



ROSS & CATHERALL

Leveraging five decades of expertise in vacuum melted superalloy production

Applying our expertise to deliver your superalloy requirements

Turning **Metals** into **Motion**

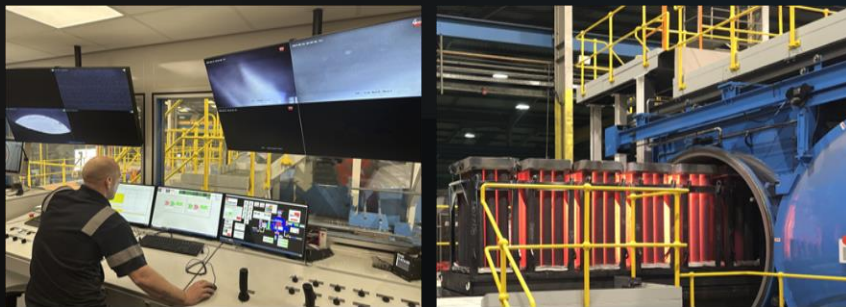
Manufacturing footprint



Plant: Ross & Catherall Ltd.

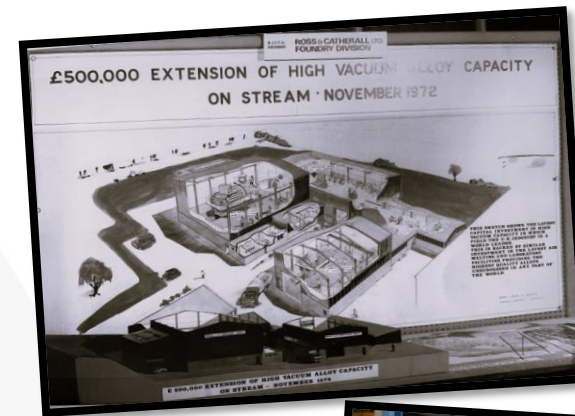
Location: Sheffield, UK

Employees: 150



Our continued philosophy to investment ...

- From 1968, Ross & Catherall have been pioneering vacuum melted superalloys, utilising the latest manufacturing techniques, and investing in new technologies, people, training, and equipment to meet our customers' exacting requirements for over 50 years
- Product quality is paramount; we ensure meticulous attention to customer specifications throughout our technical contract reviews, planning, methods of manufacture, melting, and finishing routes, ensuring that our customers receive the highest quality cast bar stick



Our "new" State-of-the-art furnace installed in 1972

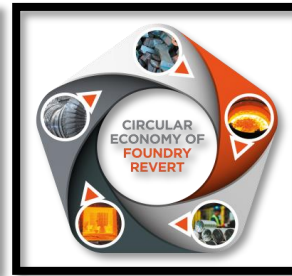
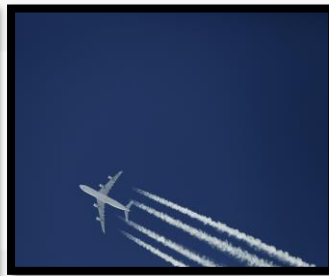
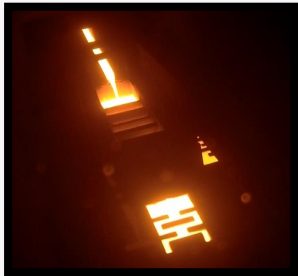


Our latest State-of-the-art furnace installed in 2023



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Ross & Catherall...



...are a leading supplier of vacuum melted nickel and cobalt based superalloy cast bar stick

...supply alloys to aerospace, IGT, space exploration, and additive manufacturing

...have major OEM and industry leading cast house approvals for Aerospace and Gas Power Turbine, Space and Additive Manufacturing

...have a global supply footprint for sales, technical support and deliveries

...have a long history and strong capability of alloy development and technical support

...have established alloy revert chains to ensure cost-effective melting solutions

...have established programmes for investment in technical excellence, people, capability and plant capacity

Superalloy manufacturing excellence



- Vacuum melting from 1968 ✓
 - 150 employees
- Over half a century of superalloy melting, development, manufacturing and processing experience ✓
 - World's largest selection of VIM furnace capacity options utilising the latest melting technology ✓
- Markets served: Aerospace, IGT, Additive Manufacturing, Space Exploration, and biomedical sectors ✓
 - Manufacturers of cast bar stick to the Investment Casting foundry sector ✓
 - Long history of product and process development ✓



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Superalloys for investment casting



Ross & Catherall capabilities

- Technical, metallurgical & chemical specialists with long service industry knowledge and experience ✓
 - Fully accredited laboratory with ISO17025:2017 & Nadcap approvals ✓
- Largest volume capacity range of any superalloy manufacturer worldwide - 8 VIM furnaces ✓
- Invested and committed workforce with knowledge, experience and continuity in the sector ✓
 - Exact Chemistry control and bar cleanliness ✓
 - Low N <5ppm ✓
 - Low S & Super Low S < 3ppm and < 1ppm ✓

In-house Revert Processing - Sustainability is possible using your in-house revert



- Our commitment to sustainability drives us to adopt environmentally friendly practices and reduce our carbon footprint, ensuring that our production processes are as sustainable as they are efficient
 - Customer revert segregated, prepared & cleaned for melting
 - Revert storage “closed-loop” guaranteed
 - Revert ready for use in one of our 8 furnaces



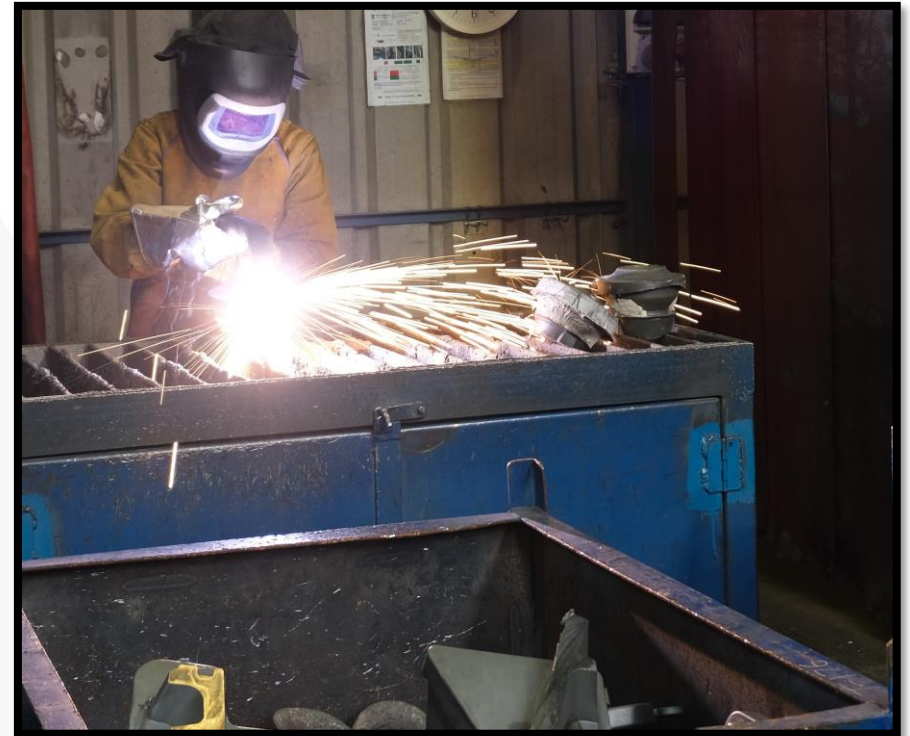
Managed revert from customers

- Revert is processed & melted from customers worldwide ✓
 - Revert value fully optimised ✓



Ross & Catherall revert processing facility

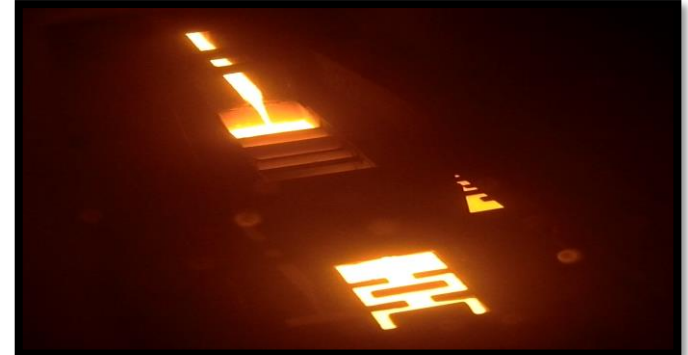
- Dedicated revert cell that ensures customers that the product quality is maintained through a “closed loop” network
- Customer “owned” revert is guaranteed to be used in customer's own alloy
- Dedicated revert processor, not “scrap” processor, optimising revert yields
- Zero contamination from “third-party” scrap – full traceability for all revert material received
- Revert can be cleaned and made “furnace ready” for remelting, utilising one of our 8 VIM furnaces, into recycled bar stick
- 100% recycling process providing sustainable solutions for the environment with minimal carbon footprint



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Melting Furnace Capabilities

1 x 500kg (1,100lb), 2 x 2800kg (6,200lb) 1 x 4000kg (8,800lb) & 1 x 7200*kg (15,800lb) VIM furnaces



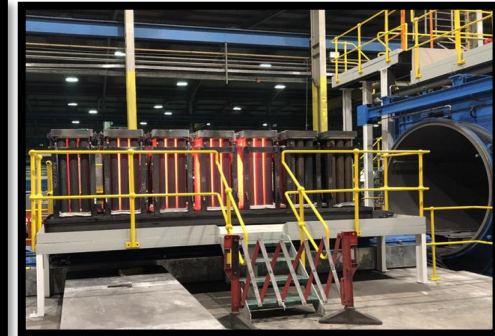
* 3 additional 7200kg & 6000kg bodies

Melting & Product Size Capabilities

Furnace capacities kgs (lbs)	Bar Diameters mm (inches)
500 (1,100)	75 (3"), 88 (3½"), 100 (4"), 125 (5"), 150 (6"), 175 (7")
2 x 2800 (6,200)	
4000^ (8,800)	
7200 (15,800) *	

* Furnace yields approx. +/- 10% of stated capacity, * 3 x 7200kg & 6000kg furnace bodies ^ New furnace commissioned Q4 2023

- We are confident that we can meet your varying volume alloy demands using any one of our 8 VIM furnaces, combined with our revert processing cell – guaranteeing a truly sustainable “circular economy” for your revert stream



State-of-the-art 4t furnace commissioned June 2023



Advantages of our new 4t furnace...

- The furnace provides the latest VIM design specifically configured for the highest quality masteralloy production of highly specialised nickel and cobalt-based superalloy cast bar stick, with features including:
 - Rapid exchange furnace design for expedited maintenance turn-around and maximised furnace up-time
 - Short tundish VIM design with multiple filtration to ensure optimum metallurgical quality and cleanliness
 - Multi-charging system capability for shortest melting, safety considerations and flexibility
 - High melting efficiency and Power Factor throughout total operation
 - Integrated Unidirectional Stirring system to provide enhanced metal stirring / agitation for shortest degassing times with the highest possible electrical efficiency
 - Dry vacuum pumping system combined with the latest high vacuum oil vapour booster technology incorporating energy saving modules
 - Remote control of melting operations and extensive safety design features



Technical Philosophy

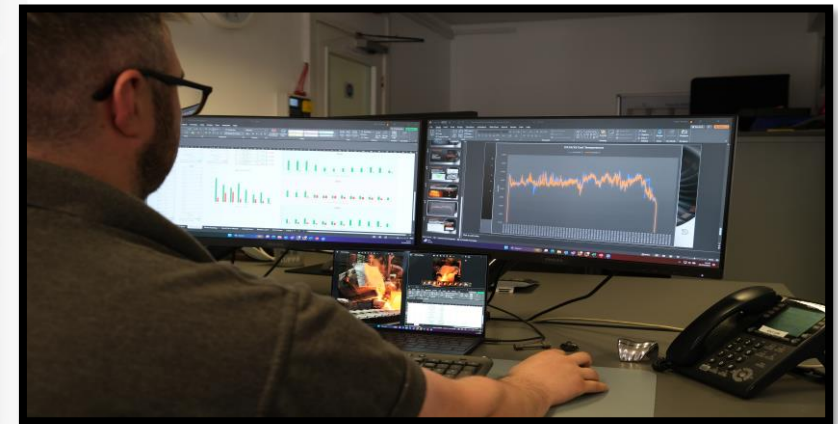
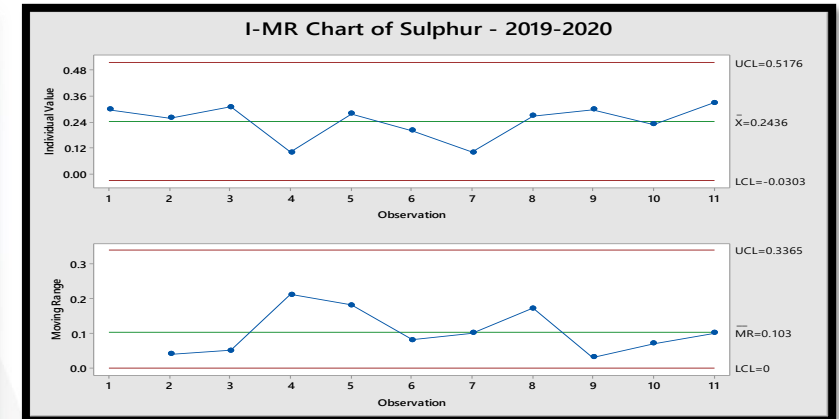


Melt Technology

- Low Sulphur Melt Practice
 - 3 tier system
 - Ultra-low S (ULS) <0.5ppm
 - Low S (LS) 0.5 – 1.0ppm
 - Desulphurised 1.0 – 1.5 ppm
- Lining Control
 - Control of build materials using SPC.
 - 3D laser scanning of coil shape and distortion to prevent lining deterioration.
 - SAVEWAY® system helps to protect the furnace coils from molten metal by allowing the continuous measurement of the furnace refractory lining thickness during operation.
 - Enhanced sequencing logic to prevent cross contamination and maintain chemistry.
- Furnace Pressures & Leak Rates
 - SPC control of furnace pressures and leak rate to ensure product consistency.
 - Team review of data (Operations/Maintenance and Technical) to instil condition-based maintenance.

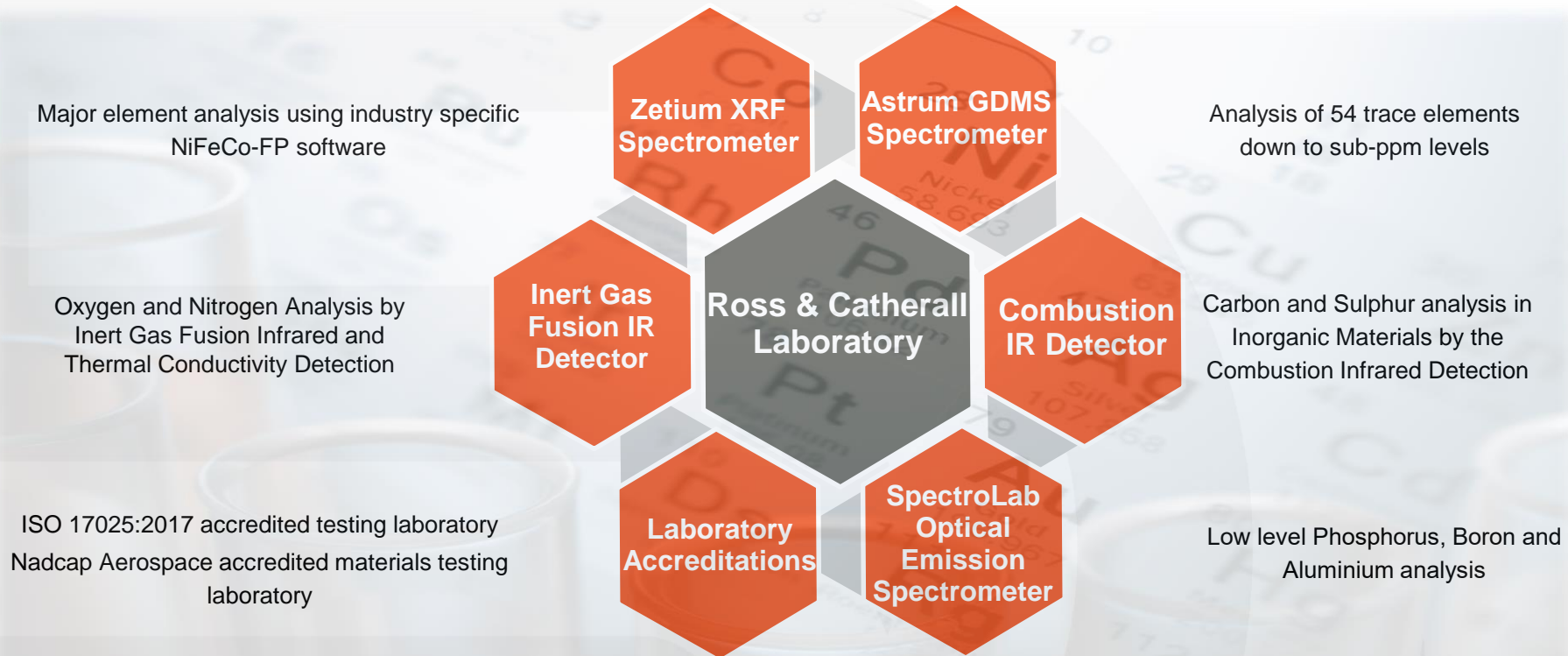
Single Crystal Alloy Manufacture

- Ultra-low S capability
- Low N (<5ppm to control secondary grains from nitrides)
- Low O (<5ppm)
- Control of lining and melt sequencing (control of residual Mg)
- Melt filtering – minimum 2 x filters; finest filter 30ppi or less



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Laboratory Capabilities



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Laboratory Capabilities

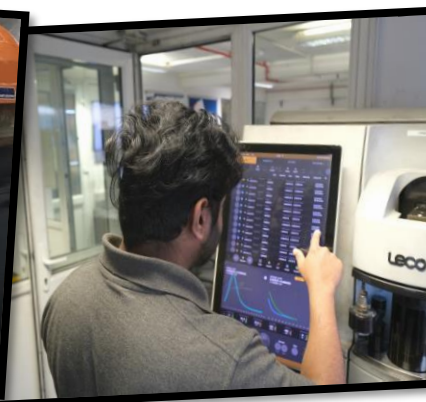
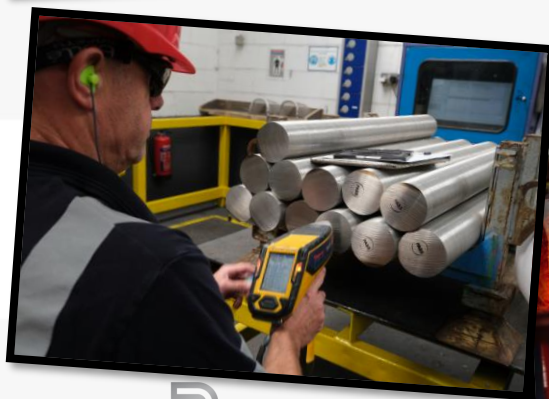
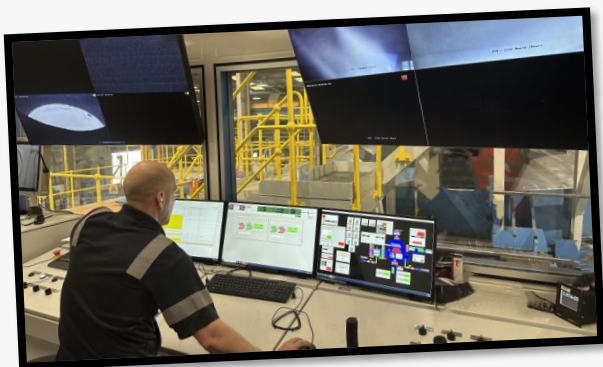
- XRF - Panalytical Zetium
- OES – Spectro SPECTROMAXx and SpectroLab
- Combustion LECO C&S CS844ES and CS844
- Gas fusion O&N Leco ON836
- GDMS – Nu Instruments, Astrum
- Duplicate instruments. Replacement to state-of-the-art technology on a rolling Capex programme.



ROSS & CATHERALL

Our people are our strength!

- Mastermelt principle melters - continuity of workforce with over 150 years* experience and knowledge
- Senior Management Team - average tenure 10 years at Ross & Catherall, several with over 30 years industry experience
- Technical and Laboratory specialists, many with over 25 years industry experience in superalloy metallurgical development and chemical services
- Established programmes for investment in technical excellence, people, capability and plant capacity



What do Ross & Catherall provide?

- Supply chain confidence ✓
 - Known element prices/availability for all alloy requirements for 3,6,12 months (based on volume commitment)
 - Guaranteed melting slots and volume commitment*
 - Latest furnace technology of any superalloy bar stick manufacturer worldwide
 - Known, programmed deliveries
- Flexibility ✓
 - Scheduled melting and delivery to align with your customers forecasts/demands*
 - Largest range of melting furnace capacities from 500kg-7200kg (8 furnaces in total) – widest choice worldwide
 - Revert managed, prepared in-house and available to meet known melt demand
- Location ✓
 - Centrally located for deliveries worldwide
- In-house revert processing & preparation facility ✓
 - Revert managed and shipped from customers worldwide
 - Revert prepared, stored and available to meet known melt demand – readily available*
 - Revert is utilised sooner and alloy bar stick is delivered in time, in full



New 4t furnace commissioned June 2023

Does your current supplier offer this level of expertise and experience?

Superalloy Manufacturing Excellence

- Vacuum melting since 1968
- World's largest selection of VIM furnace capacity options utilising the latest melting technology
- Aerospace, IGT, Additive Manufacturing, Space Exploration and biomedical sectors
- Supplying to the Investment casting and Additive Manufacturing industries
- Over 50-year history of product and process development
- Our expertise adds value to chemical elements to meet customers exacting “chemistries”

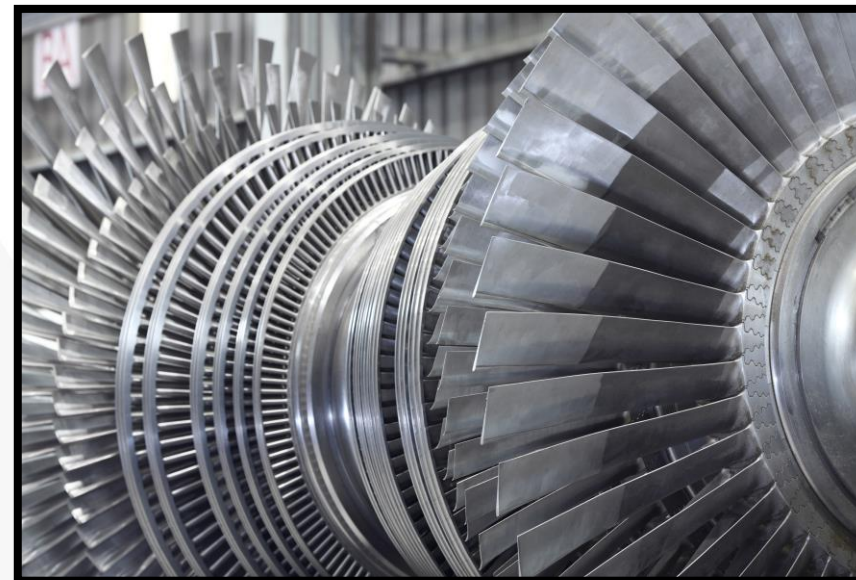
SERVING THE GLOBAL INVESTMENT CASTING COMMUNITY FOR OVER 50 YEARS



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Industry Approvals

- AS 9100: Rev D / ISO 9001: 2015
- ISO 14001: 2015 Environmental Management Standard
- ISO 45001: 2018 Occupational Health & Safety Management
- ISO17025: 2017 Testing and Calibration Laboratories
- Nadcap (MTL)



Copies of all certificates can be provided



Materials Testing Laboratories

Advantages of using Ross & Catherall

Ross & Catherall hold a prestigious position within the investment casting sector for the manufacture of superalloy cast bar stick, leveraging over 50 years of expertise and continuous innovation in vacuum melted superalloy production, while supplying our knowledge to your specifications

- We are a technological, quality and service orientated supplier with the most flexible melting capabilities of any superalloy manufacturer worldwide.
- Largest volume capacity options worldwide of any superalloy cast bar stick manufacturer - choice of 8 VIM furnaces ✓
- Located “centrally” to all major Aerospace & IGT producers ✓
- Alloy cleanliness ✓
- Delivering Low N <5ppm ✓
- Delivering Low S & Super Low S < 3ppm and < 1ppm ✓
- Fully accredited laboratory with ISO17025:2017 & Nadcap approvals ✓

Your trusted partner in advanced superalloy solutions

Customer Approvals

- Safran (Aircraft - Lab 445; Helicopter - AA14507).
- Rolls-Royce
- Honeywell Aerospace
- Pratt & Whitney Canada
- GE Aviation
- Mitsubishi
- MTU
- ITP Aero

- Approvals include supply of 1st, 2nd & 3rd generation SX alloys.



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