

Zirconium-rich Master Alloy for Grain Refining Mg Alloys not containing Aluminium

Technical Information Sheet

General

AM-cast™ is an improved Mg-Zr master alloy for making grain refining additions of zirconium to magnesium alloys that do not contain aluminium. Small additions of zirconium have an exceptional grain refining capability in these alloys.

Specialty magnesium alloys used in sand cast components for the aerospace industry and racing cars are grain refined with zirconium. New creep resistant alloys, such as AMT's AM-SC1™, that are suitable for sand casting or permanent mould casting of automotive powertrain components, also require zirconium grain refining.

Prior to the advent of AM-cast, the efficiencies of most zirconium master alloys have required Zr additions in excess of 2-3 times the amount actually required for grain refinement. The use of excessive zirconium unavoidably leads to a significant build-up of sludge in the bottom of the crucible, decreases the yield of the alloy and increases costs.

The carefully controlled microstructure of AM-cast results in high utilisation of the available zirconium in the grain refining process and minimal levels of sludge formation.

The key technical and economic benefits of AM-cast are:

- greater efficiency in the utilisation of Zr
- reduced sludge formation
- less wastage of both the master alloy and the alloy to be grain refined
- highly uniform grain refinement
- optimisation of mechanical properties through a uniformly fine microstructure

Foundry trials of AM-cast have demonstrated that the master alloy is highly effective as a grain refiner and improves foundry economics through improved yield and reduced formation of costly sludge.



Light weight turbo diesel engine with AM-SC1 engine block grain refined with AM-cast

Characteristics

AM-cast is a Mg -25% Zr master alloy. It is produced as square ~ 0.5 kg nuggets (~ 80 x 80 x 30 mm). AM-cast™ contains a fine distribution of zirconium particles, the vast majority of which lie in the size range 1-6 µm. These particles are distributed in a magnesium rich matrix containing ~ 0.5% dissolved zirconium.

Owing to its highly alloyable microstructure, AM-cast can be readily introduced into molten magnesium when assisted by a few minutes of stirring or puddling.

The large number of small zirconium particles in AM-cast results in a high proportion remaining in suspension for extended settling times.

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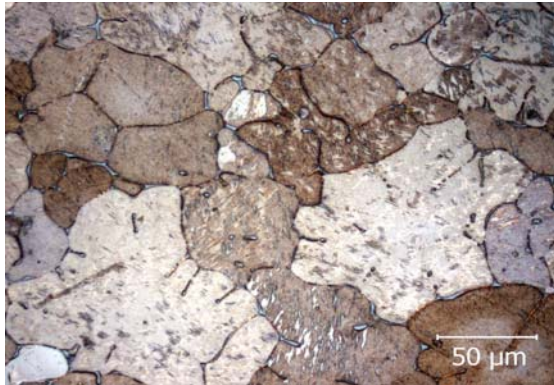
Grain refining capability

AM-cast master alloy can be readily alloyed to molten magnesium when assisted by a few minutes of stirring or puddling.

AM-cast is used for the grain refinement of alloy AM-SC1 in sand casting of magnesium engine blocks. An example of its capabilities is given by the following test. AM-cast was added to a melt of AM-SC1 at 730°C in a mild steel crucible. The melt was held at 730°C before allowing it to solidify in the crucible. The alloy was remelted at 730°C the following day and sand cast into engine block moulds. Little sludge was found in the bottom of the crucible and tests showed that the melt still had excellent grain refining capability. Prior to casting of the engine blocks, the melt was puddled for 5 minutes and allowed to settle for 30 minutes.

Trials on a wide range of magnesium alloys have consistently demonstrated excellent grain refinement by AM-cast, in sand casting, permanent mould casting, and DC casting of billet.

The figures below show the grain refining effect of AM-cast added to alloy AM-SC1 at 730°C in an uncoated mild steel crucible and cast into a preheated chill bar mould.



Non grain refined AM-SC1.
Average grain size 55 µm



AM-SC1™ grain refined with AM-cast
Average grain size 16 µm

Health and safety

Precautions should always be taken when handling and melting magnesium alloys. Safety procedures are outlined in the AMT Technical Information Sheet "*Safe Handling of Magnesium*".

When handling molten magnesium alloys it is recommended that the AM-cover protective gas system is used. The AMT Technical Information Sheet: "*The AM-cover™ System for Protecting Molten Magnesium*", provides some guidelines for the safe use of AM-cover.

Further detailed information on AM-cover is available from Advanced Magnesium Technologies.

Product development

AMT acknowledges the contribution of its research partner, CAST, in the development of AM-cast.

Reference

"A new zirconium-rich master alloy for the grain refinement of magnesium alloys"
Proc 6th International Conference on Magnesium Alloys and Their Applications (Ed K.U. Kainer) Wolfsburg 2003 Germany pp. 706-712.

Advanced Magnesium Technologies has made every effort to ensure the information contained in this document is relevant and up-to-date, but makes no representation as to its comprehensiveness or accuracy. The information is general in nature, and is not intended for use without careful consideration of each specific application. Persons receiving this information should exercise their independent judgement in determining its appropriateness for a particular purpose, and should seek further information or advice as required.

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Further information on AM-cast™ can be obtained from Advanced Magnesium Technologies.