D E F E N C E

CONCEPT • CASTING • COMPLETION

GOODWIN STEEL CASTINGS

ESTABLISHED 1883

Goodwin Steel Castings Ltd (GSC) are trusted to deliver build to print project engineering to meet the discerning project requirements of our tier one and tier two customers, founded on 130 years of manufacturing heritage.

We manufacture high integrity steel castings ranging from 50kg through to 40,000kg and fabricated casting assemblies up to 100,000kg. Our manufacturing capability includes a wide range of technically advanced materials including carbon steels, high yield steels, stainless steels, duplex stainless steels and super nickel alloys.

Supported by our sister machine shop Goodwin International Ltd (GI) we offer a one stop shop for large finish machined components. Our machine shop capabilities include large scale machining centres, fabrication, assembly, pressure test and surface coating facilities.

The GSC foundry and GI machine shop operate under a common management in which we accept single purchase orders for bespoke project engineering to proprietary drawings and specifications. Our employees are Security Cleared (SC) to execute sensitive projects and have access to secure offline programming facilities for restricted projects.

We are regarded by our long standing customers to be a critical path supplier, in which real value is added to complex programmes through early engagement in terms of Design For Manufacture (DFM) and performance reviews in the form of Learning From Experience (LFE).

Our experience and expertise include the supply of finished machined castings for some of the most technologically advanced and prestigious defence projects globally, under Manufacturing License Agreements (MLA) and Technical Assistant Agreements (TAA).

Bernard Goodwin
Managing Director

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Axial Isolation Valve cast, machined and assembled by Goodwin

Pump and Volute Castings in 316 Stainless Steel

High Yield 80 Steel Fairlead Chain Wheel

CONCEPT

Goodwin Steel Castings Ltd has a proven track record for achieving substantial cost reduction when engaged at an early stage of design and manufacture.

REVIEW OF CUSTOMER REQUIREMENTS

An outline sketch or drawing indicating the principle dimensions and any required mechanical properties or chemical composition is forwarded to GSC. We aim to fully assess the requirements of your project with a cross functional review team prior to quotation, this ensures that we provide a competitive offer, avoiding any surprises for either party during project execution.

INITIAL DESIGN FOR MANUFACTURE

GSC generate a detailed three-dimensional drawing using the sketch concept, adding features essential to the casting process such as machining allowance and moulding taper. If required, we can carry out a finite element analysis of the casting to check structural adequacy.

Multiple FE analysis of casting solidification are performed to optimise the net casting geometry and to mitigate volumetric shrinkage and residual stresses in the casting.

A manufacturing drawing is then returned detailing the final casting geometry, highlighting any proposed deviation that could be accommodated to achieve cost reduction within the manufacturing process.

FIXED PRICE QUOTATION, MANUFACTURING INSPECTION TEST PLAN (MITP) & DELIVERY PROGRAMME

Following a Design For Manufacutre (DFM) review stage, a detailed quotation based on the itemised MITP and delivery programme is provided with each enquiry based on first principle costings.

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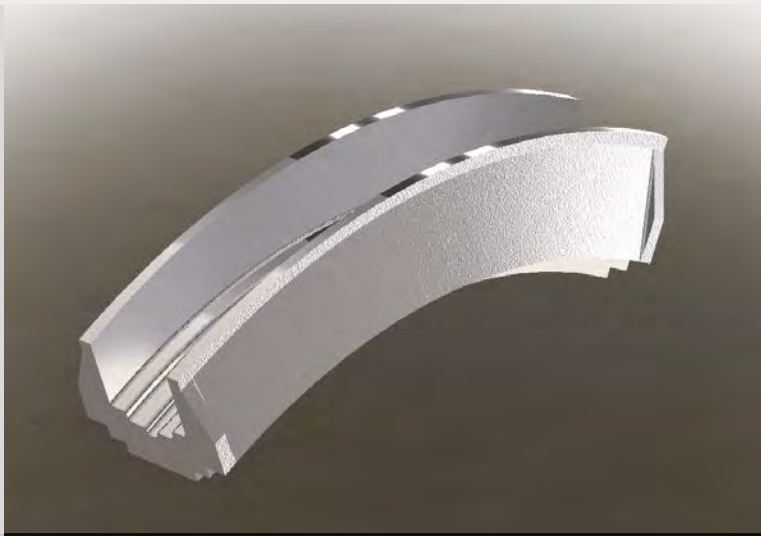
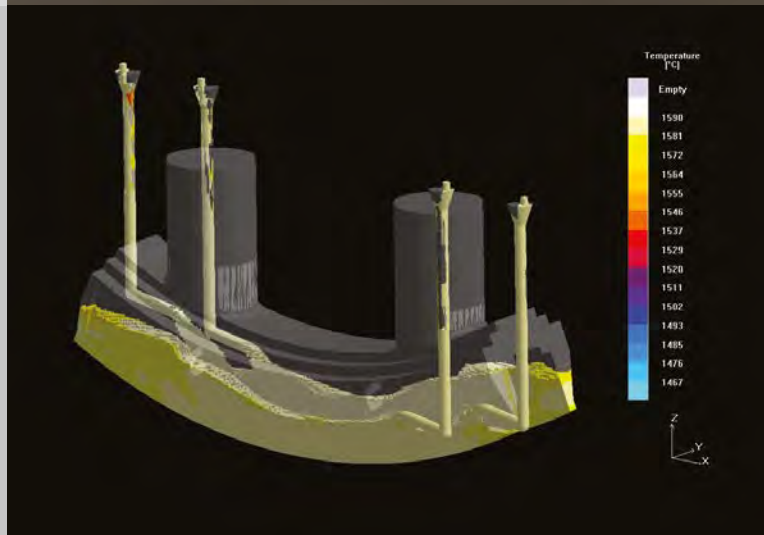
GSC work closely with your professional design team to assist in the production of an optimised and competitive solution for your casting requirements. We offer a complete manufacturing review.



Three dimensional design stage drawing



Computer solidification simulation

Large scale pattern inspection

Large scale melting & pouring

Large scale CNC machining capabilities

COMPLETION

PATTERN CONSTRUCTION

Our in-house pattern shop produces bespoke pattern equipment from which each casting is manufactured. Pre-production tooling is also administered.

MOULDING

The pattern equipment is used to produce the sand moulds into which molten metal is poured. Moulding activities include the specific manufacturing method determined at the earlier DFM stage; this method affects feeder locations / gating system / chills / sand system and pouring temperature.

MELTING & POURING

Primary electric arc or induction furnaces are used to melt the metal. If required the metal is transferred to the Argon-Oxygen Decarburisation Vessel (AOD) for secondary refining. Here volatile elements are removed from the mix, reducing impurities and inclusions in the steel. The moulds are poured and once cooled, the casting is "knocked out" of the mould and given a preliminary fettle to remove the sand and feeding system.

HEAT TREATMENT

Following initial processing the castings are given a quality heat treatment. This process ensures material exhibits the required mechanical and metallurgical properties to international standards.

NON-DESTRUCTIVE TESTING (NDT) & MECHANICAL TESTING

NDT is carried out after quality heat treatment and magnetic particle, liquid-penetrant, ultrasonic or radiographic testing is conducted to determine the casting integrity. The casting is processed to approved NDT procedures and client specifications before final inspection and release for mechanical testing.

At this point test material which was heat treated along with the casting is destructively tested to prove that the quality heat treatment has provided the correct mechanical and metallurgical properties; this is certified using our onsite UKAS accredited test facility.

FINISH MACHINING, FABRICATION, ASSEMBLY AND INSPECTION

The casting may require machining features unsuitable for the casting process in addition to fabrication or assembly. The finish machined surfaces are inspected for any discontinuities following which final dimensional inspection takes place. Any further assembly or inspection also takes place at this stage.

Once all manufacturing activities are complete Customer Source Inspection is conducted before the casting is preserved, packed and shipped to its final destination.

SURFACE PLATFORMS

UK TYPE 26 GLOBAL COMBAT SHIP

GSC manufacture critical duty component parts for the UK Royal Navy's most advanced anti-submarine warfare (ASW) vessel as part of the worlds first digital warship platform. To meet the demanding inspection regime prior to installation, collaboration with all stakeholders took place at an early stage to ensure the acceptance criteria could be met. All component parts are produced to Lloyds Register Shipping Rules.

EXPORT NAVAL PROJECTS

GSC are actively engaged in the supply of component parts to defence market primes around the world. Some of our shipbuilding clients include Huntington Ingalls Industries, Bath Iron Works and Naval Group where we are listed on their respective approved vendor lists.

Our manufacturing experience has aided material selection and facilitated weight reduction of critical components for future ASW platforms.

National Security Cutter (NSC) for the US Coastguard, all parts produced in accordance with ABS ships rules

Sir David Attenborough Polar Research Vessel port and starboard Stern Tubes produced in accordance with Lloyds ships rules

Landing Helicopter Assault (LHA) for the US Navy, all parts produced in accordance with NAVSEA requirements

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GLOBAL COMBAT SHIP
TYPE 26

SUBMARINE PLATFORMS

NUCLEAR DETERRENT SUBMARINES

Since 1969 the UK Royal Navy has been committed to it's Continuous At Sea Deterrant Programme (CASD). As a consequence the Dreadnaught Class of Ballistic Submarines has been commissioned.

GSC are supplying critical duty components for the Primary and Secondary propulsion systems which form part of the Dreadnought Programme.

In support of the Polaris Sales Agreement between the US & UK Governments, GSC are supplying machined components for the Common Missile Compartment.

ATTACK SUBMARINES

Goodwin work with Rolls-Royce in the supply of finish machined stainless steel castings as part of the primary propulsion system for the Astute Submarine.

GSC have Manufacturing Licence Agreements and Technical Assistance Agreements in place, allowing us to engage in the manufacture of critical class castings for the US Virginia submarine programmes.

US Navy Columbia Class (Ohio Replacement)

US Navy Virginia Class Attack Submarine (including VPM)

Australian Navy SEA1000 Future Attack Submarine

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UK Navy
Astute & Dreadnaught
Class Submarine Programmes

SUBMARINE PLATFORMS

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NUCLEAR CAPABILITY

GSC maintains an independently accredited ISO9001 Quality Management System that meets the requirements of ASME Section III, Division 1 – NCA-3820 (b) and NCA-3842. This allows ASME certificate holders to approve our facility which allows for the supply of castings under ASME NCA-3800 or RCCM for nuclear facilities.

In addition to our customer audit approvals, we also hold Rolls-Royce approval for the manufacture of High Alloy Steel and Nickel Alloy castings, including X-Ray Radiography, Dye Penetrant Inspection and Heat Treatment Processing for Nuclear Submarines.

We supply cast components for primary (class one) and secondary (class two) cooling loops in the form of pumps and valves. GSC have also supplied critical duty class one structural components for military facilities within the UK.

We regularly work with tier one suppliers providing bespoke components for both civil and military applications within the nuclear arena and have a mature management system that aligns to ASME NCA 3800.

Nuclear flask for the defueling of submarines, manufactured to ASME codes

Valves and critical duty infrastructure for Hinkley Point Nuclear Power Station

Goodwin Axial valves manufactured in accordance with ASME 3800

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Self sheilded storage box for contaminated nuclear waste

CUSTOMERS

GSC continue to engage in commercial activities with the following companies:

GENERAL DYNAMICS Electric Boat

BAE SYSTEMS

Huntington Ingalls Industries

Newport News Shipbuilding

Rolls-Royce

AWE

SIEMENS

Precision Custom Components

GE

BWXT

NAVAL GROUP

babcock

GENERAL DYNAMICS Bath Iron Works

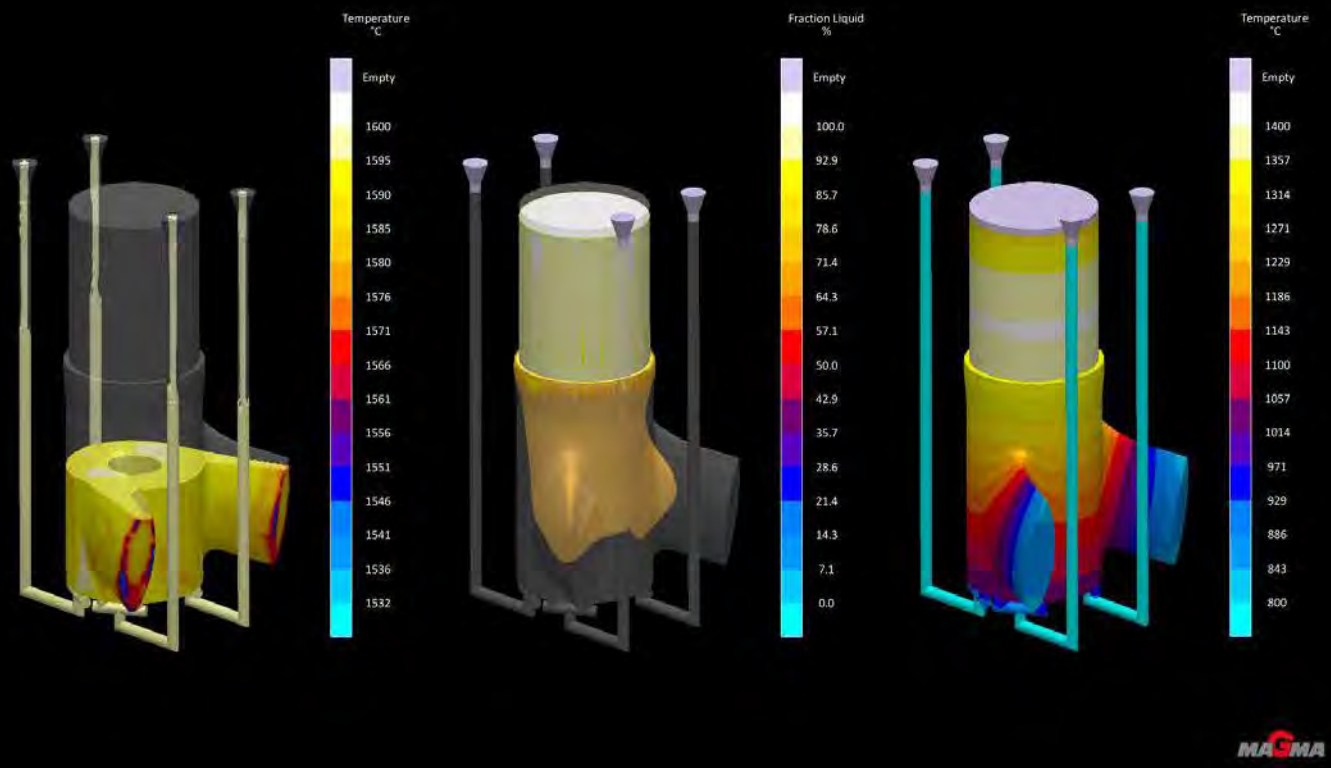
HOLTEC INTERNATIONAL

Westinghouse

FOUNDRY SITE OVERVIEW

MAGMASOFT™ AIDED DESIGN

- Finite element solidification analysis inclusive of fluid flow and heat transfer
- Material data sets developed within the facility for optimised casting design



ON-SITE PATTERN CONSTRUCTION FACILITIES

- State of the art, pattern manufacture facilities
- Creaform™ laser scanning technology for dimensional inspection
- Secure in-house equipment storage with integrated fire suppressant system

PRIMARY MELTING BY ELECTRIC ARC AND INDUCTION FURNACES WITH SECONDARY ARGON OXYGEN DECARBURISATION REFINING

- Castings of 40,000kg finished weight poured
- Recycling sensitive materials (destruction melting) into safe forms for onward processing

GANTRY SAW

- Cutting capability up to 3m x 3m x 9m
- Employed to process alloys susceptible to thermal shock such as high yield steels / super duplex / super nickel alloys

WORLDS LARGEST AUTOMATED WATER QUENCH HEAT TREATMENT FACILITY

- 50,000kg capability (5m x 5m 5m)
- Key to achieving heavy section mechanical and metallurgical properties
- 1 of 7 in-house heat treatment furnaces
- Dedicated dehydrogenisation facitily

Metal Proving Services
LIMITED

METAL PROVING SERVICES LTD PROVIDE ON-SITE MECHANICAL TESTING

- ISO 17025 UKAS accredited
- Reduced cycle time for mechanical and metallurgical verification
- Competences include:
  - Dynamic Tear Testing
  - Charpy V-notch Test
  - Tensile Test
  - Corrosion Test
  - Metalurgical Inspection

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RADIOGRAPHIC INSPECTION FACILITY

- Fully articulated 9MeV Linatron allowing detailed inspection of large complex geometries
- 70,000kg overhead lifting capability with a 30,000kg rotating bed
- 2 linear accelerators available on-site

NON DESTRUCTIVE TESTING (NDT)

- Level III certified personnel for NDT techniques
- 29 qualified on site NDE personnel holding 87 certificates in 5 seperate NDT disciplines
- On site activities includes
  - Magnetic Partical Inspection
  - Liquid Penetrant Inspection
  - Ultrasonic Inspection
  - Radiographic Inspection

MACHINE SHOP SITE OVERVIEW

PRECISION MACHINE TOOL SETTING

- Repetition is vital for long term defence programmes and as such we utilise Zoller pre-set tooling to de-risk the manufacturing process

- Laser scan tools ‘as built’ for block build programmes

VERTICLE TURNING CENTRE WITH LIVE SPINDLE TOOLING

- 5-axis capability with 5.5m diameter bed
- 100,000kg overhead crane lifting capability
- 11 in-house CNC controlled Vertical Turning Centre available

EXTENSIVE MILLING CAPABILITY

- Double column gantry with 9m bed
- Twin pallet capacity for rapid change overs
- 22 on-site CNC controlled Milling Machines, many have 5-axis capability

FABRICATION AND OVERLAY WELDING

- On-site certified Welding Engineer
- Welder Workmanship Programme to Navsea Techpub TP9074-AQ-GIV-010/248
- Automated, robotic and manual welding capability
- All welders are ASME IX or ISO certified

COORDINATE MEASURING MACHINE (CMM)

- Largest commercially available Gantry type CMM in the UK
- Accuracy of 12 microns per m^2
- 6 in-house Coordinate Measuring Machines available

MATERIAL GRADES

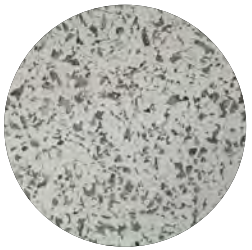
NAVSEA Technical Publication T9074-BD-GIB-010/0300 TP-300 REV. 2 Approved.

Goodwin are approved by NAVSEA for the supply of components for nuclear submarines and surface platforms.

NAVSEA's scope of approval is HY80 castings, inclusive of heat treatment, non destructive testing, inc radiographic testing.

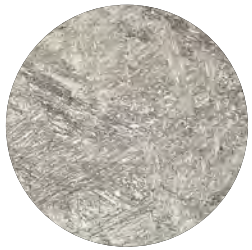
Goodwin retain the capability to supply HY100 components for nuclear submarines to Defence Standard 02-736 Part 3 Issue 3.

Goodwin retain the capability to supply Q1N components for nuclear submarines to Defence Standard 02-880 Part 3 Issue 1.



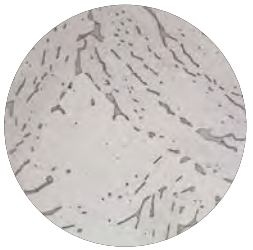
CARBON STEEL

Casting which are readily weldable, suitable for the manufacture of Struts / Main Supports / Bracket Couplings / Structural Castings for Sails or Ailerons.



ALLOY STEEL

NiCrMo steels such as 13Cr4Ni and CA6NM utilised for their high tensile strength combined with excellent corrosion resistance with suitability for the manufacturing of Steam Turbine Castings.

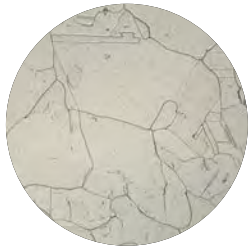


COBALT RESTRICTED STAINLESS STEELS

Applications include Primary Pumps & Pipework as well as Impact Limiters for defueling transportation.

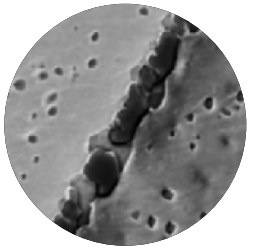
SUPER DUPLEX STAINLESS STEEL

Produced using our AOD refining process to excellent composition control with enhanced mechanical properties. Used for Through Hull Penetrators / Sea Water Valves / Tube Sheets / Condensors.



SOLUTION STRNGTHENED NICKEL ALLOY

Excellent elevated temperature performance and corrosion resistance used for Sea Water Diesel Exhausts.



PRECIPITATION NICKEL ALLOY

State of the art precipitation hardened nickel alloys, suitable for use in advanced high temperature and high pressure environments such as Sea Water Diesel Exhausts.

Combustion Analysis to measure ultra low levels of carbon, nitrogen and oxygen

Metalagraphic Polishing & Chemical Etching of Specimens

Scanning Electron Microscope With x30,000 Times Magnification & EDS Analysis

PROJECTS DON'T
SUCCEED
BY STARTING
WITH
POOR QUALITY
CASTINGS

APPROVALS & CERTIFICATES

GSC is part of the Goodwin Engineering Group and are one of the foremost, independent producers of high alloy and high quality integrity castings globally.

ISO 9001

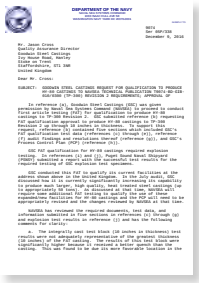
Goodwin Steel Castings Ltd was the first steel foundry worldwide to be accredited by BSI to BS5750 (now ISO 9001). Accreditation was first granted in 1984.

ISO 14001

The foundry facility is accredited to the Environmental Management system ISO 14001.

ISO 45001

The foundry facility is accredited to the Occupational Health and Safety system ISO 145001.

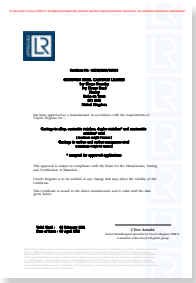


NAVSEA

Goodwin is approved to manufacture HY-80 grade steel to NAVSEA T9074-BD-GIB-010/0300 Revision 02.

Rolls-Royce

Our foundry facility is an approved supplier to the Submarine sector of Rolls-Royce.



Lloyds Register

Goodwin is approved as a manufacturer under the Lloyds Rules for the manufacture, testing and certification of materials.

ABS

We are approved as a manufacturer under the American Beuro of Shipping for the manufacture, testing and certification of materials.

CONTACTS & LOCATION

Goodwin Steel Castings Ltd is easily accessible from the M6 motorway at junction 15 or 16 and then along the A500. From the M1 motorway, take junction 24a and then the A50 to Stoke-on-Trent.

Brian Quinn
Sales Director
Tel +44 (0)1782 220244
Mobile +44 (0)7766 315829
Email bquinn@goodwingroup.com

Pascal Bohnenberger
European Sales Director
Tel +44 (0)1782 220000
Mobile +44 (0)7813 354643
Email pascalb@goodwingroup.com

North America - Agents
Jon Metal Fab Inc
John Patrick O'Neill
Email jposteel@msn.com

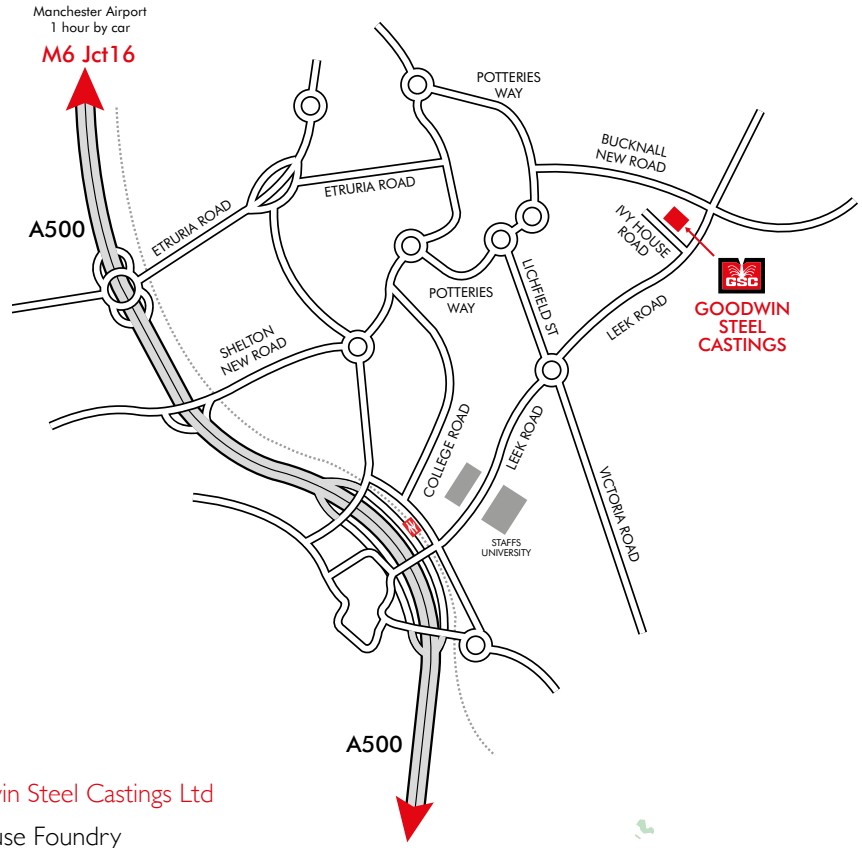
GKS Forging & Castings Sales Inc
Kevin Shaw
Email gkshaw.sales@gmail.com

South America – Agents
Sealand Global Ltd
Goncalo Baptista
Email goncalo.baptista@sealandglobal.com

Goodwin Korea Ltd - Pacific Basin
Chan S Park
Email cspark@goodwin.co.kr

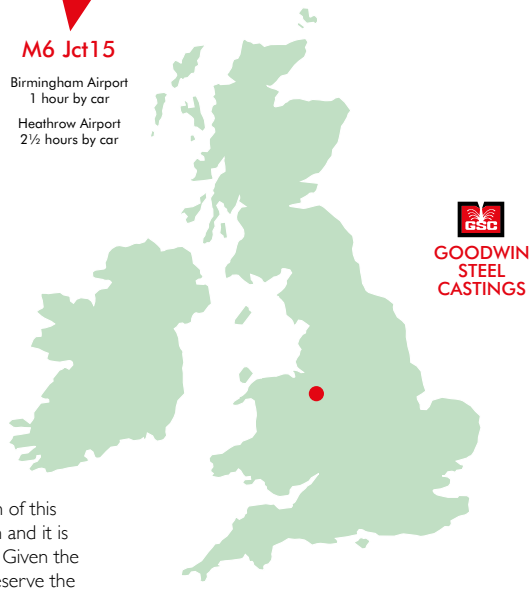
Subcontract Facilities
Andy Lowe
Email andyl@goodwingroup.com

Ingot & Feedstock Sales
Ian Martin
Email imartin@goodwingroup.com



Goodwin Steel Castings Ltd
Ivy House Foundry
Hanley
Stoke-on-Trent
ST1 3NR
United Kingdom

Tel +44 (0)1782 220000
Fax +44 (0)1782 208060
Email castings@goodwingroup.com
Web www.goodwinsteelcastings.com



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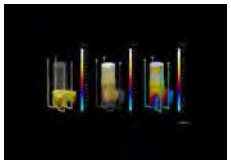



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