# BUILDING INTERIORS
## THE FERRITIC SOLUTION

ISSF INTERNATIONAL STAINLESS STEEL FORUM

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FERRITIC STAINLESS STEEL APPLICATIONS

# Foreword

## FERRITICS INDOORS

"Today, stainless steel is well-known for its presence in building envelopes. These often use austenitic grades. For interior uses, however, an austenitic grade often seems a rather luxurious solution. Less expensive, more stable in price but possessing fine properties, ferritic grades are the perfect alternative for indoor use.

"Given the continued volatility in the price of certain alloying elements, notably nickel, it is more than ever the responsibility of the stainless steel industry to guide its customers in correct grade selection. Existing and potential users can no longer afford to lavishly over-specify grades for their applications. In this context, ISSF has decided to encourage greater use of 'ferritic' stainless steel – a type of stainless steel that uses no nickel.

"The resulting ISSF brochure "The Ferritic Solution" and similarly titled video*, place these grades firmly on the pedestal they deserve, as superb stainless steels suitable for innumerable uses. The present booklet is one of several follow-up publications on ferritic grades in specific application areas. Our approach has been to feature case studies that demonstrate beyond doubt that ferritics are indeed ideal for many interior building applications."

"As with these previous projects, the International Chromium Development Association (ICDA) has co-funded this booklet. I thank ICDA** for this help, as I do those users of ferritics who have contributed case studies about the excellence of these grades in building interiors."

*Both brochure and video are available free of charge from ISSF (www.worldstainless.org). The video can also be viewed on the ISSF website and downloaded.

**ICDA website: www.icdachromium.com

**Jürgen Fechter**
Chairman
Marketing Development Committee
ISSF

## International Stainless Steel Forum (ISSF)

Founded in 1996, the International Stainless Steel Forum (ISSF) is a non-profit research organisation that serves as the world forum on various aspects of the international stainless steel industry. Whilst having its own Board of Directors, budgets and Secretary General, ISSF is part of the International Iron and Steel Institute (IISI). ISSF now comprises some 73 company and affiliated members in 26 countries. Jointly, they are responsible for around 85 percent of worldwide stainless steel production. A full list of members can be found on the ISSF website: www.worldstainless.org.

# Contents



# FERRITICS – A CLEAR SOLUTION

Ferritic grades make it easy to benefit from the advantages of stainless steel in today's interior building applications.

Daidalos system

Architects, designers and building specialists throughout the world will unanimously testify to the advantages of stainless steel in interior building contexts.

Today, we are all familiar with the silken sheen of stainless steel handrails or balustrades and stainless steel panels of lifts and escalators. Other "visible" interior-building applications for this versatile material include indoor wall cladding, door panels and floor tiles.

Less visible established applications include plumbing, window hinges and fasteners and structural uses – including roof support.

## MORE THAN JUST GOOD LOOKING

Stainless steel is renowned above all for its resistance to corrosion and its attractive, striking appearance. Both are due to the presence of chromium as an alloying element. Steel has to contain at least 10.5 percent of it to become "stainless" (i.e. highly corrosion-resistant).

Stainless steel also boasts physical and mechanical properties that make it an exceptionally useful and desirable material for the widest variety of applications.

On the production and assembly front, stainless steel offers ease of manufacture and excellent workability and weldability. For the end user, it guarantees long service life and low Life Cycle Cost (LCC) advantages. It usually needs no surface treatment (such as painting) and is easy to keep clean and maintain.

## THE AUSTENITIC HABIT

Until lately, architects, designers, fabricators and builders have tended to favour the so-called austenitic ("300-series") grades of stainless steel.

As well as chromium, these grades contain nickel, which alters the atomic structure, making them non-magnetic and enhancing ductility, formability, toughness and "general-corrosion" resistance.

Intrinsically expensive because of their nickel content, austenitic grades are also totally at the mercy, in terms of their price, of the soaring and volatile nickel price.

This problem threatens to drive some existing and potential users away from stainless steel as a material choice altogether. Stainless steel may seem either simply too expensive or too unpredictable in terms of price. An architect estimating for a major development project, for example, needs to know that the cost of the material he has specified will not double over the contract period.

## THE FERRITIC ANSWER

Thankfully, the problem is illusory, deriving as it does from a widely held false belief – that only austenitic grades really resist corrosion. This idea, which lingers stubbornly in user's minds, causing them to sniff at grades that contain no nickel, is totally false! Nickel is not the basic corrosion-resistance ingredient of stainless steel – chromium is.

Stainless steel grades not containing nickel are known as "ferritic" (400-series) grades. Ferritics are highly resistant to corrosion – and especially to what is known as localised or "pitting" corrosion. In most interior-building applications (and indeed in numerous other sectors), a ferritic grade can be found that will do the job just as well as an austenitic.

*"...a ferritic grade (...) will do the job just as well..."*

The fact that interior building applications are more at risk of "localised corrosion" than "general corrosion" further strengthens the case for ferritics in this sector.

The individual level of corrosion resistance of ferritic grades is mainly determined by the amount of chromium they contain. Chromium is historically stable in price, and this stability is reflected in the price of these intrinsically very affordable grades.

THE 5 GROUPS OF FERRITIC GRADES

| Group 1 | Group 2 | Group 3 | Group 4 | Group 5 |
|---|---|---|---|---|
| 10%-14% | 14%-18% | 14%-18% stabilised | Added Mo | Others |
| Cr content: 10%-14% | Type 430 Cr content: 14%-18% | Types 430Ti, 439, 441, etc. Cr content: 14%-18%. Include stabilising elements such as Ti, Nb, etc. | Types 434, 436, 444, etc. Mo content above 0.5% | Cr content of 18%-30% or not belonging to the other groups |

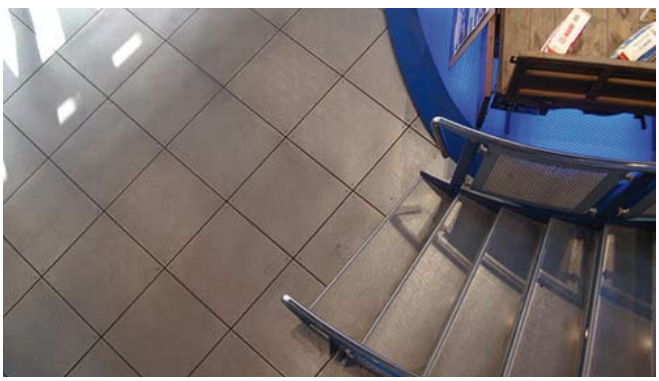
## FIVE FERRITIC FAMILIES

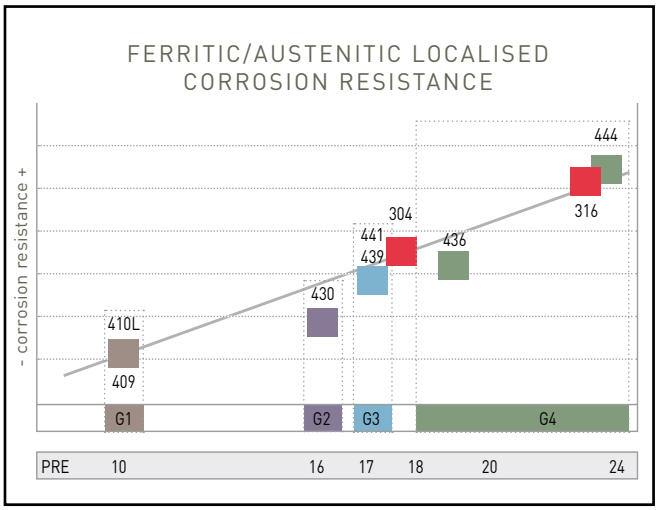
ISSF classifies ferritic grades in five groups – three families of "standard" grades and two of "special grades".

As well as chromium, the higher-alloyed grades contain additional elements such as titanium, niobium and molybdenum, to enhance specific properties. Group 1 grades can be perfectly adequate for applications in non- or lightly-corrosive environments. Type 430 (Group 2) is the most widely used ferritic grade, with better corrosion resistance. It can often replace austenitic Type 304. Group 3 grades, offering enhanced formability and weldability, are also often used to replace Type 304. Group 4 grades have added molybdenum, giving extra corrosion resistance – equivalent to that of Type 316. Group 5 grades are superior to Type 316 in corrosion resistance.

## LOCALISED CORROSION RESISTANCE

Austenitic and ferritic grades can be seen as two interchangeable stainless steel families, in terms of their resistance to localised corrosion.






The PREN (Pitting Resistance Equivalent Number) – %Cr +3,3 %Mo+ 0,16%N – is a measure of the pitting-corrosion resistance of a stainless steel grade in a chloride-containing environment. The higher the PREN the greater the corrosion resistance.

A comparison of the corrosion resistance of the five ferritic "groups" with that of austenitic Type 304 highlights the key role of chrome and molybdenum. It shows that the corrosion resistance of most ferritics matches that of nickel-containing grades.

***"...the corrosion resistance of most ferritics matches that of nickel-containing grades."***

## CHOOSING THE RIGHT GRADE

There follows a group of case studies that illustrate conclusively the perfect suitability of ferritic grades for a very varied selection of interior building applications.

These case studies refer to specific ferritic grades that have proved suitable for the applications concerned. Users should, however, always consult their stainless steel producer about the correct grade for their application. They should imperatively acquire their material from a reliable source, able to offer proven guarantees as to the grade, quality and origin of the material supplied.

STANDARDS REFERRED TO:
- ASTM A 240-07, April 2007
- EN 10088 - 2 Sept. 2005
- JIS G 4305, 1991

| | Type | Element Cr | Element Mo | Standard | Ref. |
|---|---|---|---|---|---|
| 10%-14%Cr Group 1 | 410 | 10.5 - 12.5 | | UNS, EN, JIS | S41003, 1.4003, SUS410L |
| 14%-18%Cr Group 2 | Type | Element Cr | Element Mo | Standard | Ref. |
| | 430 | 16.0-18.0 | | UNS, EN, JIS | S43000, 1.4016, SUS430 |
| 14%-18%Cr stabilised Group 3 | Type | Element Cr | Element Mo | Standard | Ref. |
| | 430J1L | 16.0-20.0 | | JIS | SUS430J1L |
| | 430LX | 16.0-19.0 | | JIS | SUS430LX |
| | 439 | 17.0-19.0 | | UNS | S43035 |
| | 430Ti * | 16.0-18.0 | | EN | 1.4510/1.4520 |
| | 430 Nb * | 16.0-18.0 | | EN | 1.4511 |
| | 441 | 17.5-18.5 | | UNS, EN | S44100, 1.4509 |
| *Common designation | | | | | |
| Added Mo Group 4 | Type | Element Cr | Element Mo | Standard | Ref. |
| | 436 | 16.0-18.0 | 0.75-1.25 | UNS, EN | S43600, 1.4513 |
| | 436J1L | 17.0-20.0 | 0.4-0.6 | JIS | SUS436J1L |
| | 444 | 17.5-19.5 | 1.75-2.5 | UNS | S44400 |
| | | 17.0-20.0 | 1.8-2.5 | EN | 1.4521 |
| | | 17.0-20.0 | 1.75-2.5 | JIS | SUS444 |
| Others (> 19% Cr) Group 5 | Type | Element Cr | Element Mo | Standard | Ref. |
| | 445 | 19.0-21.0 | | UNS | S44500 |
| | 445J1 | 21.0-24.0 | | JIS | SUS445J1 |
| | 445J2 | 21.0-24.0 | 1.5-2.5 | JIS | SUS 445J2 |
| | 446 | 25.0-27.0 | 0.75-1.5 | UNS, JIS | S44626, SUSXM27 |

Non-exhaustive list. See ISSF brochure "The Ferritic Solution" pp. 60-61 for complete details.

CASE STUDY

# Handrails and balustrades

Ferritic grades bring all the glamour and practical virtues of stainless steel to this important application.

Grade 1.4003

This case study looks at the use of about 100 m of ferritic stainless steel tubes for handrails in a shopping mall in South Germany. The choice of a ferritic grade was determined here by price considerations.

## STRUCTURAL REQUIREMENTS

The ferritic grade chosen had to conform to Germany's building code "Allgemeine bauaufsichtliche Zulassung Nr. Z-30.3-6 des Deutschen Instituts für Bautechnik für Erzeugnisse, Verbindungsmittel und Bauteile aus nichtrostenden Stählen, gültig bis zum 31.12.2008". While this is a purely national code, the EN recommendations "Eurocode 3, part 1.4 Design of steel structures. Supplementary rules for stainless steels" include similar criteria.

The standard specifies a minimum thickness of at least 1.50 mm for structural purposes such as handrails. It also lists permitted stainless steel grades according to type of environment – ranging from indoor to highly aggressive. For an indoor environment, it lists only two ferritic grades: 1.4003 (UNS S41003) and 1.4016 (Type 430).

Grade 1.4003 tube, of 1.50-2.50 mm x 48.3 mm diameter, available on the German market, was selected for the present application.

## FABRICATION CONSIDERATIONS

The producer of the handrails offers several models of stainless steel and glass handrail systems, some completely welded and others involving bolted connections.

### Welding

Using purchased tubes as well as in-house laser-welded tubes, the company found welding to be no more difficult than welding an austenitic grade.

### Bending

Bending into the final shape proved to be problem-free.

### Corrosion resistance

The purchased tubes were stored outdoors before further fabrication for at least six months, without showing any signs of corrosion. However, they had been subjected to a proprietary passivation process, to ensure optimal use of the level of corrosion resistance afforded by the grade concerned.

### Polishing

The tubes responded well to polishing, coming up with a particularly brilliant shine.

## A CLEAR CASE FOR FERRITICS

This highly successful use of a basic, Group 1, 12%Cr grade proves beyond doubt that the use of an austenitic grade in this indoor application would be a dramatic over-specification.

The low cost of the grade used also makes stainless steel a highly attractive alternative to a non-stainless steel material, such as painted steel.

CASE STUDY

# Door panels

Attractive, reflective, hygienic, easily maintainable, long-lasting – ferritic stainless steel is a contemporary architect's dream material.

Ferritic stainless steel is so versatile that it lends itself ideally to use as a door-panelling material. The case illustrated here shows toilet doors in an underground metro station in Seoul, South Korea.

## AESTHETIC AND FUNCTIONAL

Various forms (curved or flat), colours, finishes and perforated patterns can be brought into play, to meet a wide range of aesthetic and practical requirements.

Even with little or no extra surface treatment, ferritic stainless steels can provide an alternative solution where other materials than stainless steel would have to be coated.

Stainless steel is easy to fix to an existing support, and the material meets contemporary requirements in terms of thermal insulation, acoustic insulation and fire safety.

## ECONOMIC ADVANTAGES

In the present case, the architect chose to use grade STS445NF (Group 5).

This particular ferritic solution is not only correct in terms of specification, but also meant considerable cost-saving. An austenitic grade would not be required for this application, given that a ferritic grade can do the job just as well.

# CASE STUDY
# Wall cladding

High strength, excellent corrosion resistance, ease-of-fabrication and a progressive, contemporary look – ferritics have it all.

Façade cladding is a notable way in which stainless steel can play a striking role in imaginative architectural designs.

For more than 70 years, stainless steel has provided external weatherproofing for many of the world's tallest buildings, from the New York's Chrysler Building in 1930 to the Petronas Twin Towers in Kuala Lumpur in the 1990's.

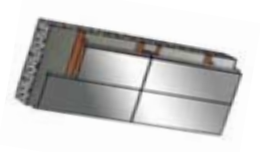
## MILLION-DOLLAR WALLS

Most metal cladding systems are applicable outdoors as well as indoors.

For indoor wall cladding, ferritic grades offer all the versatility, glamour and practical properties of stainless steel, at a stable and reasonable price.

Ferritic stainless steel wall panels look exciting and beautiful. Architects are spoilt for choice in terms of possible colours, surface finishes and perforated patterns and can opt for flat or curved panels.

Ferritics meet all today's thermal-insulation, acoustic-insulation and fire-safety requirements and can be easily fixed (see diagram of a composite system) by cladding rail or support frame, to any type of wall, be it concrete, masonry or combined steel and brick.



## EASY ON THE EYE

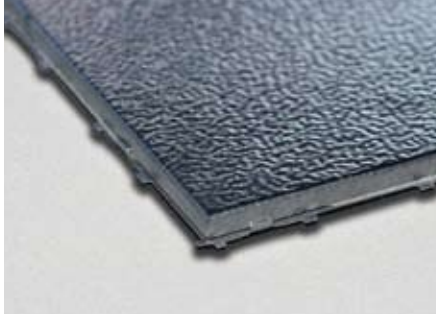
The present case study case features the Institute of Theoretical and Applied Optics (IOTA), in Palaiseau, France. This striking building required 1200 m2 of both external and internal cladding.

The architectural firm SERAU SA architectes et ingénieurs associés chose austenitic Type 304 (EN 1.4301) 1.50 mm sheet, with a bright annealed finish, for the exterior cladding.

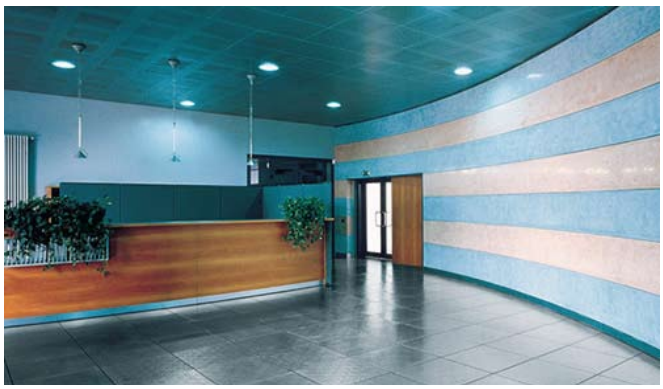
For indoors, this grade would have been a lavish over-specification, in an environment devoid of general-corrosion risk. Here, ferritic Type 430 (EN 1.4016) 1.50 mm sheet (again with a bright annealed finish) proved the perfect solution. The chosen surface finish was intended to match the optics-oriented mission of the Institute, by its extraordinary reflectivity, clarity and "visual" nature.

CASE STUDY

# Removable floor tiles



Affordable, durable, wear-resistant and easy to fit, ferritic stainless steel floor tiles provide a high-tech, ultra-contemporary design effect.



Removable metal floor tiles are used in contexts such as bars, showrooms, kitchens and exhibition stands.

The Italian tile manufacturer who provided the present report explains that the demand for this type of tiling emerged in the mid-nineties from architects looking for more attractive and novel flooring systems.

Removable flooring of this kind is also available in marble, glass and even carbon steel (hot rolled).

## EASY TO FIT

The "removable" quality is either ensured by a system of supports and screws (between the tiles and the supports) or simply by immobilising the tiles in a lattice of mostly plastic supports, damped by rubber sheets.

## THE STAINLESS ADVANTAGE

Despite the initial cost difference between carbon steel and stainless, carbon steel tiles are not more cost-effective. Firstly, stainless steel tiles come in thicknesses as thin as 0.60 mm, whereas (hot rolled) carbon steel is not available below 1.50 mm – which makes for heavier tiles. Carbon steel tiles also require surface waxing (they are covered with black oxide).

The relative simplicity of floor tiles allows the full potential of stainless steel's mechanical strength and wear resistance to be exploited.

## SAFE TO WALK ON

The company performs an in-house embossing operation to give sufficient anti-slip properties to the original smooth surface provided by the stainless steel mills. To extend the choice of stainless steel options, coloured finishes are available. Since the traditional electrochemical method of colouring stainless steel surfaces does not offer sufficient wear resistance, the company is examining new methods, such as PVD (Physical Vapour Deposition).

## FERRITIC VS AUSTENITIC

Traditionally, the stainless steel grade for these tiles has been Type 304 (1.4301). However, in view of the unstable price of austenitics, the company now proposes ferritic Type 430 (EN 1.4016) for dry, indoor applications such as bars and showrooms.

There have been no reported problems with the manufacture, installation or use of these ferritic grades, which have to perform in demanding conditions. In such environments, in an application that involves no forming or welding, the switch from austenitic to ferritic stainless steel is clearly justified and feasible. The final product is in no way compromised.

CASE STUDY

# Cold store door frames

Stainless steel is a vital material in the food industry. Ferritic grades are gaining acceptance in innumerable applications in the sector.

Cold stores are used in the food-processing industry, to store perishable food.

The panels, doors and frames of cold stores are often made of stainless steel, since it is easy to clean and thus ideal for food-industry hygiene requirements. Stainless steel is also long-lasting.

## TWO COMPLEMENTARY GRADES

The German cold-store manufacturer, cool-it Isoliersysteme GmbH, that has contributed to the present report, explains that the most common grades used in cold stores are austenitic Types 304 and 316L. However, increases in the price of nickel in recent years have meant major increases in the price of austenitic stainless steel.

Both to stay competitive and take further advantage of the properties of stainless steel, manufacturers of cold stores have been evaluating ferritic grades.

For some parts of the construction, such as door frames with thicknesses of 1.5 mm and above, cool-it Isoliersysteme GmbH has started using ferritic Type 441 (1.4509).

This ferritic grade provides excellent corrosion resistance and can be easily combined with the doors and panels, for which the company still uses austenitic grades. It makes the company more competitive in the marketplace and allows it to offer a perfect combination of first-rate performance and economical pricing.

CASE STUDY

# Drinking-water pipes

Pipes carrying our drinking water must be durable, chemically neutral and easy to install. Ferritic stainless steel is gaining ground in the sector.


Pipes for tap water are an important application for stainless steel – a material that offers a high level of corrosion resistance and excellent formability.

The grade most commonly used in this application is austenitic Type 316L. However, in recent years, stainless steel water-pipe producers were faced with significant increases in the price of nickel, which made their product less competitive against materials such as polymers and copper.

It became essential to find a substitute from within the stainless steel families

## A FERRITIC SUCCESS STORY

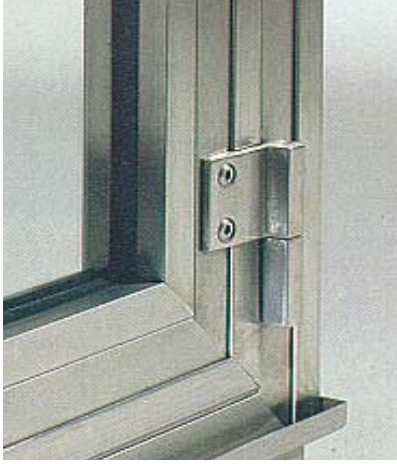
The focus of this case study, the Swiss company Nussbaum, reports that in consultation with stainless steel producers, piping-system manufacturers discovered that ferritic Type 444 (1.4521) is a suitable alternative.

Offering excellent corrosion resistance and durability and low maintenance, it can replace Type 316L in this application.

Intensive laboratory tests and trial installations finally led to approval of Type 444 by the German (DVGW) and Swiss (SVGW) authorities for use in drinking-water contexts.

Using the ferritic grade Type 444 as a cost-saving alternative, stainless steel's market share was not only maintained but actually increased. This substitution thus represents a big success for the use of ferritics in interior building applications.

# CASE STUDY
# Window hinges



For rigidity, life-span and wear resistance, stainless steel window hinges are the best. Ferritic grades cut costs but not quality.

The demand for stainless steel hinges began in the U.S., where performance criteria went up when the introduction of a kitemark system of standards led manufacturers to offer guarantees and assurances regarding the life of their components.

Stainless steel provides exceptional corrosion resistance and mechanical strength, ensuring longevity of the end product. These properties allow the hinge manufacturer to offer a guarantee of between two and five years. The consumer can thus rest assured that the product is of high quality.

## STAINLESS – AN OPEN AND SHUT CASE

Window hinges are produced in many different metals. Factors in the search for new materials include increasing consumer demand for longer-life products, the pressure on manufacturers to differentiate their products from competitors in the global market and cost and manufacturing-time constraints within the building industry.

Widely available in various grades and finishes, corrosion resistant, mechanically strong, versatile, able to withstand the in-service requirements of a high-use product and maintenance free, stainless steel has proved the answer.

A window hinge comprises 0.80 mm 2B or BA stainless steel for the track, 1.5 mm for the stay and 2 mm or 2.5 mm for the hinge. Window furniture products are produced from strip in coil, pre-slit to narrow bands and increasingly supplied in traverse wound coils from suppliers to manufacturers, for reasons of productivity.

The components are cut to length, pierced, machined, de-burred, edge-dressed and assembled in cell manufacture, in the form of kits to be supplied to window manufacturers for assembly on site.

## FERRITICS MEET THE SPEC

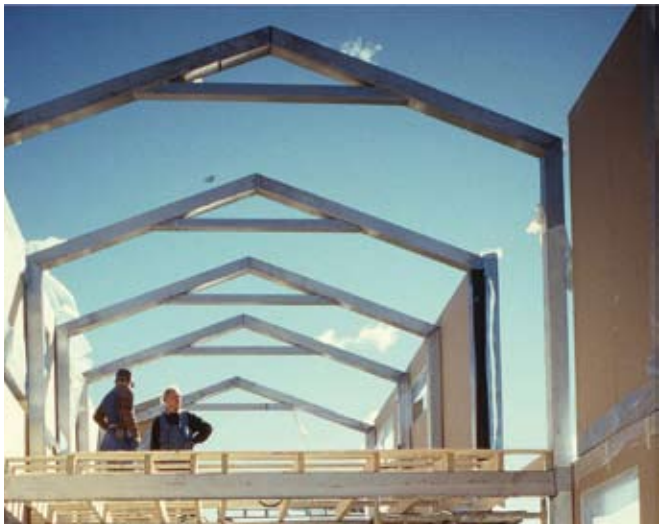
Window manufacturers first used Type 304 (1.4301), as it was readily available, had excellent corrosion resistance and met the criteria in terms of specification and guarantee. This grade was the first approved for the U.S. standard bearing the kitemark.

Subsequently, ferritic grades such as Type 430 (1.4016) and stabilised ferritic variants have been introduced, in answer to the economic pressures of mass-volume manufacture, without in any way compromising product performance.

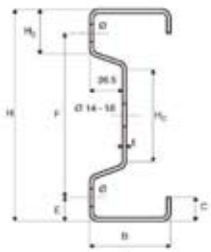
CASE STUDY

# Light-gauge building structures

A building structure is the most critical and complex part of the construction process. Ferritics can take the strain.



Performance is the over-riding criteria in the design and the realisation of structural members. It is common to use stainless steel for structural members, exploiting its high tensile strength, proof-stress properties and impressive elongation parameters – which enable ease of transformation and facilitate design and load calculations. Austenitic and duplex stainless steel grades are those most frequently specified.



The demand for stainless steel structures is inextricably linked to performance, guarantee and life-cycle requirements. Projects may be large-scale, necessitating significant investment, extensive planning and on-site work and requiring longevity and minimal maintenance.

## THE FERRITIC POTENTIAL

Low-chromium stabilised ferritic grades steels are emerging in this application, as an alternative to galvanized steel. They lend themselves ideally to building structures. Knowledge and use of these grades is, however, in its infancy.

Firstly, present legislation governing the use of stainless steel in structures makes little reference to ferritic stainless steels. Eurocode 3 does not actively promote this family of materials in the same way as other grades. Secondly, there are as yet few software and calculation tools on the market to facilitate the role of the design engineer and surveyor. Thirdly, there are not enough companies capable of working with these materials. Finally, market penetration is in its early stages. Ferritcs must be actively promoted through projects and lobbying.

## STAINLESS TRUMP CARDS

The main material choice for secondary structures is galvanised mild steel, typically Z275 or S355.

Stainless steel presents a number of advantages. With ferritics, there is no need for surface preparation or treatment. Thinner gauges can be used, optimizing the mechanical characteristics of the material. If individual structural elements are thinner, they weigh less, which means fewer site personnel, less erection time, more off-site fabrication and, therefore, the possibility of lower construction costs.

These gains are particularly valuable in the construction of modular or pre-fabricated buildings such as affordable housing and temporary or emergency accommodation, as well as small-footprint structures such as shelters.

Grade 1.4003 is the grade of choice for such applications, due to its high tensile strength, industrial availability and wide product range in both hot-rolled and cold-rolled, from 0.80mm to 12mm.

CASE STUDY

# "Unit bath" wall and ceiling panels

Steel panels in Japanese "unit bath" bathrooms have to be stainless. Ferritic SUS430 is the affordable choice.

"Unit baths" are prefabricated bathroom modules often installed in houses, apartments and hotels in Japan. Ferritic stainless steel sheets are commonly used for the wall and ceiling panels of these modules.

Stainless steel sheets are not used "bare" in this application. Since bright, warm tones are preferable in a bathroom, the sheets are print-laminated.

Being subjected to high moisture for extended periods in this application, panels must be highly anti-humid. Also, since they may be cleaned with detergents, they must have adequate anti-chemical, anti-scratch and anti-stain properties.

## A BETTER LAMINATION MATERIAL

The most common lamination material for unit-bathroom panels used to be steel sheets coated with heavy vinyl-chloride film, for good corrosion resistance. With recent heightened environmental awareness and the establishment of Pollutant Release and Transfer Registers (PRTRs), the use of PVC materials that have the environment hormone dioctyl phthalate ("DOP") in their plasticizers has become unpopular.

Of the several materials that can replace PVC, PET (polyethylene teRepthalate) film is best, with its flame-resistant, corrosion-resistant and anti-humid characteristics. Stainless steel sheets laminated with printed PET film have thus now come into use for bathroom panels.

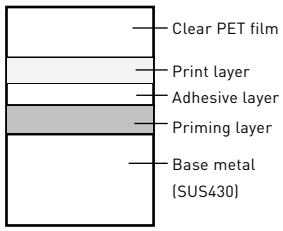
## ATTRACTIVE AND FUNCTIONAL

The panels have bright designs and good corrosion-resistant, humidity-resistant and stain-resistant properties.

Their designs are created with a tone combination of printed patterns under the highly-transparent PET film and the primer layer (coloured "hiding layer"). PET film is harder than PVC and has superior scratch resistance and stain resistance.

## THE CASE FOR FERRITICS

Zinc-coated or aluminium-coated carbon steel sheets can be used as the base material but these sheets are prone to blistering at cross-cut sections and cut edges. Ferritic SUS430 stainless steel is therefore preferred, for high-end bathrooms.




With corrosion-resistant stainless steel as the base material, PVC film can be replaced with thinner PET film, thus reducing production costs.

The main reason for using SUS430 rather than an austenitic grade is the cost advantage. In Japan, stainless steel is mostly represented by SUS304. However, the high cost of austenitic grades, mainly due to the volatile nickel price, has increased demand for ferritic grades such as SUS430J1L (19Cr-0.5Cu-Nb).

CASE STUDY

# Composite panels

Attractive and durable, composite ferritic stainless steel panels are suitable for both external and internal use.

Stainless steel composite sheet consisting of a non-combustible mineral-filled core sandwiched between stainless steel sheets, is used for external cladding, roof coverings and inner building panels.

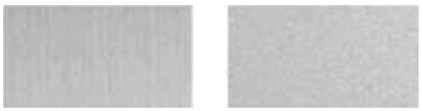
This material features excellent corrosion-resistance, sophisticated appearance, relatively light weight and excellent fire resistance.

## THE SANDWICH

The top-side skin is usually 0.3 mm grade SUS445J2 ferritic sheet and the core material non-combustible aluminium tri-hydroxide mineral filler and polyethylene.

The rear-side skin is grade 0.3 mm SUS430 ferritic sheet with a clear service coating on one side. Standard surface finishes are Hairline and Dull.

### Surface finishes



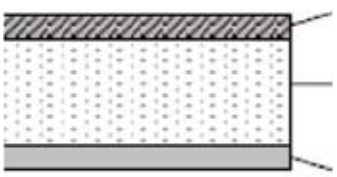
Hairline Dull

## USEFUL QUALITIES

Continuous-laminating ensures that these panels have excellent flatness. They are rigid and light. This 4 mm-thick panel is as rigid as a 2.9 mm plain sheet, which means a weight saving of around 55%. SUS445J2 grade has outstanding corrosion-resistance, comparable to austenitic Type 316.

In Japan, this type of panel, produced by one manufacturer, has fire approval for exterior and interior uses, based on the heat-release rate of the ISO 5660-1 fire-test and on gas-toxicity testing.

Since these panels are a composite of materials that have quite different properties, special machines may be required for processes such as cutting or grooving.



0.3mm stainless steel

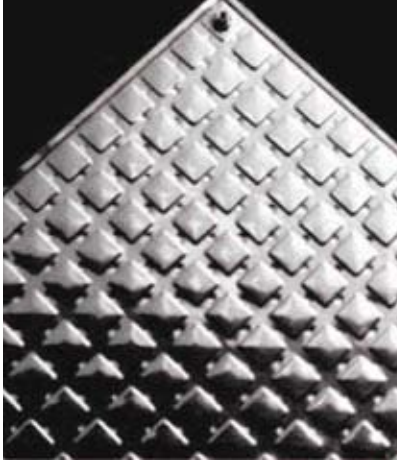
3.4mm non-combustible mineral-filled core

0.3mm stainless steel

Total thickness: 4mm

CASE STUDY

# Radiant panels



Temperature conditioning using ferritic stainless steel panels, for greater efficiency, comfort and health.

For some years now, the Swiss company Energie Solaire SA has offered a superior solution for indoor air conditioning, using plate heat exchangers originally designed for solar-panels.

Sometimes referred to as passive conditioning, this heating/cooling approach uses water (in closed loop) in radiant ceiling or wall panels. Such hydronic systems are progressively replacing conventional air-conditioning methods.

The Energie Solaire SA radiant panels consist of two thin ferritic stainless steel sheets, stamped with regularly-spaced, square bumps. Front and back sheets are seam welded at their periphery and spot welded between the bumps. The geometry and particular alignment of the sheets ensures uniform water flow.

Some 98% of the circulating water is directly in contact with the exchanger surface, resulting in high heat-transfer efficiency between water and panel.

## HEALTHIER AND MORE EFFICIENT

Radiation is a much more comfortable source of temperature conditioning than convection or conduction. With radiant panels, a room's occupants are heated or cooled by the surfaces, not by moving air, so the system offers a higher level of comfort at lower ambient air temperature than do conventional systems. It is also much healthier, of course.

Radiant panels mostly operate at a temperature close to the required ambient temperature and heating is usually achieved at temperatures below that of the human body. It is therefore possible to use low-temperature heat sources or operate heating systems at levels at which they are highly efficient. Ground water, rivers or lakes are perfectly suitable cooling sources for passive conditioning.

## FERRITIC ADVANTAGES

Radiant panels offer energy-consumption savings, superior environment quality and great temperature-conditioning efficiency. Ferritic stainless steel contributes to this by offering high thermal conductivity. In addition, the strength of ferritic stainless steels makes it possible to fabricate very thin, thermally efficient panels.

The corrosion resistance of grade 1.4509 (Type 441) ferritic stainless steel guarantees that the panels will have a long service life and require little or no maintenance. Furthermore, the reasonable, stable cost of this grade only adds to the economic gains offered by the use of these steels.

# APPENDICES

## SURFACE FINISHES

Available finishes for ferritic stainless steels are the same as those for austenitic grades. The most common include:

**Cold rolled finishes**
These standard finishes are the direct result of the stainless steel processing cycle at the mill. The most common are 2B and BA/2R. Both are often used for interior building applications.

• 2B finish has a smooth, fairly bright appearance, achieved by cold rolling, annealing and pickling, followed by a final skin pass rolling using perfectly smooth rolls.
• BA/2R finish is obtained by bright annealing in an inert gas atmosphere after cold rolling, followed by a final skin pass. This highly attractive surface is smoother, brighter and more reflective than 2B.

**Brushed and polished finishes**
These finishes can be applied to both 2B and BA surfaces. The grade of abrasive used determines the fineness or coarseness of the finish. Mechanically applied, these finishes can be achieved with either wet or dry grinding and can be used for many inner building applications. They are highly suitable for wide areas of stainless steel cladding.

**Patterned finishes**
Proprietary pattern-rolled finishes are also widely employed in buildings. These are usually achieved by rolling with patterned rolls. As with brushed surfaces, stainless steels with patterned surfaces are suitable for extensive, flat, indoor areas, such as panelling or claddings. In areas of heavy public traffic, such as building entrances, lift cages and airport terminals, where surfaces are susceptible to knocks and scratches, patterned surfaces are less likely to show damage.

**Special decorative finishes**
Modern techniques and processes make it possible to create exciting and dynamic graphic designs. Beside brushed, polished and patterned surfaces, acid etched, shot blasted or coloured surfaces are also available. These techniques provide an even wider range of surface variations. Indeed, for architects working on interior building applications, stainless steels provide a huge range of design possibilities.


## ACKNOWLEDGEMENTS

ISSF is grateful to Philippe Richard (ArcelorMittal Stainless, France), who coordinated a working group consisting of Dr. Ulrich Brand (ThyssenKrupp Stainless), Takeshi Utsunomiya (Nisshin Steel Co., Ltd), Sung-Joon Pak (Kosa), David Holland (Arcelor Mittal Stainless Europe, France), Calvin Tai, Nina Li (Yusco), Benoit Van Hecke (Euro Inox).

Thanks are also due to English-language consultant and writer Paul Snelgrove (Paris, France), for his help in preparing the booklet and to Franck Kamionka (MBCom, Paris, France) for designing and producing it.


## PHOTO CREDITS

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