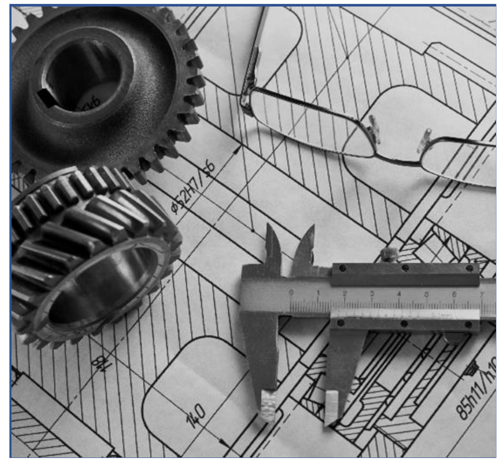
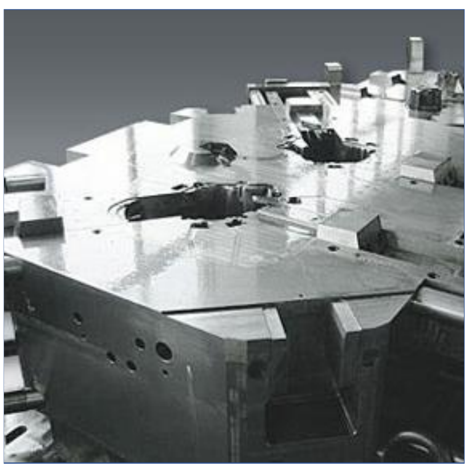
Delivery

Engineered

Solutions





MES

Die Castings

Design and Specification Guide

Rev 1 – 9-2017

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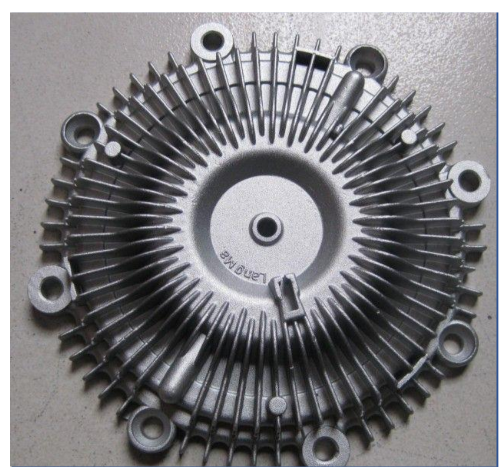


KEY
DESIGN
DECISION
STEPS

"We are transforming age old industrial commodity supply chain using our IT and data analytics systems"

-----MES, INC.

Matching Material Properties

Pure aluminum is rather weak and malleable on its own. But mixed with other metals such as silicon, iron, copper, magnesium, manganese, or zinc strengthens and brings other benefits to the metal. Adding silicon and magnesium to aluminum, for example, results in an alloy that is extremely resistant to corrosion. There are 530 different alloy compositions with more compositions being created and registered every year. The versatility that aluminum alloys offer is undeniable, and the advantages of A380 make it one of the most widely used alloy for manufacturing and die casting.

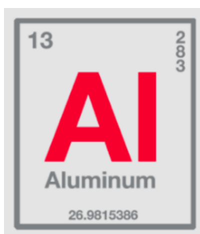
Die casting materials are precisely formulated metal alloys which offer the mechanical properties of medium-strength metals. They are generally several times as strong and many times more rigid than plastics, and their mechanical properties compare favorably with powdered iron, brass, and screw-machined steel.

Designing for proper strength in a product depends on two main factors: strength of the material selected and configuration of the part.

Die casting alloys offer a wide range of as-cast material strengths, ranging as high as 54 ksi (372 MPa) ultimate tensile. The designer can usually develop sufficient strength in critical features simply by providing adequate wall thickness. Where additional strength is required, reinforcing features such as ribs, flanges and locally thickened sections can be accurately computed and precisely cast.

The die casting process allows the product designer freedom to create extremely intricate contours, varying the wall thicknesses over various sectors of the product. Where strength requirements are not critical, MES high-tech die casting can produce rigid components with ultrathin walls. As a result, the designer has much more latitude with die casting than with plastics, powdered metals, or stampings to design relatively thick walls for strength in some areas, and very thin walls for conserving material in others.

MES offers the designer material choices in all of the major non-ferrous alloy categories: aluminum, magnesium and zinc.



Aluminum Alloy (See the layout for this per attached JPEG)

Die casting alloy Al 380 is the most widely used of the aluminum die casting alloys, offering the best combination of properties and ease of production. If offers significant benefits including best combination of casting, mechanical and thermal properties, excellent fluidity, pressure tightness and resistance to hot cracking. It is used for a wide variety of products including but not limited to lighting, automotive, housing and agricultural industries

Other alloys including but not limited to A360, A383, A384, A390 and A413 are also used frequently based on the applications

Zinc (ZAMAK) Alloys

Zinc alloys used in die casting development possess properties that make production simple, while providing an end-product that is durable. Zinc's strength and hardness administer high impact strength and stability that make assembly uncomplicated. The high ductility of zinc alloys is ideal for the die casting process with a strong ability to be cast without fracturing under pressure. Zinc offers unmatched electrical and thermal conductivity while maintaining physical strength, strong stability and corrosion resistance.

Most common grades include Zamak 2, Zamak 3, Zamak 5, Zamak 7.

Magnesium Alloy

Magnesium is the lightest commonly used structural metal. Its use in die cast parts has grown dramatically, often replacing plastic parts with greater strength and rigidity at no weight penalty. Mg alloy AZ91D is the most widely-used magnesium die casting alloy, offering high-purity with excellent corrosion resistance, excellent strength and excellent castability. Corrosion resistance in AZ91D is achieved by enforcing strict limits on metallic impurities. Magnesium's high cost limits it to weight sensitive applications in aerospace and automotive industries.

MATERIAL PROPERTIES & NOMINAL CHEMISTRY

Table 1 **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. (2006 *NADCA Standards. Sec. 3*)

	Die Casting Alloys				Thermoplastics
Commercial:	**Al 380**	**Mg AZ910D**	**Zn 3**	**ZA-8**	**Polycarbonate**
ANSI/AA:	**380.0**		**AG-40A**		
MECHANICAL PROPERTIES					
Ultimate Tensile ksi (MPa)	46 (320)	34 (230)	41 (283)	54 (372)	19 (130)
Yield StrengthⒶ ksi (MPa)	23 (160)	23 (160)	32 (221)	41-43 (283-296)	- -
Elongation % in 2 in. (51 mm)	3.5	3	10	6-10	3-5Ⓗ
Hardness_ BHN	80	75	82	100-106	- -
Shear Strength ksi (MPa)	28 (190)	20 (140)	31 (214)	40 (275)	10.5 (72)
Impact Strength ft-lb (J)	3 (4)	1.6 (2.2)	43Ⓕ (58)	24-35Ⓔ (32-48)	2Ⓘ (100)
Fatigue StrengthⒸ ksi (MPa)	20 (140)	10 (70)	6.9 (47.6)	15 (103)	6Ⓙ (40)
Young's Modulus psi x 10^6 (GPa)	10.3 (71)	6.5 (45)	Ⓖ	12.4 (85.5)	1.25 (8.6)
PHYSICAL PROPERTIES					
Density lb/in3 (g/cm3)	0.099 (2.74)	0.066 (1.81)	0.24 (6.6)	0.227 (6.3)	0.052 (1.43)
Melting Range °F (°C)	1000-1100 (540-595)	875-1105 (470-595)	718-728 (381-387)	707-759 (375-404)	- -
Specific Heat BTU/lb°F (J/kg°C)	0.230 (963)	0.25 (1050)	0.10 (419)	0.104 (435)	0.27
Coefficient of Thermal Expansion µ in./in./°F x 10-6 (µ m/m°K)	12.2 (22.0)	13.8 (25.0)	15.2 (27.4)	12.9 23.2	12.1 (22)
Thermal Conductivity BTU/ft hr °F (W/m°K)	55.6 (96.2)	41.8Ⓒ (72)	65.3 (113)	66.3 (115)	150Ⓚ (0.21)
Electrical Conductivity % IACS	27	n/a	27.0	27.7	23
Electrical ResistivityⒺ µ Ω in. (µ Ω cm)	n/a	35.8 (14.1)	n/a	n/a	- -

Table 2 **Nominal Chemical Composition: Die Casting Alloys**

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

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

With mechanical properties, note die casting alloys 380.0, A380.0, 383.0 and 384.0 are substantially interchangeable. Ⓐ0.2% offset Ⓑ 500 kg load, 10mm ball Ⓒ Rotary Bend 5 x 107/108 cycles Ⓓ Notched Charpy. Ⓔ AT 68°F (20°C) Ⓕ ASTM E 23 unnotched 0.25 in. die cast bar Ⓖ Varies with stress level; applicable only for short-duration loads. Use 107 as a first approximation. Ⓗ At rupture Ⓘ Izod notched1/8"(3.2mm) ft.lb. (J/M) Ⓙ ASTM D671, 2.5mm cycles. Ⓚ Btu-in/h-ft2-°F

Die & Unit Die Construction

Die casting tool has four main components – Unit Holder, Cavity Block, Replaceable Cavity Unit and Cavity Insert.

Multiple-cavity dies can be used to increase production rates substantially; in some cases, the use of multiple cavities may limit the use of certain moving core slide operations.

MES unit dies are standardized unit die holders into which replaceable die cavity "units" can be inserted. These replaceable units can be removed from, or placed into, a unit die holder without removing the unit frame from the die casting machine. MES unit dies can significantly reduce die construction costs at smaller volumes. They are available in single and double unit holders.

The limitations of unit dies are that they generally can only accommodate the production of smaller-sized parts, and they restrict, or may eliminate, the use of moving core slides. The configuration of interchangeable unit die inserts, with the resulting limited die area for core slide functions, makes unit dies most appropriate for less complex product designs.

While any die casting die is a major investment, the aggregate manufacturing cost of a component, through final finishing and assembly, should be one of the key production decision criteria. The elimination of secondary machining, cosmetic finishing and assembly operations can often cost justify more sophisticated die casting die designs.

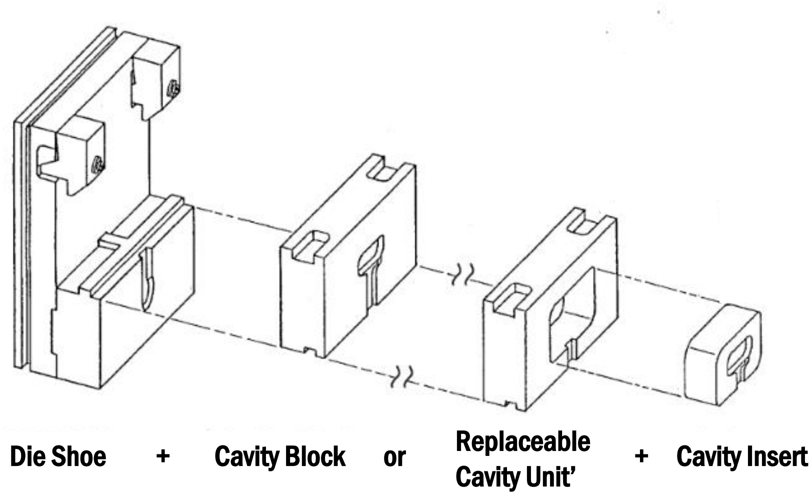


Figure. Components of a unit die illustrate each part of the assembly and the die construction option of a cavity block or a holder block with cavity insert.

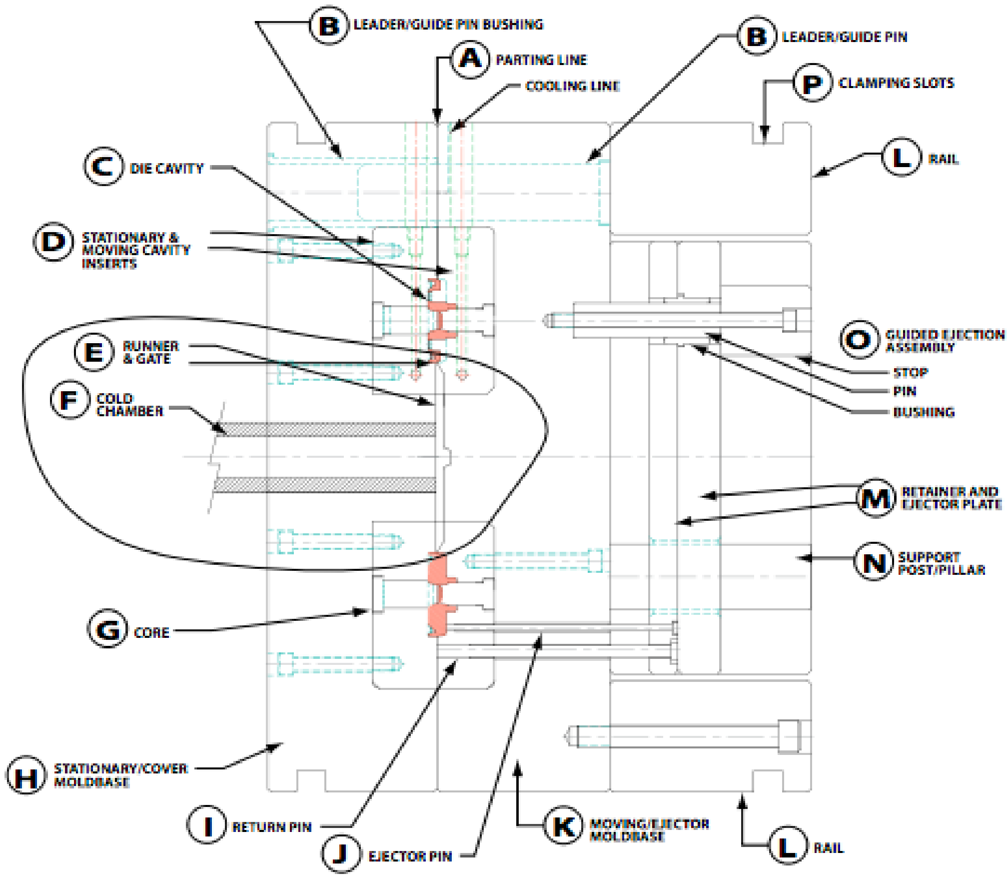
Cast Features & Die Elements

The features that are required of a cast part determine the complexity of the die. The simpler the part, the lower the cost of the die casting tool.

Most commonly used materials for aluminum tools are H-10, H-11, and H-13 tool steels.

For the proper design of production tooling, pressure tightness, secondary machining and surface finishing specifications must be understood in detail. Areas of the casting subject to machining must be fully discussed at the outset, so that the die can be designed to reduce to an absolute minimum the presence of porosity in those areas. Cosmetic surface requirements for the casting will require special finishing of the cavities of the die.

The NADCA Standards Manual provides detailed treatment of the tolerancing implications of various casting design features, as well as guidelines which apply under differing casting conditions.



A-PARTING LINE

Surface where two die halves come together.

B-LEADER/GUIDE PIN & BUSHING

Guides the two die halves together and maintains die alignment.

C-DIE CAVITY

Die recess in which casting is formed.

D-STATIONARY & MOVING CAVITY INSERT

Premium grade tool steel containing the cavity details.

E-RUNNER & GATES

Precisely designed passage thru which metal flows from sprue hole or cold chamber into die cavity.

F-COLD CHAMBER

Passage thru which metal enters runners and gates.

F1-SPRUE HOLE & SPRUE PIN

Forms passage thru which metal enters runners & gates in a hot chamber die.

G-CORE

Usually a round tapered pin used to cast various hole details.

H-STATIONARY/COVER MOLDBASE

Stationary holder that contains and supports the cover inserts.

I-RETURN PIN

Large ejector pin that resets ejection system.

J-EJECTOR PIN

Pin which pushes casting from die cavity.

K-MOVING/EJECTOR MOLDBASE

Movable holder that contains and supports the ejector inserts.

L-RAILS

Supports the ejector side moldbase and contains clamp slots.

M-RETAINER AND EJECTOR PLATE

Contains and pushes the ejector pins.

N-SUPPORT POST/PILLAR

Additional support members to resist die deflection.

O-GUIDED EJECTION ASSEMBLY(STOP, PIN & BUSHING)

Supports and guides the ejection system.

P-CLAMPING SLOTS

Opening for die clamps to mount die halves to machine platens.

KEY
DESIGN
DECISION
STEPS

Matching Material Properties

Die & Unit Die Construction

Minimizing Part Porosity

Preplanning Post-Cast Machining

Tolerancing Guidelines

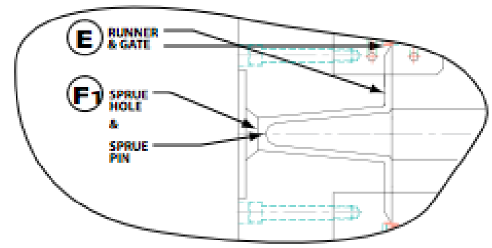
Metal Extension (Flash) Guidelines

As-Cast Finish Guidelines

Further Design Assistance

Die Flow Simulation

COLD CHAMBER DIE



HOT CHAMBER DIE

Figure Shown above is a multiple-cavity cold chamber die casting die. With this process the metal enters the die runners, gates and cavity through the cold chamber. The Sprue replaces the cold chamber in the hot chamber process which is used for zinc and smaller magnesium components.

Moving Core Slide Options

Fixed cores and core slides (or pulls) can be designed into the die casting die to form selected features, as cast, which otherwise would have to be produced by additional machining of the die cast part.

Core slides, also called moving die components or moving die parts, are similar to collet or cam movements and can be activated by various sources of motion. Two of the most common are angle pins and hydraulic cylinders.

The angle pin is a mechanical source of motion activated by the opening and closing of the die. Its advantages are that it does not require hydraulics or limit switches, and is generally more economical to manufacture. Its limitations are that it can be used only for short slide travel and there is no control over the cycle of the slide pull.

The hydraulic method of slide motion permits a choice of cycles, the placement of slides on any side of the die and avoids interference when removing the casting from the die, as is the case with the angle pin.

The choice of these and other methods of slide motion depend on factors such as production volume, the size of die, the length of travel of the slide, the size of area being cored out and the specific configuration of the part.

MES will always make the most cost-effective recommendation for the particular core slide suited to achieve the desired result.

Importance of a Casting’s Parting Line

The parting line is that perimeter on the casting which is the separation point of the two halves of the die casting die. This line affects which half will be the “cover” die half and which will be the “ejector” half.

This line also influences any tolerances that must be held in this area of the cast part. Tolerancing standards are specific to part characteristics at the parting line and more information can be found in NADCA specification

Designation of a parting line on a casting drawing is an important decision, and is rarely obvious to a designer not familiar with the die casting production process. Placement of the parting line must always be the final decision of the die casting engineer, since its location is essential for the casting to meet desired specifications.

If there is no cosmetic surface requirement, the casting can be oriented in the two die halves to suit the most favorable overall casting conditions.

In the case of a part that must have a cosmetic surface finish, the cover die half will generally be used to produce a specified cosmetic surface. This permits the ejector die half to contain the required ejector pins which assist in ejecting the part cleanly from the die after each casting shot as well as any engraved lettering or ornamentation to be cast into the part.

With parts requiring a cosmetic surface, it is critical that the customer discuss such specifications in detail in the earliest review meeting. Location of the casting’s parting line, as well as its gate, overflows and vents, must not interfere with or blemish any of the part’s designated cosmetic surfaces.

Normal, incremental die erosion in production is inherent in the die casting process. Where there are cosmetic requirements, special die maintenance procedures to extend the ability of the die to

continue to produce parts to the required high quality surface finish must be discussed. Secondary surface finishing, such as polishing or buffing, may be complementary to such needs. (Refer to As-Cast Finish Guidelines on page 10.)

Assuring Longer Die Life

The number of parts which can be die cast from a set of die casting dies, before cavity replacement, is dependent on factors such as the quality of the die steel used, the alloy specified, the specific design of part features, and the cosmetic surface requirements for the part.

While MES utilizes the highest quality premium tool steel in all of its die casting die construction, as well as a proven die surface treatment to optimize die life, awareness of design features that can drastically shorten die life is important for the product engineer.

Sharp internal or external corners should be modified to reasonable radii. The smooth, highly cosmetic as-cast surfaces, of which the die casting process is uniquely capable, can be expected to result in shorter die life.

A comparison of MES die life by alloy category appears in the table above.

Die Casting Die Specification Checklist

MES makes available a Die Casting Die Specification Checklist which should be consulted when approaching the production of a new design as a die casting.

MES PART PRODUCTION & DIE LIFE, BY ALLOY

Table 3a **Aluminum, Magnesium and Zinc Alloys** Ⓐ

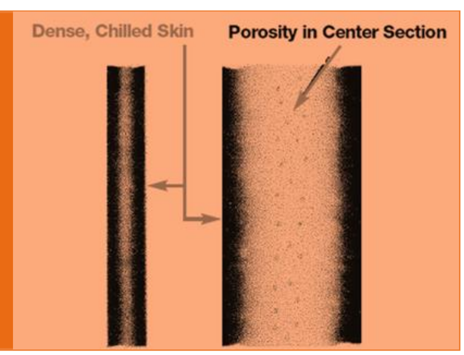
	Al 380	Mg AZ91D	Zn No. 3	Miniature Zn 2, 3, 5, 6, ZA-8
Part Size Range	.75″ x .75″ to 18″ x 18″	.75″ x .75″ to 18″ x 18″	.75″ x .75″ to 18″ x 18″	Minuscule to 4″ x 4″ x 1″
Part Weight Range	.5 oz. to 10 lbs.	.25 oz. to 10 lbs.	.5 oz. to 8 lbs.	1/14 oz. (2g) to 3/4 lb. (337g)
Machine Tonnage Range	200-800 tons	80-650 tons	150-500 tons	4-Slide Miniature
Vacuum-Assist Availability	Yes	Yes	No	No
Expected Die Life	1X	3X to 5X	Life of Part	Life of Part

Ⓐ 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.

Minimizing Part Porosity

The high metal velocities and pressures used to achieve the fine product detail, cosmetic surfaces and high cycle rates unique to the die casting process normally result in some internal porosity, below the "skin" of the die cast part (Fig. 3).

Fig. 3 In a thin-walled die casting, the fine-grained dense "skin" is a large percentage of the section, as in the section above, left, which would contain virtually no porosity. The dense "skin" in a thick section (right) represents a small percentage of the wall.



Porosity levels in a cast part can be defined by "X-ray" or "sectioning" procedures. MES utilizes various methods such as X-ray imaging, MPT (Magnetic Particle Test) and other destructive and non-destructive methods to accurately document the presence of internal porosity.

Minimizing porosity begins with early planning in the design of the die cast part and communication with MES engineering. If porosity in specific areas will be detrimental to product function, this should be clearly outlined before die design and construction begins, since zero porosity is virtually impossible to achieve in a die casting.

Acceptable modifications in part designs can often be suggested that will greatly reduce potential porosity problems. Once this important step has been taken, MES can utilize mold flow simulation, optimized gating and overflow design, die design, special management of the heating and cooling lines in the die, and sophisticated process control and monitoring to limit porosity to noncritical areas of the part.

When 100% pressure tightness is essential in a die cast part, early MES consultation becomes even more important.

Preplanning Post-Cast Machining

When machining is to be performed on a die casting, a minimum amount of material should be removed so as to avoid penetrating the less dense portion below the "skin" (see Fig. 3).

To assure clean-up, an allowance must be provided for both the machining variables and the casting variables. These allowances are a function of specified linear dimension tolerances and parting line tolerances.

The best post-casting (secondary) machining results are attained if the die casting is located from datum points that are in the same die half as the feature to be machined.

It is important to discuss any and all secondary machining requirements with MES prior to die design. If consultation occurs early in the design of the part itself, MES engineers can often minimize the effect of tolerance accumulation and unnecessary machining. Most important, with a combination of minor part design revisions and special considerations in the design of the die, higher-density areas can be assured in regions of critical secondary machining.

If MES will be contracted to perform secondary machining after die casting, and deliver the part to size, lesser dimensional tolerances may be possible.

A complete presentation of machining stock allowances is given in the NADCA Standards, Sec. 4 as well as appropriate GD&T guides. I

Tolerancing Guidelines

The extent to which the coordinate dimensioning guidelines shown here for precision die casting tolerances can be achieved in production for a given die cast part design is highly dependent on part size and configuration, shrink factors, and the precise feature in which the dimension is planned.

Caution: The design engineer should understand that precision dimensions in every feature of a part are not possible in production. Precision tolerances should only be specified in agreed upon critical areas, since assuring these tolerances nearly always involves extra precision in die construction and/or special controls in processing, with additional costs often involved. Consultation with MES engineering in the final part design stage is important to cost-effective production and part quality assurance.

Note, in some cases and on specific features, even closer dimensions than those shown can be held by repeated sampling and recutting of the die casting die cavity, in combination with the use of machine capability studies.

Table 3b **Precision Dimensional Tolerances** Ⓐ

QUICK GUIDE TO COORDINATE DIMENSIONING

Die Casting Alloy:	Aluminum	Magnesium	Zinc/ZA-8
WALL THICKNESSES			
Nominal wall thicknesses that can be die cast are heavily dependent on part geometry. With small castings, wall thicknesses of 0.030 in. (.762 mm) may be			
LINEAR DIMENSION TOLERANCES			
Length of Dimension in same die half			
Basic Tolerance up to 1" (25.4 mm)	**±0.002** (±0.05 mm)	**±0.002** (±0.05 mm)	**±0.002©** (±0.05 mm)
Additional Tolerance for each additional inch over 1" (25.4 mm)	**±0.001** (±0.025 mm)	**±0.001** (±0.025 mm)	**±0.001©** (±0.025 mm)
PARTING LINE TOLERANCES—added to Linear Tolerances			
Projected Area of Die Casting: inches² (cm²)—Tolerances are "plus" values only			
up to 10 in² (64.5 cm²)	**+0.0035** (+0.089 mm)	**+0.0035** (+0.089 mm)	**+0.003** (+0.076 mm)
11 in² to 20 in² (71.0 cm2 to 129.0 cm2)	**+0.004** (+0.102 mm)	**+0.004** (+0.102 mm)	**+0.0035** (+0.089 mm)
21 in² to 50 in² (135.5 cm² to 322.6 cm²)	**+0.005** (+0.153 mm)	**+0.005** (+0.153 mm)	**+0.004** (+0.102 mm)
51 in² to 100 in² (329.0 cm² to 645.2 cm²)	**+0.008** (+0.203 mm)	**+0.008** (+0.203 mm)	**+0.006** (+0.153 mm)
101 in² to 200 in² (651.6 cm² to 1290.3 cm²)	**+0.012** (+0.305 mm)	**+0.012** (+0.305 mm)	**+0.008** (+0.203 mm)
201 in² to 300 in² (1296.8 cm² to 1935.5 cm²)	**+0016** (+0.406 mm)	**+0016** (+0.406 mm)	**+0.012** (+0.305 mm)
For projected area of die casting over 300 in2 (1935.5 cm2), **consult MES.**			
MOVING DIE COMPONENT TOLERANCES—added to Linear Tolerances			
Projected Area of Die Casting: inches2 (cm2)—Tolerances are "plus" values only			
up to 10 in² (64.5 cm²)	**+0.006** (+.152 mm)	**+0.005** (+.127 mm)	**+0.005** (+0.127 mm)
11 in² to 20 in² (71.0 cm² to 129.0 cm²)	**+0.010** (+0.254 mm)	**+0.007** (+.178 mm)	**+0.007** (+0.178 mm)
21 in² to 50 in² (135.5 cm² to 322.6 cm²)	**+0.014** (+0.356 mm)	**+0.010** (+0.254 mm)	**+0.010** (+0.254 mm)
51 in² to 100 in² (329.0 cm² to 645.2 cm²)	**+0.018** (+0.457 mm)	**+0.014** (+0.356 mm)	**+0.014** (+0.356 mm)
101 in² to 200 in² (651.6 cm² to 1290.3 cm²)	**+0.024** (+0.61 mm)	**+0.019** (+0.483 mm)	**+0.019** (+0.483 mm)
201 in² to 300 in² (1296.8 cm² to 1935.5 cm²)	**+0.030** (+0.762 mm)	**+0.024** (+0.61 mm)	**+0.024** (+0.61 mm)
For projected area of a die casting over 300 in2 (1935.5 cm2), **consult MES.**			
FLATNESS TOLERANCES: **inches** (mm)			
Maximum Dimension of Die Cast Surface			
Up to 3.00 in. (76.20 mm)	**0.005** (0.13 mm)	**0.005** (0.13 mm)	**0.005** (0.13 mm)
Additional tolerance, in. (mm) for each additional in. (mm)	**0.002** (0.05 mm)	**0.002** (0.05 mm)	**0.002** (0.05 mm)

Ⓐ Values shown represent greater casting accuracy involving extra precision in die construction and/ or special control in production. (2006 NADCA Standards, Sec. 4A) Ⓑ Based on MES recommendations. © For some zinc designs, tighter tolerances can sometimes be held, with use of artificial aging.

Precision Tolerance Qualifications

In the case of Linear Dimension, Parting Line, Moving Die Component, and Flatness Tolerances, the complete individual standards for each in the NADCA Product Specification Standards for Die Castings manual should be consulted for proper interpretation and qualifications.

Draft and Cored Holes

Precision Tolerances for Draft call for a draft on inside walls at 3/4 degrees per side, with outside walls requiring half this amount of draft.

KEY DESIGN DECISION STEPS

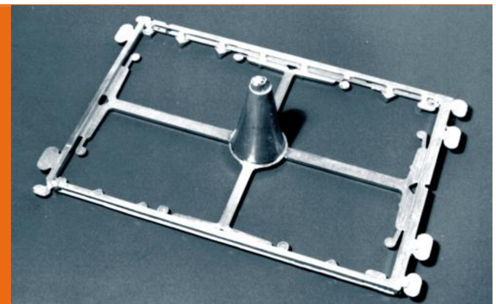
Precision tolerances for Cored Holes, i.e., die cast holes planned for tapping, are provided in NADCA Standards, in terms of diameter, thread depth, and hole depth requirements.

Geometric Dimensioning & Tolerancing

A growing number of design engineers are utilizing GD&T markup on their part engineering drawings. When used properly, geometric dimensioning can help reduce the cost of a diecast part by facilitating functional gaging. Product engineers not already familiar with GD&T procedures are urged to become so. An introductory discussion, as applied to die cast part drawings, appears in NADCA Standards, together with more detailed GD&T references.

The die cast frame, right, illustrates the appearance of a center-gated die casting before trimming, showing gate, runners and overflow extension. Photo below is the same die cast frame after receiving its normal die cast trimming operation. In many cases the trim die will require multiple "slides" similar to the die casting die, with comparable attention to quality materials and die design details.

Note: All MES tooling orders include a trim die that meets or exceeds NADCA "Commercial Trimming" standards.



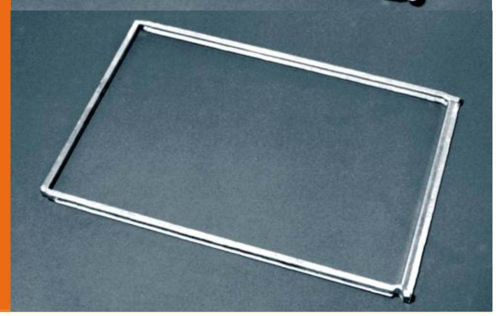


Table 4 **Guide to Nominal Metal Remaining by Type of**

	Type of Extension & Nominal Amount Remaining After Degating & Trimming				
Operation Description	**Thick Gates & Overflows** ≥ 0.12 (3 mm)	**Thin Gates & Overflows** ≤ 0.12 (3 mm)	**Parting Line & Seam Line** Metal Extension	**Metal Extension in Cored Holes**	**Sharp Corners**
After Degating only Extension Remaining	Rough within 0.12" (3.0 mm)	Rough within 0.12" (3.0 mm)	Excess Only Broken Off	Not Removed	Not Removed
After Commercial Trimming* Extension Remaining	Within 0.06" (1.59 mm)	Within 0.03" (0.8 mm)	Within .015" (0.38 mm)	Removed within .010"	Not Removed

* "Commercially trimmed" does not include washing to remove loose material. For very heavy gates and overflows, consult MES.

Metal Extension (Flash) Guidelines

An extension of metal (or flash) is normally formed on a die casting at the parting line of the two die halves and where moving die components operate. A seam of extended metal may also occur where separate die parts cast a part feature.

The cost of required trimming of any cast metal extension, estimated as part of production costs, can be reduced by preplanning in the part design stages and consideration of the amount of metal extension required to be removed and the removal method to be employed.

Early consultation with MES can often result in production economies in this removal step.

Table 4, above, is the NADCA guide to the types of die casting metal extension (flash) which occurs in typical die castings and the amount of metal extension material which remains after (1) degating (removal of any gates and runners from the casting), and (2) commercial trimming of die casting metal extension. These guidelines represent normal production practice. Precision trimming, closer than standard commercial trimming, or complete removal of all extension entails additional operations and should be specified only when requirements justify the additional cost.

Die-castings are often cleaned or deflashed using a variety of vibratory cleaners including sand blasting, bead blasting and many other blasting technologies available commercially.

As-Cast Finish Guidelines

The die casting process is uniquely qualified to provide metal parts with a superior as-cast external surface, important to many component applications— and essential for consumer product housings and other decorative parts.

The NADCA surface finishing guidelines presented in Table 5 classify as-cast surface finishes for die castings into a series of five grades so that the type of cast finish required may be defined early in the product planning stage, and well in advance of die casting die design.

These guidelines should be used for general type classification purposes only, not to take the place of specific discussion with MES regarding the steps necessary to assure satisfying as-cast product finishing specifications. Such specifications should be agreed upon with MES prior to die design to assure cost-effective production.

The first four as-cast surface finish classifications listed in Table 5, right, relate to cosmetic surfaces. Class five, “Superior Grade,” relates to the surface specification required over a very selective area for special applications.

Further Design Assistance

MES sales-engineers, and the MES engineering staff, are available to make your early design decisions the correct ones for product success

Table 4 **Guide to Nominal Metal Remaining by Type of**

Class	As-Cast Finish	Final Finish or End Use
1 Utility Grade	No cosmetic requirements. Surface imperfections (flow lubricant build-up, etc.) are acceptable	**Used as-cast orwith protective coatings:** Anodize (non-decorative) Chromate
2 Functional Grade	Surface imperfections (flow marks, rubs, surface porosity, etc.), that can be removed by spot polishing or can be covered by heavy paint, are acceptable.	**Decorative Coatings:** Lacquers Enamels Plating (Al) Chemical Finish Polished finish
3 Commercial Grade	Slight surface imperfections that can be removed by agreed upon means are acceptable.	Structural Parts (high stress areas) Plating (Zn) Electrostatic Painting Transparent paints
4 Consumer Grade	No objectionable surface imperfection. Where surface waviness (flatness), noted by light reflection, is a reason for rejection special agreement should be reached with the die caster.	Special Decorative Parts
5 Superior Grade	Surface finish, applicable to limited areas of the casting and dependent on alloy selected, to have an average value in micro inches as specified on print.	O-Ring Seats or Gasket Areas

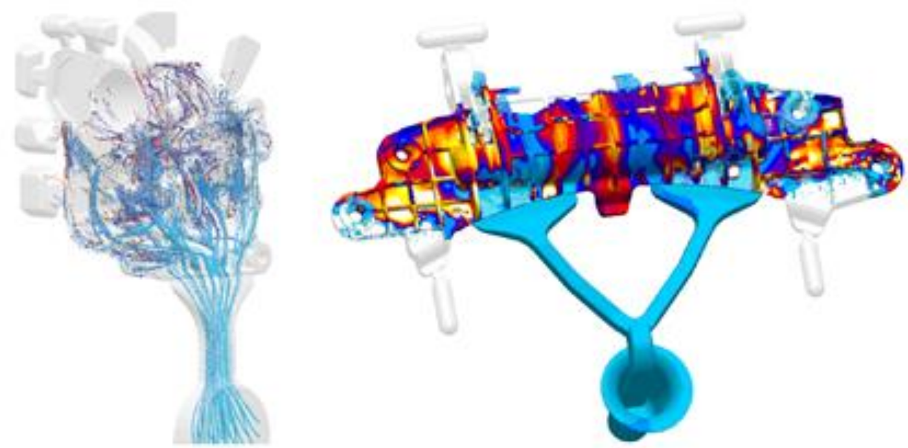
(2006 NADCA Standards, Guidelines G-6-6-06)

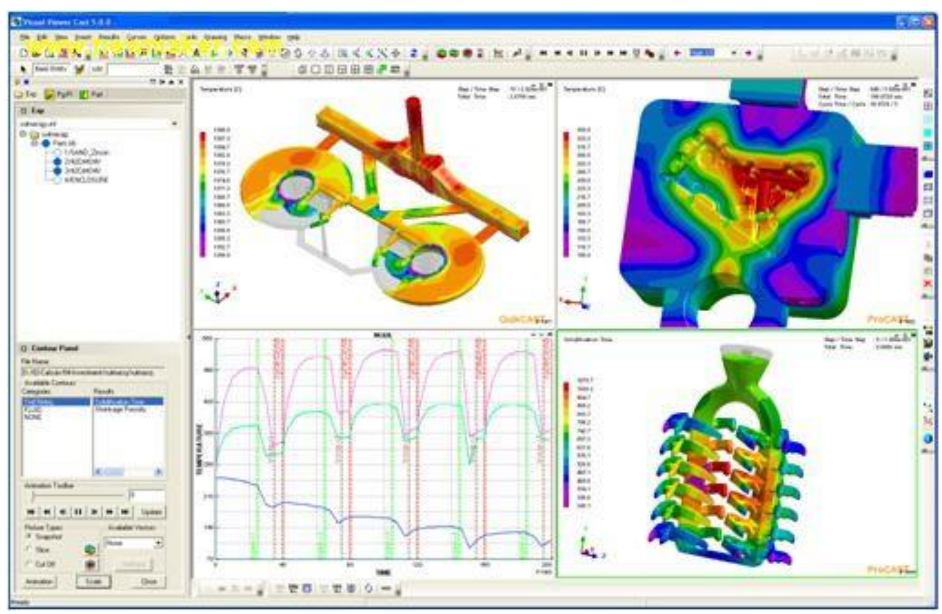
KEY
DESIGN
DECISION
STEPS

Die Flow Simulation

MES and its suppliers use a variety of software packages including ProCast, Magmasoft and other softwares to study and predict the flow into the die cavity for a proposed component. When done early, this practice can lead to significant reduction in cost and lead-times.

In most cases the software can be effectively applied to a proposed product design using its 3D CAD files even before the die cavity design has been developed. The design's expected thermal distribution





can be quickly explored.

The initial die casting die cavity design can now be based on the die designer's experience plus the results of this invaluable early metal flow data.

Another simulation can then be run, based on the proposed die cavity design, to validate the die design assumptions made.

Further die design modifications and simulation iterations may be indicated to optimize the integrity and surface quality of the proposed part, improve die casting productivity and lower eventual die casting costs.