

A worker in an orange safety suit and white hard hat is working on a large industrial fuel nozzle. The worker is wearing safety glasses and earplugs. The nozzle is a complex, cylindrical metal structure with various components and pipes. The background shows a large industrial facility with various pipes and structures.

Accessories &
Components,
Aberdeen

Heavy Industrial Fuel Nozzle
Overhaul Capability

OCTOBER 2025



Contents

This slide pack focuses on the following:

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Aberdeen Facility History



Accessories & Components locations



Overview of our regulatory approvals



- **AS9110** - This is the aero version of the ISO 9001-2015 and is a more comprehensive quality management system approval
- **CAA (Civil Aviation Authority)** - This covers us to repair aircraft engine fuel nozzles and accessories under the UK authority.
- **FAA (Federal Aviation Administration)** - This covers us to repair aircraft engine fuel nozzles and accessories under the US authority which also covers us for the majority of the world



Overview of our OEM approvals



- **Advanced Atomisation Technologies (AA Tech)** - This is the OEM of the GE LM series fuel nozzles and premixers and is a JV between GE Aviation and Parker Aerospace. Ties into the above GE approval
- **Woodward** - This is the OEM of certain GE LM series accessories. Ties into the above GE approval. We are an AISF (Authorised Independent Repair Facility)
- **Parker Aerospace (Hannifin)** - This is the OEM of certain GE LM series accessories. Ties into the above GE approval. We are approved to repair and overhaul the Lube & Scavenge Pumps



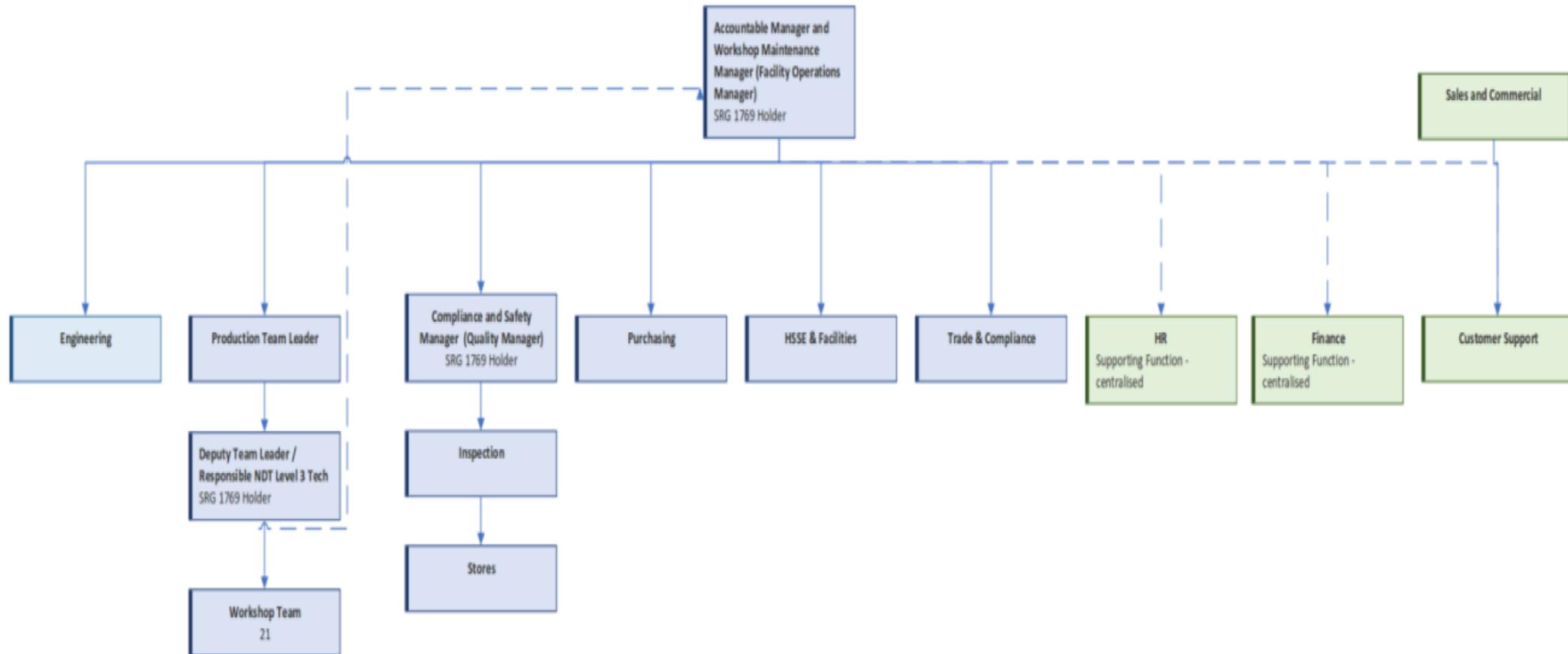
Overview of our OEM approvals



- **Hydra Service (aka Dynapower)** - This is the OEM of hydraulic starters and pumps found on the GE LM series GTs as well as Solar GTs. We are approved to repair and overhaul their product
- **Siemens** - On the ex Rolls-Royce industrial engines (RB211, Avon, Olympus and 501K) we are approved to repair and overhaul fuel burners and numerous accessories.



A&C Aberdeen – Personnel – Management Organisation Chart



A&C Aberdeen – Personnel – Manpower Resources



EthosEnergy Accessories and Components Aberdeen employ around 32 full-time employees to support the business.

These employees are approximately split into the following categories:

(Due to the size of the organisation and activities carried out some employees are included in more than one category)

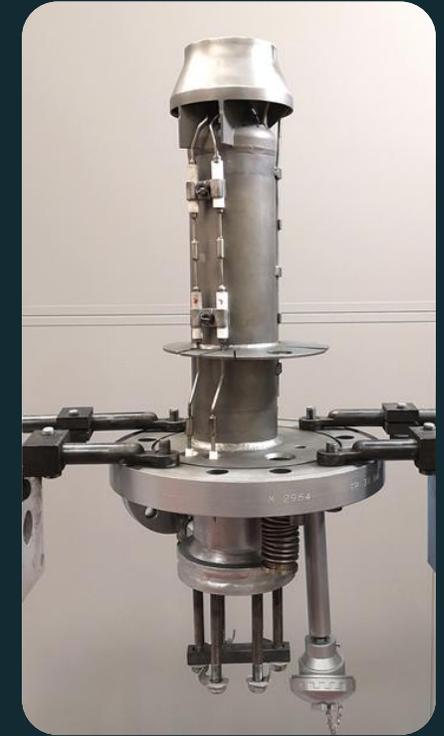
Category	Personnel Qty
Management	25
Technical Supporting Staff	36
Compliance Monitoring Staff	10
Safety Management Staff	10
Certifying Staff	15
Base Maintenance Support Staff	15
Maintenance Technical Staff (Workshop)	257
Stores and Procurement Staff	18
Trainee Staff	4
Contracted Staff	2

Heavy Industrial Fuel Nozzles – Capability List



GE Frame
MS3001
MS3002
MS5001
MS5002
MS6001B
MS6001FA
MS7001B
MS7001EA
MS7001FA
MS7001FA+e
MS9001B
MS9001E
MS9001FA
MS9001FA+e

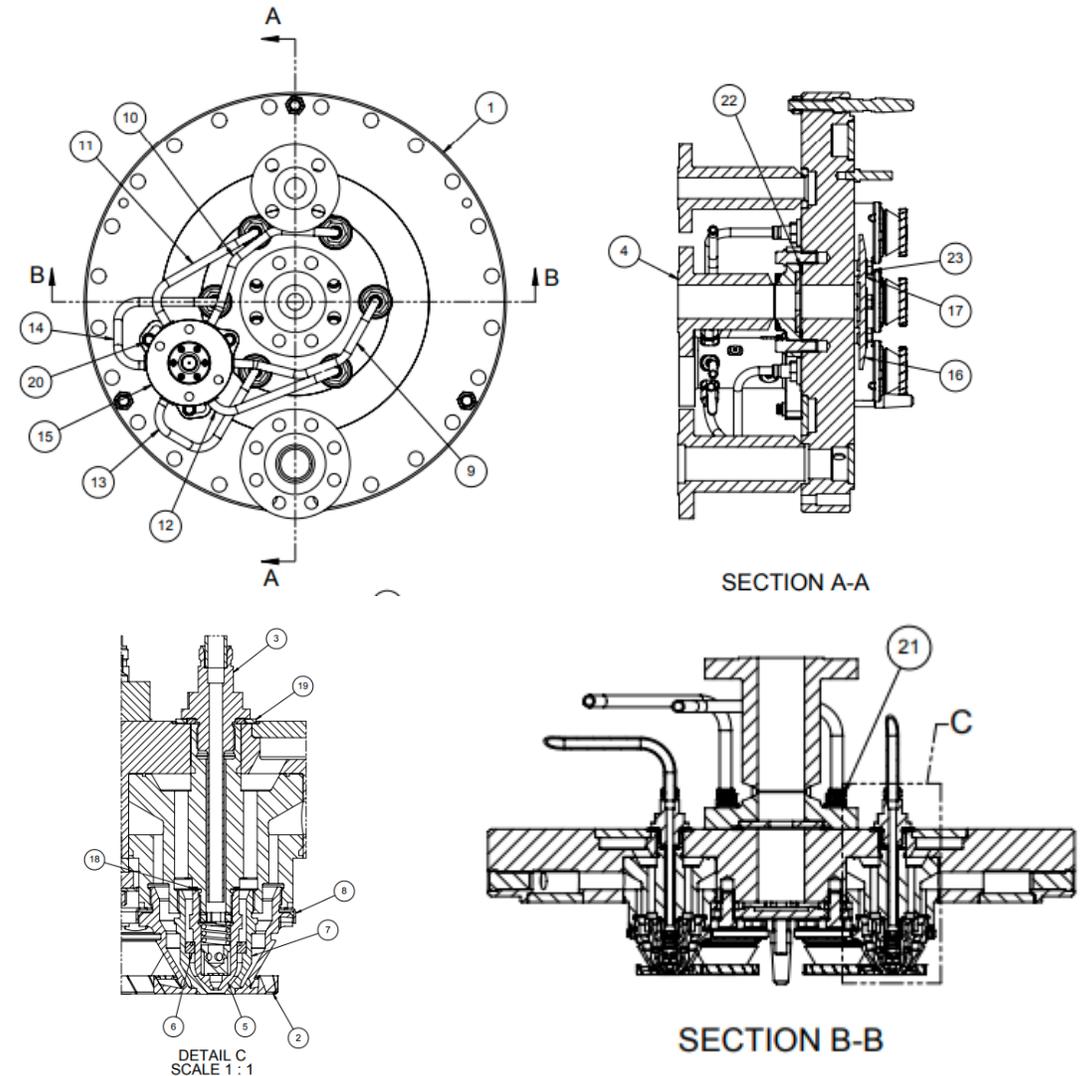
Other	
Siemens	V64.3
	V84.2
	V93.1
	V94.2
Hitachi	H-15
	H-25
GE Alstom	GT11
	GT13DM
	GT13E2
MHI/SW	191
	251
	301
	501
	701



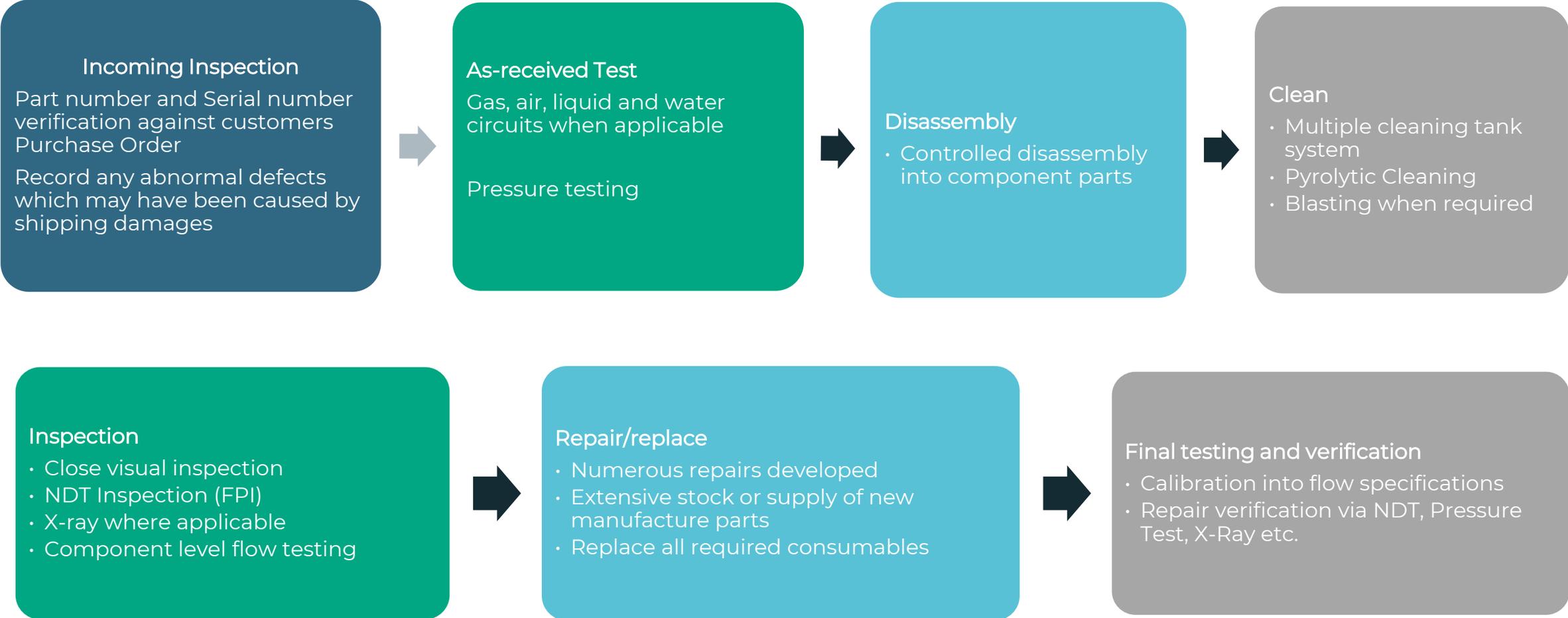
A&C Aberdeen Fr6FA / MNQC / Syngas Fuel Nozzle History



Date Processed	QTY
2017	3
2018	2
2019	5
2020	1
2021	3
2022	4
2023	3
2024	5
2025	2



Heavy Industrial Fuel Nozzles – Work Method Overview



Heavy Industrial Fuel Nozzles – Work Method Overview



Incoming Inspection

Upon receipt of shipment, all components are removed from as-received packaging at our incoming inspection department, and an initial visual inspection is performed, with a focus on the following:

- a) Part number and Serial number verification against customers Purchase Order
- b) Any abnormal defects which may have been caused by shipping damages

Unboxed components are then booked in and processed within our Heavy Industrial Cell within the EthosEnergy A&C Facility in Aberdeen, where the following initial processes will take place:

- a) Part Number and Serial Number verification against internal paperwork
- b) Borescope inspection performed on internal passages prior to flow testing

Heavy Industrial Fuel Nozzles – Work Method Overview



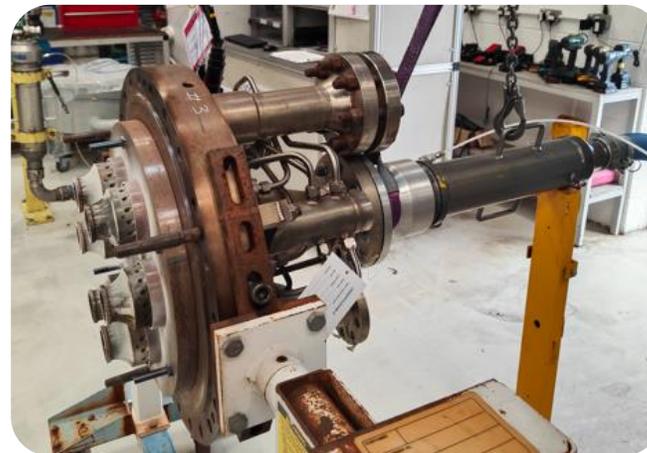
As-Received Testing

Nozzles are subjected to flow testing on all required passages to assess as-received (pre-clean) condition of passages, gather data, and check whether they are flowing within the required flow specification limits.

Capabilities and equipment for Both Gas/Air passage and Liquid fuel/Water test equipment is available on site, with all equipment regularly calibrated as per manufacturer/EE A&C quality system requirements.

All results are recorded on engineering-controlled Test Data Sheets and stored in the relevant job file.

Additionally pneumatic and hydrostatic pressure tests are performed to check the integrity of the nozzle.



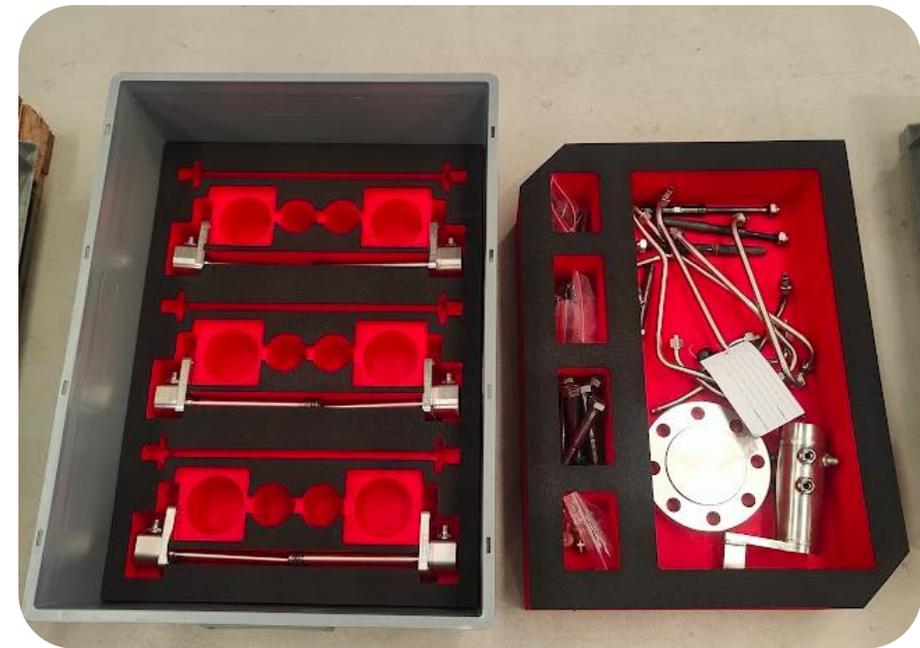
Air Flow Testing

Heavy Industrial Fuel Nozzles – Work Method Overview



Disassembly

Following as-received testing, parts are then fully disassembled into component parts, with each part clearly marked for identification with the nozzle assembly S/N and position. All parts from each individual nozzle assembly are then segregated and stored as per the corresponding S/N.



Heavy Industrial Fuel Nozzles – Work Method Overview



Cleaning

All nozzle components are subjected to caustic cleaning in a multi-stage chemical solution system, used to break down carbon deposits (internally and externally), oils, grease, rust, discolouration, etc.

If required pyrolytic cleaning is also available at the EthosEnergy A&C facility but is only used to remove contaminants which haven't been successfully removed with Caustic cleaning methods.

Grit blast capability is also available on site, to remove any heavy contamination or paint prior to chemical cleaning, or to provide a required surface finish to specific components.



Multi-tank Cleaning System

Heavy Industrial Fuel Nozzles – Work Method Overview



Inspection

Upon completion of the cleaning of the nozzles, visual and dimensional inspection, and NDT commences to assess the condition of the nozzles in accordance with EE A&C inspection documentation. The following areas are examples of features and defects which are addressed during the inspection process:

- Condition of all welds via NDT (Fluorescent Penetrant Inspection)
- Condition of hot side components (gas swirlers etc.) for cracking, wear, thermal degradation etc. – Visual, Dimensional, NDT (FPI)
- Metering orifice condition – Dimensional, Visual, Flow Testing results
- Inlet flange sealing face condition – Visual, Leak test results
- Thread condition – Visual, Gauges
- Borescope Inspection of internal passages
- General assessment of integrity and serviceability of all components

Results of the inspection process are recorded on engineering-controlled Inspection Process Cards and stored in the relevant job file. A report is also issued to the customer, summarising all findings and recommended repairs.

Heavy Industrial Fuel Nozzles – Work Method Overview



Repair

Upon approval of repair quote, the recommended repairs highlighted in the inspection report / repair quote will be carried out to bring the nozzles back into a serviceable condition.

All Machining, Welding, Brazing, processes required for the repair workscope are performed within the EthosEnergy A&C Facility in Aberdeen with all repairs carried out in accordance with EE processes and criteria, which maintain the OEM standards and functionality of the parts.



Heavy Industrial Fuel Nozzles – Work Method Overview



Final testing and verification

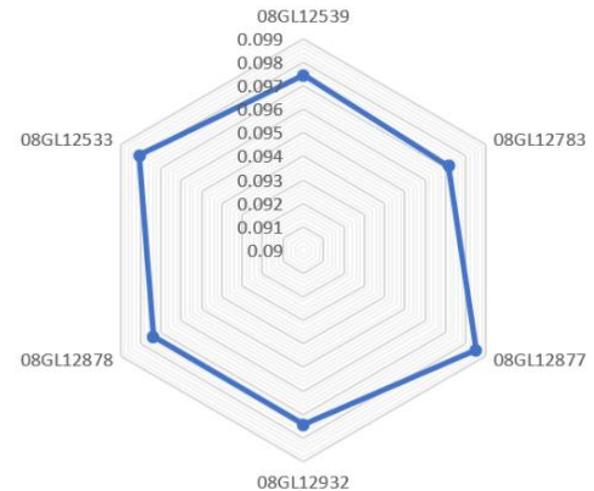
Upon completion of repairs, nozzles are subjected to the following testing to confirm the integrity of the repairs:

- Dimensional and Positional checks
- Pneumatic / Hydrostatic pressure testing
- Radiographic inspection (where required)
- Fluorescent Penetrant Inspection
- Final flow and calibration of all passages

All operations highlighted above are completed in accordance with EE A&C requirements.

With the values obtained after the final flow testing and calibration process, a recommended nozzle position chart can be generated:

6.3 Recommended Position Chart



Position	S/N	PM1 Inner Flow
1	08GL12539	0.09744
2	08GL12783	0.09715
3	08GL12877	0.09850
4	08GL12932	0.09744
5	08GL12878	0.09738
6	08GL12533	0.09807

Process Paperwork – Route Card Example



Date Required **25-Aug-2025**

EthosEnergy Accessories and Components Limited

Date Received 11-Aug-2025
 Work Order Type Repair
 Part Number 119E9942G033
 Part Description GE FRAME 6FA U.3 - ALT

WO Qty 6
 Prepared By -
 Revision Number -
 Revised Date -
 Product Manual -
 OEM Manual
 Date Printed 17-Oct-25

Serial Number 10844371, 10844372, 10844373, 10844374, 10844375, 10844376

Work Order Number **AB826053**

Customer Number WOOD45
 Parent Order AB9015557
 Sales Order AB9015557

Notes:

Page: 1 of 3

Sales Order Work Instructions

Operation Number	Repair Scheme	Operation Description	Sch. Comp. Date	Completed By	Date Completed
0010	RECEIPT TO BASIC	RECEIVE IN INSPECTION Check P/N's and S/N's match those stated on route card and authorisation for work.			
0020	RECEIPT TO BASIC	GATE REVIEW Perform gate review on incoming job to ensure all P/N's, S/N's, paperwork is in order.			
0030	RECEIPT TO BASIC	BORESCOPE INSPECTION Borescope as per COP 2.12. CTQ - SAVE VIDEO IN G DRIVE			
0040	RECEIPT TO BASIC	AS RECEIVED FLOW TEST Flow gas, air, liquid, and water passages as per COP 4.01, COP 4.02, and TDS 119E9942G003 Record results on TDS 119E9942G033 PASS: _____ OR FAIL: _____			

Date Required **25-Aug-2025**

EthosEnergy Accessories and Components Limited

Parent Order AB9015557

Page: 2 of 3

Serial Number 10844371, 10844372, 10844373, 10844374, 10844375, 10844376

Work Order Number **AB826053**

Operation Number	Repair Scheme	Operation Description	Sch. Comp. Date	Completed By	Date Completed
0050	RECEIPT TO BASIC	DISASSEMBLY Disassembly nozzle under guidance of Engineering. Development work is required - ensure photographs are taken at every stage and retain any seals or consumables that are removed.			
0060	RECEIPT TO BASIC	CLEAN Clean all of the disassembled components as per COP 8.20-ABZ.			
0070	RECEIPT TO BASIC	PRESSURE TEST HOUSING Perform pneumatic pressure test of cover Record results on TDS 119E9942G003			
0080	RECEIPT TO BASIC	PRESSURE TEST LIQUID AND WATER CART Perform pneumatic pressure test of liquid and water cartridge at 200PSIG. No leakage is allowed.			
0090	RECEIPT TO BASIC	FPI Fluorescent Penetrant inspect cover as per COP 2.06 - Method A or C - Sensitivity Level 3 No cracking is allowed PASS: _____ OR FAIL: _____			
0100	RECEIPT TO BASIC	FPI Fluorescent Penetrant inspect swirl plates as per COP 2.06 - Method A or C - Sensitivity Level 3 No cracking is allowed PASS: _____ OR FAIL: _____			

All components being processed through the A&C facility are controlled via engineering-issued Route-cards which detail all required operations, along with all relevant manuals, process instructions, test data sheets, etc. This paperwork is generated before the job commences and stays with the job until it leaves the facility

After an operation is completed, it is stamped and dated by the technician who performed the task

Process Paperwork – Test Data Sheet Example



All results are recorded on engineering-controlled Test Data Sheets and stored in the relevant job file. An example of a Test Data Sheet is shown below:



TEST DATA SHEET
 Sheet 1 of 1

TDS 119E9942G033
 REV 0, 20 Aug 25

Sales Order Number	AB9015557
P/N	119E9942G033
Generic Part Number	F6-FA-4M9QC
Customer	

Export Control				
US Technology Content			Yes	No
			X	
Classification (ECCN)	US	EU	Swiss	Thai
	EAR99	EAR99		

This document is subject to United States Export Administration Regulations ("EAR", 15 CFR Parts 730-774), United States International Traffic in Arms Regulations ("ITAR", 22 CFR 120-130), European Union, Swiss and/or other national export control regulations. Diversion contrary to United States and/or other applicable national law is prohibited. Chinese Disarmament Undertaking and United States Export Administration Regulations ("EAR", 15 CFR Part 730-774), United States International Traffic in Arms Regulations ("ITAR", 22 CFR 120-130), Europäische Union, Schweiz und/oder anderen nationalen Ausfuhrkontrollbestimmungen. Eine Umleitung, die gegen diese Bestimmungen verstößt, ist ausdrücklich untersagt.

Highlight accordingly: AS RECEIVED POST CLEAN FINAL

Max	0.1076	0.3902	0.0000	2181.0000	3000.0000
Min	0.0704	0.3456	0.0000	1056.0000	2705.0000
Average	0.0941	0.3657	#DNV/!	1826.8333	2910.8333
Range (%)	39.57%	12.21%	#DNV/!	61.58%	10.13%
±%	19.79%	6.10%	#DNV/!	30.79%	5.07%

TEST LIMITS	-	-	-	-	-
Serial No.	Natural Gas @ 1.25PR	Syngas @ 1.25PR	N2/Steam @ 1.25PR	Liquid @ 100PSI	Water @ 100PSI
371	0.10143	0.34556	N/A	1815	2955
372	0.10763	0.35401	N/A	2181	2983
373	0.09882	0.35548	N/A	1894	2948
374	0.08163	0.38528	N/A	1056	2705
375	0.07039	0.39020	N/A	2021	3000
376	0.10479	0.36387	N/A	1994	2874

Process Paperwork – Inspection Report Example



INSPECTION REPORT

Customer	EthosEnergy Thailand
Customer PO Number	770682
Part Description	Frame 6FA MNQC Syngas Dual Fuel Nozzles
Report No	AB9015557-250919 Rev 1
Report Date	25 th September 2025
Author	Liam Watson
Revision Date	14 th October 2025
Revised By	Liam Watson

Export Control				
US Technology Content			Yes	No
			X	
Classification (ECCN)	US	EU	Swiss	Thai
EAR99	EAR99			

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	N2/Steam @ 1.25PR	Liquid Fuel @ 100psig	Water @ 100psig
5	-	1815	2955
6	-	2181	2983
8	-	1894	2948
9	-	1056	2705
10	-	2021	3000
17	-	1994	2874
	-	1826	2910
	-	2181	3000
	-	1056	2705
	-	61.58%	10.13%

are reported in effective area (in²)
are reported in pounds per hour (PPH)

passages during as-received flow testing. This wear to the internal components of the nozzle as the N2/Steam passage was blanked off upon or performed. All tested passages are expected and to a tight flow spread following cleaning, Section 4 of this report, and the final flow and

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Criteria Finding Disposition

Parts are to be visually inspected for damage, erosion, wear, and deformation to the required dimensional values.

Fail - Parts eroded and undersized. See recorded dimensional values.

Perform a repair to replace the worn liquid cartridge tips.

Minimum vane OD

Measured OD Dimension

0.531"

0.480"

44371

Minimum vane OD

Measured OD Dimension

0.531"

0.526"

44372 (1)

EthosEnergy Accounts & Components, 10 International Avenue, Avonlea, A621 0B1, UK
80 Prospect Hill Road, East Windsor, CT 06088, USA

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Criteria Finding Disposition

Parts are to be free of indications / defects / cracking.

Fail - Parts are cracked

Perform a repair to replace end cover these gas swirlers.

End Cover Gas Swirler Cracking – Example 1

End Cover Gas Swirler Cracking – Example 2

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gas Dual Fuel nozzles discussed have been as-received tested, dimensionally inspected, NDT inspected, and Section 4 of this report in order to be returned to a

get in touch with our customer support team, sales@ethosenergy.com if you require any further information

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End Photographs

Received (Hot side) with Evidence of DFI

2 - Nozzle Received (Cold Side)

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80 Prospect Hill Road, East Windsor, CT 06088, USA

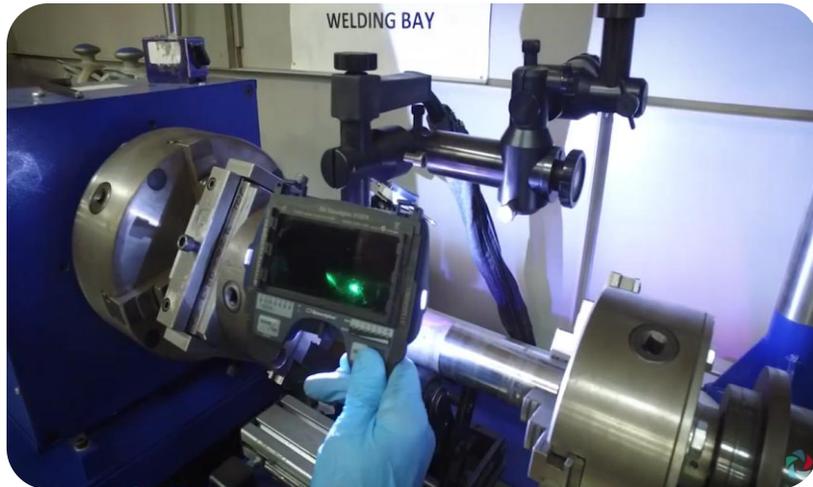
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Repair Capability – Welding



- In-house welding capabilities for repair processes
- Welding personnel approved to AWS D17.1 for multiple material groups
- Manual TIG and automated rotary TIG welding equipment
- Welding processes approved and verified as per EE A&C controlled operating procedures



Repair Capability – Machining



In-house machining capability for all nozzle repair work:

- Lathe Operations
- Milling Operations
- EDM (Electrical Discharge Machining)
- Custom tooling and fixturing design and manufacture





Repair Capability – Vacuum Brazing

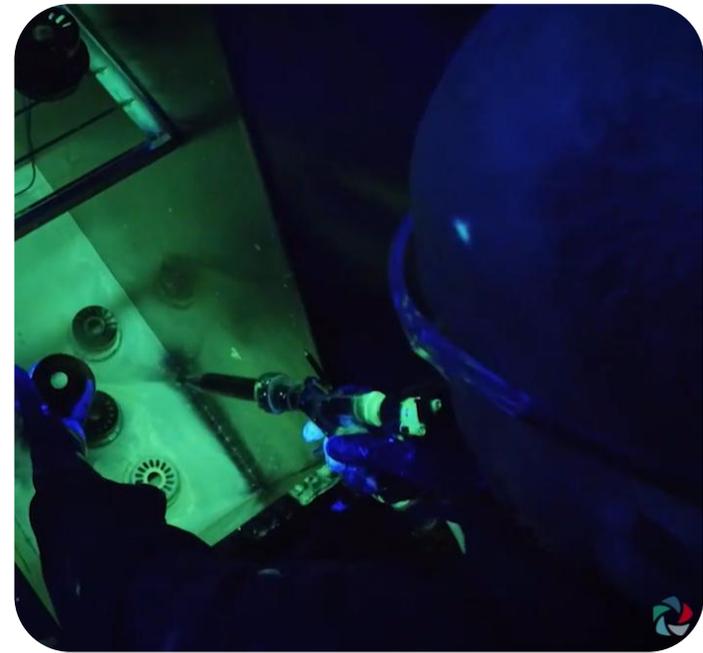
In-house vacuum brazing and heat treatment capability for all nozzle repair work:

- High joint strength and integrity: Creates strong, void-free, and leak-proof joints.
- Cleanliness: Produces flux-free joints with no residue.
- No flux required: Eliminates the need for a flux and the subsequent cleaning required to remove it.
- Joins dissimilar materials: Can be used to join parts made of different metals and even ceramics.
- Stress reduction: Slow heating and cooling rates minimize thermal stress and distortion in the parts.



Non-Destructive Testing Capability – FPI

- In-house fluorescent penetrant inspection (FPI)
- Level 3 Certified Tech and two Level 2 Certified Techs
- Three lines giving range of sensitivity and methods
- Level II,III and IV Methods A,C & D



Special Coating Capability



- In-house advanced coating and refurbishment facility equipped to process all combustion and hot-gas-path components for GE Frame, Siemens, and MHI gas turbines.
- Comprehensive surface restoration technologies, including precision machining, vacuum brazing, and high energy thermal spray systems (HVOF, Plasma, and Arc Spray) for metal and ceramic coating applications.
- MCrAlY bond coatings applied for oxidation and corrosion resistance, ensuring reliable performance under severe thermal cycling conditions.
- Thermal Barrier Coatings (TBC) utilizing high-purity yttria-stabilized zirconia, applied with controlled porosity and thickness uniformity to extend part life and reduce metal temperatures.
- Abrasive-resistant coatings applied on shrouds, liners, and transition pieces to minimize wear and maintain tight clearances during operation.
- In-house heat treatment and diffusion-bonding processes to achieve metallurgical integrity equal to or exceeding OEM standards.
- Full coating inspection and qualification capability, including metallographic cross-section analysis, bond strength testing, and coating thickness verification per AS9100 and ASTM standards.
- Certified coating technicians trained to aerospace and power-generation specifications, ensuring repeatability and traceability across all operations.
- Integrated quality management system (ISO 9001 & AS9110) governing every stage of refurbishment from surface preparation to final coating verification, ensuring the highest standard of durability and performance.

Contacts

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EthosEnergy