NIPPON STEEL

www.nipponsteel.com

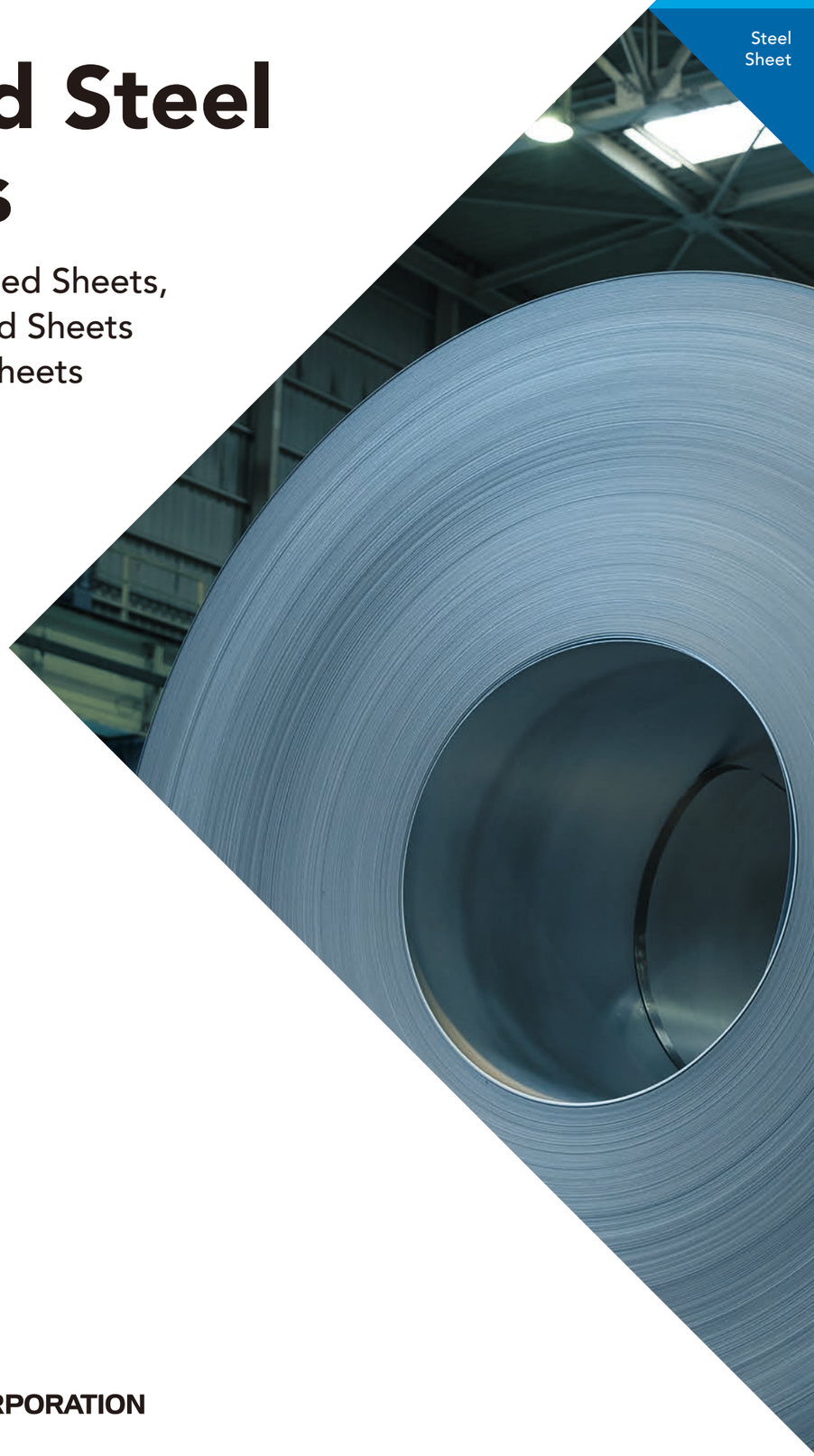
NIPPON STEEL CORPORATION
2-6-1 Marunouchi, Chiyoda-ku,Tokyo 100-8071 Japan
Tel: +81-3-6867-4111

Coated Steel Sheets
U008en_02_202004f
© 2019, 2020 NIPPON STEEL CORPORATION

NIPPON STEEL

Coated Steel Sheets

Hot-dip Galvanized Sheets,
Electrogalvanized Sheets
and Precoated Sheets



NIPPON STEEL CORPORATION

Coated Steel Sheets of NIPPON STEEL

Steel sheets are applied throughout a broad spectrum of life and industry—including automobiles, home electric appliances, building materials, housing, beverage cans, and transformers. Economic growth in the emerging countries and other parts of the world has spurred an expansion in steel sheet use.

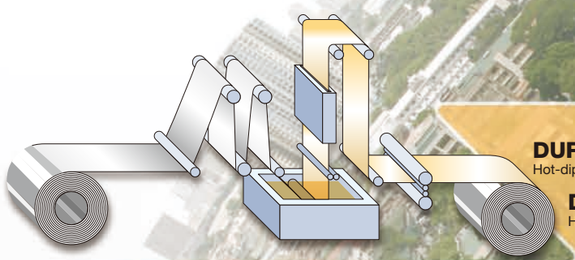
By its speedy response to a wide range of needs and its rich line-up of products, NIPPON STEEL is renowned for its coated steel sheets. NIPPON STEEL develops and markets high-performance steel materials capable of responding to increasingly stringent needs, such as growing concern for the environment and energy conservation.

Coated steel sheets, in particular, are required to possess not only rust resistance but press formability, weldability, paintability, and various other properties as well. In addition to metallurgy, a growing diversity of other technologies is indispensable for meeting these needs. They include electro-chemistry, thin-film engineering, paint engineering, interface engineering, corrosion science, thermal technology, and alloying control (diffusion) technology. In the case of coated steel sheets, if any of these technologies is lacking, customer needs cannot be fulfilled.

NIPPON STEEL has outstanding command of these various elemental technologies and continues to develop products that precisely meet the performance requirements of its customers.


Hot-dip galvanizing line


Electrogalvanizing line



Hot-dip galvanized steel sheets

- Advanced control over the coating atmosphere secures adhesion of the zinc to the base metal, thereby ensuring good workability. These products are used mainly in home electric appliances and building materials.

DURGRIP™
Hot-dip galvannealed steel sheet and strip

DURGRIP™
Hot-dip galvanized steel sheet and strip

SuperDyma™
Hot-dip zinc-aluminum-magnesium-silicon alloy coated steel sheet and strip

ALSHEET™
Hot-dip aluminum-coated steel sheet and strip

ECOKOTE™-S
Sn-Zn coated steel sheet and strip

Building structural member
Civil engineering structure
Road fence
Heater
Microwave oven
Kitchen stove
Roof, wall
Housing structural member
Duct
Air conditioner (outdoor unit)
Washing machine
Refrigerator
Automobile
Deck plate
Greenhouse
Steel furniture
Automatic vending machine
Tank roof

Electrogalvanized steel sheets

- The surface texture is uniform and beautiful. The lack of heat treatment during the coating process helps to retain the properties of the base metal. These products are used mainly in home electric appliances for indoor use.

ZINKOTE™
Electrolytic zinc-coated steel sheet and strip

DURZINKLITE™
Electrolytic zinc-nickel alloy-coated steel sheet and strip

ECOTRIO™
Zn-Si-Ni alloy coated steel sheet and strip

SUPERNICKEL™
Nickel Coated Steel Sheet and strip

AV equipment
Precision machine
Copying machine
Office equipment
Battery cell

Precoated Sheets

ZINKOTE™ COLOR
Pre-Coating Steel Sheet and Strip

VIEWKOTE™
Pre-Coating Steel Sheet and Strip

Washing machine
Refrigerator
Air conditioner (outdoor unit)
Building structural member
Housing structural member
Office equipment
AV equipment
Copying machine
Steel furniture
Washing machine
Refrigerator
Air conditioner (outdoor unit)
Heater
Kitchen stove
Automobile

Notice: While every effort has been made to ensure the accuracy of the information contained within this publication, the use of the information is at the reader's risk and no warranty is implied or expressed by NIPPON STEEL CORPORATION with respect to the use of the information contained herein. The information in this publication is subject to change or modification without notice. Please contact the NIPPON STEEL CORPORATION office for the latest information.

Please refrain from unauthorized reproduction or copying of the contents of this publication.
The names of our products and services shown in this publication are trademarks or registered trademarks of NIPPON STEEL CORPORATION, affiliated companies, or third parties granting rights to NIPPON STEEL CORPORATION or affiliated companies. Other product or service names shown may be trademarks or registered trademarks of their respective owners.

Lineup of Coated Steel Sheets of NIPPON STEEL

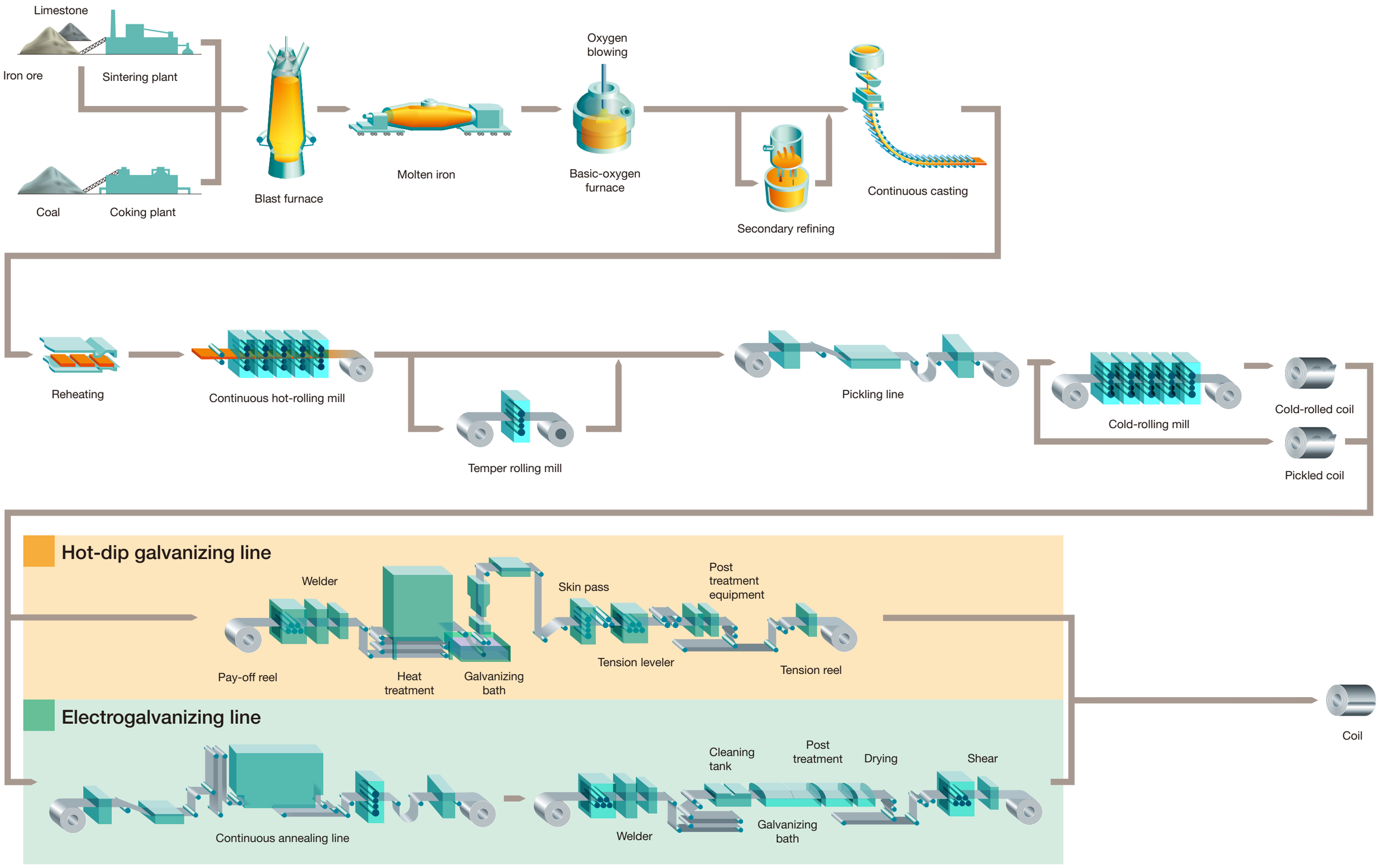
Type		Brand name	Coating structure (representative example)	Available sizes: Coating mass (g/m^2)	Available sizes: Plate thickness (mm)	Available sizes: Width (mm)	Features	Post treatment: No treatment	Post treatment: Chromate-free treatment: General	Post treatment: Chromate-free treatment: Lubricating	Post treatment: Chromate-free treatment: Other special treatments	Main applications	Introduction page
Hot-dip galvanized sheet	Hot-dip galvannealed steel sheet and strip	**DURGRIP™**	Zn-Fe alloyed 45g/m²(6μm) → Base metal	30 ~ 120	0.5 ~ 4.5	610 ~ 1,850	Corrosion resistance Press formability Weldability Paint adhesion	○	—	○	—	Automobile outer and inner panels home appliance Structural member (shutter) Steel furniture, automatic vending machine	6
	Hot-dip galvanized steel sheet and strip	**DURGRIP™**	Zn 120g/m²(17μm) → Base metal	60 ~ 600	0.23 ~ 6.0	580 ~ 1,840	Corrosion resistance	○	○	○	○	Structural member (house, civil engineering structure, road member) Automobile outer and inner panels home appliance Automatic vending machine	7
	Hot-dip zinc-aluminum-magnesium-silicon alloy coated steel sheet and strip	**SuperDyma™**	Zn-Al (11%) -Mg (3%) -Si (0.2%) → Base metal	60 ~ 275	0.27 ~ 9.0	580 ~ 1,700	Corrosion resistance (30 times higher than common galvanized sheet) Cut-edge surface corrosion resistance Alkaline resistance Scratch resistance	○	○	○	○	Structural member (house, agriculture/stockbreeding structure, solar panel supporting structure, civil engineering/road structure), home appliance, automobile parts Automatic vending machine	8
	Hot-dip aluminum-coated steel sheet and strip	**ALSHEET™**	Al-Si alloy 50g/m² (18.5μm) → Base metal	40 ~ 160	0.3 ~ 2.5	610 ~ 1,250	Corrosion resistance Thermal resistance, heat reflectivity Chemical resistance Decorativeness (aluminum)	○	○	—	○	Automobile exhaust system parts Heating equipment Toaster, hot-water system	9
	Sn-Zn coated steel sheet and strip	**ECOKOTE™-S**	Sn-Zn layer → Special film → Base metal	30 ~ 50	0.3 ~ 2.0	610 ~ 1,250	Corrosion resistance (bio fuel) Fuel non-permeable property	○	○	—	—	Fuel tank	10
Electrogalvanized sheet	Electrolytic zinc-coated steel sheet and strip	**ZINKOTE™**	Zn 20g/m² (2.8μm) → Base metal	10 ~ 40	0.4 ~ 3.2	600 ~ 1,650	Corrosion resistance Conductivity Lubricity, formability Fingerprint resistance Scratch resistance Paint adhesion *Diverse post-treatment menu	○	○	○	○	AV equipment, electronic device home appliance OA equipment Automobile outer and inner panels	11
	Electrolytic zinc-nickel alloy-coated steel sheet and strip	**DURZINKLITE™**	Zn-Ni alloy 20g/m² (2.8μm) → Base metal	10 ~ 40	0.4 ~ 2.3	600 ~ 1,650	Corrosion resistance Weldability Paint adhesion	○	○	○	○	Automobile outer and inner panels home appliance Housing equipment	13
	Zn-Sn-Ni alloy coated steel sheet and strip	**ECOTRIO™**	Zn-Sn-Ni alloy → Special film → Base metal	4 ~ 15	0.15 ~ 1.0	580 ~ 1,024	Whisker resistance Solder wettability	○	○	—	—	AV equipment, electronic device OA equipment	14
	Nickel Coated Steel Sheet and strip	**SUPERNICKEL™**	Fe-Ni alloy → Ni layer → Base metal	1 ~ 4 (μm)	0.15 ~ 0.8	25 ~ 1,000	Corrosion resistance (particularly after forming) Coating adhesion Thermal resistance, heat reflectivity Decorativeness (luster)	—	○	—	—	Battery, Heating equipment, Automobile fuel parts	15
Precoated sheet	**ZINKOTE™ COLOR**		Topcoat → Zn → Base metal	10 ~ 40	0.4 ~ 0.8	600 ~ 1,650	Decorativeness, corrosion resistance, elimination of coating process at user plant (reduction of production process, cost cutting) *Different properties depending on the type	○	○	—	○	home appliance AV equipment, electronic device OA equipment Housing equipment (interior, steel furniture)	12
	VIEWKOTE™		Paint → Zn → Base metal	EG type 10 ~ 40 CG type 60 ~ 150	0.3 ~ 1.2	25 ~ 1,300	Decorativeness, corrosion resistance, elimination of coating process at user plant	—	○	○	○	home appliance, AV equipment, electronic device Fuel cell Steel furniture	16

Information about environmental load chemical substances contained in the products of NIPPON STEEL is supplied in the form shown below:

1) Material Safety Data Sheet (MSDS)
2) Information about specified chemical substance content (supplementary MSDS)
3) Specified Chemical Substances Data Sheet (SSDS)

For more details, please confirm by accessing our website: www.nipponsteel.com

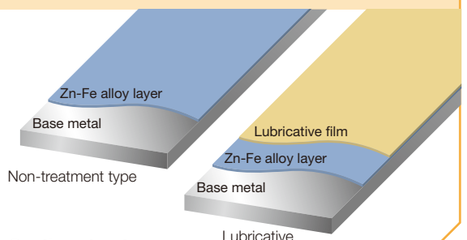
◆Production Process



DURGRIP™
Hot-dip galvannealed steel sheet and strip

◆Main Characteristics

- Excellent paint adhesion and weldability—provided by reheating the zinc-iron alloyed layer produced by heating
- Exceptional post-painting corrosion resistance
- Excellent press-formability, ranging from bending to deep drawing
- Availability of sheet with highly lubricative film treatment

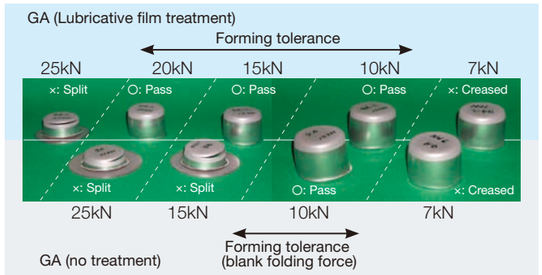


● **Coating structure (representative example)**

◆Typical Properties

Press Formability

The application of lubricative film treatment imparts good press formability.



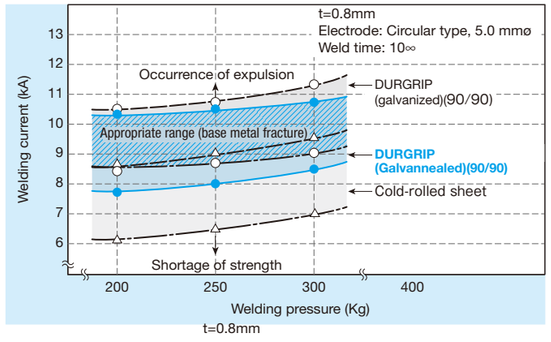
Weldability

The resistance weldability of galvanized steel sheet, in contrast to that of cold-rolled steel sheet, generally requires appropriate welding conditions in the region of high heat input. This is because zinc is a soft metal that easily conforms to the partner metal and because zinc's low melting point causes it to melt and spread out during the initial welding stage, thereby resulting in lower current density. Consequently, less heat is generated in the overlapped areas.

Direct Spot Weldability

The appropriate welding conditions for coated steel sheets are shown in the figure below. Adequate welding current regions for coated steel sheets are higher than those for cold-rolled steel sheets.

•Example of Appropriate Welding Conditions for Galvanized Sheet



Paint Adhesion

DURGRIP has a finely textured yet rugged surface, ensuring good paint adhesion.

•Examples of Paint Adhesion (Primary Adhesion)

Galvanized sheet	DURGRIP (Galvannealed)	Cold-rolled sheet
		

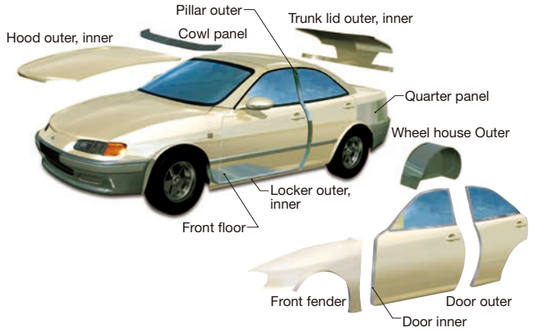
Treatment condition : Dip-type phosphate treatment
Cation ED 20μ baking
Assessment test : After drawing grid pattern
Erichsen stretch forming, cellophane tape peeling off
○ 3mm
○ 5mm
} Stretching

•Examples of Surface Appearance of Base Substrate Sheet before Coating (Scanning Electron Microscope × 1,000)

DURGRIP (galvanized)	DURGRIP (Galvannealed)	Cold-rolled sheet
		

◆Main Applications

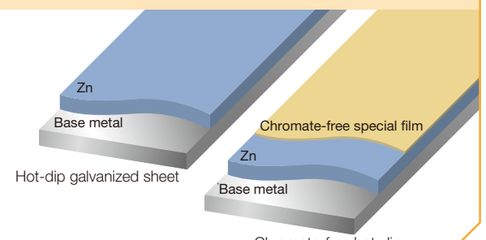
- **Electric appliances**
  Washing machine, refrigerator, air conditioner, automatic vending machine (outer plate, side plate, back plate, bottom plate, parts)
- **Building and furniture**
  Signboard, door, sash, shutter, cabinet, steel furniture, office equipment
- **Automobile (outer, inner, parts)**



DURGRIP™
Hot-dip galvanized steel sheet and strip

◆Main Characteristics

- High corrosion, and rust resistance similar to that of conventional chromate-treated sheet even with chromate-free treatment
- Excellent zinc adhesion and responsiveness to severe fabrication conditions
- Product lineup with excellent tribological properties by means of chromate-free treatment

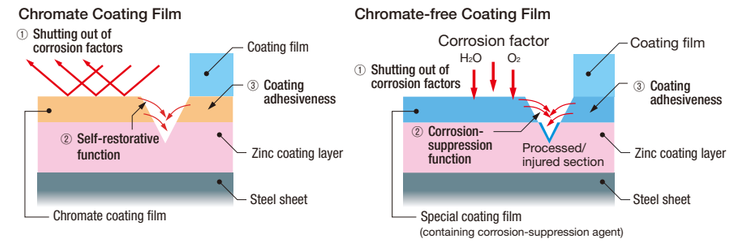


● **Coating structure (representative example)**

◆Typical Properties

Corrosion Resistance Mechanism of Conventional Chromate Treatment and Chromate-free Coating Film

•Structure and Function of Coating Films

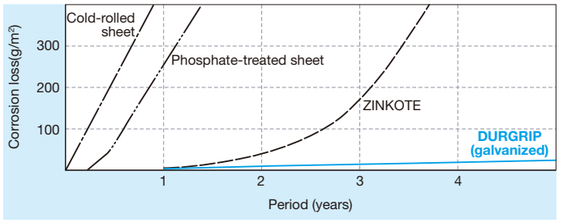


When this film is injured, soluble hexavalent chromium leaches out to offer a "self-restorative function" that repairs the film.

Corrosion Resistance Mechanism of Chromate-free Coating Film : Chromate-free film uses substances selected because they provide the characteristic features of chromate film such as its barrier effect, self-restorative function and paint adhesiveness. Chromate-free coated sheet has been realized by use of this special coating film.

Function of Chromate Coating Film
•Barrier effect
•Self restoration function
→ Effects similar to those offered by special coating film containing corrosion-suppression agent

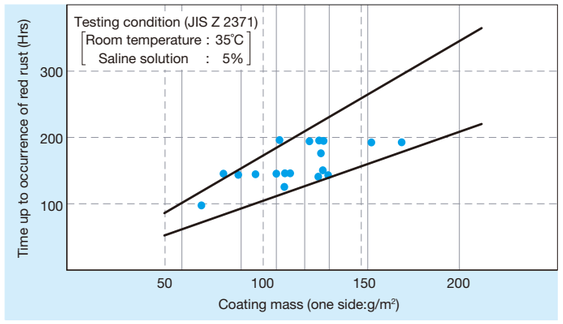
•Example of Outdoor Exposure Weathering Tests (Salt Spray Tests)



Zinc Coating Mass and Corrosion Resistance

As the zinc coating mass increases, the corrosion resistance of the hot-dip galvanized sheet is extended.

•Zinc Coating Mass and Time up to Occurrence of Red Rust (Example) (Salt Spray Test)



◆Main Applications

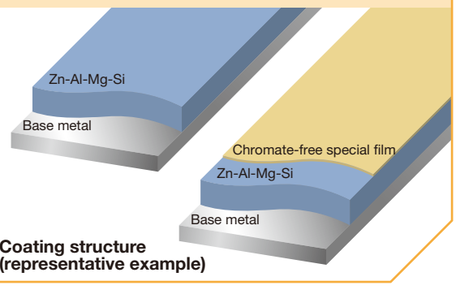
- **Civil engineering structure and building construction**
  Guard rail, corrugated pipe, spiral pipe, deck plate, duct, roofing material, fence, sound-insulation wall, scaffolding pipe, light-gauge shape, shutter, sash, door, housing structural member (column, beam)
- **Automobile**
  Floor, various parts
- **Shipbuilding**
  Duct, panel
- **Electric appliance**
  Refrigerator, washing machine, heating equipment, air conditioner, automatic vending machine, showcase parts
- **Industrial machinery**
  Container for transporting agricultural product, various parts requiring corrosion resistance

SuperDyma™

Hot-dip zinc-aluminum-magnesium-silicon alloy coated steel sheet and strip

◆Main Characteristics

- With remarkably high corrosion resistance compared to hot-dip galvanized steel sheet, inhibits corrosion resistance in cut-end surfaces
- Strong alkaline resistance even in direct contact with mortar and concrete
- Superior substitute for stainless steel (weak in chlorine resistance) and aluminum (weak in alkaline resistance)
- Availability of chromate-free sheet having properties similar to those of chromate-treated sheet

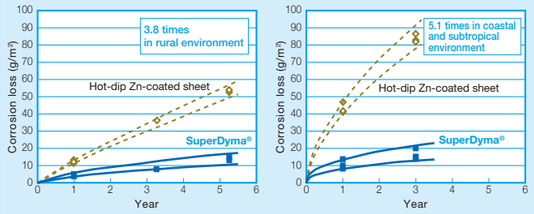


● Coating structure (representative example)

◆Typical Properties

Coating Layer Composition and Corrosion Resistance (Salt Spray Tests)

Comparision of the plating corrosion loss (Result of outdoor exposure tests)



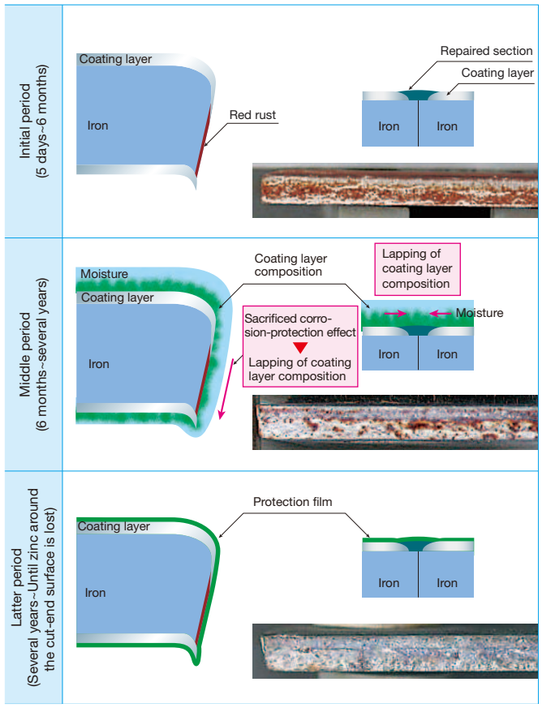
"Excerpts from No.342 test results certificate of special evaluation method certificate of the Ministry of Land, Infrastructure and Transport"

Corrosion Resistance of Flat Surfaces

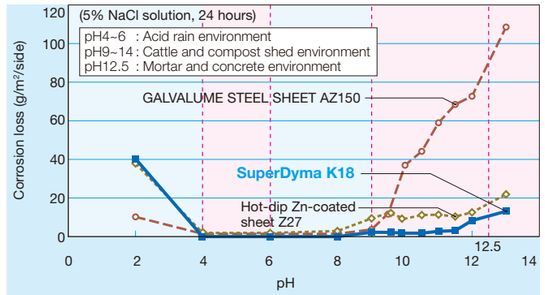
The corrosion resistance of SuperDyma (assessed by salt-spray tests to determine corrosion rate) is extremely high — about 30 times that of hot-dip Zn-coated sheets.

Corrosion Protection Mechanism on Cut-end Surfaces and at Welded Sections

• Corrosion Protection Mechanism at Cut-end Surfaces

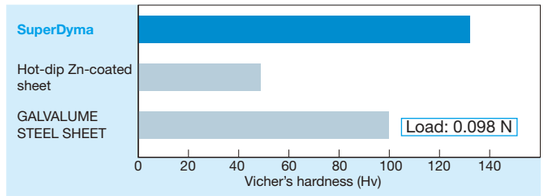


Acid and Alkaline Resistance of Various Coated Sheets



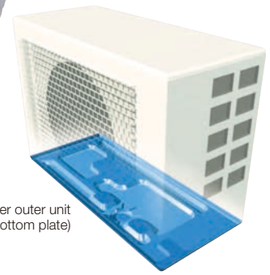
Scratch Resistance

The coating layer of SuperDyma is hard, thus offering high scratch resistance.



◆Main Applications

Automobile parts



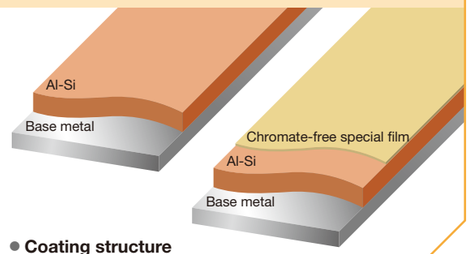
Air-conditioner outer unit (bottom plate)

ALSHEET™

Hot-dip aluminum-coated steel sheet and strip

◆Main Characteristics

- Outstanding weather resistance and corrosion resistance
- Discoloration and high thermal resistance in high-temperature application
- Excellent high-temperature heat reflectivity, compared to hot-dip galvanized steel sheets



● Coating structure (representative example)

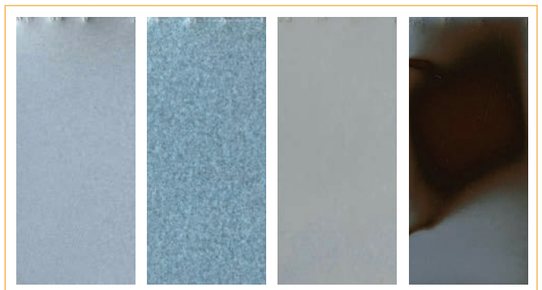
◆Typical Properties

Thermal Resistance

The surface appearance of ALSHEET at high temperatures is far superior to that of hot-dip galvanized steel sheet or that of cold-rolled steel sheet. No surface discoloration occurs at 350℃ or under. At temperatures above that, the surface becomes an Al-Fe alloy, causing a discoloration. However, this conversion to an alloy prevents oxidization of the base metal, helping to retain the steel sheet's thermal resistance.

•An example of surface conditions after heating (300°C × 200 hours)

When heated at temperatures below 350°C, ALSHEET undergoes no surface discoloration, retaining its beautiful appearance.



Heat reflectivity

Because of its extremely beautiful surface, ALSHEET shows exceptional heat reflectivity—nearly 80% at temperatures of 450°C or below. Accordingly, ALSHEET is ideal for use in applications requiring heat reflectivity, including the inner heat shields for toasters and the upper reflectors for gas ovens and kerosene heaters.

•Example of Heat Reflectivity of Various Materials (unit:%)

Item	Test condition	ALSHEET	ZINKOTE (electrogalvanized sheet)	Hot-dip galvanized sheet	
				Spangled	Non-spangled
Heat reflectivity	100℃×24Hrs	90	95	95	95
	400℃×24Hrs	80	30	20	20

•Measurement at room temperature after heating

•D and S AERP emissivity meter (measurement wave 3 – 30m)

Corrosion resistance

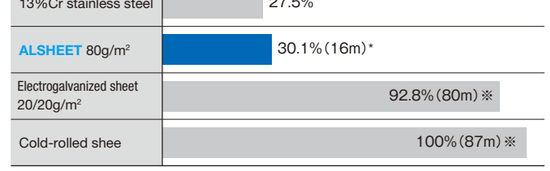
Because ALSHEET, like aluminum, easily generates fine yet stable oxide and hydroxide films in the atmosphere and in water, its corrosion resistance under various conditions is superior to that of galvanized steel sheets. In application, however, it should be borne in mind that, contrary to galvanized steel sheet, galvanic action (sacrificial action) cannot be expected of ALSHEET.

•Cyclic wetting and drying tests (Resistance to exhaust gas corrosion)

As a result of corrosion tests using automobile exhaust gas-condensed simulated fluids, ALSHEET demonstrates better corrosion resistance than do electrogalvanized steel sheets and cold-rolled steel sheets.

•Example of Muffler Test Result (Chrysler's Spec 461H-83)

Cold-rolled sheet set as 100



* ( ): Corrosion loss

Chemical resistance

Unlike zinc, aluminum has the property of being resistant to weak acidity and vulnerable to alkalinity.

◆Main Applications

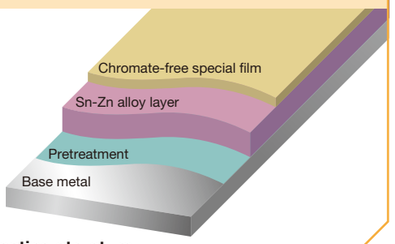
- **Hot-water system**
- **Oven toaster**
- **Bread machine**
- **Stove**
- **Fan heater**
- **Cloth dryer**
- **Automobile**
  (muffler, manifold cover, converter cover)

ECOKOTE™-S

Sn-Zn coated steel sheet and strip

◆Main Characteristics

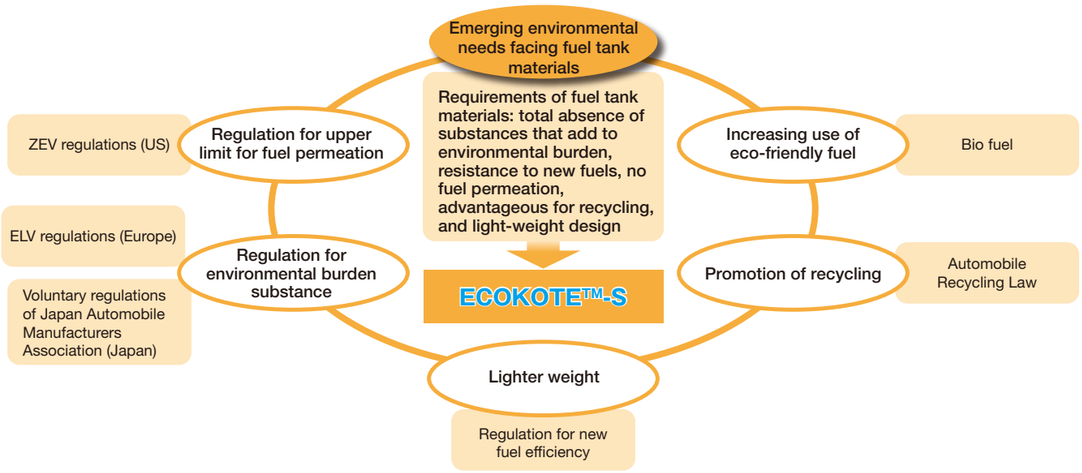
- Higher corrosion resistance than found in conventional fuel tank metallic materials
- High corrosion resistance, even when used with bio fuels
- Meets hydrocarbon permeation regulations; is free of environmental load substances
- Highly recyclable



● Coating structure (representative example)

◆Typical Properties

Responsiveness to Environmental Preservation: ECOKOTE™-S is most suitable for use as an eco-friendly fuel tank material.



Characteristic Properties of Fuel Tank Material

	ECOKOTE™-S (Sn-Zn coating)	ALSHEET™ (Aluminum coating)	TERNESHEET (Pb-Sn coating)	Resin
Regulation for upper limit for fuel permeation	No fuel permeation because of steel sheet			Inferior permeation shut-off performance
Promotion of recycling	High recyclability because of steel sheet			Inferior recyclability
Lighter weight	Lighter weight by use of steel's rigidity instead of identical capacity			
Regulation for environment burden substance	No inclusion of environment burden substance		Use of lead	No inclusion of environment burden substance
Increasing use of eco-friendly fuel	Outstandingly high corrosion resistance	Concerns about corrosion resistance in case of using common bio fuel		Growing concerns about permeation and deterioration

	Inner surface corrosion resistance			Outer surface corrosion resistance	Press formability	Weldability	Paintability
	Degraded gasoline	Degraded 20%FAME-mixed gasoline	Degraded ethanol-mixed gasoline				
ECOKOTE™-S (Sn-Zn coating)	Excellent	Excellent	Excellent	Excellent	Excellent	Fair	Excellent
ALSHEET™ (aluminum coating)	Excellent	Excellent	×	Fair	Fair	Fair	Excellent
TERNESHEET (Pb-Sn coating)	Fair	Fair	Fair	Fair	Excellent	Good	Excellent

◆Main Applications

- **Fuel tank**

ZINKOTE™

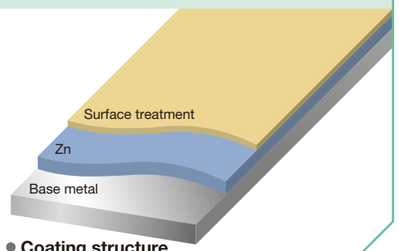
Electrolytic zinc-coated steel sheet and strip

◆Main Characteristics

- Demonstrates similar effects in application as chromate-treated sheet due to ZINKOTE's special film containing a corrosion inhibitor
- Availability of characteristic properties that conform to respective customer needs thanks to ZINKOTE's diverse post-treatment lineup

[Main Properties of ZINKOTE]

•Corrosion resistance •Lubricity •Conductivity •Spot weldability
•Thermal resistance •Alkaline resistance •Solvent resistance
•Fingerprint resistance •Paint adhesion

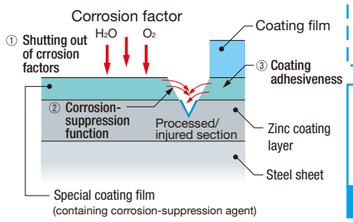


● Coating structure (representative example)

◆Typical Properties

Corrosion Resistance Mechanism of Chromate-free Coating Film

• **Chromate-free Coating Film**



Function of Chromate Coating Film
•Barrier effect
•Self restoration function
When this film is injured, soluble hexavalent chromium leaches out to offer a "self-restorative function" that repairs the film.

Corrosion Resistance Mechanism of Chromate-free Coating Film : Chromate-free film uses substances selected because they provide the characteristic features of chromate film such as its barrier effect, self-restorative function and paint adhesiveness. Chromate-free coated sheet has been realized by use of this special coating film.

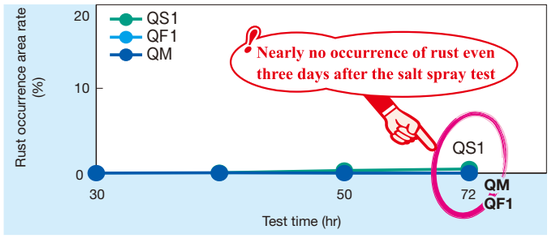
Effects similar to those offered by special coating film containing corrosion-suppression agent

	Film	Required performance
Organic film	High formability and lubricity due to surface film action	•Importance on conductivity •Importance on corrosion resistance and scratch resistance
Inorganic film	Excellent conductivity and adhesion because of thin film thickness	•Importance on conductivity, paintability and ironing property

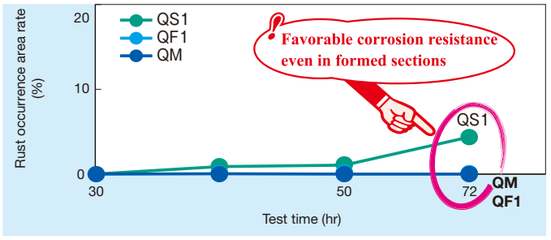
Corrosion Resistance

Salt Spray Test: Flat Surface Section and Formed Section (Erichsen 7 mm Extruded Section)

• **Example of Corrosion Resistance of Flat Surface Section (A kind of typical surface treatments is shown)**



• **Example of Corrosion Resistance of Formed Section**



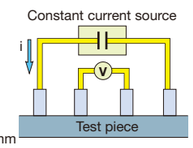
Conductivity (Grounding Property)

•Loresta (4 Prove Type)

• **Concept of Contact Resistance Measurement Device (Loresta 4 Prove Type)**

Measurement device	Loresta EP type made by Mitsubishi Chemical Corp.
Measurement system	4 contact/4 probe method, constant current application system
Measurement range	10^{-2}～10^{6} Ω
Probe	ESP probe (Pin tip 2 mmϕ × 4 contacts, pin interval 5 mm spring pressure 2.4 N/spring
Assessment	Conducting rate (%) = $\frac{\text{Conducting cycle}^*}{20\ \text{cycles}} \times 100$

*Conducting=Les than 1mΩ



• **Example of Contact Resistance Tests (Loresta 4 Prove Type)**

◆Main Applications

ZINKOTE: Used for high-performance electric appliances and OA equipment

ZINKOTE is a chromate-free electrogalvanized sheet used for flat panel displays, copying machines, printers and other devices and equipment.

• **Main End Products Employing ZINKOTE**

Application (example)	Application member
Flat panel display	Chassis, various parts
Copying machine, printer	various parts

• **Various Parts**
Audio equipment, etc

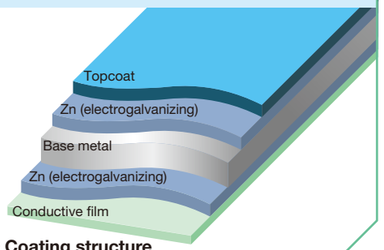
• **Side Plate**
Refrigerator, washing machine, etc

ZINKOTE™ COLOR

Pre-Coating Steel Sheet and Strip

◆Main Characteristics

- Excellent cost performance and reduced manufacturing term at user plant by coating only one side of ZINKOTE with a beautiful topcoat
- Available colors (3): black, silver and white, and preparation of improved scratch-resistant type
- Black coated sheets (2): both-sided black coated type, and high-conductivity/good heat-absorption type



● **Coating structure (representative example)**

◆Product Lineup

Color	Type		Heat treatment symbol	Surface finish
Black	Improved scratch-resistant type	Improved scratch resistance due to addition of large-diameter beads to film	KJ2	D
Silver	Improved scratch-resistant type	Improved scratch resistance due to addition of large-diameter beads to film	SJ2	D

◆Main Applications

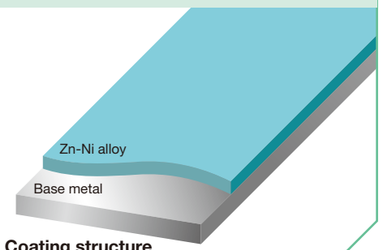
- **Home appliance**
- **AV equipment, electronic device**
- **OA equipment**
- **Housing equipment (interior, steel furniture)**

DURZINKLITE™

Electrolytic zinc-nickel alloy-coated steel sheet and strip

◆Main Characteristics

- Outstandingly high corrosion resistance even with conventional electrolytic galvanizing mass
- Fine appearance and finishing after coating, similar to cold-rolled sheet
- Easy spot and seam welding



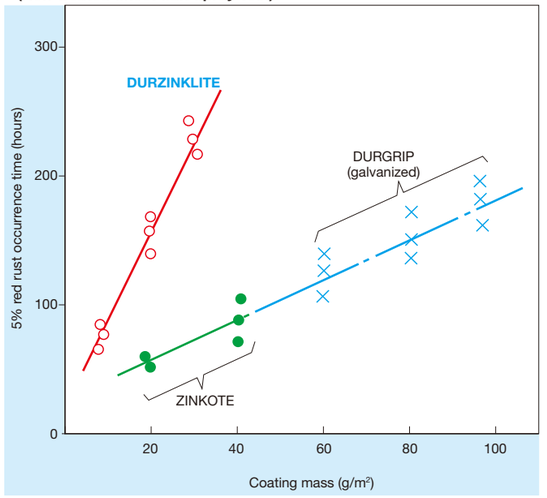
● **Coating structure (representative example)**

◆Typical Properties

Bare Corrosion Resistance

In commonly conducted salt spray testing, the bare corrosion resistance of DURZINKLITE coated surfaces is more than 3 times greater than galvanized sheets with equal coatings. This product shows favorable corrosion resistance even with a thin coating mass, but the provision of a special chromate treatment further improves corrosion resistance.

- **Example of Corrosion Resistance Assessment of DURZINKLITE (Non-treated Sheet Salt Spray Test)**



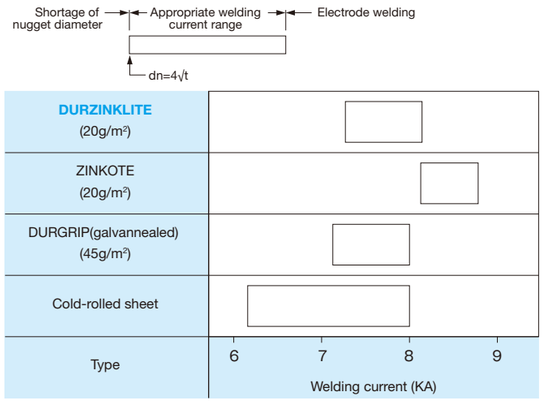
Reference: Time required for the occurrence of red rust in the salt spray test JIS Z 2371

Weldability

Individual spot or seam welding of DURZINKLITE can be conducted using low welding current, and because the welding current range is wide, welding is easy.

Examples of single spot welding at a range of welding currents for both-side galvanized sheet are shown at right. In each case, adequate nuggets are formed using a comparatively low welding current, and the recommended range of welding currents is wide to allow easy welding.

- **Example of Welding Current Range for Single Sport Welding of Both-side Galvanized Sheet**

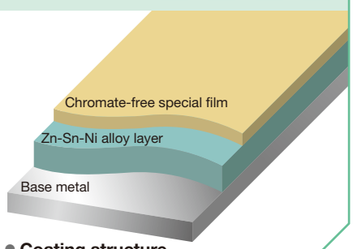


ECOTRIO™

Zn-Sn-Ni alloy coated steel sheet and strip

◆Main Characteristics

- Lead-free and chromate-free, and conforms to RoHS (Restriction of Hazardous Substances) Directive
- Greater suppression of whiskers compared to electrolytic tinplate
- Solderability and conductivity that are similar to electrolytic tinplate and higher than those of galvanized steel sheet
- Availability of thin-gauge products with a minimum thickness of 0.15 mm
- NEW ECOTRIO even in thin coating mass specifications: Taking over the basic properties of ECOTRIO
- High-strength ECOTRIO: Cost-cutting substitute for nickel silver and stainless steel sheets

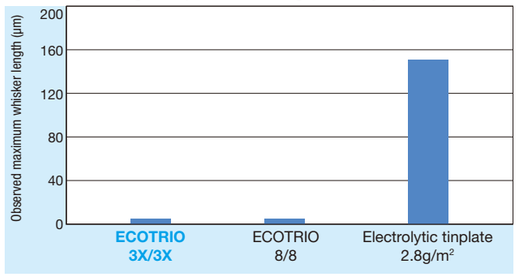


● **Coating structure (representative example)**

◆Typical Properties

Chromate-free Coating Film

•Test Result for Occurrence or No Occurrence of Whisker under High Temperature and High Humidity Condition

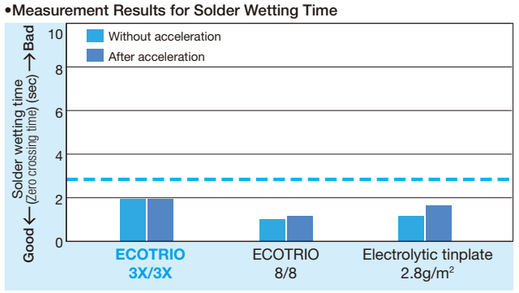


[Test condition]
Test piece:
Plate thickness 0.3 mm, cup forming
Environment:60℃ × 90%RH
Time:1000hrs

* The data shown here is an example of test results, which therefore does not mean any quality guarantee.
* In cases when the whisker resistance under strict high-temperature conditions (for example, high temperature and high humidity surpassing 60°C) is required, the product with importance on whisker resistance can be proposed. For details, please send inquiries.

Solder Wettability (Solder Wetting Time)

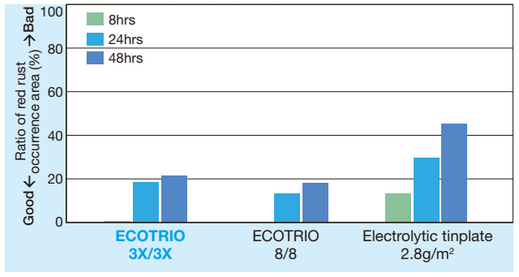
•Measurement Results for Solder Wetting Time



[Test condition]
Test piece:
0.3mm×20mm×7mm
Kind of solder:
Sn-Ag-Cu
Solder melting temperature
Flux applied:
Rosin alcohol active type
accleleration conditions:
100°C (saturated humidity), 8 hrs

Corrosion Resistance

•Corrosion Resistance (Salt Spray Test)



[Test condition]
Corrosion resistance:
(Salt spray test JIS Z2371)
Test piece:
Flat sheet with edge seal

High in whisker resistance, solder wettability and corrosion resistance

◆Main Applications

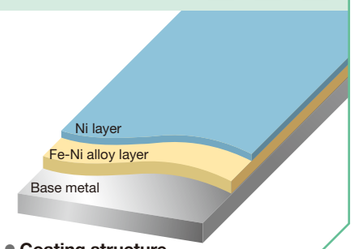
- **Game console**
- **Automobile AV equipment**
- **TV set**
- **Personal computer**
- **Electric and electronic parts**
- **Audio system**

SUPERNICKEL™

Nickel Coated Steel Sheet and strip

◆Main Characteristics

- High adhesion and corrosion resistance due to formation of Fe-Ni alloy layer
- Availability of material quality that conforms to the particular application and the degree of fabrication
- Diverse surface finishes are available, from an outstandingly fine mirror finish to a rough dull finish.
- Availability of coatings from thin to heavy and of differential coatings on front and rear surfaces
- Same thermal resistance as that of stainless steel

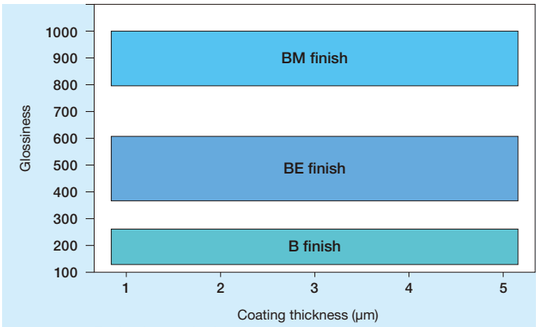


● **Coating structure (representative example)**

◆Typical Properties

Surface gloss

•Glossiness of surface finish



Evaluation method
Glossiness:Measured in transverse direction at an incidence angle of 60 degrees with Nihon Denshoku Model VGS-ID glossmeter.

Coating Adhesion (workability)

•An example of evaluation of coating adhesion (workability)

		SUPERNICKEL	Comparative example: Ni-coated sheet without alloy layer (non-diffusion type)
Coating adhesion (tape peeling)	Bending test	◎ (No peeling found)	△ (Peeling found)
	Erichsen test	◎ (No peeling found)	◎ (No peeling found)
	Cupping test	◎ (No peeling found)	△ (Peeling found)
Work follow (SEM observation)	Bending test	○ (Virtually no cracks found)	× (Many cracks found)
	Erichsen test	○ (Virtually no cracks found)	× (Many cracks found)
Test Methods	Bending test	A cellophane tape on the coating is peeled after 0T bend.	
	Erichsen test	A cellophane tape on the coating is peeled after a 7mm-deep cup is formed.	
	Cupping test	Cellophane tapes on the inside and outside are peeled after a 30mm-deep cup is drawn.	

◆Main Applications

- **Primary battery case, Secondary battery case**
- **Negative electrode collector for secondary battery**
- **Oven toaster reflector plate**
- **Fuel filler pipe and parts**

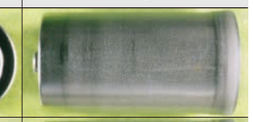
•Battery

◆Main Applications

Post-fabrication Corrosion Resistance

External appearances of the top and body parts of size C and AA batteries made of SUPERNICKEL steel sheets and Ni-coated sheets without alloy layer, after subjected to 60 minutes of salt spray tests are shown below.
In both cases, batteries made of SUPERNICKEL steel sheet shows better post-fabrication corrosion resistance.

•External appearances after SST (coating thickness: 2μm)

		Top	Body
Fabricated into size C batteries	SUPERNICKEL		
	Ni-coated sheet without alloy layer		

※SST: Pursuant to JIS Z 2371

Corrosion Resistance of As-coated Flat Sheet Without Fabrication

SUPERNICKEL steel sheet shows better corrosion resistance than Ni-coated steel sheet without alloy layer on both unfabricated and fabricated parts due to① reduced pinholes on the coating layer, ② formation of an Fe-Ni alloy layer having good adhesion, and③ improved ductility due to recrystallization and softening of the Ni coating layer.

Heat Resistance

SUPERNICKEL steel sheet has heat resistance comparable to stainless steel (SUS) that is normally used as a heat-resistant material (heating temperature ~300°C). As typical evaluation results of heat resistance, changes in glossiness, changes in infrared-ray reflectance and changes in color tone on heating are shown below.

VIEWKOTE™

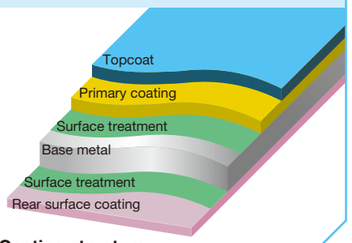
Pre-Coating Steel Sheet and Strip

◆Main Characteristics

- Smooth and fine painted surface
- Selection of colors and material properties that meet specific needs, through the combined use of diverse paints and base substrates
- Improved such factors as process, space, energy and load savings at user plant

[Paint type of VIEWKOTE]

- Type Ⅰ / Highly workable type
- Type Ⅱ / Balanced type in workability surface physical properties
- Type Ⅲ / Stain-resistance type
- Type Ⅳ / Highly workable, stain-resistant type(universal type)
- Type Ⅴ / Highly corrosion-resistant type



● **Coating structure (representative example)**

◆Typical Properties

Application	Application parts/ materials	VIEWKOTE recommended specifications	
Lighting equipment	Reflecting board	Front side	VIEWKOTE Type Ⅰ
		Back side	VIEWKOTE Type Ⅰ
Flat-panel TV	Back panel	Front side	VIEWKOTE Type Ⅳ
		Back side	Electroconductivity Type
Digital recorder	Chassis	Front side	VIEWKOTE Type Ⅳ
		Back side	Electroconductivity type
Auto on-board equipment	Chassis	Front side	VIEWKOTE Type Ⅳ
		Back side	Heat Absorption Type

Application	Application parts/ materials	VIEWKOTE recommended specifications	
Outdoor air-conditioner unit	Top, outside panel	Front side	VIEWKOTE Type Ⅳ
		Back side	VIEWKOTE Type Ⅱ
Refrigerator, washing machine	Side panel	Front side	VIEWKOTE Type Ⅳ
		Back side	Rear surface coating
Automobile parts	Oil filter	Front side	VIEWKOTE Type C
		Back side	Lubrication Type

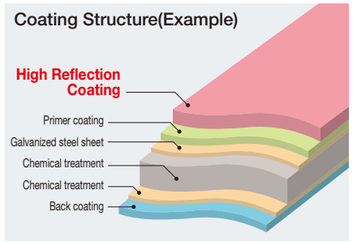
- **Home appliance**
- **AV equipment, electronic device**
- **Fuel Cell**
- **Steel furniture**

◆Premium Series

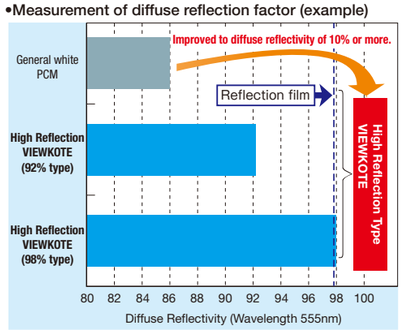
High Reflection Type VIEWKOTE

❶Diffuse reflectivity of 92-98%.
❷Can be deep drawn.
❸Has excellent basic properties including corrosion and chemical resistance.
❹Both electromagnetic shielding and temperature control can be achieved by selecting heat absorption types with good electroconductivity in the back coating.
❺Chromate-free and eco-friendly.

Coating Structure(Example)



•Measurement of diffuse reflection factor (example)

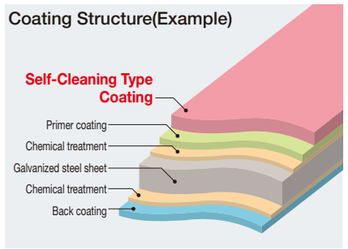


※ Can be designed with reflectivity of 92 or 98%, depending on the application.

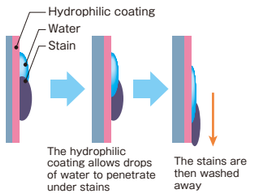
Self-Cleaning Type VIEWKOTE

❶Hydrophilic coating vastly improves resistance against rain drop stains.
❷Offers high workability thanks to optimal substrate design.
❸Also offers excellent weatherability and stain resistance in processed areas.
❹A wide range of color variations, including metallic tones.
❺Chromate-free and eco-friendly.

Coating Structure(Example)



•How self-cleaning works



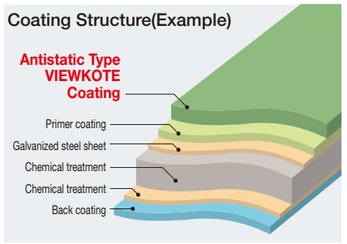
Outdoor exposure for 1.5 years at Kimitsu City, Chiba, Japan (industrial zone)

Self-Cleaning Type | Conventional VIEWKOTE for outdoor air-conditioner units

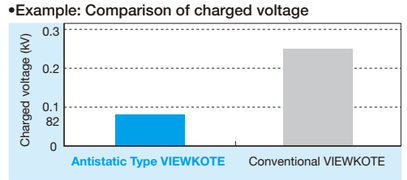
Antistatic Type VIEWKOTE

❶Prevents static electricity caused by friction from conveyors and rubber suction disks in the processing/ production process.
❷Reduces dust adhesion caused by static electricity.
❸Reduces electric shocks caused by static electricity.
❹Chromate-free and eco-friendly.

Coating Structure(Example)



•Example: Comparison of charged voltage



Experiment conditions :
Measurement of the charged voltage of the coating surface by non-contact type static electricity measuring apparatus immediately after VIEWKOTE sample (70×150mm) makes contact with a piece of neoprene resin (50×100mm) and is then detached.

Orange-Peel-Surfaced VIEWKOTE

❶A pebbled surface like that of an orange peel is achieved by special beads in the coating. These beads then melt during heating when the coating is enameled.
❷This coating improves processing yield by making handling scratches less visible.
❸Its workability, chemical resistance, and other basic properties are the same as conventional VIEWKOTE. (Can also include antistatic property.)
❹Chromate-free and eco-friendly.

Coating Structure(Example)

•Example:Orange-Peel-Surfaced VIEWKOTE