STEEL, SHEET, COLD ROLLED, DUAL PHASE (CR DP)	**WSS-M1A368-A11/A12/A13/A14/A15**
STEEL, SHEET, COLD ROLLED, DUAL PHASE (CR DP LOW/HIGH YIELD)	WSS-M1A368-A21/A22/A23/A24/A25
STEEL, SHEET, HOT ROLLED, DUAL PHASE (HR DP)	WSS-M1A368-A31/A32
STEEL, SHEET, HOT ROLLED, FERRITE BAINITE (HR FB)	**WSS-M1A368-A41/A42/A43**
STEEL, SHEET, COLD ROLLED, TRIP (CR TR)	WSS-M1A368-A51/A52/A53
STEEL, SHEET, COLD ROLLED, COMPLEX PHASE (CR MP)	WSS-M1A368-A61/A62
STEEL, SHEET, HOT ROLLED, COMPLEX PHASE (HR MP)	WSS-M1A368-A71/A72
STEEL, SHEET, COLD ROLLED, MARTENSITIC (CR MS)	**WSS-M1A368-A81/A82/A83/A84**
STEEL, SHEET, HOT ROLLED, MARTENSITIC (HR MS)	**WSS-M1A368-A91/A92**

Note: Steels shown in gray typeface are not in the Global material strategy and should not be used without approval from the Sheet Metal Tech Club.

1. SCOPE

The materials defined by these Global specifications are hot rolled or cold rolled steel sheet with specified tensile strengths from 450 MPa to 1500 MPa, suitable for cold forming such as stamping, roll forming and tube making, and use in automotive applications.

The specification applies to uncoated and coated steel sheet generally categorized as advanced high strength steels:
- Dual Phase (ferrite and martensite microstructure, including grades with low and high yield, DP)
- Ferrite-Bainite (ferrite and bainite microstructure, FB)
- TRIP "transformation induced plasticity" (ferrite, bainite and retained austenite microstructure, TR),
- "Multi-Phase" or "Complex Phase" (ferrite, martensite, bainite plus precipitation hardening, MP)
- Martensitic (mainly martensitic microstructure, MS).

The steel sheet may achieve its final thickness by cold rolling, hot rolling, continuous thin-strip casting, or other means. All requirements of the specific variant are to be met regardless of the final thickness reduction method.

Specification WSS-M1P94-A shall be used where pre-coating by the steel supplier is required. All requirements of the specific variant are to be met with or without pre-coating, except as noted in these specifications or as noted as exceptions on the Engineering Drawing.

Ford Motor Company may, at its option and in agreement with the local or regional supplier, define additional and/or restricted technical delivery requirements such as mechanical properties, forming characteristics and surface texture, for a specific grade and/or part. The defined requirements shall be mandatory and no characteristics shall conflict with this engineering specification.

Date	Action	Revisions	Rev. 0
2012 01 10	Released	D. Jordan, NA / A. Toennessen, EU	

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2. APPLICATION

These Global specifications were released originally for automotive body and chassis parts.

2.1 LIMITATIONS

Common Global Grade Names are provided for information purposes and are not intended to be used on Engineering Drawings or CAD files.

Not all grade / gauge / width / coating combinations are available. Contact Product Development Materials Engineering for assistance or Global Materials and Fastener Standards (gmfs@ford.com) for help in locating the responsible engineer.

Variants shown with an asterisk and gray typeface in Tables 1-4 presently are not in the Global material strategy and should not be used without approval from the Sheet Metal Tech Club. Sources for these grades may not exist in your region. Contact Product Development Materials Engineering for assistance or gmfs@ford.com for help in locating the responsible engineer.

High strength materials delivered to this specification may be sensitive to hydrogen assisted cracking. Electro galvanized products may require baking treatment.

Material supplied to these specifications may contain titanium or other transition metals as alloying additions. Such alloyed steels, if subsequently surface treated by a nitrocarburising and/or oxidizing process, risk becoming embrittled due to the formation of ultrafine TiN or other precipitates. Accordingly, special consideration should be given to low carbon steel that contains intentional additions of titanium or other transition metals for parts that may be subjected to nitrocarburising and/or oxidizing processes.

3. REQUIREMENTS

3.1 STANDARD REQUIREMENTS FOR PRODUCTION MATERIALS

Material suppliers and part producers must conform to the Company's Standard Requirements for Production Materials (WSS-M99P1111-A).

Material suppliers and part producers must conform to the Company's Quality System Requirements. In order for materials to comply with the requirements of the material specification they shall be sourced from suppliers listed in the Ford Motor Company Approved Source List, (ASL). See also paragraph 4.1.

3.2 CHEMICAL COMPOSITION AND MICROSTRUCTURE
(ASTM E112, JIS G0320, ISO 4967 / ASTM E45)

3.2.1 Chemical Composition
The upper and lower limits of chemical composition of the controlled elements shall be established by the supplier and included in the supplier's Control Plan.

Heat and/or check analyses shall be provided as part of the initial material source approval process in a format suitable for upload into the Ford Material Database.

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3.2.2 Microstructure

The grain size number shall be established as part of the initial material source approval process and shall be consistent (within 1 unit) throughout the thickness of the sheet.

The steel sheet shall be free from internal defects that adversely affect manufacturing or part functionality. Examples of defects may include: pipe laminations, non-metallic inclusions, segregation, and blowholes. Non-metallic inclusion content shall not exceed a rating of 2.0 for thin and 2.0 for heavy when tested in accordance with ASTM E 45 Method D, Plate III, by analysis at 100X.

3.3 MECHANICAL PROPERTIES

(ASTM E8M, ASTM E290, ASTM E646, EN 10002-1, EN 10325, ISO 6892, ISO 10275, ISO/TS 16630, SEP 1240, JFS T 1001, JIS Z2201, JIS Z2241)

For initial approval requirements see paragraph 4.1.

Mechanical properties listed are valid in longitudinal direction. Certification of ongoing production material shall be in accordance with regional and/or local requirements.

For the determination of mechanical properties, the material cross sectional area shall be defined as that of the steel; contribution of any metallic and/or organic coating to the cross-sectional area used for stress calculation is neglected.

Yield Strength is defined as lower yield stress or 0.2% proof stress (for materials without marked yield point).

ASTM Total Elongation is measured with an ASTM (50 mm) test bar (ASTM E 8M).
EN Total Elongation is measured with an ISO II (80 mm) test bar (EN 10002-1).
JIS Total Elongation is measured with a JIS #5 test bar (JIS Z 2201).

Strain Hardening Exponent (n-value) is measured over the range 10-20% strain (or 10% to end of uniform elongation if less than 20%). See ASTM E 646 or ISO 10275. If uniform elongation is less than 12%, n-value shall be reported as $n_{UE} = \varepsilon_{UE}$ (n at uniform elongation equals true strain at uniform elongation.)

BHI (Bake Hardening Index) is defined as the increase in lower yield strength due exclusively to the baking portion of the following:

Strain 2% in the longitudinal direction, note stress and release load.
Bake at 170 (+/- 2) deg C peak metal temperature for 20 (+/- 1) minutes.
Determine post-bake yield strength per ASTM E 8M, EN 10002-1, EN 10325, or JIS Z 2241.
BHI is the difference between the pre-bake stress at 2% strain and the post-bake yield strength.

BHI neglects the contribution of work hardening to yield strength and includes only the contribution due to thermal response. Actual processing conditions (temperature profiles and strain conditions) dictate the observed strength levels of individual parts.

Hole expansion testing shall be performed to ISO/TS 16630 or JFS T 1001.

Bend testing shall be performed to ASTM E 290.

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