

ENGINEERING MATERIAL SPECIFICATION

Material Name

Specification Number

GREY CAST IRON, PISTON RINGS, ALLOYED
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WSD-M1A301-A4
WSD-M1A301-A5
WSD-M1A301-A6
WSD-M1A301-A7

1. SCOPE

The material defined by this specification is a high alloyed iron, with specified microstructures.

2. APPLICATION

This specification was released originally for materials used in the production of piston rings.

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 %, ladle analysis)

	A4	A5	A6	A7
Carbon (total)	3.10-3.50	2.50-3.30	3.20-3.80	3.00-3.40
Silicon	1.90-2.50	3.60-4.60	2.20-3.20	1.90-2.50
Phosphorus	0.30 max	0.35 max	0.20-0.50	0.25-0.45
Sulphur	0.15 max	0.15 max	0.10 max	0.10 max
Chromium	0.25-0.55	0.20-0.60	0.30-0.70	0.20-0.40
Vanadium	0.10-0.30	0.30-0.70	0.10-0.30	----
Manganese	0.60-0.90	0.80-1.20	0.50-0.80	0.40-0.80
Copper	0.90-1.30	0.50-1.00	0.80-1.20	0.75-1.25
Nickel	2.00-2.40	0.50-1.00	0.30-0.80	----
Molybdenum	0.80-1.20	0.50-1.00	0.50-1.30	0.75-1.25
Titanium	----	0.10-0.30	----	----
Tungsten	----	0.80-1.20	----	----
Niobium	----	0.10-0.40	----	----

Carbon equivalent and alloying elements shall be controlled within the above range to accommodate the ring section, size and method of casting (static/centrifugal are acceptable). The anticipated working range for each component shall be restricted to a limited band within the above.

3.3 HARDNESS

(ISO 6506, ASTM E 18)

Date	Action	Revisions
2002 10 09	Revised	Updated and renumbered
1995 01 30	Activated	Added A6 & A7
1993 06 23	C10312721	Released Janssen EAO J.C. Webster NAAO

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Page 1 of 3



Documents

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	A4	A5	A6	A7
HB	-----	350 - 470	-----	-----
HRC	28 - 38	-----	30 - 42	-----
HRB	-----	109 - 116	106 - 114	103 - 111
HRD	-----	-----	-----	45 - 53

An average of three results taken (1) adjacent to the gap,(2) 90 degrees to the gap and (3) opposite the gap.

Any other position will be within 10 HB points, 2 Rockwell B, or C, or D points.

3.4 MICROSTRUCTURE (ASTM A 247)

A4/A5 Graphite: Primary graphite (ASTM A 247) Form VII types A and B; size 5 and finer. Type C is not permitted.

Matrix: Fine grained tempered martensite or bainite with a uniform distribution of fine isolated carbide particles.

A6 Graphite: Shall be predominantly Type A and B flakes, size 5 to 8. Small amounts of Type D and E graphite are permissible but shall be held to a minimum.

Matrix: Shall consist of an acicular structure and/or partially spheroidized pearlite. Free ferrite or massive carbides shall be held to a maximum of 5 % of any field viewed at 100x. The steadite constituent shall be uniformly distributed as non- massive particles.

Chemical composition shall be secondary to microstructure and physical properties for acceptance or rejection.

The castings shall be heat treated for a minimum of one hour at a temperature of between 580 and 630 °C. The actual temperature shall be such that the hardness requirements are met.

A7 Graphite: Shall consist of predominantly AFS types D/E with an inter-mixture of random forms A/B, size 5 and finer.

Matrix: Shall be composed of close grained martensite. There shall be free ferrite present. Carbides, if present, shall be uniformly distributed, non-massive and shall not exceed 5 % of any field at 100 diameter magnification. Steadite shall be well distributed in a broken non-continuous network.