	304
Main thickness or diameter	1.2 mm
Manufacturer	Kuo Chuan Stainless Steel
Material supplier	YUSCO
Source of information	YUSCO

The burning of prayer papers is a traditional religious practice in Taiwan and is an important medium between religious practitioners and their Gods. Almost all of the temples in Taiwan burn prayer papers to express the highest respect to the Gods. However, the burning papers can produce harmful emissions which could affect public health. This stainless steel furnace has been developed in order to achieve optimum combustion so as to prevent air pollution.

Other

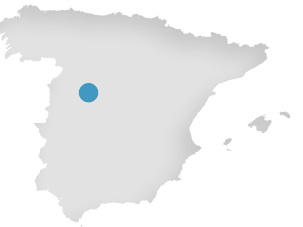
Stainless Steel Traffic Lights

Location	Japan
Environment	Outdoor
Grade/surface	SUS430
Manufacturer	Kyosan Electric Mfg Co.,Ltd.
Material supplier	JFE Steel
Source of information	JSSA

In Japan, the material of choice for traffic light fittings has been aluminum. With the introduction of LED lights, there has been a need to consider a replacement for existing fixtures. Kyosan Electric Manufacturing Company noted the price stability of ferritic stainless steels and researched the technology development of this material, leading it to specify ferritic grade 430 for its new generation traffic lights. Using deep-drawing technologies, coupled with the improved formability of ferritic stainless steels, the developer has succeeded in forming complex, sharply-bent, sections, enabling it to produce similar fixtures while using stainless steel. The material change has created a new demand for stainless steel and it is anticipated that this application will increase to 10,000 units per year in the future and continuous use of stainless steel for this application can be expected over the coming years.

Transport

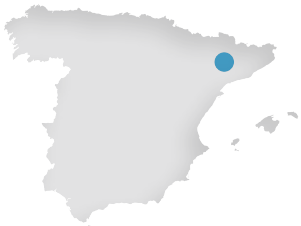
Ship Propeller Nozzle



Environment	Marine
Fabrication process	Plasma cutting, welding
Grade/surface	EN 1.4404 (316L)
Manufacturer	Wärtsilä Ibérica, S.A., Bermeo (Vizcaya)
Material supplier	Acerinox, Madrid, Spain
Source of information	Cedinox Magazine

The design of the nozzles of ship propellers is extremely important for the overall fluid mechanics and the energy efficiency of sea vessels. A manufacturer of ship propulsion systems in the north of Spain has specified stainless steel for the parts that constitutes the nozzles. They used grade 316L for its combination of high corrosion resistance with excellent formability and weldability. Depending on customer requirements, the stainless steel ratio in the fabricated component ranges from 33 % to 100 %. A design challenge lies in the fact that the carbon steel of the hull, the stainless steel used for the nozzle and the copper alloy of the propeller can interact electrochemically causing galvanic corrosion. Furthermore, because of its salt content, seawater is exceptionally corrosive to metals and the chloride increases the electrical conductivity, potentially exacerbating galvanic corrosion effects. Cathodic protection ensures that the mixed-material system safely meets the durability requirements.

Photo courtesy of Wartsila Ibérica S.A.



Transport

Waste Skimming Boat

Location	Catalonia, Spain
Environment	Marine
Grade/surface	316L (EN 1.4404)
Owner/operator	Ecolmare Ibérica S.A., Tarragona, Spain
Manufacturer	AISTER, Moaña (Pontevedra), Spain
Material supplier	Acerinox
Source of information	Cedinox Magazine

Plastic waste and bottles are a nuisance and an ecological problem for the marine environment. A company on the Mediterranean coast of Spain provides dedicated cleaning services to local port authorities. Entirely made from stainless steel. Its bow can be opened like a pair of scissors to trap floating garbage from the water surface. As the name, "Pelican", implies, it collects the waste in its bow for recycling. Typically deployed at the beginning and at the end of the tourist season, it helps the coastal communities to keep their ports and marinas clean and attractive. A recent mission in the waters of Cartagena is a case in point: 7.5 tons of floating waste were collected in a single campaign, which illustrates the size of the problem. Stainless steel is part of the solution.

Transport

SKIFF Rowing Boat

Fabrication process	Brake pressing
Grade/surface	304 (EN 1.4301)
Dimensions	1 mm
Designer	Benedict Boderius, Cologne, Germany
Date of completion	2015
Source of information	German Steel Federation

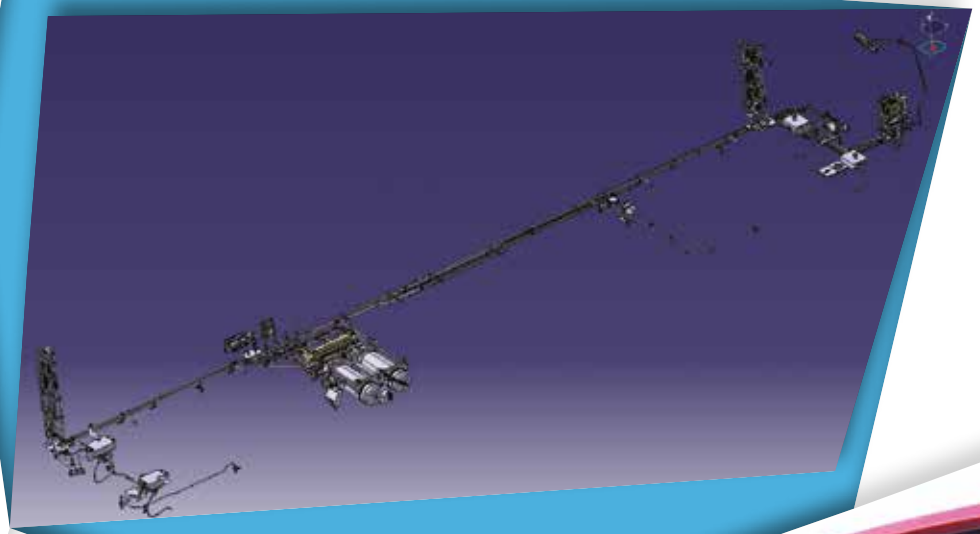
Stainless steel makes rowing boats easier to fabricate and lighter in weight than other materials. This possibility was demonstrated by a design that started from a sheet of stainless steel 3,000 x 1,500 x 1 mm. Brake pressing followed by the manual forming of beads in the transverse direction result in a zig-zag pattern that provides structural integrity. The polymer end plates make the boat virtually unsinkable. The wooden bench and railing are practical without having any structural function. The boat is designed for three people, but its geometry can be scaled to other required dimensions, and it is easy to fabricate. It does not require any cutting operations and the final shape is produced only by forming. The design won the third prize in the 2015 Steel Innovations Award by the German Steel Federation.

Transport

Stainless Steel Parts for Truck Bodies

Location	Brazil
Environment	Outdoor
Fabrication process	Drawing
Grade/surface	AISI304/polished
Main diameter or thickness	3 mm
Manufacturer	Carrocerias Ibiporã
Material supplier	Aperam Stainless Services & Solutions Brazil
Source of information	Aperam South America Timóteo

In these examples, hinges, handles and door locks for truck bodies have been manufactured from austentic grade 304 stainless steel. Not only does the stainless steel give the body a more professional and attractive appearance, but the parts will last significantly longer, given their strong resistance to corrosion and their superior mechanical properties. Grade 304 had the advantage of being very malleable, making formation, drawing, stamping and fabrication of intricate shapes and sizes relatively simple.




ATM

Metro Hydraulic System

Location	Milan, Italy
Grade	304 (EN 1.4301)
Manufacturer	AnsaldoBreda
Date of completion	2015
Source of Information	Centro Inox, Milan, Italy

For a new generation of 30 trainsets, which went into service on the Underground Network of Milan in 2015, the effort to reduce weight was extended to include the hydraulic components. These are placed under the body where they are subjected to both vibrations and corrosive attack. Stainless steel tubes, which had been laser-welded were used. The design specifications included high levels of fatigue and corrosion resistance together with excellent formability to a radius of 2.5 times the outer diameter of the tube. Stainless steel contributed to reducing the energy consumption of these new trains by up to 25 % compared with the previous models.

Rail Bridge Cappings

Location	United Kingdom
Environment	Various, including urban and coastal
Fabricator	Ancon Building Products, Sheffield (UK)
Product Type	Sheet
Surface finish	Specialised polish
Source of information	Ancon Building Products

Stainless steel was specified for the cappings and all associated support brackets for bridges of the Channel Tunnel Rail Link. This high speed rail line, which links London with the European continent, travels through industrial urban suburbs, residential areas as well as coastal regions. The cappings must fulfill high standards in terms of function, aesthetics, corrosion resistance and durability. Each capping was supplied in a perforated pattern. The curved sheet metal added to the height of the walls, which was a key factor for noise absorption, with only a minimal addition to the weight of the bridge. Because the edges would have been prone to corrosion, stainless steel, which is an intrinsically corrosion-resistant material, was a priority. The specialised polished finish applied to its exposed face served as an architectural feature.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Transport

Cladding of a Refurbished Tunnel

Location	Valtournenche, Italy
Environment	Rural
Fabricator	S.P.A.I., Timoline di Cortefranca, BS, Italy
Stainless steel grade	430
Product type	Coil-coated sheet
Dimension	1 mm
Surface finish	Coil-coated sheet; polyester-based organic double-layer coating, 20-25 µm thick
Producer or supplier	Acciai Speciali Terni
Source of information	Centro Inox

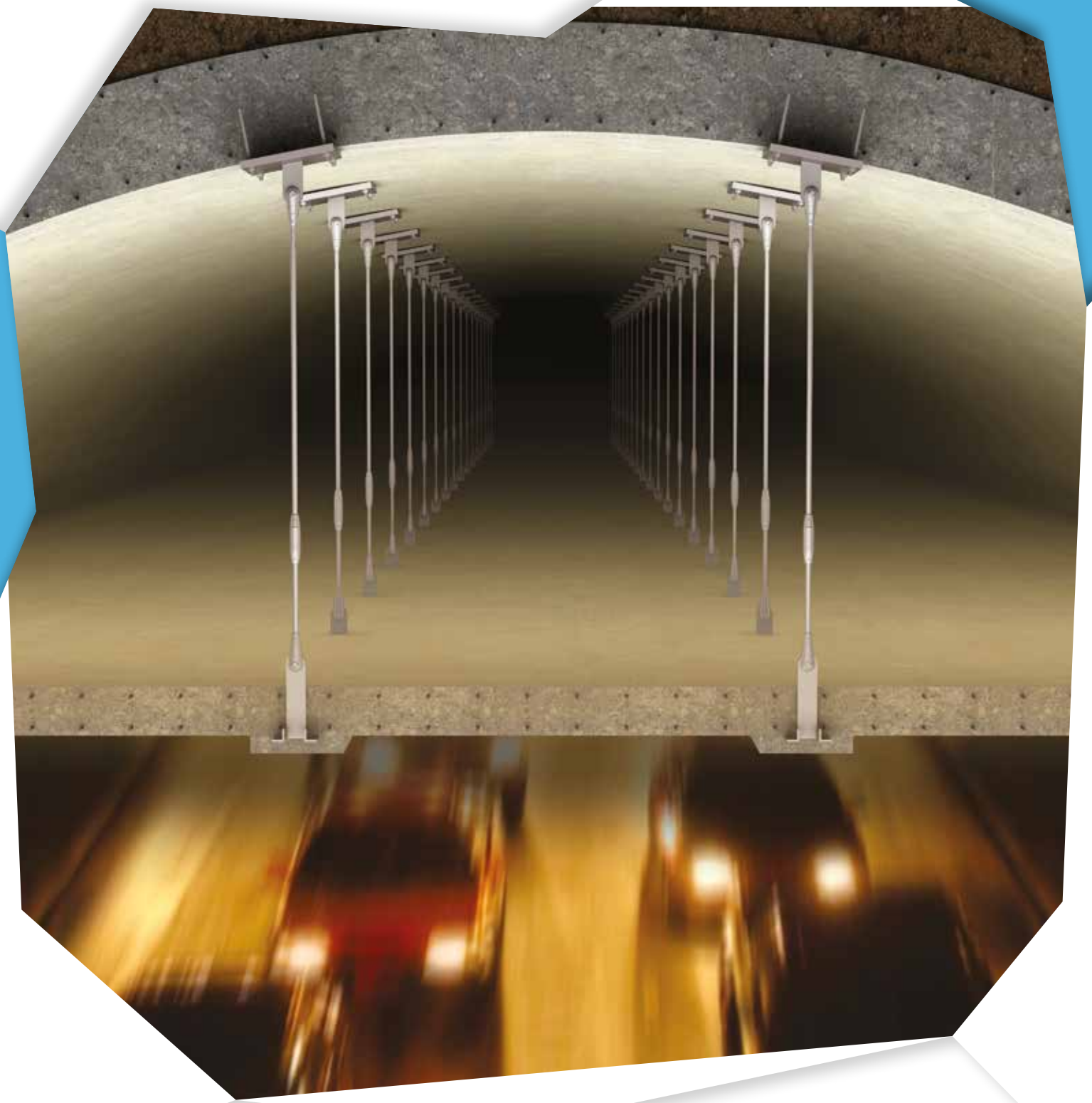
The refurbishment of a 283 meter-long road tunnel in the mountainous area of the Aosta Valley involved the installation of a new cladding, for which colour-coated stainless steel was specified. The stainless steel substrate ensures long-term corrosion resistance, especially in view of the inevitable exposure of the reverse side of the sheet to humidity. On the front side it was necessary to avoid highly, reflective metallic surfaces in order to prevent glare. In-line colour coated stainless steel fulfilled both of these critical requirements. The proven ferritic 17% chromium grade was a cost-effective solution. The selected colour, white, spread the light evenly without causing glare. The chemical composition of both the primer and the coating ensured that no toxic gases could develop even in the case of a fire. Installation was fast and efficient, making it possible to complete the refurbishment within two months.

Transport

Slab Suspension in a Bypass Tunnel

Location	Brisbane, Australia
Environment	Coastal
Fabricator	Ancon, Sheffield, UK
Stainless steel grade	EN 1.4462 (22 % Cr 5 % Ni duplex stainless steel)
Product type	Bar
Source of information	Ancon Building Products

The CLEM7 Tunnel, known as the North-South Bypass Tunnel is a toll road built under the Brisbane River, including two 4.8 kilometer twin-lane tunnels which bypass the city's central business district and serve to reduce congestion. This is the longest road tunnel in Australia, and is also the most advanced, with many safety features. In the event of a fire or explosion, a high-tech ventilation system comprising 100 jet fans will rapidly extract smoke to a longitudinal duct above the road deck. A stainless steel suspension system holds the immense concrete slabs which form the duct. In addition to the suspension system, 33,000 light gauge stainless steel posts support the architectural lining around the tunnel walls.



Transport

Wall Cladding of an Underground Station

Location	Barcelona, Spain
Environment	Urban
Architects	Sanchez Piulachs
Structural engineers	Acciona, Isolux-Corsán & Proinosa
Owner/developer	Barcelona Council
Fabricator	Codina, La Torre de Claramunt (Barcelona), Spain; Vargasa Metal; Inoxarte
Stainless steel grade	AISI 316 (EN 1.4401)
Product type	Mesh, sheet.
Construction company	UTE L5 HORTA (Acciona, Isolux-Corsán y Proinosa)
Producer or supplier	Acerinox and Inoxfil
Source of information	Cedinox Magazine

In the underground system of the vibrant Spanish city of Barcelona the authorities opted for three-dimensional stainless steel for cladding walls and ceilings. Woven metal has been used in various shapes and dimensions. The molybdenum-alloyed stainless steel grade 316L is on the safe side with regards to durability and corrosion resistance. Mesh is an efficient medium for noise absorption. It invites users to come closer and discover the intricate interplay of wires, bars and strips in the cladding. Despite its smooth metallic nature, the complex geometrical structure of the surfaces makes them appear matt from a distance so that glare is avoided. Stainless steel contributes to a feeling of safety and comfort.

Picture courtesy of CODINA, VARGASA METAL, INOXARTE


01:32

Transport

Walkway Suspension in an Underground Station

Location	Bilbao, Spain
Environment	Urban
Architects	Norman Foster
Structural engineers	Ingenería Metro de Bilbao, S.A. (IMEBISA)
Owner/developer	Bilbao Council
Fabricator	Gramometal, Ortuella, Spain
Stainless steel grade	316 and 310S
Product type	Sheet, bar
Surface finish	2B
Producer or supplier	Acerinox
Source of information	Cedinox Magazine

In the underground stations across Bilbao, the capital of the Spanish Basque region, stainless steel grade 316 is a common feature for stairwells and claddings, where its aesthetic qualities and proven low-maintenance properties are an asset. But an additional feature makes some of them quite special: the walkways seem to hover above the platforms and rails. Filigree stainless steel suspension bars make this elegant construction possible. As the stairs and elevated access paths are part of the escape route, they must meet high fire resistance requirements. So stainless steel AISI 310S (EN 1.4845) is a 24-26 % Cr, 19-22 % Ni austenitic grade has been specified. The structural engineers used the mechanical and physical properties to translate the architect's daring concept into a technical solution.

Transport

Runway Extension into the Sea

Location	Tokyo, Japan
Environment	Marine
Fabricator	Nippon Steel Engineering Co., Ltd and Joint Ventures
Stainless steel grade	NAS354N (UNS N08354) for the upper part in the splash zone; NSSC270/NAS185N (SUS312L, UNS S31254, EN 1.4547) for the lower part in the tidal zone
Product type	Stainless steel-clad structural steel circular hollow sections
Dimensions	1.2 mm (upper part), 0.4 mm (lower part)
Surface Finish	No 4 finish (upper part), bright annealed (lower part)
Producer or supplier	Nippon Steel & Sumikin Stainless Steel Corporation/Nippon Yakin Kogyo Co., Ltd.
Source of information	JSSA; Nippon Yakin Kogyo

When Tokyo Haneda International Airport was expanded, the scarcity of land made it necessary to build the new runway D out into the sea. The supporting structure of a connecting bridge to the artificial island is in direct contact with sea water. Reconciling the 100 year durability requirement with Life Cycle Cost constraints was a challenge. Organic coatings would have required regular repair and resulted in unacceptable maintenance costs. Technically and economically, the cladding of structural steel with high-end austenitic stainless steel turned out to be the optimal solution. For the tidal zone, a 20 % Cr, 18 % Ni and 6 % Mo grade with an excellent corrosion resistance was used. The corrosion load is highest in that part of the structure which is not permanently wet. In such recessed areas, splash water dries without the aid of rainwater to wash the chloride-containing deposits away. For these conditions, an even stronger alloy with 23 % Cr, 35 % Ni and 7.5 % Mo was found most appropriate. The first-time application of this technique in an airport facility won the stainless steel producers the ISSF New Applications Award in May 2015.


R4-b III
R4-b II

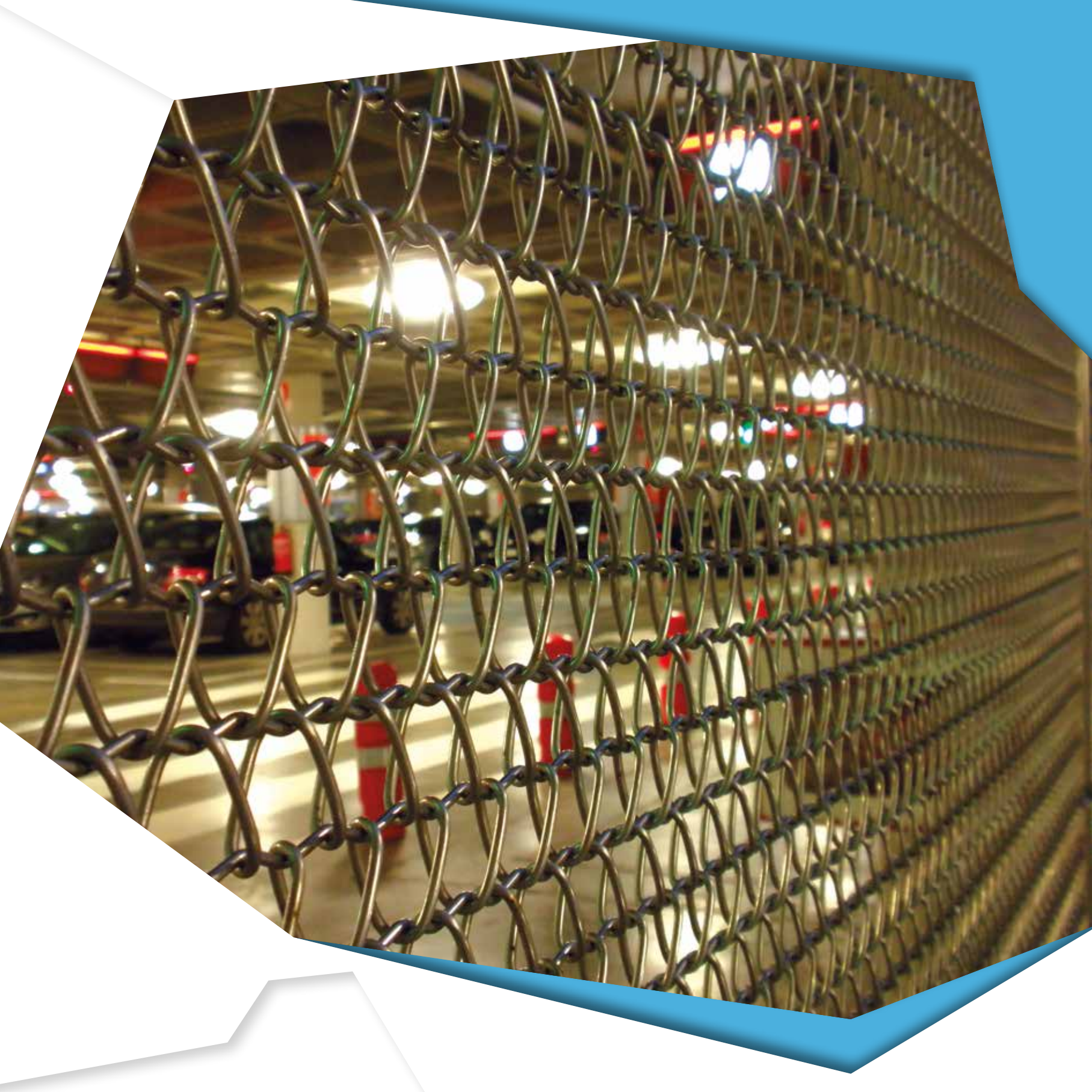
Transport

Enclosures for Airport Buildings

Location	Madrid, Spain
Environment	Urban
Architects	Richard Rogers and Carlos Lamela
Structural engineers	Folcra
Owner/developer	AENA
Fabricator	Codina
Stainless steel grades	AISI 316 and duplex 1.4462
Product type	Stainless steel bars, fasteners and mesh
Dimension	Several
Producer or supplier	Roldan, Inoxfil (Acerinox Group)
Source of information	Cedinox Magazine

Terminal 4 of Madrid's Barrajas Airport is known for its extensive use of stainless steel in baggage belts, rainwater drainage and ventilation. There is also another dimension of stainless steel use which is equally important: enclosures. The glazed façade depends on Duplex stainless steel EN 1.4462. In the car park, stainless steel wire mesh, grade AISI 316 (EN 1.4401) fulfills three functions: it provides protection against ventilation and allows natural light into the building.

Photo courtesy of Codina



Transport

Breakwater Repairs

Location	Bayonne, France
Environment	Marine
Stainless steel grade	EN 1.4462
Product type	Rebar
Dimension	10 mm and 12 mm Ø
Producer or supplier	Ugitech
Source of information	Ugitech

The harbour of Bayonne, on the North Sea coast of France, is regularly exposed to stormy weather. In the 1960s, a breakwater was erected to protect the entrance channel, including a wall and a platform wide enough to accommodate a heavy duty crane, which was used to re-position the 40 ton concrete blocks that cover the exposed outside of the structure. For the repairs to the structure in 2014, the authorities specified a 22% chromium, 5% nickel duplex stainless steel grade whose additional molybdenum and nitrogen contents provide superior corrosion resistance and mechanical properties. As grade EN 1.4462 in the ribbed condition has a minimum yield strength of → 750 MPa, rebar diameters could be reduced, thereby contributing to the overall economics of the stainless steel solution.

Ferritic Stainless Steel Water Tank for Shanghai Tower

Location	Shanghai, China
Environment	Outdoor
Fabrication process	Welding, stamping
Grade/surface	B444Ti/2B
Main thickness or diameter	1.0 – 2.5 mm
Manufacturer	Shanghai Tonghua Stainless Steel Pressure Vessel Engineering Co.,Ltd.
Material supplier	Baosteel
Source of information	Baosteel

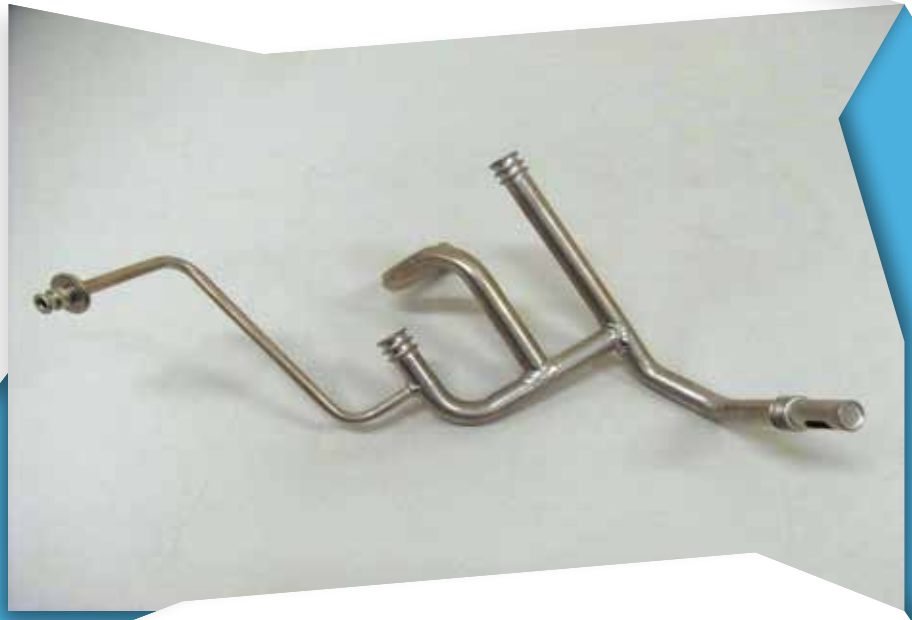
Baosteel supplied a ferritic grade B444Ti with 18% Chrome and 2% Molybdenum), with good corrosion resistance and good weldability, for the manufacture of a water tank panel in Shanghai Tower. This grade is also suitable for other applications in the water industry, including water treatment plants, water circulation pipes, effluent treatment and general plumbing operations.

Water Equipment

Stainless Steel Pipes for Ecocute Hot Water Systems

Location	Japan
Environment	Outdoor
Grade/surface	SUS445J1
Manufacturer	Hitachi Appliance Co.,Ltd
Material supplier	Nisshin Steel
Source of information	JSSA

The EcoCute is an energy efficient electric heat pump, water heating and distribution system that uses heat extracted from the air to heat water for domestic, industrial and commercial use. Instead of the more conventional ammonia or haloalkane gases, EcoCute uses carbon dioxide as a refrigerant. The technology offers a means of energy conservation and reduces the emission of greenhouse gas. The Ecocute Systems have introduced ferritic grade SUS445J1 Stainless steel for their water pipes because of its combination of strength and resistance to corrosion. The system has been designed to clean the pipes automatically after use. Keeping the inside of the pipes clean enhances the immaculate image of the energy-saving and environment-friendly Ecocute System.



Water Equipment

Water Pipe Bridge

Location	Hekinan City, Aichi Prefecture, Japan
Environment	Coastal
Owner/developer	Hekinan City
Stainless steel grade	SUS316
Product type	Welded pipe
Surface finish	Pickled and passivated
Source of information	JSSA

When drinking water or waste-water pipes have to cross rivers and canals, they are often integrated into the girders of road and rail bridges or attached to them. In Hekinan, the steel pipes of one such bridge had developed leaks and needed to be replaced. On this occasion, its capacity needed to be increased to meet growing demand, but larger capacity pipes could not be integrated into the existing bridge. The municipal authorities therefore decided to build a separate structure alongside the road bridge. The design was of the truss-stiffening type, in which the conduit has two functions: besides conveying the water, it also serves as the lower section of the truss. Molybdenum-alloyed grade SUS316 was used for three reasons. Firstly, this grade is known to be corrosion resistant in drinking water composition water quality is unaffected. Secondly, under coastal atmospheric conditions the outer surfaces must be corrosion resistant. Repair coatings, therefore, become redundant. The stainless steel structure was found to be the most cost-effective option from a life cycle costing point of view. Thirdly, the exceptional ductility of austenitic stainless steels is an advantage in seismic conditions. Stainless steel is tougher than competing materials and can undergo stronger deformation without breaking. In the event of earthquakes, it is essential to maintain drinking water supply as a key element of public infrastructure. The requirement to manage both chloride-containing coastal atmosphere and earthquakes is quite typical of Japanese locations, so, it is not surprising that about 40 % of all pipe bridges involve stainless steel in this country.

Water Equipment

Buffer Zones in Storm Water Treatment Plants

Location	Spain
Environment	Urban or coastal
Fabricator	Hidrostank
Stainless steel grade	304 (EN 1.4301), in coastal locations 316 (EN 1.4401)
Product type	Cold rolled
Surface finish	Glass bead blasted
Producer or supplier	Inoxcenter (Acerinox Group)
Source of information	Cedinox Magazine

In warm climatic regions like Spain, there can be long periods of drought followed by sudden violent thunderstorms and heavy rainfall. To ensure that the water treatment system can cope, large capacity buffer basins have been built, which reduce the risk of flooding. Apart from the large volumes of water, there is another problem: when it starts raining, solid matter and pollutants, which may have accumulated over several months, are washed away within minutes. Consequently, the initial surge of water is heavily charged with sand, dirt and pollutants. For this reason, the water treatment system is designed to allow sedimentation of the solids, which can then be collected and disposed of safely. As hydrogen sulphide is likely to be present, stainless steel is the preferred material to prevent corrosion and also to extend the life of the water treatment plants.

Acknowledgements

During the course of producing this book we have had willing help from lot of people. In no particular order, I would like to record our appreciation to Olli-Matti-Saksi, Stephen Jones, Anne Myllykoski and Saara Tahvanainen at Outokumpu; Eric Haekens, Carole Lecomte and Jean-Michel Damasse at Aperam; Lucien Matthews and Jacob Mouw at Columbus Stainless; Dr. Wei Zhang at Baosteel Stainless; Luis Peiro, José-Carlos Valencia and Susana Adámez at Acerinox; Fernando Correa at Iminox; Richard Matheson and Lissel Port at ASSDA; John Tarboton and Lesley Squires at SASSDA; Masaharu Uzawa and his team at JSSA; Hyun-Seok Cho and his colleagues from POSCO; Takeo Tomita and his colleagues from Nisshin Steel; Bernard Héritier and Jo Claes from the ISSF; Thomas Pauly from Euro Inox; Marcus White at Roccbox; Jane Walter at OrganicKidz; Ignacio Pascual at North American Stainless; Daniel Fondimore; Joseph May; John Carroll Runnels;Harriet Mildon-King at Patterson Architects; Nicole Kinsman at IMOA; Nigel Ward and Clare Richardson at the Nickel Institute; John Wu, Fiona Yu and Chen Shang Shen at Shanghai Krupp Stainless; Fausto Capelli and his team at Centro Inox; Paolo Zanettin at Zanettin Srl; Dipl.-Ing. David Bailly at Institut für Bildsame Formgebung; Olivier Jourdan at Ugitech; Michail Karpenko at NZSSDA; the German Steel Federation; Jeffrey Hsu, Jeff Yang, Calvin Tai and Andy Chiang at YUSCO; Paul Didier at Industeel; Nippon Yakin Kogyo; Nippon Steel and Sumikin Stainless Steel Corporation; JFE Steel; ThyssenKrupp Materials Services; Laura Louise Stanley at Ancon Building Products; Eva Liu and Fran Xiao at Macau Society of Metal Structures; Korea Iron & Steel Association; Marielle Fevrier at Syndicat Mixte Baie du Mont-Saint-Michel; Trudi Smith at the Buffalo Bayou Partnership.

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