ALUMINUM ALLOY, SHEET, HEAT TREATABLE, ENHANCED HEMMING **WSS-M2A174-A1**

ALUMINUM ALLOY, SHEET, HEAT TREATABLE, ENHANCED BAKE RESPONSE **WSS-M2A174-A2**

1. SCOPE

The materials defined by these specifications are for thin gage, direct cast, 6000 series aluminum sheet with enhanced temper response.

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 pretreatment, for a specific grade and/or part. The defined requirements shall be mandatory and no characteristics shall conflict with these engineering specifications.

2. APPLICATION

These global specifications were released originally for stamped automotive body parts.

2.1 LIMITATIONS

The yield strength of the material in the part after the paint baking process is a function of the amount of forming deformation and the time-temperature profile during the paint baking process. The mechanical property values shown in Table 2 apply only to the listed condition; individual parts will have different properties, depending on specific processing in the vehicle manufacturing plants.

2.2 DEFINITIONS

Variant A1 is an enhanced hemming alloy, typically applied to outer body panels (Class 1) that require small hem radii.

Variant A2 is an enhanced bake response alloy, typically applied to outer body panels (Class 1) that require good formability and improved dent and ding behavior.

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 4.2).

Date	Action	Revisions	Rev 01
2014 06 20	Revised	See Summary of Revisions	G. Mracna, NA
2013 11 06	Released		G. Mracna, NA

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3.2 CHEMICAL COMPOSITION

(ASTM E34, ASTM E716, ASTM E1251)

3.2.1 Chemical Composition

The upper and lower limits of chemical composition of the controlled elements shall be established by the supplier by any of the listed methods and included in the Supplier's Control Plan. In case of dispute, the referee method shall be ASTM E34.

The tabulated upper and lower limits of chemical composition for each variant may not agree with those listed in the Aluminum Association "Teal Sheets." The values in Table 1 take precedence.

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

Table 1: Ladle Chemical Composition (weight percent maximum, unless shown as a range or a minimum, balance Al)

	A1/A2
Si	0.50 – 1.00
Fe	0.30
Cu	0.20
Mn	0.15
Mg	0.40 - 0.80
Cr	0.10
Zn	0.10
Ti	0.10
Others (each)	0.05
Others (total)	0.15

3.3 MECHANICAL PROPERTIES

(ASTM E8M, ASTM B557M, 50 mm gauge length; ASTM E517; FLTM BB 115-01)

Mechanical properties are valid in the longitudinal, transverse, and diagonal directions, except as noted. Certification of ongoing production material shall be in accordance with regional and/or local requirements. In cases of dispute, test data obtained from supplier retained samples that have been stored under environmentally controlled conditions will serve as the arbitrator. The samples shall be tested at a third party laboratory.

Mechanical properties shall be valid for a period of between thirty (30) and ninety (90) days following solution heat treatment unless otherwise noted.

For the determination of mechanical properties, the material cross sectional area shall be defined as that of the aluminium alloy; contribution of any surface treatments to the calculated cross-sectional area used for stress calculations is neglected.

The test specimen geometry and orientation relative to the rolling direction are to be established locally to certify on going production material.

Yield Strength is defined as 0.2% proof stress. Yield strength and ultimate tensile strength shall be measured per ASTM B557M. Yield Strength (T81) is defined and measured per FLTM AB 107-01 at 30 days.

Uniform elongation shall be measured per ASTM E8M, Sec. 7.9.3 or 7.9.3.2. In cases of dispute, section 7.9.3 shall be the umpire method.

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Plastic Strain Ratio (r-value) is defined for a specific test direction with respect to the rolling direction. It is measured at 10% elongation.

Normal anisotropy (r-bar, r_{avg}, or r_m) is calculated from the individual r-values per ASTM E517.

Strain Limit for Flat Hemming is defined and measured per FLTM BB 115-01.

Table 2: Mechanical Properties (minimum, unless shown as a range or maximum)

	A1	A2
Yield Strength, MPa	95 - 135	105 – 145
Yield Strength at 180 days*, MPa, max	145	155
Ultimate Tensile Strength, MPa	195-260	200 - 270
Uniform Elongation, %	19	19
r_{avg}	0.50	0.50
r_{45}	0.30	0.30
Yield Strength Increase After T81, MPa	40	50
Strain Limit for Flat Hemming, %, max	15	7

* The max yield strength between 90 and 180 days shall be determined via linear interpolation from the yield strength at 90 days and 180 days.

3.3.1 Lot Release Limits

The supplier shall propose initial lot release values that will be used prior to addition to the ASL. The final lot release requirements shall be agreed upon between the supplier and Ford Materials Engineering during initial mechanical property testing and included into the source approval.

For any lot release property that is reported as an average of three measured directions (L, D, & T), the individual directional measurements shall also be reported on the lot release certification.

3.3.2 Ongoing Mechanical Property Testing

For ongoing production, the testing frequency shall be agreed upon annually between the supplier, Ford Product Development and Ford STA. It will include all of the properties listed in Table 2 and be available upon request.

3.4 DIMENSIONS AND DIMENSIONAL TOLERANCES

3.4.1 Thickness and Thickness Tolerance

Unless otherwise specified by Ford Motor Company on the Engineering Drawing or Purchase Order, the tolerance for thickness shall comply with ESBAU5-1N260-(*)

(*) – latest level

3.4.2. Other Dimensional Tolerances

Length, width, flatness, camber, out-of-square, mass and other tolerances for the material as delivered by the aluminum alloy supplier are defined by the relevant local manufacturing activity. Examples include ANSI – H35.2 and EN 485-4.

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