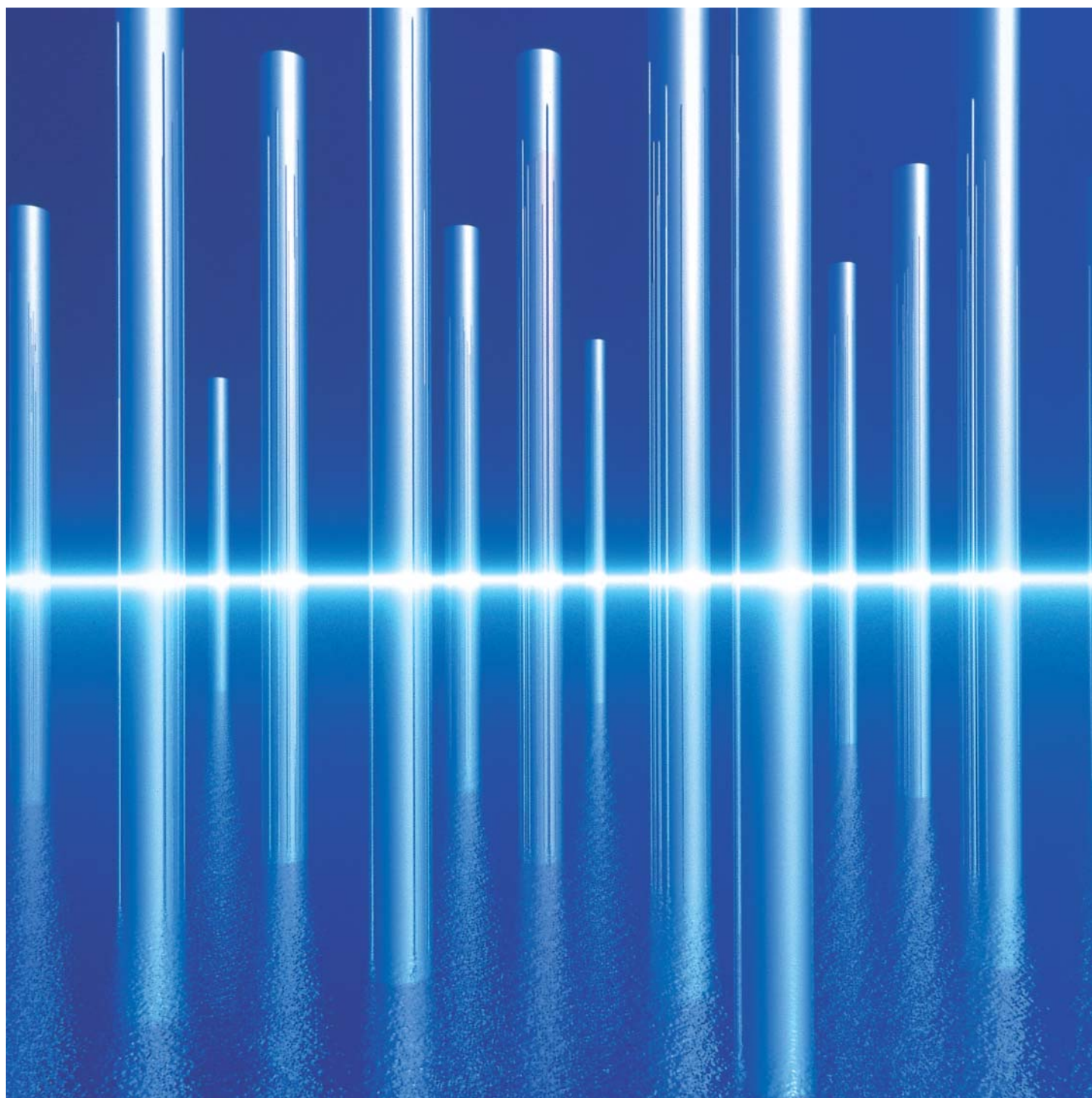




JFE

TINPLATE and TIN FREE STEEL



JFE Steel Corporation

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Introduction

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

Tinplate is used for making all types of containers such as food cans, beverage cans, 18-liter cans, and artistic cans. Its applications are not limited to containers; recently, tinplate has also been used for making electrical machinery parts and many other products.

Tin Free Steel (TFS) is produced by applying electrolytic chromic acid treatment over steel sheets. This steel product was developed to meet economic requirements, and excels tinplate in paintability, paint adhesion, and economy. It is widely used for making beverage cans and 18-liter cans. It is also used for making photographic film cases and as a protective material for optical fiber cables.

As new TFS products, JFE BRITE have been launched, which allow welding without grinding in contrast to conventional TFS products that require grinding before welding to remove the metallic coating layers.

Today, social concerns over the global environment are intensifying throughout the world. Prioritizing the environmental friendliness in its business operations, JFE developed UNIVERSAL BRITE (UBT), a TFS product on which PET or polypropylene films are laminated in order to eliminate the painting and cleaning processes when using TFS, thus suppressing the emissions of off-gas and the amount of water used.

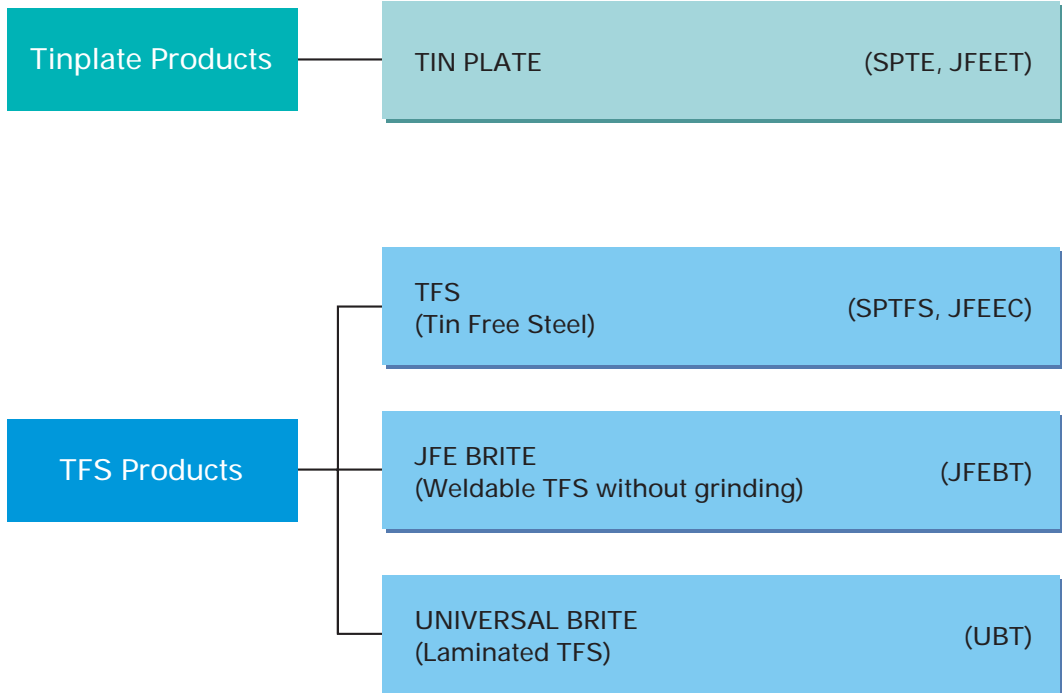
JFE manufactures the tinplate and TFS products under the ISO9001-based integral quality management system, which covers every step from materials to final finishing processes, earning high regard from its customers on product quality.

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.

List of Tinplate & TFS (Tin Free Steel) Products

JFE's tinplate & TFS (Tin Free Steel) products include the following.

- List of Product Names & Product Designations



① Features of Tinplate Products

Features of TIN PLATE

1. Beautiful Appearance

TIN PLATE is characterized by its beautiful metallic luster. Products with various kinds of surface roughness are produced by selecting the surface finish of the substrate steel sheet.

2. Excellent Paintability & Printability

Printing is beautifully finished using various lacquers and inks.

3. Excellent Formability & Strength

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

4. Excellent Corrosion Resistance

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

5. Excellent Solderability & Weldability

TIN PLATE is widely used for making various types of cans by soldering or welding.

② Features of TFS Products

Features of TFS

1. Features That Excel TIN PLATE

- **Paint adhesion** ————— TFS has excellent paint adhesion properties that far surpass those of TIN PLATE, allowing its use for making DRD cans and adhesive bonded cans.
- **Heat resistance** ————— High-temperature baking causes neither discoloration nor deterioration in material properties.
- **Resistance to black sulfide stain** ————— Excellent resistance to black sulfide stain makes it the most suitable material for making fish cans.

2. Features Different from TIN PLATE

- **Appearance** ————— Even when the same surface finish as TIN PLATE is applied to the substrate steel sheet, it provides the unique surface luster characteristic of metallic chromium.
- **Corrosion resistance** ————— As it has excellent corrosion resistance after painting, it is generally used with both surfaces painted. It can also be used with the internal surface unpainted, depending on the contents.
- **Solderability** ————— TFS is not compatible with soldering.
- **Weldability** ————— Although TFS can be welded when the metallic coating layers are removed, its weldability is inferior to TIN PLATE.

Features of JFE BRITE

1. Features That Excel TFS

- **Weldability** ————— JFE BRITE can be welded without grinding the surface to remove the metallic coating layer owing to the thin chromium oxide film. As the grinding process is eliminated, cleaner cans are manufactured.

2. Features Different from TFS

- **Resistance to galling** — JFE BRITE is generally used with both surfaces painted like TFS. For using it with the internal surface unpainted, it is recommended to apply Inbricant such as wax when press forming.

Features of UNIVERSAL BRITE (UBT)

1. Features That Excel TFS

- **Environmental compatibility** ————— The painting process can be eliminated.
- **Barrier effect** ————— UNIVERSAL BRITE has excellent bare corrosion resistance and resistance to black sulfide stain.
- **Formability** ————— The excellent formability more than equivalent to prepainted steel sheets allows deep drawing without applying lubricant.

2. Features Different from TFS

- **Heat resistance** ————— High-temperature baking after painting and printing may deteriorate material properties of UNIVERSAL BRITE.

● Comparison of Properties

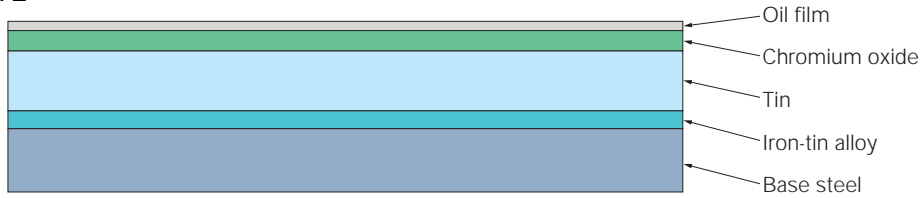
		TIN PLATE (g/m ²)		TFS	JFE BRITE	UNIVERSAL BRITE	
		2.8	over 5.6			PET	PP
Bare Corrosion Resistance (sealed) ⁽¹⁾	Rust Resistance	○	◎	○	○	◎	◎
	Acid Resistance	○	○	△	△	◎	◎
	Alkali Resistance	△	△	◎	◎	○	◎
	Black Sulfide Stain Resistance	△	△	◎	◎	◎	△
	Stress Cracking Resistance	◎	◎	△	△	△ ⁽⁵⁾	△ ⁽⁵⁾
Paintability		○	○	◎	◎	◎ ⁽⁵⁾	◎ ⁽⁵⁾
Corrosion Resistance after Painting ⁽²⁾		◎	◎	○	○	◎ ⁽⁵⁾	◎ ⁽⁵⁾
Filiform Corrosion Resistance		◎	◎	◎	◎	◎	◎
Paint Adhesion		○	○	◎	◎	○ ⁽⁵⁾	○ ⁽⁵⁾
Internal Surface No-lubricant Press Formability		○	○	△	△	◎	◎
Solderability		○	◎	×	×	×	×
Weldability		○	○	△ ⁽³⁾	○ ⁽⁴⁾	○ ⁽⁶⁾	○ ⁽⁶⁾
Heat Resistance ⁽⁷⁾		○	○	◎	◎	○	△

◎ : excellent ○ : good △ : fair × : poor

- (1) Bare corrosion resistance is evaluated under tightly sealed conditions. Evaluation of each product may change according to the 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) The evaluation is for the case where welding is performed without grinding the surface to remove the metallic coating layer.
- (4) The evaluation is for the case where welding is performed without grinding the surface to remove the metallic coating layer. Evaluation may change according to the type of welding machine and actual welding conditions.
- (5) The evaluation of performance of UNIVERSAL BRITE may change according to the actual use conditions. Please consult us in advance.
- (6) Weldability of UNIVERSAL BRITE is evaluated at no varnishing areas where there is no laminate coating. Therefore, the evaluation may change according to the type of welding machine and actual welding conditions.
- (7) High-temperature baking after painting and printing may cause changes in material properties.

Tinplate Products

● TIN PLATE



TFS Products

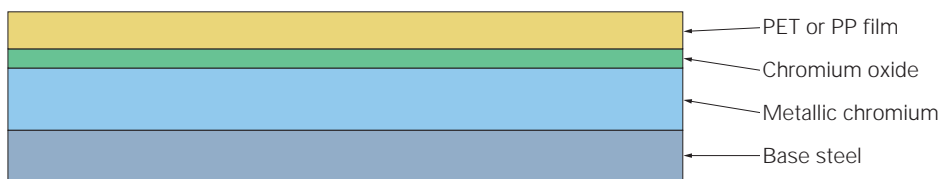
● TFS

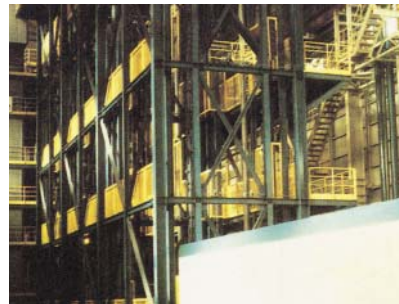
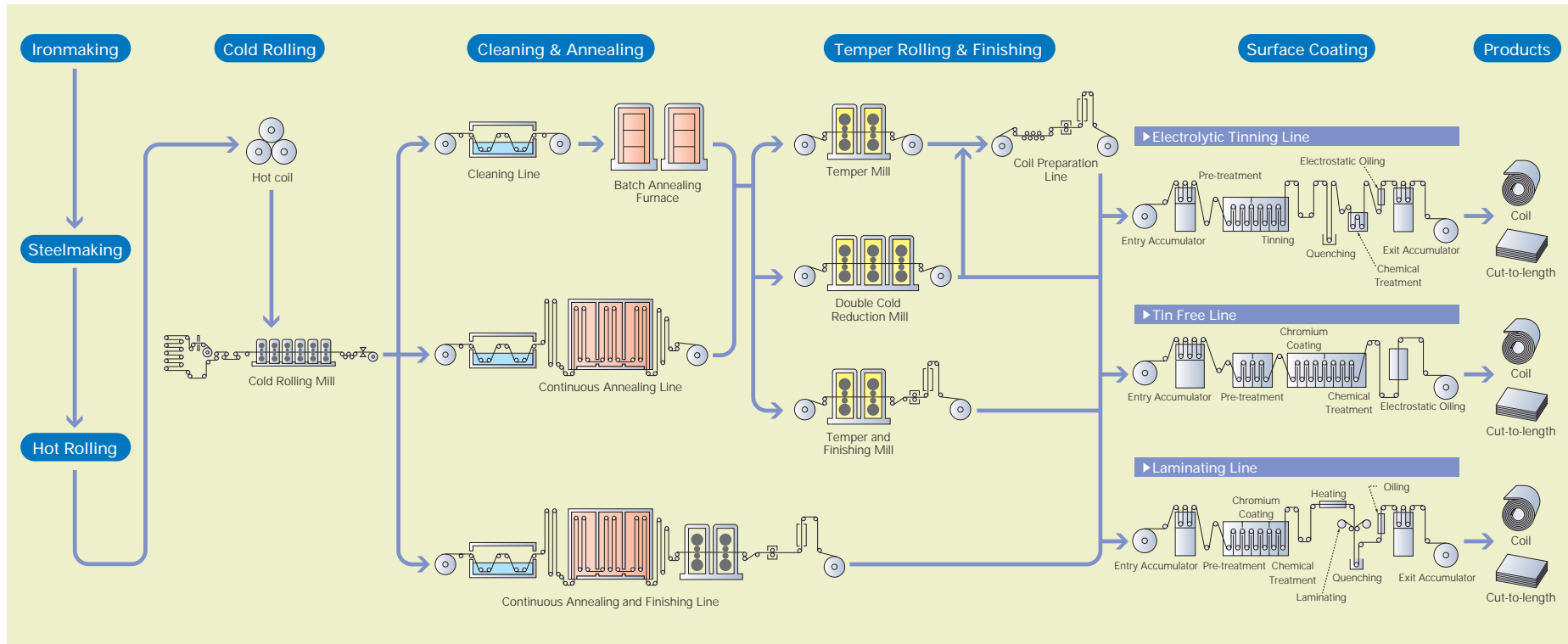


● JFE BRITE



● UNIVERSAL BRITE (UBT)





Note:
Tinplate and TFS products are manufactured under strict quality control all through the manufacturing process to provide the excellent corrosion resistance and uniform material properties required of can-making materials.

Major control items in the main manufacturing steps are as follows:

- Steelmaking:** Chemical composition, minimization of inclusions.
- Hot Rolling:** Finishing temperature, coiling temperature, gage profile.
- Cold Rolling:** Gage, flatness.
- Annealing:** Heating temperature, soaking temperature, cooling temperature, atmospheric gas composition.

Temper Rolling: Shape, surface roughness.
Electrolytic Plating: Coating weight, chemical treatment, oiling amount.

In particular, inclusions are thoroughly minimized during steelmaking and then the steel undergoes strict gage control in hot and cold rolling to obtain substrate for manufacturing tinplate for DI cans and easy-open lids, and TFS for DRD cans.

In manufacturing TFS that is used for making adhesive bonded cans that are subjected to hot-packing or retorting treatment, the quality and thickness of chromium oxide layer are strictly controlled in the TFS line.

In the laminating line, the substrate steel is continuously chromium-plated and film-laminated.

Specifications and Available Sizes

1. Available Sizes

(1) Sheet		T1 ~ T5		DR8 ~ DR10	
		Available Size Range	Size Range for Normal Production	Available Size Range	Size Range for Normal Production
Thickness	mm	0.15 ~ 0.60	0.18 ~ 0.50	DR8	0.13 ~ 0.60
				DR9	
				DR10	0.20 ~ 0.36
Width	mm	457 ~ 1,067	650 ~ 950	457 ~ 1,067	690 ~ 950
Length	mm	406 ~ 1,110	500 ~ 1,050	406 ~ 1,110	500 ~ 1,050

(2) Coil		T1 ~ T5		DR8 ~ DR10	
		Available Size Range	Size Range for Normal Production	Available Size Range	Size Range for Normal Production
Thickness	mm	0.15 ~ 0.60	0.15 ~ 0.50	DR8	0.13 ~ 0.60
				DR9	
				DR10	0.20 ~ 0.36
Width	mm	457 ~ 1,067	650 ~ 950	457 ~ 1,067	690 ~ 950
Inside Dia.	mm (in.)	406, 420, 508 (16, 16.5, 20.0)		406, 420, 508 (16, 16.5, 20.0)	
Outside Dia.	mm	2,130 max.		2,130 max.	
Coil Weight	mt	1.0 ~ 18.0	3.0 ~ 15.0	1.0 ~ 18.0	3.0 ~ 15.0

(1) Coils may include welded portions.

(2) When ordering a product that is outside the size range for normal production but inside the available size range, please consult us.

2. Temper Grade

	Temper Grade	Hardness Guarantee HR30T	Applications
Single Reduced	T-1	49 ± 5	Cans, nozzles and other applications involving deep drawing that requires large flexibility.
	T-2	53 ± 5	Items that require moderate drawability and some stiffness.
	T-2.5	55 ± 5	Items that require the drawability of T-2 in combination with the stiffness of T-3. For general use.
	T-3	57 ± 5	Proper stiffness is imparted to prevent buckling. For general use.
	T-S	59 ± 5	Items that require better formability than T-4 (JFE Standard)
	T-4	61 ± 5	Can bodies, ends and crowns that require comparatively large stiffness.
	T-5	65 ± 5	Can bodies, ends and other applications that require excellent buckling resistance.
Double Reduced	DR-8	73 ± 5	Bodies of carbonated beverage cans and beer cans that require stiffness and strength.
	DR-9	76 ± 5	Ends of carbonated beverage cans and beer cans that require stiffness and strength.
	DR-9M	77 ± 5	The same as DR-9.
	DR-10	80 ± 5	Special applications that require strength.

Remarks(1) There are two types of annealing : batch annealing and continuous annealing. When continuous annealing is designated, the symbol of "CA" is added after the temper grade symbol such as "T-4CA".

(2) The soft materials (T-1 to T-3) can also be manufactured by continuous annealing. Please consult us.

(3) DR-8, DR-9, and DR-10 are thin materials with high strength manufactured by cold-reducing the materials after cold-reducing and annealing.

3. Coating Weight

Tinplate

	New Coating Designation & Nominal Coating Weight(g/m ²)	Minimum average Coating Weight(g/m ²)	Former Coating Designation
Equally coated	2.8 / 2.8	2.45 / 2.45	# 25
	5.6 / 5.6	5.05 / 5.05	# 50
	8.4 / 8.4	7.55 / 7.55	# 75
	11.2 / 11.2	10.1 / 10.1	# 100
Differentially Coated	2.8 / 5.6	2.45 / 5.05	# 25 / 50
	2.8 / 8.4	2.45 / 7.55	# 25 / 75
	2.8 / 11.2	2.45 / 10.1	# 25 / 100
	5.6 / 8.4	5.05 / 7.55	# 50 / 75
	5.6 / 11.2	5.05 / 10.1	# 50 / 100
	8.4 / 11.2	7.55 / 10.1	# 75 / 100

- The tin coating weight is determined in accordance with specific end use applications. Tinplate with a heavy coating weight is used for making cans that require a high corrosion resistance or those used bare. Tinplate with a light coating weight is used for making cans that do not require so high a corrosion resistance or those used after painting or printing.
- Differential Markings
A white line (differential marking) is painted along the edge of a differentially coated product in order to clearly indicate that it is differentially coated, and "D" is added after the coating designation symbol for the marked side (e.g., 2.8D/5.6).
- With regard to other types of differential markings, please consult us.

TFS

	Minimum Average Coating Weight	Maximum Average Coating Weight
Metallic Chromium Layer	50mg/m ²	150mg/m ²
Chromium Oxide Layer	5mg/m ²	35mg/m ²

Specifications and Available Sizes

5. Surface Finishes

Finish	Surface Roughness Aim Ra (*)	Features & Applications
Bright	0.25	Bright finish for general use.
Stone	0.40	Surface finish with stone marks that make printing and can-making scratches less conspicuous.
Super Stone	0.60	Surface finish with heavy stone marks.
Matte	1.00	Dull finish mainly used for making crowns and DI cans (unmelted finish for tinplate).
Silver (Satin)	—	Rough dull finish mainly used for making artistic cans (tinplate only, melted finish).

*Remark : Sub-classified based on the surface finishing of the blackplate.

6. Steel Types

Continuously cast, aluminum-killed steel is used except where otherwise specified.

Type	Description
MR	Base steel low in residual elements that has excellent corrosion resistance, widely used in general applications.
L	Base steel extremely low in residual elements such as Cu, Ni, Co, and Mo that has excellent corrosion resistance to certain types of food products.
D	Aluminum-killed base steel used in applications involving deep drawing or other types of severe forming that tend to give rise to Lueder's lines.

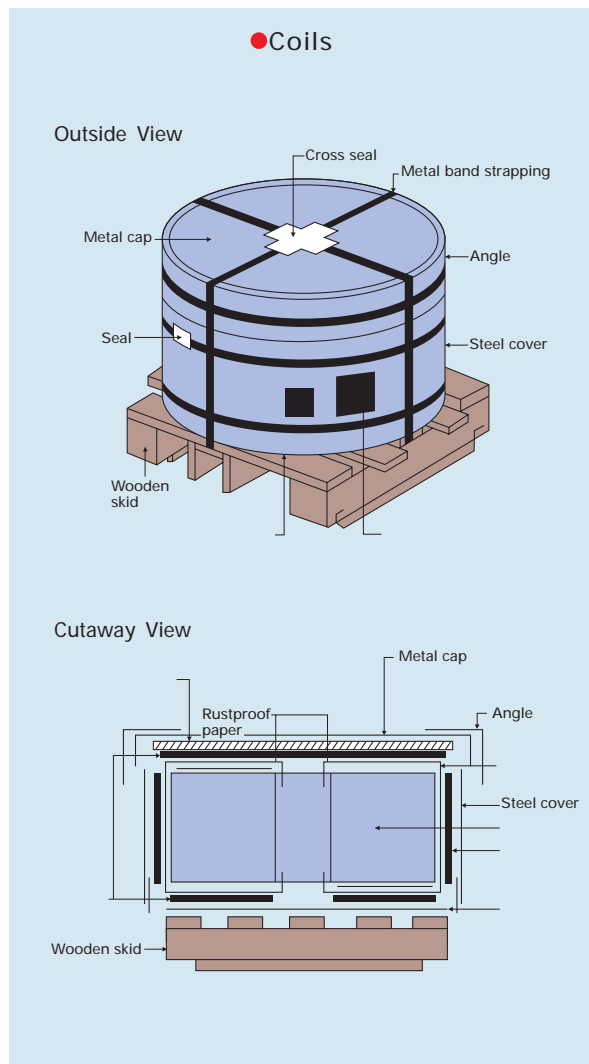
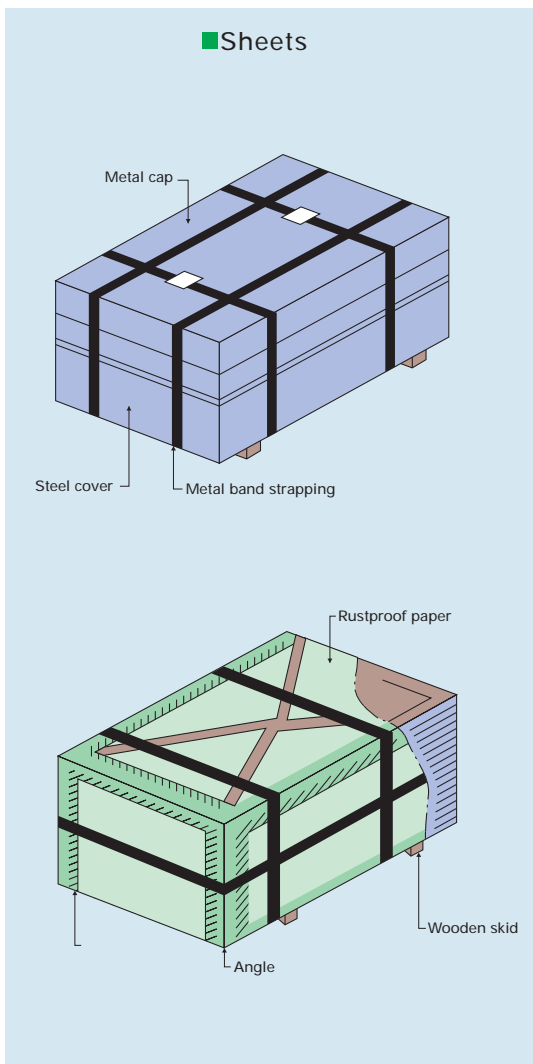
Remark : With regard to steel types other than those listed above, please consult us.

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.



Usage Precautions for TIN PLATE

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

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 TIN PLATE 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. 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 TIN PLATE. Due precautions should be taken not to cause scratches on the surface of TFS after it is formed into cans and painted.

Usage Precautions for JFE BRITE

1. As JFE BRITE is a TFS product with no grinding weldability, its basic characteristics are the same as TFS.
2. Although JFE BRITE is a material that allows welding operations without grinding, the metallic coating layers in the welded areas need to be removed in advance under certain welding conditions depending on such factors as the type of welding machine, welding speed, power frequency, and welding pressure.
3. Although JFE BRITE can be used bare in some applications, it is recommended to use it painted. In particular, the external surface should always be painted or printed.

Usage Precautions for UNIVERSAL BRITE (UBT)

1. Although UBT has excellent bare corrosion resistance, base steel is exposed at cut ends. 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.

Information Required with Orders and Inquiries

Orders and inquiries shall be accompanied by the following information.

1. Product name and grade.
2. Coating weight (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. Inner diameter and maximum acceptable unit coil weight (for coiled products).
8. Other special requirements, if any.

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