Die Casting Glossary

NADCA Product Specification Standards for Die Castings / 2009

Provided by: Twin City Die Castings Company
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Twin City Die Castings Company is a member of The North American Die Casting Association (NADCA). NADCA is committed to promoting industry awareness, domestic growth in the global marketplace and member exposure. NADCA's Die Casting Standards cover specification, design and production guidance for both users and manufacturers of conventional high pressure die castings. The material includes tooling and processes information, alloy properties, standard and precision tolerances, GD&T, design guidelines, quality assurance provisions and more. Additional resources are available at: https://www.diecastingdesign.org/

Twin City Die Castings is a full-service provider of precision Aluminum and Magnesium die castings, and is an employee owned company. For over 100 years, TCDC has been dedicated to creating custom die casting solutions for the Automotive, Recreational, Industrial Equipment, Defense, Aerospace, Computer, HVAC, and Medical Industries. As a full-service provider, you will benefit from our die casting expertise and state-of-the-art technology.

TCDC was founded in 1919 in Minneapolis, Minnesota and has grown to three IATF 16949:2016 certified US locations. A leader in die casting technology and machining, TCDC maintains 184,000 sq. feet of space and approximately 25 high pressure die cast machines ranging in size from 350 to 1000 tons. Continually engaging in emerging technology and die casting automation allows us to reduce overall product costs, and provide consistently high quality parts. The methods we've developed provide incredible customer benefits, and have also been instrumental in allowing us to win multiple international Awards for die casting excellence.

As a provider of precision aluminum and magnesium die castings, we hold our parts to the highest NADCA standards for cast tolerances and boast advanced in-house die casting and CNC machining. This rare capability makes us an ideal supplier for aluminum or magnesium die cast parts requiring custom or close-tolerance machining.

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Glossary

This glossary of terms is presented to aid the product designer and specifier in communicating with the custom die caster during product development and production. It includes definitions involved in product prototyping, the design and construction of the die casting die and trim die, die casting production and post-casting machining and surface finishing operations.

Abrasive blasting

A process for cleaning or finishing by which abrasive particles are directed at high velocity against a casting or work piece.

Acid pickle

A method to remove oxides and other contaminants from metal surfaces.

Aging

A change in the metallurgical structure of an alloy occurring over a period of time following casting, which affects the properties and dimensions. Heating accelerates aging.

Aging, artificial

A low temperature heat treatment meant to accelerate aging, generally applied to increase strength and/or to stabilize properties.

Aging, natural

Aging that occurs at room temperature.

Alloy

A substance having metallic properties and composed of two or more chemical elements, of which at least one is metal. Alloy properties are usually different from those of the alloying elements.

Alloy, primary

Any die casting alloy whose major constituent has been refined directly from ore, not recycled scrap metal.

Alloy, secondary

Any die casting alloy whose major constituent is obtained from recycled scrap metal. Nearly 95% of die castings provided in North America are made from secondary alloys.

Alloy, standard

Any die casting alloy that has been assigned an ASTM designation.

Alloying

The process of making a die casting alloy from its various constituents. The process usually consists of melting the major constituent and adding the others to the bath where they then dissolve. The molten metal is then cleaned of contamination by fluxing.

Anode

The electrode in a plating bath at which metal ions are formed, negative ions are discharged or other oxidizing reactions occur.

Anodic metal

Any metal that tends to dissolve, corrode or oxidize in preference to another metal when the metals are connected electrically in the presence of an electrolyte.

Anodizing

To subject a metal to electrolytic action as the anode of a cell in order to coat with a protective or decorative film.

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ANSI

American National Standards Institute.

AQL

Acceptable Quality Level, as agreed upon for the fulfillment of production orders.

As-Cast

Condition of a casting that has not been given a thermal treatment subsequent to casting. This is also termed as the "F temper."

ASQ

American Society for Quality.

ASTM

American Society for Testing and Materials.

Atmospheric corrosion

Surface corrosion caused by exposure in the environment to gasses or liquids that attack the metal.

Ball burnishing

The smoothing of surfaces by means of tumbling parts in the presence of hardened steel balls, without abrasives.

Barrel burnishing

The smoothing of surfaces by means of tumbling a part in rotating barrels in the presence of metallic or ceramic shot, without abrasives.

Barrel plating

Plating in which a part is processed in bulk in a rotating container.

BHN

Brinell Hardness Number, scale used to indicate hardness.

Biscuit

Excess metal left at the end of the injection cylinder of a cold-chamber die casting machine, formed at the end of the plunger stroke. Also called a slug.

Black chromium

Nonreflective, black chromium coating electrodeposited from a sulfate-free bath.

Black nickel

Nonreflective, decorative, black nickel coating having little protective value, produced by electroplating or simple immersion.

Blister

A surface defect or eruption caused by expansion of gas, usually as a result of heating trapped gas within the casting, or under metal which has been plated on the casting.

Blow holes

Voids or holes in a casting that may occur due to entrapped air or shrinkage during solidification of heavy sections.

Bright finish

A finish with a uniform nondirectional smooth surface of high specular reflectance.

Bright nickel

Decorative nickel plate that is deposited in the fully bright condition.

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Bright plating

A process that produces an electrodeposit having a high degree of specular reflectance in the asplated condition. Abrasive particles are applied in liquid suspension, paste or greasestick form.

Buffing

Smoothing a surface with a rotating flexible wheel, to the surface of which fine abrasive particles are applied in liquid suspension, paste or grease-stick form.

Burnishing

The smoothing and polishing of a metal surface by rubbing or tumbling in the presence of metallic or ceramic balls and in the absence of abrasives.

Butyrates

Organic coatings based on butyric acid derivatives having excellent initial color and good resistance to weathering.

Cp

Capability index.

Cpk

Total process capability. A production process capability index of both a process dispersion and its central tendancy, taking into account the spread of the distribution and where the distribution is in regard to a specification midpoint.

CQI

Continuous Quality Improvement.

Cadmium plate

A coating of cadmium metal applied to an aluminum or steel substrate for corrosion protection or improved solderability. Cadmium plate on zinc die castings requires an intermediate barrier layer of nickel.

Cass test

(Copper accelerated salt spray) An accelerated corrosion test for electroplated substrates (ASTM 368-68).

Castability

The relative ease with which an alloy can be cast; includes the relative ease with which it flows and fills out a die/mould cavity, and its relative resistance to hot cracking and tearing.

Casting rate

The average number of shots that can be cast during one hour of steady running.

Casting section thickness

The wall thickness of the casting. Since the casting may not have a uniform thickness, the section thickness may be specified at a specific place on the casting. Also, it is sometimes useful to use the average, minimum or typical wall thickness to describe a casting.

Casting yield

The weight of casting or castings divided by the total weight of metal injected into the die, expressed as a percent.

Casting cycle

The total number of events required to make each casting. For die castings, the casting cycle generally consists of solidification time, machine movement and sequencing time and the operator's manual movements.

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Casting drawing

The engineering drawing that defines the size, shape and tolerances of the casting. This is a detailed drawing of the casting only and not an assembly of the product in which the casting is included.

Casting, functional

A die casting that serves a structural or mechanical purpose only. It has no decorative value.

Casting thickness

See Casting section thickness.

Casting, thin wall

A term used to define a casting which has the minimum wall thickness to satisfy its service function.

Casting volume

The total cubic units (i.e. cu. in. or cu. mm) of cast metal in the casting.

Cathode

The electrode in electroplating at which metallic ions are discharged, negative ions are formed or other reducing actions occur.

Cathode robber

An auxiliary cathode so placed as to divert electrical current to itself from portions of the articles being plated which would otherwise receive too high a current density.

Cathodic metal

Any metal that does not tend to dissolve, corrode or oxidize in preference to another metal when the metals are connected electrically in the presence of an electrolyte.

Cavity

The recess in the die in which the casting is formed.

Cavity block

The portion of the die casting die into which most, if not all, the cavity is formed. There are usually at least two cavity blocks in each die set.

Cavity fill time

That period of time required to fill the cavity with metal after the metal begins to enter the cavity.

Center line shrinkage

Shrinkage or porosity occurring along the central thermal plane or axis of a cast part.

Charpy

Name of an impact test in which the specimen, forming a simple beam, is struck by a hammer while resting against anvil supports spaced 40 mm apart.

Checking

Fatigue of a die surface, especially when subjected to repeated heating by molten alloys at high casting temperatures. The resulting fine cracks produce corresponding raised veins on die castings.

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Chemical cleaning

The removal of foreign material from a surface by means of immersion or spraying without the use of current.

Chromate

A conversion coating consisting of trivalent and hexavalent chromium compounds.

Chromating

The application of a chromate coating.

Chrome pickle

A chemical treatment for magnesium in nitric acid, sodium dichromate solution. The treatment gives some protection against corrosion by producing a film that is also a base for paint.

Chromium plate

A coating of electrodeposited chromium metal which affords superior resistance to tarnishing and abrasion.

Clamping capacity

The force a die casting machine is capable of applying against the platen to hold the die closed during metal injection.

Clamping force

Actual force applied by a die casting machine to a die clamp to keep the die closed. This may be less than the clamping capacity of the die casting machine.

Cold forming

Bending of a die casting without the application of heat to achieve a desired shape that is different than that as cast. Cold forming is frequently used to hold an assembled part to the die casting.

Cold shut

A lapping that sometimes occurs where metal fronts join during the formation of solidified metal that sometimes occurs in the formation of die castings which constitutes an imperfection on or near the surface of the casting.

Cold-Chamber machine

A die casting machine designed so that the metal chamber and plunger are not continually immersed in molten metal.

Color anodize

An anodic coating that is dyed before sealing with an organic or inorganic coloring material.

Coloring

The production of desired colors on metal surfaces by appropriate chemical or electrochemical action, or light buffing of metal surfaces for the purpose of producing a high luster; also called Color Buffing.

Combination die

A die with two or more different cavities each producing a different part, also called a family die.

Composite plate

An electrodeposit consisting of two or more layers of metal deposited successively.

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Compressive yield strength

The maximum stress that a metal, subjected to compression, can withstand without a predefined amount of yield (normally 0.2% for die castings).

Contraction

The linear change typically occurring in metals and alloys on cooling to room temperature.

Contraction Factor

A factor used to multiply casting dimensions to obtain casting die dimensions. It accomodates differences in Coefficients of Thermal Expansion of the die steel and alloy die operating temperatures.

Conversion coating

A coating produced by chemical or electrochemical treatment of a metallic surface that forms a superficial layer containing a compound of the metal; example: chromate coatings on zinc and cadmium, oxide coating on steel.

Cooling channel

A tube or passage in a die casting die through which a coolant (typically water, oil or air) is forced to cool the die.

Copper plate

A coating of copper deposited by electrolytic or electroless plating methods. Copper electroplated from a cyanide solution is generally used as the initial layer in plating zinc die castings. Acid copper is used as a leveling deposit under nickel-chromium plate.

Core

A part of a die casting die that forms an internal feature of the casting (usually a feature with considerable dimensional fidelity) and is a separate piece from the cavity block. A core may be fixed in a stationary position relative to the cavity block or may be actuated through some movement each time the die is opened.

Core pin

A core, usually of circular section. Core pins are hot work tool steel pins, usually H-13, used for a cored hole in a die casting and may be fixed or movable. A core is made from a core pin.

Core plate

The plate to which the cores are attached and which actuates them.

Core slide

Any moving core.

Core, fixed

A core that, as the die opens and closes, does not move relative to the cavity block into which it is mounted.

Core, moving

A core that must move through some travel as the die opens or immediately after the die has opened, to allow the unrestricted ejection of the casting.

Corrodkote

An accelerated corrosion test for electroplated substrates (ASTM 380-65).

Corrosion

Degradation of a metal by chemical or electrochemical reaction with its environment.

Corrosion endurance

Resistance to corrosion as a function of time.

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Cover gas

A mixture consisting of sulfur hexafloride, carbon dioxide and air, used to protect and minimize oxide formation on the surface of molten magnesium.

Cover; cover die

The stationary half of a die casting die.

Covering power

The ability of a plating solution, under a specified set of plating conditions, to deposit metal on the surfaces or recesses of a part, or in deep holes.

Creep

Plastic deformation of metals held for long periods under stresses less than the normal yield strength.

Creep strength

The constant nominal stress that will cause a specified amount of creep in a given time at a constant temperature.

Current shield

A nonconducting medium for altering the current distribution on an anode or cathode.

Damping

Ability of material to dampen vibration in components and thus lower noise levels.

DOE

Design of Experiments

Deburring

The removal of burrs, sharp edges or fins by mechanical, chemical, electrochemical or electrical discharge means.

Decorative finish

A plated, painted or treated surface having aesthetic qualities and the ability to maintain those qualities in service.

Defect

Imperfections in a cast part - such as pores, inclusions, cracks, cold shuts, laps or the like.

Deflection

The bending or twisting of a die casting or a tool when a load is imposed on it. Deflection is normally used to describe elastic strain (i.e., the item will return to its original shape when the load is removed) rather than permanent (plastic) deformation.

Deformation, plastic

Bending or twisting of a die casting or a tool by a load that is beyond its elastic limits, and the casting or tool does not return to its original shape when the load is removed.

Degasifier

A substance that can be added to molten metal to remove soluble gases that might otherwise be entrapped in the metal during solidification.

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Degassing

(1) A chemical reaction resulting to remove gases from the metal. Inert gases are often used in this operation. (2) A fluxing procedure used for aluminum alloys in which nitrogen, chlorine, chlorine and nitrogen and chlorine and argon are bubbled up through the metal to remove dissolved hydrogen gases and oxides from the alloy. See also flux.

Degreasing

The removal of grease and oils from a surface.

Dendrite

A crystal that has a tree-like branching pattern most evident in cast metals slowly cooled through the solidification range.

Deoxidizing

(1) The removal of oxygen from molten metals through the use of a suitable deoxydizer. (2) Sometimes refers to the removal of undesirable elements other than oxygen through the introduction of elements or compounds that readily react with them. (3) In metal finishing, the removal of oxide films from metal surfaces by chemical or electrochemical reaction.

Dichromate process

A chemical treatment for aluminum, magnesium and zinc alloys in a boiling dichromate solution, resulting in a surface film that resists corrosion.

Die

A metal block used in the die casting process, incorporating the cavity or cavities that form the component, the molten metal distribution system and means for cooling and ejecting the casting.

Die block

The large block of steel that forms the base for one half of a die casting die. All other components of the die are attached to or mounted on the die block.

Die cast skin

The metal on the surface of a die casting, to a depth of approximately 0.020 in. (0.8 mm), characterized by fine grain structure and freedom from porosity.

Die casting

A process in which molten metal is injected at high velocity and pressure into a mold (die) cavity.

Die halves

A die casting die is made in two parts, the cover and the ejector. These are called the “halves” of the die.

Die insert

A removable liner or part of a die body.

Die life

(1) The number of usable castings that can be made from a die before it must be replaced or extensively repaired. (2) The distance, in inches or millimeters, measured in the direction of the trimming action that a die cast trimming die is fitted to the casting. As trim dies are repeatedly sharpened, die life distance is reduced. When the die life is completely sharpened off, the die steels must be replaced.

Die release

Die coating to improve casting surface quality and facilitate removal from die.

Die or steel safe

A technique employed in close-tolerance die casting in which exterior surfaces of the casting are deliberately made slightly under size, and interior surfaces slightly over size. After a trial casting run, all dimensions are brought within specified tolerances. This technique ensures that all final die modifications, no matter how slight, are made by removing, rather than adding, metal.

Die temperature

A die casting die has a very complex pattern of temperatures across its parting surface and through its thickness. The expression "die temperatures" is usually used to mean die surface temperatures.

Die temperature control

The use of thermocouples in the die casting die to regulate flow rate of the cooling fluid through the die, keeping die temperature within preset range.

Die weight

The mass (weight) of a die. The weight is stamped on the die so individuals handling it can select the proper lifting equipment.

Die, miniature

Single cavity die casting dies for making die castings that weigh less than two ounces (55 grams) are usually considered to be miniature die casting dies.

Die, multiple-cavity

A die having more than one casting cavity.

Die, single cavity

A die casting die that has only one cavity.

Dimension, critical

A dimension on a part that must be held within the specified tolerance for the part to function in its application. A noncritical tolerance is specified for weight saving or for manufacturing economy, and is not essential for the product's function.

Dimension, linear

Any dimension to features of the die casting that are formed in the same die component (half). Any straight line dimension on a part of die print.

Dimension, nominal

The size of the dimension to which the tolerance is applied. For example, if a dimension is 2.00 ±0.02, the 2.00 is the nominal dimension and the ±0.02 is the tolerance.

Dimension, parting line

A dimension on a casting, or in a die casting die cavity, that is parallel to the direction of die pull and crosses the die parting line.

Dimensional stability

Ability of an alloy to retain its size and shape unchanged with time.

Discontinuity

Any interruption in the normal physical structure or configuration of a part, such as cracks, laps, seams, inclusions or porosity. A discontinuity may or may not affect the utility of the part.

Dolomite

A mineral made up of calcium and magnesium carbonate.

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Double-Layer nickel

An electroplated, double-layer nickel coating, of which the bottom layer is semi-bright nickel containing less that 0.005% sulfur and the top layer is bright nickel containing more than 0.04% sulfur; the thickness of the bottom layer is not less than 60% of the total nickel thickness, except on steel where it is not less than 75%.

Dowel pin

A guide to ensure registry between two die sections.

Draft allowance

The maximum angle of the draft that is allowed by the casting's part print.

Draft

The taper given to cores and other parts of the die cavity to permit easy removal of the casting.

Drag-Out

The solution that adheres to the objects removed from cleaning and plating baths.

Dross

Metal oxides in or on the surface of molten metal.

Dull finish

A finish virtually lacking both diffuse and specular reflectance.

Eject

To push the solidified casting out of the cavity of the die casting die.

Ejection, accelerated

A system, usually within the die casting die, that causes selected ejector pins to move faster and further than the others during the final portion of the ejection travel. Also called Secondary Ejection.

Ejector marks

Marks left on castings by ejector pins, frequently including a light collar of flash formed around the ejector pin.

Ejector pin

A pin actuated to force the casting out of the die cavity and off the cores.

Ejector plate

Plate to which the ejector pins are attached and which actuates them.

Ejector; ejector die

The movable half of a die casting die containing the ejector pins.

Electrolyte

A substance, usually liquid, in which the conduction of electricity is accompanied by chemical decomposition. An electrolyte is one of the factors required for electrolytic corrosion to occur.

Electromotive series

A list of elements arranged according to their standard electrode potential.

Electroplate

An adherent metallic coating applied by electrodeposition on a substrate for the purpose of improving the surface properties.

Electropolishing

The improvement in surface finish of a metal effected by making it anodic in an appropriate solution.

Elongation

Amount of permanent extension in the vicinity of the fracture in a tensile test, usually expressed as a percentage of original gage length.

Engraved finishes

Designs etched on die cavity surfaces by chemical dissolution to produce specified patterns in the as-cast part.

Entrained air

Air or other gases that are mixed with the flowing molten metal as the die cavity is filling.

Epoxies

Organic coatings applied to parts, having superior corrosion resistance and adhesion.

Erosion

A damaged condition in the die cavity or die runners caused by the in impingement of the molten metal during injection.

Expansion, thermal coefficient of

A numerical value of the unit change in length of a substance with each degree of temperature change. These values are arrived at by experimentation and are tabulated in reference books.

Extractor

In die casting, a mechanical apparatus that enters the space between the two halves of the opened die casting die, grips the cast shot, pulls it free from the ejector pins and removes it from the die space.

FAIR

First Article Inspection Report

FMEA

Failure Mode and Effect Analysis

FEA

See Finite element analysis.

Fatigue

The phenomenon leading to fracture under repeated or fluctuating stresses that have a maximum value less than the tensile strength of the material.

Fatigue, thermal

The cracking (or crazing) of the die cast die cavity surface. This is caused by the expansion and contraction of the cavity surface which happens every time molten metal is injected into the die.

Feedback

A process control principle in which information about the actual performance of a machine, tool, die or process is inputted into the machine control system for the purpose of possible machine adjustments to correct any inaccurate variable.

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Feeding

The process of supplying molten metal to the die cavity to compensate for volume shrinkage while the cast part is solidifying.

Ferric nitrate treatment

Process for producing a bright, corrosion-resistant finish on magnesium.

Fillet

Curved juncture of two surfaces; e.g., walls that would otherwise meet at a sharp corner.

Fin

In die casting, the thin metal sections between die cast parts that are produced in multi-cavity dies. See Flash.

Finish machining

(1) The last machining operation on the cavity of a die casting die before the hand work (benching or polishing) is started. (2) Machining operations on a part that has been die cast to bring the part to final specified tolerances, where die casting to net-shape was not economically feasible.

Finish

The smoothness of the surface of a die casting or a die casting die cavity. The finish quality of a cavity surface may be specified as the grit size to be used in the final polishing, microinch RMS value or SPI/SPE finish standard number.

Finite element analysis

A numerical simulation procedure that can be used to obtain solutions to a large class of engineering problems including stress analysis, fluid flow, heat transfer and many more.

Fit

The preciseness or accuracy with which two parts must be fitted together. The clearance or interference between two interconnected parts. When a die casting must be made to unusually close tolerances to achieve a specified fit, it may impose a higher cost on its manufacture.

Fixture

Any apparatus that holds a part, such as a die casting, firmly in a predetermined position while secondary operations are being performed on the part.

Flash (metal extension)

The thin web or fin of metal on a casting occurring at die partings, air vents, and around movable cores. The excess metal is due to the working pressure and operating clearances in the die.

Flash, clearance

In die casting dies, spaces deliberately provided between parts of the die for the formation of flash. In trim dies and other secondary tooling, spaces provided for the positioning of the casting flash.

Flash, trimmed

The excess material that has been trimmed from a die casting that will be remelted and used over again.

Flow lines

Marks appearing on the surface of a casting that indicates the manner of metal flow.

Flow pattern

The pattern with which the molten metal progressively fills the cavity of a die casting die.

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Flow rate

The volume per unit time of molten metal entering a cavity in a die casting die. Flow rates are expressed in cubic inches or cubic millimeters per second.

Fluid bed coating

A process in which the metal to be coated is heated and inserted into the powdered resin which is fluidized in air.

Fluidity

Having fluidlike properties. In die casting: the distance the molten metal will travel through a channel before it freezes, at a given temperature.

Flux

A substance such as halide salts used to protect and minimize oxide formation on the surface of molten metal. Also used to refine scrap metals.

Form

The shape of a die casting.

Forming, cold

Any of several processes in which a die casting is reshaped by a tool or fixture, usually in a power press, without the application of heat. Spinning, which generates some localized heat, is still considered a cold forming operation. Heat staking, which utilizes heated punches, is not a cold forming operation.

Fracture test

Breaking a specimen and examining the fractured surfaces to determine such things as composition, grain size, soundness or presence of defects.

Freezing range

That temperature range between liquidus and solidus temperatures in which molten and solid constituents coexist.

GD&T

Geometric Dimensioning and Tolerancing

Gage

A fixture or apparatus that checks the dimensional accuracy of a produced part such as a die casting. A gage performs no work on the part.

Gaging

The process of using a gage to determine if a part is dimensionally usable.

Galling

Tearing out of particles from a metal surface by sliding friction.

Galvanic corrosion

Corrosion associated with the current of a galvanic cell consisting of two dissimilar conductors in an electrolyte or two similar conductors in dissimilar electrolytes.

Gas, trapped

A defect in a die casting where gases (such as air and gases from the decomposition of the parting material) have become entrapped within the casting and have formed one or more voids.

Gate erosion

Die damage induced by the long term high-temperature and high-velocity metal stream from the die inlet gate(s).

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Gate runner

The runner in a die casting die that is directly adjacent to the gate. The runner feeds the injected metal to the gate.

Gate

The passage connecting a runner or overflow with a die cavity. Also, the entire ejected content of a die, including the casting or castings and the gates, runners, sprue (or biscuit) and flash.

Gate, center

A gating arrangement in a die casting die that causes the injected metal to enter the cavity from the center of the part instead of along an outer edge. The casting must be open in the center, like a wheel or bezel, to be center gated.

Gating system

The passages, except the cavity, in a die casting die through which the injected metal must flow. The gating system includes the sprue or biscuit, main runner, branch runners (if any), gate runners, approach, the gate, overflows and vents.

Geometric characteristics

Geometric characteristics refer to the basic elements or building blocks which form the language of geometric dimensioning and tolerancing. Generally, the term refers to all the symbols used in form, orientation, profile, runout and location tolerancing.

Globular microstructure

A microstructure in which the primary phase is globular, rather than dendritic. This is the typical microstructure for semi-solid castings after heating to the semi-solid forming temperature. See also degenerate dendrites.

Gooseneck

In hot-chamber die casting, a spout connecting a metal pot or chamber with a nozzle or sprue hole in the die and containing a passage through which molten metal is forced on its way to the die.

Grain

A region within a solidified metal where the crystalline structure of the atoms is relatively perfect. The entire structure of the metal is made up of such grains. During cooling the grains are formed by growing larger from chance joining of atom pairs or from an impurity. As the grains grow they meet each other and the crystalline structure ends at these boundaries.

Grain refinement

The manipulation of the solidification process to cause more (and therefore smaller) grains to be formed and/or to cause the grains to form in specific shapes. The term “refinement” is usually used to mean a chemical addition to the metal, but can refer to control of the cooling rate.

Grain structure

The size and shape of the grains in a metal.

Grit blasting

Abrasive blasting with small irregular pieces of ferrous or ceramic material.

Growth

Volumetric increase of a casting as a result of aging, intergranular corrosion or both.

Hard anodizing

A variation of the sulfuric acid anodizing process using lower temperatures and higher voltages.

Hard buffing

Procedure for cutting down rough surfaces using buffs made with a high thread count and an aggressive compound.

Hard chromium

Chromium that is plated for engineering rather than decorative applications, and is not necessarily harder. It provides a wear-resistant surface and can be used to salvage worn or undersized parts.

Hard spots

Dense inclusions in a casting that are harder than the surrounding metal.

Hardware finish

An especially smooth, as-cast surface requiring no polishing and little buffing in preparation for plating.

Heat checking

See Fatigue, thermal.

Heat sink

(1) Feature of a die casting die designed to remove heat from the die or from a specific region within the die. Water channels are the most common type of heat sink. However, high thermal conductivity materials are also used. (2) A die casting designed to function as a heat sink in an assembly.

Heat transfer coefficient

The rate a material will transfer heat energy per unit time through a distance due to a temperature difference. The heat transfer coefficients for different materials are given in Btu/hr-ft-°F and W/m-°C.

Hiding power

The ability of a paint to hide or obscure a surface to which it has been uniformly applied.

Hole, cored

In a die casting, any hole that is formed by a core in the die casting die. A cored hole is distinguished from a hole that is added after the casting has been made (as by drilling).

Hot-chamber machine

A die casting machine designed with the metal chamber and plunger continually immersed in molten metal, to achieve higher cycling rates.

Hot cracking

A rupture occurring in a casting at or just below the solidifying temperature by a pulling apart of the soft metal, caused by internal thermal contraction stress.

Hot short

Brittle or lacking strength at elevated temperatures.

Hot shortness

A tendency for some alloys to separate along grain boundaries when stressed or deformed at temperatures near the melting point. Hot shortness is caused by a low melting constituent, often present only in minute amounts, that is segregated at grain boundaries.

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Hot tear

A fracture formed in a metal during solidification because of hindered contraction. Compare with hot crack.

ISIR

Initial Sample Inspection Report

Impact strength

Ability to absorb shock/energy, as measured by a suitable testing machine.

Impression

A cavity in a die. Also, the mark or recess left by the ball or penetrator of a hardness tester.

Inclusions

Particles of foreign material in a metallic matrix. The particles are usually compounds (such as oxides, sulfides or silicates), but may be of any substance that is foreign to (and essentially insoluble in) the matrix.

Ingate

The passage or aperture connecting a runner with a die cavity.

Ingot

A pig or slab of metal or alloy.

Injection

The act or process of forcing molten metal into a die.

Injection profile

The preprogrammed change in speed with time of the injection ram. Speed is often changed during the injection stroke to minimize air entrapment and die filling time.

Insert

A piece of solid material, usually metal, that becomes an integral part of the casting. Inserts are commonly set in the die so that metal is cast around that portion left exposed in the die cavity. Alternatively, inserts are often applied subsequent to casting. (Note: inserts become a part of the casting, whereas die inserts are a part of the die.)

Intergranular corrosion

A type of corrosion that preferentially attacks the grain boundaries of a metal or alloy, resulting in deep penetration.

Izod

Name of an impact test and testing machine in which the specimen is clamped at one end only and acts as a cantilever beam when struck by the hammer.

Jewelry finish

The highest-quality, defect-free, electroplated decorative finish for a die cast part.

Knock-Out; loose piece

A core positioned by, but not fastened to, a die and so arranged as to be ejected with the casting. The knock-out is subsequently removed and used repeatedly.

Lacquer

A coating composition which is based on synthetic thermoplastic film-forming material dissolved in organic solvent and which dries primarily by solvent evaporation.

Laminated object manufacturing

A method of rapid prototyping for producing a prototype part which uses CAD data to position a laser beam over a sheet of heat-activated, adhesive-coated paper, bonding each layer on top of the last.

Leveling electroplate

An electroplate that produces a surface smoother than the substrate.

Logo (logotype)

A symbol used to identify a company, often cast into a die cast part.

Lot size

The number of pieces made with one die and machine setup.

Metal distribution ratio

The ratio of the thickness of metal upon two specified areas of a cathode. See Throwing power.

Metal extension (flash)

The thin web or fin of metal on a casting occurring at die partings, air vents and around movable cores. The excess metal is due to the working pressure and operating clearances in the die.

Metal saver

A core used primarily to reduce the amount of metal in the casting and to avoid sections with excessive thickness.

Metal, hot delivery of

The practice of transferring molten metal from the smelting plant to the die casting plant. Hot-metal delivery results in considerable energy and dross savings since the metal does not have to be remelted at the die casting plant. Metal may be transported in the molten state for several hundred miles.

MHD Casting

Magneto-Hydro Dynamic casting is a casting process in which the metal is vigorously stirred by a magnetic field during solidification.

Microthrowing power

The ability of a plating solution or specified set of plating conditions to deposit metal in fissures, pores or scratches.

Moving core mechanism

The parts of a die casting die that hold and move a moving core. These may include gibs, locking wedge, angled pins, dogleg cams, racks, pinions and/or hydraulic cylinders.

NADCA

North American Die Casting Association, consolidation of the Society of Die Casting Engineers and the American Die Casting Institute.

Glossary

NADCA Product Standards

Die casting product standards originally published by the American Die Casting Institute, which this publication supersedes. ADCI and SDCE (the Society of Die Casting Engineers) merged to become NADCA, the North American Die Casting Association.

Net casting yield

See Casting yield.

Nickel plate

A coating of nickel, deposited by electrolytic or electroless plating methods, for decorative purposes and corrosion resistance. It is usually coated with a chromium flash plate for greater resistance to tarnish and wear.

Nitric acid pickle

A pre-pickle for the ferric nitrate treatment of magnesium.

Nitriding

A heat treating process for increasing the surface hardness of tool steels by diffusing nitrogen into the surface.

Nozzle

The outlet end of a gooseneck or the tubular fitting that joins the gooseneck to the sprue hole.

Operation, secondary

A manufacturing operation, or step, that is performed on, or to, a die casting after the casting is produced but before it is shipped to the customer or assembled into the finished product.

Overflow

A recess in a die, connected to a die cavity by a gate, remote from the entrance gate (ingate).

Overflow gate

A passage or aperture connecting a die cavity to an overflow.

Oxidation

A reaction in which electrons are removed from a reactant, as in the formation of ions at the anode surface in electrolysis. The combination of a reactant with oxygen or an oxidizing agent.

Oxide coating

A coating produced on a metal by chemical or electrochemical oxidation for the purpose of coloring or providing corrosion and wear resistance.

PPAP

Pre-Production Approval Process

PPM, Parts per Million

The acceptance level for the fulfillment of a production order based on the number of defective parts permissible per million parts shipped.

Part print

An engineering drawing (sometimes a reproduction of the engineering drawing) showing the part design. Usually “part print” refers to the drawing of a die casting rather than a die, tool or machine.

Glossary

Parting face

The surface of a die casting die half that closes against a mating surface on the opposite die half. See Surface, parting.

Parting line

The junction between the cover and ejector portions of the die or mold. Also, the mark left on the casting at this die joint.

Parting line, stepped

A condition on a die casting where the parting line changes abruptly from one level to another.

Passive stirring

Another process for producing the feed material for semi-solid casting. The liquid metal is forced through restrictive channels as it cools, breaking up the dendrites.

Phosphate coating

A conversion coating applied to metal surfaces for the purpose of improving paint adhesion and corrosion protection.

Phosphoric acid pickle

A treatment to remove surface segregation from magnesium die castings and improve corrosion resistance.

Pickling

Removing surface oxides by chemical or electrochemical reaction.

Pin

A core, usually of circular section, normally having some taper (draft). Also, a dowel (or guide pin) to ensure registry between two die sections.

Pitting

The appearance of small depressions or cavities produced during solidification or as a result of corrosion and cavitation.

Platen

Portion of a casting machine against which die sections are fastened, or of trim presses against which trim dies are fastened.

Plating rack

A frame for suspending parts and carrying current to articles during plating operations.

Plunger

Combination of tip and rod that forces metal into the die.

Polishing

The smoothing of a metal surface by means of the action of abrasive particles attached by adhesive to the surface of wheels or endless belts usually driven at a high speed.

Porosity

Voids or pores, commonly resulting from solidification shrinkage; air (primarily the nitrogen component of air) trapped in a casting or hydrogen exuded during electroplating.

Porosity dispersion

The degree to which the porosity is spread throughout the casting, as opposed to being all in one place.

Porosity, internal

Porosity that is completely encased within the die casting.

Glossary

Porosity, surface

Porosity in a die casting that is open to the surface of the casting.

Port

Opening through which molten metal enters the injection cylinder of a hot-chamber machine or is ladled into the injection cylinder of a cold-chamber machine.

Pouring hole/slot

Port through which molten metal is ladled into the cold-chamber of a die casting machine.

Powder coating

This method involves electrostatically spraying a premixed granulated powder onto a workpiece and then curing at an elevated temperature to obtain final coating properties. Powder coating has many advantages, including the absence of organic solvents, a wide choice of coating materials for many service conditions, minimal material waste, and easy handling.

Preheating

The process of heating a die casting die prior to making castings to minimize the thermal shock from the first few castings. Also applies to die heating prior to die placement in the machine, for more rapid die changing and onset of production.

Press, trimming

A power press (either mechanical or hydraulic) used to trim the flash, runners and overflows from die cast parts after casting.

Pressure tightness

A measure of the integrity of a die casting in which a fluid under pressure will not pass through the casting. The method of testing and the pressure used must be specified.

Process capabilities

The range, or variation, of critical casting quality parameters (such as dimensional tolerances) within which a particular die and machine combination will operate.

Quench

The cooling of a die casting from its ejection temperature to room temperature.

Quench, water

The cooling of a die casting from its ejection temperature to room temperature (or to nearly room temperature) by placing it in water.

Quick-Change

(1) Any construction for a tooling component that allows the component to be replaced without removing the tool or die from the machine in which it is operated. (2) Die casting die features and procedures, such as preheating, which enable dies to be changed on die casting machines with a minimum of interrupted production. Such features usually add cost to the original construction of the tool or die, but can save considerable machine downtime costs.

R&R

Repeatability and Reproducibility.

Radiograph

A picture produced on a sensitive surface, as a photographic plate, by electromagnetic radiation of wavelength less than 500 angstrom units. The most common is the X-ray. X-ray pictures of die castings can often reveal flaws inside the castings.

Radius

A convex arc blending two surfaces on a die casting or on the model from which a die casting is to be made. See Fillet.

Rapid prototyping

Production of a full-scale model of a proposed design more quickly and inexpensively than by traditional methods like single-cavity prototype die casting, gravity casting or machining. See also: Stereolithography, Selective laser sintering, Laminated object manufacturing.

Reclaim

The process of smelting trimmings, scrapped parts, dross and machine turnings back to original alloy specifications.

Refine

In magnesium melting practice, the removal of magnesium oxide and other suspended non-metallic matter by use of flux that preferentially wets the impurities and carries them to the bottom of the pot as sludge.

Release agent

A material that is applied to the surface of the die cavity to keep the casting from sticking to the die. Such materials are usually applied frequently, sometimes every cycle, and are usually applied by spraying. To facilitate the spraying, the material is mixed with water or a mineral solvent which evaporates from the cavity surface.

Remelt

Sprues, gates, runners and as-cast defective castings returned directly to the melting pot.

Rheocasting

Another term for semi-solid metal casting.

Rib

A wall normal to a second wall or surface to strengthen or brace the second wall or surface.

Robber

See Cathode robber.

Runaround scrap

See Remelt.

Runner

A die passage connecting the sprue hole or plunger hole of a die to the gate or gates where molten metal enters the cavity or cavities.

Salt fog test

An accelerated corrosion test in which specimens are exposed to a fine mist of a solution usually containing sodium chloride.

Satin finish

A surface finish that behaves as a diffuse reflector, which is lustrous but not mirror-like.

Glossary

Scale

A build-up of material that forms on the die cavity surface during the operation of the die casting die. The build-up material is usually a combination of the oxide of the metal being cast and the parting material. The scale leaves an imprint on the casting and in extreme instances can even change dimensions on the casting.

SDCE

Society of Die Casting Engineers, which merged with the American Die Casting Institute to become the North American Die Casting Association (NADCA).

Sealed chrome pickle

A treatment for magnesium consisting of a chrome pickle, followed by sealing in a dichromate solution.

Sealing of anodic coating

A process which, by absorption, chemical reaction or other mechanism, increases the resistance of an anodic coating to staining and corrosion, improves the durability of colors produced in the coating or imparts other desirable properties.

Section, heavy

Any place in a die casting where the thickness is significantly greater than (at least double) that of the majority of the casting.

Segregation

Non-uniform distribution of alloying elements, impurities, or microstructures.

Selective laser sintering

A method of rapid prototyping which uses a modulated laser beam on specialized powders to transform CAD data into full size prototypes in polycarbonate, nylon, or investment wax.

Semi-bright nickel

Nickel plate, containing less than 0.005% sulfur, that requires polishing to give full brightness or is used as-plated for the bottom layer in a double-layer nickel plate.

Shield

A nonconducting medium for altering current distribution on an anode or cathode.

Shot

Die filling or part of the casting cycle in which molten metal is forced into the die.

Shot peening

The procedure of impacting a metal surface with a high-velocity stream of metal shot or glass beads for the purpose of (1) cleaning or (2) improving resistance to stress corrosion by producing a compressive stress.

Shot size

The cubic volume of a die cast shot or the cubic volume of die casting alloy that a die casting machine is capable of injecting into a die. Shot sizes are sometimes expressed in weight or mass units.

Shrink mark

A surface depression, often called a shadow mark, that sometimes occurs at a thick section that cools more slowly than adjacent sections. Also known as a sink.

Shrinkage factor

See Contraction factor.

Shrinkage pits

A condition on a die casting where the solidification shrinkage has resulted in small holes on the surface of the casting. These holes are sometimes called “heat holes.” When they form along the gate, they are called “gate holes.”

Shrinkage, internal

Condition during the solidification of a casting where volumetric shrinkage results in the formation of a void inside the casting.

Shrinkage, solidification

Volume reduction that accompanies the freezing (solidification) of metal in passing from the molten to the solid state.

SIMA

(Strain Induced, Melt Activated) A wrought process for producing feed material for semi-solid metal casting. The metal is generally hot extruded and cold drawn.

Skin

See Die cast skin.

Sleeve, shot

The molten metal chamber of a cold-chamber die casting machine. This is a hardened steel tube through which the shot plunger moves to inject the molten metal into the die.

Slide

Portion of a die generally arranged to move parallel to the parting line. The inner end forms a part of the die cavity wall and sometimes includes a core or cores.

Slug

See Biscuit.

SMED

Single minute exchange of dies, a technique from Lean Manufacturing disciplines to reduce die set up times.

Soldering

The sticking or adhering of molten metal to portions of the die following casting.

Solidification shrinkage

See Shrinkage, solidification.

Solution heat treatment

Heating an alloy to a suitable temperature, holding at that temperature long enough to allow one or more constituents to enter into solid solution and then cooling rapidly enough to hold the constituents in solution.

SPC, statistical process control

Statistical techniques to measure and analyze the extent a process deviates from a set standard.

Split gate

A gate of castings having the sprue axis or plunger axis in the die parting line.

Sprue

Metal that fills the conical passage (sprue hole) that connects the nozzle or hot chamber to the runners of a hot-chamber machine. (Most cold-chamber machines form a slug and have no sprue.)

Glossary

Sprue pin

A tapered pin with rounded end projecting into a sprue hole and acting as a core to keep the casting in the ejector portion of the die.

Sputter coating

The formation of a deposit by the condensation of atoms or particles formed by ejection from a surface subjected to high-energy ion bombardment.

SQC, statistical quality control

Statistical techniques to measure and improve the quality of a given process.

Staking

A cold forming operation to a die casting. Staking is usually performed in a power press to bend tabs or swage heads onto studs.

Stereolithography

A method of rapid prototyping which converts 3-D CAD data into a series of very thin slices and uses a laser-generated ultravioliet light beam to trace each layer onto the surface of a vat of liquid poly-mer, forming and hardening each layer until the complete, full-size prototype is formed.

Strength, ultimate tensile

The maximum tensile (pulling) stress a metal can stand before rupturing.

Strength, yield

The stress at which a material exhibits a specified limiting permanent strain or permanent deformation.

Stress corrosion cracking

Cracking due to the combined effects of stress and corrosion. Usually this type of failure occurs as a fine hairline crack that propagates across the section without any exterior sign of corrosion.

Stress

Force per unit area. When a stress is applied to a body (within its elastic limit) a corresponding strain (i.e., change in shape) is produced, and the ratio of strain to stress is a characteristic constant of the body.

Stress, thermal

Stress induced into a material when a temperature change causes a force trying to change the size or shape of the part, but the part is restrained and cannot re-spond to the thermally induced force.

T&T

Taper and Tolerance.

TQM

Total Quality Management.

Unit system

A die casting die built to a standardized design and dimensions. Also, a series of units, for a variety of castings, that are installed and run in the die holder as the need for various castings dictates.

Vacuum

A space completely devoid of matter, even gases. Shrinkage voids in a die casting can be a vacuum. It is not necessary for a void to include entrapped air.

Vacuum assist

The action of voiding the die casting die of gasses during or prior to the flow of molten metal to form the casting.

Vent

A thin narrow passage that permits air to escape from the die cavity as it is filled with metal.

Vibratory finishing

A process for deburring and finishing mechanically by means of abrasive media in a container subjected to high-rate oscillations.

Void

A large pore or hole within the wall of a casting usually caused by solidification shrinkage or gas trapped in the casting. Also, a blow hole.

Water line, cooling channel

See cooling line.

Wet blasting

A process for cleaning or finishing by means of a slurry of abrasive in water, directed at high velocity against the parts being processed.

Wire brushing

The method of burr removal, edge blending and surface finishing by contacting the work surface with a variety of rotating wire brushes.

Yield

See Casting yield.

ZA

A designation followed by a number, which is used to designate a group of three zinc based casting alloys. The number indicates the approximate nominal aluminum content.

Zamak

An acronym for zinc, aluminum, magnesium and copper, used to designate the zinc alloys 2, 3, 5 and 7.