



COMPACTED GRAPHITE CAST IRON

WSS-M1A354-A

1. SCOPE

The material defined by this specification is a compacted graphite cast iron, with a combined nodular and vermicular graphite morphology, to be used for applications requiring mechanical properties intermediate to those of grey and nodular iron.

2. APPLICATION

This specification was originally released for material used in the production of V6 Diesel Engine Cylinder Blocks.

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

Composition shall be selected in order to optimize castability, mechanical properties, microstructure, and machinability requirements. Specific composition limits (including mandatory maximum limits for Titanium, Chromium and Manganese shown below) and foundry practices to meet performance and manufacturing requirements will form part of an agreed Control Plan for individual component geometries.

Weight %

Titanium	0.015 max.
Chromium	0.10 max.
Manganese	0.40 max.

3.3 HARDNESS (Unless otherwise stated on the Engineering Drawing) (ASTM E 10/ISO 6506)

Head Face	215 - 265 HB
Sections: Bulkhead	210 - 260 HB
Section: Intrabore	215 - 265 HB

Date	Action	Revisions	Rev. 2
2013 01 03	Revised	3.5.1 removed reference to ES4R8Q-6010-CB	G. Weber, NA
2004 04 23	Revised	Para 3.4.3 deleted and 4.3 added	R. Batty
2003 10 09	Activated		R. Batty (AD), G. Weber (POFF)



Unless otherwise specified, castings may be normalized or annealed to meet the hardness range. If this is the case, the heat treatment cycle shall be specified on the Engineering Drawing.

The method, frequency and location for checking hardness shall be specified in the Engineering Specification and in the Supplier Control Plan.

3.4 TENSILE PROPERTIES

(ASTM E 8M/ISO 6892/ASTM E 111)

3.4.1	Ultimate Tensile Strength, Bulkheads 2 & 3,	420 MPa min.
3.4.2	Yield Strength, Bulkheads 2 & 3	310 MPa min.
3.4.3	Moved to paragraph 4.3.	
3.4.4	Modulus of Elasticity (Chord Modulus Method, 5 to 25% of UTS)	140 GPa min.

The values above will be measured on test bars taken from components. The test bar shall be taken such that minimum expected properties are represented, and the frequency and exact location for taking the sample shall be indicated in the appropriate Engineering Specification, and reflected in the Supplier Control Plan.

3.5 MICROSTRUCTURE

(Determined using SinterCast methodology – chart version (B-15-11-0.1))

3.5.1	Graphite morphology	Cylinder Bore	Bulkhead
	Nodularity	< 20%	< 20%
	Flake Graphite	not permitted	not permitted
	Cast Surface Flake Skin	n/a	0.30 mm max
	Degenerate Forms	not permitted	not permitted

Locations for test pieces shall be identified in the Engineering Specification or on the Engineering Drawing.

3.5.2	Matrix		
	Pearlite	85 – 100% (target 93%)	>80%
	Carbides or Phosphides	1% max.	1% max.

3.6 QUALITY AND CLEANLINESS

As-cast components shall be free of loose sand, oxide and scale. No inclusions are permitted on the finished surfaces or any remaining machined portion of the components.

Porosity and shrinkage requirements shall be described in the Engineering Specification, and appropriate method and locations for checking shall be specified in the Supplier Control Plan.