



Designation: A1088 – 13 (Reapproved 2019)

Standard Specification for Steel, Sheet, Cold-Rolled, Complex Phase (CP), Dual Phase (DP) and Transformation Induced Plasticity (TRIP)¹

This standard is issued under the fixed designation A1088; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers cold-rolled, complex phase (CP) grade, dual phase (DP) grade, and transformation induced plasticity (TRIP) grade steel sheet in coils and cut lengths.

1.2 Product furnished under this specification shall conform to the applicable requirements of the latest issue of Specification A568/A568M, unless otherwise provided herein.

1.3 The product is available in a number of designations and grades with mandatory chemical requirements and mandatory mechanical properties that are achieved through thermal or thermal-mechanical treatments, and are designed to be compatible with automotive application requirements.

1.4 The grade designation nomenclature of the product differs from other cold-rolled sheet products having mandatory mechanical properties in that ordering is to tensile, rather than yield strength values.

1.5 The text of this specification references notes and footnotes that provide explanatory material. These notes and footnotes, excluding those in tables and figures, shall not be considered as requirements of this specification.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.19 on Steel Sheet and Strip.

Current edition approved Nov. 1, 2019. Published November 2019. Originally approved in 2013. Last previous edition approved in 2013 as A1088 – 13. DOI: 10.1520/A1088-13R19.

2. Referenced Documents

2.1 *ASTM Standards*:²

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A568/A568M Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

E646 Test Method for Tensile Strain-Hardening Exponents (n -Values) of Metallic Sheet Materials

3. Terminology

3.1 *Definitions*—See Terminology A941 for definitions of general terminology relating to cold-rolled steel sheet products.

3.2 *Definitions*:

3.2.1 *complex phase (CP) steel, n*—steel sheet with a ferritic/bainitic matrix containing small amounts of retained austenite or pearlite, or both where significant grain refinement is caused by retarded crystallization or precipitation of microalloying elements.

3.2.2 *dual phase (DP) steel, n*—steel sheet with a ferritic matrix containing a martensitic phase present in the form of islands.

3.2.3 *transformation induced plasticity (TRIP) steel, n*—steel sheet with a mainly ferritic matrix containing retained austenite where, during the forming process, retained austenite can transform to martensite.

4. Classification

4.1 The material is available in several designations and grades as follows:

4.1.1 Complex phase (CP) steel (Grades 600T/350Y, 780T/500Y, and 980T/700Y),

4.1.2 Dual phase (DP) steel (Grades 440T/250Y, 490T/290Y, 590T/340Y, 780T/420Y, and 980T/550Y), and

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

4.1.3 Transformation induced plasticity (TRIP) steel (Grades 690T/410Y and 780T/440Y).

4.2 Cold-rolled steel sheet is supplied for either exposed or unexposed applications. Within the latter category, cold-rolled sheet is specified either “temper rolled” or “annealed last.” For details on processing, attributes and limitations, and inspection standards, refer to Specification **A568/A568M**.

5. Ordering Information

5.1 It is the purchaser’s responsibility to specify in the purchase order all ordering information necessary to describe the required material. Examples of such information include, but are not limited to, the following:

- 5.1.1 ASTM specification number and year of issue;
- 5.1.2 Name of product (steel sheet, cold-rolled);
- 5.1.3 Designation of sheet [CP (Grades 600T/350Y, 780T/500Y, or 980T/700Y), DP (Grades 440T/250Y, 490T/290Y, 590T/340Y, 780T/420Y, or 980T/550Y), or TRIP (Grades 690T/410Y or 780T/440Y)];
- 5.1.4 Finish (see 8.1);
- 5.1.5 Oiled or not oiled (see 8.2);
- 5.1.6 Dimensions (show thickness, minimum or nominal, width, flatness requirements, and length, (if cut lengths));

NOTE 1—Not all producers are capable of meeting all the limitations of the thickness tolerance tables in Specification **A568/A568M**. The purchaser should contact the producer regarding possible limitations prior to placing an order.

- 5.1.7 Coil size requirements (specify maximum outside diameter (OD), acceptable inside diameter (ID), and maximum mass);
- 5.1.8 Quantity;
- 5.1.9 Packaging;
- 5.1.10 Certification, if required, heat analysis and mechanical property report;
- 5.1.11 Application (part identification and description); and
- 5.1.12 Special requirements (if any).

NOTE 2—Typical ordering descriptions are as follows: steel sheet, cold-rolled, DP Grade 590T/340Y, ASTM A1088, oiled, minimum 1.00 by

1200 mm by coil, 1520 mm maximum OD, 600 mm ID, 10 000 kg maximum, for side reinforcement strut.

6. Chemical Composition

6.1 The heat analysis of the steel shall conform to the requirements shown in **Table 1**.

6.2 Each of the elements listed in Table 1 shall be included in the report of heat analysis, including each element in columns with grouped elements. When the amount of copper, nickel, chromium, or molybdenum is less than 0.02 %, report the analysis as either <0.02 % or the actual determined value. When the amount of vanadium, titanium, or niobium is less than 0.008 %, report the analysis as either <0.008 % or the actual determined value.

NOTE 3—Niobium is also known as Columbium.

6.2.1 See Specification **A568/A568M** for chemical analysis procedures and product analysis tolerances.

7. Mechanical Properties

7.1 All designations and grades shall conform to the mechanical property requirements in **Table 2**.

7.1.1 All designations and grades shall conform to bake hardening index requirements included in **Table 2**. The minimum increase in yield strength is based on the lower yield stress, after a prestrained specimen has been exposed to a standard bake cycle of 170 °C for 20 min. The method for measuring the bake hardening index is described in the **Annex A1**.

7.2 Mechanical property tests shall be conducted in accordance with the methods specified in Specification **A568/A568M**, or those prescribed by the purchaser.

7.3 *Bending Properties Minimum Cold Bending Radii*—High-strength sheet steels are commonly fabricated by cold bending. There are many interrelated factors that affect the ability of a steel to cold form over a given radius under shop conditions. These factors include thickness, strength level, degree of restraint, relationship to rolling direction, chemistry,

TABLE 1 Chemical Requirements^A Steel Sheet Designations, CP, DP, and TRIP

Designation/Grade	Composition, %—Heat Analysis Element, max (unless otherwise shown)								
	C	Mn+Al+Si ^C	P	S	Cu ^B	Ni	Cr+Mo ^C	V+Nb ^D +Ti ^C	N
CP									
600T/350Y	0.18	5.30	0.080	0.015	0.20	0.50	1.00	0.35	...
780T/500Y	0.18	5.50	0.080	0.015	0.20	0.50	1.00	0.35	...
980T/700Y	0.25	5.20	0.080	0.015	0.20	0.50	1.00	0.35	...
DP									
450T/250Y	0.15	3.00	0.080	0.015	0.20	0.50	1.00	0.35	...
490T/290Y	0.15	3.40	0.080	0.015	0.20	0.50	1.00	0.35	...
590T/340Y	0.17	4.75	0.080	0.015	0.20	0.50	1.40	0.35	...
780T/420Y	0.18	5.40	0.080	0.015	0.20	0.50	1.40	0.35	...
980T/550Y	0.23	6.00	0.080	0.015	0.20	0.50	1.40	0.35	...
TRIP									
690T/410Y	0.32	6.20	0.12	0.015	0.20	0.50	0.60	0.40	...
780T/440Y	0.32	6.70	0.12	0.015	0.20	0.50	0.60	0.40	...

^A Where an ellipsis (...) appears in the table, there is no requirement but, the analysis shall be reported.

^B When copper is specified, the copper limit is a minimum requirement. When copper steel is not specified, the copper limit is a maximum requirement.

^C The producer shall report the individual composition of each element in the grouping.

^D Niobium (Nb) is also known as Columbium (Cb).