



TIN MILL PRODUCTS



JFE advanced technology for tin mill products





Tin mill products for supporting life and living



Line Up of JFE tin mill products

Since tin mill products are used for making all types of containers such as food cans , beverage cans and artistic cans, those are necessary to our life and living.

JFE is supporting metal containers category by supplying tin mill products, which include Tinplate, Tin Free Steel (TFS) and Laminated steel sheet.

Tinplate is a thin steel coated with tin. It has extremely beautiful metallic luster as well as excellent properties in corrosion resistance, solderability and weldability.

TFS is electrolytic chromium coated steel, which has superior paintability and paint adhesion. JFE has developed a Laminated steel sheet "JFE UNIVERSAL BRITE" that has excellent corrosion resistance and environmental friendliness.

JFE manufactures tin mill products under the ISO9001-based integral quality management system, which covers every process from raw materials to final finishing processed, earning high regard from its customers on product quality.

JFE will continue to exert utmost efforts on the quality improvement and new product development in order to meet customer requirements, and hopes to be favored with your continued patronage.

TIN MILL PRODUCTS

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List of Tin Mill Products



Tinplate

Tinplate is a thin steel coated with tin. Tinplate is characterized by its beautiful metallic luster as well as excellent properties in corrosion resistance, solderability and weldability.

Tin Free Steel(TFS)

TFS is electrolytic chromium coated steel, which has a superior paintability and paint adhesion. Since TFS has an excellent sulfide stain resistance, it can be applied to food usage with inside coating.

Laminated Steel Sheet (JFE UNIVERSAL BRITE)

JFE UNIVERSAL BRITE is made by laminating TFS sheet with PET and PP film. PET has good formability and corrosion resistance and PP can be applied to contents with wide pH range. This is an environmentally friendly product because painting and baking process can be omitted. White and gold colors as well as clear are available for laminate film.

1 Specifications

Products	Product name	Order standard
Tinplate	Tinplate	SPTE
		JFEET
Tin Free Steel(TFS)	Tin Free Steel(TFS)	SPTFS
		JFEEC
Laminated Steel Sheet	JFE UNIVERSAL BRITE	UBT

2 Comparison of Properties

◎ : Excellent ○ : Good △ : Poor x: Bad

Property		Tinplate Tin Coating mass(g/m ²)		TFS	JFE UNIVERSAL BRITE ^{*6}	
		2.8	≥ 5.6		PET	PP
Bare Corrosion Resistance (sealed) ^{*1}	Rust Resistance	○	◎	○	◎	◎
	Acid Resistance	○	○	△	◎	◎
	Alkali Resistance	△	△	◎	○	◎
	Black Sulfide Stain Resistance	△	△	◎	◎	△
	Stress Cracking Resistance	◎	◎	△	△ ^{*4}	△ ^{*4}
Paintability		○	○	◎	◎ ^{*4}	◎ ^{*4}
Corrosion Resistance after Painting ^{*2}		◎	◎	○	◎ ^{*4}	◎ ^{*4}
Filiform Corrosion Resistance		◎	◎	◎	◎	◎
Paint Adhesion		○	○	◎	○ ^{*4}	○ ^{*4}
Internal Surface No-lubricant Press Formability		○	○	△	—	—
Solderability		○	◎	x	x	x
Weldability		○	○	○ - △ ^{*3}	○ - △ ^{*3}	○ - △ ^{*3}
Heat resistance ^{*5}		○	○	◎	○	△

*1 Bare corrosion resistance is evaluated under tightly sealed conditions. Evaluation of each product may change according to contents actually packed. Please consult us in advance.

*2 Corrosion resistance after painting is evaluated by crosshatching corrosion tests. Evaluation of each product may change according to actual use conditions.

*3 Evaluation result under non-grinding Cr coating layer. This result might change depending on Cr coating mass. Evaluation may change according to the type of welding machine and actual welding conditions.

*4 The evaluation of performance of JFE UNIVERSAL BRITE may change according to the actual use conditions. Please consult us in advance.

*5 High-temperature baking after painting and printing may cause changes in material properties.

*6 Double-sided lamination

3 Temper Designation

<Single cold-Reduced(SR)>

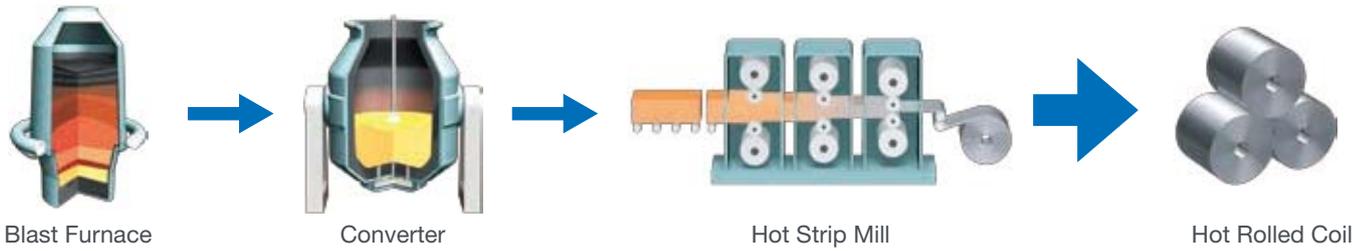
Temper Designation	Rockwell Superficial Hardness (HR 30T5m)		
	Thickness (mm)		
	t ≤ 0.210	0.210 < t ≤ 0.280	0.280 < t
T-1	50 ± 4	49 ± 4	48 ± 4
T-2	54 ± 4	53 ± 4	52 ± 4
T-2.5	56 ± 4	55 ± 4	54 ± 4
T-3	58 ± 4	57 ± 4	56 ± 4
T-3.5	60 ± 4	59 ± 4	58 ± 4
T-4	62 ± 4	61 ± 4	60 ± 4
T-5	66 ± 4	65 ± 4	64 ± 4

<Double cold-Reduced(DR)>

Temper Designation	Rockwell Superficial Hardness (HR 30T5m)
DR-7.5	71 ± 4
DR-8	72 ± 4
DR-8.5	73 ± 4
DR-9	75 ± 4
DR-9M	76 ± 4
DR-10	79 ⁺³ -4

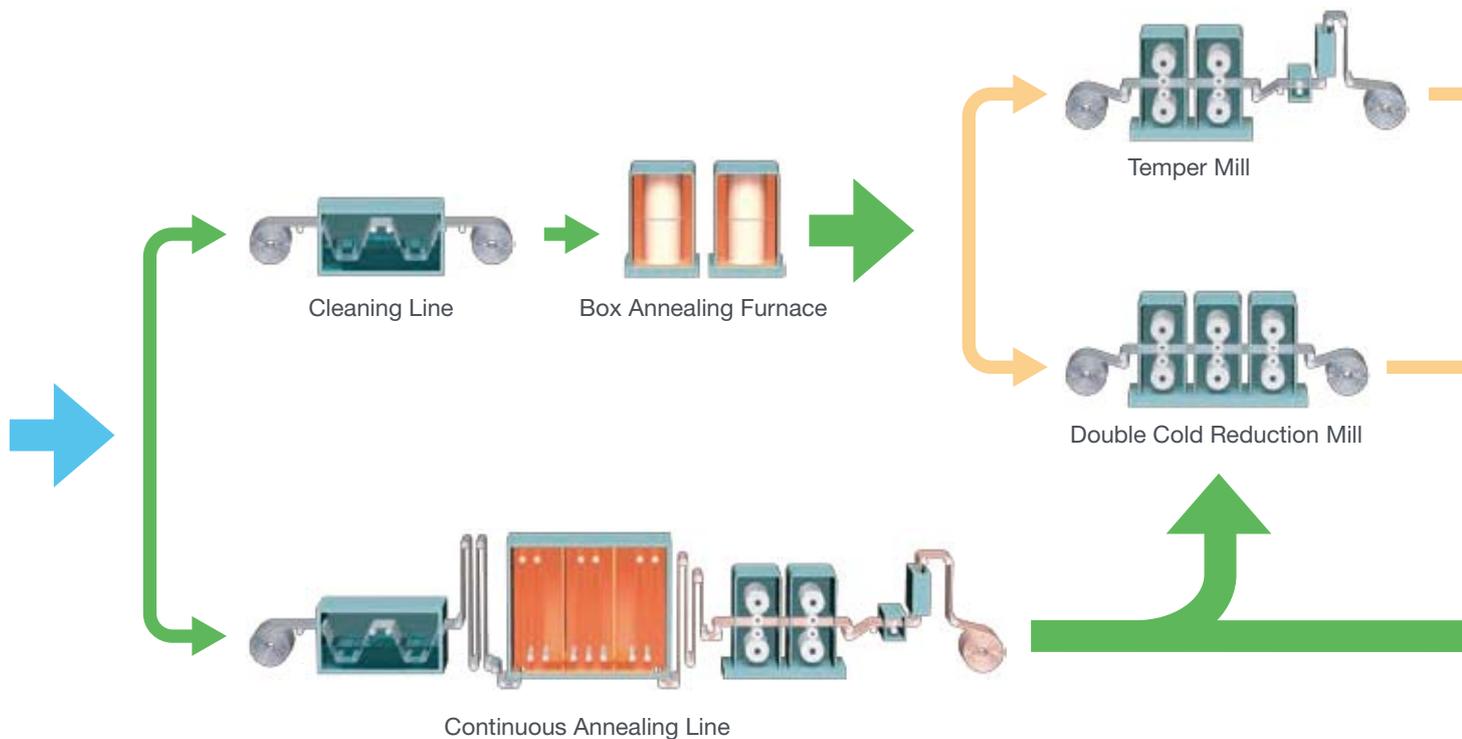
Manufacturing Process

Ironmaking , Steelmaking, Hot Rolling



Cold Strip Mill

Cleaning/Annealing



Temper rolling/finishing

<Manufacturing Process Notes>

JFE manufactures tin mill products under strict operating in order to meet customer requirement. For example, since the inclusion defect in substrate is controlled in steel making process and thickness profile is controlled in hot and cold strip mill, JFE's tin mill products can be applied to Drawing can and Easy-open End(EOE) usage.

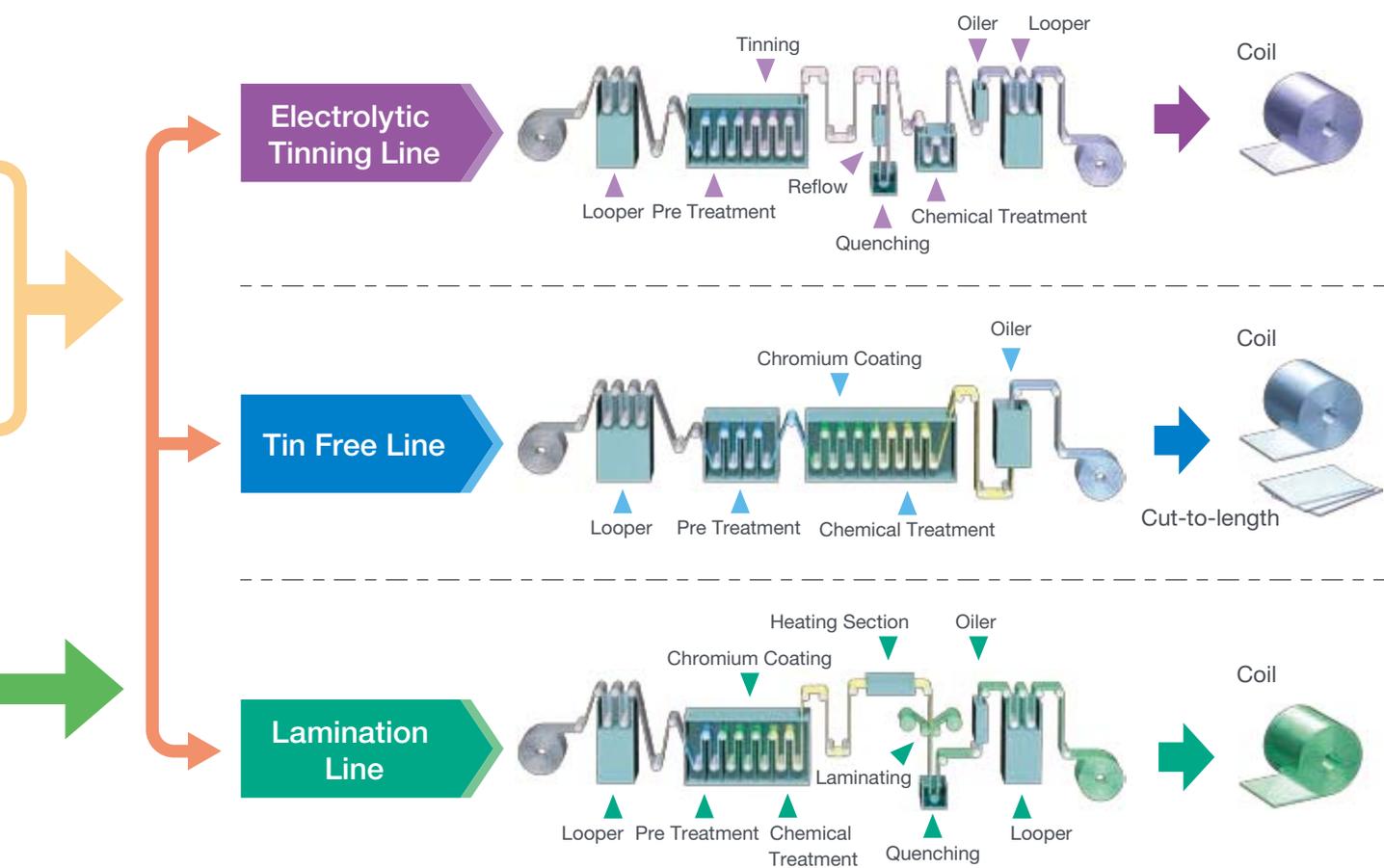
<QC&QA Control / Process>

- [Steelmaking]** Chemical composition, Steel Cleanness
- [Hot Strip Mill]** Finishing Temperature and Coiling Temperature
- [Cold Strip Mill]** Flatness, Thickness Uniformity
- [Annealing]** Heating, Soaking and Cooling Temperature, Atmospheric Gas Composition
- [Temper Mill]** Flatness, Surface Roughness
- [Surface Coating]** Coating Mass (Plating, Chemical Treatment)
Amount of Anti-Rust Oil , Laminate Heating Temperature



| Surface Coating

| Product



| Cold Strip Mill

| Continuous Annealing Line

| Electrolytic Tinning Line

| Tin Free Line



Tinplate



Tinplate

<Features>

1 Beautiful Appearance

Tinplate is characterized by its beautiful metallic luster. Products with various kinds of surface finish are produced by controlling surface roughness of blackplate.

2 Excellent Paintability & Printability

Printing is beautifully finished using various lacquers and inks.

3 Excellent Formability & Strength

By selecting a proper temper designation, appropriate formability is obtained for various applications as well as the required strength after forming.

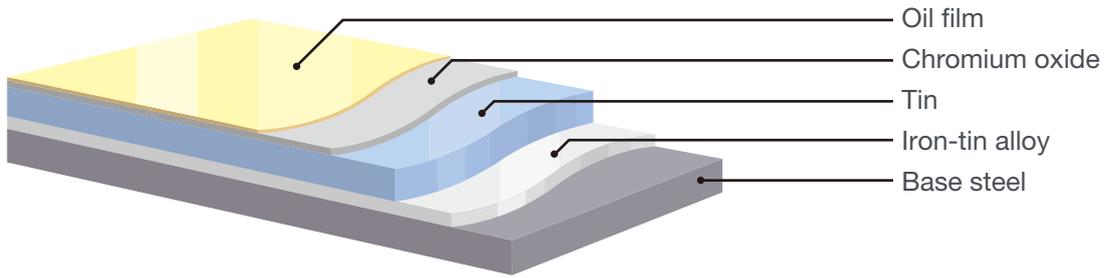
4 Excellent Corrosion Resistance

By selecting a proper coating mass, appropriate corrosion resistance is obtained against container contents.

5 Excellent Solderability & Weldability

Tinplate is widely used as base metal of soldering cans and welding cans.

<Coating Structure>



<Applications>

Tinplate is applied to various containers such as food, beverage, artistic containers and electric parts.



Food cans



Beverage cans



18-liter cans



Artistic containers

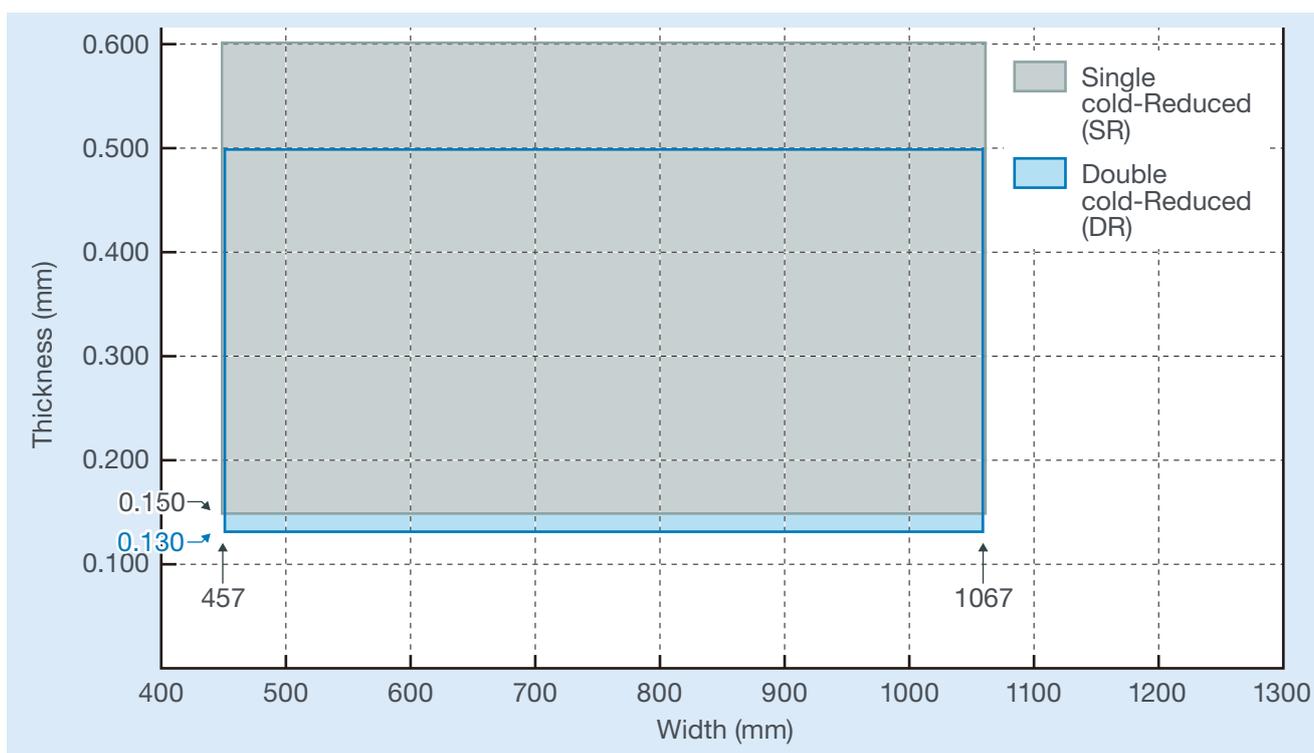
Available Sizes and Specifications

1 Available Sizes

<Coil>

		Single cold-Reduced(SR)	Double cold-Reduced(DR)
Thickness	mm	0.150 - 0.600	0.130 - 0.500
Width	mm	457 - 1,067	
Inside Diameter	mm	419/508	
	(inch)	(16.5/20.0)	
Outside Diameter	mm	Max. 2,130	
Coil weight	ton	1.0 - 18.0	

<Available Sizes>



The productable area is changed depending on the combination of width, thickness and temper designation, so please consult us before ordering.

2 Tin Coating Mass

	Designation of Standard Tin Coating Mass (g/m ²)
Equally Coated	2.8
	5.6
	8.4
	11.2
Differentially Coated	2.8/5.6
	2.8/8.4
	2.8/11.2
	5.6/8.4
	5.6/11.2
	8.4/11.2

- The tin coating mass is changed depending on usage. In case of heavier tin coating mass, it is applied to high corrosion contents and to non painting can in general. On the other hand, in case of lighter tin coating mass, it is applied to low corrosion contents and to painting can in general.
- Indication of Different Tin Coating Mass
As for method of expressing differentially coated tinplate, the marking shall be made by using a continuous line near one edge on the lightly coated surface. "S" is placed after the mass number indicating differentially coated tinplate.
(Ex.: 2.8S/5.6)
- With regard to other types of differential markings, please consult us.

3 Surface Finishes

4 Steel Types

With regard to details about surface finishes and steel types, please refer to page 16 [Surface finishes, steel types (for both Tinplate and TFS)].



Tin Free Steel (TFS)

<Features>

1 Advanced Features

▶ Paint Adhesion

TFS has excellent paint adhesion properties that far surpass those of Tinplate, allowing its use for making various painted cans for example DRD cans.

▶ Heat Resistance

High-temperature baking causes neither discoloration nor deterioration in coating properties.

▶ Resistance to black sulfide stain

Excellent resistance to black sulfide stain makes itself the most suitable material for making food can with inside painting.

2 Features Different from Tinplate

▶ Appearance

Although the same surface finish as that of Tinplate can be applied to TFS, the appearance after Cr coating is a metallic luster and is different from that of Tinplate.

▶ Corrosion Resistance

As it has excellent corrosion resistance after painting, it is generally used with both surfaces painted. But, it can also be used with the internal surface unpainted, depending on the contents.

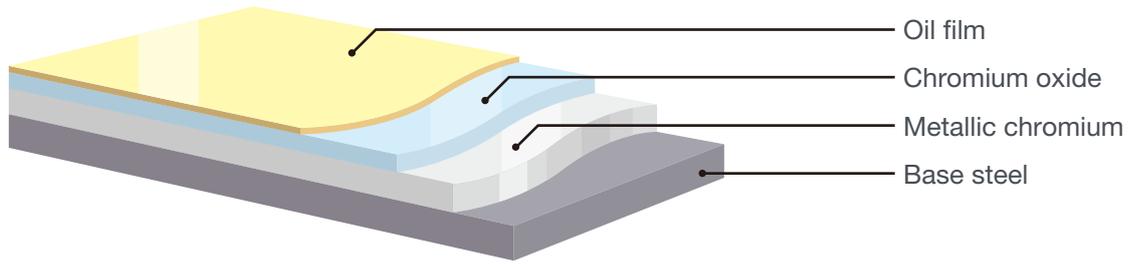
▶ Solderability

TFS is unsuitable for soldering.

▶ Weldability

Although TFS can be welded when the metallic coating layers are removed, its weldability is inferior to Tinplate.

<Coating Structure>



<Applications>

Excellent paint adhesion makes itself the most suitable material for making food can, crown, artistic can and general can with painting.



DRD cans



Various painted cans, crowns and caps

Available Sizes

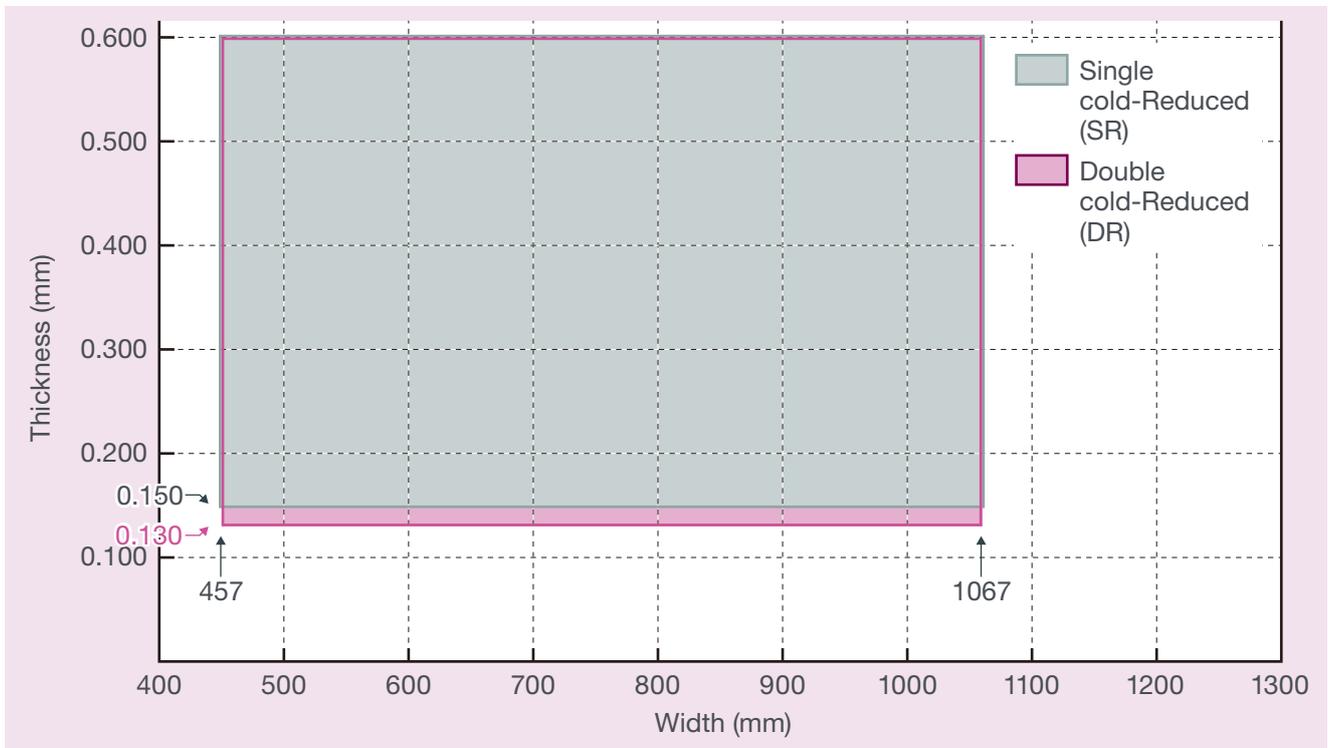
<Sheet>

		Single cold-Reduced(SR)	Double cold-Reduced(DR)
Thickness	mm	0.150 - 0.600	0.130 - 0.600
Width	mm	457 - 1,067	
Length of Sheet	mm	406 - 1,110	

<Coil>

		Single cold-Reduced(SR)	Double cold-Reduced(DR)
Thickness	mm	0.150 - 0.600	0.130 - 0.600
Width	mm	457 - 1,067	
Inside Diameter	mm	406/419/508	
	(inch)	(16.0/16.5/20.0)	
Outside Diameter	mm	Max. 2,130	
Coil weight	ton	1.0 - 18.0	

<Available Sizes>



The productable area is changed depending on the combination of width, thickness and temper designation, so please consult us before ordering.

Surface Finishes, Steel Types (both for Tinplate and TFS)

1 Surface Finishes

Surface Finishes	Code	Surface Roughness Aiming Ra(μm)	Features and Applications
Bright	B	0.25	Luster Bright
Bright Stone	BR	0.30	Slight Grind Finish
Stone	R 1	0.40	Grind Finish (Scratches during printing and tin manufacturing don't show.)
Super Stone	R 2	0.60	Rough Grind Finish
Matte	M	1.00	Dull Finish. (For bottle crowns and DI cans (no-melt material in case of tinplate))
Silver 1	S 1	1.00	Dull Finish. (For artistic canisters (tinplate melt material only))
Silver 2	S 2	2.50	Rough, Dull Finish. (For artistic canisters (tinplate melt material only))
Silver 3	S 3	3.00	Rough, Dull Finish. (For artistic canisters (tinplate melt material only))

(Note) Sub-classified based on the surface finishing of the blackplate.

2 Steel Types

Continuous cast, aluminum-killed steel is used.

Steel Type	Description
MR	Base steel low in residual elements that has excellent corrosion resistance, commonly used for most tin mill products.
L	Base steel extremely low in residual elements such as Cu, Ni, Cr and Mo that has improved corrosion resistance for certain food product containers.
D	Aluminum-killed base steel required to minimize severe fluting and stretcher-strain hazards or for severe drawing applications.

Laminated Steel Sheet



Laminated Steel Sheet (JFE UNIVERSAL BRITE)

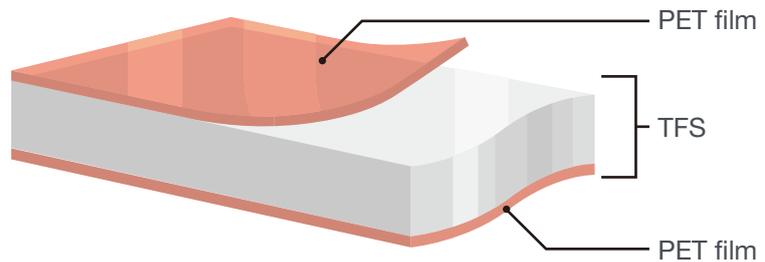
<Features>

- ▶ **Environmentally Friendly**
Omitting painting and baking process
- ▶ **Corrosion Resistance**
Excellent corrosion resistance and black sulfide stain resistance make itself suitable for food can.
- ▶ **Formability**
Excellent formability makes itself suitable for lid and drawing can (film laminated and wax coating on both sides)

<Film Structure>

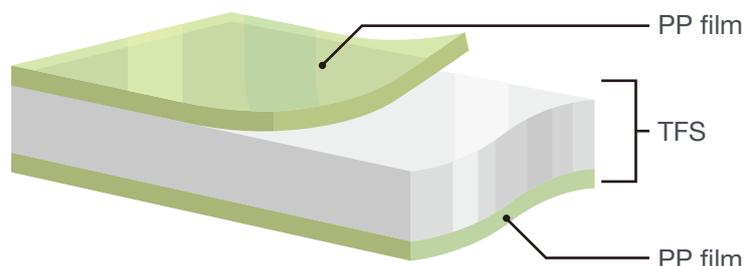
JFE UNIVERSAL BRITE can be classified into two types : PET and PP.

■ PET film structure



PET film thickness: 12 - 20 μm

■ PP film structure



PP film thickness: 50, 70 μm

(Note)

- (1) For information on the film thickness outside the above range, please consult us.
- (2) Both sides lamination is recommended to prevent bare side from rusting. If one side laminated material is required, please consult us.

<Applications>

JFE UNIVERSAL BRITE <Type F>

This is the first food can using laminated TFS material in history. This product satisfies a wide variety of needs including "contents release property" for food can use, and also enables cost saving of can manufacture.



Basic Performance

◎ : Excellent ○ : Good △ : Poor x: Bad

		JFE UNIVERSAL BRITE		TFS (comparison)
		PET	PP	
Corrosion Resistance when used bare ^{*1}	Rust Resistance	◎	◎	○
	Acid Resistance	◎	◎	△
	Alkali Resistance	○ ^{*2}	◎	◎
	Black Sulfide Stain Resistance	◎	△	◎
	Stress Cracking Resistance	△ ^{*4}	△ ^{*4}	△
Paintability		◎ ^{*4}	◎ ^{*4}	◎
Corrosion Resistance after Painting ^{*3}		◎ ^{*4}	◎ ^{*4}	○
Filiform Corrosion Resistance		◎	◎	◎
Paint Adhesion		○ ^{*4}	○ ^{*4}	◎
Internal Surface No-lubricant Press Formability		◎	◎	△
Solderability		x	x	x
Heat Resistance ^{*6}		○	△	◎

*1 Corrosion resistance when used bare : Evaluated in the closed state. The evaluation may change depending on the content actually used. Please consult us in advance.

*2 Please contact us for the desired pH in advance.

*3 Evaluation by cross-cut corrosion test : The evaluation may change depending on the actual conditions of use.

*4 Each performance may change depending on the actual conditions of use.

*5 Evaluation when welded with the plating layer not polished.

*6 Heat resistance : The properties may change through the process of painting or printing.

* Film cracking may occur depending on the environment if the film is flawed due to processing.

* Shelf life of the container may be affected by can design, container making process and packing condition. Packing test with the same condition to commercial production is essentially required before applying this product to every particular contents.

JFE Advanced Technology

1 Contents Release Property

JFE has developed the film with contents release property by adding wax to the film.

JFE UNIVERSAL BRITE

Lacquered TFS



Contents release property after retort processing and packing Contents: mixture of meat, eggs, etc.

2 Design Properties

It is possible to manufacture laminated steel sheets of various colors by adding dye or pigment to the film. Please contact us in case of special requirements for the color.



<Clear>



<White>



<Gold>

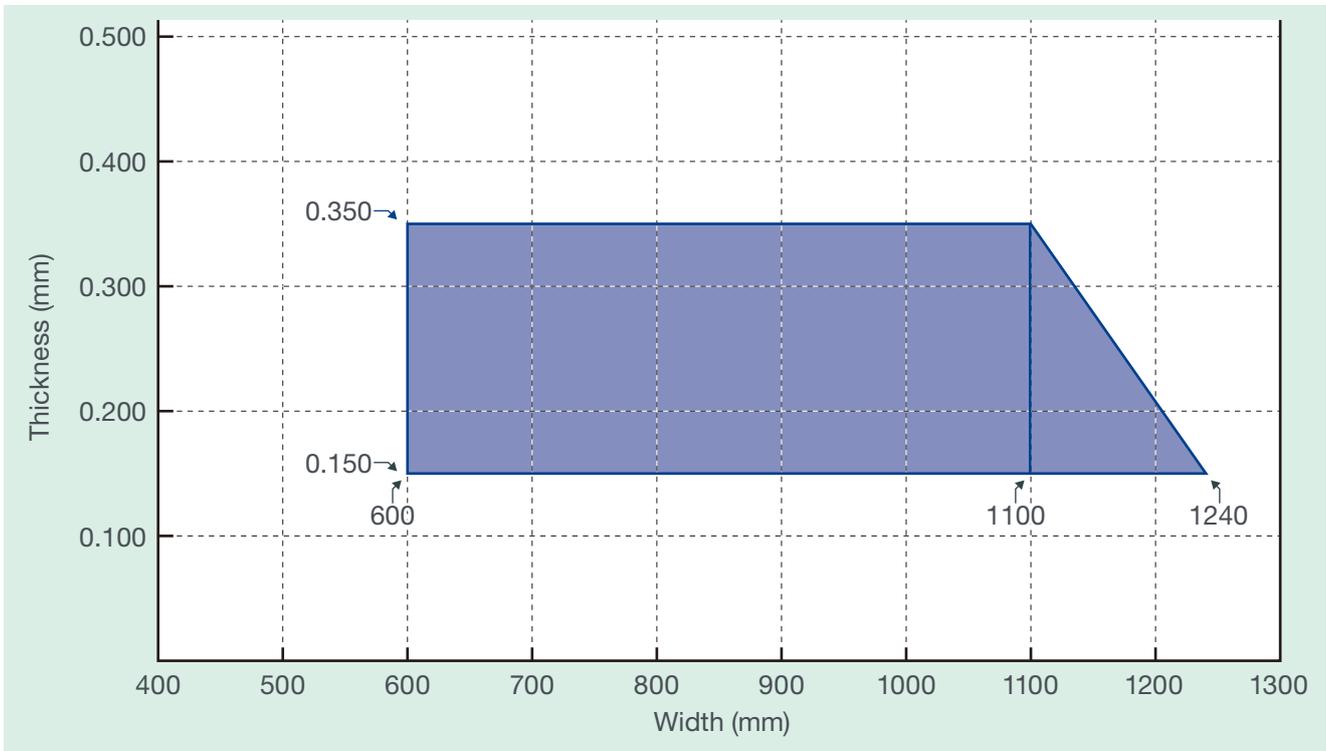
Available Sizes

<Coil>

		Single cold-Reduced(SR)	Double cold-Reduced(DR)
Thickness	mm	See [Fig. 1].	See [Fig. 1].
Width	mm	See [Fig. 1].	See [Fig. 1].
Inside Diameter	mm	419/508	
	(inch)	(16.5/20.0)	
Outside Diameter	mm	Max. 2,130	
Coil weight	ton	1.0 - 18.0	

<Available Sizes>

[Fig. 1]



The productable area is changed depending on the combination of width, thickness and temper designation, so please consult us before ordering.

High Strength / Outstanding High Processability A Leading Edge Thin Gauge Flat Steel Product for Cans **JATT series**

JATT applications: 3-piece can Body, normal END, EOE and Bottle Crown using DR material.

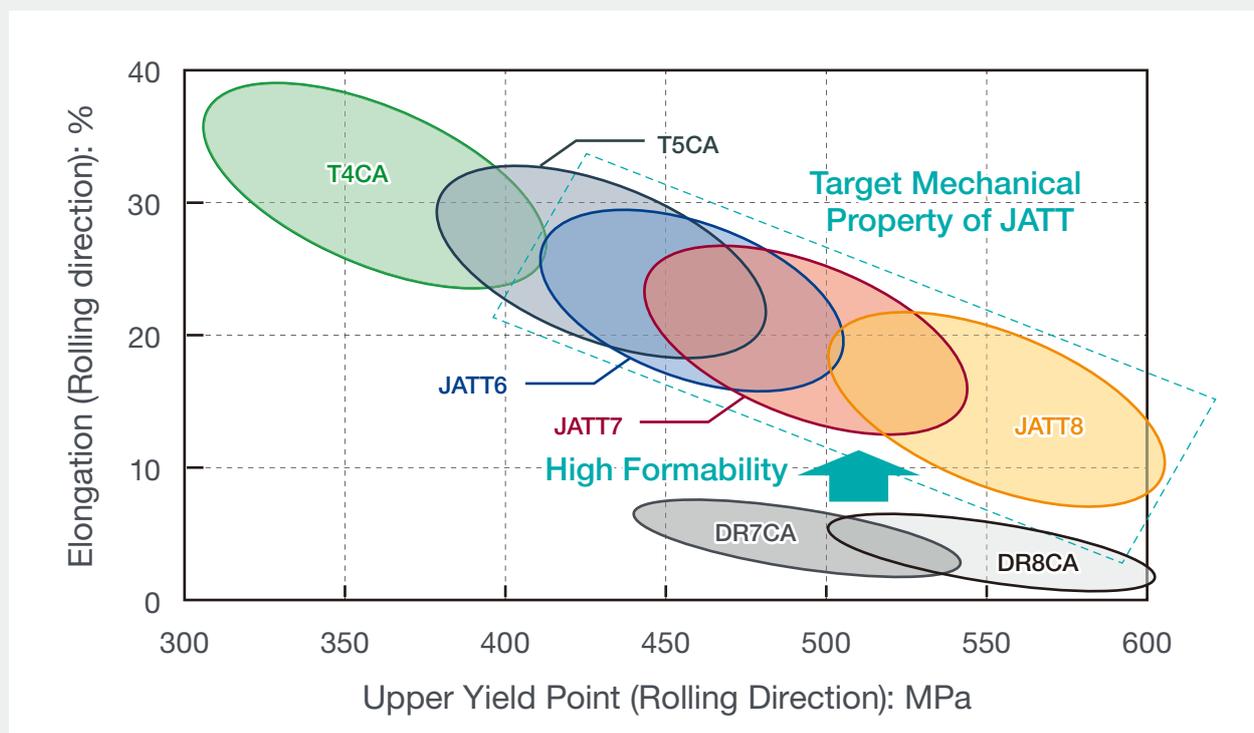
Features of JATT

1 Excellent Strength-ductility Balance

JFE has been developing the new material "JATT" with high formability while maintaining the strength as those of conventional DR material. Each from JATT6 to JATT8 offering is provided to match the required strength level. (Table 1)

*DR: Double cold-Reduce (characterized by work hardening by double rolling (for higher strength))

<Fig. 1: Strength-ductility Balance of JATT series>



<Table 1: Mechanical Properties of JATT series>

		Target Mechanical Property		
		Hardness	Yield Point (MPa)	Elongation (%)
JATT	6	67±4	460±50	15≤
	7	69±4	480±50	15≤
	7.5	71±4	520±50	15≤
	8	72±4	550±50	(10≤)

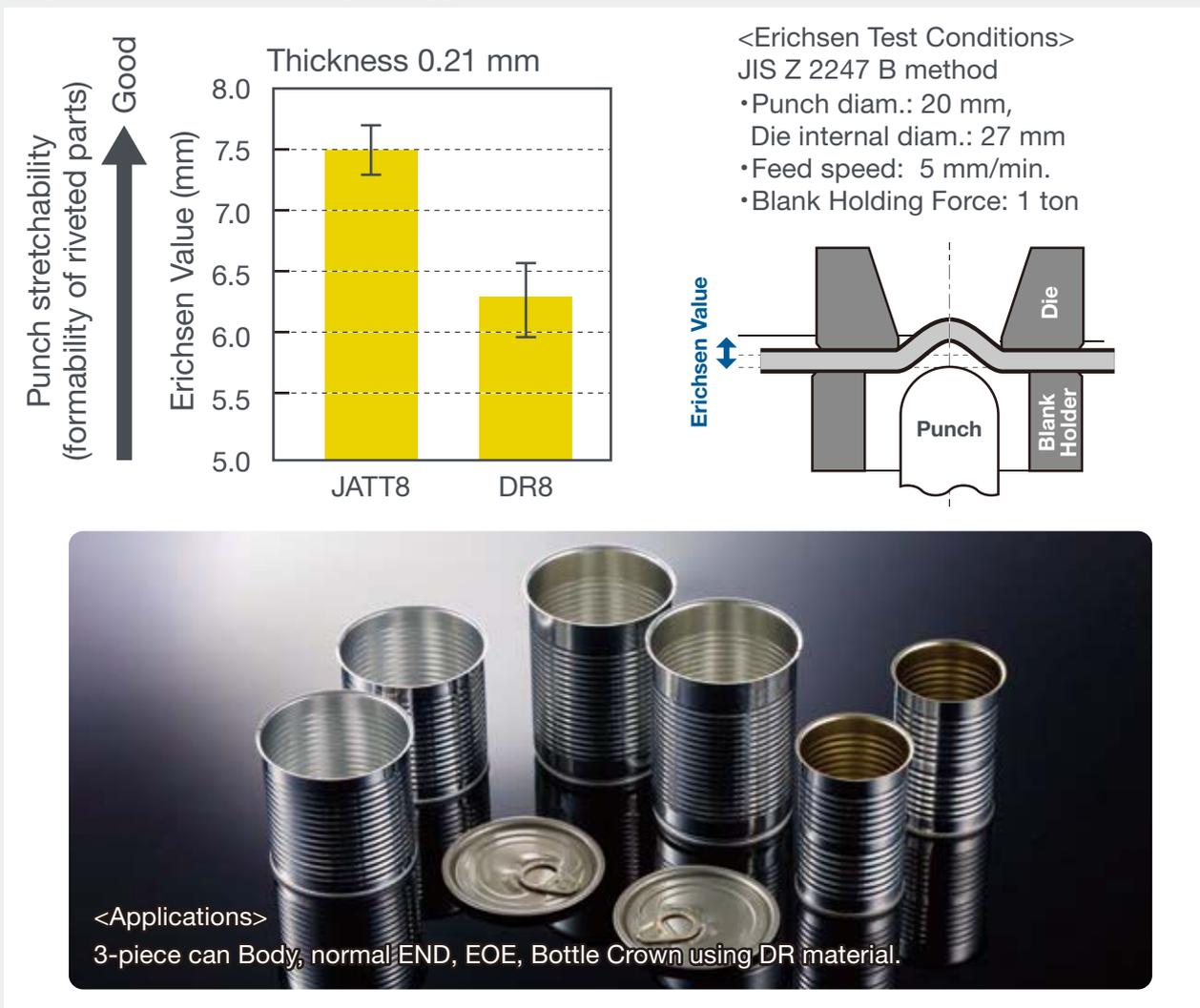
JFE Advanced Thin gauge Tin mill products

Exceptional strength-ductility balance and improved formability broaden the range of applications

2 Supporting the can manufacturing technologies of our customers

- 1 Improved formability (Fig. 2) reduces cracking around flange of 3-piece cans and rivets of can ends.
- 2 Buckling or dent deformation is suppressed effectively.
- 3 Customer's freedom of can design increases and a competitive differentiation is created.

<Fig. 2: JATT series formability and applications>



3 Excellent Corrosion Resistance

The main approach to increase strength is utilizing dissolved nitrogen, without adding a large quantity of alloying elements, so there is no negative impact on corrosion resistance. In this way, the high corrosion resistance of conventional material is preserved.

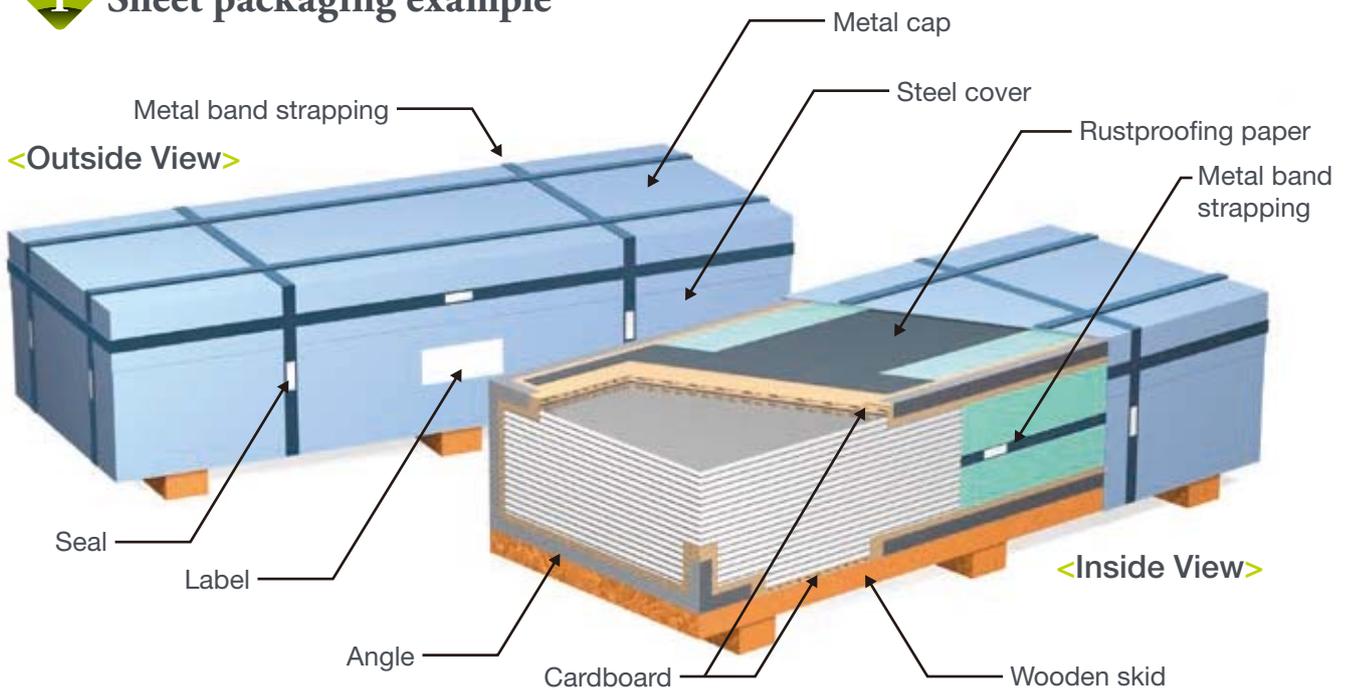
Packaging and Marking

The products are packaged in the manners shown below in order to prevent them from being damaged.

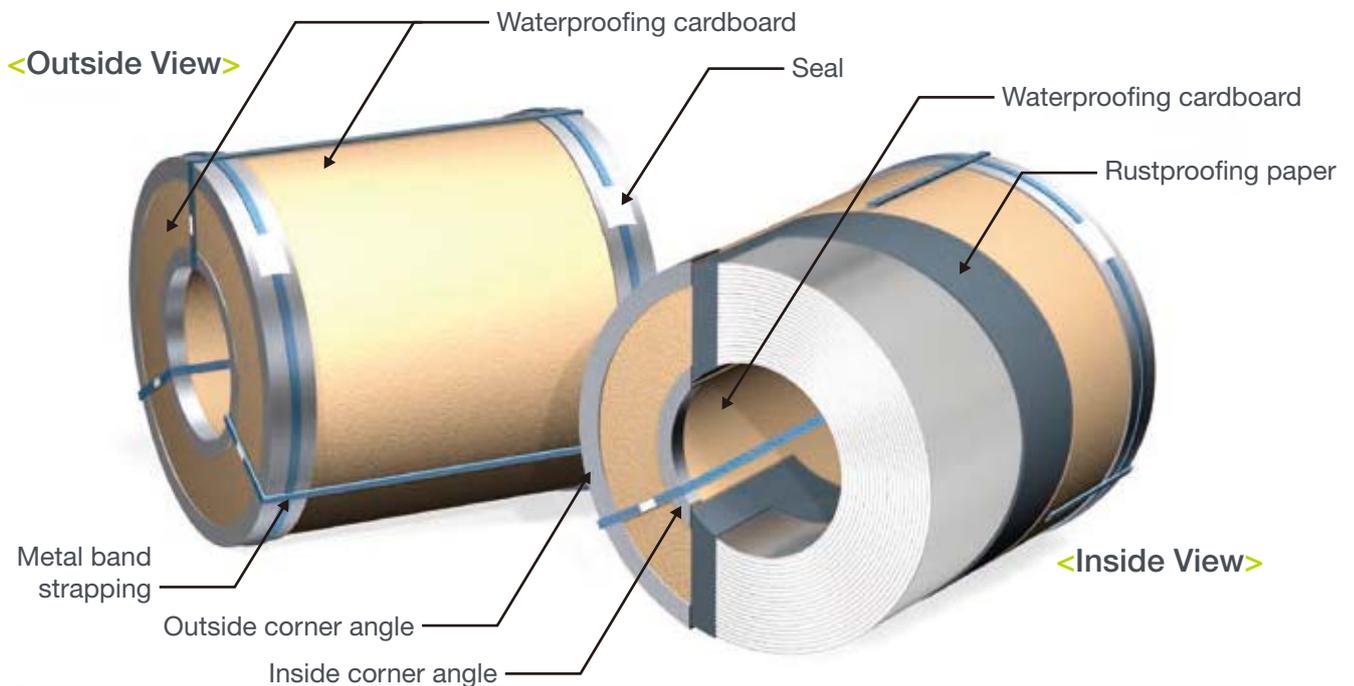
A label that indicates the manufacturing history is affixed to the outside of the packaging. In addition, a service card is contained inside.

The label and service card show the following information on each packaging : specification, size, grade, number of sheets(for cut-to-length products), weight, inspection number, coil number, and production date.

1 Sheet packaging example



2 Coil packaging example



Usage Precautions

1 Usage Precautions for Tinplate

- 1) As Tinplate is covered by soft metallic tin coatings, due precautions should be taken not to cause scratches by rough handling or vibration during transportation. Please use as soon as possible after unpacking.
 - 2) Note that after it is manufactured the paintability, printability, solderability, and mechanical properties of Tinplate may deteriorate over time. Please use as soon as possible after delivery.
 - 3) Although Tinplate has excellent corrosion resistance, it tends to rust in a humid atmosphere. Please use as soon as possible after unpacking.
 - 4) Tin is dissolved by a strongly alkaline solution. When using Tinplate for making cans for alkaline contents, please paint the internal surface.
 - 5) As contents that contain sulfur cause blackening of the Tinplate surface, please paint the internal surface.
-

2 Usage Precautions for TFS

- 1) TFS is not compatible with soldering and DI forming. However, once painted, it can be used in almost all applications where Tinplate is used.
- 2) The metallic coating layer of TFS has a high electrical resistance. When welding it, the metallic coating layers in the welded areas should be removed in advance.
- 3) TFS tends to rust in a humid atmosphere. Please use as soon as possible after unpacking. The external surfaces of cans should be painted to prevent corrosion.
- 4) The internal surfaces should also be painted to prevent corrosion except when the content is motor oil or cooking oil.
- 5) TFS does not provide sacrificial protection like Tinplate. Due precautions should be taken not to cause scratches on the surface of TFS after it is formed into cans and painted.

3**Usage Precautions for JFE UNIVERSAL BRITE(UBT)**

- 1) Although UBT has excellent bare corrosion resistance, base steel is exposed at cut ends. The uncovered surface of single-sided laminate is TFS. Due precautions should be taken when handling and storing it like other products.
- 2) When UBT is cut, the laminated film may generate chips. Due attention should be paid to wear, clearance, and other conditions of the cutting tools.
- 3) In some cases, desired characteristics may not be obtainable depending on the contents, paint baking, and other process conditions. Please consult us in advance in order to secure the laminated product that best meets your requirements.
- 4) Note that since the heat resistance of UBT is different to that of TFS, its properties may deteriorate when it is heated after it is painted or printed.

Information Required with Orders and Inquiries

Orders and inquiries shall be accompanied by the following information.

- 1) Product name and grade
- 2) Coating mass (for Tinplate only), temper grade, finish, and product size
- 3) Rolling direction
- 4) Quantity
- 5) Application and delivery date
- 6) Number of sheets per packaging (for cut-to-length products)
- 7) Inside Diameter and maximum acceptable unit coil weight (for coiled products)
- 8) Film type, color, contents, and other details of use and environment (for JFE UNIVERSAL BRITE)
- 9) Other special requirements, if any

Note that inquiries regarding orders and technical queries about product use can be directed to us at the telephone numbers below.

<Head office>

Tin Mill Products Export Sec., Tin Mill Products Sales Dept. Tel: +81-3-3597-3766

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