

SHANGHAI RELYON METAL MATERIALS CO., LTD.

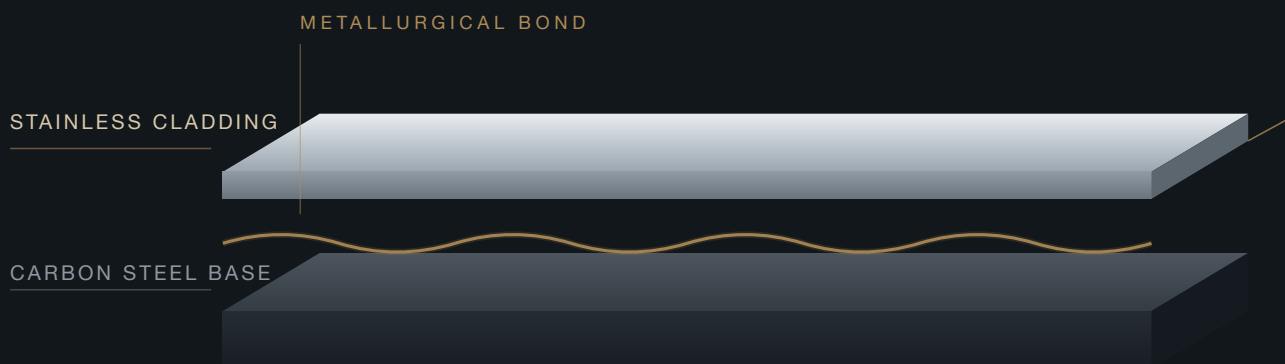
上海瑞联易创金属材料有限公司

A NEW WAY TO REPLACE SOLID STAINLESS

替代不锈钢的新方案——不锈钢复合板

Stainless clad plate: cut raw material cost by 10%–50%.

Carbon steel carries the load; stainless resists the medium.



EXPORTING WORLDWIDE

面向全球不锈钢市场

EXPLOSION BONDED · HOT-ROLL BONDED

SINGLE-SIDED & DOUBLE-SIDED

CLAD PLATE · CLAD PIPE & FITTINGS

100% ULTRASONIC TESTED

Why is clad plate better?

为什么不锈钢复合板更好？

Have you ever thought that the material you are using can, while keeping the same safety and the same quality and the same dimensions, save you 10%–50% of the raw material cost simply by replacing part of it with another material — and at the same time give it the performance of that other metal? Then you must not miss it: stainless clad plate.

有没有想过你所使用的材料可以在保证安全和质量的同时，规格不变，仅仅只是将其一部分替换成了另外一种材料就可以为您节省 10%~50% 的原材料成本，同时赋予它另外一种金属的性能。那请您一定不要错过它——不锈钢复合板。

10–50%

Lower raw material cost
原材料成本下降

100%

Same safety, quality and dimensions
安全、质量、规格全部不变

2 metals

Two metals, two jobs, one plate
两种金属，各司其职，合为一板

10–50% 从哪里来

Single-sided clad is normally **30%–50%** cheaper than the solid stainless it replaces. Double-sided cold-rolled clad is the conservative case: some gauges save only about **10%**, and the saving grows with thickness and with the core material chosen — up to **50%**.

单面复合板通常比它替代的纯不锈钢便宜 30%~50%；双面冷轧复合板是最保守的一档，部分规格只便宜约 10%，随着厚度增加、或把中间芯层换成更经济的材质，优惠最高可到 50%。

Construction & thickness

结构 × 工艺 × 总厚度（基层+复层）

4–16 mm

Single-sided · hot-rolled

单面复合 · 仅热轧

0.8–12 mm

Double-sided · cold & hot-rolled

双面复合 · 冷轧与热轧

8–300 mm

Explosion-bonded

爆炸复合

Thickness is the total sheet — base steel plus cladding. / 以上厚度均为总厚度（基层+复层），不是只有复层。

What is a stainless steel clad plate?

什么是不锈钢复合板？

Think of it as a perfectly bonded sandwich. A thick core — carbon steel, or a more economical stainless such as 201, or another low-cost metal — gives the plate its strength and carries the load. A thin skin of stainless steel faces the corrosion — the acid, the brine, the food, the chemical.

把它想成一块完美焊合的"三明治"。厚实的芯层可以是碳钢，也可以是更经济的不锈钢（如 201）或其他低成本金属，负责强度与承重；表层是薄薄的不锈钢，负责抵抗酸液、海水、食品和化学品的腐蚀。

The two layers are not glued, not painted and not lined. They are fused into one single plate at the atomic level, so the whole plate behaves as one piece of metal.

两层不是粘合、不是涂覆、也不是内衬，而是在原子层面熔合为一整块钢板，整板行为如同一块单一金属。

Why this matters / 为什么这很关键

You get the corrosion resistance of stainless only where it is needed, and pay for an economical core everywhere else.

只在真正需要的地方使用不锈钢抗腐蚀，其余部分用更经济的芯层材料（碳钢或经济型不锈钢），成本大幅下降。

✗ NOT A COATING

A coating fails the moment it is scratched through.

涂层一旦被划穿就失效。

✗ NOT A LINING

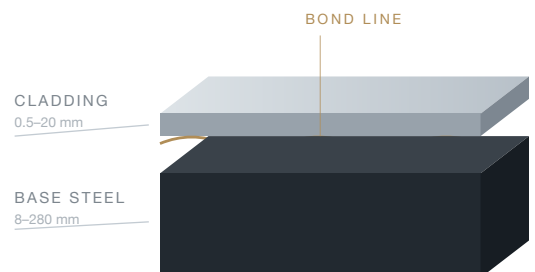
A lining can peel, blister or collapse under vacuum.

内衬会脱落、起泡，真空工况下会塌陷。

✗ NOT WELD OVERLAY

Overlay dilutes and varies in thickness across the plate.

堆焊会稀释合金成分，且全板厚度不均。

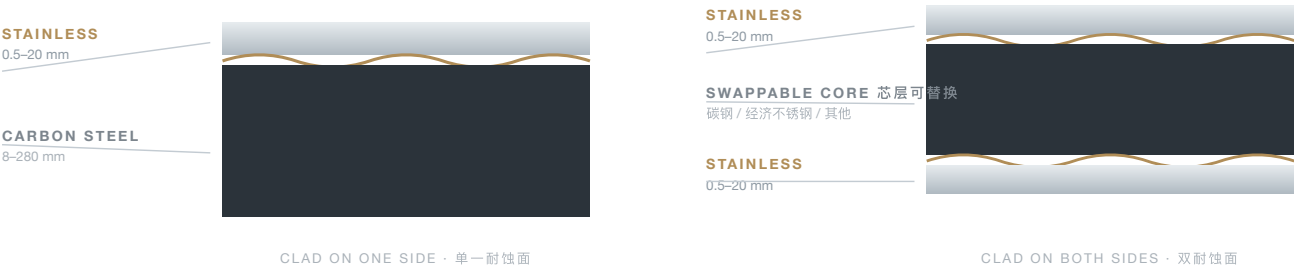


Clad on one side, or on both?

单面复合与双面复合

One plate, two ways to lay it up. Which one you need is decided by a single question: how many sides meet the corrosive medium?

同一块复合板，两种叠层方式。怎么选，只取决于一个问题：有几个面接触介质？



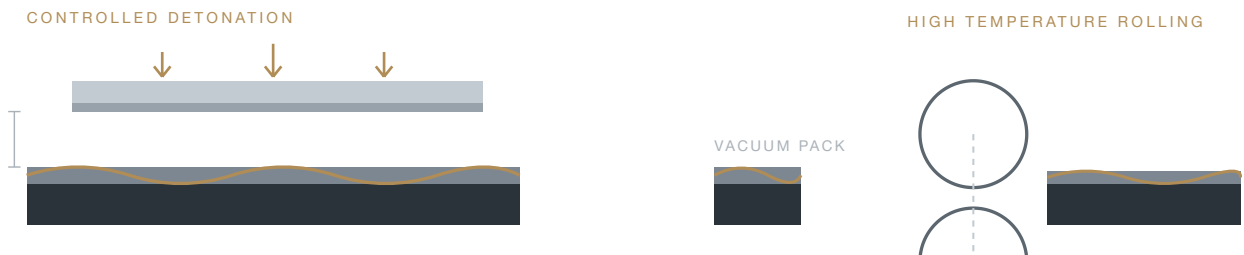
DIMENSION	SINGLE-SIDED 单面复合	DOUBLE-SIDED 双面复合
Lay-up 叠层	Stainless on the side that meets the corrosive medium; carbon steel behind. 介质面为不锈钢，背面为碳钢。	Stainless on both sides, low-cost core layer between. 两面均为不锈钢，中间为低成本芯层。
Most economical when 最经济的选择	Only one side is exposed to the corrosive medium. 只有一面接触腐蚀介质。	Both sides are exposed to the corrosive medium, or both sides are visible and must look good. 两面都接触介质，或两面都需美观。
Cladding ratio 复层比例	Up to 1:3 复层:基层最大 1:3	1 : 8 : 1 on a non-carbon core; cold-rolled 0.8–3 mm for decorative work 1 : 8 : 1（非碳钢芯层）；装饰用冷轧 0.8–3 mm
Core material 芯层材料	Carbon steel — the base plate itself. 碳钢，即基层本身。	Carbon steel as standard; swappable for an economy stainless. 常规碳钢；可换成经济型不锈钢。
Typical applications 典型应用	Tanks · Vessels · Piping 储罐 · 容器 · 管道	Elevator cars · door frames · façades · food equipment 电梯轿厢 · 门框 · 幕墙 · 食品设备
Flatness after welding 焊后平整度	—	Symmetric lay-up — less bowing and distortion. 对称结构 — 翘曲与变形更小。
Boundary to know 须知的边界	Only one corrosion-resistant side. 仅一个耐蚀面。	A 201 core is not rated for pressure — architectural and decorative service only. 201 芯层非承压牌号，仅用于建筑与装饰用途。

Two ways to fuse two metals

两种复合工艺

Both routes end in the same thing: a metallurgical bond that will not peel, however the plate is later formed or welded.

两条路线得到的都是同一样东西：一道不会剥离的冶金结合面——无论这块板之后怎么成型、怎么焊接。



DIMENSION	EXPLOSION BONDING 爆炸复合	HOT-ROLL BONDING 热轧复合
How it bonds 结合机理	A controlled detonation drives the stainless plate onto the carbon steel at several kilometres per second; the impact welds a wave-shaped, atomic-level bond without melting either bulk. 可控爆破使不锈钢板以每秒数千米撞向碳钢板，撞击面形成波状原子级结合，两块板基体均不熔化。	The two plates are stacked, vacuum-sealed and rolled hot; pressure and atomic diffusion fuse the entire interface. 两块板叠合、真空封焊后高温轧制，靠压力与原子扩散在整个界面实现结合。
Bonding rate 结合率	GB/T 8165-2025 — Grade I 100% · II ≥99% · III ≥95% GB/T 8165-2025 一级 100% · 二级 ≥99% · 三级 ≥95%	Normally 100% across the interface 通常全界面可达 100%
Total thickness 总厚度	8 – 300 mm	0.8 – 12 mm
Material combinations 材料组合	Unlimited — titanium, copper, aluminium, nickel alloys, zirconium, tantalum, niobium. 不受限制——钛、铜、铝、镍基合金、锆、钽、铌。	Stainless or nickel-base on carbon or low-alloy steel. 不锈钢或镍基合金复合碳钢、低合金钢。
Best for 最适合	Heavy plate, typically over 50 mm, and one-off fabrications. 厚板（一般 50 mm 以上）与单件设备制造。	Wide plate and coil, continuous production. 大幅面与卷材，可连续生产。
What you gain 优势	Higher shear strength, unlimited metal pairs. 剪切强度更高，材料组合不受限制。	Larger plate, better flatness, shorter lead time. 幅面更大，平整度更好，交期更短。

What the plate is actually made of

材料特性与结构组成

PROPERTY	TYPICAL VALUE
Bonding rate (UT) 界面结合率	Grade I 100% Grade II ≥ 99% Grade III ≥ 95%
Interface shear strength 界面剪切强度	≥ 210 MPa (Gr. III) ≥ 250 MPa (Gr. I-II) GB/T 8165 · NB/T 47002.1
Bending, 180° 弯曲性能	No delamination no surface crack
Mechanical strength 力学性能	Per base steel
Intergranular corrosion 晶间腐蚀	GB/T 4334 pass
Configuration 复合形式	Single-sided / double-sided (carbon or economy stainless core)
Surface finish 表面处理	No.1 / 2B / brushed mirror / embossed

Cladding — the corrosion barrier

复层 — 耐腐蚀层

304 · 304L · 316 · 316L · 316Ti · 321 · 317L · 904L
2205 · 2507 · 254SMO

Base — the structural layer

基层 — 结构承载力层

Q235B · Q345R · Q355NH
SA516 Gr.60/70 · P355GH · S355JR
or stainless core 201 / 304 — 不锈钢芯层

Why the bond never fails

Because there is no third material between the layers — no adhesive, no interlayer that can degrade. The bond is metallic, and it survives bending, rolling, thermal cycling and welding.

因为两层之间没有任何第三种材料，没有胶黏剂、没有会老化的中间层。这个结合是金属性的，能承受弯曲、卷制、热循环与焊接。

Design stays simple

设计无需改变

Strength is calculated with the base-steel tables you already use.
Corrosion life is specified from standard stainless practice. No new codes, no re-learning.

强度计算沿用您现有的碳钢规范，耐蚀选材按不锈钢惯例，无需学习新的设计体系。

Why the base governs

为什么按基层计算

The thin cladding does not reduce the load capacity of the plate — engineers treat it exactly like a plain carbon-steel plate of the same total thickness.

复层很薄，不会降低整板承载能力，可按同厚度普通碳钢板直接进行设计计算。

Five reasons it wins the specification

选择它的五个理由

01

Cut material cost by 10–50%

Stainless is used only as a thin working skin, so 70–90% of the costly alloy is replaced by ordinary carbon steel.

不锈钢仅作为薄层工作面使用，70–90% 的昂贵合金被普通碳钢替代。

02

Full structural strength

Load is carried by the carbon steel core, exactly as with a normal pressure-vessel steel plate.

载荷由碳钢芯层承担，力学计算方式与普通压力容器钢板完全一致。

03

3–5× longer service life

Equipment that would rust through in a few years keeps working for decades in chloride, acid and salt-spray environments.

在氯离子、酸性及盐雾环境中，原本几年就锈穿的设备可继续服役数十年。

04

Fabricated like ordinary steel

Cut, bent, rolled and welded with standard workshop equipment — no special plant required.

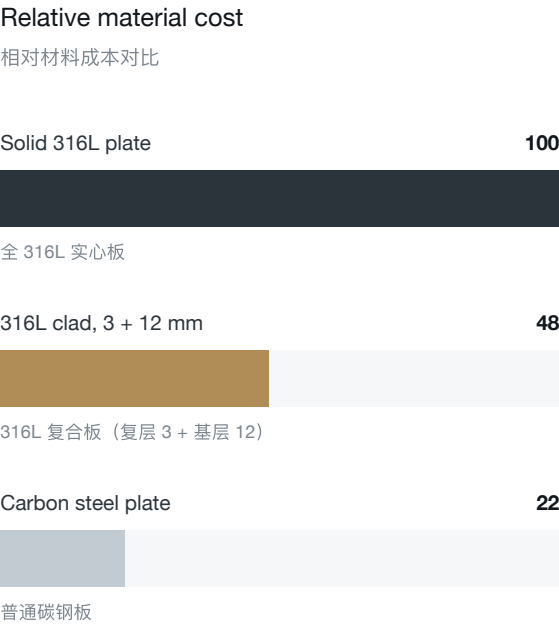
可使用常规车间设备进行切割、折弯、卷制和焊接，无需专用产线。

05

Lower carbon footprint

Nickel and molybdenum are among the most carbon-intensive steels to produce. Using less of them lowers the embodied carbon of every vessel you build.

镍与钼是碳足迹最高的合金元素之一。少用它们，等于降低每一台设备的隐含碳排放。



INDICATIVE RELATIVE COST PER M²

示意性相对成本，实际以当期报价为准

同一台设备，用复合板制造可以拿到接近全不锈钢的耐蚀寿命，而材料支出通常只有其一半左右。

Applications

应用场景

<div></div> <div>Petrochemical & Refining 石油化工与炼油 Storage tanks, reactors, heat exchangers, desulphurisation towers. 316L / 317L + Q345R</div>	<div></div> <div>Food & Beverage 食品与饮料加工 Fermentation tanks, CIP lines, mixing vessels, hygienic storage. 304 / 316L + Q235B</div>
<div></div> <div>Sugar Milling 制糖设备 Evaporator bodies, crystallisers and juice heaters in high-temperature sugar liquor service. 304 / 316L + Q235B</div>	<div></div> <div>Desalination & Water 海水淡化与水处理 MSF and MED chambers, RO pressure vessels, brine piping. 2205 / 316L + Q345R</div>
<div></div> <div>Marine & Shipbuilding 船舶与海洋工程 Ballast tanks, cargo tank linings, deck structures, offshore modules. 316L / 2205 + ship steel</div>	<div></div> <div>Power & Flue-Gas Desulphurisation 电力与烟气脱硫 FGD absorber towers, chimney liners, ducting and flue-gas path. 316L / 317L + Q235B</div>
<div></div> <div>Pharmaceutical & Hygiene 制药与卫生级设备 Reactors, clean process pipework and vessels requiring a fully austenitic wetted surface. 316L + Q345R</div>	<div></div> <div>Storage Tanks & Pipelines 大型储罐与管道 Crude and product tanks, chemical storage, long-run process piping. 304 / 316L + Q235B</div>

Built for the world's toughest climates / 为全球严苛工况设计

High humidity, salt-laden coastal air and year-round heat accelerate corrosion on ordinary steel. For coastal industrial zones, marine environments and hot climates worldwide we supply molybdenum-bearing steel grades and duplex families that keep a clean surface where ordinary stainless begins to pit.

高湿度、含盐海岸空气与常年高温会加速普通钢材腐蚀。针对全球沿海工业区、海洋与热带工况，我们提供含钼不锈钢及双相钢组合方案，在普通不锈钢开始点蚀的环境中依然稳定。

Fourteen environments, photographed

十四个应用场景实拍

The same logic repeated in fourteen industries: the process medium touches an alloy surface, the load is carried by carbon steel. Under each photograph, the configuration we would normally supply.

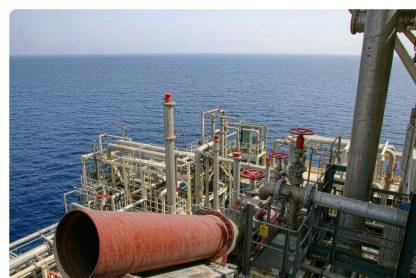
同样的逻辑重复出现在十四个行业：介质接触合金复层，载荷由碳钢基层承担。每张照片下方标注该场景通常推荐的复合配置。



石油化工与炼油
Petrochemical & refining
316L · 825 + SA516 Gr.70



油气集输
Oil & gas gathering
316L · 2205 + X52-X70



海上平台与水下
Offshore & subsea
2205 · 625 + 碳钢



海水淡化与海水
Desalination & seawater
2205 · 904L + Q345R



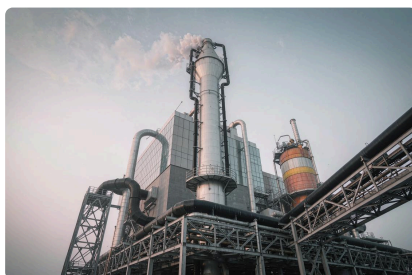
化工与化肥
Chemical & fertiliser
316L 尿素级 · 25-22-2 + Q345R



食品饮料与制糖
Food, beverage & sugar
304 · 316L + Q235B



医药与生物
Pharmaceutical & biotech
316L · 904L + Q345R



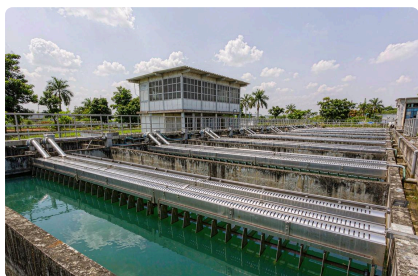
制浆造纸
Pulp & paper
304L · 316L · 625 + 碳钢



电力与烟气脱硫
Power generation & FGD
2205 · 904L + Q235B

Your project could be next

下一个采用复合板的，也许就是你的项目



水与污水处理

Water & wastewater

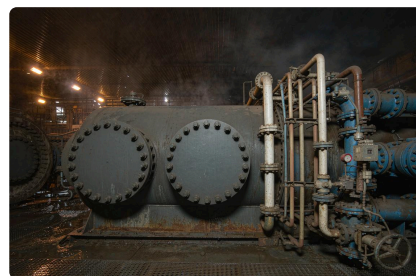
304 · 316L + Q235B



船舶与海工

Marine & shipbuilding

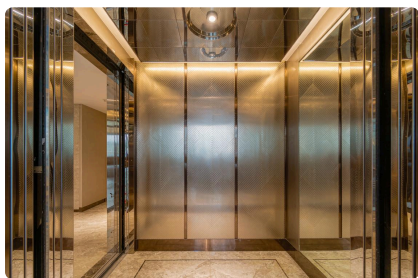
316L · 2205 + 船板



矿山与选冶

Mining & mineral processing

625 · 钛 + 碳钢



建筑电梯与装饰

Architecture, elevator & interiors

304 · 316L + 201 芯层



氢能与碳捕集

Hydrogen & carbon capture

316L · 825 + L245-L450

Fourteen industries are only the ones we photographed. If your project has a surface that must resist corrosion and a cost target — a tank, a panel, a door, a duct, a vessel — send the drawings or the operating conditions to our engineers. We will assess whether a clad configuration can replace solid stainless at the same quality, and return a material proposal with a cost comparison, free of charge.

十四个行业只是被拍摄下来的部分。只要你的项目里存在一个需要抗腐蚀的表面和一个成本目标 —— 储罐、面板、门、风道、容器 —— 把图纸或工况发给我们：工程师会免费评估能否在同等质量下 用复合材料替代纯不锈钢，并给出材料方案与成本对比。

More than a plate — it is a surface

表面处理与装饰应用

A clad plate can be finished exactly like a solid stainless sheet. Whether the requirement is an industrial brushed surface or a full mirror for a lift lobby, the finish is applied to the bonded plate and carried through to the finished part.

复合板可以像全不锈钢板一样做表面处理。无论是工业拉丝面，还是电梯厅用的镜面，处理都在复合完成后施加，并一直保持到成品。



Hairline / Brushed

拉丝

Fine, continuous parallel grain. Hides fingerprints and minor scratches.

Lifts · Appliances · Curtain walls / 电梯 · 家电 · 幕墙



Mirror / 8K

镜面

Polished to a full mirror reflection, specified where the surface itself is the design.

Lift doors · Feature walls / 电梯门 · 形象墙

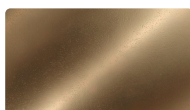


Embossed / Patterned

压花

A pattern rolled into the surface — diamond, linen, wave or leather. Adds grip and disguises wear.

Anti-slip floors · Panels / 防滑地面 · 装饰板

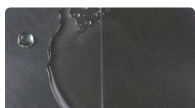


PVD Colour Coating

真空镀色

Titanium gold, black titanium, rose gold and champagne. A hard vacuum-deposited layer, not paint.

Architectural trim · Signage / 建筑装饰 · 标识

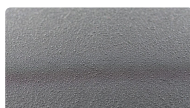


Anti-Fingerprint

抗指纹

A nano-scale coating that keeps greasy marks from showing on brushed and mirror faces.

Appliances · Lift interiors / 家电 · 电梯内饰



Sandblasted

喷砂

Uniform matte texture with no directional grain. Soft to the eye and easy to keep clean.

Panels · Equipment housings / 装饰板 · 设备外壳

Where these finishes are used / 典型装饰应用

Architectural curtain walls, lift doors and car interiors, appliance fronts, commercial kitchen equipment, signage and facade cladding panels.

建筑幕墙、电梯门与轿厢内饰、家电面板、商用厨具、标识牌与外墙装饰板。

Worked like ordinary sheet

成型与加工方式



折弯成型 · 复层随弯不断裂



卷制成筒 · 用于储罐与管道

Bending

折弯

V, U and L profiles on standard press brakes. The cladding follows the bend without cracking or separating.

Curving & Rolling

卷制

Rolled into cylinders, cones and tank shells on ordinary plate-rolling machines.

Grooving & Folding

开槽折边

A V-groove is cut from the carbon-steel side and the sheet folded up, leaving the stainless surface unbroken.

Stamping

冲压

Pressed into panels, trays and housings where a formed shape is required.

Cutting

切割

Laser, plasma, waterjet or shear. Keep the clad side up to protect the finished surface.

Punching & Drilling

冲孔与钻孔

Openings, bolt holes and perforated patterns, cut with stainless-rated tooling.

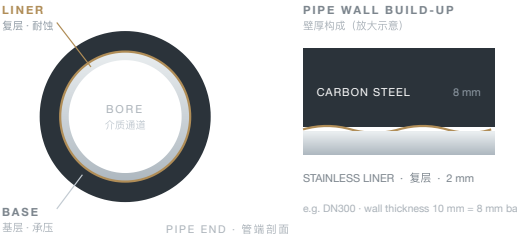
Finishes that survive fabrication / 加工后依然完好

Surface finishes are applied after bonding, so the texture and colour run through to the finished part. With the correct bend radius, brushed and mirror surfaces fold without cracking.

表面处理在复合完成后施加，纹理与颜色一直保持到成品；采用正确的折弯半径时，拉丝与镜面表面折弯不开裂。

The same idea, formed into a pipe

不锈钢复合管



Stainless where it counts

只在关键处用不锈钢

Clad pipe starts from the same composite billet as our plate, then is formed and welded into a tube. Carbon or low-alloy steel on the outside carries the pressure; a corrosion-resistant alloy on the inside is exposed to the medium. Fused into one pipe wall, the bore behaves like all-alloy pipe while the pipe is priced like carbon steel — and the interface is a metallurgical bond of typically ≥ 210 MPa shear.

复合管与复合板同源源于复合坯料，再经成型、焊接制成管材。外层碳钢或低合金钢承受压力，内层耐蚀合金接触介质。两者熔合为一道完整管壁——管内壁的表现等同纯耐蚀合金，而成本按碳钢计；界面为冶金结合，剪切强度通常 ≥ 210 MPa。

TYPICAL 组合

Base steel: API 5L X42–X80, Q235, Q345, 20G —
Liner: 304, 316L, duplex 2205, alloys 825 / 625 / C-276.
基层: API 5L X42–X80、Q235、Q345、20G; 复层: 304、316L、双相 2205、825/625/C-276。

NOT ONLY CARBON

The core can also be an economy stainless — e.g. a 316L + 304 + 316L square tube, used where the cut section must never rust.
中间层也可以是经济型不锈钢——如 316L+304+316L 方管，用于断面不允许生锈的场合。

Two ways to bond a pipe

两种复合管：冶金复合与机械复合

	METALLURGICALLY BONDED 冶金复合管	MECHANICALLY LINED 机械复合管
Bond 结合方式	Atom-to-atom fusion — hot-roll, explosion or overlay 原子级熔合，热轧 / 爆炸 / 堆焊	Interference fit — liner hydraulically expanded 液压胀形，过盈贴合，无熔合
Alloy layer 复层厚度	1 – 6 mm 可依工况加厚	2 – 3 mm 受胀形工艺限制
Pressure design 承压设计	Liner counts to wall thickness 复层计入壁厚，与纯材管同等设计	Carbon steel wall only 仅计碳钢壁厚，复层不承压
Relative cost 相对碳钢管成本	3 – 5× carbon steel 约为碳钢管的 3–5 倍	2 – 3× carbon steel 约为碳钢管的 2–3 倍
Best for 适用工况	High pressure & temperature, sour gas (H₂S) service, subsea, cyclic service 高压高温、酸性工况、深海、循环载荷	Moderate conditions, onshore gathering 中低压工况、陆上集输

Stainless performance, carbon steel cost

不锈钢复合管的优势

01 Two metals, two jobs

The outer wall thickness is sized for pressure, the liner for corrosion. Alloy goes only where it pays for itself.

外层按压力选材，内层按腐蚀选材。耐蚀合金只用在真正需要的位置。

02 30–50% less material cost

A pipe made entirely of alloy is alloy all the way through. Clad pipe concentrates the alloy in a 1–3 mm liner, so at the same corrosion performance the material bill typically falls by 30–50%.

纯合金管整道壁厚都是合金；复合管把合金集中在 1–3 mm 复层，在同等耐蚀性能下材料成本通常下降 30–50%。

03 The full strength of carbon steel

Pressure rating, toughness and impact resistance follow the base steel grade. Laying, bending and hydrostatic testing use the same equipment as any carbon line.

承压等级、韧性与抗冲击性能取决于基层钢材牌号；布管、弯管与水压试验沿用碳钢管线常规设备。

04 A bond that stays closed

Shear strength of ≥ 210 MPa against the 137.8 MPa floor of API 5LD — headroom that keeps the interface shut through thermal shock and flattening.

结合剪切强度 ≥ 210 MPa，高于 API 5LD 的 137.8 MPa 底线；在热冲击、弯曲与压扁试验中界面始终不张开。

05 Large diameters, fewer field joints

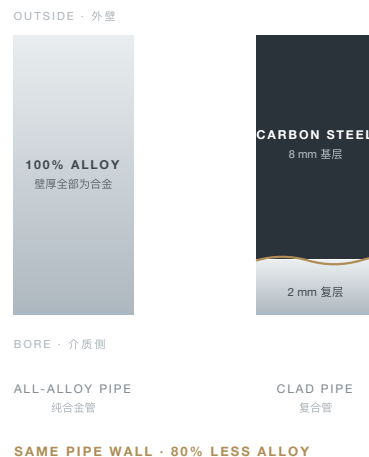
All-alloy pipe gets scarce and expensive above DN600. Clad pipe is made well past DN1200 in single lengths up to 12 m, cutting field welds and installation time.

纯合金管超过 DN600 后货源稀少、价格陡增；复合管可做到 DN1200 以上，单支长度达 12 m，显著减少现场焊口与安装工期。

06 Long life, lower carbon

Designed for 25 years and more in aggressive service. Replacing an all-alloy pipe wall with a 2 mm liner keeps tonnes of nickel and chromium out of the bill of materials.

在恶劣工况下设计寿命 25 年以上；以 2 mm 复层替代整道合金壁厚，可大幅减少镍、铬用量。



AT A GLANCE

CLAD PIPE

Alloy in the pipe wall 壁厚中合金占比	1 – 3 mm
Bond shear strength 结合剪切强度	≥ 210 MPa
Pressure rating 承压等级	Same as base steel
Operating temperature 使用温度	up to 600 °C
Design life 设计寿命	25+ years

The saving is material, not performance

Corrosion resistance is set by the alloy that touches the medium — not by how much alloy sits behind it. The liner decides the service life, the carbon steel wall decides the pressure rating.

耐蚀性能由接触介质的那层合金决定，与背后堆了多少合金无关。复层决定使用寿命，碳钢壁厚决定承压等级。

Where it runs

不锈钢复合管的应用范围

Six operating conditions, six liner choices — the pipe itself is the same product every time. Which liner you get is decided by the medium, never by the production method.

六种工况，六种复层选择——管材本身始终是同一个产品。选哪一种，由介质决定，与生产工艺无关。



APPLICATION 应用场景	WHY IT IS HARD 工况难点	RECOMMENDED 推荐配置
 Oil & Gas Gathering 油气集输管线	Sour H ₂ S and CO ₂ service — a carbon line corrodes. 含 H ₂ S、CO ₂ 酸性工况——碳钢必然腐蚀。	X65 + 316L / 825
 Subsea Flowlines & Risers 深海管线与立管	High pressure, low temperature, 25-year design life. 高压、低温、25 年设计寿命。	X65 + 625 / C-276
 Petrochemical & Refining 石化与炼化装置	Chlorides and organic acids in lines and exchangers. 工艺管线与换热器中的氯化物与有机酸。	316L / 2205 + 20G
 Desalination & Brine 海水淡化与盐卤	Chloride-rich seawater at high flow. 高流速富氯海水。	2205 + Q345R
 Power Plant Desulphurisation 电厂脱硫	Low-pH flue-gas slurry; corrosion plus abrasion. 低 pH 烟气浆液；腐蚀叠加磨损。	316L / Cr26 + Q235B
 Mining & Tailings 矿山与尾矿输送	Abrasion and corrosion together, at once. 磨损与腐蚀同时发生。	Cr26 / 316L + Q235B

Choosing the liner / 复层怎么选

304 / 316L — general corrosion, food, water and dilute acids · **2205 duplex** — chlorides, seawater and brine · **825 / 625 / C-276** — sour gas (H₂S) service, high temperature, hydrogen and CO₂ transport.

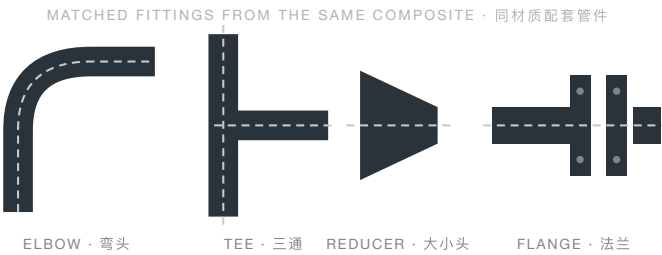
304/316L 用于一般腐蚀、食品、水与稀酸工况；2205 双相用于氯化物、海水与盐卤；825/625/C-276 用于酸性工况、高温以及输氢与碳捕集管道。

Fabricated like carbon steel pipe

复合管的加工与配套场景

Six fabrication steps, all of them ordinary line-pipe practice. Only the root weld pass changes.

六道车间工序，全部是常规管线作业——只有打底焊不同。



OPERATION	WHAT IS DONE 做法	WHAT TO WATCH 注意
Beveling 坡口加工	Machined from the carbon-steel side, leaving a small land. 从碳钢侧加工，复层上留一小段钝边。	The root weld pass must be made in alloy. 打底焊须落在合金复层上。
End overlay & sealing 管端堆焊与封端	Ends buttered with stainless or nickel filler. 管端用不锈钢或镍基焊材堆焊。	Closes alloy-to-alloy. 合金对合金闭合。
Girth welding 对接焊	Alloy filler for root and inner cap; carbon filler outside. 打底与内盖面用合金焊材，外侧用碳钢焊材。	Each weld pass follows the WPS. 每一道次按 WPS 执行。
Bending 弯管与煨弯	Cold and induction bending are both routine. 冷弯与感应煨弯均为常规工艺。	Liner on the compression side. 复层置于受压侧。
Clad fittings 复合管件	Elbows, tees and reducers from the same composite. 弯头、三通、异径管用同一复合材料。	Protection must not stop at the pipe. 防腐不能止于管材。
Field installation 现场安装	Ordinary line-pipe equipment throughout. 全程使用常规管线设备。	Only the root weld pass differs. 只有打底焊不同。

One corrosion barrier from end to end

In a clad line the fittings are the weak point: one carbon steel elbow is where corrosion starts, and the whole line eventually has to come out. We supply pipe, bends and fittings from the same composite, so the barrier runs unbroken from wellhead to storage.

复合管系统的薄弱点常在管件——一条复合管线里只要有一个碳钢弯头，腐蚀就会从那里开始，最终整条线报废。我们从管材到弯头、三通均以同一复合材料供货，防腐屏障从井口到储运全程连续。

Round, square, rectangular

复合管的截面与规格范围

One clad construction, formed into whatever section the line or the structure asks for. Round for pressure and flow; square and rectangular for structure.

同一种复合结构，可成型为管线或结构所需的任意截面：圆管承压输送，方管与矩形管用作结构。

SECTION 截面	SIZE OR FORM 尺寸与形式	WALL THICKNESS & STAINLESS FACE 壁厚与复层面	WHERE IT IS USED 典型用途
Round pipe 圆管	OD 25 – 2,134 mm 外径 25 – 2,134 mm	Wall thickness 6 – 70 mm · liner 1 – 3 mm 壁厚 6 – 70 mm · 复层 1 – 3 mm	Pressure and flow — seamless or welded 承压与输送——无缝或焊接
Square tube, SHS 方管	20 × 20 – 400 × 400 mm	Wall thickness 1.5 – 16 mm · stainless face 0.5 – 3 mm 壁厚 1.5 – 16 mm · 不锈钢面 0.5 – 3 mm	Columns, railings, support frames 立柱、栏杆、支撑框架
Rectangular tube, RHS 矩形管	20 × 40 – 300 × 500 mm	Same wall thickness and clad face range as SHS 壁厚与复层面范围同方管	Façade framing, platform beams, purlins 幕墙龙骨、平台梁、檩条
Clad fittings 复合管件	Elbows, tees, reducers, flanges, stub ends 弯头、三通、异径管、法兰、翻边短节	Cut and welded from the same composite 用同一复合材料切割焊接	Keeps the barrier unbroken 防腐屏障不断开

Supplied with every length 每支管材随附

ITEM 项目	DETAIL 说明
Pipe ends 管端	Beveled and buttered on the cladding, ready to weld 复层侧坡口并堆焊，到场即可对接
Single length 单支长度	Up to 12 m — fewer field joints 最长 12 m——减少现场焊口
Documentation 交付文件	EN 10204 3.1 or 3.2 with every shipment 每批随货提供 EN 10204 3.1 或 3.2 质保书

LINE PIPE · 管线管

API 5LD · GB/T 31940

SY/T 6623 · ASTM A928 · DNV-OS-F101

HOLLOW SECTIONS · 空心截面

GB/T 6728 · EN 10219

ASTM A554 方管与矩形管

Sizes, steel grades and standards

规格范围与执行标准

ITEM	RANGE
Cladding thickness 复层厚度	0.5 – 20 mm
Base plate thickness 基层厚度	8 – 280 mm
Total thickness 总厚度	0.8 – 300 mm by process 单面热轧 4–16 · 双面冷/热轧 0.8–12 · 爆炸 8–300
Cold-rolled thin gauge 冷轧薄规格	0.8 – 3 mm, coil or sheet 总厚 0.8–3mm, 可成卷或单张; 装饰与电梯用双面复合
Max width 最大宽度	4,000 mm · explosion bonded
Max length 最大长度	15,000 mm · explosion bonded
Single plate weight 单张重量	up to 35 t
Configuration 复合形式	Single / double-sided
Base material 基层材质	Carbon steel or stainless 碳钢或不锈钢 (如 201)
Cladding ratio 复合比例	Single-sided up to 1:3 double-sided 1:8:1 单面最大 1:3 · 双面 1:8:1
Delivery condition 交货状态	Hot rolled / annealed / pickled
Minimum order 起订量	4 tonnes per specification 每牌号 4 吨起, 可混规格拼单
Lead time 交货周期	Stock: same-day dispatch · Machining: per production · Custom melt: 30–45 days 现货最快当日发货 · 加工按实际工期 · 特殊材质定做 30–45 天

Recommended combinations

推荐组合

304 + Q235B

GENERAL · 通用型

Storage tanks, food and sugar processing equipment.
储罐、食品与制糖加工设备。

316L + Q345R

CHEMICAL · 化工型

Petrochemical, flue-gas desulphurisation and coastal plants.
石油化工、烟气脱硫与沿海工厂。

2205 + Q345R

MARINE · 海洋型

Desalination, brine service and offshore structures.
海水淡化、盐卤工况与海洋工程结构。

316L + 304 + 316L

DOUBLE-SIDED · SWAPPABLE 双面 · 可替换芯层

Faces for the corrosive medium, core for cost. Also 2205 + 201 + 2205, 304 + 201 + 304.
面层按介质、芯层按成本选材。另有 2205 + 201 + 2205、304 + 201 + 304。

Standards we manufacture to

可执行的产品标准

GB/T 8165-2025	China 中国 · effective 2026-01-01
NB/T 47002	Pressure equipment 承压
ASTM A263 / A264	USA 美国
ASME SA263 / SA264	Pressure vessels 压力容器
JIS G3601	Japan 日本
EN 10028 / PED	Europe 欧洲
GB/T 43109	Ship & offshore 船舶海工

Documentation

EN 10204 3.1 or 3.2 inspection certificate issued with every shipment, including chemical analysis, mechanical properties, UT report and shear test results.

每批随货提供 EN 10204 3.1 或 3.2 质保书, 包含化学成分、力学性能、探伤报告与剪切试验结果。

Any two metals, one plate

任意两种金属，复合为一块板

Stainless is what most customers order. It is not the limit of an explosion-welding line. Titanium, copper, aluminium, nickel alloys, zirconium, tantalum and niobium are bonded onto carbon or low-alloy steel exactly the same way: the flyer plate is accelerated into the base plate, and the oblique collision strips both surfaces and drives a wave-shaped metallurgical bond in microseconds — without melting either metal.

不锈钢复合板是我们出货最多的产品，但它不是爆炸复合的能力边界。钛、铜、铝、镍基合金、锆、钽、铌，都能用同一种方式复合到碳钢或低合金钢上：飞板加速撞击基层，斜向碰撞在微秒级清除两侧表面并形成波状冶金结合，两种金属都不熔化。

What we will not claim

我们不会承诺的

No clad plate works at any temperature. Titanium–steel stops at 350 °C and copper–steel at 200 °C because the standard says so, not because of our process. Explosion-bonded cladding is normally 3 mm and up; below 1 mm is a roll-bonded job. And passing UT is not the same as a 100% bonding rate — they are two different columns on the material certificate, and we will show you both.

没有任何复合板能在任意温度使用。钛-钢上限 350 °C、铜-钢上限 200 °C 是标准规定，不是工艺限制。爆炸复合的复层一般在 3 mm 以上，1 mm 以下要靠轧制复合。UT 合格也不等于结合率 100%：这是质保书上两栏不同的数据，我们两栏都提供。

Interlayers / 过渡层

Some pairs grow brittle intermetallics when they sit in contact at temperature — FeAl_3 and Fe_2Al_5 on aluminium–steel from about 450 °C, CuAl_2 on copper–aluminium from about 250 °C, FeTi and Fe_2Ti on titanium–steel. Explosion welding holds them back: the wavy interface leaves a transition zone under 50 μm . Where the part is afterwards annealed, rolled or given PWHT, we add the layer — pure aluminium for Al–steel, titanium for the Al–Ti–steel joint, niobium, copper or nickel for titanium–steel.

有些配对在温度下长期接触会生成脆性金属间化合物——铝-钢约 450 °C 起生成 FeAl_3 、 Fe_2Al_5 ，铜-铝约 250 °C 起生成 CuAl_2 ，钛-钢生成 FeTi 、 Fe_2Ti 。爆炸复合能抑制它们：波状界面留下的过渡区不足 50 μm 。若工件随后还要退火、轧制或焊后热处理，我们会加入过渡层——铝-钢用纯铝，铝-钛-钢用钛，钛-钢用铌、铜或镍。

Metal pairs we clad

可复合的金属配对（抗剪为所引标准的最低门槛）

METAL PAIR	CLADDING STEEL GRADES	SHEAR STRENGTH – STANDARD MIN.	MAX SERVICE TEMP
Titanium – steel 钛-钢	TA1 / TA2 / TA9 / TA10 (Gr1, Gr2, Gr7, Gr12)	≥196 MPa (Cl.0) ≥140 MPa (Cl.1–2) GB/T 8547-2019	≤350 °C GB/T 4732.2
Titanium – stainless 钛-不锈钢	TA1 / TA2 / TA9 (Gr1, Gr2)	GB/T 8546-2017	≤350 °C
Copper & copper alloy – steel 铜及铜合金-钢	T2 / TP2 / TU1 / B10 / B30 / H62	≥100 MPa GB/T 13238 · NB/T 47002.4	≤200 °C GB/T 4732.2
Aluminium – steel (STJ) 铝-钢 (STJ)	1060 / 3A21 / 5083 + pure-Al interlayer	Per project spec 依工艺，按实测区间	<300 °C
Aluminium – titanium – steel (STJ) 铝-钛-钢 (STJ)	5083 / 3A21 + TA2 2 mm + hull steel	CB 1343-1998	≤450 °C
Nickel & nickel-base – steel 镍及镍基合金-钢	N6 / N04400 / N06600 / N06625 / N08825 / N10276	≥210 MPa NB/T 47002.2 · ASTM A265 ≥140	Per base metal 依基层牌号
Zirconium – steel 锆-钢	R60702 (Zr702) / R60705 (Zr705)	≥137.9 MPa ASTM B898	≤300 °C
Tantalum / niobium – steel 钽/铌-钢	Ta1 / Ta2 (R05200) · Nb (R04200)	≥137.9 MPa ASTM B898	Oxidises >300 °C 高温氧化
Copper – aluminium 铜-铝	Cu T2 / TU1 on Al 1060 / 6061 / 5083	Per project spec 依工艺，按实测区间	≤200–250 °C
Titanium – copper 钛-铜	Ti Gr1 / Gr2 on Cu T1 / T2 / C11000	≥137.9 MPa ASTM B898	By application 按工况

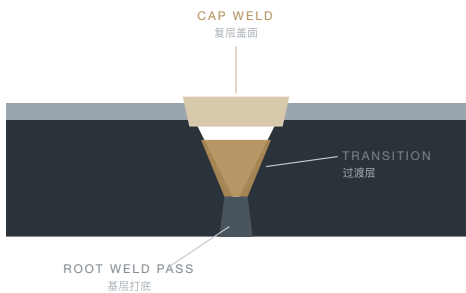
Where the result depends on the bonding process we quote a range from our plant test rather than a fixed figure. Our capacity: explosion-bonded 8–300 mm and roll-bonded 0.8–12 mm total thickness, base steel plus cladding.
结果依工艺而变的配对，我们按实测区间报价，不写死一个数字。产能：爆炸复合总厚 8–300 mm，轧制复合总厚 0.8–12 mm（均为基层+复层总厚）。

Welding the plate

复合板焊接工艺

Three weld passes, in a fixed order. Weld them out of sequence and the joint loses either its corrosion resistance or its load path.

三道焊序，顺序固定。顺序颠倒，接头要么失去耐蚀性，要么失去承载路径。



复合板对接坡口与三层焊接顺序示意

Every order can be supplied with a qualified WPS and PQR, transition-joint guidance and, where required, on-site technical assistance.

每批订单可随附经评定合格的焊接工艺规程（WPS）与工艺评定报告（PQR），提供过渡接头技术指导，必要时可安排现场技术服务。

OPERATION	FILLER 焊材	WHAT IT DOES 作用	KEY CONTROL 关键控制
Groove preparation 坡口准备	Machined so both the carbon steel and the cladding are exposed correctly. 切削坡口，使碳钢与复层都正确露出。	This is what makes the three-pass welding sequence work. 这是三层焊序能够成立的前提。	—
STEP 01 · Root & fill 道次 01 · 打底与填充	Carbon-steel filler matching the base plate. 与基层匹配的碳钢焊材。	Carries all the structural load. 承担全部结构载荷。	—
STEP 02 · Transition 道次 02 · 过渡层	A controlled buffer weld pass. 受控的过渡层焊道。	Separates carbon steel from the stainless cap and prevents carbon migration. 把碳钢与不锈钢盖面隔开，避免接头处碳迁移。	Hold heat input inside the qualified range — excess heat forms a hard, brittle zone. 热输入控制在评定范围内——热量过大会形成硬脆区。
STEP 03 · Cladding cap 道次 03 · 复层盖面	Stainless filler matching the cladding steel grade. 与复层牌号匹配的不锈钢焊材。	The weld ends up as corrosion-resistant as the plate itself. 焊缝耐蚀性与母材一致。	Stainless-only tools, brushes and wheels on the clad surface — carbon dust leaves rust spots. 复层面只用不锈钢专用工具、刷子与砂轮——碳钢粉尘会留下锈点。

Tested before it leaves our plant

出厂前的质量验证

A clad plate is only as good as its bond. Every plate is checked against the full test set — not sampled, not assumed.

复合板的好坏全看结合质量。我们发出的每一张板都经过完整的结合性能、力学性能与耐蚀性能检测，不是抽检，也不是想当然。

TEST	STANDARD 依据	WHAT IT PROVES 证明 什么
100% ultrasonic testing 全板 100% 超声波探伤	GB/T 7734 · NB/T 47013 equivalent to ASTM A578	No unbonded area beyond the specified limit. 无超出等级允许的未结合区。
Interface shear strength 界面剪切强度试验	GB/T 8165- 2025	Every heat verified — ≥250 MPa (I–II), ≥210 MPa (III). 每个炉批验证——一级/二级 ≥250、三级 ≥210 MPa。
180° side bend 180° 侧弯试验	—	No separation at the interface, no face cracks. 界面无分层，表面无裂纹。
Metallography & chemistry 金相与化学成分	—	Wave-shaped interface, no brittle phase; both layers spectro-analysed. 界面呈波状、无脆性相；复层 与基层均做光谱分析。
Intergranular corrosion 晶间腐蚀试验	GB/T 4334 · ASTM A262	Cladding resists the specified medium. 复层耐得住指定介质。

Third-party inspection

SGS, BV, TÜV or Intertek, arranged before shipment at cost.

可根据客户要求，在发货前安排 SGS、BV、TÜV 或 Intertek 第三方检验，费用另计。

Packing & shipment

包装与运输

Seaworthy packing with protective film and edge protection on the cladding. Plates are marked and bundled for container or break-bulk shipment.

复层表面覆保护膜并做边缘防护，采用适合海运的包装；按规格喷标、打捆，可配柜发运或散货发运。

Stock sizes

现货规格最快当日发货

Same day

Machining / custom

加工按实际工期；特殊材质定做 30–45 天

30–45 days

Export terms

贸易条款可协商

FOB / CIF

How far clad plate reaches 复合板能用到哪里

WHAT WORKS, AND WHERE THE LIMIT IS 适用与边界 THE RULE 规则

Vessels · tanks · absorbers · digesters

塔器 · 储罐 · 吸收塔 · 蒸发器

Alloy where the process fluid is, low-cost metal for strength.

介质处用合金，强度处用低成本金属。

Elevator cars · escalator panels · façades

电梯轿厢 · 扶梯围裙板 · 幕墙

Dry indoor decorative service — a 201 core is fine.

干燥室内装饰——可用 201 芯层。

Desalination · seawater · high-pressure service

海水淡化 · 海水全浸 · 承压工况

Vessel-grade core layer, with sealed edges.

承压级芯层并封边。

Deep-drawn thin parts · small-bore piping

深冲薄壁件 · 小口径管路

Not plate products — we will route you to the right process.

不属板材范畴——我们给出合适工艺路线。

SHANGHAI RELYON METAL MATERIALS CO., LTD.

上海瑞联易创金属材料有限公司

Let's talk about your project.

聊聊您的项目

Mr. Cui

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