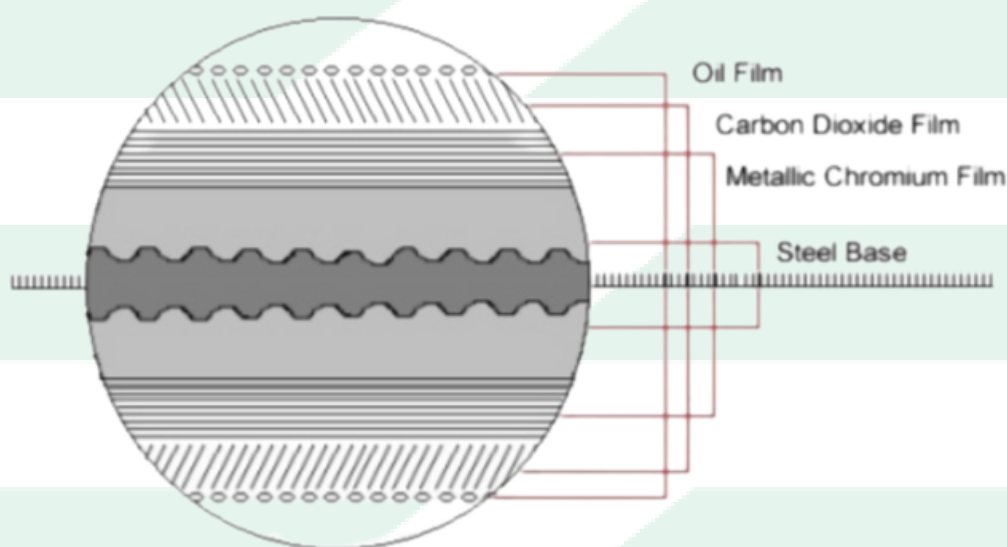


# TECHNICAL DATASHEET

## Tin Free Steel

1. Tin Free Steel (TFS), known as E.C.C.S. (Electrolytic Chromium Coated Steel), is a steel sheet coated on both side with a double film of metallic chromium, chromium oxide and oil.

Tin free steel consist in four elements each of which performs a different role:



**1.1 Steel Base:** Provides stiffness to the material due to its thickness and mechanical strength. Its chemical composition imparts special properties to resist corrosion.

**1.2 Metallic chromium:** Provides to the material some corrosion resistant features. In general, it is considered that tin free steel has corrosion resistant properties similar than 2,8 g/m<sup>2</sup> tinplate.

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**1.3 Chromium oxide:** Improves sulfur and iron oxide resistant. Inks and varnishes adherence, depends on this layer.

**1.4 Oil Film:** Protects the sheet from the humidity in the environment and makes easy to handle. It is applied using an electrostatic oiler on both sides of the sheet.

## 2.0 USES

Tin free steel can be used for stamped parts, lids and ends, oval and cylindrical two pieces cans, rectangular cans and crown caps for soft drinks and beer, according to the mechanical properties derived from temper and type of annealing.

## 3.0 TECHNICAL SPECIFICATIONS.

### 3.1 STEEL

| TYPES OF STEEL | FEATURE  |
|----------------|--|
| D              | Aluminum killed steel (deoxidized). This is used for deep drawn cans (two-piece cans, aerosol, etc.) or in those processes where wrinkles –de Luders– are likely to appear during machining. |
| L              | Contains small quantities of metalloids and residual elements such as: Cu, Ni, Cr, Mo. Used to improve the internal corrosion resistance of cans for certain food products.                  |
| MR             | Contains low percentages of residual elements and has a good corrosion resistance. It is the most common in the market and is used for general purposes, including cans.                     |

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## 3.2 CHEMICAL COMPOSITION

| CHEMICAL COMPOSITION FOR STEEL USED FOR ETP |              |                  |                   |
|---|--------------|------------------|-------------------|
| Elemental                                   | Type D % max | Type L (1) % max | Type MR (1) % max |
| Carbon                                      | 0.12         | 0.13             | 0.13              |
| Manganese                                   | 0.60         | 0.60             | 0.60              |
| Phosphorus                                  | 0.02         | 0.015            | 0.02              |
| Sulfur                                      | 0,05         | 0,05             | 0,05              |
| Silicon(2)                                  | 0.02         | 0.02             | 0.02              |
| Copper                                      | 0.20         | 0.06             | 0.20              |
| Nickel                                      | 0.15         | 0.04             | 0.15              |
| Chromium                                    | 0.10         | 0.06             | 0.10              |
| Molybdenum                                  | 0.05         | 0.05             | 0.05              |
| Others, each                                | 0.02         | 0.02             | 0.02              |

According to ASTM A623-2009. (1) Double reduction products are obtained in type L and MR. (2) When it is used steel obtained by continuous casting killed by silicon it is accepted until 0.08%

## 3.3 FINISHES.

| ECCS FINISHED |  |  |
|---------------|--|--|
| TYPE          | MAIN USES                                    | FEATURES   |
| BRIGHT        | General purpose cans                         | Finishing with melted tin, with a bright shine   |
| MATE          | Crown caps                                   | Matte finish, without shine, with electrolytically deposited tin without melting on the matte finishes steel plate                             |
| SILVER        | Cans for differente applications, crown caps | Finish with melted tin produced using a special treatment on the base metal  |
| STONE         | General use cans                             | Finish with melted tin, produced on the base metal, with a slightly matte appearance. Resist scratching during lithography or cans production. |

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### 3.4 HARDNESS, TEMPER AND REDUCTION TYPE.

| TEMPER        | Hardness,<br>HR 30T | Thickness:<br>e,mm   | Uses  |
|---------------|---------------------|----------------------|---|
| T1-BA         | Max 53              | $e \leq 0,21$        | Necks, nozzles, taps, toys bottoms for 5 gal. cans for oil and other uses that require deep drawing.        |
|               | Max 52              | $0,21 < e \leq 0,28$ |   |
|               | Max 51              | $e > 0,28$           |   |
| T2-BA         | $53 \pm 4$          | $e \leq 0,21$        | Small, square cans, cans for fish (0) salted meat, rings and other uses, with moderate draw.                |
|               | $52 \pm 4$          | $0,21 < e \leq 0,28$ |   |
|               | $51 \pm 4$          | $e > 0,28$           |   |
| T2,5 - BA, CA | $56 \pm 4$          | $e \leq 0,21$        | Crowns, for cans and other applications that require moderate draw and harness.                             |
|               | $55 \pm 4$          | $0,21 < e \leq 0,28$ |   |
|               | $54 \pm 4$          | $e > 0,28$           |   |
| T3 - BA,CA    | $58 \pm 4$          | $e \leq 0,21$        | Bodies for 5 gal oil cans, large cans and other applications that require an appropriate level of hardness. |
|               | $57 \pm 4$          | $0,21 < e \leq 0,28$ |   |
|               | $56 \pm 4$          | $e \geq 0,28$        |   |
| T4 - C4 (1)   | $62 \pm 4$          | $e \leq 0,21$        | Bodies and bottoms for cans that require relatively high strength, and crown caps.                          |
|               | $61 \pm 4$          | $0,21 < e \leq 0,28$ |   |
|               | $60 \pm 4$          | $e \geq 0,28$        |   |
| T5 - CA (1)   | $65 \pm 4$          | $e \leq 0,21$        | Bodies and bottoms for cans that require a combination of high hardness, strength, and good formability.    |
|               | $65 \pm 4$          | $0,21 < e \leq 0,28$ |   |
|               | $64 \pm 4$          | $e \geq 0,28$        |   |

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|                 |        |                      |  |
|-----------------|--------|----------------------|--|
| DR 7,5          | 70 ± 4 | $e \leq 0,21$        | Bodies and bottoms of small diameter cans requiring high strength. |
|                 | 70 ± 4 | $0,21 < e \leq 0,28$ |  |
|                 | 70 ± 4 | $e \geq 0,28$        |  |
| DR 8(2) BA - CA | 73 ± 4 | $e \leq 0,21$        |  |
|                 | 73 ± 4 | $0,21 < e \leq 0,28$ |  |
|                 | 73 ± 4 | $e \geq 0,28$        |  |
| DR 9(2) CA      | 76 ± 4 | $e \leq 0,21$        |  |
|                 | 76 ± 4 | $0,21 < e \leq 0,28$ |  |
|                 | 76 ± 4 | $e \geq 0,28$        |  |
| DR 9 M (2)      | 77 ± 4 | $e \leq 0,21$        |  |
|                 | 77 ± 4 | $0,21 < e \leq 0,28$ |  |
|                 | 77 ± 4 | $e \geq 0,28$        |  |
| DR 10           | 80 ± 4 | $e \leq 0,21$        |  |
|                 | 80 ± 4 | $0,21 < e \leq 0,28$ |  |
|                 | 80 ± 4 | $e \geq 0,28$        |  |

(1) CA means continuous annealing and BA means box annealing.

(2) DR: Base metal produced using the double cold reduction process; provides greater stiffness and strength than conventional base material and, therefore, provides the same strength using smaller cross sections. These advantages make it possible to produce more cans per unit weight of electrolytic tinplate. Service characteristic, thickness distribution and chemical characteristics are similar to those of conventional steel.

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### 3.5 TIN FREE STEEL AVAILABILITY

| <b>DIMENSIONS AND COATING AVAILABILITY</b>       |              |                |                |
|--|--------------|----------------|----------------|
| <b>Variable</b>                                  | <b>Units</b> | <b>Minimum</b> | <b>Maximum</b> |
| <b>3.4.1. MECHANICAL PROPERTIES AND COATINGS</b> |              |                |                |
| Thickness  | mm           | 0,15           | 0,6            |
| Temper   | N/A          | T1             | DR10           |
| Metallic tin                                     | g/m2         | 1,1            | 13,4           |
| Iron - tin - alloy                               | g/m2         | 0,4            | 1,2            |
| Chromium oxide (passivation)                     | µg/dm2       | 40             | 70             |
| Oil  | mg/m2        | 0              | 25             |
| <b>3.4.2. PACKAGES PRESENTATION</b>              |              |                |                |
| <b>Rectangular cutting sheets</b>                |              |                |                |
| Cutting length                                   | mm           | 457,2          | 1250           |
| Width  | mm           | 600            | 965,2          |
| Package weight                                   | Kg           | N/A            | 2500           |
| Package height                                   | mm           | N/A            | 450            |
| <b>Pre-scroll cutting sheets</b>                 |              |                |                |
| Thickness  | mm           | 0,13(1)        | 0,50           |
| Cutting length                                   | mm           | 610            | 1016           |
| Width  | mm           | 610            | 1118           |
| Package weight                                   | Kg           | N/A            | 2500           |
| Package height                                   | mm           | N/A            | 457,2          |

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| <b>Rectangular re-squared cutting sheets</b> |    |              |              |
|--|----|--------------|--------------|
| Thickness                                    | mm | 0,13(1)      | 0,40         |
| Width  | mm | 600          | 1000         |
| Cutting length                               | mm | 500          | 1000         |
| Package weight                               | Kg | N/A          | 2500         |
| Package height                               | mm | N/A          | 450          |
| <b>Lithographed sheets (Press)</b>           |    |              |              |
| Width  | mm | 710          | 1130         |
| Lenght                                       | mm | 510          | 960          |
| Maximum printing area                        | mm | 1130 (Width) | 945 (Length) |
| Package weight                               | Kg | N/A          | 2500         |
| Package height                               | mm | N/A          | 450          |
| <b>Varnished sheets</b>                      |    |              |              |
| Width  | mm | 710          | 1130         |
| Lenght                                       | mm | 510          | 960          |
| Maximum printing area                        | mm | 1130 (Width) | 970 (Length) |
| Package weight                               | Kg | N/A          | 2500         |
| Package weight                               | mm | N/A          | 450          |
| <b>3.4.3 COILS PRESENTATION</b>              |    |              |              |
| <b>3.1 Coils</b>                             |    |              |              |
| Coil weight                                  | Kg | 1000         | 9000         |
| Internal diameter                            | mm | 419          | 505          |
| External diameter                            | mm | 610          | 1626         |

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| <b>Strips</b>     |       |      |       |
|-------------------|-------|------|-------|
| Thickness         | mm    | 0,17 | 0,6   |
| Coil width        | mm    | 600  | 984   |
| Strip width       | mm    | 20   | 614   |
| Strips by step    | Units | 2    | 15    |
| Coil weight       | Kg    | 1000 | 9000  |
| Internal diameter | mm    | 505  | ----- |
| External diameter | mm    | 610  | 1624  |

Sheets with thickness less than 0.15 mm are provided by the customer

## **4.0 RECOMMENDATIONS AND PRODUCT HANDLING**

### **4.1 General recommendations**

- Apply a moderate quantity of lubricant in the fabrication process. Oil is an important constitutive layer of the tin free steel and never should be specified without oil.
- Before any cutting or forming process, apply lacquer or varnish on both sides of the tin free steel to avoid friction problems associated with the chromium coating.
- Use cutting and stamping tools with special steels, like a carbon steels with tungsten, to avoid it fast wear.
- If it is necessary the same tone of the lithography applied over tin free steel than the lithography applied over tinplate, it is necessary, in some cases, to change inks formulation or increase film thickness, among others. If these conditions are necessary, the standards should be modified and the optimum formulation has to be found, before industrial processing.

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- Tin free steel could be used on products with less than 1% of organic acids (acetic acid and lactic acid), provided that the tin free steel is coated with the appropriated lacquer.
- When tin free steel will be used on bodies and bottoms for food cans, specific test have to be done to assure that coating materials and conditions are the appropriated, because content and thermal treatment used are not uniform.
- Do not use tin free steel for cans type DI – deep drawing.

## 4.2 Handling recommendations.

Tin free steel is designed and processed to be corrosion resistant applying lithography coatings on both sides, however for best results, it is recommend to have into account the following points:

- Store tin free steel with special care with the humidity
- Never store tin free steel outdoor
- Use tin free steel maximum ten (10) days after have been unpagged
- Handle tin free steel with gloves. Fingerprints and sweat can be easily removed rubbing with an alcohol-impregnated cloth.
- Do not store tin free steel in process, with lacquer or lithography on one side, for a period longer than one week
- Material storage should be as follows:
  - In general the lots with greater area or quantity should be located in the stack's lower side
  - Stack height should be necessary enough to keep visual control to avoid injuries. Moreover, the stability due the base/height and floor capacity resistant should be considered.

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