
D E F E N C E
CONCEPT • CASTING • COMPLETION



GOODWIN STEEL CASTINGS
ESTABLISHED 1883



Goodwin Steel Castings Ltd has become synonymous with high standards of precision manufacturing over a history of over 130 years.

We are able to supply large machined castings from 50kg to 30,000kg, fabricated castings and assemblies up to 70,000kg from carbon steels, stainless steels, duplex stainless steels and cutting edge materials such as super nickel alloys.

The foundry is supported by its sister company, Goodwin International Ltd, located 8km away, which satisfies our CNC machining, fabrication and assembly requirements.

Goodwin Steel Castings Ltd have supplied fully machined, coated, pressure tested castings for some of the world's most technologically advanced and prestigious defence projects.

Goodwin Steel Castings Ltd and Goodwin International Ltd work in conjunction with each other so, from a single purchase order you can get cast, machined, finished, export packed goods that are made precisely to your drawings and specifications.

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600MW control valve assembly for power generation.



Reverse engineered main steam valve.



Re-circulating pump to ASME requirement.





CONCEPT TO COMPLETION

Detailed below is an outline of the interaction between a professional design team and Goodwin:

OVERVIEW OF CUSTOMER REQUIREMENTS

An outline sketch or drawing indicating the principle dimensions and any required mechanic or chemical properties is forwarded to Goodwin.

INITIAL DESIGN

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

A computer simulation of the solidification of the casting is run to optimise the shape, predict where shrinkage and residual stresses would occur, and then design them out of the component. A drawing is then returned to the client detailing the final dimensioned shape, showing any areas where we would suggest that a deviation be accommodated to achieve cost reduction within our manufacturing process, or to adjust the tolerances as drawn, because they would incur additional costs.

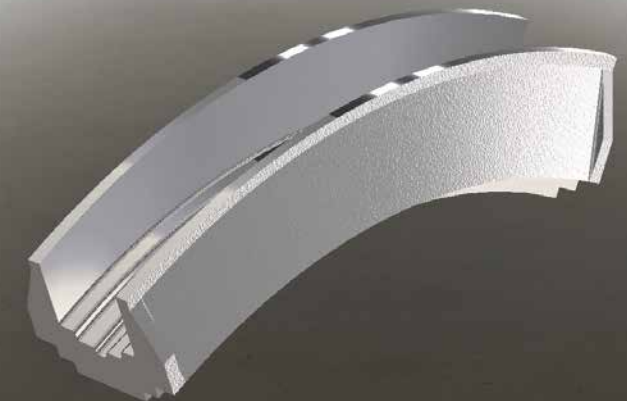
We like to clarify everything upfront to ensure that we give you the best price, avoiding any surprises for either party during the project execution.

QUOTATIONS & PROGRAMME

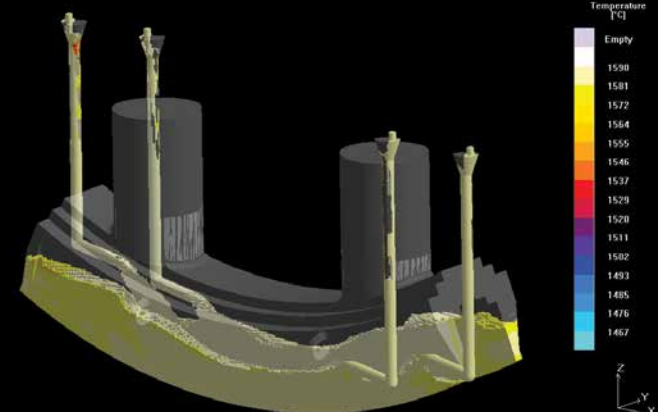
A detailed quotation with a manufacturing, inspection and test plan programme is provided for each enquiry.

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Goodwin will work closely with the professional design team or contractor to assist in the production of an optimised and competitive solution to their casting needs. We appreciate that development work will be needed during the early stages of design, prior to a tendering process, so we are prepared to invest our time without commitment.



Three Dimensional design stage drawing.



Computer solidification simulation.



Pattern inspection.



Melting & pouring.



CNC machining.

PATTERN MANUFACTURE

Our in-house pattern shop produces the patterns from which the castings will be manufactured. The patterns will be used to create the sand moulds into which molten metal is poured.

MELTING & POURING

Metal is melted in one of four electric furnaces and, if required, transferred to the AOD (argon-oxygen decarburisation) vessel for refining. Here, volatile elements are removed from the mix, helping to reduce the impurities and inclusions in the steel.

Molten metal is dispensed from the furnace into a ladle. The ladle is then positioned above the mould before pouring the molten metal into the mould. The metal is then left in the mould to cool until it solidifies. This process can often take days rather than hours. Once cooled, the casting is "knocked out" of the mould and given a preliminary fettling.

TESTING & MACHINING

Following fettling, the casting is heat treated in order to optimise its mechanical properties followed by NDT (non-destructive testing) such as radiographic, magnetic particle or ultrasonic inspection.

The casting is cast with an integral test block that is heat treated with the casting and then destructively tested to prove the heat treatment has given the actual component the correct mechanical properties.

The casting then undergoes machining to the specified dimensions. Here internal cavities or features too complex for the casting process are cut into the component. Any further fabrication will also take place at the machine shop. Following any testing, final dimensional inspection is conducted before the casting is painted, packed and shipped to its destination.

www.goodwinsteelcastings.com



FASLANE NUCLEAR SUBMARINE SYNCROLIFT

This facility is used to lift Royal Navy nuclear submarines out of the water for refits and maintenance. By using the Syncrolift, work can be carried out on a submarine without the space restrictions of a traditional dry dock.

The facility, located in Scotland, is housed in a covered dock building and is 165m in length with a lifting capacity in excess of 25,000 tons.

Goodwin manufactured high tensile steel hanger beams that anchor the platform hoist system together with stainless steel submarine guide rails.

As the hanger beams are a critical element of the lift, the mechanical, chemical and toughness characteristics of the castings were carefully controlled and monitored.

PROJECT	FASLANE SUBMARINE BASE
LOCATION	SCOTLAND
DESIGN ENGINEER	NEI SYNCROLIFT, MIAMI
CONSULTING ENGINEER	BABTIE, SHAW & MORTON



A submarine approaches the Faslane base near Glasgow. This is one of the few facilities in the world where a nuclear submarine can be lifted out of the water.



Goodwin produced 120 fully machined stainless steel guide rails to meet the specified stringent tolerance requirements.



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FASLANE NUCLEAR SUBMARINE SYNCRO LIFT

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PREVIOUS PROJECTS

ASTUTE SUBMARINE

Goodwin are supplying reactor class components to Rolls Royce for the ASTUTE submarine propulsion system.

SUCCESSOR AND OHIO REPLACEMENT SUBMARINE

Goodwin are supplying castings for the Common Missile Compartment programme in HY-80 & carbon steel grades.

OTHER NAVAL PROJECTS

Goodwin expertise helped to develop a material change to a High Yield Strength material, which in turn enabled a weight reduction and other benefits on a sensitive vessel.



Astute Submarine.



Chainstopper in Norsok M-122 Grade 420.



Kingpost casting for cable laying vessel.

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SUCCESSOR & OHIO REPLACEMENT SUBMARINE

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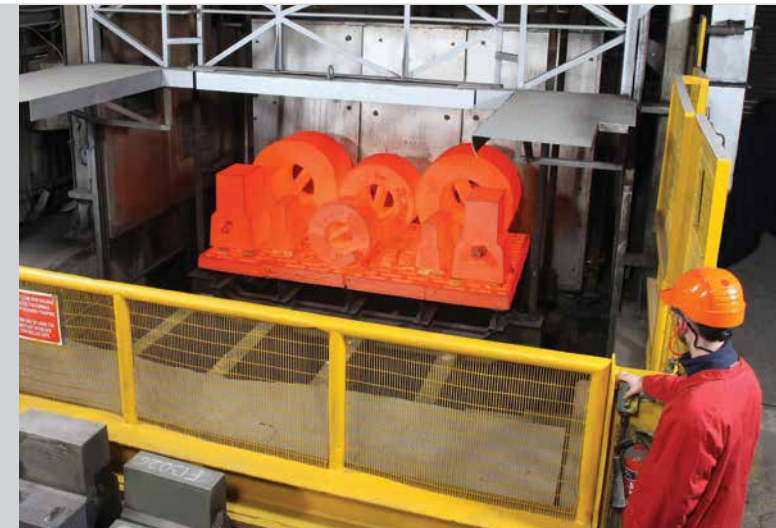
FACILITIES

FOUNDRY CAPABILITY

- Solidification simulation, fluid flow and stress analysis packages MAGMASOFT™ and SOLSTAR™
- In-house Pattern Shop
- Melting & Analysis:
 - Electric arc and induction furnace melting.
 - AOD refining vessel with oxygen, argon and nitrogen injection (operating since 1994)
 - Thermofisher 4460 33 channel, Direct reading optical emission spectrometer.
 - Pouring capacity of 34,000 kg
- Heat Treatment :
 - High temperature water quench furnace (10,000 kg)
 - Gas fired low thermal mass bogie hearth furnace (50,000 kg)
 - 3 x Gas fired low thermal mass top-hat furnaces (20,000 kg)
- Large 3.5m CNC Gantry Saw
- Radiographic Inspection:
 - Varian M9a 9MeV Linatron in a 10m x 8m x 9m Bay with a 70 ton overhead crane
 - Raytech Super-X 8.5MeV Linac
- Max crane capacity 60,000 kg



AOD refining vessel



Heat treatment and water quench facilities



CNC Gantry Saw

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Water cooling valves for the Toshiba Westinghouse AP1000 Nuclear Power Plant.

NUCLEAR CAPABILITY

Goodwin Steel Castings Ltd has been accredited by ASME (The American Society for Mechanical Engineers) as a Material Organisation (MO) to ASME NCA 3800 to supply castings for nuclear applications.

Goodwin has supplied cast components for primary (class one) and secondary (class two) cooling loops in the form of pumps and valves and also supplied critical duty class one structural components.

We regularly work with tier one suppliers supplying components to the civil nuclear industry such as the AP1000 PWR and proprietary military installations such as Faslane (Scotland) nuclear submarine naval base.

In addition to the ASME Nuclear Quality System Certificate Goodwin also holds Rolls Royce Nuclear Sector Submarine approval for the manufacture and machining of steel and nickel alloy castings.

ASME NCA 3800

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NON-DESTRUCTIVE TESTING

NDT (NON-DESTRUCTIVE TESTING)

Goodwin carries out extensive in house non destructive examination including:

- Radiographic Inspection
- Ultrasonic Inspection
- Magnetic Particle Inspection
- Dye Penetrant Inspection

Goodwin directly employs a total of 36 qualified NDE personnel including 2 x PCN & SNT level III qualified quality assurance managers.

CERTIFICATION AND TRACEABILITY - ISO9001:2008

Goodwin Steel Castings was the first steel foundry worldwide to be accredited by the British Standard Institution to BS5750 (now ISO9001). Accreditation was first granted in 1984. Goodwin machining facility was also accredited in 1984.

All castings are fully traceable, this traceability consists of the internal (Goodwin) job number and a sequential casting number which when taken together provides unique traceability for each casting.

The unique casting number is traceable to the following as a minimum:

- The cast (unique lot of molten metal) that the casting was poured from.
- The results of the final (certified) chemical analysis.
- All heat treatment activities and the heat treatment furnace load number.
- All final NDT inspection reports and the individual who carried out the testing.
- All weld repair maps, the identity of the welder and the batch number of the welding consumables used.
- Any post weld heat treatment activities and the furnace load number.
- The results of the mechanical tests

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One of two on-site linear accelerators



Dye penetrant inspection

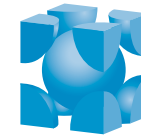


Ultrasonic inspection





Precision carbide sectioning and CNC 5 axis machining.



Metal Proving Services
LIMITED

Metal Proving Services Limited (MPS), a sister company to Goodwin Steel Castings Limited, is a comprehensive mechanical and metallurgical inspection facility employing advanced in house material sectioning and machining facilities.

The laboratory benefits from precision sectioning, 5-axis machining, metallographic preparation, corrosion suites, metallographic and scanning electron microscope analysis.

The ability, location and close relationship that is shared between MPS and Goodwin Steel Castings, mean that test results are available 72 hours after the submission of test material.

UKAS accredited to ISO/IEC 17025:2005 in:

- Tensile
- Impact
- Hardness
- Ferrite
- Corrosion Testing



Scanning Electron Microscope



Sub-zero charpy v-notch impact and tensile testing.

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MACHINE SHOP FACILITIES

MACHINE SHOP CAPABILITY

- Programming by Gibbs CAM & Siemens NX
- Verification by VERICUT
- Biometric access to off line programming room for 3D modelling, CNC programming and Verification for restricted work.
- 4 axis Gantry Mill with 20m travel and 40 tonne capacity
- 7 x Large CNC Vertical Boring – maximum swing 3.7m and 30 tonne capacity
- 7 x Conventional Vertical Boring Centres
- 2 x large CNC Floor Borers – fully indexable tables, 13mtr travel and 60 tonne capacity
- 3 x large CNC Horizontal Borers – 4 axis, 3m x 2m x 2m travel and 20 tonne capacity
- 4 x large CNC Horizontal Borers – 4 axis, 3m x 2m x 1.5m travel and 6 tonne capacity
- 5th Axis Rotary table with 15 ton capacity available for all large boring machines
- 2 x Conventional Horizontal Boring Centres – 2m x 2m, 4 tonne capacity
- 6 x CNC Lathes
- 2 x Reiss 6 axis Robotic Welders with rotary tables
- 2 x CMM, max 5m x 3m x 2m bed
- 2 x Faro Articulated Arm CMM
- Faro Laser Tracker for dimensional verification for larger components
- Faro Laser Scanner for 3D Reverse Engineering
- Max crane capacity 100,000 kg



CNC Vertical Boring



5m x 3m x 2m CMM



Faro Laser Scanner

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9.5% Cr
fabricated pipes.

CUSTOMERS

Goodwin has supplied the following companies:



Rolls-Royce®



BAE SYSTEMS

Raytheon



TOSHIBA

GENERAL DYNAMICS
Electric Boat



SIEMENS



ALSTOM



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MATERIALS

HIGH YIELD STRENGTH CARBON STEELS

Material Type	
NORSOK M122 Grade 420	
HY80	(T9074-BDGIB-010/0300 Rev 2)

SUPER NICKEL ALLOYS

Material Type		ASTM	UNS
Alloy DS	Ni Cr 31/18		N08330
Alloy 825	NiCrMoCu Nb 41/21/3/2	CU5MCuC	N08825
Alloy 625	NiCrMo Nb 62/21/9	CW6MC	N06625
Alloy 617	NiCrCoMo AlTi 45/22/12/9		N06617
Hastelloy™ B2	NiMo	N-7M	N10665
Hastelloy™ C276	NiCrMo WV 57/16/17	CW-12MW	N10276

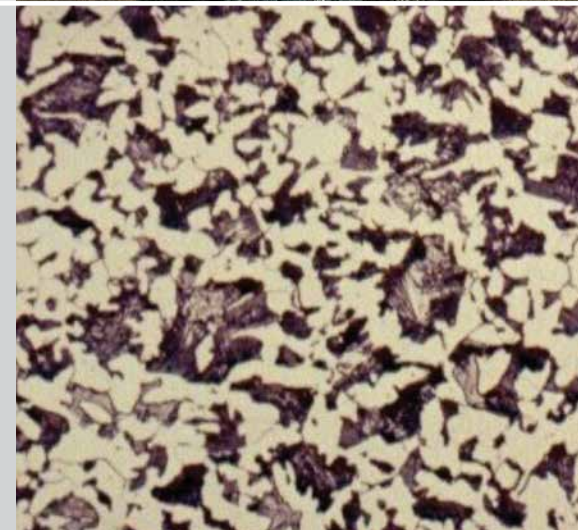
DUPLEX STAINLESS STEELS

Material Type	ASTM A890	EN 10213-4	DIN	UNS
22Cr 5Ni Mo N (duplex)	4A	GX2CrNiMoN22-5-3	1.4470	J92205
25Cr7Ni Mo N	5A	GX2CrNiMoN26-7-4	1.4469	J93404
25Cr 7Ni Mo N (super duplex)	6A	GX2CrNiMoN26-7-4	1.4469	J93380
25Cr 6Ni MoCuN (super duplex Cu)		GX2CrNiMoCuN25-6-3-3	1.4517	S32550

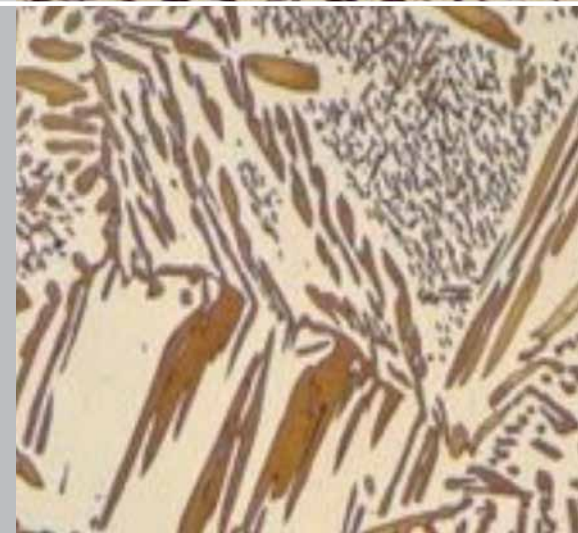
Alloying elements.



Carbon Steel
Ferrite & Pearlite
Micro-Structure.



Duplex Stainless Steel
Ferrite & Austenite
Micro-Structure.



AUSTENITIC STAINLESS STEELS

Material Type	ASTM A351	BS BS3100	EN 10213-4	DIN	UNS	JIS G5121
19/10 CrNi low C (304L)	CF3	304C12	GX2CrNi19-11	1.4309	J92500	SCS13
19/10 CrNi (304)	CF8	304C15	GX5CrNi19-10	1.4308	J925600	
19/10 Nb (347)	CF8C	347C17	GX5CrNiNb19-11	1.4552	J92710	SCS21
19/10/2.5 CrNiMo low C (316L)	CF3M	316C12	GX2CrNiMo19-11-2	1.4409	J92800	SCS16A
19/10/2.5 CrNiMo (316)	CF8M	316C16	GX5CrNiMo19-11-2	1.4408	J92900	SCS14
19/10/2.5 CrNiMoNb	318C17		GX5CrNiMoNb19-11-2	1.4581		
19/10/2.5 N (316LN)	CF3MN				J92804	

CHROME & CHROME MOLY STEELS FOR USE AT ELEVATED TEMPERATURES

Material Type	ASTM A351	BS BS3100	EN 10213-4	DIN	UNS	JIS G5121
1Cr 0.5Mo	CF3	304C12	GX2CrNi19-11	1.4309	J92500	SCS13
2.5Cr 1Mo	CF8	304C15	GX5CrNi19-10	1.4308	J925600	
0.4Cr 0.5Mo 0.25V	CF8C	347C17	GX5CrNiNb19-11	1.4552	J92710	SCS21
1Cr 1Mo 0.25V	CF3M	316C12	GX2CrNiMo19-11-2	1.4409	J92800	SCS16A
5Cr 0.60Mo	CF8M	316C16	GX5CrNiMo19-11-2	1.4408	J92900	SCS14
9Cr 1Mo	318C17		GX5CrNiMoNb19-11-2	1.4581		
9Cr 1Mo NbN	CF3MN				J92804	

HIGH CHROME & CHROME MOLY STEELS

Material Type	ASTM A351	BS BS3100		UNS	JIS G5121
12Cr	A217:CA15	410C21		J91150	SCS1
12cr 4Ni	A352:CA6NM	425C12	GX3CrNi13-4QT		



APPROVALS & CERTIFICATES

Goodwin Steel Castings is part of the Goodwin Engineering Group and one of the foremost, independent producers of high alloy and high quality integrity castings in Europe.



Rolls Royce

The foundry facility is an approved supplier to the Submarine Sector of Rolls Royce



NCA-3800

American Society of Mechanical Engineers Nuclear Accreditation



ISO 14001 (21539)

The foundry facility is accredited to the environmental management system ISO 14001



ISO 9001 (FM336)

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.



Lloyds Register (MD00/0609)

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



OHSAS 18001

The foundry facility is accredited to OHSAS 18001:2007.



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PART OF THE GOODWIN PLC GROUP



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