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The Die Casting Process: A Designer's Overview

An OEM Mini-Seminar on
Capitalizing on the Advanced
Die Casting Process for Cost-
Efficient Component Production

This is a 24-slide silent Webinar presentation, approximately 12 minutes in length.

Click Attached “Notes” for viewing, in panel at left, before advancing with “Forward Arrow.”





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CWM operates under third-generation family management from a modern 136,000 sq. ft. facility in Bensenville, IL near Chicago's O'Hare Airport. Founded in 1937, CWM's top management team represents more than 160 years of design, engineering and production of exceptional Al, Mg and Zn die cast housings and components for OEMs worldwide.



The Die Casting Process

Overview Presentation Summary

- Cost-efficient, net-shape parts **for wide range of applications**
- Unique cost & performance benefits **for product designers**
- Alloy options: Al, Mg, Zn— **Performance & Cost comparisons**
- Production options: **Miniature 4-slide to Large-part capacity**
- Tooling options: **Comparisons by alloy, complexity & cost**
- Prototyping options: **Performance & Cost Comparisons**
- Part cost-reduction options: **Hi-tech tooling vs Post-casting CNC**
- Surface finishing options: **Library of finishes with cast samples**
- Recommendations to designers **for optimizing process results**
- Reference guide **to additional resources**



**Die casting offers net- and near-net shape components—
intricate shapes produced at lowest unit costs**





**Tight-toleranced features, bosses and holes cast-to-size —
with superior as-cast surface finishes**





**Light-weight parts offering high strength and rigidity,
—with built-in EMI shielding and excellent heat dissipation**





Die Casting Product

Cost Benefits

- **Net-shape to final specs without machining**
- **Intricate, complex shapes, as cast**
- **Minimum or zero draft angles, as cast**
- **High-quality surface finishes, as cast**
- **Alloys offering inherent bearing properties**
- **Allows designs to reduce multiple-part assembly**



Die Casting Product Performance Benefits

- **High strength, stiffness and rigidity**
- **The look and feel of real metal**
- **Sound dampening properties**
- **Can meet 100% pressure tightness requirements**
- **Excellent part surface for cosmetic final finishes**
- **Uses recyclable Al, Mg and Zn alloys**



Special Benefits for Electrical/Electronic Products

- **Built-in EMI/RFI shielding**
- **High thermal conductivity**
- **Excellent heat dissipation for integral heat sinks**
- **Strong, thin walls for minimum package sizes**
- **Cast part weights comparable to plastic**

See more in Notes

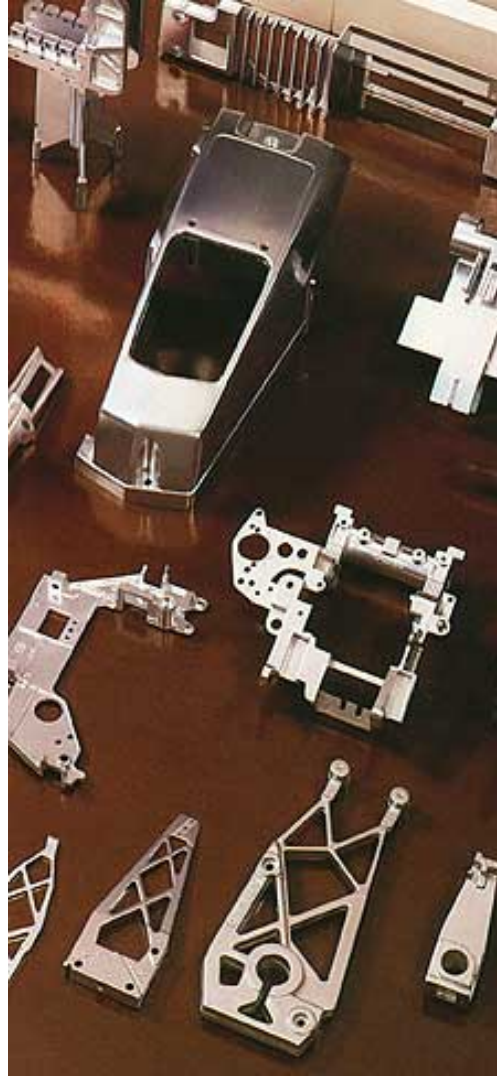


Alloy Options

Al



Mg



Zn





Alloy Options: Performance Comparison

	Aluminum	Magnesium	Zinc
Strength/Stiffness	Good	Good	Good
Strength-to-Wt. Ratio	High	Very High	Average
Dimensional Stability	Very Good	Very Good	Very Good
Thermal Conductivity	Good	Good	Very Good
As-cast Surface Quality	High	High	High
Corrosion Resistance*	Good	Good	Good

* For galvanic corrosion protection, appropriate design considerations may be necessary

See more in Notes



Alloy Options: Cost Comparison

	Aluminum	Magnesium	Zinc
Processing Costs	Average	Above Average	Below Average
Die Maintenance Costs	Above Average	Average	Below Average
Machining Costs	Average	Average	Average
Surface Finishing Costs	Average	Above Average*	Below Average
Material Cost	(Varies by relative material volume of casting)		

* Electroplating of magnesium requires additional surface preparation.

See more in Notes



Automated Die Casting

Performance Options

Miniature (4-slide) Machines

- Net-shape parts to very close tolerances, flash-free
- Very fast cycle times, dies guaranteed for project life
- Limited to Zn (including ZA-8 alloys), small part sizes

Small to Large (50- to 4000-ton) Machines

- Wide part size & weight range, complex features
- Net- and near-net-shape parts in Al, Mg & Zn alloys



Automated Die Casting

Part Size & Weight Range

Miniature (4-slide) Machines

- Size Range Minuscule to 4 in. x 4 in. x 1 in.
- Weight Range Fractions of an oz. to 3/4 lbs.

Small to Large (50- to 4000-ton) Machines

- Size Range* .5 sq. in. to 2,000 sq. in.
- Weight Range** .25 oz to 50+ lbs.

* Part sizes will vary directly with the projected area of the cast part

** Dependent on the projected area of the cast part.

See more in Notes



Die Cast Production Tooling Investment Options

■ **Miniature Machine Die**

- 4-slide dies [for specialized miniature machines](#)

■ **Unit Die for Small-to-Medium Machines**

- Modular units in standard frames [for lower die costs](#)

■ **Single-Cavity Die for Small-to-Large Machines**

- Small- to large-part production [at lower unit costs](#)

■ **Multiple-Cavities for Small-to-Large Machines**

- Small- to large-part production [at lowest unit costs](#)



Die Cast Tooling

Investment Option Comparisons

	Mini 4-Slide Dies	Small to Medium Unit Dies	Small to Large Single- Cavity Dies	Small to Large Multi- Cavity Dies
Alloy Choices	Zn (Incl. ZA-8)	Al, Mg, Zn	Al, Mg, Zn	Al, Mg, Zn
Part Complexity	High	Average	High	High
Die Costs	Very Low	Low	Med/High	High
Part Costs	Very Low	Low	Low	Very Low

See more in Notes



Prototyping Options prior to Die Construction

- 1. Single-Cavity Prototype Die**
or “Unit” Prototype Die Casting Die
- 2. Gravity Casting plus Machining**
to proposed Die Casting Production Specs
- 3. CNC Machining**
from Wrought, Rod or Sheet Stock
- 4. Rapid Prototyping (RP)**
in Plastic Resin
- 5. RP Master to Plaster Mold and Metal Pour**
Plastic Rapid Prototype to Plaster to Gravity Pour



Prototyping Option Comparisons:

Costs and Dimensions/Properties Match

	Costs	Die Cast Dimensions	Die Cast Properties
Single-Cavity Unit or Prototype Die	High to Very High	Exact	Exact
Gravity Casting + Machining	High	Very Close	Varies*
CNC Machined Stock	Medium	Very Close	Varies*
Rapid Prototyping (RP)	Low to Medium	Close	Plastic**
RP +Plaster Mold + Metal Pour	Medium	Close	Varies*

* Any non-die casting alloy property requires analysis for each desired die cast property.

** Properties of plastic resin are not transferable to die cast part properties.

See more in Notes



Die Cast Part Cost-Reduction Alternatives

- **Higher-Tech Tooling for Cast-to-Spec Features** ^(a)

Not always feasible
for every part design



OR

- **Post-Casting Machining to Final Specs** ^(b)

CNC finishing can offset cost
of added or alternate tooling



(a) Two long slots at top of frame were more cost-efficient cast to net shape

(b) A part with an opening requiring alternate configurations may be more cost-efficiently produced with post-casting machining

See more in Notes



Die Cast Component Surface Finishing Options

■ **Decorative**

To Meet Cosmetic Appearance Specs

■ **Wear Resistance**

Protect Against Premature Wear

■ **Corrosion Barrier**

Environmental or Galvanic Protection

■ **Pressure Tightness**

To Meet 100% Specs

■ **Shielding**

Further Enhance Built-in EMI/RFI *

* Where 100% fail-safe EMI shielding is a mandatory specification

See more in Notes



Surface Finishing Options

By Alloy

	Aluminum	Magnesium	Zinc
Decorative Finish	Powder coat Liquid paint Plating	Powder coat Liquid paint Plating	Powder coat Liquid paint Plating
Added Wear Resistance	Hard anodize	Hard anodize Plating	Plating
Corrosion Barrier	Powder coat Liquid paint Tri. chromate	Powder coat Liquid paint Tri. chromate	Powder coat Liquid paint Tri. chromate
Pressure Tightness	Impregnate	Impregnate	Impregnate
Added EMI Shielding	Nickel Plate	Nickel Plate	Nickel Plate

See more in Notes



Die Cast Surface Finishing

Sample Plate and Reference Library

CWM maintains a unique library of finished die cast sample plates in Al, Mg and Zn.

Each plate is keyed to a comprehensive *Surface Finishing Reference Manual* describing the uses, advantages and limitations of each finish.

Sample plates and the Reference Manual are available to OEM designers when discussing a die casting project.



See more in Notes



Guidelines for Optimizing Production Results

- 1. Think part function first**
then the optimum process
- 2. Choose a producer who offers**
all options for the process
- 3. Involve the producer early**
for all the benefits of DFM cost reduction
- 4. All post production requirements**
should be outlined well prior to die design
- 5. Inform yourself on**
how design features impact process success



Reference Materials for this Webinar

Access these resources at the CWM Web [OEM Resource Center](#)

A “Design & Production Planning Guide,” PDF Item # 5114 under Engrg. Bulletins, provides a detailed summary of all items listed.

Res. Ctr. [Subsection](#)

Die Casting Design & Spec Guide, CWM, 16p (# 0325)

Design Guides

Product Design for Die Casting, NADCA, 178p (# 3101)

Reference Manuals

Engineering Bulletins & Tech Briefs:

Engineering Bulletins # 020, 021, 022, 071, 074, 075.
Application/Tech Briefs # 024, 031, 034.

**Engrg. Bulletins
Applic/Tech Briefs**

Die Casting Product Standards, NADCA, 223p (# 3103)

Reference Manuals

Quick Guide to Surface Finishing, CWM, 8p (# 3318)

Design Guides

Checklists: Tooling, Production, Finishing,

NADCA D.C. Tooling (#065), D.C. Production & Finishing (#090)

Engrg. Bulletins

CWM Custom Production Capabilities Credentials:

Complete D.C. Capabilities (#3100), Mini D.C. Capabilities (#3400)
CNC Machining (#3300), Contract Manufacturing (#3200)

Capabilities Brochures

See more in Notes