NIPPON STEEL

Steel Sheet

NIPPON STEEL QUALITY PRODUCTS

ZAM®

ZAM® is a highly corrosion-resistant hot-dip coated steel sheet that has a coating layer of zinc, 6% aluminum, and 3% magnesium.

NIPPON STEEL CORPORATION

What is ZAM™ ?

ZAM® is a highly corrosion-resistant hot-dip Zinc-Aluminum-Magnesium alloy coated steel sheet that NIPPON STEEL has succeeded in launching on the market for the first time in the world.
Due to the effects of magnesium and aluminum, ZAM® has excellent corrosion resistance, scratch resistance as well as formability, and can be applied in a wide range of fields.

NIPPON STEEL has provided not only steel products but also various solutions for our customers.
We aim to create new market opportunities along with supplying high-value-added products, which we have developed with our advancing technologies based on our worldwide research and development.

NIPPON STEEL QUALITY PRODUCTS

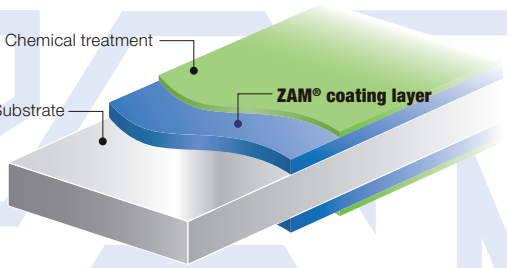
ZAM™

ZAM® is a highly corrosion-resistant hot-dip coated steel sheet that has a coating layer of zinc, 6% aluminum, and 3% magnesium.

1 What is ZAM™ ?

Long product life

Substitute for post hot-dip galvanizing



Light coating weight yet high corrosion resistance

Reduction in both coating and transportation costs

LCC (Life Cycle Cost)
Reduced repair cost

Eco-friendliness through process saving

Reduced manufacturing cost

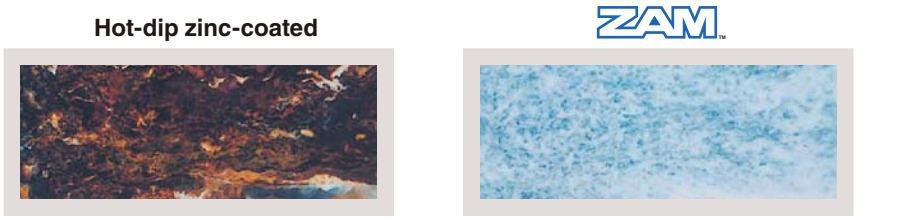
■ **A new hot dip coated steel sheet that has a coating layer of zinc, 6% aluminum, and 3% magnesium.**

Superior corrosion resistance - 1

In terms of corrosion resistance, ZAM® is 10 to 20 times better than hot-dip zinc-coated steel sheets*1 and 5 to 8 times better than hot-dip zinc-5%aluminum alloy coated steel sheets*2.

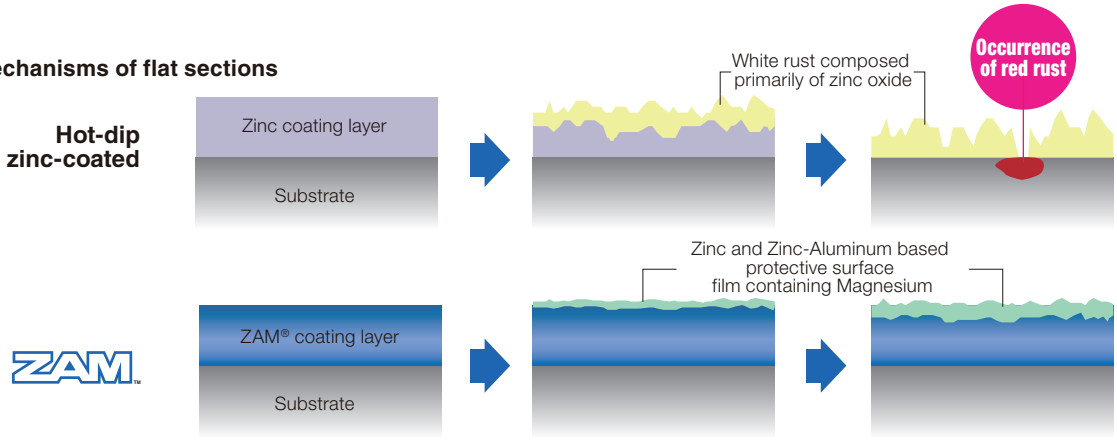
*1, *2: Estimated by salt spray test

■ **Comparison of corrosion resistance of flat sections**



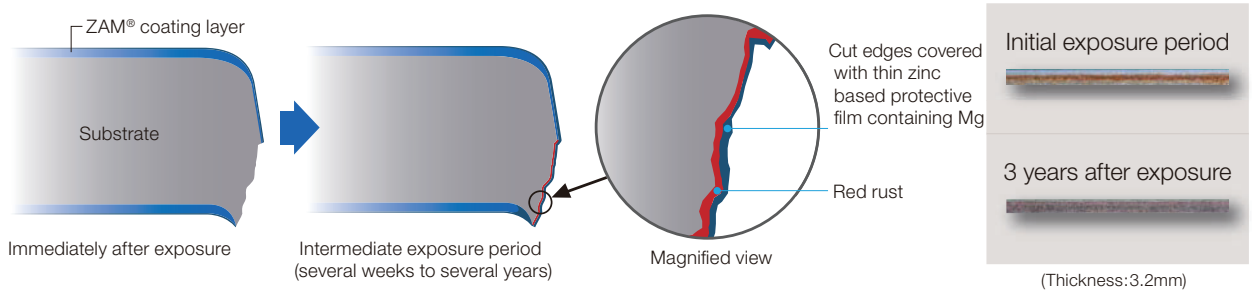
● After 2,500 hours of salt spray test, the surface appearances of the samples were compared (coating weight: 90/90 g/m²).

■ **Corrosion mechanisms of flat sections**



Superior corrosion resistance - 2

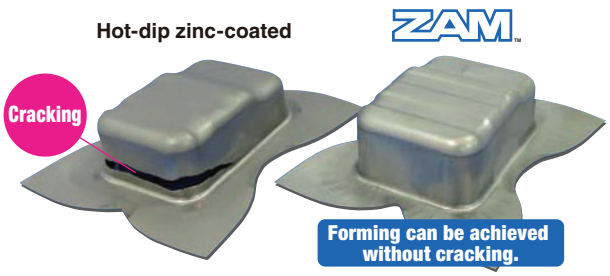
Excellent corrosion resistance is achieved on cut edge of ZAM® with a fine zinc-based protective film that contains Al and Mg leaching from the coating layer.



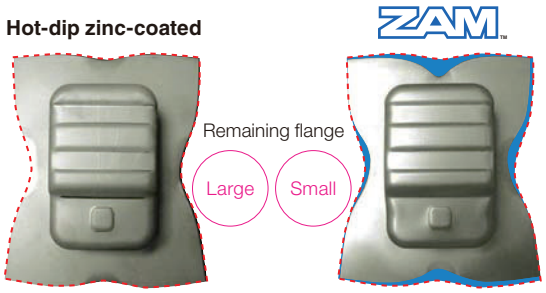
Superior press formability

With a harder and smoother coating layer than hot-dip zinc-coated steel sheets, ZAM® shows excellent press formability contributing to higher productivity.

Comparison in drawing properties



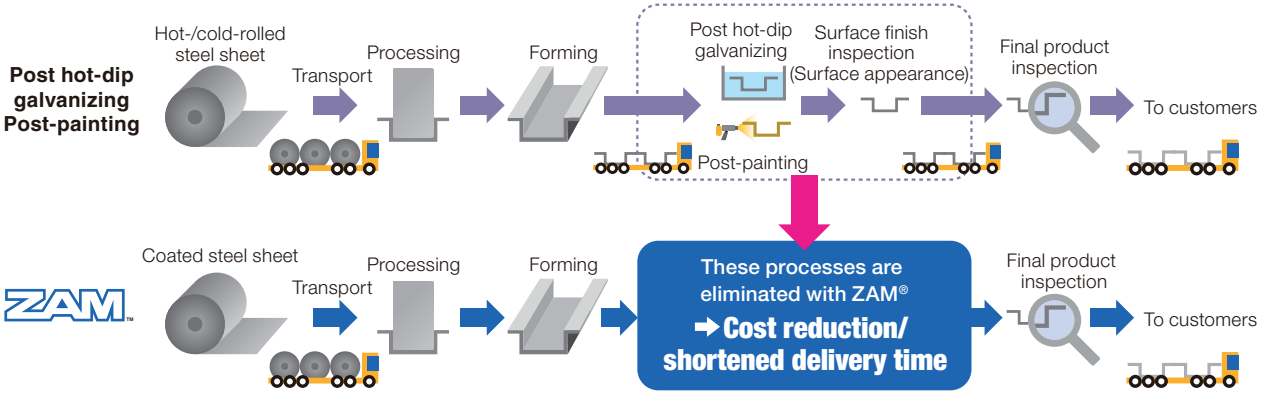
● This comparison test was conducted on the same steel grades under the same forming conditions.



ZAM® leaves a smaller area of flange after forming.
➡ Superior drawing properties

Cost reduction through eliminating post hot-dip galvanizing process.

Cost reduction by post hot-dip galvanizing / post painting process omission



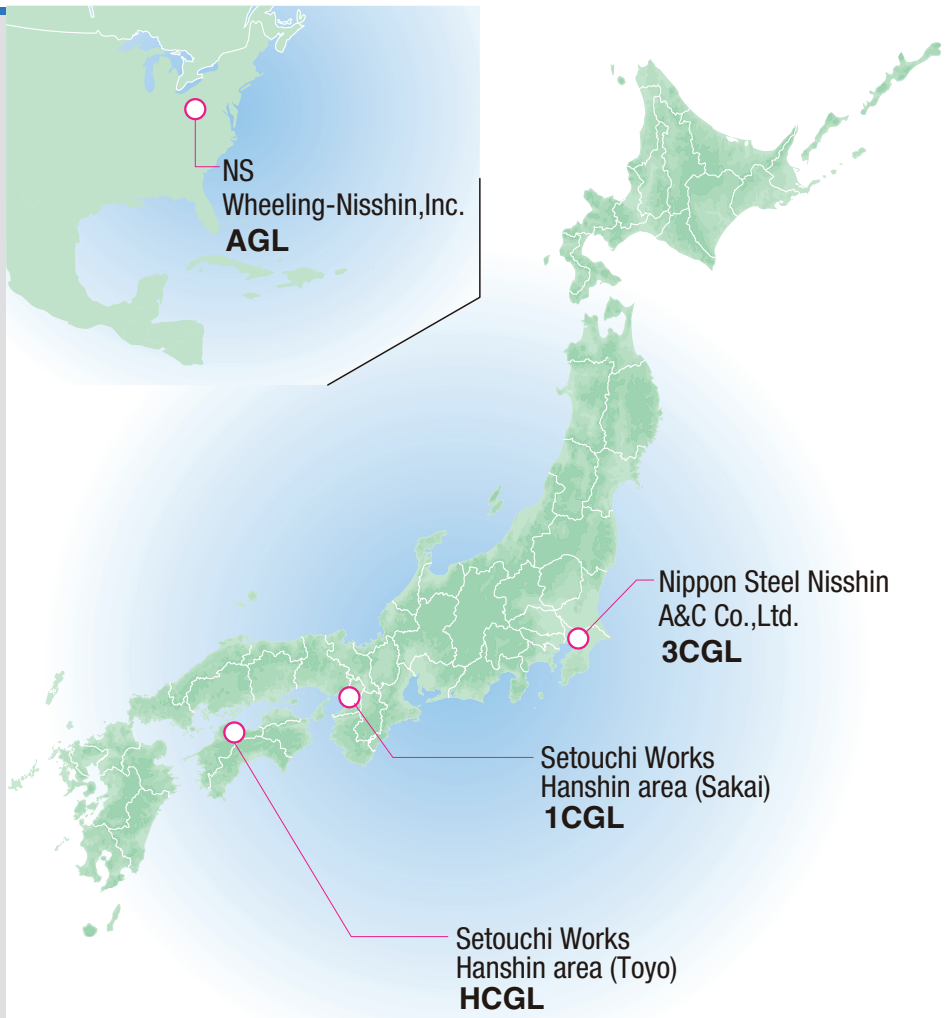
ZAM® can contribute to reducing costs significantly - for instance, it enables initial cost reduction through process omission and life cycle cost reduction thanks to its superior corrosion resistance.

2 Production process

Production bases

ZAM® is

produced with HCGL in Setouchi Works Hanshin area (Toyo), 1CGL in Setouchi Works Hanshin area (Sakai), 3CGL in Nippon Steel Nisshin A&C co.,Ltd. (Chiba), and AGL in NS Wheeling-Nisshin ,Inc.(U.S.A)



Production range

	Sheet thickness (mm)
Setouchi Works Hanshin area (Toyo)	0.8 - 6.0
Setouchi Works Hanshin area (Sakai)	0.25 - 1.2
Nippon Steel Nisshin A&C Co.,Ltd.	0.25 - 2.3
NS Wheeling-Nisshin,Inc.	0.35 - 3.2

Setouchi Works Hanshin area (Toyo)
962-14 Hojo, Saijo-City,
Ehime, 799-1354 Japan

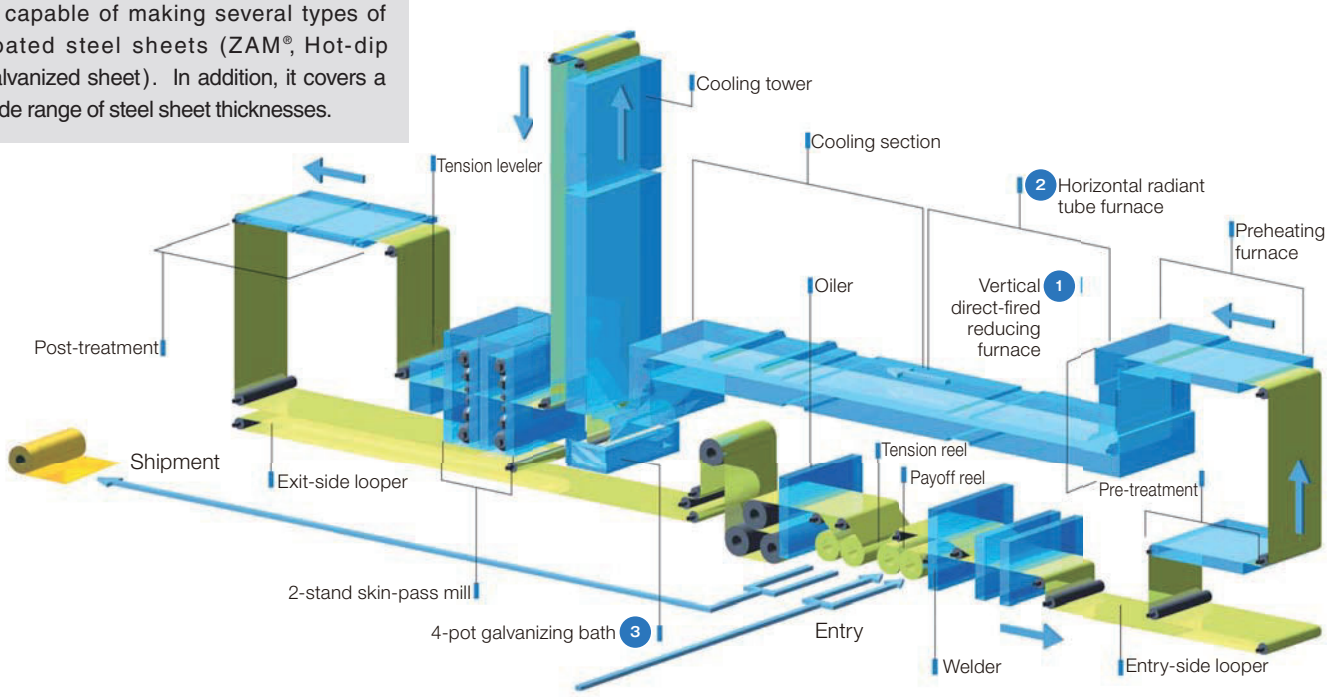
Setouchi Works Hanshin area (Sakai)
5 Ishizunishimachi, Nishi-ku, Sakai-City,
Osaka, 592-8332 Japan

Nippon Steel Nisshin A&C Co.,Ltd.
7-1 Koyashinmachi, Ichikawa-City,
Chiba, 272-0011 Japan

ZAM® production line

Setouchi Works Hanshin area (Toyo) HCGL (hot dipping line)

In this hot dipping line (HCGL), a vertical direct-fired reducing furnace and a horizontal radiant tube furnace are combined to achieve improvement in both annealing furnace operation and product quality. Incorporating four pots, this production line is capable of making several types of coated steel sheets (ZAM®, Hot-dip galvanized sheet). In addition, it covers a wide range of steel sheet thicknesses.



Pickling and cold-rolling equipment

1

Annealing furnace (Vertical direct-fired reducing furnace)

2

Annealing furnace (Horizontal radiant tube furnace)

3

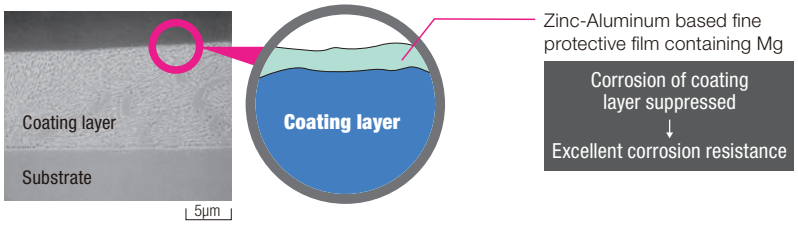
Galvanizing pot

3 Quality characteristics

Corrosion resistance mechanism of ZAM®

Mechanism of corrosion resistance on flat section

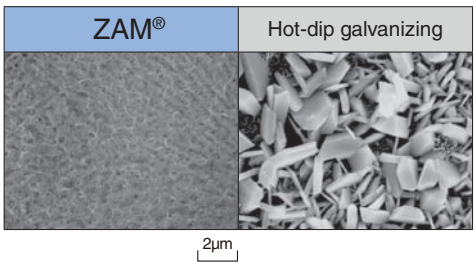
Al and Mg in the coating layer of ZAM® combine to form a fine, tightly adhered zinc-based protective film on its coating surface as time passes. This protective film suppresses corrosion of the ZAM® coating.



● Galvanized coating layer also forms a protective film on the surface. This protective film, however, is not as fine as in ZAM®, and less adhesive (see photo at right).
In contrast, the protective film formed on the coating surface of ZAM® is excellent in both fineness and adhesion, and consequently it inhibits permeation of corrosion factors, preserving high corrosion resistance over a long period.

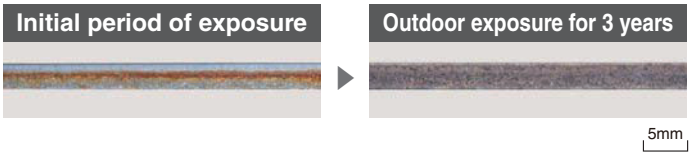
Protective film formed on the coating surface after salt spray test (4 hours)

(Thickness: 0.8 mm, coating weight: 90/90 g/m², untreated)



Mechanism of corrosion resistance on cut edge

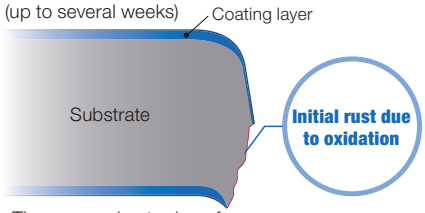
Excellent corrosion resistance is achieved on cut edge parts by covering the ends with a fine zinc-based protective film that contains Al and Mg leaching from the coating layer.



(Thickness: 3.2 mm, coating weight: 150/150 g/m², post-treatment: chromate 50 mg/m²)

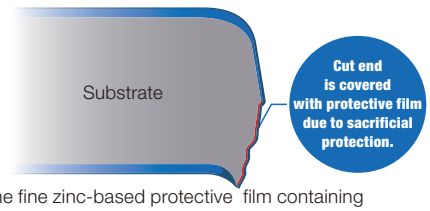
Note: The color and the speed of change in color depend on sheet thicknesses and exposure environments (region, installation location, aspect, etc.).

Initial exposure period
(up to several weeks)



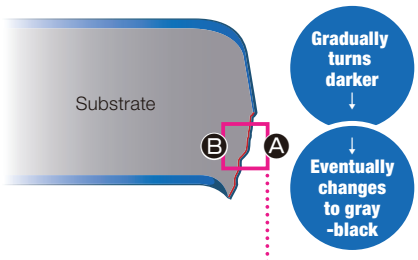
The exposed cut edge of substrate is oxidized due to rain, condensation, etc.

Intermediate exposure period
(several weeks to several years)



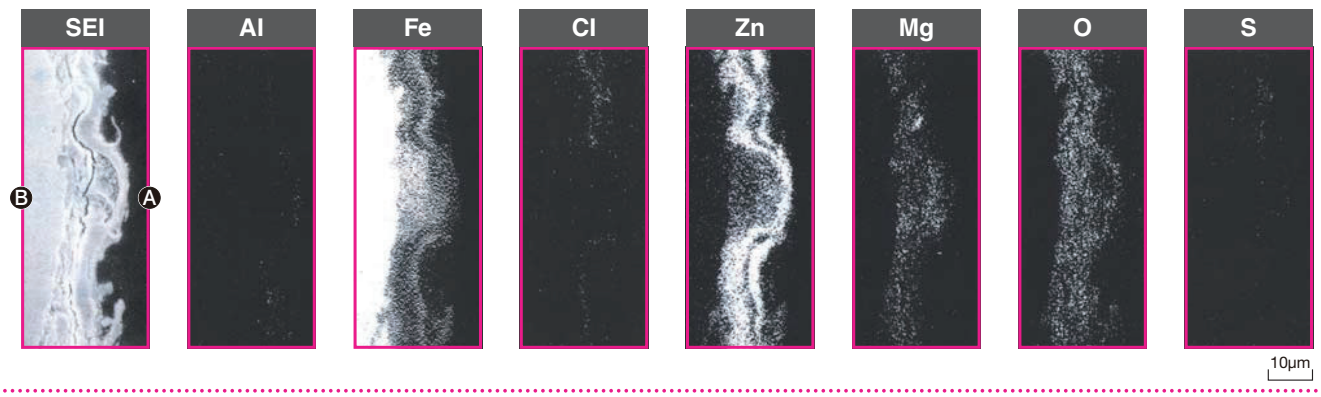
The fine zinc-based protective film containing Mg covers the cut edge with leaching of Zn, Al, and Mg from the coating layer.

Long exposure period



Cross-sectional structure and distribution of elements formed on cut edges after 18 months of outdoor exposure test

(Thickness: 2.3 mm, coating weight: 130/130 g/m², post-treatment: chromate 50 mg/m²)

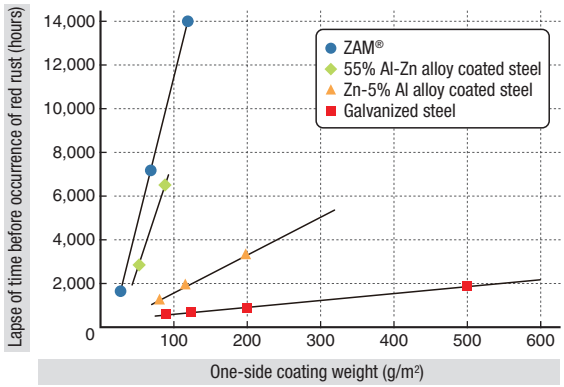


Comparison of properties with various types of coated steel sheets

Corrosion resistance on flat parts

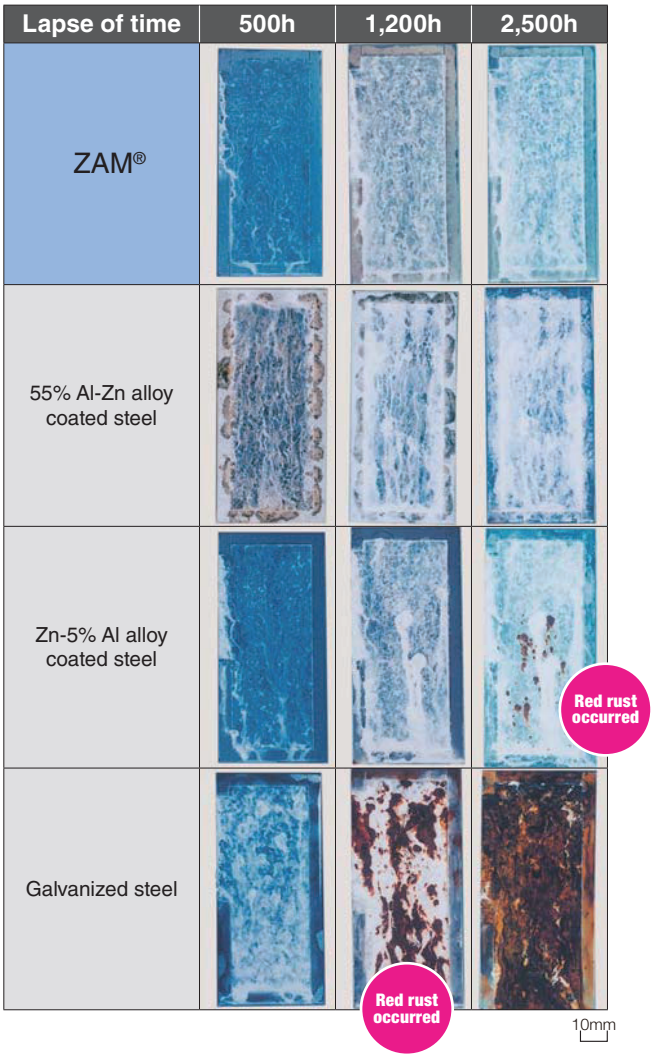
ZAM® has better resistance to red rust than galvanized and hot-dip zinc-5% aluminum alloy coated steel sheets.

Red rust occurrence after salt spray test (untreated)



Results of salt spray test (SST: JIS Z 2371)
Appearances of specimens after salt spray test

(Coating weight: 90/90 g/m², untreated)

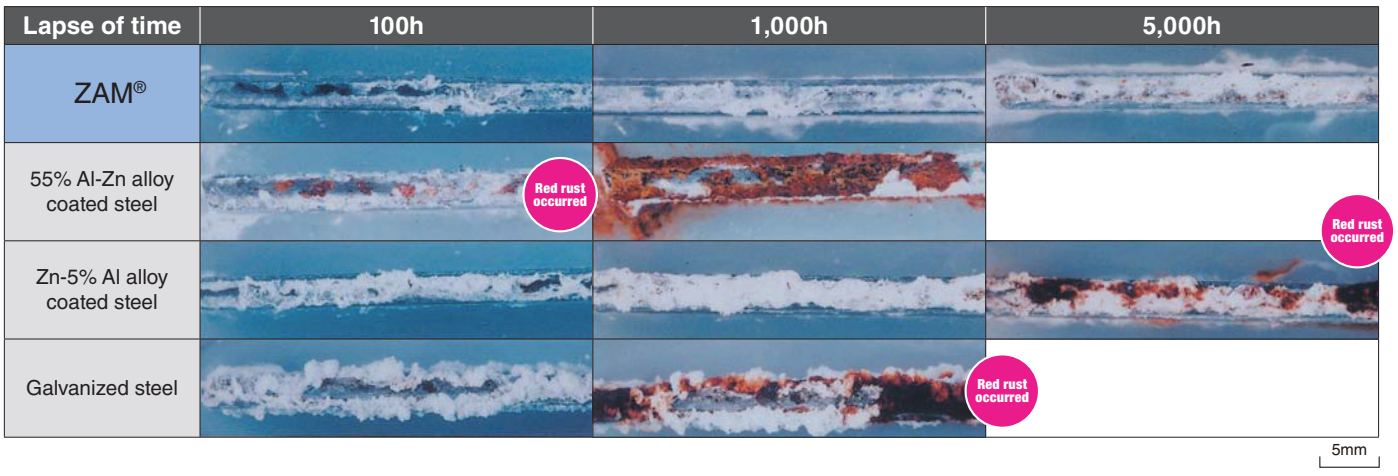


Corrosion resistance on cut edge

ZAM® shows better red-rust resistance (durability) on cut edge than any other coated steel sheet.

Appearances of cut edges after salt spray test

(Thickness: 3.2 mm, coating weight: 120/120 g/m², untreated)



3 Quality characteristics

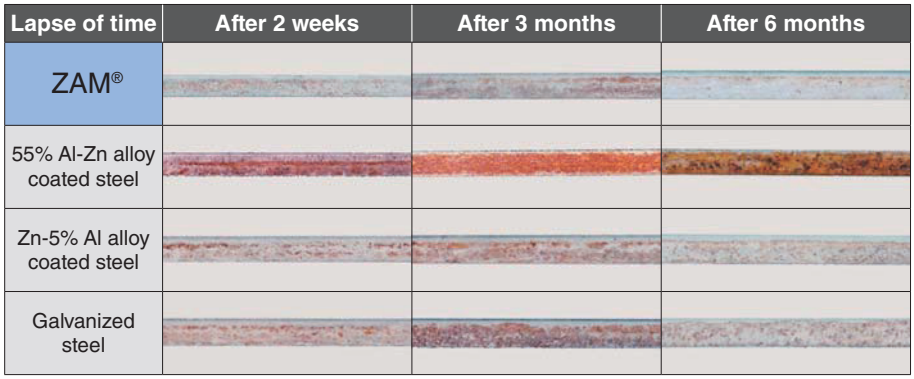
Comparison of properties with various types of coated steel sheets

Change in the appearance of cut edge during outdoor exposure test

The cut edge of ZAM® will be covered with a protective film and change to a subdued color as time passes.

Appearances of cut edge sections after outdoor exposure test (testing location: seaside industrial area in Sakai)

(Thickness: 2.3 mm, coating weight: 90/90 g/m², chromate treatment: 50 mg/m²)

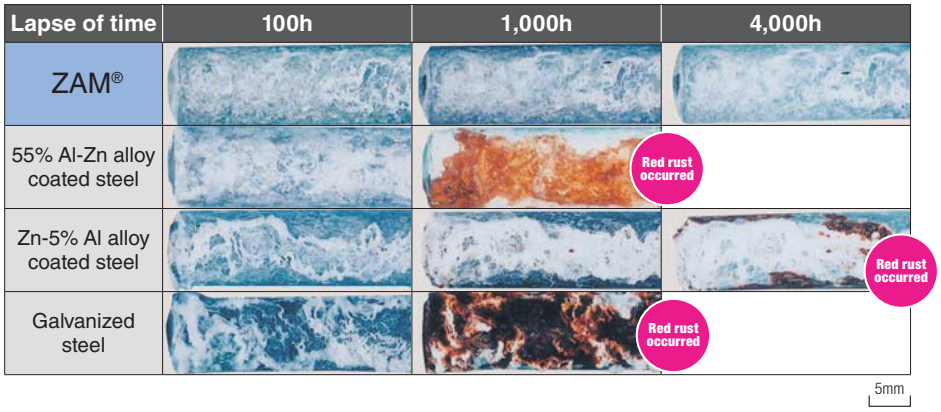


Corrosion resistance of bent sections

ZAM® shows better corrosion (red-rust) resistance even in bent sections than any other coated steel sheets.

Appearances of 1t bent section after salt spray test

(1t, 180° bending, thickness: 3.2 mm, 120/120 g/m², untreated)

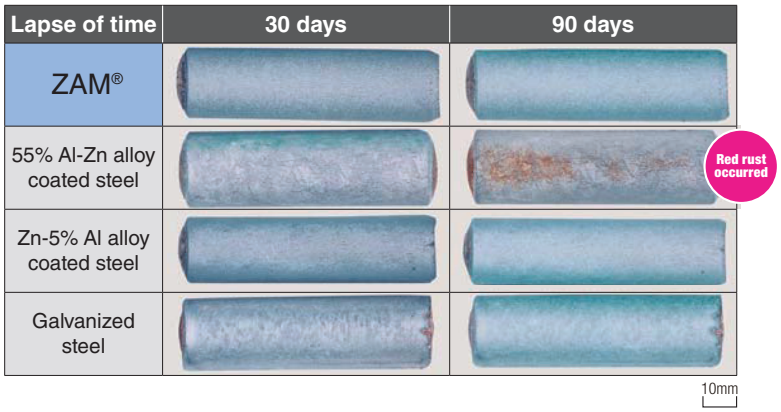


Change in appearance at bent section during outdoor exposure test

ZAM® shows almost no change in appearance at the bent section.

Appearances of 1t bent section after outdoor exposure test

(1t, 180° bending, thickness: 3.2 mm, 120/120 g/m², untreated)

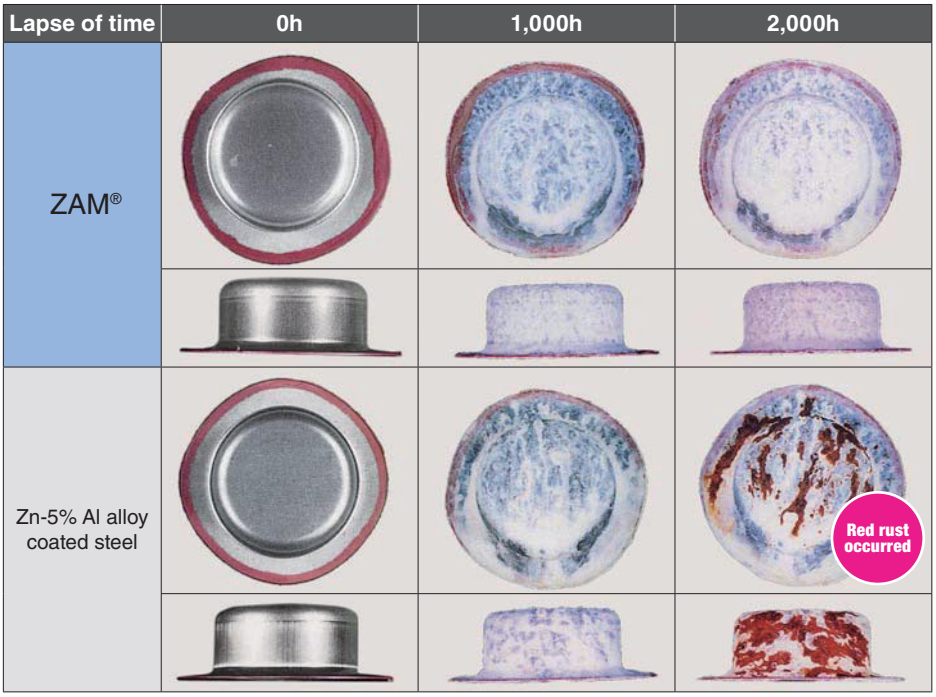


Corrosion resistance of drawn sections

ZAM® shows better corrosion resistance on drawn parts compared to hot-dip zinc-5% aluminum alloy coated steel sheets.

Appearances of drawn parts after salt spray test

(Drawing height: 25 mm, thickness: 0.8 mm, coating weight: 70/70 g/m², untreated)



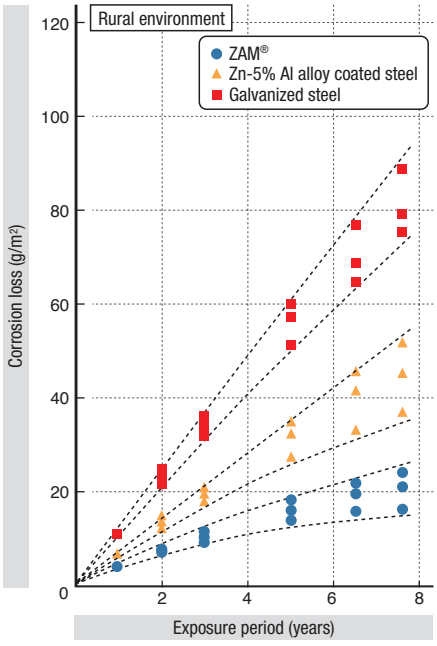
Outdoor exposure test results

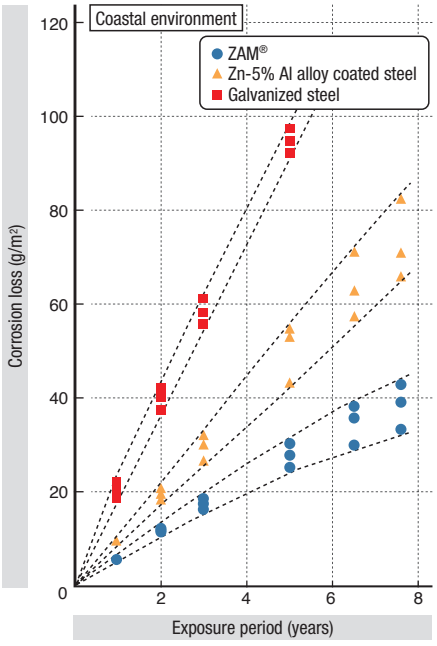
Corrosion loss of coating layers after outdoor exposure test

ZAM® shows approximately four times higher corrosion resistance than hot-dip zinc-coated (according to the results of 8 years of exposure test)

Outdoor exposure test site

	Exposure site
Rural environment	Kiryu-City, Gunma
Coastal environment	Nakagusukuson, Okinawa (approx. 30m from the seashore)





3 Quality characteristics

Chemical resistance

Acid/alkali resistance

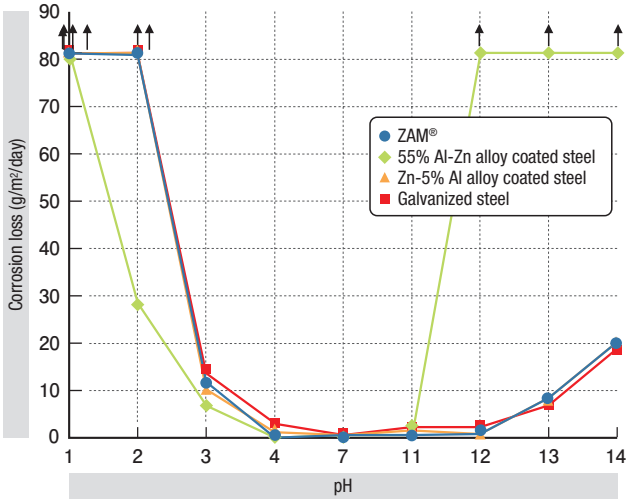
In acidic and alkaline aqueous solutions, ZAM® shows the same corrosion behavior as other zinc-based coated steel sheets.

Test method

- Solution: Starting with an aqueous solution containing 1 g/L Na_2SO_4 as the base mix, its pH was varied from 1 to 14 by adding H_2SO_4 on the acidic side and NaOH on the alkaline side.
- To determine corrosion loss test pieces (n = 3) were immersed for 24 hours in a solution adjusted to each pH at 30°C, and the corrosion loss was determined. The cut edges and bottom surfaces of the test pieces were sealed.

Corrosion weight losses of coated steel sheets in acidic and alkaline aqueous solutions

(Thickness: 2.3 mm, coating weight: 80/80 g/m², untreated)



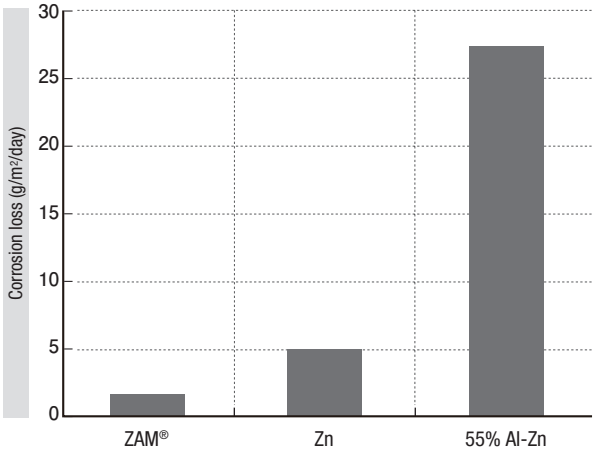
Ammonia resistance

ZAM® shows better resistance to ammonia than hot-dip zinc-coated and hot-dip 55% aluminum-zinc alloy coated steel sheet

Test method

After immersion for 24 hours in 5% ammonia water at 22°C, the corrosion loss of each test pieces were measured. The cut edges and bottom surfaces of the test pieces were sealed.

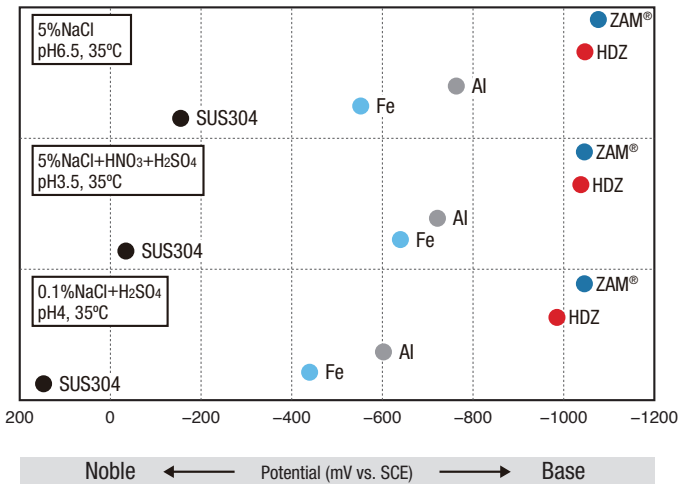
Corrosion weight loss of coated steel sheets in ammonia water



Corrosion potential

ZAM® and post hot-dip galvanized product (HDZ) show nearly the same level of corrosion potential.

Corrosion potential in different solutions (after immersion for an hour)



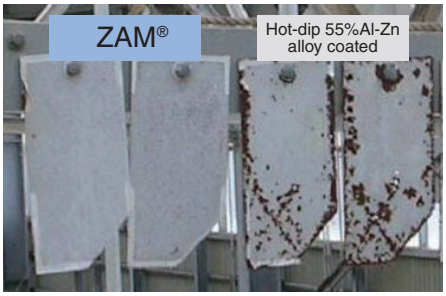
Corrosion potential test solutions

Solution	pH	Temperature (°C)	Remarks
5% NaCl	6.5	35	Solution specified in JIS Z2371 (salt spray test)
5% NaCl + HNO_3 + H_2SO_4 *1	3.5	35	Solution specified in JIS H8502 (cyclic artificial acid rain test)
0.1% NaCl + H_2SO_4 *2	4	35	Solution specified in acid rain simulated combined-cycle corrosion test (see page 14)

Measurement was taken after the specimen was immersed in water solution for an hour and its corrosion potential was found fairly stable.

*1: 5% NaCl (10 L) + HNO_3 (12 mL) + H_2SO_4 (17.3 mL), pH adjusted by NaOH
*2: H_2SO_4 is added to 0.1% NaCl solution to adjust pH to 4.

<Reference> Results of exposure test in a closed compost house (5 years)



Exposure test in a compost house (Shibetsu-City, Hokkaido)

ZAM® showed better corrosion resistance than hot-dip 55%Al-Zn alloy coated sheet.
(No red rust occurred in any of the flat sections bent sections, and cut edges.)

3 Quality characteristics

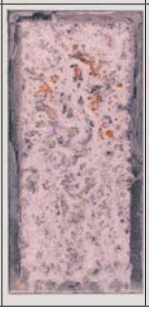
Results of corrosion resistance comparison with post hot-dip zinc-coated steel sheets

Corrosion resistance comparison with post hot-dip zinc-coated steel sheets (HDZ55: JIS H8641)

With only 1/6 of the coating weight of post hot-dip zinc-coated steel sheets, ZAM® exhibits corrosion resistance equal to or better than theirs. The following examination certifications admit that ZAM® may replace post hot-dip galvanized steel. (see page 38).

- Construction technology examination certification (building technology)
  Building Center of Japan
- Construction technology examination certification
  Public Works Research Center

Appearances of flat parts after salt spray test

Lapse of time	500h	1,000h	2,000h	4,000h
ZAM® Thickness: 2.3 mm 90/90 g/m²				
Post hot-dip galvanized product (HDZ55) Thickness: 2.3 mm 560/560 g/m²				

20mm

Appearances of cut edges after salt spray test

Lapse of time	500h	1,000h	2,000h	4,000h
ZAM® Thickness: 2.3 mm 90/90 g/m²				
Post hot-dip galvanized product (HDZ55) Thickness: 2.3 mm 560/560 g/m²				

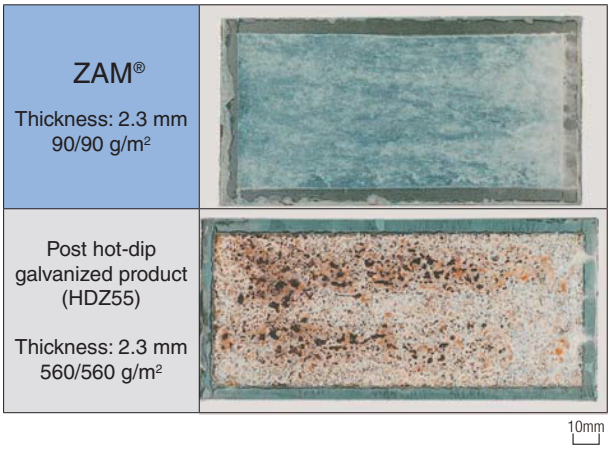
5mm

*Post hot-dip products are first cut to shape and then coated.

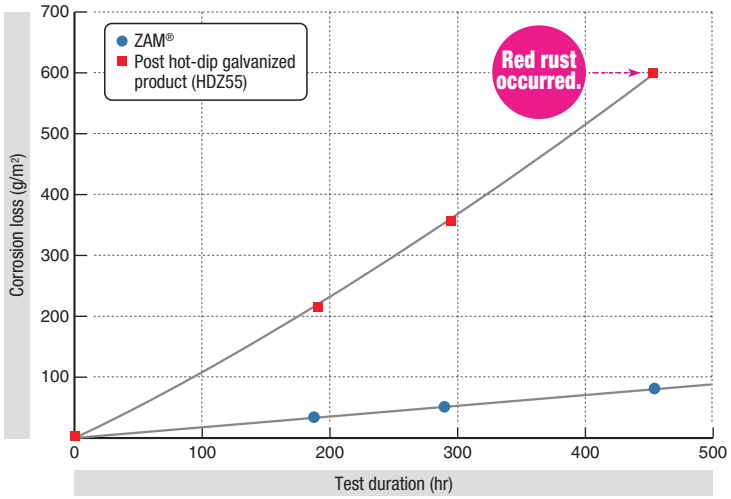
Corrosion resistance comparison in a sulfur dioxide environment

ZAM® shows better corrosion resistance compare to post hot-dip zinc-coated steel sheets (HDZ55) in a sulfur dioxide (sulfurous acid gas) environment.

Appearances after 450 hours of sulfur dioxide test



Corrosion loss of ZAM® and post hot-dip galvanized product in sulfur dioxide test



Test conditions

Sulfur dioxide concentration: 100 ppm
Testing temperature: 40ºC
Relative humidity: 98% or more

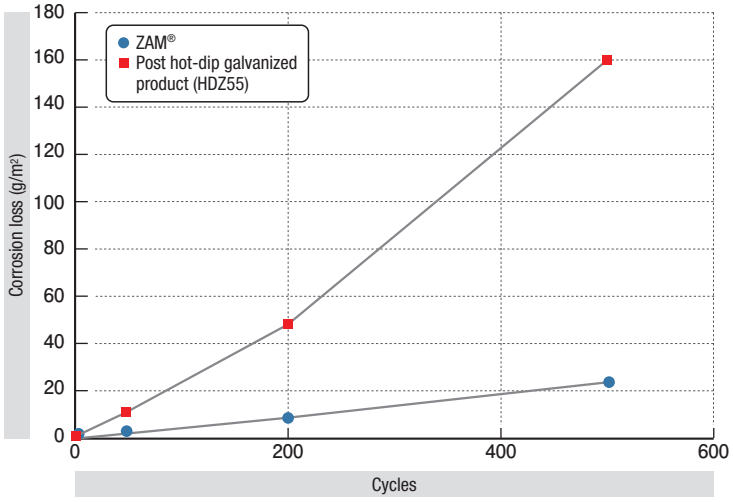
Corrosion resistance comparison in acid rain simulated combined-cycle corrosion test

ZAM® shows better corrosion resistance compare to post hot-dip zinc-coated steel sheets (HDZ55) in an acid rain environment.

Test conditions

Acid rain simulated solution spraying 1 hr, 35ºC, pH:4
(0.1%NaCl+H2SO4)
↓
Drying 4 hrs, 50ºC, relative humidity: 30%
↓
Moistening 3 hrs, 50ºC, relative humidity: 98%
↓

Corrosion loss of ZAM® and post hot-dip galvanized product in acid rain simulated combined-cycle corrosion test



Corrosion rates of ZAM® and post hot-dip galvanized product in acid rain simulated combined-cycle corrosion test

	Corrosion rate
ZAM® 90/90 g/m², untreated	0.05 g/m²/cycle
Post hot-dip galvanized product 560/560 g/m², untreated	0.32 g/m²/cycle

Note: Mean value during 500 cycles

3 Quality characteristics

Comparison in characteristics with post galvanized (Electrogalvanized) and post-painted (cationic electrodeposition coating) products

Results of combined-cycle corrosion tests of flat parts and cut edges

ZAM® shows better corrosion resistance than post hot-dip galvanized and post-painted products.

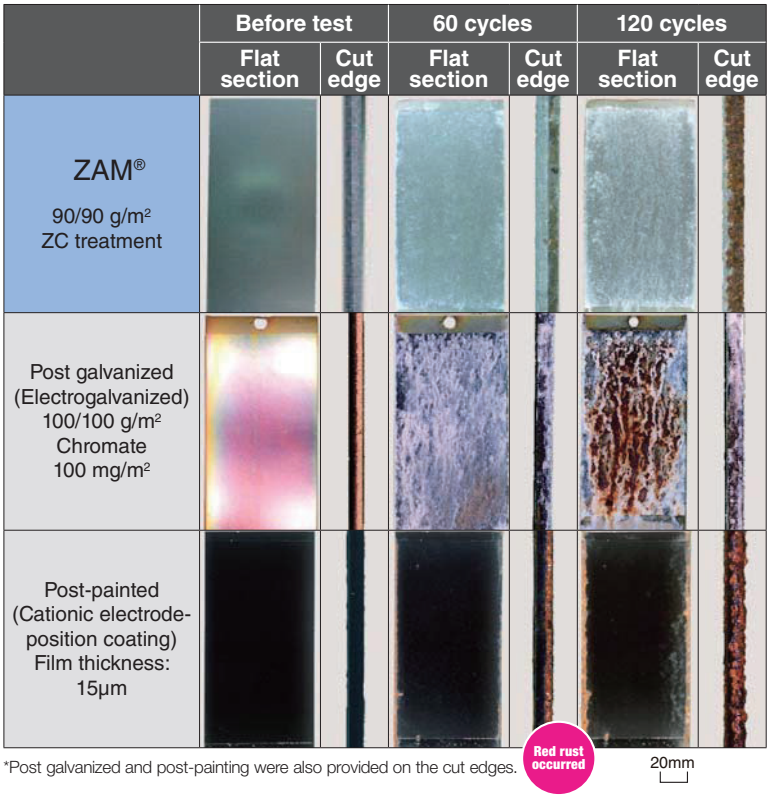
Test conditions

JASO M609-91

Salt spray 2 hrs, 35°C, 5%NaCl
↓
Drying 4 hrs, 60°C, relative humidity: 30%
↓
Moistening 2 hrs, 50°C, relative humidity: 95%

Appearances of flat parts and cut edges after combined-cycle corrosion test

Thickness: 2.3 mm



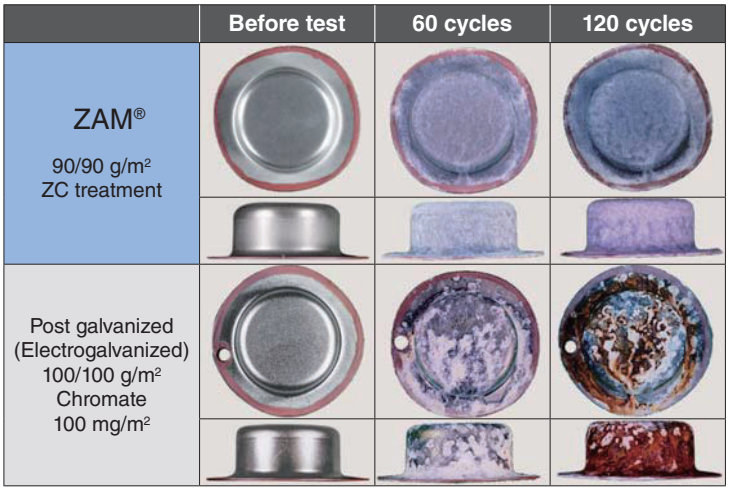
*Post galvanized and post-painting were also provided on the cut edges.

Results of combined-cycle corrosion tests of drawn section

Drawn sections of ZAM® exhibit better corrosion resistance than those of post galvanized steel (galvanized after processing).

Appearances of drawn section after combined-cycle corrosion test

Drawing height: 25 mm, thickness: 0.8 mm



*Post galvanizing was conducted after processing. The cut edges were sealed.

Post-paintability

Results of corrosion tests of painted materials

ZAM® is superior to other coated steel sheets in terms of corrosion resistance after painting.

Test conditions

①SST: JIS Z2371 (neutral salt spray test)
35°C, continuous spraying with 5% NaCl
②CCT: JASO M609-91
(combined-cycle corrosion test)
SST (2 hrs) → Drying (4 hrs) → BBT (2 hrs)

Material tested: Untreated material of each coated steel sheet
Pre-treatment: Zinc phosphate treatment (PALBOND 138)
Paint: Acrylic resin Super Lac F-50
Film thickness: 30 μm

Appearances of coated materials after corrosion test (cross cut sections)

・Precautions
(1) As with Hot-dip Zn-5%Al alloy coated, it is recommended to control the concentrations of treatment solutions because aluminum contained in the coating layer dissolves into pre-treatment (zinc phosphate treatment) solutions and lessens their effects.
(2) The above painting data is an example. It is recommended that each customer test and check the paintability beforehand.
(3) When chemically-treated substrate is used, application of adequate primer is recommended.

3 Quality characteristics

Weldability

As with other zinc-based coated steel sheets, weldability of ZAM® is affected by its coating layer which is a metal with a low melting point. In arc welding, ZAM® is more susceptible to spatters, blow holes, crack-induced decline in joint strength and other defects than hot-rolled and cold-rolled steel sheets. However, ZAM® can be welded into joints with adequate strength under proper conditions. Even in spot welding, adequate strength can be obtained under proper conditions. Since factors including types of welding machines and shapes of joints influence the quality of welds, tests should be carried out beforehand to establish optimal welding parameters and procedures. If you have any questions, please feel free to contact us.

*In arc welding, high tensile stress may be caused around the weld beads depending on shapes and compositions of materials and procedures. When zinc coated steel sheets including ZAM® are welded, coating layer melted by the heat of welding may penetrate the grain boundary and cause cracks in the zones affected by such high tensile stress.

Arc welding

1. Welding machine
ZAM® can be welded with a off-the-shelf welding machine. Welding environment can be improved with the use of inverter-controlled welding machines developed by equipment manufacturers to reduce spatters.

2. Welding wire
Welding wires for carbon steel and structural steel can be used. However, to reduce spatters, blow holes, pits, and other defects, it is advisable to use welding wires developed specially for galvanized steel. Recommended wires are shown on the right.

3. Shielding gas
The third-class carbon dioxide stipulated in JIS K 1106 is used. (The combination of pulse current and Ar+20% CO_2 gas will tend to decrease spatters to a greater extent.)

4. Welding current and voltage
When welding ZAM® at the same speed as in the case of hot- or cold-rolled steel sheets, the initial welding temperature should be set slightly higher as more heat is absorbed by the evaporation of coating material (current to be raised by 5%-10%).

5. Welding speed
When such defects as blowholes or pits are found, the welding speed should be set lower than in the case of hot- or cold-rolled steel sheets. Good beads can be made if weld speed is slow enough to release zinc vapor from the surface of the molten metal pool.

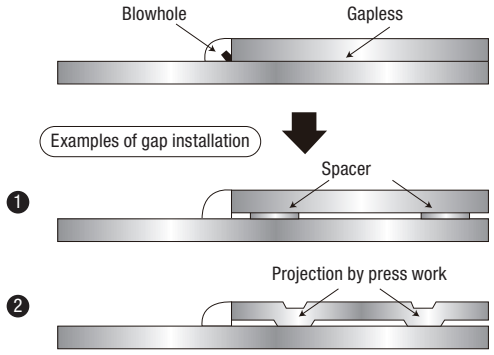
6. Installation of gaps
Lap fillet welding tends to cause such defects as blowholes or pits frequently. The most effective countermeasure is to set up gaps between steel sheets. A gap of 0.6 mm or wider helps substantially reduce these defects.

Recommended welding wires for class 400N substrates

	Recommended welding wire brand (shielding gas: Carbon dioxide)
General-purpose wire	Kobe Steel: MG50T, Nippon Steel Welding & Engineering Co., Ltd.: YM28, Daido Steel: DS1A, etc. (equivalent to YGW12)
Wire for coated steel sheets	Kobe Steel: MG1Z (G49A0C12), Nippon Steel Welding & Engineering Co., Ltd.: YM28Z (G49A0C0),
Flux-cored wire	Kobe Steel: DW-Z100 (T49J0TI-ICA-U), Neis: GC 2Z-2, etc., Nippon Steel Welding & Engineering Co., Ltd.: SM-1 (T49J0T15-0CA-G-UH5), SM-1F (T49J0TI-0CA-UH5),

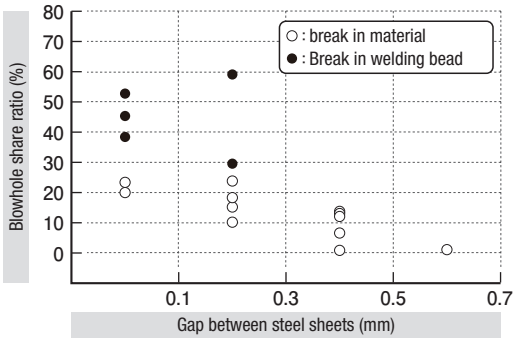
● Please consult us when welding wires for steel sheets other than class 400N are used.

Examples of gaps for blowhole countermeasures (lap-fillet welded joint)



Decrease of welding defects with gaps

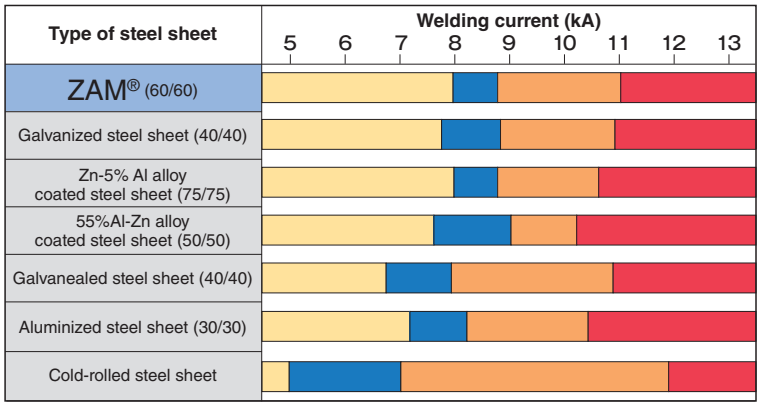
(ZAM® Thickness: 2.3 mm, symbol; 90, lap-fillet welded joint)



Spot welding

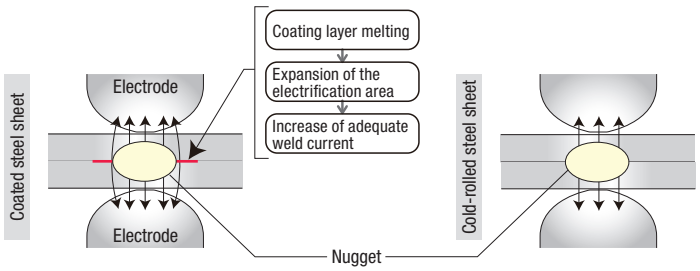
When a coated steel sheet is spot-welded, the energizing path expands due to melting of the coating layer, resulting in a decrease in electric current density. It is therefore necessary to use a greater welding current than in the case of cold-rolled steel sheets.
The zinc contained in the coating layer reacts with the copper alloy used for the electrodes, which causes the electrodes to wear rapidly, shortening their life. For this reason, grasp the life of the electrodes in advance and periodically dress or replace them.

Examples of spot welding conditions for various types of coated steel sheets



Test conditions Electrode pressure : 200 kgf Weld time : 12 cycles Thickness: 0.8 mm
Electrode tip shape: CF type, 6 mm in diameter

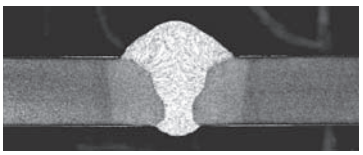
Spot welding of coated steel sheet (schematic)



Quality of welds

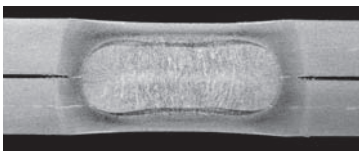
To obtain defect-free joints with sufficient weld strength and a desirable internal sectional structure, it is essential to conduct welding under appropriate conditions.

Condition of an arc weld zone



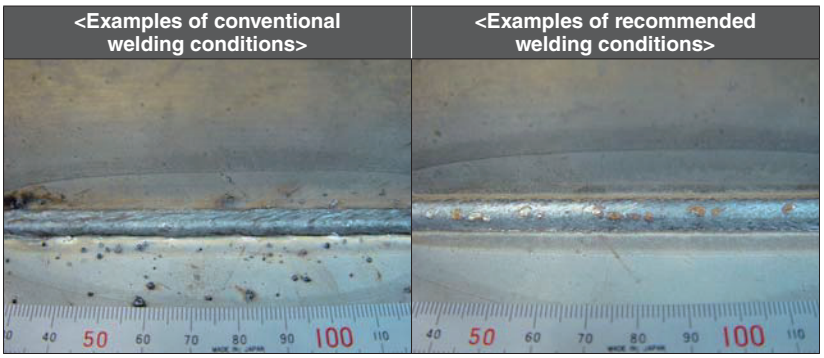
Sectional structure
3.2 mm, coating weight: 145/145 g/m²

Condition of a spot weld zone



Sectional structure
1.6 mm, coating weight: 70/70 g/m²

Photos of bead appearances



Conventional welding conditions
Inverter type CO_2 arc welding machine
Wire: YGW12
Shielding gas: Carbon dioxide gas

Recommended welding conditions
Pulse MAG welding machine
Wire: YGW12
Shielding gas: Ar + 20%CO_2

Sputter and other problems can be prevented by conducing under appropriate conditions.

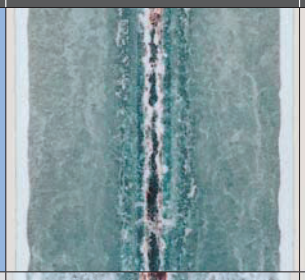
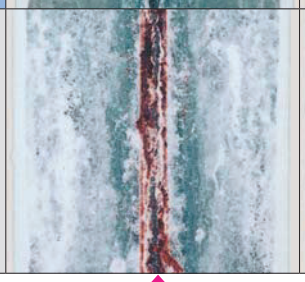
3 Quality characteristics

Corrosion resistance of weld zones

Corrosion resistance of weld zones (as welded)

Generally, the heat affected area on coated steel by arc welding or spot welding reduces corrosion resistance because the coating layer is melted or vaporized. The welded portion on ZAM®, however, is less likely to suffer from red rust than other types of coated steels.

Appearances of arc weld zones after salt spray test

Lapse of time	2,000h	4,000h
ZAM® Thickness: 2.3 mm 90/90 g/m²		
Zn-5% Al alloy coated steel Thickness: 2.3 mm 90/90 g/m²		

20mm

Appearances of spot weld zones after salt spray test

Lapse of time	Before test	2,000h	4,000h
ZAM® Thickness: 2.3 mm 90/90 g/m²			
Zn-5% Al alloy coated steel Thickness: 2.3 mm 90/90 g/m²			

10mm

Touch-up painting (solvent)

A Zn-Al based paint is recommended for touch-up of weld zones and cut eages.

Examples of touch-up paints

Paint name	Manufacturer	Type of paint	Color
Roval Silver	Roval Corporation	Zn-Al based	Silver
Zinky special	Nippon Paint Anti-corrosive Coatings Co., Ltd.	Zn-Al based	Silver
O-well Mekki Silver (ZAM® color)	Nihon Ruspert Co., Ltd.	Zn-Al based	Silver

・Notes
1. Details of touch-up paints including their proper use, quality characteristics, and compatibility with environmental regulations should be checked with respective makers.
2. In some cases, painting is not possible over touch-up paints. Be sure to check beforehand.

Corrosion resistance of weld zones after touch-up

Satisfactory corrosion resistance can be obtained by touching up the weld zones in an appropriate manner.

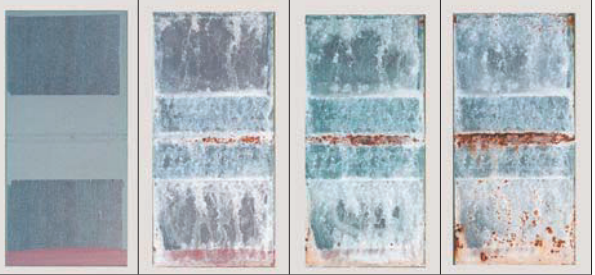
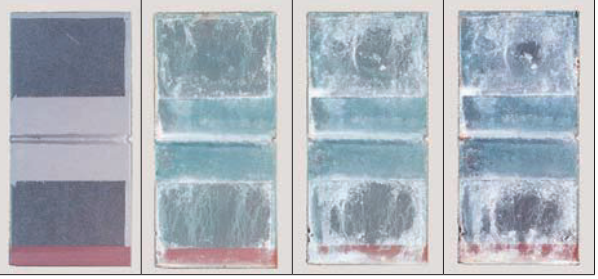
Test conditions

JASO M609-91

Salt spraying 2 hrs, 35ºC, 5%NaCl
↓
Drying 4 hrs, 60ºC, relative humidity: 30%
↓
Moistening 2 hrs, 50ºC, relative humidity: 95%

Appearances of touch-up painted areas after combined-cycle corrosion test

Thickness: 2.3 mm, coating weight: 85/85 g/m²

Paint	Cycles			
	0	100	150	200
Zn based				
Zn-Al based				

20mm

Sample of welding method

・Welding method: CO_2 arc welding
・Joint shape: Butt welding

Painting method

・Pre-treatment: Wire brush
・Degreasing: Organic solvent
・Painting: Brushed on
・Drying: 60ºC, 10 min
・Film thickness: Approx. 40 μm

Corrosion resistance of cut edges after touch-up

Additional corrosion resistance can be obtained by touching up the cut edges.

Appearances of touched-up cut edges after combined-cycle corrosion test

Thickness: 2.3 mm, coating weight: 85/85 g/m²

Paint	Cycles	
	100	200
Zn-Al based		

3 Quality characteristics

Touch-up painting

Other touch-up items

Various methods of touch-up are available in addition to those with general solvent-based touch-up paints. (Before using any of the methods described in this section, necessary prior confirmation should be made by the user.)

① Touch-up painting can be easily conducted without drying.

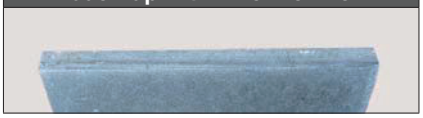
Item	Crayon containing Zn powder
Name	Zinc Rich Pen
Advantages	・Can be applied only to necessary areas. ・No drying is required.
Distributor	Sanyu Chemical Industry Co., Ltd.

Zinc Rich Pen

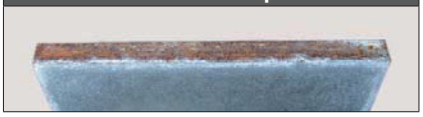
Appearance after one year of exposure test

ZAM® 150/150 g/m², 6.0mm thick, Ichikawa-city, Chiba

Touch-up with Zinc Rich Pen



No touch-up



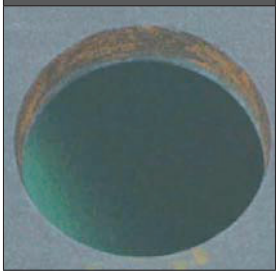
② Even materials with many end faces can be easily touched up at one time.

Item	Phosphate solution for cut edge treatment
Name	ET Coat
Usage	Immersion (Brushing is also possible.)
Advantages	・Materials with many end faces can be touched up at one time by immersing them in this solution.
Distributor	Sanyu Chemical Industry Co., Ltd.

Appearance after one month of exposure test

ZAM® 70/70 g/m², 6.0 mm thick, Sakai-city, Osaka

Untreated



With ET Coat

③ Can be touched up in a color approximate to that of ZAM®

Item	ZAM® - approximate color paint
Name	#6900 Silver
Usage	Spray
Advantages	・The color close to ZAM® makes the touched-up area unnoticeable.
Distributor	Daiho Paint Co., Ltd.

Comparison in appearance after touch-up

#6900 Silver

← Before touch-up →	← After touch-up →

General touch-up paint

← Before touch-up →	← After touch-up →

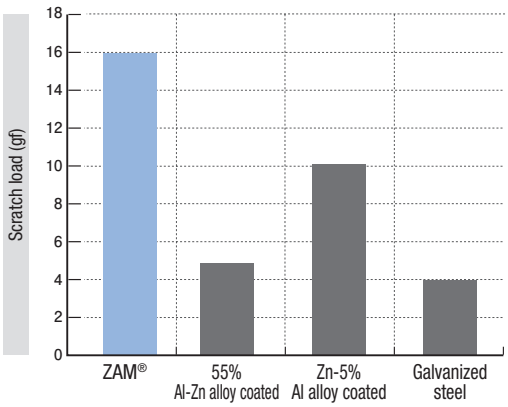
Scratch resistance of the coating layer

ZAM® has a harder coating layer than hot-dip galvanized or aluminum-zinc alloy coated steel sheets. Thus, ZAM offers better scratch resistance and can be used in applications where it is subjected to scratching and repeated friction during processing.

<Reference> Hardness of the coating layer (Vickers hardness (HV) measurement examples)

ZAM®	140 ～ 160
55% Al-Zn alloy coated	100 ～ 110
Zn-5% Al alloy coated	80 ～ 100
Galvanized steel	55 ～ 65

Scratch resistance of various types of coated steel sheets (scratch test)



Scratch load measurement conditions

Testing needle material	Sapphire
Testing needle tip radius	0.05 mm
Load	0.0196 - 0.196 N (2 - 20 gf)
Travel distance	20 mm

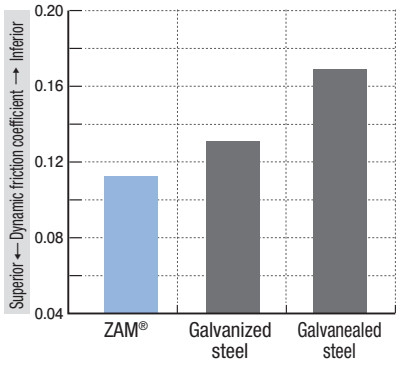
- The surface was visually examined for any scratching.
- The minimum load that produced scratching was taken as the scratching load.

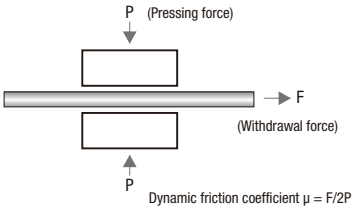
Sliding characteristics/Workability

Sliding characteristics

Having a coating layer with high surface hardness and smoothness, ZAM® exhibits superior sliding characteristics.

Dynamic friction coefficients of various types of coated steel





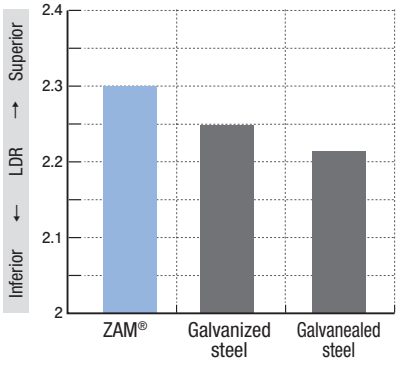
Sliding test conditions

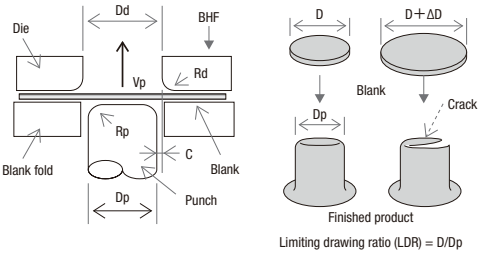
Sample size	0.8 mm (thickness) x 30 mm (width) x 300 mm (length)
Press oil	Z5 (Idemitsu Kosan)
Pressing pressure	0.72、1.45、2.90N/mm²
Pressing force	1、2、4kN
Pressing area	46 × 30mm²
Withdrawal rate	1000mm/min
Mold surface roughness	#1000 (Polishing for each session)
Mold material	SKD11

Workability

ZAM® has better drawing characteristics than other types of coated steel sheets.

Limiting drawing ratios (LDRs) of various types of coated steel sheets





Samples

	Coating mass	Material	Post-treatment
ZAM®	70/70 g/m²	Deep drawing quality	ZC treatment
Galvanized steel	60/60 g/m²	Deep drawing quality	ZC treatment
Galvanealed steel	45/45 g/m²	Deep drawing quality	ZC treatment

Conditions for deep drawing test

Diameter of punch (Dp)	40mm
Diameter of die (Dd)	42mm
Shoulder radius of punch (Rp)	5mm
Shoulder radius of die (Rd)	5mm
Stroke speed (Vp)	60mm/min
Press forming oil	Z5 (Idemitsu Kosan)

4 Chromium-free treatment

Five different types of chromium-free treatments

With the superior corrosion resistance of ZAM® maintained,
five different types of chromium-free treatments are available to suit various applications.
All of these treatments conform to the environmental regulations, including RoHS and ELV.

ZAM PLUS™

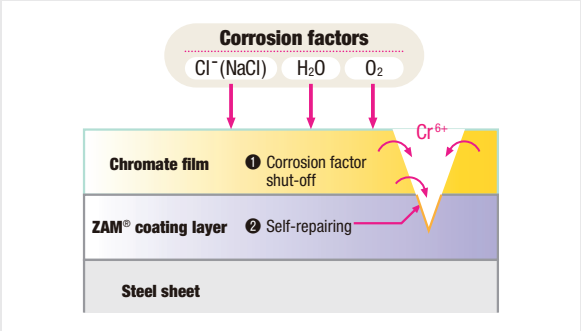
Electrical conductivity	Processability	High processability	Post-paintability	Antidazzle property
Inorganic	Organic	Organic lubrication	Phosphate	Phosphate + organic
Chromium-free inorganic treatment	Chromium-free organic special treatment	Chromium-free organic lubrication treatment	Chromium-free phosphate treatment	Chromium-free low gloss treatment
ZC	**ZG**	**ZJ**	**ZP**	**ZPG**
Electrical conductivity equivalent to that for chromate treatment + Weldability	Damage reduced during processing	High-processability type that allows continuous press	Superior post-paintability	Superior antidazzle property
Page 24	Page 25	Page 26	Page 27	Page 28

Anticorrosion mechanism of films

Mechanism of corrosion control by chromate film

(1) Corrosion control with environmental deprivation
- The chromate film covers the coating layer uniformly to prevent direct contact with corrosion factors.

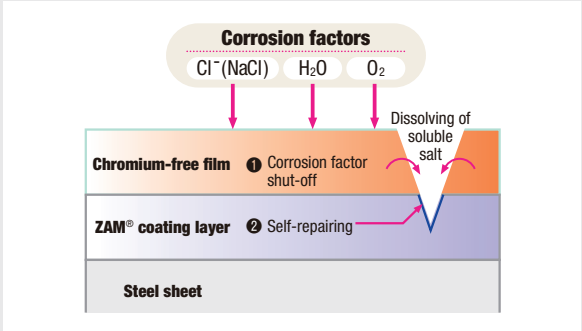
(2) Corrosion control with self-repairing function
- If the chromate film is damaged due to processing for instance, hexavalent chromium dissolves in a moist environment to form an oxide film for self-repairing.



Mechanism of corrosion control by chromium-free film

(1) Corrosion control with environmental deprivation
- The chromium-free film covers the coating layer uniformly to prevent direct contact with corrosion factors.

(2) Corrosion control by self-repairing function
- If the chromium-free film is damaged due to processing for instance, soluble salt dissolves under a moist environment to form insoluble salt at the damaged are for self-repairing.



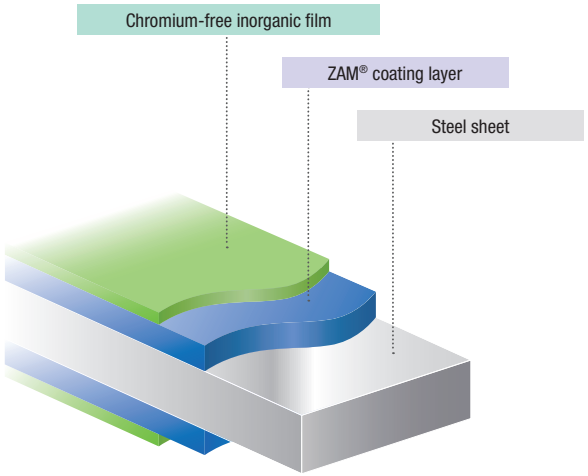
ZC treatment Chromium-free inorganic treatment

Electrical conductivity

① **Excellent electrical conductivity**
The inorganic film has low electrical resistance and excellent surface conductivity (spot weldability).

② **Corrosion resistance**
The resultant film has corrosion resistance equivalent to that obtained in the case of chromate treatment (A treatment).

③ **Superior compatibility with the environment**
The resultant material is friendly to the environment because its film is entirely free of chromium.

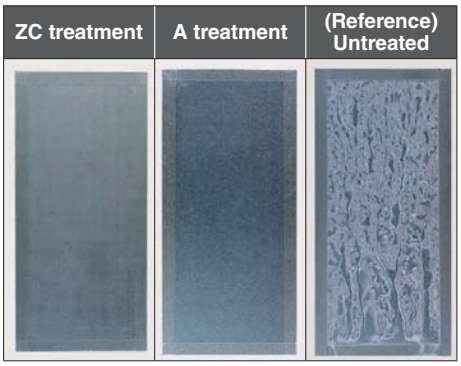


Quality characteristics

Treatment	Elution of chromium	Corrosion resistance (SST72h)	Contact resistance value (grounded)	Fingerprint resistance	Alkali resistance	Solvent resistance	
						Ethanol	Acetone
ZC treatment	No elution	White rust occurrence 10% or less	$10^{-5} \sim 10^{-4}\ \Omega$	$\Delta L \leqq 1.0$	○	○	○
Chromate treatment (A treatment)	Elution	White rust occurrence 10% or less	$10^{-5} \sim 10^{-4}\ \Omega$	$\Delta L \leqq 1.0$	○	○	○

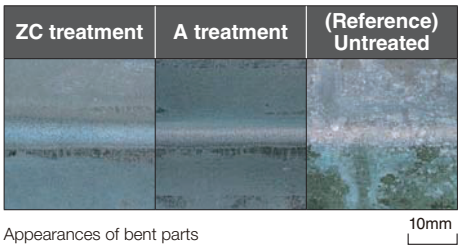
Elution of chromium: Amount of chromium elution measured after the specimen has been immersed for 3 minutes in boiling water
Corrosion resistance: Salt spray test (JIS Z2371)
Contact resistance value: Measured by the four-terminal, four-probe method (Dia Instruments MCP-TPO3P)
Fingerprint resistance: Difference in brightness (ΔL) before and after impression with artificial finger-smudge solution (JIS K2246)
Alkali resistance: Appearance after immersion for 2 minutes in alkali degreasing agent (Nippon Paint SD-270) adjusted to pH of 12 and a temperature of 40°C
Solvent resistance: Appearance after rubbing 5 times with gauze impregnated with the solvent
(Evaluation standard/ ○ : no change, △ : some discoloration, × : film peeling)

Corrosion resistance of flat part



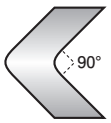
Appearances after 72 hours of salt spray test (SST)
・No significant change in appearance was found in the ZC-treated material even with SST lasting 72 hours.

Corrosion resistance of bent part



Appearances of bent parts
after 24 hours of humidity cabinet test (BBT)
(90° bend, bending radius: 1 mmR)
・No significant change in appearance was found in the ZC-treated material even with BBT lasting 24 hours.

Product shape



Test pieces

・ZC treatment: Coating weight symbol 90, thickness: 0.8 mm
・A treatment: Coating weight symbol 90, thickness: 0.8 mm
・Untreated: Coating weight symbol 90, thickness: 0.8 mm

4 Chromium-free treatment

ZG treatment Chromium-free organic special treatment

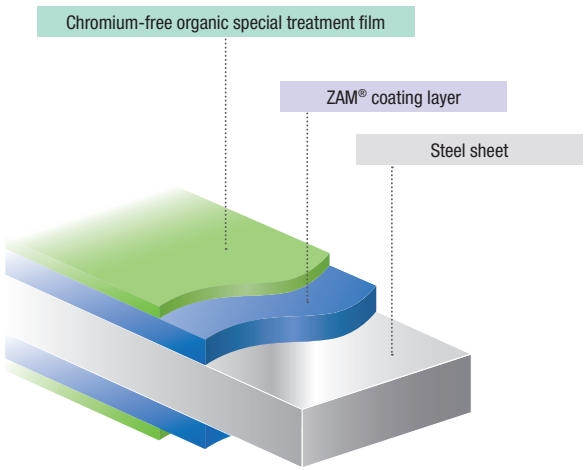
Processability

① **Reducing damage during processing**
It is expected that this processing reduces damage to the coating layer during roll forming or press working.

② **Superior corrosion resistance**
The special film provides better corrosion resistance both on flat and bent parts.

③ **Excellent fingerprint resistance**
Fingerprints left during handling are hardly noticeable.

④ **Superior compatibility with the environment**
The resultant material is friendly to the environment because its film is entirely free of chromium.

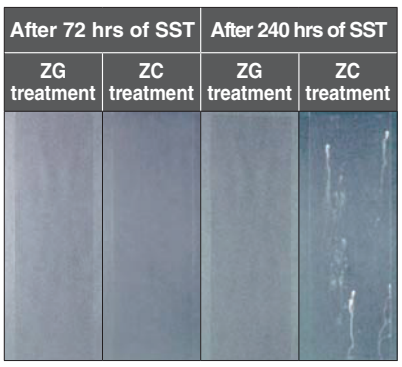


Quality characteristics

Treatment	Elution of chromium	Corrosion resistance	Scratch resistance	Contact resistance (grounded)	Fingerprint resistance	Alkali resistance	Solvent resistance
ZG treatment	No elution	SST240h, white rust occurrence 10% or less	○	∞	ΔL ≦ 0.5	○	○
ZC treatment	No elution	SST72h, white rust occurrence 10% or less	△	10^{-5} ～ 10^{-4} Ω	ΔL ≦ 1.0	○	○

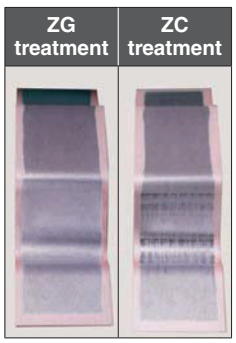
Elution of chromium: Amount of chromium elution measured after the specimen has been immersed for 3 minutes in boiling water
Corrosion resistance: Salt spray test (JIS Z2371)
Scratch resistance: Appearance of the coating layer during processing
Contact resistance value: Measured by the four-terminal, four-probe method (Dia Instruments MCP-TPO3P)
Fingerprint resistance: Difference in brightness (ΔL) before and after impression with artificial finger-smudge solution (JIS K2246)
Alkali resistance: Appearance after immersion for 2 minutes in alkali degreasing agent (Nippon Paint SD-270) adjusted to pH of 12 and a temperature of 40°C
Solvent resistance: Appearance after immersion for 2 minutes in acetone
(Evaluation standard for alkali resistance and solvent resistance/ ○ : No change, △ : Some discoloration, × : Film peeling)

Corrosion resistance of flat section



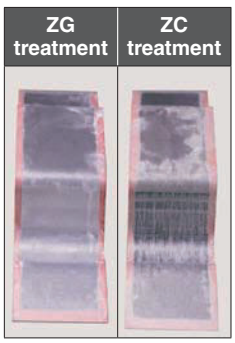
Appearances after salt spray test

Scratch resistance of bent section



Appearances after processing

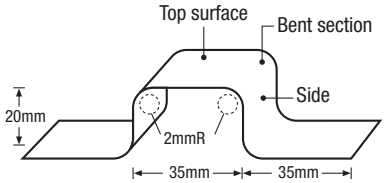
Corrosion resistance of bent section



After 72 hours of salt spray test (SST)

Product shape

・Drawn into a hat-shaped section



Test pieces

・ZG treatment: Coating weight symbol 90, thickness: 0.8 mm
・ZC treatment: Coating weight symbol 90, thickness: 0.8 mm

ZJ treatment Chromium-free organic lubrication treatment

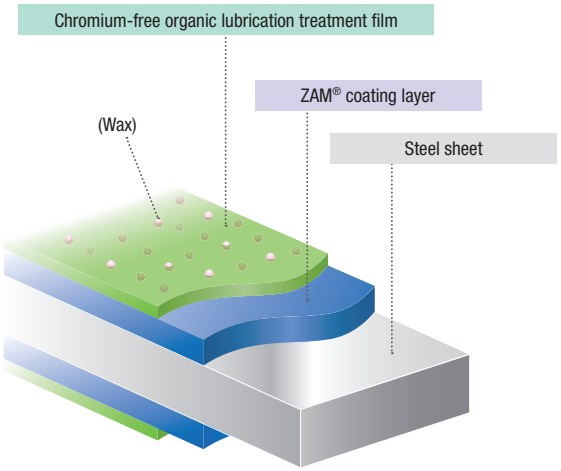
High formability

① **Good formability**
The coefficient of friction is reduced by the addition of special wax so that the product exhibits excellent formability and allows elimination of additional forming lubricants.

② **Superior corrosion resistance**
Flat and bent sections show superior corrosion resistance.

③ **Excellent fingerprint resistance**
Fingerprints left during handling are hardly noticeable.

④ **Superior compatibility with the environment**
The resultant material is friendly to the environment because its film is entirely free of chromium.

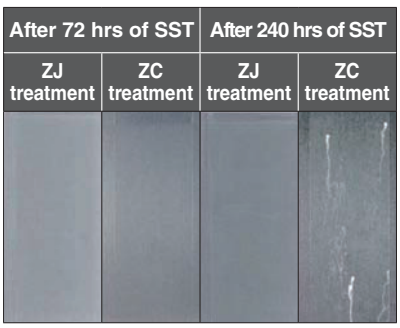


Quality characteristics

Treatment	Type	Elution of chromium	Corrosion resistance	Coefficient of dynamic friction	Contact resistance (grounded)	Fingerprint resistance	Alkali resistance	Solvent resistance
ZJ treatment	Organic	No elution	SST240h, white rust occurrence 10% or less	0.1	∞	ΔL ≦ 0.5	○	○
ZG treatment	Organic	No elution	SST240h, white rust occurrence 10% or less	0.2	∞	ΔL ≦ 0.5	○	○
ZC treatment	Inorganic	No elution	SST72h, white rust occurrence 10% or less	0.3 ～ 0.4	10^{-5}～10^{-4} Ω	ΔL ≦ 1.0	○	○

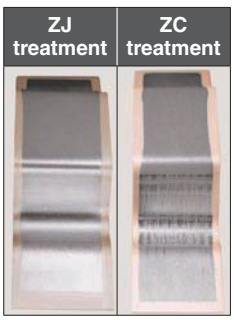
Elution of chromium: Amount of chromium elution measured after the specimen has been immersed for 3 minutes in boiling water
Corrosion resistance: Salt spray test (JIS Z2371)
Coefficient of dynamic friction: Reference sheet: SUS304BA, load: 0.98 N, sliding rate: 150 mm/min
Contact resistance value: Measured by the four-terminal, four-probe method (Dia Instruments MCP-TPO3P)
Alkali resistance: Appearance after immersion for 2 minutes in alkali degreasing agent (Nippon Paint SD-270) adjusted to pH of 12 and a temperature of 40ºC
Fingerprint resistance: Difference in brightness (ΔL) before and after impression with artificial finger-smudge solution (JIS K2246)
Solvent resistance: Appearance after immersion for 2 minutes in acetone
(Evaluation standard for alkali resistance and solvent resistance/ ○ : No change, △ : Some discoloration, × : Film peeling)

Corrosion resistance of flat section



Appearances after salt spray test

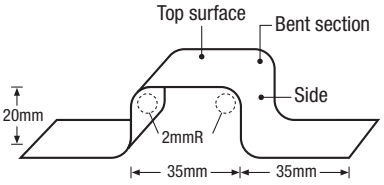
Scratch resistance of bent section



Appearances after processing

Product shape

・Drawn into a hat-shaped section



Test pieces

・ZJ treatment: Coating weight symbol 90, thickness: 0.8 mm
・ZC treatment: Coating weight symbol 90, thickness: 0.8 mm

4 Chromium-free treatment

ZAM PLUS™

ZP treatment Chromium-free phosphate treatment

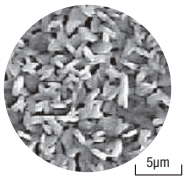
Post-paintability

① **Superior paintability**
This material has superior paint adhesion, making it possible to omit the process of pre-paint surface preparation.

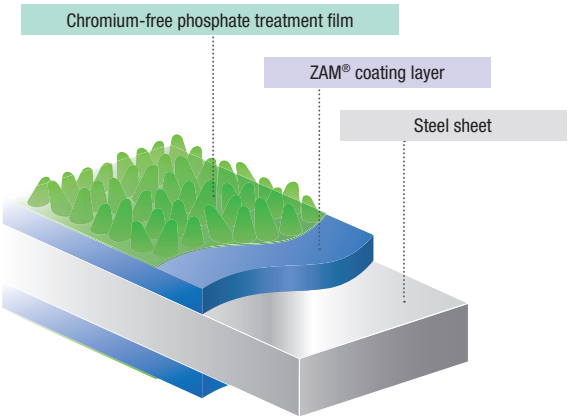
② **Excellent corrosion resistance after painting**
Processed and spot welded parts of the material also exhibit excellent corrosion resistance after painting.

③ **Superior compatibility with the environment**
The resultant material is friendly to the environment because its film is entirely free of chromium.

④ **"Plus" high coating performance**



(Photo of phosphate treatment film)



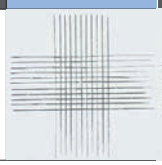
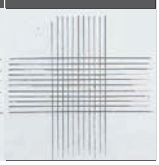
Quality characteristics

Sample		Elution of chromium	Corrosion resistance (before painting) (8 hrs of SST)	Paint adhesion		Corrosion resistance after painting (150 cycles of CCT)
Name	Treatment			Primary adhesion	Secondary adhesion	
ZAM®	ZP treatment	No elution	○	○	○	◎
Galvanealed Steel	Chromate treatment	Elution	○	○	○	○
Electrolytic Zinc-coated steel	Chromate-free Phosphate treatment	No elution	○	○	○	△

The above data is an example of our products.

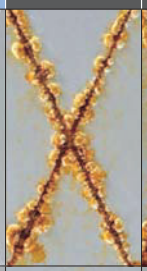
Elution of chromium: Amount of chromium elution measured after the specimen has been immersed for 3 minutes in boiling water
Corrosion resistance: Salt spray test (JIS Z2371) 8 hrs (○ : White rust occurrence 10% or less, × : white rust occurrence more than 10%)
Paint adhesion: Primary adhesion: Lattice pattern (1 mm) cutting and cellophane tape peeling test (○ : no peeling, × : peeling)
Secondary adhesion: After immersion for 2 hours in hot water (90ºC), lattice pattern cutting and cellophane tape peeling test (○ : no peeling, × : peeling)
Corrosion resistance after painting: Combined-cycle test (JIS G0594) 150 cycles (superior ◎ ○ △ inferior)

Paint adhesion for ZP treatment

Sample	ZAM® ZP treatment	Galvanealed steel Chromate treatment	Electrolytic Zinc-coated steel Chromate-free Phosphate treatment
Secondary adhesion			

<Painting conditions>
Acrylic paint (30μm: spraying + baking finish)
<Samples>
・ZAM® ZP treatment steel : Thickness: 0.8 mm, one-side coating weight: 47 g/m²
・Galvanealed steel Chromate treatment : Thickness: 0.8 mm, one-side coating weight: 40 g/m²
・Electrolytic Zinc-coated steel Chromate-free Phosphate treatment : Thickness: 0.8 mm, one-side coating weight: 10 g/m²
<Paintability evaluation>
・Secondary adhesion: After immersion for 2 hours in hot water (90°C), lattice pattern cutting and cellophane tape peeling test
<Corrosion resistance evaluation>
・Combined-cycle test (JIS G0594)
1 hr of SST → 4 hrs of drying (50°C) → 3 hrs of BBT (50°C, 95%RH or higher)

Corrosion resistance after painting (after 150 cycles of CCT)

Sample	ZAM® ZP treatment	Galvanealed steel Chromate treatment	Electrolytic Zinc-coated steel Chromate-free Phosphate treatment
Cross-cut section			
Spot welded section			

ZAM PLUS™

ZPG treatment Chromium-free low-gloss treatment

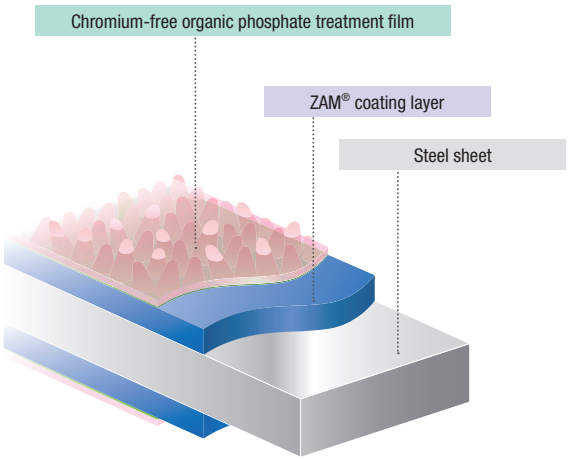
Antidazzle property

① **Excellent antidazzle property**
This material features low metallic luster, reducing reflection of sunlight.

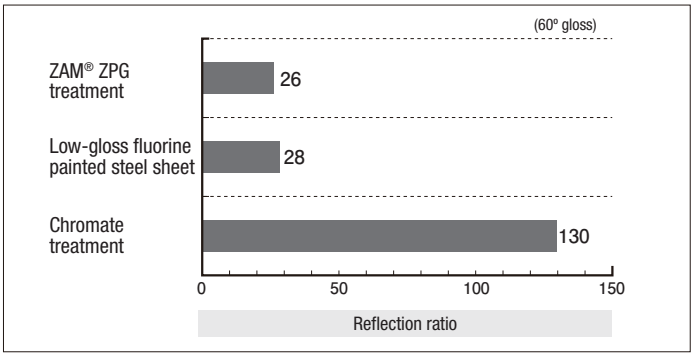
② **Superior corrosion resistance**
Sealed with an organic film, this material has superior corrosion resistance.

③ **Superior compatibility with the environment**
The resultant material is friendly to the environment because its film is entirely free of chromium.

④ **"Plus" high antiglade performance**



60° specular gloss (10 points on average) JIS Z8741



Comparison between chromate and low-gloss treatments

Application example to sound insulation wall

NIPPON STEEL Standard

Types and symbols

See the following tables for the types of sheets and coils available.

Types and symbols (in the case of hot-rolled base sheets)

Type			Application
Product symbol	Base sheet classificatio	Application symbol	
MSM	H	C	General use
MSM	H	D ✻	Drawing
MSM	H	K370	Class 370N for structural use
MSM	H	K390	Class 390N for structural use
MSM	H	K400	Class 400N for structural use
MSM	H	K440 ✻	Class 440N for structural use
MSM	H	K490 ✻	Class 490N for structural use
MSM	H	K540 ✻	Class 540N for structural use
MSM	H	K590 ✻	Class 590N for structural use

Remarks
:Contact us for the products marked with an asterisk (*) and other grades not listed here.
:If no hot-rolled sheet is designated for a thickness between 1.6mm and 3.2mm, there may be cases where cold-rolled sheets satisfying the hot-rolled base sheet specifications are used.

Types and symbols (In the case of cold-rolled base sheets)

Type			Application
Product symbol	Base sheet classificatio	Application symbol	
MSM	C	C	General use
MSM	C	D	Drawing
MSM	C	E	Deep drawing
MSM	C	U ✻	Ultra-deep drawing
MSM	C	K370	Class 370N for structural use
MSM	C	K390	Class 390N for structural use
MSM	C	K400	Class 400N for structural use
MSM	C	K440	Class 440N for structural use
MSM	C	K490 ✻	Class 490N for structural use
MSM	C	K540 ✻	Class 540N for structural use
MSM	C	K570 ✻	Class 570N for structural use
MSM	C	K590 ✻	Class 590N for structural use

Surface finish

The standard surface finish is skin-passed (symbol: D).

Coating mass

Products can be manufactured with the coating weights listed in the following table.

Minimum coating mass (total mass on both sides)

Symbol (NIPPON STEEL Standard 1)	Minimum average coating mass at triple-spot test (g/m²)	Minimum coating mass at a single spot (g/m²)	Symbol (NIPPON STEEL Standard 2)	Minimum average coating mass at triple-spot test (g/m²)	Minimum coating mass at a single spot (g/m²)
K 06✻	60	51	45	70	60
K 08	80	68	60	90	77
K 10	100	85	—	—	—
K 12	120	102	—	—	—
K 14	140	119	90	140	119
K 18	180	153	120	190	162
K 20	200	170	—	—	—
K 22	220	187	150	230	196
K 25	250	213	—	—	—
K 27	275	234	190	290	247
K 35✻	350	298	—	—	—
K 45✻	450	383	300✻	500	425

Notes 1: Coating weight can be specified by NIPPON STEEL Standard 1 or 2.
2: The coating weight symbol in NIPPON STEEL Standard 2 represents the coating weight on one side (g/m²).
3: For items marked ✻, contact us for information.

Chemical treatments and oiling

Chemical conversion treatments and oiling are performed according to the following tables.

Chemical conversion treatment types and symbols

Chemical conversion treatment	Symbol
Chromium-free inorganic treatment	ZC
Chromium-free organic special treatment	ZG
Chromium-free organic lubrication treatment	ZJ
Chromium-free phosphate treatment	ZP
Chromium-free low-gross treatment	ZPG
High corrosion-resistance chromate	A
Untreated	M

Remarks: For items not listed above, contact us.

Oiling types and symbols

Type of oiling	Symbol
Oiling	O
No oiling	No symbol

Mechanical properties

(1) Bendability

When the bendability of flat sheets and coils is tested according to the following table, coating peel-off, cracking of the base sheet (to the extent it can be confirmed with the naked eye), or ruptures should not occur on the surface (measured at min. 7 mm from each longitudinal edge of the test piece).

Bendability

Symbol of the type (Cold- or hot-rolled base sheet)	Bending angle of 180°								
	Nominal thickness Under 1.6 mm			Nominal thickness 1.6 mm or more, less than 3.0 mm			Nominal thickness 3.0 mm and over		
	Coating weight symbol (Upper: NIPPON STEEL Standard 1, lower: NIPPON STEEL Standard 2)			Coating weight symbol (Upper: NIPPON STEEL Standard 1, lower: NIPPON STEEL Standard 2)			Coating weight symbol (Upper: NIPPON STEEL Standard 1, lower: NIPPON STEEL Standard 2)		
	K27 or lower 190 or lower	K35	K45 300	K27 or lower 190 or lower	K35	K45 300	K27 or lower 190 or less	K35	K45 300
General use	1	1	2	1	2	2	2	2	2
Drawing	1	—	—	1	—	—	—	—	—
Deep drawing / Ultra-deep drawing	0	—	—	0	—	—	—	—	—
Class 370N for structural use	1	1	2	1	1	2	2	2	3
Class 390 / 400N for structural use	2	2	2	2	2	2	3	3	3
Class 440 / 490 / 500 / 540N for structural use	3	3	3	3	3	3	3	3	3
Class 590N for structural use	—	—	—	—	—	—	—	—	—

Remarks 1: In the case of hot-rolled sheets, nominal thicknesses of 1.6 mm and over apply.
2: The figures in the table are the numbers of sheets of the nominal thickness at the inside spacing of the bend.
3: The deep drawing and ultra-deep drawing columns apply only to cold-rolled sheets.

(2) Tensile tests

The following table shows the yield point, tensile strength, and elongation of flat sheets and coils.

Yield point, tensile strength, and elongation

Application	Yield point (N/mm^2)	Tensile strength (N/mm^2)	Elongation	
			Nominal thickness (mm)	(%)
Drawing application	—	Min. 270	0.4 incl. to under 0.6	Min. 34
			0.6 incl. to under 1.0	Min. 36
			1.0 incl. to under 1.6	Min. 37
			1.6 incl. to 2.3 incl.	Min. 38
Deep drawing application	—	Min. 270	0.4 incl. to under 0.6	Min. 36
			0.6 incl. to under 1.0	Min. 38
			1.0 incl. to under 1.6	Min. 39
			1.6 incl. to 2.3 incl.	Min. 40
Ultra-deep drawing application	—	Min. 270	0.6 incl. to under 1.0	Min. 40
			1.0 incl. to under 1.6	Min. 41
			1.6 incl. to 2.3 incl.	Min. 42
Class 370N for structural use	Min. 265	Min. 370	Applies to 0.4 mm and over Reference value for under 0.4 mm	Min. 18
Class 390N for structural use	Min. 285	Min. 390		Min. 18
Class 400N for structural use	Min. 295	Min. 400		Min. 18
Class 440N for structural use	Min. 335	Min. 440		Min. 18
Class 490N for structural use	Min. 365	Min. 490		Min. 16
Class 540N for structural use	Min. 400	Min. 540		Min. 16
Class 570N for structural use	Min. 560	Min. 570		—
Class 590N for structural use	Min. 560	Min. 590		—

Remarks: Deep drawing and ultra-deep drawing columns apply only to cold-rolled sheets.

5 Standards

Size tolerances

(1) Thickness tolerances
In the case where base sheet thicknesses are indicated, the following coating weights should be added to such respective thicknesses to identify the applicable size tolerances. (before coating thickness)
In the case where coated sheet thicknesses are indicated, size tolerances for such thicknesses apply. (after coating thickness)
The thickness tolerance is according to the following table. The thickness is measured at any point no less than 25 mm from the edge.

Thickness tolerances
Cold-rolled base steel

(Unit: mm)

Nominal thickness \ Width	Under 630	630 to under 1,000	1,000 to under 1,250	1,250 to 1,325 incl.
0.25 incl. to under 0.40	± 0.05	± 0.05	± 0.05	± 0.06
0.40 incl. to under 0.60	± 0.06	± 0.06	± 0.06	± 0.07
0.60 incl. to under 0.80	± 0.07	± 0.07	± 0.07	± 0.07
0.80 incl. to under 1.00	± 0.07	± 0.07	± 0.08	± 0.09
1.00 incl. to under 1.25	± 0.08	± 0.08	± 0.09	± 0.10
1.25 incl. to under 1.60	± 0.09	± 0.10	± 0.11	± 0.12
1.60 incl. to under 2.00	± 0.11	± 0.12	± 0.13	± 0.14
2.00 incl. to 2.30 incl.	± 0.13	± 0.14	± 0.15	± 0.16

Thickness is measured at any point no less than 25 mm from the edge.

Hot-rolled base steel

(Unit: mm)

Nominal thickness \ Width	600 to under 1,200	1,200 to under 1,325
1.60 incl. to under 2.30	± 0.17	± 0.18
2.30 incl. to under 2.50	± 0.18	± 0.20
2.50 incl. to under 3.20	± 0.20	± 0.22
3.20 incl. to under 4.00	± 0.22	± 0.24
4.00 incl. to under 5.00	± 0.25	± 0.27
5.00 incl. to under 6.00	± 0.27	± 0.29
6.00	± 0.30	± 0.31

Thickness is measured at any point no less than 25 mm from the edge.

Corresponding coating thickness

Coating mass symbol NIPPON STEEL Standard 1	K06	K08	K10	K12	K14	K18	K20	K22	K25	K27	K35	K45
Equivalent coating thickness (mm, total of both sides)	0.015	0.020	0.025	0.031	0.034	0.041	0.048	0.051	0.059	0.064	0.076	0.094

Coating mass symbol NIPPON STEEL Standard 2	45	60	—	—	90	120	—	150	—	190	—	300
Equivalent coating thickness (mm, total of both sides)	0.015	0.020	—	—	0.030	0.040	—	0.050	—	0.063	—	0.100

● The coating density of ZAM® for calculating thickness of coating layer : 6.0g/cm³

(2) Width and length tolerances
The width and length tolerances are shown in the following tables.

Width tolerances

Product shape	Width tolerance
Wide coils and flat sheets	+ 25mm, -0
	+ 10mm, -0
	+ 7mm, -0
	+ 3mm, -0
Slit coils	± 0.5mm
	± 0.3mm

Length tolerance (flat sheets)

Length tolerance (mm)
+ X , -0

Remarks: X may be set anywhere in the range of 2 to 15.

Standard labeling method

MSM - □ △△△△ - △ △△ ＊＊＊
① ② ③ ④ ⑤ ⑥

① ZAM® product symbol
② Base sheet classification (H: hot-rolled, C: Cold-rolled)
③ Application symbol
④ Surface finish
⑤ Chemical conversion treatment and oiling
⑥ Coating mass symbol

Label examples

Example 1

MSM - CC - DZC 90

Type: Cold-rolled base sheet for general use
Post-treatment: Chromium-free inorganic treatment
Coating mass: 140 g/m² (minimum value on both sides)

Example 2

MSM - HK400 - DZG K27

Type: Class 400N hot-rolled sheet for structural use
Post-treatment: Chromium-free organic special treatment
Coating mass: 275 g/m² (minimum value on both sides)

Chemical composition

Hot-rolled sheet

(Unit: wt%)

Application symbol	C	Si	Mn	P	S
C	Max. 0.15	—	Max. 0.80	Max. 0.05	Max. 0.05
K400	Max. 0.25	—	Max. 1.70	Max. 0.20	Max. 0.05
K440	Max. 0.25	—	Max. 2.00	Max. 0.20	Max. 0.05
K490	Max. 0.30	—	Max. 2.00	Max. 0.20	Max. 0.05
K540	Max. 0.30	—	Max. 2.50	Max. 0.20	Max. 0.05

Cold-rolled sheet

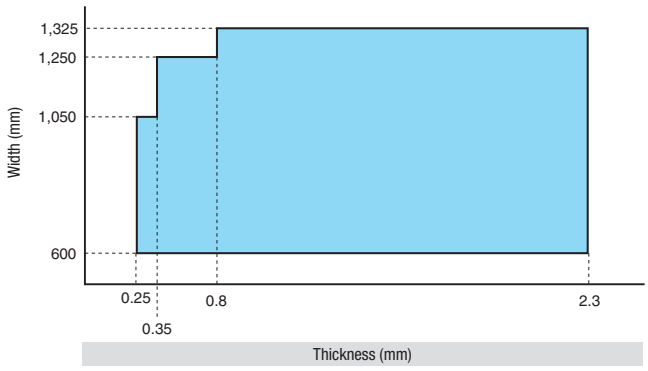
(Unit: wt%)

Application symbol	C	Si	Mn	P	S
C	Max. 0.15	—	Max. 0.80	Max. 0.05	Max. 0.05
D	Max. 0.12	—	Max. 0.60	Max. 0.04	Max. 0.04
E	Max. 0.10	—	Max. 0.45	Max. 0.03	Max. 0.03
U	Max. 0.08	—	Max. 0.45	Max. 0.03	Max. 0.03
K400	Max. 0.25	—	Max. 1.70	Max. 0.20	Max. 0.05
K440	Max. 0.25	—	Max. 2.00	Max. 0.20	Max. 0.05
K490	Max. 0.30	—	Max. 2.00	Max. 0.20	Max. 0.05
K570	Max. 0.30	—	Max. 2.50	Max. 0.20	Max. 0.05

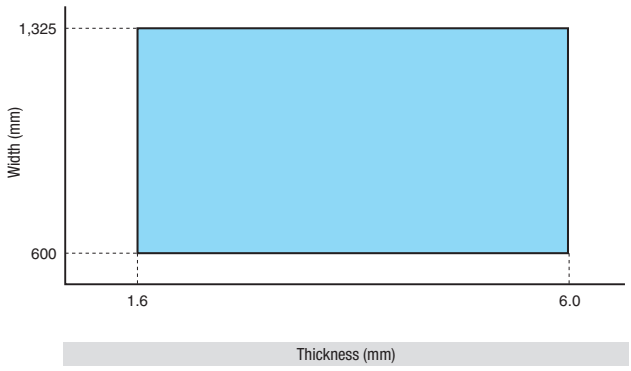
Available sizes

· The production range varies depending on the specifications. For details contact us.
· For sizes other than those shown in the figure below, consult us.

Cold-rolled sheet



Hot-rolled sheet



ASTM A1046/A1046M - 09 (Excerpts From ASTM Standard)

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

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.

1. Weight (Mass) of Coating

Weight [Mass] of Coating Requirement [A]

Inch-Pound Units		
Coating Designation	Minimum Requirement	
	Triple-Spot Test Total Both Sides, oz/ft²	Single-Spot Test Total Both Sides, oz/ft²
ZM20	0.20	0.16
ZM30	0.30	0.25
ZM40	0.40	0.30
ZM60	0.60	0.50
ZM75	0.75	0.65
ZM90	0.90	0.80
ZM115	1.15	1.00
ZM140	1.40	1.20
ZM165	1.65	1.40
ZM210	2.10	1.80

SI Units		
Coating Designation	Minimum Requirement	
	Triple-Spot Test Total Both Sides, g/m²	Single-Spot Test Total Both Sides, g/m²
ZMM60	60	50
ZMM90	90	75
ZMM120	120	90
ZMM180	180	150
ZMM220	220	190
ZMM275	275	235
ZMM350	350	300
ZMM450	450	385
ZMM500	500	425
ZMM600	600	510

[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 coutinuous 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.

2. Chemical Composition

Chemical 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 fumished 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% maz.
[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 fumished as a stabilized steel.

Chemical Requirements [A]

Composition, %-Heat Analysis Element. max (unless otherwise shown)												
Designation	C	Mn	P	S	Cu	Ni	Cr	Mo	V[B]	Cb[B]	Ti[B C D]	N
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] Class1. 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] Class3	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	0.01min	0.005min	0.01min	—
50[340]	0.20	1.50	—	0.035	0.20	0.20	0.15	0.16	0.01min	0.005min	0.01min	—
60[410]	0.20	1.50	—	0.035	0.20	0.20	0.15	0.16	0.01min	0.005min	0.01min	—
70[480]	0.20	1.65	—	0.035	0.20	0.20	0.15	0.16	0.01min	0.005min	0.01min	—
80[550]	0.20	1.65	—	0.035	0.20	0.20	0.15	0.16	0.01min	0.005min	0.01min	—
HSLAS-F[F]												
40[275]	0.15	1.50	—	0.035	—	0.20	0.15	0.16	0.01min	0.005min	0.01min	—
50[340]	0.15	1.50	—	0.035	0.20	0.20	0.15	0.16	0.01min	0.005min	0.01min	—
60[410]	0.15	1.50	—	0.035	0.20	0.20	0.15	0.16	0.01min	0.005min	0.01min	—
70[480]	0.15	1.65	—	0.035	0.20	0.20	0.15	0.16	0.01min	0.005min	0.01min	—
80[550]	0.15	1.65	—	0.035	0.20	0.20	0.15	0.16	0.01min	0.005min	0.01min	—

[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.

3. Mechanical Properties

Mechanical Property Requirements, Base Metal (Longitudinal)

Inch-Pound Units				
Designation	Grade	Yield Strength min, ksi	Tensile Strength min, ksi[A]	Elongation in 2 in.. min.%[A]
SS	33	33	45	20
	37	37	52	18
	40	40	55	16
	50 Class1	50	65	12
	50 Class2	50	—	12
	50 Class3	50	70	12
	50 Class4	50	60	12
	80[B]	80[C]	82	—
HSLAS	40	40	50[D]	22
	50	50	60[D]	20
	60	60	70[D]	16
	70	70	80[D]	12
	80	80	90[D]	10
HSLAS-F	40	40	50[D]	24
	50	50	60[D]	22
	60	60	70[D]	18
	70	70	80[D]	14
	80	80	90[D]	12

SI Units				
Designation	Grade	Yield Strength min, MPa	Tensile Strength min, MPa[A]	Elongation in 50 mm, min.%[A]
SS	230	230	310	20
	255	255	360	18
	275	275	380	16
	340 Class1	340	450	12
	340 Class2	340	—	12
	340 Class3	340	480	12
	340 Class4	340	410	12
	550[B]	550[C]	570	—
HSLAS	275	275	340[D]	22
	340	340	410[D]	20
	410	410	480[D]	16
	480	480	550[D]	12
	550	550	620[D]	10
HSLAS-F	275	275	340[D]	24
	340	340	410[D]	22
	410	410	480[D]	18
	480	480	550[D]	14
	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.

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

Designation	(Longitudinal Direction)			$\bar{r}_m$ Value [C]	N Value [D]
	Yield Strength		Elongation in 2 in. [50mm]%		
	ksi	MPa			
CS TypeA	25/55	[170/380]	≧ 20	E	E
CS TypeB	30/55	[205/380]	≧ 20	E	E
CS TypeC	25/60	[170/410]	≧ 15	E	E
FS TypesA 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 information 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] $\bar{r}_m$ 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 changes in mechanical properties over time, that is, nonaging.

4. Bend Test

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			SSGrade [B]			HSLAS [B]			HSLAS-F				
	Through 0.039 in	Over 0.039 Through 0.079 in	Over 0.079 in	33	37	40	40	50	60	40	50	60	70	80
ZM20	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZM30	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZM40	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZM60	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZM70	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZM90	0	0	1	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZM115	0	0	1	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZM140	1	1	2	2	2	2½								
ZM165	2	2	2	2	2	2½								
ZM210	2	2	2	2	2	2½								

SI-Units Ratio of the Bend Diameter to Thickness of the Specimen (Any Direction)														
Coating Designation [A]	CS, FS, DDS, EDDS Sheet Thickness			SSGrade [C]			HSLAS [C]			HSLAS-F				
	Through 1.0mm	Over 1.0 Through 2.0mm	Over 2.0mm	230	255	275	275	340	410	275	340	410	480	550
ZMM60	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZMM90	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZMM120	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZMM180	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZMM210	0	0	0	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZMM275	0	0	1	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZMM350	0	0	1	1½	2	2½	1½	1½	3	1	1	1	1½	1½
ZMM450	1	1	2	2	2	2½								
ZMM500	2	2	2	2	2	2½								
ZMM600	2	2	2	2	2	2½								

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

● The coating density of ZAM® for calculating thickness of coating layer : 6.0g/cm^3

AS 1397 (Excerpts From Australian Standard)

Continuous hot-dip metallic coated steel sheet and strip –Coatings of zinc and zinc alloyed with aluminum and magnesium

1. Chemical Composition

Requirements For Chemical Composition

Steel grade designation AS1397	Chemical composition (cast analysis), % max.			
	Carbon	Manganese	Phosphorus	Sulfur
G450, G500, G550	0.20	1.20	0.040	0.030
G300, G350 (see Note)	0.30	1.60	0.100	0.035
G250, G1	0.12	0.50	0.040	0.035
G2	0.10	0.45	0.030	0.030
G3	0.08	0.40	0.020	0.025

NOTE: For grade G300, nitrogenized steel may be used for sections greater than 1.00 mm thick.

2. Mechanical Properties

Mechanical Property Requirements For Formability Grades

Steel grade designation	Transverse tensile test (see Note 1)		Transverse bend test	Thickness range for lockseam (see Note 2) mm
	Min. elongation, %		Degree of bend	
	on 50mm	on 80mm		
G1	—	—	180°	—
G2 (Note 3)	30	27	180°	≦ 1.60
G3 (Note 3)	35	32	180°	All

NOTES 1: Applies to test picces equal to or greater than 0.60 mm thick. Refer to supplier for typical yield and tensile strengths for design purposes.
2: The ability of grades to lockseam is dependent on recognized profiling practices and machine settings to avoid excessive stretching of the product.
3: For information on fabricating characteristics see Paragraph D2 of Appendix D.

Mechanical Property Requirements For Structural Grades

Steel grade designation	Longitudinal tensile test				Transverse bend test	
	Min. yield strength (Note 1)	Min. tensile strength	Min. elongation, % (Note 2)		Angle of bend	Diameter of mandrel in terms of test piece thickness (t)
	MPa	MPa	L_o=50mm	L_o=80mm	degrees	
G250	250	320	25	22	180	0
G300	300	340	20	18	180	t
G350	350	420	15	14	180	$2t$
G450 (Note 3)	450	480	10	9	90	$4t$
G500 (Note 4)	500	520	8	7	90	$6t$
G550 (Note 5)	550	550	2	2	—	—

NOTES 1: The yield strength is the lower yield stress. If well-defined yielding is not obvious, the 0.2% proof stress should be determined.
2: Applies to test pieces equal to or greater than 0.6 mm in thickness. For material up to 0.6 mm in thickness, the minimum elongation values in the table are not covered by this standard.
L_o =original gauge lenghth.
3: Applies to recovery annealed , i.e. not recrystallized after annealing, material equal to or greater than 1.50 mm thick.
4: Applies to recovery annealed ,i.e. not recrystallized after annealing, material between 1.00 mm and 1.50 mm thick.
5: Applies to recovery annealed, i.e. not recrystallized after annealing, material up to and including 1.00 mm thick; the values of yield strength,0.2% proof stress and tensile strength are, for practical purposes, the same.

3. Coating Mass

Coating Mass Requirements : Type 'ZM' Coatings

Coating class designation	Minimum coating mass, g/m²		
	Total both surfaces		One surface
	Triple spot	Single spot	Single spot
ZM60	60	54	24
ZM90	90	80	35
ZM120	120	110	50
ZM150	150	135	60
ZM180	180	160	70
ZM220	220	200	90
ZM275	275	250	110
ZM350	350	315	140
ZM450	450	405	180

4. Coating Adhesion

Coating Adesion (180° Bend Test) Requirements

Steel grade designation	Diameter of mandrel in terms of thickness of product (t)			
	Coating class			
	ZM90, ZM120, ZM150, ZM180,	ZM220, ZM275	ZM350	ZM450
G250	0	0	0	t
G300	0	t	t	t
G350	0	t	t	t
G450	t	$2t$	$2t$	$2t$
G500	$2t$	$2t$	$2t$	$2t$
G550	$2t$	$2t$	$2t$	$2t$
G1	0	0	0	t
G2	0	0	0	t
G3	0	0	0	t

NOTE : 0 indicates that the coated steel is bent flat on iteself

● The coating density of ZAM® for calculating thickness of coating layer : 6.0g/cm³

6 Examples of processed products

(Examples of processing performed by our company and its subsidiary companies)

ZAM™

Shaped steel

- Light gauge steel sections for general structure (JIS G 3350)
  - Light grooved shaped steel (Channel)
  - Lip shaped steel (Lipped channel)
  - Light mountain shaped steel (Angle)
- Special shaped steel
  - Hat-shaped steel
  - Light Z-shaped steel
  - Pre-notched shaped steel
- Pre-notched shaped steel
  - Shaped steel produced by continuously shaping on the same line steel strips which have been notched by a press beforehand (Steel strips pre-shaped and pre-notched with the press are continuously formed on the same processing line.)

Steel pipe

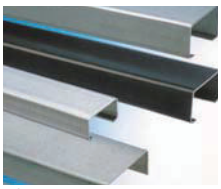
- Carbon steel tubes for general structure (JIS G 3444)
- Carbon steel square and rectangular tubes for general structure (JIS G 3466)

H-shaped steel (H-beams)

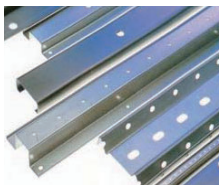
- Lightweight welded H-shaped steel (H-beams) for general structure

Others

- Corrugated sheet
- Punching metal
- Non-slip metal



General structure material lightweight shaped steel
(Light gauge steel sections for general structure)

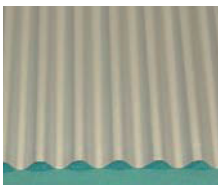


Pre-notched shaped steel

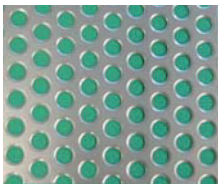
Lightweight H-shaped steel (H-beams)
(Example of steel processed by a customer)

Round pipes

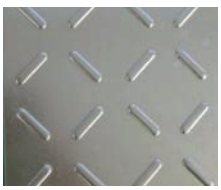
Square pipes



Corrugated sheet



Punching metal



Non-slip metal

Made-to-order:
Nippon Steel Nisshin A&C Co., Ltd.

7 Acquired certifications

List of building work technology/technology examination certifications

Certifications	Explanation	Certification number	Acquisition date
Architecture execution technology and technology examination certification	A "Construction execution technology and technology examination certificate" has been obtained from the Building Center of Japan.	BCJ Examination certificate No.85	October 2, 2005 Renewed July 10, 2015 Minor change April 19, 2019
	As for chromium-free after-treatment, "Construction execution technology and technology examination certificate" has also been obtained from the Building Center of Japan.	BCJ Examination certificate No.138	January 31, 2008 Renewed January 31, 2018 Minor change April 19, 2019
Construction technology examination certification	"Construction technology examination certification" has been obtained from the Civil Engineering Research Center.	Examination certificate No.0122	March 18, 2002 Renewed March 18, 2017 Content change May 13, 2019
Law concerning promotion of housing quality assurance, etc.	Under the provisions of the "Quality Assurance Law," we have obtained certification by the Minster of Land Infrastructure and Transport for special evaluation methods for degradation measure classes (structures, etc.) to be displayed in accordance with the Japan housing performance labeling standards.	Certification No.618	June 7, 2005
Architecture standards law	Certification by the Minister of Land Infrastructure and Transport has been obtained as a product conforming to the provisions of Item 2 of Article 37 of the Building Standards Act.	Toyo Works MSTL-0064 Sakai Works MSTL-0065	December 21, 2001
Nippon Expressway Company Limited New technology and new building methods	The product is registered in a database of new technologies and new construction methods of expressways managed by NEXCO, Nippon Expressway Company Ltd.	200100085	April 20, 2001
New technology for Tokyo expressways	The "high-durability hot-dip steel sheet ZAM® is mentioned on the Metropolitan Expressway CO., Ltd. and in "Systems using new technology" (internal company database).	—	November 20, 2007

7 Certificates

Architecture execution technology and technology examination certificate

Issued on October 2, 2005/Renewed on July 10, 2015/Minor change April 19, 2019

BCJ－審査証明－85

建設技術審査証明書（建築技術）

技術名称：連続式溶融亜鉛-アルミ系めっきによる建築用鋼材の防食技術
「高耐食溶融亜鉛－6%アルミニウム－3%マグネシウムめっき鋼板 ZAM」

2005年10月2日
2010年10月1日（更新）
2015年7月10日（更新）
2019年4月19日（軽微な変更）

建設技術審査証明協議会会員
一般財団法人 日本建築センター
The Building Center of Japan
理事長 橋本 公博

記

1．審査証明結果
2．審査証明の前提
3．審査証明の範囲
4．審査証明の詳細（別添）
5．審査証明の有効期間　2020年10月1日
6．審査証明の依頼者
日鉄日新製鋼株式会社　住所 東京都千代田区丸の内三丁目4番1号

Construction technology examination certificate

Issued on March 18, 2002/Renewed on March 18, 2017/Content change May 13, 2019

建設技術審査証明書

建技審証第0122号

技術名称　溶融亜鉛－6%アルミニウム－3%マグネシウム合金めっき鋼板
「ZAM」

（開発の趣旨）
鋼製の土木用材料で特に耐食性を必要とする部位には、溶融亜鉛めっき（「亜めっき」）を施すことが一般的である。
「ZAM」は、連続めっき設備においてコイル状の鋼板を連続的に溶融して製造するプレめっき鋼板であり、亜鉛のっき中に若干量のアルミニウムとおよそ3%のマグネシウムが添加されている。「ZAM」は、これらの成分の効果により、「亜めっき」に比べ、優れた耐食性を有している。また、めっき浴中の溶存酸素が少ない為に熱影響を受け難いため、質量の合金厚さが薄めて済こと、優れた加工性を有しており、さらには、溶断まで自社な工法選定、形状にて対応できる。また、材料の加工工程における防食っきを省略できるため、製品加工における納期短縮が可能となる。
上記特性を有する亜鉛系合金めっき鋼板を提供する。
（開発目標）
以下の項目を開発目標とした。
(1) めっき層の物理特性
1) JIS G 3302に規定される曲げ試験において、鋼材の曲げ変形が1ｔ曲げの場合にめっき層が剥離しないこと。
2) JIS H 8641に規定される溶融亜鉛めっき（HDZ55）と同等のめっき密着性を有すること。
(2) めっき鋼板の耐食性
めっき付着量90g/m²（片面当たり）以上を施した「ZAM」は、JIS H 8641に規定される溶融亜鉛めっき（HDZ55）と同等以上の耐食性を有すること。
(3) 塗膜の密着性
JIS H 8641に規定される溶融亜鉛めっき（HDZ55）と同等の塗膜密着性を有すること。
一般財団法人土木研究センターの建設技術審査証明事業実施要領に基づき、依頼のあった標記の技術について下記のとおり証明する。

2002年3月18日
2007年3月18日　更新
2012年3月18日　更新
2017年3月18日　更新
2019年5月13日　内容変更

建設技術審査証明事業実施機関
一般財団法人 土木研究センター
理事長 常田賢一

記

1．審査証明の結果
2．審査証明の前提
3．審査証明の範囲
4．留意事項
5．審査証明の詳細　建設技術審査証明報告書
6．審査証明の有効期間　2022年3月17日
7．審査証明の依頼者
日鉄日新製鋼株式会社
所在地：東京都千代田区丸の内三丁目4番1号

Issued on January 31, 2008/Renewed on January 31, 2018/Minor change April 19, 2019

BCJ－審査証明－138

建設技術審査証明書（建築技術）

技術名称：化成処理にクロメートフリー処理を用いた建築用 ZAM 鋼材の初期防錆技術
「クロメートフリー化成処理 ZC 処理および ZG 処理」

2008年1月31日
2013年1月31日（更新）
2018年1月31日（更新）
2019年4月19日（軽微な変更）

建設技術審査証明協議会会員
一般財団法人 日本建築センター
The Building Center of Japan
理事長 橋本 公博

記

1．審査証明結果
2．審査証明の前提
3．審査証明の範囲
4．審査証明の詳細（別添）
5．審査証明の有効期間　2023年1月31日
6．審査証明の依頼者
日鉄日新製鋼株式会社　住所 東京都千代田区丸の内三丁目4番1号

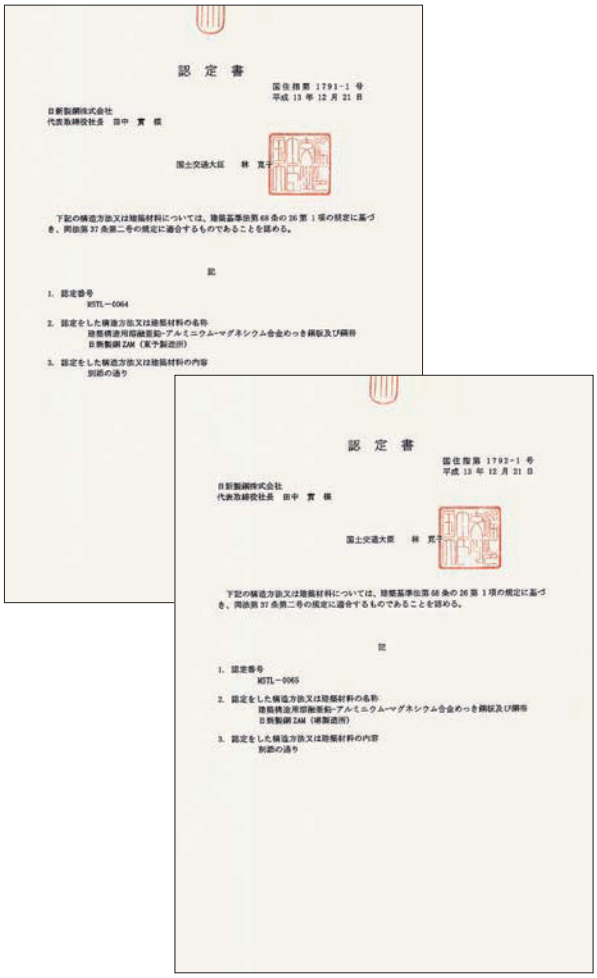
We have obtained "Architecture execution technology and technology examination certificate (BCJ examination certificate No.85)" from the Building Center of Japan and "Construction technology examination certificate (construction technology examination certificate No.0122)" from the Civil Engineering Research Center.

These awards attest that ZAM® can "replace post hot-dip zinc-coated steel sheets, having at least equivalent corrosion resistance with only about one-sixth of the coating weight."
Such technical information in these certifications does not guarantee that any whatsoever of our products.

Also, acquisition of the Building Center of Japan " Construction technology examination certificate (building technology)" (BCJ Examination certificate 138) certifies that the chromium-free treatments (ZC treatment and ZG treatment), which are ZAM®, after-treatments, " have white-rust resistance that is at least equivalent to that of high-corrosion-resistance chromate treatment (A treatment), without using chromium."

Architecture Standards Law certificate

Issued on December 21, 2001



認 定 書

国住指第 1791-1 号
平成 13 年 12 月 21 日

日新製鋼株式会社
代表取締役社長 田中 實 様

国土交通大臣 林 寛子

下記の構造方法又は建築材料については、建築基準法第 68 条の 26 第 1 項の規定に基づき、同法第 37 条第二号の規定に適合するものであることを認める。

記

1. 認定番号
MSTL－0064

2. 認定をした構造方法又は建築材料の名称
建築構造用溶融亜鉛-アルミニウム-マグネシウム合金めっき鋼板及び鋼帯
日新製鋼 ZAM（東予製造所）

3. 認定をした構造方法又は建築材料の内容
別添の通り

認 定 書

国住指第 1792-1 号
平成 13 年 12 月 21 日

日新製鋼株式会社
代表取締役社長 田中 實 様

国土交通大臣 林 寛子

下記の構造方法又は建築材料については、建築基準法第 68 条の 26 第 1 項の規定に基づき、同法第 37 条第二号の規定に適合するものであることを認める。

記

1. 認定番号
MSTL－0065

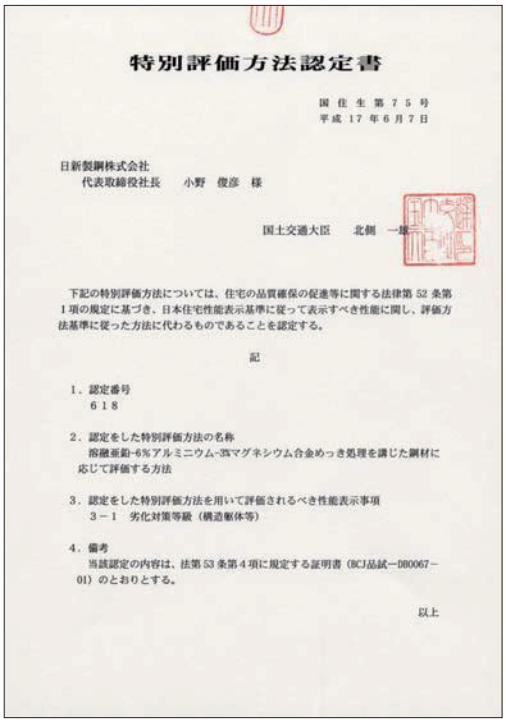
2. 認定をした構造方法又は建築材料の名称
建築構造用溶融亜鉛-アルミニウム-マグネシウム合金めっき鋼板及び鋼帯
日新製鋼 ZAM（堺製造所）

3. 認定をした構造方法又は建築材料の内容
別添の通り

Certification by the Minister of Land, Infrastructure and Transport has been obtained proclaiming the product's compliance with the provisions of the Architecture Standards Low, article 37, number 2.

Special evaluation certificate under the Law Concerning Promotion of Housing Quality Assurance, etc.

Issued on June 7, 2005



特別評価方法認定書

国 住 生 第 7 5 号
平 成 17 年 6 月 7 日

日新製鋼株式会社
代表取締役社長 小野 俊彦 様

国土交通大臣 北側 一雄

下記の特別評価方法については、住宅の品質確保の促進等に関する法律第 52 条第 1 項の規定に基づき、日本住宅性能表示基準に従って表示すべき性能に関し、評価方法基準に従った方法に代わるものであることを認定する。

記

1．認定番号
6 1 8

2．認定をした特別評価方法の名称
溶融亜鉛-6%アルミニウム-3%マグネシウム合金めっき処理を講じた鋼材に応じて評価する方法

3．認定をした特別評価方法を用いて評価されるべき性能表示事項
3－1 劣化対策等級（構造躯体等）

4．備考
当該認定の内容は、法第 53 条第 4 項に規定する証明書（BCJ品試－DB0067－01）のとおりとする。

以上

Under the provisions of the "Quality Assurance Law," certification by the Minister of Land ,Infrastructure and Transport has been obtained for special evaluation methods to classify measures against degradation measures classes (structures, etc.) to be displayed in accordance with the Japan housing performance labeling standards. With acquisition of this certification, performance of ZAM® can be labeled according to these standards.

8 Mass tables

Mass of cut sheets

The mass of a cut sheet is expressed in kilograms and is stated as theoretical mass.

ZAM® Mass table for coating mass symbol 60

Coating mass symbol 60	Nominal size	3×6	4×8
	Width (mm)	914	1,219
	Length(mm)	1,829	2,438
	Area (m²)	1.672	2.972
Coating mass constaint		0.120	
Thickness (mm)	Unit mass (kg/m²)	Mass/sheet (kg)	Mass/sheet (kg)
0.27	2.240	3.75	6.66
0.3	2.475	4.14	7.36
0.4	3.260	5.45	9.69
0.5	4.045	6.76	12.0
0.6	4.830	8.08	14.4
0.8	6.400	10.7	19.0
1.0	7.970	13.3	23.7
1.2	9.540	16.0	28.4
1.6	12.68	21.2	37.7
2.0	15.82	26.5	47.0
2.3	18.18	30.4	54.0
3.2	25.24	42.2	75.0
4.0	31.52	52.7	93.7
4.5	35.44	59.3	105
6.0	47.22	79.0	140

ZAM® Mass table for coating mass symbol 90

Coating mass symbol 90	Nominal size	3×6	4×8
	Width (mm)	914	1,219
	Length(mm)	1,829	2,438
	Area (m²)	1.672	2.972
Coating mass constaint		0.180	
Thickness (mm)	Unit mass (kg/m²)	Mass/sheet (kg)	Mass/sheet (kg)
0.27	2.300	3.85	6.83
0.3	2.535	4.24	7.53
0.4	3.320	5.55	9.87
0.5	4.105	6.86	12.2
0.6	4.890	8.18	14.5
0.8	6.460	10.8	19.2
1.0	8.030	13.4	23.9
1.2	9.600	16.1	28.5
1.6	12.74	21.3	37.9
2.0	15.88	26.6	47.2
2.3	18.24	30.5	54.2
3.2	25.30	42.3	75.2
4.0	31.58	52.8	93.9
4.5	35.50	59.4	106
6.0	47.28	79.1	141

ZAM® Mass table for coating mass symbol 120

Coating mass symbol 120	Nominal size	3×6	4×8
	Width (mm)	914	1,219
	Length(mm)	1,829	2,438
	Area (m²)	1.672	2.972
Coating mass constaint		0.240	
Thickness (mm)	Unit mass (kg/m²)	Mass/sheet (kg)	Mass/sheet (kg)
0.27	2.360	3.95	7.01
0.3	2.595	4.34	7.71
0.4	3.380	5.65	10.0
0.5	4.165	6.96	12.4
0.6	4.950	8.28	14.7
0.8	6.520	10.9	19.4
1.0	8.090	13.5	24.0
1.2	9.660	16.2	28.7
1.6	12.80	21.4	38.0
2.0	15.94	26.7	47.4
2.3	18.30	30.6	54.4
3.2	25.36	42.4	75.4
4.0	31.64	52.9	94.0
4.5	35.56	59.5	106
6.0	47.34	79.2	141

ZAM® Mass table for coating mass symbol 190

Coating mass symbol 190	Nominal size	3×6	4×8
	Width (mm)	914	1,219
	Length(mm)	1,829	2,438
	Area (m²)	1.672	2.972
Coating mass constaint		0.380	
Thickness (mm)	Unit mass (kg/m²)	Mass/sheet (kg)	Mass/sheet (kg)
0.27	2.500	4.18	7.43
0.3	2.735	4.57	8.13
0.4	3.520	5.89	10.5
0.5	4.305	7.20	12.8
0.6	5.090	8.51	15.1
0.8	6.660	11.1	19.8
1.0	8.230	13.8	24.5
1.2	9.800	16.4	29.1
1.6	12.94	21.6	38.5
2.0	16.08	26.9	47.8
2.3	18.44	30.8	54.8
3.2	25.50	42.6	75.8
4.0	31.78	53.1	94.5
4.5	35.70	59.7	106
6.0	47.48	79.4	141

Coating mass symbol	45	60	90	120	150	190	300
Coating mass constant	0.090	0.120	0.180	0.240	0.300	0.380	0.600

Mass of cut sheets

ZAM® Mass table for coating mass symbol K08

Coating mass symbol K08	Nominal size	3×6	4×8
	Width (mm)	914	1,219
	Length(mm)	1,829	2,438
	Area (m²)	1.672	2.972
Coating mass constaint	0.120		
Thickness (mm)	Unit mass (kg/m²)	Mass/sheet (kg)	Mass/sheet (kg)
0.27	2.240	3.74	6.66
0.3	2.475	4.14	7.36
0.4	3.260	5.45	9.69
0.5	4.045	6.76	12.0
0.6	4.830	8.07	14.4
0.8	6.400	10.7	19.0
1.0	7.970	13.3	23.7
1.2	9.540	15.9	28.4
1.6	12.68	21.2	37.7
2.0	15.82	26.4	47.0
2.3	18.18	30.4	54.0
3.2	25.24	42.2	75.0
4.0	31.52	52.7	93.7
4.5	35.45	59.3	105
6.0	47.22	78.9	140

ZAM® Mass table for coating mass symbol K14

Coating mass symbol K14	Nominal size	3×6	4×8
	Width (mm)	914	1,219
	Length(mm)	1,829	2,438
	Area (m²)	1.672	2.972
Coating mass constaint	0.203		
Thickness (mm)	Unit mass (kg/m²)	Mass/sheet (kg)	Mass/sheet (kg)
0.27	2.323	3.88	6.90
0.3	2.558	4.28	7.60
0.4	3.343	5.59	9.94
0.5	4.128	6.90	12.3
0.6	4.913	8.21	14.6
0.8	6.483	10.8	19.3
1.0	8.053	13.5	23.9
1.2	9.623	16.1	28.6
1.6	12.76	21.3	37.9
2.0	15.90	26.6	47.3
2.3	18.26	30.5	54.3
3.2	25.32	42.3	75.2
4.0	31.60	52.8	93.9
4.5	35.53	59.4	106
6.0	47.30	79.1	141

ZAM® Mass table for coating mass symbol K18

Coating mass symbol K18	Nominal size	3×6	4×8
	Width (mm)	914	1,219
	Length(mm)	1,829	2,438
	Area (m²)	1.672	2.972
Coating mass constaint	0.244		
Thickness (mm)	Unit mass (kg/m²)	Mass/sheet (kg)	Mass/sheet (kg)
0.27	2.364	3.95	7.03
0.3	2.599	4.34	7.72
0.4	3.384	5.66	10.1
0.5	4.169	6.97	12.4
0.6	4.954	8.28	14.7
0.8	6.524	10.9	19.4
1.0	8.094	13.5	24.1
1.2	9.664	16.2	28.7
1.6	12.80	21.4	38.1
2.0	15.94	26.6	47.4
2.3	18.30	30.6	54.4
3.2	25.36	42.4	75.4
4.0	31.64	52.9	94.0
4.5	35.57	59.5	106
6.0	47.34	79.1	141

ZAM® Mass table for coating mass symbol K27

Coating mass symbol K27	Nominal size	3×6	4×8
	Width (mm)	914	1,219
	Length(mm)	1,829	2,438
	Area (m²)	1.672	2.972
Coating mass constaint	0.381		
Thickness (mm)	Unit mass (kg/m²)	Mass/sheet (kg)	Mass/sheet (kg)
0.27	2.501	4.18	7.43
0.3	2.736	4.57	8.13
0.4	3.521	5.89	10.5
0.5	4.306	7.20	12.8
0.6	5.091	8.51	15.1
0.8	6.661	11.1	19.8
1.0	8.231	13.8	24.5
1.2	9.801	16.4	29.1
1.6	12.94	21.6	38.5
2.0	16.08	26.9	47.8
2.3	18.44	30.8	54.8
3.2	25.50	42.6	75.8
4.0	31.78	53.1	94.4
4.5	35.71	59.7	106
6.0	47.48	79.4	141

Coating mass symbol	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

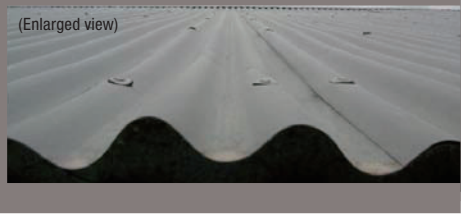
9 Typical applications

Farming

▲ Greenhouse

▲▼ Henhouse roof

(Enlarged view)



Construction

▲ Refrigerant duct

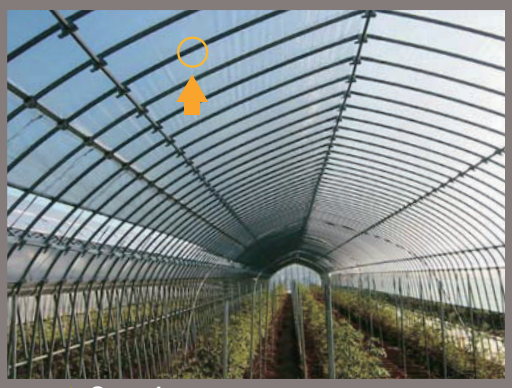
▲ Sound barrier louver

▲ Heavy-duty shutter

▲ Indoor baseball field

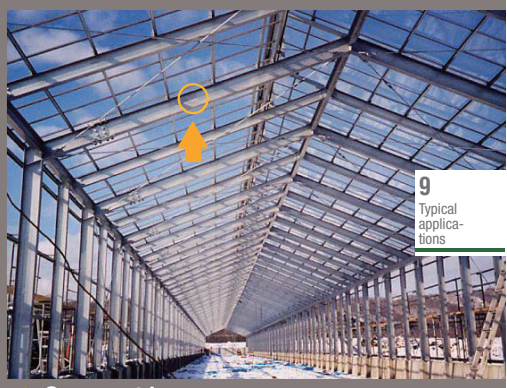
▲ Ceiling crosspiece

▲ House frame



▲ Greenhouse

▲ Compost house



▲ Compost house

▲ Cropper ❶rotary case ❷Front cover

▲ Grape arbor prop

▲ Fish preserve (frame)

9 Typical applications

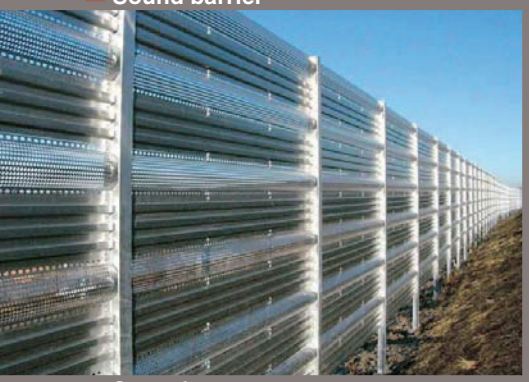
Road / Civil engineering

▲ Bridge reinforcing plate (steel plate adhesion method)
ZAM® ZKS processing, ZAM Grout

▲ Wind barrier panel

▲ Sound barrier

▲ Sound barrier member

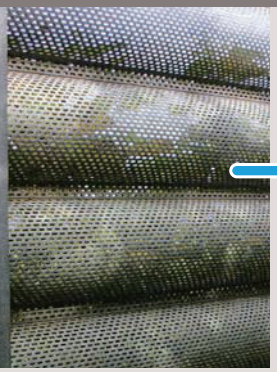


▲ Snow fence

▲ Guardrail

▲ Bridge railing

Change in appearance of actual constructions

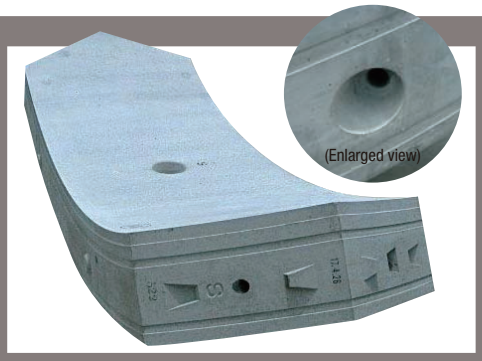


Snow fence (Hokkaido)

No red rust was observed on its surface or end face even after the lapse of 10 years since construction.

Guardrail

No red rust was observed on its surface even after the lapse of 5 years since construction.



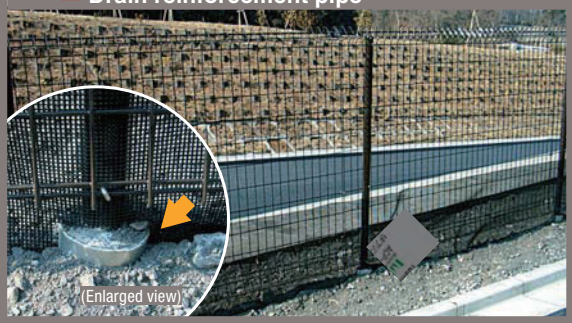
▲ Pipe for joining bolt of concrete block

▲ Rock bolt

▲ Windbreak screen

▲ Drain reinforcement pipe

▲ Handrail in tunnel



▲ Steel pipe pile

▲ Fireproof protection for optical fiber

① Inspection catwalk

② Middle step

③ Inspection catwalk

▲ The Second Tomei Expressway [Yahagigawa Bridge (Toyoda arrows bridge)]

Railroad

▲ Sound barrier louver (station building)

▲ Ventilation duct for train depot

▲ Cable bracket

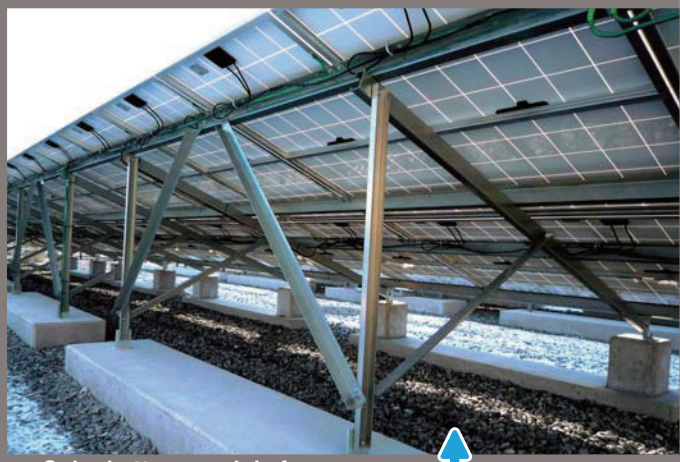
▲ Cable duct

▲ Inner panel of platform door

9 Typical applications

Electric power and electric equipment

▲ Solar battery module frame



▲ Solar battery module frame

▲ Solar battery module frame

Others

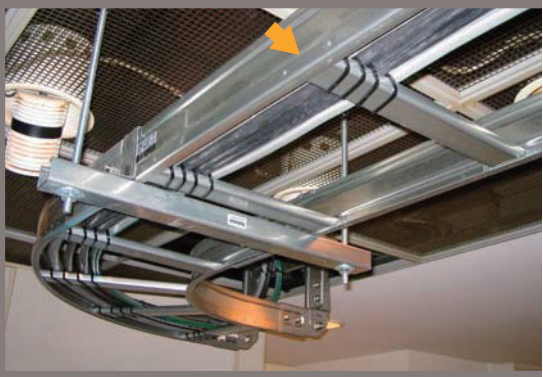
▲ Parking palette

▲ Multistory mechanical parking garage

▲ Bicycle racks

▲ Power control board

▲ Air conditioning unit



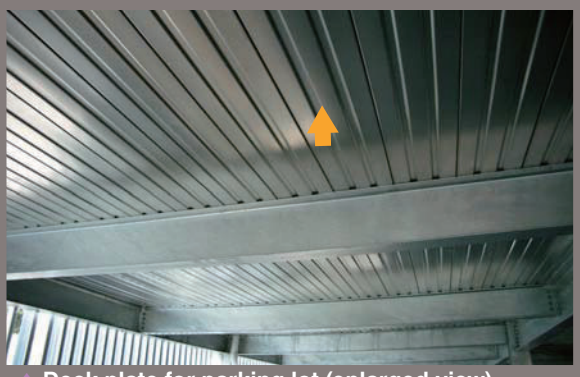
▲ Cable rack

▲ Cable rack

▲ Switchboard

▲ Cable rack

▲ Self-propelled multistory parking garage (distant view)



▲ Deck plate for parking lot (enlarged view)

▲ Fire-hydrant cabinet

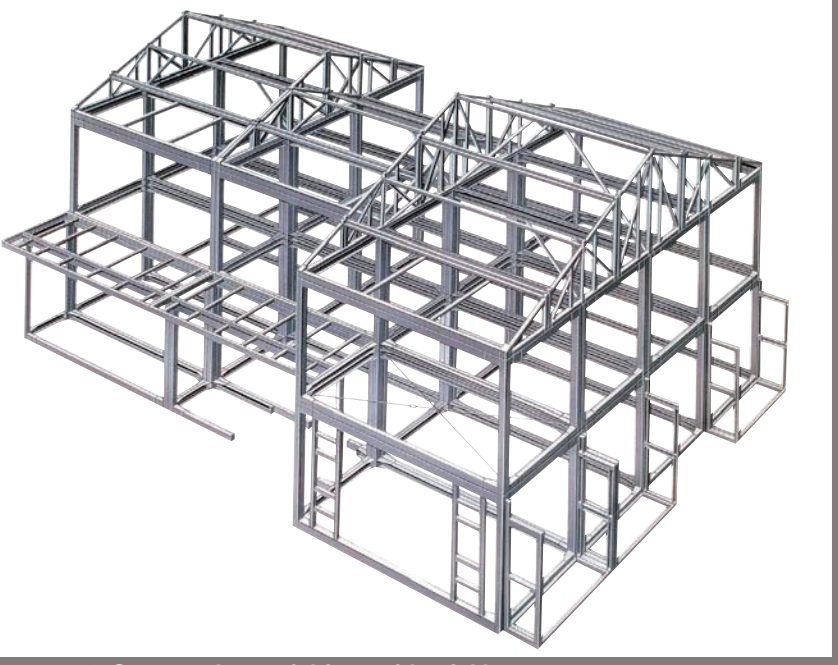
9 Typical applications

Housing
Electrical machinery/construction

▲ Antenna mounting bracket

▲ Grounding rod

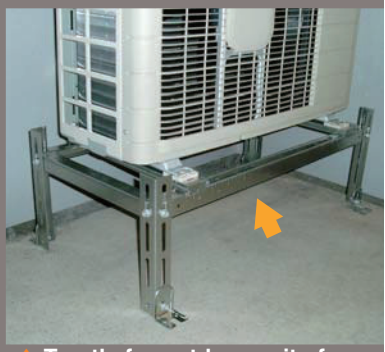
▲ EV charger



▲ Structural material for residential house

▲ Joint metal

▲ Structural material for housing (crossbeam)



▲ Trestle for outdoor unit of air conditioner (unpainted)

▲ Fuel tank for oil fan heater

▲ Trestle for outdoor unit of air conditioner (pained)

9 Typical applica-tions

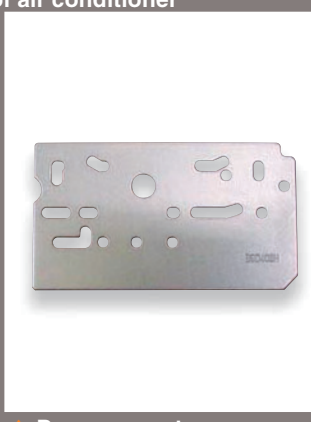
▲ Bottom plate for outdoor unit of air conditioner

▲ Structural material for housing (crossbeam)

▲ Mounting strap

▲ Mounting strap

▲ Window anchor



▲ Door supporter

9 Typical applications

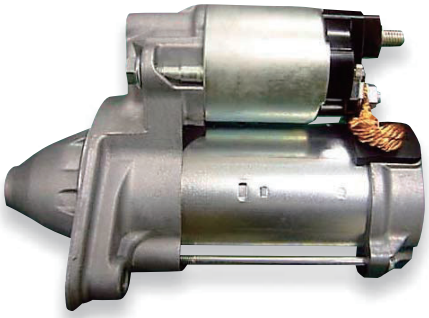
Automobile parts

Wiper linkage

Filter case

Radiator fan motor cover

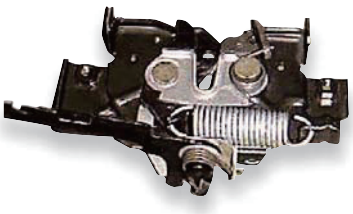
Starter motor yoke



Horn

Pulley

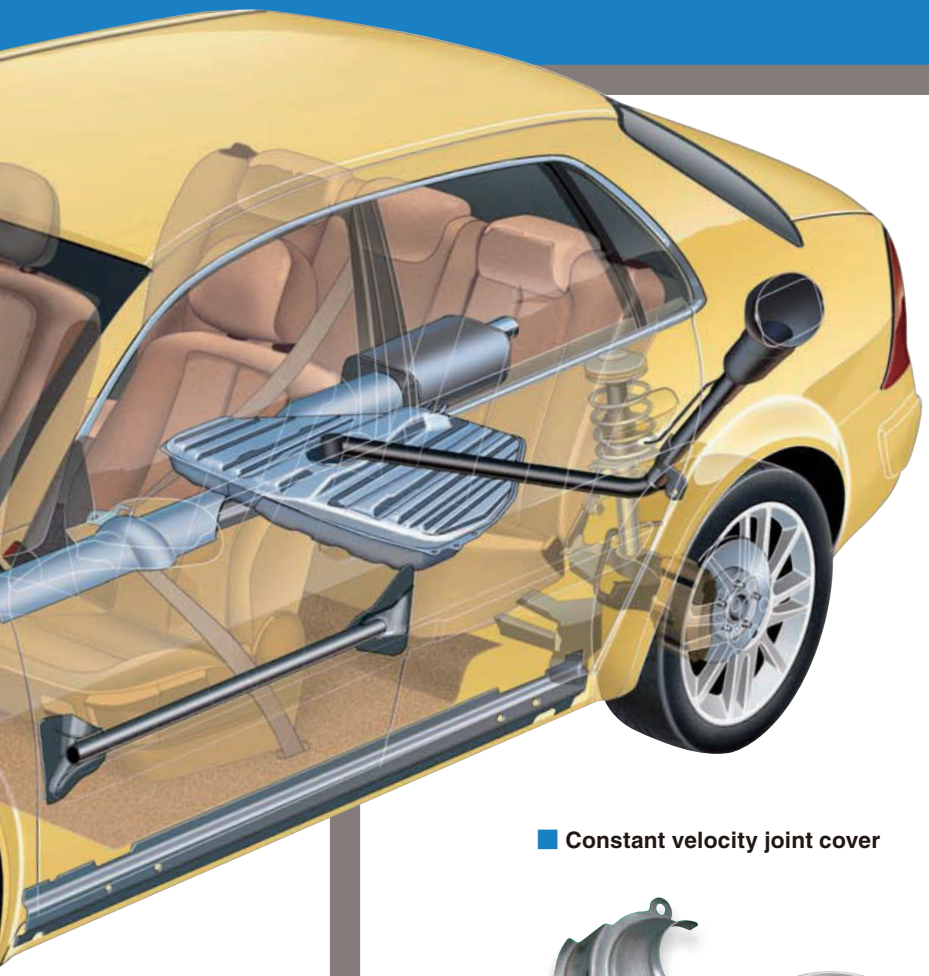
Hood lock



Splash guard

▲ Engine room parts

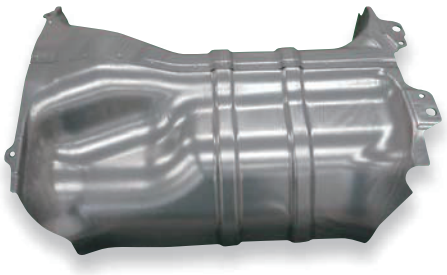
▲ Car body parts



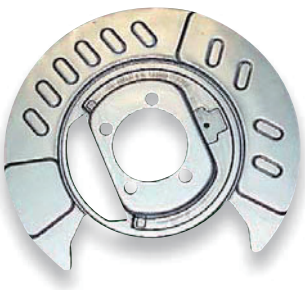
■ Battery module cover for HEV
(Frame + cover)

■ Constant velocity joint cover

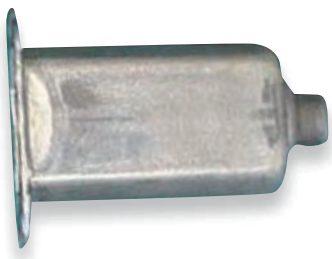
■ Tank heat protector



■ Latch



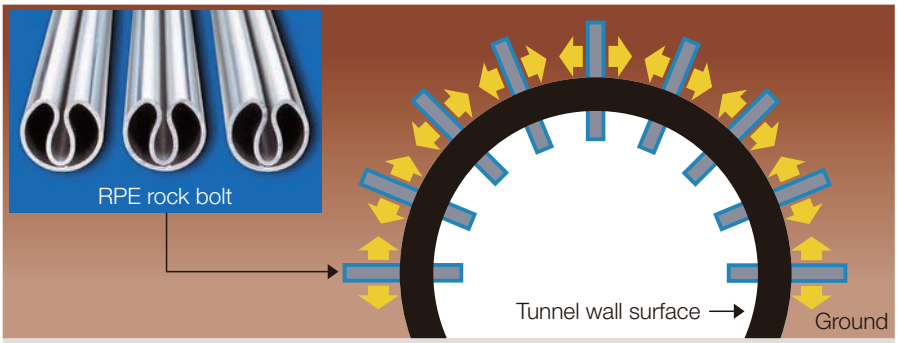
■ Window regulator motor yoke



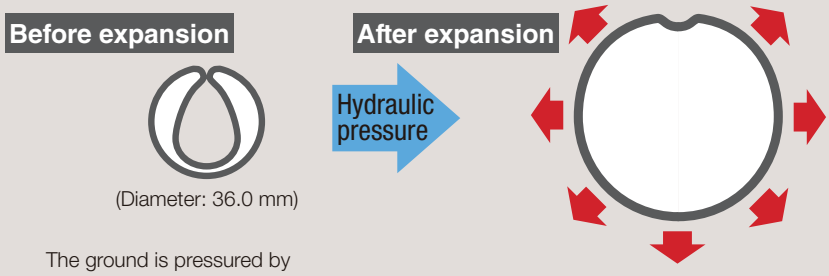
■ Lower sash

10 Affiliate companies' products

RPE rock bolt — Nippon Steel Coated Steel Pipe Co., Ltd.



Mechanism of RPE rock bolt



The ground is pressured by hydraulically expanding the steel pipe, thereby brining about a clamping effect.

A rock bolt is a type of anchor bolt used for preventing collapse of the inner wall of an excavated tunnel. Rock bolts currently available use cement mortar as a fixing material and therefore require several hours for stabilizing.
With this RPE rock bolt, a ground clamping effect can be obtained in as short as 30 seconds by hydraulically expanding the irregular shaped steel pipe. In addition, it has overcome the problem of low corrosion resistance, which has been a weakness of conventional products with expanded steel pipes.

Features

❶ High corrosion resistant material
This product uses ZAM®, which is a prestress force-retaining elastic body and at the same time a high corrosion resistant steel sheet involving only a minium of thickness reduction. It contribute greatly to the enhancement of long-term corrosion resistance of a tunnel.

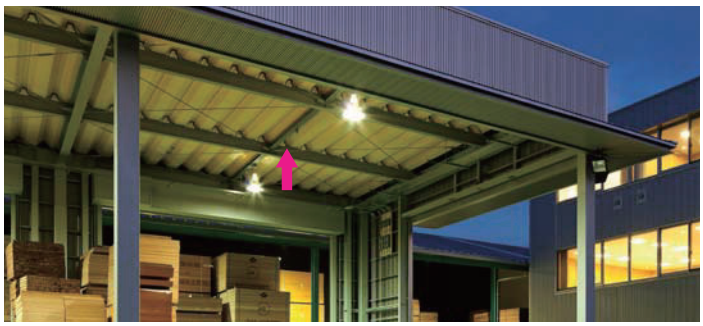
❷ High installation efficiency
Multiple (2 to 5) rock bolts can be installed at one time.

❸ Reduced environmental load
The compact and lightweight high pressure generator and the seal head lighten the work load.

Field	Application	Advantages	Coating weight symbol	Chemical conversion treatment	Thickness (mm)
Civil engineering	Rock bolt main body (12-ton proof strength)	High corrosion resistance, high concrete resistance	90	Untreated	54.0 mm in dia. X 2.0 (expanded)
	Rock bolt main body (18-ton proof strength)				54.0 mm in dia. X 2.3 (expanded)

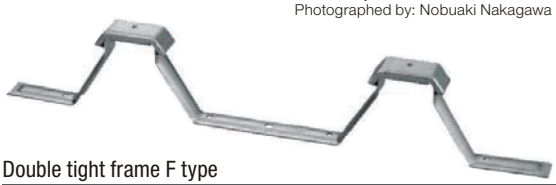
■ For information on the product, contact: Sales Division of Nippon Steel Coated Steel Pipe Co., Ltd. (Tel: 03-3216-6315, http://www.pipe.nisshin.nipponsteel.com)

Standing seam folded-plate roof HK-500 (ZAM® is used for its parts) — NST Nihonteppan Co., Ltd.



High corrosion resistance coated steel sheet ZAM® tight frame

Tsuzuki Corporation, Higashi Tokyo Office (Koto-ku, Tokyo)
Designed by: City Architectural Planning Laboratory
Installed by: Kanetomo Co., Ltd.
Photographed by: Nobuaki Nakagawa



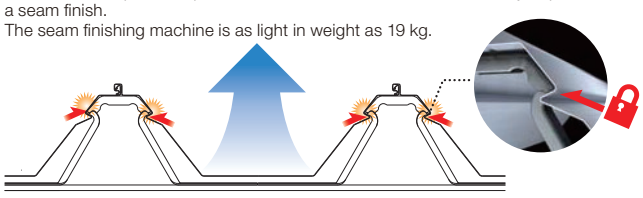
Double tight frame F type

- Enhanced durability is assured through the adoption of ZAM®, a high corrosion resistant coated steel sheet having a zinc-6% aluminum-3% magnesium coating layer.

Features

❶ Excellent performance
- As fitting positions are provided on both sides of the main body, the product exhibits superior resistance to wind load.
- A layer of air formed after seam finish prevents capillary action, increasing water-tightness.
- A fitting rib is provided to improve bending rigidity.

❷ High installation efficiency
- Without any need for a suspender, this product can be easily mounted to a tight frame.
- Because of the plate shape characteristic of the HK Series, it is easy to provide a seam finish.
  The seam finishing machine is as light in weight as 19 kg.

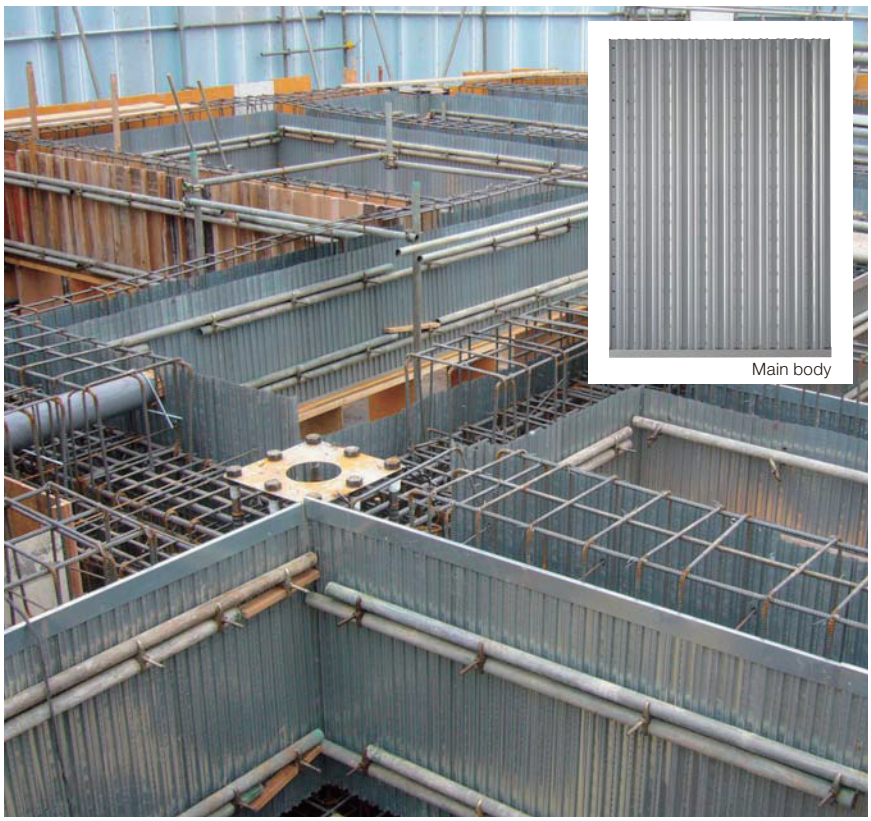


Field	Application	Advantages	Coating weight symbol	Chemical treatment	Thickness (mm)
Building material	Double tight frame F type	High corrosion resistance, high processability	90	A treatment	2.8
	Universal clamp				2.8
	Seam fitting spacer				1.6

■ For information on the product, contact: Exterior Building Material Sales Division of NST Nihonteppan Co., Ltd. (Tel: 03-3272-5120, http://www.np-nippan.co.jp)

Steel framework “Sepamate”

Nippon Steel Nisshin A&C Co., Ltd.



Main body

Features

❶ Lightweight, space-saving

This product is light in weight and easy to handle, contributing to the enhancement of work efficiency and the improvement of the work environment. Because the product is made of a light-gauge steel sheet of 0.4 mm, it can be stored in a narrow space to secure a wider work space. These features work to decrease the number of packages, lessen the amount of materials to be carried in and out, a reduce the number of trucks, and shorten operation time of heavy machines.

❷ Process simplification, cost reduction

Since no form removal is necessary, the worker can proceed to backfilling only by removing reinforcing materials after concrete placement, making it possible to shorten the work period. With only horizontal reinforcing materials required, this product involves only a small amount of materials to be carried out, leaving practically no waste materials. Nearly free of incineration cost, it also cuts down cost.

❸ Reduced environmental load

Since this product leaves practically no waste materials, unlike plywood forms,it promises to decrease environmental destruction like deforestation and significantly lessen the amount of carbon dioxide generated at the time of waste material incineration. Naturally, it is also expected that the decrease in the number of necessary vehicles and heavy machines will have the effect of reducing carbon dioxide emissions.

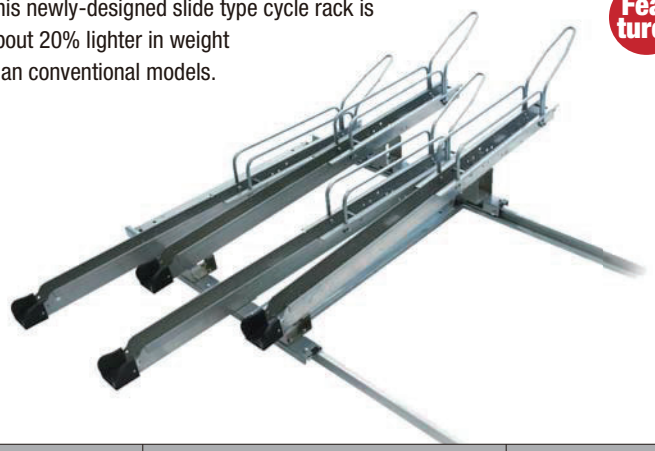
Field	Application	Advantages	Coating weight symbol	Chemical treatment	Thickness (mm)
Building material	Main body of Sepamate	High corrosion resistance, high concrete resistance	60	ZC treatment	0.4

■For information on the product, contact: Steel Sheet Processing Division of Nippon Steel Nisshin A&C Co., Ltd. (Tel: 03-5635-6123, http://www.ac.nisshin.nipponsteel.com)

Slide type bicycle rack

Nippon Steel Nisshin Business Service Co., Ltd.

This newly-designed slide type cycle rack is about 20% lighter in weight than conventional models.



Features

❶ 1.5 times higher in capacity than conventional racks

・With 20 bicycles stowed, model H-2 has a width of 5,600 mm while front wheel model Z-1 has a width of 8,600 mm.

❷ Easy to take bicycles in and out

・The rack itself can be freely moved laterally for easy storage of bicycles.

❸ Distinguished durability and environmental friendliness provided by ZAM®

・Employing ZAM®, Nippon Steel's high corrosion resistant hot-dip coated steel sheet, this product requires no painting, contributing to resource saving.

❹ Wide field of view to ensure security

・Even the upper rack of model H-2 has a height of 800 mm.
・The capacity is nearly the same as that of double-deck type.

❺ The parking lot for bicycles can be flexibly designed without any concern for the height of the ceiling height.

・Even in the presence of beams or ducts, this product can be installed without problems, thereby increasing the freedom of bicycle-parking area design.

Field	Application	Advantages	Coating weight symbol	Chemical conversion treatment	Thickness (mm)
Equipment	Main body	High corrosion resistance, high processability, process simplification	90	ZC treatment	1.6
	Tire guide				ϕ12.7×1.2
	Slider				2.3
	Rail				3.2
	Base				3.2

■For information on the product, contact: Bicycle Parking Space Division of Nippon Steel Nisshin Business Service Co., Ltd. (Tel: 03-3553-8516, http://www.bs.nisshin.nipponsteel.com)

11 Precautions

Precautions for use

● Use underwater or in flowing water

In applications underwater or with frequent exposure to flowing water, the stable protective film layer that is characteristic of ZAM® is difficult to form, so that sometimes ZAM® may gather red rust early without showing superiority to hot-dip zinc-coated steel sheets. Be aware of this when using it in such applications.

● Handling

- In order not to damage the coating surface, handle the product carefully and do not put any sweat or finger smudges on the surface.
- If the surface should become damaged, repair it.
- Be careful when removing a coil band because the end of the coil could spring up as it unwinds.
- Store products securely, so that coils do not tip over and stacked-up cut sheets do not topple.
- Be careful to prevent water stains and dew condensation.
  If packaging paper is damaged, repair it.

● Processing

- If the surface is damaged during processing, it could adversely affect corrosion resistance and paintability.
  In particular, some types of lubricating oil may corrode the coating layer during press working. It is therefore necessary to check the type of lubricating oil to be used. When lubricant is used, perform degreasing or other post-treatment after the processing.
- As time passes, a steel sheet tends to harden, resulting in a decrease in workability. To avoid this, use the steel sheet as soon as possible.

● Precautions to prevent galvanic corrosion

(1) Avoid direct contact with lead or copper (or copper ion drops)
(2) For metal fittings and attachments, use products made of stainless steel (SUS304) or aluminum or those which are painted or heavily coated with zinc for increased durability.
(3) When using ZAM® in a salt-damaged or snow-covered area, use metal fittings and attachments made of a similar metal (aluminum, zinc-coated metal) or stainless steel insulated properly and treated with an anticorrosive (or a sealing material)
(4) In such applications as lightning conductors where corrosion is likely to occur, insulation tape or aluminum wire should be used.
(Source: Preventive measures of bimetallic corrosion of prepainted/zinc-based coated steel sheets: Hot-dip zinc-coated Committee, The Japan Iron & Steel Federation)

● Precautions to prevent corrosion due to contact with a preservative-treated or termite resistant wood

ZAM® should not be left in contact with wood containing preservative/ant repellant for an extended period of time.
Wood and laminated wood treated with preservatives and ant-repellants (primarily copper-based agents) adversely affect corrosion resistance property of coated steel sheets and prepainted steel sheets. Therefore, where these steel sheets are likely to come in contact with wood materials (parts of the roofs including eaves, roof edges and joints for example), insulation underthatch (roofing stock or butyl tape) should be used for rust prevention and steel-wood direct contact should be avoided.
(Source: Preventive measures of bimetallic corrosion of prepainted/zinc-based coated steel sheets: Hot-dip zinc-coated Committee, The Japan Iron & Steel Federation.)

● Welding

- When conducting resistance welding, proper care should be taken of the electrodes to remove zinc pickups.
- For coated steel sheets containing ZAM®, coatings evaporate due to heat from welding, so that greater amounts of sputtering and fume are generated than in the case of hot- or cold-rolled steel sheets. Take appropriate safety measures at the time of welding work.

<Safety measures for welding hot-dip zinc-coated steel sheets>
When welding hot-dip zinc-coated steel sheets, in addition to such common welding hazards as electrification, damage to the eyes caused by arc ray, burn caused by contact with hot objects and fire, be careful of;

1. increase in volume of fume generated by evaporating zinc, and
2. burns or fires due to larger volumes of spatters generated.

Especially, since fume is inevitable when welding hot-dip zinc-coated steel sheets, proper measures should be put in place. Health hazards of zinc are shown in the table.

Effects of zinc on the human body

Item	Effect
Carcinogenicity	Has not been confirmed at the present time
Acute toxicity	It is known that inhaling a large quantity of zinc fumes results in a fever several hours later (zinc fume fever). The affected person recovers naturally in about 24 hours. The mechanism by which this occurs is not understood.
Chronic toxicity	No evidence has been found that zinc causes symptoms of chronic toxicity.
Other effects	Zinc deficiency can cause delayed growth, reduced functioning of the gonads, depression, loss of appetite, and other symptoms.
Zinc, which is present in the human body in greater quantity than any other [metal] element except iron, which is an important essential element. Its harmfulness is thought to be low provided that protective measures are taken and a large quantity is not ingested.	

Source : Osamu Wada, "Metals and Man : Ecotoxicology and Clinical Practice," published by Asakura Shoten (1985)

Phenomenon of darkening of hot-dip zinc-based coating

● Overview

・It is known that with the passage of time, hot-dip zinc-coated steel sheets are subject to what is called darkening, namely, decrease in surface glossiness. ZAM® may also suffer discoloration as with other hot-dip zinc-based alloy coated steel sheets.

● What is darkening?

・Darkening is a phenomenon in which the steel sheet appears gray due to the presence of a very thin oxide film on the zinc surface layer. In hot-dip hot-dip zinc-coated steel sheets, a very thin oxide film whose principal component is ZnO is formed on the zinc coating surface layer even immediately after manufacturing, and it has the property of changing and growing as time passes. From our experience to date, we infer that this phenomenon of darkening occurs by the following mechanism.

① An oxide film grows

↓

② The structure and thickness of the oxide film change

↓

③ The changed state of ② causes a change in the optical absorption coefficient

↓

④ The surface takes on a gray appearance

● Characteristics of darkening

・In hot-dip zinc-based alloy coated steel sheet the zinc surface layer is covered with a very thin oxide film (mainly composed of ZnO). But the rate at which the oxide film changes and grows varies depending on such conditions as the structure and composition of the material as well as environmental factors, and the time until darkening becomes noticeable varies.
This darkening is unavoidable, but it is known to occur more readily under conditions of high temperature and high humidity.
Darkening is just an oxidation phenomenon on the zinc coating layer, thus the product quality is normal except for its gray appearance.

・This phenomenon develops when this material is stored either in the form of coil or cut sheet. It is therefore recommended to use the product as early as possible.

11 Precautions

Guide to ordering

● Material, coating weight, chemical conversion treatment, oiling

・Select steel grade, coating weight, and chemical treatment to fit your application. Apart from the type of chemical treatment, you can choose either antirust oiling or no oiling. Oiling is recommended to minimize lubrication during press processing, soiling, and scratching. Oiling is necessary when no treatment is made.

● Size

・Design according to the production range described in this catalog. Contact us beforehand if your conditions for use require more stringent specifications.
Please consult us for sizes outside the range.

● Product Shapes

・Choose either mill edge or slit edge according to your application.
Also, choose either coils or cut sheets according to your cutting and processing conditions.
From the standpoint of promoting continuous, automated operations and optimizing yield, it is recommended to use coils.
When using coils, be aware that sometimes defective parts may be mixed in
(because such parts cannot be removed by the inspection).

● Inside diameter and outside diameter

・In the case of coils, specify the inside diameter and outside diameter to fit the specifications of your equipment. In specifying the inside diameter, allow for possible buckling in inner laps of the coil depending on the sheet thickness.

● Packing mass

・Specify the packing mass according to handling capacity, etc. For coils, specify the maximum mass (if necessary, the minimum unit mass). The greater the mass, the easier the operation will be.

● Applications and processing methods

・Quality control better suited to your application and processing method can be applied if relevant information is timely provided.

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