INVESTMENT CASTING FOUNDRY

CHEONSENG

CHEONSENG PRECISION FOUNDRY Co., Ltd.

WWW.CS-CAST.COM
COMPANY PROFILE

Your precision lost wax Investment Castings partner—Cheonseng Precision Foundry which provides outstanding service, exceptional quality, and low costs—all within short lead-times, for your casting needs.

As a major manufacturer of investment castings, we adopted the lost-wax process to serve a huge variety of markets that require metal parts in carbon steel, stainless steel and different kinds of alloy steel, including construction hardware, marine hardware, kitchen hardware, pipe fittings, auto parts, railway parts and other machinery parts. We are able to supply precision castings in many conditions involving heat treated, machined, electropolished, mirror polished polished and so on.

Excellent employees and advanced management guarantee our superb products at most competitive prices. We currently have more than 100 employees and an annual capacity of over 400 MT precision castings per year, of which over 90% are exported to Europe, America, Australia, South Korea and Japan.

Welcome to visit us and let’s work together for your next casting projects.

**MADE IN CHINA**
**MADE BY CHEONSENG**
**MADE FOR YOU...**
Mission
To meet customers’ expectations with respect to product quality, cost, delivery, and value-added services.

Policy
To satisfy customers’ requirements by being pro-active and flexible;
To impress customers with fine credit and honesty;
To focus on continuous improvement to manufacture quality products at a competitive price.

Quality System
Quality is life of an enterprise. Cheonseng Precision Foundry Co., Ltd. has established a sound quality management system, which is implemented in strict accordance with the standard of ISO9001 Management System.

We have set up specialized inspection mechanism, fitted out advanced physical & chemical analysis and quality testing equipment & instruments, such as the spectrometer and established sufficient and suitable quality inspection procedures, with strict inspection standard for the whole process from admission of raw materials to plant all the way to final release of finished products from plant; for the characteristics of precision investment casting method such as complicated process and many affecting factors, an on-site inspection mechanism has been established to implement online inspection, so that defects and rejects can be eliminated in the course of mould making, shell making, smelting and casting. In this way, no disqualified raw materials can be admitted to plant, no disqualified items of a previous procedure can go into the next one, and no disqualified products can be released from plant, so quality of products are effectively ensured. Continuing statistical process control and process capability improvement is applied for all products manufacturing process. Our commitment and continuous effort in improving product quality has established our image as a high quality manufacturer and supplier.
Main Foundry Facilities

Double-body Medium Frequency Induction Melting Furnace, 150kg, 1set;
Double-body Medium Frequency Induction Melting Furnace, 100kg, 2sets;
Electric Preheating Furnace, 150kw, 1 set, 1.5CBM;
Electric Preheating Furnace, 120kw, 1 set, 1.3CBM;
40T Wax-injection Machine, 1 set;
6T Wax-injection Machine with Two Operating Positions, 2sets;
10T Wax-injection Machine, 1set;
Mould Head Wax-injection Machine with Two Operation Positions, 1set;

Main Machining facilities:
CNC MACHINING CENTRE 2SETS (TAIWAN FUYU);
CNC MACHINE, FBL200, 2 SETS (TAIWAN FUYU);
CNC MACHINE, FBL250, 1 SET (TAIWAN FUYU);
National CNC Machines, 5 sets;
Conventional Machines, 2 sets;
Vertical Miller, 2sets;
Drilling and tapping machines, 10sets;
Radial Drilling Machine, 1set;

Main Polishing facilities:
Vertical Polishing Machine, 18sets;
Vertical Plane Polisher, 3sets;
Horizontal Plane Polisher, 2sets.
Electro Polishing, 1set.

The Process

Investment casting can also be called "precise casting" or "silica sol casting" or "lost wax casting" or "de-waxing casting". The casting materials can be widely used, and no limit to product shape as well as complex structure. The most important characteristic of investment casting is the closer tolerance control, fewer or no machining allowance, and better surface finish. In the casting industry, the investment casting can be used instead of other casting methods, so as to reduce machining allowance and the cost, improve the dimensional precision and surface finish, so as to meet the requirements of a higher level product.

Material selection

All castable materials can be processed using this method. Investment casting is particularly suitable for use with materials unsuited to machining.

Surface quality

The casting are produced without any trace of flash, and with an excellent surface finish. In many cases expect for producing the required seat dimensions, there is no need for a follow-up machining process.

Piece weights

Generally speaking, the investment casting technique is useful for small piece weights of between 5g and 10 kg. Larger workpieces up to 80 kg are also possible.
LOST WAX PROCESS

Wax Injection
The process begins with production of a heat disposable pattern. This pattern is usually made by injecting wax into a metal die or mold. Pattern is injected in Horizontal Automatic Injection Machine.

Pattern Assembly
The wax patterns are attached by the gate to a central wax runner system. The runner system is called a sprue. Patterns, runners, and pouring cup compromise the cluster or tree. Radius is provided to all joints between pattern and runner. Same checked thoroughly before coating to avoid rejection due to sand inclusions.

Shell Building
The shell building technique involves dipping the assembly into a ceramic slurry and then into a bed of extremely fine sand. After drying, the process is repeated. Up to 4 to 6 layers may be applied in this manner.

Dewax Operation
The completed shell is placed in a steam autoclave where the pattern melts and runs out through the gates and pouring cup.

Firing the Shell Mold (Preheat)
The ceramic shell molds must be fired to burn out the last traces of pattern material and to preheat the mold in preparation for casting, usually in the range of 800 to 1100 degrees centigrade.

Casting
The preheated shell is filled with molten metal by gravity pouring. As the metal cools, the parts, gates, sprue, and pouring cup become one solid casting.

Shell Removal (Knockout)
After the metal solidifies and cools, the ceramic shell is then removed by vibratory methods or water blasting.

Shell Blasting
Casting to be shot blasted to remove all small ceramic particles.

Casting Removal (Cut Off)
Individual casting is removed from the cluster by means of a cut off wheel or welding cutting.

Finishing Operation (Gate Grinding)
Remaining gate protusions are removed by belt grinding.

Heat Treatment
Casting is heat treated as per specifications.

Final Finishing
Finally casting is sand blasted or glass bead blasted as per customer requirement, packed as per customer specification and dispatched.
WHY INVESTMENT CASTING?

Cheonseng Precision Foundry offer many advantages to the end user, designer, or manufacturer, by utilizing lost wax casting process to produce components, often originally conceived to be manufactured in ways that were either too costly or too restrictive in terms of design elements. These investment castings take on a unique characteristic unattainable by other processes, due primarily to our using die injected wax shapes as patterns. This allows us to obtain the detail and accuracy of components made by injection molding, usually reserved for low melting point metals, but in fact made from high melting point metals and alloys such as steel and stainless steel. This is because of the unique formation of a seamless ceramic shell built around the precision wax shapes. The ceramic shell holds the shape of these wax geometries at extremely high temperatures while the molten metal, poured into the shells, solidifies into your castings. Due to these inherent, precise, and unlimited geometries possible with the investment casting process, the investment casting process provides the following benefits:

ACCURACY

Using investment castings produces components that are best described as near-net-shape, in other words, components that require little or no further processing. The process is capable of producing precise detail and dimensional accuracy of approximately +/-0.005 per inch of dimension in castings of up to 80 kgs or just a few grams.

WIDE CHOICE OF ALLOYS

Hundreds of different alloys can be cast using the investment casting process, in most commonly used base metals such as steels, stainless steels, copper, nickel, iron, cobalt, and more. A key advantage often overlooked is that since finish machining can be minimized or eliminated, alloy selection can be upgraded to stronger metals, which are typically harder to machine, resulting in better performance of the end product. Cheonseng casts most of the common engineering metals used by a wide range of industries, as well as many specialized metals for demanding applications.

AFFORDABLE TOOLING

In all other processes, tooling is a significant cost factor. However, investment casting tooling is produced from easily machined aluminum alloy, but because it is only receiving wax, it has an extremely long life. Cheonseng works with our clients to assist with tooling requirements, and looks after all tool manufacturing, and storage of the completed tooling. Costs for these wax tools is substantially less than that of die casting or forging dies, and many times dies can be made as multiple cavities as well as semi or full automation to reduce casting costs even more, yielding exceptionally high return on the investment of the tool.

REDUCE PRODUCTION COSTS

The most common applications for investment castings are in situations where costly finishing operations can be reduced, or even eliminated, for existing metal components. This is due to the accuracy of detail and dimensions attainable with investment casting.

Today, more and more manufacturers are turning to designing their new components as investment castings, since several parts can be made as one casting, reducing handling, assembly, welding, and inspection costs.

COMPONENT DETAILS

Investment casting is a designer's dream. Complex shapes, both externally and internally are possible through the use of tool design, soluable wax coring, or ceramic coring. Internal configurations not possible with most other manufacturing processes can be provided by Cheonseng through the use of investment castings. Externally, draft-free walls, splines, holes, bosses, lettering, serrations and even some threads can be easily cast as well.

MINIMAL METAL LOSSES

Using investment castings produces components that require little machining, and therefore there are significant reductions in lost metal to chips and shavings. This is especially valuable when working with materials such as stainless steels, nickel alloys, and cobalt alloys, which are not only costly, but difficult to machine.

CONSISTENCY OF COMPONENTS

Since cast components are produced by using wax patterns from a single tool, dimensional accuracy is the same from part to part, year after year. When design changes are required, it is usually possible to alter existing tooling at a relatively minor cost.

SPEED OF CONCEPT TO CASTING

From design to completion, investment castings can usually be supplied in under 4-6 weeks.
Design Guide & Tolerances

Cheonseng’s goal is to work in partnership with the customer to produce high quality investment cast components that will provide superior performance and durability. This requires sound mechanical design of the final component and the investment casting, reliable process controls, consideration of marketplace economic requirements, and clear communication among all parties. In any manufacturing process, the price of a product will increase as the dimensional tolerance and inspection criteria become more stringent. At Cheonseng, we believe that early involvement and input by our technical staff allows our customers to overcome traditional casting tolerance issues. The most important guideline to remember is to get Cheonseng involved early in the design stage.

1. Standard Linear Tolerance (all values in mm)

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Normal</th>
<th>Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-10</td>
<td>±0.12</td>
<td>±0.1</td>
</tr>
<tr>
<td>10-15</td>
<td>±0.20</td>
<td>±0.13</td>
</tr>
<tr>
<td>16-20</td>
<td>±0.25</td>
<td>±0.16</td>
</tr>
<tr>
<td>20-30</td>
<td>±0.30</td>
<td>±0.20</td>
</tr>
<tr>
<td>30-50</td>
<td>±0.40</td>
<td>±0.25</td>
</tr>
<tr>
<td>56-75</td>
<td>±0.50</td>
<td>±0.35</td>
</tr>
<tr>
<td>&gt;75</td>
<td>±0.65</td>
<td>±0.45</td>
</tr>
</tbody>
</table>

Standard linear tolerances for normal dimensions reflect these three sources of variation:
- Prediction of Part Shrinkage Factors (20%)
- Die Maker and Tooling Tolerance (10%)
- Process Variation (70% of linear tolerance)

This variation is a combination of part configuration effects that result in nonuniform shrinkage, and all other process variation in producing a wax pattern, ceramic mold, and the casting. All three sources of variation can be reduced by:
- Part redesign, including addition of tie bars, ribs, and gussets to contain shapes.
- Tuning of wax injection tooling after the first sample to meet nominal dimensions.
- Straightening/Coining
- Machining
All of these can assist in obtaining tighter-than-normal tolerances. There are additional costs associated with Items 2 through 5 in this list. Cheonseng will work with the customer to meet the design requirements in the most economical manner. Precision tolerance capability can be achieved, but must be considered on a part-by-part, dimension-by-dimension basis.

2. Angularity
As-cast tolerances of angles is mainly a function of the part design and their location in casting. They range from +/- 1/2 degree (considered minimum) for well-supported positions to +/- 2 degree where existing distortion could be expected. Inclusion of gussets and ribs normally minimizes distortion and many sections can be mechanically straightened.

3. Flatness, Strength and Roundness

<table>
<thead>
<tr>
<th>Section Thickness</th>
<th>Possible Tolerance</th>
<th>Sectional Sinking per Face of Casting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
<td>Premium</td>
</tr>
<tr>
<td>up to 25</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>25-50</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>60-100</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>100-150</td>
<td>0.8</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Straightening adds cost, but sometimes can not be avoided. The actual straightening costs are often dependent on the tightness of the tolerance specified, so do not specify tighter flatness, straightness, roundness, or other requirements than you actually require. (Cheonseng typically straightens parts using die sets that will be included in your tooling price.)

4. Size and Weight Range
Size and Weight. Part size and weight are the most critical factors in determining part cost because mold capacity is limited by both size and weight. The more pieces that can run on a mold, the lower the part cost. Unnecessary mass should always be removed by correct engineering practices to reduce part weight.

5. Surface Roughness
80 to 120 RMS are average. If this is important for part function, be sure to make these needs known. Secondary finishing operations can be used to improve this surface texture.

6. Hole Length
Making a good hole in a casting is dependent on the integrity of the shell. The ratio of hole diameter to length is important in determining what can be offered. Blind holes must have a radius at the top and the bottom of the hole to ensure that a strong core is built for casting purposes and to insure the best possible casting.

<table>
<thead>
<tr>
<th>Hole Type</th>
<th>Size Range</th>
<th>Length to Dia Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>thru</td>
<td>2 to 3</td>
<td>±2</td>
</tr>
<tr>
<td></td>
<td>4 to 7</td>
<td>±5</td>
</tr>
<tr>
<td></td>
<td>≥8</td>
<td>±10</td>
</tr>
<tr>
<td>blind</td>
<td>2 to 3</td>
<td>±1</td>
</tr>
<tr>
<td></td>
<td>4 to 7</td>
<td>±2.5</td>
</tr>
<tr>
<td></td>
<td>≥8</td>
<td>±3.5</td>
</tr>
</tbody>
</table>

7. Number of Gates
When possible, parts should be designed so that a single gate can feed the part. This will generally yield more pieces per mold and reduce the pour weight per mold.

8. Heat Treatment
Heat treatments are used to control hardness, mechanical properties, corrosion resistance, and surface treatments. Unless otherwise indicated, all alloy steels are quoted a normalize or anneal.

9. Gaging
Cheonseng performs a 100% visual inspection. However, if dimensional verification is required, a sampling plan and process control is less expensive than 100% gaging of each part. Fixed gages such as "go-no-go" are less expensive to use than gages with dial indicators. (Important: Whenever custom gages are used, these should be identical gages at Cheonseng and at the customer's plant.)
Design Guide & Tolerances

10. Tooling

Cheonseng utilizes a system of tooling standards to ensure uniform high quality design and fabrication of wax injection dies which are guaranteed for the life of the part.

- **Manual** – Prototype or low volume production work.
- **Semi-Automatic** – Parts that are too large or fragile for fully automatic.
- **Fully Automatic** – Higher volume parts that can be ejected into a water bath. It is less labor intensive and increases productivity.

More cavities mean higher tooling cost, but also increases productivity. Configurations that do not allow metal cores in tooling to be drawn due to undercuts or complicated internal shapes must be treated in one of the following ways:

- **Collapsible Cores** – Lowest piece price, higher tooling cost. Loose Inserts – Best for low volume parts, not an option for fully automatic tools.
- **Multi-Piece Wax Assemblies** – Best for certain configurations, tolerance control suffers along with increased part price.
- **Solute Cores** – Requires additional die for the soluble core and increased labor for injection and removal of the soluble pattern. Provides excellent flexibility at moderate additional cost.
- **Pre-Formed Ceramic Cores** – High cost for specialized shapes. Used instead of soluble pattern because coring would not be properly coated during shell building process.

### Alloy Grade

Alloys are listed from least to greatest cost:

1. Carbon and Low Alloy Steels: 8620, 4140, 1020, 1035 are best choices
2. 17-4PH and 400 Series Stainless Steel: 17-4PH & CA-16 (410) are most frequently poured. Do not specify 416 unless necessary for machinability.
3. 300 Series Stainless Steel: CF-8 (304), CF-8M (316) are best choices. Do not specify CF-18F (303) unless necessary for machinability.
4. Tool Steels: Costs vary widely depending on grade.
6. Cobalt Base Alloys: All grades pour well. Choice is based on end use and cost.
<table>
<thead>
<tr>
<th>Alloy Type</th>
<th>Standard Specification</th>
<th>Datas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tensile Strength 6 bs Mpa</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Resistant Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GJ40CrNiSi2520</td>
<td>SCH13</td>
<td>2.0</td>
</tr>
<tr>
<td>HU 309C35</td>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td>HK30 331C40</td>
<td>SCH21</td>
<td>0.25</td>
</tr>
<tr>
<td>GJ40CrNiSi2520</td>
<td>SCH22</td>
<td>0.35</td>
</tr>
<tr>
<td>GJ40CrNiSi2526</td>
<td>SCH23</td>
<td>0.35</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4309 1.4309</td>
<td>SCH13</td>
<td>1.0</td>
</tr>
<tr>
<td>1.4408 1.4408</td>
<td>SCH13</td>
<td>0.08</td>
</tr>
<tr>
<td>1.4408 1.4408</td>
<td>SCH13</td>
<td>0.08</td>
</tr>
<tr>
<td>1.4570 1.4570</td>
<td>SCH13</td>
<td>0.15</td>
</tr>
<tr>
<td>1.4466 1.4466</td>
<td>SCH13</td>
<td>0.06</td>
</tr>
<tr>
<td>Carbon Steel &amp; Low Alloy Steel</td>
<td>SCH13</td>
<td>0.04</td>
</tr>
<tr>
<td>1.0446 GB-38 1020</td>
<td>SCH13</td>
<td>0.05</td>
</tr>
<tr>
<td>1.0446 GB-38 1025</td>
<td>SCH13</td>
<td>0.05</td>
</tr>
<tr>
<td>1.0446 GB-45 1025</td>
<td>SCH13</td>
<td>0.05</td>
</tr>
<tr>
<td>1.4408 GB-45 1025</td>
<td>SCH13</td>
<td>0.05</td>
</tr>
<tr>
<td>1.4570 GB-45 1025</td>
<td>SCH13</td>
<td>0.05</td>
</tr>
<tr>
<td>1.4466 GB-45 1025</td>
<td>SCH13</td>
<td>0.05</td>
</tr>
<tr>
<td>Tool Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000CrW4</td>
<td>SCH13</td>
<td>0.9-1.0</td>
</tr>
<tr>
<td>1000CrW4</td>
<td>SCH13</td>
<td>0.8-1.2</td>
</tr>
<tr>
<td>1000CrW4</td>
<td>SCH13</td>
<td>0.9-1.2</td>
</tr>
<tr>
<td>High Mn Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G-1200Mn13</td>
<td>SCH13</td>
<td>0.9-1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel Bases Alloys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MORE2</td>
<td>SCH13</td>
<td>0.6</td>
</tr>
<tr>
<td>Hastelloy X</td>
<td>SCH13</td>
<td>0.8</td>
</tr>
<tr>
<td>Cobalt Bases Alloys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M20Cr27</td>
<td>SCH13</td>
<td>0.8</td>
</tr>
</tbody>
</table>

The above lists details of the main alloy cast, and whilst many other material are also regularly cast. It is not practical to include them all in this brochure. However, we will be pleased to discuss any other material with you. As the list only performs as a guide, for full information, the relevant standard specifications should be referred to. The comparable specifications have been compiled on the basis of chemical analysis and it is important for other factories to be taken into account.
Precision Machining

Cheonseng is pleased to provide a full compliment of machining services to provide the added value and convenience of finished investment castings for our customers.

Cheonseng possesses machining capability of two types, i.e. CNC machining & conventional machining, and has huge capacity for conventional machining, which includes Turning, Milling, Grinding, Broaching, Tapping, Drilling, Reaming and other machining processes.

Machining allowances

For sizes of fit on surface or low surface roughness factors which cannot be achieved by investment casting alone, machining allowance must take into account material specific properties and the computational unfavorable position within the tolerance field.
Hand Polishing

Hand polishing offers the widest range of finishes from satin (brush) to mirror finishes. Our "in house" polishing facilities allow us to match your existing product and samples.

Other finishing offered

* Sand Blasting (Glass head blasting, corundum-sand blasting and quartz-sand blasting etc)
* Pickling & passivating
* Plating (Tin-plated, Zn-plated)
* Electropolishing
* Power Coat
* Etching, engraving & laser marked

Electro Polishing

Cheonseng Electropolishing has the knowledge, ability and staff to handle any size, shape or quantity of parts.

The first step is inspections. Cheonseng inspects each part for damage, material compatibility and cleanliness. Every part is ultrasonic cleaned be-fore the electropolishing process is begun.
FREQUENTLY ASKED QUESTIONS

1. How do we work together?
We need to know your detailed requirement of products, and we normally demand drawing or sample, we will revert to you with a solution.

2. Can you provide complete products?
Yes. We provide complete products including machining, finishing treatment, packing and shipment on request. It is our goal to provide you with one-stop and hassle free service.

3. What benefits do we expect from buying from you?
Cost reduction without compromise on quality.

4. How is the quality assured?
Quality problems usually stem from production process, not from inspection process itself. To minimize production problems all parts are operator inspected at each step of the production process with a final inspection prior to shipping.

5. How long does it take to get a quote?
On average, it takes 2 days upon receipt of drawings and/or samples.

6. What data should be provided for quotation requirement?
In order for us to respond for a quick quote in a timely fashion, please be sure to send us the detailed information of your product, including the following factors:
- Estimated part weight, or actual weight if parts already exist
- Sample products, if any exist
- Alloy grade
- Drawings with detailed and actual sizes
- Heat treat specification
- Surface treatment requirements
- Estimated annual quantities
- State if design changes can, or cannot be made
- Blueprints must be in English, either metric or inch are all right

7. Do I need a broker to take care of the shipment?
At your request.

8. Do you have a minimum order amount?
No. We don't set a threshold. Instead, once a customer is satisfied, we are sure he will come back to us for future orders. Having said that, certain industries have their own economical appeal on volume which may result in lower costs based on a higher unit levels.

9. Do you sign non-disclosure agreements in view of protection of your customers?
Yes. To protect customers' intellectual property rights, we will sign non-disclosure agreements upon request.
MARKETS APPLIED

Cheonseng Precision Foundry has provided investment casting solutions for customers home and abroad in a wide variety of industries, including:

► Appliance
► Automotive
► Bearings & Seals
► Candy Machinery
► Chemical Processing
► Construction
► Dental Instruments
► Electrical/Electronic Equipment
► Environmental Equipment
► Fastening Machinery
► Food & Dairy Equipment
► Forming & Fabricating Equipment
► Hand Tool
► Hydraulic/Pneumatic Equipment
► Lock & Security Systems
► Machine Tool
► Marine Hardware
► Material Handling Equipment
► Military & Firearms
► Mining Equipment
► Musical Instruments
► OEM Replacement Parts
► Packaging Machinery
► Paper Processing
► Petro Chemical Equipment
► Power Electric Equipment
► Power Transmission
► Printing Equipment
► Pump & Valve
► Steel Mill
► Textile Machinery
► Transportation
► And more
FLUID EQUIPMENT AND PUMP & VALVE PARTS