Commercial Practices

SECTION 8

Commercial Practices

Frequently Asked Questions (FAQ)

1) Who owns the die cast die?
   See page 8-4, Die Ownership.
2) Are there checklists available that can be used for cast or finished specifications?
   See pages 8-15 and 8-16 for checklists.
3) How long do dies last?
   See page 8-5 and 8-6, Die Life, Maintenance, Repair and Replacement.
4) Are there any recommendations for creating CAD data files?
   See page 8-3, General Database Guidelines.
5) What is involved with die maintenance/repair/replacement?
   See page 8-5 and 8-6, Die Life, Maintenance, Repair and Replacement.

1 Introduction

In specifying die cast production, the purchase contract can be viewed as the purchase of a comprehensive engineering service from the die caster who will use the purchaser's tool to convert metal to the precise form desired by the purchaser.

The die caster will usually provide other important services, such as designing, constructing or maintaining the tool and performing machining and surface finishing operations on die cast parts. Sub-assembly services may also be provided.

The proposal and subsequent order for die castings sets forth a contract embodying the business practices governing a transaction in which custom engineered parts will be supplied on a continuing basis. Quality production of a high volume of custom parts, at the most economic level, involves a thorough understanding of the variables of the die casting process, its tooling requirements and related trimming, secondary machining and finishing operations.

The physical properties and constants of metals and alloys used for die castings are set forth in Alloy Data (Section 3 of this volume) and should be referred to with other accepted metallurgical specifications.

Aid in determining the detailed part design requirements to be specified for cost-effective production can be obtained from the Engineering and Design standards and guidelines in this volume (Sections 4, 5 and 6), together with other recognized engineering data. If geometric dimensioning is not being used on part prints, GD&T (discussed in relation to die cast parts in Section 5) is strongly recommended for optimizing quality and lowest costs.

Tooling (Section 2) and Quality Assurance (Section 7) should likewise be reviewed well before drawing up final product specifications.

Of equal importance to careful specification are the commercial arrangements which affect the buying of die castings. These trade customs have evolved from industry-wide production experience and have generally been accepted as good business practice. The commercial arrangements are normally found in the proposal and acknowledgement forms used by the North American die casting industry.

These specialized inter-relationships, among others, govern the ability of the custom producer to supply die castings to specifications on prearranged quantity schedules at competitive levels on a continuing basis. They are described in this section together with convenient die casting product specification checklists.

2 Using Die Casting Specification Checklists

The C-8-1 Checklist (Die Cast Product Specifications) and C-8-2 Checklist (Die Cast Surface Finishing Specifications), which appear at the end of this section, can help the purchaser to more clearly define the die casting requirements that will impact final costs. They can serve as a production guide to help provide accurate communication between the purchaser and the die caster, avoiding

misunderstandings later. The die caster should review these specification levels with the purchaser to assure that the most cost-effective level is selected and, if necessary, provide samples of various specification levels.

2.1 Defining Quality Requirements

The checklists also mention the use of SPC and other inspection requirements. It is highly desirable to define such requirements so there is no question about record-keeping responsibilities. While most die casters use these techniques regularly, some purchasers have special requirements (ie. critical features) that must be defined early in the process.

When using statistical techniques for quality control, it is important for the purchaser to specify the parameters when requesting a price quotation. For example, general definitions of process capability, such as Cpk, can affect tooling dimensions that are built towards one side of the tolerance to allow for future die wear. These dimensions can vary in one direction only, as in the outside dimensions of a cavity (see "Moving Die Components" – Section 4A). When applying general definitions in this situation, the tool will appear to be out of limits, while it is actually built to high quality standards for long life.

It is most important that agreement on procedures be reached prior to establishment of the quality standards. The costs for the quality level of a feature are calculated by the die caster during the quoting process, and any changes in standards at a later time may require a revision to the quotation.

Many of the specifications, such as the quality of a surface finish or the severity of internal porosity, are subjective. The methods of establishing subjective standards can vary considerably, but it is always beneficial to spend the effort required to define the standards as closely as possible.

One way of defining subjective standards is to define borderline acceptable and acceptable samples, which should be retained as "limit" samples by the customer and the die caster. In addition, it is desirable to have pictures or a complete written description of the defects that would cause rejection. Such provisions can be improved upon during the initial production phase.

2.2 Specifying Tolerances

It is well known that the die casting process can achieve very high dimensional precision. The Engineering & Design Tolerance Standards for coordinate dimensioning of parts to be die cast (Section 4A) are presented at two levels: as Standard Tolerance and as Precision Tolerance specifications. Most die casters can improve on the Standard Tolerances, but a cost penalty in increased cycle times will often be the trade-off.

Tolerance improvements are most directly related to part shape. If tolerance requirements are clearly discussed in advance with the die caster, precision tolerances can often be maintained for a cast part with significant improvements in product performance and reduced secondary machining and finishing operations.

Machining processes should also be considered well before any order for the tooling is released. A careful evaluation of machining requirements can lead to a redesign for net-shape die casting or near-net-shape production, with a reduced number of operations or setups.

2.3 Technical CAD Guidelines

Computer Aided Design (CAD) databases usually consist of a two-dimensional drawing (2-D) and a three-dimensional model (3-D). To expedite communications, the die caster and customer should be aware of each other's CAD software capabilities early on in the project. In the event that the die caster and customer do not utilize the same software packages, universal file formats can be used to communicate. Although there are many available, the most common formats are DXF or DWG (for 2-D drawings) and IGES or STEP (for 3-D models). Translation software is needed to convert files into the appropriate format.

When databases are utilized for quoting purposes, these general guidelines apply:

1. If only a 2-D drawing is provided, it should contain dimensions and general views of the part and major features. Physical properties such as mass and part volume should be included as well.

2. If only a 3-D model is provided, the die caster should be able to retrieve dimensions and properties from the model.
3. Secondary operations, such as machining, can be included in the database or supplied separately.

Some general requirements when databases are being utilized for tool construction:

1. When only a 2-D drawing is provided:
   1.1. Drawing should contain complete dimensions of all features.
   1.2. Parting line, draft, radii, datums and tolerance (dimensional and geometric) requirements should be clearly defined.
   1.3. Secondary operations that are to be performed on the part and other requirements should be clearly stated.
2. When only a 3-D model is provided:
   2.1. All necessary draft, parting line and radii should be included in the model. Ideally the 3-D model will indicate machined surfaces.
   2.2. Lines and surfaces of the model should be connected within 0.001".
   2.3. The 3-D model should be accompanied by a limited dimension part print that contains all tolerancing information and shows any secondary machining to be performed.

An incomplete database could result in an inaccurate quote and possibly require considerable database manipulation, which leads to additional cost and extended lead-time. The die caster and customer should also indicate whether the 2-D drawing or the 3-D model controls the project.

3 Die Casting Dies and Production Tooling

Any die casting can be produced in a number of different ways and every die casting plant possesses different equipment and utilizes a range of production techniques. Optimum economy and maximum efficiency for the production of any die casting, therefore, must be considered in the light of the particular equipment with which it will be produced. The experience, technology, skill and ingenuity of the die caster are all involved in selecting the method of production on which the proposal is based.

Each die caster sells die casting dies, trim dies and specialized production tooling on its own individual terms and conditions. Normally, these terms provide for an advance payment for dies with the balance paid upon receipt of, or approval of, a sample produced from the dies and tools. Length of time for approving parts to be 30 days if not otherwise agreed upon between die caster and customer.

3.1 Die Ownership

Generally, the purchaser of die castings will retain ownership of the die casting die, even though the die remains with the die caster. It has also been the custom that the design and construction of the die casting die are performed by the die caster to its own specifications, even though the purchaser owns the die. The custom generally works to everyone's advantage.

Die casting is a highly complex process that contains hundreds of interacting variables. Designing a die for die casting operations requires understanding of the different variables involved and how they can affect the quality of the casting. It is recommended that the die caster design and build the die to meet the needs of the part designer, so that the die works for the die caster's process and machine(s).

Quality issues on a die casting can stem from die design, die construction, or production operations. If a part designer designs and builds a die for a die caster to use in their operations it can lead to a point of conflict if a quality issue arises during production. It is recommended that the die caster design and build the die, but keep in contact with the part designer during the process to provide updates and resolve any potential issues.

Consequently it is preferable for the die caster to be responsible for die design and construction. In addition to eliminating questions of responsibility, this procedure also ensures that the die will match the casting equipment. In addition, the die caster has a vested interest in building a high-quality die that will give few problems in production.

The die casting die, usually owned by the purchaser, is housed and maintained at the die caster. The die caster will be responsible for loss or damage to the die and tooling while housed at the die caster's facility. Some die casters offer the option of joint ownership of the die. In either case, there are some considerations that should be addressed during the purchasing discussions.

An ownership record should be established by both parties, which will include a description of the die and all additional components of the die. Each die should have a method of identification, which is best done with engraving (tags can come off). Typically a number is assigned to the die by the die caster, which is engraved on the die, slides and cores and included in the purchaser's record of the die.

All components purchased originally with the die should be noted in the record, such as shot sleeves or extra slides or cores. These components usually wear out much more rapidly than the rest of the die and they may be worn out and unavailable if the die is claimed by the purchaser.

The question of Tool Ownership as well as Replacement is often overlooked when general discussion begins at the start of a possible new project. Since there are multiple types of tools available for the die cast process the following descriptions for tooling and ownership is to provide a starting point for those decisions.

New tools are generally paid for by the Customer, the Die Caster is responsible for normal maintenance and care (as the caretaker), the customer (as the owner) for major component replacement, full die replacement, major repairs and refurbishment. It is the responsibility of the die caster to inform the customer of any atypical maintenance or care required. If the customer elects not to follow the maintenance advice of the die caster the quality of the part could suffer. In the following cases an example will be given as to typically who owns what portion of the tool.

1) Rapid Tooled projects frequently use a tool (mold base) that is owned by the die caster and becomes a type of Universal Holder for Die Cavity inserts (for multiple customers). The inserts that are used to make the part configuration are owned by the customer and frequently will have a shorter tool life than Production made tooling.
2) For Unit Dies, the Master or Universal Holder (as above) is usually owned by the Die Caster and the individual units and their inserts are owned by the Customer. As long as a Unit Die is the equivalent of an Industry standard it should be able to move to a new die caster if needed without major cost factors involved.
3) Dies by themselves are owned by the Customer and may have different shot life attached to them based on part design and function.

Replacement is sometimes limited to the cavity inserts but could be the entire die. The die caster is generally expected to monitor the tool condition and notify the customer that the replacement or repair may be needed so that enough time is allowed to get the replacement funds approved and to allow the tooling components to be approved before the original tool wears out. Sometimes, however, it is not possible to fully predict when a tool may need to be replaced. This can be paid for at the time of construction of the replacement or in cases of a very high volume part an amortization account may have been set-up. This type of account allows for a small amount to be added to the part price that will cover the cost of the replacement when needed. It becomes the Die Caster's responsibility to manage tool replacement and to notify the Customer when new replacements are submitted for approval. It is important for the Customer and Die Caster to discuss tool replacement early in the project as stricter quality requirements or difficult geometry can lead to replacing the die sooner.

Tooling Amortization must be started at the time of the first part being produced for sale so that the account can cover the cost of replacement start and the balance due at approval. If it is not started at this time the tool may have to be pushed beyond normal life to pay for a new tool and to not interrupt Customer production. This usually results in added operations to the part which can increase costs. This process does not work with inherited tooling because of questions concerning actual shot count on the tool but can be applied after the first replacement is completed. Either the Customer or the Die Caster can be holder of the amortized funds for replacement but usage terms need to be clearly defined.

The Die Caster and the Customer need to agree on both the initial tool and replacement plans (as needed) and payment terms at the start of the project so that on-going needs are met and ownership is clear.

3.2 Die Life

The purchaser should be aware that the life of a die can be unpredictable. Die life is a function of many factors. Among them are part design, part configuration in the die, part quality expectations, release quantity, type of tool steel used for the die, the heat treatment of the die and the type of alloy being die cast.

Even when the die caster makes every effort to extend die life, early failure is still possible. It is also possible for a die to have an unpredicted very long life. An understanding of expected die life should be discussed in the initial phases of a project.

Progressive die casters can provide tool, heat treat, and/or die surface coating/hardening specifications developed through extensive NADCA research programs. Reports on various die materials, heat treatments, and die surface engineering processes can be found in the NADCA Technical Archives. Often times using non-standard material, heat treatment, or die surface coatings/hardening can increase the cost of the die, but used in the right conditions can more than pay for itself by increasing the life of the die. Customer and Die Caster should have discussions about the non-standard material, heat treatment, coating or hardening to be used to determine the expected benefits and potential risks.

When tooling is procured through a reputable die caster, tooling costs may be somewhat higher than if a purchaser dealt directly with the tool builder. The die caster will be closely involved in evaluations and decisions that will translate the product design into the optimum die casting die for successful production. The increased costs almost always represent a bargain in terms of overall costs during the life of the die.

An inexperienced purchaser who purchases tooling purely on a cost basis will find that the costs over the life of a die are significantly higher because of a lower-quality tool, although this will not be immediately apparent when the tool starts running. It cannot be emphasized too strongly that good quality tooling will cost more in the beginning but pay for itself many times over in the life of a typical die casting die.

3.2.1 Die Maintenance, Repair and Replacement

The responsibility and criteria for maintaining tooling, on the one hand, and replacing the tooling, on the other, should be understood. In some cases, the die replacement cost is requested to be amortized into the piece price. The most common way of structuring this portion of the contract is for the die caster to provide minor maintenance, and the purchaser to provide major repair and replacement.

Minor maintenance is generally described as “run-to-run” maintenance of a serviceable die to maintain die casting production. Major maintenance would cover the replacement or rebuilding of an entire die cavity, die section, or complex core slide that makes up a significant percentage of the casting detail, tool steel, the coatings applied to the die, or major die resurfacing or refurbishment. Most die casters have a preferred way of handling maintenance and it should be made clear.

The rapid wear components should be covered in the die maintenance understanding between the purchaser and the die caster. These components are frequently replaced by the die caster, although each purchaser should expect to make an individual agreement for each casting. If the components are replaced by the die caster, ownership usually remains with the die caster, although this can vary for individual agreements.

The die caster should provide their maintenance practices to the purchaser for review. If the purchaser has any specific expectations, such as expecting the die to be stress relieved after a certain number of shots, they should notify the die caster so that can be included in the maintenance schedule and cost.

Note: Computer software is available for flow simulation, thermal and distortion analysis.

Die preheating practices, gating design and die temperature control are particularly important to long die life. It is recommended that the die caster provide the purchaser with general information about the following practices to help them understand the processes in place to ensure long die life.

1. The die caster should provide what preheating practices are being used to extend the life of the die. The best results are achieved by preheating dies to a specified temperature, depending on the alloy being cast, before the first casting is made.

2. Smooth metal flow at the correct velocities from a carefully designed gate is important to reduce the die erosion at the gate, as well as having a significant effect on casting quality. Die erosion can be repaired by welding, but the onset of welding significantly reduces the ultimate life of the die.
3. The die caster should be able to discuss the use of good die design practices with the purchaser. A die caster using trial and error without calculations for gating will have many more problems with die erosion and part quality than one who uses calculation techniques developed by NADCA or other authorities.
4. Die temperature control, involving careful cooling line control and proper cooling line placement, will influence casting cycle time and have an important effect on casting quality.

3.3 Credit

The die caster generally reserves the right to change his terms of payment if a change in the customer's financial condition requires it. Such changes are usually requested in writing and, when necessary, may require the die caster to stop design and/or construction pending agreement.

3.4 Changes or Cancellations

If any changes are required by the purchaser to finished die casting dies or production tooling which deviate from the original print and/or model provided for the dies and tooling at the time of quotation, the die caster reserves the right to requote the quality, expected die life, cost and delivery of the tooling. Any changes to the order must be agreed to by the die caster, in writing.

The die caster will usually require some payment for cancelled orders. Payment is necessary to compensate the die caster for costs of work in process to the date of cancellation and commitments made by the die caster for purchases relating to the order.

3.5 Die Retention and Removal

It is customary for the die caster to retain control and possession of die casting dies and production tooling. Since the full cost of engineering, designing, obtaining, and maintaining the die casting dies and production tooling is not fully reflected in the charges to the purchaser for these items, an additional charge may be necessary for these unreimbursed costs if the die casting dies and production tooling are removed prematurely from the die caster's plant.

It is also customary to allow die casting dies and production tooling which have not been used for three consecutive years for production of die castings to be scrapped following proper notification to the purchaser by the die caster.

Rules for the accessibility of the die should be established. If the die is to be claimed by the purchaser, it should be available after notice has been provided, and all outstanding invoices due the die caster are paid in full.

3.6 Insurance

It is customary for the insurance of die casting dies and production tooling to be the responsibility of the purchaser, unless specifically agreed upon, in writing, to the contrary.

Die casters normally have liability insurance protection against fire and theft or vandalism. However, fire insurance usually excludes tools, which do not burn, except for the clean-up costs following a fire. Insurance should be reviewed in each case, and business interruption in case of fire may need to be considered. Die casters will provide worker's compensation insurance as required by law.

3.7 Gaging

Good gaging is critical to obtaining good quality parts, both during the process and at final acceptance, and can also help reduce part cost, especially if a casting is heavily machined. It is important that this aspect be discussed early in the project.

The die caster can be expected to furnish standard gages. The purchaser is expected to furnish any special gages needed in the inspection process, such as those required for determining conformance to feature and location specifications and any gages needed for functional or statistical requirements.

All gages and gaging methods should be agreed upon in advance by the purchaser and die caster, including any need for duplicate gages. This will aid in both part function and fit, in instances where the die casting will be mated or assembled with other parts not manufactured by the die caster.

3.8 First-Piece Acceptance

After the first die cast samples are received from a die casting die, the die caster or purchaser will usually be required to measure the samples and verify that they meet specifications. Modifications from the original print which have no effect on part function or appearance can be discussed at this time to ensure that high production rates can be maintained and premature die maintenance avoided.

Procedures for handling changes in the print specifications for the die casting should be agreed upon. Any costs and delivery delay incurred by such changes should be quoted by the die caster immediately after they are received. Authorization for the changes should be given by the purchaser in writing on each change order.

4 Die Cast Production Part Orders

The commercial terms of the contract items and conditions between the purchaser and the die caster for die cast part production are discussed below. Note that the trade customs outlined represent the historic and customary practices prevailing in the die casting industry. Contract forms of individual die casters will vary in some details. A model of terms and consitions can be found at www.diecastingdesign.org/terms/

4.1 Metal and Metal Pricing

Quality metal is the foundation for good castings. Even a chemical analysis does not fully define all the metal quality specifications that are necessary for good die casting. Low-cost, low-quality metal cannot be expected to meet all die casting requirements.

For example, when aluminum or magnesium alloy does not meet established criteria, machining may be more difficult or surface corrosion accelerated. When zinc alloy does not meet established criteria, mechanical properties will be progressively and seriously reduced in use with time.

Metal price is commonly established from quotations from an approved metal supplier, or based on known industry indicators such as the daily American Metal Market, the London Metal Exchange, Platts or other major markets. If the purchaser elects to use an industry indicator, he may forfeit the advantage of spot metal buys at lower than market price.

4.2 Acceptance of Orders & Reorders

4.2.1 Acceptance of Orders

Proposals for the production of die castings are prepared on the basis of the specifications and prints known at the time of estimating. Die casting proposals are, therefore, for immediate acceptance on the basis specified. Similarly, since orders are accepted on the basis of the requirements known at the time of the order, changes from the original proposal on which the order is based may result in the need for price adjustment for the parts. The die caster reserves the right to review all orders before acceptance.

The proposal, the order and its acceptance, signed by an authorized representative of the die caster, constitute the entire contract with the exception that, when any provisions of the order conflict with the proposal, the proposal and acceptance always prevail. Modifications, changes, additions, cancellations or suspensions of an order are not binding upon the die caster, unless accepted in writing by an authorized representative of the die caster and upon terms that will indemnify him against all loss.

4.2.2 Reorders

Reorders for die castings are covered by the same conditions as was the original order, provided no revised proposal and acceptance has intervened. Pricing of reorders will, of course, be affected by quantity, alloy, labor and other costs prevailing at the time the reorder is placed.

4.3 Changes, Cancellation and Errors

4.3.1 Changes or Cancellation

Any changes to the order deviating from the original basis upon which the order was accepted must be agreed to, in writing, by the die caster. These changes may result in the adjustment of prices. Changes could include, but are not restricted to, delivery dates, quantities, release dates, part prints, etc.

The die caster usually will require some payment for cancelled orders. Payment is necessary to compensate the die caster for costs of work in process to the date of cancellation and commitments made by the die caster for purchases relating to the order, including dedicated equipment specifically acquired for a cancelled project.

Any change to the delivery schedule or release dates beyond 90 days must be subject to negotiation between the die caster and the customer.

4.3.2 Errors

Clerical errors are, of course, subject to correction regardless of whether they favor the buyer or the seller and enforceable if discovered within a period of one year.

4.4 Credit, Payment Terms and Taxes

4.4.1 Credit

The die caster generally reserves the right to change terms of payment if changes in the customer's financial condition requires it. Such changes are usually requested in writing and, when necessary, may require the die caster to stop production or suspend shipment pending agreement.

4.4.2 Terms of Payment

Each die caster sells its products on its own individual terms and conditions. Shipments are generally FOB (or EXW) the city in which the die casting plant is located. Payment is normally net 30 days with provision for metal market and escalation clauses.

4.4.3 Taxes and Duties

Sales or use taxes, excise taxes, taxes on transportation, other direct taxes and applicible duties are the responsibility of the purchaser whether such taxes are federal, state or local.

4.5 Packaging and Delivery

4.5.1 Shipping Tolerances

Since the die caster cannot determine in advance the exact loss factor in a particular run, it is generally recognized that he may manufacture and ship 10% over or 10% under the number of die castings ordered or released. If no deviation is to be allowed, with pricing affected accordingly, this should be so specified in the purchasing agreement.

4.5.2 Packaging

Die castings are generally packed in bulk as the most suitable and economical method. Any special requirements, such as specifying layer packed, separated or cell-packed shipments, must be communicated to the die caster in the RFQ; otherwise a price change may be required later.

If recyclable packaging is required, it should be carefully spelled out in the quoting phase. While this type of packaging can have a positive impact on pricing, it may increase up-front costs. The die caster and customer should discuss responsibilities associated with recyclable packaging.

4.5.3 Deliveries

Unless otherwise specified, deliveries of die castings generally begin as soon as the die caster's schedules permit and, in the case of a new die, after approval of samples. Deliveries are made at a rate approximately equal to the capacity of the tools until orders are completed. The purchaser selects the method of delivery and, unless otherwise specified on the purchaser's order, the die caster will use his best judgement in routing the shipment and seeing that deliveries are effected as specified. Acceptance of the goods by the carrier shall constitute a delivery. Any charges in connection with postponement or cancellation of delivery are the responsibility of the purchaser. The purchaser will also be responsible for any additional costs of expedited or other special transportation as result of changes in delivery schedules not caused by die caster.

Penalties upon the die caster for delayed delivery, whatever the cause, are not normally acceptable unless agreed upon at the time the order is being placed.

Many die casters today can provide an electronic connection to high volume purchasers to facilitate placing orders, as well as provide bar coding. It is frequently desirable to anticipate emergencies and provide for backup tooling, a small amount of emergency inventory or some other way of addressing the catastrophic failure that can occur in any volume production process based on sophisticated tooling.

4.5.4 Lot Size versus Cost

Because of the cost of setup, die casting is usually a high-volume process where the cost of a small lot is significantly increased by setup costs. It is therefore imperative that lot sizes be considered in the discussions of the purchasing contract. Each die caster will have his own costs for setup, so the break-even point for minimum lot sizes will vary among die casters. Some purchasers use consignment inventory agreements to address the reality of die setup costs and tooling life factors that are adversely affected by the short runs.

Lot size should be considered in the early stages of determining the tooling requirements. For example, in some cases fewer cavities on a smaller die will result in lower tooling costs, lower setup costs and a smaller economical lot size. This may be more desirable even though the piece-price may be slightly higher.

If small lot sizes are required often, quick setup aids, such as quick-disconnects, can be built into the tooling. Advising the die caster of small lot requirements at the time of quotation will enable him to optimize the use of these aids.

It is desirable for the purchaser to take time to explore the options of economical lot size, costs of maintaining inventory and tooling options during the tooling quotation phase. Since there may be many options, it is suggested that the purchaser provide the die caster with those considerations that are important for the project and let the die caster propose several options. This will allow the die caster to maximize the efficiency of the equipment available in his plant and provide the most economical quote to the purchaser.

4.6 Limitations on Inspection Procedures

4.6.1 Prints and Approved Samples

Die castings may not be rejected because of variation from print dimensions if they are made to, and are unchanged from, approved samples with respect to dimensions, finish and analysis. When the purchaser has specified or approved the design, failure with regard to function or fitness for use shall be the purchaser's responsibility. If sample die castings have not been approved and conflicting models and prints have been submitted, the basis of acceptance shall be agreed to in writing.

4.6.2 Accuracy

Die castings may not be rejected if they vary from finished sizes or dimensions within limits agreed upon. Where a very close tolerance or particular dimensional accuracy is specified, the permissible variations shall be agreed upon before die work is begun. In the absence of applicable standards, tolerances will be subject to the commercial variations generally prevailing in the industry.

4.6.3 Inspection and Sampling Procedures

If specified and specifically acknowledged and agreed to by the die caster, die castings can be inspected on the basis of statistical quality control or other sampling procedures.

Use of statistical quality control standards and other related procedures require specific detailing by prior mutual agreement on all aspects involved.

4.7 Compliance with Laws

Die caster will comply with applicable laws, rules and regulations of the country where the casting is made. Die caster will provide customer with material safety data sheets and, upon request, provide other information reasonably required in order to comply with applicable laws.

5 Purchased Components

Innovation in the design of die castings and flexibility in the industry's manufacturing process have led to the use of purchased components for insertion or assembly by the die caster. The procurement and subsequent responsibilities for the delivery and quality of such components lies with the purchaser of the die casting unless otherwise agreed upon and included in the quote and the order. These components may be "insert cast" as an integral part of the die casting or may be assembled to the die casting in a separate operation.

5.1 Cast-in-Place Inserts

If the finished casting contains cast-in-place inserts, the responsibility of providing them to the proper specifications should be clearly defined. The design of the purchased component is the responsibility of the die casting purchaser and is subject to approval by the die caster. In many cases the clearances in the die will require that the insert tolerances be tighter than the purchaser would normally supply for the required end use. If the purchaser is supplying the inserts, provision must be made to ensure that all supplied inserts are within tolerance. An out-of-tolerance insert can seriously damage the die.

5.2 Inventory Costs

Regardless of who purchases an additional component, there must be consideration given for in-process spoilage and rejects. As a result, the quantities of purchased components will always exceed the number of die castings purchased. It is understood that there are costs associated with handling, storing, counting and inspecting of purchased components. Inventory of purchased components required to meet the die casting purchaser's delivery schedule are the responsibility of the die casting purchaser. The labor cost for inserting or assembling the component is normally included in the quoted piece price.

6 Price Adjustments

Because of the job-shop nature of production and the variation in product design and specifications, the prices for die castings are determined by the use of price estimating formulas.

Each die caster employs an individual pricing formula constructed in accordance with their individual methods and costs. All price estimating formulas contain a number of factors which may require adjustment, upward or downward, because of conditions beyond the control of the estimator. Significant unexpected increases in the cost of either natural gas and/or electricity may result in negotiated energy surcharges per mutual written agreement.

6.1 Quotations and Metal Market Pricing

6.1.1 Order Quotations

Order quotations for die cast products, and die casting dies and production tooling necessary to make the die cast products, are normally valid for a fixed period of time. After this time has expired, the die caster reserves the right to requote based upon price adjustment provisions as discussed above.

To establish a uniform basis of comparison, the estimated weight and monthly and/or yearly quantity requirements should be specified when soliciting quotations, and it should be requested that the material cost be itemized.

6.1.2 Metal Market Pricing

Prices for die castings are based on the die caster's prevailing cost for the alloy specified on the day the estimate is prepared. In some instances, the die caster's quotation may make reference to various published alloy prices or other indicators. The cost for the alloy is subject to fluctuation beyond the control of either the purchaser or the die caster and the actual price charged for the die casting will reflect the changes required to adjust for all metal market variations. Similar adjustments may be made on each release and/or reorder.

6.2 Labor and Operating Costs

6.2.1 Labor Costs

Many die casting dies are in production over extended periods, often over many years. For this reason, the piece-part labor cost may change over the life of the order. If piece-part labor costs change after the date of the original price estimate, it is generally necessary to change the piece-part price for future deliveries.

Customer schedules often are expanded and sometimes require production beyond the normal schedules of the die caster.

Since all die casting prices are estimated on the basis of production at straight-time rates, an adjustment is generally required if premium labor rates are necessary to meet the customer's expanded needs.

Die casting price estimates and quotations reflect labor costs based on continuous operation for the quantity specified for any delivery release. Reductions in scheduled deliveries or production interruptions by the customer, may affect labor and other piece part costs. In such cases, a price adjustment may be necessary.

6.2.2 Operating Costs

Costs of outside services (such as painting, plating and machining), or of purchased supplies and components (such as inserts, packing materials and fasteners), or action of governmental or regulatory agencies may cause periodic increases in the costs of manufacturing. These added costs must be reflected in changes to quoted prices. Also, changes in acceptance criteria by the customer may significantly affect the die caster's operating costs, making an adjustment to the part price necessary.

7 Patent Obligations

Die casting is essentially a conversion process by which metal shapes are produced for a purchaser. Therefore, if a die casting infringes, or is claimed to infringe on any letters patent or copyright, the purchaser must assume the responsibility involved.

While the die caster does provide input into the design of the customer's component for die casting manufacturing feasibility, the die caster is not responsible for the design or functionality of the customer's product or device or for the design of the die casting as part of such product or device. The purchaser of die castings is liable for his own product or device and for all patent infringement claims relating to it or any of its parts.

Die casting proposal and acknowledgment forms generally include clauses which provide that the die caster shall be indemnified and held harmless of and from all expenses arising from all such claims. When patents, design or otherwise, are involved, they should be specifically called to the attention of the die caster.

8 Intellectual Property

Die Caster is not required to provide any intellectual property used to produce parts for the purchaser. Purchaser has the right to use parts in purchaser's product.

9 Warranties Covering Die Castings

9.1 Extent of General Warranty

Die casters, like other responsible manufacturers, stand behind their product. However, it should be understood that the die caster in assuming this proper responsibility focuses its engineering efforts upon the die cast manufacturing feasibility of the component, rather than the component's product function which is the responsibility of the purchaser.

In general, die casters agree, at their option, to correct, replace or issue credit for, defective die castings, subject to specific limitations and exceptions. Reference NADCA Terms and Conditions for more details on warrenties.

9.2 Limitations on Warranty

9.2.1 Processing After Delivery

No warranty attaches to a die casting which has been altered, machined or finished after delivery to the purchaser by the die caster.

9.2.2 Reasonable Time

No claim for defective die castings will be recognized unless made in writing within 90 days (or as agreed upon between die caster and purchaser) after delivery.

9.2.3 Returns

Die castings claimed to be defective are not to be returned to the die caster without specific approval and inspection by the die caster. Returned goods accepted by the receiving department of the die caster are not exempted from the right of the die caster to inspect the die castings or to determine the extent, if any, of his liability.

9.2.4 General Limitations

Losses, damages or expenses arising from the use of a die casting, or labor costs or other charges incurred outside of the die caster's plant, or transportation costs, as well as losses due to other causes, are not acceptable basis for claims against die casters under the warranty provisions. The Warranty as stated in paragraph 8.1, above, is limited to the repair or replacement of defective die castings or the issuance of credit for their return as stated.

10 Product Liability

Die casters cannot be expected to have technical knowledge relating to the end product of the many industries they service. While they may freely offer design services to make a product easier to manufacture, at no time does this imply a knowledge of the strengths, stresses or other forces that may be induced in the product's end use. This must be exclusively the liability of the buyer and design suggestions are offered by the die casters with this understanding.

The die casting industry has always maintained the position that a die caster is not liable for the failure of a die casting in a buyer's product, if the part furnished to the buyer meets the prescribed specification.

Die casters accept the responsibility of manufacturing a part to the buyer's specifications within the agreed acceptance level. This means the buyer will accept a percentage of parts that do not conform to the specifications. Die casters cannot be held liable for any failure in the end product because of the decision on the part of the buyer to perform a limited incoming inspection or to forgo an incoming inspection altogether.

If a buyer approves a sample for production of parts that do not meet specification in any way, this approval constitutes a change in specification and the die caster's responsibility is then altered to only meet this altered specification.

It is anticipated that the buyer will indemnify and defend the die caster from any damages or claims arising from the use of die castings or other goods produced to the buyer's specifications.

11 Production and Finishing Specification Checklists

The C-8-1 Checklist (Die Cast Production Specifications) and C-8-2 Checklist (Die Cast Surface Finishing Specifications) appear on the following pages.

It is recommended that, prior to final quotations, and always before any die design commences, the casting requirements defined by these checklists be reviewed with the die caster, together with the specifications and procedures listed in Section 7, "Quality Assurance." All of these items impact final costs and should be thoroughly discussed to assure accurate communication between the purchaser and the die caster.

NADCA

C-8-1-21

CHECKLIST

This checklist is for use in consultation with your die caster prior to estimating production costs. Use in combination with the Finishing Checklist C-8-2. Also review Checklists T-2-1A and T-2-1B, for Die Casting Die Specification, in Section 2.

Casting Production Specifications

To be used in consultation with your caster (Use in combination with Checklist C-8-2)*

Checklist for Die, SSM and Squeeze Casting Production Part Purchasing

This Production Checklist provides a convenient method for assuring important factors involved in purchasing cast parts are evaluated and clearly communicated between the purchaser and the caster.

It should be used as a supplement to the essential dimensional and alloy specifications detailed on part prints submitted for quotation, since the listed factors directly affect the basis on which the casting quotation is made. The checklist may be reproduced for this purpose. Your caster will clarify any item requiring further explanation.

This checklist provides a numbering system in which the lowest numbered description for each requirement can be met at the lowest production cost, as follows:

No.	Cost Effect
☐ 1	Most economical basis for production
☐ 2	Involves additional work which may affect cost
☐ 3	Additional work which may increase cost
☐ 4	Special Requirements which may increase cost

Part # _____

A	Casting Cleanliness	☐ 1 Some residue and chips not objectionable ☐ 2 Shop run — blown reasonably free of chips but not degreased ☐ 3 Clean, dry and free of chips ☐ 4 Special requirements _____
B	Cast Surface Finish	☐ 1 Mechanical quality — finish is not significant ☐ 2 Painting quality — streaks and chill areas coverable with paint ☐ 3 Highest quality — for electroplating, decorative finishing, O-ring seats
C	Metal Extension (Flash) Removal *Parting Line External Profile*	☐ 1 No die trimming — break off gates and overflows ☐ 2 Die trimmed to _____ of die casting surface *(See NADCA Guideline G-6-5)* ☐ 3 Hand filed or polished — flush with die casting's surface ☐ 4 Customer defined requirements (such as thermal, tumble or vibratory deburring, or shot or grit blasting)
D	Metal Extension (Flash) Removal *Cored Holes*	☐ 1 Flash not removed ☐ 2 Flash trimmed _____ of die casting surface ☐ 3 Flash to be machined or otherwise completely removed
E	Metal Extension (Flash) Removal *Ejector Pins*	☐ 1 Not removed *(See NADCA Guidelines G-6-4)* ☐ 2 Crushed or flattened *(See NADCA Guidelines G-6-4)* ☐ 3 Removed from specific locations _____
F	Pressure Tightness	☐ 1 No requirement ☐ 2 Pressure-tight to agreed-upon psi (kPa). Testing medium: _____ ☐ 3 Other arrangements to be agreed upon
G	Flatness	☐ 1 No requirement ☐ 2 To NADCA "Standard" specification tolerances (S-4A-8) ☐ 3 Critical requirement — to NADCA "Precision" specification tolerances (P-4A-8) ☐ 4 Customer defined requirements
H	Dimensions	☐ 1 Normal: per NADCA "Standard" specification tolerances ☐ 2 Semi-critical: "Precision" tolerances on specified dimensions, others "Standard" ☐ 3 Critical: Special tolerances to be agreed upon
I	Customer's Receiving Inspection	☐ 1 No unusual inspection requirements — no Statistical Quality Control ☐ 2 Statistical quality control: Acceptable at Cpk 1.33 or higher (or AQL over _____) ☐ 3 Statistical quality control: Acceptable at Cpk 2.0 or higher (or AQL over_____)
J	Packaging	☐ 1 Not critical — bulk packed ☐ 2 Layer packed, with separators, or weight restriction ☐ 3 Packed in cell-type separators or individually wrapped ☐ 4 Customer defined requirements _____ _____

** The specification provisions and procedures listed in Section 7, "Quality Assurance," should also be addressed.*

8

Commercial Practices

This checklist is for use in consultation with your die caster prior to estimating production costs. Use in combination with the Finishing Checklist C-8-2. Also review Checklists T-2-1A and T-2-1B, for Die Casting Die Specification, in Section 2.

Casting Surface Finishing Specifications

To be used in consultation with your caster (Use in combination with Checklist C-8-1)*

Checklist for Finished Die, SSM and Squeeze Casting Part Purchasing

No.	Cost Effect
☐	1 Most economical basis for production
☐	2 Involves additional work which may affect cost
☐	3-4 Additional work which may increase cost
☐	5 Most difficult surface to cast on a production basis

Part # _____

This Finishing Checklist provides a convenient method for assuring that important factors involved in the surface finishing of cast parts are evaluated and clearly communicated between the purchaser and the caster.

It should be used as a supplement to the essential dimensional and alloy specifications detailed on part prints submitted for quotation, since the listed factors directly affect the basis on which the casting quotation is made. The checklist may be reproduced for this purpose. Your caster will clarify any item requiring explanation.

This checklist provides a numbering system in which the lowest numbered description for each requirement can be met at the lowest production cost, as follows:

K	Casting Insert	☐ 1 No insert used in cast part ☐ 2 Inserts required, to be supplied by customer at 10% overage ☐ 3 Inserts required, to be supplied by caster
L	Parting Lines	☐ 1 Polishing not required ☐ 2 Polish only where marked on drawing ☐ 3 Polish all parting lines (except as noted)
M	Surface Preparation	☐ 1 No buffing required ☐ 2 Mechanical (burnishing, tumbling, etc.) Specify: _____ ☐ 3 Buff as indicated on drawing
N	Plating, Anodizing or Other Special Finish	☐ 1 Protective Only — Specify: _____ ☐ 2 Decorative Paint — Specify: _____ ☐ 3 Severe Exposure Protection — Specify: _____
O	Painting	☐ 1 Heavy Paint, Protective Only — Specify: _____ ☐ 2 Decorative Paint — Specify: _____ ☐ 3 Application requires base coat or special treatment: _____ Specify: _____
P	Environmental	☐ 1 Normal interior use only ☐ 2 Exposure to weather — Specify: _____ ☐ 3 Exposure to unusual chemistry — Specify: _____
Q	As-Cast Surface See NADCA Guidelines G-6-6	☐ 1 Utility Grade — surface imperfections acceptable, nondecorative coatings ☐ 2 Functional Grade — slight, removable surface imperfections, heavier coatings ☐ 3 Commercial Grade — removable imperfections ☐ 4 Consumer Grade — no objectionable imperfections, as agreed upon, when viewed under normal lighting conditions at _____ feet viewing distance ☐ 5 Superior Grade — specified average surface finish value of _____ microinches, per print
R	Special Requirements	For special flash removal requirements, see *Checklist C-8-1*, items *C* & *E* For special packaging/weight restrictions, see *Checklist C-8-1*, item *J*

** The specification provisions and procedures listed in Section 7, "Quality Assurance," should also be addressed.*