



Technology developments

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Powering Business Worldwide

Fluid & Electrical Distribution Division

FED

Employees: 2,891
Facilities: 13
Divisional product lines: 20

Unique part numbers: 43k
Annual shipments: 17m units
Global customers: 804

North America

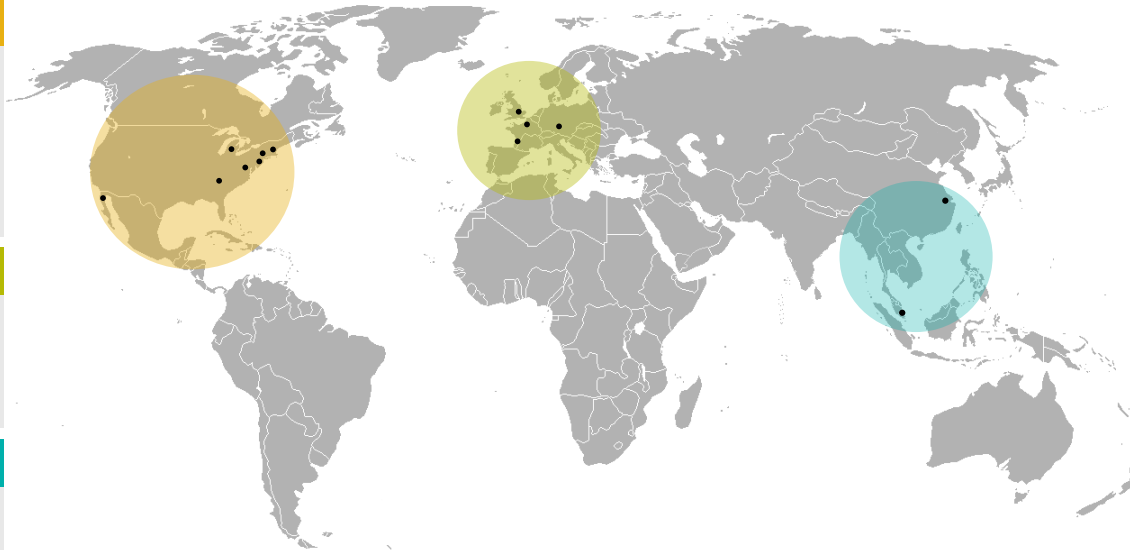
- Jackson, MI
- East Providence, RI
- Bethel, CT
- Glenolden, PA
- Beltsville, MD
- Toccoa, GA
- Tijuana, Mexico

Europe

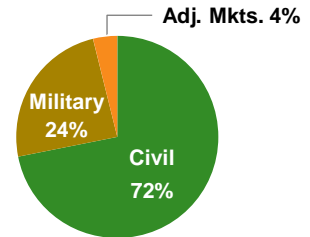
- Lakeside, UK
- Coignieres, France
- Gilching, Germany
- Serres-Castet, France

APAC

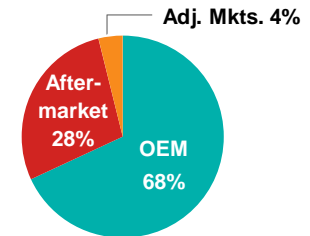
- Shanghai, China
- Batam, Indonesia



Civil / Military



OEM / Aftermarket























Fluid & Electrical Distribution Division

A collection of 20 diverse product lines in 3 business units



Conveyance
 Ducting & Sealing
 Sensing

Low/med pressure hose	High pressure hose	Tube assemblies	Quick disconnects	Coupling solutions
				
Axial fittings	Internal fittings	Flexible joints	Clamps & flanges	Low pressure ducting
				
Flexible couplings	Dynamic seals	Static seals	Accumulator devices	High pressure ducting
				
Debris monitoring	Pressure switches	Pressure transducers	Fluid system accessories	Solenoid valves
				

Aerospace industry trends

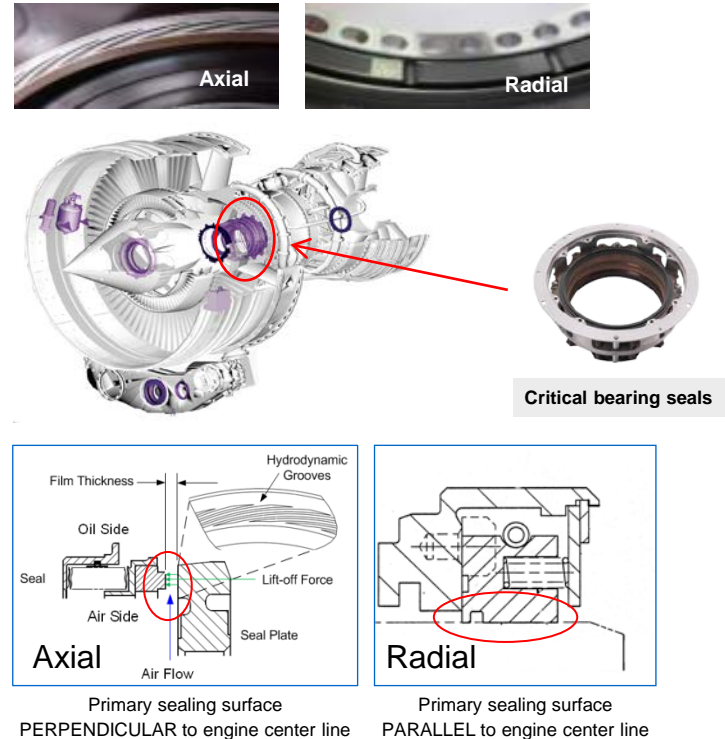
- Changing aircraft & engine architecture
 - More electric Aircraft / Electric power distribution
 - Use of composites driving weight and regulations (e.g. lightning)
 - lightweight materials / Weight reduction
- Diagnostics / health monitoring / intelligent systems
 - Integrated component performance sensing and diagnostics
- Cost of ownership / operating cost
 - Component cost - relentless price pressure
 - Reduce fuel burn - efficient, lighter weight components and systems
 - Increased equipment Life (extended overhaul periods)
- Aircraft build volumes (increasing)
- Mature technology (TRL6) is required at program launch



Engine sealing

Main shaft hydrodynamic oil seals

- Leading developer of next-generation hydrodynamic seal technology – both axial & radial configurations
- Introduces a stiff air film at the rubbing contact interface
- Applicable to small and large engines
- Hydrodynamic technology enables...
 - Increased efficiency - faster seal rubbing speeds
 - Reduces frictional heat generation by over 90%
 - Enables predictable performance vs time
 - Significantly reduces seal 'wear' rate / extends life
 - Extends projected life > two service intervals
- Current TRL 8+ (axial) and TRL 6 (Radial)
- Also developed for APU's & accessory gearbox seals



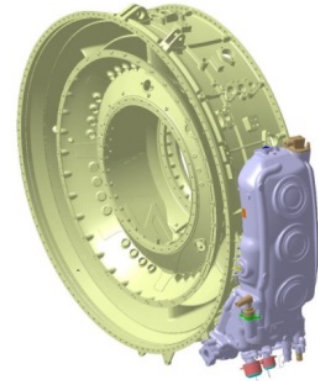
Health monitoring

Advanced Debris Monitoring (ADM)

- On-board debris condition monitoring system that detects ferrous, non-ferrous and non-metallic material in engine oil
- Provides on-condition debris monitoring of multiple materials
- Enabling technology for non-metallic bearing insertion
- TRL6 in 2017

Oil Condition Monitoring (OCM)

- Real time oil monitoring capability that detects the antioxidant depletion in turbine engine oils
- Quantifies depletion and provides on-condition prediction of remaining oil life
- Replaces oil sampling, reduces oil use
- TRL 6 in 2017



Fittings development

AeroLok™ fittings

- A reliable lightweight aerospace fitting connection system as a drop-in replacement for the standard B-Nut
- Designed for both rigid tube & flexible hose connections
- Quick, Simple tool free attachment - No torque wrench
- Lower profile than threaded connectors
- Connects in 5 sec; ~30% lighter, smaller diameter
- Qualified in 2016
 - Phase 1 - Develop 3000psi CRES – Qualified in 2016
 - Phase 2 – Develop 1500 psi Al. – Qualified in 2016 / 2017
 - Phase 3 – Develop 5000psi Ti. – Qualified in 2017 / 2018
- Significantly reduces installation and inspection time
- Large impact on full aircraft assembly time



Hose developments

Fireproof hose

- Introducing a lightweight fireproof '1200 Series' hose family
 - 20% lighter than baseline 400 series hose
 - Smaller outer diameter
 - No impact to the bend radius/flexibility
 - TSO-C140 Certification scheduled for end of 2016



High pressure Kevlar® hose

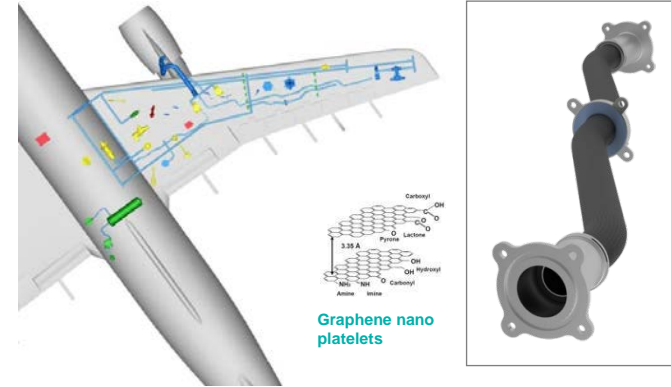
- Currently developing a high-pressure hose and fittings assembly to address in-service Teflon microvoid induced weepage
- Developed an upgrade to existing 5000psi Kevlar Hose
 - Modified PTFE hose and improved braid package (AE334+)
 - Qualify one size in 2016, remainder in 2017
 - Developed non-PTFE hose material to eliminate microvoids (NGH)
 - On hold pending AE334+ demonstrated test performance



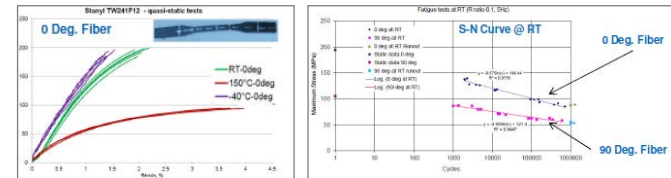
Materials and process

Non-metallic components

- Several projects positioning for weight reduction, fuel efficiency, architecture technology shift and regulatory drivers for next generation aircraft
- Partnering with Corporate Research & Technology (CRT)
- Non-Metal fuel conveyance & couplings
 - Joint development with OE as part of Innovate UK.
 - TRL 5 planned for 2016
- Lightweight high pressure tubes
 - Technology exploration
 - TRL 3-4 in 2016
- Non-metallic air ducting & couplings
 - Multiple manufacturing methods under development
 - Leading method to TRL6 in 2016
- Materials development / characterization



Materials Characterization & Allowable limits





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