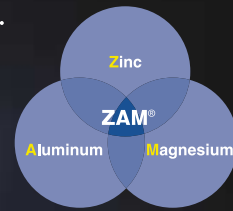


Nisshin Steel Quality Products

# ZAM<sup>®</sup>

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



## ZAM<sup>®</sup> Our highly corrosion-resistant hot dip coated steel sheet

### Contents

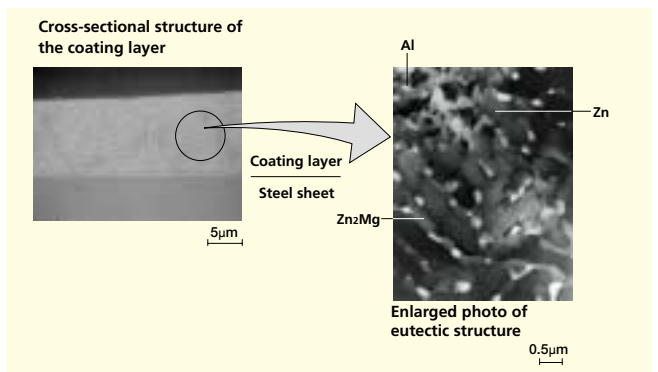
-  Introduction ..... 1
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■ A new hot dip coated steel sheet that has a coating layer of zinc, 6% aluminium, and 3% magnesium.

\* Patents have been registered for the product and its manufacture.

\* ZAM<sup>®</sup> is a registered trademark of Nisshin Steel Co., Ltd.

### Cross-section of the coating layer of the highly corrosion-resistant hot dip coated steel sheet ZAM<sup>®</sup>



Coating layer : Fine ternary eutectic structure of Zn, Al, and Zn<sub>2</sub>Mg

# Features

ZAM® is a pre-coated steel sheet that can be used in a wide variety of fields and applications due to its following features.

## 1. Superior corrosion resistance

In corrosion resistance\*, ZAM® is 10 to 20 times tougher than galvanized steel sheet and 5 to 8 times better than Zinc-5% Aluminum alloy coated steel sheet when subjected to accelerated testing.

※estimated by salt spray test

## 2. Superior scratch resistance

ZAM® has better scratch resistance than ordinary hot dip galvanized steel sheet.

## 3. Replacement for post hot dip galvanized products (surface-treated in their final shapes)

With its attribute to withstand severely corrosive environments, ZAM® can replace post hot dip galvanized products and thus enable customers to streamline manufacturing processes.

## 4. Resource-saving and Environment-friendly

ZAM® can be called a resource- saving product since it lasts long and provides excellent corrosion resistance with relatively light coating.

ZAM® can also be called an environment-friendly product since it satisfies requirements of such environmental regulations as RoHS and ELV\*.

\* Please specify "chromium-free" treatment

- Fields of application : replacement for existing hot dip coated steel sheet, replacement for post hot dip galvanized products, elimination of after-painting, replacement for stainless and aluminum.

### ●Certifications awarded to ZAM®

Certification	Explanation	Qualification number	Acquisition date	See page
Architecture execution technology and technology examination certification	A "Construction execution technology and technology examination certificate" from the Japan Architecture Center, a certification body authorized by the then-Minister of Construction.	Examination certification No. 0004	October 2, 2000 renewed October 1, 2005	29
Construction technology examination certification	"Construction technology examination certification" at the Civil Engineering Research Center.	Examination certificate No. 0122	March 18, 2002	29
Law concerning promotion of housing quality assurance, etc.	Under the provisions of the "Quality Assurance Law," certification by the Minister of Land Infrastructure and Transport (MLIT) for special evaluation methods for degradation measures classes (structures, etc.) to be displayed in accordance with the Japan housing performance labeling standards. With acquisition of this certification, this material can be performance-labeled under the housing performance labeling standards.	Certification No. 138 Certification No. 220	December 5, 2001 July 1, 2002	30
Architecture standards law	Certification by the MLIT proclaiming the product's compliance with the provisions of the Architecture Standards Law, article 37, number 2.	Toyo Works MSTL-0064, Sakai Works MSTL-0065	December 21, 2001	30
NETIS New Technology Information System	The product is registered as "ZAM®, high corrosion resistance hot dip coated steel sheet" in NETIS, a database managed by the MLIT that compiles new technologies developed by the private sector.	KT-010029	May 10, 2001	30
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	—

● **Agriculture and farming**



Compost house

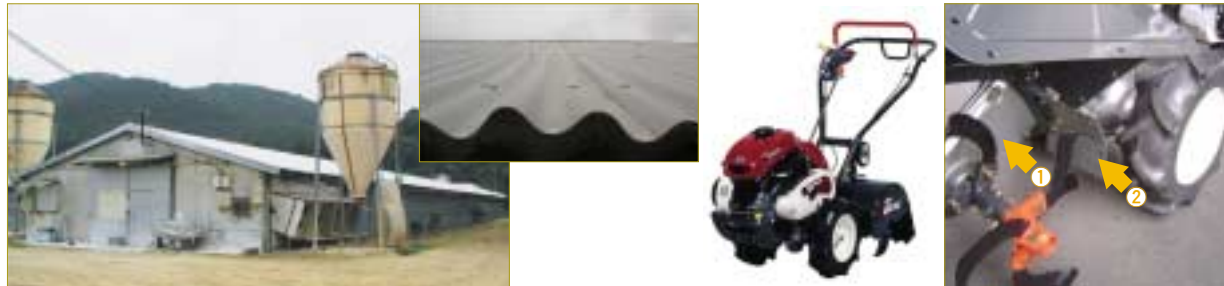
Compost house

Fish preserve (Frame)



Greenhouse

Grape arbor prop



Henhouse roof

Cropper

① Rotary case ② Front cover

● **Construction**

Architecture execution technology and technology examination certification... Examination certificate No. 0004 Acquisition date/October 2, 2000  
 Construction technology examination certification... Examination certificate No. 0122 Acquisition date/March 18, 2002  
 Architecture Standards Law... Toyo Works MSTL-0064, Sakai Works MSTL-0065 Acquisition date/December 21, 2001



Indoor baseball field

Heavy-duty shutter

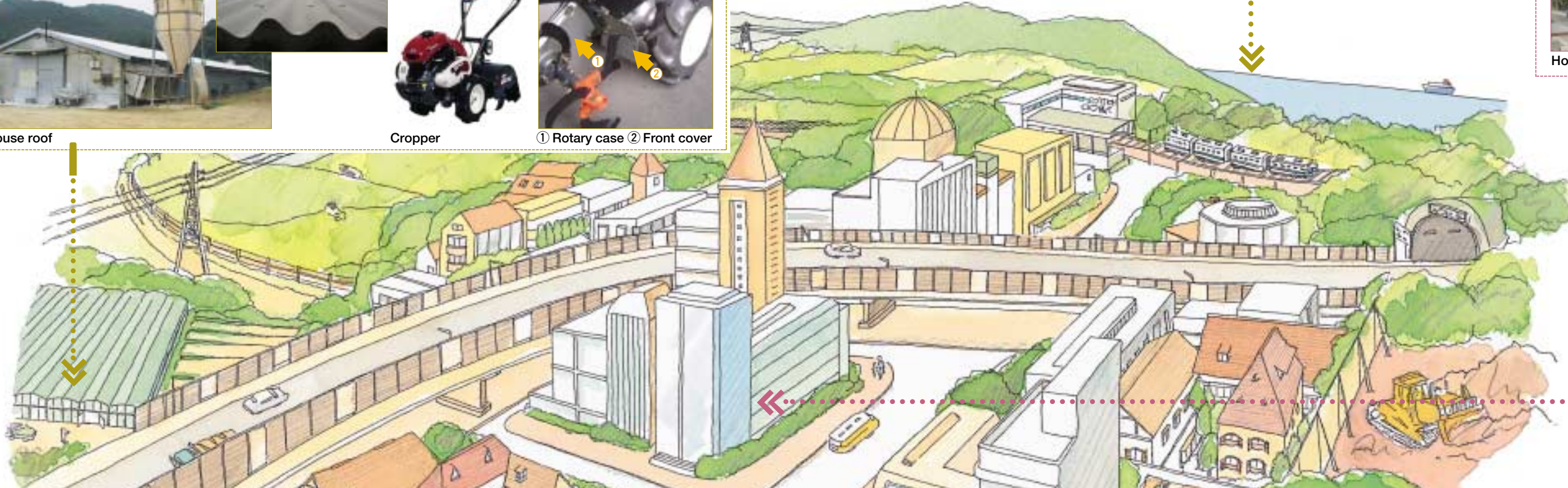
Refrigerative duct



Ceiling crosspiece

Sound barrier louver

House frame



Railroad



Sound barrier louver(Station building)

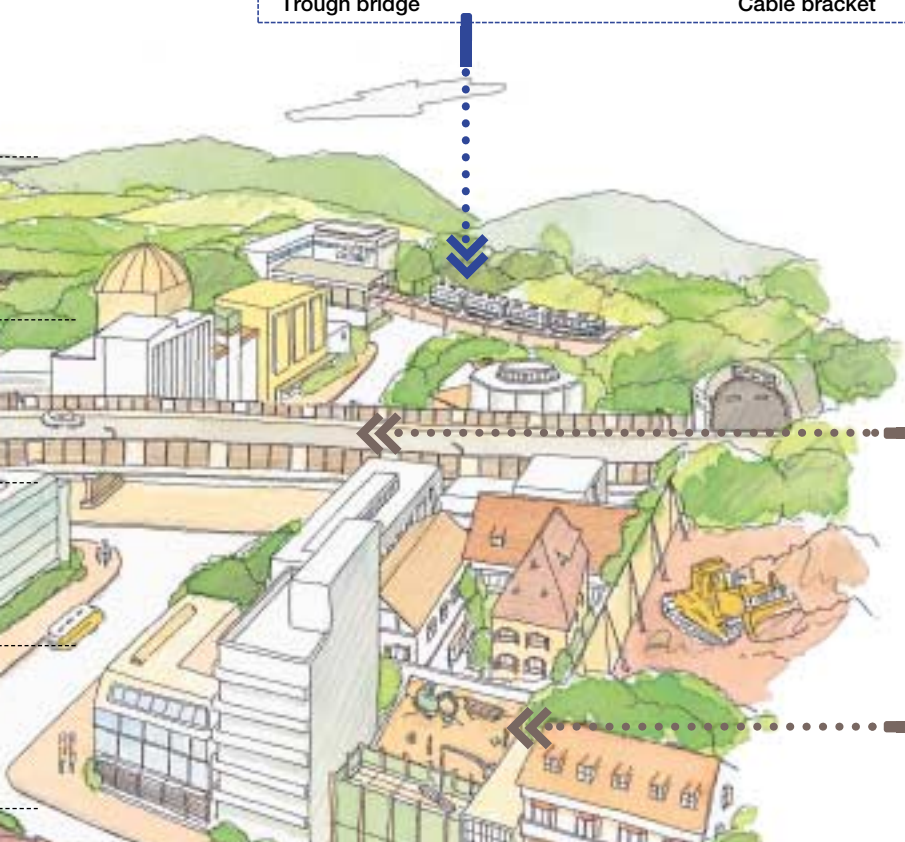
Ventilation duct for train depot

Inner panel of platform door

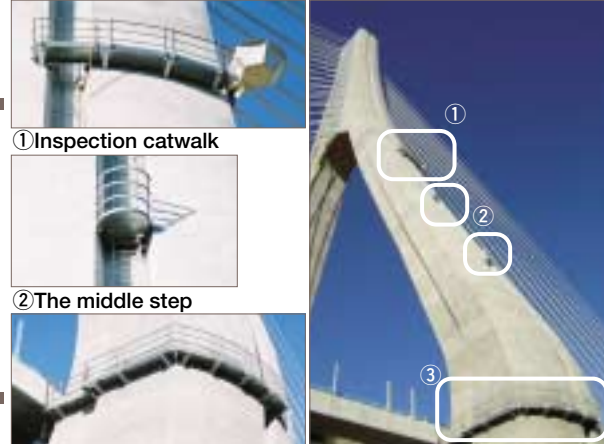
Trough bridge

Cable bracket

Cable duct



The second Tomei expressway [Yasakukawa Bridge (pet name:Toyota arrows bridge)]



① Inspection catwalk

② The middle step

③ Inspection catwalk

Road

Ministry of land,infrastructure and government of Japan new technology information system [NETIS] ... Registration No.KT- 010029  
Japan highway public corporation - new technology-new method of construction ... New technology reference No.200100085



Sound barrier (Front side)

Sound barrier members Sound barrier member (enlarged view)

Sound barrier (Back side)

Steel framed deck Steel framed deck (enlarged view)



Handrail in tunnel

Drain reinforcement pipe



Snow barrier panel



Rock bolt

Rock bolt (Section)



Wind barrier panels

Wind barrier panel (enlarged view)



Guardrail



Bridge railing



Fireproof protection for optical fiber

**Electrical machinery**

- Air conditioning unit
- Power control board
- Switchboard
- Solar battery module (frame)
- Solar battery module

**Others**

- Bicycle racks
- Fire-hydrant cabinet
- Self-propelled multistory parking garage (distant view)
- Deck plate for parking lot (enlarged view)
- Mechanical multistory parking garage
- Parking palette

**Housing**

\* Law concerning promotion of housing quality assurance, etc.  
Certification number : 138 Acquisition date/December 5, 2001 Certification number : 220 Acquisition date/July 1, 2002

- Structural materials for residential house
- Structural material for housing (Crossbeam)
- Structural material for housing (Crossbeam)
- Joint metal

**Electric power**

- Cable racks
- Cable racks
- Cable racks

● Electrical machinery



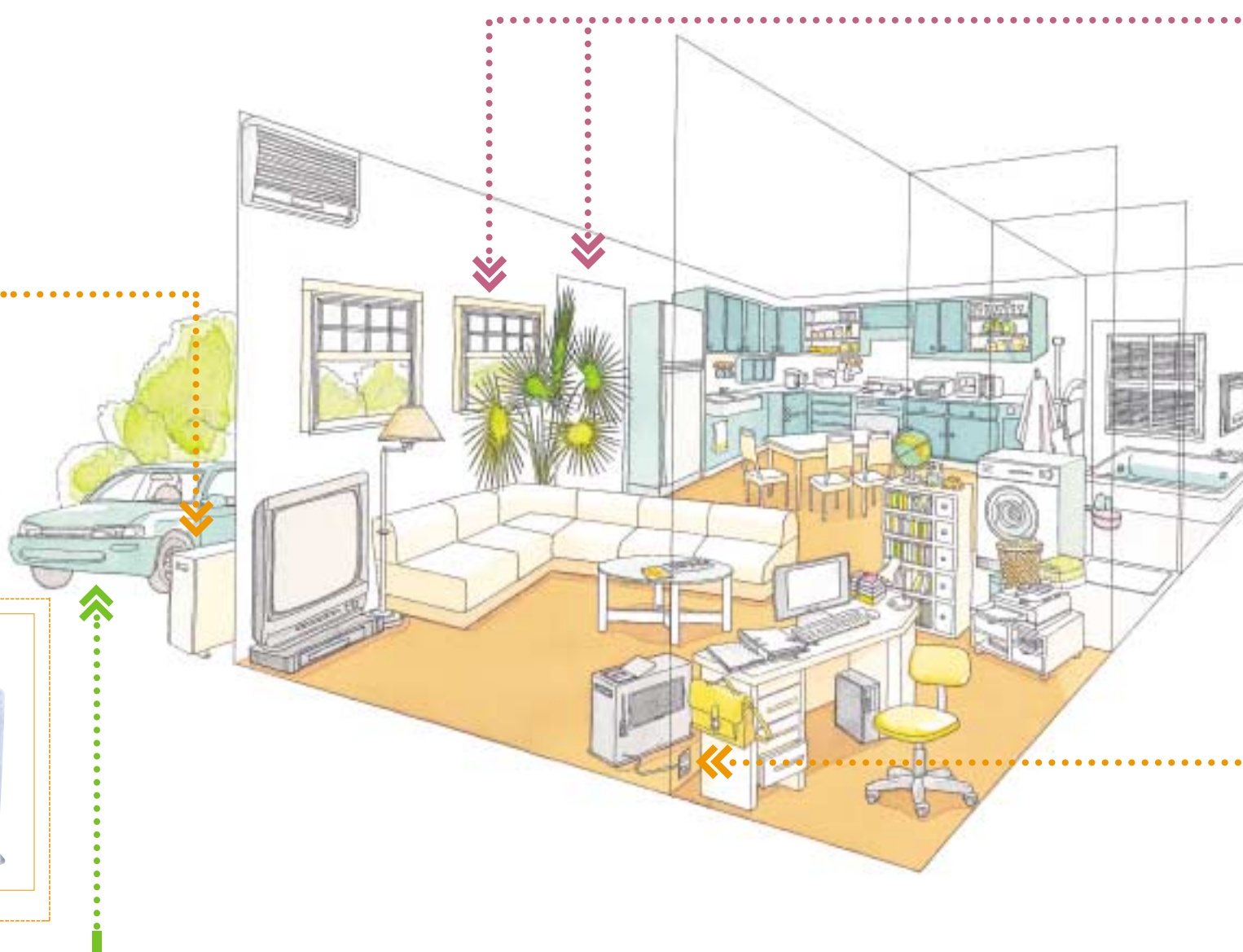
Bottom plate for outdoor unit of air conditioner



Trestle for outdoor unit of air conditioner (Painted)



Trestle for outdoor unit of air conditioner (unpainted) Fuel tank for oil fan heater



● Construction



Window anchor



Window anchor



Door supporter

● Electrical machinery



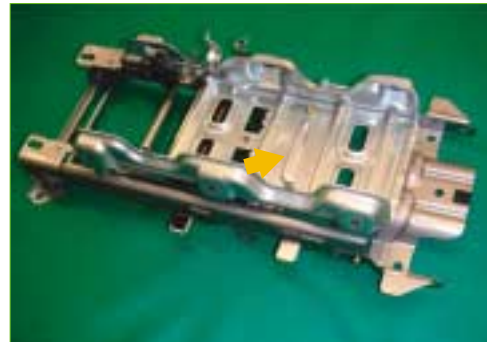
Mounting strap



Mounting strap



● Automobile



Console box bracket



Motor cover



Windshield wiper parts



Steering wheel shaft supporter



Tank heat protector



Surge tank stay

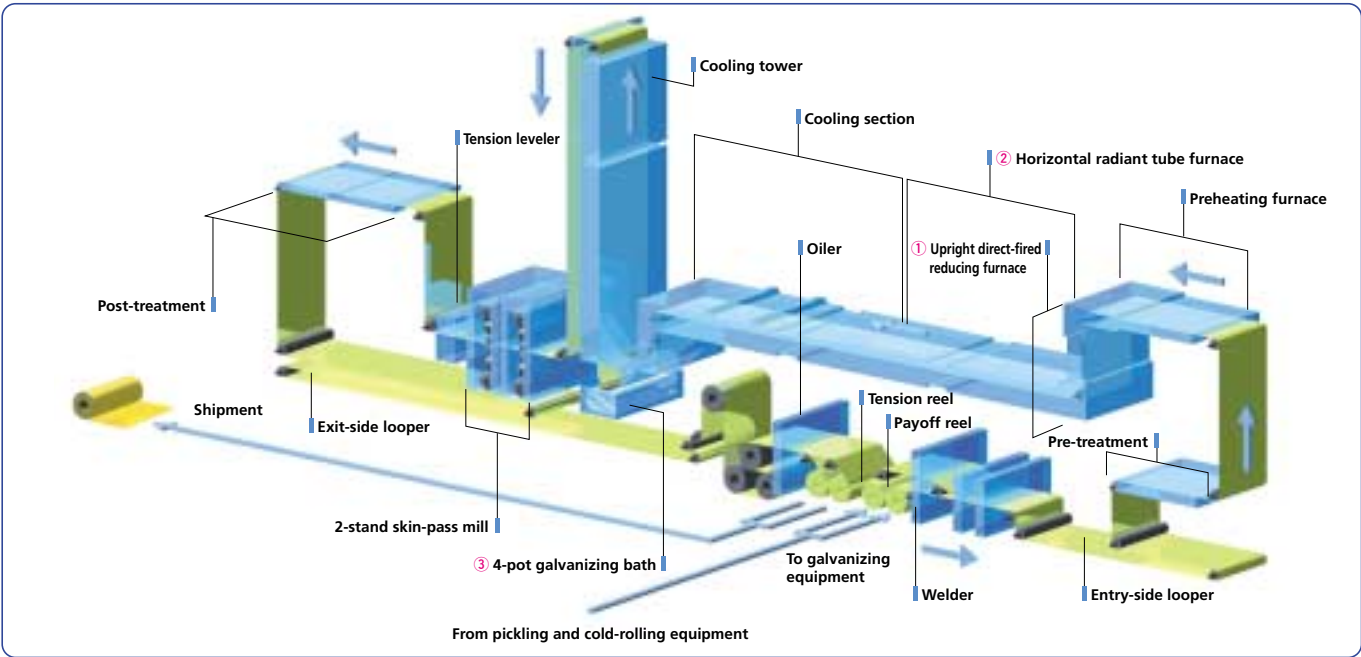


# Manufacturing process

ZAM® is produced with HCGL in TOYO WORKS & 1 CGL in SAKAI WORKS.

## Toyo Works : HCGL (hot dipping line)

In the hot dipping line (HCGL), annealing furnace operability and improved quality are obtained by the combination of an upright direct-fired reducing furnace and a horizontal radiant tube furnace, and with four pots, several types of different coating can be produced (ZAM®, Paintite B, and Paintite). A wide range of light and heavy coating weights is available.



① HCGL annealing furnace (upright direct-fired reducing furnace)



② HCGL annealing furnace (horizontal radiant tube furnace)



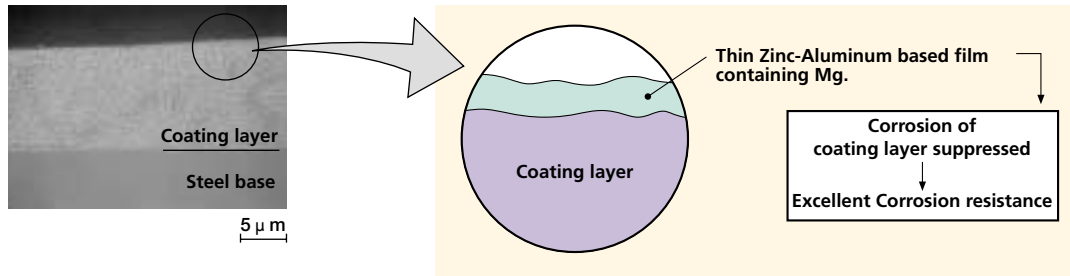
③ Galvanizing pot

# Quality characteristics

## 1. Corrosion resistance mechanism of ZAM®

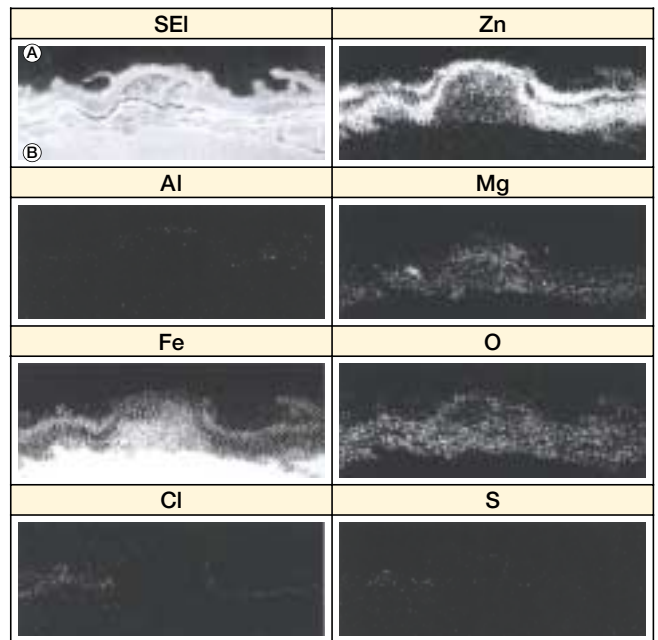
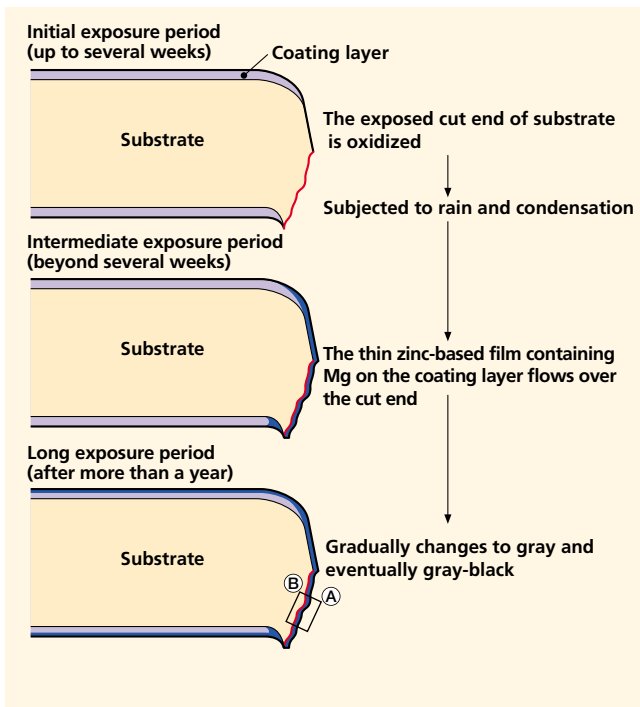
### (1) Corrosion resistance mechanism

Mg and Al in the coating layer combine to form a fine, tightly adhered protective film. This thin surface structure suppresses corrosion of the ZAM® coating, thus effectively enhancing overall corrosion resistance.



### (2) Mechanism of corrosion resistance on cut end

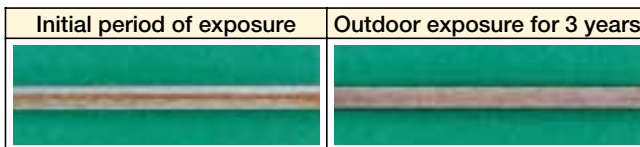
Excellent corrosion resistance is achieved on cut end parts by covering the ends with a fine zinc-based protective film that contains Al and Mg leaching from the coating layer.



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

(Thickness: 2.3mm, coating weight: 130/130g/m<sup>2</sup>, chromate treatment: 50mg/m<sup>2</sup>)

### (3) Appearance change of cut end



Appearance of cut end after outdoor exposure test 5mm  
(Thickness: 3.2mm, coating weight: 150/150g/m<sup>2</sup>, post-treatment: chromate 50mg/m<sup>2</sup>)

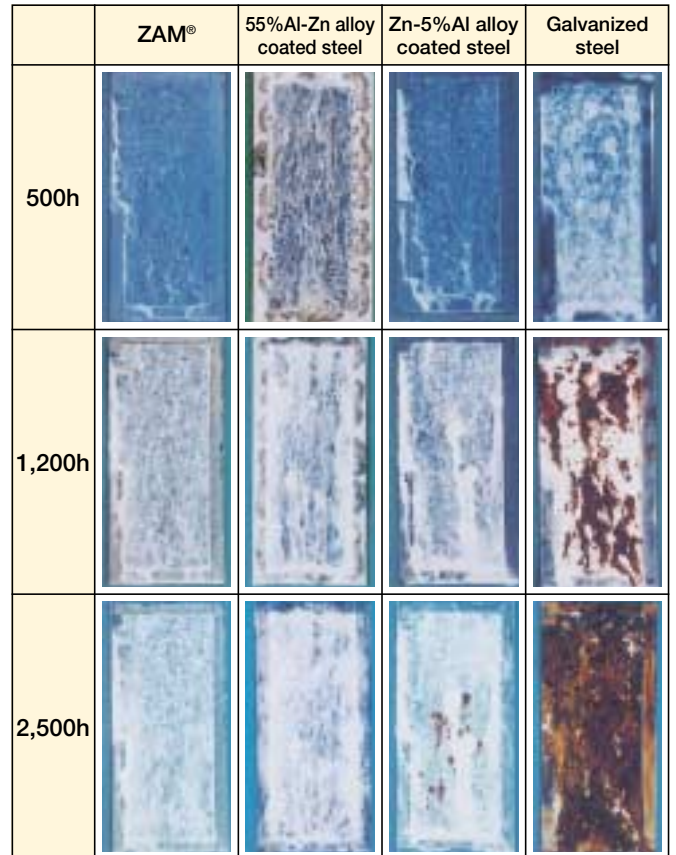
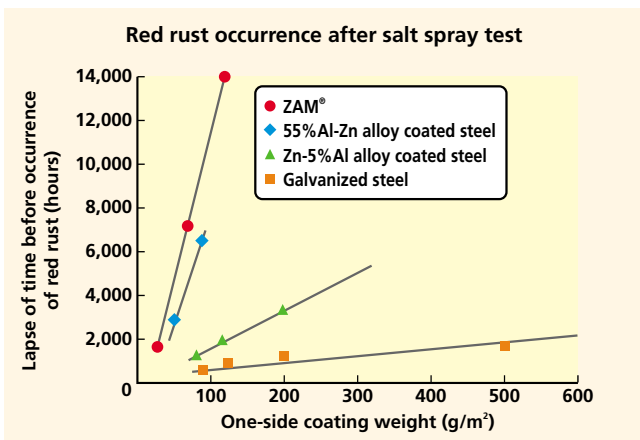
The color tone and the speed of the color tone change varies depending on the exposure environment (region, installation location, orientation, etc.).

# Quality characteristics

## 2. Comparison of properties with various types of coated steel sheets

### (1) Durability of flat parts

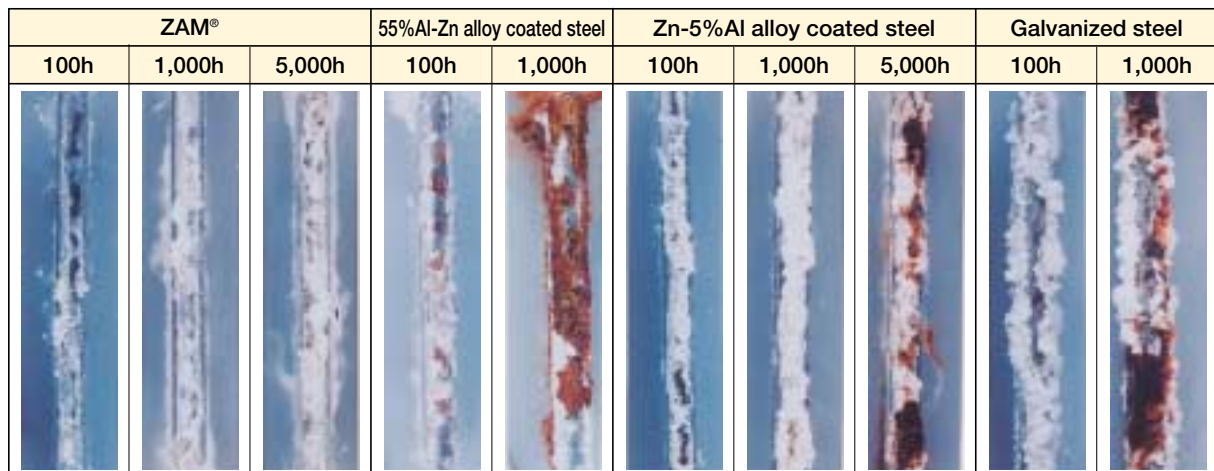
- Time to occurrence of red rust in salt spray test (SST : JIS Z2371)
- ZAM<sup>®</sup> has better resistance to red rust than hot dip galvanized steel sheet (Paintite B) and zinc-5% aluminum alloy coated.
- The level of its corrosion resistance rivals that of 55% aluminum-zinc alloy coated (Galvastar).



Appearances of specimens after salt spray test (Coating weight : 90g/m<sup>2</sup> (one side), untreated) 10mm

### (2) Corrosion resistance on cut end

Presented below are the results of an investigation of long-term corrosion resistance on cut end. ZAM<sup>®</sup> shows better red-rust resistance (durability) on cut end than any other coated steel sheet.



Appearances of cut ends after salt spray test (Thickness : 3.2mm, coating weight : 120/120g/m<sup>2</sup>, untreated) 5mm

	Thickness	After 2 weeks	After 3 months	After 6 months
ZAM®	1.0mm			
	2.3mm			
55%Al-Zn alloy coated steel	1.0mm			
	2.3mm			
Zn-5%Al alloy coated steel	1.0mm			
	2.3mm			
Galvanized steel	1.0mm			
	2.3mm			

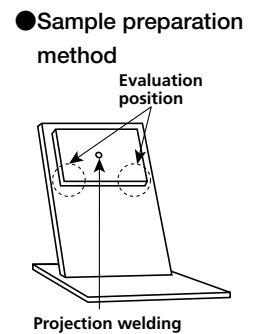
**Appearances of cut end sections after atmospheric exposure test**  
 (Industrial area : Sakai-city, Osaka-prefecture, Japan, Coating mass : 90/90g/m<sup>2</sup>, chromate treatment 50mg/m<sup>2</sup>)

The initial-period rust on the cut end due to exposure of ZAM® changes to a subdued color as time passes, showing better resistance to flowing rust than 55%aluminum-zinc alloy coated steel sheet (Galvastar).

	Thickness			
	1.0 mm	1.6 mm	2.3 mm	3.2 mm
ZAM®				
55%Al-Zn alloy coated steel				

Appearances of surface after outdoor exposure test lasting 2 years and 8 months  
 Exposure location : Coastal industrial areas in Sakai, Osaka.

Note : Red rust sometimes flows depending on the installation environment, the thickness, the cutting method, and other factors.

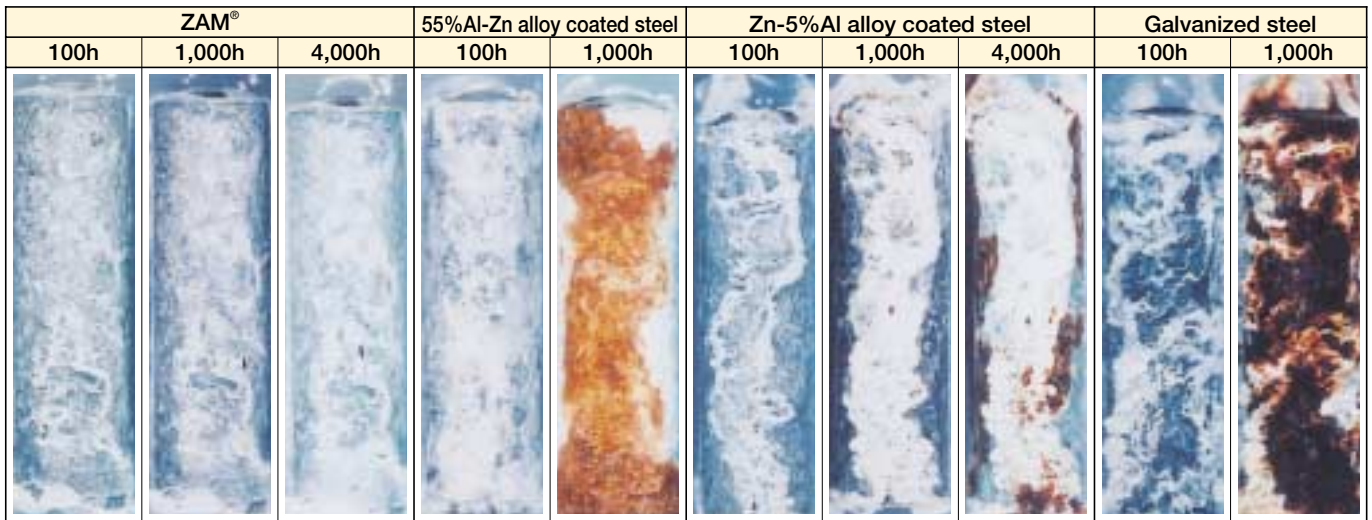


## Quality characteristics

### (3) Appearances of processed parts in a salt spray test (SST)

The photos show the occurrence of red rust on 1-mm-thick processed parts in salt spray test (SST).

Due to its excellent ability to prevent corrosion, ZAM<sup>®</sup> has better resistance to red rust on processed parts than 55%aluminum-zinc alloy coated steel sheet (Galvastar).

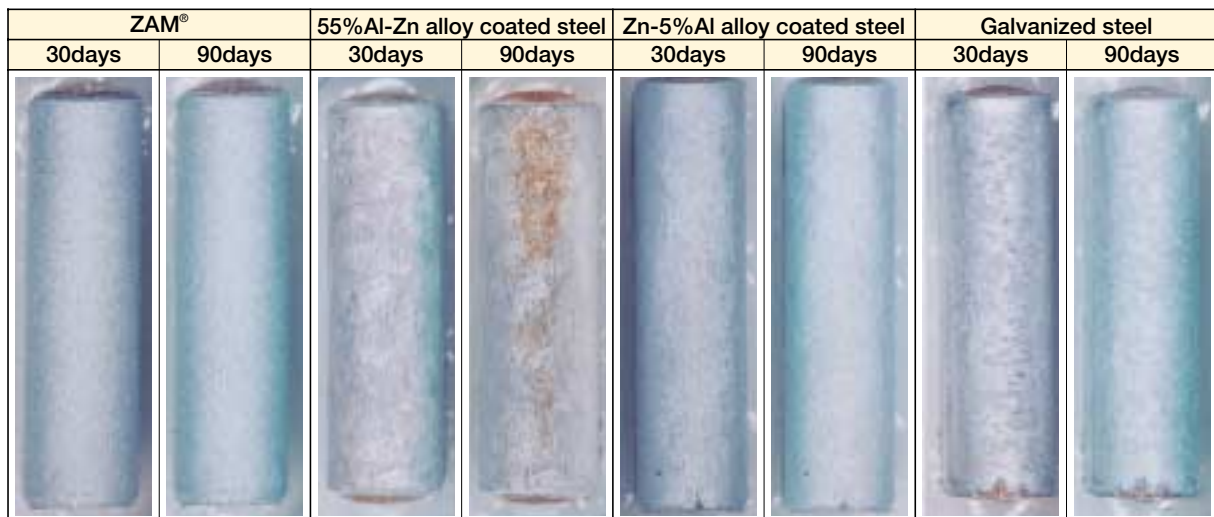


Appearances of 1-mm-thick processed part after salt spray test  
(Thickness 1mm, 180° bending, thickness : 3.2mm, 120/120g/m<sup>2</sup>, untreated)

5mm

### (4) Appearances of processed parts after outdoor exposure test

ZAM<sup>®</sup> shows excellent corrosion resistance even in processed parts.



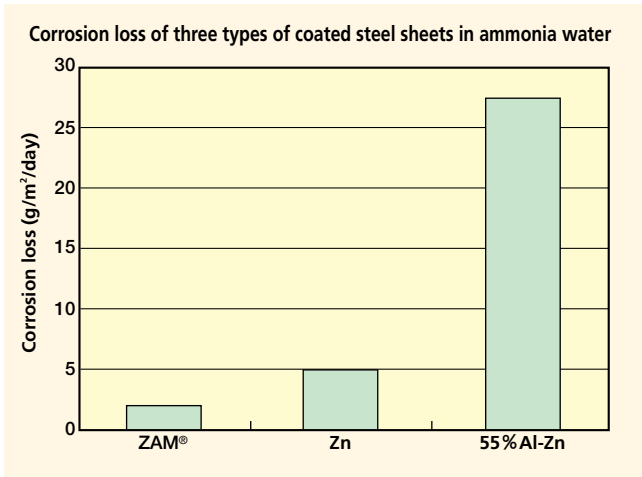
Appearances of 1-mm-thick processed part after 90-day exposure tests  
(Thickness 1mm, 180° bending, thickness : 3.2mm, 120/120g/m<sup>2</sup>, untreated)

5mm

### 3. Anti-chemical performance

#### (1) Ammonia resistance

**ZAM® has better ammonia resistance than other hot dip galvanized steel sheet (Paintite B) or 55%aluminum-zinc alloy coated steel sheet (Galvastar).**

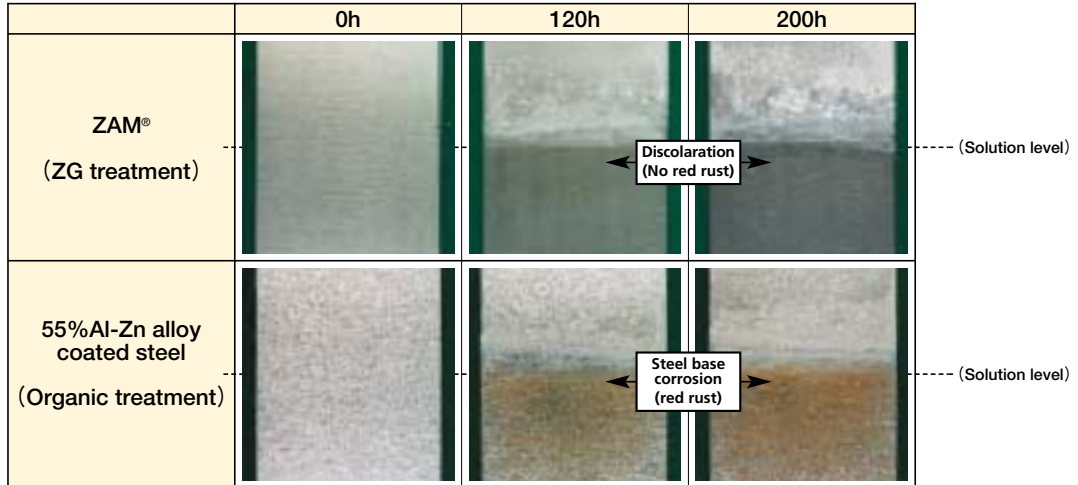


● Materials tested

	Type of coating	Coating weight	Substrate	Post-treatment
ZAM®	Zn-6%Al-3%Mg	90g/m <sup>2</sup> (one side)	Soft steel	Untreated
Galvanized steel	Zn	90g/m <sup>2</sup> (one side)	Soft steel	Untreated
55%Al-Zn alloy coated steel	55%Al-Zn	80g/m <sup>2</sup> (one side)	Soft steel	Untreated

● Testing conditions

After immersion for 24 hours in 5% ammonia water at 22°C, the corrosion loss was measured. The cut ends and the rear surfaces of the test piece were sealed.



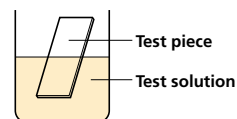
Appearances of test pieces after half-immersion test

● Materials tested

	Type of coating	Coating weight	Substrate	Chemical treatment
ZAM®	Zn-6%Al-3%Mg	90g/m <sup>2</sup> (one side)	Soft steel	ZG treatment : chromium free organic special treatment (2μm)
55%Al-Zn alloy coated steel	55%Al-Zn	AZ150 (90g/m <sup>2</sup> (one side))	Soft steel	Organic special treatment (2μm, chromium contained)

● Testing conditions

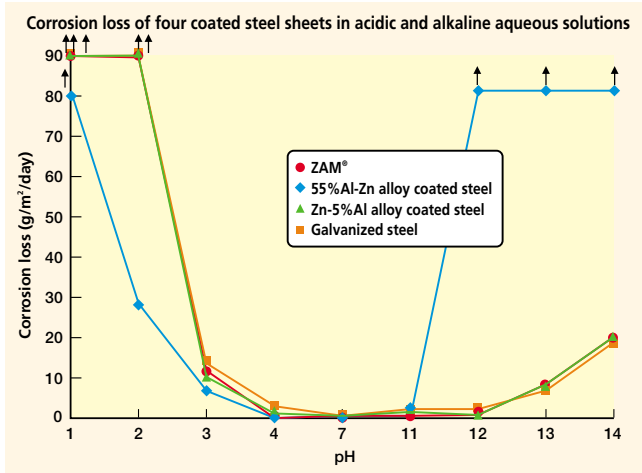
Ammonia solution concentration (pH)	Test stat	Temperature
10% (pH12.5)	Half immersion (liquid phase, gas phase)	Room temperature



## Quality characteristics

### (2) Resistance to chemicals (corrosion in acidic and alkaline aqueous solutions)

In acidic and alkaline aqueous solutions,  
**ZAM<sup>®</sup>** shows the same corrosion behavior as zinc-based coated steel sheet.



#### Materials tested

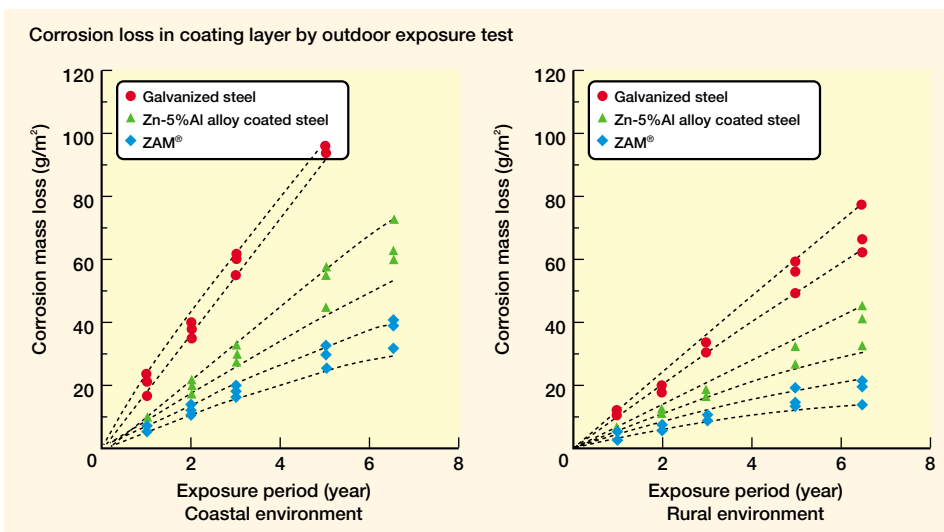
	Type of coating	Coating weight	Substrate	Post-treatment
ZAM <sup>®</sup>	Zn-6%Al-3%Mg	90g/m <sup>2</sup> (one side)	Soft steel	Untreated
55%Al-Zn alloy coated steel	55%Al-Zn	80g/m <sup>2</sup> (one side)	Soft steel	Untreated
Zn-5%Al alloy coated steel	Zn-5%Al	90g/m <sup>2</sup> (one side)	Soft steel	Untreated
Galvanized steel	Zn	90g/m <sup>2</sup> (one side)	Soft steel	Untreated

#### Testing method

- Solution : Starting with an aqueous solution containing 1g/liter Na<sub>2</sub>SO<sub>4</sub> as the base mix, its pH was varied from 1 to 14 by adding H<sub>2</sub>SO<sub>4</sub> on the acidic side and NaOH on the alkaline side.
- To measure 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. Ends and bottom surface of the test pieces were sealed.

## 4. Outdoor exposure test results

According to results of exposure tests conducted over a period of approximately seven years, ZAM<sup>®</sup> is four times as corrosion-resistant as galvanized steel sheet (Paintite B). Since corrosion mass loss of zinc-aluminum coated steel sheet tends to lessen over time, the superiority of ZAM<sup>®</sup> in this respect is likely to become more pronounced in subsequent years.

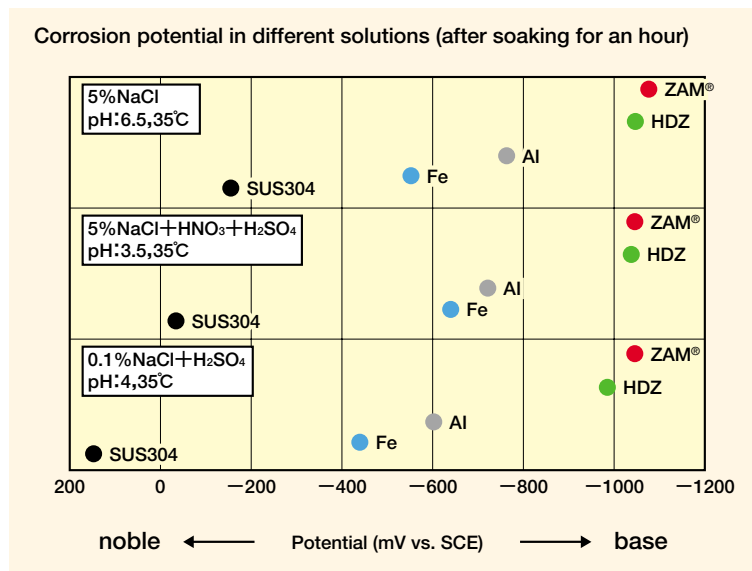


#### Outdoor exposure test site

	Exposure site
Coastal environment (approx. 30 m from the seashore)	Okinawa Prefecture Nakagusuku mura
Rural environment	Gunma Prefecture Kiryu city

## 5. Corrosion potential

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



### ● Details of specimens for test

Test specimens	coating weight (test side, g/m <sup>2</sup> )
ZAM <sup>®</sup>	200
Post hot dip galvanized	400~500
Al (Aluminum)	—
SUS304	—

### ● Corrosion potential test solution

Solution	pH	Temperature	Remarks
5% NaCl	6.5	35	Solution specified in JIS Z2371; Salt spray test
5% NaCl + HNO <sub>3</sub> + H <sub>2</sub> SO <sub>4</sub> *1	3.5	35	Solution specified in JIS H8502; Cyclic artificial acid rain test
0.1% NaCl + H <sub>2</sub> SO <sub>4</sub> *2	4	35	Solution specified in acid rain simulated combined-cycle corrosion test (see P.20)

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

\*1) 5% NaCl(10L)+HNO<sub>3</sub>(12mL)+H<sub>2</sub>SO<sub>4</sub>(17.3mL), pH adjusted by NaOH.

\*2) H<sub>2</sub>SO<sub>4</sub> is added to 0.1NaCl solution to adjust to pH to 4.

## Quality characteristics











### 6.The results of corrosion resistance comparison with post hot dip galvanized products

#### (1) Results of corrosion resistance comparison with post hot dip galvanized products (HDZ55 : JIS H8641).

ZAM<sup>®</sup> exhibits better corrosion resistance with only 1/6 coating weight of post hot dip galvanized products. (From results of various accelerated tests)











- As anti-rust technology that can replace post hot dip galvanized products, the certification for the architecture execution technology and the technology examination has been obtained at the Japan Architecture Center and the construction technology examination certification has been obtained at the Civil Engineering Research Center (page 29). (Applies to: ZAM<sup>®</sup> coating weight symbol  $\geq 120$ )

**ZAM<sup>®</sup> shows better corrosion resistance than hot dip galvanized (HDZ55) sheet in salt spray test.**

	500h	1,000h	2,000h	3,000h	4,000h
<p>ZAM<sup>®</sup></p> <p>Thickness 2.3mm 90g/m<sup>2</sup> (one side)</p>					
<p>Post hot dip galvanized products (HDZ55)</p> <p>Thickness 2.3mm 560g/m<sup>2</sup> (one side)</p>					

Surface appearances (flat part) of two types of coated steel sheets in salt spray test

20mm

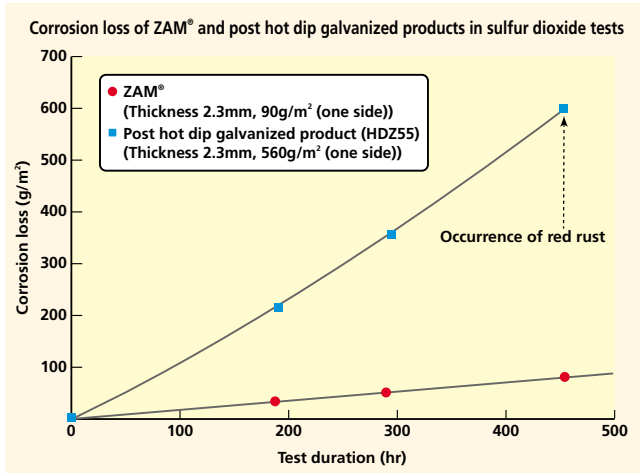
	500h	1,000h	2,000h	3,000h	4,000h
<p>ZAM<sup>®</sup></p> <p>Thickness 2.3mm 90/90g/m<sup>2</sup></p>					
<p>Post hot dip galvanized products (HDZ55)</p> <p>Thickness 2.3mm 560/560g/m<sup>2</sup> (one side)</p>					

Surface appearances (cut ends) of two types of coated steel sheets in salt spray test

10mm

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

**ZAM® shows better corrosion resistance than post hot dip galvanized products (HDZ55) in a sulfur dioxide (sulfurous acid gas) environment.**



Sulfur dioxide test conditions  
 Sulfur dioxide concentration : 100 ppm  
 Testing temperature : 40°C  
 Relative humidity : 98% or more  
 (conforms to JIS H8502)

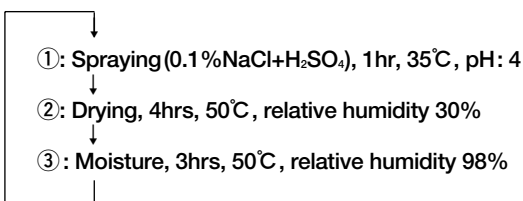


Appearances after 450 hours of sulfur dioxide test

10mm

**ZAM® shows better corrosion resistance than post hot dip galvanized products (HDZ55) in acid-rain environment.**

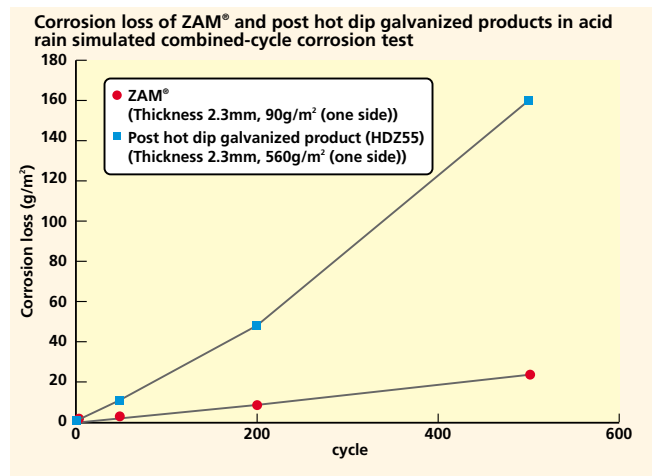
● Acid rain simulated combined-cycle corrosion test conditions



● Corrosion rate of ZAM® and post hot dip galvanized products in acid rain simulated combined-cycle corrosion test

	Corrosion rate
ZAM®	0.05g/m²/cycle
Post hot dip galvanized products	0.35g/m²/cycle

Note : Mean value at 500 cycles



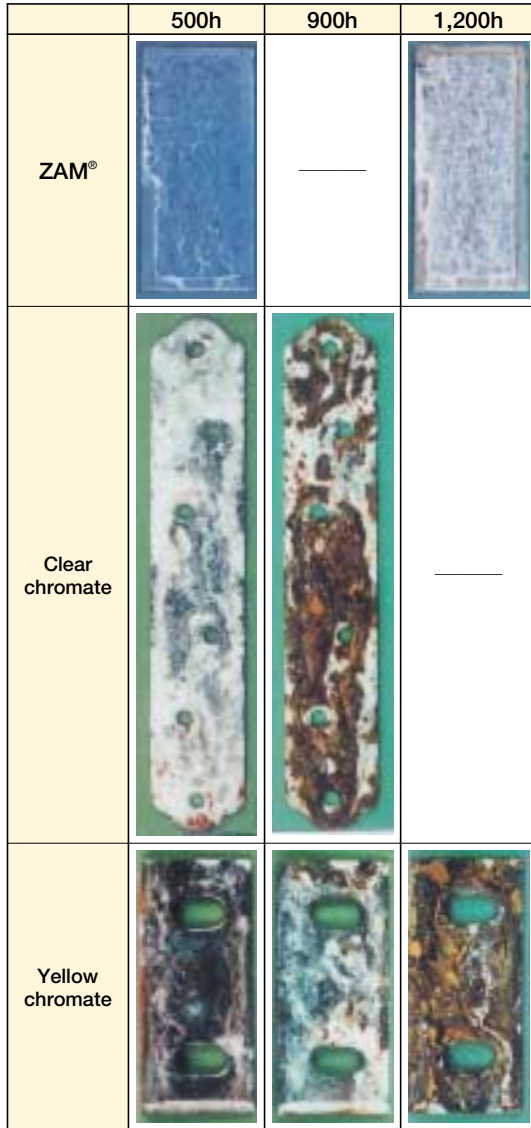
● Materials tested

Classification	Type of coating	Coating weight	Substrate	Post-treatment
ZAM®	Zn-6%Al-3%Mg	90g/m² (one side)	Soft steel	Untreated
Post hot dip galvanized products	Zn	HDZ55 (560g/m²) (one side)	Soft steel	Untreated

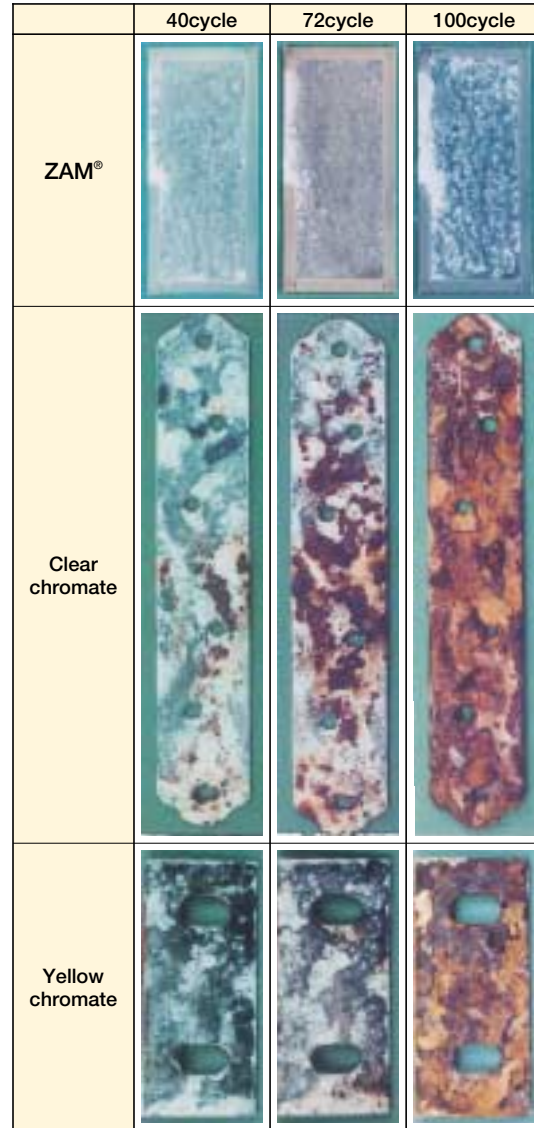
## Quality characteristics

### (2) Comparison with chromate coatings

ZAM<sup>®</sup> shows better corrosion resistance than post galvanized steel with chromate conversion coatings under severe salt water environment.



Appearances of coated steel sheets after salt-spray test



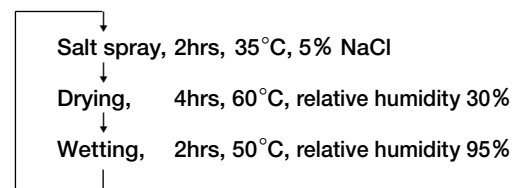
After combined-cycle corrosion test

#### ● Materials tested

No.	Type of coating	Coating weight	Substrate	Chromium weight
1	ZAM <sup>®</sup>	90g/m <sup>2</sup> (one side)	Soft steel	0mg/m <sup>2</sup> (Untreated)
2	Clear chromate	44g/m <sup>2</sup> (one side)	Soft steel	36mg/m <sup>2</sup>
3	Yellow chromate	39g/m <sup>2</sup> (one side)	Soft steel	241mg/m <sup>2</sup>

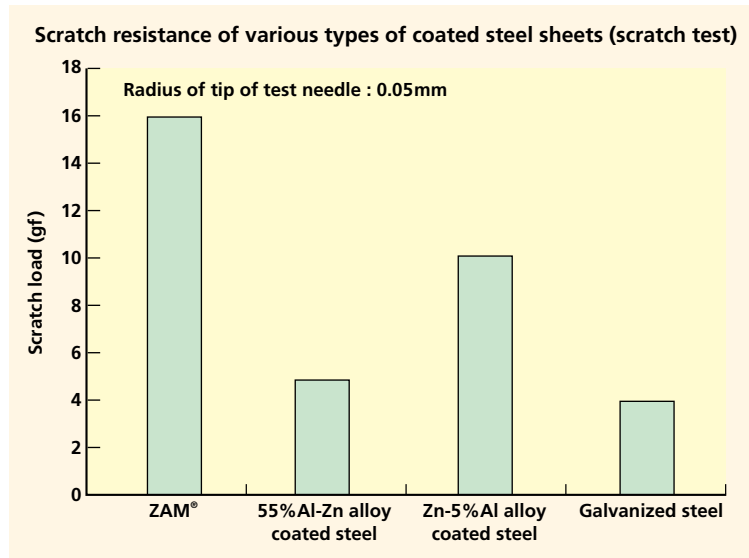
#### ● Method of combined-cycle corrosion test

JASO M609-91



## 7. Scratch resistance of the coating layer

ZAM<sup>®</sup> has harder coating layer than hot dip galvanized steel sheet or hot dip 55%aluminum-zinc alloy coated steel sheet, which gives it better scratch resistance and allows it to be used in applications that are subject to scratching and repeated friction during processing.



• How the scratching load was measured

A sapphire testing needle having a tip radius of 0.05mm was pressed vertically against the test piece with a force of 0.0196-0.196 N (2-20gf). The needle scratched across the test piece for a distance of 20mm. After the surface was visually examined for any scratching, and the minimum load that produced scratching was taken as the scratching load.

● <Reference> Hardness of the coating layer (Vickers hardness (Hv) : measurement examples)

ZAM <sup>®</sup>	140~160Hv
55%Al-Zn alloy coated steel	100~110Hv
Zn-5%Al alloy coated steel	80~100Hv
Galvanized steel	55~ 65Hv

## Quality characteristics

### 8. Weldability

Like other zinc coated steel sheet, weldability of ZAM® is affected by the coating layer which is of a low-melting-point metal. In arc welding, this results in more problems than uncoated steel sheet such as increased spattering and blowholes. However, if the conditions are properly selected, joints can be obtained that present no problems in junction strength. In spot welding too, the selection of the right welding conditions ensures adequate strength. Welding is also affected by such factors as the welding machine and the shape of the joint, hence welding tests are recommended. Please contact our technical service department for further details.

#### (1) Arc welding

##### 1. Welding machine

ZAM® can be welded with any commercial welding machine. Welding environment can be improved with the use of inverter-controlled welding machines sold in the market.

##### 2. Welding wire

Welding wires for ordinary 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 welding wires for class 400N substrate

Substrate (class 400N)	Recommended welding wire brand (Shielding gas: Carbon dioxide)
Hot or cold rolled sheets	Kobe Steel, Ltd.:MG50T, Nippon Steel Corporation:YM28, Daido Steel Co., Ltd.:DS1A etc. (Corresponding JIS YGW12)
Galvanized steel sheets	Kobe Steel, Ltd.:MG1Z, Nippon Steel Corporation:YM28Z, Daido Steel Co., Ltd.:DS1Z etc. (JIS YGW14 etc.)

● According to our test results, the welding wire most compatible with ZAM® is DS1Z made by Daido Steel Co., Ltd.

● Welding wires with flux suitable for carbon steel and structural steel of up to 490N/mm<sup>2</sup> class also work well.

(Examples Kobe Steel, Ltd.:DW-Z100, Nippon Steel Corporation:SM-1F, Neis Corporation:GC2Z-2 etc.)

● Please consult us when other substrates than 400N class are used.

##### 3. Shielding gas

Three-kind carbon dioxide provided for by JIS K1106 is used.

(When the combination of the pulse current and the Ar+20%CO<sub>2</sub> gas is used, the spatter tends to decrease.)

##### 4. Welding current and voltage

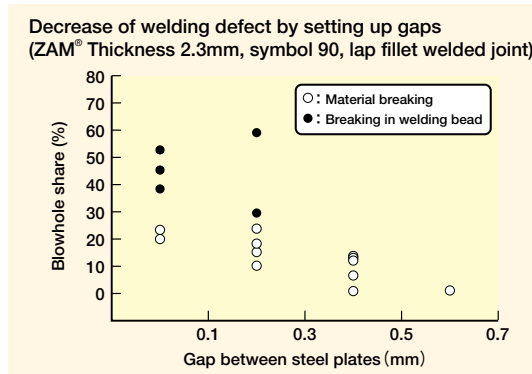
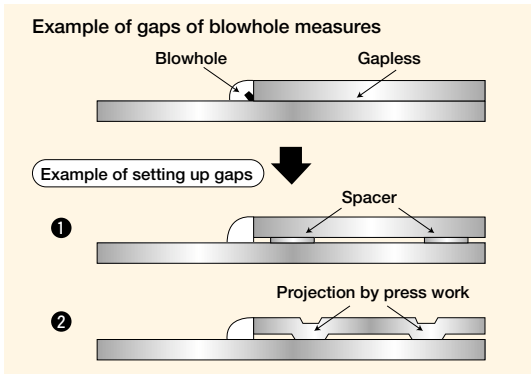
When welding ZAM® at the same speed as in the case of hot or cold rolled steel sheet, the initial welding temperature should be set higher as more heat is absorbed by the evaporation of coating material. (current raised by 5-10%).

##### 5. Welding speed

When such defects as blowholes or pits are found, the welding speed should be set lower than in case of hot or cold rolled steel sheet. Good beads can be made if welding is carried out as though releasing zinc fume from the surface of the molten metal pool at the same time.

6. Setting up gaps

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



(2) Spot welding

The following diagram presents examples of spot welding conditions for various types of coated steel sheets.

Type	Welding current (kA)								
	5	6	7	8	9	10	11	12	13
Al coated steel sheet (30/30)	Lack of strength←			Optimum	→Expulsion			→Pick-up	
55%Al-Zn alloy coated steel sheet (50/50)	←			→			→		
Zn-5%Al alloy coated steel sheet (75/75)	←			→			→		
ZAM® (60/60)	←			→			→		
Galvanized steel sheet (40/40)	←			→			→		
Galvannealed steel sheet (40/40)	←			→			→		
Cold-rolled steel sheet	←			→			→		

▲ : nugget diameter=4√t (t: thickness), pressure applied: 200kgf, electrification time: 12cycles, thickness: 0.8mm, electrode shape: CF type, 6mm in diameter

Example of proper welding conditions for various steel sheets (Figures in parentheses are the coating weight in g/m<sup>2</sup>)

- In spot welding of coated steel sheet, the melting of the coated layer expands the electric-current path, making it necessary to have a greater welding current than with cold-rolled steel sheet.
- The copper alloy of the electrodes and the zinc of the coating react with each other, cause the electrodes to wear away, and shorten the life of the electrodes; this makes it necessary to ascertain the life of the electrodes beforehand and to periodically dress and replace them.

● Touch-up painting

The weld is in a bare state with no coating layer.

If it is necessary to ensure the corrosion resistance of the weld, touch-up painting is recommended. (see p.25)









Please contact our technical service department for further details.

## Quality characteristics

### 9.Touch-up painting (solvent)

A Zn-Al-based paint is recommended for touch-up of welds.

(1) Results of an investigation of corrosion resistance (example)

Paint	Number of cycles			
	0	100	150	200
Zn-based				
Zn-Al-based				

Appearances of surface of touch-up painted part after combined-cycle corrosion test  
(Thickness : 2.3mm, coating weight : 85g/m<sup>2</sup> (one side))



- Sample welding method
  - Welding method : CO<sub>2</sub> arc welding
  - Joint shape : butt welding

- Painting method
  - Pre-treatment : wire brush
  - Degreasing : organic solvent
  - Painting : brushed on
  - Drying : 60°C, 10 minutes
  - Thickness of painting layer : 40 μm

- Testing method  
JASO M609-91
- ```

graph TD
    A[Testing method  
JASO M609-91] --> B[Salt spray 2 hrs, 35°C, 5%NaCl]
    B --> C[Drying 4 hrs, 60°C, relative humidity 30%]
    C --> D[Moisture 2 hrs, 50°C, relative humidity 95%]
  
```

(2) Appearances of touch-up painted ends after combined cycle corrosion test

| Paint       | Test duration (cycle)                                                               |                                                                                     |
|-------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|             | 100                                                                                 | 200                                                                                 |
| Zn-Al-based |  |  |

Surface appearances of touch-up painted ends after combined-cycle corrosion test  
(Thickness : 2.3mm, coating weight : 85g/m<sup>2</sup> (one side))

#### ● Examples of touch-up paint

| No. | Paint name                       | Manufacturer                                   | Type of paint | Color  |
|-----|----------------------------------|------------------------------------------------|---------------|--------|
| 1   | Royal Silver                     | Royal Corporation                              | Zn-Al based   | silver |
| 2   | Zinky Special                    | Nippon Paint Anti-corrosive Coatings Co., Ltd. | Zn-Al based   | silver |
| 3   | O-well Mekki Silver (ZAM® color) | Nihon Ruspert Co., Ltd.                        | Zn-Al based   | silver |

#### • Attention

1. Details about touch-up paints including their proper use, quality characteristics and compatibility with environmental regulations should be checked with respective makers.
2. There are other products than those listed above that have achieved the architecture execution technology and technology examination certification.
3. In some cases, painting is not possible over touch-up paints. Please be sure to check beforehand.

## 10. After-paintability

ZAM® can be painted in the same way as other coated steel sheets.

If long-term durability following painting is required, it is recommended that pre-treatment for painting be performed as shown in the following.

### ● Test material specifications and post-coating method

|                     | Base sheet                 | Type of coating | Nominal coating weight | Post-treatment | Post-coating process                                                                                                                                  |
|---------------------|----------------------------|-----------------|------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tested material     | ZAM®                       | Zn-6%Al-3%Mg    | 90                     | Untreated      | Alkali degreasing or solvent degreasing → Zinc phosphate treatment → Painting → Baking-on or normal-temperature drying<br>(Rinsing) (Rinsing, drying) |
| Comparison material | Zn-5%Al alloy coated steel | Zn-5%Al         | 190                    | Untreated      |                                                                                                                                                       |
|                     | Galvanized steel           | Zn              | 190                    | Untreated      |                                                                                                                                                       |

Notes: 1: Zinc phosphate treatment solution: Nippon Parkerizing Co. Balbond 138, 60°C for 60 seconds

2: In the ZAM® and Zn-5%Al zinc phosphate treatment, the Al in the coating layer dissolves, making it necessary to control the treatment solution

### ● Examples of evaluation results on primary adhesion of paint films

| No. | Paint film primary adhesion |         |    | Resin-based/<br>number of coats             | Post-coat     |                                                                |                           |
|-----|-----------------------------|---------|----|---------------------------------------------|---------------|----------------------------------------------------------------|---------------------------|
|     | ZAM®                        | Zn-5%Al | Zn |                                             | Manufacturer  | Paint/paint film thickness                                     | Drying method             |
| 1   | ○                           | ○       | ○  | Acrylic resin/1coat                         | Nippon Paint  | Super Lac F-50/30 μm                                           | Baking on                 |
| 2   | ○                           | ○       | ○  | Acrylic resin/2coats                        | Nippon Paint  | Primer : Orga 1000P-02/10 μm<br>Top coat : Super Lac 110/30 μm | Baking on                 |
| 3   | ○                           | ○       | ○  | Polyester resin/1 coat<br>(powder painting) | Nippon Paint  | Special-order product/50 μm                                    | Baking on                 |
| 4   | ○                           | ○       | ○  | Acrylic resin/1coat                         | Nippon Paint  | Nippon Paint acrylic/20 μm                                     | Normal-temperature drying |
| 5   | ○                           | ○       | ○  | Fluorine resin/2coats                       | Dainippon Ink | Primer : Primer E01/10 μm<br>Top coat : Dickflow A, D/30 μm    | Normal-temperature drying |

Notes: 1: Paint film primary adhesion evaluation method: checkerboard adhesion cellophane tape peeling test

2: Evaluation standard: Paintite B → relative evaluation, taking as the standard the case in which, following zinc phosphate treatment, the untreated surface is coated with the same paint ○: excellent, ◯: same, △: some degradation, ×: degradation

|                   | ZAM®                                                                                | Zn-5%Al                                                                             | Zn                                                                                  |
|-------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| SST<br>500h       |  |  |  |
| CCT,<br>62 cycles |  |  |  |
| BBT<br>500h       |  |  |  |

#### Testing conditions

- ① SST : according to JIS Z2371, continuous spraying with 5%NaCl at 35°C
- ② CCT : according to JASO M609-91, SST (2hr) → drying (4hr) → BBT (2hr)
- ③ BBT : 50°C, relative humidity 98%

#### Appearances of surface after testing painted material

Material tested : untreated material for each coated steel sheets  
 Painting pre-treatment : zinc phosphate treatment  
 Paint : Acrylic resin, 1coat (No.1),  
 Super Lac F-50 made by Nippon Paint

#### Precautions

1. As with Zn-5%Al alloy coated steel, it is necessary to control the treatment solution because the aluminum (Al) contained in the coating layer dissolves into the pre-treatment (zinc phosphate treatment) solution and lessens its 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.

## Quality characteristics

### 11. Chromium-free treatment

#### (1) ZC treatment. Chromium-free inorganic special treatment

① Superior compatibility with the environment

With its inorganic after-treatment involving no chromium at all, this material is gentle on the environment.

② Excellent electrical conductivity

The inorganic ZC treatment chromium-free layer has low electrical resistance and excellent surface conductivity.

This gives ZAM® the same electrical conductivity and suitability for spot welding as conventional materials.

③ Corrosion resistance

This chromium-free treated material has sufficient corrosion resistance on flat and machined parts (see photos).

#### Quality characteristics

| ZAM®                          |              | Corrosion resistance (SST 72hr)   | Contact resistance value (grounded) | Smudging resistance   | Alkali resistance | Solvent resistance |         |
|-------------------------------|--------------|-----------------------------------|-------------------------------------|-----------------------|-------------------|--------------------|---------|
| Type                          | Treatment    |                                   |                                     |                       |                   | Ethanol            | Acetone |
| Chromium-free                 | ZC treatment | White rust occurrence 10% or less | $10^{-5} \sim 10^{-4} \Omega$       | $\Delta L \leq 1$     | ○                 | ○                  | ○       |
| Corrosion-resistance chromate | A treatment  | White rust occurrence 10% or less | $10^{-5} \sim 10^{-4} \Omega$       | $\Delta L \leq 1$     | ○                 | ○                  | ○       |
| Untreated                     | Untreated    | —                                 | $10^{-5} \sim 10^{-4} \Omega$       | $\Delta L = 5 \sim 6$ | ○                 | ○                  | ○       |

Contact resistance value : measured by the four-terminal method (MCP-TPO3P made by Mitsubishi Chemical)

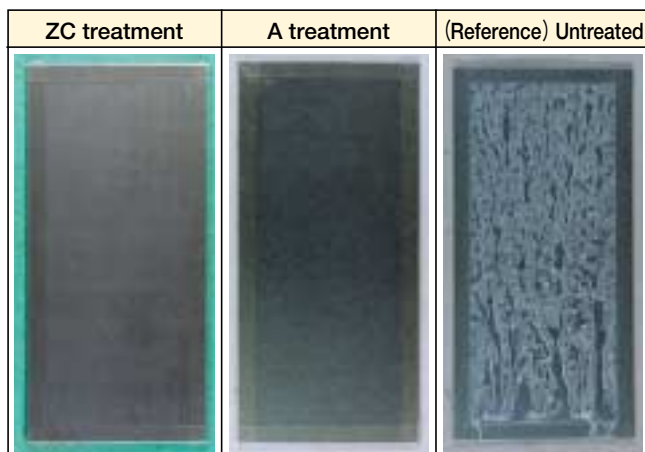
Smudging resistance : difference in brightness ( $\Delta L$ ) before and after impression with artificial finger-smudge solution (JIS K2246)

Alkali resistance : appearances after immersion for 2 minutes in alkali degreasing agent (SD-270 made by Nippon Paint) adjusted to a pH of 12 and a temperature of 40°C

Solvent resistance : appearances after rubbing 5 times with gauze impregnated with the solvent

(Evaluation standard/ ○ : no change, △ : some discoloration, × : paint film peeling)

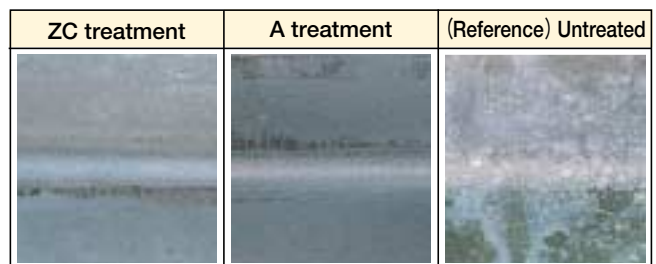
#### Corrosion resistance of flat part



Appearances after 72 hours of salt spray test (SST)

- No significant change of appearances is found in the ZC-treated material even with SST lasting 72 hours.

#### Corrosion resistance of processed part



Appearances of processed part after 24 hours of humidity cabinet test (BBT) (90° bend, bending radius : 1mm)

- No significant change of appearances is found in the ZC-treated material even with BBT lasting 24 hours.

(2) ZG treatment. Chromium-free organic special treatment

① Superior compatibility with the environment

With the chromium-free organic film, there is no elution of chromium (VI) compound and hence ZG-treated products are environment-friendly.

② Damage prevention at processing

Enhanced scratch resistance can be attained at roll forming and other processes.

③ Superior corrosion resistance

The special film provides better corrosion resistance both on flat and processed parts.

④ Good resistance to finger smudges

The fingerprint at handling is hardly visible.

Quality characteristics

| ZAM®                          |              | Elution of chromium | Corrosion resistance (SST 72hr)   | Scratch resistance | Contact resistance value (grounded) | Smudging resistance   | Alkali resistance | Solvent resistance (Acetone) |
|-------------------------------|--------------|---------------------|-----------------------------------|--------------------|-------------------------------------|-----------------------|-------------------|------------------------------|
| Type                          | Treatment    |                     |                                   |                    |                                     |                       |                   |                              |
| Chromium-free                 | ZG treatment | No elution          | White rust occurrence 10% or less | ◎                  | ∞                                   | $\Delta L \leq 0.5$   | ○                 | ○                            |
| Corrosion-resistance chromate | A treatment  | Elution             | White rust occurrence 10% or less | —                  | $10^{-5} \sim 10^{-4} \Omega$       | $\Delta L \leq 1$     | ○                 | ○                            |
| Untreated                     | Untreated    | —                   | —                                 | —                  | $10^{-5} \sim 10^{-4} \Omega$       | $\Delta L = 5 \sim 6$ | ○                 | ○                            |

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) = See under the right picture and under the left picture  
 Scratch resistance : Appearance of the coating layer at processing = See under the middle picture  
 Contact resistance value : Measured by the four-terminal method (MCP-TPO3P made by Mitsubishi Chemical)

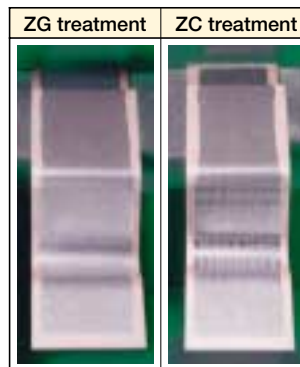
Fingerprint resistance : Difference in brightness ( $\Delta L$ ) before and after impression with artificial finger-smudge solution (JIS K2246)  
 Alkali resistance : Appearances after immersion for 2 minutes in alkali degreasing agent (SD-270 made by Nippon Paint) adjusted to a pH of 12 and a temperature of 40°C  
 Solvent resistance : Appearance after the specimen has been immersed for 2 minutes in Acetone (Evaluation standard/ ○ : no change,  $\Delta$  : some discoloration, X : paint film peeling)

Corrosion resistance of flat part

| After 72 hours |              | After 240 hours |              |
|----------------|--------------|-----------------|--------------|
| ZG treatment   | ZC treatment | ZG treatment    | ZC treatment |
|                |              |                 |              |

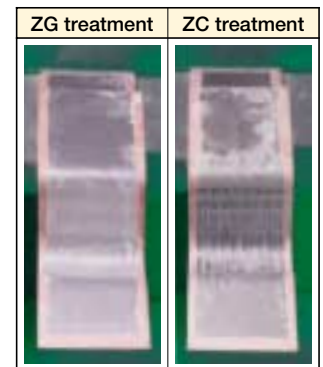
Surface appearance in salt spray test of flat part

Scratch resistance of processed part



Surface appearance

Corrosion resistance of processed part



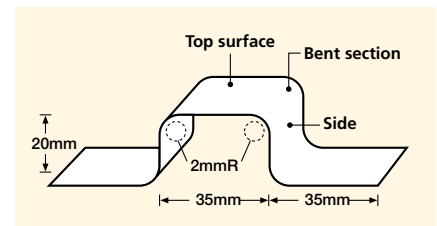
Surface appearances after 72 hour salt spray test (JIS Z2371)

Materials tested

- ZG treatment : Coating weight symbol 90, Thickness 0.8mm
- ZC treatment : Coating weight symbol 90, Thickness 0.8mm

Product shape

- Drawn into a hat-shaped section (See left fig.)



# Certificates

## 1. Architecture execution technology and technology examination certificate

Issued on October 2, 2000



We have obtained "Architecture execution technology and technology examination certificate (examination certification No.0004)" at the Japan Architecture Center, a certification body of the then-Minister of Construction and "Construction technology examination certificate (construction technology examination certificate No.0122) of the Civil Engineering Research Center. These awards attest that ZAM® "can replace post hot dip galvanized products having at least the equivalent corrosion resistance with only about one-sixth of the coating weight of post hot dip galvanized products," and "can be used in fields that could not have been properly serviced by conventional post hot dip galvanized products in terms of corrosion resistance."

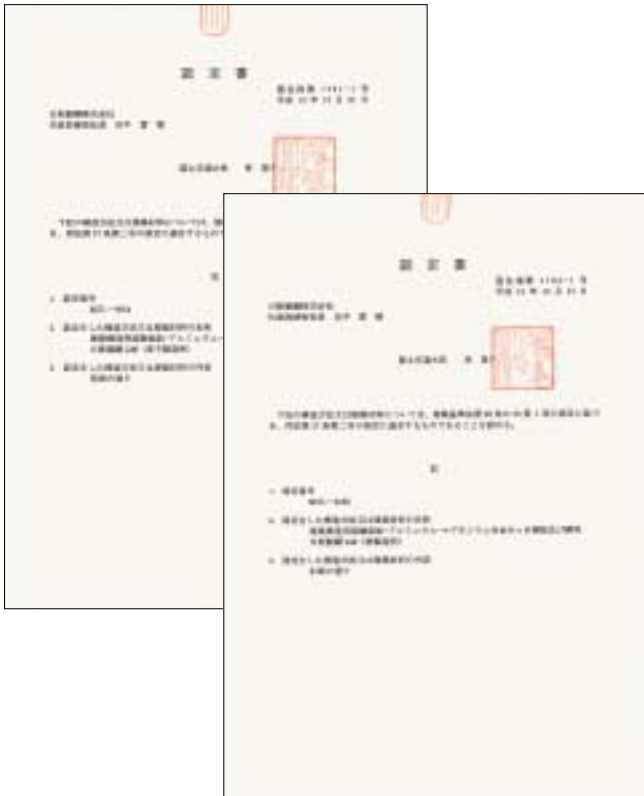
## 2. Construction technology examination certificate

Issued on March 18, 2002



### 3. Architecture Standards Law certificate

Issued on December 21, 2001



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

### 4. Special evaluation certificate under the Law Concerning Promotion of Housing Quality Assurance, Etc.

Issued on June 7, 2005



Under the provisions of the "Quality Assurance Law," certification by the Minister of Land Infrastructure and Transport has been obtained for special evaluation methods for 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.

### 5. NETIS

May 10, 2001 Registration



### Registration of NETIS (New Technology Information System)

NETIS (New Technology Information System) is a database of new technologies developed by the private sector and is managed by the Ministry of Land Infrastructure and Transportation so that useful new technologies may be proactively utilized and disseminated through public works and other means. ZAM® is registered in this database.

(Registration number: KT-010029)

## 1.Types and symbols

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

### ●Types and symbols (in case of hot-rolled substrate)

| Standard         | Type           |   |                           | Application |                               |
|------------------|----------------|---|---------------------------|-------------|-------------------------------|
|                  | Product symbol | — | Base sheet classification |             |                               |
| Company standard | MSM            | — | H                         | C           | General use                   |
|                  | MSM            | — | H                         | D*          | For 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                         | K570*       | Class 570N for structural use |
|                  | MSM            | — | H                         | K590*       | Class 590N for structural use |

Remark : Please contact us about the products marked with an asterisk (\*) and those that are not listed here.

### ●Types and symbols (in case of cold-rolled substrate)

| Standard         | Type           |   |                           |                    | Application                   |
|------------------|----------------|---|---------------------------|--------------------|-------------------------------|
|                  | Product symbol | — | Base sheet classification | Application symbol |                               |
| Company standard | MSM            | — | C                         | C                  | General use                   |
|                  | MSM            | — | C                         | D                  | For drawing                   |
|                  | MSM            | — | C                         | E                  | For deep drawing              |
|                  | MSM            | — | C                         | U*                 | For 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 |

## 2.Surface finish

The standard surface finish is temper-rolled and dull.

## 3.Coating mass

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

### ●Minimum coating mass (total mass on both surfaces)

| Symbol (Nisshin's standard-1) | Minimum average coating mass in triple-spot test (g/m <sup>2</sup> ) | Minimum coating mass at a single spot (g/m <sup>2</sup> ) | Symbol (Nisshin's standard-2) | Minimum average coating mass in triple-spot test (g/m <sup>2</sup> ) |
|-------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------|----------------------------------------------------------------------|
| K 06*                         | 60                                                                   | 51                                                        | 45                            | 70                                                                   |
| K 08                          | 80                                                                   | 68                                                        | 60                            | 90                                                                   |
| K 10                          | 100                                                                  | 85                                                        | —                             | —                                                                    |
| K 12                          | 120                                                                  | 102                                                       | —                             | —                                                                    |
| K 14                          | 140                                                                  | 119                                                       | 90                            | 140                                                                  |
| K 18                          | 180                                                                  | 153                                                       | 120                           | 190                                                                  |
| K 20                          | 200                                                                  | 170                                                       | —                             | —                                                                    |
| K 22                          | 220                                                                  | 187                                                       | 150                           | 230                                                                  |
| K 25                          | 250                                                                  | 213                                                       | —                             | —                                                                    |
| K 27                          | 275                                                                  | 234                                                       | 190                           | 290                                                                  |
| K 35*                         | 350                                                                  | 298                                                       | —                             | —                                                                    |
| K 45*                         | 450                                                                  | 383                                                       | 300*                          | 500                                                                  |

- Coating weight can be ordered by Nisshin standard-1 or 2
- Nisshin's standard-2 describes coating weight on one side
- Items marked \* are subject to confirmation

## 4.Chemical conversion treatment and oiling

Chemical conversion treatments and oiling are performed according to the following table. In addition to the usual chromate treatment, environment friendly chromium-free treatments are also available.

### ●Chemical conversion treatment types and symbols

| Chemical conversion treatment           | Symbol |
|-----------------------------------------|--------|
| Untreated                               | M      |
| High corrosion-resistance chromate      | A      |
| Chromium-free treatment                 | ZC     |
| Chromium-free organic special treatment | ZG     |

Remark : Consult us concerning items not listed above.

### ●Oiling types and symbols

| Type of oiling | Symbol    |
|----------------|-----------|
| Oiling         | O         |
| No oiling      | No symbol |

## 5. Mechanical properties

Products that satisfy the following properties can be manufactured.

### (1) Bendability

If the bendability of flat sheets and coils is tested according to the following table, coating peeling, cracking of the substrate (to the extent it can be confirmed with the naked eye), or ruptures should not occur on the surface (the part excluding min. 7mm respectively along the both longitudinal edges of the test piece).

#### ● Bendability

| Symbol of the type<br>(cold- or hot-rolled base sheets) | Bending angle 180°               |                                                     |                                     |
|---------------------------------------------------------|----------------------------------|-----------------------------------------------------|-------------------------------------|
|                                                         | Nominal thickness<br>under 1.6mm | Nominal thickness<br>1.6mm and over and under 3.0mm | Nominal thickness<br>3.0mm and over |
| General use                                             | 1                                | 1                                                   | 2                                   |
| For drawing                                             | 1                                | 1                                                   | —                                   |
| For deep drawing<br>For ultra-deep drawing              | 0                                | 0                                                   | —                                   |
| Class 370N for structural use                           | 1                                | 1                                                   | 2                                   |
| For 390, 400N for structural use                        | 2                                | 2                                                   | 3                                   |
| For 440, 490, 540N for structural use                   | 3                                | 3                                                   | 3                                   |
| For 590N for structural use                             | —                                | —                                                   | —                                   |

Remarks : 1. In case of hot rolled substrate, nominal thicknesses of 1.6 mm and over apply.  
2. The figures in the table are the number of sheets of the nominal thickness at the inside spacing of the bend.  
3. Deep drawing and ultra-deep drawing columns apply only to cold rolled substrate.  
4. In the case of K35 or K45 are subjected to confirmation.

### (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                   | Item     | Yield point<br>(N/mm <sup>2</sup> ) | Tensile strength<br>(N/mm <sup>2</sup> )                       | Elongation             |         |
|-------------------------------|----------|-------------------------------------|----------------------------------------------------------------|------------------------|---------|
|                               |          |                                     |                                                                | Nominal thickness (mm) | (%)     |
| For drawing                   | —        | —                                   | 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 |
| For deep drawing              | —        | —                                   | min. 270                                                       | 0.5 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 |
| For ultra-deep drawing        | —        | —                                   | 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<br>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                            |                                                                | —                      | —       |

Remark : "Deep drawing and for ultra-deep drawing" apply only to cold-rolled steel sheet.

## 6. Size tolerances

### (1) Thickness tolerances

In case substrate gauges are the nominal thicknesses, the following coating thickness should be added to such respective nominal thicknesses to identify the applicable size tolerances. (Before coating thickness)

In case coated sheet gauges are the nominal thicknesses, size tolerances for such nominal thicknesses apply. (After coating thickness)

The thickness tolerance is according to the following table. The thickness is measured at any point no less than 25mm from the side edge.

#### ● Thickness tolerances

[In case of cold-rolled substrate]

(unit : mm)

| Nominal thickness        | Width     |                    |                      |                      |
|--------------------------|-----------|--------------------|----------------------|----------------------|
|                          | under 630 | 630 to under 1,000 | 1,000 to under 1,250 | 1,250 to under 1,600 |
| 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 25mm from the side edge

[In case of hot rolled substrate]

(unit : mm)

| Nominal thickness        | Width              |                      |
|--------------------------|--------------------|----------------------|
|                          | 600 to under 1,200 | 1,200 to under 1,350 |
| 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 25mm from the side edge

#### ● Corresponding coating thickness

(unit : mm)

| Coating weight label symbol                           | K06   | K08   | K10   | K12   | K14   | K18   | K20   | K22   | K25   | K27   | K35   | K45   |
|-------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Corresponding coating thickness (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 weight label symbol                           | 45    | 60    | —     | —     | 90    | 120   | —     | 150   | —     | 190   | —     | 300   |
| Corresponding coating thickness (total of both sides) | 0.015 | 0.020 | —     | —     | 0.030 | 0.040 | —     | 0.050 | —     | 0.063 | —     | 0.100 |

### (2) Width and length tolerances

The width tolerances are shown in the following table.

#### ● Width tolerances

| Mode                       | Width tolerance |
|----------------------------|-----------------|
| Wide coils and flat sheets | +2%, -0         |
|                            | +10mm, -0       |
|                            | +7mm, -0        |
|                            | +3mm, -0        |
| Cut coils                  | ±0.5mm          |
|                            | ±0.3mm          |

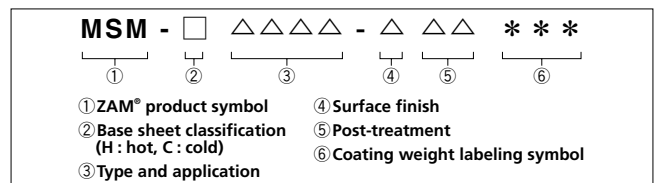
The length tolerances are shown in the following table.

#### ● Length tolerances (flat sheets)

| Length tolerances (mm) |
|------------------------|
| +X, -0                 |

Remark : X may be set anywhere in the range 2-15.

## 7. Standard labeling method



## 8. Label example

### ex1) MSM - HK400 - DA K27

Type : Hot rolled substrate class 400N for structural use

Post-treatment : High corrosion-resistant chromate treatment

Coating weight : K27 (symbol)

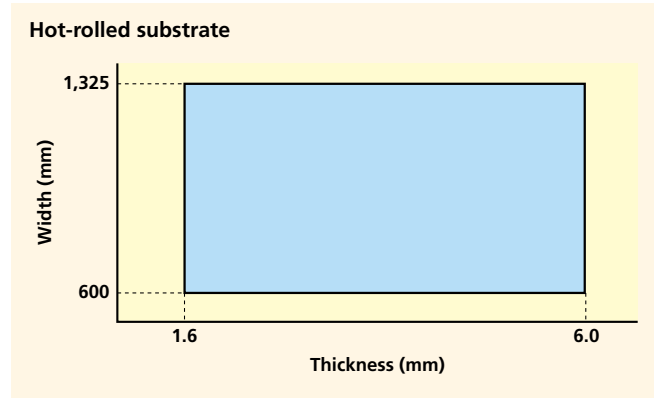
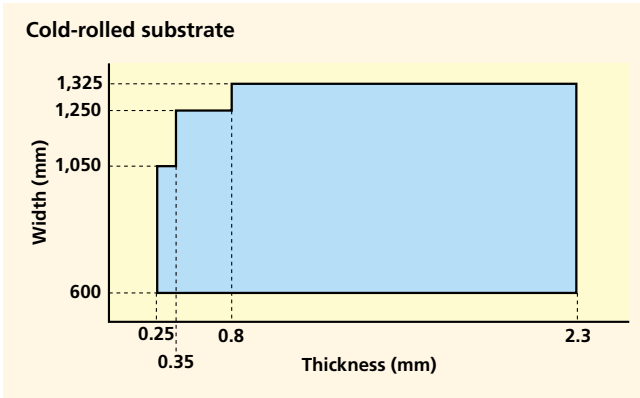
### ex2) MSM - CC - DZC 90

Type : Cold rolled substrate for general use

Post-treatment : chromium-free treatment

Coating weight : 90 (symbol)

# Available sizes



- Consult us about the details because the manufacturable range varies depending on the specifications.
- Thicknesses other than the above can also be manufactured so please consult us.

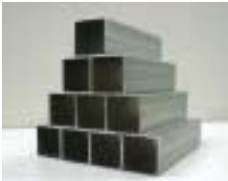
# Examples of processed products

(Examples of processing relating to our company and cooperating companies)

Round pipes



Angular pipes



Lightweight H-shaped steel



Processing example at the customer

Corrugated sheet



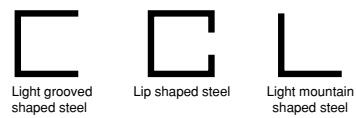
Punching metal



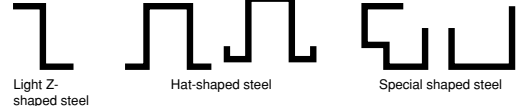
Non-slip metal



General structural material lightweight shaped steel



Special shaped steel



Pre-notch shaped steel





# Quality and quantity tables

## 1. Mass of cut sheets

The mass of cut sheets is expressed in kilograms and is stated as the calculated mass.

●ZAM® Mass table for coating weight symbol 60

| Coating weight symbol 60 | Coating weight                 |                     | 60                  |  |
|--------------------------|--------------------------------|---------------------|---------------------|--|
|                          | Nominal                        | 3×6                 | 4×8                 |  |
|                          | Width (mm)                     | 914                 | 1,219               |  |
|                          | Length (mm)                    | 1,829               | 2,438               |  |
| Area (m <sup>2</sup> )   | 1.672                          | 2.972               |                     |  |
| Coating weight constants |                                | 0.12                |                     |  |
| Thickness (mm)           | Unit mass (kg/m <sup>2</sup> ) | One-sheet mass (kg) | One-sheet mass (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 weight symbol 90

| Coating weight symbol 90 | Coating weight                 |                     | 90                  |  |
|--------------------------|--------------------------------|---------------------|---------------------|--|
|                          | Nominal                        | 3×6                 | 4×8                 |  |
|                          | Width (mm)                     | 914                 | 1,219               |  |
|                          | Length (mm)                    | 1,829               | 2,438               |  |
| Area (m <sup>2</sup> )   | 1.672                          | 2.972               |                     |  |
| Coating weight constants |                                | 0.18                |                     |  |
| Thickness (mm)           | Unit mass (kg/m <sup>2</sup> ) | One-sheet mass (kg) | One-sheet mass (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 weight symbol 120

| Coating weight symbol 120 | Coating weight                 |                     | 120                 |  |
|---------------------------|--------------------------------|---------------------|---------------------|--|
|                           | Nominal                        | 3×6                 | 4×8                 |  |
|                           | Width (mm)                     | 914                 | 1,219               |  |
|                           | Length (mm)                    | 1,829               | 2,438               |  |
| Area (m <sup>2</sup> )    | 1.672                          | 2.972               |                     |  |
| Coating weight constants  |                                | 0.24                |                     |  |
| Thickness (mm)            | Unit mass (kg/m <sup>2</sup> ) | One-sheet mass (kg) | One-sheet mass (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 weight symbol 190

| Coating weight symbol 190 | Coating weight                 |                     | 190                 |  |
|---------------------------|--------------------------------|---------------------|---------------------|--|
|                           | Nominal                        | 3×6                 | 4×8                 |  |
|                           | Width (mm)                     | 914                 | 1,219               |  |
|                           | Length (mm)                    | 1,829               | 2,438               |  |
| Area (m <sup>2</sup> )    | 1.672                          | 2.972               |                     |  |
| Coating weight constants  |                                | 0.38                |                     |  |
| Thickness (mm)            | Unit mass (kg/m <sup>2</sup> ) | One-sheet mass (kg) | One-sheet mass (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                 |  |

●ZAM® Mass table for coating weight symbol K08

| Coating weight symbol K08 | Coating weight                 |                     | K08                 |       |
|---------------------------|--------------------------------|---------------------|---------------------|-------|
|                           | Nominal                        |                     | 3×6                 | 4×8   |
|                           | Width (mm)                     |                     | 914                 | 1,219 |
|                           | Length (mm)                    |                     | 1,829               | 2,438 |
| Area (m <sup>2</sup> )    |                                | 1.672               | 2.972               |       |
| Coating weight constants  |                                | 0.120               |                     |       |
| Thickness (mm)            | Unit mass (kg/m <sup>2</sup> ) | One-sheet mass (kg) | One-sheet mass (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 weight symbol K14

| Coating weight symbol K14 | Coating weight                 |                     | K14                 |       |
|---------------------------|--------------------------------|---------------------|---------------------|-------|
|                           | Nominal                        |                     | 3×6                 | 4×8   |
|                           | Width (mm)                     |                     | 914                 | 1,219 |
|                           | Length (mm)                    |                     | 1,829               | 2,438 |
| Area (m <sup>2</sup> )    |                                | 1.672               | 2.972               |       |
| Coating weight constants  |                                | 0.203               |                     |       |
| Thickness (mm)            | Unit mass (kg/m <sup>2</sup> ) | One-sheet mass (kg) | One-sheet mass (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 weight symbol K18

| Coating weight symbol K18 | Coating weight                 |                     | K18                 |       |
|---------------------------|--------------------------------|---------------------|---------------------|-------|
|                           | Nominal                        |                     | 3×6                 | 4×8   |
|                           | Width (mm)                     |                     | 914                 | 1,219 |
|                           | Length (mm)                    |                     | 1,829               | 2,438 |
| Area (m <sup>2</sup> )    |                                | 1.672               | 2.972               |       |
| Coating weight constants  |                                | 0.244               |                     |       |
| Thickness (mm)            | Unit mass (kg/m <sup>2</sup> ) | One-sheet mass (kg) | One-sheet mass (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 weight symbol K27

| Coating weight symbol K27 | Coating weight                 |                     | K27                 |       |
|---------------------------|--------------------------------|---------------------|---------------------|-------|
|                           | Nominal                        |                     | 3×6                 | 4×8   |
|                           | Width (mm)                     |                     | 914                 | 1,219 |
|                           | Length (mm)                    |                     | 1,829               | 2,438 |
| Area (m <sup>2</sup> )    |                                | 1.672               | 2.972               |       |
| Coating weight constants  |                                | 0.381               |                     |       |
| Thickness (mm)            | Unit mass (kg/m <sup>2</sup> ) | One-sheet mass (kg) | One-sheet mass (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                 |       |



# Precautions in use

## 1. Precautions in use

### ● 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 marred, 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 of water or condensation on the products. If packaging paper is damaged, repair it.

### ● Processing

- If the surface is damaged during processing, it could adversely affect corrosion resistance and paintability. In pressing in particular, some types of lubricating oil could corrode the coating layer, therefore check the compatibility before use. When lubricant is used, perform degreasing or other post-treatment after the processing.
- Steel sheet tends to harden as time passes, which can degrade workability. To avoid this, use the steel sheet as soon as possible.

### ● Welding

- In resistance welding, proper care for the electrodes should be exercised to remove the zinc pickup.
- Because more zinc-oxide fume and spatters are generated as compared with hot and cold rolled sheets.

#### <Safety measures for welding galvanized steel sheets>

When welding galvanized 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;

1. increase in volume of fume generated by evaporating zinc, and
2. burns or fires caused by large volumes of spatters generated should be taken into account.

Especially, since fume is inevitable when welding galvanized 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)

### ● Cautions for preventing bimetallic corrosion

- (1) Direct contact between copper (including copper iron drops)/lead and ZAM® should be avoided.
- (2) Clasps and attachments of stainless steel (SUS304), aluminum, durable galvanized steel with heavy coating or prepainted products should be used.
- (3) In areas affected by salt damages or heavy snow, clasps and attachments of similar metals (aluminum, galvanized steel) should be used to the extent practicable. Stainless steel products should be treated with anticorrosive (sealing included) and insulations before use.
- (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: Galvanized Steel Sheet Committee, The Japan Iron & Steel Federation)

### ● Cautions for preventing contact corrosion with wood containing preservative/ant repellent

ZAM® should not be left in contact with wood containing preservative/ant repellent 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 under-thatch (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: Galvanized Steel Sheet Committee, The Japan Iron & Steel Federation.)

## 2. Guide to ordering

### ● Material, coating weight, post-treatment, oiling

- Select the material, coating weight, and post-treatment to fit your application. For the type of after-processing, you can separately choose either oiling or not oiling with rust-preventing oil. Select oiling to minimize lubrication during press processing, soiling, and scratching. Oiling is necessary for untreated.

### ● Size

- Design according to the available range described in this catalog. Contact us beforehand if your conditions for use require more stringent specifications. Please consult us about sizes outside the product availability.

### ● 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. Due to considerations of continuous, automatic operation and yield, we recommend that you 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.

## 3. The phenomenon of blackening of hot dip zinc-based coating

### ● Overview

- It is known from experience that hot dip galvanized steel sheet (non-alloy type) is subject to blackening, which is peculiar to this material. This phenomenon occurs regardless of the manufacturer of the material. Discoloration similarly occurs also in hot dip zinc-based alloy coated steel sheet.

### ● What is blackening?

- Blackening is a phenomenon in which the steel sheet appears black due to the presence of a very thin oxide film on the zinc surface layer. In hot dip galvanized steel sheet (non-alloy type), a very thin oxide film whose principal component is ZnO is formed on the zinc coating surface layer even immediately after manufacturing, but it has the property of changing and growing as time passes. From our experience thus far, we infer that this phenomenon of blackening 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 black appearance

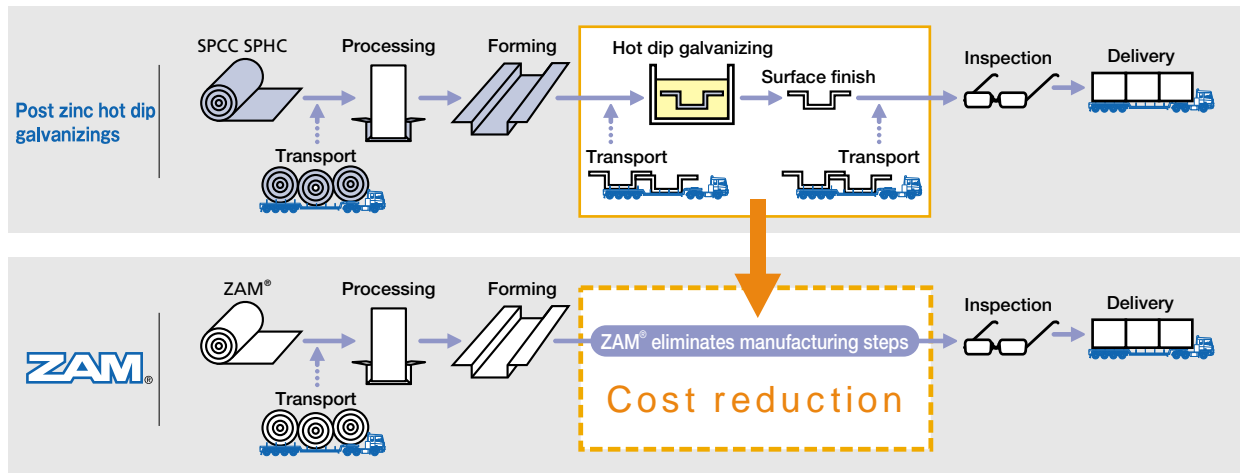
### ● The characteristics of blackening

- 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 blackening becomes noticeable varies. This blackening is unavoidable, but it is known to occur more readily under conditions of high temperature and high humidity. Blackening is just an oxidation phenomenon on the zinc coating layer, thus the quality of this part is normal except for its black appearance.

### ● What to do about blackening

- As stated above, blackening is an unavoidable phenomenon but we recommend the following methods of use. Oxidation of the coated surface can be delayed to some extent by applying oil to block its contact with the outside air. This phenomenon occurs while coils and cut sheets are kept in inventory. Therefore, these steel products should be used as soon as possible. Specific lengths of time have not been set because the rate at which blackening progresses varies depending on the environment in which the material is placed.

# Why **ZAM**® is recommended



## ZAM® is the right product of choice for customers looking for

- Better corrosion resistance and workability than offered by pre-coated products
- Better corrosion resistance, better cost performance and better environmental protection than offered by post hot dip galvanizing chromate treatments and other anticorrosive treatments
- Ways to eliminate downstream processes and simplify operations
- Ways to eliminate over specification and reduce overall cost

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