AM-HP2®

Technical Information Sheet

High Pressure Diecasting Alloy for High Temperature Powertrain Applications

General

Designation	AM-HP2®
Composition	Mg – rare earth alloy
Fabrication	High pressure diecasting
Density	1.8 g/cm³
Thermal conductivity	102 W/m·K

AM-HP2® is a patented high temperature creep resistant alloy that has been developed specifically for use in diecast automotive power train components, such as engine blocks and transmission housings. The alloy is particularly suitable for mass production of components by high pressure diecasting. The composition of the alloy has been optimised for diecastability, performance and cost. AM-HP2 is as diecastable as the mainstream diecasting alloy, AZ91, and has a creep strength that is comparable with aluminium alloys, A380 & A319, commonly used in powertrain applications.

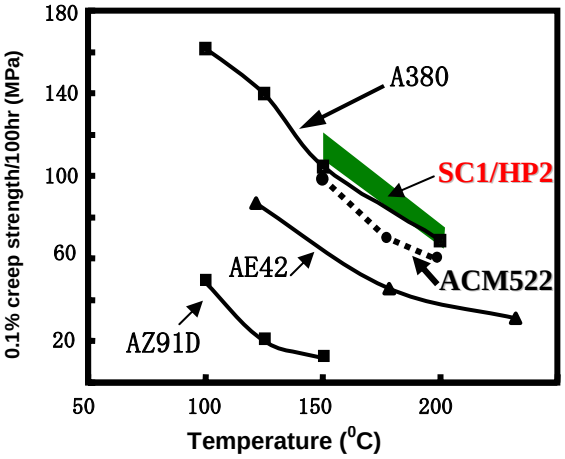
Mechanical properties

There is only a relatively minor decrease in yield strength (0.2% offset proof stress) with increasing temperature from 20°C to 177°C.

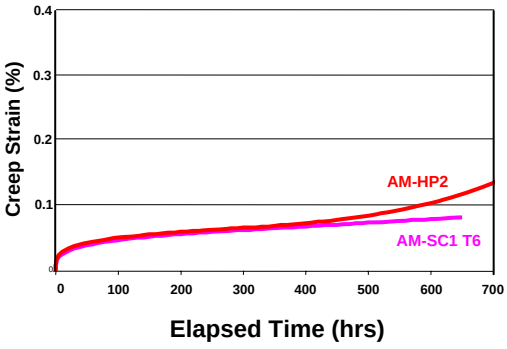
Temperature		Tensile yield strength at 0.2% offset	Ultimate tensile strength	Fracture elongation	Elastic Modulus
°C	°F	MPa	MPa	%	GPa
20	68	142	163	3	46
100	250	144	156	3	44
150	300	135	152	4	43
177	350	132	136	5	42

High temperature creep strength

The elevated temperature tensile creep strength of AM-HP2 is very similar to the highly successful alloy, AM-SC1™, that was utilised in the AVL Genios LE prototype turbo diesel engine and which has been selected as the alloy of choice for the engine block of the USCAR magnesium V6 engine. The creep properties of AM-HP2 are considerably better than other magnesium alloys that have been developed for high pressure diecast automotive components. In the temperature range of interest for power train applications (150 - 200°C) the tensile creep strength is similar to sand cast aluminium alloy A319 in the T6 condition and also high pressure die-cast aluminium alloy A380.



Comparison of creep strength of AM-SC1 and AM-HP2 with aluminium A380 alloy and some other magnesium alloys. Stress required to reach 0.1% strain after 100h.



Comparison of creep strength of AM-HP2 and AM-SC1 at a stress of 90MPa and temperature of 177°C

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Tensile Creep at Constant Load							
Temp.	Stress (MPa)	% creep strain after time		Temp.	Stress (MPa)	% creep strain after time	
		100 h	200 h			100 h	500 h
150°C	50	0.015	0.017	177°C	90	0.05	0.09
	70	0.025	0.028		100	0.06	0.22

Prototyping with AM-SC1™

The similar compositions and mechanical properties of AM-HP2 and AM-SC1 mean that the two alloys can be interchanged for similar components. This allows prototyping and short run production to be conducted with sand cast AM-SC1 prior to mass production with AM-HP2.

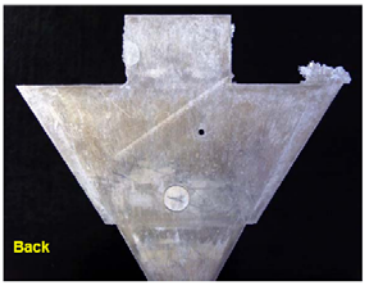
Diecasting performance

AM-HP2 has superior diecasting properties to other creep resistant magnesium alloys. This has been demonstrated using a specially designed die that tests the fluidity, filling capability and resistance to hot cracking of the metal being cast. This die features both diverging and converging flow, a thick section rib and a hollow boss for filling on return flow, significant constraint and sharp corners to test resistance to hot cracking, and three grades of surface quality to test capability to form a quality as-cast surface finish.

Under the following diecasting conditions AM-HP2 had similar diecastability to AZ91D.

- Gate dimensions = 58 x 1 mm
- Plunger diameter = 50 mm
- High speed = 2.25 m/s
- Slow speed = 0.35 m/s
- Gate velocity = 76 m/s

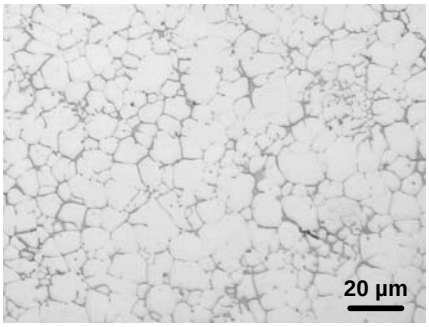
	AM-HP2®	AZ-91D
Min oil temp. °C	230	180
Die temp. °C	~ 250	~ 200
Part cooling time, sec	8-9	9
Molten metal temp. °C	740	700



Casting of AM-HP2 from diecastability test showing thick rib, hollow boss and bands of different surface finish. Note the high degree of integrity at the sharp corner at the base of the hollow boss and the excellent surface finish at the strip where the die had been polished.

Microstructure

Optical micrograph of the microstructure of HPDC AM-HP2 showing a fine dendritic morphology for the primary magnesium matrix and the interdendritic skeleton of a thermally stable Mg-RE-rich intermetallic second phase.



Development of alloy

AM-HP2 was developed by Advanced Magnesium Technologies and its research partner, CAST, in association with speciality alloy producer Magnesium Elektron Ltd.

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Further information on **AM-HP2®** can be obtained from Advanced Magnesium Technologies.

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