ECOKOTE™-S
Steel sheet coating with a tin-zinc alloy
Foreword

ECOKOTE™-S is a steel sheet that has been coated with an alloy of tin and zinc and is used in the manufacture of fuel tanks. ECOKOTE™-S harnesses the excellent corrosion-resistant properties of tin and zinc and offers superior corrosion-resistant performance compared with conventional metal products.

The diversification of automobile fuel continues apace, with fuel options such as ethanol-enriched gasoline and biofuels now readily available. ECOKOTE™-S possesses outstanding corrosion-resistance, even in these challenging corrosive environments (for example degraded biodiesel fuel and bioethanol-enriched gasoline, with its water content, are extremely corrosive), delivering a long service life for the fuel tank.

Moreover, ECOKOTE™-S contains no substances such as lead that place a burden on the environment. Fuel permeability (where the active organic substances contained in the fuel permeate through the tank material, resulting in a substance that causes atmospheric pollution) is completely prevented. ECOKOTE™-S can be completely recycled. The energy required to manufacture ECOKOTE™-S is small. These factors make it an ideal material to produce fuel tanks that is kind to the environment.

Characteristics

Product trend of Steel Sheet for the Manufacture of Fuel Tanks

ECOKOTE™-T
(Sn-Zn coated steel)

Terne Sheet
(Pb-Sn coated steel)

ALSHEET™
(Aluminum coated steel)

ECOKOTE™-S
(Sn-Zn coated steel)

Requirement:  
Lead-free

Requirement:  
Biofuel resistant

Developing a product to suitably meet the customer’s needs

Cross-Section Showing the Structure of ECOKOTE™-S

Chromate-free outer layer

Sn-Zn coating

Modified Coating Structure

Improved Corrosion-Resistance

Pre-processed layer

Steel

Contents

Characteristics .......................... 1
Examples of the Product in Use ........ 3
Manufacturing Location ................. 3
The Manufacturing Process .......... 4
List of Manufacturing Specifications .. 6
Product Quality ........................ 7
Precautions for Use .................... 8
Packaging and Labeling ............... 9
Order Guidelines ...................... 11
ECOKOTE™-S is an ideal material to produce fuel tanks that is kind to the environment.

- ZEV Regulations (USA)
- Stricter Regulations on Fuel Permeability
- Regulations on Substances that Place a Burden on the Environment
- ELV Regulations (Europe)
- Alliance of Automobile Manufacturers Voluntary Adoption (Japan)
- New Fuel efficiency Regulations
- Biofuels
- Kind to the Environment More fuel options
- Promotion of Recycling
- Lightweight
- Environmental needs that impact fuel tank materials
- Able to contain even the newest fuels without using substances that place a burden on the environment - a fuel tank materials with no fuel permeability, fully recyclable and capable of contributing to lightweight design.
- ECOKOTE™-S
- ALSheet™ (Aluminum coated steel)
- Terne Sheet (Pb-Sn coated steel)
- Plastic Resin

<table>
<thead>
<tr>
<th>Stricter Regulations on Fuel Permeability</th>
<th>Sheet steel means no fuel permeability</th>
<th>Inferior capability for preventing fuel permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promotion of Recycling</td>
<td>Sheet steel is simple to recycle</td>
<td>Not easy to recycle, degrades</td>
</tr>
<tr>
<td>Lightweight</td>
<td>Rigid composition means the same volume but a lighter weight</td>
<td></td>
</tr>
<tr>
<td>Regulations on Substances that Place a Burden on the Environment</td>
<td>Does not contain any substances that place a burden on the environment</td>
<td>Does not contain any substances that place a burden on the environment</td>
</tr>
<tr>
<td>Increase in Fuels that are Kinder to the Environment</td>
<td>Excellent corrosion-resistance</td>
<td>Some biofuels corrode this material; it has become an issue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The main concerns are permeability and degradability</td>
</tr>
</tbody>
</table>

**Characteristics of ECOKOTE™-S as a Fuel Tank Material (1)**

**Characteristics of ECOKOTE™-S as a Fuel Tank Material (2)**

<table>
<thead>
<tr>
<th>Internal Surface Corrosion Resistance</th>
<th>Degraded Gasoline</th>
<th>Degraded 20% FAME enriched</th>
<th>Degraded Ethanol enriched Gasoline</th>
<th>External Surface Corrosion</th>
<th>Press-Formability</th>
<th>Weldability</th>
<th>Paintability</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECOKOTE™-S (Sn-Zn coated steel)</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Fair</td>
<td>Excellent</td>
<td></td>
</tr>
<tr>
<td>ALSHEET™ (Aluminum coated steel)</td>
<td>Excellent</td>
<td>x</td>
<td>Fair</td>
<td>Fair</td>
<td>Fair</td>
<td>Excellent</td>
<td></td>
</tr>
<tr>
<td>Terne Sheet (Pb-Sn coated steel)</td>
<td>Fair</td>
<td>Fair</td>
<td>Fair</td>
<td>Excellent</td>
<td>Good</td>
<td>Excellent</td>
<td></td>
</tr>
</tbody>
</table>

**Examples of the Product in Use**

ECOKOTE™-S can be used for broadly any purpose where corrosion resistance is required. In particular, ECOKOTE™-S is suitable for fuel tank applications because it generates little corrosive products with fuel and it has a good formability. Moreover, due to its outstanding soldering characteristics, ECOKOTE™-S can also be used in the production of components for automobile radiators.

**Components for Automobiles**
- Gasoline Tanks
- Radiator Components, etc.

**Manufacturing Location**

A typical example of a saddle-shaped fuel tank.
The Manufacturing Process

The process to manufacture the steel coil

The Coating Process

Limestone
Iron Ore
Sintering Plant
Coal
Coking Plant
Blast Furnace
Basic Oxygen Furnace (Converter)
Continuous Casting
Heating
Finishing Mill
Pickling Line
Cold-Rolling Mill
C.A.P.L.
Cold Rolled Coil
Pay-Off Reel (Original Coil)
Welding Machine
Looper
Washer
Coating Measuring Device
Special Sublayer Processing Coating Layer
Cooling Device
Cooling Device
Gas Wiping
Looper
Looper
Tension Reel
Finished Product Coil

Coating Process
List of Manufacturing Specifications

1. Specifications and Mechanical Properties

<table>
<thead>
<tr>
<th>Material code</th>
<th>Tensile Strength (N/mm²)</th>
<th>Yield stress (N/mm²)</th>
<th>Elongation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.40≤t&lt;0.60</td>
<td>0.80≤t&lt;1.0</td>
<td>1.00≤t&lt;1.2</td>
</tr>
<tr>
<td>TZSC</td>
<td>2705</td>
<td>250〜370</td>
<td>240〜360</td>
</tr>
<tr>
<td>TZSD</td>
<td>2705</td>
<td>135〜235</td>
<td>125〜225</td>
</tr>
<tr>
<td>TZE</td>
<td>2705</td>
<td>130〜215</td>
<td>120〜205</td>
</tr>
<tr>
<td>TZSF</td>
<td>2605</td>
<td>120〜195</td>
<td>110〜185</td>
</tr>
</tbody>
</table>

Note: The tensile test sample was a piece of JIS No. 5 in the direction of the rolling.

2. Coating Weight

<table>
<thead>
<tr>
<th>Spec Code for Coating Weight</th>
<th>3 Part Minimum Coating Weight (Single Surface)</th>
<th>3 Part Maximum Coating Amount (Single Surface)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30/30</td>
<td>30g/m²</td>
<td>50g/m²</td>
</tr>
</tbody>
</table>

3. Surface Processing

<table>
<thead>
<tr>
<th>Name of Process</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>No processing</td>
<td>M</td>
</tr>
<tr>
<td>Special Non-Chromate Processing</td>
<td>GMT</td>
</tr>
</tbody>
</table>

4. Dimensions and Tolerance Intervals

The following table shows the standard thickness for the steel sheet and coil

<table>
<thead>
<tr>
<th>Standard Thickness (mm)</th>
<th>0.40</th>
<th>0.60</th>
<th>0.80</th>
<th>1.00</th>
<th>1.20</th>
<th>1.40</th>
<th>1.60</th>
<th>1.80</th>
<th>2.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness Tolerance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Thickness tolerance are applied the total values of nominal thickness and corresponding coating thickness)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal Thickness</td>
<td>&lt;1.00</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td>±0.05</td>
<td>±0.06</td>
<td>±0.06</td>
<td>±0.07</td>
<td>±0.08</td>
<td>±0.09</td>
<td>±0.10</td>
<td>±0.11</td>
<td>±0.12</td>
</tr>
<tr>
<td>Corresponding Coating Thickness</td>
<td>0.011</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spec Code for Coating Weight</th>
<th>&lt;1.250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width Tolerance</td>
<td>±7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length Tolerance</th>
<th>&lt;2.000</th>
<th>±10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>±15</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal Thickness (mm)</th>
<th>0.40</th>
<th>0.60</th>
<th>0.80</th>
<th>1.00</th>
<th>1.20</th>
<th>1.40</th>
<th>1.60</th>
<th>1.80</th>
<th>2.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spec Code for Coating Weight</td>
<td>30/30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item Type</th>
<th>ECOKOTE™-S</th>
<th>Aluminum Coating</th>
<th>Terne Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degraded Gasoline + 10% Water</td>
<td>45℃ x 1,000 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degraded Biodiesel + 10% Water (light oil enriched with 20% RME)*</td>
<td>90℃ x 1,000 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethanol + 1% Water</td>
<td>45℃ x 1,000 hours</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*RME = Rapeseed Methyl Ester

5. Steel Sheet Unit Mass

<table>
<thead>
<tr>
<th>Nominal Thickness (mm)</th>
<th>0.40</th>
<th>0.60</th>
<th>0.80</th>
<th>1.00</th>
<th>1.20</th>
<th>1.40</th>
<th>1.60</th>
<th>1.80</th>
<th>2.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spec Code for Coating Weight</td>
<td>30/30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Product Quality

Evaluation of Corrosion to Interior Surface
Examples of corrosion resistance tests on the interior surfaces of fuel tank materials using several different types of fuel

Evaluation of Corrosion to Exterior Surface
Examples of corrosion resistance tests on the exterior surfaces of fuel tank materials using 60 JASO-CCT cycles

- In the event that you require a sheet that falls outside of these parameters, please feel free to contact us.

Note: Thickness shall be measured at any point 15mm or more inside from the edge.
Precautions for Use

Improper or irregular use of ECOKOTE™-S can result in its special characteristics not performing in the way that should be expected, so please bear the following points in mind when using ECOKOTE™-S.

Storage, Loading/Unloading

1. When loading or storing ECOKOTE™-S, the presence of water can lead to rusting. Please take serious care to ensure that ECOKOTE™-S is not unloaded during a rainstorm, or in the presence of seawater or condensation. Moreover, a highly humid environment, or an environment where sulfurous acid gases are present is not suitable for storage. An indoor storage area that is both clean and dry is recommended. In particular, once the packaging has been opened please ensure that no condensation forms on the sheet when it is being stored. Moreover, please ensure that un-oiled products are given special attention when being stored. It is recommended that products are put to use as soon as possible.

2. Any damage to the packaging paper should be repaired and maintained.

Handling

1. The product should be handled with care, with particular attention paid to not damaging the outer film or coating layer. Moreover, dark spots, fingerprints, etc. if allowed to remain on the surface of the sheet can damage the coating and therefore affect the corrosion-resistant properties of the product. Moreover, unprotected sheets should be transported carefully and if moved by hand, handlers should wear gloves. In the unlikely event that the surface film or coating sustains damage, or if sweat or fingerprints make an impression on the surface, please consider post-processing or some repair/maintenance work.

Forming

1. Depending on the forming method employed, such as drawing or bending, the alloy coating may be soft enough to be affected by said forming. Attention should be paid to the following issues.
   (1) During the drawing process, choose values that give abundant clearance and select a die radius at least 6 times larger than the thickness of the sheet to ensure a good result.
   (2) During either the drawing or bending process, please ensure that the coating surface is not directly pulled or drawn through the procedure.

2. During the press forming process, when certain lubricating oils are applied as an extreme-pressure additive, this can lead to corrosion of the coating layer. Please ensure that this is checked prior to this procedure. Moreover, if there is no alternative to the use of a lubricating oil, please ensure that a resin is applied as a post-processing measure and that the resin is applied in sufficient quantity.

Welding

With regard to resistance welding, the pick-up from the metal alloy coating can damage the electrode, so please take proper care of this equipment and make changes when necessary. With regard to seam welding, using the Knurl drive method will prolong the working life of the electrodes.

Grease Removal

We recommend grease removal by using weak alkali type pH-neutral detergents or organic weld grease removal agents. Of the removal agents available, strong alkali type agents can corrode the coating layer so please ensure that the agent is checked prior to this procedure.

Aging

Conventional steel sheet will experience degradation of its material properties over time. In other words, the steel will lose its ability to be processed easily and may suffer stretcher strain as well as bending. In order to avoid these issues, it is recommended that the steel sheet be used as soon as possible. Moreover, customers who have selected the time-resistant option to cover their specifications need not concern themselves with this issue.

Packaging and Labeling

The finished product is packaged and shipped as per normal procedure for steel to ensure that it is handled and stored with care prior to its use. The external layer of packaging consists of a packaging label that contains details of the finished product that it is affixed to. Furthermore, the Package Card is also included, which is the warranty for the product in question. The Package Card is used when taking receipt of the product and confirming its condition. The information contained on the Package Card and labels is detailed herein.

Packaging Labels and Package Cards

<table>
<thead>
<tr>
<th>Item</th>
<th>Title Name</th>
<th>Notation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging Label</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Name</td>
<td>Not shown</td>
<td>Product name is displayed</td>
</tr>
<tr>
<td>Class/Grade</td>
<td>Not shown</td>
<td>Class and grade of materials used are displayed</td>
</tr>
<tr>
<td>JIS Certification Mark, JIS Certifying Body, JIS Certification Number</td>
<td>Not shown</td>
<td>Only the applicable materials are displayed.</td>
</tr>
<tr>
<td>Spec Code</td>
<td>Specification</td>
<td>The spec code for the finished product is displayed (see note below)</td>
</tr>
<tr>
<td>Weight</td>
<td>Weight</td>
<td>The weight is displayed</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Dimensions</td>
<td>The dimensions are displayed</td>
</tr>
<tr>
<td>Number of Sheets</td>
<td>Number of Sheets</td>
<td>Only for cut sheets</td>
</tr>
<tr>
<td>Quantity</td>
<td>Net Quantity</td>
<td>This is displayed depending on the contractual arrangements (actual quantity or estimated value)</td>
</tr>
<tr>
<td>Length</td>
<td>Length</td>
<td>Contractual estimate or specific coil length is displayed</td>
</tr>
<tr>
<td>Inspection Number</td>
<td>Inspection Number</td>
<td>Displayed on each package</td>
</tr>
<tr>
<td>Coil Number</td>
<td>Coil Number</td>
<td>Displayed for each production lot</td>
</tr>
<tr>
<td>Customer Name</td>
<td>Not shown</td>
<td>The customer name is displayed</td>
</tr>
<tr>
<td>Company and Works Name</td>
<td>Not shown</td>
<td>(Location Name)WORKS (or AREA), NIPPON STEEL CORPORATION is displayed</td>
</tr>
<tr>
<td>Month and Date of Manufacture</td>
<td>—</td>
<td>The date of manufacture is displayed</td>
</tr>
</tbody>
</table>

Note: Notation Used for Specifications

TZSD :  D QMT N

1: Spec Code
2: Skin-Pass Code
3: Surface Processing Code
4: Oiling Code (When no oils are used, this is given the value X)

Note: In the event of no specific skin-pass being defined, all items following the surface finishing code are displayed on the left.
Order Guidelines

When placing an order, please confirm the following matters in accordance with the purpose of the order.

specifications

Depending on the rigorousness and method of the processing to be undertaken, choose the most suitable specification from those shown in this catalog.

weight

Depending on the degree of corrosion resistance, the conditions for use and the method of the processing to be undertaken, choose the most suitable specification from those available. If the emphasis is on corrosion resistance, a thick coating layer is recommended, alternatively if the emphasis is on the workability of the steel, then a thinner coating layer is recommended.

oiling

A suitable oiling can improve rust prevention properties, as well as protecting the steel from handling issues such as fingerprints and soiling as well as acting as a lubricant during the pressing process.

dimensions

This is a basic condition for steel sheet: sheet thickness, width and length. Please make the most appropriate choice from the manufacturing ranges indicated in this catalog.

coil

The fundamental choice here is whether to opt for steel coil or for steel sheets, depending on the use and processing to follow. In terms of stock utilization, the coil option is easier to work with, in addition to being better suited to the continuation of work processes and automation. However, with steel coil, defective portions of the steel cannot be removed following an inspection so customers are asked to understand and accept that a certain small portion of the steel coil may be classified as defective. Furthermore, both extremities of the coil steel are classified as off-gauge and as such off-gauge steel may end up part of or adjacent to a weld. Therefore please make the most appropriate selection based on inspection, classification and maintenance requirements.

edge finishing

Please indicate if the order requires a milled edge or a straight edge. If the customer wishes to have steel from our production line as is, please select the straight edge option.

packing units (mass)

Please select the packing unit mass depending on loading capacity and working properties. Large unit mass can improve work properties. If the choice is coil steel, please select the largest unit mass (if necessary, the smallest unit mass is also an option). Furthermore, the mean unit mass that is actually shipped will be in proportion to the production unit mass and the dimensions of the steel manufactured.

internal and external radii

For coil steel, please specify the internal and external radii specifications for the uncoiler on the shearing line. When selecting the internal radius value, please consider the sheet thickness and the bend of the internal section of the coil as this can result in a reel mark being left on the steel. The standard value range as set by NIPPON STEEL lies between 20˚ to 24˚.

dimensions and accuracy (sheet thickness, width, length)

Dimension accuracy with regard to sheet thickness and width/length, etc. is implemented in accordance with the manufacturing ranges as stated in this catalog. However, depending on the purpose and conditions of use for the finished product in question, in some instances very strict specifications and dimensions are necessary due to accuracy requirements for assembly and/or components. Customers with these specific requirements are advised to contact NIPPON STEEL directly with their specifications.

purpose, processing methods, etc.

NIPPON STEEL prides itself on the highest standards of quality control and our awareness of the ultimate purpose of the steel being manufactured helps us maintain these standards. Please kindly state clearly the purpose and the processing methods and conditions in your order form.