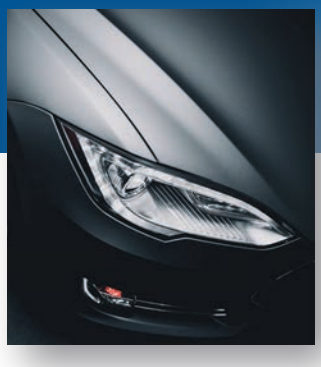
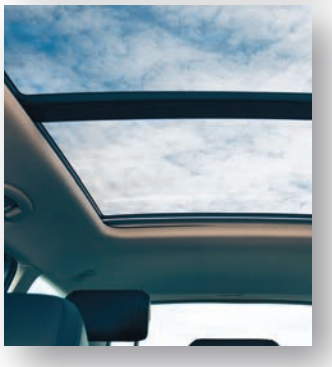
CLIFFS

COLD ROLLED AND ELECTROGALVANIZED

DUAL PHASE STEELS





Auto Body Panels

Auto Body Structure Applications

Auto Safety Cage Components

DUAL PHASE (DP) STEELS are one of the important Advanced High Strength Steels (AHSS) developed for the automotive industry. Their microstructure typically consists of a soft ferrite phase with dispersed islands of martensite. The martensite phase is substantially stronger than the ferrite phase.

Cleveland-Cliffs produces two types of DP steels: conventional dual phase grades and higher yield strength grades. Conventional dual phase grades exhibit low yield-to-tensile strength ratios, high initial work hardening (n-value), no yield point elongation (YPE) and significant bake hardening. The higher yield strength grades exhibit high yield-to-tensile strength ratios, some YPE and lower bake hardening than the conventional dual phase grades.

With careful schedule selection, the DP steels are joinable by all current welding processes, including resistance spot, resistance seam, arc and laser methods.

Grade Availability

Cleveland-Cliffs offers a full spectrum of Dual Phase (DP) steels with tensile strength levels ranging from 590 to 1180 MPa. Product details are provided on page 3.

TABLE 1 – SPECIFIED COMPOSITION

	Uncoated	EG
DP590/600	U	U
DP690/700	U	U
DP780	U	U
DP980	U	U
DP1180	U	U

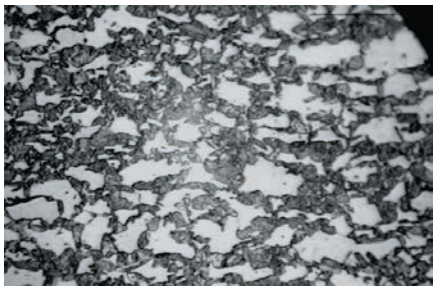
U - Unexposed, commercially available

Applications

The low and intermediate tensile strength, low yield ratio grades (590 to 980 MPa tensile strength) are frequently used in body structure applications requiring high energy absorption (i.e. the crumple zones – front and rear longitudinal rails and supporting structure). The low yield strength helps keep the initial deceleration pulse low, yet the high work hardening rate and excellent ductility absorb greater deformation energy than conventional steels. Good formability permits the use of these products in complicated shapes, and good weldability permits using these steels in tailored blank and hydroformed tube applications.

The intermediate to highest strength grades, including the high yield ratio dual phase steels, are typically used in applications requiring extremely high yield strength and adequate formability, such as passenger safety cage components, limited by axial or transverse bending. These components (rockers, pillars, pillar reinforcements, roof rails and cross members) rely on high yield strength to prevent intrusion into the passenger compartment during a collision. Dual Phase steels enable designers to apply high yield strength steels to safety cage components that are too complex to form with higher strength Martensitic steels.

Metallography - Dual Phase 980



Magnification 1000X
Approximately 60% Martensite/40% ferrite

Chemistry - Typical

	Yield-Tensile Minimums (MPa)	C	Mn	Si	Other
Cold Roll/EG					
DP590/600	340Y – 590T	0.10	1.0	0.3	
DP690	550Y – 690T	0.15	1.4	0.3	
DP780	420Y – 780T	0.10	1.6	0.3	
DP980 – mid C	550Y – 980T	0.15	1.4	0.3	
DP980 – low C	600Y – 980T	0.09	2.1	0.65	Mo
DP980 – high YS	700Y – 980T	0.09	2.1	0.65	Mo
DP1180 ASTM	875Y – 1180T	0.15	1.8	0.4	Nb, Ti
DP1180 JIS	835Y – 1180T	0.15	2.2	0.6	Nb, Ti, Al

Mechanical Properties

	Yield-Tensile Minimums (MPa)	Test – Direction	TYPICAL VALUES		
			Yield strength (MPa)	Ultimate tensile strength (MPa)	Total elongation (percent)
Cold Roll/EG					
DP590/600	340Y – 590T	ASTM – L	370	635	24.5
DP690	550Y – 690T	ASTM – L	600	760	16.6
DP780	420Y – 780T	ASTM – L	480	830	18.2
DP980 – mid C	550Y – 980T	ASTM – L	600	1030	13.8
DP980 – low C	600Y – 980T	JIS – T	650	1030	14.7
DP980 – high Yield	700Y – 980T	ASTM – L	780	1040	11.9
	700Y – 980T	ISO – L	780	1040	10.7
DP1180 ASTM	875Y – 1180T	ASTM – L	960	1270	10.1
DP1180 JIS	835Y – 1180T	JIS-T	940	1250	11.0

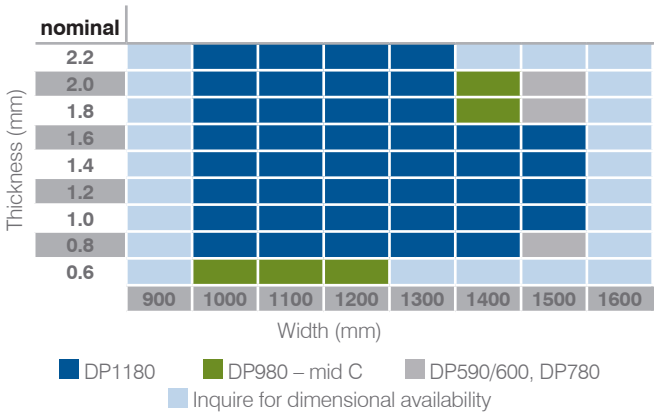
Computer Aided Engineering (CAE) structural engineers should be cautioned that the unique high work hardening and bake hardening characteristics of DP steels require special treatment in finite element analysis crash models. Generally, accounting for high strain rate behavior and forming effects (thinning/thickening, work hardening, bake hardening) will yield more accurate crash simulation results. CAE engineers should contact Cleveland-Cliffs for product specific mechanical property information to use in these situations.

CLIFFS

COLD ROLLED AND ELECTROGALVANIZED

Size Availability

COLD ROLL/EG



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, direct reduced iron, and ferrous scrap 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 supplier of steel to the automotive industry in North America. The Company is headquartered in Cleveland, Ohio with mining, steel and downstream manufacturing operations located across the United States and in Canada. For more information, visit www.clevelandcliffs.com.

CLIFFS

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

August 2023