GKN Aerospace - A global First Tier Provider

SW Regional Development Agency
&
Japanese Aerospace Mission – Great Nagoya
23rd March 2010
Agenda

Presentations
  • GKN Aerospace & Composite Capability
  • Filton
  • Research & Technology Initiatives

Q&A, Open Discussion & Lunch

Site Tour
  • Manufacturing
  • A380 FTE Assembly
  • Systems
GKN plc

➢ GKN can trace its roots directly to the origins of the industrial revolution
  ➢ Once the world leader in iron and steel production
  ➢ The business changed its focus over the last 25 years of the 20th century

➢ Now a leading supplier to the world's automotive and aerospace primes
➢ Strategic focus on high growth and high technology
GKN: leadership in four specialist, global sectors
$7,616M - 2008 Revenue

<table>
<thead>
<tr>
<th>Sector</th>
<th>Sales</th>
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<tbody>
<tr>
<td>Automotive</td>
<td>$4,032m</td>
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<tr>
<td>OffHighway</td>
<td>$912m</td>
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<tr>
<td>Powder Metallurgy</td>
<td>$1,019m</td>
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<tr>
<td>Aerospace</td>
<td>$1,653m</td>
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Operating in over 30 countries
35,500 people in subsidiaries and joint ventures
GKN Aerospace $2.4Bn 2009

Market

Business Mix

Sector

Customer Base

AIRBUS  Sikorsky
A United Technologies Company

Rolls-Royce

BOEING

Cessna
A Textron Company

imagination at work

Aviation Partners Boeing

Honeywell

Northrop Grumman

Goodrich

Airbus Helicopters

Spirit Aerospace

BAE Systems

Honda

Raytheon

AgustaWestland

Pratt & Whitney
A United Technologies Company

Bombardier

EXPECT MORE
GKN Aerospace Organisation

- Integrated Aerostructures
- Propulsion Systems
- Special Products

- Focussed business sector groups
- Coordinated Customer approaches
- Common Technology plan
- 2009 Revenues

$1.6BN

$500M

$300M
GKN Aerospace Growth Path

> St Louis-2002
  > Secure military position
  > Major Boeing Military relationship

> Stellex-2005
  > Complimentary to ST Louis
  > Boeing Commercial position on B787

> Teleflex-2007
  > Extend to engine hot section
  > Secure major GE relationship

> Rolls-Royce Composite Fan Blade JV-2008
  > Positioning for Next Gen Single Aisle
  > Strategic Partnership with RR

> Filton -2009
  > Major capability expansion and A350 position
  > Strategic position with Airbus

Focussed Strategic Acquisition Coupled to Business Integration
GKN Aerospace Today - Global Footprint

- North America - 5000
- Mexico - 200
- South America - 60
- Europe – 4350
- Asia - 13
- Australia - 240

- 10000 Employees Worldwide
- 800 Design and Stress Engineers
GKN Aerospace - Positioned for the Future

(Ship Set Values US$m)
Strength in Engineering

- **Airbus A350**
  - Integrated Wing Trailing Edge Assembly
  - Design, Development and Productionisation
  - Auto Fibre Placement and Automated Assembly

- **Boeing 787**
  - Wing Leading Edge Ice Protection System
  - Design, Development and Certification
  - Full Ice performance analysis and test

- **Bombardier Challenger 300**
  - Integrated propulsion system
  - Design, Development and Certification
  - Far 25/ Far 33 certification

- Engineering teams in UK, US and Australia – 24 hour “follow the sun” capability
- Over 600 GKN Design and Stress engineers supporting international customer Programmes
**GKN Aerospace – A Technology Leader in Aerostructures and Engine composites**

### Aerostructures Composites
- **A380** - Composite Wing Trailing Edge
- **A400M** - Full composite Primary wing spar
- **F22** - Composite Sine Wave Wing Spar
- **JUCAS** - Composite wing and fuselage structure

### Engine Composites
- **F35** - All composite engine Integrated Front Frame and Ice Protection System
- **RR** - Composite Fan Blade development JV
- **GENX** - All composite Engine fan case
Engine Products

Nozzle and Duct Systems

Exhaust Systems

Fan Modules

Turbine Exhaust Cases

Fan Blades

Complex Welded Assemblies
Turbofan & Turboprop Nacelles

- **Leader** in turboprop and small/medium jet nacelles
- **Design through** to full **in service support**
- **Major participation in large fan nacelle** components

- Gulfstream G100/G150/Dassault Falcon 50EX
- Bombardier CL300
- Lockheed Martin C-27J
- Lockheed Martin C-130J
- A330 Trent 700 Fan Cowl Door
- Bombardier Dash 8 - 400
Canopies and Transparencies

- Aircraft transparencies
  - Complete range of applications - commercial & military transports, military fast jet, business and regional jets, and helicopters
  - Leading provider of military canopies-F35/F22/F18
  - Specialty coatings for UV protection, stealth requirements, moisture barriers, abrasion resistance
  - All materials covered - glass, acrylic and polycarbonate

Canopies and Windshields for Military Applications

- Cockpit Windshields, Cabin Windows and Wing Tip Lenses
- B747 Windshield
- B787 Passenger Windows
GKN AEROSPACE

COMPOSITE CAPABILITIES
Composites At GKN Aerospace

> #1 Independent user of composite materials
> Comprehensive capabilities,
  > Design, manufacture, test & certify
> Full range of technologies and materials
  > Automated tape laying
  > Fibre tow placement
  > Filament winding
> Advanced composite manufacture and bonding
> Highly loaded complex structures
> Market leader in RFI and RTM technology
> Automation
> 23 autoclaves worldwide
  > 50 feet (15m) maximum length
  > 15 feet (4.6m) maximum diameter
> Composite Research Centres
  > UK & USA
Composite Development At GKN

- Wider use of RTM and RFI
- Automated tape laying and tape winding
- New material developments
- New tooling approaches
- Embedded sensor technologies
- New products
  - Composite fan blades
  - Fan case and inlet casings
  - Fan containment case
  - Aft mount frame
- Further weight and cost benefits
- High temperature materials
Composite Research Centre, UK

- Purpose designed facility based at Cowes
- Investigation to include fibre placement, thermal forming and composite automation
- Dedicated Resources
  - Twenty Scientists and Engineers
  - Materials Laboratory
  - Double Diaphragm Forming Machine
  - RTM capabilities
  - Freezer, Ovens and Clean Room
  - ATL Machine and 3-Axis Profiling Machine
- Working Closely with Rolls-Royce and Airbus
- Second CRC located in USA
Investment In Manufacturing

- Investment in state of the art advanced composite manufacturing facility
- Capable of producing one piece sections upto 15m in length
- Self contained automated manufacturing facility
  - Automated tape layer (20m x 4m bed)
  - Hot drape form (17m length)
  - Autoclave (15m x 4.5m diameter)
  - 5-axis Router (20m x 4m bed)
- Utilisation of air bearing technology capable of moving upto 13 tonnes
- Utilisation of lean initiatives and concepts such as “Coefficient of Transportation Difficulty” (CTD)
GKN selected (in 2007) for the design & manufacture of the rear spar and the assembly of the trailing edge requiring significant programme investment

- Design and Build Risk Sharing Partnership
- Committed to $280M over the next 5 years
- Engineering team assembled and on program
- Spar manufacture utilises cutting edge composites processes of Auto Fibre Placement (AFP)
- GKN also selected for the composite flap skin manufacture
A350 XWB Fixed Trailing Edge

Design and manufacture
- Inner, Mid and Outer Rear Spar
- Rib posts
- Root Joint Fittings
- Spar vertical stiffeners
- Spar Joints

First Delivery (into FTE Assembly): 18 August 2010

FTE Assembly
The following items are to be assembled onto Rear Spar:
- Rib Posts
- Spar Vertical Stiffeners
- Spar Join up
- Trailing Edge Details
- False Rear Spar Assembly
- Main Landing Gear fittings
- Cantilever Flap Ribs
Trailing Edge GKN Assembly only

INNER REAR SPAR ASSEMBLY

GKN will assemble Fixed trailing Edge components and Main Landing Gear components onto INNER Rear Spar
Trailing Edge GKN Assembly only

**MID REAR SPAR ASSEMBLY**

GKN will assemble Fixed trailing Edge components onto MID Rear Spar
Trailing Edge GKN Assembly only

OUTER REAR SPAR ASSEMBLY

GKN will assemble Fixed trailing Edge components onto OUTER Rear Spar
Airbus A380

- Design & build contracts and build to print contracts across multiple GKN Sites
- Major programme investment
- Fixed trailing edge largest design & build package
- Weight efficient designs
- Lean initiatives have been incorporated during the design for manufacturing phase

- Inner and Outer Trailing Edge Falseworks – matched part composite assemblies
- Wing Trailing Edge Panels – RFI Technology
- Vertical Tail Plane Ribs – Auto Tape Laid primary structure
- Actuator Brackets and rudder support structures – RTM Parts
- Flap Track Beams – close tolerance hand laid primary structure
- Landing Flap spars - Auto Tape Laid primary structure
- Landing Flap skins – Integrated Stringer Panels

Graphical representation of Airbus A380 showing materials and parts used in its construction.
Airbus – A330/A340

- Composites Components
  - Over wing panel
  - Fixed panel
  - Leg fairing
  - Hinge door
  - Lower access panels
  - Upper access panels
  - Outer false works
  - Fan cowl door
  - Outer landing flap
  - VTP and Rudder Spars
  - VTP Leading edges
  - Rudder shells

- Design, build and manufacturing contracts
- Major composite assemblies
- Supporting customer with consistent cost downs
- Over 350 ship sets delivered to date
Airbus A400M – Composite Wing Spar

> First major use of composites for wing spars on military transport aircraft

> 18m profiled close tolerance spars
  > 1,650 lbs of carbon per shipset

> Involved major programme investment including a new state of the art manufacturing facility

> Innovative manufacturing processes include auto tape laying and drape form
Airbus A320 Family

- Composites components:
  - VTP and Rudder spars
  - HTP fairings
  - Landing Flap Spars
  - Airconditioning Ducting

- Supporting rate of over 300 AC sets per year
- Application of automated manufacturing processes including
  - Auto Tape Laying for VTP, Rudder and Landing Flap Spars
  - Tape Winding of air conditioning ducting
- Composite primary structures
- Transfer of packages out of Airbus in order to support customer cost down initiatives
Boeing – C-17

> Design and manufacturing contracts
> Composite contracts include
  > Wing flaps & fixed leading edge
  > Doors
  > Cockpit floors
  > Landing gear pod & pylon skins
> Large fibre-placement technology used on landing gear pod fairings.
> Lean manufacturing techniques deployed to meet aggressive price downs
> GKN Aerospace received Boeing Quality Hero award
Lockheed Martin F/A-22 Raptor

> Multiple contracts various GKN Aerospace centres of excellence
> Current work scope includes composite, titanium metallic and transparency structures and titanium metallic structures
> State-of-the-art-high technology solutions
> Lean manufacturing techniques deployed

Composites Products

> Sine wave wing spars
> Fuselage frames
> Stabiliser kick ribs
> Engine air inlet lips
> Aileron inboard spar
Possible Technology Applications

- Aerostructures, nacelles, engine, transparencies, special products
  - New materials and processes
  - Automation
  - Large scale structures
  - Highly integrated components and products
  - Higher performance products at a lower weight
  - Transition of current technologies to new product applications

- Multiple technology applications
  - At a component level and at a product level
  - Greater benefits to cost and weight
  - Optimisation of products and lifecycle

- Bespoke technical solutions
  - Customer / program specific
  - Technologies to choose from
Kevin Hamesse, Head of Sales & Marketing
GKN Aerospace, Filton
A global tier one partner for advanced integrated wing technologies

World leading capabilities in the design, build & systems integration of major wing assemblies
Filton is at the forefront of GKN Aerospace’s integrated wing technology strategy, combining its industry leading capabilities across metallic wing structures, complex components, systems and major assemblies with a long-term investment plan in advanced composites to create a true single source partner for large complex integrated wing assemblies.

Key Facts

- Turnover £350m
- 1550 employees
- 25,000 parts shipped per week

Facilities

- Filton main: 74000m²
- Filton west: 31000m²
- Room for expansion

Approvals

- POA
- EN9100, ISO14001, ISO 18001
- NADCAP pending

Commercial


Military

A400M, F35

Propulsion

Trent 700

Program Involvement

Research

National Composites Centre — Founding member
Integrated Wing ATVP
Next Generation Composite Wing
In 1910 Sir George White announced funding to develop an aviation industry for Great Britain, to be headquartered at Filton, Bristol. On 19 February the Bristol Aeroplane Company was formed, and within 1 year it was the world’s largest factory. Incorporated into GKN Aerospace on Jan 5th 2009, Filton today represents one of the world’s leading centres for wing assembly.

Business Overview – A century of heritage

1960s British Aircraft Corporation
Concorde
VC10 Tankers

1970s British Aerospace
146 Regional Jet fuselage
Tornado machined components
A310 trailing edge

1980s
A320 wing equipping
F111 re-Life & servicing

1990s BAe Airbus
1st A321 fuselage section delivered
A330/340 major sub-assemblies
Leading & trailing edge
Outer wing box

2000s Airbus UK
A380 components & trailing edge assembly
A400M components, leading & trailing edge

2009 GKN Aerospace Filton
Major sub-assemblies and components across Airbus family
New ‘Filton West’ facility – A350XWB composite wing components & fixed trailing edge assembly
Integrated Aerostructures

World class expertise in the design for manufacture & assembly of major structures, precision components & integrated systems.

Capabilities
- High-speed machining of complex metallic structures & components
- Advanced composites manufacture of primary structures
- Integrated systems
- Major assembly & sub-assembly
- Engineering, Research & Technology
- Life of product support, incl Mods & Spares

Core Products
- Leading & Trailing Edge
- Wing Box
- Spars
- Ribs
- Gear Ribs
- Hydraulics & Pneumatics
Filton A350 Participation

- Design and Build Risk Sharing Partnership
- Committed to $270M over the next 5 years
- Engineering team assembled and on programme
- Dedicated composite facility with latest fully automated fibre placement and assembly – 15m component capability
- Commissioning began Q3 2009
- Capacity for new customer programme introduction
- 5 x AFP Machines
- 2 x Autoclaves
- 3 x 5axis router/water jet machining centres
- 4 x 5axis heavy drilling & fettling machines
the power to perform

GKN Aerospace Technology Overview
Mark Himpson, Head of Engineering - Filton
GKN Leadership in Composites

> Custodians of new technology implementation

> First application of RFI in commercial aircraft – A380

> World’s first large wing composite spars - A400M – automated lay up process

> GEnX filament wound composite fan case – a first for large commercial engines

> F35 (JSF) F135 engine fan inlet – first composite structural front end to a military engine – proprietary RTM process

> B787 first electronic wing ice protection product

> A350 – first Airbus civil aircarft composite wing. First large scale application of AFP
GKN Focused Metallic Structures

- **Leading** the industry in complex, high-speed and large machining
  - Specialising in large scale Aluminium and Titanium parts
- **Specialist** materials and proprietary processes
- **Advanced** chemical milling
- **Leader** in SPF and diffusion bonding
- **Largest Electron Beam welding** capability in N America
- **Major structural assemblies**
- **Rapid turn around** – A380 main wing rib shipped 7 weeks after receipt of order
Technology Strategy

- Strengthen position on core technologies
  - Retain leadership in advanced composite technologies
  - Expand advanced metallic technologies

- Expand niche technology portfolio focusing on differentiating capability
  - Avoid the commoditisation of core technologies

- Focus on integrating technologies and increasing functionality of products to remain competitive
Key Aerospace Key Future Technology Themes

- Advanced Composite Solutions
- Advanced Metallic Solutions
- Future Manufacturing System (Automation, Robotics)
- Advanced Acoustic Treatments
- Advanced Aerospace Surface Treatments
- Embedded Systems & Sensing
Structures Demonstrator Programmes

2008
ALCAS : Primary Spars
Large OOA, Self Heated Tooling

Integrated Wing: Wing Structures
Resin Infusion, OOA

2009
NGCW WP2: Wing Box, NGSA
Higher rate deposition, Bonded Joints, Tooling

2010
Wing Concepts: Novel Structural Designs
Analysis & Demonstrator

2011
Composite Wing-box Validation

2012
Laminar Flow Wing

2013
Composite Slat
Bird strike capability acquisition & feasibility

Integrated Ice Protected Composite slat
Composite Capability Development

2008

LuFo IV: Microwave Curing
Initial feasibility & evaluation

2009

MARCO: Microwave Curing
Capability & asset acquisition

2010

Robotic Manipulation & Assembly
Capability & asset acquisition

2011

RTM Processing – Closed Tool
Embraer PV, ELF Fan Blades

2012

Embedded Optical Sensors
Temperature & Cure Monitoring, Strain Measurement

2013

Composite Tooling
Durability, Coatings

Laser Processing Techniques
Tool cleaning, scarf repairs, ply trimming
Fan Blade Demonstrator Programmes

2008
ELF : Composite Fan Blades
Deposition, Metallics, Closed Tool RTM, NDT

2009

2010
Composite Fan Blade : Wide Body
Trent 900 Engine Replacement

2011

2012
Composite Blade : NGSA
SA Engine Replacement

2013
Engine Demonstrator Programmes

2008

Ducts & Cases

Fan Case PV

2009

SAMULET: Engine Cases
Fan frames, ducts, laser processing

2010

2011

2012

2013

Acoustic Liners

Acoustics PV

Symphony: Acoustic Liners
Test and evaluation

Open Air: Acoustics
Design Optimisation of DDOF

Optimised Liners
Manufacture & Test
Advanced Metallic Technologies

2010

Material Developments
- Aluminium Lithium Process Development
  Machine Tool Dev’t, Cutter Technology

2011

Titanium Alloy Development Development
- Nano enhancement

2012

Forging Technology Developments

2013

Casting Technology Development

Additive Layer Manufacture (Laser Sintering)

2014

Joining Technologies
- Advanced Joining Technologies
  EB welding, Diffusion bonding

- Friction Stir Welding Applications
  Dissimilar alloys, Cost Reduction

Process Improvements
- Machining Process Developments

- Material Removal Process Developments
  ECM

Metallics technology portfolio to be expanded
5 Technology Growth Initiatives

- Expansion of Engine Products research in line with JV’s
- Expansion of Cowes CRC. Focus on Engine Product Technology Development
- Expand Aerostructures portfolio to align with business strategy aspirations
- Investigate collaboration agreement with Airbus for linking the component & assembly CRCs. Expand NGCW content and secure future aerostructures content on SFW & NGCW 2
- Address portfolio gap in advanced metallic technologies
- Establish an advanced metallics research capability
- Improve technology dispersion throughout group
- Establish technology exploitation capability in US
- Expand niche technology opportunities
- Grow Ice Protection & Aerospace coating cells
GKN Aerospace Filton