



## Chicago White Metal Casting

High-Tech Al, Mg, & Zn Die Castings and  
Contract Manufacturing & Assembly  
649 N. Route 83, Bensenville, IL 60106  
Tel: 1-630-595-4424 Fax: 1-630-595-9160  
CWM E-mail: sales@cwmtl.com  
CWM Website: www.cwmdiecast.com

### Net- and near-net-shape parts for a wide range of applications

# High-Tech Die Cast Parts in the Most Widely Used Alloys

CWM can offer OEM product engineers and specifiers greater freedom from die casting design and process constraints to help achieve improved product performance with lower total costs in recyclable raw materials.

#### Complex Parts to Exacting Specs

Refinement of the die casting process at CWM has established its ability to produce extremely complex net- and near-net-shape components to exacting specifications—consistent, tighter tolerances that so-called metal molding processes cannot match. We produce such parts from volumes of a 1,000 to millions per year, in applications ranging from motor housings to advanced medical devices.

#### Objective Alloy Recommendations

Because we cast in all of the most widely used alloys in Al, Mg and Zn, you can always be

assured of the objectivity of CWM material recommendations. CWM's unique experience in hot-chamber Mg die casting offers you the mag alternative to plastic for part weights comparable to plastic with greater strength.

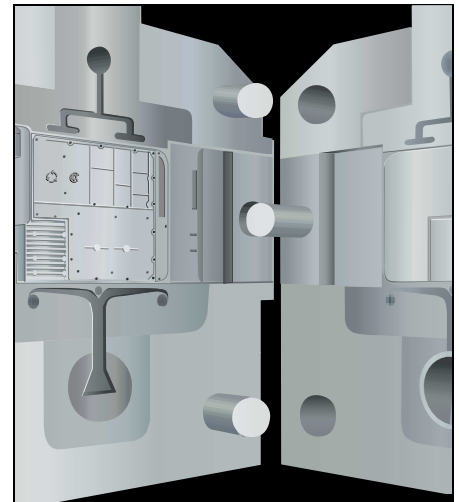
The CWM alloy production comparison chart below provides the range of part sizes and part weights that CWM casts.

Note that in the case of Zinc No. 3, the die casting dies that CWM designs and builds are guaranteed for the life cycle of the component initially placed in zinc production, excepting die changes and routine die cavity maintenance required during this life cycle.

#### Design Assistance to Lower Your Costs

CWM provides engineering guidance to optimize designs for high-tech die casting production. Early consultation with CWM can of-

ten allow engineers to design more intricate contours and closer tolerances, eliminating costs and multiple parts even on shorter production runs. Porosity can be minimized with special die designs and advanced gate and runner technology. Thinner wall designs can add package space and reduce product weight. Highly cosmetic surface finishes, as-cast, can add product quality with enhanced appearance, without



**Single-cavity die set with both fixed cores and moving core slides that can eliminate, or significantly reduce, post-casting machining needs.**

prohibitive post-casting costs.

This assistance includes 3-D computer modeling and use of the Magma<sup>®</sup> die casting process simulation software. This in-house Magma system enables more rapid optimization of die casting process parameters prior to die construction for the highest-quality casting results.

#### Built-in Prototyping, Plus Options

As part of every new CWM die casting project, a series of FDM (Fused Deposition Modeling) prototypes are made by CWM to guide production of basic tooling, trim tooling, machining fixtures and painting fixtures required—to assure minimum elapsed time from first piece to final volume delivery.

A variety of additional prototyping alternatives are available, working directly from customer CAD files. CNC machined prototypes, in the proposed casting alloy, can be economically produced in short production runs for market testing or functional evaluations. Or RP "rapid prototypes" can be provided for part evaluation prior to final die design/build sign-off.

#### Post-Casting Machining

In many cases, complex features and speci-

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## PART PRODUCTION, DIE LIFE COMPARISON

**Table 1 CWM Al, Mg & Zn Production Comparisons by Alloy<sup>Ⓐ</sup>**

	Al 380	Mg AZ91D	Zn No. 3 (ZAMAK)
<b>Part Size Range</b>	.75" x .75" to 24" x 24"	.75" x .75" to 24" x 24"	.75" x .75" to 20" x 20"
<b>Part Weight Range</b>	.5 oz. to 10 lbs.	.25 oz. to 10 lbs.	.5 oz. to 8 lbs.
<b>Machine Tonnage Range</b>	200-800 tons	80-650 tons	150-500 tons
<b>Vacuum-Assist Availability</b>	Yes	Yes	No
<b>Expected Die Life</b>	1X	3X to 5X	Life of Part <sup>Ⓑ</sup>

If your material requirements call for alloys other than Al 380, Mg AZ91D or Zn No. 3, contact the CWM Sales Dept.

<sup>Ⓐ</sup> Table values are approximations. Part sizes shown, for example, in some cases will require center gating of a part, not always practical with particular part designs.

<sup>Ⓑ</sup> The die casting dies CWM designs and builds for Zinc alloy No. 3 die casting are guaranteed for the life cycle of the product component initially placed in zinc production, excepting die changes and routine die cavity maintenance required during this life cycle.

## High-Tech Die Casting for a Wide Range of Applications

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fied tolerances can be produced as-cast with special die core slides, requiring no post-casting machining. When unusual geometries or specified tolerances require further machining operations, CWM provides a complete range of in-house CNC machining capabilities. CWM engineers will evaluate the options on your project where post-casting machining may have cost advantages by replacing the use custom core slide actions to achieve your final specifications.

### Component Surface Finishing

CWM die cast parts are often used "as-cast," with no further surface treatment. We offer a range of finishes for die castings which can be applied to enhance aesthetic appeal, increase corrosion resistance and improve mechanical properties.

Chromate coatings, platings, paints and powder coatings are the most common surface finishes recommended.

Electro-chemical chromate conversion treatments are used to improve a part's corrosion resistance. Varying chromate treatments enable part resistance to continuous salt spray test exposure from six to 150 hours.

Common platings applied to high-tech Al, Mg and Zn die cast parts are nickel, brass, copper, tin, silver, and gold, usually for cosmetic purposes. Plating also enhances conductivity, corrosion resistance, wear resistance and solderability.

Paint finishes are applied for decoration and protection, and altering surface friction.

Powder coatings are widely used for an attractive, protective finish. They cover especially evenly and provide corrosion resistance.

CWM's unique "Surface Finishing Library of Die Cast Plates" eliminates guesswork in making your final part finishing decisions.

### CWM Contract Manufacturing

With a depth of experience in subassembly production, CWM can offer special efficiencies and complete flexibility in performing this manufacturing role. This work can range from limited contract assembly steps to comprehensive single-source turnkey production of complex product subassemblies. It can include the procurement of all non-die cast components in the final packaged assembly.

For further CWM capabilities information, die cast application examples and access to die casting design guides and reference manuals and CDs, visit appropriate sections of the CWM website, or contact your Regional CWM Sales-Engineer (see Website section for locations). ■

## MATERIAL PROPERTIES & NOMINAL CHEMISTRY

**Table 2 Typical Material Properties: Die Casting Alloys & Selected Plastics**

Typical alloy values based on "as-cast" characteristics for separately die cast specimens, not specimens cut from production die castings. (2000 NADCA Standards. Sec. 3)

Commercial:	Die Casting Alloys				Thermoplastics	
	Al 380	Mg AZ91D	Zn 3	ZA-8	Lexan®	Torlon®
ANSI/AA:	380.0		AG-40A		3413	4203L
<b>MECHANICAL PROPERTIES</b>						
<b>Ultimate Tensile</b>						
ksi	46	34	41	54	19	27.8
(MPa)	(320)	(230)	(283)	(372)	(130)	
<b>Yield Strength<sup>Ⓐ</sup></b>						
ksi	23	23	32	41-43	--	--
(MPa)	(160)	(160)	(221)	(283-296)		
<b>Elongation</b>						
% in 2 in. (51 mm)	3.5	3	10	6-10	3-5 <sup>Ⓓ</sup>	15
<b>Hardness<sup>Ⓒ</sup></b>						
BHN	80	75	82	100-106	--	--
<b>Shear Strength</b>						
ksi	28	20	31	40	10.5	18.5
(MPa)	(190)	(140)	(214)	(275)	(72)	
<b>Impact Strength</b>						
ft-lb	3	1.6	43 <sup>Ⓔ</sup>	24-35 <sup>Ⓔ</sup>	2 <sup>Ⓙ</sup>	--
(J)	(4)	(2.2)	(58)	(32-48)	(100)	
<b>Fatigue Strength<sup>Ⓚ</sup></b>						
ksi	20	10	6.9	15	6 <sup>Ⓚ</sup>	--
(MPa)	(140)	(70)	(47.6)	(103)	(40)	
<b>Young's Modulus</b>						
psi x 10 <sup>6</sup>	10.3	6.5	Ⓛ	12.4	1.25	0.7
(GPa)	(71)	(45)		(85.5)	(8.6)	
<b>PHYSICAL PROPERTIES</b>						
<b>Density</b>						
lb/in <sup>3</sup>	0.099	0.066	0.24	0.227	0.052	0.050
(g/cm <sup>3</sup> )	(2.74)	(1.81)	(6.6)	(6.3)	(1.43)	(1.38)
<b>Melting Range</b>						
°F	1000-1100	875-1105	718-728	707-759	--	--
(°C)	(540-595)	(470-595)	(381-387)	(375-404)		
<b>Specific Heat</b>						
BTU/lb°F	0.230	0.25	0.10	0.104	0.27	--
(J/kg°C)	(963)	(1050)	(419)	(435)		
<b>Coefficient of Thermal Expansion</b>						
μ in./in./°F x 10 <sup>-6</sup>	12.2	13.8	15.2	12.9	12.1	17
(μ m/m°C)	(22.0)	(25.0)	(27.4)	23.2	(22)	
<b>Thermal Conductivity</b>						
BTU/ft hr °F	55.6	41.8 <sup>Ⓜ</sup>	65.3	66.3	150 <sup>Ⓜ</sup>	1.77
(W/m°C)	(96.2)	(72)	(113)	(115)	(0.21)	
<b>Electrical Conductivity</b>						
% IACS	27	n/a	27.0	27.7	23	--
<b>Electrical Resistivity<sup>Ⓝ</sup></b>						
μ Ω in.	n/a	35.8	n/a	n/a	--	--
(μ Ω cm)		(14.1)				

**Table 3 Nominal Chemical Composition: Die Casting Alloys**

For detailed chemical composition, request appropriate CWM Instant Fax Line Document.

Nominal Comp:	Cu 3.5	Al 9.0	Al 4.0	Al 8.4
	Si 8.5	Zn 0.7	Mg 0.035	Mg 0.023
		Mn 0.2		Cu 1.0

With mechanical properties, note die casting alloys 380.0, A380.0, 383.0 and 384.0 are substantially interchangeable. <sup>Ⓐ</sup> 0.2% offset <sup>Ⓑ</sup> 500 kg load, 10mm ball <sup>Ⓒ</sup> Rotary Bend 5 x 10<sup>7</sup>/10<sup>8</sup> cycles <sup>Ⓓ</sup> Notched Charpy. <sup>Ⓔ</sup> AT 68°F (20°C) <sup>Ⓕ</sup> ASTM E 23 unnotched 0.25 in. die cast bar <sup>Ⓖ</sup> Varies with stress level; applicable only for short-duration loads. Use 10<sup>7</sup> as a first approximation. <sup>Ⓙ</sup> At rupture <sup>Ⓚ</sup> Izod notched 1/8" (3.2mm) ft.lb. (J/M) <sup>Ⓛ</sup> ASTM D671, 2.5mm cycles. <sup>Ⓜ</sup> Btu-in/h-ft<sup>2</sup>·°F