JINDAL STAINLESS

DUPLEX STAINLESS STEEL

CONSISTENCY IN QUALITY AND EXCELLENCE

Lean Duplex (2101, 2304), Std Duplex(2205, 31803) & Super Duplex (32750,32760)

- Consistency in Product Batches
- Consistency in Quality
- Consistency of Delivery & Overall Experience
- Consistency in Innovating

A LEGACY BUILT ON SAFETY & TRUST

India's leading stainless-steel manufacturer, Jindal Stainless, had a consolidated annual turnover of INR 38,562 crore (USD 4.7 billion) in FY24 and is ramping up its facilities to reach 4.2 million tonnes of annual melt capacity in FY27. It has 16 stainless steel manufacturing and processing facilities in India and abroad, including in Spain and Indonesia, and a worldwide network in 12 countries, as of March 2024. In India, there are ten sales offices and six service centers, as of March 2024. The company's product range includes stainless steel blooms, slabs, coils, plates, sheets, precision strips, wire rods, rebars, blade steel, and coin blanks.

Jindal Stainless relies on its integrated operations to enhance its cost competitiveness and operational efficiency. Founded in 1970, Jindal Stainless continues to be inspired by a vision for innovation and enriching lives and is committed to social responsibility.

Jindal Stainless remains focused on a greener, sustainable future, fuelled by environmental responsibility. The company manufactures stainless steel using scrap in an electric arc furnace, which involves lower greenhouse gas emissions and enables recyclability with no reduction in quality.

DUPLEX STAINLESS STEELS

Duplex Stainless Steels (DSS), alloy with a mixed micro-structure of about equal proportion of austenite and ferrite, have existed for more than 70 years. The first generation duplexes were ferrous alloys of chromium nickels and molybdenum. In 1960, with the advent of AOD, the second generation alloys were developed by addition of nitrogen in the steels, which improved the corrosion resistances and weldability of these alloys. The 1980 saw the development of "Super Duplex Grades" for highly aggressive offshare and petrochemical industries. This was followed by development of 'Lean Duplex Grades' containing lower alloy content for less critical applications.

The product range of Jindal Stainless Ltd., encompasses the entire range from lean duplex to super-duplex stainless steels.

Since the 1990s Duplex Stainless Steels have been gaining ground over austenitics. Cost of nickel being one of the factors; improved metallurgical techniques, improved weldability and greter availlability of products have also played a role in commenting on the importance of Duplex Stainless Steels. Duplex Stainless Steels are now universally accepted as a reliable solution for corrosion related issues and a number of process industries, where life cycle costs and envirionmental factors are gaining prominence.

THE DUPLEX STRUCTURE GIVES THIS FAMILY OF STAINLESS STEEL A COMBINATION OF ATTRACTIVE PROPERTIES

Strength: Duplex stainless steels are about twice as strong as regular austenitic or ferritic stainless steels.

Toughness & Ductility: Duplex Stainless Steels have significantly better ductility than Ferritic grades & inferior to Austenitic Stainless Steels but toughness of Duplex Stainless Steels is better than both Ferritic & Austenitic Stainless Steels.

Corrosion resistance: As with all stainless steels, corrosion resistance depends mostly on the composition of the stainless steels. For chloride pitting and crevice corrosion resistance, their chromium, molybdenum and nitrogen contents are most important.

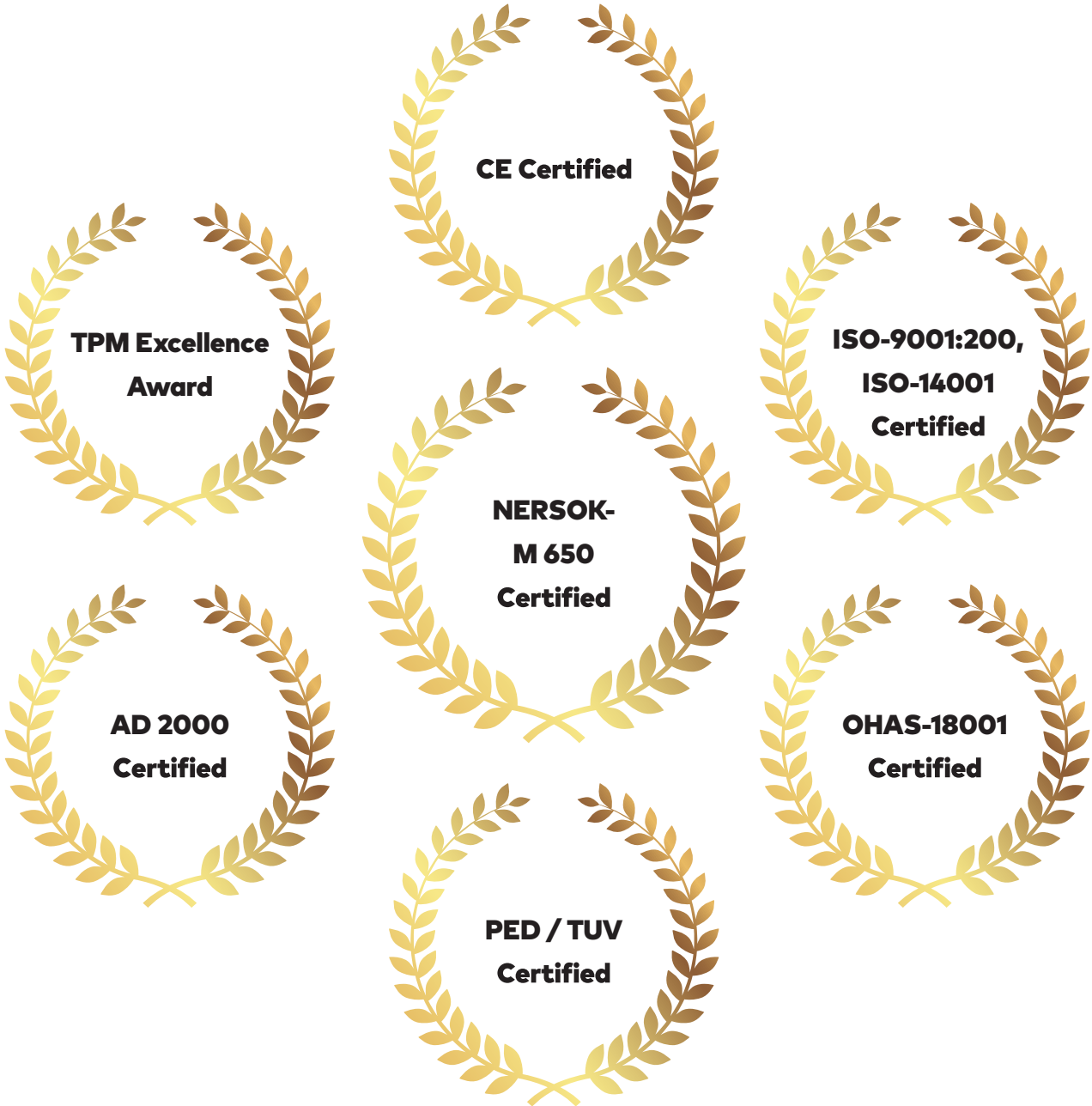
Stress corrosion cracking resistance: Duplex stainless steels show very good stress corrosion cracking (SCC) resistance, a property they have "inherited" from the ferritic side.

Cost: Duplex Stainless Steels have lower nickel and molybdenum contents than their austenitic counterparts of similar corrosion resistance. Due to the lower alloying content, Duplex Stainless Steels can be lower in cost, especially in times of high alloy surcharges. Additionally, it may often be possible to reduce the section thickness of Duplex Stainless Steels, due to its increased yield strength compared to austenitic stainless steels. The combination can lead to significant cost and weight savings compared to a solution in austenitic stainless steels.

THESE GRADES ARE CATEGORIZED IN FOLLOWS:

Regular Duplex	Lean Duplex	Super Duplex
UNS S32205 (2205,EN 1.4462)	UNSS32101(2101,EN 1.4162)	UNSS32750 (2507, EN 1.4410)
	UNS S32304 (EN 1.4362)	UNS $32760 (EN 1.4501)
		UNS 532550 (EN 1.4507)

CERTIFICATIONS



Moreover, the speciality Products Division of the company gives it the unique distinction of being the world's largest producer of high quality precision strip and stainless steel strips for razor blades. Apart from these, the company also produces coin blanks, servicing the needs of both Indian and International mints.

REGULAR DUPLEX

The 2205 is the most widely used of the Duplex Stainless Steels occupying more than 80% of the Duplex Stainless Steel market. The 2205 alloy provides better corrosion resistance in various environments where 316L is generally used with an added advantage of its higher yield strength. All 2205 alloys are metallographically examined to ensure that the shipped product is free from presence of detrimental phases such as sigma.

It is often used in the form of welded pipe or tubular components. The alloy has also been applied as a formed and welded sheet product in environments where resistance to general corrosion and chloride stress corrosion cracking is important.

CHEMISTRY

UNS No.	C%	Cr%	Ni%	Mo%	Cr%	Mn%
S31803	<0.03	21.0-23.0	45-6.5	2.5-3.5	0.08-0.2	<2.0
532205	<0.03	22.0-23.0	45-6.5	3.0-3.5	0.14-0.20	<2.0 e

SPECIFICATION EQUIVALENTS

- UNSS31803, UNSS32205, EN1.4462
- ASTM A182, A240, A276, A789, A790 and A815

MECHANICAL PROPERTIES (AS PER ASTM 240):

Grade	YS (MPa)	UTS (MPa)	% Elongation	Hardness(BHN)
131803	420 min.	620 min.	25min.	293 max.
12205	450 min.	645 min.	26min.	293 max.

TYPICAL VALUE OF MECHANICAL PROPERTIES

Grades	YS (MPa)	UTS (MPa)	% Elongation	Hardness(BHN)
131803	550	750.	30	228
S312205	530	720	20	220

GENERAL CHARACTERISTICS:

MACHINABILITY:

- PREN value 34 (Pitting Resistance Equivalent Number: %Cr +3.3%Mo+16%N)
- It is an extra Low Carbon Duplex Stainless Steel.
- Its yield strength is nearly twice as that of the Austenitic Stainless Steels.
- It has good weldability with minimal inter-granular corrosion in welded condition.
- Cutting procedures with high speed steel tools are same as for AISI 316.
- With carbide tipped tools, the cutting speeds should be 40% less than for AISI 316 in roughing operations and 20% less for finish machining.
- It has high resistance to SCC in chloride and in hydrogen sulfide containing environments.
- Exhibits high resistance to corrosion fatigue, pitting and crevice corrosion and erosion-corrosion.

FABRICABILITY

- Nearly twice the force is required to initiate plastic deformation compared to that required for AISI 304L and 316L.
- Plasticide formation proceeds as easily as in Austenitic Stainless Steel beyond yield strength.
- [It can be cold bent to 25% deformation without requiring subsequent heat treatment.
- Bending should be followed by annealing if the service conditions are prone to SCC.
- Hot bending may be carried out in the range of 950-1100 deg C and should be followed by quench annealing.
- Normal expanding methods can be used while expanding its tubes, but higher initial force is required and it should be completed in a single operation.

WELDABILITY:

- It is welded easily by Manual Metal Arc Welding (MMAW) using covered electrode, Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW).
- Heat input should be in the range of 0.5-2.5k)/mm.
- Interpass temperature should be held to 150 deg C max.
- Pre-heat or post-weld heat treatment is normally not required.
- Typical Filler metals are over alloyed with nickel like E2209.
- Welding with carbon steels, other stainless steels and nickel alloys is readily achieved.

CORROSION RESISTANCE:

- Has better general corrosion resistance as compared to AISI 316 L and 3171
- Joints easily pass inter-granular corrosion testing as per ASTM A262 Practice E-Strauss Test.
- Better resistance to pitting and crevice attack than 304 and 316 at higher temperatures and chloride contents.
- The combined high strength, hardness and corrosion resistance provide 12205 with superior corrosion fatigue and erosion/corrosion resistance.

APPLICATIONS:

- Chemical Industries — Pumps, fans, centrifuges, sulphur melting coils, chemical tanks
- Pulp &Paper Industries — Digesterin sulphate and sulfite plants, blow tanks, blow lines
- Petrochemical Industries
- Power Generation Industries
- Oil & Gas Industries
- Desalination
- Architecture and Construction
- Food Processing Equipment
- Biofuels plant
- Cargo tanks for ships and trucks

LEAN DUPLEX-UNS S32101

Lean Duplex Stainless Steels processes high strength coupled with corrosion resistance. as compared to austenitic grade like 316L. This grade as stable cost owing to low nickel and molybdenum content. This can easily substitute standard austenitic grade like 304, 304L and even 316L in most enfronments.

CHEMISTRY

UNS	EN	C%	Cr%	Ni%	Mo%	Mo%	Mn%	Cu%
S32101	1.4162	≤004	21.01-22.0	21.01-22.0	0.1-0.8	0.2-.25	4.0-6.0	0.1-0.8

SPECIFICATION EQUIVALENTS

- UNSS31803, UNSS32205, EN1.4462
- ASTM A182, A240, A276, A789, A790 and A815

MECHANICAL PROPERTIES (AS PER ASTM 240):

YS (MPa)	UTS (MPa)	% Elongation	Hardness(BHN)
450 min.	650 min.	30min.	293 max.

TYPICAL VALUE OF MECHANICAL PROPERTIES

YS (MPa)	UTS (MPa)	% Elongation	Hardness(BHN)
485	690	36	220

UNS S32304

CHEMISTRY

UNS	EN	C%	Cr%	Ni%	Mo%	Mo%	Mn%	Cu%
S32104	1.4362	≤004	21.5-24.5	3.0-5.5	0.05-0.6	0.05-0.2	≤ 2.50	0.05-0.6

MECHANICAL PROPERTIES (AS PER ASTM 240):

YS (MPa)	UTS (MPa)	% Elongation	Hardness(BHN)
400 min.	600 min.	25min.	290 max.

TYPICAL VALUE OF MECHANICAL PROPERTIES

YS (MPa)	UTS (MPa)	% Elongation	Hardness(BHN)
480	665	30	215

GENERAL CHARACTERISTICS:

- 2101 and 2304 have a PREN value around 24.
- These lean duplex alloys provide good strength, formability and economy with slightly less corrosion resistance than reference duplex alloy 2205 in various acidic environments.
- Possess good drawing and welding characteristics.
- Have excellent chloride SCC resistance and high cyclic oxidation resistance upto 970° C.
- Exhibits high ductility (superplasticity) at high temperatures (above 920 deg C) making them readily formable (formability is better than the ferritic grades but not as good as the austenitics).
- Have considerably higher resistance to sigma formation as compared to duplex stainless steels and some heat resistant steels.
- Optimised with respect to strength, maintenance, ductility and long term cost efficiency.

FABRICABILITY:

LDSS can be successfully cold-bent and expanded to the same extent as other duplex stainless steels. Because of the higher strength and lower ductility of duplex grades, greater loads and more generous bend radii are required for forming as compared to conventional Austenitic materials. It is suggested that bend radii of at least two times the metal thickness can be used when forming duplex stainless steels. Allowances will also need to be made for a larger springback than is seen with lower strength materials.

WELDABILITY:

Commercially available filler metals, which are over alloyed with nickel, are suggested for welding lean duplex alloys. Such filler metals (for example, AWS E2209 or E2507) contain more nickel than the base metal in order to produce a phase balance within the weld that is approximately the same as that of the base metal. Weld procedures for LDSS alloy have been developed using Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding(GMAW), Submerged Arc welding (SAW), and Flux Cored Arc Welding (FCAW) and Plasma Arc Welding (PAW). Root treatment can be given using Gas Tungsten Arc Welding (GTAW) for welding thicker sections. Heat input should be in the range of 0.3-1.5 KJ/mm for UNS §32101 & 0.5-2.5 KJ/mm for UNS S32304 grade.

CORROSION RESISTANCE

1. Plain and weld sample of lean duplex alloys were exposed for over 1,000 hours in a salt fogs cabinet as per ASTM: B177 and no signs of rust or pitting were observed.
2. 2101 and 2304 show more resistance to SCC than austenitic grade like 304 and 316. when u-Bend specimens of LDSS were immersed in a boiling 26% NaCl solutions for 1,000 hours, they did not crack.

APPLICATIONS

- Power Generation: Rotors impeller shafs
- Desalinations Plant: Pre-Heater shall and tube plates, Evaporator chambers
- Pulp & paper: storages tank
- Oil and Gas: Pressure vessels, flue gas cleaner, heat exchangers
- Food and Beverage Industry: Storage containers for wine, fruit juices, ethanol, silos
- Potash Industry: Chutes, Bins, fans, blowers
- Construction: Bridges
- Tanker truck hot cargo containers
- Waste water treatment system

SUPER DUPLEX UNS S32750/32760

Super Duplex Stainless steels, which combine high strength and excellent corrosion resistance in many environments, have found applications in chemical and process industries. Pulp mills, offshore systems, flue gas desulphurization units. Localized corrosion resistance of Super-Duplex Steels is close to what is achieved with 6% Mo Super-Austenitic.

CHEMISTRY

UNS No.	C%	Cr%	Ni%	Mo%	N%	Mn%	Cu%	W%
S32750	<0.03	24.0-26.0	6.0-8.0	3.0-5.0	0.24-0.32	<1.200	<0.5	-
532760	<0.03	24.0-26.0	6.0-8.0	3.0-4.0	0.20-0.30	<1.0 e	0.5-1.0	0.-1.0

Specification Equivalents:

UNS: 532750, EN 1.4410

UNS: 532760, EN 1.4501

ASTM: A240, A480, A789, A790

MECHANICAL PROPERTIES (AS PER ASTM 240):

Grade	YS (MPa)	UTS (MPa)	% Elongation	Hardness(BHN)
UNS S32750	550 min.	795 min.	15 min.	310 max.
UNS 532760	450 min.	750 min.	25min.	270 max.

TYPICAL VALUE OF MECHANICAL PROPERTIES

Grades	YS (MPa)	UTS (MPa)	% Elongation	Hardness(BHN)
UNS S32750	585	826	25	260
UNS S32760	640	820	35	240

GENERAL CHARACTERISTICS:

- Super Duplex stainless steels exhibit PREN value higher than 40.
- Possesses high strength & impact strength.
- Combines most desirable characteristics of both super-ferritic and Super-Austenitic steel.
- Has excellent resistance to chloride SCC, pitting, crevice and general corrosion and carbide related.
- Has high thermal conductivity and a lower coefficient of thermal expansion compared to Super Austenitic Steels.

FABRICABLITY

- |t should be hot worked in the range of 1250-1000 deg C, followed by a solution anneal at 1100 deg C and rapid quench.
- |t can be cold formed using methods similar to those commonly used for Stainless Steel. The primary difference is that the high yield strength makes it necessary to have higher forming forces, increased radius of bending, and increased allowance for springback.
- Deep drawing, stretch forming and similar processes are difficult to perform.

WELDABILITY

- |t possesses good weldability and can be welded to itself and other materials by Shielded Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Plasma Arc Welding (PAW) or Submerged Arc Welding (SAW).
- Surfaces must be clean before welding.
- Pre-heating is not necessary, except to prevent condensation on cold metal. ® The recommended heat input should be nearly about 0.3-1.5K) /mm.
- The interpass temperature should not exceed 150 deg C.
- The root should be shielded with commercial Ar or 90%N2 / 10%H2 purging gas.

CORROSION RESISTANCE

- It is highly resistant to carbide related inter-granular corrosion due to its low carbon content which lowers the risk of carbide precipitation at the grain boundaries during heat treatment.
- |ts critical pitting temperature (CPT) is superior to that of 904L. ® |thus excellent resistance to crevice corrosion and SCC.
- Extremely resistant to uniform corrosion by organic acids such as formic and acetic acid and also to inorganic acids, especially those containing chlorides.
- Excellent corrosion resistance against highly corrosive acids like Sulphuric, Nitric, Phosphoric acids.

APPLICATIONS

- Petrochemical industries (polymerization reactor cycle pumps and pipework)
- Oi land gas industry.
- Off-shore platforms (heat exchangers, process and service water systems, fire-fighting systems, and injection and ballast water systems).
- Chemical process industries (heat exchangers and vessels).
- Desalination plants (high pressure RO-plant and seawater piping).
- Fertilizers (Recirculation tanks, sedimentation tanks, phosphate reactor recirculation pumps) ® Powerindustry FGD systems.
- Utility & industrial scrubber systems (absorber towers, ducting, piping).
- Mining/ Extraction (hot slurry pipe work, acid leach mining).
- Sewage (critically important pipelines).
- Engineering applications (pressure vessels).

UNS S32550

CHEMISTRY

Element	%C	%Mn	%S	%P	%SI	%NI	%Ce	%Mo	%N	CU
Min	-	-	-	-	-	45	24.0	2.9	0.10	1.5
Max	0.04	1.5	0.03	0.04	1.0	6.5	27.0	3.9	0.25	2.5

GENERAL CHARACTERISTICS:

- |t is a high strength super stainless steel.
- |t combines high mechanical strength, ductility and hardness with excellent resistance to corrosion and erosion.
- Its corrosion resistance is superior to that of fully austenitic 304,316 and 317L stainless steels under extreme conditions.
- |t can be machined readily and hot worked or cold worked by conventional processes.
- It can be welded by several conventional processes.

SPECIFICATION EQUIVALENTS:

- EN 1.4507
- ASTM:A240,A479,A789 and A790
- ASME : SA 240,5A 479,5A 789, and SA 790 AWS :A5.9 and A5.4
- NACE : MR-01-75

TYPICAL VALUE OF MECHANICAL PROPERTIES

UNS32550	YS (MPa)	TS (MPa)	% Elongation	Hardness(BHN)
ASTM 240 UNS S$32550	550	760	15	302 Max
Typical values	605	835	25	242

FABRICABILITY:

- Can be readily machined using conventional techniques. Inspite of being considerably harder than austenitics, the same practices can generally be employed.
- High speed tools are normally found to be satisfactory.
- Machining speeds can often be substantially increased by the use of carbide-tipped tools.
- |t has good hot working and cold working characteristics.
- |t can be hot worked or cold worked by conventional processes.

WELDABILITY:

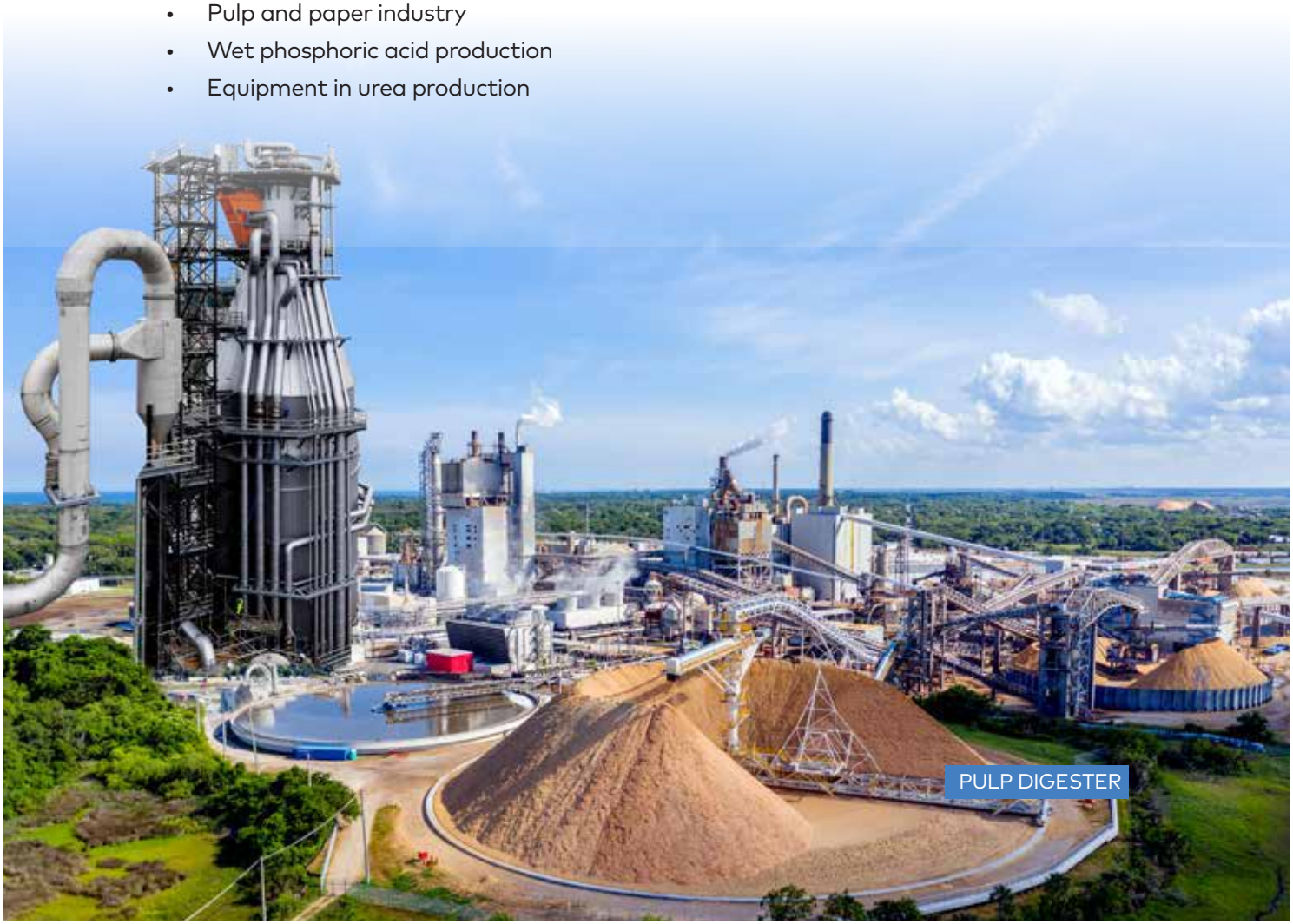
- It can be welded successfully by GTAW, GMAW or SMAW process. °
- It can successfully joint to itself, and a variety of dissimilar combinations, both stainless and carbon steel dissimilar joints.

CORROSION RESISTANCE:

- It has outstanding resistance to corrosion and is superior to fully austenitic AISI Types 304, 316 and 317L stainless steels under most service conditions.
- It exhibits excellent resistance to sulfuric, phosphoric, nitric, hydrochloric and many other acids and salts, and other severely reducing acids and chemicals.
- Highly resistant to acetic, formic and other organic acids and compounds.
- Particularly suitable for the higher concentrations and temperatures where pitting and preferential corrosion are common causes of failure with most conventional Austenitic stainless steels in the presence of chlorides and other impurities. It has improved resistance to SCC (in NaCl, sea water and many other environments), crevice corrosion and pitting when compared to austenitics like Types 304, 316,317L and even 20Cr-25Ni grades.

APPLICATIONS:

- Equipment in chemical process industry, H2504 production
- Oil and gas industry
- Petro-chemical industry
- Equipment in pollution control
- Pulp and paper industry
- Wet phosphoric acid production
- Equipment in urea production



PULP DIGESTER

APPLICATIONS

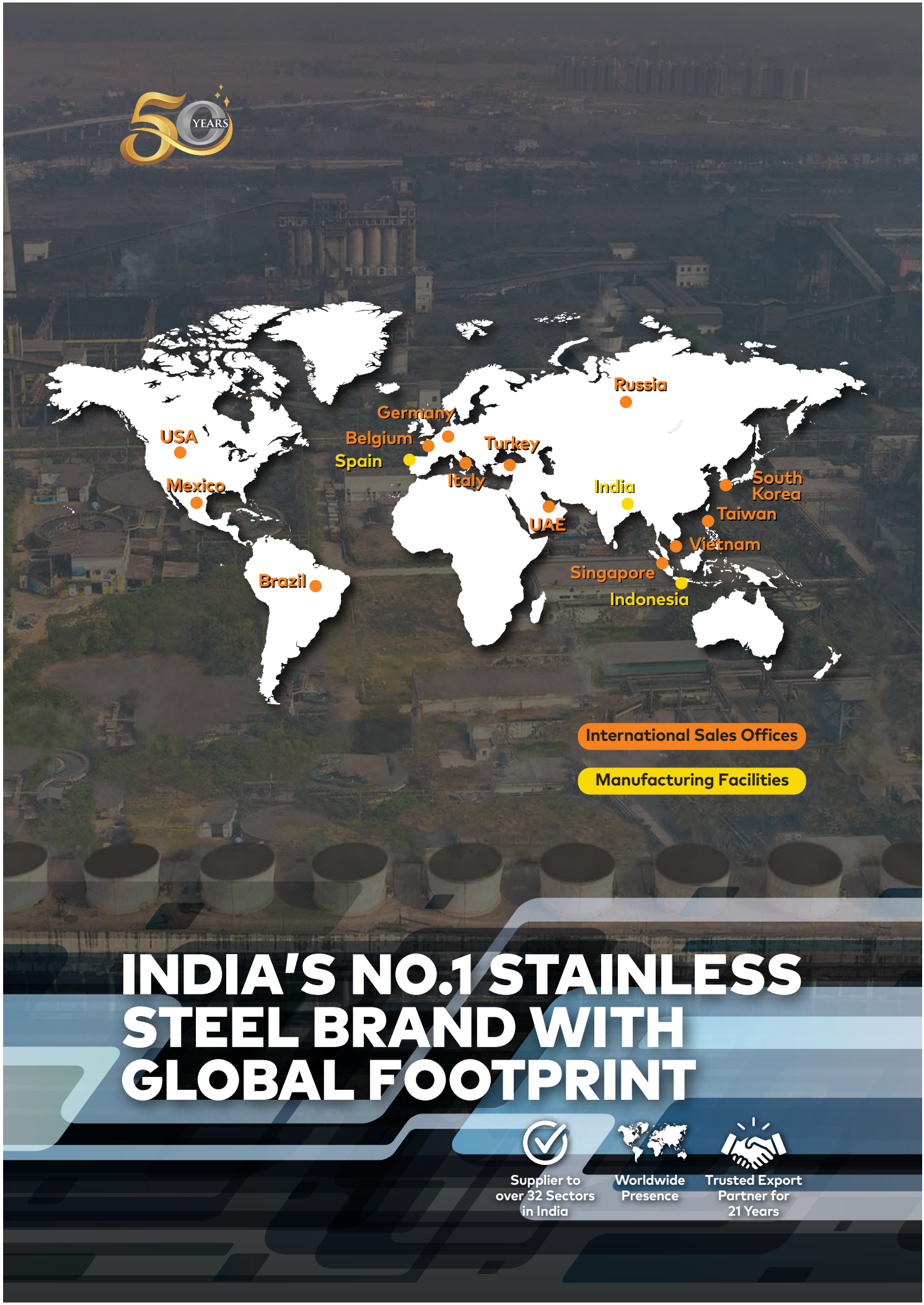

SILOS


PIPELINES


PIPELINES


WATER & WASTE MANAGEMENT


CHEMICAL REACTORS



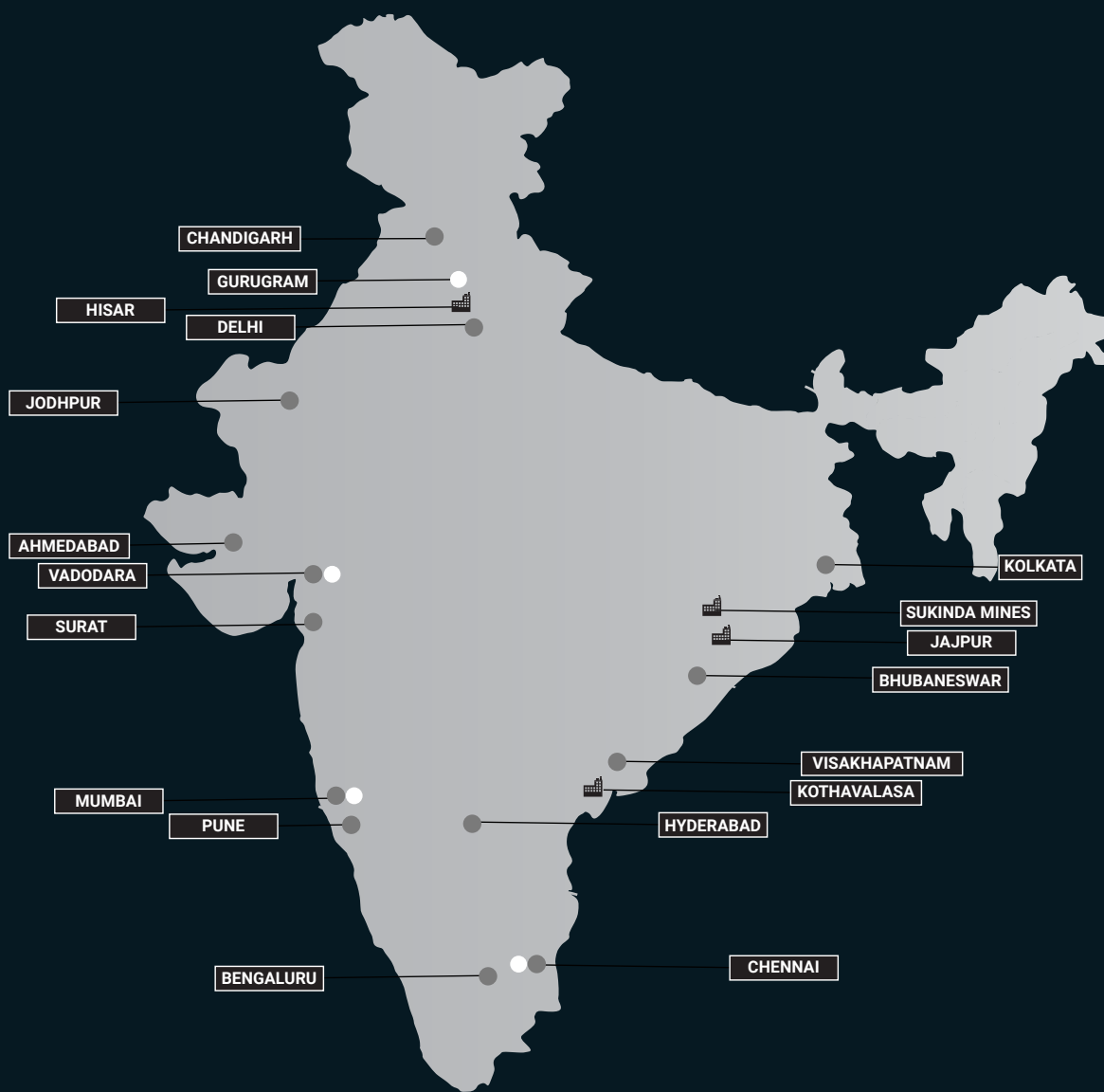
INDIA'S NO.1 STAINLESS STEEL BRAND WITH GLOBAL FOOTPRINT

Supplier to over 32 Sectors in India

Worldwide Presence

Trusted Export Partner for 21 Years

MANUFACTURING FACILITIES



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