



STEEL, FORGING, AIR COOLED MEDIUM CARBON

WSS-M1A340-A1
WSS-M1A340-A2
WSS-M1A340-A3
WSS-M1A340-A4

1. SCOPE

The materials defined by these specifications are medium carbon steels which develop their properties upon controlled air cooling from the forging temperature. Both microalloyed and plain carbon steels, which may contain nitrogen, are included.

2. APPLICATION

These specifications were originally released for materials used in the manufacture of high durability cycle engine crankshafts and connecting rods. The materials defined by these specifications are not recommended for applications involving impact loading.

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).

3.2 CHEMICAL COMPOSITION (Weight Percent)

	A1	A2	A3	A4
Carbon	0.36 - 0.40	0.36 - 0.40	0.42 - 0.47	0.30 - 0.36
Silicon	0.50 - 0.65	0.50 - 0.65	0.15 - 0.35	0.15 - 0.35
Manganese	1.40 - 1.55	1.35 - 1.45	1.20 - 1.40	1.10 - 1.40
Sulfur	0.050 - 0.065	0.050 - 0.065	0.045 - 0.065	0.080 - 0.130
Phosphorus	0.025, max	0.015, max	0.035, max	0.035 - 0.080
Chromium	0.10 - 0.20	0.10 - 0.20	----	0.05 - 0.35
Molybdenum	0.05, max	0.05, max	----	----
Nickel	0.15, max	0.15, max	----	----
Copper	0.25, max	0.25, max	----	----
Vanadium	----	0.08 - 0.12	0.10 - 0.15	0.23 - 0.30
Aluminum*	0.006 - 0.020	0.010 - 0.030	0.025, max	----
Nitrogen	0.013 - 0.020	0.013 - 0.020	----	----
Carbon Equivalent	----	----	----	1.04 - 1.10

Carbon Equivalent (C.E.) = %C + 0.28(%Mn) - 1.03(%S) + 0.323(%Cr) + 1.69(%V)

*When steel for A1 is silicon killed, aluminum shall be 0.015% max.

Date	Action	Revisions
2007 08 03	Revised	Revised 3.2, 3.3, 4.1, 4.3 & 4.4; Inserted 4.5 & 4.6; and added A4 version G. Weber
2002 09 19	Revised	Updated and renumbered
1999 05 17	Activated	



Documents

Daeth, G. Weber
Document Sharing Hub



3.3 MECHANICAL PROPERTIES (ISO 6892/ASTM E 8M)

Mechanical properties will be measured on test specimens taken from parts produced according to the approved Control Plan. The test specimen and Brinell hardness location shall be indicated on the appropriate Engineering Drawing and/or Engineering Specification, and reflected in the Supplier Control Plan. Tests may be carried out on substandard test specimens if standard specimens cannot be obtained.

		A1	A2	A3	A4
3.3.1	Tensile Strength, MPa, min	750	850	900	890
3.3.2	0.2% Offset Yield Strength, MPa, min	450	580	625	700
3.3.3	Elongation, %, min	12	12	10	10
3.3.4	Hardness, HB (ASTM E 10)	223 - 269	255 - 298	269 - 331	262 - 363

3.4 MICROSTRUCTURE (ASTM E 112)

The general microstructure, as observed in forged parts, shall be comprised of ferrite and pearlite. No acicular transformation products such as bainite are permitted. Ferritic grain size shall be ASTM size 4 or finer, with sporadic areas of size 3 permissible at depths 5 mm or greater below the forged surface. Test location shall be identified on the Engineering Drawing.

3.5 CONTINUOUSLY CAST BLOOMS AND BILLETS (ASTM E 381)

A1, A2, A3: Acceptance criteria for macroetch testing per ASTM E 381 must be agreed upon between the steel producer and forging manufacturer and must be included in the Control Plan. Sufficient reduction ratios and proper control of casting temperature should be part of the Control Plan. Evidence of dendritic structure or other conditions defined in the above standard must not be present in the final product.

A4: Acceptance criteria for macroetch testing per MES MM010A must be agreed upon between the steel producer and forging manufacturer and must be included in the Control Plan.