

GUIDE TO SELECTING **METALS**



NICKEL, DUPLEX, STAINLESS, AND CORROSION RESISTANT MATERIALS

COURTESY OF
 **R-V
INDUSTRIES
INC.**

NICKEL ALLOYS

INCONEL® 600

A nickel-base alloy with excellent carburization and good oxidation resistance at elevated temperatures. 600 alloy has useful resistance to dry Cl₂ and HCl gases at moderately elevated temperatures. However, 600 alloy is not suggested for use at red heat when sulfur is present due to elevated nickel quantities.

INCONEL® 601

A nickel-chromium alloy that is highly resistant to oxidation through 2200°F. 601 alloy develops a tightly adherent oxide scale which resists spalling under severe thermal cycling. The alloy has good high temperature strength, and retains its ductility after long service exposure. 601 alloy also has good hot corrosion resistance under oxidizing conditions.

INCONEL® 625

A nickel-base alloy used both for its high strength and outstanding aqueous corrosion resistance. The strength of alloy 625 is primarily a solid solution effect from molybdenum and columbium. Alloy 625 has excellent weldability and is frequently used to weld AL-6XN® alloy. Matching filler metals are also used to join dissimilar metals.

INCONEL® 825

Possesses good mechanical properties from cryogenic temperatures to moderately high temperatures. The chemical composition provides exceptional resistance to many corrosive environments. Nickel content provides sufficient resistance to chloride-ion, stress-corrosion cracking.

AL-6XN®

(UNS N08367) A low carbon, high purity, nitrogen-bearing, “super-austenitic” stainless alloy. The AL-6XN alloy has been demonstrated to be resistant to a broad range of very corrosive environments. The high strength and corrosion resistance of the AL6XN alloy make it a better choice than the conventional duplex stainless steels and a cost effective alternative to more expensive nickel-base alloys where excellent formability, weldability, strength, and corrosion resistance

RA330®

Originally created to service the need of thermal process industries for a reliable source of a wrought alloy that could handle the rigors of high temperature carburizing conditions and repeated quenching. RA330 alloy is an austenitic heat and corrosion resisting alloy offering an exceptional combination of strength and resistance to carburization, oxidation, and thermal shock. This alloy features oxidation resistance to 2100°F.



NICKEL ALLOY APPLICATIONS

INCONEL® 600

- Heat treating muffles and retorts
- Vacuum furnace fixtures
- Chlorination equipment to 1000°F
- Titanium dioxide plants

INCONEL® 625

- Aircraft ducting systems
- Jet engine exhaust systems
- Engine thrust-reverser systems
- Bellows and expansion joints
- Turbine shroud rings
- Flare stacks
- Seawater components
- Chemical process equipment handling mixed acids both oxidizing and reducing

INCONEL® 601

- Copper brazing, annealing, and sintering muffles and retorts
- Radiant tubes
- Strand annealing tubes
- Steam superheater tube supports
- Rotary kilns and calciners
- Thermocouple protection tubes

INCONEL® 825

- Chemical processing equipment
- Acid production
- Nuclear fuel reprocessing
- Handling and disposing of radioactive wastes

RA330®

- Muffles
- Bar Baskets
- Radiant Tubes

AL-6XN®

- Distillation Columns
- Offshore Oil and Gas
- Heat Exchangers

DUPLEX STAINLESS STEELS



ZERON® 100

Zeron® 100 has corrosion resistance and strength properties which have led to its widespread adoption in a range of industries. Oil and gas applications include process, seawater, firewater, and subsea pipework systems, with associated risers, manifolds, pressure vessels, valves, and heat exchangers. Applications of ZERON® 100 in other industries include pollution control equipment such as flue gas desulfurization equipment (FGD), pulp and paper, power generation, chemical, and pharmaceutical industries.

LDX 2101®

A combination of a duplex structure and high nitrogen content that provide significantly higher strength levels than 316/316L stainless steel. Often a lighter gauge of LDX 2101® can be utilized, while maintaining the same strength as a 300 series fabrication. The resultant weight savings can dramatically reduce the material and fabrication costs of a component.

2205

A practical solution to chloride stress, corrosion-cracking problems experienced with 304/304L or 316/316L stainless. In addition, the design strength of 2205 is significantly higher than 316/316L, often permitting lighter wall construction. 2205 has good notch impact toughness down to temperatures below -40°F.

2507

A super duplex stainless steel designed for demanding applications where exceptional strength and corrosion resistance is required. The steel has excellent resistance to chloride stress corrosion cracking, high thermal conductivity, and a low coefficient of thermal expansion. The high chromium, molybdenum, and nickel levels provide excellent resistance to pitting, crevice, and general corrosion.

DUPLEX STAINLESS STEEL APPLICATIONS

ZERON® 100

- Subsea manifolds and pipe work
- Flue gas desulfurization equipment
- Sulfuric acid plants
- Various pressure vessels

LDX 2101®

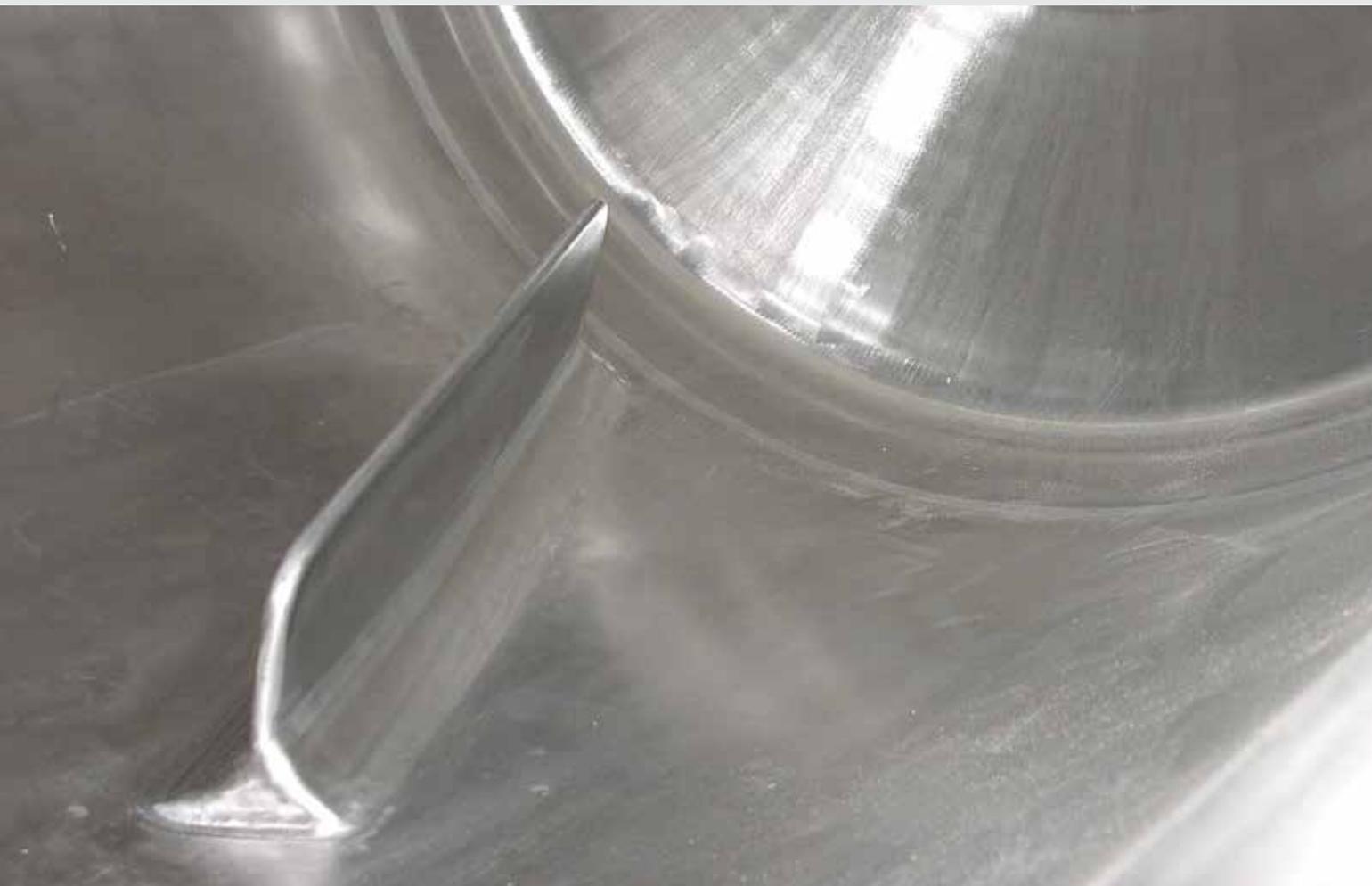
- Chemical process pressure vessels, piping, and heat exchangers
- Pulp and paper mill equipment
- Mixers and agitators
- Ethanol production

2205

- Chemical process vessels, piping, and heat exchangers
- Pulp mill digesters, bleach washers, chip presteaming vessels
- Food process equipment
- Oil field piping and heat exchangers

2507

- Oil and gas industry equipment
- Chemical process industries (heat exchangers, vessels, and piping)
- Mechanical and structural components



STAINLESS STEELS

304/304L

The original “18-8” stainless. It is produced in greater quantity than any other austenitic stainless steel. 304 provides useful resistance to corrosion in many environments ranging from moderately reducing to moderately oxidizing.

316/316L

The most commonly used austenitic stainless steel in the chemical process industry. The addition of molybdenum increases general corrosion resistance, improves chloride pitting resistance, and strengthens the alloy in high temperature service.

RA 253 MA[®]

A lean austenitic heat resistant alloy with high strength and outstanding oxidation resistance. It offers an excellent combination of creep strength along with excellent resistance to oxidation, sulfidation, and erosion at high temperatures in an alloy containing just 11% nickel. Because of its lean chemistry, RA 253 MA is very economical compared to most heat resistant alloys. With the addition of rare earth elements, RA 253 MA still performs well at temperatures up to 2000°F (1093°C), similar to that of 310 stainless steel.

309

An austenitic heat resistant alloy with oxidation resistance to 1900°F under constant temperature conditions. 1850°F resistant with frequent thermal cycling. The high chromium and relatively low nickel content of 309 provide good resistance to high temperature sulfur bearing atmospheres. 309 has only moderate resistance to carbon absorption and is not suggested for use in highly carburizing atmospheres.

310

Has excellent resistance to oxidation under mildly cyclic conditions through 2000°F characterizes 310. Because of its high chromium and medium nickel contents, 310 has good resistance to sulfidation and other forms of hot corrosion. 310 is widely used in moderately carburizing atmospheres such as encountered in petrochemical environments. 310 is not suggested for thermal shock of repeated liquid quenching.

317L

A molybdenum containing austenitic stainless steel, with improved corrosion resistance over 304/304L and 316/316L stainless steel. The increased levels of chromium, nickel, and molybdenum over 316L stainless steel improve chloride pitting resistance and general corrosion.

321

A titanium stabilized grade commonly used for service in the 1000-1600°F temperature range. For service temperatures up to about 1600°F, a stabilizing treatment at 1550-1650°F, air cool, may be used to provide optimum resistance to intergranular corrosion and to polythionic acid stress corrosion cracking.

347

Has slightly improved corrosion resistance over type 321 stainless steel in strongly oxidizing environments. Type 347 is stabilized with columbium, it is preferable for aqueous and low temperature environments due to its good resistance to intergranular attack. Both 347 and 321 offer good resistance to polythionic acid stress corrosion cracking, encountered in oil refineries. 347 is useful to 1500°F.

410

A corrosion and heat resistant 12% chromium steel. It is the most widely used of the hardenable stainless steels. Heat treated 410 has mechanical properties comparable to the engineering alloy steel AISI 4130, coupled with the additional benefit of good corrosion resistance. 410 is highly resistant to atmospheric corrosion.

STAINLESS STEEL APPLICATIONS

304/304L

- Food processing and handling
- Heat exchangers
- Chemical process vessels
- Conveyors

316/316L

- Food processing
- Marine
- Pulp and paper
- Chemical process vessels
- Pharmaceutical equipment and steam sterilizers

RA 253 MA®

- Boiler Nozzles
- Bar Baskets
- Radiant Tubes

309

- Annealing covers and boxes
- Waste incinerators
- Pulverized coal burners
- Radiant tubes
- Paper mill equipment
- Power boiler tube hangers

310

- Flare tips
- Fluidized bed coal combustors
- Radiant tubes
- Burners and combustion chambers
- Food processing equipment
- Cryogenic structures

317L

- Chemical process vessels
- Petrochemical equipment
- Pulp and paper equipment
- Condensers in power generation

321

- Expansion joints
- Thermal oxidizers
- Refinery equipment
- High temperature chemical process equipment

347

- Oil refineries
- Fluid catalytic cracking units
- Recuperator tube sheets, shells, and supports
- Fired heater tubes

410

- Petrochemical equipment
- Gate valves
- Distillation trays



CORROSION RESISTANT MATERIALS

Hastelloy® C276

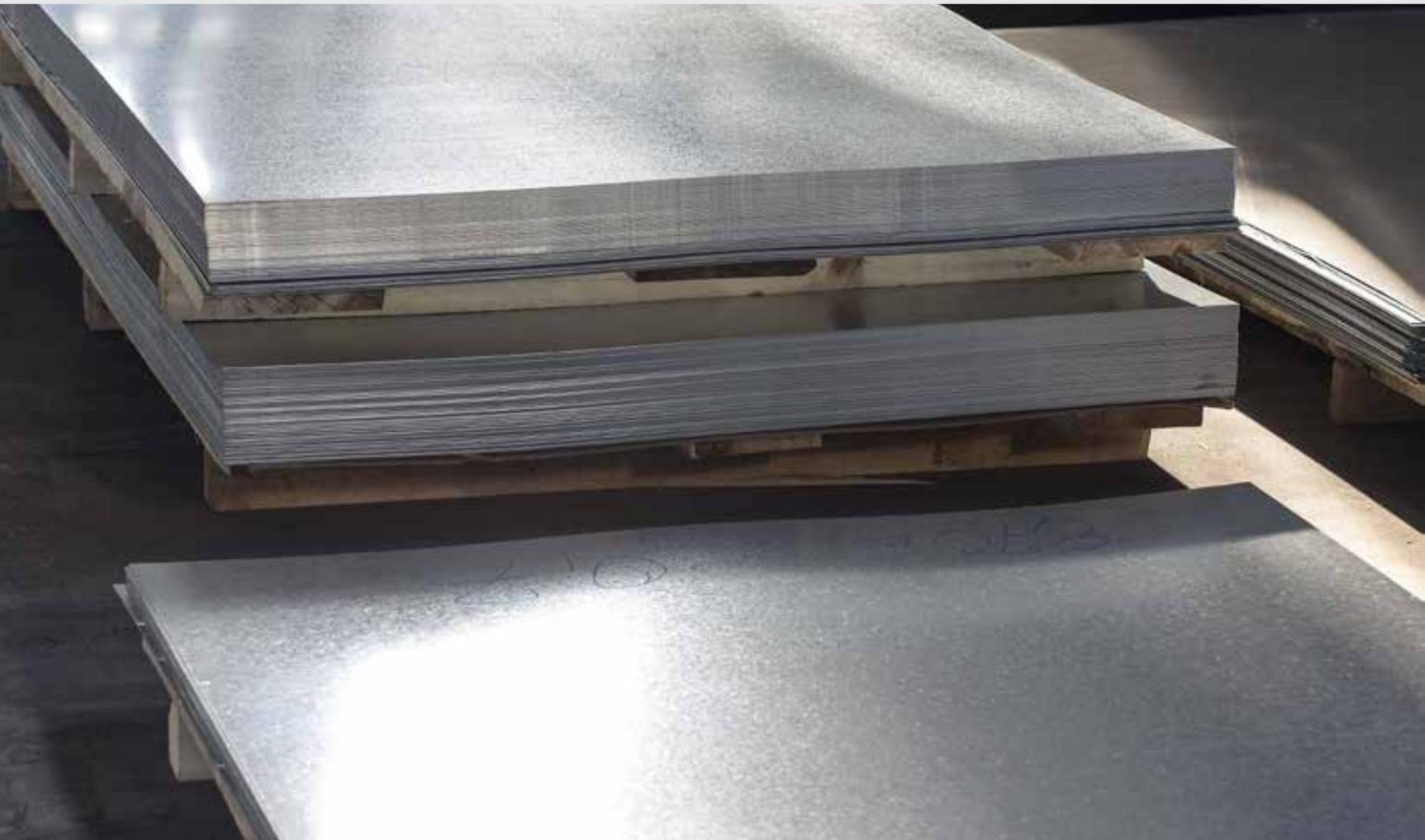
Known as the most universally corrosion resistant material available today. It is a solid-solution-strengthened, nickel-molybdenum-chromium alloy with a small amount of tungsten, which exhibits excellent corrosion resistance in an assortment of harsh environments.

Hastelloy® C22

Displays exceptional resistance to a broad range of corrosive environments. It has excellent resistance to oxidizing aqueous media, including wet chlorine and mixtures containing nitric acid or oxidizing acids with chlorine ions. Resistance to reducing acids such as sulfuric and hydrochloric can also be expected.

Monel® 400

A single phase, solid-solution alloy that offers superior resistance to many corrosive environments over a temperature range from sub-zero to 800°F. Alloy 400 has been widely used in many applications but has been particularly useful in marine and chemical processing.



CORROSION RESISTANT APPLICATIONS

Hastelloy® C276

- Petrochemical and chemical processing
- Power generation
- Pharmaceutical vessels
- Pulp and paper production equipment

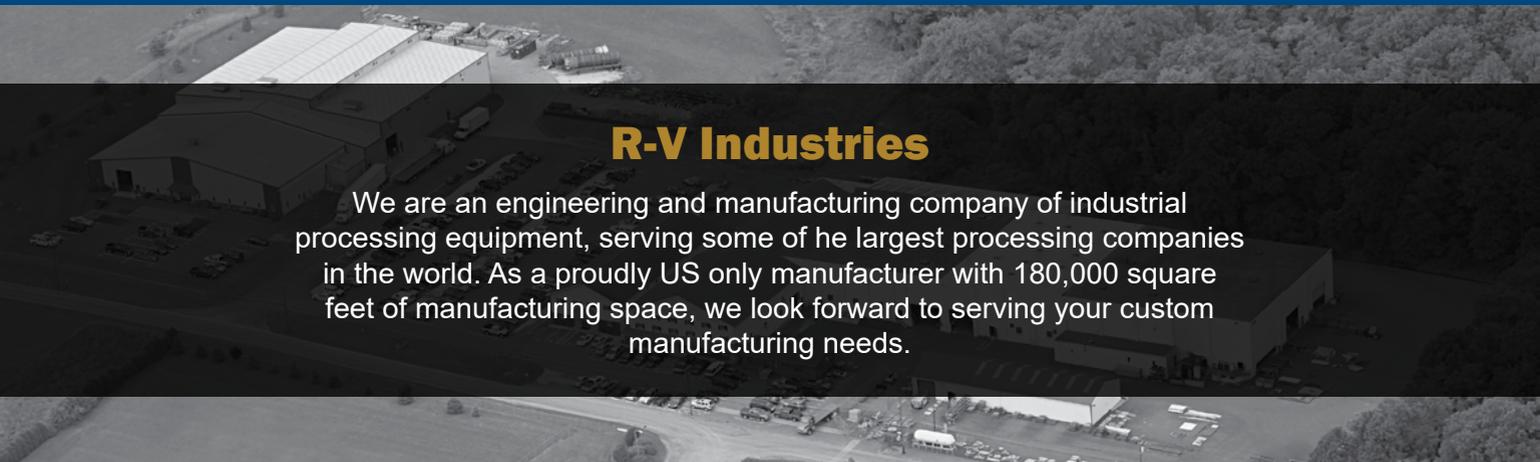
Hastelloy® C22

- Incinerators
- Waste water processing
- Nuclear fuel reprocessing and spent fuel containers
- Chemical manufacturing processes

Monel® 400

- Pumps and propeller shafts
- Chemical process equipment
- Gasoline and fresh water tanks
- Crude petroleum stills
- Process vessels and piping
- Boiler feedwater heaters and heat exchangers
- Deaerating heaters





R-V Industries

We are an engineering and manufacturing company of industrial processing equipment, serving some of the largest processing companies in the world. As a proudly US only manufacturer with 180,000 square feet of manufacturing space, we look forward to serving your custom manufacturing needs.

A Special Thanks

A special thanks to some of our material suppliers for supplying the technical information found in this report. Those suppliers include: Rolled Alloys, Corrossion Materials, Penn Stainless, and Special Metals.