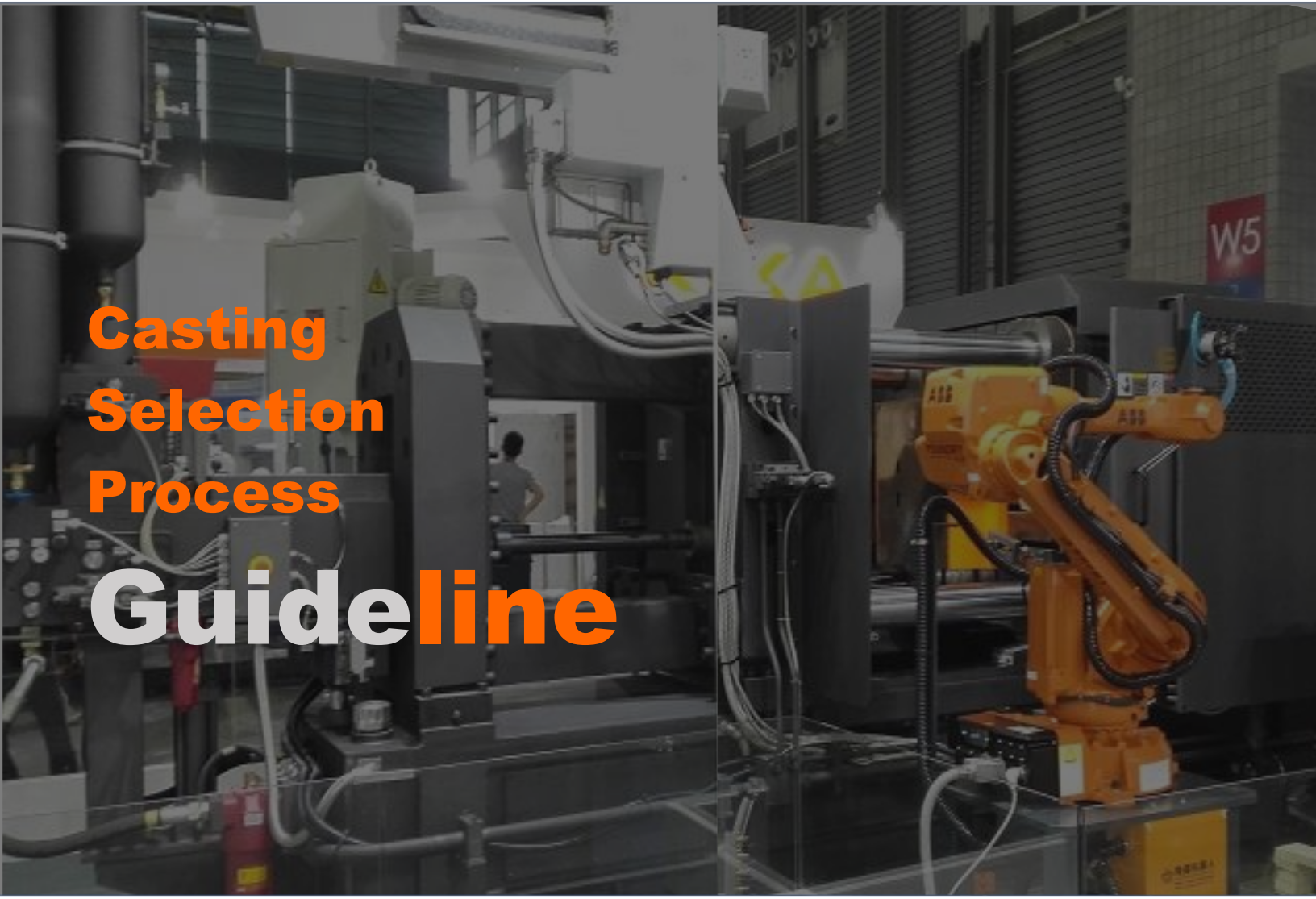

Casting Selection Process Guideline

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Introduction

In order to select the most appropriate alloy in which to cast a component, designers should first select the most appropriate casting method. This decision is usually based on the anticipated production volumes of the component. It can also be influenced by considerations of the required dimensional accuracy and surface finish.

Once the most appropriate process has been selected, designers should decide upon the alloy which has the mechanical and physical properties most appropriate to the particular application, whilst also considering whether the casting characteristics are appropriate to the chosen process.

Factors In Choosing A Process

- **Correlating processes with your material preference**
- **Comparing properties of the casting process according to your requirements (in some cases, this step may be done before step 1)**
- **Comparing lead times and cost**
- **Location and availability of potential casting suppliers using that process.**

The table below will assist you to choose the process most appropriate to your requirements, however it is often necessary to obtain quotations for more than one process in order to decide which will be the most economic.

			Sand Casting	Gravity Die Casting	High Pressure Die Casting
Tolerances on Critical Dimensions	Up to 25mm Each Additional cm Across Parting Line Ad.		± 1mm ± 0.39mm ± 1mm	± 0.4mm ± 0.02mm ± 0.25mm	± 0.1mm ± 0.016mm ± 0.12mm
Minimum Taper	On Inside Walls On Outside Walls		2° 2°	1° 1°	1° 0.5°
Minimum Wall Thickness	On Small Castings On Large Castings		3mm 5mm	3mm 4mm	1mm 2mm
Minimum Size of Cored Hole			15mm		
Ability to use Sand Cores			Yes		
Surface Finish			Poor 6.5-12.5 µ	Fair 4-10 µ	Good 1.5 µ
Alloys commonly used in this form	Aluminium	LM5			▪
		LM6	▪	▪	▪
		LM9	▪	▪	
		LM16	▪	▪	
		LM24			▪
		LM25	▪	▪	
		LM27	▪	▪	
	Zinc	LM31		▪	▪
		ZA3			
	Copper	ZA8	▪	▪	
		ZA12	▪	▪	
		ZA27	▪	▪	
		LG2	▪		
		PB2			
Typical Production Quantities per annum			1-500	250-50000	2000-500000
Typical Tool Life			5,000	100,000	500,000

Category Details & Requirements

SAND CASTING

Sand casting offers the simplest medium for production of non-ferrous castings, by pouring molten metal into a sand mould. This process is chosen for the production of small numbers of castings, for complex shape castings requiring intricate cores, or for large castings. Advantages include low tooling costs, largest casting sizes achievable, very low gas porosity is possible, and general versatility of the process is good. Limitations include low casting rate, 3-5mm minimum wall thickness, poor linear tolerance (e.g. 4mm/m), rough surface finish (6.5-12.5µm), and a coarser grain size than gravity die castings. Further information on Sand Casting

Suitable for:

- Most types of metal.
- Moderate or simple complexity
- Large, medium or small casting sizes (less than 1 lb. to 10,000s of lbs.)
- Quantities in the large, medium or small ranges.

Features:

- Thicknesses down to 0.125 in.
- Base tolerances of +/- 0.4-1 in. for green sand and +/- 0.01-0.5 in. for resin-coated.
- Surface finish of 120-350 RMS.
- Minimum draft of 0.25-5 degrees.
- Moderate to low tooling lead times.
- Low tooling cost.
- Moderate to low casting lead times.
- Moderate to low casting cost.
- Moderate to high finishing cost.

GRAVITY DIE CASTING (ALSO KNOWN AS PERMANENT MOULD OR CHILL CASTING)

Gravity die casting is produced by pouring molten metal into permanent cast-iron moulds. This process produces chill castings. The process has a higher casting rate than sand casting, but the metal moulds are higher cost than sand patterns. Advantages include the possibility of low gas porosity, and fine grain sizes can be obtained. Less finishing and polishing will be required than for sand castings. Gravity die casting tends to produce the highest quality castings, however the accuracy achievable is limited. Minimum wall thickness possible is c. 3-5mm.

Suitable for:

- Aluminum, copper-base, magnesium and zinc alloys.
- Simple complexity.
- Small to medium casting sizes (ounces to more than 100 lbs.)
- Quantities in medium to large ranges.

Features:

- Thicknesses down to 0.125 in.
- Base tolerance of +/- 0.015 in.
- Surface finishes between 150-250 RMS.
- Draft of 2-4 degrees.
- Moderate tooling lead times.
- Moderate tooling cost.
- Low to moderate casting lead times.
- Low to moderate casting cost.
- Moderate finishing cost.

DIE CASTING

- **LOW PRESSURE DIE CASTING**

Low pressure casting is a development of the permanent mould process, in which the metal is introduced into the chill mould from below. Gas pressure holds the metal in the die until it solidifies. As with high pressure diecasting the process requires complex machinery. It is repetitive, and may be automated. Production rates are fair, but not as good as high pressure. Minimum wall thickness' are as little as 2-3mm. It has high yields of over 90%, as runners and risers are excluded, also reducing fettling and trimming costs. Pore-free castings are obtainable. Machine size will limit the size of castings. Surface finishing and minimum wall thickness' are both better than gravity die casting, but poorer than high pressure die casting.

- **HIGH PRESSURE DIE CASTING**

High pressure die casting, often shortened to Pressure Die Casting, is a repetitive process where identical parts are cast at high production rates by injecting molten metal under pressure into a metal die. Again, this process requires complex machinery. High pressure die casting is ideally suited to high production rates, and wall thickness' can be as little as 1-2.5mm. It provides the best surface finish (1.5µ), and a very fine grain surface can be obtained. Pressure die casting has high strength. Castings may be quenched from the die. Machine size will limit casting size. Sound thick sections are difficult to cast, and core configurations must be complex to enable disassembly. High pressure die castings may suffer from porosity, although evacuated chamber and other techniques may reduce this. High startup costs are only reduced by long casting runs, thus enabling low unit cost with a high volume production. Pressure die castings cannot be fully heat treated.

Suitable for:

- Aluminum, magnesium and zinc alloys.
- Simple to moderate complexity.
- Very small to medium casting sizes (ounces to 30 lbs.)
- Quantities in the medium to very large ranges.

Features:

- Thicknesses down to 0.025 in.
- Base tolerance of +/- 0.002 in.
- Surface finishes between 32-90 RMS.
- Draft of 0.5-3 degrees.
- High tooling lead time.
- High tooling cost ($5,000-$500,000).
- Low to moderate casting lead time.
- Low casting cost.
- Low finishing cost.

INVESTMENT CASTING (ALSO KNOWN AS LOST WAX CASTING)

This casting method involves producing a "wax pattern" by injecting wax or plastic into a pattern die. The pattern is attached to gating and runner systems and this assembly is dipped in a hard setting refractory slurry which is then cured. The pattern is melted out of the mould to leave an exact cavity. The mould is heated to cure the refractory and to volatilize the remaining pattern material. The moulds are baked and molten metal is poured into the mould cavity. On solidification of the casting, the mould material is broken away from the casting.

Suitable for:

- Iron, steel, aluminum, copper-base, high-alloy steel, magnesium and titanium alloys.
- Moderate to high complexity.
- Very small to medium casting sizes (ounces to 50 lbs.)
- Quantities in the small to medium range.

Features:

- Thicknesses down to 0.025 in.
- Base tolerances of +/- 0.003-0.008 in.
- Surface finishes between 63-125 RMS.
- Draft of 0-1 degrees
- Moderate to high tooling lead time.
- Moderate to high tooling cost.
- Moderate casting lead time.
- Low to high casting cost
- Moderate to high finishing cost.