FERRITIC AND PEARLITIC (ARMASTEEL) MALLEABLE IRON CASTINGS

GM11M GM84M GM85M GM86M GM88M

1 SCOPE. This specification covers castings made of ferritic and pearlitic (ArmaSteel) malleable iron used in the products of the automotive and other industries. A suffix number system is provided for designation when monitoring of tensile, yield, and elongation properties is required of specific castings.

1.1 Castings shall have no discontinuities detrimental to subsequent processing or to the service for which they are intended. Their surface shall be reasonably smooth and free from scale and burned-on sand.

1.2 No repairing, plugging or welding of any kind shall be permitted, unless specific permission as to location and procedure to be used has been requested by the supplier and granted by the purchaser. Castings that have been repaired by welding shall be reannealed so that their microstructure will comply with 4.1.

1.3 Additional casting requirements may be agreed upon by the purchaser and supplier. These should appear as additional product requirements on the casting drawing or applicable document.

2 REFERENCED STANDARDS.

ASTM A47 ASTM E10

3 HARDNESS.

3.1 The hardness of castings furnished to this standard shall conform to the limits shown in Table 3. Where this limit is intended to apply to a specific area or areas of the casting, or where other limits are required for specific castings, the engineering drawing of the part shall so note.

NOTE: Consultation with supplier to determine areas of test is highly desirable.

3.2 Hardness readings shall be taken according to ASTM E10, Test for Brinell Hardness of Metallic Materials, after sufficient material has been removed from casting surface to insure representative readings.

4 MICROSTRUCTURE.

4.1 FERRITIC MALLEABLE IRON. The microstructure of the ferritic malleable iron shall consist of temper carbon nodules distributed in a matrix of ferrite and shall be free from massive carbides, primary graphite, and excessive pearlite. Recommended relationship of pearlite and carbide is shown in Table 1.

TABLE 1 - RECOMMENDED MICROSTRUCTURE MATRIX

GM Number	Pearlite, % max	Carbide, % max
GM11M	5	3

4.1.1 Because of reaction with the annealing furnace atmosphere, some depletion of carbon and silicon occurs at the surface of the casting. This usually results in a pearlitic rim or surface layer which shall not exceed 1.3 mm.

4.2 PEARLITIC MALLEABLE IRON. The microstructure of pearlitic malleable iron shall consist of temper carbon nodules distributed in a matrix of ferrite and pearlite in the case of air quenched and tempered grades and martensite and tempered products of the austenite transformation in the case of liquid quenched and tempered grades. The microstructure shall be free from primary graphite and contain no more than 3% carbides.

5 CHEMICAL COMPOSITION.

5.1 The chemical composition range of ferritic and pearlitic malleable iron generally conforms to the following ranges:

TABLE 2

Chemical Composition	Mass
Total Carbon	2.45-2.75
Silicon	1.25-1.55
Manganese	0.30-0.60
Sulphur	0.12 max
Phosphorus	0.05 max

5.2 The typical ranges shown above are not mandatory since it is recognized that constituents are often adjusted to achieve other specified properties.

6 MECHANICAL PROPERTIES. The tensile strength, yield strength, and elongation properties shown in Table 3 indicate the performance level of metal as measured in cast-to-shape test bars ASTM A47 poured from the same batch of metal as the casting. Properties will vary depending on solidification rate and cooling rate of individual castings and those are significantly influenced by casting and section size. Because of this, the properties of bars machined from casting may vary from those machined from cast-to-shape test bars.

6.1 Basic grade number is not appended. The acceptance or rejection of castings shall be based on hardness and not on tensile, yield, or elongation properties.

6.2 Basic grade number is appended by suffix (2). This indicates that limits shown in Table 1 are applicable to separately cast test bars, as specified in ASTM A47, which are poured periodcally at such intervals as to represent regular foundry practice. In addition, the results of such tests made during a period when the purchaser's castings are being processed shall be available to the purchaser upon request. Example: GM84M (2).

6.3 Basic grade number is appended by suffix (3). This indicates that standard test specimens will be cut from castings

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(parts). The engineering drawing will specify the area from which to cut the specimen and will define the property values. These values are to be determined by testing a statistically significant number of test specimens cut from the specified area of production typical castings. Example: GM84M (3).

7 MARKING.

7.1 The manufacturer's identification mark and pattern numbers of sufficient size assigned by the purchaser shall be cast on all castings in such positions that they will not interfere with the service of the castings.

8 INITIAL SOURCE APPROVAL. No shipment shall be made by any supplier until representative initial production samples have been approved by engineering as meeting the requirements of this specification.

8.1 Completed copies of the GM Material Safety Data Sheet and Critical Material Register (available from the engineering department for laboratory), or equivalent, must be submitted with any new submissions or when a composition change has occurred.

9 INSPECTION AND REJECTION. All shipments of material or parts under contract or purchase order manufactured to this specification shall be equivalent in every respect to the initial samples approved by engineering. There shall be no changes in either formulation or manufacturing processes permitted without prior notification and approval by engineering. Lack of notification by the supplier constitutes grounds for rejection of any shipment. while samples may be taken from incoming shipments and checked for conformance to this specification, the supplier shall accept the responsibility for incoming shipments meeting the specification without dependence upon purchasers inspection.

10 APPROVED SOURCES. Engineering qualification of an approved source is required for this specification. Only sources listed in the GM Material File under this specification number have been qualified by engineering as meeting the requirements of the specification. Sources are available through the on-line MATSPC System.

11 GENERAL INFORMATION. This specification was first published in October 1924 and was completely revised in June 1982. The specifications issued were GM84M, GM85M; June 1942, GM86M, and GM88M; December 1956. The latest revisions include:

Rev	Date	Description	Div
B	8/93	Complete revision; combined ferritic and pearlitic into same spec	MET

TABLE 3 - MECHANICAL PROPERTIES, SUFFIX 2 TEST BAR VALUES

Type of Malleable Iron	Grade[1]	Hardness[2]		Tensile Strength, mPa, min	Yield Strength, mPa, min[3]	Elongation, min[4]
		HB	BID			
Pearlitic	GM88M	269-302	3.5-3.7	720	585	2.0
Pearlitic	GM84M	241-269	3.7-3.9	690	550	2.0
Pearlitic	GM85M	197-241	3.9-4.3	550	410	3.0
Pearlitic	GM86M	163-207	4.3-4.7	480	330	5.0
Pearlitic	GM11M	156 max	4.8 min	345	225	10.0

[1] Where grade number includes suffix symbol 2 or 3, see Section 6.

[2] Brinell Indention dia (BID) is the dia in millimeters of the impression of a 10 mm dia standard ball with 3000 g load which is applied for a min of 15 s.

HB = Brinell hardness number.

[3]Yield strength determined @ 0.2% offset.

[4]% elongation in 50 mm.

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