



ENGINEERING MATERIAL SPECIFICATION

STEEL, SHEET, BORON TREATED, ALUMINIZED, HIGH STRENGTH

WSS-M1A357-A1

1. SCOPE

The sheet metal material defined by this specification is applicable for the direct press hardening (combined hot forming/die quenching) production process. The metallurgical concept conforms to cold rolled, fully killed, fine grained, boron treated steel. The steel substrate is hot dip aluminized coated (AISI coated). Typical thickness range is 0.8 mm to 2.5 mm.

The material specification defines the properties of the sheet material as delivered to the press-shop in the soft condition before press hardening. Fully processed press hardened part requirements like mechanical properties or final coating layer structure shall meet the performance specification WSS-M99P39-A1/A4

Flexibly rolled (Tailor Rolled Blank) material used for direct press hardening is covered by this specification, see paragraph 3.7 for details.

Tailor Weld Blanks may include a section made from material to WSS-M1A357-A1. The material callout section of the drawing has to show the material used for all sections and refer to the Ford Engineering Specification for TWB and additional requirements listed there.

2. APPLICATION

This material specification was released originally for use in AISI coated direct press-hardened body structure parts.

2.1 LIMITATIONS

See the WSS-M99P39-A1 performance specification for the description and limitations of direct press hardening part production processes.

The aluminized steel sheet metal material specified herein shall not be used for indirect hot forming / press hardening processes with significant cold (pre-) forming prior to austenitization because of the limited ductility of the coating layer.

3. REQUIREMENTS

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.

Steel suppliers have the responsibility to supply raw material which enables the direct hot-forming process. The raw material must be capable to achieve the specified strength and performance for the hardened condition using state of the art press hardening tools and processes. This needs to be demonstrated during the material approval process. For initial approval requirements see paragraph 4.1.

Date	Action	Revisions	Rev. 01
2016 07 29	Revised	See sect.5. for revision summary	D. Ruhno, I. Schenk, NA
2007 02 22	Activated		D. Jordan, NA



3.2. DIMENSIONS AND DIMENSIONAL TOLERANCES

3.2.1 Thickness and Thickness Tolerances

The material thickness specified on the Engineering Drawing shall be nominal and shall include both the substrate thickness and the coating thickness.

The nominal incoming material thickness in each area or plateau of multiple- thickness blanks (e.g., tailor welded or tailor rolled blanks) shall be identified on the Engineering Drawing. Tailor rolled blanks shall include plateau transition position / length tolerances on the drawing.

Specified Nominal Thickness (mm)	Tolerance (mm) Cold Rolled
0.8 – 1.19	+/- 0.07
1.2 – 1.49	+/- 0.08
1.5 – 1.99	+/- 0.09
2.0 – 2.59	+/- 0.11
2.6 – 3.00	+/- 0.14

Note: Refer to WSS-M99P39-A1/A4 for the allowable thickness reduction resulting from the press hardening process.

3.2.2 Other Dimensional Tolerances

Length, width, flatness, camber, and mass tolerances for the material as delivered by the steel supplier are defined by the relevant national standards and/or regional Ford requirements. Details will be agreed between material supplier and the parts producer.

3.3 MANUFACTURING/ PROCESS REQUIREMENTS

Final material properties in the part are achieved by heat treatment.

Detailed process requirements and process parameter limitations for the direct hot forming / press hardening process are provided in WSS-M99P39-A1/A4.

3.4 CHEMICAL COMPOSITION

The chemical composition applies for all material delivered to this material specification (wt.-%)

C	0.20 – 0.25
Mn	1.10 – 1.40
P	0.025 max
S	0.008 max
Si	0.50 max
Cr	0.35 max
Mo	0.35 max
B	0.005 max
N	0.009 max
Al	0.02 – 0.06 (*)
Ti	0.02 – 0.05 (**)
Cu	0.2 max
Ca	***
Ni, Sn, Nb, V	****





*	Sufficient to fully kill the steel.
**	Sufficient to stabilize nitrogen.
***	Sufficient for sulfide inclusion shape control
****	No requirement.

All listed elements shall be reported for material source approval and shall be listed on the steel Supplier's Control Plan if added intentionally.

The upper and lower limits for each of the controlled elements shall be established by the Supplier and included in the steel Supplier's Control Plan.

Sulfide inclusion shape control is required and shall be accomplished by calcium additions. Typical calcium content is 0.001–0.005 -wt. %.

See paragraph 4.3 for Restricted Substances Management.

3.5 MICROSTRUCTURE

The material microstructure in an as delivered condition shall be fine grained, predominantly ferrite-perlite with some carbides present. The grain size shall be uniformly distributed along the sheet thickness.

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 III, by analysis at 100X or other method if agreed with regional Ford Materials Engineering.

Occurrence and type of material inhomogenities (eg. martensite lines, slag inclusions, sulfide inclusions, segregation) should represent the state-of-the-art technology and should be limited in size and frequency to ensure a proper production quality and proper performance (crash, fatigue) of the finished part.

3.6 MECHANICAL PROPERTIES

(ASTM E8M, ISO 6892-1) For initial approval requirements see paragraph 4.1.

Note: The mechanical properties of direct hot formed / press hardened parts correspond to the martensite microstructure of the material after austenitization / die quench processing.

The requirements for the material properties after press-hardening are given in the WSS-M99P39-A1/A4 performance specification and added to the part drawing. The set of properties given in the paragraph below describe the raw material which is shipped directly from steel suppliers to the direct press hardening operation (see paragraph 3.7 for Tailor Rolled Blanks, TRB).

Mechanical properties listed are valid in both transverse and longitudinal test direction. The cross sectional area for stress calculation shall be defined as that of the measured sample including the steel substrate and the coating. The tensile test has to be done acc. to ASTM 8M (50 mm) or ISO 6892-1 (80 mm). Yield Strength is defined as 0.2% proof stress.

Certification of ongoing production material shall be in accordance with regional and/or local requirements (e.g. test direction) and agreed between supplier and receiving operation.

Yield Strength	335 – 550 MPa
Ultimate Tensile Strength	500 – 700 MPa
Total Elongation	12% min

The actual production statistics will be monitored during source approval process and production line specific tighter property ranges may be agreed.