



# COMMERCIAL FOOD EQUIPMENT

## THE FERRITIC SOLUTION



FERRITIC STAINLESS STEEL APPLICATIONS



# Foreword

## FERRITICS IN THE FOOD BUSINESS

“The world of commercial food equipment has been particularly hit by the volatile nickel price and its effect on the price of nickel-containing stainless steels. The inevitable swing away from nickel-containing grades towards nickel-free ‘ferritic’ grades is well in motion and, happily, ferritics have proved the perfect technical and economic answer in many application fields.

“There remains much confusion and lack of knowledge amongst users about ferritic stainless steels and their properties. This publication aims to put that right and guide users towards correct material choices. It is a sequel to the ISSF’s brochure ‘The Ferritic Solution’ and the video of the same title\*. Both are recommended to those wanting to discover the great merits of ferritics.

“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 testimonials about the excellence of these grades in commercial food equipment.”

\*Both brochure and video are available free of charge from ISSF and can also be viewed on the ISSF website ([www.worldstainless.org](http://www.worldstainless.org)) and downloaded.

\*\*ICDA website: [www.icdachromium.com](http://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](http://www.worldstainless.org).

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# FERRITICS TO THE RESCUE!

In the commercial food equipment world, ferritic stainless steels have emerged as a perfect alternative to nickel-containing grades.



Bourgeat, Type 436, France

Stainless steel is without question the best metal for use in commercial food equipment.\*

Used for work surfaces, pans, fridges, sinks, display units, rotisseries, ovens, chip fryers, cabinets, dishwashers, woks, extractor hoods and endless other applications, stainless steel is everywhere, in kitchens all around the world!

No other material can challenge stainless steel's supremacy in providing properties vital to end-users in this sector. These properties include remarkable corrosion resistance, temperature resistance, cleanability, durability, impact resistance and an attractive appearance. Stainless steel is also a very hygienic material and totally neutral in food-contact contexts. Manufacturers, too, find in stainless steel a material that ideally suits their needs in terms of its forming, welding and polishing characteristics and its flatness.

## THE AUSTENITIC QUANDARY

Until recently, designers, manufacturers and users of commercial food equipment have almost exclusively favoured nickel-containing stainless steel grades – the “300 series” (notably Type 304).

This choice has stemmed from the widespread (but inaccurate) belief that only these so-called austenitic grades have sufficient corrosion resistance in humid or aggressive environments.

Times are changing, however. The soaring and highly unstable price of nickel has become a major problem, since it is inevitably reflected in the price of austenitic stainless steels.

The phenomenon has repercussions for austenitic customers, who may, for example, have difficulty fixing an annual catalogue price for their products.



Lincat Limited, Type 430 (partial), UK

\*[see APPENDICES for definition of commercial food equipment segments]

Similarly, architects may tear their hair over estimating for major projects, not knowing how much the cost of austenitics will fluctuate over the contract period.

*“...stainless steel is everywhere, in kitchens all around the world!”*

The repercussion may just be that “decent” stainless steel itself seems quite simply too expensive. In a fix, the fabricator, designer or kitchen architect may feel compelled to choose a “second best” material.

## THE FERRITIC SOLUTION

The good news is that there is absolutely no need to get round the problem by changing to a material that will not have stainless steel’s unique practical and aesthetic merits.

“Ferritic” grades of stainless steel, which contain no nickel, are perfect for commercial food equipment and every bit as suitable as their nickel-containing cousins. Known as the “400-series”, ferritics are unaffected by the nickel market. They are both stable in price and, being nickel-free, cost less to start with. And users need have no fear – they are highly corrosion resistant!



Mareno All S.p.a., Type 441, Italy

Ferritics even boast some unique technical advantages of their own that further enhance their appeal in this sector. For one thing, unlike 300-series grades, they are magnetic – a very useful quality in commercial food equipment applications.

The popular prejudice that their magnetism is a sign that ferritics are “not real stainless steels” is nonsense. Ferritics are the real thing. Corrosion resistance has nothing to do with magnetism.

## THE MAGIC OF CHROMIUM

Stainless steels are “stainless” because their chromium content gives them remarkable resistance to corrosion. This corrosion resistance is not due to the presence of nickel, as some mistakenly believe.

Ferritic grades, containing only iron, carbon and chromium (and sometimes other elements such as Mo, Ti or Nb), are therefore true, corrosion-resistant stainless steels.



Type 430

## Viewpoint

### TAKAHARU FUJIEDA

GROUP MATERIAL PROCUREMENT LEADER  
SUN WAVE CORPORATION, JAPAN

*“Our use of stainless steel mainly concerns kitchens, bathtubs and bathroom wall panels. In terms of kitchens, we mostly do household kitchens but we’ve also been doing commercial kitchens for many years.*

*“We use about 300 tons of stainless a month, of which ferritic is about 30 percent of our overall consumption and 90 percent of our commercial-kitchen consumption. We’ve been using ferritic since 1964, for economy reasons. Grade SUS430 is particularly successful for us.*

*“We may select SUS304 for certain sections, such as legs, which are harder to keep clean. Recently, however, ferritic grades such as SUS430J1L have been developed, with very high corrosion resistance. We’re working towards making commercial kitchen equipment only in ferritic.*

*“Since manufacturing processes are mainly bending and welding, the superior workability of austenitics is not essential. The yield strength of SUS430 is slightly higher than SUS304, so there are differences in production parameters. It takes more power to bend SUS430 and optimal welding conditions are narrower than those of SUS304. But these are not big problems. Nickel prices being what they are, ‘going ferritic’ is the way forward.”*

## A FERRITIC REVOLUTION

Well-known standard ferritic grades have been the mainstay of two major applications for years – Type 409 for exhaust systems and Type 430 for washing-machine drums.

It would be hard to imagine more powerful testimony to the merits of these grades than such tough applications, yet ferritics have lingered in the shadows in other sectors.



Gayc Fabrica Maquinaria, Type 430, Spain

Currently, however, there is a remarkable swing towards ferritics across many sectors, brought about by the unstable cost of nickel. Long-delayed, this recognition is nonetheless well-deserved.

***“...there is a remarkable swing towards ferritics across many sectors...”***

These fine grades have great potential in a vast range of applications. In many cases, nickel-containing grades are turning out to be an unnecessary expense.

Over the years, superb new ferritic grades have been developed, such as 439, and 441, 436, 444 and 445, to meet the most demanding requirements. Boasting fantastic corrosion resistance, they can be formed to more complex shapes and joined using most conventional joining methods.

There is no doubt that most ferritics can stand proudly alongside Type 304 within the stainless steel family. They can also be an alternative to “200-series” austenitic stainless steel grades – at a more stable price.

Ferritics can also replace other materials (e.g. carbon steel, Cu, Zn, Al, plastic, etc.) in many areas, thanks to their special technical properties and Life Cycle Cost (LCC) advantages.

## FERRITICS AND FOOD

Commercial food equipment is a glaringly obvious ferritic application and the ferritic revolution is already well under way in this sector.

Wherever stainless steel is needed – and it is needed in practically all food-service contexts – ferritics can do the job. These grades are suitable for every commercial food segment, every country, every culture, every cooking tradition, every cooking style and every type of equipment.

In fact, ferritics will do the job especially well, thanks to their magnetism, low thermal expansion, high thermal conductivity and resistance to high-temperature oxidation.

The popular, limiting belief that they are not up to the task or can only be used in certain, “undemanding” contexts must be abandoned, once and for all. In this sector, whatever the task, there is a ferritic grade that can handle it!



### Viewpoint

**SERGIO ZANARDO**  
PRODUCTION MANAGER  
MARENO ALI, ITALY

*“We specialise in large commercial kitchen installations.*

*“Before starting to use ferritics, we did salt-spray tests. The results were similar to Type 304 austenitic grade, so we decided to use ferritics for the sides, back and base of all our products.*

*“The market is sceptical about the use of this material, but we have given our agents, in Italy and abroad, full information on the characteristics of ferritic grades. Complete acceptance is only a matter of time.*

*“In production, with ferritics you can’t achieve depths of over 5/6 mm in cold forging, but we’ve had no problems with other processing operations. We are, however, carrying out further checks on electrical spot welding and welding and finishing on corners of semi-processed parts.*

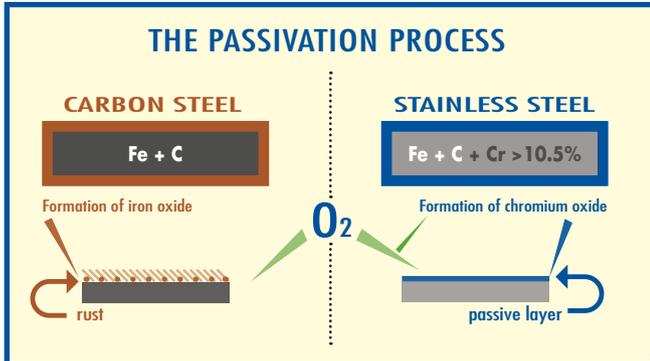
*“The most significant gain from using ferritic grades is the cost reduction compared to Type 304. We are more competitive on the market and this benefits our customers too.*

# FERRITIC - TERRIFIC STAINLESS STEEL

Ferritics resist pitting corrosion mainly because of their chromium content. New ferritic grades deliver enhanced performance.

The basis of stainless steel is iron (Fe), carbon (C) and a minimum of 10.5% chromium (Cr). Chromium is the alloying element that makes stainless steel corrosion resistant. The more chromium, the greater the resistance to corrosion.

When alloyed with iron and carbon, chromium forms an invisible, protective surface layer of chromium oxide. Impervious to air and water, this “passive” layer provides corrosion resistance and increases scaling resistance and wear resistance. If damaged, the layer repairs itself, re-forming spontaneously.



## FERRITICS FOREVER!

Different types of stainless steel, with enhanced properties, are obtained by adding alloying elements to the basic “mix”.

Austenitic (300-series) grades, for example, contain nickel. Standard 200-series austenitic grades contain nickel and manganese. Nickel alters the atomic structure – making the steel non-magnetic and enhancing ductility, formability, toughness and generalised-corrosion resistance (a criterion relevant to the chemical industry but not to commercial food equipment). The problem is the price.



Tournus Equipment, Type 441, France

Ferritics are the original stainless steels. They contain no nickel and no manganese. They do, however, contain chromium, the magic corrosion-resistance ingredient of all stainless steels. Many ferritic grades meet commercial food equipment specifications perfectly.

## NEW GRADES, MORE APPLICATIONS

Higher-alloyed ferritic grades contain more chromium and such additional elements as titanium (Ti), niobium (Nb) and molybdenum (Mo).



Type 439

## Viewpoint

**JEONG-SUK ROH**  
MANAGING DIRECTOR  
KOREA CLAD TECH  
KOREA

*“Clad metal is rolled plate combining more than two materials, such as stainless steel, aluminium and copper. It’s mainly used for roof tiles, industrial materials and kitchen appliances. We manufacture a variety of industrial and kitchen products.*

*“Faced with the rising price of 300-series grades, we now use ferritic grades for clad products. The ridging that can occur in deep drawing proved a problem in adapting ferritics to clad, so a low-ridging 439 grade was developed for us.*

*“We are delighted with this grade. The cost savings it brings are a key factor in our success. With its help, we doubled our sales of ferritic products in 2007 and expect growth in export sales this year.”*

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

Group 2 (Type 430) is commonly used in commercial food equipment, being ideal for certain applications. However, new economic and technical market requirements have led stainless steel producers to offer higher-performance grades – Groups 3, 4 and 5. Group 1 grades are generally not used in food-service applications, due to their low chromium content.

Group 2	Group 3	Group 4	Group 5
14%-18%	14%-18% stabilised	Added Mo	Others
Type 430 Cr content: 14%-18%	Types 430Ti, 430Nb, 439, 441, etc. Cr content: 14%-18%. Include stabilising elements such as Ti, Nb, etc.	Types 436, 444, etc. Mo content above 0.5%	Types 445, 446 Cr content of 18%-30% or not belonging to the other groups

Because of a lack of good information available to the market, unfounded prejudice about ferritics has lingered on. In reality, there is absolutely no need to hesitate about using ferritic grades in food-contact, high-temperature or wet-environment situations.



Sun Wave Corp., SUS430, Japan



Type 441

## Viewpoint

**PIERRE MARCEL**  
MANAGING DIRECTOR  
TOURNUS EQUIPEMENT, FRANCE

*“We design and manufacture furniture for the food-service sector and stainless steel is our main raw material. We use about 2,500 metric tons of it a year, of which about 75 percent is ferritic.”*

*“Since the 2006-7 nickel-price explosion, we’ve been introducing Type 441. As an alternative to Type 304, it’s more stable in price, suits our production processes and is acceptable to customers.”*

*“Type 441 is less ductile than 304, which meant significant production adjustments. We still use 304 for extreme deep drawing.”*

*“Making the change is a big step. We did it rapidly, which involved a sincere campaign to inform customers and end-users. Of course, we adjusted our prices to reflect our use of ferritics.”*



Type 430

## Viewpoint

**PETER JIANG**  
PURCHASING MANAGER  
MANITOWOC (CHINA) REFRIGERATION CO. LTD  
CHINA

*“As a leading supplier of ice-making machines, we use significant amounts of stainless steel. Some 70 percent of our consumption is Type 430 ferritic. We started using 430 in late 2006, finding it highly suitable for our products. In terms of production, we find this material easier to cut and bend than carbon steel and we’re very happy with it. Our customers are too and appreciate the excellent quality of our grade 430 stainless steel panels.”*

# NICE PRICE, NICE MATERIAL!

The cost advantage of ferritics is so clear that the remarkable merits of these grades can no longer be ignored.



Gayc Fabrica Maquinaria, Type 441, Spain

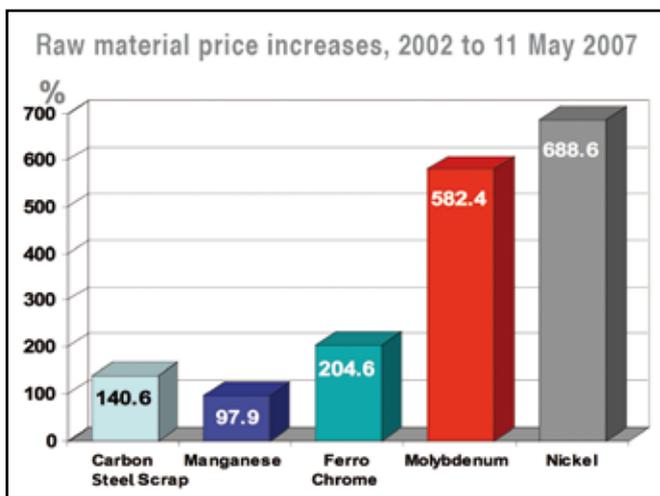
It is vital for designers, manufacturers, architects and others in the supply chain that the materials they use should be stable in price.

Stability of price can be as important as the price itself. A material may be expensive, but once the decision has been made to use it, “end-product” costing is a straightforward matter if its price is stable over time.

Price stability becomes more critical the longer the time that will elapse between pricing and sale – or between estimating and contract completion.

## SMALL IS BEAUTIFUL

A price graph of raw materials reveals an especially high increase in the nickel price over a five-year period. This was inevitably reflected in the price of nickel-containing stainless steels.



Molybdenum, which is an ingredient of some ferritic grades, also rose sharply. Fortunately for users of ferritic grades,

molybdenum is used in only relatively modest quantities in Group 4 and 5 grades. These grades are, in any case, not commonly used in commercial food equipment applications.



Type 441

## Viewpoint

**GERARD ROZIER**  
MANAGING DIRECTOR  
BOURGATE, FRANCE

*“We use various materials for our very broad range of professional kitchen equipment products and consume about 2,000 tons of stainless steel, of which 60 percent is ferritic, mainly Types 441, 436 and 445.*

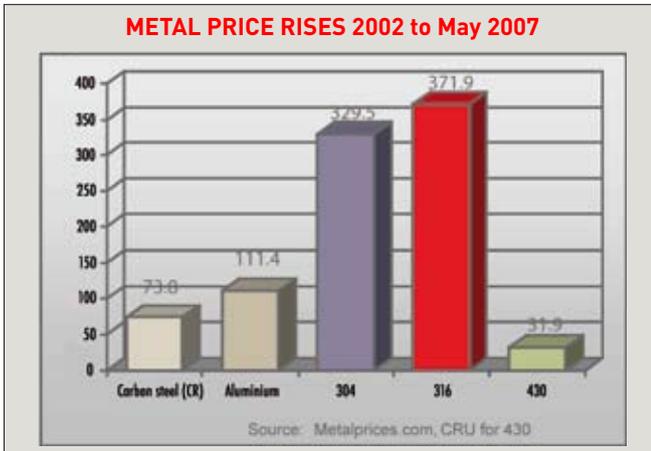
*“We introduced ferritics about fifteen years ago, specifically for induction cooking vessels. More recently, of course, the fluctuating nickel price has been a deciding factor.*

*“A certain investment in tools and training was needed to master the deep drawing requirements of these grades but we’re happy with ferritics. Our customers are happy too, because they get identical performance at a stable price.*

*“Ferritic stainless steels meet customers’ needs. It’s simply not necessary to add another ingredient, such as nickel. So with ferritics we’re economising on resources and favouring sustainable development.”*

## KEEPING A LOW PROFILE

Another price-rise comparison – that of ferritic Type 430 with carbon steel, aluminium and two nickel-containing stainless steel grades – shows 430 winning hands down.



A glimpse at a price graph for nickel shows extreme volatility over the course of a two-year period. Thankfully, nickel is not the key ingredient in stainless steels. Chromium is. And chromium has always been relatively stable in price.

Clearly, the use of ferritic grades – whose corrosion resistance is primarily governed by chromium content – leads to excellent cost performance. Indeed, ferritics are an ideal economic and technical solution for those wishing to use stainless steel in these applications.



Type 430

## Viewpoint

**PERI COZER OLHOVETCHI**  
PRESIDENT  
FALMEC DO BRASIL, BRAZIL

*“Stainless steel is our main material for the production of kitchen hoods. We use about 200 tons a year, all ferritic. We’ve used ferritics since 2002, for reasons of price, availability and aesthetics. They’ve made us more competitive in the marketplace.*

*“By using the right technology we get the same results as can be achieved with austenitic grades. We’ve never had any processing problems. Ferritics are aesthetically pleasing and have good formability and weldability.”*



Tournus Equipement, Type 441, France



Type 441

## Viewpoint

**ANTONIO MONLLEVI**  
PURCHASING MANAGER  
GAYC FABRICA MAQUINARIA HOSTELERIA, S.A.  
BARCELONA, SPAIN

*“Gayc is a leader in commercial food equipment. We currently use some 150 tons of stainless steel a year and may reach 400 to 500 tons a year. At present, about 80 percent of the stainless steel we use is ferritic.*

*“We started using ferritics about 30 years ago. These grades quite simply meet the requirements for our applications. For example, they work fine in contact with oil, say inside a fryer. Then their low thermal expansion means they’re ideal for oven walls. And, of course, they’re cheaper than austenitics.*

*“Their excellent corrosion resistance means ferritics are fine for the outside of equipment too. And with Scotch-Brite™, polished or satin surface finishes, our equipment has a great appearance. In thirty years, we’ve never had a corrosion problem. Our customers know we use ferritics, of course, and are happy about it.*

*“In terms of manufacturing, the mechanical properties of ferritics are different from those of Type 304, but not significantly. We’ve never had any problems.*

*“I think stabilised ferritic grade Type 441 equals Type 304 in many characteristics, with a price between 25 to 40 percent lower, depending on the nickel price. Ferritics are the future of stainless steel.”*

# FIRST-RATE CORROSION RESISTANCE



The corrosion resistance of many ferritic stainless steels is ideal for commercial food equipment applications.

Corrosion can affect all metals and alloys. However, stainless steel's naturally-forming chromium-oxide surface layer keeps corrosion at bay, by protecting the steel from its environment.

A minimum of 10.5% chromium content is necessary for this "passivation" phenomenon to occur, in a stable manner. At this level, the protective layer will also "self-heal" if damaged.

The stability of the protective layer depends, of course, on the particular corrosive environment, so the grade chosen for the application must be up to the task. The more chromium, the higher the grade and the greater the protection.

***"The more chromium (...) the greater the protection."***

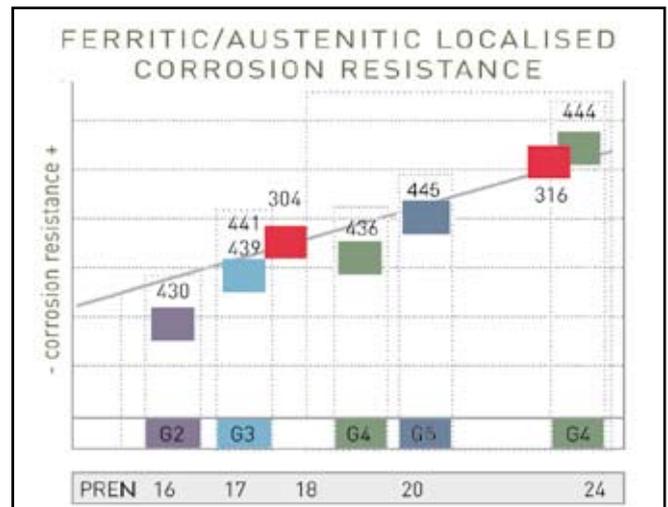
## PITTING CORROSION RESISTANCE

Of the various types of corrosion, commercial food equipment is usually most at risk of "pitting".

In the commercial food sector, throughout the world, salt (sodium chloride) is used for cooking and disinfecting products containing chlorides are used for cleaning. Both can encourage pitting corrosion if not used correctly.

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

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



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.

For hygiene reasons, commercial food equipment has to be designed without cavities, crevices, breaks and open seams. If bacteria are to be eliminated and removed, there must be no areas inaccessible to cleaning and disinfecting products and rinsing water. This design factor also means that another type of corrosion – crevice corrosion – should not occur in these applications.

## ATMOSPHERIC CORROSION RESISTANCE

Outdoors, commercial food equipment is often at risk of "atmospheric" corrosion. Outdoor environments vary in corrosive aggressiveness, the most aggressive being, of course, coastal and marine. The ferritic grade chosen for an open-air beach restaurant, for example, should be relatively high on the PREN scale.

## KEEP IT SMOOTH

Stainless steel's performance in terms of cleanability and resistance to corrosion is related to surface smoothness. Smooth surfaces retain less dirt and contaminants than do rough surfaces.

### DESIGN, FABRICATION AND INSTALLATION TIPS

#### Rules of thumb for avoiding eventual in-service deposit accumulation:

- In the case of an aggressive environment, select a grade with a higher chromium and/or molybdenum content.
- Avoid rough surface finishes – favour a fine polished or brushed surface with a low Ra value.
- Optimise the design for “washability”.
- Avoid crevice-like geometries.
- Brushing, pickling and passivation should be performed after processing (including welding).
- Carefully rinse away acid-based products used to remove cement for new tiling.

## RULES FOR THE KITCHEN

While corrosion can have various causes, inadequate or inappropriate cleaning is often to blame. All grades of stainless steel must be correctly cleaned if corrosion is to be avoided.

Prevention of eventual corrosion requires a carefully controlled, regular cleaning programme, to remove cooked-in grease, scale or other deposits.

Regular cleaning removes the need to use strong concentrations of cleaning products. This in itself reduces the risk of corrosion.

All these risks and guidelines apply to ferritic and nickel-containing grades alike. If the suggestions made are observed, ferritic grades (or any other grade suited to the application) will give years of perfectly corrosion-free service life in any commercial food equipment context.

*“...ferritic grades (...) will give years of perfectly corrosion-free service life...”*



## Viewpoint

**NICK MCDONALD**  
MARKETING MANAGER  
LINCAT LIMITED, LINCOLN, UK

*“Lincat has been a front-runner in professional kitchen equipment for 38 years. We’ve used Type 430 ferritic stainless steel from day one. This grade ideally matches the spec of these applications. It’s an economical way of enjoying all the advantages of stainless steel, which is so important in food preparation and presentation.*

*“In addition, 430’s low thermal expansion is a technical plus in high-temperature applications. We make virtually everything in 430, except a few components in 304. We’ve built a reputation for outstanding product reliability and sturdy, durable construction. Type 430 ferritic is an essential part of the equation.”*

### CLEANING TIPS FOR END USERS

- Avoid overdosing cleaning and disinfectant products
- Never use concentrated bleach or bleach diluted in hot water.
- Observe the contact time recommended by the product manufacturer.
- Observe the cleaning temperature recommended by the product manufacturer.
- For certain cleaning products the stainless steel surface must be cold.
- Always rinse thoroughly after each cleaning or disinfecting and dry the surface.
- Use only recommended cleaning products.
- Heat the water in a stainless steel utensil before adding salt (never put salt in first).
- Before first using a new stainless steel cooking vessel, heat some vegetable oil or water in it, then wash it, to remove traces of chloride-containing drawing oils.

(The ISSF video “Best practice in cleaning and disinfecting stainless steel commercial food equipment” illustrates all these points thoroughly.)

# SOME SPECIAL QUALITIES

Ferritic stainless steels have special in-service properties that make them ideal for commercial food equipment.



Bonnet, Groupe Horis, Type 430Ti, France

Fabricators and end-users in the food service sector are discovering that price stability is not ferritic stainless steel's only advantage. These grades have some particularly useful technical characteristics.

## FERRITIC TRUMP CARDS

- Magnetism
- Low thermal expansion
- No stress corrosion cracking
- High thermal conductivity
- Excellent high-temperature oxidation resistance

## MAGNIFICENTLY MAGNETIC

Unlike many other grades of stainless steel, ferritics are magnetic. Magnetism is, in fact, one of the most powerful arguments for ferritics in food service applications.

For one thing, induction cooking depends on the cookware being magnetic, since the process involves generating heat in the cookware itself, by transfer of magnetic energy.

*“...magnetism (...) is one of the most powerful arguments for ferritics in food service applications.”*

Little imagination is required to see that magnetism has many other handy uses in a food service environment.

Opportunities for innovation include:

### Temporary or permanent adhesion:

- Temporary labelling: for example of a cart or trolley with signs indicating its temporary purpose or destination...
- Personalisation: putting a name on a tray (e.g. that of a patient on a special diet).
- Storage of lids: cookware lids with detachable magnetic handles for easy storage of the lids.
- Storage of cutlery or implements: e.g. an ozone cupboard, for disinfecting knives (held by a magnetic bar) under an ozone lamp.
- Signage: “dangerous area”, “hot”, “cold”, “sharp edges”, “not washed”, “washed”, etc.



Type 430

## Viewpoint

**BERNHARD BLAESER**  
DIRECTOR  
MACADAMS BAKING SYSTEMS (PTY) LTD  
SOUTH AFRICA

*“My company makes baking ovens and provers. With the increase in austenitic prices in the recent past, many players in the industry are moving away from stainless steel altogether. However, since ferritic prices have not been as severely affected, an alternative is to substitute ferritic. I believe manufacturers should consider substituting austenitics with ferritics rather than dropping stainless steel entirely.”*

### Short-distance magnetic door closure

This technique (already used in fridges) eliminates door mechanisms and ensures reliable closure.

### Sliding door

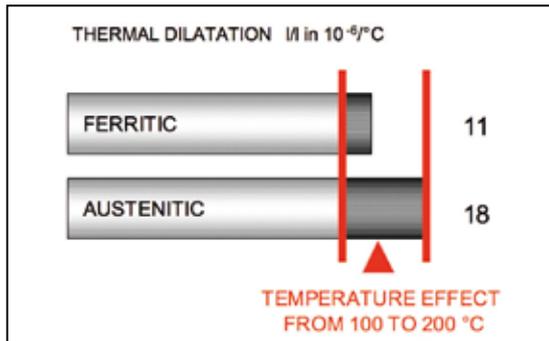
Magnetic suspension, allowing movement without contact, eliminates friction and wear.

### Magnetic refrigeration

As well as induction cooking, the magneto-caloric effect makes possible magnetic refrigeration, which requires no polluting refrigeration liquid.

## LOW THERMAL EXPANSION

Ferritic grades expand much less than austenitics when heated. They also have an advantage in this respect over copper and aluminium. Low thermal expansion is a critical advantage in, for example, cooking vessels or the double walls of oven doors, where consistent flatness is essential.



## HIGH-TEMPERATURE OXIDATION RESISTANCE

Thanks to their lower thermal expansion coefficient, ferritics are much less prone than austenitics to high-temperature cyclic oxidation scaling. Where there is no spalling or cracking, there is no new oxidation. Ferritics are therefore especially suitable for burners.



Groupe Horis, Type 430, France

## HIGH THERMAL CONDUCTIVITY

Ferritic grades conduct heat more efficiently than austenitic grades. This means, for example, that heat under a ferritic cooking pot will spread more quickly and evenly, making cooking quicker and more efficient.



## NO STRESS CORROSION CRACKING

Stress corrosion cracking occurs when long-term mechanical load and corrosive environment combine to initiate cracks. Unlike austenitics, ferritics are not prone to this problem.



Type 441

## Viewpoint

**ALESSANDRO ALBONI**  
COMMERCIAL DIRECTOR  
FACILITAS, ITALY

*“Stainless steel is very important to us, as manufacturers of metal cabinets for the food service sector.*

*“In 2006, the volatile nickel price meant we had to find alternatives to Type 304. After independent laboratory tests on scale models of metal cabinets, it was clear that Type 441 showed an excellent price/performance ratio. So, since 2007, we’ve backed up our Type 304 products with a range in 441.*

*Our customers habitually believed that, being magnetic, ferritics are of low quality. They therefore hesitated to introduce these steels. We had to convince them, on a case-by-case basis.*

*“We’ve had to make modifications to production parameters, but 441’s excellent price stability and corrosion resistance is an attractive proposition for our customers.”*

## OUR ADVICE...

Users should discuss technical questions regarding the use of ferritic grades with a reputable material supplier, a stainless steel producer or a stainless steel marketing association. Excellent information is available these days to help users select the most appropriate grade for their application.



Bourgeat, Type 441, France



Type 443CT, Linkco, PRC



Type 441

## Viewpoint

### FRANÇOIS TESNIERE

ARCHITECT

3bornes ARCHITECTES, FRANCE

*“The new central kitchen we designed for the municipality of Nevers, France, will turn out 2,200 meals a day. Everything but the floor is in stainless steel. We used over 15 tons of it, about 60 percent of which is ferritic.*

*“Using nickel-free grades optimised the investment, saving up to 15 percent on some parts. The stability of the price of ferritics also helped. It’s hard to design a project when you don’t know if, two years later, when you’re ready to build it, the cost of the raw material will have doubled.*

*“Sustainability was also important. Ferritics have a better carbon footprint than austenitics. And using ferritics meant we could afford to include more stainless steel parts.*

*“We had no particular workability or weldability difficulties in the production phase.”*



Type 430TI

## Viewpoint

### MAURICE REVELLI

MAESTRO GC FACTORY MANAGER

GRUPE HORIS

FRANCE

*“We use mainly stainless steel in our Maestro Grande Cuisine cooking suite, rotisserie and salamander grill and consume about 60 tons a year. About half of this is ferritic. We’ve used this material right from the start, in 1989.*

*“Our design philosophy involves giving our cooking suite tops a lot of free space, for plates. You can’t do this using austenitic Type 304, for example. With temperatures around 500°C in the centre of a solid top, you need the low thermal expansion of ferritics. This free space on the suite tops means our suites offer a different approach to kitchen organisation.*

*“We’ve never had any production difficulties with ferritic stainless steel. Our philosophy is to use the right material in the right context. If ferritics are correctly used, they are highly satisfactory. Our Maestro and Bonnet cooking suites are sold worldwide and are universally admired. They’re used by top chefs, for whom quality is paramount. We’ve never had a complaint.”*



Lincaat Limited, Type 430, UK

# APPENDICES

Basically just containing iron, carbon and chromium, ferritics are the original stainless steels.

Early experiments with iron/chromium alloys date back to the 19<sup>th</sup> century. Stainless steel was really “born”, however, in the early 20<sup>th</sup> century, when researchers discovered that a minimum level of 10.5 percent chromium content gives a big boost to steel’s corrosion resistance. Additional chromium means additional corrosion resistance.

Grades from 2, 3, 4 and 5 of the five groups into which ISSF divides available ferritic grades are regularly used in commercial food equipment applications. These grades contain between 13% and 30% chromium – and sometimes other ingredients, to enhance specific properties.

## CHEMICAL COMPOSITION

Group 1 grades, containing between 10.5% and 14% chromium, are generally not used in these applications. This group is therefore absent from the chemical composition table below.

### STANDARDS REFERRED TO:

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

14%–18%Cr Group 2	Type	Element		Standard	Ref.
		Cr	Mo		
	430	16.0–18.0		UNS, EN, JIS	S43000, 1.4016, SUS430
14%–18%Cr stabilised Group 3	Type	Element		Standard	Ref.
		Cr	Mo		
	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		Standard	Ref.
		Cr	Mo		
	436	16.0–18.0	0.75–1.25	UNS, EN	S43600, 1.4513
	436J1L	17.0–20.0	0.4–0.8	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		Standard	Ref.
		Cr	Mo		
	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. 60-62 for complete details.

## SURFACE FINISHES

Ferritic surface finishes are exactly the same as those available for austenitic and other grades. Surface finishing treatments applied to stainless steels can take many forms. The finishes most commonly used in the commercial food equipment sector are:

### Cold rolled finishes

These finishes are produced directly during the metal’s manufacturing cycle. For example:

- 2B finish has a smooth, fairly bright appearance, achieved by cold rolling, annealing and pickling, followed by a final cold-roll pass (“skin pass”) on perfectly smooth rolls.
- BA or 2R finish is obtained by bright annealing in an inert atmosphere after cold rolling, followed by a skin pass. The result is smoother, brighter and more reflective than 2B.

### Brushed or polished finishes

These finishes are applied to 2B or BA surfaces. The grade of abrasive used determines the fineness or coarseness of the finish. In the case of commercial food equipment, a smooth finish (using fine-grade abrasives) is preferable, to facilitate in-service cleaning. The smoother the surface the lower the risk of corrosion.



2D



2B



BA



no. 4



no. 6



Tournus Equipement, Type 441, France

## REGULATIONS

Ferritic stainless steels are suitable for use in contact with foods of all kinds.

The principal norms and regulations covering food safety in commercial food equipment are those issued by the EU and the USA and Japan.

At the time of publication of this booklet, there is no European norm defining grades of stainless steel that can be used in food-contact applications. There is, however, a European directive.

In some European countries, there are national regulations (directives, decrees, etc.) specifying grades that can be used in these contexts.

Other than the European zone, most countries take the U.S norms as their guideline. There remain, however, many countries in which no such criteria are observed and no reference is made to any established norms.

### FOOD SAFETY LAWS AND REGULATIONS

#### EUROPEAN UNION



##### **Framework Regulation no. 1935/2004/EC**

Defines basic requirements for materials intended for food contact.

Makes no restrictions regarding any grade of stainless steel.

#### USA



##### **USA Standard NSF/ANSI 51 - 2007**

Food equipment material in contact with food.

Defines as suitable:

AISI 200, AISI 300 or AISI 400: chromium >16% (for blades or knives: chromium >13%).

#### JAPAN



##### **Food Sanitation Law No. 233 of 24 December 1947 and last amendment, Law No. 87 of 26 July 2005**

Makes no specifications concerning stainless steels.



# COMMERCIAL FOOD EQUIPMENT SEGMENTS

## DISHWASHING



Sun Wave, SU5430, Japan

- Dishwashers
- Trolley washers
- Glass washers
- Tray washers
- Utensil washers

## DISTRIBUTION



Lincat Limited, Type 430 (partial), UK

- Self-service counters
- Reheating ovens and trolleys
- Plate heaters
- Hot cupboards

## REFRIGERATION



Type 430T, Xineng, PRC

- Refrigerators
- Refrigerated cupboards
- Refrigerated rooms
- Chillers

## HANDLING



Bourgeat, Type 441, France

- Conveyor systems
- Trolleys
- Heated trolleys
- Gastronorms
- Trays
- Boxes

## PREPARATION



Agathe Systeme, Type 441, France

- Washer arms
- Sink units
- Tables
- Shelves
- Cupboards
- Mixers
- Accessories

## BARS AND GALLEYS



JSSA, SUS401 J/L, Japan

Espresso machines  
Percolators  
Coffee grinders  
Ice-cube machines  
Juicers

## COOKING



Bonnet, Groupe Horis,  
Type 430T, France

Rotisseries  
Fryers  
Frying pans  
Kettles  
Bains-maries  
Salamanders  
Ovens  
Ranges

## SPECIAL EQUIPMENT



Siemens, Type 430, PRC

Extractor hoods  
Waste-disposal equipment  
Fire-protection equipment  
Electrical boxes

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