

Cold Rolled STEELS



Cold Rolled Steels provide excellent press formability, surface finish, and thickness and flatness tolerances. AK Steel manufactures three low- or ultra-low-carbon grades to meet a variety of customer formability requirements: CS Type B, DS Type B, EDDS, and EDDS+. AK Steel also produces HSLAS and Structural Steel grades for those applications that require specified strength levels. Cold Rolled Steels can also be specified as Dent Resistant or Bake Hardenable for applications that require dent resistance after forming and painting. Each grade can be processed with several surface finishes depending on customer requirements. Lubricants can be applied to enhance formability and to avoid at-press lubrication.

PRODUCT FEATURES

■ Excellent Surface Appearance

Cold Rolled Steels have manufacturing controls in place assuring consistent surface quality to satisfy customer requirements.

■ Formability

Cold Rolled Steels can be used to produce parts containing simple bends to parts with extreme deep drawing requirements.

■ Paintability

Due to stringent surface roughness controls, Cold Rolled Steels are readily paintable using essentially any paint system.

■ Weldability

Cold Rolled Steels can be joined using virtually any accepted welding practice.

SURFACE FINISH

Cold Rolled Steels are manufactured with a matte finish obtained by rolling with specially roughened rolls on the cold mill and the temper mill. This finish helps to maintain effective lubrication during metal forming and

improves the appearance of painted surfaces. Non-standard matte finishes can be provided that optimize the opposing effects of surface roughness on painted part appearance and lubrication during press forming.

SURFACE PROTECTION AND LUBRICATION

To prevent rusting in transit and storage, Cold Rolled Steels can be supplied with a rust protective oil film or press forming lubricants. AK Steel will apply a light rust preventative oil unless otherwise specified. A pre-applied press forming lubricant provides uniform lubrication and

eliminates the housekeeping problems associated with at-press lubrication. A dry film (acrylic/polymer) lubricant can also be supplied by further processing the cold rolled product through a coil coating facility. These specialty organic coatings are easily removed with a mild alkaline cleaner.

FORMABILITY AND MECHANICAL PROPERTIES

The formability of all steel products is a result of the interaction of many variables, the main ones being the mechanical properties of the steel, the forming system (tooling) used to manufacture parts, and the lubrication used during forming. Of these three, AK Steel can only directly affect the mechanical properties of the steel. Tight control over chemical composition, hot rolling parameters, amount of cold reduction, annealing time and temperature, and the amount of temper rolling allow the production of high-quality Cold Rolled Steel products to meet customers' requirements.

Commercial Steel (CS Type B) should be used for moderate forming or bending applications. CS Type B products are produced from aluminum-killed continuously cast slabs

and, unless otherwise specified, have a carbon content of less than 0.15%.

To prevent the occurrence of fluting or stretcher strains during forming, CS products are tempered as a normal step in the mill processing.

For more severe forming applications, Drawing Steel Type B (DS Type B) should be ordered. DS Type B has a controlled carbon content (<0.06%) and is produced in such a manner that parts formed from DS Type B Steel should not exhibit stretcher strain.

Extra Deep Drawing Steel (EDDS) or Extra Deep Drawing Steel Plus (EDDS+) should be ordered for the most demanding forming applications. These steels (also known as Interstitial Free or I-F® steels) are produced from a vacuum degassed,

titanium stabilized grade. EDDS and EDDS+ have the lowest carbon content available (<0.010%) and have been specially formulated to be AK Steel's most ductile products.

For high strength or structural applications, Cold Rolled Steels are also available in yield strengths up to 50 ksi as shown in Table 2.

Cold Rolled Steels can also be specified as Dent Resistant or Bake Hardenable for applications that require dent resistance after forming and painting; see Table 3.

Typical mechanical properties are shown in Table 1. The n-value, i.e. strain hardening exponent, has been shown to correlate with stretch forming behavior, while the r-value, r_m , is a measure of deep-drawing capability.

TABLE 1 – TYPICAL MECHANICAL PROPERTIES – STANDARD GRADES

Quality Designation	Description	YS		UTS		% Elong. in 2"	Hardness		
		ksi	MPa	ksi	MPa		HRB	"n"	"r _m "
Commercial Steel (CS Type B)	May be moderately formed. A specimen cut in any direction can be bent flat on itself without cracking.	30	207	46	317	40	42	N/A	N/A
Drawing Steel (DS Type B)	DS Type B is made by adding aluminum to the molten steel and may be used in drawing applications.	26	179	44	303	44	37	.23	1.7
Extra Deep Drawing Steel (EDDS)	Interstitial Free (I-F) steels are made by adding titanium and/or niobium to the molten steel after vacuum degassing and offer excellent drawability.	23	159	44	303	45	30	.24	1.8
Extra Deep Drawing Steel Plus (EDDS+)	Interstitial Free (I-F) steels are made by adding titanium and/or niobium to the molten steel after vacuum degassing and offer excellent drawability.	21	145	43	296	46	30	.25	1.9

Typical properties produced by AK Steel for these grades. These are ordered by the appropriate ASTM Specification, A 366, A 620, and A 969, which contain typical mechanical properties and required chemical compositions.

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TABLE 2 – ASTM SPECIFIED PROPERTIES

Quality Designation	Description	Min. YS		Min. UTS		Min. Elong. %
		ksi	MPa	ksi	MPa	
Structural Steel (SS)	Grade 25	25	170	42	290	26
	Grade 30	30	205	45	310	24
	Grade 33 Type 1 & 2	33	230	48	330	22
	Grade 40 Type 1 & 2	40	275	55	360	20
	Grade 80 (Full Hard Only)	80	550	82	565	–
High Strength Low Alloy Steel (HSLAS)	Grade 40/SAE J1392 040 XLK Or 040YLK	40	280	55	380	25
	Grade 45 CL 1/ SAE J1392 045 XLK	45	310	60	415	22
	Grade 45 CL 2/ SAE J1392 045 XLK	45	310	55	380	22
	Grade 50 CL 1/ SAE J1392 050 XLK	50	340	65	450	20
	Grade 50 CL 2/ SAE J1392 050 XLK	50	340	60	410	20

TABLE 3 – TYPICAL MECHANICAL PROPERTIES

Dent Resistant (DR 180)	Dent Resistant 180 SAE J2340 Type 180 A	26	180	45	310	–
(DR 210)	Dent Resistant 210 SAE J2340 Type 210 A	30	210	48	330	–
Bake Hardenable (BH 180)	Bake Hardenable 180 SAE J2340 Type 180 B	26	180	44	300	–
(BH 210)	Bake Hardenable 210 SAE J2340 Type 210 B	30	210	46	320	–

PAINTABILITY

Cold Rolled Steels can be easily painted using a variety of paint systems provided proper care is taken in preparing the material. Prior to painting, the surface should be carefully cleaned with either a solvent or alkaline cleaner. Cleaning should be followed by a pre-treatment prior to painting. Zinc or iron phosphates

give good results on Cold Rolled Steels. Mild abrasion prior to pre-treating may also be used to enhance mechanical bonding of the paint.

Cold Rolled Steels can be supplied as pre-painted or pre-primed through AK Steel's arrangements with outside coil coaters.

SPECIFICATIONS

Cold Rolled Steels are produced in conformance to the following specifications:

ASTM A 366	CS
ASTM A 568	General
ASTM A 607	HSLAS
ASTM A 611	SS
ASTM A 620	DS
ASTM A 715	HSLAS
ASTM A 794	CS Carbon (0.16% - 0.25%)
ASTM A 969	EDDS
SAE J1392 and	
SAE J2340	HSLAS

For any specifications not listed here, please consult your AK Steel Sales or Technical Representative.

ENGINEERING PROPERTIES

TABLE 4

Young's Modulus of Elasticity	200 x 10 ⁶ MPa at 20°C
Density	7.87 g/cm ³ at 20°C
Coefficient of Thermal Expansion	Low-Carbon/HSLA: 12.4 μm/m/°C in 20°C to 100°C range I-F Steel: 12.9 μm/m/°C in 20°C to 100°C range
Thermal Conductivity	Low-Carbon/HSLA: 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°C to 100°C range
Electrical Resistivity	0.142 μΩm at 20°C

OUTSIDE PROCESSING

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

MORE INFORMATION/TECHNICAL ASSISTANCE

AK Steel's Technical Representatives can provide you with more detailed information concerning this product.

They also are available to assist you in solving any welding, forming, painting, or other material selection issue.

MILL LIMITS

Cold Rolled Steels are generally available in thicknesses from 0.0126" (0.32 mm) to 0.157" (3.99 mm), and widths to 80" (2032 mm), depending on thickness.

The standard inner diameter of our coils is 24" (610 mm).

Thickness, width, and flatness tolerances are covered in ASTM Specification A 568.



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Data referring to mechanical properties and chemical analyses are the result of tests performed on specimens obtained from specific locations of the products in accordance with prescribed sampling procedures; any warranty thereof is limited to the values obtained at such locations and by such procedures. There is no warranty with respect to values of the materials at other locations.

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