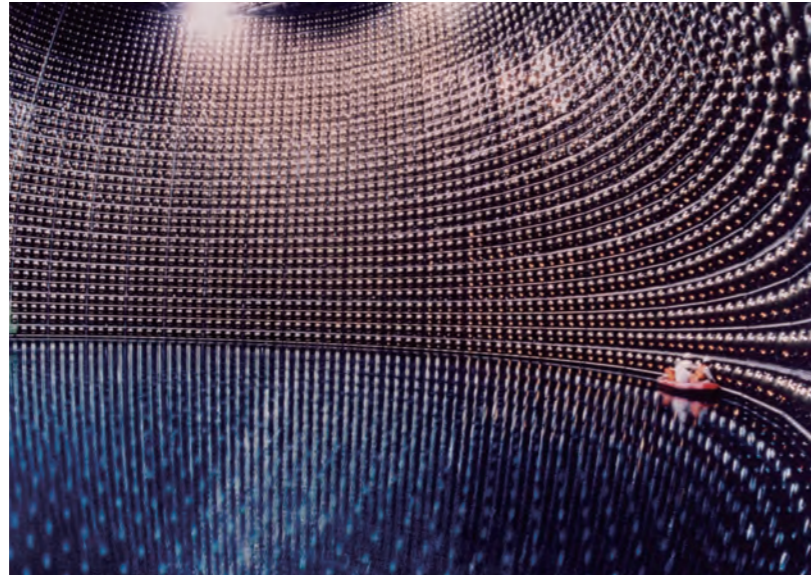
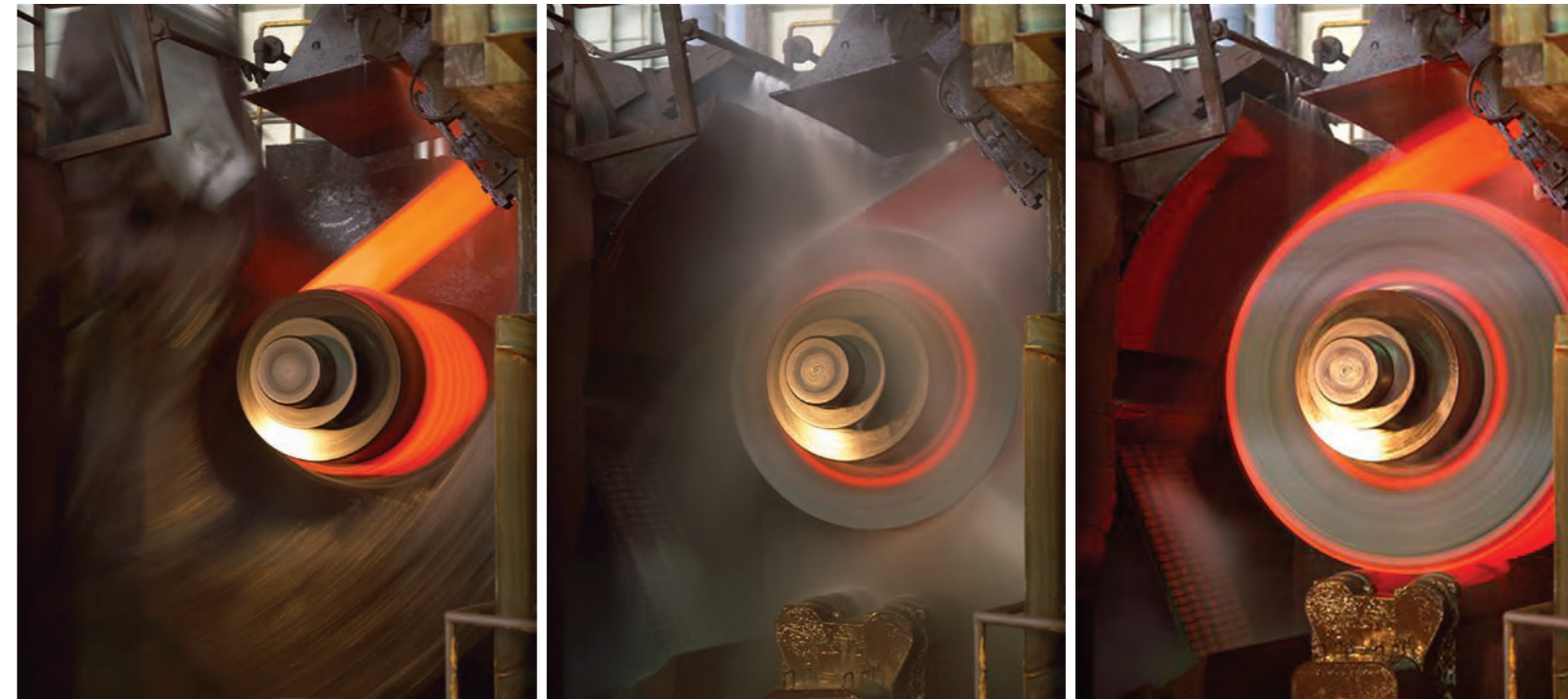


# High-performance alloy & Stainless steel NIPPON YAKIN KOGYO GROUP



Super-Kamiokande's water tank. (304 bottom plate)  
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 **Nippon Yakin Kogyo Co., Ltd.**

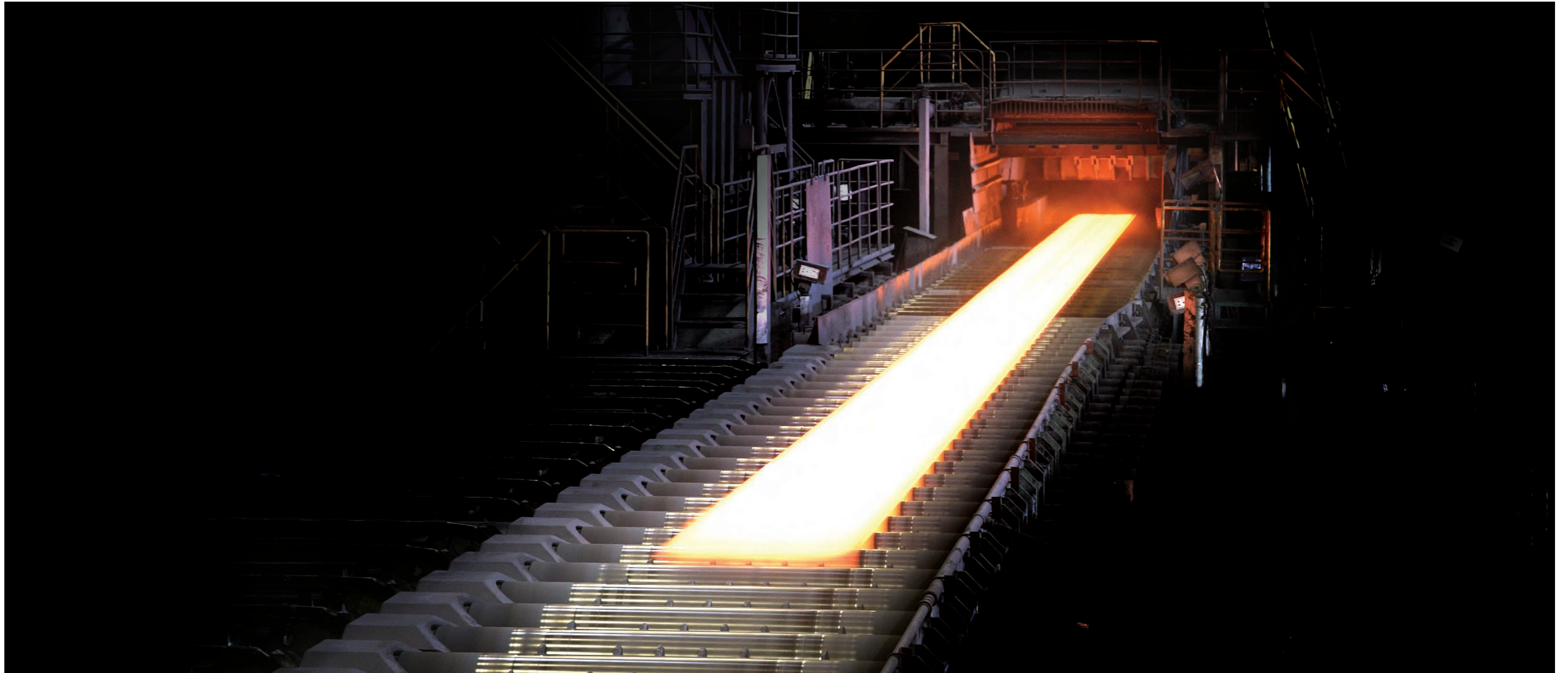
<http://www.nyk.co.jp/en/>

**Note regarding the handling of property data:**

The technical information contained in this product guide is representative values obtained in property tests and other items used to explain the performance of the product. With the exception of items specifically mentioned as provisions of a "Standard," the contents do not represent guaranteed upper limit or lower limit values. The respective data given on this technical information are typical examples and may be different in some cases from the data obtained from the actual product. No responsibility shall, therefore, be assumed for damages arising from using the technical information data. This information is also subject to change in the future without notice. To obtain the most recent information, please contact Nippon Yakin.

2019.09 ver.3

 **NIPPON YAKIN KOGYO CO., LTD.**



***Creating Novel Stainless Steels and High-Performance Alloys from a New Perspective***

***————— The Mission of Nippon Yakin Kogyo***

Nippon Yakin Kogyo was established in 1925. Since the commercialization of 18-8 stainless steel (SUS304) in 1935, the company has continued to research ways of manufacturing high-grade stainless steels and super alloys from nickel ore. Over the years, the company has systematically developed outstanding technologies and sophisticated production facilities under a comprehensive quality assurance system. And the company's products have earned a high reputation among customers.

Nippon Yakin Kogyo, as the leading stainless steel manufacturer in Japan, is now expanding confidently its business field to manufacture high-performance alloys for new applications together with conventional stainless steels aiming at a "new special stainless steel manufacturer," applying the sophisticated production technologies we have acquired through years of stainless steel manufacturing.

## Two major production bases

### Kawasaki Plant

*Excellent Research and Development Capabilities, and Outstanding Production Technologies*



Kawasaki Plant manufactures special stainless steels, Fe-Ni alloys and high Ni alloys, which are called high-performance alloys with advanced production technologies and high R&D potential. Ultra-modern facilities covering melting and refining, continuous casting, hot rolling, cold rolling are in operation, built on the core technologies of Kawasaki Plant.

### Oheyama Plant

*Manufacturing raw materials of specialty steels*



Oheyama Plant is located near the Oheyama mountain range as well as Amano Hashidate, considered one of the three most beautiful places in Japan. Oheyama Plant manufactures ferro-nickel which is an essential starting material of specialty steels for the Nippon Yakin Kogyo. By giant rotary kilns, the company smelts nickel ore from overseas to manufacture the base materials for products with better cost performance.

Kawasaki Plant

Oheyama Plant

**Core Technologies of the Nippon Yakin Kogyo Group:**

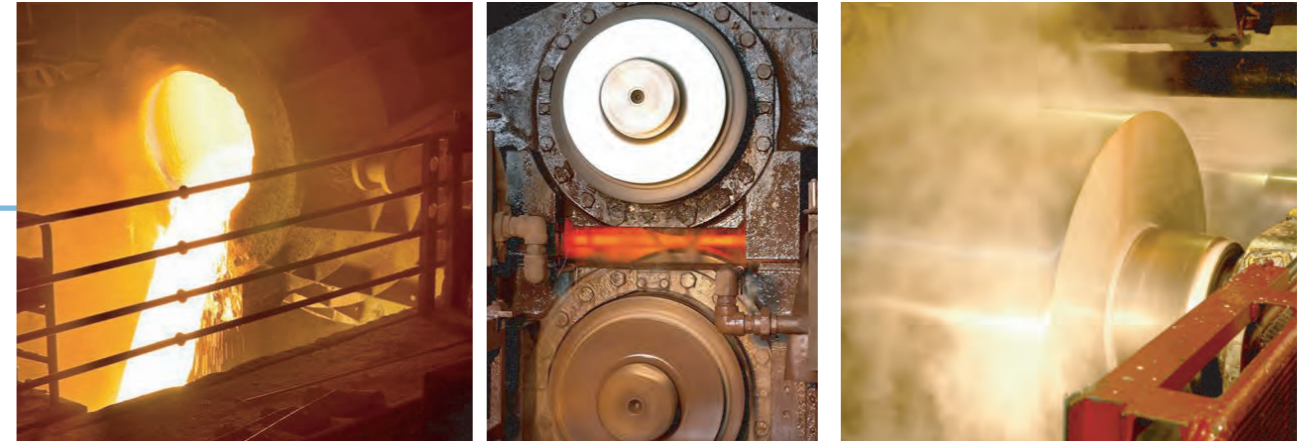
1. Refining technologies to produce ultra-clean alloys
2. Continuous casting technologies of alloy steels and high nickel alloys
3. Thermo-mechanical treatment of high nickel alloys
4. Welding of high nickel alloys
5. Technology of surface control

**Five Core Technologies for the Production of High-Performance Alloys**

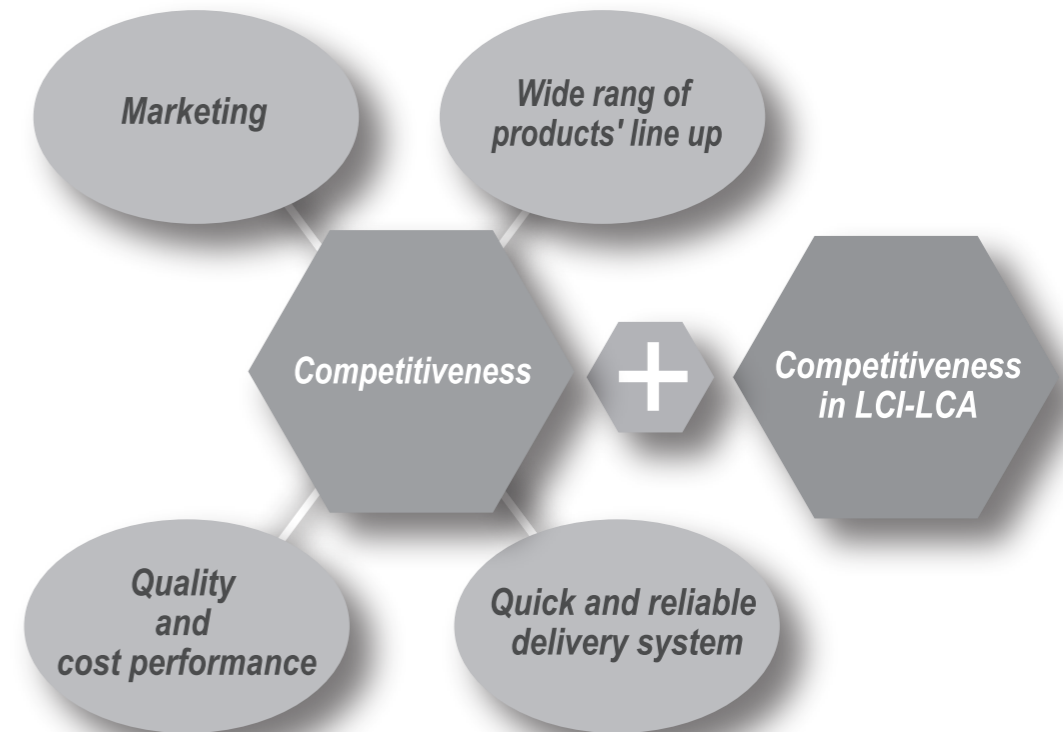
High-performance alloys are manufactured by the same facilities as those for stainless steels.

Technologies required include: refining that assures high cleanliness; casting for high Ni-alloys by a vertical continuous casting machine; thermo-mechanical treatment through hot rolling in Steckel mill; welding for practical applications of the products; and surface treatment to increase the corrosion resistance.

Together with these production technologies, various energy-saving technologies are contributing to an environmentally-sustainable society.



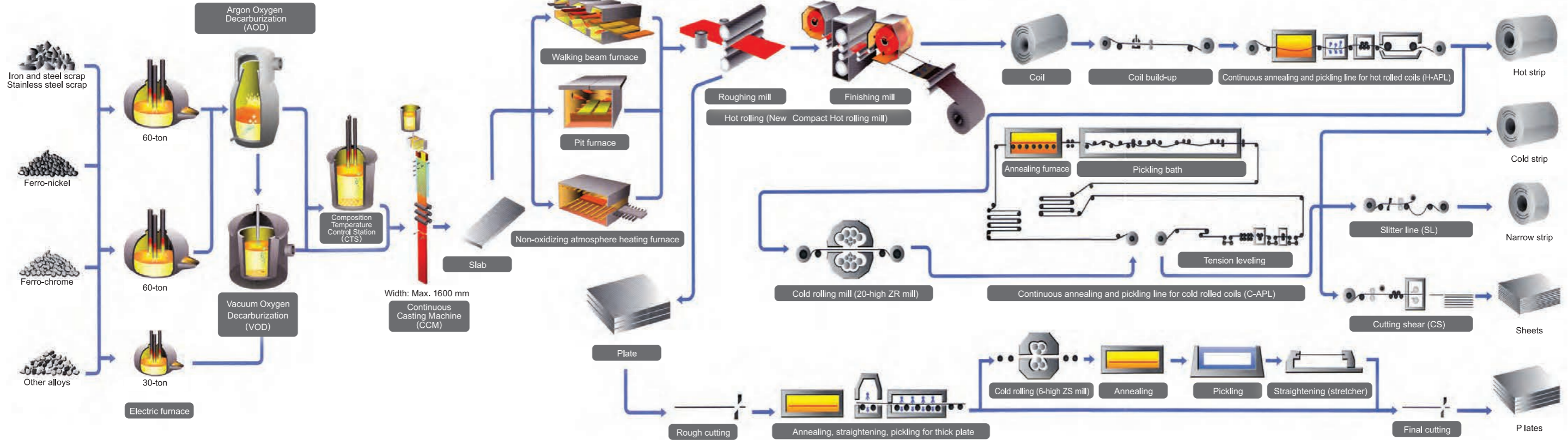
Knowledge, Experience, and Ideas — Core elements underpin all our technologies



**With supremely reliable facilities and optimized production processes, we deliver high-quality products to customers.**

The Nippon Yakin Kogyo Group is continually challenging the frontiers of technology, delivering special stainless steel products that satisfy customers' needs, and its mission to help build a creative society. Based on the concept, the Nippon Yakin Kogyo Group strives to establish and standardize production and inspection technologies that answer customers' needs, and to improve product quality.

**Flow chart of production processes**



**Argon oxygen decarburization systems (AOD)**



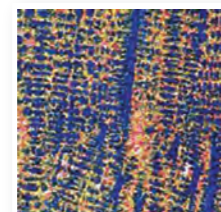
Satisfactory quality cannot be obtained by a simple process of melting and solidifying the raw materials such as scrap metals and various ores. Impurities in the raw metallic materials must be strictly controlled. To reduce and regulate the carbon, sulfur, and gas constituents which inevitably remain after controlling impurities, refining is required. It is also important to control other trace constituents and non-metallic inclusions. Our unparalleled technology for controlling non-metallic inclusions is famed worldwide, and the technology acquired the John Chipman Award from the American Iron and Steel Institute in 2002.



**Continuous casting machine**



A vertical continuous casting machine, as tall as a 7-story building, is in operation. Since high-performance alloys contain many kinds of elements, cracks tend to occur if the slab largely bends during continuous casting as it cools and solidifies. The vertical facility, however, generates no non-uniform force to the slab, making it ideal for producing high-performance alloys.



Kawasaki Plant has developed a leading-edge technology to suppress segregation, resulting in products that customers trust.

**Hot roughing mill**



Among NCH hot rolling mills, the roughing mill plays a big role. The mill performs both rough bar rolling for strip (down to 25 mm in thickness) and rolling for wide plate. The mill is equipped with edgers and a hydraulic AGC.

Optimum rolling schedule is set up by a computer for each product.

- Main specifications
- Roughing mill : 4-high reverse mill
  - Rolling force : max. 4,000 ton
  - Rolling speed : max. 314 mpm
  - Rolling-size range
  - Thickness : 6.0~220 mm
  - Width : max. 2,500 mm

**Hot finishing mill**



The finishing mill is a type capable of producing longitudinal/cross sectional, thickness, surface quality of strip. The mill allows the difficult to roll and high alloys. Hot rolling starts with slab temperatures as on the product requirements. For manufacturing high-performance alloys, we in the heating of alloys (Cr), such as the technology oxidation using a non-oxidizing atmosphere. The furnace is particularly advantageous for heating Invar alloys and soft magnetic alloys.

- Main specifications
- Finishing mill : 4 high
  - Rolling force : max. 4,000 ton
  - Rolling speed : max. 836 mpm
  - Rolling-size range
  - Thickness : 2.0~25 mm
  - Width : max. 1,600 mm

**Cold rolling mill**



Three sets of 20-high Sendzimir cold rolling mill - to meet diverse range of rolling requirements.

**Continuous annealing and pickling line**

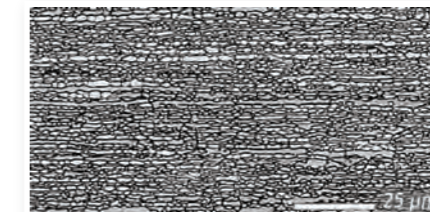


Four lines are in operation, offering a wide range of production conditions to suit the types and sizes of products. This allows us to fine tune our response to various requirements. (Photo shows No.5 Annealing and Pickling line.)

**Annealing furnace for thick plate**



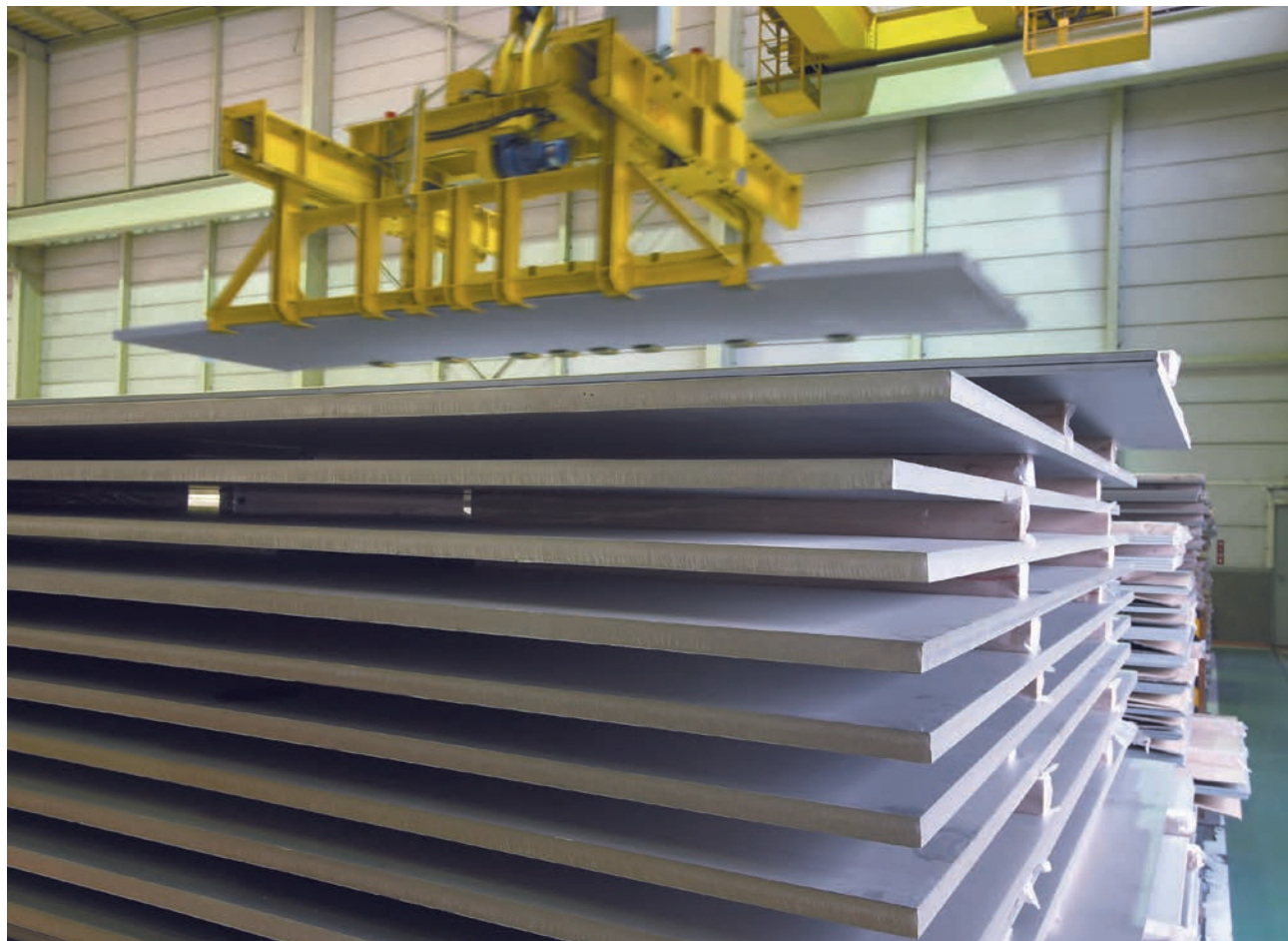
A thick plate annealing furnace conduct heat treatment under optimum conditions for products of every type and size, and supplying top-quality products.



Duplex stainless steel structure of 64 (UNS S32506), finely recrystallized by annealing



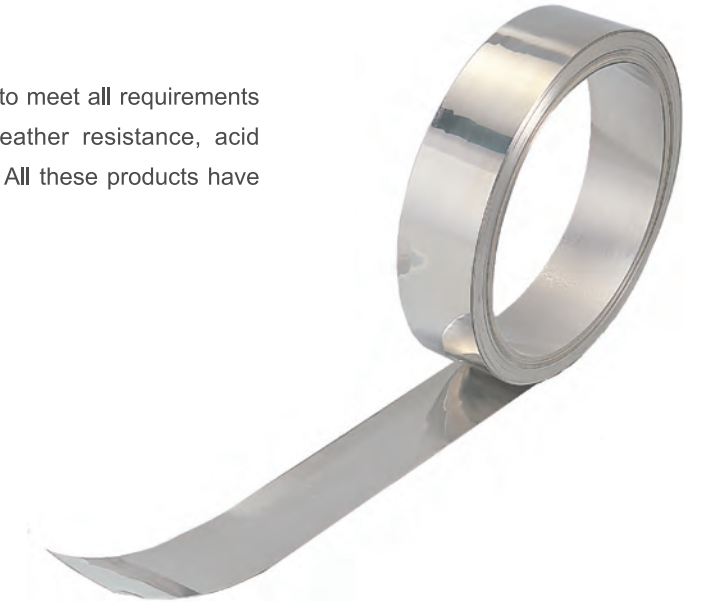
*Delivery of products in various shapes for individual needs and uses*



The all-purpose and special high-grade stainless steels of Nippon Yakin Kogyo are manufactured by an integrated production system.

The company has systematized excellent technologies and advanced production facilities, developed over many years and backed by a comprehensive quality assurance system, enabling it to offer recognized Nippon Yakin special stainless steel products to customers.

The broad range of high-quality stainless steels is sure to meet all requirements in terms of corrosion resistance, heat resistance, weather resistance, acid resistance, high strength, machinability, and formability. All these products have earned strong reputations among customers.



### Certifications for the Works

#### 1 Certifications of Japanese Industrial Standards

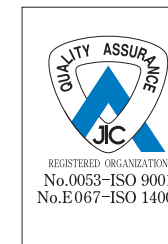
- JIS G4304 Hot rolled stainless steel plates, sheets and strip
- JIS G4305 Cold rolled stainless steel plates, sheets and strip
- JIS G4312 Heat-resisting steel plates and sheets and strip

#### 2 ISO Certifications

- JIS Q9001:2015/ISO 9001:2015
- JIS Q14001:2015/ISO 14001:2015
- JIS Q 9100:2016

#### 3 Other certifications

- Nippon Kaiji Kyokai (NK)  
Rolled stainless steel plates
- Lloyd's Register
  1. Stainless Steel Plates and Strip
  2. Fe-Ni alloys Plates and Strip
- DNV · GL  
Austenitic Stainless Steel
- BUREAU VERITAS (BV)
  1. Mode II  
(Stainless Steel Products)
  2. Stainless Steel Strips and Plates
- TÜV Rheinland
  1. AD2000-Merkblatt WO  
·Stainless Steel Strip, Plate, Sheet, Forging and Bar
  2. PED 2014/68/EU Annex I.4.3  
·Stainless Steel Strip, Sheet, Plate, Forging and Bar  
·Nickel and Nickel Alloy Strip, Sheet and Plate
- NORSOK M-650
  - NORSOK M-630 MDS D45 UNS S31803 UNS S32205 Plate, Sheet, Strip
  - NORSOK M-630 MDS D55 UNS S32750 Plate, Sheet, Strip
  - NORSOK M-630 MDS R15 UNS S31254 Plate, Sheet, Strip
  - NORSOK M-630 MDS D55 UNS S32760 Plate



Registered marking

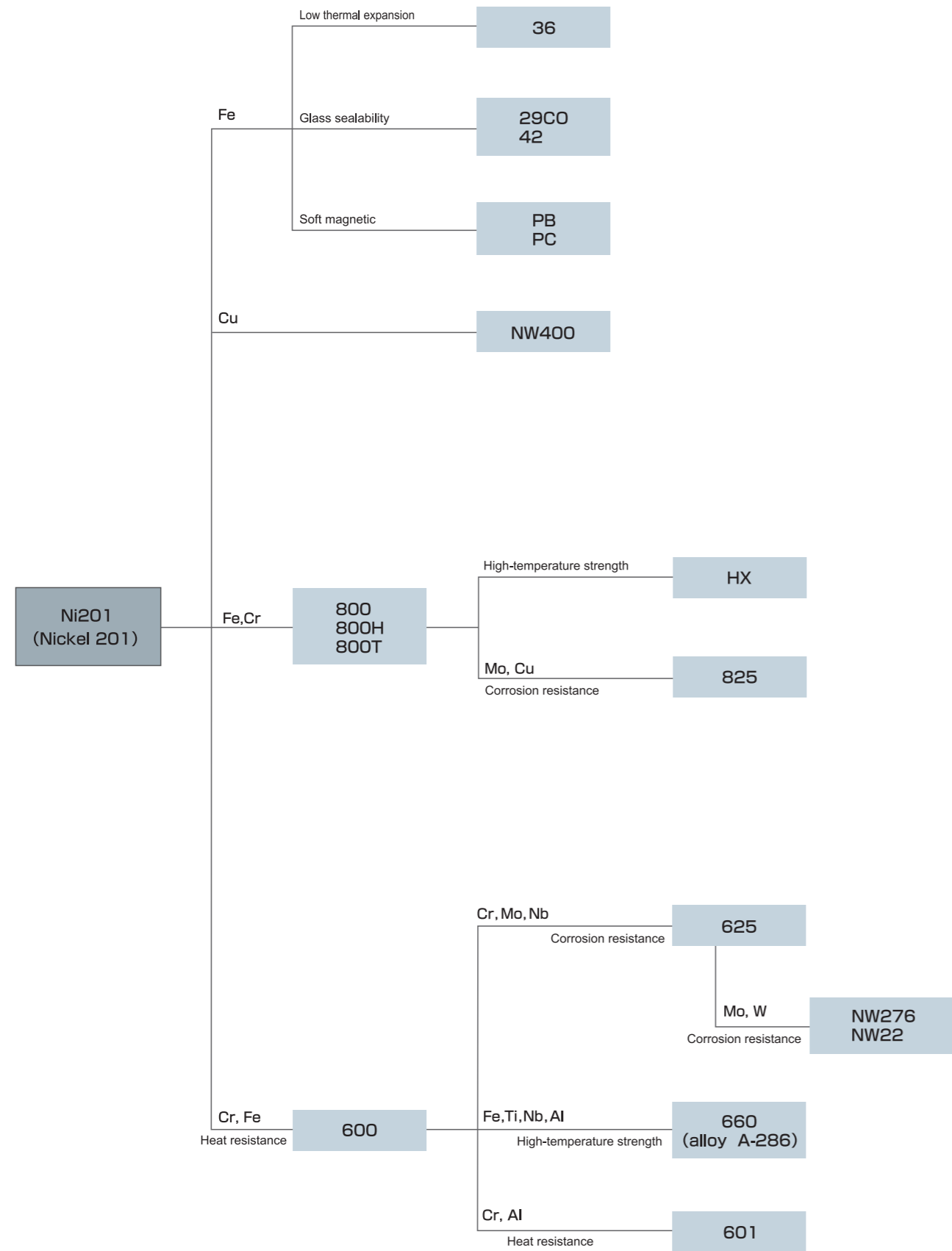


Certified marking

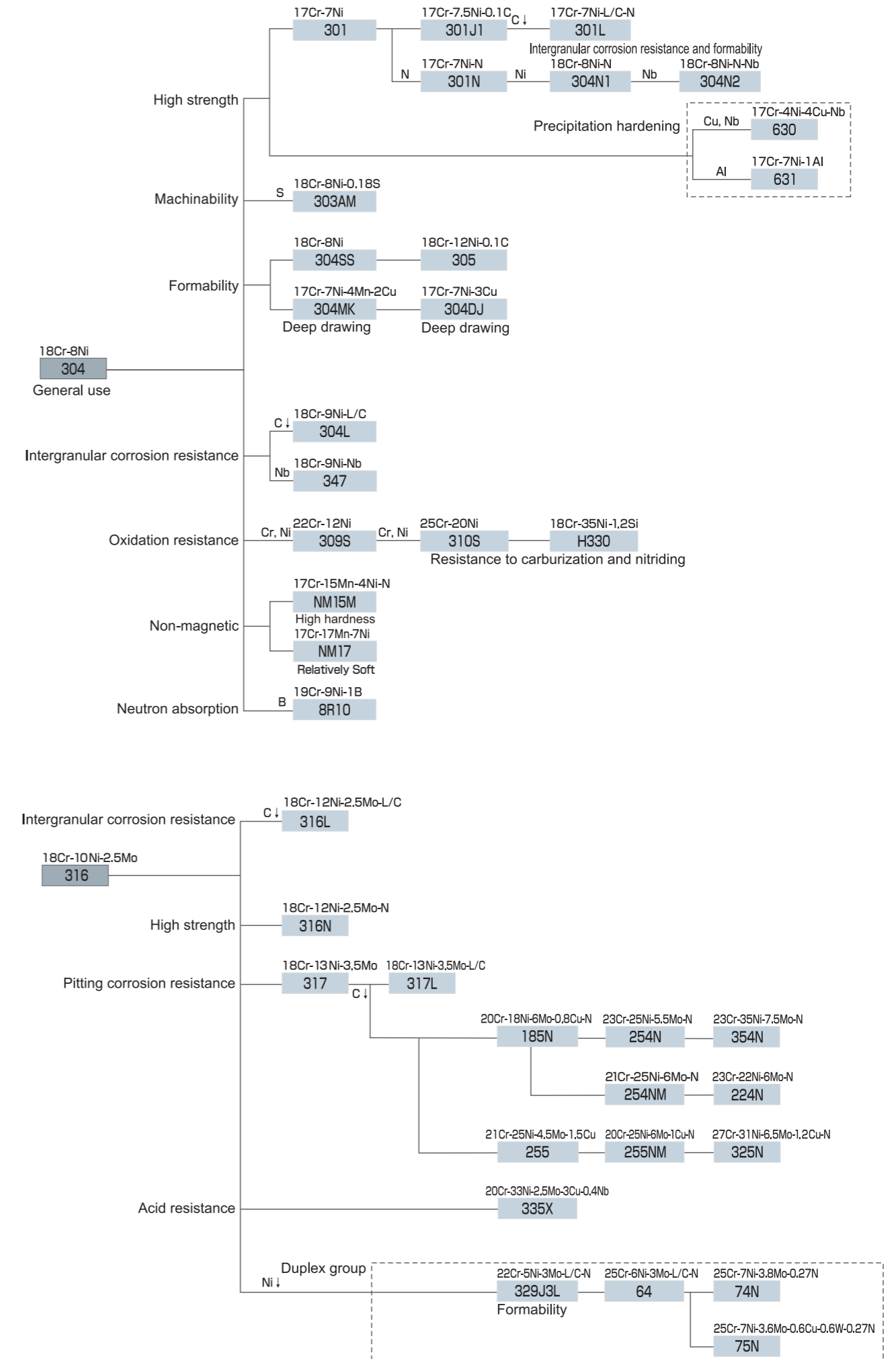
Nippon Yakin has registered company for JIS 9001:2015 and ISO 9001:2015.

Registered Scope: Design, Development, Production and Servicing of Hot Rolled Plates, Hot Rolled Strip, Cold Rolled Sheets, Cold Rolled Strip and Forged Products

## Systematic layout of high Ni alloy products



## Systematic layout of stainless steel products



# High-Performance Alloys Products Overview (grades, chemical composition, characteristics, mechanical properties)

| Type                           |                             |            |               |            |                  |           |      | Chemical composition (%) |             |           |             |             |              |           |  | Characteristics   | Mechanical properties  |                  |            |  |                   |      |                  |
|--------------------------------|-----------------------------|------------|---------------|------------|------------------|-----------|------|--------------------------|-------------|-----------|-------------|-------------|--------------|-----------|--|---|--|------------------|------------|--|-------------------|------|------------------|
| Class                          | Nippon Yakin Grade          | UNS Number | DIN/EN Number | JIS Number | Standard         |           |      | C                        | Si          | Mn        | Ni          | Cr          | Mo           | Cu        | other  |   | Yield Strength   | Tensile Strength | Elongation | Hardness   |                   |      |                  |
|                                |                             |            |               |            | ASME             | ASTM      | AMS  |                          |             |           |             |             |              |           |  |   |  |                  |            | N/mm <sup>2</sup>  | N/mm <sup>2</sup> | %    | HRB              |
| Corrosion Resistant Alloys     | 255                         | N08904     | 1.4539        | SUS890L    | SA-240/SB-625    | A240      | -    | ≤0.020                   | ≤1.00       | ≤2.00     | 23.00~28.00 | 19.00~23.00 | 4.00 ~5.00   | 1.00~2.00 | -  | Higher acid resistance than 317L  | ≥215   | ≥490             | ≥35        | ≤90  | ≤200              | ≤187 |                  |
|                                | 335X                        | N08020     | 2.4660        | -          | SA-240/SB463     | A240/B463 | -    | ≤0.070                   | ≤1.00       | ≤2.00     | 32.00~38.00 | 19.00~21.00 | 2.00 ~3.00   | 3.00~4.00 | Nb 8Xc~1.00  | High corrosion-resistant stainless steel  | ≥240   | ≥550             | ≥30        | ≤95  | -                 | ≤217 |                  |
|                                | 185N                        | S31254     | 1.4547        | SUS312L    | SA-240           | A240      | -    | ≤0.020                   | ≤0.70       | ≤1.00     | 17.50~18.50 | 19.50~20.50 | 6.00 ~6.50   | 0.50~1.00 | N 0.18~0.25  | High corrosion-resistant super stainless steel  | ≥310   | ≥655             | ≥35        | ≤96  | -                 | ≤223 |                  |
|                                | 254N                        | S32053     | -             | SUS836L    | Code Case 2445-2 | A240      | -    | ≤0.030                   | ≤1.00       | ≤1.00     | 24.00~26.00 | 22.00~24.00 | 5.00 ~6.00   | -         | N 0.17~0.22  | Super stainless Steel for high-temperature seawater (developed by Nippon Yakin Kogyo)   | ≥295   | ≥640             | ≥40        | ≤96  | ≤230              | ≤217 |                  |
|                                | 254NM                       | N08367     | -             | -          | SA-240/SB-688    | A240/B688 | -    | ≤0.030                   | ≤1.00       | ≤2.00     | 23.50~25.50 | 20.00~22.00 | 6.00 ~7.00   | -         | N 0.18~0.25  | High corrosion-resistant super stainless steel  | ≥310   | ≥655             | ≥30        | -  | -                 | ≤240 |                  |
|                                | 255NM                       | N08926     | 1.4529        | -          | SA-240/SB-625    | A240/B625 | -    | ≤0.020                   | ≤0.50       | ≤2.00     | 24.00~26.00 | 19.00~21.00 | 6.00 ~7.00   | 0.50~1.50 | N 0.15~0.25  | High corrosion-resistant super stainless steel  | ≥295   | ≥650             | ≥35        | -  | -                 | -    |                  |
|                                | 224N                        | S32050     | -             | -          | SA-240           | A240      | -    | ≤0.030                   | ≤1.00       | ≤1.50     | 20.00~23.00 | 22.00~24.00 | 6.00 ~8.00   | ≤0.40     | N 0.21~0.32  | High corrosion-resistant super stainless steel  | ≥330   | ≥675             | ≥40        | -  | -                 | ≤250 |                  |
|                                | 325N                        | N08031     | -             | -          | SB625            | B625      | -    | ≤0.015                   | ≤0.3        | ≤2.0      | 30.00~32.00 | 26.00~28.00 | 6.00 ~7.00   | 1.00~1.40 | N 0.15~0.25  | High corrosion-resistant super stainless steel  | ≥276   | ≥650             | ≥40        | -  | -                 | -    |                  |
|                                | 354N                        | N08354     | -             | NCF354     | Code Case 2585-1 | B625      | -    | ≤0.030                   | ≤1.00       | ≤1.00     | 34.00~36.00 | 22.00~24.00 | 7.00 ~8.00   | -         | N 0.17~0.24  | High corrosion-resistant super stainless steel (developed by Nippon Yakin Kogyo)  | ≥295   | ≥640             | ≥35        | ≤96  | ≤230              | ≤217 |                  |
|                                | 329J3L*                     | S32205     | 1.4462        | SUS329J3L  | SA-240           | A240      | -    | ≤0.030                   | ≤1.00       | ≤2.00     | 4.50~6.50   | 21.00~24.00 | 2.50 ~3.50   | -         | N 0.08~0.20  | High corrosion-resistant duplex stainless steel   | ≥450   | ≥620             | ≥18        | HRC≤32   | ≤320              | ≤302 |                  |
|                                | 64                          | S32506     | -             | SUS329J4L  | Code Case 2543   | A240      | -    | ≤0.030                   | ≤0.90       | ≤1.00     | 5.50~7.20   | 24.00~26.00 | 3.00 ~3.50   | -         | N 0.08~0.20, W 0.05~0.30                             | High corrosion-resistant duplex stainless steel   | ≥450   | ≥620             | ≥18        | HRC≤32   | ≤320              | ≤302 |                  |
|                                | 74N                         | S32750     | 1.4410        | SUS327L1   | SA-240           | A240      | -    | ≤0.030                   | ≤0.80       | ≤1.20     | 6.00~8.00   | 24.00~26.00 | 3.00 ~5.00   | ≤0.50     | N 0.24~0.32  | High corrosion-resistant super duplex stainless steel   | ≥550   | ≥795             | ≥15        | -  | -                 | ≤310 |                  |
|                                | 75N                         | S32760     | 1.4501        | -          | SA-240           | A240      | -    | ≤0.030                   | ≤1.00       | ≤1.00     | 6.00~8.00   | 24.00~26.00 | 3.00 ~4.00   | 0.50~1.00 | N 0.20~0.30, W 0.50~1.00                             | High corrosion-resistant super duplex stainless steel   | ≥550   | ≥750             | ≥25        | -  | -                 | ≤270 |                  |
|                                | 825                         | N08825     | 2.4858        | NCF825     | SB-424           | B424      | -    | ≤0.050                   | ≤0.50       | ≤1.00     | 38.00~46.00 | 19.50~23.50 | 2.50 ~3.50   | 1.50~3.00 | Ti 0.60~1.20 Al≤0.20                                 | High corrosion-resistant / heat resistant alloy   | ≥235   | ≥580             | ≥30        | ≤96  | ≤214              | ≤207 |                  |
|                                | 625                         | N06625     | -             | NCF625     | SB-443           | B443      | 5599 | ≤0.10                    | ≤0.50       | ≤0.50     | ≥58.00      | 20.00~23.00 | 8.00 ~10.00  | -         | Ti ≤0.40 Al≤0.40 Fe≤5.0 Co≤1.0 Nb 3.15~4.15          | High corrosion-resistant alloy  | ≥276   | ≥690             | ≥30        | -  | -                 | -    |                  |
|                                | NW22                        | N06022     | 2.4602        | NW6022     | SB-575           | B575      | -    | ≤0.015                   | ≤0.08       | ≤0.50     | Bal         | 20.00~22.50 | 12.50 ~14.50 | -         | Fe 2.0~6.0, W 2.5~3.5, V ≤0.35, Co ≤2.5              | Acid-resistant alloy (for hydrochloric acid, sulfuric acid, phosphoric acid, chloride, etc.) also used as a heat-resistant alloy. | ≥240   | ≥660             | ≥35        | -  | -                 | -    |                  |
|                                | NW276                       | N10276     | 2.4819        | NW0276     | SB-575           | B575      | -    | ≤0.010                   | ≤0.08       | ≤1.00     | Bal         | 14.50~16.50 | 15.0 ~17.0   | -         | Co ≤2.5, Fe ≤4.0~7.0, W 3.0~4.5, V ≤0.35             | Acid-resistant alloy (for hydrochloric acid, sulfuric acid, phosphoric acid, chloride, etc.) also used as a heat-resistant alloy. | ≥275   | ≥690             | ≥40        | -  | -                 | -    |                  |
|                                | NW400                       | N04400     | -             | NW4400     | SB-127           | B127      | 4544 | ≤0.30                    | ≤0.5        | ≤2.0      | ≥63.0       | -           | -            | 28.0~34.0 | Fe ≤2.5  | High corrosion-resistant Ni-Cu alloy, resistant to sea water  | ≥195   | ≥480             | ≥35        | -  | -                 | -    |                  |
| Heat Resistant Alloys          | H330                        | N08330     | -             | -          | SB-536           | B536      | -    | ≤0.08                    | 0.75~1.50   | ≤2.00     | 34.0~37.0   | 17.0~20.0   | -            | ≤1.00     | Pb ≤0.005 Sn ≤0.025                                  | Good high-temperature strength, good oxidation resistance   | ≥207   | ≥483             | ≥30        | 70~90  | -                 | -    |                  |
|                                | 800                         | N08800     | 1.4876        | NCF800     | SB-409           | B409      | 5871 | ≤0.10                    | ≤1.00       | ≤1.50     | 30.00~35.00 | 19.00~23.00 | -            | ≤0.75     | Ti 0.15~0.60, Al 0.15~0.60                           | Good high-temperature strength, good oxidation resistance   | ≥205   | ≥520             | ≥30        | ≤89  | ≤182              | ≤179 |                  |
|                                | 800H                        | N08810     | 1.4876        | NCF800H    | SB-409           | B409      | -    | 0.06~0.10                | ≤1.00       | ≤1.50     | 30.00~35.00 | 19.00~23.00 | -            | ≤0.75     | Ti 0.15~0.60, Al 0.15~0.60, Fe ≥39.5                 | Good high-temperature strength, good oxidation resistance   | ≥175   | ≥450             | ≥30        | ≤86  | ≤171              | ≤167 |                  |
|                                | 800T                        | N08811     | 1.4876        | -          | SB-409           | B409      | -    | 0.06~0.10                | ≤1.00       | ≤1.50     | 30.00~35.00 | 19.00~23.00 | -            | ≤0.75     | Ti 0.15~0.60, Al 0.15~0.60, Fe ≥39.5                 | Good high-temperature strength, good oxidation resistance   | ≥175   | ≥450             | ≥30        | -  | -                 | -    |                  |
|                                | H840                        | -          | -             | -          | -                | -         | -    | ≤0.08                    | ≤1.00       | ≤1.00     | 18.00~22.00 | 18.00~22.00 | -            | -         | Ti 0.15~0.60, Al 0.15~0.60                           | Good high-temperature strength, good oxidation resistance   | ≥170   | ≥485             | ≥30        | ≤92  | -                 | -    |                  |
|                                | H880                        | -          | -             | -          | -                | -         | -    | ≤0.030                   | 0.30~0.50   | 0.35~0.65 | 24.50~27.00 | 22.80~23.90 | 1.15~1.35    | ≤0.25     | Al 0.20~0.40, Ti 0.25~0.45, Co 0.05~1.00, Nb ≤0.02   | High heat resistant / corrosion resistant alloy (developed by Nippon Yakin Kogyo)   | ≥205   | ≥520             | ≥30        | -  | -                 | -    |                  |
|                                | 600                         | N06600     | 2.4816        | NCF600     | SB-168           | B168      | 5540 | ≤0.15                    | ≤0.50       | ≤1.00     | ≥72.00      | 14.00~17.00 | -            | ≤0.50     | Fe 6.00~10.00  | Excellent high-temperature strength, good high-temperature corrosion resistance   | ≥245   | ≥550             | ≥30        | ≤89  | ≤182              | ≤179 |                  |
|                                | 601                         | N06601     | 2.4851        | NCF601     | SB-168           | B168      | 5870 | ≤0.10                    | ≤0.50       | ≤1.00     | 58.00~63.00 | 21.00~25.00 | -            | ≤1.00     | Al 1.00~1.70   | Excellent high-temperature strength, good high-temperature corrosion resistance   | ≥195   | ≥550             | ≥30        | -  | -                 | -    |                  |
| High-strength Stainless Steels | 660                         | S66286     | -             | SUH660     | -                | -         | 5525 | ≤0.08                    | ≤1.00       | ≤2.00     | 24.00~27.00 | 13.50~16.00 | 1.00 ~1.50   | -         | Ti 1.90~2.35, V 0.10~0.50<br>Al ≤0.35, B 0.001~0.010 | Precipitation hardening austenitic steel  | S  | -                | ≥730       | ≥25  | ≤91               | ≤202 | ≤192             |
|                                | HX                          | N06002     | 2.4665        | NW6002     | SB-435           | B435      | 5536 | 0.05~0.15                | ≤1.00       | ≤1.00     | Bal         | 20.50~23.00 | 8.00 ~10.00  | -         | Fe 17.00~20.00, Co 0.5~2.5, W 0.2~1.0                | Excellent high-temperature strength, excellent oxidation resistance   | ≥240   | ≥655             | ≥35        | -  | -                 | -    |                  |
|                                | 630                         | S17400     | 1.4542        | SUS630     | SA-693           | A693      | -    | ≤0.07                    | ≤1.00       | ≤1.00     | 3.00~5.00   | 15.00~17.50 | -            | 3.00~5.00 | Nb 0.15~0.45   | Precipitation hardening martensitic steel, for steel belt   | H900 treatment   | ≥1175            | ≥1310      | ≥5   | HRC ≥40           | ≥375 | -                |
| Controlled Expansion Alloys    | 631                         | S17700     | 1.4568        | SUS631     | SA-693           | A693      | 5528 | ≤0.09                    | ≤1.00       | ≤1.00     | 6.50~7.75   | 16.00~18.00 | -            | -         | Al 0.75~1.50   | Precipitation hardening martensitic steel, having cold formability and cold work-hardening ability                                | S  | ≥380             | ≤1030      | ≥20  | ≤92               | ≤200 | ≤192             |
|                                | XM-19                       | S20910     | -             | -          | SA-240           | A240      | -    | ≤0.06                    | ≤0.75       | 4.00~6.00 | 11.50~13.50 | 20.50~23.50 | 1.50~3.00    | -         | Nb 0.10~0.30, V 0.10~0.30, N 0.20~0.40               | High corrosion resistance; High strength  | ≥380   | ≥690             | ≥35        | ≤100   | -                 | ≤241 |                  |
|                                |                             |            |               |            |                  |           |      |                          |             |           |             |             |              |           |  |   |  |                  |            |  |                   |      | TH1050 treatment |
| Soft Magnetic Alloys           | PB                          | -          | 1.3920        | -          | -                | -         | -    | ≤0.05                    | ≤0.50       | ≤0.80     | 45.0~49.0   | -           | -            | -         | -  | Soft-magnetic material  | -  | -                | -          | -  | -                 | -    |                  |
|                                | PC                          | -          | 2.4530        | -          | -                | -         | -    | ≤0.05                    | ≤0.50       | ≤1.5      | 75~80       | ≤0.30       | 3 ~ 5        | 1.0~6.0   | -  | Soft-magnetic material  | -  | -                | -          | -  | -                 | -    |                  |
|                                | Ni                          | Ni201      | N02201        | 2.4068     | NW2201           | SB-162    | B162 | 5553                     | ≤0.02       | ≤0.3      | ≤0.3        | ≥99.0       | -            | -         | ≤0.2   | Fe ≤0.4   | High corrosion resistance to high temperature and high concentration of alkali, chlorine gas, etc. | ≥80              | ≥345       | ≥30 (thicker than 0.5 and not thicker than 1.2)<br>≥35 (thicker than 1.2 and not thicker than 2.7) | -                 | -    | -                |
|                                | Neutron Absorption Material | 8R10       | -             | -          | -                | -         | -    | -                        | ≤0.08       | ≤1.00     | ≤2.00       | 8.00~10.50  | 18.00~20.00  | -         | -  | B 1.00~1.25   | Neutron absorption material (developed by Nippon Yakin Kogyo)                                      | ≥205             | ≥520       | ≥10  | ≤100              | -    | -                |
|                                |                             | NM15M      | -             | -          | -                | -         | -    | -                        | 0.040~0.090 | ≤0.90     | 14.00~15.00 | 4.00~4.60   | 16.50~17.50  | -         | -  | N 0.30~0.35   | Outstanding non-magnetization even under high degree of working (developed by Nippon Yakin Kogyo)  | ≥390             | ≥690       | ≥30  | ≤98               | ≤228 | ≤228             |
|                                | Non-Magnetic Material       | NM17       | -             | -          | -                | -         | -    | -                        | ≤0.10       | ≤1.00     | 16.00~17.00 | 7.00~8.00   | 16.00~18.00  | -         | -  | N ≤0.20   | Nonmagnetic soft stainless steel (developed by Nippon Yakin Kogyo)                                 | ≥250             | ≥550       | ≥40  | -                 | ≥180 | -                |

\*329J3L can be also used as S31803



## Stainless Steel Products Overview (grades, chemical composition, characteristics, mechanical properties)

| Type                       |                                    |                        |          | Chemical Composition (%) |           |           |             |             |             |            |            | Characteristics   | Mechanical properties  |                   |            |          |      |      |      |
|----------------------------|------------------------------------|------------------------|----------|--------------------------|-----------|-----------|-------------|-------------|-------------|------------|------------|---|--|-------------------|------------|----------|------|------|------|
| Class                      | Nippon Yakin Grade                 | Corresponding Standard |          | C                        | Si        | Mn        | Ni          | Cr          | Mo          | Cu         | Other      |   | Yield Strength   | Tensile Strength  | Elongation | Hardness |      |      |      |
|                            |                                    | JIS                    | AISI     |                          |           |           |             |             |             |            |            |   | N/mm <sup>2</sup>  | N/mm <sup>2</sup> | %          | HRB      | HV   | HB   |      |
| Austenitic Stainless Steel | Standard Type                      | 301                    | SUS301   | 301                      | ≤0.15     | ≤1.00     | ≤2.00       | 6.00~8.00   | 16.00~18.00 | -          | -          | -   | Room temperature strength and work hardenability are better than 304.  | ≥205              | ≥520       | ≥40      | ≤95  | ≤218 | ≤207 |
|                            |                                    | 304                    | SUS304   | 304                      | ≤0.08     | ≤1.00     | ≤2.00       | 8.00~10.50  | 18.00~20.00 | -          | -          | -   | General corrosion resistance   | ≥205              | ≥520       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            |                                    | 305                    | SUS305   | 305                      | ≤0.12     | ≤1.00     | ≤2.00       | 10.50~13.00 | 17.00~19.00 | -          | -          | -   | 304 + cold workability (non-magnetic)  | ≥175              | ≥480       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            |                                    | 316                    | SUS316   | 316                      | ≤0.08     | ≤1.00     | ≤2.00       | 10.00~14.00 | 16.00~18.00 | 2.00 ~3.00 | -          | -   | Corrosion resistance and pitting corrosion resistance to diluted sulfuric acid, sulfurous acid, acetic acid, and various organic acids | ≥205              | ≥520       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            |                                    | 317                    | SUS317   | 317                      | ≤0.08     | ≤1.00     | ≤2.00       | 11.00~15.00 | 18.00~20.00 | 3.00 ~4.00 | -          | -   | Better corrosion resistance than 316   | ≥205              | ≥520       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            | Intergranular Corrosion Resistance | 301L                   | SUS301L  | -                        | ≤0.030    | ≤1.00     | ≤2.00       | 6.00~8.00   | 16.00~18.00 | -          | -          | N≤0.20  | 301 + corrosion resistance   | ≥215              | ≥550       | ≥45      | ≤95  | ≤218 | ≤207 |
|                            |                                    | 304L                   | SUS304L  | 304L                     | ≤0.030    | ≤1.00     | ≤2.00       | 9.00~13.00  | 18.00~20.00 | -          | -          | -   | 304 + resistance to intergranular corrosion  | ≥175              | ≥480       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            |                                    | 347                    | SUS347   | 347                      | ≤0.08     | ≤1.00     | ≤2.00       | 9.00~13.00  | 17.00~19.00 | -          | -          | Nb≥10xC   | 304 + resistance to intergranular corrosion; also used at high temperatures up to 650°C  | ≥205              | ≥520       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            |                                    | 316L                   | SUS316L  | 316L                     | ≤0.030    | ≤1.00     | ≤2.00       | 12.00~15.00 | 16.00~18.00 | 2.00 ~3.00 | -          | -   | 316 + resistance to intergranular corrosion  | ≥175              | ≥480       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            |                                    | 317L                   | SUS317L  | 317L                     | ≤0.030    | ≤1.00     | ≤2.00       | 11.00~15.00 | 18.00~20.00 | 3.00 ~4.00 | -          | -   | 317 + resistance to intergranular corrosion  | ≥175              | ≥480       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            | For Forming                        | 304MK                  | SUS304J2 | -                        | ≤0.030    | ≤1.00     | 3.60~5.00   | 6.50~8.00   | 15.50~17.00 | -          | 1.50 ~2.00 | -   | Deep drawing steel; equivalent to corrosion resistance 304 (developed by Nippon Yakin Kogyo)   | 155~255           | 450~600    | ≥55      | ≤80  | ≤155 | ≤187 |
|                            |                                    | 304DJ                  | SUS304J1 | -                        | 0.04~0.08 | ≤1.70     | ≤3.00       | 6.50~7.50   | 16.00~18.00 | -          | 2.00 ~3.00 | -   | For deep drawing and stretch forming   | ≥155              | ≥450       | ≥55      | ≤90  | ≤200 | ≤187 |
|                            |                                    | 304SS                  | SUS304   | 304                      | ≤0.08     | ≤1.00     | ≤2.00       | 8.00~10.50  | 18.00~20.00 | -          | -          | -   | For deep drawing and stretch forming   | ≥205              | ≥520       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            | Free-Machining                     | 303AM                  | SUS303   | 303                      | ≤0.08     | ≤1.00     | ≤2.00       | 8.00~10.00  | 18.00~19.00 | -          | -          | S≥0.15  | 304 + free-machining ability   | ≥205              | ≥520       | ≥40      | ≤90  | ≤200 | ≤187 |
|                            | High Strength                      | 301N                   | (SUS301) | -                        | ≤0.15     | 0.80~1.00 | ≤2.00       | 6.00~8.00   | 16.00~18.00 | -          | -          | N 0.03~0.07   | 301 + high strength  | ≥245              | ≥690       | ≥30      | ≤95  | ≤220 | -    |
|                            |                                    | 304N2                  | SUS304N2 | -                        | ≤0.08     | ≤1.00     | ≤2.50       | 7.50~10.50  | 18.00~20.00 | -          | -          | N 0.15~0.30Nb≤0.15  | 304 + high strength  | ≥345              | ≥690       | ≥35      | ≤100 | ≤260 | ≤248 |
| Heat Resistance            | 309S                               | SUS309S                | 309S     | ≤0.08                    | ≤1.00     | ≤2.00     | 12.00~15.00 | 22.00~24.00 | -           | -          | -          | Formability and weldability are better than SUH309; used also as acid-resistant steel | ≥205   | ≥520              | ≥40        | ≤90      | ≤200 | ≤187 |      |
|                            | 310S                               | SUS310S                | 310S     | ≤0.08                    | ≤1.50     | ≤2.00     | 19.00~22.00 | 24.00~26.00 | -           | -          | -          | Formability and weldability are better than SUH310; used also as acid-resistant steel | ≥205   | ≥520              | ≥40        | ≤90      | ≤200 | ≤187 |      |

**High-performance alloys for various uses**  
**Resembling each other in appearance and shape with different performances**



Materials used in our surroundings, such as metals and alloys, generate particular reactions according to external stimulations.

These reactions are manifested in changes in appearance or touch, such as hard, cool, rust-free, magnetic, or non-magnetic.

The reactions are examples of the functionality of materials. High-performance alloys feature distinctive functions that are inherent to the materials themselves.

Even if we cannot observe or feel their functions, high-performance alloys offer advanced electric, magnetic or radiation-shielding properties.

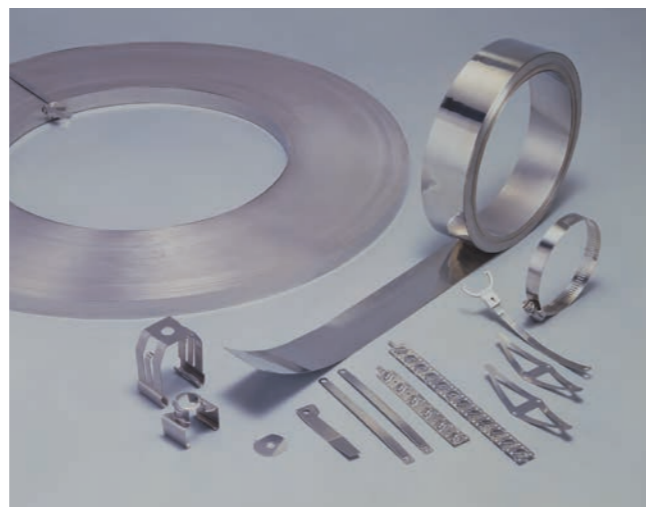
**Electronic parts**  
**/Precision machinery parts**

▲ Buzzers used in telephones, various household electric appliances, and office equipments use the flexural oscillation of a diaphragm as the sound source. The diaphragm is fabricated by laminating a piezoelectric element and a metallic sheet.

The flexural oscillation is induced by the driving force of a magnetic field which is created by a magnet, thus generating sound.

Soft magnetic materials, such as 42 and PB are best suited for the diaphragm.

▼ The material on the high thermal expansion side of the bimetal is 21-6, 22-3, and 206MN, while that on the low thermal expansion side is 36.



**Environment**



▲ The desulfurization unit is auxiliary facilities of thermal power plants designed to prevent air pollution. In the flue gas desulfurization unit at coal fired power generation plants, chlorine in the fuel condenses to create a corrosive environment of high concentration chloride. In environments where the chlorine ion concentration exceeds 10,000 ppm, the super stainless steels 254NM and 74N, and highly corrosion-resistant Ni alloys NW276 and NW22 are used to reduce the cost and to extend the service life of the unit.

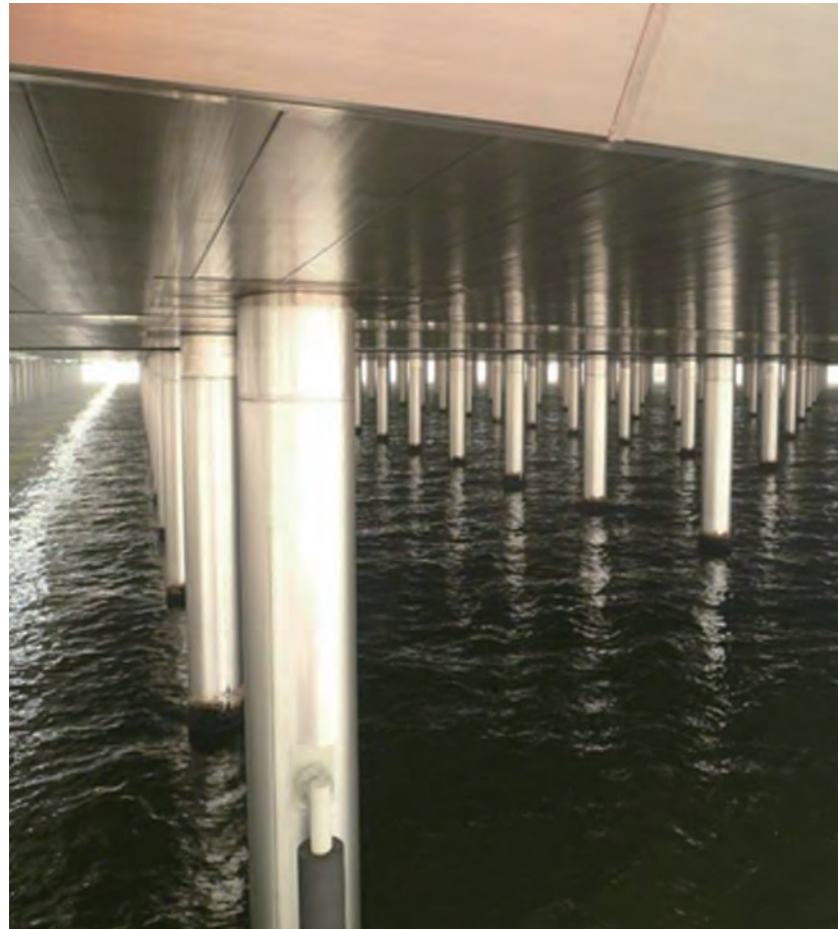
▼ Kiln for Waste Incineration

There are various activities currently pursued to utilize gas, that is produced from waste incineration plants by the carbonization and gasification of wastes contained carbon or hydrogen, for power generation. Our product, 800H, that has excellent heat resistance property has been used to the body section of the kiln for such waste incineration plants.



## High-performance alloys for various uses

Resembling each other in appearance and shape with different performances



### Marine steel structures 1

185N and 354N were used as overlay material at the pier of D runway of Tokyo Haneda Airport. These stainless steels are so called super stainless steel containing a large amount of Cr, Ni, Mo, and N, and have excellent corrosion resistance. These super stainless steels were adopted from the viewpoint of securing long-term corrosion resistance to seawater considering the LCC necessary for the piers of the marine runway. This application case won the ISSF 2015 New Applications Award.



### Marine steel structures 2

Since marine steel structures are exposed to harsh environments, super stainless steels which contain rich amounts of Cr, Ni, Mo, and N are used instead of standard grade stainless steels.

245N developed by Nippon Yakin Kogyo shows high cost performance during its life cycle for marine steel structures, providing excellent corrosion resistance, long service life and easy maintenance.

The overlay is generally constructed by welding or bolting. 254N is applicable to both methods.



### Energy

LNG tankers are an essential means of transporting natural gas by sea from the country of production.

An LNG tanker, which stores liquefied natural gas at very low temperature, has a tank structure capable of holding very low temperatures and providing thermal insulation to minimize vaporization of the gas.

36LG, which was developed for the lining of box-shaped membrane tanks, suppresses the thermal stress caused by temperature variations as it has a very low coefficient of thermal expansion.

36LG plays an important role in the safe transportation of liquefied natural gas.

### Chemical Industry

Caustic soda ( which is a material for soap ), and chlorine ( which is used in chloride compounds ) are basic materials supporting everyday life, and are electrolytically produced by decomposing brine(salt water).

In this photograph, Nippon Yakin's pure nickel plate Ni201 is used in the cathode of the electrolytic cell for this production process.

This pure-Ni plate, which Nippon Yakin began supplying less than 20 years ago, is the widely used by chemical manufacturers, not only in Japan but in other countries around the world, and is one example of the international recognition of this company's outstanding technologies.





▲Soy sauce fermentation tanks

### Food processing plants

"Soy sauce fermentation tank" (Photo: top)  
 In the past, soy sauce fermentation tanks were lined with resin or FRP. To reduce maintenance and operational cost, however, these tanks have been recently replaced by super stainless steel tanks.

Since soy sauce contains very high concentrations of salt, standard grade stainless steels would suffer pitting corrosion, crevice corrosion, and stress corrosion cracking. Super stainless steel, however, offers excellent corrosion resistance even under such severe environments.

"Salt mirin tank" (Japanese traditional seasoning) (Photo: left)

Standard grade stainless steels have been used for tanks for brewing beer and wine which do not contain salt and which are processed at relatively low temperature. However, the tanks for seasoning which contains large quantities of chloride are exposed to a severe corrosive environment owing to the reduction in pH and the increase in temperature, so standard grade stainless steel cannot be used.

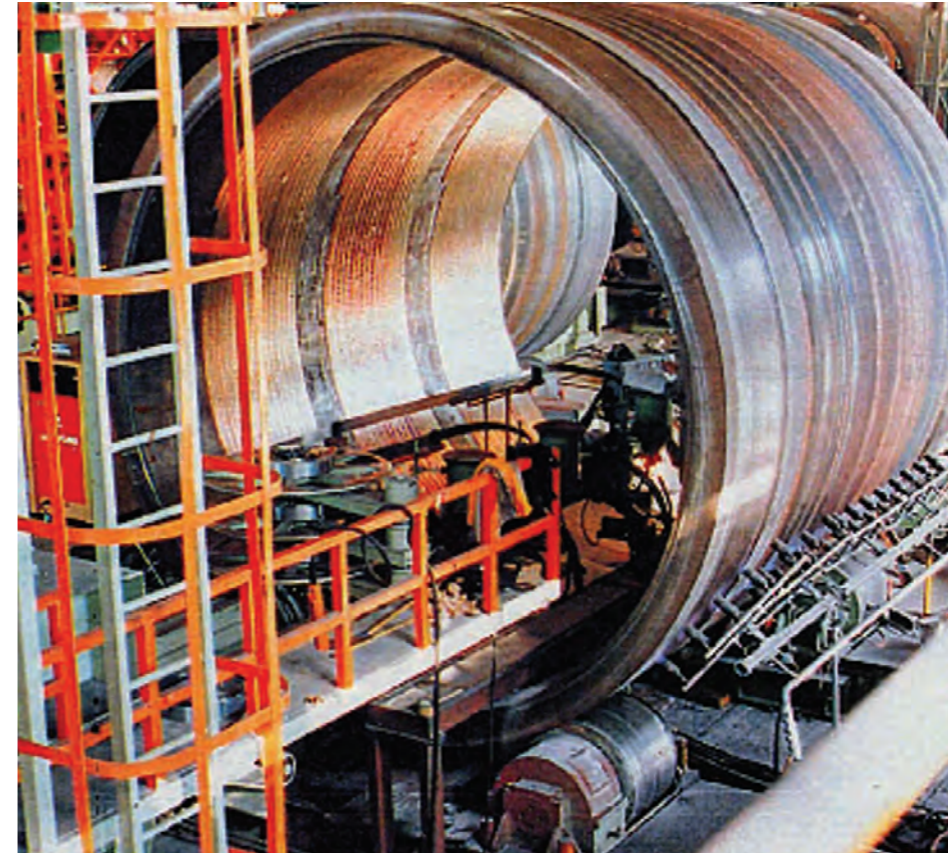
The excellent corrosion resistance of the super stainless steel 254N can withstand severe usage environments, and extends the life of the food processing plant.



▲Salt mirin tanks



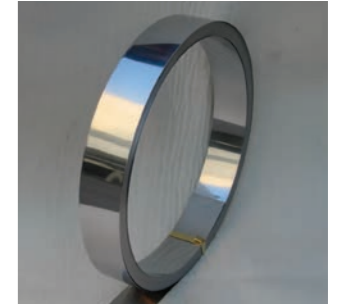
▲Miniature model tank made of 254N



### A hoop coil for weld overlay

Stainless steel band hoop material (weld material of narrow strip shape) used in chemical plants tends to crack during welding owing to its metallic structure. To overcome this, the quantity of  $\delta$ -ferrite has to be increased. However, increasing the quantity of  $\delta$ -ferrite induces cracks during hot rolling which is a key process for manufacturing stainless steel, so it has been difficult to manufacture band hoop material containing a large quantity of  $\delta$ -ferrite.

Nippon Yakin Kogyo has therefore established a process for manufacturing band hoop material containing a large quantity of  $\delta$ -ferrite by adjusting the composition and improving the production processes. Sales of the product as a high-performance alloy have increased steadily.



Weld metal



Welding

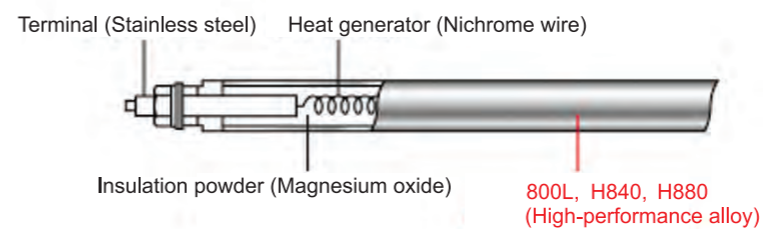
## Surely functions under severe environments, Thanks to the performance of high-function materials

### High temperature environment

The sheathed heater generates heat in household electric appliances such as electric ovens, electric stoves, and air conditioners, and also industrial apparatuses such as driers, train heaters, etc., yet invisibly to users.

The sheathed heater is fabricated by forming a heat-generating wire into a spiral shape, which is held at the center of a metallic pipe made of 800L, H840 or H880 then filling and compacting an insulation material into the pipe to surround the wire.

Since the sheath itself is heated to high temperatures, it is made of 800L, H840 or H880 which has excellent resistance to high-temperature oxidation and high-temperature creep.





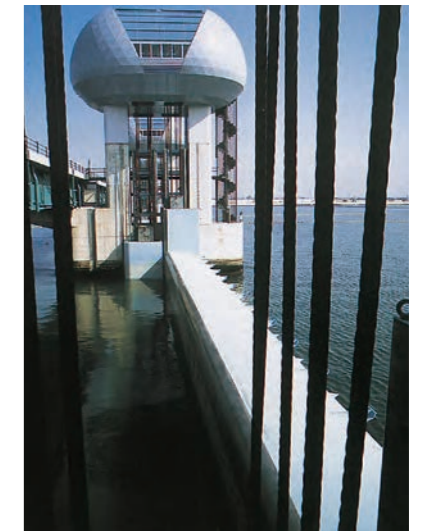
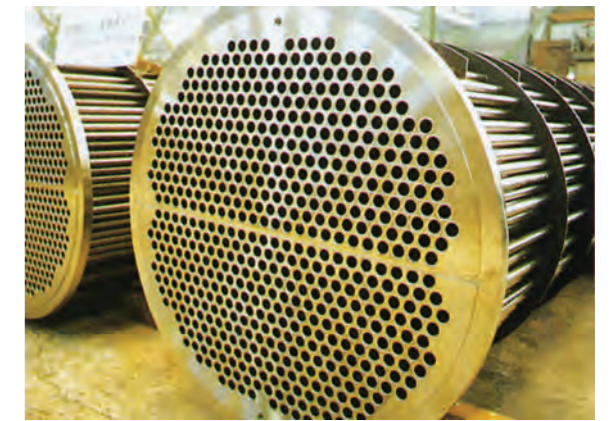
***Stainless steels  
in various fields and  
for various applications***

Ordinary steels sometimes show tendency of rusting. Compared to that, stainless steels resist against corrosion in our daily life. This resistance owes to film structures on their surface, which occasionally called "passive film".

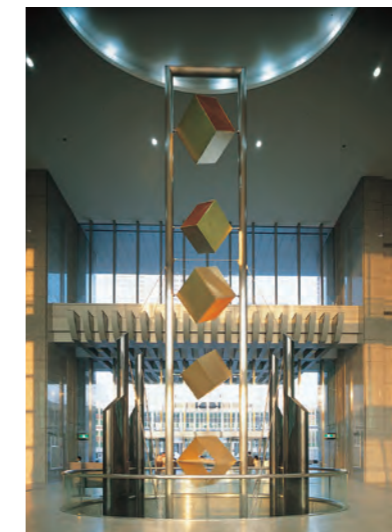
Stainless steels are rust-resistant and beautiful, and offer a long service life and ease of working.

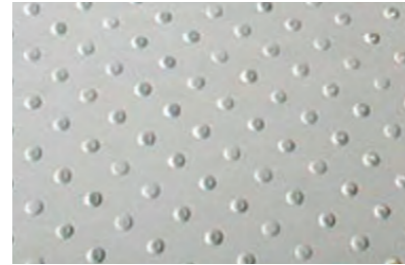
Stainless steels are a key material used in daily life and industry to meet the emerging needs of the information-oriented 21st-century society.

IT'S YAIKIN  
THE NIPPON YAIKIN KOGYO GROUP'S  
CORPORATE PROFILE



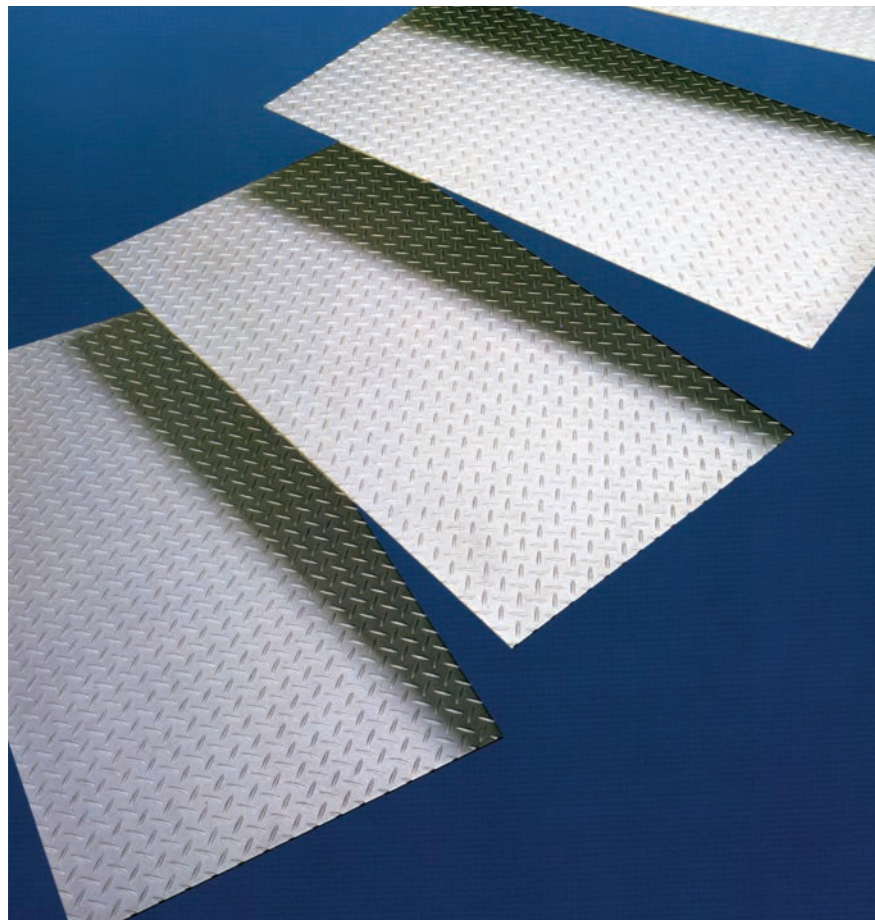
***Our high-performance stainless steels enhance your life.***





### **POLKA PLATE**

- POLKA PLATE is a 304-based stainless steel plate for flooring, having excellent corrosion resistance, heat resistance, durability, and workability.
- The surface morphology resists slip and is easy for walking.
- Easy to clean and drain.
- Round protrusions give a softer appearance than conventional checkered plate.
- Applicable fields are wide, including floors, stairways, frames, pit covers, and landscape materials
- POLKA PLATE has undergone slip resistance testing by the Institute for Occupational Safety and Health of the German Social Accident Insurance according to DIN standard 51130 with the highest level of antislip performance.



### **CHECKER PLATE**

- CHECKER PLATE is a 304-based stainless steel plate for flooring.
- The plate has excellent corrosion resistance, heat resistance, low temperature resistance, strength and durability.
- The surface shows the inherent beauty of stainless steel.
- The workability is good, equivalent to general stainless steel plates.
- Wear of protrusions is small (one seventh that of AI), and no painting is required.
- Suitable uses include places where ordinary steel lacks corrosion resistance, where a beautiful appearance for a long time is required, and where non-magnetic property is needed.
- Applications include vehicles, ships, buildings, civil engineering, and electric-related uses.

## **Various Products Fabricated by Stainless Steel with High Added Value**



### **Coat Clean (Fancy-finish steel plate)**

- Coat Clean is a clear coat stainless steel plate that stays clean.
- Coat Clean has excellent resistance against heat, water, acid, alkali and detergent.
- Coat Clean is a stainless steel sheet whose performance is optimized for the external surfaces of kitchen electric appliances such as refrigerators and rice cookers.
- Coat Clean allows diverse designs, such as clear-color and clear-pearl finishes.



### **GS Clear (Hard Clear Coating)**

- GS Clear is a hard coat specification of Coat Clean.
- In addition to its fancy-finish surface, GS Clear improves anti-marking performance (higher than 3H grade by pencil hardness test).
- Acrylic resin finish and fluorocarbon resin finish are available.



