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Castings Technology International (Cti) provides advanced casting expertise and manufacturing; including computer process modelling, design for casting manufacture and rapid low-volume manufacture of precision castings for aerospace and other high-value manufacturing sectors.

Cti is dedicated to working with manufacturing businesses operating in the global supply chain, ranging from multi-national aerospace giants to local SMEs. We work with a world-wide membership operating in over 30 countries that pay an annual fee to access our services and expertise.

Cti employs around 60 highly qualified engineers and technicians specialising in state-of-the-art design, simulation, traditional and rapid pattern-making, moulding and casting (air and vacuum) in a variety of ferrous, non-ferrous, light and reactive alloys.

Cti is a wholly owned-subsidiary of the University of Sheffield situated in a purpose-built centre on the Advanced Manufacturing Park in South Yorkshire. Its 5000sqm facility is currently in the process of being extended by 1200sqm to accommodate additional titanium melting processes of up to 1000kg.

To find out how your company could benefit, contact:

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W: castingstechnology.com
Our team can help you to minimise the cost, time and risk involved in progressing a concept design through to full scale production.

Using high level software to simulate casting manufacture, our design engineers can optimise designs to facilitate the production of components to the required specifications at the lowest cost. They have considerable experience in simultaneous engineering and by means of electronic data interchange; work on projects for companies around the world.

We have the range of skills needed to support total project management of castings procurement, assisting you with:

- Design optimisation
- Material selection
- Process selection
- Procurement specifications
- Third party surveillance and manufacture

Cti’s casting design centre provides expertise in the processing and properties of cast metals, and in casting design and manufacturing techniques.
Titanium castings – a unique capability within the UK and Europe

Cti supplies fully-certified titanium castings to users around the world, a service that is unrivalled in the UK and has wide ranging experience of making castings for diverse sectors such as chemical, oil and gas, marine, aerospace and defence, medical and the automotive sectors.

We can produce one-off, low rate initial productions (LRIP) and volume manufacturing of titanium castings with a range of melt capabilities and a casting envelope extending up to 2m³.

Future developments for 2016 include the ability to produce large-scale titanium castings up to 1000kg poured weight. This will enable UK companies to break into global markets for large-scale titanium aerospace engine and structural components weighing up to 500kg.

We produce components using either investment casting techniques based on traditional wax tooling or our range of prototyping technologies, which are particularly suited to one-off and low-volume components.

Our melting and casting processes are supported by finishing, inspection and metallurgical services; with the ability to conduct post-cast processes such as vacuum heat treatment.

Benefits
- Near net shape manufacture for improved manufacturing times and costs

Features
- Quality Management System certified to AS9100C (EN 9100:2009)
- NADCAP accredited for aerospace, defence and related industries, including accreditations for vacuum heat treatment (AC7102)
- Approved to the NORSOK M-650 Rev 4 standard established by the Norwegian petroleum industry and can supply commercially pure titanium alloy castings in accordance with NORSOK MDS-T02 Rev5
- Certified castings can be produced in commercially pure titanium (ASTM B367 C-2) and its common alloy, 6Al-4V (ASTM B367 C-5)
- Ability to produce castings from other reactive alloys, including include Ti-1.5Al, TiXT, Ti 6-2-4-2, Ti 6-2-4-6, Ti 10-2-4, nitinol, gamma titanium aluminide and zirconium alloys

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Vacuum induction melting castings

Cti has extensive experience of melting and casting alloys using vacuum induction melting (VIM).

Our experience encompasses high strength vacuum cast steels, nickel-based super alloys, Nimonic and cobalt chromium alloys. Such alloys are commonly utilised in aerospace and power generation applications where creep and temperature resistance is paramount.

Many VIM casting facilities are limited to lower metal weights, but Cti has the ability to melt up to 500kg and produce castings up to 2m³ in volume. This allows us to make a wider range of products from alloys containing reactive elements.
Replicast® and precision investment casting

Replicast® is a novel moulding and casting process developed by Cti.

Replicast® allows users to cut costs, waste and meet demand for tailor-made, high-integrity castings, weighing from a few grams up to 3.5 tonnes; whilst improving quality and dimensional accuracy at the same time.

The process replaces conventional wooden patterns with dimensionally precise replicas made from expanded polystyrene, dipped several times in special slurry and different grades of ceramic to create a solid, ceramic shell. The shell is significantly thinner than a traditional investment casting shell, but with the same excellent internal surface finish.

Shells are fired, removing the foam, put in casting boxes and surrounded with refractory sand. The sand is compacted on a vibrating table before a partial vacuum is applied to the sand to create a firm support for the shell, after which molten metal is poured in.

Benefits
- 25 per cent lighter castings
- 50 per cent less feed metal
- 40 per cent more castings per melt
- Reduced waste
- Improved machinability
- Consistently high dimensional accuracy

Features:
- Inert ceramic moulds reduces the possibility of hydrogen defects found with steel and nickel based alloy casting
- High as-cast integrity
- Excellent surface finish (3.2 – 7.6μm; 130 – 300μm) ISO 8062 CT5 – CT8
MEGAshell®

MEGAshell® enables the production of huge ceramic shell moulds to deliver the benefits of Replicast® for one-off and low volume castings. These castings can be produced to a size and weight much greater than most casting manufacturers would have thought possible.

To date, ceramic moulds with dimensions of up to 2m³ have been manufactured, so that heavy section valve castings weighing several tonnes can be manufactured 34 per cent lighter than the sand cast equivalent.

More than 3500 ceramic moulds have been manufactured by the MEGAshell® technology, demonstrating its capability to meet the market demand for large castings, particularly in costly alloys of steel and nickel.

In addition to the benefits of the Replicast® process:
- Cost reductions of 50 per cent or more can be achieved
- Near net shape castings

Features
- MEGAshell® can be used for castings of reactive alloys of titanium and zirconium
Repliwax®

Demand from industry to extend the weight range of near net shape investment castings, while reducing manufacturing costs, has led Cti to develop our Repliwax® process.

The process is related to our Replicast® process, but uses a pattern made from liquid wax which is injected into an aluminium or steel die and allowed to solidify, in the place of expanded polystyrene.

As with Replicast®, the pattern is used to make a ceramic shell which is put in a casting box and surrounded with refractory sand. The sand is compacted on a vibrating table and a partial vacuum is applied to the sand to create a firm support for the shell.

This support provided by the compacted sand means the shell can be thinner and does not require pre-heating, so offers reduced energy costs and reduced safety risks.

Benefits

- Increase in production with a faster turn around
- Reduced certification costs
- Improved surface finish at larger sizes than typically available with investment casting
- Significantly reduced ceramic raw materials costs due to thin mould technology
- Ideal for applications where the directly cast surface is key to the performance of the end application
3D printed moulds and cores

This technology enables complex cores that would normally require multiple core-boxes to be made in one piece, through a process of 3D printing layers.

As there are no restrictions on undercuts, cores that would otherwise be impossible to make by traditional techniques can also be produced.

Benefits

- Moulds and cores can be made with an accuracy of ± 0.25mm
- Moulds and cores delivered to the foundry within 48 hours of receipt of 3D CAD model files
- Reduced lead time to production

Features

- Castings to be made to dimensional standards equivalent to that of lost-wax investment castings (ISO 8062 Casting Tolerance Grade CT4 to CT6)
Patternless® is a technique whereby moulds are directly machined out of blocks of sand.

This process proves to be a very cost effective way of producing prototype, one-off or small batch castings of a few kilograms to 15 tonnes; as it does not require the manufacture of patterns and core boxes.

The Patternless® Process can be used to produce almost any mould size, as mould pieces can be assembled together. The largest single mould piece Cti can produce is 2.2 x 3.5 x 1.5m, although machines capable of producing moulds of 4.5 x 5.5 x 2.0m have been installed at member-foundries around the world.

Any chemically bonded sand type can be machined, making the Patternless® Process suitable to produce castings in any metal grade of steel, iron, copper-based, aluminium and magnesium alloys.

**Benefits**
- Reduced time to manufacture
- Reduced total manufacturing costs
- Castings of high integrity and dimensional accuracy
- Appropriate surface finish and enhanced letter definition
- Suitable for castings of all sizes and weights
- No pattern storage or maintenance costs

**Features**
- On-site working envelope of 2.6 x 4.0 x 2.0m
- Rough machining of a mould cavity equivalent to a one tonne casting in 30 minutes
- Machining accuracy of ±0.01mm
- Uses specially developed cutters with minimal wear
- Uses block of sand (up to 10,000kg) readily made in any foundry from new or reclaimed sand
Testing

Cti has extensive knowledge and experience of testing a wide range of metals and alloys, used to produce castings and other products.

Access to a wide range of specialised testing equipment gives us the flexibility to respond rapidly to specific requirements, which an organisation that relied on regular contract testing might not.

Our foundry consultants provide high levels of practical advice and solve clients’ problems, based on our own manufacturing experience, in addition to providing straightforward laboratory analysis.

We have a team of casting specialists and non-destructive testing operators who can discover the root causes of failures and how to prevent them in future. They have a range of casting and welding-specific qualifications and a vast knowledge of casting processes and alloys.

The services we offer include:
- Manufacturing support
- Failure investigation
- Non-destructive testing
- Microscopic examination
- Chemical analysis

Our metallurgical specialists offer testing in:
- Optical emission spectroscopy
- Microstructural analysis, phase balance and inclusion counting
- Combustion testing
- Vickers hardness testing
- Rockwell hardness testing
- Brinell hardness testing
- Heat treatment
- Loss on ignition testing
- Sand sieve analysis
- Sand mould tensile compression strength testing
- Sample preparation and reporting on sub-contract wet chemical analysis

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Confidence in confidential consultancy

Cti provides a broad ranging consultancy service, offering support in areas such as new foundry design, foundry process review and optimisation, scrap and weld reduction programmes and multi-disciplined, skilled on-site support.

Cti aims to provide a comprehensive range of environmental and health and safety consultancy services; delivering a high quality, efficient, reliable and cost effective service carried out by experienced staff.

We can also provide assistance with formulating environmental management systems, applying for environmental permits, investigating land contamination and waste management.

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## Process reference index

<table>
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<tr>
<th>Capability</th>
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Find out how your company could benefit from...

3D printed sand moulds & cores

Replicast®

Patternless®

Titanium castings

MEGAsheil®