

STANDARD FERRITIC

stainless steel

*Adding stainless
quality to life*



COLUMBUS
STAINLESS
— [Pty] Ltd —

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cedi
nox

Introduction

Standard ferritic stainless steels are plain chromium stainless steels, and can be stabilised with niobium and/or titanium. Annealed **standard ferritics** are ductile and can be formed using a wide variety of roll forming or mild stretch bending operations as well as the more common drawing and bending operations. They do not harden excessively during cold working.

Being ferritic, they are not susceptible to stress corrosion cracking. These steels have limited weldability and should not be used in the as-welded condition for dynamic or impact loaded structures.

Standard ferritics can undergo grain growth in the heat affected zone of weldments, which may adversely affect the mechanical properties in these zones. Applications involving welded **standard ferritics** are thus generally limited to a maximum thickness of 2.5 mm. Edge welds are not recommended for applications using **standard ferritics**. Standard ferritics are unsuited for use in cryogenic applications as brittle fracture could occur at sub-zero temperatures.

409

is a 12% chromium, titanium stabilised ferritic stainless steel. It is not as resistant to corrosion or high temperature oxidation as the higher alloyed stainless steels (for example 430 or 304), but is still superior to mild steel and low alloy corrosion resisting steels and most coated mild steels. 409 finds its major application in silencers, catalytic converters and tubing for motor vehicle exhaust systems.

430 & 430DDQ

are low carbon plain chromium ferritic stainless steels. With 16% chromium, the steels have good corrosion resistance in moderately corrosive environments and good oxidation resistance at elevated temperatures.

They have excellent polishing characteristics and are therefore used in applications such as architectural trim. **430** has good formability and corrosion resistance and this makes it suitable for applications such as catering equipment and kitchen sinks. **430DDQ** has even better formability and is thus used in deep drawing applications.

439

is a low carbon niobium and titanium stabilised ferritic stainless steel (S43932). With 17% chromium, the steel has good corrosion resistance in moderately corrosive environments.

The stabilization improves the steel's resistance to sensitization in the weld heat affected zone. 439 has similar formability to 430DDQ. They are used in applications such as evaporator tube in the sugar industry and heat exchanger tubing.

441

is a low carbon, dual stabilised ferritic stainless steel. With 18% chromium, the steel has good corrosion resistance in moderately corrosive environments and good oxidation resistance at elevated temperatures. 441 has good high temperature oxidation resistance and creep resistance and this makes it suitable for use in applications in automotive exhaust systems.

Product range

The latest revision of the Product Catalogue should be consulted, as the product range is subject to change without notice.

The Product Catalogue is available from the Technical Department or can be found at www.columbus.co.za

Specifications and tolerances

Columbus Stainless (Pty) Ltd supplies the standard ferritics to ASTM A240, JIS and EN 10088-2.

Columbus Stainless (Pty) Ltd normally supplies material to the following tolerances:

HOT ROLLED

ISO 9444 - material processed as coil		ISO 9444-2	
ISO 18286 - material processed as plate		ISO 18286	
ASTM A480	ASTM A480M	EN 10051	EN 10029
ASME SA480	ASME SA480M	IS 6911	

COLD ROLLED

ISO 9445	ISO 9445-2
ASTM A480	ASTM A480M
ASME SA480	ASME SA480M
IS 6911	

Other specifications and tolerances may be available on request.

Further information is available in the Product Catalogue, which can be obtained from the Technical Department or can be found at www.columbus.co.za

Further information:

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Chemical composition

In accordance with the Columbus Stainless mill specification, ASTM A240 and EN 10088-2.

Compositions are ranges or maximum values.

	C	Si	Mn	P	S	N	Cr	Nb	Ni	Other
409	0.03	1.0	1.0	0.040	0.015	0.03	10.5 11.7		0.5	Ti: 6x(C+N)* Ti: 8x(C+N); >0.15** Ti: 8x(C+N)***
430	0.08	1.0	1.0	0.040	0.015		16.0 18.0		0.75	
430DDQ	0.08	1.0	1.0	0.040	0.015		16.0 18.0		0.75	Al: 0.30 max
439	0.03	1.0	1.0	0.040	0.015	0.03	17.0 18.0		0.5	Ti+Nb: 4x(C+N)+0.2
441	0.03	0.75	1.0	0.040	0.015		17.5 18.5	3xC+0.3 1.00		Ti: 0.1 0.6

*S40910

**S40920

***option for 1.4512

Mechanical properties

In accordance with ASTM A240 and EN 10088-2.

	Rm (MPa)	Rp _{0.2} (MPa)	Elongation (%)	Max Hardness (BHN)
409	380 to 560	220	25	179
430	450 to 630	280 (≤2.5 mm) 260 (≤2.5 mm)	20 (≤1.27 mm) 22 (≤1.27 mm)	183
430DDQ	450 to 630	280	26	183
439	420 to 600	240	23	183
441	430 to 630	250	18	180

- Minimum values, unless Max or range is indicated.
- () Indicates applicable gauge range.
- The table assumes certification to both ASTM A240 and EN 10088-2.

Properties at elevated temperatures

The properties quoted below are typical of annealed 409, 430, 439 and 441 steels. These values are given as a guideline only, and should not be used for design purposes.

Short time elevated temperature tensile strength (MPa)

	100°C	200°C	300°C	400°C	500°C	600°C	700°C	800°C	900°C	1000°C
409	380	370	350	325	280	205	110			
430	475	450	420	380	315	200	105	55	30	15
439	450	420	390	350	295	215	100			
441	460	425	400	380	350	295	200			

Short time elevated temperature 0.2 proof stress (MPa)

	100°C	200°C	300°C	400°C	500°C	600°C	700°C	800°C
409	245	230	205					
430	270	255	230	210	180	125	50	40
439	240	225	190					
441	280	255	230					

Maximum recommended service temperature

	Continuous °C	Intermittent °C
409	620	730
430	730	870
439	830	930
441	850	950

In oxidizing conditions

Maximum recommended service temperature

Temperature (°C)	Stress (MPa) to produce 1% strain			Stress (MPa) to produce rupture	
	10 000 hours		100 000 hours	1 000 hours	10 000 hours
	430	441	430	430	430
500	95	145	70	175	150
550	55	80	40	100	75
600	30	45	20	55	40
650	15	30	10	35	25
700	10	25	5	20	15
750	7			10	
800	5			5	

Physical properties

The values given below are for 20°C, unless otherwise stated.

	409	430 430DDQ	439	441
Density (kg/m ³)	7700	7800	7700	7700
Modulus of Elasticity in Tension (GPa)	200	200	220	210
Modulus of Elasticity in Torsion (GPa)	77	65		
Specific Heat Capacity (J/kg K)	460	460	460	460
Thermal Conductivity at	100°C (W/m K)	23.0	26.1	25.1
	500°C (W/m K)	25.0	26.3	26.5
Electrical Resistivity (x10 ⁻⁹ Ω m)	610	600	630	630
Mean Coefficient of Thermal Expansion from	0 to 100°C (x10 ⁻⁶ K ⁻¹)	11.1	10.4	10.0
	0 to 300°C (x10 ⁻⁶ K ⁻¹)	11.7	11.0	10.2
	0 to 500°C (x10 ⁻⁶ K ⁻¹)	12.4	11.4	10.5
	0 to 700°C (x10 ⁻⁶ K ⁻¹)	12.7	11.7	10.8
Melting Range (°C)	1480	1425	1390	1390
	1530	1510	1460	1460
Magnetic	Yes			



Thermal processing and fabrication

ANNEALING

Annealing is achieved by heating to the following temperatures for 90 minutes per 25 mm thickness (3.5 min/mm) followed by air quenching. Controlled atmospheres are recommended in order to avoid excessive oxidation of the surface.

	ANNEALING TEMPERATURE (°C)
409	820 to 920
430 430DDQ	750 to 850
439	870 to 970
441	920 to 1020

WELDING

The **standard ferritic** stainless steels are prone to grain growth in the heat affected zone of weldments. As such, the tensile, fatigue and toughness properties in the welded condition are relatively poor. They should thus not be used for applications where tensile or dynamic loading will be experienced.

The **standard ferritics** are generally limited to a combined thickness in the welded condition of 2 mm for 430, 2.5 mm for 441 and 439 and 3 mm for 409. Edge welds are not recommended.

The use of austenitic filler metals such as types 308L, 309L or 316L will improve the ductility of welds to some extent but all welding procedures should nevertheless endeavour to maintain minimum heat inputs. The weld discolouration should be removed by pickling and passivating to restore maximum corrosion resistance.

COLD WORKING

Standard ferritic stainless steels have good formability characteristics with useful mechanical properties. Their good ductility allows them to be readily formed by bending and deep drawing. They do not undergo significant work hardening when cold formed.

430DDQ is a 430 steel with superior deep drawability. It is suitable for drawn applications such as holloware, sink bowls, etc. To ensure the correct allocation of material, if drawing quality is required, orders must state 430DDQ. In order to best suit a customer's end use, it is imperative that the actual end use is stated when 430DDQ is ordered.

STRESS RELIEVING

Stress relieving after welding is not normally required. Should this be necessary, temperatures between 200°C and 300°C are recommended for 60 minutes per 25 mm thickness (2.5 min/mm).

HOT WORKING

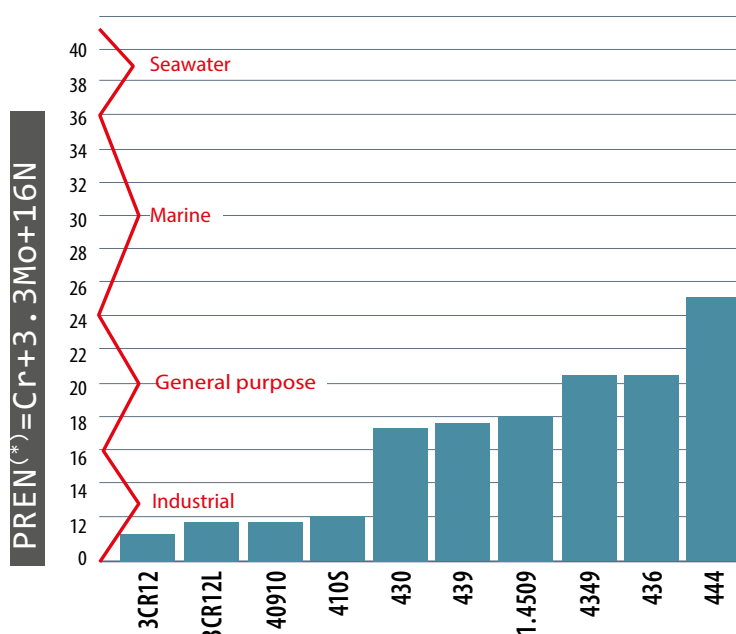
Uniform heating of the steel in the range of 950°C to 1050°C is required. The finishing temperature should be below 750°C and the steel should be cooled rapidly between 550°C and 400°C to prevent 475 embrittlement. Extended holding times above 1000°C should be avoided as excessive grain growth may occur and ductility may be detrimentally affected.

All hot working operations should be followed by annealing and then pickling and passivating to restore the mechanical properties and corrosion resistance.



Resistance to corrosion

The below diagram summarizes the corrosion resistance of the ferritic stainless steels produced at Columbus Stainless. For **standard ferritic** stainless steels, the corrosion resistance is largely a function of the chromium content.



*Pitting Resistance Equivalent Number

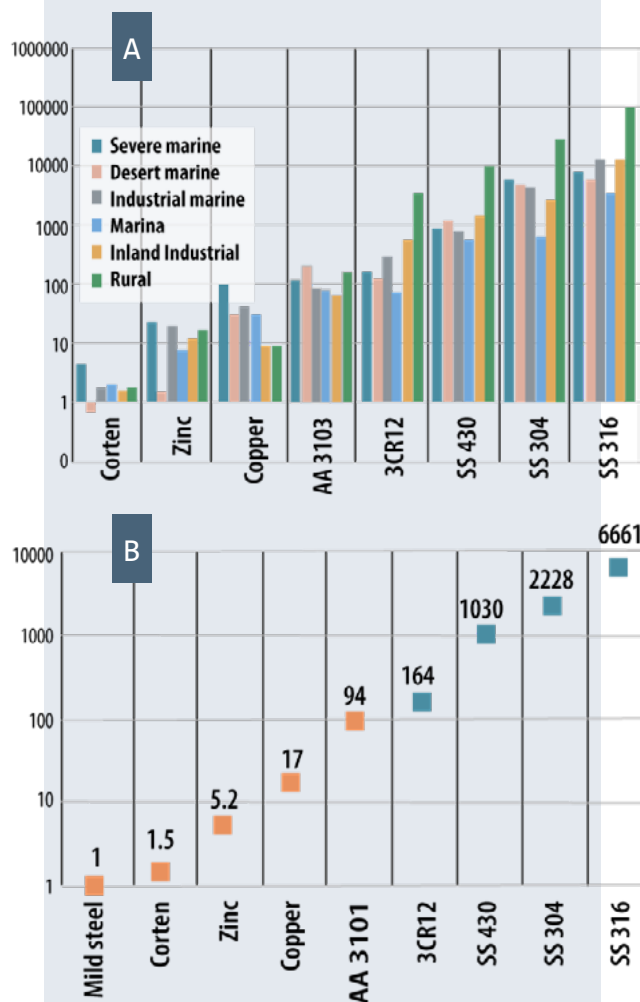
GENERAL CORROSION

409 is significantly more corrosion resistant than mild or low alloy corrosion resistant steels. However, it has a lower corrosion resistance than the highest chromium **standard ferritics**. 409 should only be used in mildly corrosive conditions where aesthetics is not a prime requirement. A light surface patina or discolouration will form in most corrosive environments and this patina will, to some extent, retard further corrosion.

430 has good resistance to a wide variety of corrosive environments including nitric acid and some organic acids. It is generally used for highly polished applications and in mild atmospheres such as for food processing and dairy equipment. Atmospheric corrosion resistance is good, although in highly polluted or marine environments staining may occur. 439 and 441 have good resistance to a wide variety of corrosive environments. They are generally used in the automotive industry for exhaust systems. Atmospheric corrosion resistance is good, although in highly polluted or marine environments staining may occur.

ATMOSPHERIC CORROSION

From the report 'Atmospheric Corrosion Testing in Southern Africa. Results of a Twenty Year Exposure Programme' by BG Callaghan, Division of Materials Science and Technology, CSIR, the following graphs were constructed. The graph A shows the relative life of eight metals compared to mild steel in six different environments. This can be summarized to give an average relative life of the different metals in atmospheric conditions (see graph B). In appearance, all the metals showed discolouration at the most severe sites after 20 years. None were washed during the exposure program and this clearly emphasizes the importance of keeping stainless steel clean and that stainless steel is a LOW maintenance (not NO maintenance) option in atmospheric corrosion applications.



Some recommendations

Handling and transport

Before shipping, make sure every chain and steel element is not in contact with stainless steel. Raffia or wooden elements must be used at possible contact places.



When outside storage is required, material should be covered by a waterproof canvas.



Avoid contact with the ground using wooden blocks and store stainless steel and carbon steel separately. This way we avoid problems with contamination by oils, dirt or by contact among different materials.



When stainless steel has to be moved with lift trucks, the forks should be protected with nylon.



Avoid carbon steel slings, use nylon or polypropylene ones wherever possible.

Fabrication and installation

Make sure stainless steel is contamination free before starting to work. If there is any, it will be removed by pickling or mechanical means (*).



If cleaning is required, do it with pressurized water. Do not use sea or brackish water.



All tools employed in the installation must be made of stainless steel and these should have been never used with carbon steel. If this is not possible, tools must be carefully cleaned before use.



Stainless steel should be processed in machines exclusively dedicated to this material, in order to avoid contamination by projections or oxide traces from other materials.



Excessive temperature oxidation or *blueing* due to abrasive cutting, should be removed with pickling paste. Good refrigerated cutting tools help to avoid the problem.



If coating may be considered for aesthetic reasons, surface preparation is extremely important and may be performed either by acid pickling or mechanical means such as blasting.

(*) It is always advisable to contact the supplier

Some applications



Silencers
Catalytic converters
Tubing for motor vehicle
exhaust systems

409

409

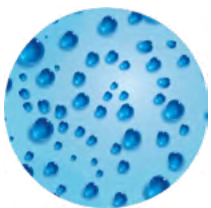
441



Catering equipment
Architectural trims
Deep drawing applications

430

430DDQ



Evaporator tubes
Heat exchanger tubing

439

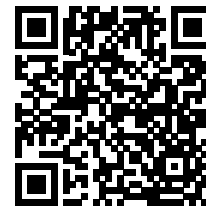


Certificates

Columbus Stainless' product meets the following international standards:

PED 2014/68/EU Certificate	BIS Certification Mark License
CPR 305/2011/EU Certificate	PESR Certificate
CPR Declaration of Performance	JIS G4304 & G4305 Certificate of Compliance
	JIS G4312 Certificate of Compliance

Available at www.columbus.co.za/quality/product-certifications or scan the code:

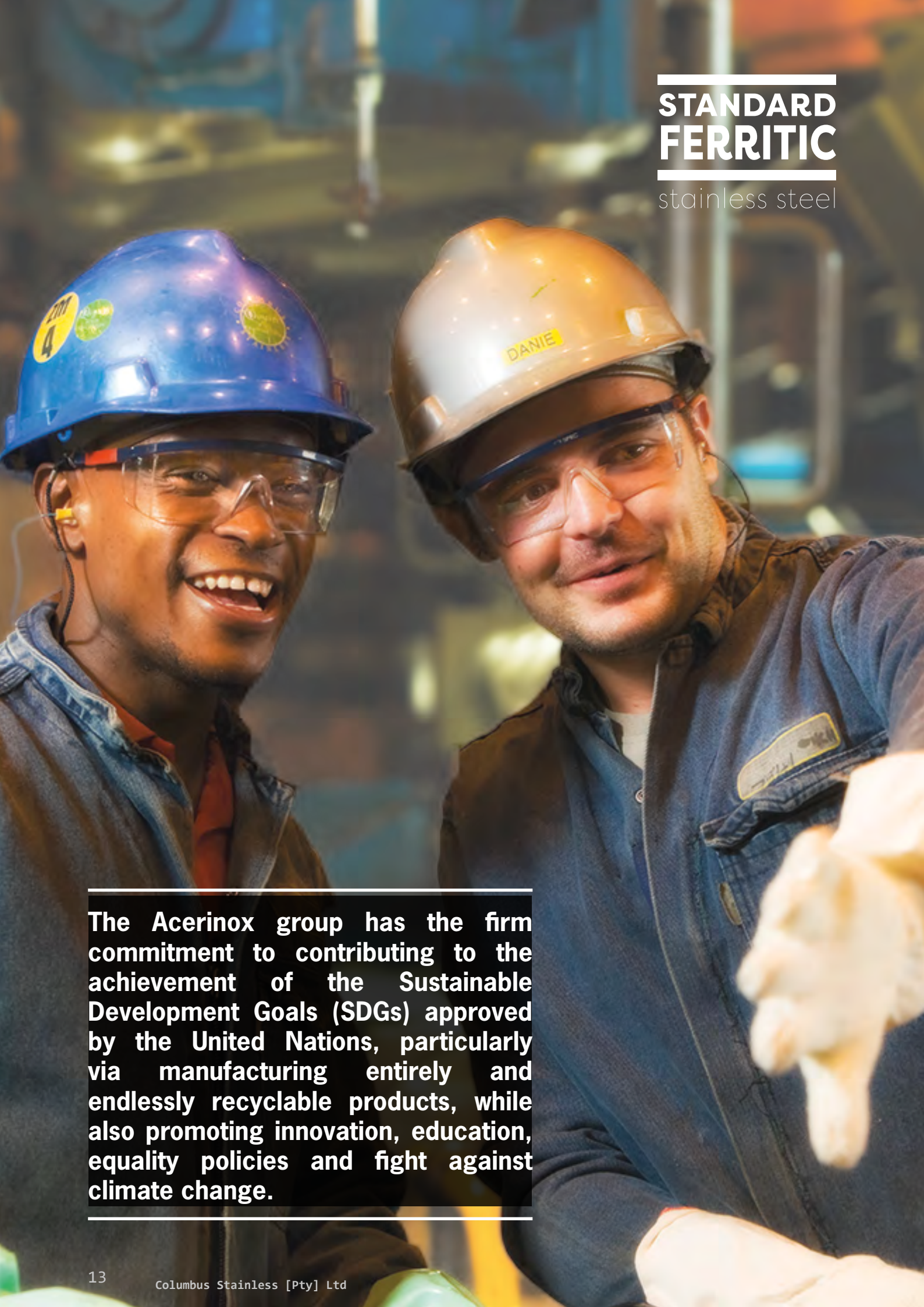


Committed to sustainable growth

Acerinox is one of the major scrap recyclers wherever it is located. The production in the factories of Acerinox is transformed into final products which return to the factories as scrap to be melted again. This is a cycle that could be infinite due to the material properties.

Columbus Stainless also ensures optimum utilisation of raw materials and energy sources by focusing on the reduction of waste in both power, water and raw materials. Not only do these reduce the impact on the environment but also reduce the costs of producing quality products.



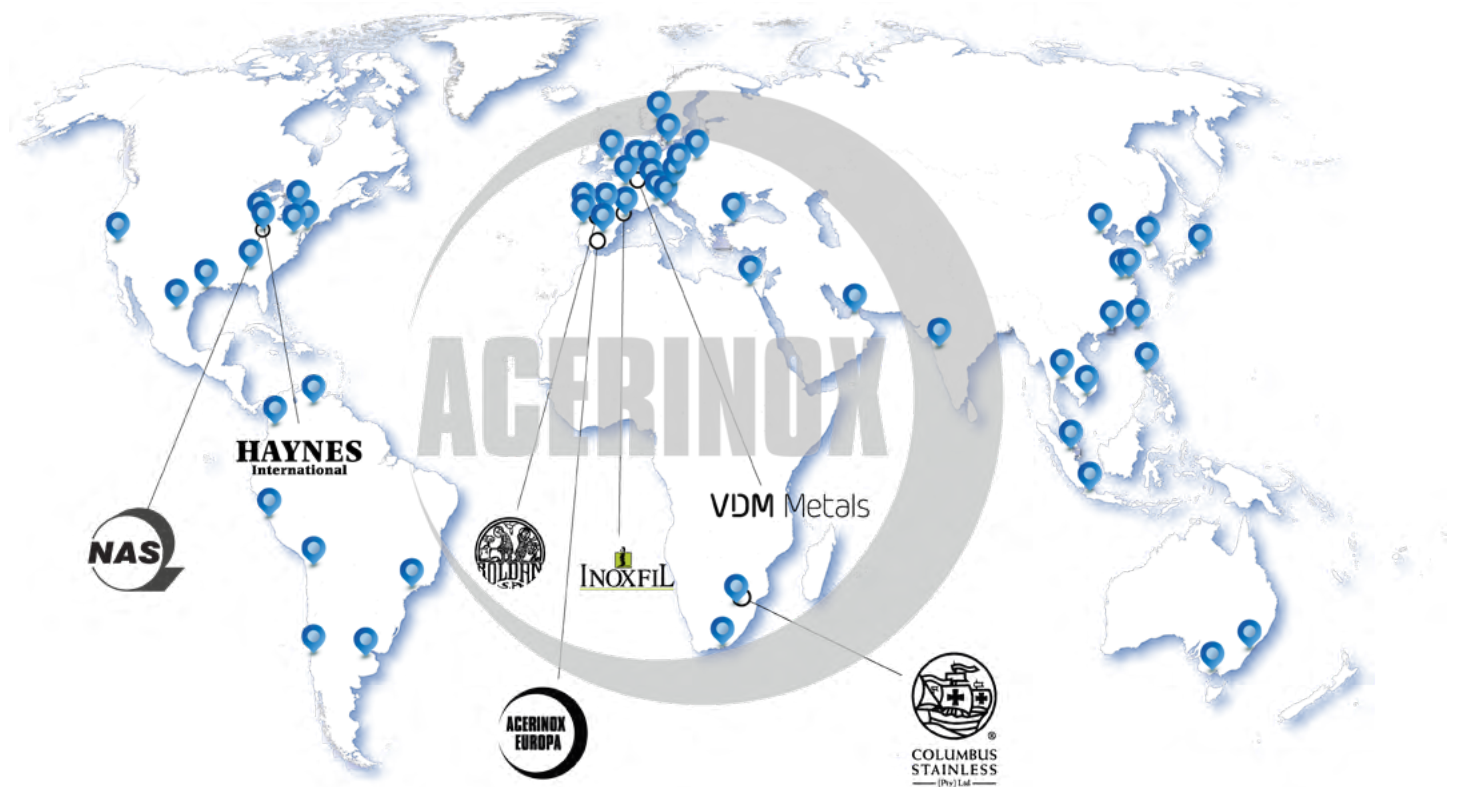


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The Acerinox group has the firm commitment to contributing to the achievement of the Sustainable Development Goals (SDGs) approved by the United Nations, particularly via manufacturing entirely and endlessly recyclable products, while also promoting innovation, education, equality policies and fight against climate change.

Acerinox: the confidence of a strong group



Acerinox is the Spanish multinational global leader in stainless steel manufacturing. With a total production capability of 3.5 million tonnes per year. Acerinox owns factories worldwide confirming its global presence, stainless steel flat products manufacturing at Acerinox Europa, North American Stainless and Columbus Stainless; and Roldan, Inoxfil and North American Stainless for long products manufacture. In March 2020, VDM Metals, worldwide leader in high performance alloys manufacture and design, has also become part of the group. In November 2024, Acerinox completes the acquisition of Haynes International, U.S. leading manufacturer and marketer of technologically advanced high-performance alloys.

Every Acerinox facility satisfies the quality and environmental controls required by each country legislation, apart from the application of the Environmental Management System according to ISO 14001. Furthermore, subsidiaries assume higher standards than legal requirements in areas such as quality, safety and sustainability.

Scrap plays a key role in all Acerinox fabrication processes. Thus, a great value is added bringing it back to the material life cycle, reducing the environmental impact with the use of the same material for centuries.

Columbus Stainless was founded in 1966 in South Africa. It is the only integrated stainless steel factory on the African continent and today is the main supplier of stainless steel solutions for both the domestic and the continent market.

The factory is equipped with the most efficient and technologically advanced machinery in the sector, has seen the most significant technological advances in the sector, and has a considerable competitive advantage due to its location, not only for distributing its finished products, but also thanks to its proximity to the raw material extraction sources, especially chrome. It also supplies semi-finished flat products to other Acerinox Group factories.

A full-page background image of a stainless steel manufacturing facility. In the foreground, several large rolls of stainless steel are wrapped in blue plastic. A worker wearing a hard hat and safety vest stands behind the rolls, looking towards the right. In the background, a yellow overhead crane is visible, and the industrial structure of the factory with its steel beams and walkways is illuminated by warm overhead lights.

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Columbus Stainless is the premier Stainless Steel Manufacturer and Provider in Africa. Our plant is technologically advanced, fully integrated and a single-site operation. This gives us flexibility to adjust quickly to changes in the market. We supply high-quality flat-rolled stainless and carbon steel products.



VDM Metals

HAYNES
International



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