posco STEELEON

Seoul Office
11F, POSCO Center West Wing, 440, Teheran-ro, Gangnam-gu, Seoul, Korea
Tel. +82 (0)2 3457 4100/4200

Galvanizing Mill
173, Cheolgang-ro, Nam-gu, Pohang-si, Gyeongsangbuk-do, Korea
Tel. +82 (0)54 280 6114

Prepainting Mill
243, Daesong-ro, Nam-gu, Pohang-si, Gyeongsangbuk-do, Korea
Tel. +82 (0)54 280 6600

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COATED STEEL SHEET ENG.

Vol.3

ENG.

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ALCOSTA (Hot-dip aluminized steel sheet)

ALZASTA (Hot-dip 55% Al-Zn alloy coated steel sheet)

ALSUSTA (Hot-dip aluminized stainless steel)

MACOSTA (Hot-dip Zn-Al-Mg alloy coated steel sheet)

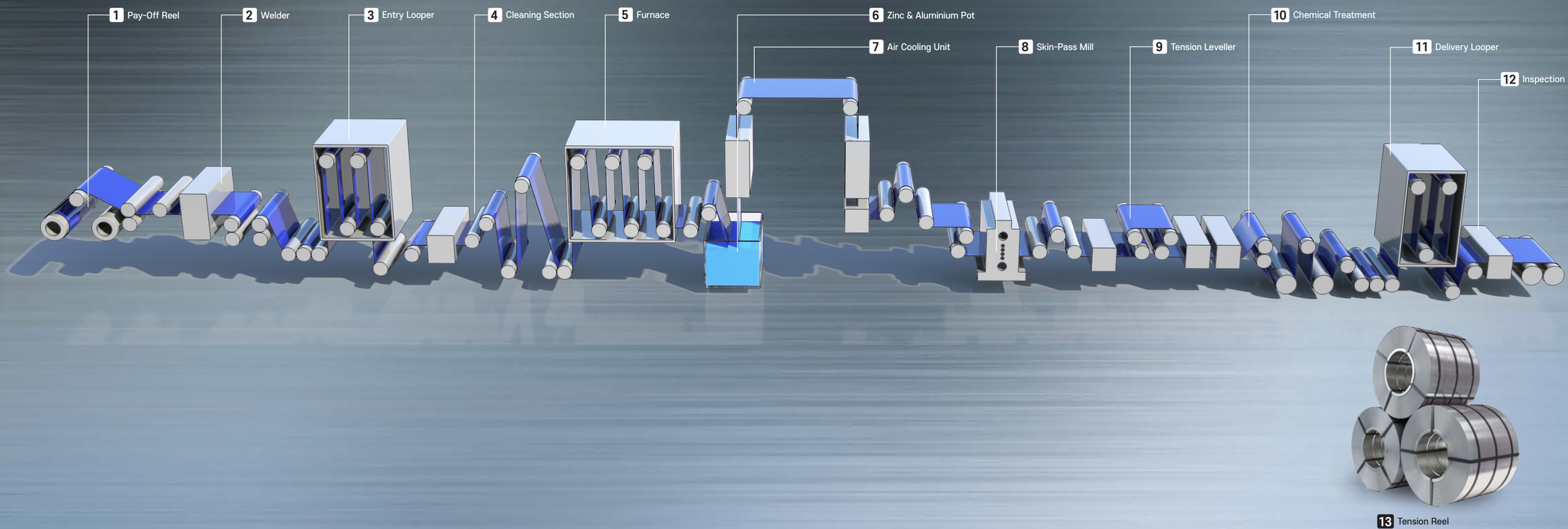
MANUFACTURING PROCESS

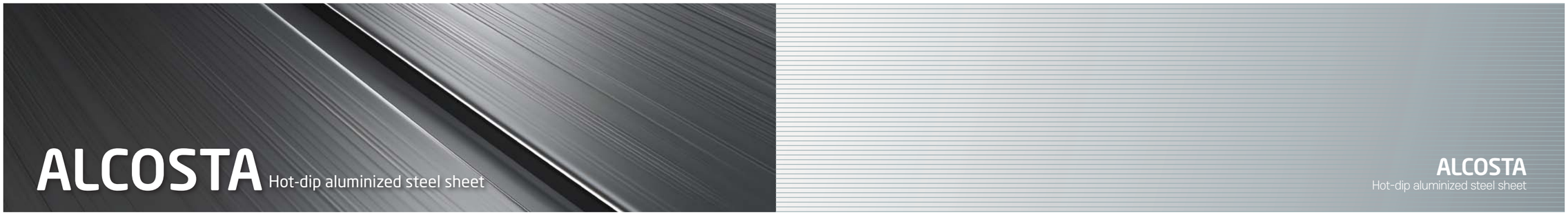
Continuous Galvanizing Process

- **ALCOSTA** (Hot-dip aluminized steel sheet)
- **ALZASTA** (Hot-dip 55% Al-Zn alloy coated steel sheet)
- **ALSUSTA** (Hot-dip aluminized stainless steel)
- **MACOSTA** (Hot-dip Zn-Al-Mg alloy coated steel sheet))

posco STEELEON

POSCO STEELEON's hot-dip aluminized steel sheet (**ALCOSTA**) has been recognized for the excellence of quality and technology in the global market as it was selected as world's top product offering the best quality in galvanized steel sheet industry, and is also leading the color-coated steel sheets by launching printed sheets, **PosART**(inkjet-printed steel sheet), and Lami steel sheet, leading the upgrades of color steel sheets.





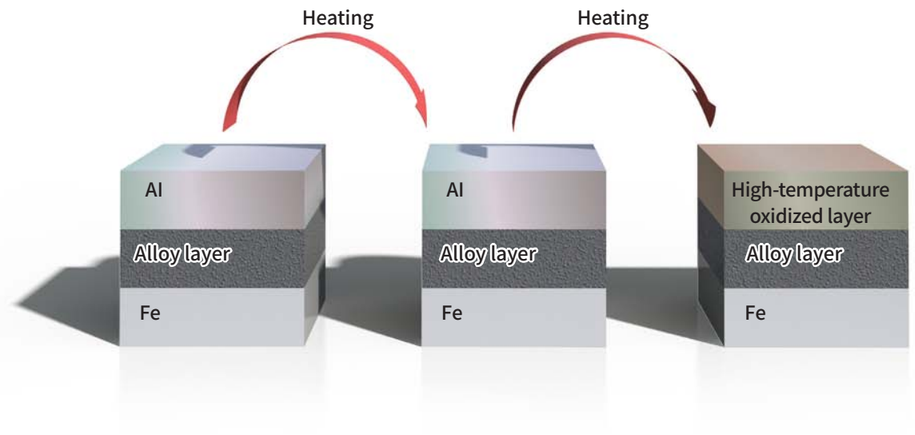
Product features

Product	Characteristics	Application
ALCOSTA **(Aluminized Steel)**	• Beautiful surface as POSCO STEELEON's technology suppresses crystallization during solidification of melted aluminum layer • Excellent corrosion resistance due to the formation of a aluminum oxide film on the surface • Outstanding corrosion resistance/heat resistance, paintability	• Home appliances • Automobile parts • Steel cans • Oil pipeline cover (post-plated products)

Heat resistance

ALCOSTA's heat resistance is superior compared to galvanized steel sheet, 55% Al-Zn alloy-coated steel sheet, and cold-rolled steel sheet. Even after long-term use at high temperatures of around 400°C, there is no damage or discoloration of the surface. (At temperatures higher than 400°C, the surface transitions into an Al-Fe alloy layer, which may change color, but heat/corrosion resistance remains intact. The product can be used up to about 600°C.) Furthermore, as the coating weight increases, heat resistance improves. For extended use at around 500°C, a specialized high heat resistance ALCOSTA product is available.

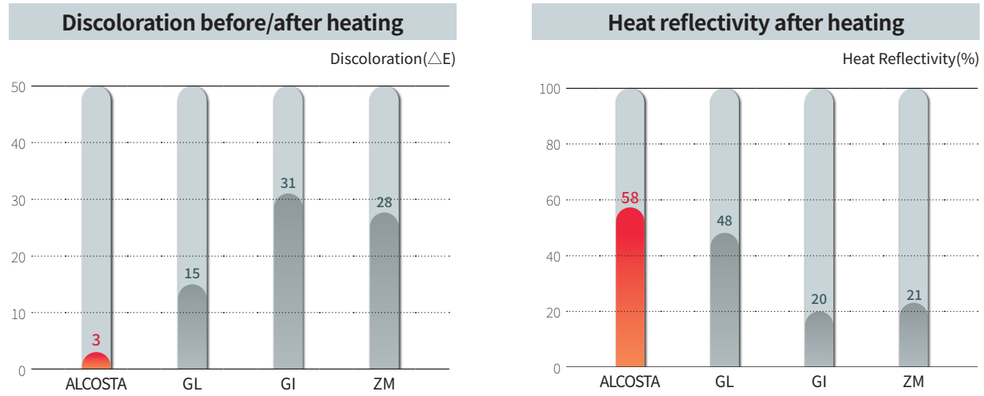
| Transformation of coated layer with heating |



Discoloration & Heat Reflectivity

The surface of ALCOSTA is very beautiful and has outstanding heat reflectivity. It is used for thermal reflectors in toaster, gas range, oil stove, gas oven, clothes dryer, etc.

| Comparison by coating material (at 400°C, 24Hrs) |



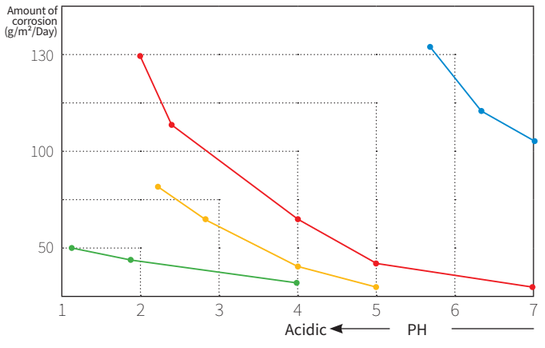
Corrosion resistance

ALCOSTA forms a thin oxide layer and hydroxide layer in the air and water, and offers outstanding corrosion resistance.

| Corrosion resistance in acidic solution |

ALCOSTA offers stronger corrosion resistance in acidic solution compared to galvanized steel sheet.

- ALCOSTA (Room temperature)
- ALCOSTA (60℃)
- Galvanized steel sheet (Room temperature)
- Galvanized steel sheet (60℃)



ALCOSTA Hot-dip aluminized steel sheet

ALCOSTA
Hot-dip aluminized steel sheet

Salt spray test

Al shows higher electrode status than Fe, and as Fe is cathodized, Al prevents the corrosion of Fe as a sacrificial anode. In the salt spray test of ALCOSTA, its outstanding corrosion resistance was proven as follows.

| Salt spray test result by product |

제품명		24Hrs.	72Hrs.	240Hrs.	360Hrs.	720Hrs.
ALCOSTA SA1D(40 *g* /m²)	Room temperature 250°C×24Hrs.			Red rust forms after 288 hours		
ALCOSTA SA1D(80 *g* /m²)	Room temperature 250°C×24Hrs.				Red rust forms after 384 hours	
GALVANIZED Steel Sheet	Room temperature 250°C×24Hrs.		20% red rust	100% red rust		

Corrosion resistance test against exhaust gas

In the corrosion test using exhaust gas, ALCOSTA and stainless steel demonstrated similar corrosion resistance effects.

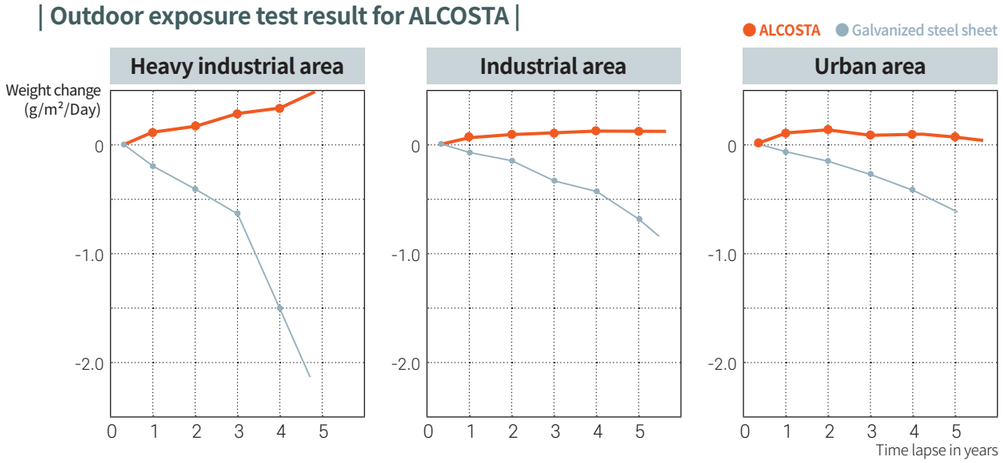
| Muffler Test Result : Comparison based on corrosion rate of CR material as 100% |

Products	Corrosion ratio (Decrease of thickness in the parenthesis)
STS439	22.9%
STS409L	27.5%
ALCOSTA(80g/m²)	30.1% (16㎛)
EGI(40g/m²)	92.8% (80㎛)
Cold-rolled steel sheet	100% (87㎛)

Weatherability

ALCOSTA forms a fine, stable oxide layer on the surface, and offers outstanding weatherability in severely corrosive environments of industrial areas.

| Outdoor exposure test result for ALCOSTA |



※ ALCOSTA may turn brown based on outdoor environment, but there is no change in weatherability.

Formability

ALCOSTA has a solid alloy layer between steel and AL layers, therefore, is generally known to have less formability than cold-rolled steel sheets or galvanized steel sheets. However, DQ and DDQ of ALCOSTA offer better formability than cold-rolled steel sheets.

| Mechanical properties of ALCOSTA by type |

(Specimen Thickness : 0/8㎜)

Product	Type	Symbol (KS/JIS)	Tensile test		
			Yield strength (MPa)	Tensile strength (MPa)	Elongation (%)
ALCOSTA	Commercial Quality	**SA1C**	≥ 226	≥ 294	-
	Drawing Quality	**SA1D**	≥ 206	≥ 284	≥ 36
	Deep Drawing Quality	**SA1E**	≥ 196	≥ 275	≥ 40

※ Above figures are the general values of 0.8T. For the scope of warranty, please refer to the manufacturing specifications.

ALCOSTA Hot-dip aluminized steel sheet

Paintability

ALCOSTA offers better paintability than galvanized steel sheet, and can achieve more outstanding paintability through chemical conversion treatment.

Pre-treatment for painting

Degreasing → Chemical conversion treatment → Painting

Use caution with PH
(Use neutralized degreasing agent)

Chromic acid treatment

Paint

Applicable paints are as follows.

- Vinyl resin paint
- Silicone resin painting
- Phenolic resin paint
- Polyurethane resin paint
- Lacquer

Usage

It is used in various products including home appliances, kitchen appliances, automobile parts, steel can (food container, paint container, lubricant container), post-galvanized products (oil pipeline cover), etc.

| Home/Kitchen Appliances |

- Brown tube band
- Gas oven range
- Dryer
- TV Cover Bottom
- Heat pump
- Microwave
- Stove
- Boiler
- Washing machine
- Water heater

| Automobile |

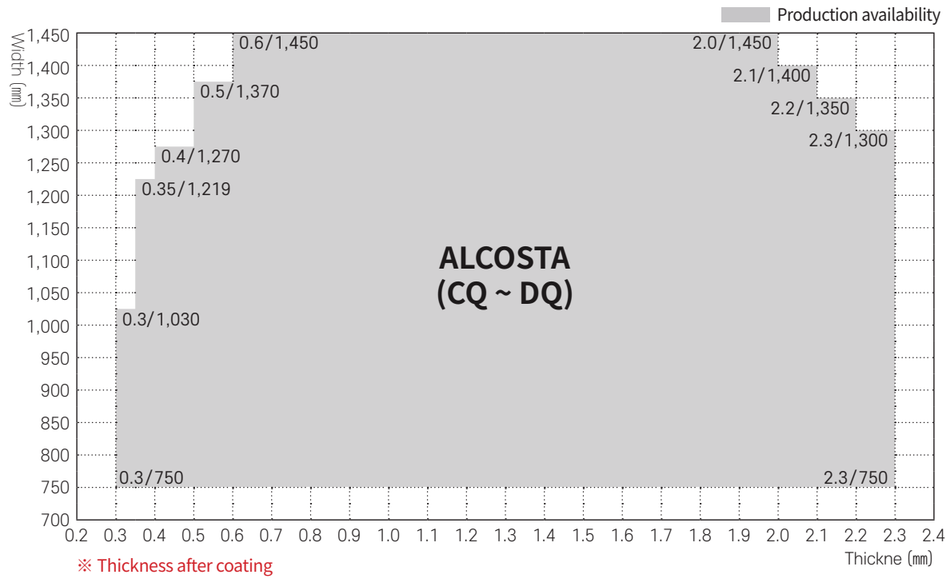
- Muffler
- Fuel tank
- Oil filter
- Engine cover
- Heat shield
- Battery cover

| Others |

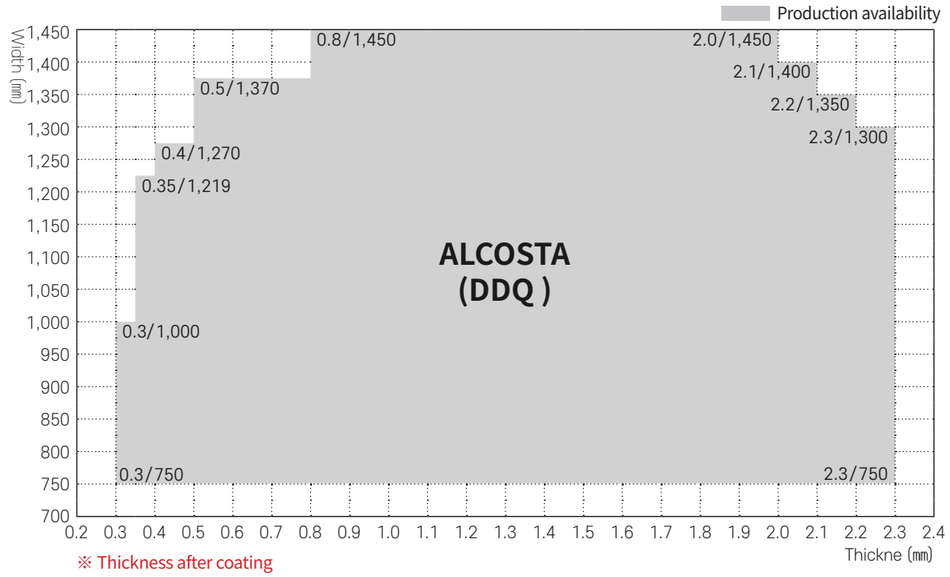
- Steel can
(food container, paint can, lubricant can)
- Post-coated ALCOSTA (oil pipeline cover)

Product Specifications

Production availability



※ Thickness after coating

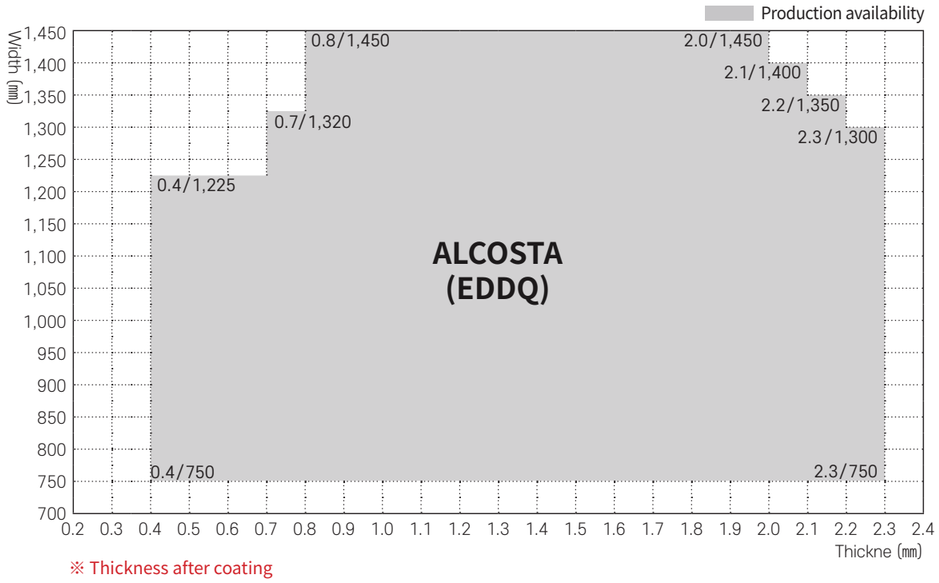


※ Thickness after coating

ALCOSTA Hot-dip aluminized steel sheet

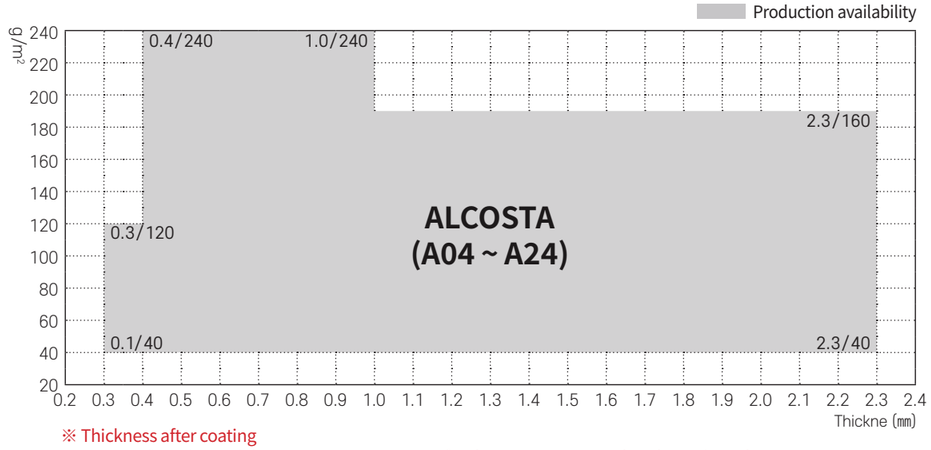
ALCOSTA
Hot-dip aluminized steel sheet

Production availability



※ Thickness after coating

Coating Weight



※ Thickness after coating
※ In case of coating weight over A16, acceptance of order acceptance needs to be reviewed

Quality specifications

| Standard Comparison |

Classification	KS D 3544	JIS G 3314	ASTM A 463	DIN EN 10346
Commercial Quality	SA1C	SA1C	CS	DX51D
Drawing Quality	SA1D	SA1D	-	DX52D, 53D
Deep Drawing Quality	SA1E	SA1E	DDS	DX54D
Extra Deep Drawing Quality	-	-	EDDS	DX56D

| KS D 3544 |

Classification	Symbol	Elongation(%)			Bending	
		0.4≤t<0.6	0.6≤t<1.0	1.0≤t	Bend Angle	Inner Spacing od Bend
Commercial Quality	SA1C	-	-	-	18°	4t
Drawing Quality	SA1D	≧ 30	≧ 32	≧ 34	180°	1t
Deep Drawing Quality	SA1E	≧ 34	≧ 36	≧ 38	180°	1t

※ Tensile strength is provided as reference, which should be 28kgf/㎟ (275N/㎟) or higher.

| JIS G 3314 |

Classification	Symbol	Tensile strength (MPa)	Yield strength (MPa)	연신율(%)				굽힘	
				0.3≤ t <0.4	0.4t < 0.6	0.6 < t ≤ 1.0	1.0 ≤ t	Bend Angle	Inner Spacing od Bend
Commercial Quality	SA1C	(≥205)	(≥270)	-	-	-	-	180°	4t
Drawing Quality	SA1D	-	≥280	(≥28)	≥30	≥32	≥34	180°	1t
Deep Drawing Quality	SA1E	-	≥270	-	≥34	≥36	≥38	180°	1t

ALCOSTA Hot-dip aluminized steel sheet

ALCOSTA
Hot-dip aluminized steel sheet

Quality specifications

| ASTM A 463 |

Classification	Symbol	Yield strength (MPa)	EL(%)
Commercial Quality	CS Type A	170~345	≥20
	CS Type B	205~345	≥20
	CS Type C	170~380	≥15
Drawing Quality	DDS	140~240	≥32
Deep Drawing Quality	EDDS	125~205	≥38

| DIN EN 10346 |

Classification	Symbol	Yield strength (MPa)	Tensile strength(MPa)	EL(%)
Commercial Quality	DX51D	-	270~500	≥22
Drawing Quality	DX52D	140~300	270~420	≥26
	DX53D	140~260	270~380	≥30
Deep Drawing Quality	DX54D	120~220	260~350	≥34
Extra Deep Drawing Quality	DX56D	120~180	260~350	≥39

Coating Weight

| Minimum coating weight (Double side) |

(Unit : g/m²)

Coating weight symbol	Minimum coating weight for 3 points on both sides	Minimum coating weight for 1 point on both sides	POSCO STEELEON	KS D 3544	JIS G 3314	ASTM A 463	DIN EN 10346
40	40	30	A04	40	40	T1-13(40)	-
60	60	45	A06	60	60	-	AS 060
80	80	60	A08	80	80	T1-25(75)	80
100	100	75	A10	100	100	-	AS 100
120	120	90	A12	120	120	T1-40(120)	120
160	160	120	A16	-	-	-	-

1. Average 3-point coating weight on both sides is the arithmetic mean of 3 test piece measurements obtained from the sample.
2. Minimum/Maximum coating weight is determined based on the discussion with POSCO STEELEON.

Post-treatment

| Chemical treatment |

Type	Symbol
General chemical treatment	CX
Cr-Free treatment	NX
Lubrication treatment	LX
No treatment	XX

| Oiling |

Type	Symbol
OILED	• PS : Single side 300~500mg/m² • PL : Single side 501~1000mg/m² • PG : Single side 1001~1500mg/m² • PH : Single side 1501~2000mg/m²
NON-OILED	PX (No oiling)

Dimensional tolerance

Thickness tolerance

| KS, JIS |

(Unit : mm)

Thickness(t) \ Width(w)	W < 1,000	Mark
0.40≤ t <0.60	± 0.07	± 0.07
0.60≤ t <1.00	± 0.10	± 0.11
1.00≤ t <1.60	± 0.13	± 0.14
1.60≤ t <2.30	± 0.17	± 0.18
2.30≤ t	± 0.21	± 0.22

| ASTM |

(Unit : mm)

Thickness(t) \ Width(w)	W≤1,500
t≤0.4	±0.08
0.4<t≤1.0	±0.10
1.0<t≤1.5	±0.13
1.5<t≤2.0	±0.15
2.0<t≤2.5	±0.30

| DIN EN |

(Unit : mm)

Thickness(t) \ Width(w)	W≤1,200	1,200 <W≤1,500
T ≤ 0.40	±0.05	±0.06
0.40<t≤0.60	±0.05	±0.06
0.60<t≤0.80	±0.06	±0.07
0.80<t≤1.00	±0.07	±0.08
1.00<t≤1.20	±0.08	±0.09
1.20<t≤1.60	±0.11	±0.13
1.60<t≤2.00	±0.14	±0.15
2.00<t≤2.30	±0.16	±0.17

Width tolerance

| KS, JIS |

(Unit : mm)

Width (W)	Tolerance
Max 1,500	+ 7
	- 0

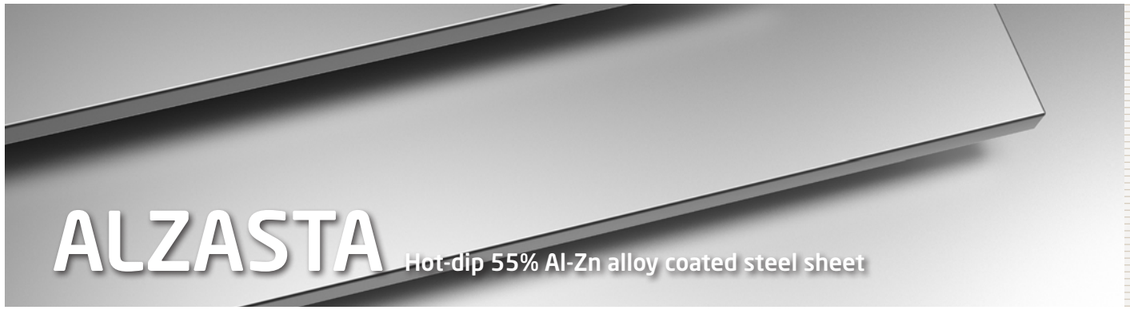
| ASTM |

(Unit : mm)

Width (W)	Tolerance
600 ≦ t < 1,200	- 0, + 5
1,200 ≦ t < 1,500	- 0, + 6

Q. Is it possible to weld ALCOSTA with other materials?

A. Dissimilar-material welding is possible. However, welding conditions vary depending on the thickness/material/coating weight of both metals, welding equipment (maker/model), welding method, welding rod type, shielding gas composition, etc. If you provide us with these details, we can offer the optimal welding condition solutions.



ALZASTA
Hot-dip 55% Al-Zn alloy coated steel sheet

Product features

Product	Characteristics	Application
ALZASTA (55% Al-Zn Alloy Coated Steel)	• Outstanding corrosion resistance due to the strong oxide coating of aluminum and sacrificed protection of zinc • Bright gray appearance with unique smoothness, flatness, and fine spangles • Outstanding paintability	• Building interior/exterior materials (roof, wall, shutter, ceiling, floor) • Home appliance interior/exterior (refrigerator, outdoor AC unit) • Automobile parts

Heat resistance

ALZASTA offers outstanding heat resistance compared to galvanized steel sheet, and can be used at high temperature of 350°C without short-term discoloration.

| Heat resistance by product |

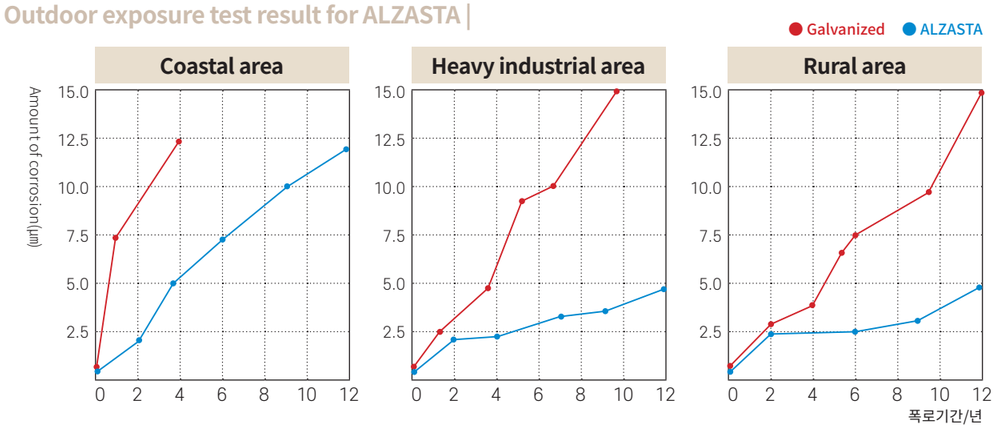
Condition	ALZASTA	GI
350°C, 24hrs.		

Condition	Coating Amount	Coating Thickness	△L	
			Before	After
ALZASTA	150(g/㎡)	40(㎛)	89.8	88.2
GI	275(g/㎡)	40(㎛)	87.2	62.8

Corrosion resistance

ALZASTA offers over 4 times more corrosion resistance than galvanized steel sheets in various corrosive environments. This is due to the sacrificial effect of galvanized steel sheet caused by stable corrosion product under corrosive environment and dense oxide coating creation by aluminized steel sheet.

| Outdoor exposure test result for ALZASTA |



| Corrosion resistance by product (flat surface) |

Galvanized steel sheet	100hr	500hr	1580hr	1860hr
AZ (70g/㎡, Both Side)				
GI (140g/㎡, Both Side)				-

ALZASTA
Hot-dip 55% Al-Zn alloy coated steel sheet

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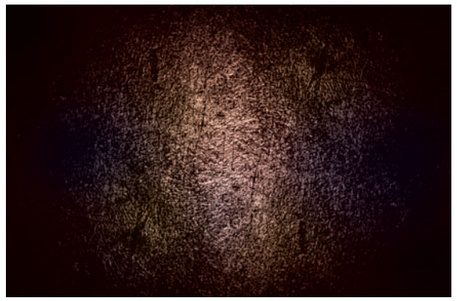
Hot-dip 55% Al-Zn alloy coated steel sheet

Coating adhesion and formability

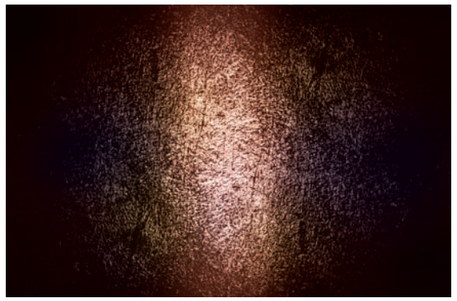
ALZASTA offers an equivalent level of formability as galvanized steel sheets and outstanding durability because there are less cracks in processed area.

Ball Impact Test



No peeling off in 1kg, 500mm impact test

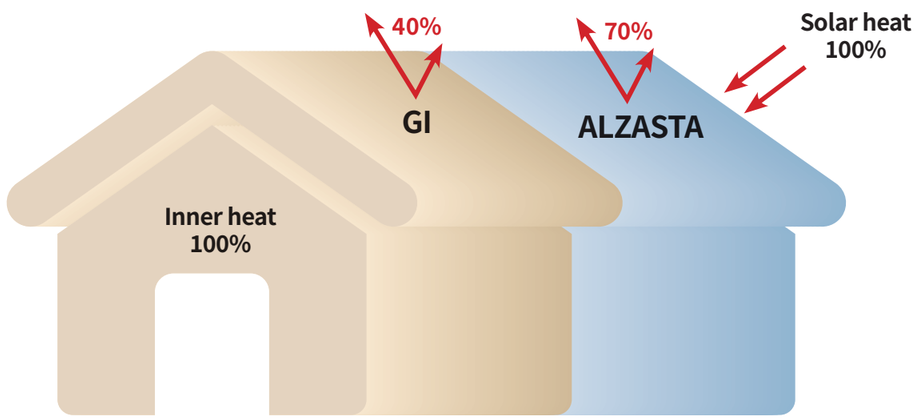
Bending Test



No peeling off in 0t, 180° bending test

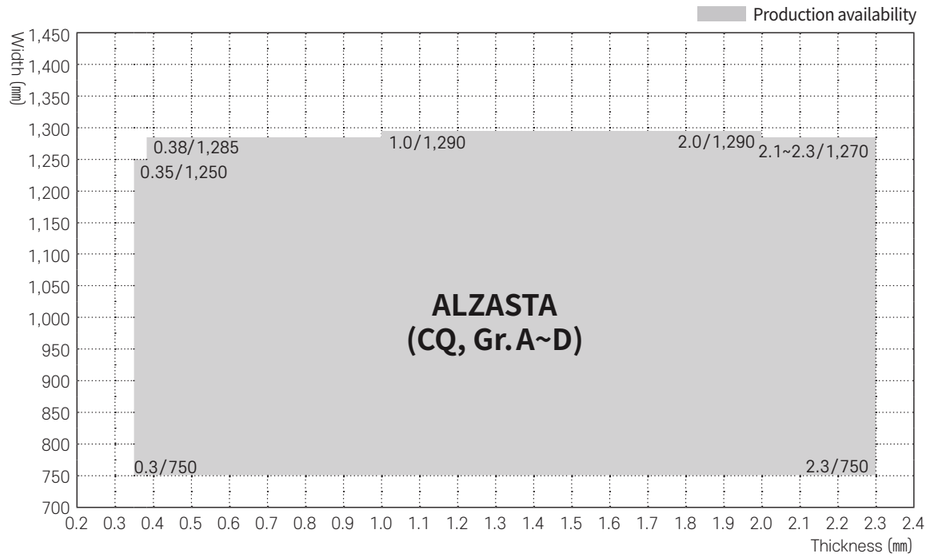
Heat reflectivity

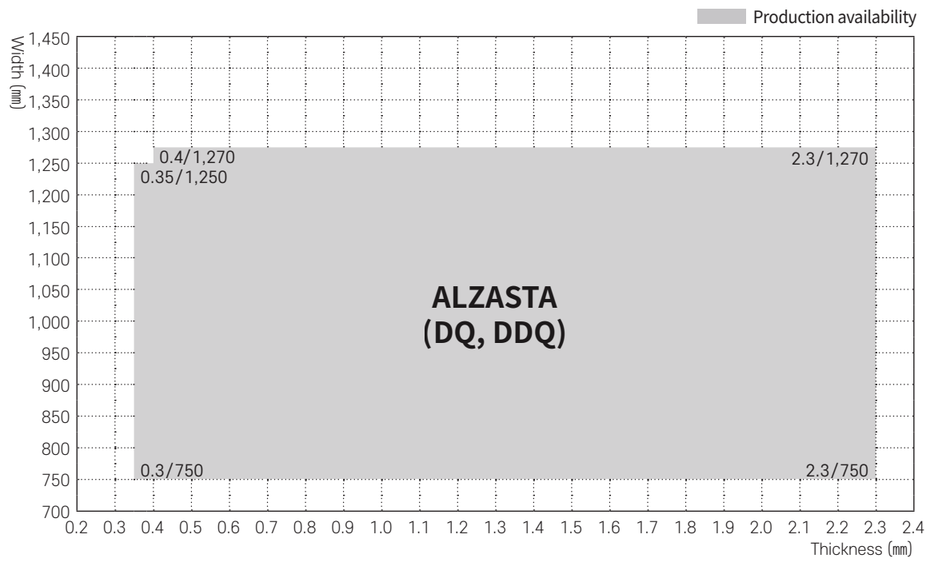
ALZASTA offers 2 times more heat reflectivity than galvanized steel sheets, and brings great energy cost reduction effect when used as the roofing material of various buildings. In particular, it can be combined with black paint containing complex oxide black pigment for even better effect in suppressing temperature increase.



Product Specifications

Production availability





ALZASTA
Hot-dip 55% Al-Zn alloy coated steel sheet

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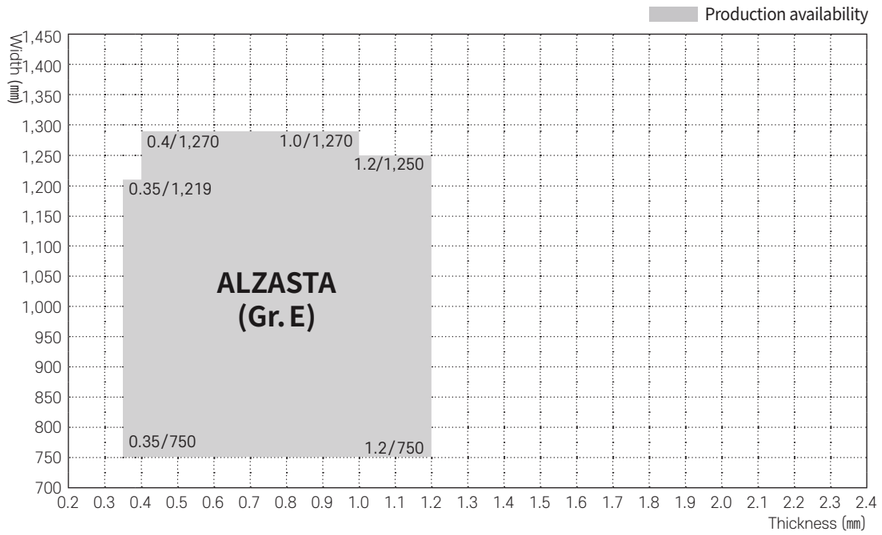
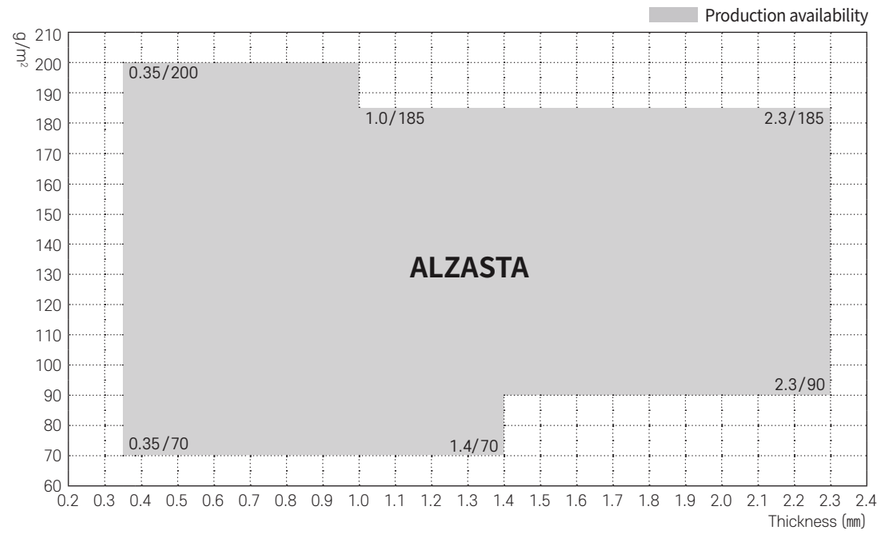
Hot-dip 55% Al-Zn alloy coated steel sheet

Production availability



※Consult in advance when receiving orders below 0.35㎜ or <1.0㎜ in thickness exceeding the production availability
※Consult in advance when receiving orders over 1270㎜ or below 750㎜ in width exceeding the production availability

Coating weight



Quality Specifications

| Specification comparison table |

Classification		SPECIFICATIONS			
		KS D 3770	JIS G 3321	ASTM A 792	DIN EN 10346
Commercial Quality		SGLCC	SGLCC	CS	DX 51D
Drawing Quality		SGLCD	SGLCD	DS	DX52D, 53D
Deep Drawing Quality		SGLCDD	SGLCDD	-	DX 54D
Structural Steel	**295**MPa	SGLC295Y	SGLC400	Grade 275	S320GD
	335MPa	SGLC335Y	SGLC440	Grade 340	S350GD
	365MPa	SGLC365Y	SGLC490	Grade 410	S420GD
	560MPa	SGLC560Y	SGLC570	Grade 550	S550GD

| POSCO STEELEON STANDARD |

Classification		THICK-NESS(㎜)	Y.P (MPa)	T.S (MPa)	Elongation(%)				
					0.3≤t<0.4	0.4≤t<0.6	0.6≤t<1.0	1.0≤t<1.6	1.6≤t<2.3
Commercial Quality		0.35≤ t <2.3	≥250	≥270	≥20	≥21	≥24	≥24	≥25
Drawing Quality			-	≥270	-	≥27	≥31	≥32	≥33
Deep Drawing Quality			-	≥270	-	≥29	≥32	≥34	≥35
Structural Steel	**295**MPa		≥295	≥400	≥16	≥17	≥18	≥18	≥18
	335MPa		≥335	≥440	≥14	≥15	≥16	≥18	≥18
	365MPa		≥365	≥490	≥12	≥13	≥14	≥16	≥16
	560MPa		≥560	≥570	-	-	-	-	-

※ Please consult in advance for specifications other than seen in the table

ALZASTA
Hot-dip 55% Al-Zn alloy coated steel sheet

ALZASTA
Hot-dip 55% Al-Zn alloy coated steel sheet

Dimensional tolerance

Thickness tolerance

| KS, JIS | (Unit : ㎜)

Displayed thickness (t)	Width (W)		
	630＜W	630≦W ＜1,000	1,000≦W
0.35≤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	±0.08	±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

| EN (DX51D~S550GD 기준) | (Unit : ㎜)

Displayed thickness (t)	Width (W)	
	W≤1,200	1,200＜W ≤1,500
T≤0.40	±0.05	±0.06
0.40＜t≤0.60	±0.05	±0.06
0.60≤t＜0.80	±0.06	±0.07
0.80≤t＜1.00	±0.07	±0.08
1.00≤t＜1.25	±0.08	±0.09
1.25≤t＜1.60	±0.11	±0.11
1.60≤t＜2.00	±0.14	±0.15
2.00≤t＜2.30	±0.16	±0.17

| ASTM | (Unit : ㎜)

Displayed thickness (t)	Width (W)	
	W＜1,500	1,500≦W
t＜0.40	±0.08	±0.08
0.40≤t＜1.00	±0.10	±0.10
1.00≤t＜1.50	±0.13	±0.13
1.50≤t＜2.00	±0.15	±0.15
2.00≤t＜2.30	±0.30	±0.34

Width tolerance

| KS, JIS | (Unit : ㎜)

Width (W)	Tolerance
Max 1,500	+ 7
	- 0

| EN | (Unit : ㎜)

Width (W)	Tolerance
600≤W≤1,200	+ 5
1,200＜W ≤1,500	+ 6

| ASTM | (Unit : ㎜)

Width (W)	Tolerance
600 ≦ t ＜ 1,200	- 0, + 5
1,200 ≦ t ＜ 1,500	- 0, + 6

Post-treatment

Type	CODE	Use	Remark
Chrome Treatment	CX	Construction Materials	Standard Chrome
	XG	Construction Materials	Organic Coating
	XA	Roofing Materials	Organic Coating (Blue)
	XB	Roofing Materials	Organic Coating (Green)
	XD	Ondol Panel (floor heating panel)	Organic Coating (Gold)
Chrome-Free Treatment	XT	Construction / Home Appliances	Organic Cr-Free
	JX	Boiler Components	Inorganic Cr-Free
	BT	Construction Materials	Biomass Cr-Free
	WT	Roofing Materials	Wax-Zero Cr-Free
Others	XF	Roofing Materials	XG(Top)+PE-Form(Back)

※For unprocessed materials such as color materials, the code is XX

※컬러용 소재 등 무처리의 경우 Code는 XX

Usage

| Home appliances |

• LCD monitor • AC outdoor unit
• TV shrinkage band

| Construction materials |

• Indoor/outdoor panels • Duct
• Metal roof tile • Panel board

ALSUSTA
Hot-dip aluminized stainless steel

Product features

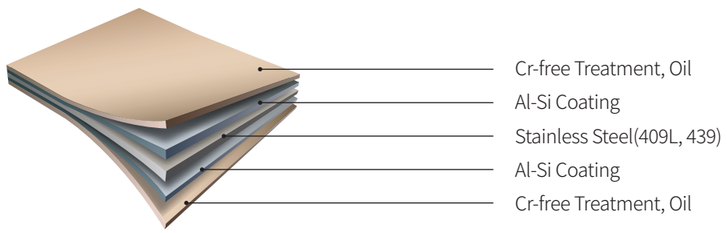
Product	Characteristics	Use
ALSUSTA **(Aluminized Stainless Steel)**	• Highly corrosion-resistant STS enhanced with aluminum plating that forms a passivation film, resulting in an elegant appearance and improved heat-corrosion resistance. • Excellent red rust resistance maintained up to 427°C. • Superior corrosion resistance achieved through a construction of an STS substrate, an alloy layer, and an aluminum plating layer, offering better performance against condensation corrosion and surface staining compared to conventional materials (409L, 439).	• Automobile exhaust system

| Specification comparison table |

Order specification		Model name	YP(N/㎟)	EL(%)
ASTM A 463	FSS Type 409	Al-STS 409L	170~345	≥20
	FSS Type 439	Al-STS 439	205~415	≥22

Product structure

Lower cost than 400 series STS, great decorative tendency due to outstanding corrosion resistance and beautiful appearance.



Formability

Highly processable ALSUSTA offers great molding ability and seam welding formability.

| ALSUSTA processing results |

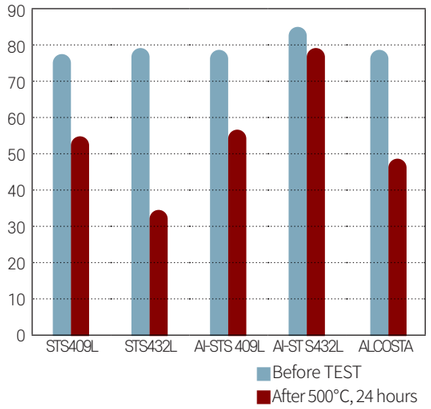
• Stamping formation evaluation

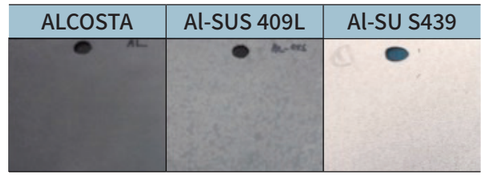
• Pipe-forming capacity evaluation

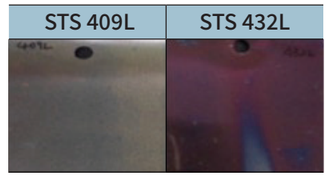
Heat Resistance

Heat Resistance Evaluation Results

- Test Conditions: 500°C, 24 hours
- Test Materials : STS 409L(11%Cr), STS 432L(17%Cr-0.5%Mo), Al-SUS 409L, Al-SUS 439, ALCOSTA







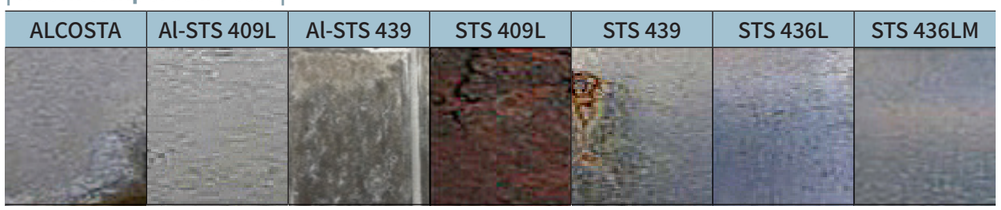
A smaller difference in whiteness (before and after the test) indicates a better product. ("Whiteness" refers to the brightness/darkness level of the surface.)

Corrosion

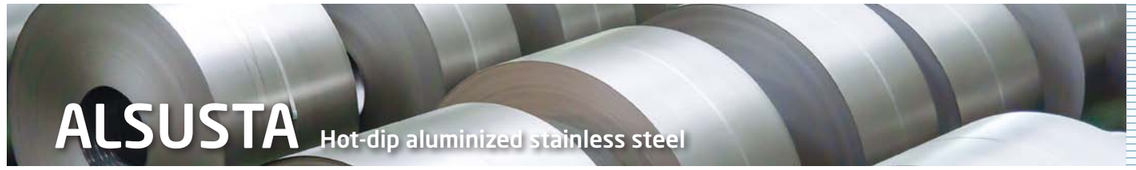
ALSUSTA offers outstanding corrosion resistance in corrosive environment.

※1Cycle : SST(35°C, 95%RH, 5hr) ➡ Dry(70°C, 30%RH, 2hr) ➡ Humidity(50°C, 95%RH, 3hr) ➡ Dry(60°C, 30%RH, 2Hr)

| Room temperature test |



| Heat Treatment (500°C, 24hrs) ➡ Salt Spray (35°C, 5%NaCl) |



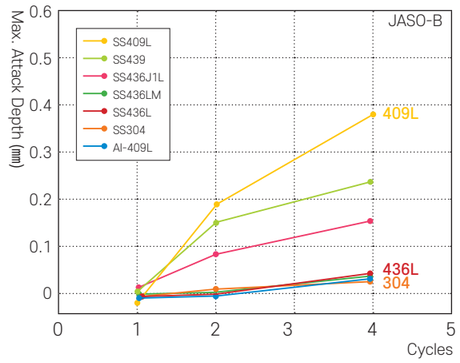
Corrosion resistance

■ Interior corrosion test against condensed water and deicing salt crack test

| Interior condensed water test method and result |

Category	Test condition
Solution (ppm)	Cl-100, NO_3-20, SO_3^2-600, $SO_4$2- 600, CH_3COO- 800
pH	8.0
Temperature	80℃
Time	24 days
Pattern repetition	Repeat 300cc, 24Hr evaporation 5 times, and heat once at 250℃ for 24Hrs

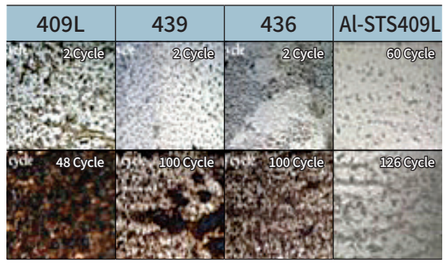
※ Al-STS409L has better interior corrosion resistance than 409L and 439, but lower than 436L and 304.



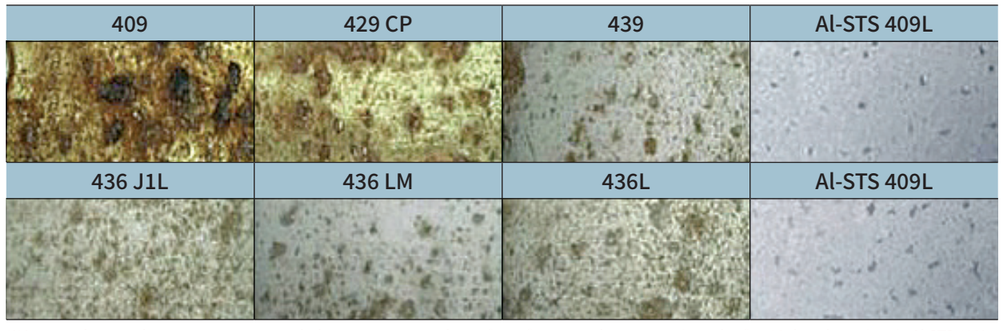
| Deicing salt crack test method and result |

Category	Test condition
Solution (ppm)	5% NaCl + 5% $CaCl_2$
Spraying condition	35℃, 1 Hr
Drying condition	60 ℃, 20~30% RH, 2 Hr
Wetting condition	50 ℃, > 95% RH, 1 Hr
Pattern repetition	Maximum 20 cycles of spraying-drying-wetting

※ Based on the result of deicing salt accelerated corrosion result, crack area is Al-STS409L < 436 < 439 < 409L



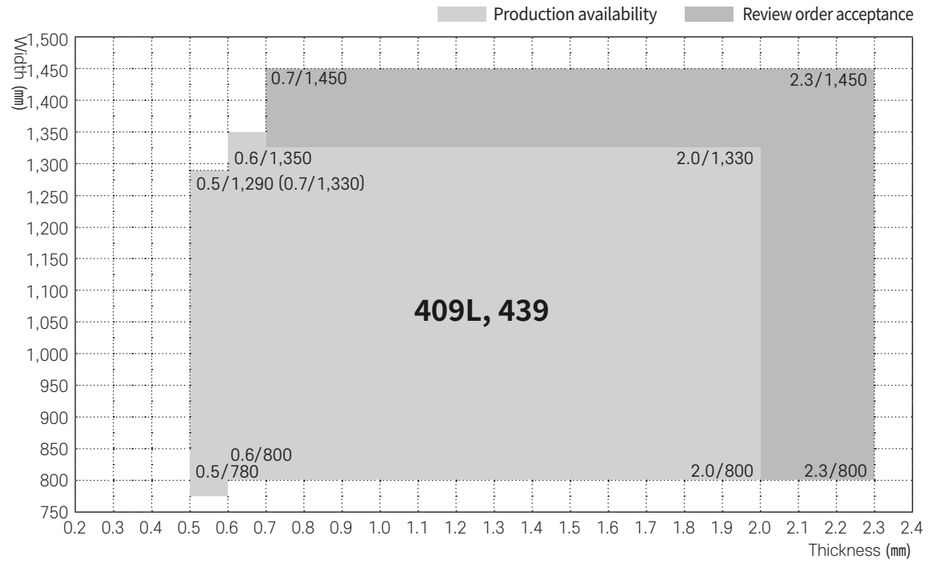
■ Outdoor exposure result (after 4 months)

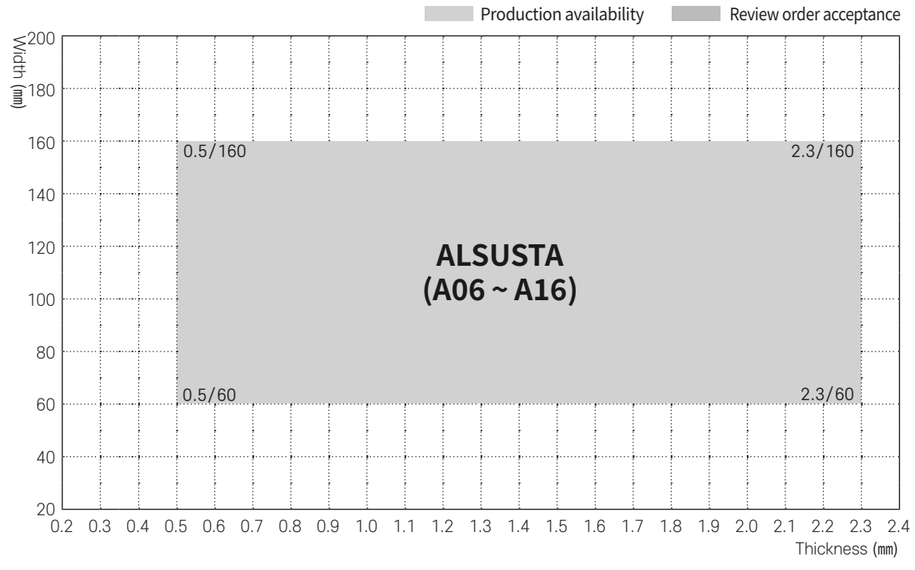


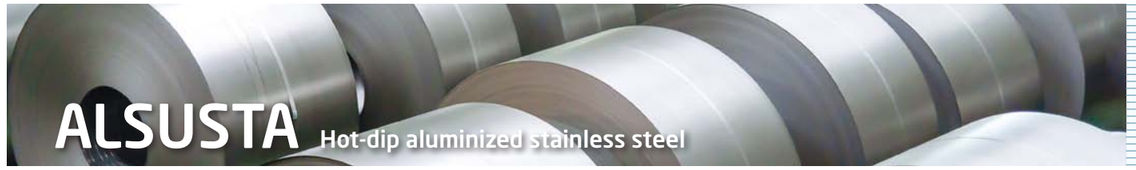
※ In coastal atmosphere exposure test, cracks began to occur on the surface of most products approximately after 10 days, but minor in Al-STS 409L
※ Corrosion resistance (crack area) of the specifications after 4 months of atmosphere exposure is Al-STS409L < 436L=436LM < 436J1L < 439 < 429CP < 409L.

Product specifications

Production availability

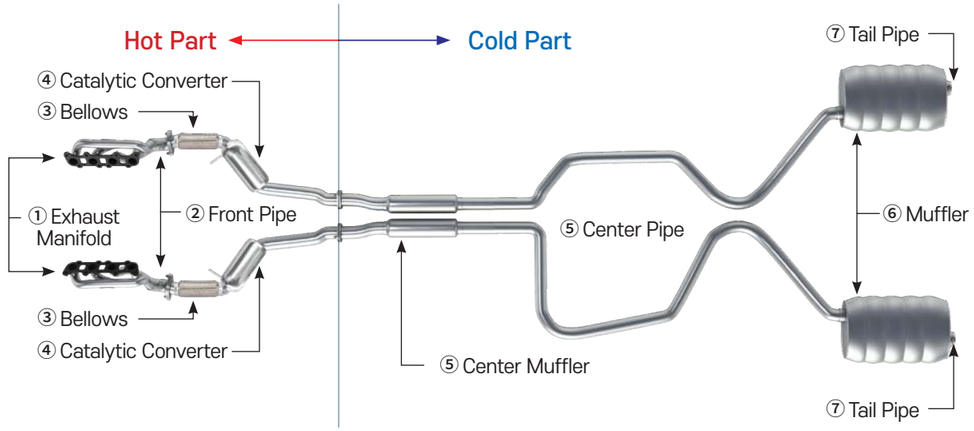






Application

| Automobile exhaust system |



| Interior condensed water test method and result |

Part	①	②	③	④	⑤	⑥	⑦
Part Name	Exhaust Manifold	Front Pipe	Bellows	Catalytic Converter	Center Muffler & Pipe	Muffler	Tail Pipe
Operating Temperature (℃)	1,000~1,200	950~750		800~600	600~400	400~100	
Required Characteristics	· High temperature strength · Thermal fatigue · Oxidation resistance · Formability	· High temperature strength · High temperature salt corrosion · Formability		· Oxidation resistance · Thermal shock resistance	Salt corrosion resistance	· Internal corrosion resistance (condensate) · External corrosion resistance (salt damage)	
Applied Steel	444 441 429EM	441 429EM 439	316Ti 321 309S	409L, 439 430J1L, 436L 436J1L	409L, 439 436L, 436J1L AL409L, AL439	409L, 439 436L, 436J1L, AL409L, AL439	

| Application in Hyundai-Kia Motors |

※ Applied in all models including Tucson, Kona, K3, etc. in addition to above models

MACOSTA
Hot-dip Zn-Al-Mg alloy coated steel sheet

Product specification

MACOSTA is a ternary hot-dip Zn-Al-Mg alloy steel sheet (KS D 3030) with outstanding corrosion resistance and formability, developed based on POSCO STEELEON's unique technology.

KS D 3030 : Regulates hot-dip coated steel sheets and coils made with alloy that consists of 1.5~8% of combination of MG and Al and the rest with Zn (MACOSTA: Hot-dip Zn-Al-Mg alloy steel sheet)

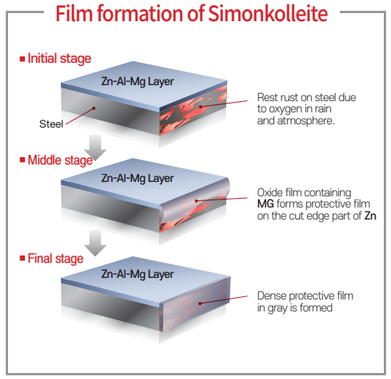
Corrosion resistance

Slab

- Promotes the formation of Simonkolleite (Zn5(Oh)8Cl2 · H2O), a dense corrosion product with Mg in highly stable state in the coating layer.
- Simonkolleite is formed and maintained like a film on the surface of coating layer, preventing corrosion of substrate steel sheet.

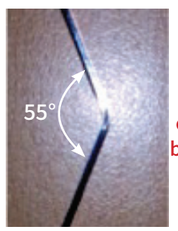
Cross section

- Upper coating layer is dissolved to cover the cross section and promote stable growth of corrosion product.
- Corrosion product covers the red rust on substrate steel sheet that is already exposed to prevent corrosion.

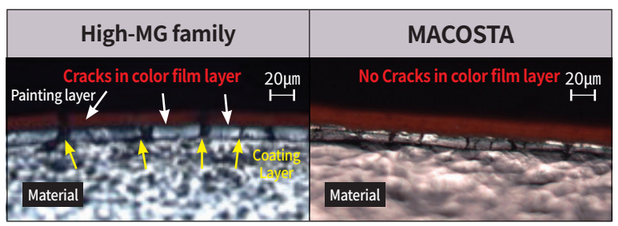


Formability

Offers similar formability to existing coated steel sheets, and particularly reduces cracks in processing compared to ternary alloy-coated steel sheets with high Mg content over 3% for outstanding corrosion resistance in processing parts.



Cross sectional comparison after bending test at 55°



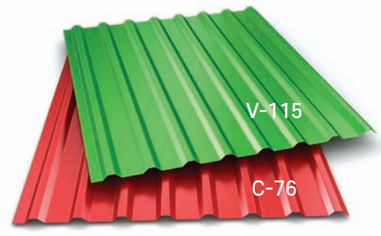
- **Outstanding hardness of coating layer :** Hardness of coating layer is outstanding compared go GI product, and minimizes contamination of mold during processing ➡ Great galling

Paintability

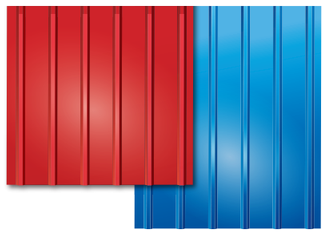
Continuous painting and powder painting can be applied just like the existing painted steel sheets and formability.

Roofing material

High weatherproof product



Fluorinated product



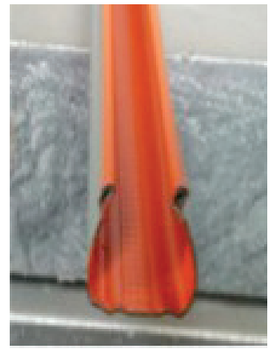
Metal roof tile

Traditional roof tile (MATT product)

Regular roof tile (MATT product)

Vinyl greenhouse pad

Bio antibacterial product



Welding characteristics

Various welding methods can be applied including arc welding, spot welding, EWR welding, etc.

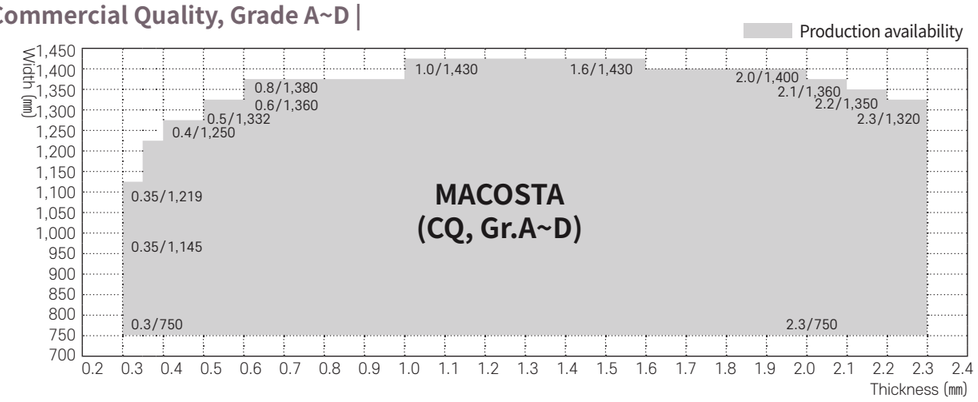
Test sample	Evaluation category			
	Welding current range	Consecutive spot welds	Cracks in welding area	Cross section of welding sample
GI	6.0~8.8kA	500	0μm	No cracks
MACOSTA	6.0~7.6kA	500	0μm	No cracks

MACOSTA
Hot-dip Zn-Al-Mg alloy coated steel sheet

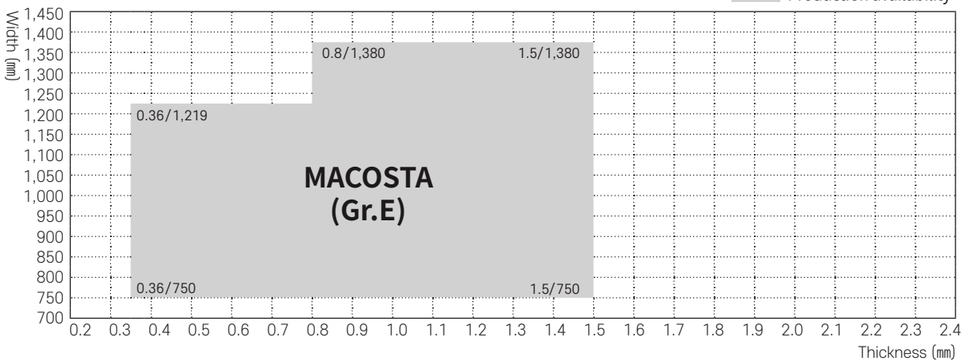
MACOSTA
Hot-dip Zn-Al-Mg alloy coated steel sheet

Production availability

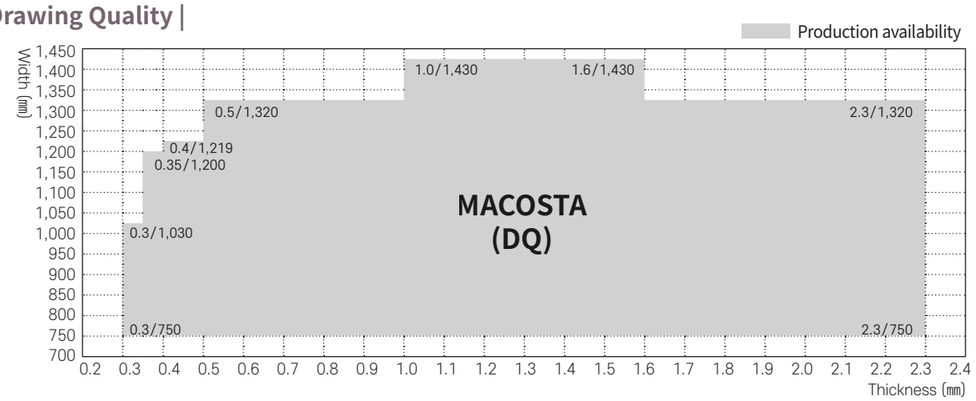
| Commercial Quality, Grade A~D |



| Commercial Quality, Grade E |



| Drawing Quality |



Corrosion resistance performance after processing

- **3~5 times higher corrosion resistance compared to regular galvanized steel sheets (HGI, GI)**
- **Corrosion resistance of cross section :** Simonkolleite formation in MACOSTA prevents red rust in the cross section, cost reduction for secondary post-plating can be omitted (CR+post-coating, powder coating excluded)

Time	MACOSTA (g/㎡, Cross section)		Galvanized steel sheet (g/㎡, Cross section)		Galvalume (g/㎡, Cross section)
	50	90	50	60	50
144 hrs					
576 hrs					
1,008 hrs			-	-	

| Molded safety foothold |

Type	POSCO STEELEON	Other Mill
	MACOSTA	GI
	0.9t, 120g/m²	0.9t, 120g/m²
936 hrs		
1,440 hrs		-

※ 5% NaCl (ionized solution), PH6.5~7.2, temperature: 35±2°C

Corrosion resistance performance after processing

| Saline water spray test in processing area |

Product	Before test	192hrs	552hrs	912hrs
MACOSTA (Coating weight on both sides 134)				
ZAM (Coating weight on both sides 346)				
GI (Coating weight on both sides 129)				
Galvalume (Coating weight on both sides 97)				

| Saline water spray test on pipe |

Category	MACOSTA (g/㎡, Cross section)		High-Mg, highly corrosion-resistant steel sheet (g/㎡, Cross section)	
내식성 (1,848 hrs)				

※ Compared to high-Mg, highly corrosion-resistant galvanized steel sheet

Corrosion resistance performance after processing

| Automobile fuel filter housing |

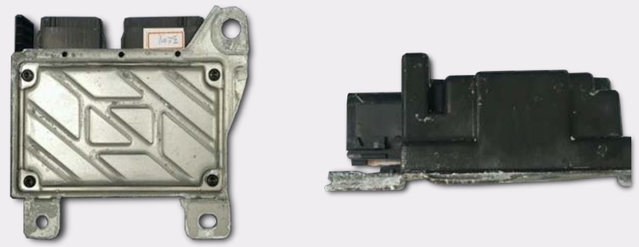
※ No red rust on MACOSTA after 600 hours based on SST ➡ Outstanding formability

| EX-MEAL Test |

Product	Before test	264hrs	432hrs
MACOSTA (1.2t, 120g/㎡)			
CR+secondary post-galvanizing			
CR			

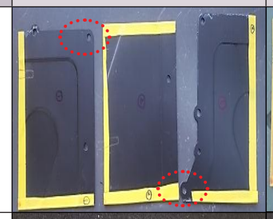
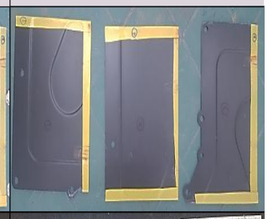
Corrosion resistance performance after processing

| Test on automobile electronic part covers |

MACOSTA	
CR+secondary post-galvanizing	

※ MACOSTA's outstanding corrosion resistance in molding area, cutting area : CR post-plating replacement completed.

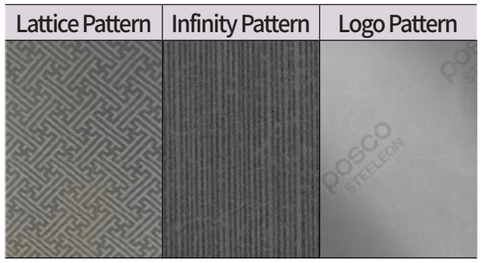
| Test on automobile electronic part covers |

Product	480hrs	1,000hrs	1,200hrs
Electric Zn-Ni coated product			
MACOSTA (1.2t, 120g/㎡)			

※ MACOSTA's outstanding corrosion resistance in molding area, perforated area: No red rust, change to MACOSTA completed.

Pattern**MAC**

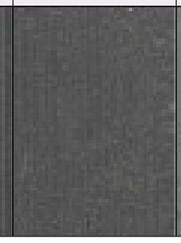
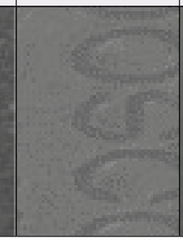
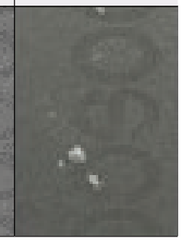
PatternMAC is a proprietary product of MACOSTA that features a variety of rolling patterns and textures on the surface, imparting an upscale appearance and enabling strategic brand marketing for POSCO STEELEON.

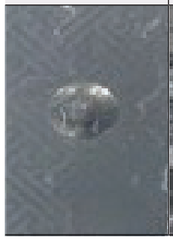


- **Lattice Pattern:** Provides non-slip characteristics by increasing the friction coefficient in two directions due to its unique pattern arrangement.
- **Infinity Pattern:** Amplifies incomplete diffuse reflection with a continuous linear pattern, significantly enhancing surface gloss on rough surfaces.
- **Logo Pattern:** Incorporates the POSCO STEELEON logo during processing and post-installation, offering differentiation from imported and lower-grade materials.

Product Properties (Salt Water Spray Test)

- Comparable corrosion resistance to standard MACOSTA.
- 3 to 5 times higher corrosion resistance compared to galvanized steel sheets.

MACOSTA		PatternMAC(Infinity Pattern)		PatternMAC(LOGO Pattern)	
120hrs	600hrs	120hrs	600hrs	120hrs	600hrs
					

PatternMAC(Grid Pattern)		GI		GL	
120hrs	600hrs	120hrs	600hrs	120hrs	600hrs
					

※ The implementation of diverse patterns through the rolling process minimizes damage to the plating layer.

FAQ

Q. Why does the Mg content vary in ternary alloy coated steel sheets?

A. POSCO STEELEON's MACOSTA complies with KS D 3030. Various types of ternary alloy coated steel sheets are manufactured around the world, and their uses can be designated based on Mg content. Generally, the use that requires no processing and high corrosion resistance needs high Mg content, and if processing and corrosion resistance are both required, product with low Mg content is needed.
-Ternary alloy coated steel sheets complies with KS D 3030 by the Korean Agency for Technology and Standards. KS D 3030 defines it as hot-dip coated steel sheets and coils made with alloy that consists of 1.5~8% of combination of MG and Al and the rest with Zn.

High corrosion resistance steel sheet production around the world

Steel manufacturer (Mg composition)		Brand Name	Alloy composition			Use
			Mg	Al	Other	
High-Mg (3% ↑)	**POSCO**	**PosMAC**	**3**	**2.5**		General steel building material
	NSSMC	Super Dyma	3	11	0.3% Si	
	NISSIN	ZAM	3	6	0.1% Ti	
	JFE	ECOGAL	5	0.5	0.03% Ni	
	Arecelor Mittal	Magnelis	3	3.5		
Low-Mg (1~2%)	**POSCO STEELEON**	**MACOSTA**	**1.5**	**1.5**		General steel building material, Colored steel sheet, Automobile
	Tata Steel	MagiZinc +	1.6	1.6		
	Voestalpine	Corrender	2.0	2.0		Automobile
	TKS	Eco Protect	1.0	1.0		General steel building material, Colored steel sheet, Automobile
	Salzgitter	Stroncoat	2.0	2.0		

Q. Isn't higher Mg content better?

A. Mg promotes the formation of corrosion product in the air and reinforces corrosion resistance. Of course, more Mg content increases corrosion resistance in the original state. However, increase of Mg leads to increase of hardness in coating layer, which may cause cracks in coating/film layers during bending. Moisture infiltration due to cracks aggravates corrosion of processed products, losing the unique characteristics of highly corrosion-resistant steel sheets. POSCO STEELEON is mostly manufacturing cold-rolled F/H-based thin sheets between 0.35T~2.3T, and has jointly developed the product with POSCO to maintain both corrosion resistance and formability by adjusting Mg content.

FAQ

Q. What are the benefits of using MACOSTA?

A. MACOSTA offers great corrosion resistance on the cross section as well as the plane surface. As opposed to post-coating (hot-dip galvanizing, electric Zn-Ni coating, etc.) or post-painting (powder) to reinforce corrosion resistance of existing cold rolled/hot rolled steel sheets (HR, CR, etc.), MACOSTA is used as is and reduces the cost for post-coating dramatically. Also, it can bring more cost reduction by replacing expensive imported highly corrosion-resistant products and low-cost STS products.

Q. I am currently using galvanized steel sheets. I want to use MACOSTA, but how should I decide the coating weight?

A. We suggest you decide the coating weight after fully reviewing the corrosion resistance level that you require. We inform our customers as follows, so please review as reference.

Galvanized steel sheet(GI)	Z120	Z180	Z220	Z270	Z350	Z400	Z600
MACOSTA	**M80**	**M100**	**M120**	**M180**	**M220**	**M270**	**M350**

Q. I want to use MACOSTA, and would like to know where the design is reflected.

A. When designing, please refer to KS or specification details. For example, in case of a solar panel support, the Revised New Renewable Energy Facility Criteria Guideline by Korea Energy Agency designates the use of "hot-dip galvanized or hot-dip Zn-Al-Mg alloy coated section steel for the support and joint."

Steel houses are regulated by KS D3854 (Zn-coated light gauge steels for structure) for the structure, which also allows the use of hot-dip Zn-Al-Mg alloy coated section steel (KS D 3030). If the design allows the use of KS D 3030, MACOSTA can be applied.

Q. Does MACOSTA show any white rust at all?

A. MACOSTA suppresses red rust by forming dense white rust oxide known as simonkolleite. In order to suppress white rust as much as possible, POSCO STEELEON is developing various post-treatment materials.

Q. What are the exterior defects that occur in Zn-Al-Mg alloy products like MACOSTA?

A. There may be darkening of the surface and dark spots ranging between 1~5mm in diameter in Zn-Al-Mg alloy steel sheets. Darkening is accelerated in high temperature and humidity, and except the surface looking dark gray due to the general oxidation in the galvanized layer, it is identical to normal products. Dark spots are created as the result of Zn, Al oxides due to local rapid cooling in the cooling process of the galvanized layer. Durability of dark spot area is identical to the durability in other areas.

Product Usage Guidelines

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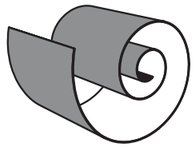

This guide deals with information on storage, handling and usage precautions of coated steel sheets, and is prepared to prevent issues caused by improper storage or handling. Not complying with the following may result in product loss, so please use extreme caution.

Product warranty information

Please note that product damages due to the following reasons are excluded from warranty.

- Zn peeling off while processing caused by changes with aging due to long-term storage (coated steel sheets: over 6 months, colored steel sheets: over 12 months) - Prompt use is recommended
- White rust due to humidity and moisture infiltration during storage - Pay attention to humidity and moisture infiltration when storing in coil and sheet forms
- Damaged blocking caused during transport and handling
- Defect caused by the use of product that is different from the purpose of order
- Product damage caused by other improper handling and storage

Handling precautions

Hot-dip galvanized steel sheet does not fully demonstrate its characteristics when not properly used, so please pay attention to the following.

Storage

Avoid places with humidity or possible moisture infiltration, or temperature difference, and store in well-ventilated indoor area. If packing material is damaged during storage, please repair immediately. If stored for a long period of time, fine white rust may develop even if the packing is perfect, so please reduce the storage time as much as possible. In case of humidity or moisture infiltration, dry immediately and use caution not to damage the coated side during transport or operation.

Processing

Lubricants containing special additives corrodes Zn, so please use non-corrosive lubricant, and if inevitable, please degrease and perform other anticorrosion treatment immediately after processing. For processing, please select the specification appropriate for the use. Please avoid processing in the environments of high humidity or severe sulfur dioxide or exhaust.
When performing processing such as slitting, shearing, roll forming, or press forming, it is recommended to work at a moderate speed and at room temperature to prevent the coating from peeling off at the processed areas. Additionally, during roll forming and press forming, regularly check the cleanliness of rolls and press molds to prevent product surface damage caused by the adhesion of foreign substances (e.g., chips).

Degreasing

Weak alkaline degreasing agent, natural degreasing agent, and organic solvent are good for degreasing. Strong alkaline degreasing agent corrodes Zn, so please avoid using it.

Handling precautions

Welding

In resistance welding, zinc adheres to the electrodes, so periodic cleaning is required, and in seam welding, using the KNURL GEAR DRIVE system can extend electrode life. High temperature brazing, especially on GA materials, should be avoided, and since welding produces fumes, it is essential to work in a well ventilated area; generally, soldering molten coated products with standard flux is difficult.

Painting

Since zinc is a highly active metal, achieving excellent adhesion by painting directly onto hot dip galvanized steel without pretreatment is challenging, so phosphating or other chemical pretreatment should be performed before painting.

Blackening Phenomenon

Over time, the surface gloss may deteriorate, resulting in a blackening phenomenon a normal oxidation process of the zinc coating that is accelerated in high temperature, humid environments; therefore, storage must take the surrounding conditions into consideration.

Installation

When loading materials on site for solar structure installations, it is important to avoid direct contact with the soil by using dunnage or pallets and to prevent contamination, because direct soil contact can damage the coating and accelerate corrosion. If contamination occurs, foreign substances should be removed promptly.

Structures

Initial corrosion may occur in areas where the coating layer remains in constant contact with other surfaces. To prevent continuous and direct exposure to moisture, it is recommended to improve the installation method or apply additional protective materials.

Aging

Areas that are in constant contact with the coating can experience initial corrosion, so it is advisable to improve the installation method or apply protective materials to prevent continuous moisture exposure. Moreover, as time passes, formability may decrease or phenomena such as stretcher strain or fluting may occur, so using non ageing steel sheets is recommended.

Usage

If the product is used for purposes other than those specified at the time of order, processing issues may arise, so caution is advised.

Transportation

During transportation or when moving the product in and out of warehouses and construction sites, wire ropes should not be directly attached to the product, as this may cause damage to its appearance.

Handling Method

When handling coated steel, any contamination or scratches may not only impair surface quality but also reduce durability, so care should be taken.

Repair

If scratches or defects occur during use, they should be repaired with rust inhibitors. In coastal areas where salt accelerates corrosion, periodic repairs of vulnerable cut edges are recommended.

Other

When processing products without any additional treatment such as painting on the coated surface, the benefits of using coated steel may be diminished depending on the environment, so caution is necessary.

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Handling precautions

Prohibited Installation Areas
In regions that promote corrosion such as coastal areas, heavy industrial zones, or livestock facilities it is best to refrain from using coated steel. If use is unavoidable, additional measures like packing or sealing should be applied to prevent corrosion.

Roof Pitch
When installing roofs, an appropriate pitch must be ensured so that rainwater drains properly, as water accumulation can lead to corrosion.

Uniform Direction Forming/Installation
When forming or installing in the same direction, differences in surface color may occur due to light reflection depending on the width and length directions, and there may also be color variations between lots; therefore, it is recommended to install using the same orientation and the same lot.

Drainage Gap
A drainage gap of approximately 10 mm should be secured at the junction of walls and structural members to prevent water accumulation, which can cause corrosion on cut edges.

Caulking Material
It is advisable to select high quality caulking products that match the durability of the coated steel, such as silicone or modified silicone based sealants.

Surface Discoloration
In areas near metal processing factories or scrap yards, metal powders such as iron can be carried by the wind and adhere to the product surface, leading to discoloration as the iron corrodes before the coating does. To prevent this, contact with metal powders should be avoided by using protective packaging, and care must be taken during onsite cutting to prevent metal chips from embedding in the surface.

Interior Wall Use
Although anti corrosion treatments are applied to both the upper and lower surfaces during production of the coated steel, when it is used as an interior wall material, additional insulation, condensation prevention, and waterproofing are fundamentally required.

Chemical/ Electrolytic Action
The strong alkalinity of concrete, the preservatives used in wood, and the contact between dissimilar metals can create an environment that rapidly accelerates electrochemical corrosion in the presence of moisture, so caution is necessary.

Wood Joints
Wood and plywood are typically treated with preservatives containing copper to prevent decay and improve durability; however, this copper can promote galvanic corrosion when in contact with steel, so insulating anti corrosion treatment is recommended at contact points.

Caution with Graphite
Since graphite, as found in pencils, can accelerate electrochemical reactions by acting as a catalyst in the presence of oxygen and water, it is important to avoid marking the coated steel surface with graphite containing instruments.

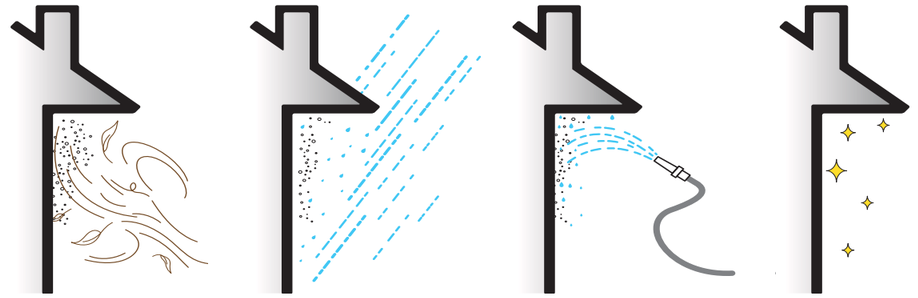
Cleaning Areas Not Exposed to Rain
Areas that are not washed by rain may accumulate dust containing salts and acidic substances, which can adhere and fix to the surface, leading to rapid corrosion; therefore, periodic cleaning with water is recommended.

Separation of Anti-Corrosion Post-Treatment Components
In moisture exposed environments, the anti corrosion post treatment components applied to both the upper and lower surfaces of the coated steel may separate, reducing their effectiveness. It is important to ensure that neither side is excessively exposed to moisture.

Customer Precautions

**Please take extra care with areas not exposed to rain,
as these regions can experience premature corrosion.**

Areas where rain does not easily reach, salts or acidic corrosive substances may not be washed away but instead become concentrated, thereby accelerating corrosion. It is advisable to regularly spray water on areas such as under eaves, overhangs, and balconies to wash away corrosive substances (take care indoors to prevent water leakage).

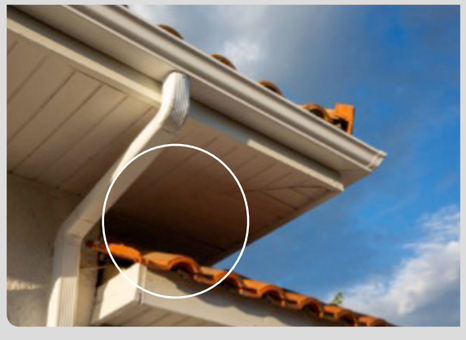


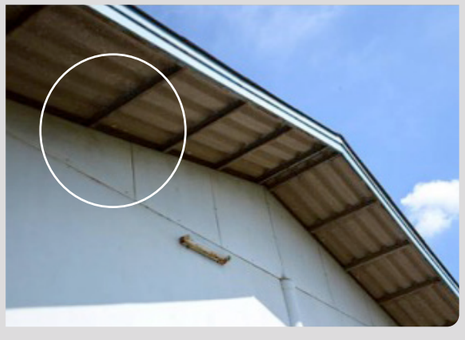
Dust carried by the wind is also a source of corrosion.	While areas exposed to rain are naturally washed clean, those shielded from rain tend to accumulate dust.	Spray water and remove the dust that causes corrosion.	The benefits of such cleaning are undeniable even if performed only a few times a year.

※Cleaning Precautions

- If using a detergent, it is recommended to use a neutral detergent.
- To avoid damaging the surface, use a soft sponge or cloth.

※Example: Areas that are not exposed to rain.





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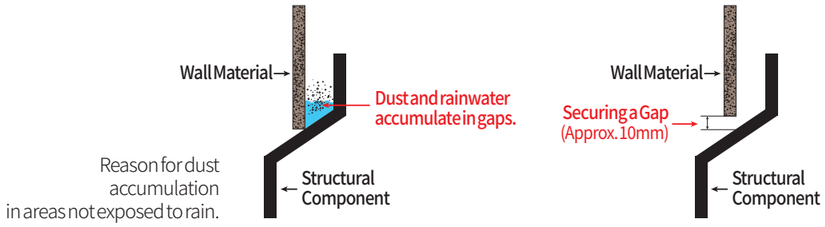
Design, Processing, and Construction Contractor Precautions

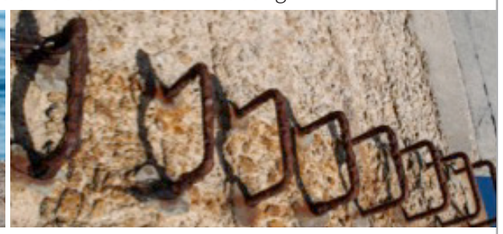
Ensure that there is an adequate gap between the wall material and drainage components to allow for proper water drainage.

Without a sufficient gap approximately 10mm water may accumulate along the edges of the steel, making these areas highly susceptible to corrosion. This gap prevents the build-up of dust and runoff, which are particularly prone to accumulate in areas that do not receive direct rainfall.



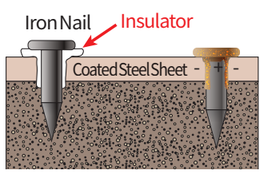
Avoiding Contact with Concrete

Avoid direct contact with concrete. When concrete becomes wet, its alkaline components can leach out and dissolve the plating on the steel surface. In addition to insulating the steel from concrete, make sure to design a structure that prevents rainwater and condensation from infiltrating.



Precautions for Direct Contact with Other Metals

Be cautious about direct contact with other metals. Different metals exhibit varying tendencies to ionize; when a metal with a higher ionization tendency contacts one with a lower tendency, the higher tendency metal will preferentially corrode due to the potential difference. For instance, if zinc (Zn) or iron (Fe) comes into contact with copper (Cu), the metal with the higher ionization tendency (Zn or Fe) will corrode before the copper does. This phenomenon is known as “dissimilar metal contact corrosion. ” If contact between different metals is unavoidable, insert an insulating material such as a rubber sheet at the contact point to prevent direct contact.



Example of Corrosion: Contact Between Dissimilar Metals

Exercise caution regarding contact corrosion when using preservative-treated wood.

Recently, wood treated with preservatives and antitermiticides is widely used to enhance durability. However, most preservatives contain copper, which can, upon moisture ingress, come into contact with the coated steel and rapidly induce corrosion. Therefore, areas where wood contacts the steel such as roofing should be insulated, and the design should ensure that rainwater or condensation does not infiltrate.

Roof Pitch and Water Puddling

Be mindful of water puddles formed due to shallow roof pitches. In the installation of folded metal roofs, a pitch of less than 3/100 can cause water to accumulate in sticky areas of the roof. During construction, ensure that the roof has a sufficient pitch to prevent water from collecting.

Avoid Mixing Different Lots on the Same Surface

Do not adhere different production lots to the same surface if possible. Although efforts are made to minimize appearance and tonal differences between lots, bonding different lots on the same surface may result in visible color variations. If layering is unavoidable, consider applying different lots to separate components or in areas that are not prominently visible.

Maintain Uniform Direction in Forming and Installation

There may be differences in the coated surface color due to light reflection depending on the width and length directions, and color variations may also occur between lots. Therefore, it is recommended to use the same direction and the same lot during installation.

Prevent Slipping During Construction

Take care to prevent slipping during construction. The drainage-considerate pitch used in roof installations can lead to slippery conditions, especially during rain or snowfall. Prior to beginning work, implement appropriate safety measures to prevent slipping.

Avoid Scratches During Construction

During construction, be careful not to cause scratches on the plated steel. Working on the surface with shoes contaminated by dirt or sand can result in scratches or blemishes, which may damage the anti-corrosion treatment and the plating layer, thereby reducing the product’s corrosion resistance. Extra care must be taken to maintain the surface integrity.

Post-Construction Cleaning

After construction, clean the surface of the steel. Leftover chips, screws, wires (e.g., copper), and other residues can come into contact with the plated steel and cause dissimilar metal contact corrosion, accelerating the deterioration of the plating. Ensure that all metallic residues are completely removed after construction.

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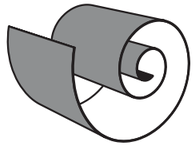

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Precautions for outdoor storage

▲Use cover, perform condensation control ventilation

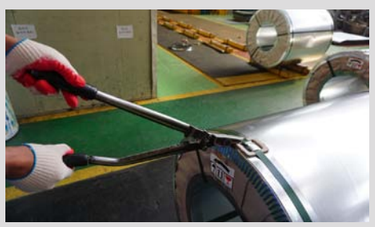
▲Incorrect outdoor storage (cover not used)

- Product should be stored indoors, but if inevitable, use cover (vinyl) for outdoor storage to keep products away from rain. After the rain, ventilate to avoid moisture.
- In case of dew condensation, remove moisture immediately and use caution to avoid film swelling due to moisture infiltration.
- Keep products away from rain, and use the product immediately once it is wet with rain.

Safety precautions

Slippery floor after installation

Risk of coil unwinding



▲Cut from the side of coil when cutting band

- The surface of product is slippery after installation. Please wear anti-slippery shoes and move carefully. (Use caution when installing on roof and ceiling)
- When cutting the steel band for packaging, please cut from the side of the coil.
- When cutting the steel band or removing filament tape fastened around the product, there is a risk of coil unwinding.

Transport precautions

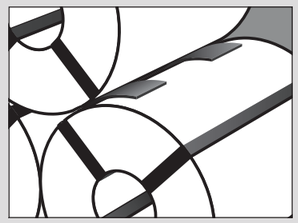
▲Transport in rain

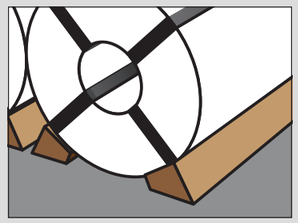
▲Panel-type transport

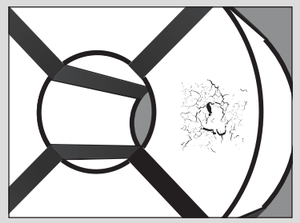
▲Dent prevention

- Avoid loading/unloading in rain, and use cover to prevent white rust due to rainwater infiltration during transport.
- Please pay attention to film surface defect (scratch, dent, etc.) when transporting panels.
- Drive accordingly for the road condition, and avoid speeding and sudden stops to prevent defects caused by transport.
- Prevent defects from floating by using 5-angle skid, and keep the position of banding clamp away from contacting the product.

Other precautions







- When stacking in 2 layers, please insert a rubber pad on the bottom layer of coils, and use rubber pad and 5-angle ski on the ground to prevent dents by foreign matters.
- Performing urethane coating in the area that is in direct contact with the product can prevent damages in the inner diameter.
- Pleas use caution to avoid dents and damages by impact from product handling tools.

Safe handling tool use

Do not overload

No excessive impact

Do not touch with contaminated gloves