

# ELECTROGALVANIZED STEEL



**Auto Body Panels**

**Appliances**

**Architectural Products**



**ELECTROGALVANIZED STEEL**, known as ZINCGRIP® ELECTRASMOOTH® Steel, offers superior surface quality, corrosion resistance, excellent formability and paintability for automotive exterior panels, as well as other exposed applications where these attributes are desired.



Pure zinc (Zn) coatings applied to Cleveland-Cliff's quality cold-rolled sheet steel deliver both galvanic and barrier protection against corrosion. Even when damaged, such coatings continue to protect the base metal.

ZINCGRIP ELECTRASMOOTH Steel is available in a wide variety of base metal grades and coating weights.

# ELECTROGALVANIZED STEEL

## Product Features

### CORROSION RESISTANCE

The zinc coating protects the base metal by providing a barrier to corrosive elements and also by the sacrificial nature of the coating. Ultimate service life depends on coating thickness and the severity of the environment.

### EXCELLENT SURFACE APPEARANCE

ZINCGRIP ELECTRASMooth STEEL has a uniform appearance suitable for the most demanding surface critical applications.

### FORMABILITY

ZINCGRIP ELECTRASMooth STEEL can be used to produce parts containing simple bends to parts with deep drawing requirements.

### PAINTABILITY

ZINCGRIP ELECTRASMooth Steel is readily paintable, provided proper pretreatment is performed.

### WELDABILITY

ZINCGRIP ELECTRASMooth Steel can be joined using a variety of accepted welding practices.

## Process

ZINCGRIP ELECTRASMooth steel is produced by the GRAVITEL process. Vertical electroplating cells are used to apply zinc to the steel substrate.

The continuous process consists of surface preparation, plating and oiling. Surface preparation is essential to assure good coating adhesion and consists of spray alkaline cleaning, brushing, electrolytic alkaline cleaning and sulfuric acid surface activation.

In the plating section, electrical current is passed through the strip, which is immersed in an aqueous solution containing zinc ions. As a result, the zinc is uniformly deposited onto the steel substrate. The thickness of the deposit is constantly monitored by an in-line x-ray coating weight gauge.

After plating, a uniform application of rust preventative oil or prelude is electrostatically deposited on the strip.

## Coating Characteristics

The electrogalvanized coating is 99.9% pure zinc and is available in a variety of coating weights. Due to the nature of the electrogalvanizing process, the zinc coating is uniformly applied throughout the coil. A schematic of the coating cross section is shown in Figure 2.

ZINCGRIP ELECTRASMooth Steels can be specified in a wide range of coating weight categories as shown in Table 1. The coating designation is explained by the diagram in Figure 1. For coating weights not listed, contact your Cleveland-Cliffs Steel sales representative.

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## Surface Protection and Lubrication

To prevent staining in transit, it is recommended that ZINCGRIP ELECTRASMOOTH Steel be supplied with a rust preventative oil. A pre-lubricant is also available.

For other surface protection, please contact your Cleveland-Cliffs Steel sales representative.

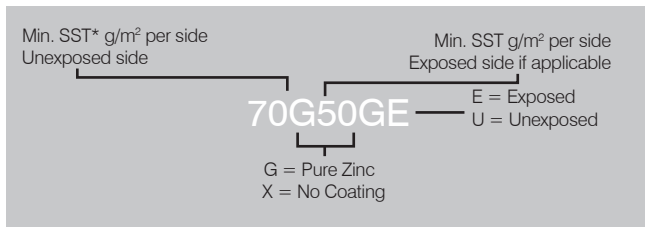
**TABLE 1 – COATING WEIGHT**

Coating Designation	Coating Weight Min.	
	oz./ft. <sup>2</sup>	g/m <sup>2</sup>
20G/20G	0.07/0.07	20/20
30G/30G	0.10/0.10	30/30
40G/40G	0.13/0.13	40/40
50G/50G	0.16/0.16	50/50
60G/60G	0.20/0.20	60/60
70G/70G	0.23/0.23	70/70
90G/90G	0.29/0.29	90/90
98G/98G	0.32/0.32	98/98

Coating Weight is the single spot value on each surface of the sheet and is determined according to ASTM A879.

For one-side or differential coating, please inquire.

**FIGURE 1 – COATING DESIGNATION**



**FIGURE 2 – COATING CROSS SECTION**



\*Layers not shown to scale.

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### Formability and Mechanical Properties

The formability of all steel products is a result of the interaction of many variables. These variables include: the mechanical properties of the steel, the forming system (tooling) used to manufacture parts, and the lubrication used during forming. Of these three, Cleveland-Cliffs can directly affect the mechanical properties of the steel. Tight control over chemical composition, hot rolling parameters, the amount of cold reduction, annealing time and temperature, and the amount of tempering allows the production of high quality ZINCGRIP ELECTRASMOOTH Steels to meet customers' requirements.

#### **COMMERCIAL STEEL (CS)**

ZINCGRIP ELECTRASMOOTH is available in a variety of base metals. Commercial Steel (CS Type B) should be used for moderate forming or bending applications. CS Type B products are produced from continuously cast slabs and, unless otherwise specified, have a carbon (C) content of less than 0.15%. To prevent the occurrence of fluting or stretcher strains during forming, CS Type B products are temper rolled as a normal step in the mill processing.

#### **DRAWING STEEL(DS)**

For more stringent forming applications, Drawing Steel (DS Type B), should be ordered. DS Type B has a controlled carbon content less than 0.06%C and parts formed from DS Type B steel should not exhibit stretcher strain.

#### **EXTRA DEEP DRAWING STEEL(DS)**

Extra Deep Drawing Steel or Extra Deep Drawing Steel Plus (EDDS+) should be ordered for the most demanding forming applications. These steels, also known as Interstitial Free (I-F) steels, are produced from vacuum degassed less than 0.010%C, titanium (Ti) stabilized grades. EDDS+ has the lowest carbon content available and has been specially formulated to be Cleveland-Cliff's most ductile product.

Typical mechanical properties are shown in Table 2, page 3.

Bake Hardenable (BH) and Dent Resistant (DR) Steels are available.

For high strength or structural applications, ZINCGRIP ELECTRASMOOTH Steel is also available in yield strengths up to 50 ksi. (345 MPa).

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## PAINTABILITY

ZINCGRIP ELECTRASMOOTH steel is particularly well suited for applications where a high quality paint finish is required.

Prior to painting, the steel should be cleaned with a mild alkaline cleaner in order to insure the removal of organic contaminants. After cleaning, a zinc phosphate or other adequate pre-treatment should be performed immediately prior to painting.

Coil coated ZINCGRIP ELECTRASMOOTH Steel is also available through Cleveland-Cliff's arrangements with outside processors. In this case, the electrogalvanized substrate is coated in coil form with a wide range of specialty organic systems. These systems can be tailored to meet the customers' specific needs. Coil coating options include pre-treating or pre-priming and the application of dry-film lubricants.

## SPECIFICATIONS

ZINCGRIP ELECTRASMOOTH Steel is produced in conformance to the following specifications:

ASTM A1008	General Cold-rolled Specifications
ASTM A568	General Requirements
ASTM A879	Coating Weight Designation
ASTM A917	General Requirements
SAE J1392	HSLAS
SAE J2340	HSLAS
SAE J2329	Mild Steel

*For any specifications not listed here, contact your Cleveland-Cliffs sales representative.*

## OUTSIDE PROCESSING

Tailored blanks, tension leveling, re-squaring, slitting, cut-to-length and coil coating are just some of the services Cleveland-Cliffs can provide through arrangements with outside processors.

## MORE INFORMATION/TECHNICAL ASSISTANCE

Cleveland-Cliff's technical representatives can provide you with more detailed information concerning this product. They also are available to assist you in reviewing any welding, forming, painting or other material selection issues.

## MILL LIMITS

ZINCGRIP ELECTRASMOOTH Steel is available in thicknesses from 0.017 – 0.076 in. (0.43 –2.01 mm), and widths up to 75 in. (1904 mm) depending on dimensions and product quality. For sizes outside these limits, please contact your Cleveland-Cliffs sales representative.

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## Tables

**TABLE 2 – TYPICAL MECHANICAL PROPERTIES – STANDARD GRADES**

Quality Designation	Description	YS		UTS		Min. Elong %	n-Value	r <sub>m</sub>
		ksi.	MPa	ksi.	MPa			
Commercial Steel (CS Type B)	May be moderately formed. A specimen cut in any direction can be bent flat on itself without cracking.	29	200	46	317	40	0.19	—
Drawing Steel DS (DS Type B)	Type B may be used in drawing applications	27	186	44	300	42	0.21	1.7
Extra Deep Drawing Steel (EDDS)	Interstitial Free (I-F) steels	24	163	42	292	44	0.22	1.8
Extra Deep Drawing Steel Plus (EDDS+)	Interstitial Free (I-F) steels	23	157	41	280	45	0.23	1.8

*Typical properties produced by Cleveland-Cliffs for these grades.*

*Commercial Steel, Deep Drawing Steel and Extra Deep Drawing Steel are designations of the various steels described in the ASTM specifications. Each of the steel sheet designations is associated with unique requirements for chemical composition and with non-mandatory, typical mechanical properties. All properties are tested per ASTM A370.*

The following qualities are available to various customer or industrial requirements.

**TABLE 3 – ENGINEERING PROPERTIES**

Young's Modulus of Elasticity	200 x 10 <sup>3</sup> MPa at 20 °C
Density	7.87 g/cm <sup>3</sup> at 20 °C
Coefficient of Thermal Expansion	Low-Carbon/HSLAS: 12.4 μm/m/°C in 20 – 100 °C range I-F Steel: 12.9 μm/m/°C in 20 – 100 °C range
Thermal Conductivity	Low-Carbon/HSLAS: 89 W/m°C at 20 °C I-F Steel: 93 W/m°C at 20 °C
Specific Heat	481 J/kg/°C in 50 – 100 °C range
Electrical Resistivity	0.142 μΩ·m at 20 °C

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## Tables

**TABLE 4 – OTHER AVAILABLE GRADES**

Bake Hardenable (BH) grades offer good formability with increased strength from work hardening and subsequent paint/bake cycle.	Dent Resistant (DR) grades offer good formability with increased strength from a high work hardening rate.	High Strength Low Alloy Steel (HSLAS)		Advanced High Strength Steel (AHSS) Grades
MPa	MPa	ksi.	Mpa	MPa
BH 180 BH 210 BH 220 BH 240 BH 250	DR 180 DR 190 DR 210	HSLAS 36 HSLAS 40 HSLAS 45 HSLAS 50	250 280 300 340/350	DP 590 DP 780 DP 980 MP 980 MP 1180 M900 M1100 M1300 M1500

*For strength levels not listed, please inquire.*

### About Cleveland-Cliffs Inc.

Cleveland-Cliffs is the largest flat-rolled steel producer in North America. Founded in 1847 as a mine operator, Cliffs also is the largest manufacturer of iron ore pellets in North America. The Company is vertically integrated from mined raw materials and direct reduced iron to primary steelmaking and downstream finishing, stamping, tooling, and tubing. The Company serves a diverse range of markets due to its comprehensive offering of flat-rolled steel products and is the largest steel supplier to the automotive industry in North America. Headquartered in Cleveland, Ohio, Cleveland-Cliffs employs approximately 25,000 people across its mining, steel and downstream manufacturing operations in the United States and Canada.



#### **CLEVELAND-CLIFFS INC.**

200 Public Square  
 Suite 3300  
 Cleveland, OH 44114-2315  
 844.STEEL99 | 844.783.3599  
 clevelandcliffs.com

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