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# **NADCA Product Specification Standards for Die Casting**

**Aluminum,  
Aluminum-MMC,  
Copper,  
Magnesium,  
Zinc and  
ZA Alloys**



**North American  
Die Casting Association**

**Wheeling, Illinois**

**Revised for 2006  
6<sup>th</sup> Edition**

**Dedicated  
to Continuous  
Improvement**



The North American Die Casting Association's mission is to continue as the worldwide leader in stimulating growth and improvement in the die casting industry.

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OEM product engineers and specifiers can contact NADCA for information on a range of materials and services aimed at helping designers achieve product cost reductions and performance improvements through today's advanced die casting technology. These include an OEM design, specification and sourcing website, design engineering publications and a regional and on-site OEM design seminar program.

### **Product Standards Disclaimer**

The standards and guidelines for the specification of products to be produced as die castings presented in this volume are generic in nature. They are offered as a convenient reference for the general direction of die casting component designers and specifiers, whose final decisions must depend on their own engineering and design judgment and predictive testing under application conditions. Use of these standards and guidelines is voluntary.

The unique characteristics and features of a specific die cast component design are the major determinants of the final specifications which can be economically achieved by the die casting process.

The OEM product engineer is urged to consult with their die caster to establish more precisely those guidelines which can be expected to apply to a particular design under consideration.

Although every effort has been made to assure accuracy of the data presented, the publisher cannot be responsible for results obtained through the use of this data.

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No warranties, expressed or implied, are given in connection with the accuracy or completeness of this publication. The data presented are subject to modification without notice.

### **Revisions and Additions Schedule**

NADCA Product Specifications Standards for Die Castings will be revised as needed on a yearly basis. Major revisions and additions are incorporated on a three (3) year schedule.

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**"Design for  
Die Casting"  
Assistance**

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# Introduction to this Manual

**T**hese specification guidelines and standards for die castings have been formulated to aid product designers and specifiers in the successful execution of their designs as die cast components. Significant advances in the capabilities of North American process technology, and the introduction of an expanded number of die casting alloys, have created new opportunities for cost-effective die cast designs. To achieve net-shape or near net-shape components, designers today are using die casting to capitalize on improved dimensional accuracy and stability, cosmetic surface quality, and more dependable product performance. To best capitalize on all of these advantages, designers and specifiers should consult the guidelines presented here at an early design stage, in collaboration with a qualified die caster.

Today's die casting process can offer significant reduction in, or elimination of, part machining costs through its ability to cast dimensions, holes and features to precision tolerances at high volumes. Such major cost reductions can also often make die castings practical in lower production volumes. Through parts consolidation, die castings can reduce finished product assembly costs and improve product integrity and operation. Selected alloys can allow bearing properties to be integrally incorporated into a part, eliminating the need for inserts. The established strength and durability of die castings can allow undamaged disassembly, refurbishing or remanufacture to extend a product's useful life. And at the end of a product's life cycle, die castings allow for optimum reclamation with eventual remelting and realloying, followed by die casting back into high-level applications – without degradation of properties.

The first section of this manual, Process & Material Selection for Product Recyclability, presents the facts on this important new product requirement for process and material selection.

The Tooling Section will familiarize engineers, especially those new to the process, with the unique characteristics of die casting tooling requirements.

The Alloy Data Section provides an updated reference to die casting materials commercially available for component design specification in North American production. These material families include the aluminum alloys; aluminum metal matrix composites; copper alloys including brass and bronze; magnesium alloys; zinc (Zamak) alloys; and zinc-aluminum (ZA) alloys. Lead and tin are rarely die cast because of relatively low mechanical properties. Ferrous-metal die casting is carried out on a limited production basis, with very high melting temperatures necessitating the use of special refractory metals for dies and other special procedures. Alloy tables provide data for comparison of chemical composition and properties for each alloy and their characteristics in die casting and post-casting operations. Poisson's Ratio, where available, is included to aid finite element analysis (FEA).

Replacing the former ADICI/NADCA "E" Series are the comprehensive Engineering and Design Sections. These now present die casting coordinate dimensioning specifications for "Standard" Tolerances and "Precision" Tolerances, with values up to 65% tighter than the former "E" Series. In addition, guidelines for Geometric Dimensioning are presented as they relate to die casting part designs.

Sections on Quality Assurance and Commercial Practices will aid the specifier and die caster in reaching agreement on the procedures and practices that should be followed to assure purchaser satisfaction.

A detailed contents page appears at the beginning of Sections 2 through 9. A listing of all numbered standards, guidelines, and checklists appears on the next page. An index and glossary of die casting terms appear in Section 10.

More than one section should be reviewed in making process decisions. The special features and geometry of an individual component to be die cast, its dimensional, functional, finishing and end-use requirements – considered in relation to production parameters – must be carefully weighed.

The appropriate tooling, engineering and quality assurance guideline information provided should be evaluated in combination with alloy data. The benefits of early consultation with an experienced die caster are obvious.

These guidelines are prepared and published by NADCA, in collaboration with OEM engineers and dedicated die casting industry technical specialists. Thanks go to the many industry members who contributed at various stages to the development, research, organization and review that resulted in this volume.

NADCA wishes to acknowledge the Product Standards Task Force for the efforts provided to establish this 6th Edition and Richard Farrara, consultant for the redevelopment of Section 5 on Geometric Dimensioning.

# Guideline & Checklist Cross Reference

Cross Reference between former ADCI Product Standards, former NADCA Volume 401 Product Guidelines and NADCA 2006 Product Specification Standards for Die Casting.

<b>ADCI</b>	<b>NADCA #401</b>	<b>NADCA 2006</b>	<b>Subject</b>
ADCI-M2	NADCA-M2	NADCA A-3-1-06 NADCA A-3-2-06	Composition & Properties of Standard Aluminum Alloy Die Castings
ADCI-M3	NADCA-M3	NADCA A-3-1-06 NADCA A-3-2-06	Composition & Properties of Special Aluminum Alloy
ADCI-M4	NADCA-M4	NADCA A-3-3-06	Characteristics of Aluminum Alloys
ADCI-M5	NADCA-M5	NADCA A-3-7-06 NADCA A-3-8-06	Composition & Properties of Copper Alloy Die Castings
ADCI-M6	NADCA-M6	NADCA A-3-9-06	Characteristics of Copper Alloys
ADCI-M7	NADCA-M7	NADCA A-3-10-06 NADCA A-3-11-06	Composition & Properties of Mg Alloy Die Castings
ADCI-M8	NADCA-M8	NADCA A-3-12-06	Characteristics of Mg Alloy Die Castings
ADCI-M9	NADCA-M9	NADCA A-3-13-06 NADCA A-3-14-06	Composition & Properties of Zn. & ZA Alloy Die Castings
ADCI-M10	NADCA-M10	NADCA A-3-15-06	Characteristics of Zn. & ZA Alloy Die Castings
ADCI-M11	NADCA-M11	(Discontinued)	Certified Zinc Alloy Plan for Die Casting
ADCI-C1-76	NADCA-C1-88	Comm'l Practices pgs. 8-7 to 8-10	Commercial Terms of Orders
ADCI-C2-76	NADCA-C2-88	Comm'l Practices pg. 8-3	Specifying Tolerances
ADCI-C3-76	NADCA-C3-88	Comm'l Practices pg. 8-4	Die Casting Dies & Production Tooling
ADCI-C4-79	NADCA-C4-88	Comm'l Practices pg. 8-11	Price Escalation Provisions
ADCI-C5-76	NADCA-C3-88 NADCA-C5-88	Comm'l Practices pgs. 8-6, 8-10	Insert: Gauges
ADCI-C6-76	NADCA-C6-88	Comm'l Practices pg. 8-12	Patent Obligations
ADCI-C7-76	NADCA-C7-88	Comm'l Practices pg. 8-12	Warranties
ADCI-C8-76	NADCA-C8-88	Comm'l Practices pgs. 8-2 to 8-4	Limitations on Inspection
ADCI-C9-76	NADCA-C9-88	NADCA C-8-1-06	Checklist for Die Casting Production Part Purchasing
ADCI-C10-76	NADCA-C10-88	NADCA C-8-2-06	Checklist for Finished Die Cast Production Part Purchasing
ADCI-Q1	NADCA-Q1	Quality Assurance pgs. 7-3 to 7-4	Drawing & Specifications
ADCI-Q2	NADCA-Q2	Quality Assurance pgs. 7-4	Gage, Measurements & Test Equipment
ADCI-Q3	NADCA-Q3	Quality Assurance pgs. 7-4 to 7-6	Statistical Quality Control

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Cross Reference between former ADCI Product Standards, former NADCA Volume 401 Product Guidelines and NADCA 2006 Product Specification Standards for Die Casting.

<b>ADCI</b>	<b>NADCA #401</b>	<b>NADCA 2006</b>	<b>Subject</b>
ADCI-Q4	NADCA-Q4	Quality Assurance pg. 7-11	First Piece Inspection for Die Approval
ADCI-Q5	NADCA-Q5	Quality Assurance pgs.7-7 to 7-10	Porosity
ADCI-Q6	NADCA-Q6	Quality Assurance pg. 7-11	Pressure Tight Castings
ADCI-E1-83	NADCA-E1-83 NADCA-E1-65	NADCA S-4A-1-06 NADCA P-4A-1-06	Linear Dimension Tolerances
ADCI-E2-83	NADCA-E2-83 NADCA-E2-65	NADCA S-4A-2-06 NADCA P-4A-2-06	Parting Line Tolerances
ADCI-E3	NADCA-E3-83 NADCA-E3-65	NADCA S-4A-3-06 NADCA P-4A-3-06	Moving Die Component Tolerances
ADCI-E4	NADCA-E4-83 NADCA-E4-55T	NADCA S-4A-7-06 NADCA P-4A-7-06	Draft Tolerances
ADCI-E5	NADCA-E5-83 NADCA-E5-65	NADCA S-4A-8-06 NADCA P-4A-8-06	Flatness Tolerances
ADCI-E6	NADCA-E6-83 NADCA-E6-65	(1) (See below)	Depth of Cored Holes
ADCI-E7	NADCA-E7-83 NADCA-E7-65	(1) (See below)	Draft Requirements in Cored Holes
ADCI-E8	NADCA-E8-83 NADCA-E8-65	NADCA S-4A-9-06 NADCA P-4A-9-06 NADCA P-4A-10-06 NADCA S-4A-11-06	Cored Holes for Threads (1) The Cored Holes for Threads sections requirements include cored hole & draft requirements
ADCI-E9	NADCA-E9-83 NADCA-E9-65	NADCA G-6-4-06	Ejector Pin Marks
ADCI-E10	NADCA-E10-83 NADCA-E10-65	NADCA G-6-5-06	Flash Removal
ADCI-E11	NADCA-E11-83 NADCA-E11-65	Engrg. & Design Section 5	Angularity Tolerances
ADCI-E12	NADCA-E12-83 NADCA-E12-65	Engrg. & Design Section 5	Alignment & Concentricity Tolerances
ADCI-E13	NADCA-E13-83 NADCA-E13-65	NADCAS/P-4A-13-06	Machining Stock Allowance
ADCI-E14	NADCA-E14-83 NADCA-E14-65	NADCA S-4A-12-06	Die Cast Threads
ADCI-E15	NADCA-E15-83 NADCA-E15-65	NADCA G-6-2-06 NADCA G-6-3-06	Fillets, Ribs & Corners
ADCI-E16	NADCA-E16-83 NADCA-E16-65	NADCA G-6-7-06	Lettering & Ornamentation
ADCI-E17	NADCA-E17-83 NADCA-E17-63T	NADCA G-6-1-06	Pressure Tightness
ADCI-E18	NADCA-E18-83 NADCA-E18-64T	NADCA G-6-6-06	Surface Finish, As-Cast
ADCI-M1	NADCA-M1	Alloy Data Tables Section 3	Alloy Cross Reference Designations

# List of NADCA Standards, Guidelines & Checklists

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Guideline to Increase Die Life	T-2-2-06	Guideline	2-20
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Parting Line Tolerances	P-4A-2-06	Precision	4A-10
Moving Die Component Tolerances	S-4A-3-06	Standard	4A-11
Moving Die Component Tolerances	P-4A-3-06	Precision	4A-12
Angularity	S/P-4A-4-06	Standard/Precision	4A-13-16
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# Current Revisions and Additions

<b>Title</b>	<b>Page</b>	<b>Comment</b>
Tooling for Die Casting	2-2	Fig 2-1 Nomenclature modified.
Tooling for Die Casting	2-3	Fig 2-2 Figure replaced with new photograph.
Tooling for Die Casting	2-5	Single-cavity, multi-cavity and unit die line drawings replaced with photographs.
Tooling for Die Casting	2-5	Paragraph 2.3 Rapid Tooling Dies added
Selecting Aluminum Alloys	3-5	Footnote for aluminum alloy tables was modified to include Silafonts and AA365
Selecting Magnesium Alloys	3-19	Footnote was modified to include comment on elevated temperature and creep resistant alloys.
Elevated Temperature Properties	3-26	Added subsection 9 tables and chart for elevated temperature properties
Property Comparison	3-30	Added subsection 10, a table of comparative properties
Cross Reference	3-34	Subsection 9 was moved, it is now subsection 11
Linear Dimensions	4A-7	A statement was added to clarify that linear tolerances apply to radii and diameters
Cored Holes for Formed Threads	4A-36	A statement was added to address thread forming fasteners (self-tapping screws).
Cored Holes for Pipe Threads	4A-38	Gaging requirements information was added
Threads	4B-10	The figure for cast threads was updated
Geometric Dimensioning	Sec. 5	The section was revised for clarity and to define where gages can and cannot be used.
Fillets	6-4	Isometric drawings were added
Ribs and Corners	6-5	Isometric drawings were added
Surface Finish	6-8	Typical as-cast surface roughness table and a table of coatings for castings were added
Die Cast Lettering and Ornamentation	6-10	Isometric drawings were added
Capability	7-6	Figure 7-3 was re-drawn for clarification
Porosity	7-7	Text on porosity and three figures of example radiographs were added.
Casting Examples	Sec. 9	Five new examples were added and five old ones were removed.

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