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|---|---|
| **STEEL, SHEET, COLD ROLLED, LOW CARBON** | **WSS-M1A365-A11** |
| **STEEL, SHEET, COLD ROLLED, LOW CARBON, GENERAL FORMABILITY** | **WSS-M1A365-A12** |
| **STEEL, SHEET, COLD ROLLED, LOW CARBON, IMPROVED FORMABILITY** | **WSS-M1A365-A13** |
| **STEEL, SHEET, COLD ROLLED, LOW CARBON, HIGH FORMABILITY** | **WSS-M1A365-A14** |
| **STEEL, SHEET, COLD ROLLED, LOW CARBON, EXTRA HIGH FORMABILITY** | **WSS-M1A365-A15** |
| **STEEL, SHEET, HOT ROLLED, LOW CARBON** | **WSS-M1A365-A20** |
| **STEEL, SHEET, HOT ROLLED, LOW CARBON, GENERAL FORMABILITY** | **WSS-M1A365-A21** |
| **STEEL, SHEET, HOT ROLLED, LOW CARBON, IMPROVED FORMABILITY** | **WSS-M1A365-A22** |
| **STEEL, SHEET, HOT ROLLED, LOW CARBON, HIGH FORMABILITY** | **WSS-M1A365-A23** |

## 1. SCOPE

The materials defined by these Global specifications are fully killed, fine grained, low carbon steel sheet, with specified minimum yield strength between 110 and 240 MPa and good forming, joining, and painting characteristics.

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.

Hot rolled flat products are usually supplied in thicknesses greater than 1.8 mm, for uncoated products in a pickled and oiled condition.

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.

| Date | Action | Revisions | Rev. 1 |
|---|---|---|---|
| | | | |
| 2017 09 06 | Revised | See Summary of Revisions | L. Liu, AP |
| 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.

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

Note: Drawing Precedence – Any part specific exceptions or restrictions of requirements listed in paragraph 3 shall be recorded on the part drawing and have to be considered in all engineering testing and attribute confirmation checklists.

### 3.1 APPROVED SOURCES

This specification requires the use of approved sources. Only the sources identified on the Ford Approved Source List (ASL) can be used when this specification is listed on the drawing, CAD file, or other documents. The list of approved sources is located within Ford at www.mats.ford.com or available externally through a Ford Materials Engineer. 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. Guidelines for chemical composition are provided in section 4.4.

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.

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 E45 Method D, Plate I-r, by analysis at 100X.

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## 3.3 MECHANICAL PROPERTIES

(ASTM E8M, ASTM E517, ISO 6892-1, ISO 10113, ISO 10275,JIS Z2241,JIS Z2254)

For initial approval requirements see paragraph 4.1.

Mechanical properties are valid in both the transverse and longitudinal directions. Certification of ongoing production material shall be in accordance with regional and/or local requirements.
It is acceptable to certify material for shipment using only one test direction. However, disputes will be settled using longitudinal, transverse and diagonal test bars sampled from the suspect material.

For the determination of mechanical properties, the material cross sectional area shall be defined as that of the steel substrate only; contribution of any metallic and/or organic coating to the calculated cross-sectional area used for stress calculations is neglected. (i.e. Zn, e-coat and/or paint are not included). This method of determining the cross sectional area of the test bar will be used as the referee method in all cases where the mechanical properties of the incoming material are in dispute.

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 (ISO 6892-1).
JIS Total Elongation is measured with a JIS #5 test bar (JIS Z 2241).

Plastic Strain Ratio (r-value) is defined for a specific test direction with respect to the rolling direction. It is measured at 20% total elongation (or maximum uniform elongation if less than 20%). See ASTM E 517, ISO 10113, or JIS Z 2254.

Average Plastic Strain Ratio ($r_{avg}$) is calculated as a weighted average of the individual r-values, i.e., ( $0^o + 90^o + 2 \times 45^o$ ) / 4. For grades with ravg requirements, data is collected for initial source approval. Ongoing certification to ravg requirements is not required for all coils. However, disputes will be settled using longitudinal, transverse and diagonal test bars sampled from the suspect material.

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. n-value measurements only valid for material up to 6.4 mm. For gauges over 6.4 mm n-values are not required.

Bend testing shall be performed to ASTM E290. Using a V-Bend test setup through a 90º bend angle. Other test setups may be acceptable at the discretion of the regional Materials Engineering

Mechanical properties are reported following standard rounding rules.

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