NIPPON STEEL

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Steel Sheets for Vitreous Enameling
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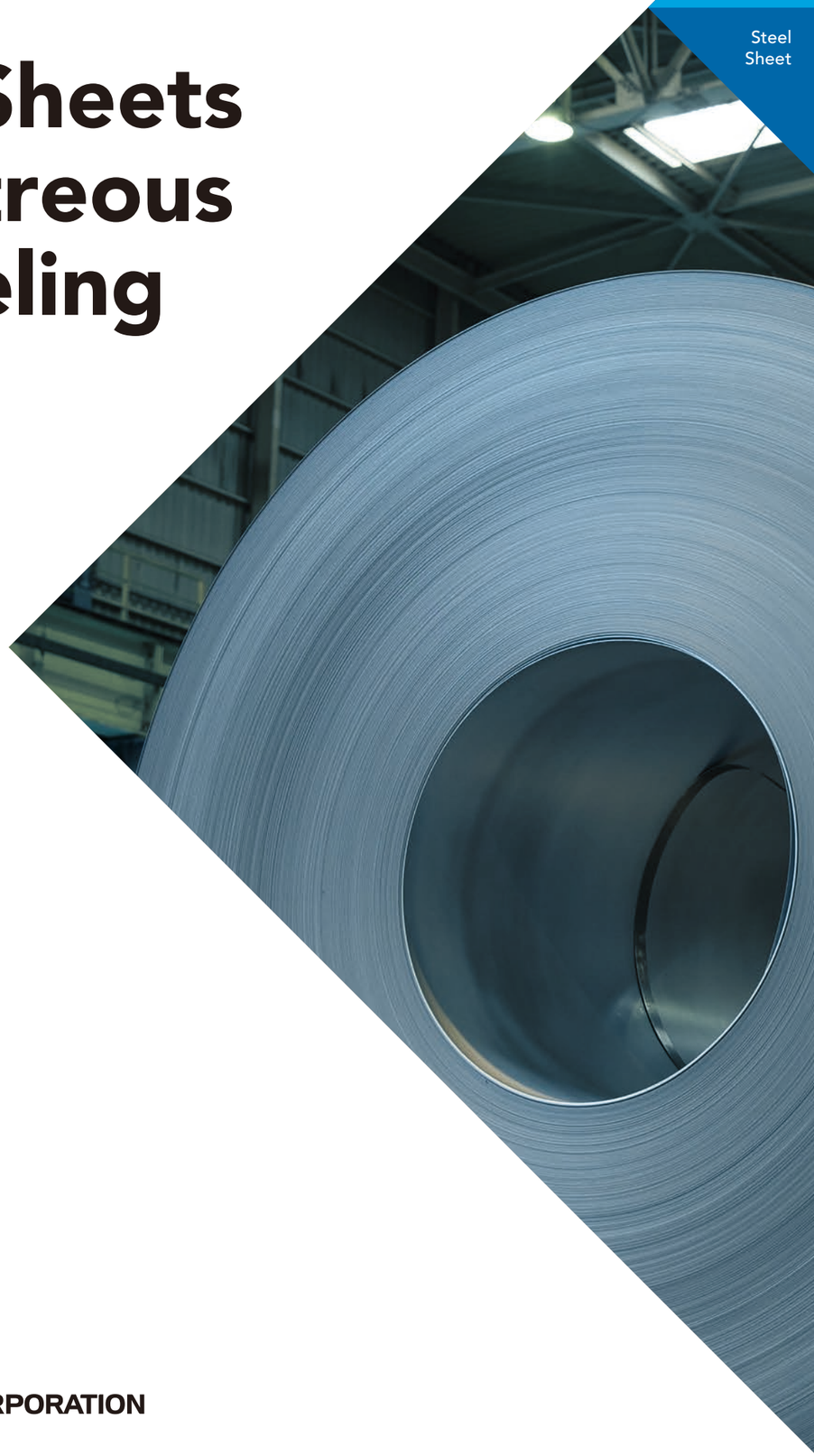
NIPPON STEEL

Steel Sheets for Vitreous Enameling

Steel Sheet



NIPPON STEEL CORPORATION

Introduction

Vitreous enamel is made by coating metal surface with glass. The compound material combines the properties of metal, such as high strength and excellent workability, with the characteristics of glass, such as corrosion resistance, chemical resistance, wear resistance, and visual appeal. Vitreous enamel has a long history, and the origin of industrial vitreous enameling is said to date back to the 17th century.
Vitreous enamel is applied to not only kitchen utensils like pots, kettles and bathtubs but also containers used in the chemical and medical fields, sanitary wares, chemical machineries, building materials, and various components used in the energy field (such as heat exchanger elements installed at electric power plants). Among relatively recent applications are cooking range housings and trays.
Since 1965, NIPPON STEEL has been manufacturing steel sheets for vitreous enameling, which will be processed into vitreous enameled products downstream.

In order to not only improve the level of our quality that satisfies customers, but also to propose additional values to them, NIPPON STEEL has been continuously improving the quality of our existing products and developing new products. One of our long-term research and development themes was to make steel sheets with workability and enamelability at the same time. We are pleased to share with you that NIPPON STEEL has successfully developed the steel sheets for vitreous enameling that meet these two conflicting requirements. These steel sheets are currently tested and used by an increasing number of customers. Since we are confident that our steel sheets for vitreous enameling will live up to your expectations, we would like you to try the new products.

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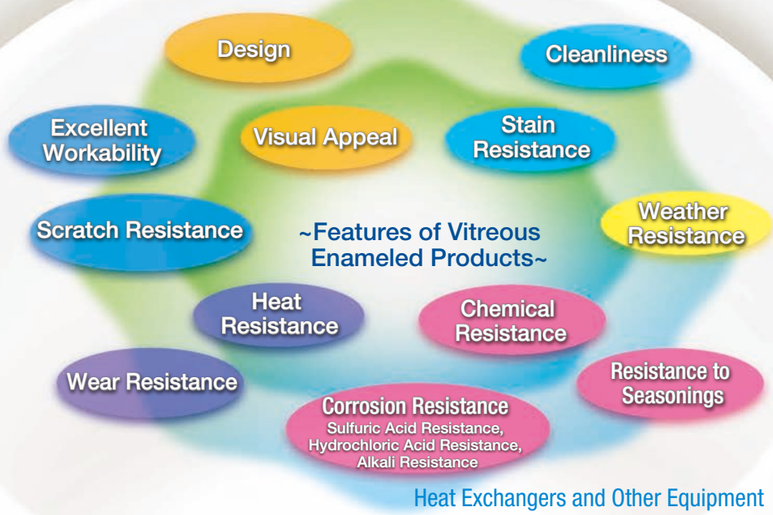
Home-Use Vitreous Enameled Products (Gas Ovens and Microwave Ovens)



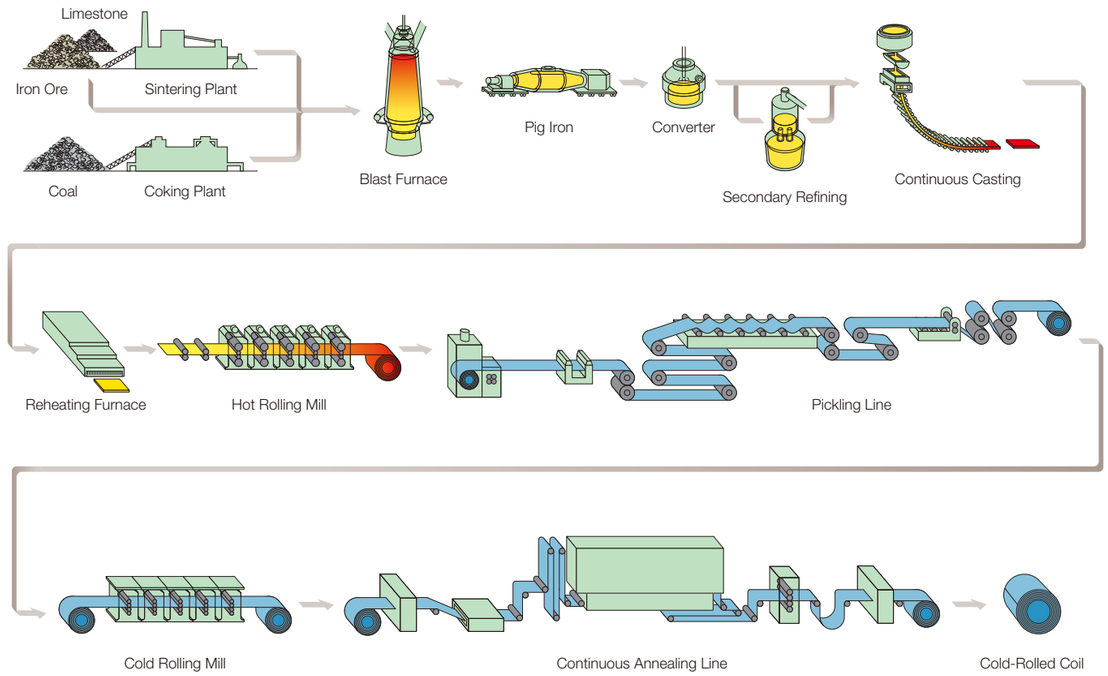
Heat Exchangers and Other Equipment

NIPPON STEEL's Steel Sheets for Vitreous Enameling

Manufacturing Processes

In addition to the high strength and excellent workability of cold-rolled steel sheets, steel sheets for vitreous enameling need to satisfy additional customer requirements such as higher adhesion strength of vitreous enamel, higher fishscaling resistance, and better enamel finish.
For this reason, in manufacturing steel sheets for vitreous enameling, the composition of the molten metal is controlled to an optimum level and decarburized in the secondary refining process, and the temperature of the steel strip is precisely controlled in the hot rolling process and the continuous annealing process.

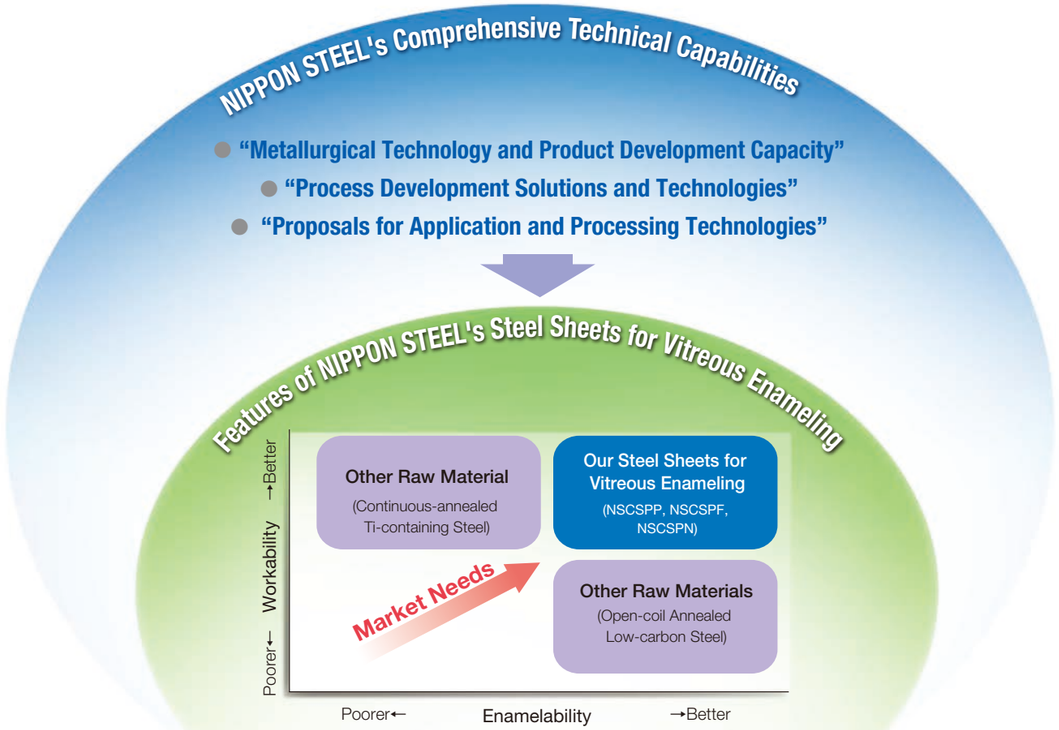
Our Steel Sheets for Vitreous Enameling Manufacturing Processes




Converter


Hot Rolling

NIPPON STEEL's Steel Sheets for Vitreous Enameling **Features**



One of the features of our steel sheets for vitreous enameling is excellence in both workability and enamelability (excellent fishscaling resistance, fewer defects in vitreous enamel coating layers, such as air bubbles, black spots, and blisters, and excellent coating adhesion).

Proposals to Our Customers

● High Quality & High Performance
- Improved visual attractiveness
- Improved design flexibility

● Cost Reductions
- Reduced thicknesses of vitreous enamel layers
- Use of inexpensive frits
- Improved yields

● Streamlined Manufacturing Processes
- Improved productivity
- Elimination of some existing processes

TIPS

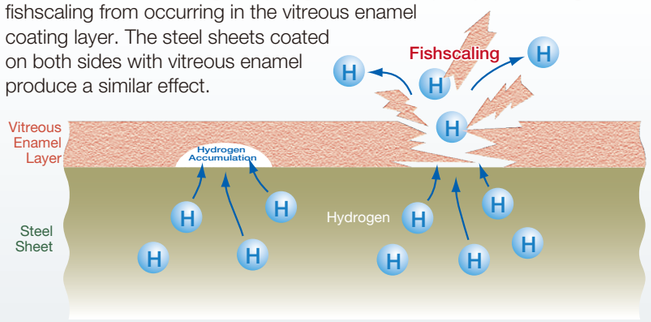
● Why are steel sheets used as the base material for vitreous enameled products?

The metals that can be used as the base material for vitreous enameled products are steel, cast iron, stainless steel, aluminum, copper, gold, and silver. Of these metals, steel is most commonly used for vitreous enameled products. One of the reasons is that steel sheets are excellent in workability while having a moderate level of strength at the same time. In addition, the base metal used for vitreous enameled products should satisfy the following requirements.
1) The temperature suited for vitreous enameling should be lower than the melting point of the base metal.
2) The base metal must not deform significantly at the temperature suited for vitreous enameling.
3) The base metal must not generate large quantities of gas at the temperature suited for vitreous enameling.
4) At the temperature suited for vitreous enameling, the base metal should get oxidized moderately so that the metal and the enamel tightly adhere to each other.
Iron (steel sheet) was the metal that satisfied all of these requirements.

NIPPON STEEL's Steel Sheets for Vitreous Enameling **Product Performance**

1 Excellent Fishscaling Resistance

Our steel sheets have higher hydrogen storage capacity, preventing fishscaling from occurring in the vitreous enamel coating layer. The steel sheets coated on both sides with vitreous enamel produce a similar effect.



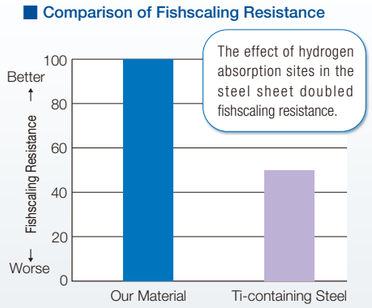
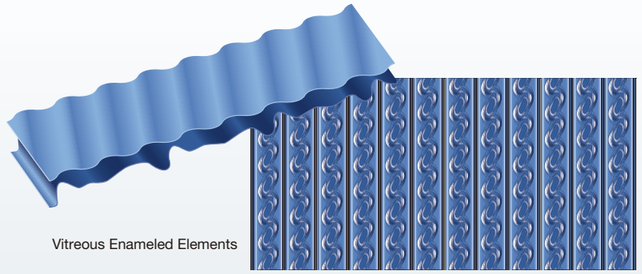


Figure 1: Fishscaling Resistance (Internal Data)

2 Excellent Durability

When applied to heat exchanger elements that are exposed to corrosive environments, these steel sheets exhibit excellent durability.



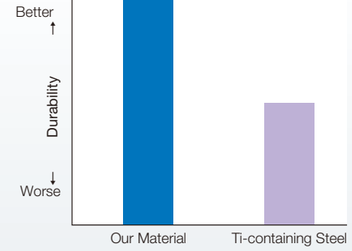
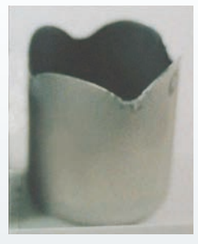


Figure 2: Durability Comparison (Internal Data)

3 Low Earing Characteristics

Our materials are made from ultra low carbon steel, exhibiting sufficiently low earing characteristics.

Our NSCSPF



Ti-containing Steel

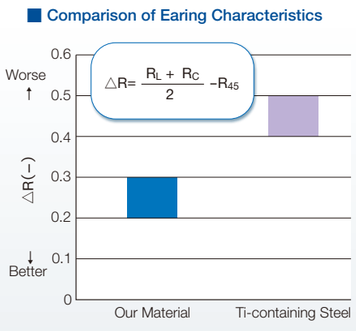


Figure 3: Earing Characteristics (Internal Data)

NIPPON STEEL's
Steel Sheets for Vitreous Enameling

Examples of Applications

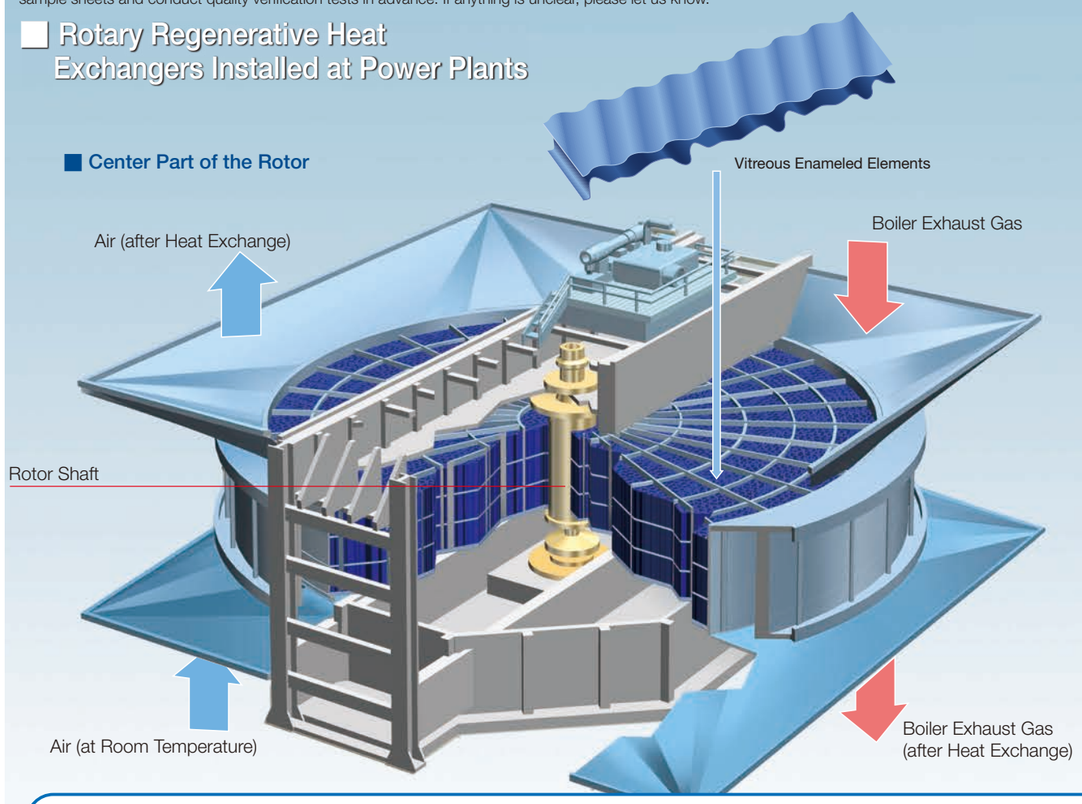
Guidelines for Material Grade Selection by Application

JIS Designation	NIPPON STEEL Standards	Type of Forming	Major Applications	
			Equipment Name	Part Name
SPPC,SPPD,SPPE	NSCSPP1	General forming	Boards and the like Building materials	White boards, sign boards, billboards, traffic signs Building panels
No applicable JIS standards	NSCSPP2 NSCSPP3	Stretch forming	Heat exchangers Heating devices Ovens Gas ranges Microwave ovens	Vitreous enameled elements Top board of stove heaters and the like Cooktops Manifolds, side panels Trays
	NSCSPP4	Extra stretch forming	This grade is recommended when you find it extremely difficult to form one of the above-mentioned products	
	NSCSPN1·2	Drawing	Heat exchangers	Vitreous enameled elements
	NSCSPF1	Deep drawing	Washing machines	Dewatering bins
	NSCSPF2 NSCSPF3	Extra deep drawing	Water heaters Toilet equipment Ovens Cooking equipment Bathtubs Washing stands Drum-type washing machines, washing & drying machines Kitchen utensils	Water heater tanks Sanitary wares Oven side and inner cavity panels, bottom doors Fryers Bathtubs Sink bowls Top boards Pots and kettles

*The information contained in this table only provides guidelines for your material grade selection, and it doesn't guarantee the quality of your end products. In selecting the grades you are going to order, please make sure that you have experience with products involving the same type of forming process. We recommend that you obtain sample sheets and conduct quality verification tests in advance. If anything is unclear, please let us know.

Rotary Regenerative Heat Exchangers Installed at Power Plants

Center Part of the Rotor



[Factors that May Affect the Durability of Vitreous Enameled Elements]

- Fishscaling resistance
- Acid resistance, wear resistance
- Air bubbles and cracks on the surface of vitreous enamel
- How well the end faces are covered with vitreous enamel

Designed to satisfy good workability and enamelability at the same time, our steel sheets for vitreous enameling improve the durability of vitreous enameled elements

Household Appliances


Bathtubs, Building Panels


Washing Stands


Heating Appliances


Water Heaters


Kitchen Utensils


Microwave Ovens

Built-in Kitchens

NIPPON STEEL's Steel Sheets for Vitreous Enameling Standards (Excerpted)

Steel Sheet Types and Mechanical Properties

Table 1: Decarburized Steel Sheet and Strip for Vitreous Enameling (JIS G 3133)

Designation	Application	Applicable Thicknesses (mm)	Chemical Composition[a] (%)						Mechanical Properties							Test Specimen
			C	Si	Mn	P	S		Yield Point (N/mm^2)	Tensile Strength (N/mm^2)	Elongation (%), Thickness Range (mm)					
											0.40 ≤ t < 0.60	0.60 ≤ t < 1.0	1.0 ≤ t < 1.6	1.6 ≤ t < 2.5	2.5 ≤ t < 2.8	
SPPC	General forming	0.40 ≤ t ≤ 2.8	≤ 0.008	–	≤ 0.50	≤ .0040	≤ 0.040		–	270 ≤	34 ≤	36 ≤	37 ≤	38 ≤	39 ≤	JIS No. 5 Rolling direction
SPPD	Drawing	0.40 ≤ t ≤ 2.8							(≤ 240) [b]	270 ≤	36 ≤	38 ≤	39 ≤	40 ≤	41 ≤	
SPPE	Deep drawing	0.40 ≤ t ≤ 2.8							(≤ 220) [b]	270 ≤	38 ≤	40 ≤	41 ≤	42 ≤	43 ≤	

a) Alloying elements such as Ti, Nb, Zr, V, and B may be added as needed. When these elements are added, the manufacturer should report the content of each element.
b) The upper limit values for yield points or proof strength in parentheses are for reference purposes only. Those values may be applied if the supplier and the customer agree to do so.

Table 2: NIPPON STEEL's Steel Sheets for Vitreous Enameling (NIPPON STEEL Standards)

Designation	Application	Applicable Thicknesses (mm)	Mechanical Properties					Mechanical Properties					Test Specimen
			Yield Point (N/mm^2)	Tensile Strength (N/mm^2)	Elongation (%), Thickness Range (mm)			Elongation (%), Thickness Range (mm)					
					0.40 ≤ t < 0.60	0.60 ≤ t < 0.80		0.80 ≤ t < 1.0	1.0 ≤ t < 1.2	1.2 ≤ t < 1.4	1.4 ≤ t < 1.6	1.6 ≤ t ≤ 2.3	
NSCSPP1	Stretch forming	0.40 ≤ t ≤ 2.3	≤ 235	–	40 ≤	41 ≤		42 ≤	43 ≤	44 ≤	44 ≤	45 ≤	JIS No. 5 Rolling direction
NSCSPP2		0.40 ≤ t ≤ 2.3	≤ 200	–	42 ≤	43 ≤		44 ≤	45 ≤	46 ≤	46 ≤	47 ≤	
NSCSPP3		0.60 ≤ t ≤ 2.3	≤ 200	–	–	45 ≤		46 ≤	47 ≤	48 ≤	48 ≤	49 ≤	
NSCSPP4		0.80 ≤ t ≤ 2.3	≤ 200	–	–	–		48 ≤	49 ≤	50 ≤	50 ≤	51 ≤	
NSCSPN1	Drawing	0.40 ≤ t ≤ 2.3	180 ≤	–	38 ≤	39 ≤		41 ≤	42 ≤	43 ≤	44 ≤	45 ≤	
NSCSPN2		0.40 ≤ t ≤ 2.3	≤ 235	–	39 ≤	40 ≤		42 ≤	43 ≤	44 ≤	45 ≤	46 ≤	
NSCSPF1	Deep drawing	0.40 ≤ t ≤ 2.3	≤ 220	–	40 ≤	41 ≤		43 ≤	44 ≤	45 ≤	46 ≤	47 ≤	
NSCSPF2		0.60 ≤ t ≤ 2.3	≤ 220	–	–	44 ≤		45 ≤	46 ≤	47 ≤	47 ≤	49 ≤	
NSCSPF3		0.60 ≤ t ≤ 2.3	≤ 220	–	–	44 ≤		45 ≤	46 ≤	47 ≤	47 ≤	49 ≤	

Temper Grades

The temper grade of steel sheets for vitreous enameling is standard.

Table 3: NIPPON STEEL Standards

Temper Grade	Temper Designation
Standard	S

Surface Finish Grades

The surface finish grade of steel sheets for vitreous enameling is dull.

Table 4: NIPPON STEEL Standards

Surface Finish Grade	Surface Finish Designation
Dull	D

Oil Coating

Unless otherwise specified, steel sheets for vitreous enameling are coated with standard oil. If another type of oil is specified, please let us know in advance.

Table 5: NIPPON STEEL Standards

Oil Coating	Oil Coating Designation
Standard oil	N

Dimensional Tolerances

Table 6: Thickness Tolerances (JIS G 3133, NIPPON STEEL Standards)

Thickness (mm) \ Width (mm)	600 ≤ W < 1,000	1,000 ≤ W < 1,250	1,250 ≤ W < 1,600	1,600 ≤ W
0.40 ≤ t < 0.60	±0.05	±0.05	±0.06	—
0.60 ≤ t < 0.80	±0.06	±0.06	±0.06	±0.07
0.80 ≤ t < 1.00	±0.06	±0.07	±0.08	±0.09
1.00 ≤ t < 1.25	±0.07	±0.08	±0.09	±0.11
1.25 ≤ t < 1.60	±0.09	±0.10	±0.11	±0.13
1.60 ≤ t < 2.00	±0.11	±0.12	±0.13	±0.15
2.00 ≤ t < 2.50	±0.13	±0.14	±0.15	±0.17
2.50 ≤ t ≤ 2.80	±0.15	±0.16	±0.17	±0.20

Thickness shall be measured at points located at least 15mm inside each of the steel strip edges (on both sides in the width direction) where the surface condition is good.

Table 7: Width Tolerances (JIS G 3133, NIPPON STEEL Standards)

Width (mm)	Width Tolerance (mm)
< 1,250	+ 7.0
1,250 ≤	+ 10.0

Table 8: Length Tolerances (JIS G 3133, NIPPON STEEL Standards)

Length (mm)	Length Tolerances (mm)
L < 2,000	+ 10.0
2,000 ≤ L < 4,000	+ 15.0
4,000 ≤ L < 6,000	+ 20.0

Shape Tolerances

Table 9: Maximum Flatness (JIS G 3133, NIPPON STEEL Standards)

Width (mm)	Flatness (mm), Distortion Types		
	Bow, Wave	Edge Buckle	Center Buckle
W < 1,000	12	8	6
1,000 ≤ W < 1,250	15	9	8
1,250 ≤ W < 1,600	15	11	8
1,600 ≤ W	20	13	9

The flatness of steel sheets shall be measured on the surface plate. For steel strips, the flatness values shown above shall be applied to portions free from damage. Additionally, bow tolerance shall not be applied to steel strips.

Table 10: Maximum Camber (JIS G 3133, NIPPON STEEL Standards)

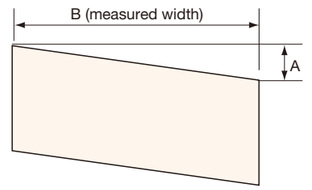
Width (mm)	Steel Sheet		Steel Strip
	L < 2,000	2,000 ≤ L	
600 ≤	2	2 in any 2,000mm sheet length	

Squareness (JIS G 3133, NIPPON STEEL Standards)

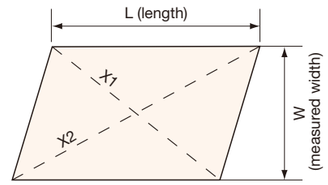
The squareness of steel sheets shall be measured with either a) a method to use perpendicular lines, or b) a method to use diagonal lines.

a) In the method using perpendicular lines, the value A/B as shown below shall not exceed 1.0%.
b) In the method using diagonal lines, the value (|X1-X2|/2) as shown below shall not exceed 0.7% of the width of the steel sheet.

a) Method to use perpendicular lines



b) Method to use diagonal lines

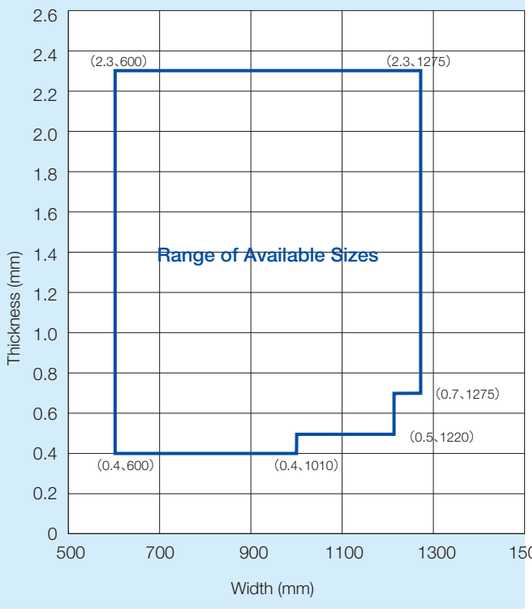


NIPPON STEEL's
Steel Sheets for Vitreous Enameling

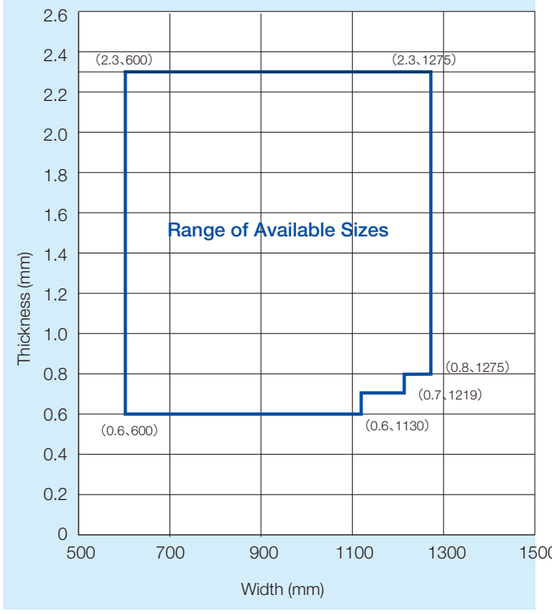
Product Size Range

If the size you need falls outside the ranges shown below, please let us know. In some cases, we may be able to manufacture that size.

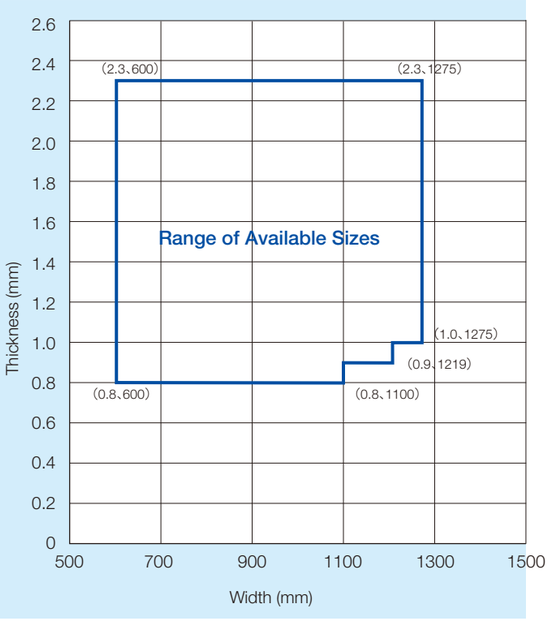
[1] SPPC, SPPD, SPPE, NSCSPP1, NSCSPP2 NSCSPN1, NSCSPN2



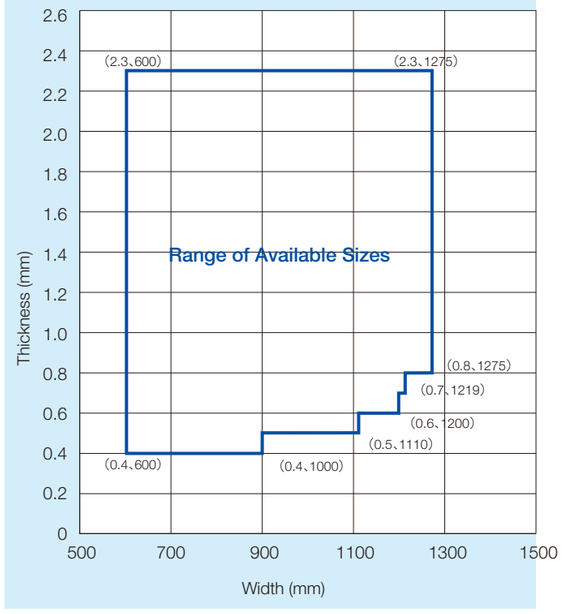
[2] NSCSPP3



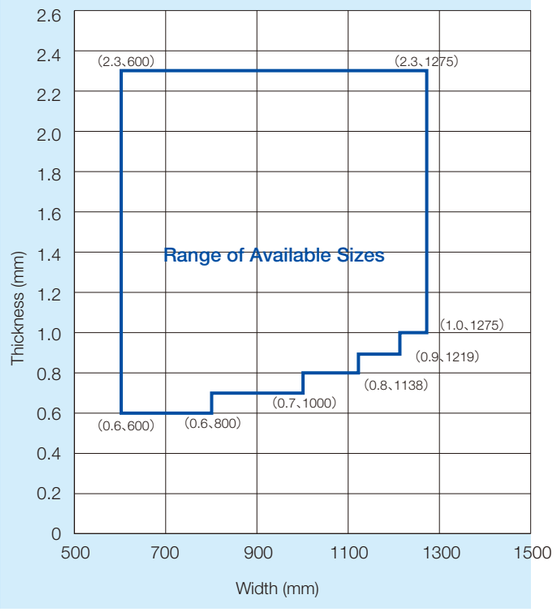
[3] NSCSPP4



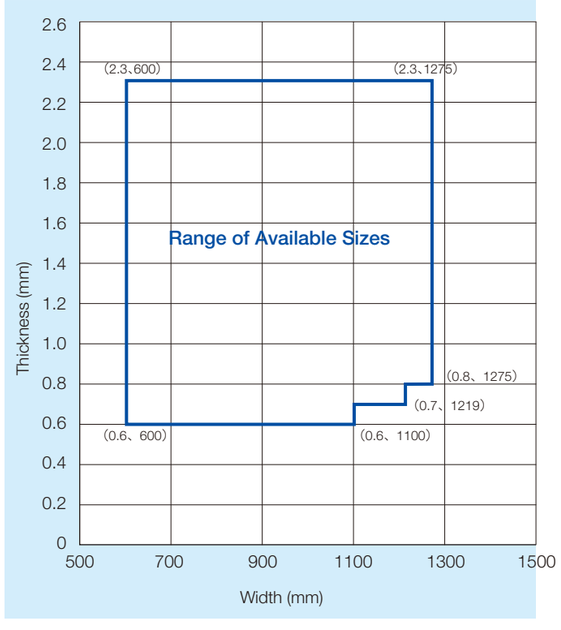
[4] NSCSPF1



[5] NSCSPF2



[6] NSCSPF3

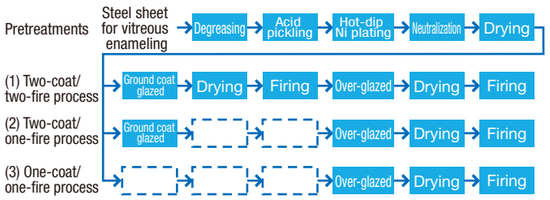


Precautions

As steel sheets for vitreous enameling are part of cold-rolled steel sheets, you are expected to handle these steel sheets as you do for conventional cold-rolled steel sheets, including rust prevention management until you start using them, degreasing/acid pickling in the pretreatment process, press formability in the forming process, and weldability in the assembling process. Products which are formed using conventional cold-rolled steel sheets will be painted or plated. On the other hand, products which are formed using steel sheets for vitreous enameling will be glazed and fired. For this reason, as well as the general precautions for handling cold-rolled steel sheets, you are expected to be familiar with the precautions specific to steel sheets for vitreous enameling.

1. Types of Vitreous Enameling Processes

The basic process of vitreous enameling is two-coat/two-fire processes. In addition to this type of enameling process, there are two-coat/one-fire processes, in which the product is glazed with ground coat, over-glazed, dried, and then fired. Furthermore, there are one-coat/one-fire enameling processes, in which both glazing and firing are done in a single process by ingeniously modifying pretreatments and optimizing glass frit compositions.



2. Pretreatments

(1) Degreasing

Our steel sheets for vitreous enameling are coated with rust preventive oil, and the lubricant used in the press forming process may also remain on the sheet surface. This is why the sheet surface must be degreased before the vitreous enameling process. There are various degreasing methods including solvent degreasing and alkaline degreasing, and the latter degreasing method is most commonly used.

For alkaline degreasing purposes, chemicals such as caustic soda, sodium carbonate, and sodium orthosilicate are used. Among various degreasing conditions, duration, temperature, and stirring/not stirring are particularly important. The addition of a surfactant would also help degrease the sheet surface. In some cases, steel sheets are simply baked to remove residual oil on the surface.

(2) Acid Pickling

Steel sheets for vitreous enameling are acid cleaned for the purpose of removing oxide film and rust from the surface of steel sheets, and roughening the surface to improve the adhesion of vitreous enamel. For this purpose, the acidity condition should be properly selected. Particularly in the one-coat/one-fire enameling process, a sufficient amount of acid pickling weight loss is necessary.

(3) Hot-Dip Ni Plating

As with acid pickling, Ni deposition on vitreous enameled products improves the adhesion of vitreous enamel. The adhesion of vitreous enamel is influenced not only by the selection of the best Ni deposit amount in combination with acid pickling weight loss but also by the surface morphology of Ni deposit. This is why attention should also be paid to the condition of Ni baths.

3. Vitreous Enameling

The following are typical problems encountered in vitreous enameling.

(1) Poor Adhesion

Please make sure that the adhesion of vitreous enamel is not lost after a change in pretreatment conditions, types of glazes, or firing conditions.

(2) Fishscaling

When vitreous enamel is being fired, hydrogen contained in the steel sheet, or hydrogen entering the steel sheet, builds up during cooling at the interface between the base steel sheet and the vitreous enamel layer. Fishscaling is a phenomenon that is observed when the hydrogen gas pressure eventually destroys the vitreous enamel layer. In some cases, fishscaling occurs several days to several months after the product is enameled. Among other things, you should select base steel sheets capable of storing a sufficient amount of hydrogen. You also need to control the operating condition so that hydrogen generated from water vapor in the enamel firing process will not enter the base steel sheet.

(3) Air bubbles, Black Spots

Large air bubbles develop near the surface in the vitreous enamel layer. These defects may not only impair corrosion resistance of the vitreous enamel but also degrade its surface quality. The first thing you should do is select an appropriate steel sheet for vitreous enameling. You should pay particular attention to incomplete water washing/neutralization, insufficient firing, and impurities contained in the glaze, which are probable causes of these defects.

(4) Firing Strain

Firing strain is a phenomenon that is seen when the steel sheet is strained or distorted in various degrees during the vitreous enamel firing process. This phenomenon has something to do with the fact that the iron crystal in the steel sheet transforms from ferrite to austenite during firing. Attention needs to be paid to this phenomenon. Firing strain does occur with ultra-low carbon steel, but the impact is smaller compared with low carbon steel. Please be aware that all our steel sheets for vitreous enameling are based on ultra-low carbon steel.

(5) NIPPON STEEL's Technical Support and Solution Proposals

As technology advances, vitreous enameling processes have been rationalized as shown below.

- One-coat/one-fire process
- Two-coat/one-fire process
- Elimination of hot-dip Ni plating process
- Elimination of acid pickling process
- Elimination of acid pickling and hot-dip Ni plating processes

In either case, many factors are intertwined in a complex manner, such as types of steel sheets, and types of glazes, and vitreous enameling conditions. To maintain the quality of vitreous enameled products on an ongoing basis, you need to control and optimize these conditions.

Among other things, NIPPON STEEL proposes appropriate steel materials best suited for the needs of customers. At the same time, we are willing to help you solve any problems you may encounter in your manufacturing processes. Please don't hesitate to contact us for help or with questions.

4. Rust Prevention

Our steel sheets for vitreous enameling are coated with rust preventive oil. If the steel sheets are left unpacked for extended periods of time, it may cause them to rust. For this reason, please use the steel sheets within a short period of time after they are unpacked. If you still need a certain period of time before painting or plating them, we recommend you take the following precautions.

a. Generally speaking, the more humid it becomes, the more quickly steel sheets tend to rust. For this reason, you need to keep steel sheets where humidity can be controlled.
b. Air pollution also contributes to rust formation. The presence of hygroscopic substances, such as hydrochloric acid gas, ammonium chloride gas, and sea salt particles, could cause steel sheets to rust even at low humidity levels or at air temperatures above the dew point. Additionally, dust and dirt attached to the surface of steel sheets could break the protective oil film and form a local galvanic cell with the base steel material, which may lead to rust formation.

5. Welding

Making satisfactory end products hinges on the selection of an appropriate welding method and its associated welding skills and techniques. Listed below are the welding methods that are typically applied to steel sheets. We recommend you select the most appropriate ones, taking into consideration the appearance, strength, and cost effectiveness that your product calls for.

(1) Gas Welding

For oxyacetylene welding, we recommend that you use as high quality acetylene gas as possible and welding rods that satisfy JIS Z 3201 (Gas Welding Rods for Mild Steel).

(2) Shielded Metal Arc Welding

Of the welding rods produced to satisfy JIS Z 3211 (Covered Electrodes for Mild Steel), high-purity titanium oxide or lime titania type electrode rods are recommended. These electrode rods provide excellent bead appearance and weld penetration.

(3) Resistance Welding

a. Spot Welding

To obtain sufficient shear strength, the weld zone must melt into a nugget. The table below shows standard spot welding conditions for mild steel sheets for reference.

b. Seam Welding

Seam welding can be regarded as a variation of continuous spot welding. To obtain good welds, seam welding requires 1.5 to 2.0 times greater current, and 1.2 to 1.6 times greater electrode force than spot welding.

Figure (a)

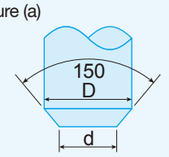
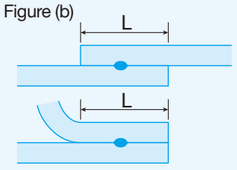


Figure (b)



Sheet Thickness[1][7]		Electrode[2]		Minimum Pitch[3]	Minimum Lap[4]	Best Condition (Class A)					Medium Condition (Class B)					Standard Condition (Class C)				
						Time[5]	Electrode force	Current	Weld Diameter	Strength[6] ±14%	Time[5]	Electrode force	Current	Weld Diameter	Strength[6] ±17%	Time[5]	Electrode force	Current	Weld Diameter	Strength[6] ±20%
(mm)	(in)	d (mm)	D min (mm)	(mm)	(mm)	(∞)	(kg)	(A)	(mm)	(kg)	(∞)	(kg)	(A)	(mm)	(kg)	(∞)	(kg)	(A)	(mm)	(kg)
0.6	0.031	4.0	10	10	11	7	150	6,600	4.7	300	13	100	5,500	4.3	280	26	50	4,300	4.0	225
0.8	0.040	4.5	10	12	11	9	190	7,800	5.3	440	15	125	6,500	4.8	400	30	60	5,000	4.6	355
1.0	0.048	5.0	13	18	12	10	225	8,800	5.8	610	20	150	7,200	5.4	540	36	75	5,600	5.3	530
1.2	0.062	5.5	13	20	14	12	270	9,800	6.2	780	23	175	7,800	5.8	680	40	85	6,100	5.5	650
1.6	0.078	6.3	13	27	16	16	360	11,500	6.9	1,060	30	240	9,100	6.7	1,000	52	115	7,000	6.3	925
2.0	0.125	7.0	16	35	18	20	470	13,300	7.9	1,450	36	300	10,300	7.6	1,370	64	150	8,000	7.1	1,305
3.2	0.024	9.0	16	50	22	32	820	17,400	10.3	3,100	60	500	12,900	9.9	2,850	105	260	10,000	9.4	2,665

(1) The materials listed in the table above, which are used for spot-welded structures, are cold-rolled steel sheets that have tensile strength in the range of 290 to 310N/mm2. These materials are supplied thinly coated with oil. Before being spot welded, the surface of these materials must be free from any oxides, paint, dust, and other types of impurities.
(2) The material for electrodes shall be RWMA Class 2 (75% electric conductivity, Rockwell hardness B75). The electrodes shall have a tip shape as shown in Figure (a). The tolerance of dimension "d" shall be ±0.4mm.
(3) The minimum (spot) pitch refers to the distance between adjacent welds beyond which the shunt effect in resistance spot welding can be practically ignored. If the design requires spot welding at intervals of the minimum pitch or shorter, you need to increase welding current in consideration of the shunt effect.
(4) The minimum lap refers to the length indicated as "L" in Figure (b).
(5) The weld time is expressed in the number of current cycles on a 60Hz power supply. In other words, 10 cycles are equivalent to one-sixth of a second. On a 50Hz power supply, you should set weld time at five-sixths of the value shown in the table above.
(6) The strength refers to the shear strength of a spot weld, and the number on the right shows the range of variations.
(7) When spot welding two sheets with different thicknesses, you should set the welding condition suited for the thinner sheet. (In this case, the ratio of sheet thicknesses shall not exceed 1 to 3.) For lap spot welding up to four sheets, the conditions in the table above shall be applied. (In this case, however, the sum of all the sheets shall not exceed four times the sheet thickness.)

Packaging and Labeling

Our products are packed at the steel plant to prevent any possible damage being caused during normal handling or storage before the customer unpacks them for use. The outer package is affixed with a package label that indicates product descriptions. In addition, the product in the package is affixed with an inspection card that certifies the product descriptions. During receiving inspection, please check these labels and cards, which contain the following product descriptions.

1. Examples of Items Indicated on Package Label and Package Card

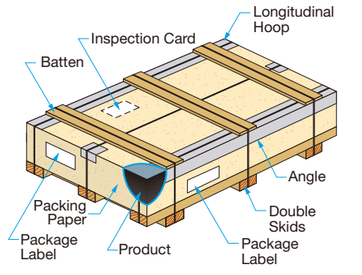
Item Name	Marking Criteria		Marking Method and Examples of Marking Descriptions
	Standard Marking	Customer-Specified Marking	
Product Name	○		The specified product name shall be indicated.
Class/Grade	○		First Class
JIS Certification Mark	*○		If the product complies with JIS-certified standards and is authorized to indicate JIS-certification marks, a (JIS) mark shall be indicated on the package label. The mark shall not be indicated on the inspection card.
Standard Designation	○		All the description items, excluding those not applicable to this product, shall be indicated left-aligned in the order as shown below. **JIS G3133 SPPC : S D N** ① ② ③ ④ ① ... Abbreviated standard name, standard No., standard designation, etc. ② ... Temper designation S : standard temper ③ ... Surface finish designation D : dull finish ④ ... Oil coating designation H : heavy coated N : standard L : lightly coated X : no oil
Dimensions	○		Ordered dimensions (T x W x L) shall be indicated. For coil products, C shall be indicated in place of L.
Guaranteed Surface(s)		*○	This item shall be indicated only when the bottom surface (or both surfaces) is guaranteed.
Net Mass	○		The net mass of the product shall be indicated.
Number of Sheets	*○		For cut-to-length sheets, the number of pieces actually packed shall be indicated.
Number of Coils	*○		This item shall be indicated only when the hooped package contains at least two coils.
Steel Manufacture No.		*○	This item shall be indicated only when the order calls for the marking of steel manufacture No.
Inspection No.	○		The inspection No. for each shipping unit shall be indicated.
Coil No.	○		The coil No. for each manufacturing lot shall be indicated.
Date of Manufacture	○		This item shall be indicated unless the order requires no marking for the date of manufacture.
Customer Name	○		This item shall be indicated on the package label.
Manufacturer Name	○		NIPPON STEEL CORPORATION
Steel Works Name	○		(Location Name) WORKS (or AREA)

○ : These items shall be indicated without exception.
* ○ : These items shall be indicated when the product falls under the condition in “Marking Method and Examples of Marking Descriptions.”

■ Packaging Examples

(1) Cut-to-Length Sheet Products

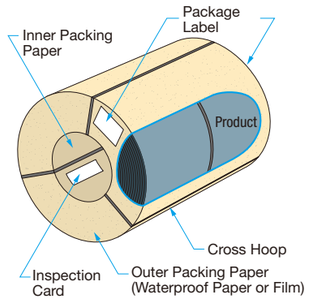
An Example of Paper Packaging on Wooden Double Skids



*Packaging specifications vary depending on the haul distance and the type of transportation

(2) Coil Products

An Example of Paper/Film Packaging without Inner/Outer Rings



*Packaging specifications vary depending on the haul distance and the type of transportation

MEMO

TIPS

● Are vitreous enameled products eco-friendly?

Vitreous enameled products are a compound material that is made of only iron and glaze (inorganic glass). These two raw materials are mined from the natural world. The vitreous enameled products collected from the market will be fed back into the converters at steel plants as a high-quality steel raw material. The inorganic glass contained in those products can be removed from the steel making process in the form of slag, ending up in landfills. Currently a recycling process is being studied to separate the bare steel and the inorganic glass contained in vitreous enameled products. The glaze component collected will be used as a fresh glaze material.

■Concept of Recycling Vitreous Enameled Products