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SuperDyma™ Catalog Series Materials
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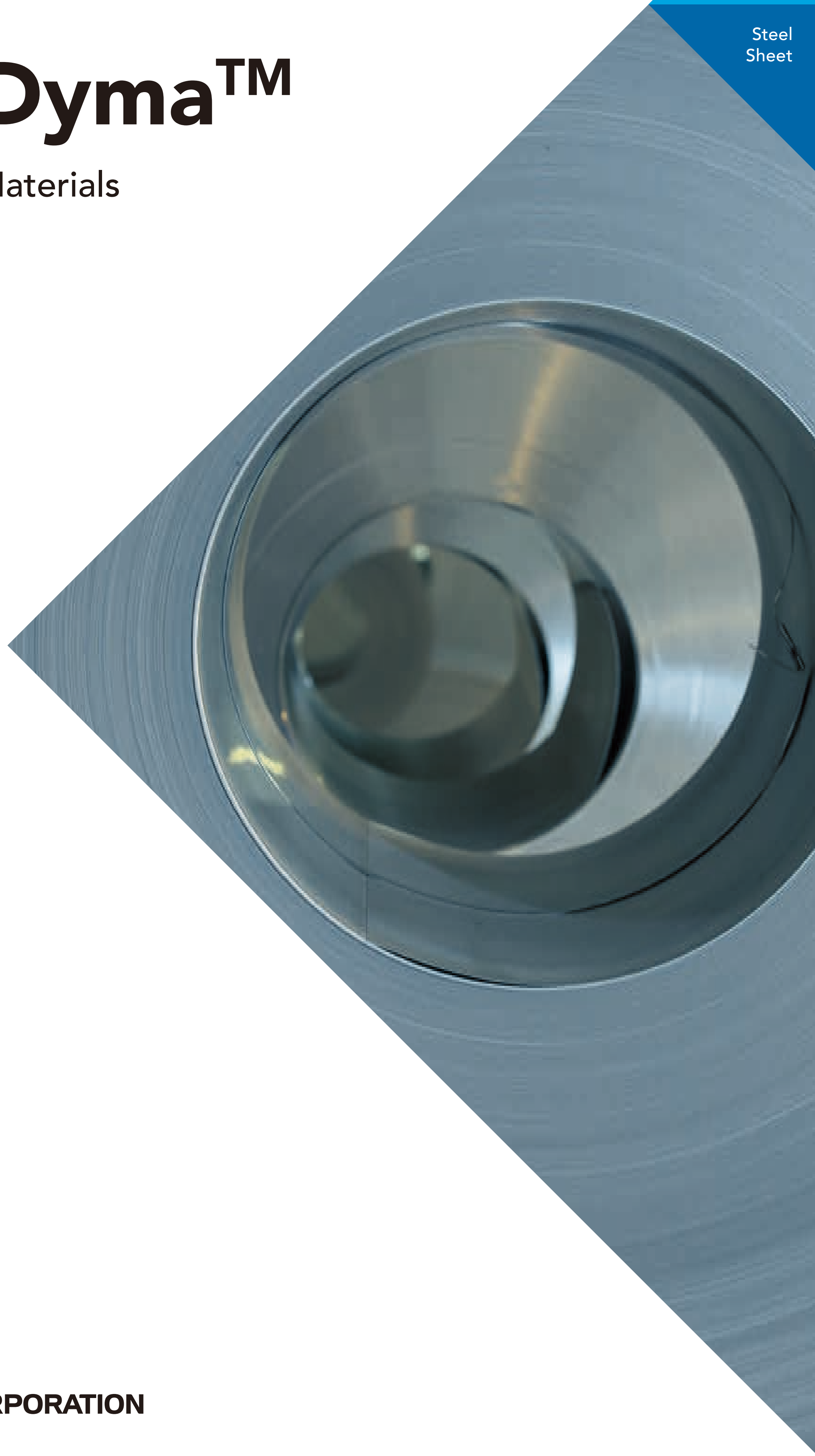
NIPPON STEEL

Steel Sheet

SuperDyma™

Catalog Series Materials



NIPPON STEEL CORPORATION

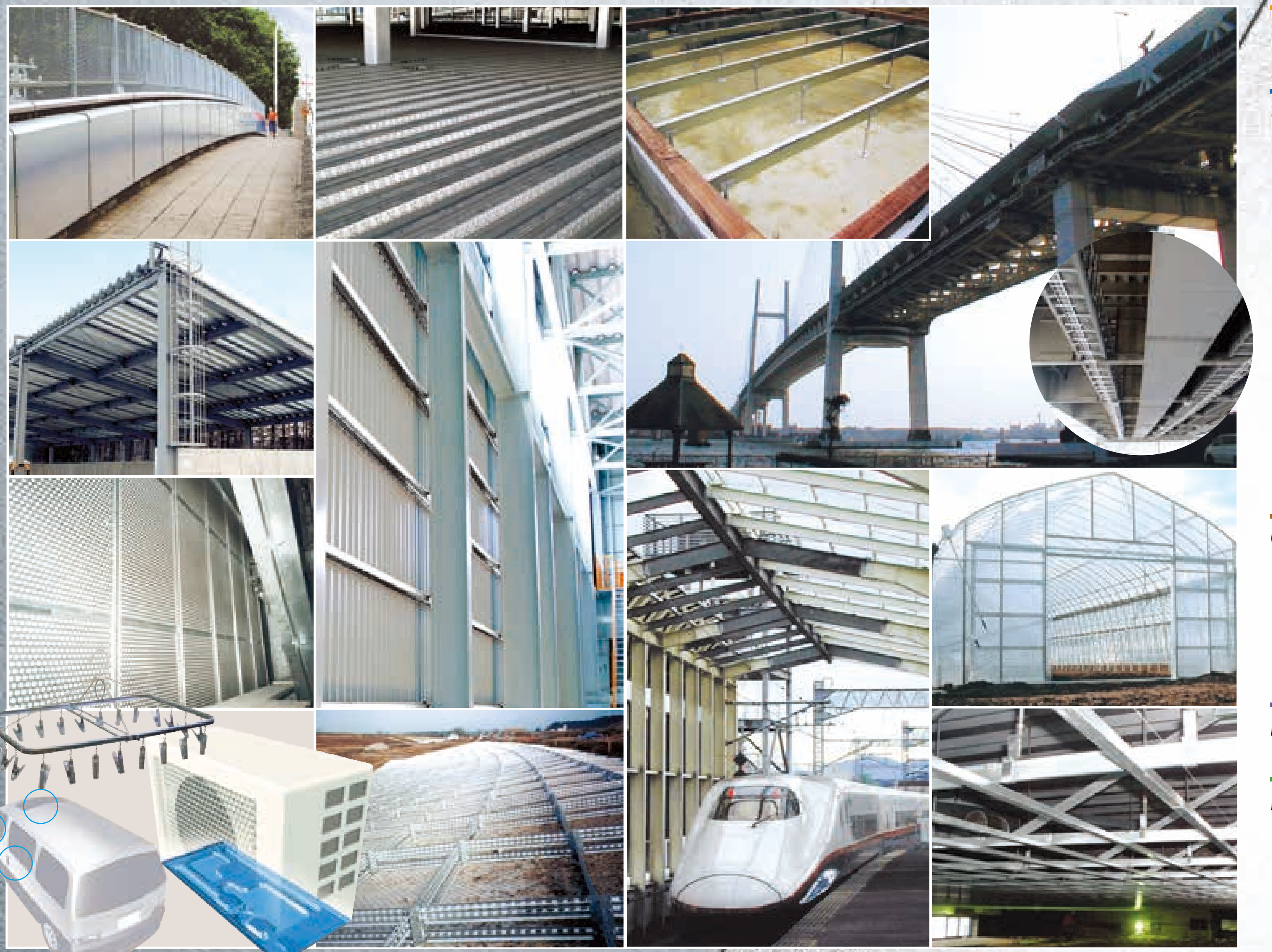
SuperDyma™

Catalog Series Materials

NIPPON STEEL Developed

Highly Corrosion-resistant Coated Steel Sheets, SuperDyma

SuperDyma is a new type of highly corrosion-resistant coated steel sheet with a coating composition consisting of zinc as the main substrate in combination with aluminum (about 11%), magnesium (about 3%) and a trace amount of silicon.



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Exceptional Resistance to Rust !

- Not only rust resistant on flat surfaces
- But also highly rust resistant on cut-end surfaces
- In addition, extremely high alkaline resistance

The corrosion resistance of SuperDyma is enhanced by the composite effect of adding aluminum, magnesium and silicon to the conventional zinc coating. Silicon, among other elements, is highly effective in inhibiting corrosion when combined with Mg.

High Workability

- Strongly resistant to rust at bends and in cylindrically-drawn sections; fine finishes with fewer scratches after fabrication
- Distinguished weldability and paintability

SuperDyma offers high coating adherence that can withstand severe fabricating processes. The coating has a high degree of hardness, thus offering excellent scratch resistance.

New Steel Materials Excellent in Value Analysis

- Reductions in cost and delivery time due to the elimination of post-coating and post-painting
- Proposal to replace stainless steel and aluminum

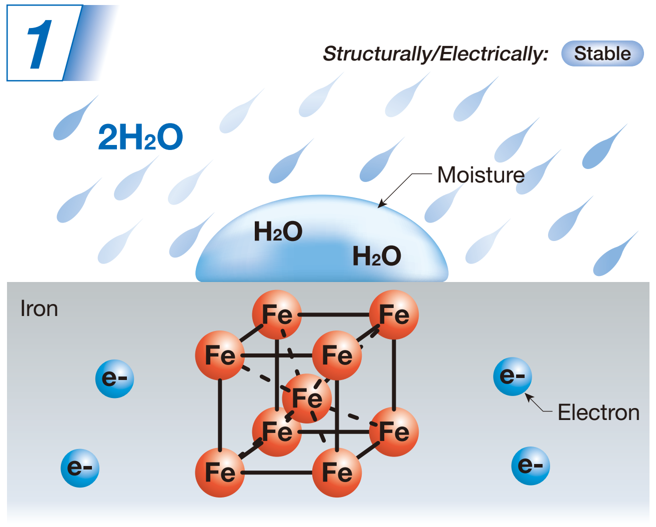
In contrast to fabricated products using post-coated and post-painted steel sheets, the total cost and delivery time associated with fabricated products using SuperDyma can be greatly reduced. Furthermore, due to its resistance to red rust, SuperDyma can be used as a substitute material for stainless steel and aluminum products.

Corrosion Mechanism

Why Does Steel Rust?

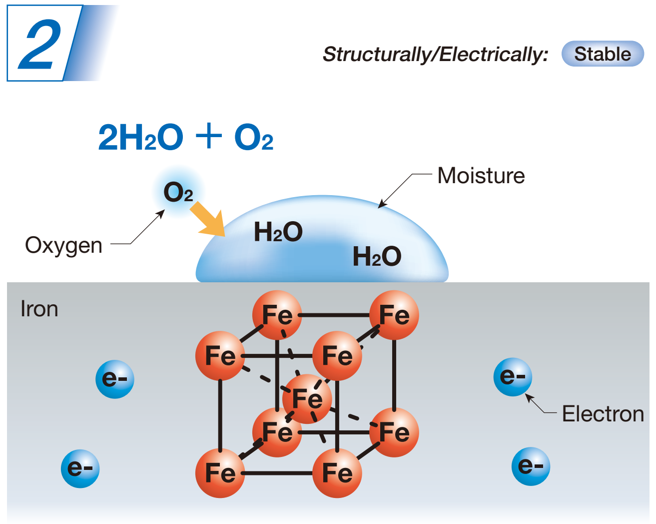
Twenty-one percent of the air is oxygen. That is why it is virtually impossible for any metal to exist in pure form. Metals combine with atmospheric oxygen to form oxides. Iron in its natural state exists as iron ore, an oxide, and steel is produced by using coke to reduce the iron ore. The resulting steel tends to react again with the oxygen in the air to cause oxidation—this oxidation of steel is a phenomenon called "rusting."

Corrosion Mechanism

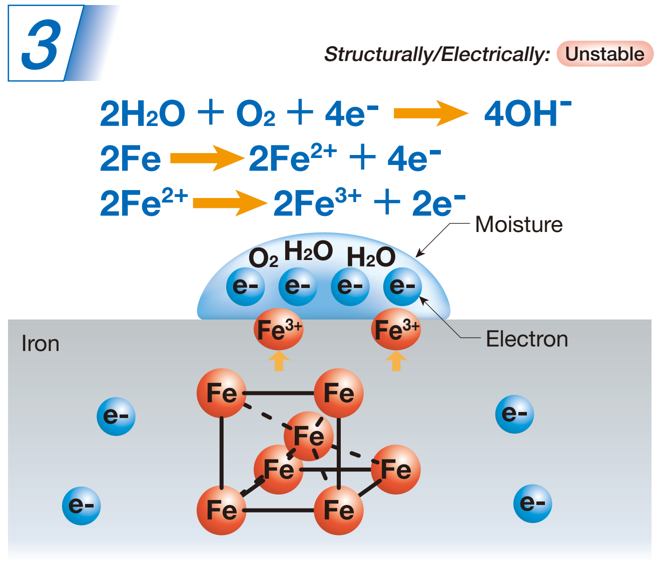


Iron (steel) is composed of Fe and electrons (e-).

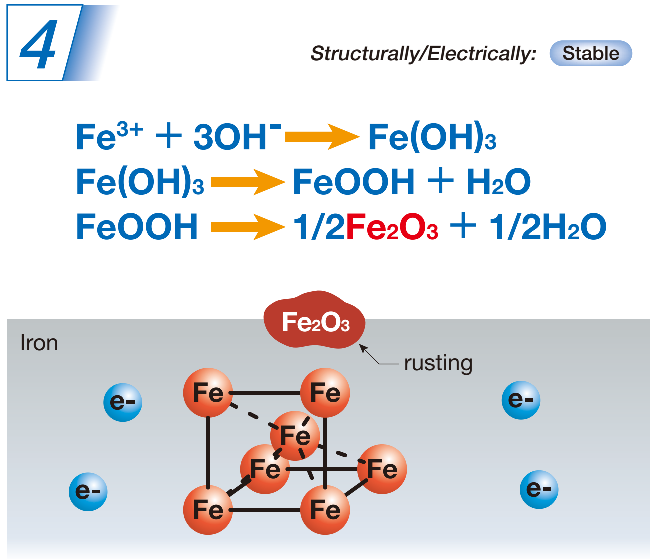
When iron is exposed to rain and water, moisture is adsorbed onto iron's surface.



Because moisture on iron's surface is exposed to the atmosphere, oxygen in the atmosphere is absorbed into moisture.

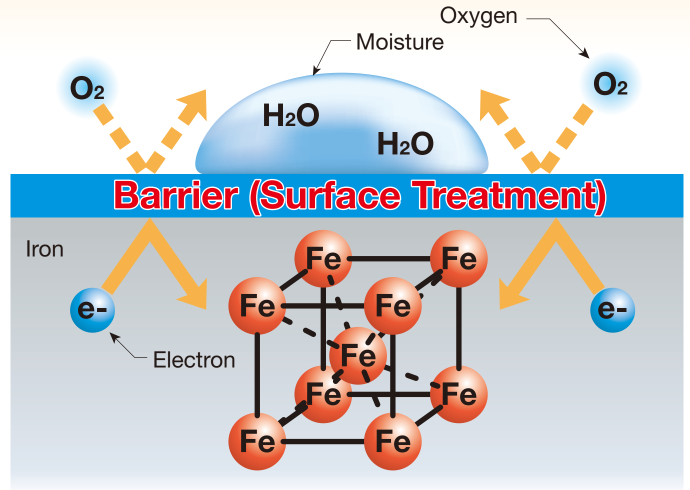


Because moisture reacts chemically with oxygen, moisture extracts the necessary electrons from the iron to produce OH^- anions in the moisture. The iron (Fe) loses these electrons, transforms into cations of Fe^{3+} and dissolves into the moisture.



OH^- and Fe^{3+} bond together to generate $Fe(OH)_3$, and then moisture (H_2O) runs out to generate rust (**Fe_2O_3**). This is the mechanism whereby rust occurs.

Hence, the rust prevention method—



The occurrence of rust can be prevented by forming a barrier on the surface of the iron and suppressing the chemical reaction that causes rust.

Accordingly, iron is given **surface treatments** as a means to prevent rust from developing.

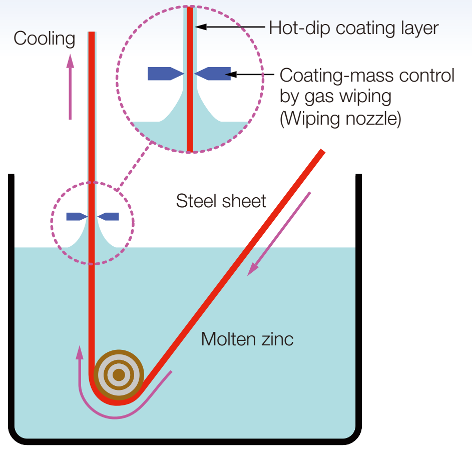
History of Metallic Coatings

In order to protect steel from rusting, metallic coatings serve as "makeup" for the surface of steel material. The most typical metallic coating is galvanizing, or zinc coating, and goes back to the early 1740s. This was when the high-volume production of zinc ingots became possible in the United Kingdom owing to improvements in zinc smelting process and the galvanizing method was invented in France. Steel by nature tends to return to an oxide in the air. An iron oxide film forms on the steel surface before the steel reaches the coating process. This makes it difficult to deposit molten zinc on the surface. To solve this problem, a flux (salt) was applied to the surface before the steel materials were immersed in molten zinc. This hot-dip galvanizing (flux) method was invented in 1837 and is the archetype of today's hot-dip continuous galvanizing.

The flux method is suited to sheet-by-sheet galvanizing, but does not lend itself to continuous production. A new method was devised in 1931 whereby cold-rolled coils were continuously heated at high temperature and reduced by hydrogen to clean the surfaces. This innovative technique is known as continuous hot-dip galvanizing, or the Sendzimir process. NIPPON STEEL introduced this method from 1953 to 1954.

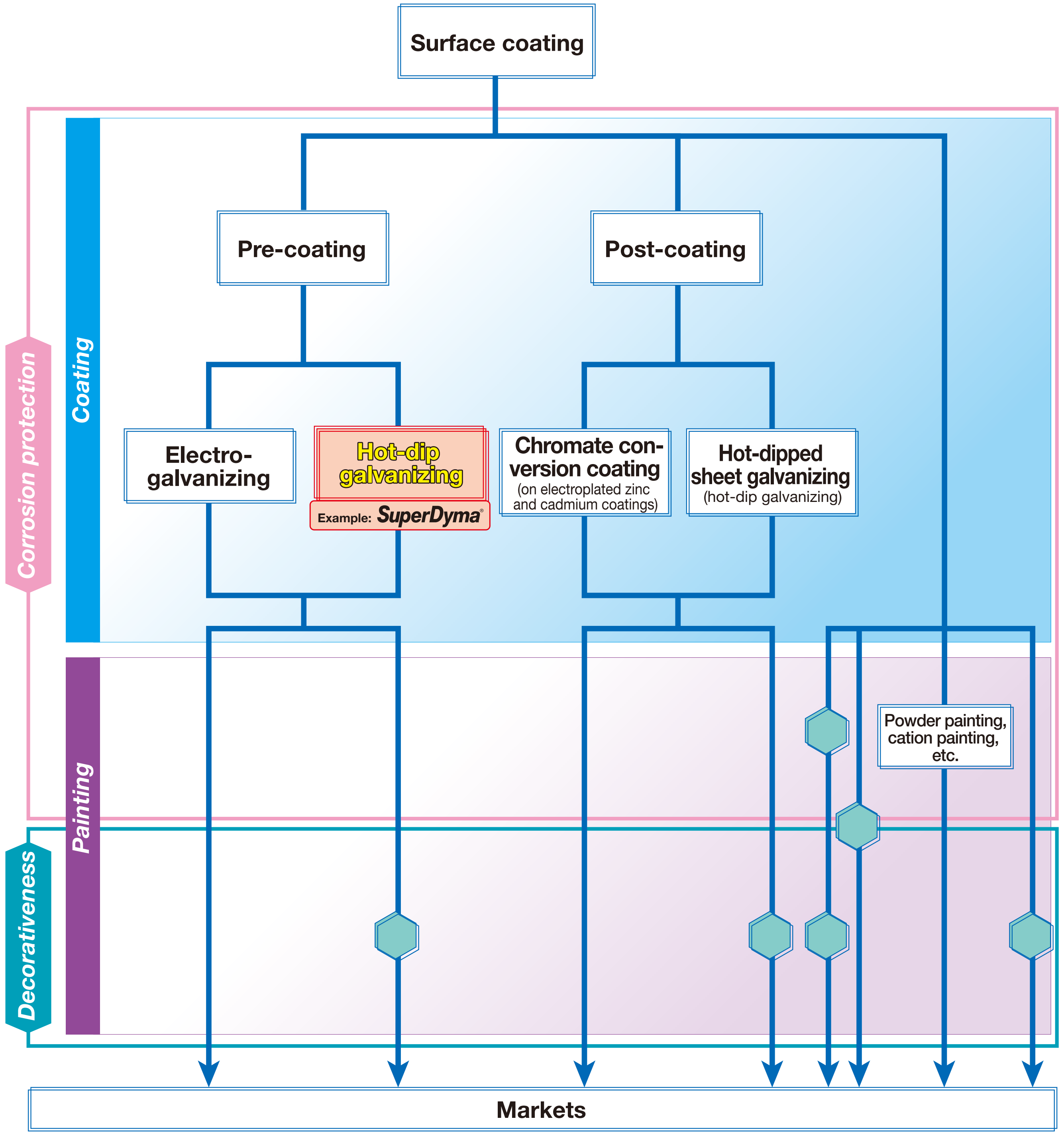
(Citation from *Nippon Steel Monthly*, June 2003: The Genesis of Product Making—Efforts to Combat Rust)

Arrangement for Hot-dip Coating



Metallic coating is deposited on the surface of steel sheets when immersed in a solution of molten coating metal. This method is adopted for coating steel sheets intended for applications such as automotive steel sheets and building materials that are used in highly corrosive environments.

(Citation from *Nippon Steel Monthly*, June 2003: The Genesis of Product Making—Efforts to Combat Rust)



Surface treatments are roughly classified into two types: coating and painting.

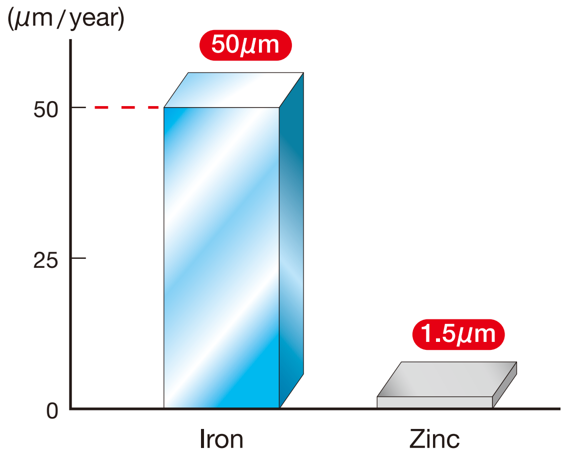
There are two kinds of coating: pre-coating in which the steel is coated prior to fabrication, and post-coating in which the coating is applied afterwards. Further coating is classified into two: electro-coating whereby electrolytic coating is provided, and hot-dip coating whereby the steel is dipped into a molten coating material.

Most steel sheets are put on the market after receiving treatments for corrosion resistance and decorativeness.

(Reference: Service Life of Steel Depending on Corrosion)

Annual Corrosion Rate

The annual corrosion rates for iron and zinc are compared at the right. In rural environments, while iron oxidizes to a depth of 20 microns, zinc demonstrates much better corrosion resistance by oxidizing to only 1.5 microns. Utilizing this superior performance, zinc is an effective material for surface treatment.

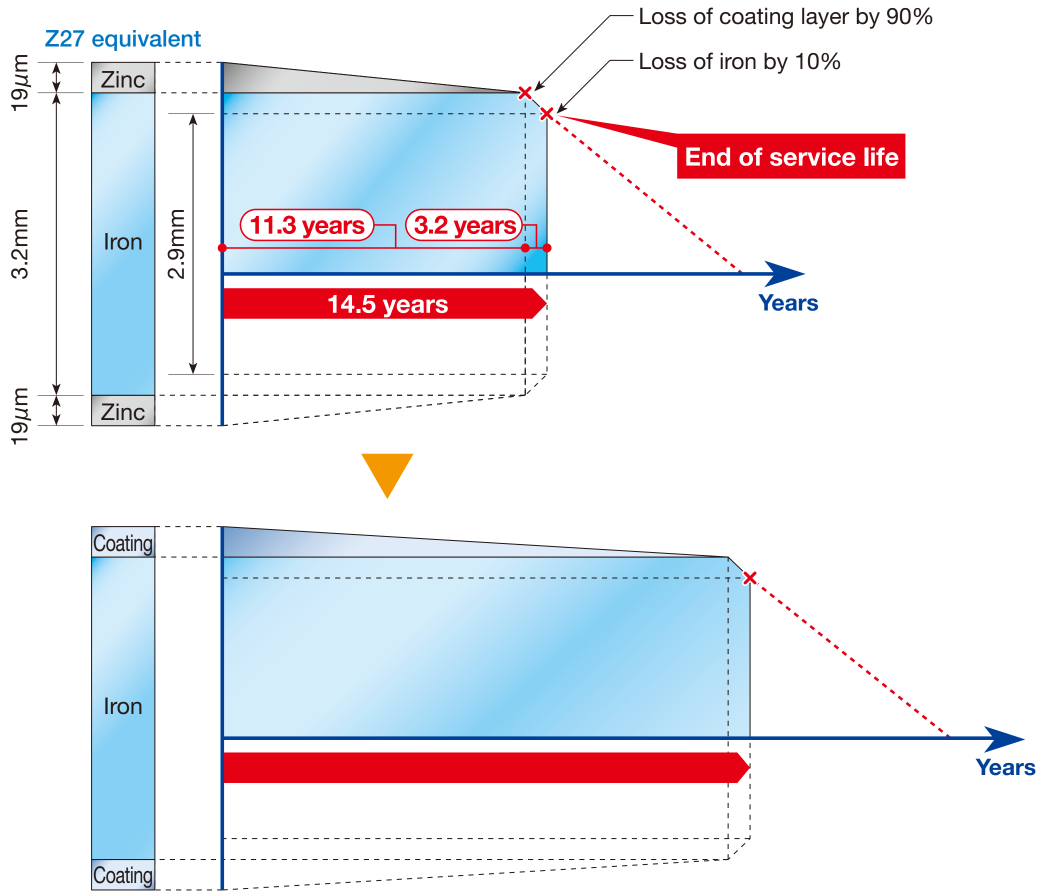


Service Life of Steel

An example of the service life of hot-dip galvanized (Zn-coated) steel sheet (thickness: 3.2 mm; Z27) is shown below.

This galvanized steel sheet offers about an 11-year service life when provided with a 19-micron coating of zinc. However, once the zinc coating is lost, the steel still has a service life of three years, for a total service life of 15 years.

By providing coatings with higher corrosion resistance, the service life of steel as a whole can be prolonged.

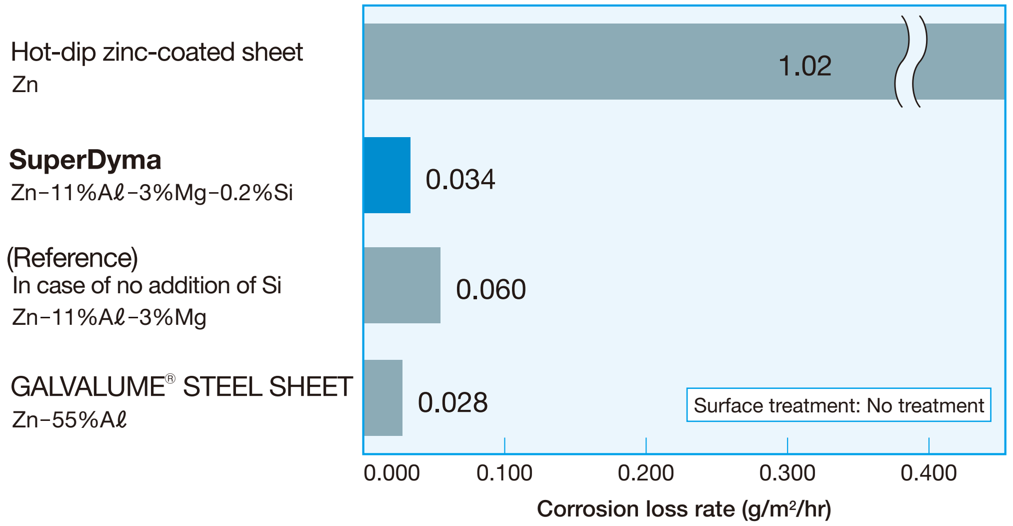


Mechanism of Corrosion Resistance

Corrosion Protection Mechanism on Flat Surfaces

SuperDyma is produced by coating aluminum, magnesium and silicon to the conventional zinc coating, thereby using the composite effect of these added elements to derive its high corrosion resistance. That is, SuperDyma's capacity to protect against corrosion is enhanced by adding silicon and magnesium, whose beneficial effect is demonstrated by NIPPON STEEL's hot-dip Zn-5%Aℓ alloy coated sheets and DYMAZINC™ (Zn-Mg alloy-coated steel), to the conventional additive aluminum. Silicon is effective in improving the workability of coatings containing aluminum and at the same time enhances corrosion suppression through composite action with magnesium.

Coating Layer Composition and Corrosion Resistance (Salt Spray Tests)

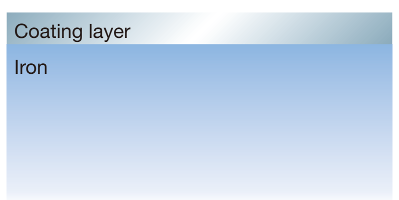


Corrosion Resistance of Flat Surfaces

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 and about 5 times that of hot-dip Zn-5%Aℓ alloy-coated sheets.

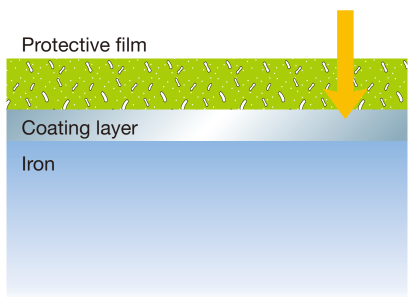
Corrosion Protection Mechanism on Flat Surfaces

Coatings are provided in order to improve corrosion resistance



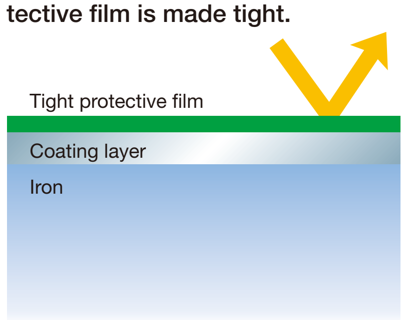
A protective film is formed on coatings after corrosion of coating layer begins. The performance of this film is important for improving the corrosion resistance of flat surfaces.

Coatings form a protective film to maintain corrosion resistance



Coatings form a protective film to maintain corrosion resistance. But, if the formed protective film is coarse, moisture and oxygen will penetrate to the base metal, causing the onset of corrosion.

In order to enhance the corrosion resistance of the coating, the protective film is made tight.



However, if a tight protective film is formed, corrosion can be suppressed.

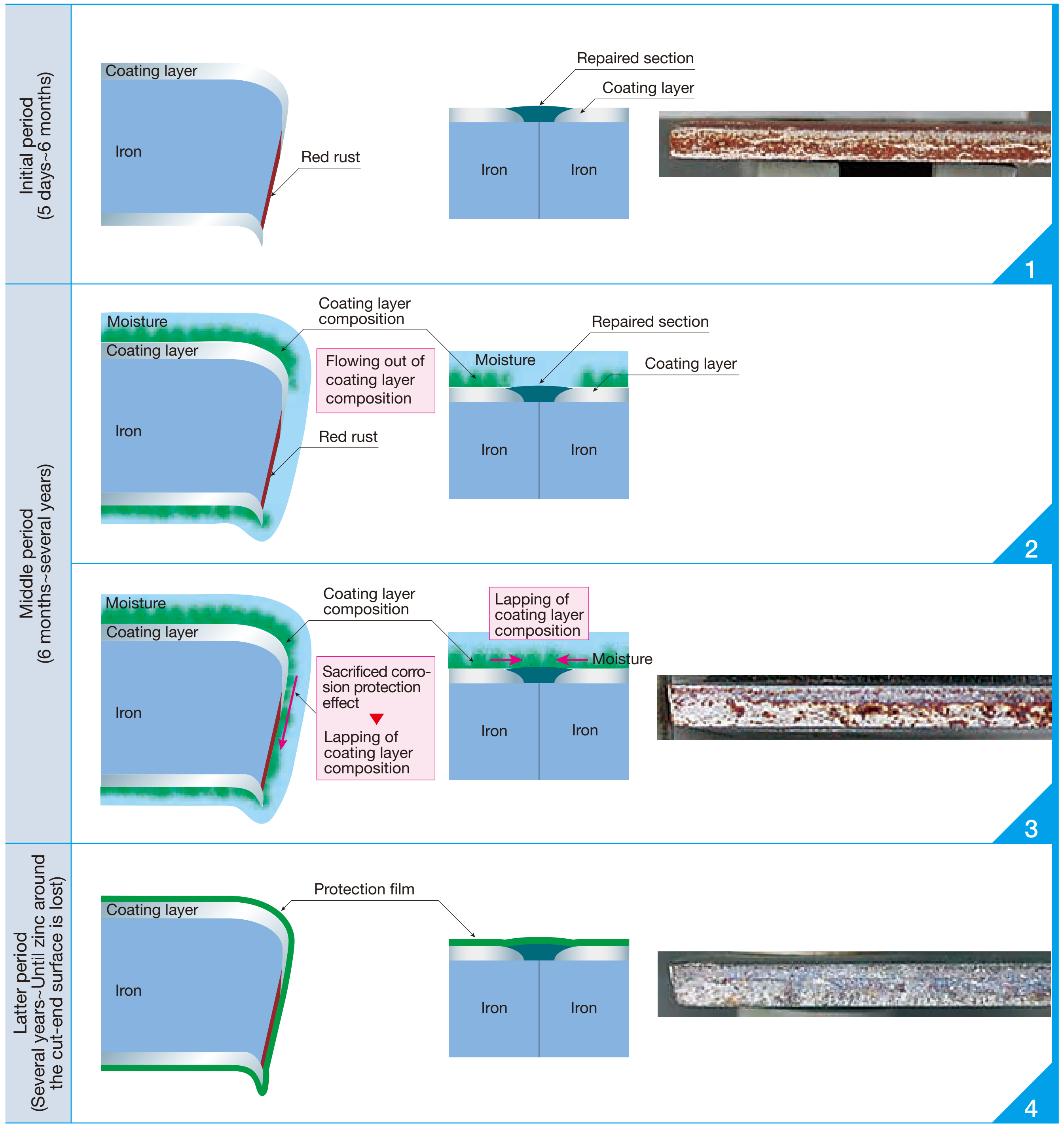
Note: GALVALUME® is a trademark of BIEC Internatioal Inc.

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

Because the cut-end surface of SyperDyma's base metal is exposed, red rust sometimes occurs during the initial stage of application.

However, the composition of the coating around the cut-end surface is such that it leeches out to form a tight protective film composed mainly of zinc hydroxide ($Zn(OH)_2$), basic zinc chloride ($ZnCℓ_2 \cdot 4Zn(OH)_2$) and magnesium hydroxide ($Mg(OH)_2$). This tight film covers the cut-end surface within several months. It is low in electric conductivity and effective in suppressing the development of corrosion at the cut-end surface. Further, the silicon contained in the coating acts to accelerate the formation of the protective film described above.

Corrosion Protection Mechanism at Cut-end Surfaces

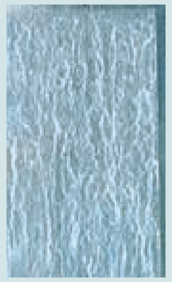
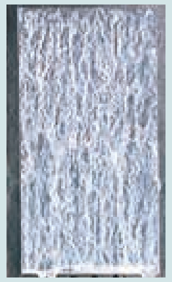


Corrosion Resistance of Flat Surfaces

Conventional hot-dip Zn-coated steel sheets also produce a protective film. However, this film is rough in texture, allowing the penetration of moisture and oxygen and a resultant growth of corrosion.

By contrast, the dense protective film formed on the surface of SuperDyma arrests the corrosion process and stabilizes corrosion behavior.

Corrosion Resistance of Flat Surfaces (Salt Spray Tests)

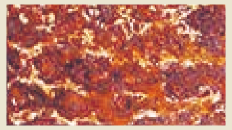
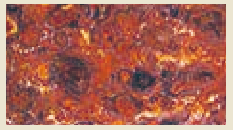
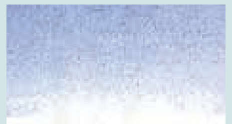
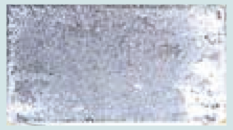
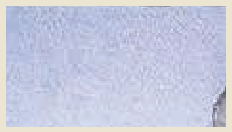
Test time	Before test	500 hours	1,000 hours	2,000 hours
SuperDyma Thickness: 3.2 mm Coating mass symbol: K12 Special chromate treatment				

30mm

Corrosion Resistance of Flat Surfaces (Results of JASO)

Specimen	Type of coating	Coating mass	Surface treatment	Thickness
Hot-dip Zn-coated sheet	Zn	Z27	Special chromate treatment	1.6mm
SuperDyma	Zn–11%Aℓ–3%Mg–0.2%Si	K18		
GALVALUME STEEL SHEET	Zn–55%Aℓ	AZ150		

Test conditions:
Cyclic corrosion test (JASO M609-91 method)
Repetition of ① to ③ as a cycle
① Salt spray: 2 hours (5% NaCℓ, 35°C)
② Drying: 4 hours (60°C)
③ Wetting: 2 hours (50°C, humidity 95% or more)

	90 cycles	180 cycles
Hot-dip Zn-coated sheet		
SuperDyma		
GALVALUME STEEL SHEET		

Corrosion Resistance at Cut-end Surfaces

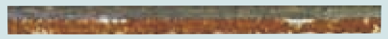
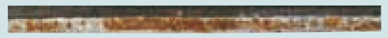
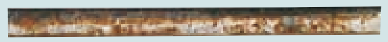
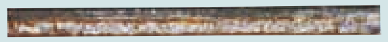
SuperDyma has superb corrosion resistance at its cut-end surfaces.

Corrosion Resistance at Cut-end Surfaces (Results of Salt Spray Tests)

Specimen conditions Thickness: 3.2 mm Surface treatment: No treatment	Salt spray test: 500 hours
Hot-dip Zn-coated sheet Coating mass: 100 g/m²/side	
SuperDyma Coating mass: 90 g/m²/side	
GALVALUME STEEL SHEET (Laboratory trial-made sample) Coating mass: 90 g/m²/side	

Corrosion Resistance at Cut-end Surfaces: Initial Period (Results of Outdoor Exposure Tests)

Specimen conditions
SuperDyma
Thickness: 3.2mm
Coating mass symbol: K27
Surface treatment: Special chromate treatment (Y treatment)
Exposure site: Urayasu Plant of KANEYASU Co.

	Downward
Original	
7 days	
14 days	
1 month	
2 month	
3 month	

In continuation

Results of Outdoor Exposure Tests

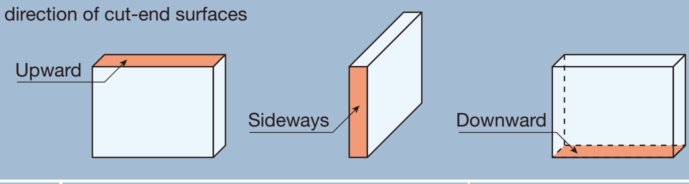
- In the actual exposure environment outdoors, a slight degree of initial red rust occurs on cut-end surfaces, but, after a while, a stable protective film covers the cut-end surface, thus virtually arresting further progress of corrosion in the long run.
- Red rust which occurs in the initial phase is arrested in progress, with time, by the effect of the protective film and, soon entirely covered by the film, becomes quite inconspicuous.

Corrosion Resistance at Cut-end Surfaces: Middle and Latter Periods (Results of Outdoor Exposure Tests)

Specimen conditions SuperDyma
Thickness: 3.2 mm
Coating mass: 90 g/m²/side (K18)
Surface treatment: No treatment

Exposure site: NIPPON STEEL's weathering site at Futtsu

Set direction of cut-end surfaces



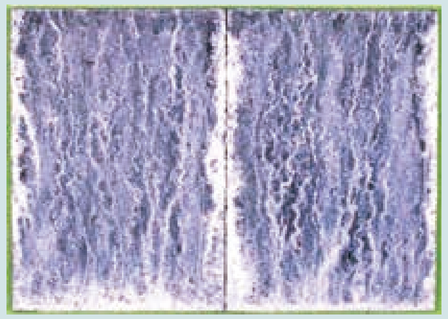
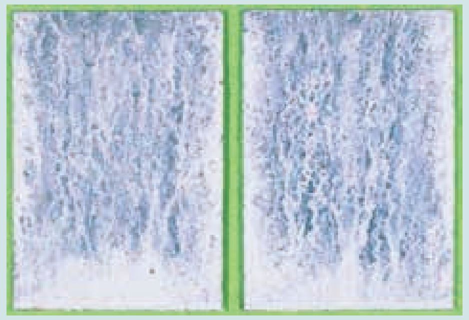
	Upward	Sideways (The left is the underside in the photo)	Downward
8 months			
20 months			

Corrosion Resistance at Flat Surfaces

In the case of fabricated post-coated products with heavy zinc coatings of 550 g/m^2 per side (HDZ55, according to JIS H8641), the protective film has a coarse texture that over time allows corrosion to progress until red rust forms.

SuperDyma even with a coating of only 90 g/m^2 per side (coating mass symbol: K18) is quite free of red rust, thus offering corrosion resistance equal or superior to that of HDZ55.

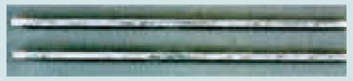
Corrosion Resistance at Flat Surfaces (Results of Salt Spray Tests)

Test time	1,000 hours	2,000 hours
SuperDyma K18 (Thickness: 1.6 mm)		
Post-coated sheet HDZ55 (Thickness: 6.0 mm)		

Corrosion Resistance at Cut-end Surfaces

The results of a 2,000-hour salt spray test on SuperDyma K18 show that red rust does not occur on cut-end surfaces.
(The specimen installation angle conforms to JIS Z2371 "Methods of salt spray testing".)

Corrosion Resistance at Cut-end Surfaces (Results of Salt Spray Tests)

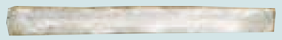
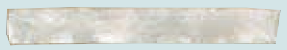
	Thickness	1,000 hours	2,000 hours
SuperDyma K18	1.6mm		
	3.2mm		
Post-coated sheet HDZ55	1.2mm		
	6.0mm		

Repair Coating at Cut-end Surfaces (Results of Salt Spray Tests)

Specimen conditions
SuperDyma
Thickness: 4.5 mm, 6.0 mm, 9.0mm
Coating mass: K18
Surface treatment: Special chromate treatment (Y treatment)

Repair coat
Zinky Coat SD Spray
(Product of Nippon Paint Corrosion Protection Coating Co., Ltd.)

SuperDyma K18 (Repair-coated for cut-end surface; test time: 2,000 hours)

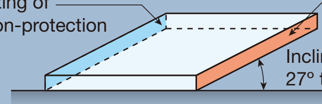
Thickness: 4.5 mm	Thickness: 6.0 mm	Thickness: 9.0 mm
		

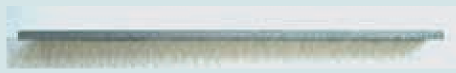
Corrosion-protection Treatment at Cut-end Surfaces

Specimen conditions
SuperDyma
Thickness: 3.2 mm
Coating mass: K18
Surface treatment: Special chromate treatment (Y treatment)

Corrosion-protection agent
Breton R143-C
(Product of Sugimura Chemical Industry Co., Ltd.)

Test method
① After coating of one side of cut-end surfaces with corrosion-protection agent, the specimen was exposed outdoor (see the figure below)
② Exposure site: Ichikawa, Chiba Prefecture (rural environment)
③ Exposure period: August 8, 2001~



Exposure period	Coating of corrosion-protection agent	No coating of corrosion-protection agent
1 week		
1 month		

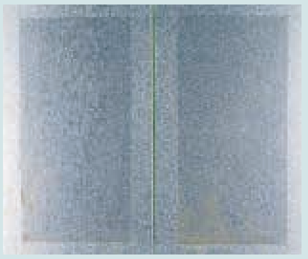
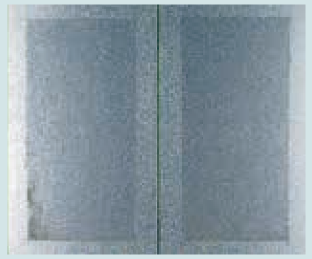
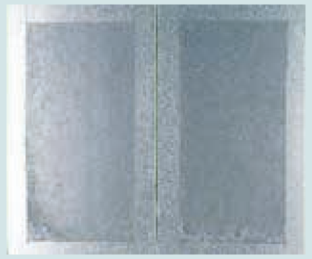
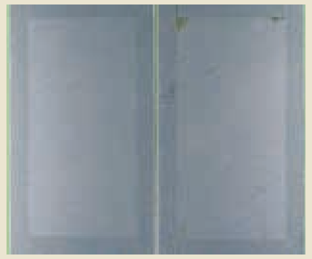
Comparison with Stainless Steel, Aluminum and GALVALUME STEEL SHEET

It is true that stainless steel offers superb corrosion resistance thanks to the passivated film that forms on its surface. However, it has the disadvantage of being vulnerable to corrosion caused by salt. Meanwhile, the protective film that forms on the surface of SuperDyma provides a strong and effective barrier against salt corrosion. In terms of resistance to pitting corrosion and other properties that affect the "service life of steel" and are of key importance when steel is used as a structural material, stainless steel is superior. SuperDyma, on the other hand, is far more advantageous in applications such as panel surfaces where "resistance to red rust" is paramount.

The exceptional corrosion resistance of aluminum also derives from the passivated film on its surface. GALVALUME STEEL SHEET, with an alloy coating that is 55% aluminum, demonstrates a similar effectiveness. However, aluminum exhibits poor alkali resistance.

Corrosion Resistance of SuperDyma and Stainless Steel at Flat Surfaces (Results of JASO)

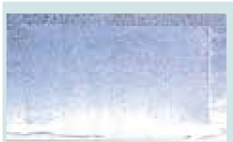
Test conditions: Cyclic corrosion test (JASO M609)
Repetition of ① to ③ as a cycle
① Salt spray: 2 hours (5% NaCℓ, 35°C) ② Drying: 4 hours (60°C, humidity 30%) ③ High-temperature wetting: 2 hours (50°C, humidity 98%)

	30 cycles	60 cycles	90 cycles
SuperDyma K18 (Special chromate treatment)			
Stainless steel SUS304			

Corrosion Resistance of SuperDyma and GALVALUME STEEL SHEET at Flat Surfaces (Results of JASO)

Specimen	Type of coating	Coating mass	Thickness
SuperDyma	Zn-11%Aℓ-3%Mg-0.2%Si	K18	1.6mm
GALVALUME STEEL SHEET	Zn-55%Aℓ	AZ150	

Test conditions: Cyclic corrosion test (JASO M609-91 method)
Repetition of ① to ③ as a cycle
① Salt spray: 2 hours (5% NaCℓ, 35°C) ② Drying: 4 hours (60°C)
③ Wetting: 2 hours (50°C, humidity 95% or more)

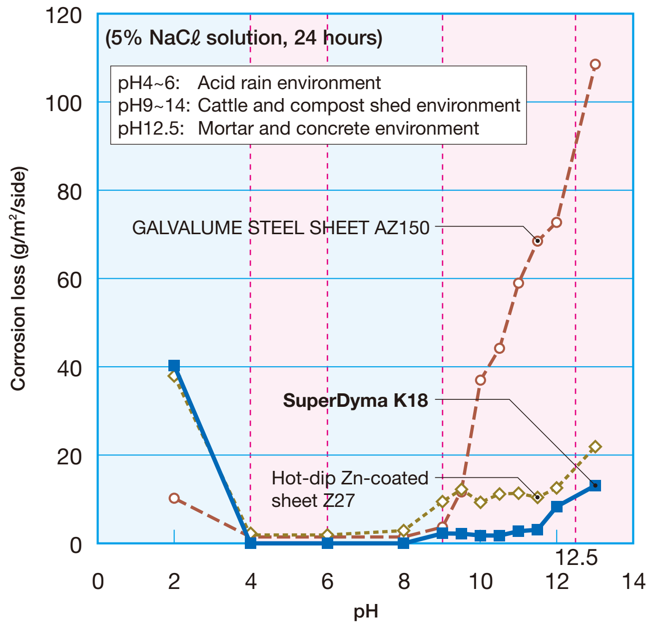
	90 cycles	180 cycles
SuperDyma		
GALVALUME STEEL SHEET		

Corrosion Resistance at Cut-end Surfaces (Results of Salt Spray Tests)

Specimen conditions Thickness: 3.2 mm Surface treatment: No treatment	Salt spray test: 500 hours
SuperDyma Coating mass: 90 g/m²/side	
GALVALUME STEEL SHEET (Laboratory trial-made sample) (*) Coating mass: 90 g/m²/side	

(*) GALVALUME STEEL SHEET is a product sold and registered trade mark in Japan.

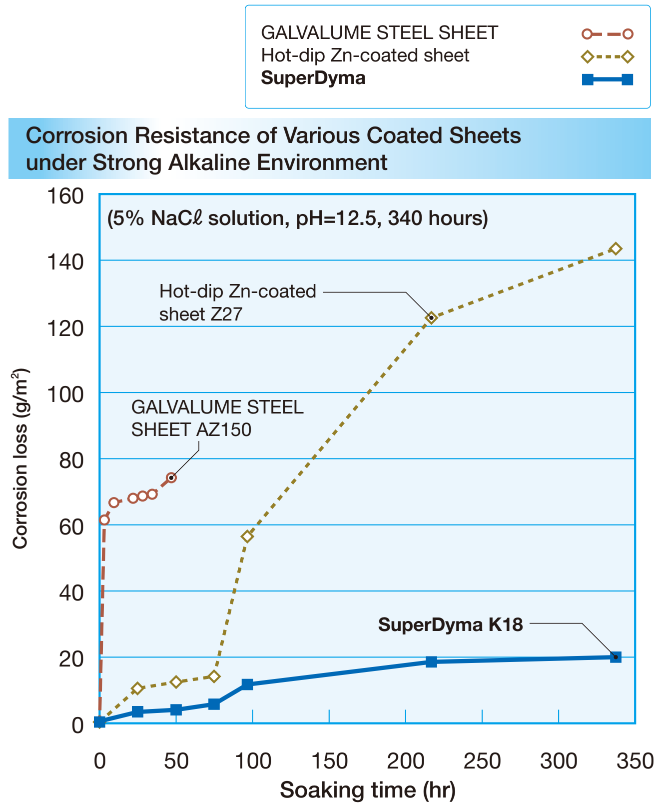
Acid and Alkaline Resistance of Various Coated Sheets



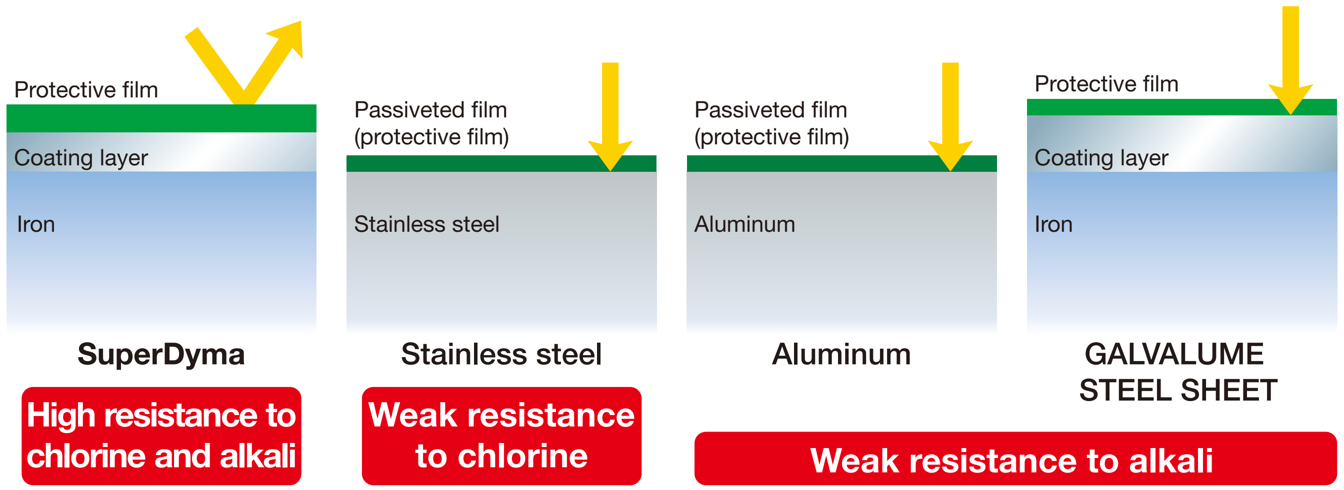
Under alkaline conditions with a relatively high pH, GALVALUME STEEL SHEET corrodes very quickly while SuperDyma shows less susceptibility to corrosion and remains virtually intact.

In alkaline environments (cattle and compost sheds, mortar and concrete), the quality of SuperDyma remains high.

Corrosion Resistance of Various Coated Sheets under Strong Alkaline Environment



Under severer conditions requiring the immersion of steel sheets in an alkaline solution with a strong pH of 12.5, ordinary metallic-coated steel sheets experience rapid corrosion over a period of 100 hours. But, SuperDyma keeps the corrosion to a minimum and remains stable after 300 hours.

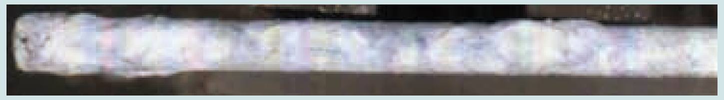
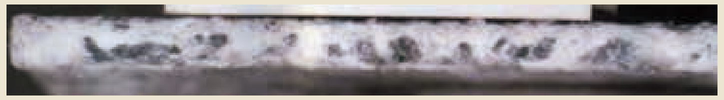


MATERIAL
SuperDyma™
Comparison with Stainless Steel, Aluminum and GALVALUME STEEL SHEET

Corrosion Resistance of Bends

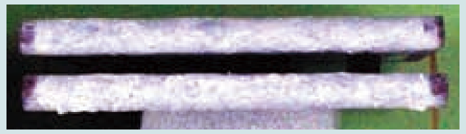
● SuperDyma shows the same excellent corrosion resistance at bends as it does on flat surfaces.

Corrosion Resistance of 1t Bends (Results of Salt Spray Tests)

Specimen conditions Thickness: 0.8 mm Surface treatment: No treatment Specimen processing: 1t bending	Salt spray test: 1,000 hours
Hot-dip Zn-coated sheet Coating mass: 135 g/m²/side	
SuperDyma Coating mass: 90 g/m²/side	
GALVALUME STEEL SHEET Coating mass: 75 g/m²/side	

● SuperDyma K18 shows higher corrosion resistance at bends than post-coated HDZ55.

Corrosion Resistance of 1t Bends (Results of Salt Spray Tests)

Test time	1,000 hours	2,000 hours
SuperDyma K18 (Thickness: 1.6 mm)		
Post-coated sheet HDZ55 (Thickness: 3.2 mm)		

Note: Post-coated sheet was coated after bending

Corrosion Resistance of Cylindrically-drawn Sections

● SuperDyma shows the same excellent corrosion resistance in cylindrically-drawn areas as it does on flat surfaces.

Corrosion Resistance of Cylindrically-drawn Sections (Results of Cyclic Corrosion Tests)

Specimen	Thickness	Coating mass/side	Chromate mass/side	Reference
SuperDyma	1.0t (mm)	95 mg/m²	40 mg/m²	Trial-made product for practical use
Hot-dip Zn-coated sheet		130 mg/m²	15 mg/m²	Product for practical use

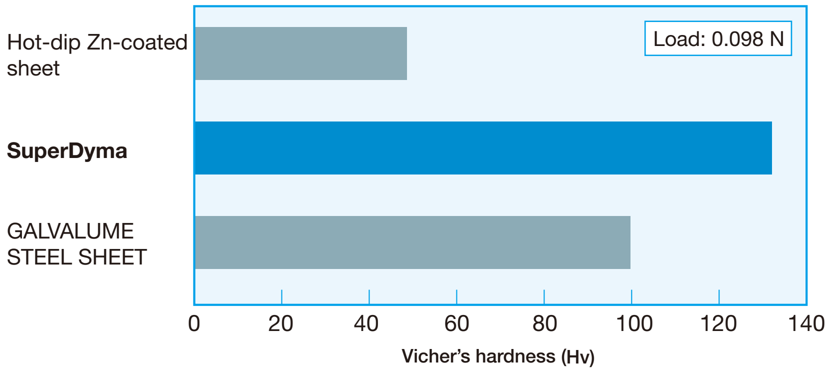
Deep-drawing test conditions ●Punch dia. 50ϕ ●Die shoulder R10 ●Punch shoulder R10 ●Drawing ratio 2.0 ●Blank holding pressure 0.5 tons

Corrosion Resistance Tests
Repetition of ① to ③ as a cycle
① Salt spray: 2 hours (5% NaCℓ, 35°C)
② Drying: 4 hours (60°C, humidity 30%)
③ Wetting: 2 hours (50°C, humidity 98%)

	Before test	30 cycles	60 cycles
SuperDyma			
Hot-dip Zn-coated sheet			

Scratch Resistance

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



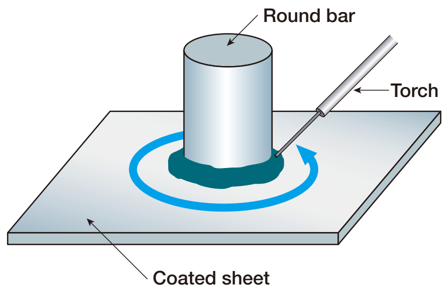
Weldability

- As thin-coat SuperDyma exhibits high corrosion resistance, impediments brought about by heavier coating thicknesses are not presented.
- A variety of welding methods (lapped fillet arc welding, spot welding) can be applied to SuperDyma.

(Note)
In the case of arc welding, while the weld bead will generally show shrinkage, large internal tension force is at work on the base metal in the vicinity of the bead, depending on the structure of the members to be welded.(Example: Circumferential fillet welding, see figure at right).
When coated steel sheets such as SuperDyma are applied in such welding, there are cases in which the base metal in the vicinity of the bead may crack*, and thus prior confirmation is recommended before application.

*Liquid metal embrittlement phenomenon: Embrittlement caused by penetration into the grain boundary of iron upon which tensile stress is at work. Also called zinc embrittlement.

Circumferential fillet welding



Thin coating layer → Advantageous in welding = By optimizing welding conditions Arc welding Spot welding **OK**

Corrosion Resistance of Spot Welds

- In the case of SuperDyma, the protective film covers the weld as the cycle increases, thus suppressing the development of red rust.

Corrosion Resistance of Spot Welds (Results of Salt Spray Tests)

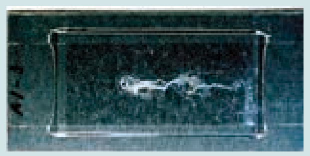
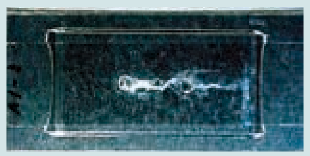
Specimen conditions Thickness: 0.8 mm
Coating mass/side: 90 g/m²
Post-treatment: Y treatment

Corrosion Resistance Tests Repetition of ① to ③ as a cycle
① Salt spray: 4 hours (5% NaCℓ, 35°C)
② Drying: 2 hours (60°C, humidity 30%)
③ High-temperature wetting: 2 hours (50°C, humidity 98%)

Welding conditions

Pressure	Squeeze	Up slope	Welding time	Hold	Cooling water	Current value
1,860 N	30 cycles	3 cycles	7 cycles	25 cycles	2ℓ/min	13 KA

Electrode applied: Obara DHO-type, Preliminary spotting: 20 dots

Test time	3 cycles	6 cycles	9 cycles
SuperDyma			

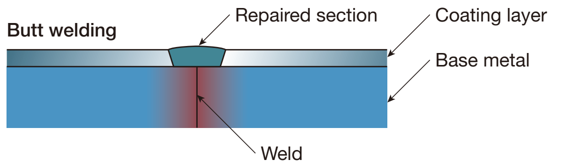
Corrosion Resistance of Repaired Welds

- Repaired welds of SuperDyma that use zinc-rich paint showed great improved corrosion resistance. It is presumed that the improved corrosion resistance is a result of the corrosion-inhibiting action of the protective film, peculiar to SuperDyma, at work on the repaired welds.

Assessment Results for Corrosion Resistance of Repaired Welds (Results of Salt Spray Tests)

Specimen conditions Thickness: 0.8 mm
Kind of coating: SuperDyma
Coating mass/side: 160 g/m²
Post-treatment: Y treatment

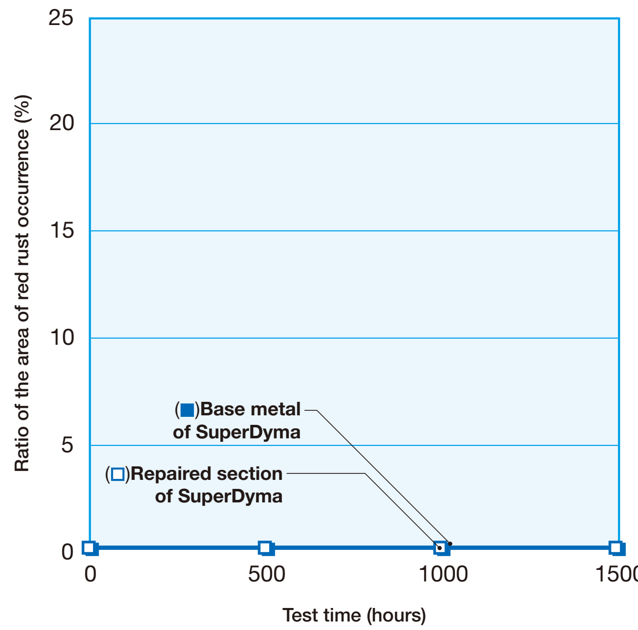
Test method Welding and repairing of welds
Ⅰ) After high-frequency butt welding, the weld is repaired by coating zinc-rich paint (see the figure below).



Ⅱ) Film thickness in repair coating is shown below.

Results of repair using zinc-rich paint

Coated sheet	Repair film thickness (μm)
SuperDyma	18.6



Paintability

- Super Dyma has excellent pre-treatability for painting.
- Painted Super Dyma has superb corrosion resistance, with little susceptibility to corrosion-induced rises of the coating film in cut-end surfaces and cross-cut parts.

CCT 30 Cycles of Structural Materials

Specimen conditions	Test conditions
Thickness: 0.8 mm	Repetition of ① to ④ as a cycle
Coating conditions: Pretreatment — Chromate treatment (Parker ZM3391)	① Salt spray: 4 hours (0.5% NaCℓ, 35°C)
Primer coat — Epoxy P-01 coating film thickness 5 μm	② Drying: 4 hours (70°C, humidity 30%)
Top coat — Polyester NSC300HQ coating film thickness 15 μm	③ High-temperature wetting: 4 hours (50°C, humidity 98% ore more)
	④ Drying: 4 hours (70°C, humidity 30%)

Hot-dip Zn-coated sheet	Super Dyma	GALVALUME STEEL SHEET
Coating mass: 135 g/m²/side	Coating mass: 90 g/m²/side	Coating mass: 75 g/m²/side

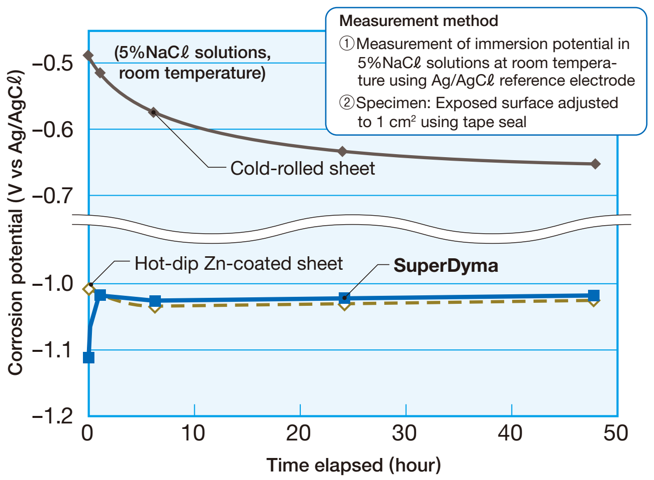
Corrosion Potential (Contact Corrosion with Different Metals)

- A certain metal comes into contact with another metal, where corrosion is accelerated— This phenomenon is called the contact corrosion with different metals.
- In case of contact of two kinds of metals, the metal having low electric potential (less precious metal) causes corrosion. (Refer to the table below: for example, in case when iron contacts with zinc, zinc corrodes.)

Standard Electrode Electric Potential (Hydrogen Electrode as Parameter)

	Metal	Electric potential (V) (25°C)
Precious →	Hydrogen	0.000
	Nickel	−0.250
	Iron	−0.440
	Zinc	−0.763
	Aluminum	−1.662
← Less precious	Magnesium	−2.363

Changes in Corrosion Potential with Time



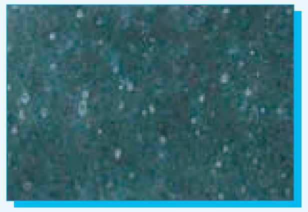
- SuperDyma, which contains magnesium and shows inferior potential attributable to $MgZn_2$ immediately after immersion, attains potential equal to that of other zinc-system coated sheets in one hour (see the figure below). It is conjectured that anodic dissolution of the coating is arrested under the influence of the magnesium-bearing hydrated film.
- This indicates that when SuperDyma comes into contact with different metals, the result ing phenomenon of contact corrosion attributable to corrosion potential is approximately the same as that with ordinary zinc-system coated sheets.
- Because SuperDyma has higher corrosion resistance than conventional zinc-coated sheets, the degree of corrosion due to contact with different metals seems less.
- However, the phenomenon of contact corrosion occurs, and accordingly when bolts, rivets and other members are used in contact with SuperDyma, it is recommended to use those bolts and rivets having the electric potential equal to that of SuperDyma (post-coated and other similar products) or provided with coating treatment.

Results of 3-year Exposure of Unpainted SuperDyma in Okinawa

When the results of 3-year exposure of SuperDyma and other test specimens are examined, red rust does not occur in SuperDyma, showing fine surface appearance. Further, occurrence of white rust is less for SuperDyma, compared to hot-dip Zn-coated sheets.

Corrosion loss of SuperDyma after removal of white rust is about 25% that of hot-dip Zn-coated sheets.

SuperDyma

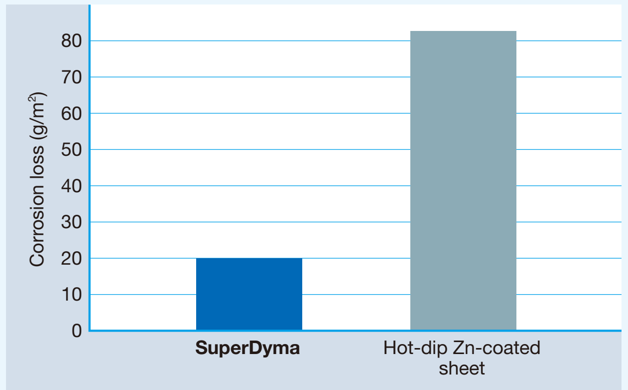


Hot-dip sheet

Specimen	Coating mass (one side)	Post-treatment
SuperDyma	90 g/m²	No treatment
Hot-dip Zn-coated sheet	135 g/m²	No treatment

Exposure site: Okinawa
Exposure period: 3 years (Dec. 1999~Dec. 2002)

Corrosion Loss After 3-year Exposure in Okinawa



Reference

Unit Weight

Standard thickness (mm) \ Symbol of coating mass	K06	K08	K10	K12	K14	K18	K20	K22	K25	K27	K35	K45
0.27	2.210	2.240	2.270	2.303	2.323	2.364	2.405	2.425	2.470	2.501	2.578	2.685
0.30	2.445	2.475	2.505	2.538	2.558	2.599	2.640	2.660	2.705	2.736	2.813	2.920
0.40	3.230	3.260	3.290	3.323	3.343	3.384	3.425	3.445	3.490	3.521	3.598	3.705
0.50	4.015	4.045	4.075	4.108	4.128	4.169	4.210	4.230	4.275	4.306	4.383	4.490
0.60	4.800	4.830	4.860	4.893	4.913	4.954	4.995	5.015	5.060	5.091	5.168	5.275
0.70	5.585	5.615	5.645	5.678	5.698	5.739	5.780	5.800	5.845	5.876	5.953	6.060
0.80	6.370	6.400	6.430	6.463	6.483	6.524	6.565	6.585	6.630	6.661	6.738	6.845
0.90	7.155	7.185	7.215	7.248	7.268	7.309	7.350	7.370	7.415	7.446	7.523	7.630
1.0	7.940	7.970	8.000	8.033	8.053	8.094	8.135	8.155	8.200	8.231	8.308	8.415
1.2	9.510	9.540	9.570	9.603	9.623	9.664	9.705	9.725	9.770	9.801	9.878	9.985
1.6	12.65	12.68	12.71	12.74	12.763	12.80	12.85	12.87	12.91	12.94	13.02	13.13
2.0	15.79	15.82	15.85	15.88	15.903	15.94	15.99	16.01	16.05	16.08	16.16	16.27
2.3	18.15	18.18	18.21	18.24	18.258	18.30	18.34	18.36	18.41	18.44	18.51	18.62
3.2	25.21	25.24	25.27	25.30	25.323	25.36	25.41	25.43	25.47	25.50	25.58	25.69
4.5	35.42	35.45	35.48	35.51	35.528	35.57	35.61	35.63	35.68	35.71	35.78	35.89
6.0	47.19	47.22	47.25	47.28	47.303	47.34	47.39	47.41	47.45	47.48	47.56	47.67
9.0	70.74	70.77	70.80	70.83	70.853	70.89	70.94	70.96	71.00	71.03	71.11	71.22

Note:
Unit mass of base sheet (kg/m²)=Base sheet's basic mass×Thickness (mm)
Base sheet's basic mass=7.85 (kg/mm·m²)
Unit mass of sheet (kg/m²)=Base sheet's unit mass+Coating mass constant

Symbol of coating mass	K06	K08	K10	K12	K14	K18	K20	K22	K25	K27	K35	K45
Coating mass constant	0.090	0.120	0.150	0.183	0.203	0.244	0.285	0.305	0.350	0.381	0.458	0.565

Chromate-free treatment of SuperDyma is attained by providing a special film to SuperDyma and features the following characteristics.

❶ It contains no chromate at all.
SuperDyma is coated with a special film that does not contain any chromate.

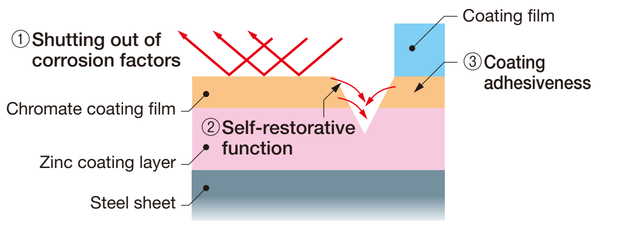
❷ It excels in corrosion resistance.
The special film ensures corrosion resistance equal or superior to that of the conventional normal chromate-treated steel sheets.

❸ Its workability is equal or superior to that of conventional chromate-treated steel sheets thanks to the effects of the special film.
The QN type has workability comparable to that of the conventional chromate-treated steel sheets.
The QFK type features a low coefficient of friction. Thus, it is more workable than the conventional chromate-treated steel sheets.

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

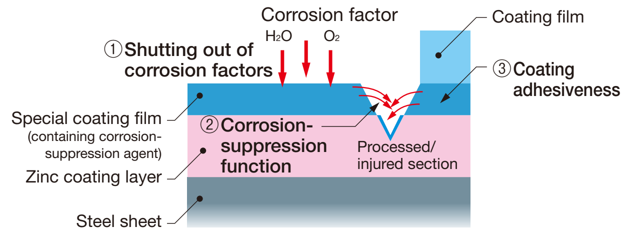
● Structure and Function of Coating Films

Chromate Coating Film



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

Chromate-free Coating Film



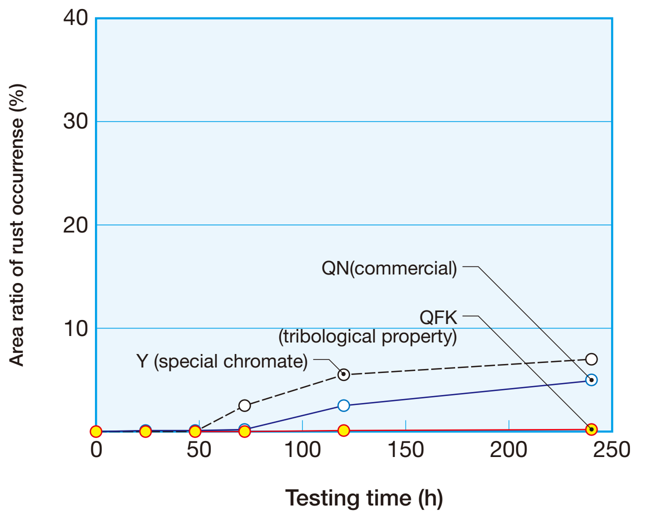
Corrosion Resistance Mechanism of Chromate Coating Film
Chromate-free film uses substances selected because they provide the characteristic features of chromate film such as its barrier effect, self-restorative function and paint adhesiveness. Chromate-free coated sheet has been realized by use of this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

Corrosion Resistsnce

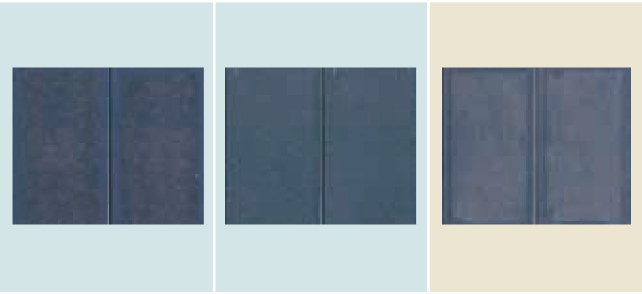
Salt water spray test (JIS Z2371)

Example of saltwater spray test results (flat sheet)



Example of appearance after 120-hr saltwater spray test (flat sheet)

Chromate-free treatment of SuperDyma		Y (Special chromate)
QN (commercial use)	QFK (tribological-property type)	

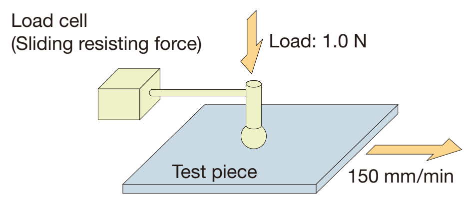


Lubricity

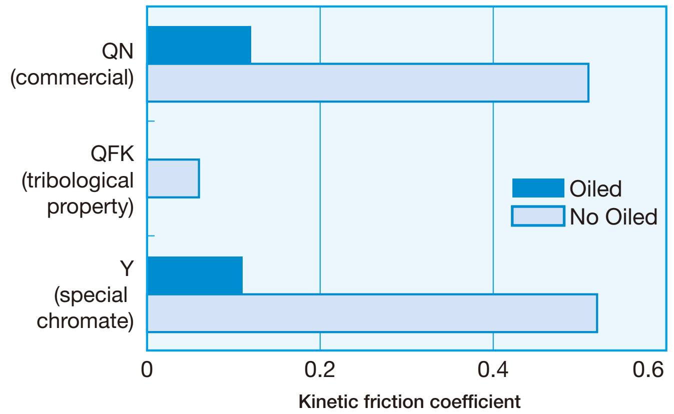
Kinetic friction coefficient

Conceptual diagram of the kinetic friction coefficient measuring system

Sliding contact: 10 mmϕ SUS ball tip
Traveling speed: 150 mm/min
Load: 1.0 N
Oiling: No oiling or rust-preventive oil



An example of kinetic friction coefficient

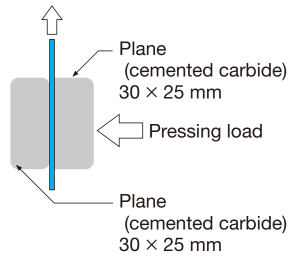


Lubricating Property (zinc-coated plane sheet drawing test)

Sliding property

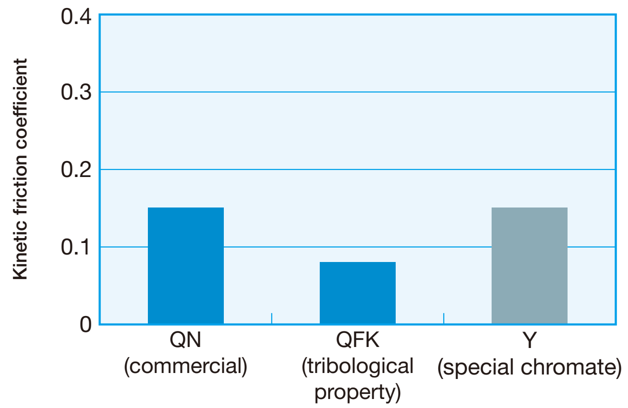
Plane sliding system

Pressing load: 1.0 ton
Drawing speed: 200 mm/min
Drawing distance: 100 mm
Oil: Rust-preventive oil
Evaluation: Friction coefficient*



* QFK was tested with no oiling.
* Friction coefficient = (Each load vs. each drawing load)/2

An example of friction coefficient during drawing of plane sheet



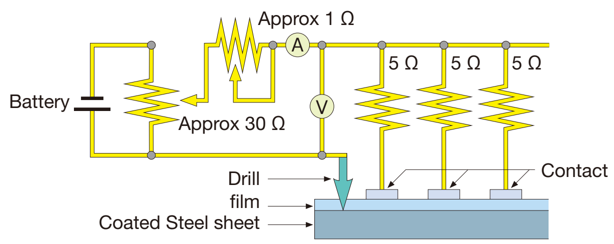
Electric Conductivity

Surface insulation resistance test (JIS C 2550)

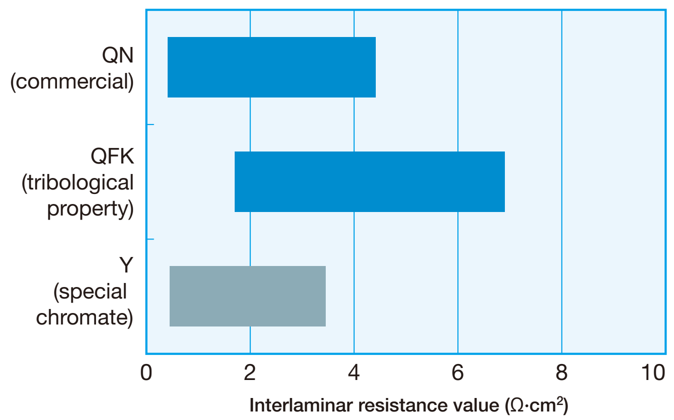
Conceptual diagram of the surface insulation resistance measuring system

Test voltage: 0.5 V
Current measuring range: 0~1 A
Surface area of contact: 1cm² × 10
Standard test pressure: 2 N/mm²±5 %

R_s=A (1 / i − 1)
R_s : Surface insulation resistance value (Ω·cm²/sheet)
A : Total area of contacts =10(cm²)
i : Average value of current (A)



An example of interlaminar resistance test results



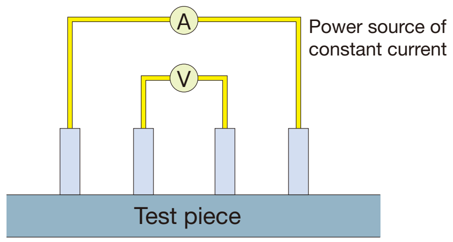
Conductivity (grounding property)

LORESTA (4-probe type)

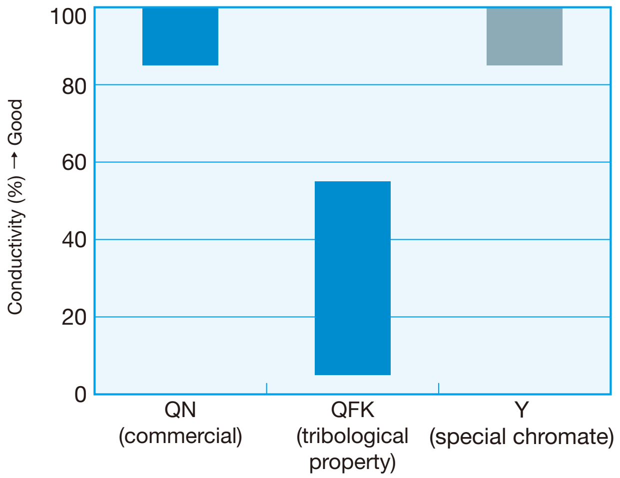
Conceptual diagram showing the contact resistance (LORESTA 4-probe type) measuring system

Tester: LORESTA MP-type of Dia Instrument Co., Ltd.
Test current: 1 μA ~ 100 mA
Resistance measuring range: 10^6 ~ 10^{-2} Ω
Surface area of contacts: 2mmϕ × 4 Interpole distance 5 mm
Contact load: 1.5 N
Evaluation: Continuity rate (%) = number of continuity*/20 tests ×100

* continuity = less than 1 mΩ



An example of the contact resistance (LORESTA 4-proble type) test results (conductivity)



Coating Property

Coat adherence

An example of paint adhesion test results

Coating conditions

Type of coating material	Thickness of coat	Baking conditions
Melamine alkyd type	20 μm	120℃ × 20min

Surface treatment		QN	QFK	Y
Primary	Cross-cut test	◎	◎	◎
	Erichsen test	○	◎	○
Testing method		Cross-cut test: After cross-cutting at 1 mm intervals, peeling with adhesive tape. Erichsen test: After extruding 7 mm, peeling with adhesive tape.		
Judgment		◎No change ○Slight peeling △ Considerable peeling × Complete peeling		

Primary: Evaluation after top coating.

Coating property varies according to the type of coating material used and the method of coating employed. So, please make sure to check beforehand with the coating material to be used.

Please also refrain from applying zinc phosphate for under-treating as it dissolves the coating film in some cases. (Please use untreated substrates which are easy to produce zinc phosphate film.)

A variety of welding methods (arc welding, spot welding, etc.) can be applied to SuperDyma by adjusting the welding conditions.

Welding-applicable Coating Mass

A variety of welding methods can be applied to SuperDyma with coating mass symbols from K06 to K45.

Meanwhile, for coated sheets with a coating mass symbol greater than K27, apply welding after decreasing or after reducing the coating thickness to the equivalent of K27 or under.

Note:
In the case of arc welding, there are cases in which the base metal in the vicinity of the bead may crack depending on the welding conditions, and thus prior confirmation is recommended before application. (For details, refer to note on page 16.)

Recommended Welding Conditions

Arc Welding

❶ **Welding machine: Use CO^2 or MAG welding machines**
The use of inverter- or pulse-type power sources that are available on the market allows for the suppression of sputtering and the prevention of burn-through.

❷ **Welding wire and shield gas:**
Application of the conditions listed in the following table for welding wire and shield gas is recommended.

Welding machine	Kind of wire	Shield gas
CO^2 welder	JIS Z 3312 YGW14 equivalents	CO^2
MAG welder	JIS Z 3312 YGW17 equivalents	80% argon + 20% CO^2

Spot Welding

It is necessary that the optimum conditions for spot welding be determined according to the plate thickness. For example, when spot welding coated sheets 3.2 mm in thickness, it is recommended that the electrode and welding conditions (welding pressure, welding time, welding current) shown in the following table be applied.

Steel sheet	Spot welding machine	Electrode			Welding pressure (kN)	Welding time(cyc.) 50 Hz			Welding current (kA)
		Outside diameter (D)	Tip shape	Size		Sq.T	W.T	Ho.T	
Plate thickness	1 ϕ AC, 150kVA	ϕ25	CR (R75)	ϕ11	8	30	65	35	14.0 ~ 16.5

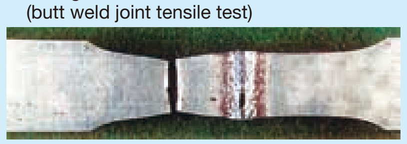
(For details, refer to the catalog under Superdyma—Welding.)

(Reference) Assessment of Welds

Welding is applied under the above-mentioned conditions, and it has been confirmed that there are no problems with regard to product quality vis-à-vis weld strength, internal weld conditions or others.

Specifications: NSDH400; Plate thickness: 3.2 mm; Coating mass symbol: K27

● Strength of arc-welded section (butt weld joint tensile test)

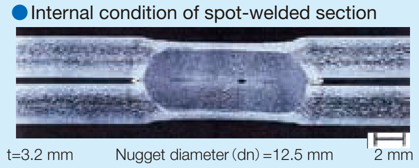


Fracture condition

● Internal condition of arc-welded section

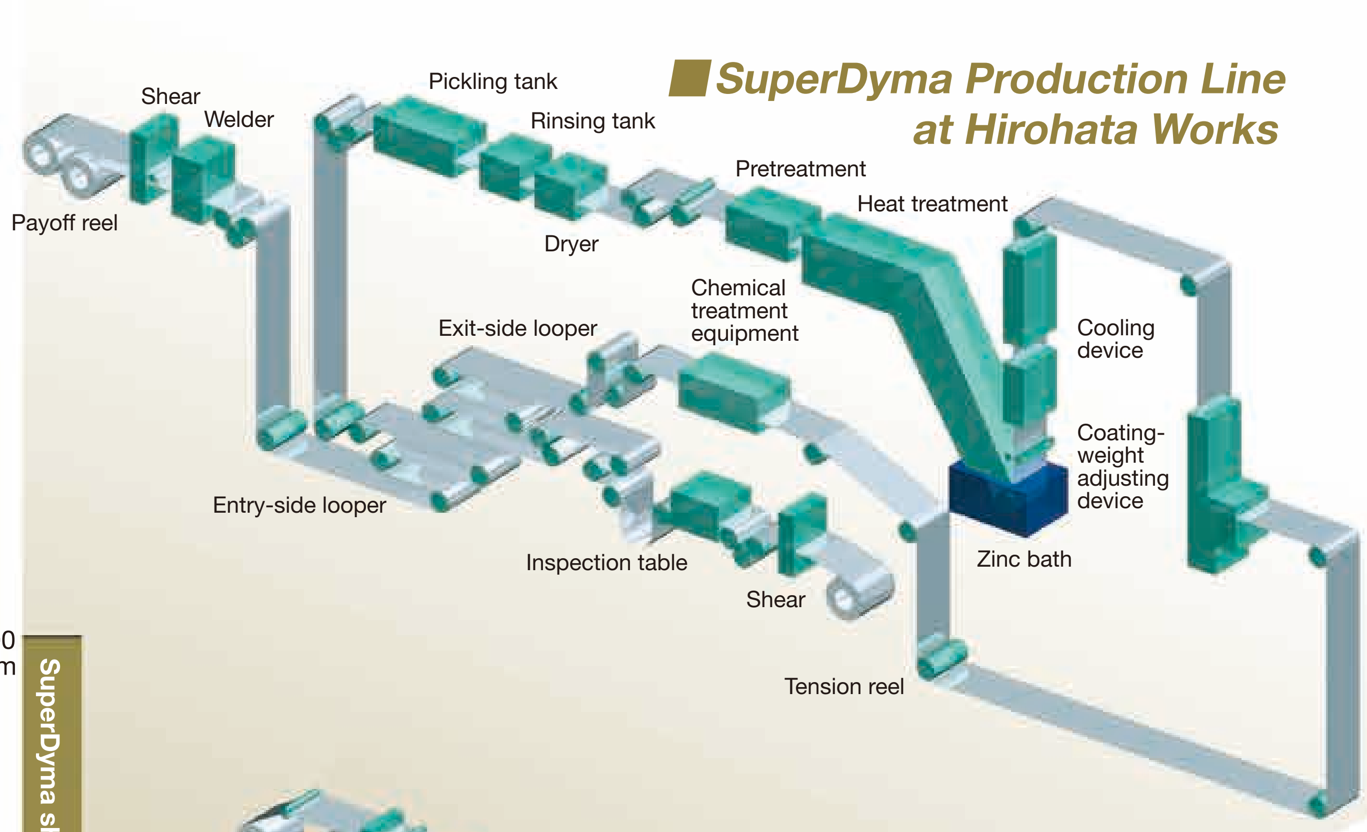
Sectional microstructure

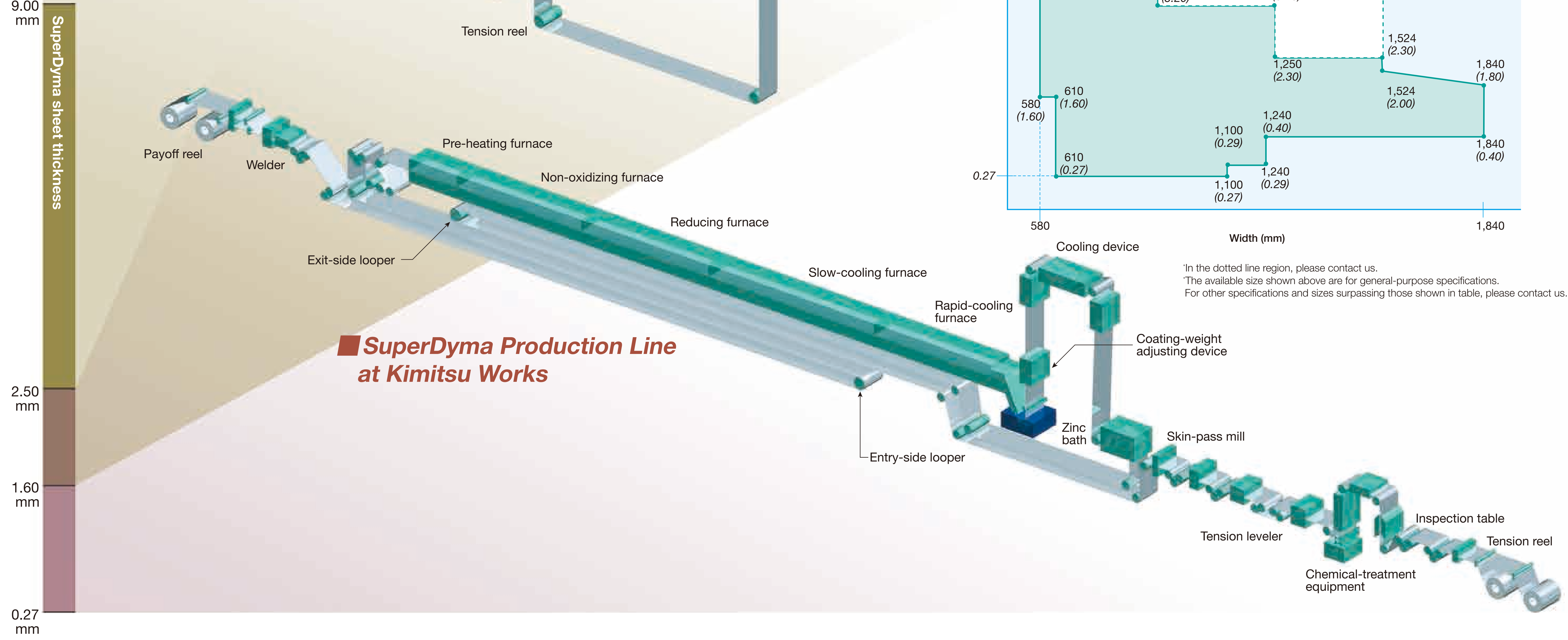
● Internal condition of spot-welded section



t=3.2 mm Nugget diameter (dn) =12.5 mm 2 mm

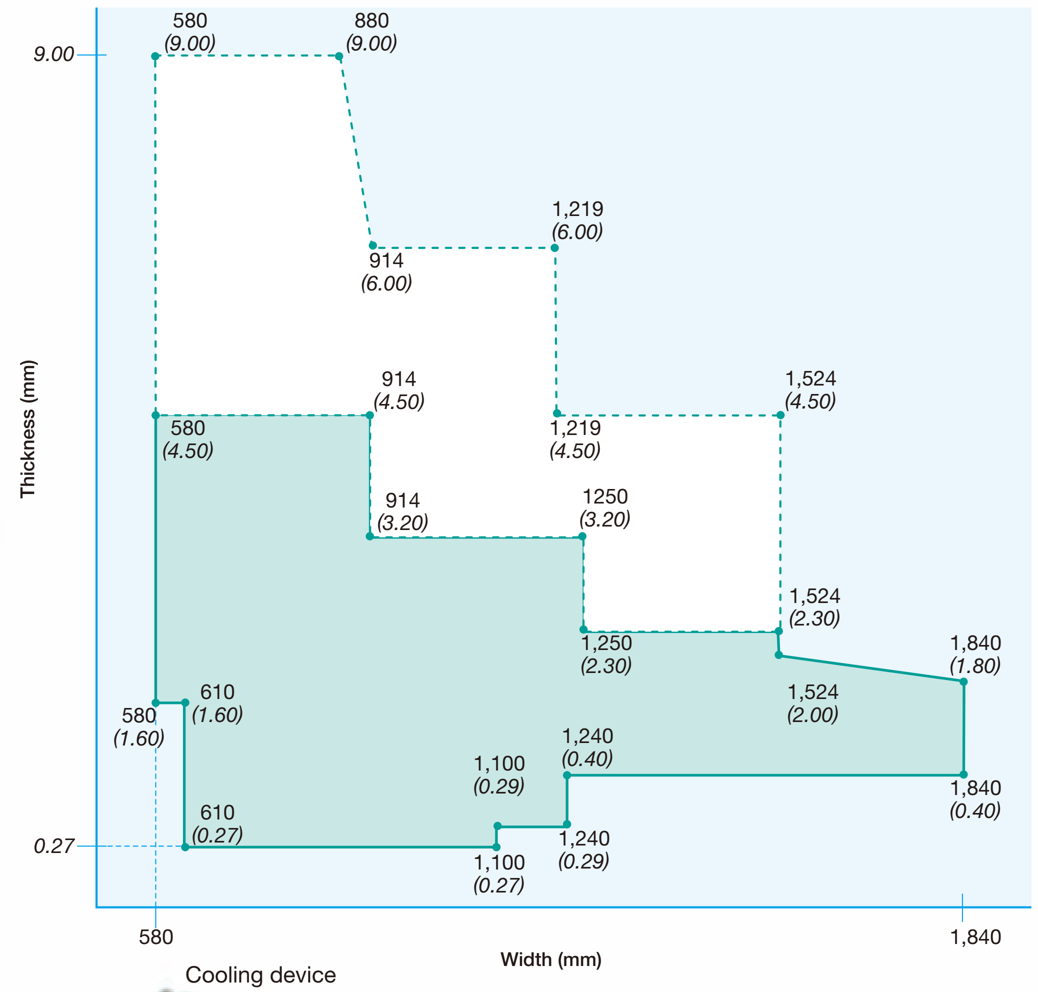
Production Process





Available Sizes

The range of manufacturable sizes is as shown below.



·In the dotted line region, please contact us.
·The available size shown above are for general-purpose specifications.
For other specifications and sizes surpassing those shown in table, please contact us.

Specifications

Kinds and Symbols

Thicknesses from 0.27 mm to 9.0 mm are available.

The kinds of plates/cut sheets and coils using hot-rolled base sheets (HR sheets) are as shown in Table 1-1, and those using cold-rolled base sheets (CR sheets) in Table 1-2.

●Table 1-1 Kinds and Symbols (HR Sheets)

Symbol of kinds	Nominal thickness (mm)	Application
NSDHC	1.60 ≦ t ≦ 9.00	For commercial use
NSDHP1	1.60 ≦ t ≦ 9.00	For drawing use-1
NSDHP2	1.60 ≦ t ≦ 9.00	For drawing use-2
NSDH340	1.60 ≦ t ≦ 9.00	For structural use
NSDH400	1.60 ≦ t ≦ 9.00	
NSDH440	1.60 ≦ t ≦ 9.00	
NSDH490	1.60 ≦ t ≦ 9.00	
NSDH540	1.60 ≦ t ≦ 9.00	

Note: Nominal thicknesses other than those given in Table 1-1 may be agreed upon between the parties involved with deliveries.

●Table 1-2 Kinds and Symbols (CR Sheets)

Symbol of kinds	Nominal thickness (mm)	Application
NSDCC	0.27 ≦ t ≦ 2.30	For commercial use
NSDCH	0.27 ≦ t ≦ 1.00	For commercial use, hard class
NSDCD1	0.40 ≦ t ≦ 2.30	For drawing use-1
NSDCD2	0.40 ≦ t ≦ 2.30	For drawing use-2
NSDCD3	0.60 ≦ t ≦ 2.30	For drawing use-3
NSDC340	0.27 ≦ t ≦ 2.30	For structural use
NSDC400	0.27 ≦ t ≦ 2.30	
NSDC440	0.27 ≦ t ≦ 2.30	
NSDC490	0.27 ≦ t ≦ 2.30	
NSDC570	0.27 ≦ t ≦ 2.00	

Note: 1. NSCD3 sheets and coils, when non-aging property is to be guaranteed according to the specifications of the orderer, letter "N" shall be affixed to the end of the symbol of the kind: namely, NSDCD3N.
2. Nominal thicknesses other than those given in Table 1-2 may be agreed upon between the parties involved with deliveries.
3. Prior consultation is requested for every lot of orders for NSDCH and NSDC570 products.

Skin-pass Treatment

The skin-pass treatment for achieving a smooth surface may be specified in the order.

Coating Mass

Coating symbol and mass are as shown in Table 2.

●Table 2 Minimum Coating Mass and Coating Mass Symbols of Differentially Zinc-coated Sheets (unit: g/m²)

Symbol of coating mass	Average minimum coating mass in triple-spot test on both sides	Minimum coating mass in single spot on both sides
K06	60	51
K08	80	68
K10	100	85
K12	120	102
K14	140	119
K18	180	153
K20	200	170
K22	220	187
K25	250	213
K27	275	234
K35	350	298
K45	450	383

Note: Maximum coating mass of Zn coating may be agreed upon between the parties involved with deliveries. For K06 and K45, please consult us.

Chemical Treatment

The kind and symbol of chemical treatment for plates/cut sheets and coils are as shown in Table 3.

●Table 3 Kinds and Symbols of Chemical Treatment

Kind of treatment	Symbol	Reference
No treatment	M	–
Special chromate treatment	Y	–
Corrosion resistant chromate treatment	E	–
Chromate-free treatment	QN	Commercial use
	QFK	Tribological property

Note: 1) Kinds of chemical treatments not shown in Table 3 may be agreed upon between the parties involved with deliveries.
2) For more details, please consult us.

Oiling

The kind and symbol of oiling for plates/cut sheets and coils are as shown in Table 4.

●Table 4 Kinds and Symbols of Oiling

Kinds of oiling	Symbol
Heavy oiling	H
Ordinary oiling	N
Thin oiling	L
Non-oiling	X

Note: Kinds of oiling not shown in Table 4 may be agreed upon between the parties involved with deliveries.

Mechanical Properties

Yield Point, Tensile Strength, Elongation and Non-aging Property

Yield point, tensile strength, elongation and non-aging property (in the case of using CR base sheets) of plates/cut sheets and coils are as shown in Tables 5 and 6.

●Table 5 Yield Point, Tensile Strength and Elongation (HR Base Sheets)

Symbol of kind	Yield point (N/mm²)	Tensile strength (N/mm²)	Elongation (%) Nominal thickness (mm) 1.6 ≦ t < 2.0	2.0 ≦ t < 2.5	2.5 ≦ t < 3.2	3.2 ≦ t < 4.0	4.0 ≦ t ≦ 6.0	Specimen
NSDHC	–	–	–	–	–	–	–	JIS No. 5, rolling direction
NSDHP1	–	270 ≦	34 ≦	35 ≦	35 ≦	36 ≦	36 ≦	
NSDHP2	–	270 ≦	–	38 ≦	38 ≦	39 ≦	39 ≦	
NSDH340	245 ≦	340 ≦	20 ≦	20 ≦	20 ≦	20 ≦	20 ≦	
NSDH400	295 ≦	400 ≦	18 ≦	18 ≦	18 ≦	18 ≦	18 ≦	
NSDH440	335 ≦	440 ≦	18 ≦	18 ≦	18 ≦	18 ≦	18 ≦	
NSDH490	365 ≦	490 ≦	16 ≦	16 ≦	16 ≦	16 ≦	16 ≦	
NSDH540	400 ≦	540 ≦	16 ≦	16 ≦	16 ≦	16 ≦	16 ≦	

●Table 6 Yield Point, Tensile Strength and Elongation (CR Base Sheets)

Symbol of kind	Yield point (N/mm²)	Tensile strength (N/mm²)	Elongation (%) Nominal thickness (mm) 0.25≦t<0.40	0.40≦t<0.60	0.60≦t<1.00	1.00≦t<1.60	1.60≦t≦2.30	Specimen
NSDCC	–	–	–	–	–	–	–	JIS No. 5, rolling direction
NSDCH	–	–	–	–	–	–	–	
NSDCD1	–	270 ≦	–	30 ≦	33 ≦	36 ≦	38 ≦	
NSDCD2	–	270 ≦	–	36 ≦	38 ≦	39 ≦	40 ≦	
NSDCD3	–	270 ≦	–	38 ≦	40 ≦	41 ≦	42 ≦	
NSDC340	245 ≦	340 ≦	20 ≦	20 ≦	20 ≦	20 ≦	20 ≦	
NSDC400	295 ≦	400 ≦	18 ≦	18 ≦	18 ≦	18 ≦	18 ≦	
NSDC440	335 ≦	440 ≦	18 ≦	18 ≦	18 ≦	18 ≦	18 ≦	
NSDC490	365 ≦	490 ≦	16 ≦	16 ≦	16 ≦	16 ≦	16 ≦	
NSDC570	560 ≦	570 ≦	–	–	–	–	–	

Note:
1) In case when non-aging property is specified for plates/sheets and coils for NSDCD3, non-aging property is guaranteed for 6 months after delivery from production plants. Non-aging property indicates the property of no occurrence of stretcher strains during fabrication.
2) Prior consultation is requested for every lot of orders for NSDCH and NSDC570 products.

References:
1) NSDCC has normally yield point of 205 N/mm² or more and tensile strength of 270 N/mm² or more.
2) NSDCH is not applied with annealing and has Rockwell hardness of 85 H_{RB} or more and Vicker's hardness of 170 Hv or more (test load: optional).

Dimensional Tolerances

Thickness Tolerances

1. Thickness tolerances shall apply to the sum of the nominal base sheet thickness and the equivalent coating thickness shown in Table 9.
2. Thickness tolerances shall be in accordance with Tables 7-1, 7-2 and 8.
3. Sheet thickness shall be measured at an optional point more than 25 mm inside from the edge.

Table 7-1 Thickness Tolerances (HR Base Sheets, For Commercial Uses)

Nominal thickness (mm)	Width (mm)	
	W < 1,200	1,200 ≦ W ≦ 1,250
1.60 ≦ t < 2.00	± 0.17	± 0.18
2.00 ≦ t < 2.50	± 0.18	± 0.20
2.50 ≦ t < 3.15	± 0.20	± 0.22
3.15 ≦ t < 4.00	± 0.22	± 0.24
4.00 ≦ t < 5.00	± 0.25	± 0.27
5.00 ≦ t < 6.00	± 0.27	± 0.29
6.00 ≦ t < 8.00	± 0.30	± 0.31
8.00 ≦ t ≦ 9.00	± 0.33	± 0.34

Table 7-2 Thickness Tolerances (HR Base Sheets, For Structural Uses)

Nominal thickness (mm)	Width (mm)
	W ≦ 1,250
1.60 ≦ t < 2.00	± 0.20
2.00 ≦ t < 2.50	± 0.21
2.50 ≦ t < 3.15	± 0.23
3.15 ≦ t < 4.00	± 0.25
4.00 ≦ t < 5.00	± 0.46
5.00 ≦ t < 6.30	± 0.51
6.30 ≦ t ≦ 9.00	± 0.56

Table 8 Thickness Tolerances (CR Base Sheets)

Nominal thickness (mm)	Width (mm)		
	W < 630	630 ≦ W < 1,000	1,000 ≦ W ≦ 1,250
t < 0.25	± 0.04	± 0.04	± 0.04
0.25 ≦ t < 0.40	± 0.05	± 0.05	± 0.05
0.40 ≦ t < 0.60	± 0.06	± 0.06	± 0.06
0.60 ≦ t < 0.80	± 0.07	± 0.07	± 0.07
0.80 ≦ t < 1.00	± 0.07	± 0.07	± 0.08
1.00 ≦ t < 1.25	± 0.08	± 0.08	± 0.09
1.25 ≦ t < 1.60	± 0.09	± 0.10	± 0.11
1.60 ≦ t < 2.00	± 0.11	± 0.12	± 0.13
2.00 ≦ t ≦ 2.30	± 0.13	± 0.14	± 0.15

Note: Indicated thicknesses other than those given in Table 9 may be agreed upon between the parties involved with deliveries.

Table 9 Equivalent Coating Thickness

Symbol of coating thickness	Equivalent coating thickness (mm)
K06	0.016
K08	0.021
K10	0.027
K12	0.033
K14	0.036
K18	0.044
K20	0.051
K22	0.054
K25	0.062
K27	0.068
K35	0.082
K45	0.101

Width Tolerances

Table 10 Width Tolerances (mm)

Width	In the care of using HR sheets		In the care of using CR sheets
	Mill edge (A)	Cut edge (B)	
W ≦ 1,500	+ 25 0	+ 10 0	+ 7 0
1,500 < W			+ 10 0

Length Tolerances

Table 11 Length Tolerances (mm)

Length	In the care of using HR sheets	In the care of using CR sheets
L < 2,000	+ 15 0	+ 10 0
2,000 ≦ L		+ 15 0

Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process

Specification

Scope

1. This specification covers zinc-aluminum-magnesium alloy-coated steel sheet in coils and cut lengths.
2. This product is intended for applications requiring corrosion resistance and paintability.
3. The steel sheet is produced in a number of designations, types, grades and classes designed to be compatible with differing application requirements.
4. This specification is applicable to orders in either inch-pound units (as A 1046) or SI units (as A 1046M). Values in inch - pound and SI units are not necessarily equivalent. Within the text, SI units are shown in brackets. Each system shall be used independently of the other.
5. This standard dose not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Table 1 Weight [Mass] of Coating Requirement[A]

Inch-Pound Units			SI Units		
Coating Designation	Minimum Requirement		Coating Designation	Minimum Requirement	
	Triple-Spot Test Total Both Sides, oz/ft²	Single-Spot Test Total Both Sides, oz/ft²		Triple-Spot Test Total Both Sides, g/m²	Single-Spot Test Total Both Sides, g/m²
ZM210	2.10	1.80	ZMM600	600	510
ZM165	1.65	1.40	ZMM500	500	425
ZM140	1.40	1.20	ZMM450	450	385
ZM115	1.15	1.00	ZMM350	350	300
ZM90	0.90	0.80	ZMM275	275	235
ZM75	0.75	0.65	ZMM220	220	190
ZM60	0.60	0.50	ZMM180	180	150
ZM40	0.40	0.30	ZMM120	120	90
ZM30	0.30	0.25	ZMM90	90	75
ZM20	0.20	0.16	ZMM60	60	50

[A] The coating designation number is the term by which this product is specified. Because of the many variables and changing conditions that are characteristic of continuous hot-dip coating lines, the weight [mass] of the coating is not always evenly divided between the two surfaces of a sheet, nor is the coating evenly distributed from edge to edge. However, it can normally be expected that not less than 40 % of the single -spot test limit will be found on either surface.

• Prior consultation is requested for every lot of orders for the products having coating masses of ZM210, ZM165, ZM140, ZM115, ZMM600, ZMM500, ZMM450 and ZMM350.

Table 2 Chemicale Requirements[A]

	Composition, %-Heat Analysis Element, max (unless otherwise shown)												
Designation	C	Mn	P	S	Al, min	Cu	Ni	Cr	Mo	V	Cb	Ti[B]	N
CS Type A[C,D,E]	0.10	0.60	0.030	0.035	· · ·	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
CS Type B[C,F]	0.02 to 0.15	0.60	0.030	0.035	· · ·	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
CS Type C[C,D,E]	0.08	0.60	0.100	0.035	· · ·	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
FS Type A[C,G]	0.10	0.50	0.020	0.035	· · ·	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
FS Type B[C,F]	0.02 to 0.10	0.50	0.020	0.030	· · ·	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
DDS[D,E,H]	0.06	0.50	0.020	0.025	0.01	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
EDDS[H,I]	0.02	0.40	0.020	0.020	0.01	0.20	0.20	0.15	0.06	0.10	0.10	0.15	· · ·

[A] Where an ellipsis (· · ·) appears in this table, there is no requirement, but the analysis shall be reported.
[B] For steels containing more than 0.02 % carbon, titanium is permitted to 0.025 % provided the ratio of % titanium to % nitrogen does not exceed 3.4.
[C] When a deoxidized steel is required for the application, the purchaser has the option to order CS and FS to a minimum of 0.01 % total aluminum.
[D] Steel is permitted to be furnished as a vacuum degassed or chemically stabilized steel, or both, at the producer's option.
[E] For carbon levels less than or equal to 0.02 %, vanadium,columbium, or titanium, or combinations thereof are permitted to be used as stabilizing elements at the producer's option. In such cases, the applicable limit for vanadium and columbium shall be 0.10 % max. and the limit for titanium shall be 0.15 % max.
[F] For CS and FS, specify Type B to avoid carbon levels below 0.02%.
[G] Shall not be furnished as a stabilized steel.
[H] Minimum Al content is not required if agreed to by purchaser and supplier.
[I] Shall be furnished as a stabilized steel.

Remarks: Regarding the suffix H in the table, it is required for the lower limit for Al not to be provided. In cases when the lower limit for Al is necessary, prior consultation is requested.

Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process

Specification - 2

Table 3 Chemical Requirements[A]

Designation		C	Mn	P	S	Cu	Ni	Cr	Mo	V[B]	Cb[B]	Ti[B,C,D]	N
		Composition, %-Heat Analysis Element, max (unless otherwise shown)											
SS Grade	33[230]	0.20	· · ·	0.04	0.040	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
	37[255]	0.20	· · ·	0.10	0.040	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
	40[275]	0.25	· · ·	0.10	0.040	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
	50[340] Class 1,2 and 4	0.25	· · ·	0.20	0.040	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
	50[340] Class 3	0.25	· · ·	0.04	0.040	0.20	0.20	0.15	0.06	0.008	0.008	0.025	· · ·
	80[550]	0.20	· · ·	0.04	0.040	0.20	0.20	0.15	0.06	0.008	0.015	0.025	· · ·
HSLAS[E]	40[275]	0.20	1.50	· · ·	0.035	· · ·	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·
	50[340]	0.20	1.50	· · ·	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·
	60[410]	0.20	1.50	· · ·	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·
	70[480]	0.20	1.65	· · ·	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·
	80[550]	0.20	1.65	· · ·	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·
HSLAS-F[F]	40[275]	0.15	1.50	· · ·	0.035	· · ·	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·
	50[340]	0.15	1.50	· · ·	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·
	60[410]	0.15	1.50	· · ·	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·
	70[480]	0.15	1.65	· · ·	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·
	80[550]	0.15	1.65	· · ·	0.035	0.20	0.20	0.15	0.16	0.01 min	0.005 min	0.01 min	· · ·

[A]Where an ellipsis (· · ·) appears in this table there is no requirement, but the analysis shall be reported.
[B]For carbon levels less than or equal to 0.02 %, vanadium, columbium, or titanium, or combinations thereof, are permitted to be used as stabilizing elements at the producer's option. In such cases, the applicable limit for vanadium and columbium shall be 0.10 % max, and the limit for titanium shall be 0.15 % max.
[C]Titanium is permitted for SS steels to 0.025 % provided the ratio of % titanium to % nitrogen does not exceed 3.4.
[D]For steels containing more than 0.02 % carbon, titanium is permitted to 0.025 %, provided the ratio of % titanium to % nitrogen does not exceed 3.4.
[E]HSLAS and HSLAS-F steels commonly contain the strengthening elements columbium, vanadium, and titanium added singly or in combination. The minimum requirements only apply to the microalloy elements selected for strengthening of the steel.
[F]The producer has the option to treat HSLAS-F steels by means of small alloy additions to effect sulfide inclusion control.

• Prior consultation is requested for every lot of orders for SS80 (550), HSLAS60 (410), MSLAS70 (480), HSLAS80 (550) and HSLAS-F products.

Table 4 Mechanical Property Requirements, Base Metal (Longitudinal)

Designation	Inch-Pound Units: Grade	Yield Strength, min ksi	Tensile Stength, min, ksi[A]	Elongation in 2 in., min, %[A]	SI Units: Grade	Yield Strength, min MPa	Tensile Stength, min, MPa[A]	Elongation in 50 mm, min, %[A]
SS	33	33	45	20	230	230	310	20
	37	37	52	18	255	255	360	18
	40	40	55	16	275	275	380	16
	50 Class 1	50	65	12	340 Class 1	340	450	12
	50 Class 2	50	· · ·	12	340 Class 2	340	· · ·	12
	50 Class 3	50	70	12	340 Class 3	340	480	12
	50 Class 4	50	60	12	340 Class 4	340	410	12
	80[B]	80[C]	82	· · ·	550[B]	550[C]	570	· · ·
HSLAS	40	40	50[D]	22	275	275	340[D]	22
	50	50	60[D]	20	340	340	410[D]	20
	60	60	70[D]	16	410	410	480[D]	16
	70	70	80[D]	12	480	480	550[D]	12
	80	80	90[D]	10	550	550	620[D]	10
HSLAS-F	40	40	50[D]	24	275	275	340[D]	24
	50	50	60[D]	22	340	340	410[D]	22
	60	60	70[D]	18	410	410	480[D]	18
	70	70	80[D]	14	480	480	550[D]	14
	80	80	90[D]	12	550	550	620[D]	12

[A]Where an ellipsis (· · ·) appears in this table, there is no requirement.
[B]For sheet thickness of 0.028 in. [0.71 mm] or thinner, no tension test is required if the hardness result in Rockwell B 85 or higher.
[C]As there is no discontinuous yield curve, the yield strength should be taken as the stress at 0.5 % elongation under load or 0.2 % offset.
[D]If a higher tensile strength is required, the user should consult the producer.

•Prior consultation is requested for every lot of orders for SS80 (550), HSLAS60 (410), MSLAS70 (480), HSLAS80 (550) and HSLAS-F products.

Specification - 3

Table5 Typical Ranges of Mechanical Properties (Nonmandatory)[A,B]

Designation	(Longitudinal Direction) Yield Strength ksi	Yield Strength MPa	Elongation in 2 in. [50 mm]%	r_m Value[C]	N Value[D]
CS Type A	25/55	[170/380]	≥20	[E]	[E]
CS Type B	30/55	[205/380]	≥20	[E]	[E]
CS Type C	25/60	[170/410]	≥15	[E]	[E]
FS Types A and B	25/45	[170/310]	≥26	1.0/1.4	0.17/0.21
DDS	20/35	[140/240]	≥32	1.4/1.8	0.19/0.24
EDDS[F]	15/25	[105/170]	≥40	1.6/2.1	0.22/0.27

[A]The typical mechanical property values presented here are nonmandatory. They are intended solely to provide the purchaser with as much infomation as possible to make an informed decision on the steel to be specified. Values outside of these ranges are to be expected. The purchaser may negotiate with the supplier if a specific range or a more restrictive range is required for the application.
[B]These typical mechanical properties apply to the full range of steel sheet thicknesses. The yield strength tends to increase and some of the formability values tend to decrease as the sheet thickness decreases.
[C]r_m Value – Average plastic strain ratio as determined by Test Method E 517.
[D]N Value – Strain-hardening exponent as determined by Test Method E 646.
[E]No typical mechanical properties have been established.
[F]EDDS Sheet will be free from chages in mechanical properties over time, that is, nonaging.

Table 6 Coating Bend Test Requirements

Inch-Pound Units
Ratio of the Bend Diameter to Thickness of the Specimen (Any Direction)

Coating Designation[A]	CS, FS, DDS, EDDS Sheet Thickness: Through 0.039 in.	Over 0.039 through 0.079 in.	Over 0.079 in.	SS Grade[B] 33	37	40	HSLAS[B] 40	50	60	HSLAS-F 40	50	60	70	80
ZM210	2	2	2	2	2	2 1/2								
ZM165	2	2	2	2	2	2 1/2								
ZM140	1	1	2	2	2	2 1/2								
ZM115	0	0	1	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZM90	0	0	1	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZM70	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZM60	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZM40	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZM30	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZM20	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2

SI - Units
Ratio of the Bend Diameter to Thickness of the Specimen (Any Direction)

Coating Designation[A]	CS, FS, DDS, EDDS Sheet Thickness: Through 1.0 mm	Over 1.0 through 2.0 mm	Over 2.0 mm	SS Grade[C] 230	255	275	HSLAS[C] 275	340	410	HSLAS-F 275	340	410	480	550
ZMM600	2	2	2	2	2	2 1/2								
ZMM500	2	2	2	2	2	2 1/2								
ZMM450	1	1	2	2	2	2 1/2								
ZMM350	0	0	1	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZMM275	0	0	1	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZMM210	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZMM180	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZMM120	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZMM90	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2
ZMM60	0	0	0	1 1/2	2	2 1/2	1 1/2	1 1/2	3	1	1	1	1 1/2	1 1/2

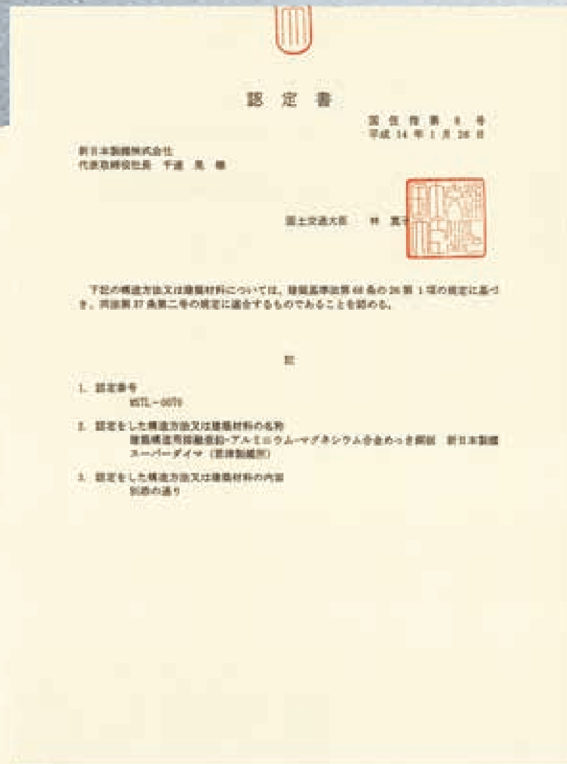
[A]If other coatings are required, the user should consult the producer for availability and suitable bend test requirements.
[B]SS Grades 50 and 80 and HSLAS Grades 70 and 80 are not subject to bend test requirements.
[C]SS Grades 340 and 550 and HSLAS Grades 480 and 550 are not subject to bend test requirements.

•Prior consultation is requested for every lot of orders for the products having coating masses of ZM210, ZM165, ZM140, ZM115, ZMM600, ZMM500, ZMM450 and ZMM350.

SuperDyma has obtained special approval as a structural material specified by the Minister of Land, Infrastructure and Transport according to the provisions of the Building Standard Law, Article 37, No. 2.


認定書

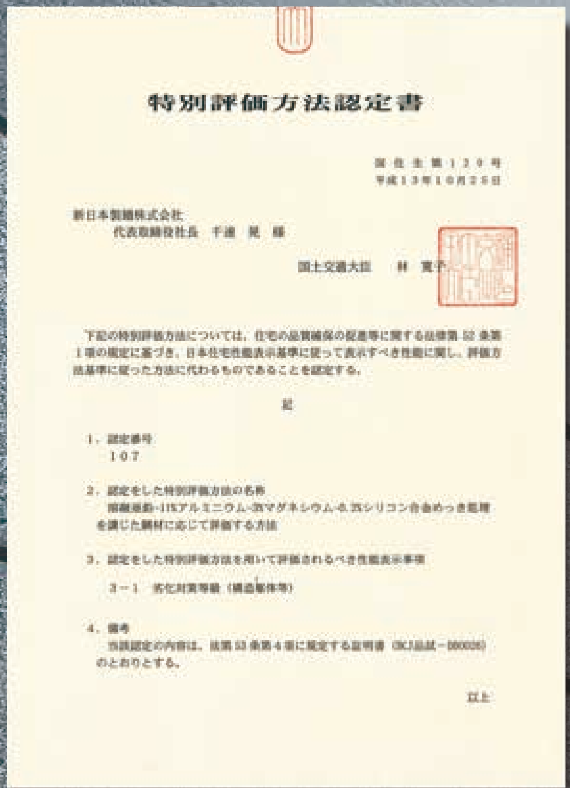
Hirohata Works


認定書

Kimitsu Works


建設技術審査証明書

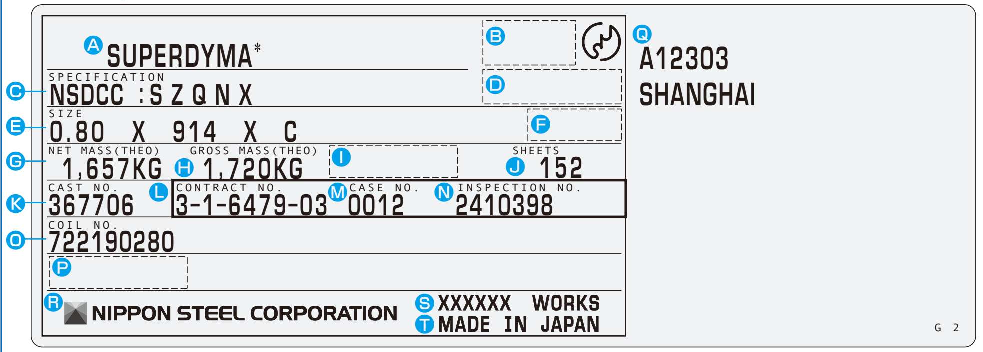
SuperDyma has obtained special approval as a durable structural material for housing construction according to the provisions of the Law Concerning Promotion of Securement of Housing Quality.


特別評価方法認定書

Coated steel sheets are packaged and then shipped to protect them against damage that can be caused by normal handling and storage during the period from manufacture to practical application. A marking label is attached to each package to indicate the details of the content. Further, an inspection sheet is sealed inside the package to guarantee the product.
Please use these label and sheet to check receipt of the product. The items described on these label and sheet are as follows.

Contents of the Package Label

Package Label



Item No.	Item
A	Brand name
B	Inspector mark
C	Specifications
D	Coating
E	Size
F	Inspection side
G	Net mass
H	Gross mass
I	TMW net mass
J	Sheets
	Coils
	Length (and Bundling Number)
K	Cast number
L	Contract No.
M	Case No.
N	Inspection No.
O	Coil No.
P	Production date
Q	Shipping mark
R	Maker's name
S	Works
T	Country of origin

*Indication of Specifications

Products Conforming to ASTM Specifications

ASTM A1046M (CS TYPE B) - 06 : S Z QN X
① ② ① ③ ④ ⑤ ⑥

①:Standard No.
②:Type designation
③:Skin-pass rolling symbol
④:Surface finish symbol
⑤:Surface treatment symbol
⑥:Oiling symbol (in the case of oiling: O(N))

Products Conforming to NIPPON STEEL's Own Specifications

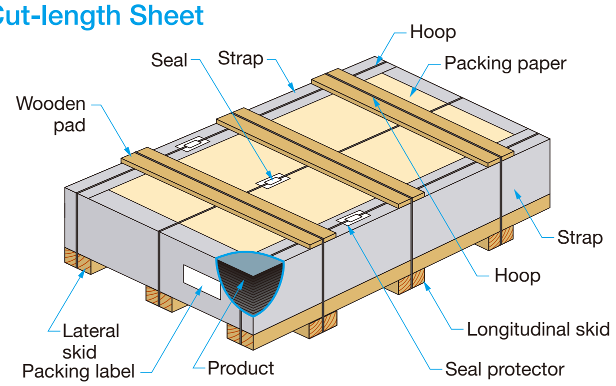
NSDCC : S Z QN X
① ② ③ ④ ⑤

①:Type designation
②:Skin-pass rolling symbol
③:Surface finish symbol
④:Surface treatment symbol
⑤:Oiling symbol (in the case of oiling: N)

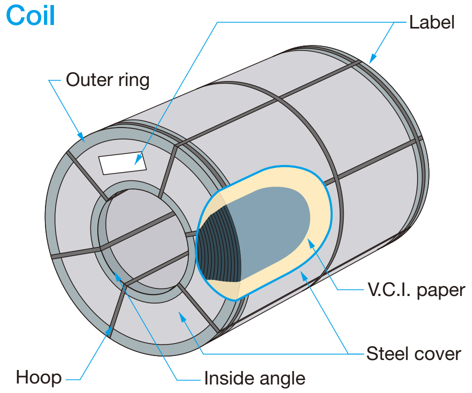
Note: If skin-pass rolling is not specified, the items after surface finish symbol are indicated by moving these items to the left.

Example of Packaging

Cut-length Sheet



Coil



When inappropriate handling and application methods are used, superdyma cannot demonstrate its characteristic properties.
It is recommended that attention be paid to the following precautions regarding use.

Storage and Loading/Unloading

① Water leakage during loading/unloading and storage constitutes a cause of corrosion. Strictly avoid loading/unloading during rain and prevent exposure to seawater and dew condensation. Also, avoid storage in atmospheres of high humidity or sulfur-dioxide. Indoor storage under dry, clean conditions is recommended.
② Broken or torn packaging paper must be repaired.
③ When coils and cut-length sheets are stored in piles for an extended time, the coated surfaces may become blackened. Because of this, early application is recommended.

⚠Warning

● Falling and rolling coils are very dangerous, as is the collapse of piled sheets. To prevent such accidents during storage, due care should be paid to storing products in a stable, secure state.

Handling

① Handle products carefully so as not to damage coatings or surface-treatment films.
② Perspiration and fingerprints impair paintability and corrosion resistance. If either occurs, appropriate post-treatment and repair are required.

⚠Attention

● When removing (cutting) coil binding hoops (bands) for use, make certain that the end of the coil is directly beneath the coil center in order to prevent the end of the coil from sudden springing out of the coil end; or, be certain to conduct the removal in a place where safety can be assured and no danger is posed if the coil end were to spring out upon release.
● Coils are formed by winding flat sheets. When the binding hoops or other external forces that keep the sheet in coil form are removed and the coil end is freed, the coil end will spring outward to return to a flat state. Further, there are also cases when the coil bindings become loose, allowing the coil to spring out. Such cases may endanger nearby workers and cause damage, so careful attention must be paid when removing the coil binding hoops (bands).

Press Forming

① The application of certain kinds of extreme pressure agents as lubricants during press forming can cause corrosion of the coating layer. Prior confirmation is requested when such agents are used. When such agents must be used, degreasing and other post treatments should be conducted thoroughly and quickly.
② In press forming, severe damage to the surface layer can adversely affect paintability and corrosion resistance.

Aging

Generally, steel sheets tend to show deterioration in quality over time—e.g. degraded formability, stretcher stains, and coil breaks. To avoid this, usage at the earliest possible time is recommended. However, this problem can be avoided if products with aging resistance are selected.

Welding

① In resistance welding, because the electrodes are soiled by the pick up of zinc, they should be properly maintained and replaced at regular intervals.
② In welding, fumes consisting mainly of zinc oxides are generated. Although the effect of these fumes will differ depending on the working environment, it is recommended that welding be conducted in a well-ventilated place.

Guide to Ordering

When placing orders, confirmation is required for the following items per each intended application.

Standards

Select the most suitable material quality from among the standards described in this catalog according to the severity and methods of fabrication.

Coating Mass

Select the most suitable coating mass according to the required corrosion resistance, application conditions, and fabrication methods.

Sizes

The size of galvanized steel sheets (thickness, width and length) is the basic condition for product yield. Design the product referring the range of available sizes described in this catalog. Sizes are available in 0.05-mm increments for thickness and 1-mm increments for width and length.

Coils

Select coils or cut-length sheets according to shear and fabrication conditions.
The selection of coils will effectively improve product yield by allowing continuous and automated operation. In the case of coils, however, some defective parts may unavoidably be included because their removal, based on inspection, is impossible.

Edge Finish

Specify either mill edges or slit edges according to the application conditions.

Surface Treatment

Select the most suitable surface treatment from among those described in this catalog according to the treatment method after fabrication and the application conditions.

Oiling

The decision whether or not to apply rust-preventive oil can be made separately from the kind of surface treatment. Oiling is recommended in order to improve intermediate rust resistance, to mitigate fingerprints and damage during handling, and to maintain lubrication during press forming. Meanwhile, oiling is indispensable for galvanized sheets lacking surface treatment.

Package Mass

Specify the package mass according to the local loading/unloading capacity and work efficiency. The heavier the coil mass, the higher the work efficiency. In the case of coils, specify the maximum mass (unit minimum mass if necessary).
The average package mass of actual shipments is determined by the relation between the maximum mass and the size to divide the manufacturing mass.

Inside and Outside Coil Diameters

In the case of coils, specify the inside and outside coil diameters according to the specifications of the uncoilers on the shearing line. When selecting inside diameters, it is necessary to consider the occurrence of break and reel marks on the area of the inside diameter, depending on the thickness.

Dimensional Accuracy (Thickness, Width and Length)

Dimensional accuracy of thickness, width and length is guaranteed within the range of sizes described in this catalog. However, there are cases that require strict size specifications with respect to assembly accuracy and dimensional accuracy of the parts, depending on the application conditions of the finished products. In such cases, consult us in advance to clarify the specifications.

Applications, Fabrication Methods and Others

NIPPON STEEL implements quality control to better suit the intended application. For that purpose, it is requested that the intended application, fabrication method, and other requirements be clearly indicated.

OTHERS
SuperDyma™
Guide to Ordering

“Super Fabricated Products” Employing Super Dyma of NIPPON STEEL

SuperDyma: “The Right Material” — Promotes Cost Cutting

SuperDyma vs. Stainless and Aluminum Products

- Is it true that such superior corrosion resistance is necessary?
- Aren’t you resigned to the fact that steel is prone to rust?

►►► *Allows cost cutting in applications where the corrosion resistance offered by stainless and aluminum products is not required.*

SuperDyma vs. Post-coated and Post-painted Sheets

- Metallic coating plus painting: Is this time-consuming and costly processing truly necessary?

►►► *Highly effective in reducing the inevitable “coating expense + transport cost” issues associated with post-coated and post-painted sheets*

- Don’t you adopt a heavier-than-needed sheet thickness just because of the difficulty involved in the coating of steel sheet*?

*When subjected to post-coating, thin sheets of substantial length and width commonly suffer distortion and cost run-ups.

►►► *Target applications: Thickness range of 3.2 mm or less for post-coated sheets*

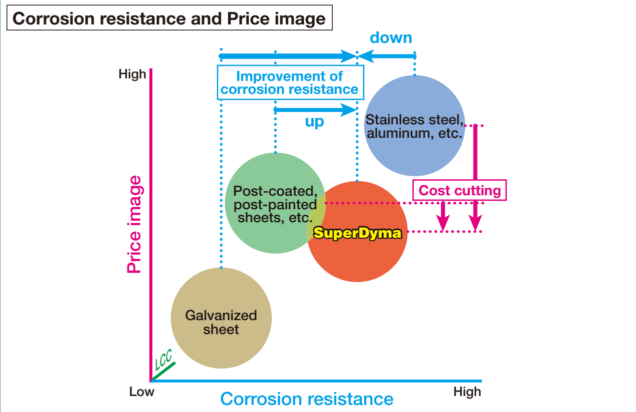
- Beautiful manufactured surface texture: How would you like this type of decorativeness?

►►► *Enhanced decorative freedom obtained by fully utilizing metallic materials*

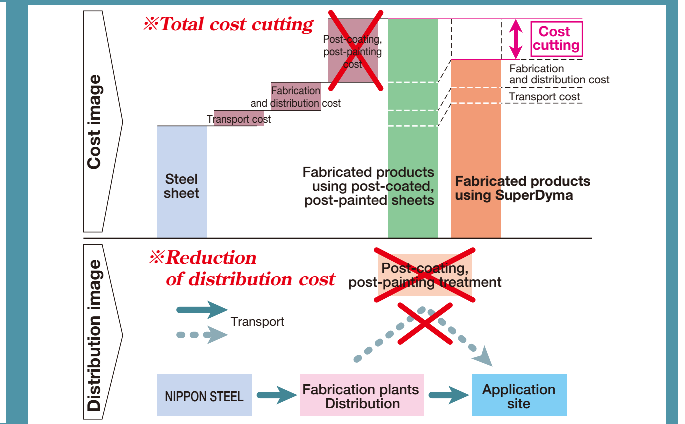
(Reference)

For improving VA proposal image

【Matrix for corrosion resistance and cost】



【Flow for fabrication and distribution cost】



SuperDyma: “The Right Place” — Meeting the Need for Corrosion Resistance

Highly corrosive and alkaline environments

Application Environments That Require Higher Corrosion Resistance

Areas of salt damage

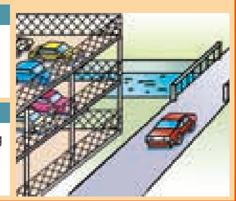
1. Areas within 2 km of a coast line: Environments subject to flying particles of sea salt (seawater mist)
2. Highways, bridges and surrounding areas in cold regions: Environments where agents used to melt ice and snow are dispersed to prevent freezing

〈Target Applications〉

Multi-storied parking garages, factory buildings, plants, warehouses, bridges, highway- and railway-related facilities, other civil engineering/building steel structures

〈Steel Products for Applications〉

Light-gauge steel shapes, pipes (square, round), steel backing materials for ceiling, cable racks, deck plates, steel fences, ducts, various panel members, gratings



Swimming pools, hot springs, underground sites and tunnels

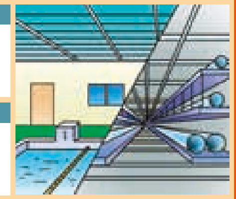
1. Environments subject to high temperature and humidity, where condensation is likely to occur
2. Environments with a chlorine atmosphere
3. Environments with bad ventilation, poor air conditioning and constant dampness

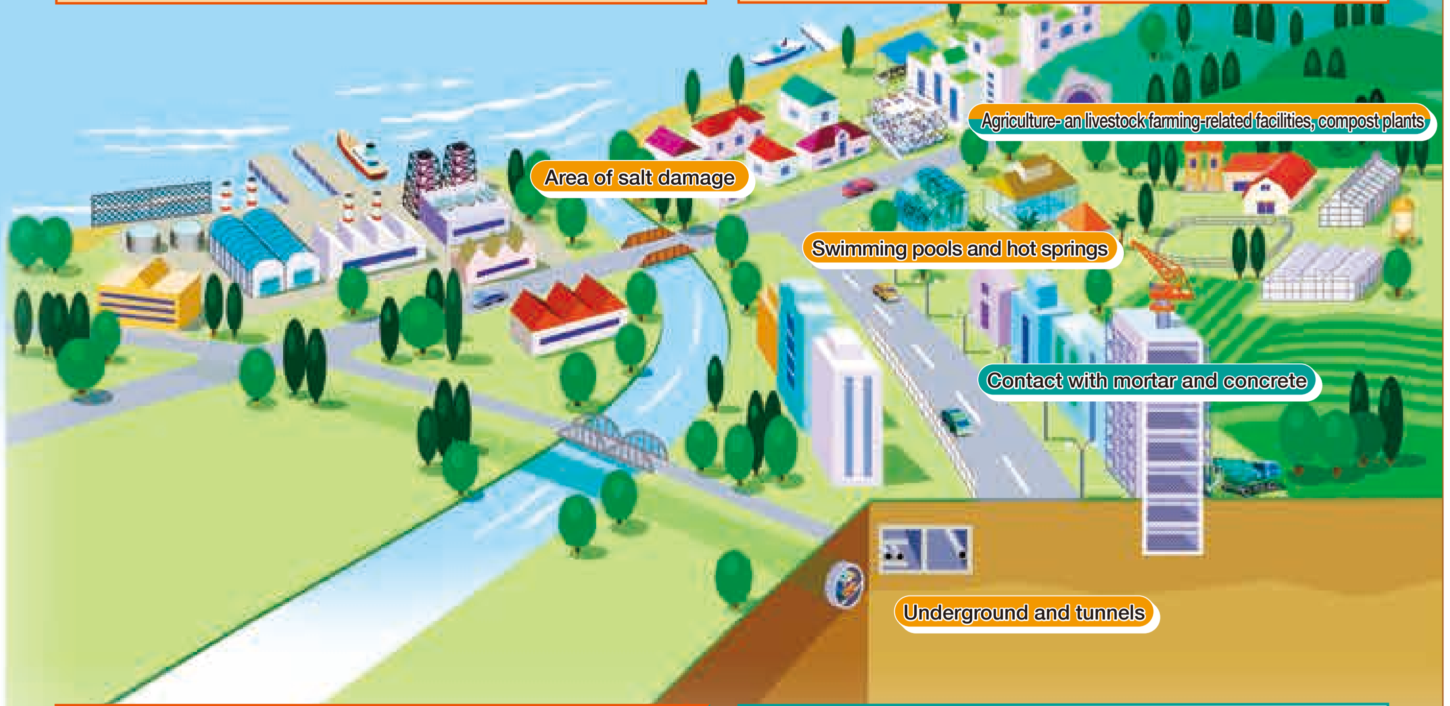
〈Target Applications〉

Swimming pools, bathrooms, hot spring underground structures, tunnels, underground multi-purpose duct inside

〈Steel Products for Applications〉

Light-gauge shapes, pipes (round, square), steel backing materials for ceiling, cable racks, steel fences, ducts, various panel members, various metal fixtures





Facilities and compost plants related to agriculture and dairy farming

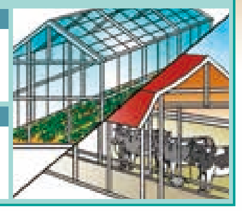
1. Environments subject to high humidity and temperature, where temperature differences are large and condensation is likely to occur
2. Environments with a strong alkaline atmosphere and where gases are generated from livestock feed, manure, etc.

〈Target Applications〉

Agricultural houses, cattle sheds (henhouse, cowhouse, pigsty), compost houses and plants

〈Steel Products for Applications〉

Light-gauge shapes, pipes (round, square), steel backing materials for ceiling, cable racks, deck plates, steel fences, ducts, various panel members



Contact with mortar and concrete

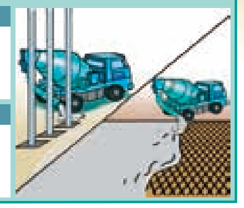
1. High alkaline environments where contact points with mortar and concrete have a pH of 12~13

〈Target Applications〉

Posts, steel structures and metal fixtures that contact with concrete

〈Steel Products for Applications〉

Light-gauge shapes, pipes (round, square), deck plates, gratings, lath sheets, expanded metal



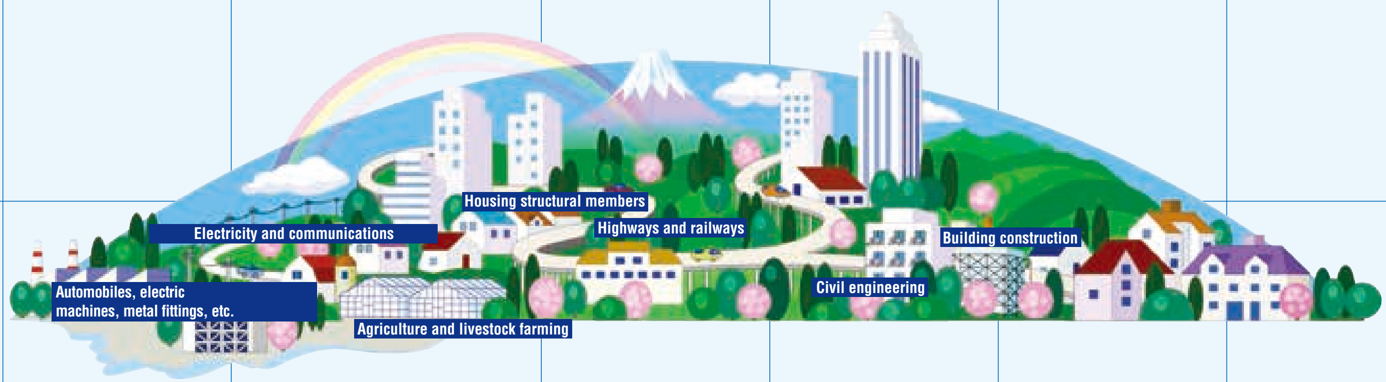
No Hesitation in Selection! **Matrix for Selecting Super Fabricated Products**

Right Materials
P Post-coating and post-painting elimination R Replacement use for stainless steel and aluminum products

Right Places
S Salt damage area A Alkaline environment H High-humidity environment

Fabricated products / Application fields	Light-gauge Shapes	Square and Round Pipes	Lath Sheets and Expanded Metals	Punched metal	Fine floors, perforated folded sheets, gratings
Building construction	●Main house member (Meiji Kogyo's Tochigi plant) ●Furring strip member (Nippon Steel Logistics' warehouse) (Meiji Kogyo's Tochigi plant) ●Factory and warehouse buildings ●Building facility P R S H	●Column member (Nippon Steel Logistics' warehouse) ●Plant and warehouse buildings P R S H	●Roof sound-insulation panel ●Falling-prevention net ●Mortar cement backing material P R S A H	●Ceiling noise-absorption panel (Chubu International Airport passenger terminal building) ●Noise-suppressing member (waste treatment plant) ●Exterior finish material (Ikuei High School's College) ●Ceiling panel, silencer P R S H	●Exterior finish material, perforated folded sheets (Fuji Women High School) ●Exterior finish material, perforated folded sheets (Mito Crystal Hotel) ●Exterior finish material, perforated folded sheets (Rock Field's new Kobe Plant) P R S H
Civil engineering			●Earth-retaining fence ●River cage-mat material P R H	●Wind-breaking fence P R S H	●Wind-breaking and snow-protection fences ●Grating floor slab P S H
Housing structural members		●Housing steel strut (round) ●Housing fence component P R S H	●Detached and multi-storied house fences P R S H	●Housing exterior finish material ●Detached and multi-storied housing fence P R S H	
Agriculture and livestock farming	●Agricultural house ●Cattle shed P R S A H	●Agricultural house ●Cattle shed P R S A H	●Agricultural facility and cattle shed fences P R S A H		
Highways and railways	●Main house member (station platform) P R S	●Highway and railway fence posts P R S H	●Highway and railway fence P R S H	●Ceiling panel (Taiwan Superexpress station building) ●Ceiling panel, silencer P R S H	●Grating floor slab P S H
Electricity and communications				●Noise-absorption panel (thermal power plant) P R S H	
Electric machines, metal fittings, automobiles and others			●Home appliance dryer component ●Umbrella stand P R	●Umbrella stand P R	

Fabricated products / Application fields	Deck Plates	Roofs and Walls	Steel Backing Materials for Ceiling	Cable Racks	Ducts and Tunnels	Metal Fabrication
Building construction	●Multi-storied parking garage at Chubu International Airport ●Multi-storied parking garage at Okinawa Phoenix Hall ●Office building ●Kooriyama/Hachiyamada Hospital P S A H	●Show room ●NIPPON STEEL's Kimitsu Works (exterior wall) ●Chubu International Airport cockpit air-conditioner room (roof) ●Factory and plant (exterior wall) P R S H	●Tokyo Dome City redevelopment ●Oyodocho Health Cener ●James Mountain public bath ●Coca Cola Ichikawa Plant ●Higashi-Kawaguchi Sports Center ●Gold Gymnasium Omori ●Nara Transport's Kashiwata Sports Building ●Tanaka Industry's Nomigawa Building P R S H	●Office building ●Hospital facility ●Waste treatment plant ●University facility ●Fire & Disaster Management Agency building P R S H	●Passenger terminal building of Chubu International Airport (duct) ●Yuhara Hot Spring Hospital (duct) ●Plant (duct) ●Nihonbashi Building (smoke stack) ●Meiji-Yasuda Life Insurance Building (smokestack) P R S A H	●Toyota Stadium (framing for spectator seat) ●Structural fitting (scaffolding clamp) ●KANEYASU Co. (shutter) ●Noise-reduction equipment (silencer, looper) P R S H
Civil engineering						●Slope frame for nature-oriented revetment (Ee frame) P R S A H
Housing structural members		●House, shop (exterior wall) P R S				●Prefabricated house (joist, sleeper, strut, foundation) ●Gutter fixture ●Structural fitting ●Door for multi-storied housing P R S H
Agriculture and livestock farming		●Compost house (roof, wall) ●Compost plant (roof, wall) ●Livestock-farm cattle shed (roof, wall) P R S A H			●Cattle shed (duct) P R S A H	●Greenhouse structural member ●Agricultural ventilation fan (framing) ●Henhouse (framing) P R S A H
Highways and railways				●Yokohama Bay Bridge ●Highway and railway tunnels P R S H	●Fukuoka High-speed Railway (ventilation tower) P R S H	●Rear-surface noise-absorption panel (Tokyo Outer Loop Expressway) ●Highway sound barrier, U-shaped channel protecting cover ●Musashino bridge at Route 16, Tomiokagawa bridge at Route 357, Kajigaya elevated bridge at Route 246 (optical fiber protecting board) ●Moriya Station of Tsukuba Express (stair fascia, platform door) ●Highway fence and lamp-cover material ●Anti-glare board P R S H
Electricity and communications						●Mega Solar (back board) ●NIPPON STEEL's Kimitsu Works (control panel) ●Electrical equipment material (electric pole band) ●Construction material (metal fixture) P R S H
Electric machines, metal fittings, automobiles and others						●Air-conditioner outdoor equipment, bathroom dryer ●Automobile component (truck body parts, passenger car sliding door rail) ●Rice storage building (base kit, hinge) ●Manger, flower pot ●Square hanger, hot-water bottle, key case ●Trash box framing, ashtray P R S A H



INDEX
SuperDyma™
Matrix

Super Fabricated Products Application field:

Building Construction

Application field in which high decorativeness in addition to high corrosion resistance of SuperDyma is fully utilized

Light-gauge shape

Tochigi Plant of Meiji Kogyo

(Light-gauge shape)

Light-gauge shape

Round and square pipes

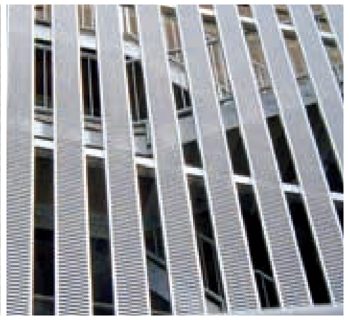
Warehouse
of Nippon Steel Logistics

(Light-gauge shape
/Square pipe)

Fine floor, perforated folded sheet, grating

Mito Crystal Hotel

(Exterior finish material
/Fine floor)



Punched metal

Noise-insulation wall
at waste treatment plant

(Punched metal)

Fine floor, perforated folded sheet, grating

Fuji Women High School

(Exterior finish material
/Steel fence)

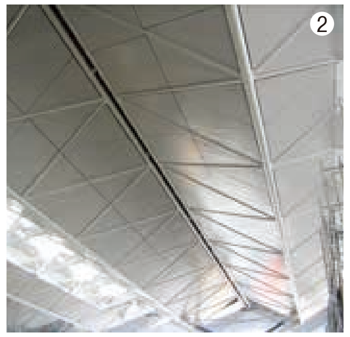
Design: Hiroo Tanahashi
+AD Network Architectural Design Institute

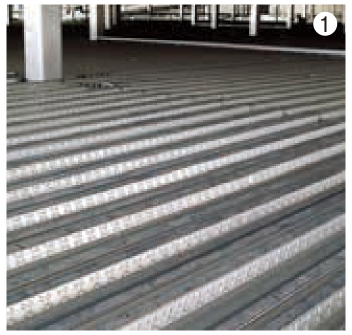
Duct, smokestack

Punched metal

Deck plate

Multi-storied parking garage
at Chubu International Airport
(1 Composite slab deck)
Passenger terminal building
at Chubu International Airport
(2 Punched metal/Ceiling
noise-absorption panel)
(3 Duct)





Deck plate

Office building

(Flat deck)

PRODUCTS
SuperDyma
Building Construction

Building Construction

Deck plate

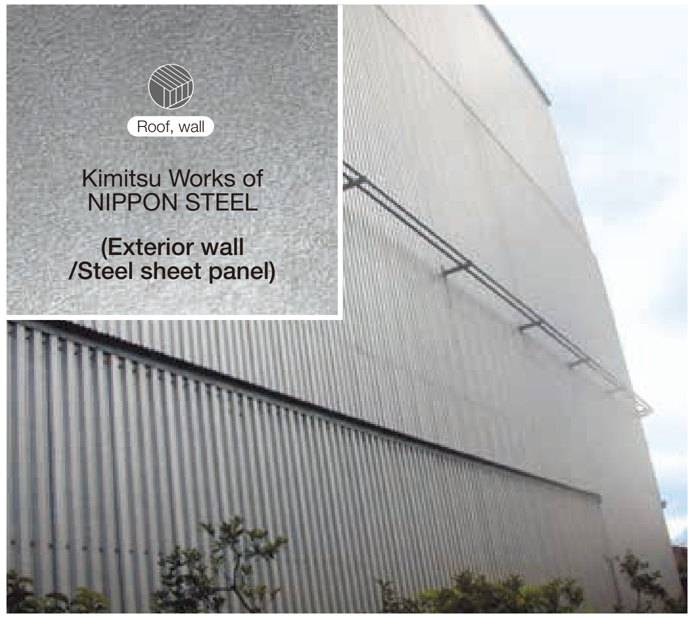
Multi-storied parking garage at Okinawa Phoenix Hall

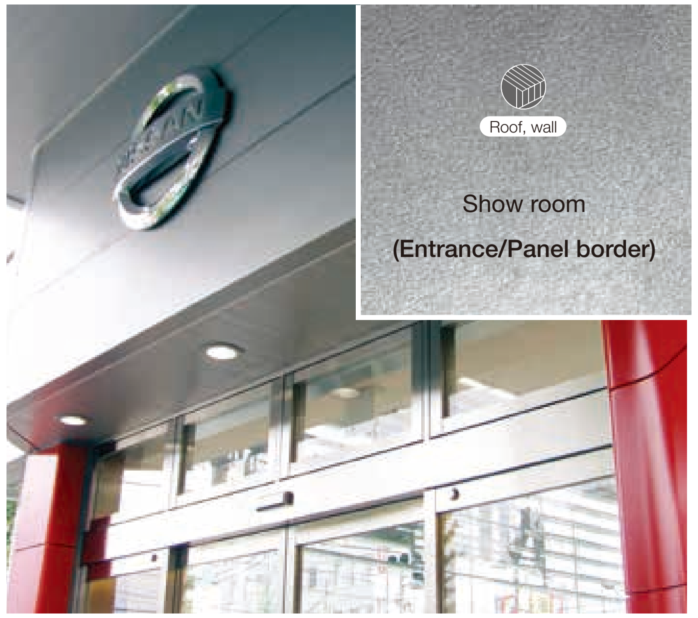
(Composite slab deck)

Roof, wall

Kimitsu Works of NIPPON STEEL

(Exterior wall /Steel sheet panel)





Roof, wall

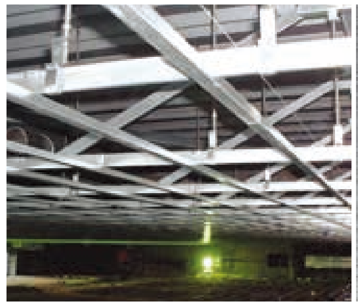
Show room

(Entrance/Panel border)

Cable rack

Fire & Disaster Management Agency building

(Cable rack)



Steel backing material for ceiling

Swimming pool

(Steel backing material for ceiling)

Cable rack

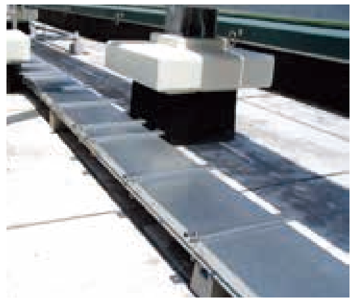
University facility

(Refrigerant pipe /Cable rack)

Cable rack

Hospital facility

(Cable rack)



Cable rack

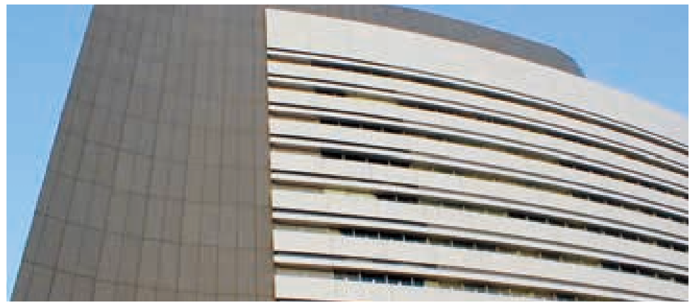
Waste treatment plant

(Cable rack)

Cable rack

Office building

(Cable rack)



Duct, smokestack

Office building

(Smokestack)

Metal fabrication

KANEYASU Co.

(Shutter)

Metal fabrication

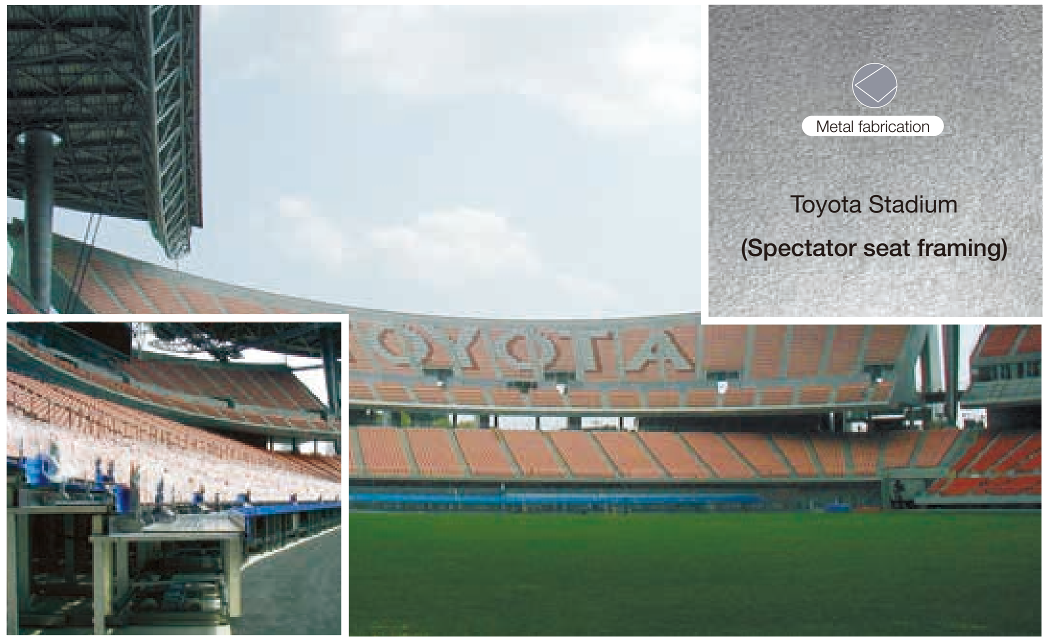
Noise-reduction equipment

(Silencer/Looper)

Metal fabrication

Metal fitting

(Scaffolding clamp)



Metal fabrication

Toyota Stadium

(Spectator seat framing)

Super Fabricated Products Application field:

Civil Engineering

Even in the application field where contact with earth and mortar concrete is unavoidable, SuperDyma demonstrates its inherent characteristic performances

Metal fabrication

Excavation revetment work at Koyoshigawa/Sanjo area, Akita Prefecture

(Ee frame/Steel slope frame for nature-oriented revetment)

Fine floor, steel fence, grating

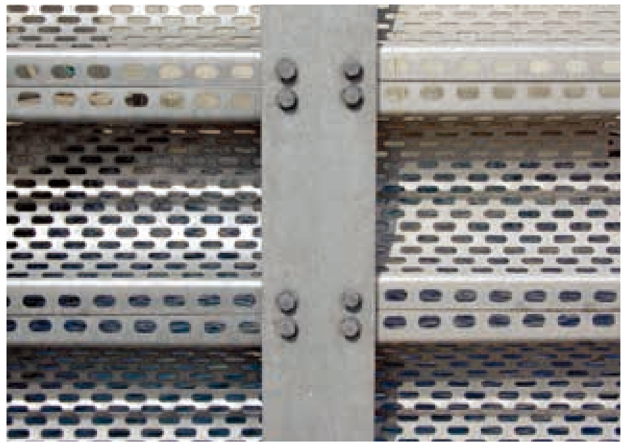
Wind-breaking and snow-protection fences

(Steel fence)

Punched metal

Wind-breaking fence

(Punched metal)



Lath sheet, expanded metal

Earth-retaining fence

(Expanded metal)

PRODUCTS

SuperDyma™

Civil Engineering

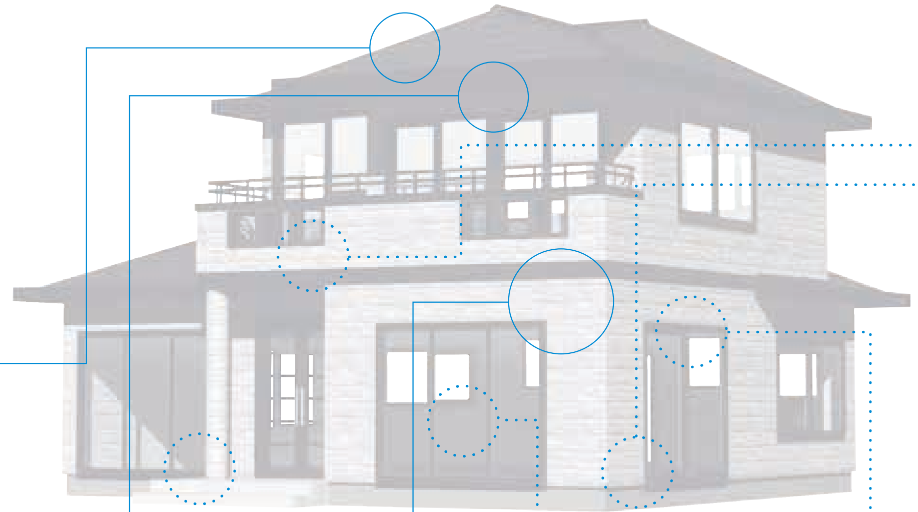
Housing Structural Members

Application field where excellent workability and decorativeness can fully be utilized

Round and square pipes
Punched metal
Roof, wall
Metal fabrication

Prefabricated house

Truss



Gutter fixture

Floor joist

Living-room partition

3-story steel-framed house (exterior finish panel)

Metal fixture

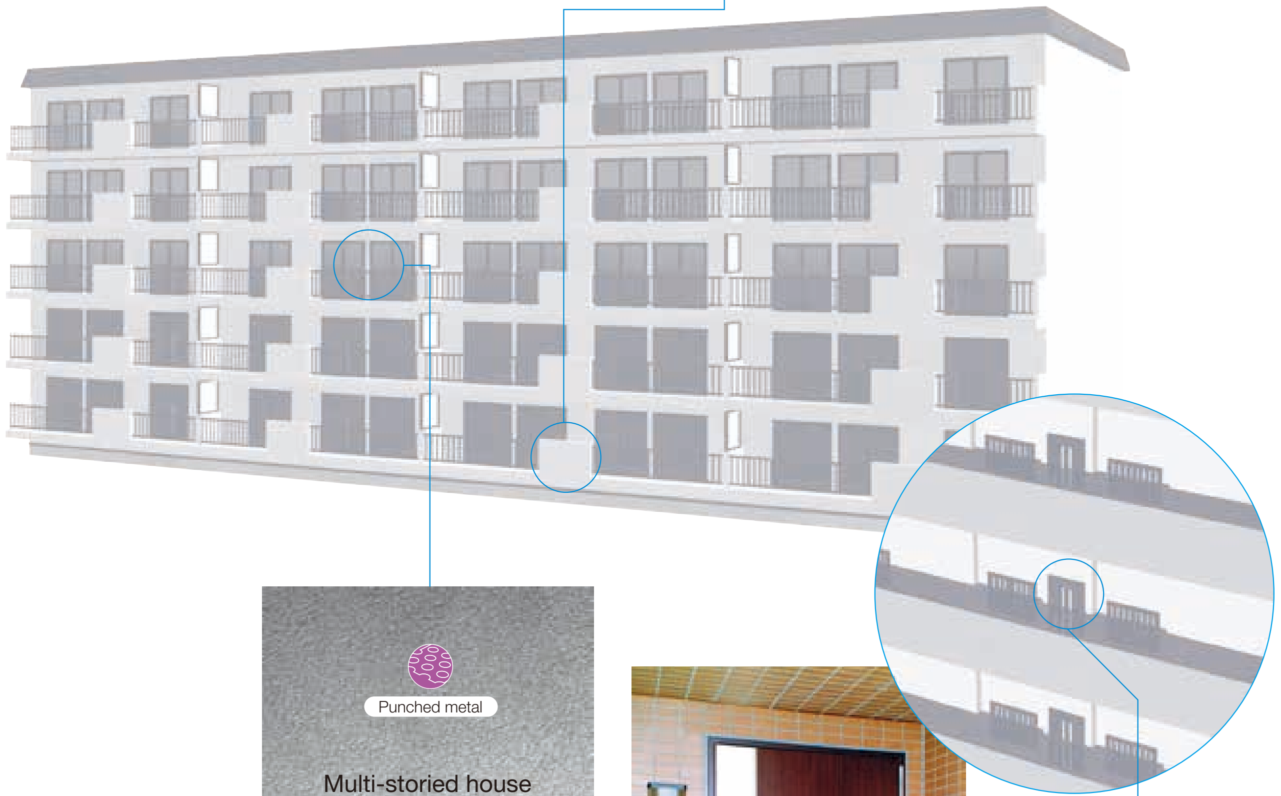
Suspended ceiling joist

Sleeper, strut

Punched metal

Multi-storied house

(Fence)



Punched metal

Multi-storied house

(Fence)

Metal fabrication

Multi-storied house

(Door)

Super Fabricated Products | Application field:

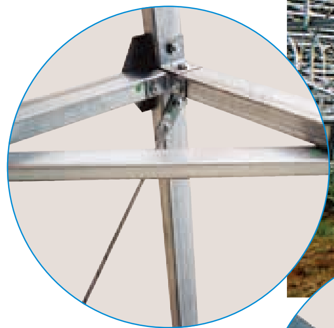
Agriculture and Livestock Farming

In the application field of agriculture and livestock-faming, excellent alkaline resistance of SuperDyma is demonstrated to the maximum

Light-gauge shape

Agricultural house

(Light-gauge shape+Component)



Roof, wall

Stock-farm cattle shed

(Roof)

Light-gauge shape

Henhouse

(Framing)

Metal fabrication

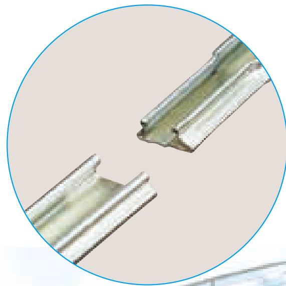
Agricultural ventilation fan

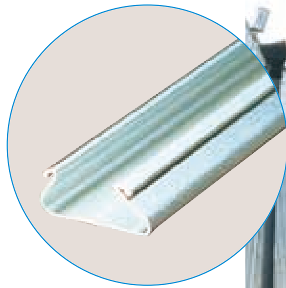
(Framing)

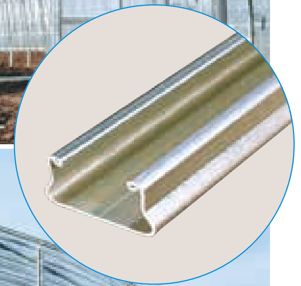
Metal fabrication

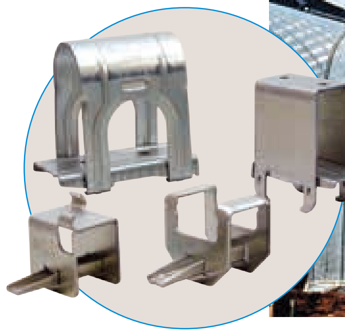
Greenhouse

(Framework member+Component)









Roof, wall

Compost house

(Roof)

PRODUCTS
SuperDyma
Agriculture and Livestock Farming

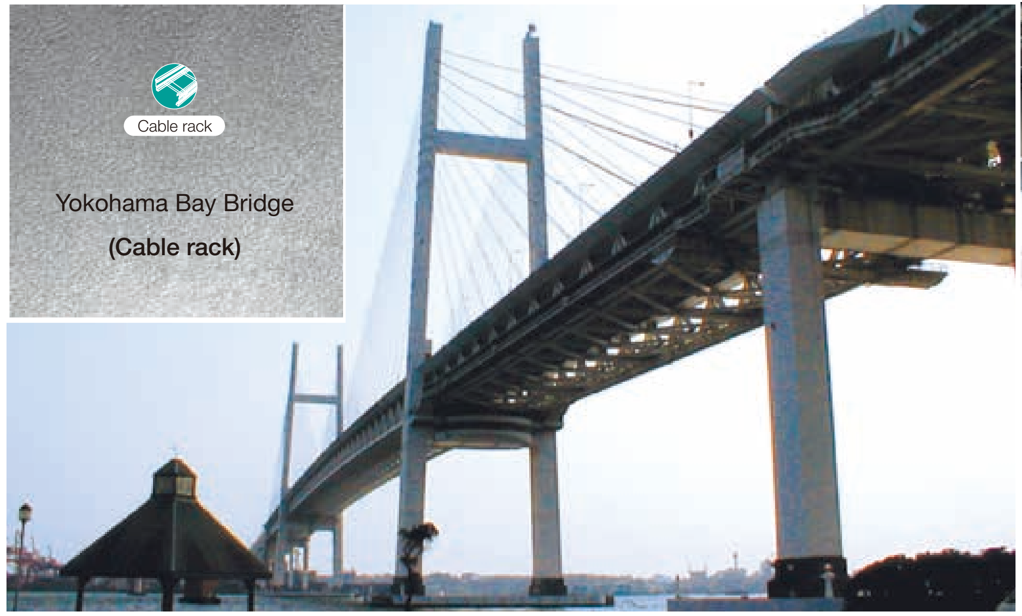
Highways and Railways

In the field of highways and railwaysæthe infrastructure field requiring high durability, high corrosion resistance of SuperDyma is highly assessed

Cable rack

Yokohama Bay Bridge

(Cable rack)



Metal fabrication

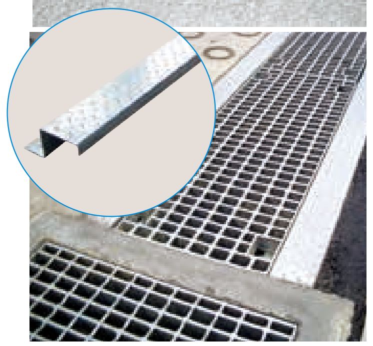
Musashiono Bridge at Route 16

(Optical fiber protecting board)

Metal fabrication

Parking lot

(U-shaped channel protecting cover)



Metal fabrication

Highway noise barrier

Metal fabrication

Tokyo Outer Loop Expressway

(Rear-surface sound-absorption panel)

Metal fabrication

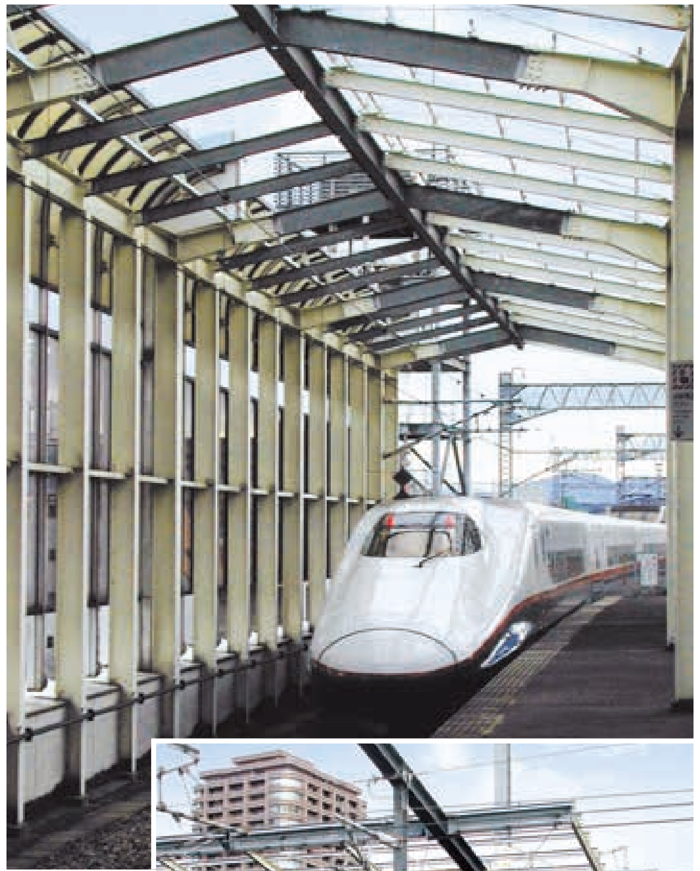
Tsukuba Express

(Platform door)

Light-gauge shape

Station platform

(Main house member /Light-gauge shape)



Metal fabrication

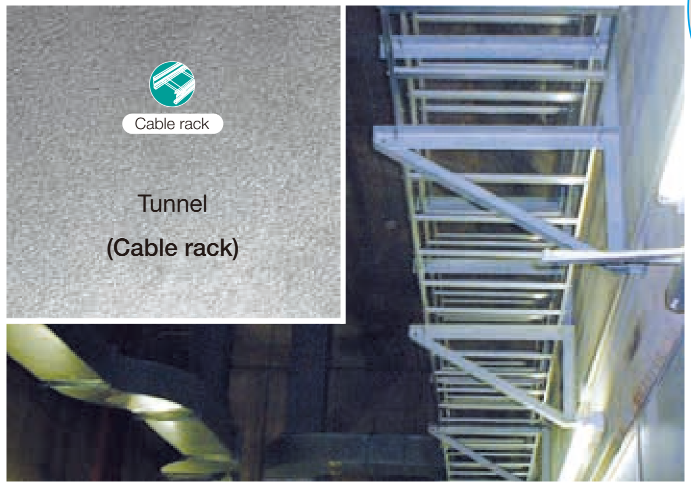
Moriya Station at Tsukuba Express

(Stair fascia board)

Cable rack

Tunnel

(Cable rack)



Punched metal

Station building at Taiwan Superexpress

(Ceiling panel)