

# Comparison with Zinc Diecasting Alloys

The new diecasting alloy, **AM-lite®**, offers considerable advantages over zinc diecasting alloys. AM-lite diecasts and **electroplates as easily** as zinc alloys and, apart from improvements in mechanical properties, AM-lite also has a **much lower density** and offers **significant cost reductions**.

## Reduced costs

In times of soaring zinc prices, AM-lite is an increasingly attractive option for manufacture of parts previously made in zinc. Compared to zinc diecasting alloys, AM-lite provides clear benefits in the following areas:

- Light weight design
  - density less than 1/3 that of zinc
  - significantly higher design strength
  - much greater high temperature creep strength and bolt load retention
  - no creep at room temperature
- Cost of metal per part
  - 3.3 more parts per unit weight can be made from AM-lite, assuming similar designs
  - cost savings in range of 70 - 75%
- Diecasting
  - reduced cycle time possible because of lower heat input
- Surface finishing
  - significantly reduced defects due to blistering during baking in painting and powder coating operations

## Case study: projected cost savings for a car door opening handle

Operation	Saving with AM-lite
<b>Diecasting</b>	
• Weight	67% weight saving
• Cost of metal	70-75% cost saving
• Manufacturing costs	30% cost saving
<b>Savings on cost of diecast part</b>	<b>40-50% cost saving</b>
<b>Finishing</b>	
• Buffing/polishing	same
• Painting/powder coating	blister defects eliminated
<b>Savings on painting costs</b>	<b>~15% cost saving</b>
<b>Electroplating</b>	
• Buffing/polishing	same
• Electroplating	simple pretreatment
<b>Electroplating costs</b>	<b>similar</b>



Weight of handle in zinc: 256g  
Weight in AM-lite: 85g

## Surface finishing

Diecast AM-lite provides an excellent substrate for all surface finishing operations including painting, powder coating and electroplating. Compared to zinc diecasting alloys, AM-lite results in fewer defects due to blistering in baking operations. This is because AM-lite has much higher creep strength than zinc alloys and can resist the development of internal pressure arising from gases entrained by the high pressure diecasting process.

## AM-lite® can be readily electroplated

As for zinc diecasting alloys, AM-lite can be readily electroplated to produce a variety of decorative finishes. The process sequence for electroplating of AM-lite is the same as that for zinc with the addition of just one simple, extra step in the pretreatment. This pretreatment process, Bondal® Mg, has been developed by MacDermid Inc. AM-lite is not like other magnesium alloys that are very difficult and expensive to electroplate.

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## Properties

The design strength of AM-lite is higher than for zinc alloys because zinc alloys have poor creep resistance at all temperatures down to room temperature. Also, because of its low density, AM-lite has a considerably higher specific strength than common zinc diecasting alloys.

Property	Zinc Alloys 3 & 5 *	AM-lite **	Comment
Density	6.6 g/cm <sup>3</sup>	2.0 g/cm <sup>3</sup>	Density of AM-lite is less than 1/3 that of zinc
Young's modulus	85.5 GPa	45.3 GPa	Specific modulus of AM-lite is much greater than zinc
Specific modulus (E/ρ)	13 GPa(g/cm <sup>3</sup> ) <sup>-1</sup>	22.6 GPa(g/cm <sup>3</sup> ) <sup>-1</sup>	
Yield stress (0.2% proof)	220-230 MPa	160-170 MPa	Specific yield strength of AM-lite is more than double that of zinc. Yield strength of zinc is highly strain rate dependent.
Specific yield stress (YS/ρ)	33-35 MPa(g/cm <sup>3</sup> ) <sup>-1</sup>	80-85 MPa(g/cm <sup>3</sup> ) <sup>-1</sup>	
Ultimate tensile strength	280-330 MPa	230-250 MPa	Specific UTS of AM-lite is more than double that of zinc. UTS of zinc is highly strain rate dependent.
Specific UTS (UTS/ρ)	42-50 MPa(g/cm <sup>3</sup> ) <sup>-1</sup>	115-125 MPa(g/cm <sup>3</sup> ) <sup>-1</sup>	
Design strength ***	15 MPa	100 MPa	Design strength of AM-lite is much higher because of the tendency for Zn to creep at ambient temperatures
Bolt load retention × 35°C 6kN 150°C 20kN	70% ~ 5%	100% 70%	AM-lite has good creep strength and excellent bolt load retention
Corrosion (mass loss, 5day, ASTM salt spray test) ××	0.37 mg.cm <sup>-2</sup> day <sup>-1</sup>	0.2 mg.cm <sup>-2</sup> day <sup>-1</sup>	AM-lite is more resistant to general corrosion

- \* Data for Zinc Alloys 3 & 5 obtained from ILZRO ([www.dezign.org](http://www.dezign.org))
- \*\* Data for AM-lite® obtained from specimens excised from 2mm thick diecastings
- \*\*\* Design strength for Zn is stress that gives 0.2% creep elongation over 5 years at 20°C
- × Bolt load retention data: final load divided by initial load after 100h at temperature
- ×× Corrosion data obtained on 2mm thick diecast plates

## Lightweight design

Thin detailed parts can be designed in AM-lite because of its high strength combined with its ability to be diecast into thin sections with high reproducibility of die detail. Because of the tendency for zinc to creep at temperatures as low as room temperature, the design strength is much higher for AM-lite. This allows bosses for bolted sections to be made considerably thinner when designing with AM-lite.

## Melt handling

AM-lite behaves more like zinc than other magnesium alloys. While use of a cover gas is necessary, the consumption of cover gas is less than for magnesium alloys such as AZ91 and AM60. Because it is protected from oxidation by a cover gas, melt loss due to dross and sludge formation is generally less for AM-lite than for zinc alloys. As is the case for zinc alloys, returns (biscuits, runners and gates) from diecasting of AM-lite may be recycled in-cell or in a central melting facility.

## Diecasting

AM-lite is as diecastable as zinc alloys. The alloy has a high ability to fill thin sections and reproduce fine detail from the die. Castings with a mirror finish on the as-cast surface can be achieved. Cycle times may be substantially reduced because of the lower heat input during the casting cycle.

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