Karl-Heinz Rendigs

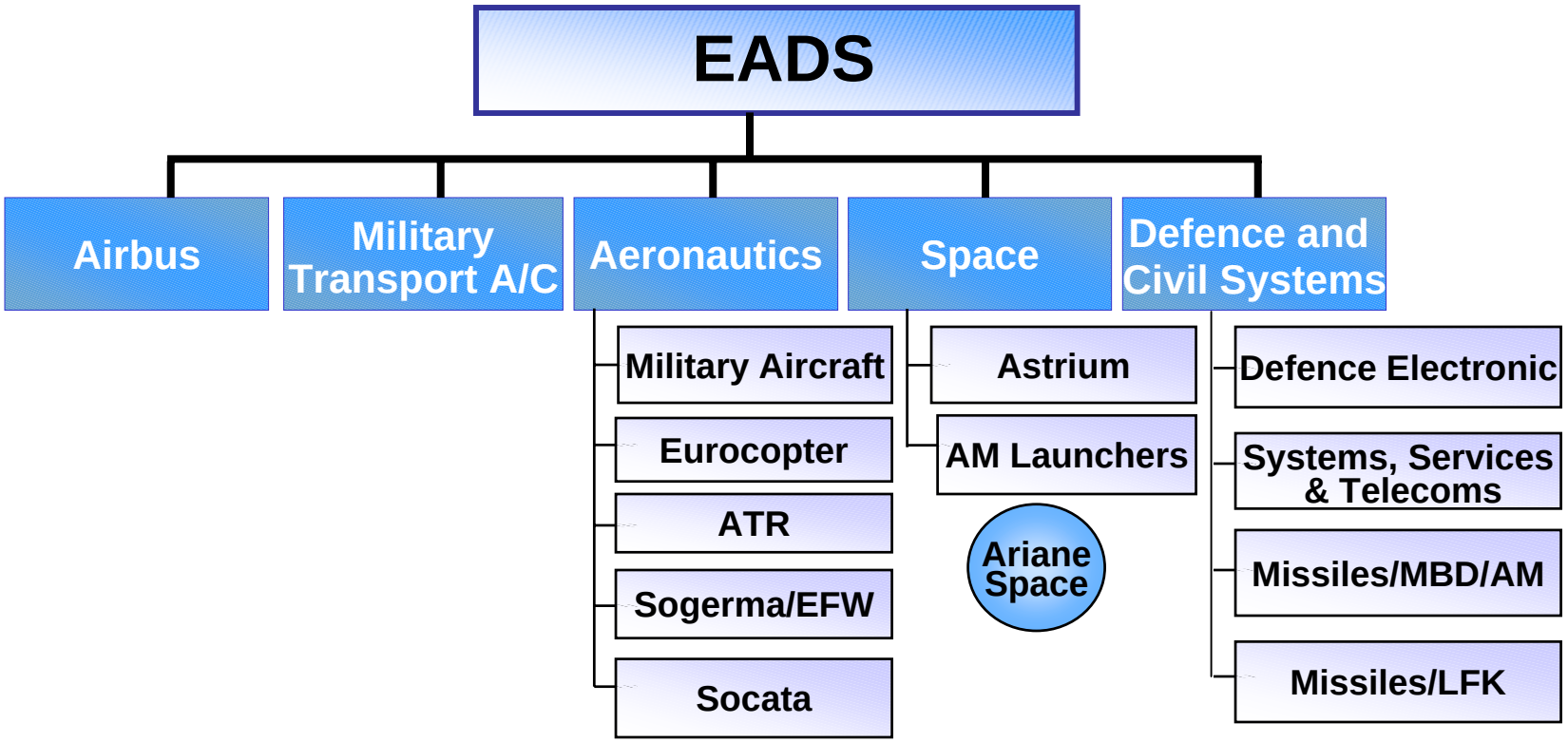
Materials & Processes
Airbus Germany, Bremen

Presented by Michael Niedzinski
Director of Technology & Standardization USA

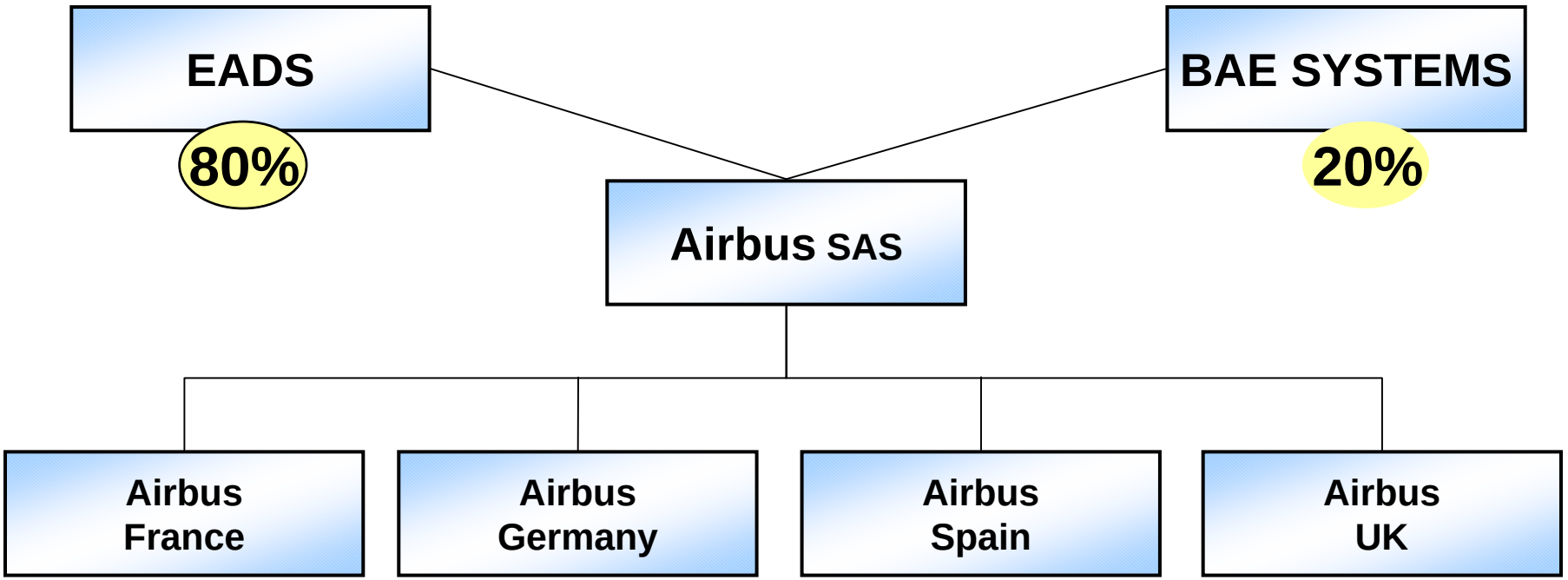
Airbus and Current Aircrafts Metal Technologies

Contents

Structure of EADS

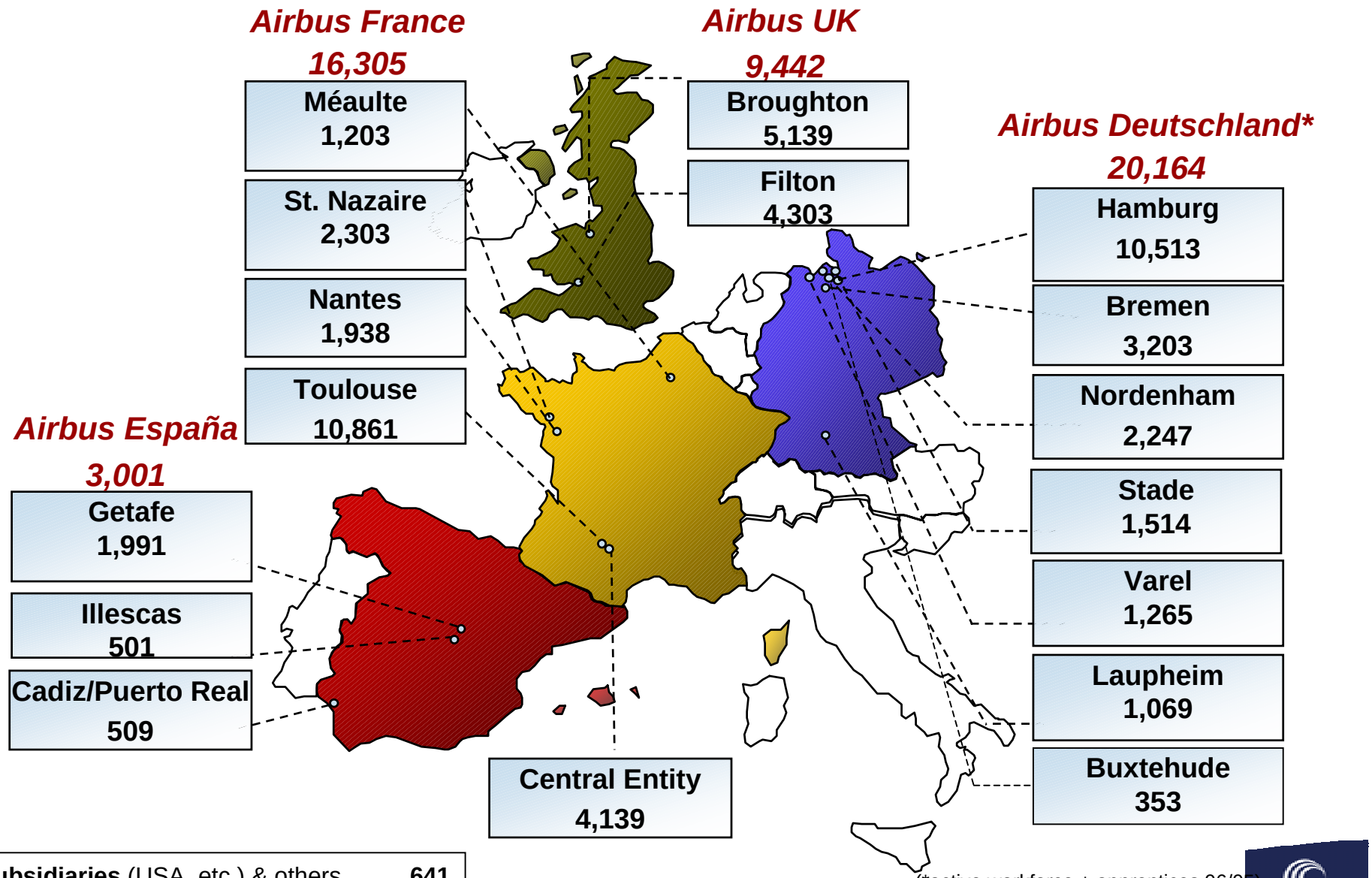


The Ownership System of Airbus (SAS)



Airbus is a company under French law (SAS).

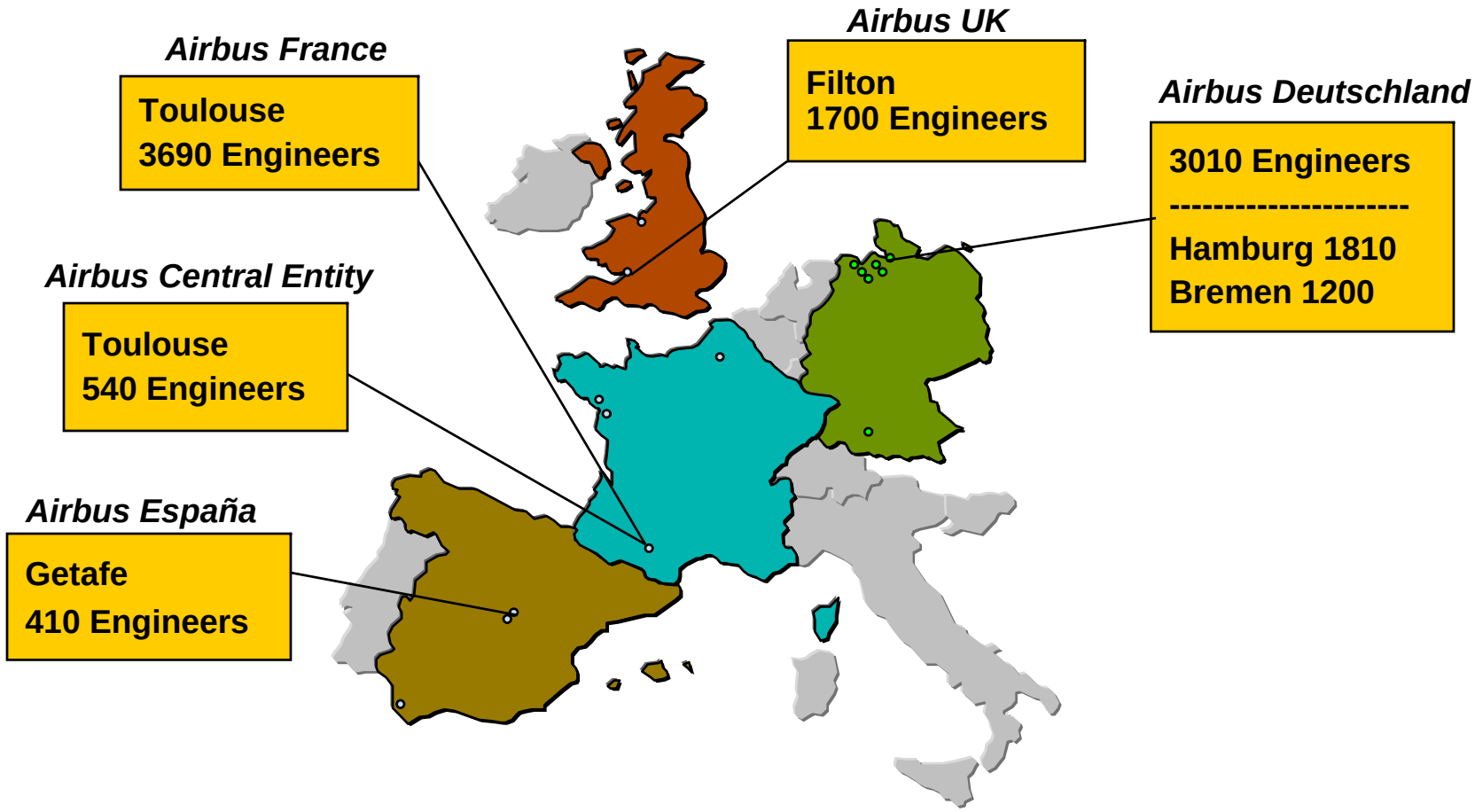
Employees in Europe



Subsidiaries (USA, etc.) & others **641**

(*active workforce + apprentices 06/05)

Airbus Engineering Workforce



Some 9350 permanent Engineering employees are presently working in Centres of Competence (CoC), Centres of Excellence (CoE) and Central Engineering Centres (CEC). Including subcontracting this sums up to over 17000 people.

Airbus Product Range

A380

A340-600

A340-500

A330-300

A340-300

A330-200

A350-800

A300-600

A310

A321

A320

A318

A319

seats

600

500

400

300

200

100

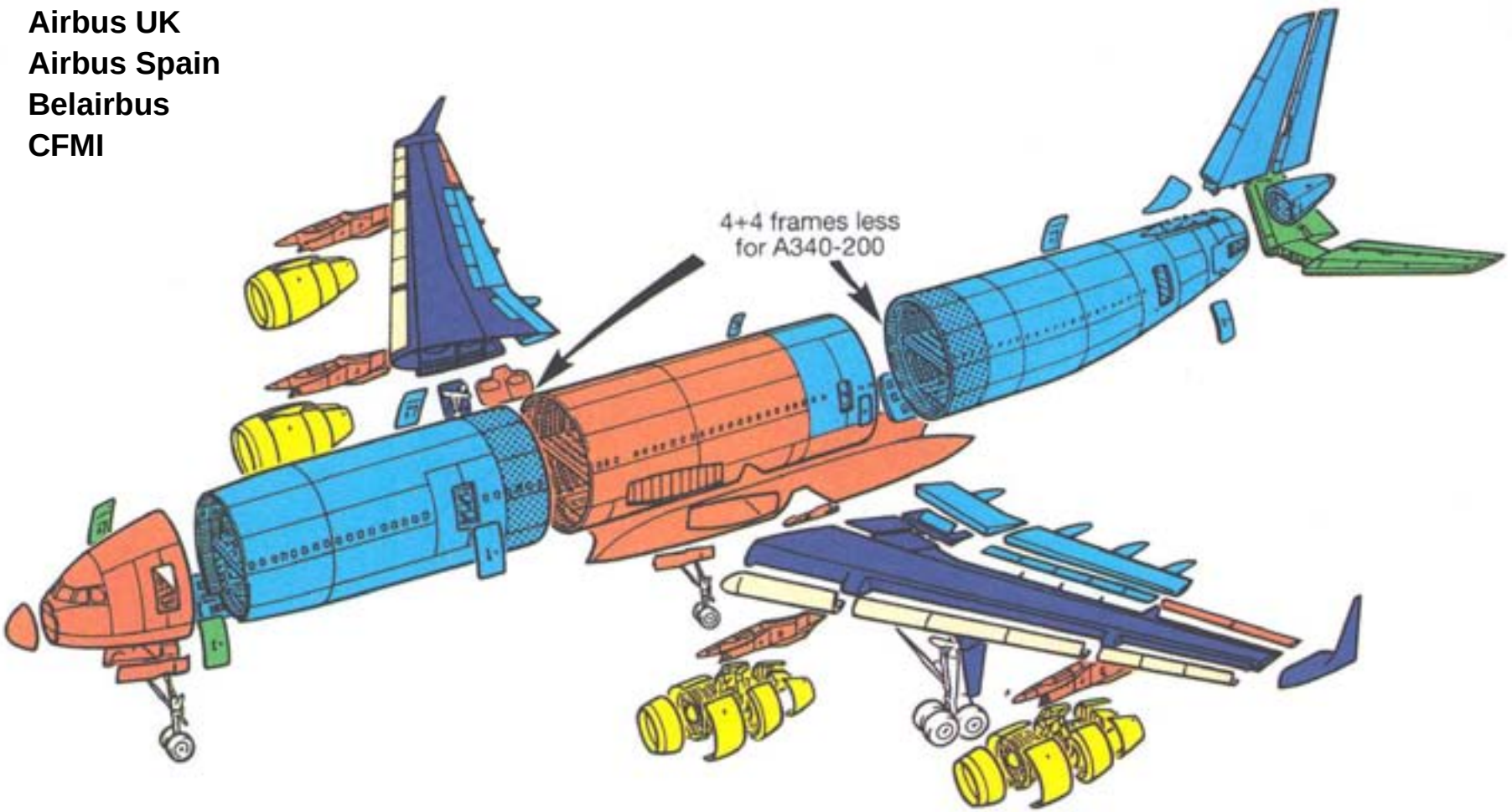
range

3000 4000 5000 6000 7000 8000 9000 nm

Competitive Product Range
(more than 5,500 Orders and
more than 3,900 Deliveries)

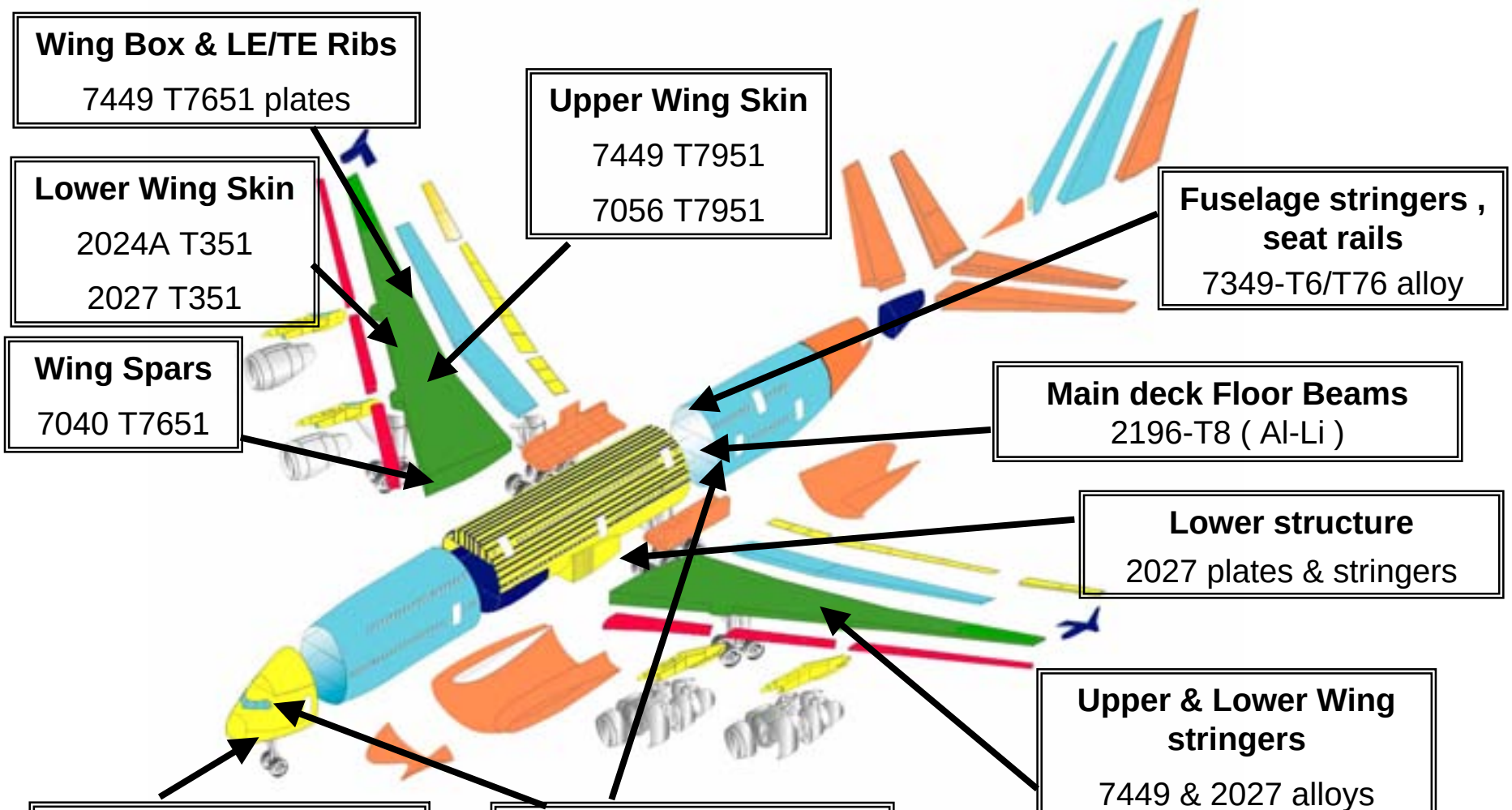
Workshare Airbus

- **Airbus France**
- **Airbus Germany**
- **Airbus UK**
- **Airbus Spain**
- **Belairbus**
- **CFMI**

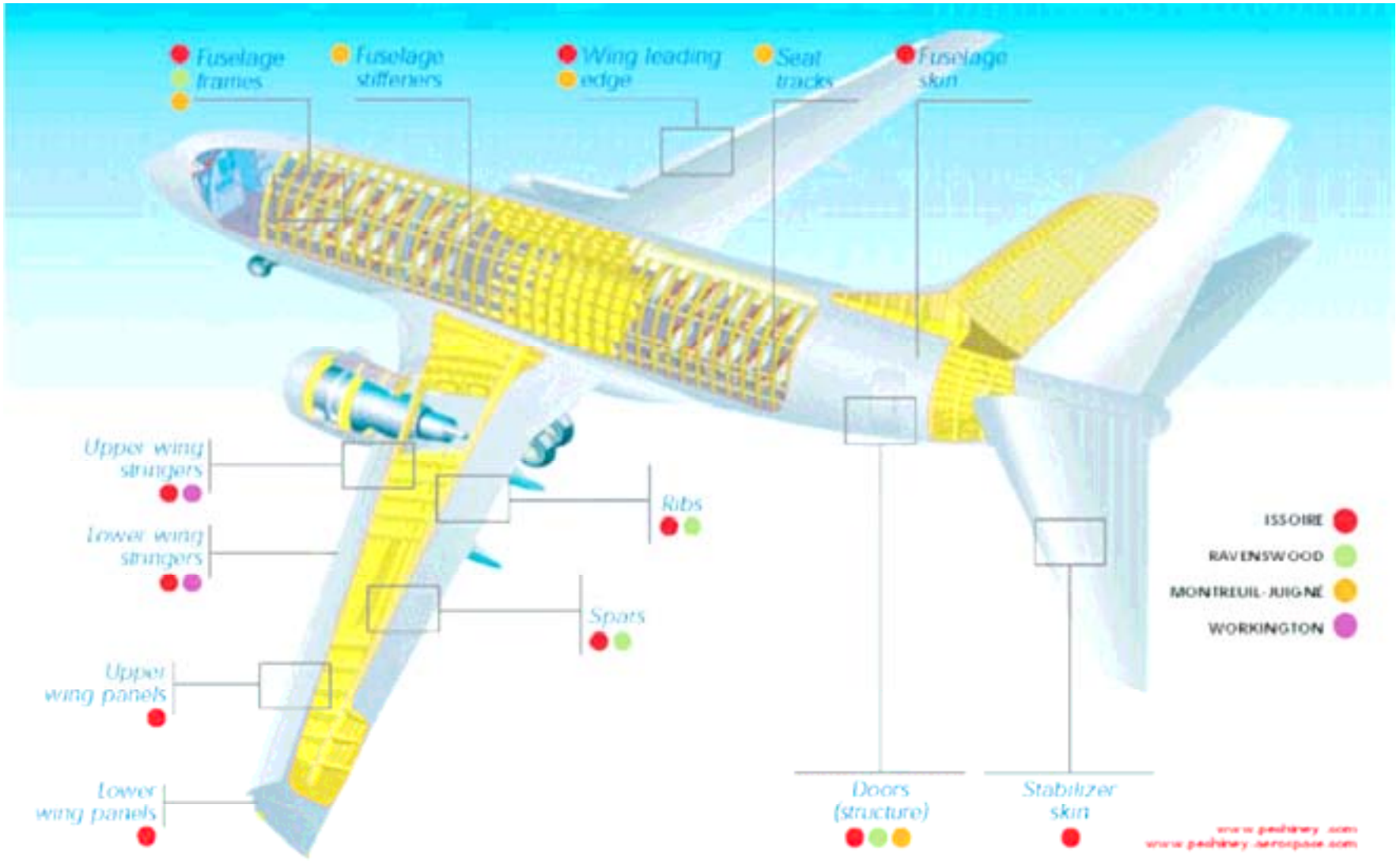


- WHERE DOES ALCAN FIT INTO AIRBUS PROGRAM?
- WHAT IS MY ROLE?
- HOW DOES METALLURGY RELATE TO AIRCRAFT PROGRAMS?

Overview of Alcan Material Used on Recent Airbus Programs



Aircraft Parts Manufactured with Alcan Material

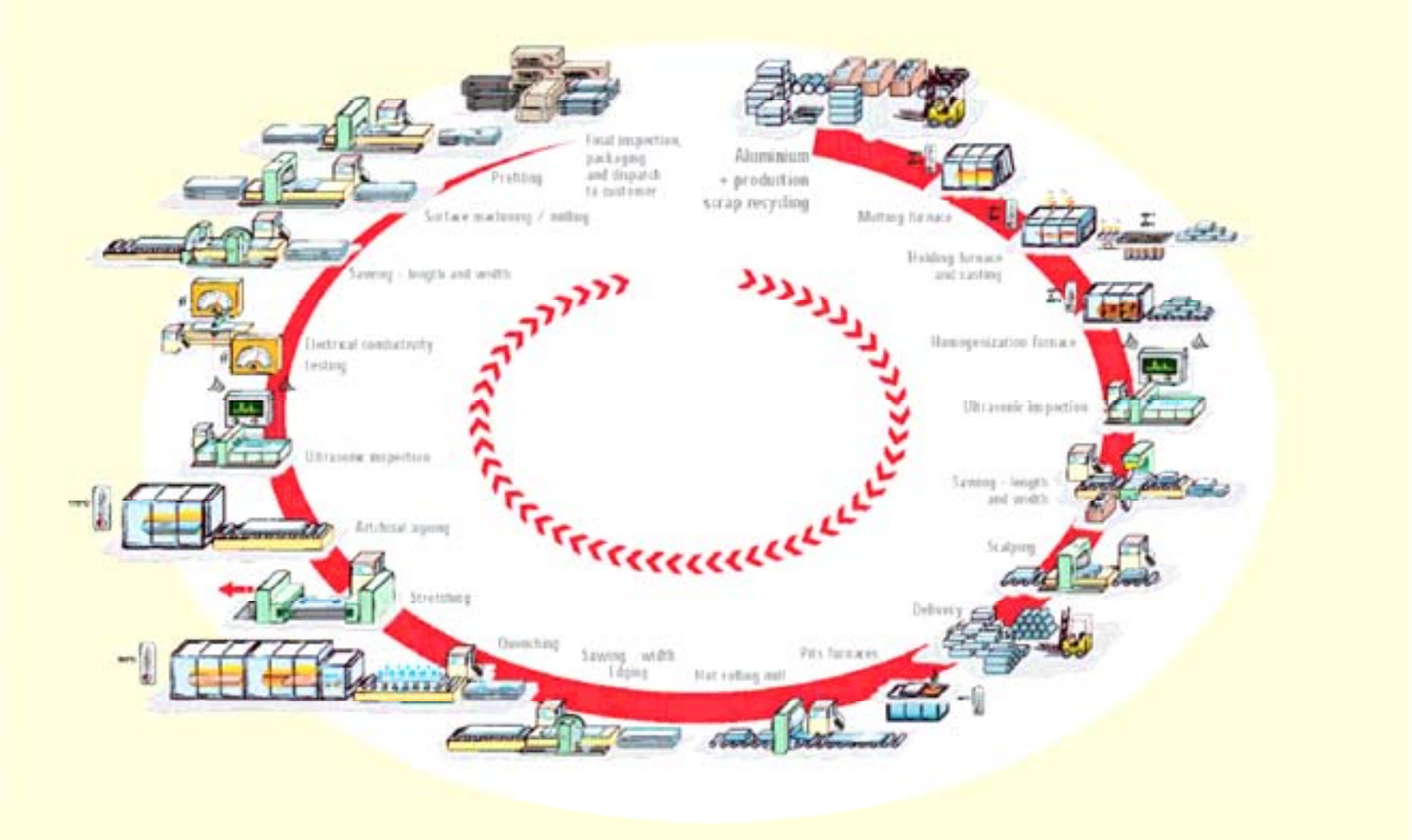


Alcan Issoire Workshops

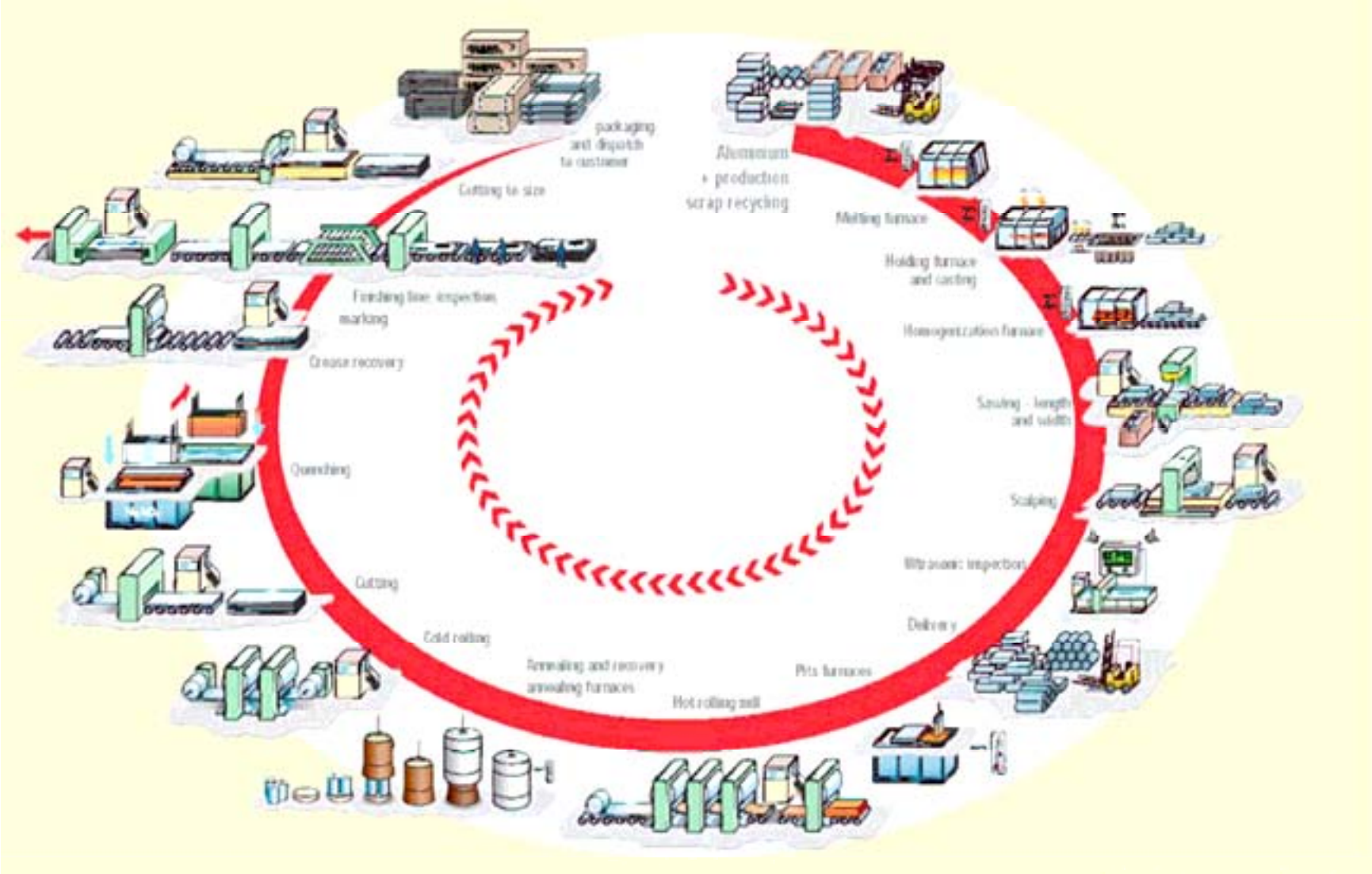
Alcan Issoire Plant – Essential Data

Workforce	1 514 people
Output	95 000 tons
Net sales 2005	500 Million €
Export	Almost 75% of total production
Facility area	90 hectares
Facility area under roof	24 hectares
Plant startup	1949

Alcan Issoire – Wing Production Steps



Alcan Issoire – Aircraft Plate Production Steps



Contents

General Arrangement

43.8 m

14.6 m

42.4 m

- Four 10 000 shp class Turboprop Engines
- **High Cruise Speed Mach 0.68 to 0.72**
- Cruise Ceiling (normal operations) 37 000 ft
- Ferry Range 5000 nm
- MTOW 130 tonnes
- **Maximum Payload 37 Tonnes**

European Staff Requirement (ESR)

The harmonised and endorsed requirements of eight European air forces (BE, FR, GE, IT, PL, SP, TU & UK) for their next generation of strategic & tactical airlifters.

Belgium France Germany Italy Portugal Spain Turkey UK

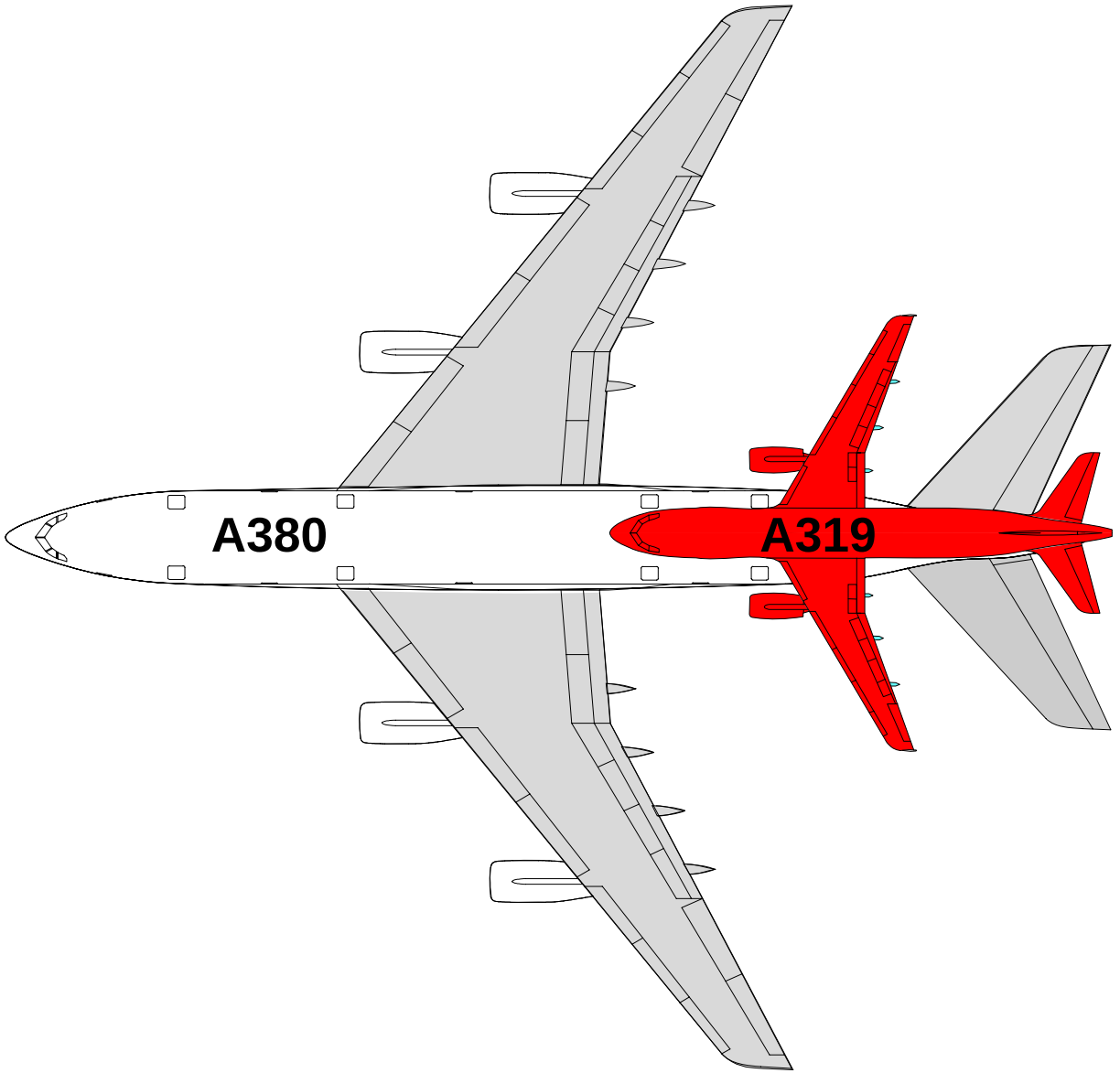
A400M Launch Nations

A firm launch base of 180 aircraft for seven Nations

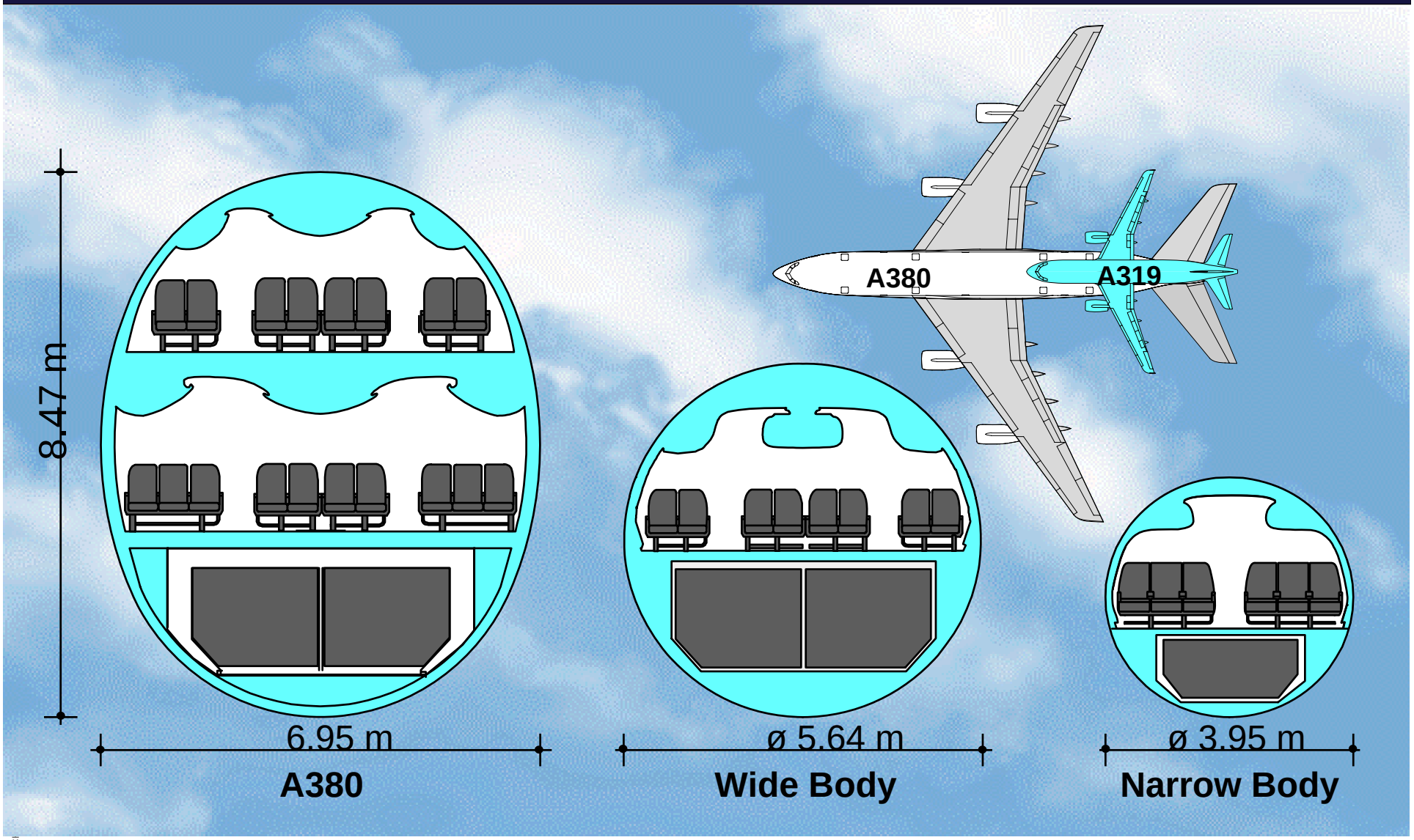
Belgium 7	France 50	Germany 60	Luxemburg 1	Spain 27	Turkey 10	UK 25

Contents

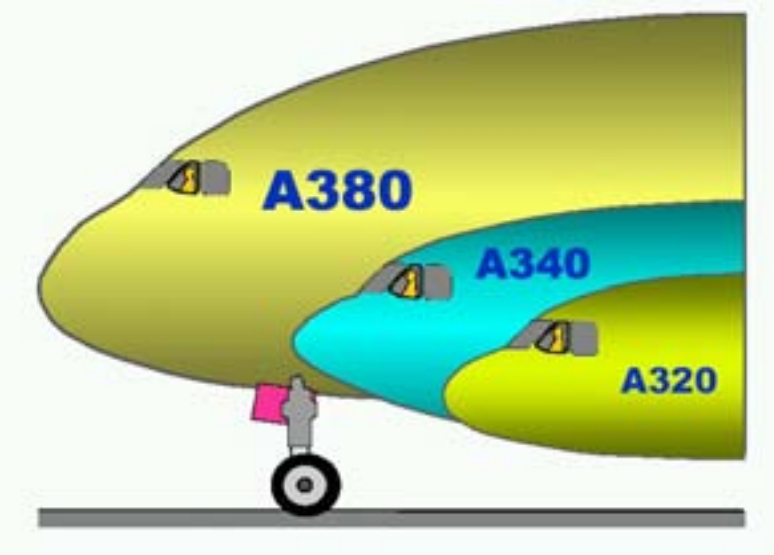
Comparison A380 with A319



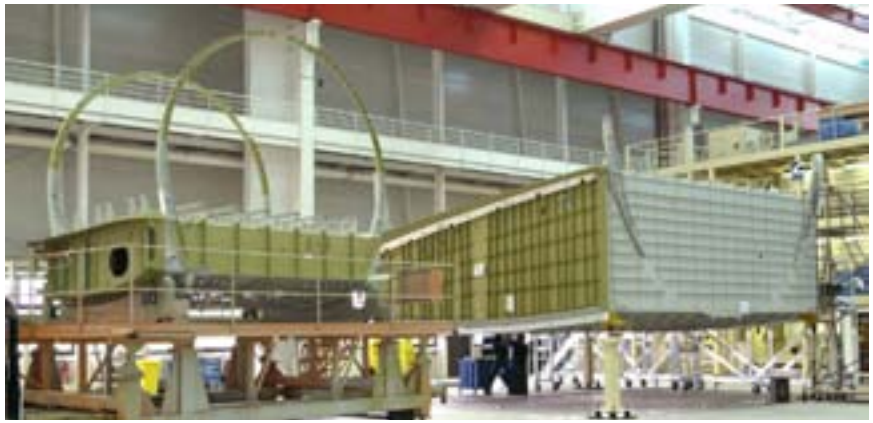
Airbus aircraft: Fuselage Cross-Sections

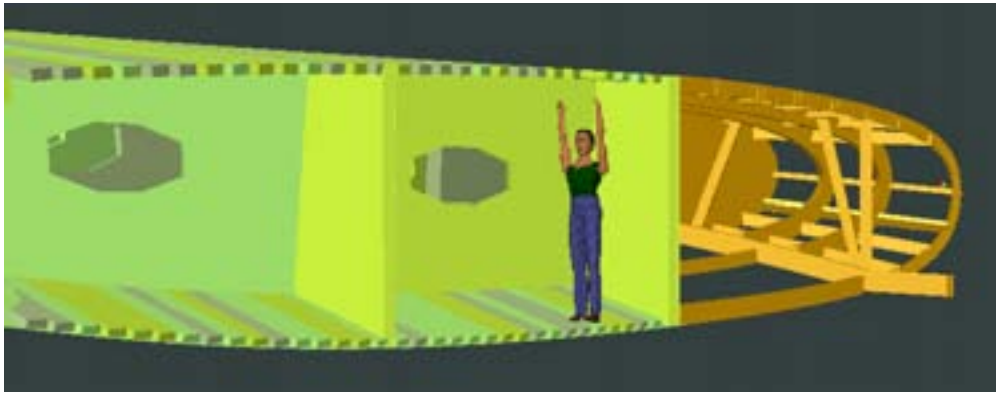


A380 Components Scale



A320 & A380 Section 21 Comparison





A380 Internal Wingbox structure

A380 Transport System

A380 Fuselage Section Transport to Toulouse

A380 New Final Assembly Line in Toulouse

A380 – PAX and Freighter Version

560t

555 seats

8000 nm

EIS 2006

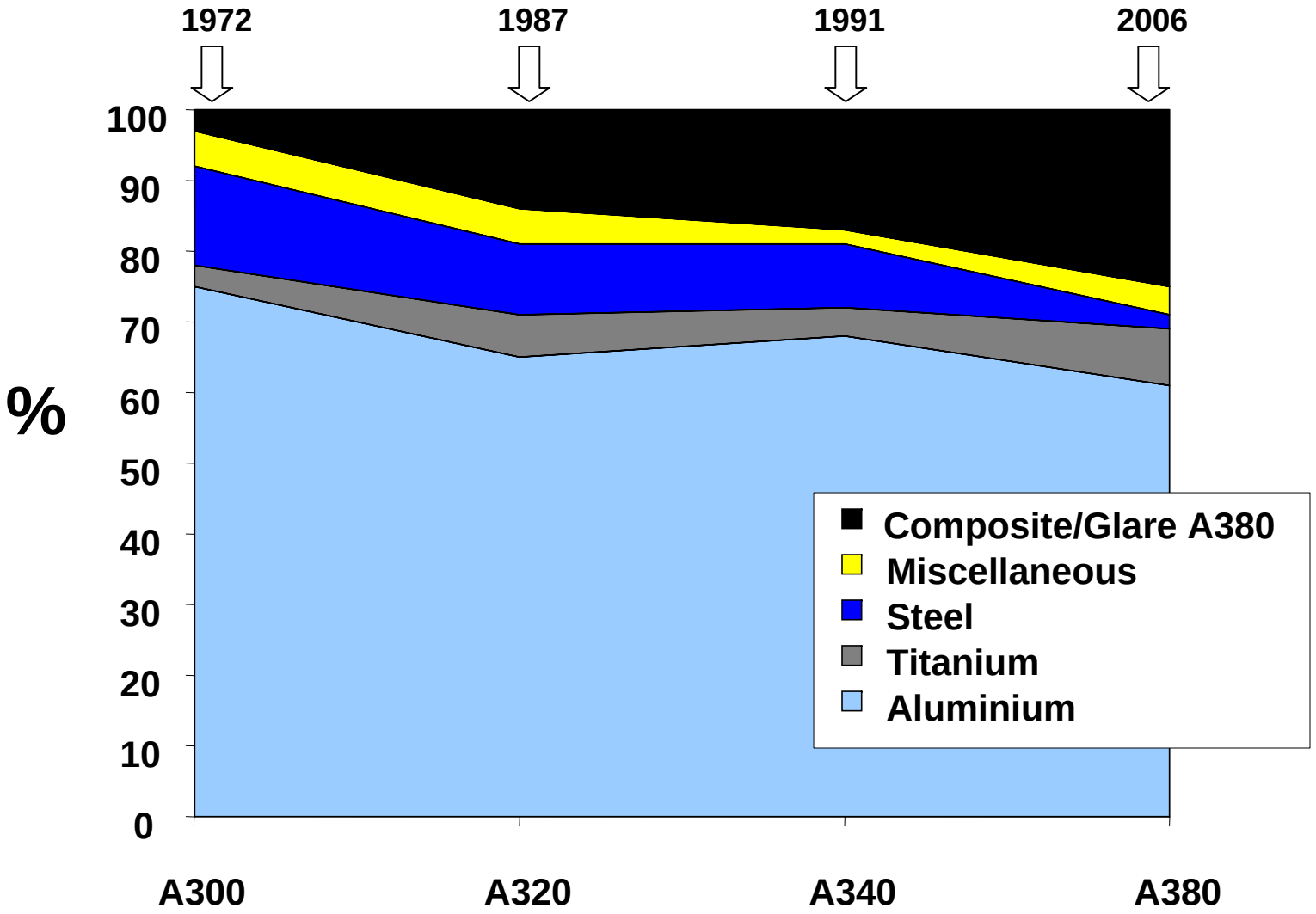
590t

150 t

5620 nm

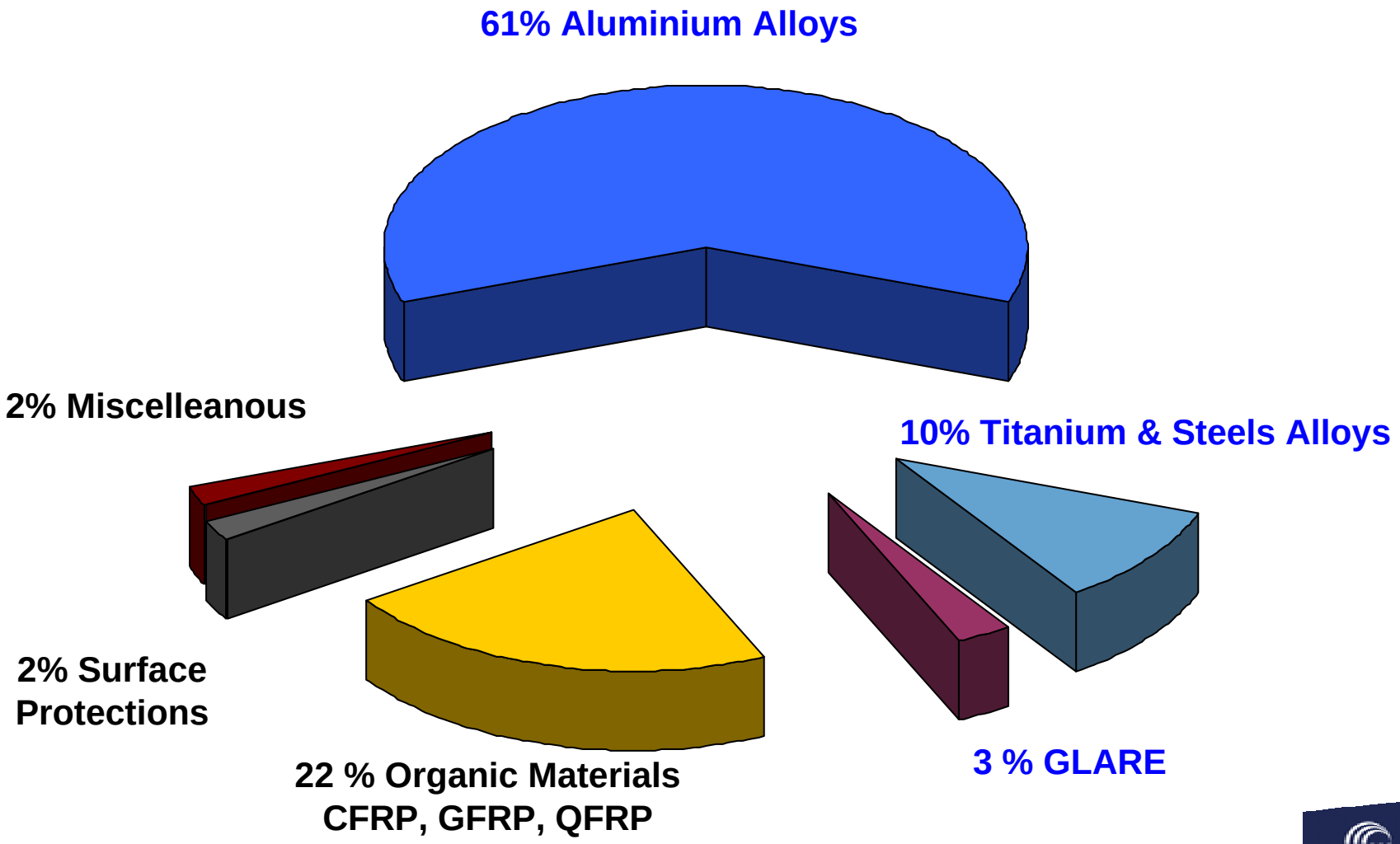
EIS 2008

Material Distribution in Airbus Aircraft



A380-800 Materials Distribution

Structure Material Breakdown
(Engine, Landing gear not included)



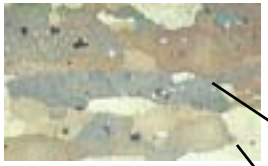
A380 – First Flight and Flight Test Program

The flight test program proves the capacity of the A380 now already

Simultaneously: simulation of the life cycle in Dresden

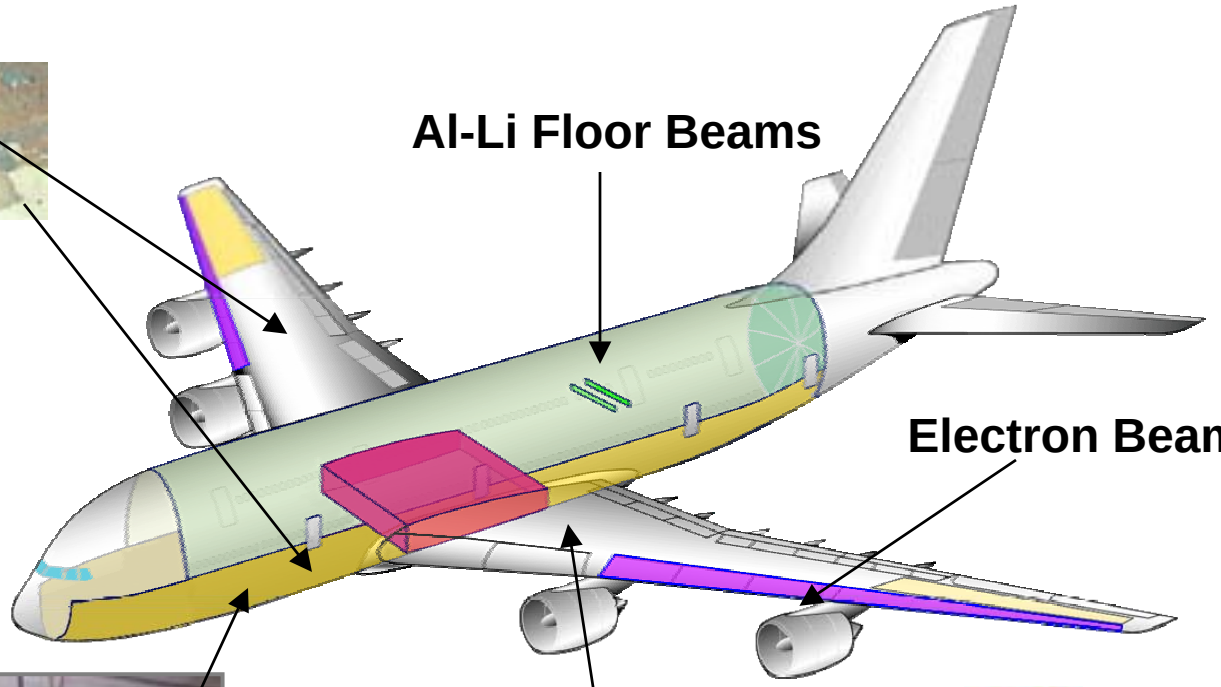
Contents

A380 Innovative Metal Technology (Examples)



New Al-alloys

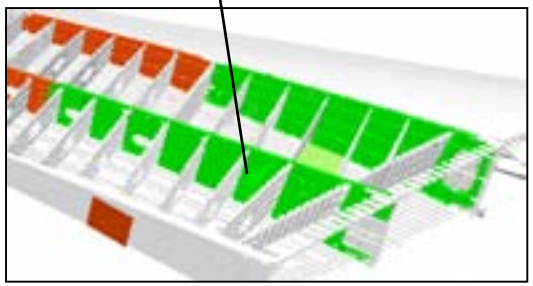
Al-Li Floor Beams



Electron Beam Welding

Integral Structures (LBW)

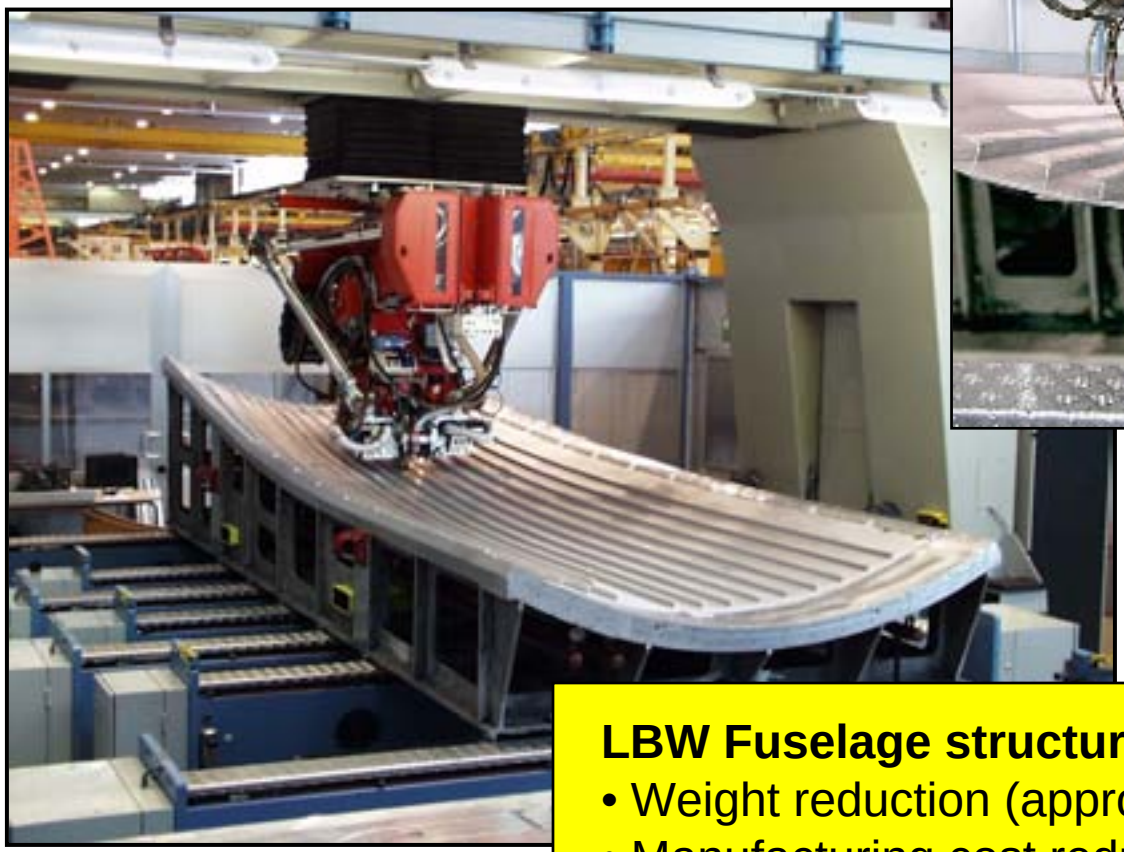
More Ti & New Ti-alloys

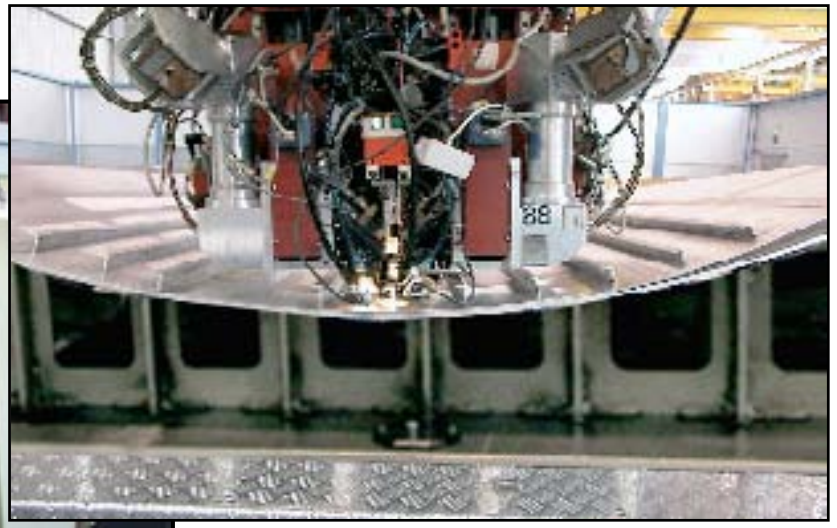


Wing Centre Spar, Die Forgings

Laser Beam Welding

LBW machine – stringer to skin welding



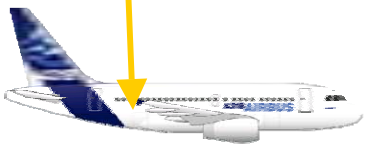


LBW Fuselage structure:
- Weight reduction (approx. 10%)
- Manufacturing cost reduction (approx. 20%)
- Improved corrosion resistance

Laser Beam Welding

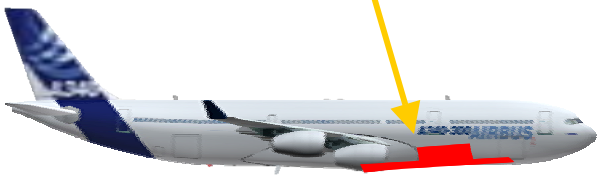
Laser Beam Welding

A318:
1 laser beam welded panel in section 17



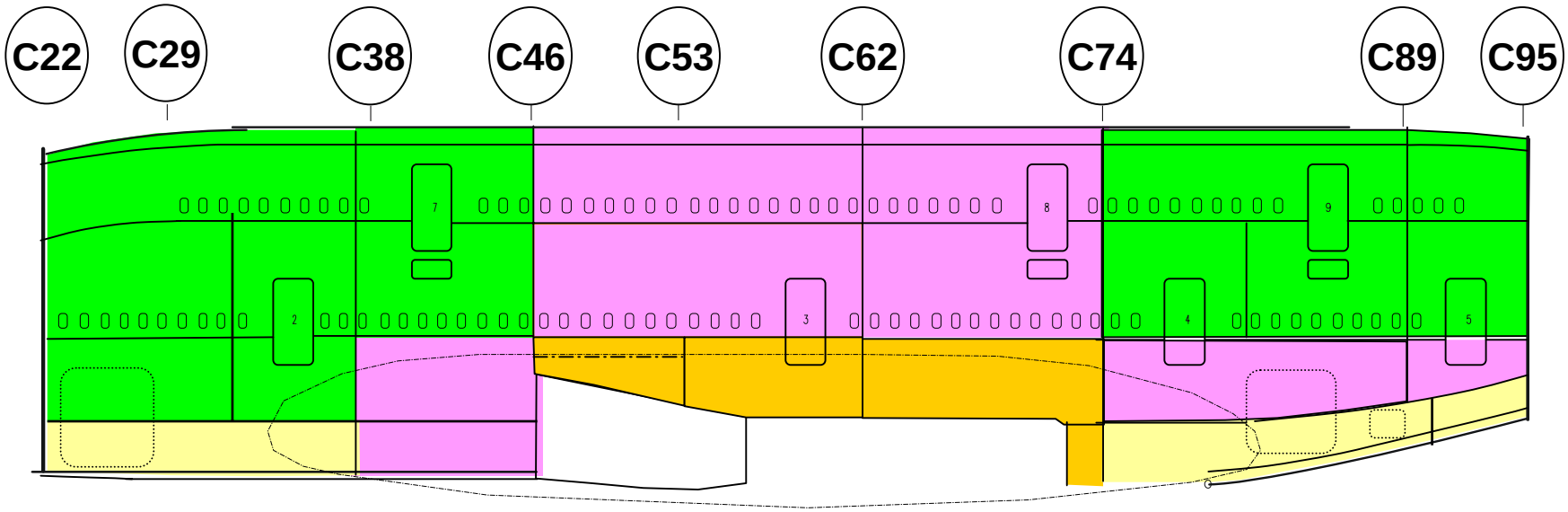
A380:
8 laser beam welded panel
- 3 panels in section 13
- 5 panels in section 18

A340 HGW:
14 laser beam welded panel
- 4 panels in section 13
- 6 panels in section 14
- 4 panels in section 14b



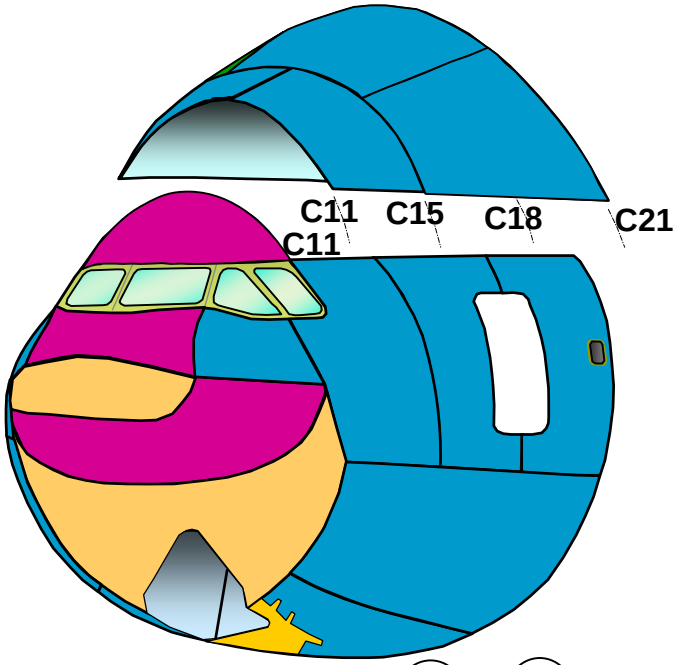
New Aluminium Alloys on A380-800 Fuselage

A380-800



Glare | 7475 | 2024 HDT | 6013

Materials for A380 Freighter Fuselage



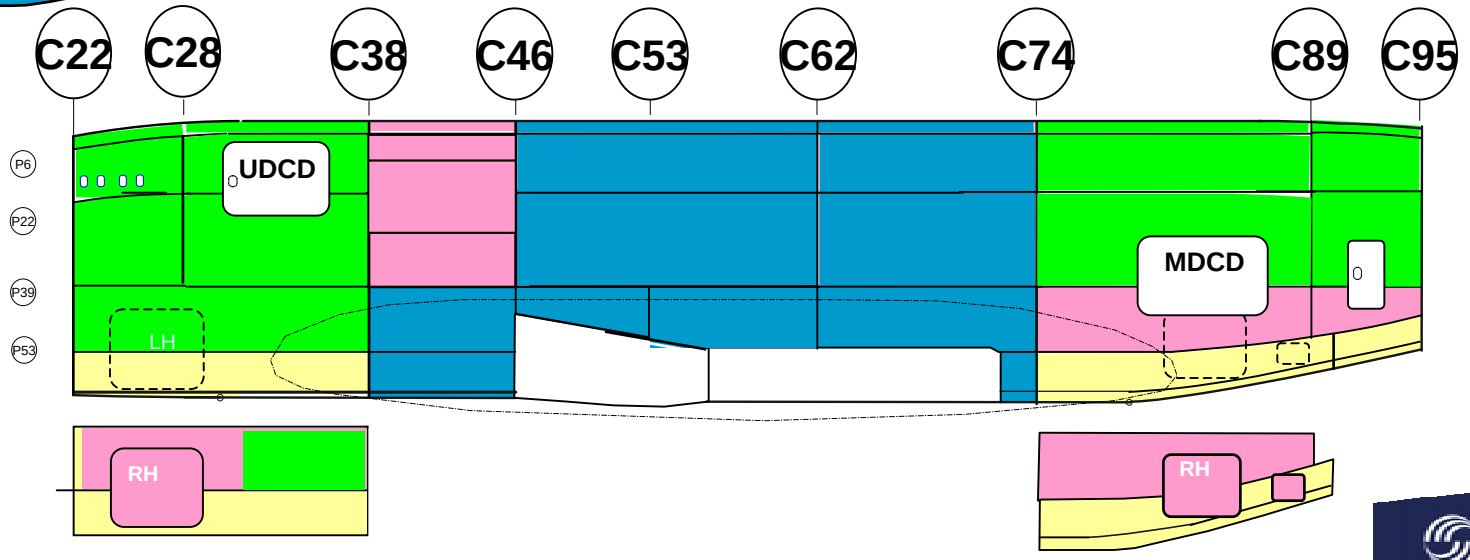
2024

2024 HDT

Glare

6013

Al-Li



Status ALCAN alloys
Overview - Fuselage

Aircraft Part		Design drivers	Ref Alloy	Alcan Proposals	Th range (mm/in)
Fuselage	Upper shell panels	Compression & DT (+formability)	2024 Cl T3	2024 HF Cl T3, 2098-T8, 2056 Cl T3	0.8 – 12mm
	Lower shell panels	Tension & DT	2024 Cl T3	6156 (HDT) Cl T6 / bare T78	1.6 – 8mm
	Stiffeners	Tension / compression	7175-T73	7349-T6/T76 – 6056-T6/T78	
	Upper panel CWB	Tension / Compression	7010-T6	7449-T651	6 – 20mm
	Lower panel CWB	Tension and DT	2024-T3	2027-T351	12 – 55mm
	Main frames	All kind / complex	7010&50-T74 7x75-T73	7040-T7451, 2050-T851	<= 216 mm
	Seat tracks	Tension	7175-T73/T79	7349-T6/T76	

Example: A380 Deck Crossbeams

CFRP floor beams

Al-Li floor beams

Composite and innovative Al-alloy material for optimum crossbeam material choice

New Aluminium Alloys on A380 Wing

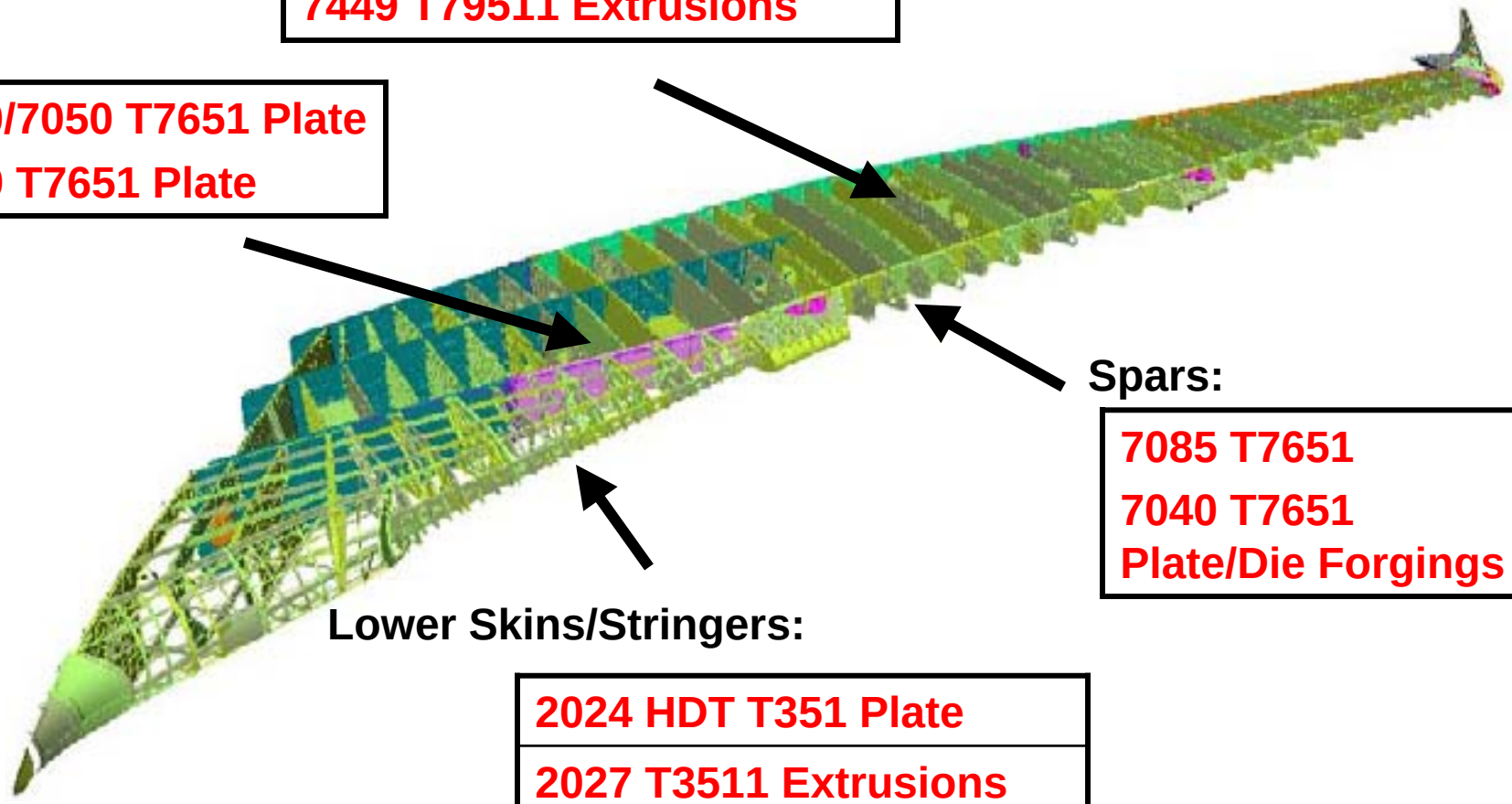
Upper Skins/Stringers:

7055 HF T7951 Plate
7010/7050 T7651 Plate

7449 T79511 Extrusions

Ribs:

7010/7050 T7651 Plate
7449 T7651 Plate



Spars:

7085 T7651
7040 T7651
Plate/Die Forgings

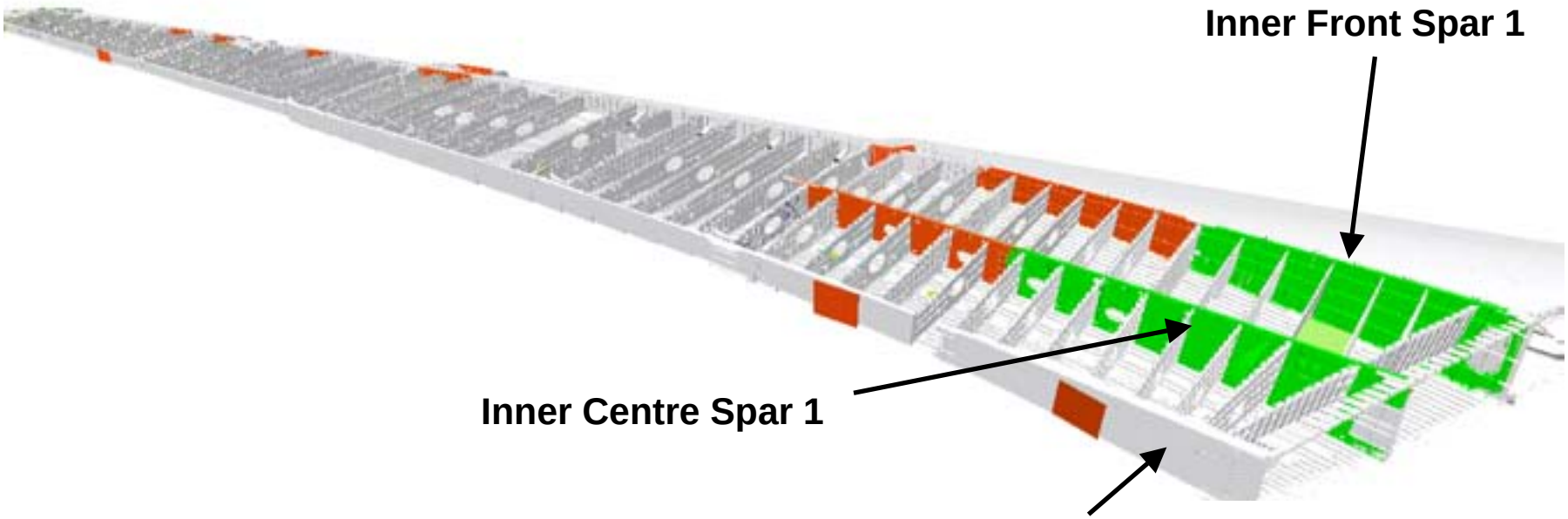
Lower Skins/Stringers:

2024 HDT T351 Plate

2027 T3511 Extrusions

Aluminium Forgings

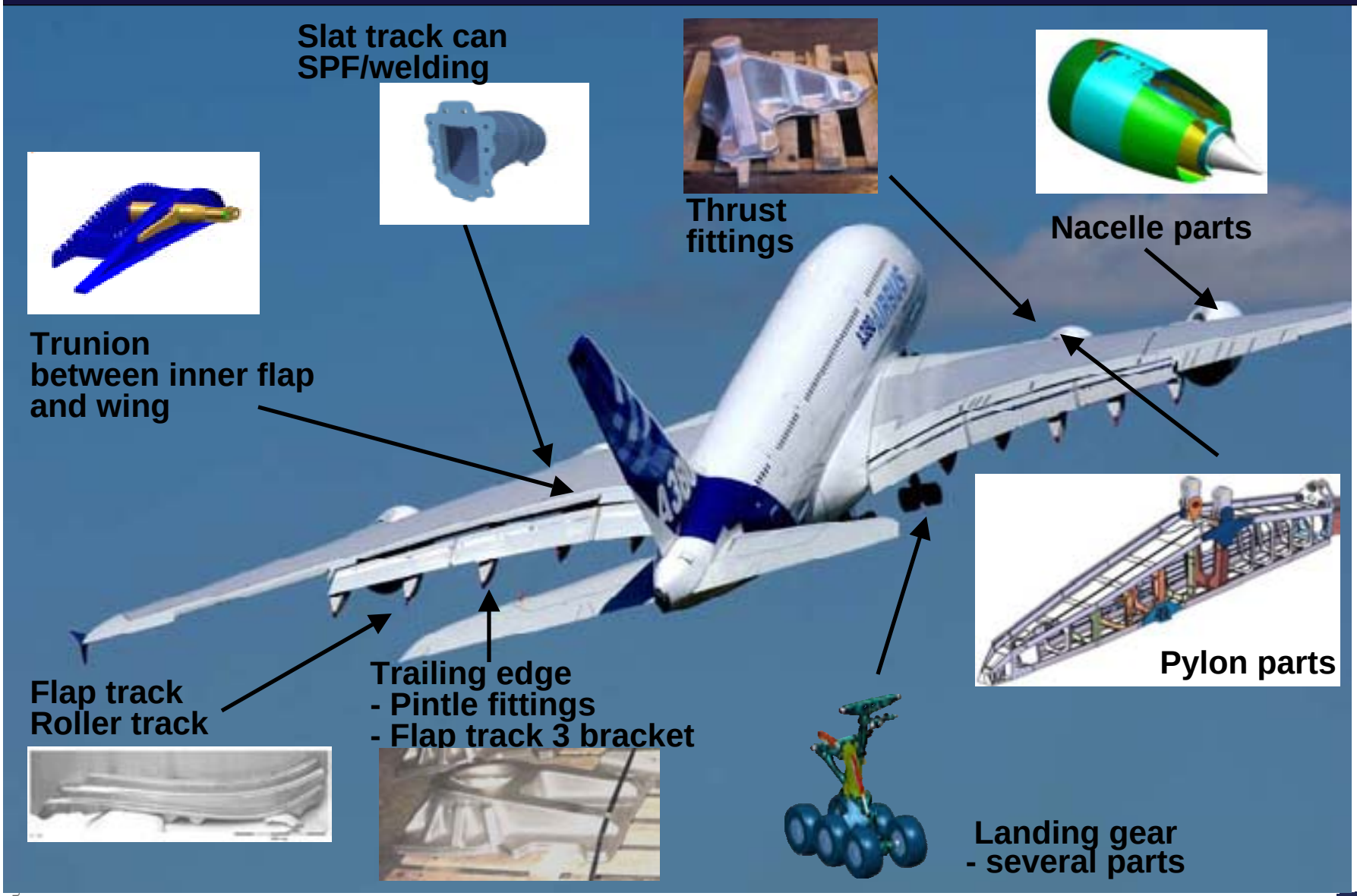
Location of 7085 die forgings on the A380 wing



Aluminium Forgings

A380 Inner centre spar 1

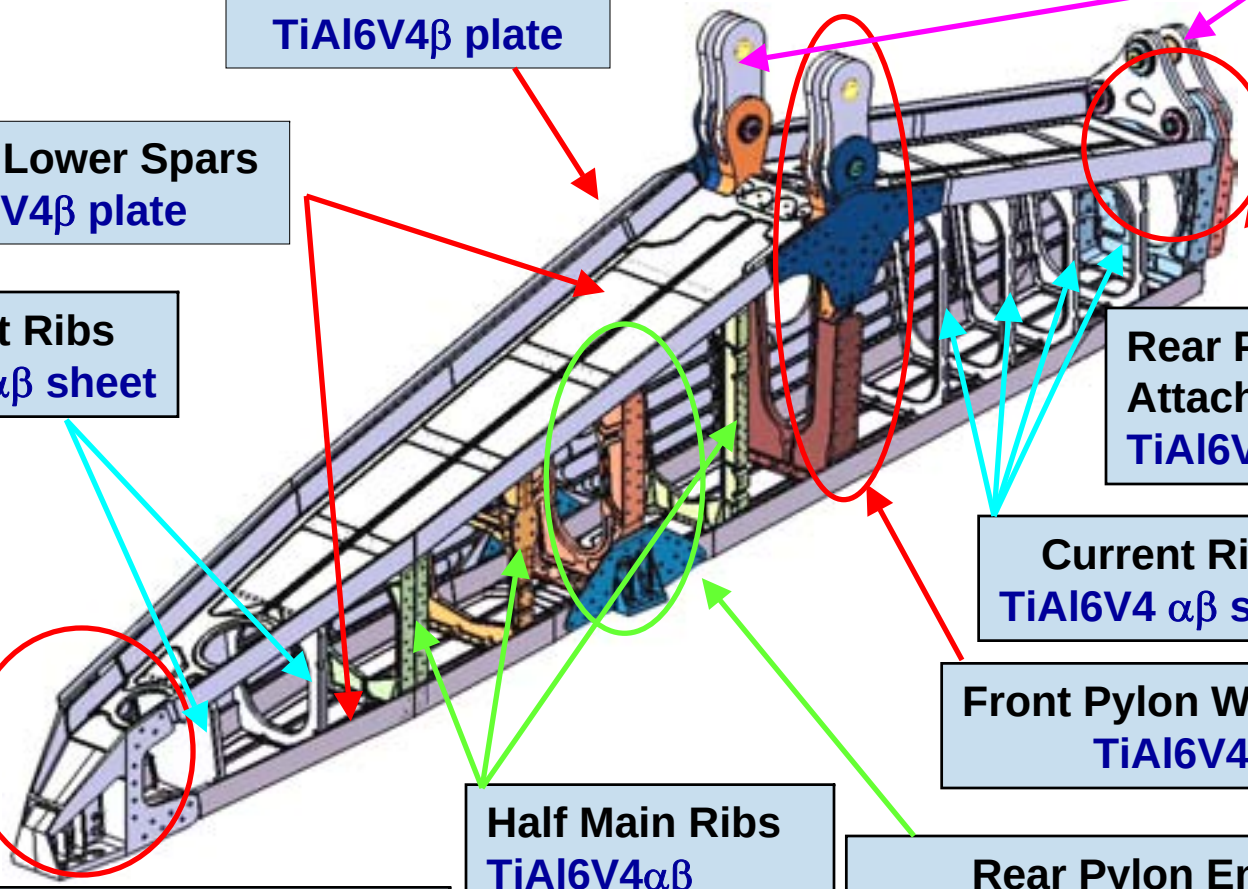
A380 Titanium Structural Applications



- Typical titanium alloy and its characteristics
- Ti-6%Aluminum-4%Vanadium
- Density .160 Lb/inch
- Typical strength Yield Strength 145,000lbs/inch
- Temperature range –160F to 750F

A380 Titanium Applications

Engine pylon



Rear & Front Links
TiAl6V4β plate

Side Panels
TiAl6V4β plate

Upper & Lower Spars
TiAl6V4β plate

Current Ribs
TiAl6V4 αβ sheet

Rear Pylon Wing Attachment
TiAl6V4β plate / forging

Current Ribs
TiAl6V4 αβ sheet

Front Pylon Wing Attachment
TiAl6V4β forging

Half Main Ribs
TiAl6V4αβ precision casting

Rear Pylon Engine Attachment
TiAl6V4αβ forging

Front Pylon Engine Attachment
TiAl6V4β forging

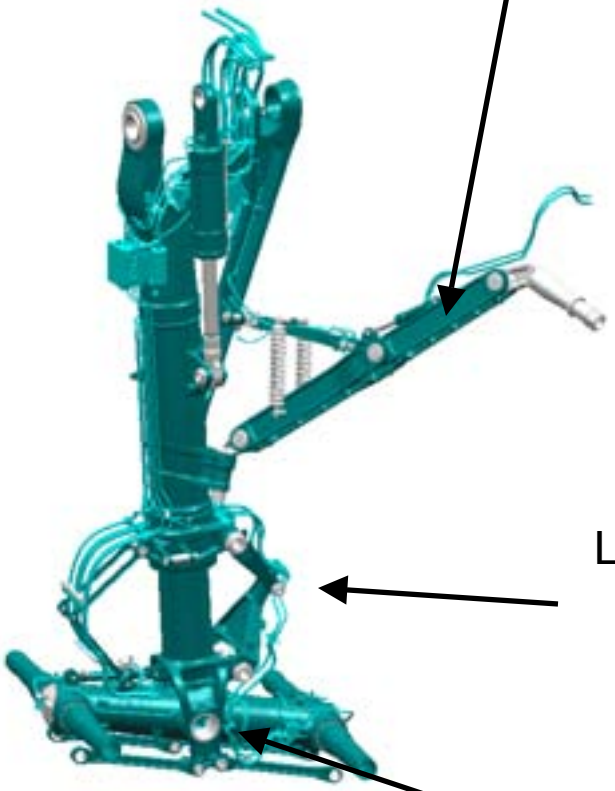
A380 Titanium Applications

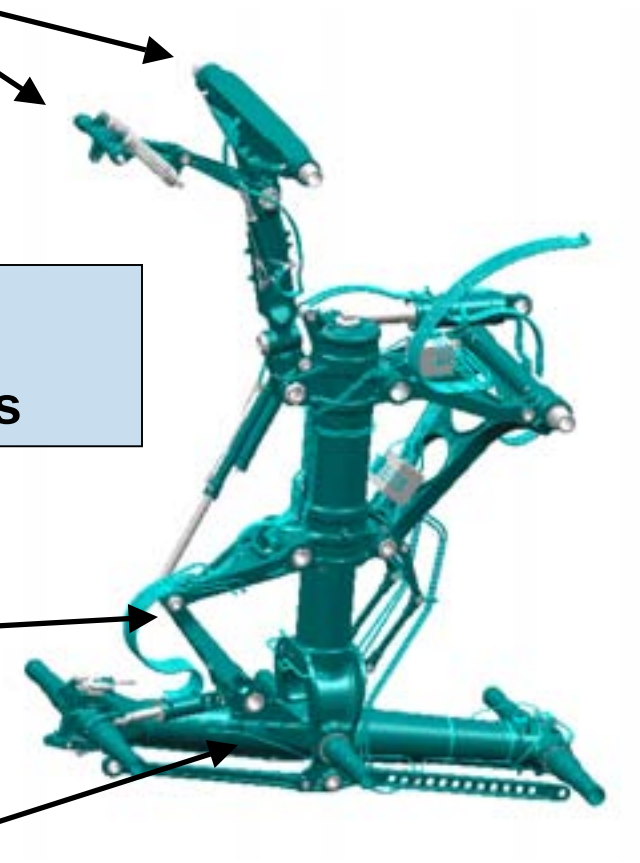
Wing landing gear

Body landing gear

Sidestay

Top & front panels





Ti 10-2-3

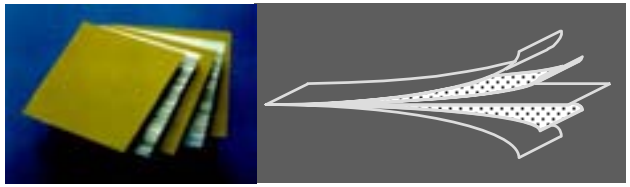
plates & forgings

Lower & upper
Torque links
(arms)

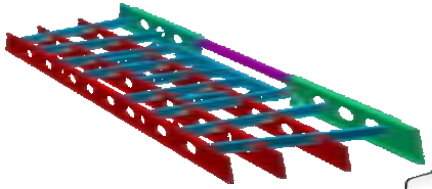
Bogie Beam

A380 New Composite Applications (Examples)

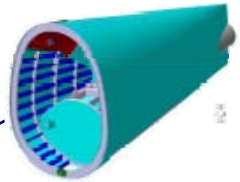
GLARE®

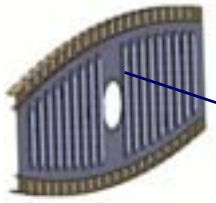


CFRP Floor Beams for Upper Deck



CFRP Section 19.1





CFRP Wing Ribs

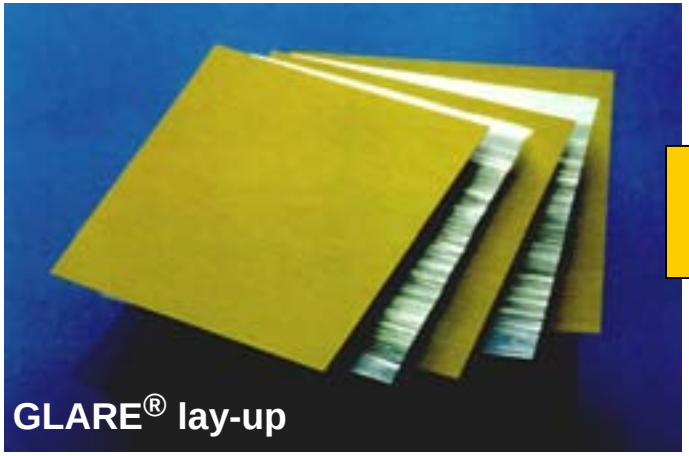
CFRP Section 19

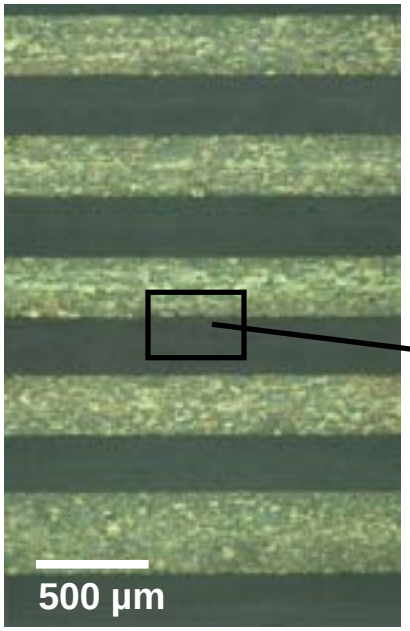
CFRP flap tracks

CFRP Center Wing Box

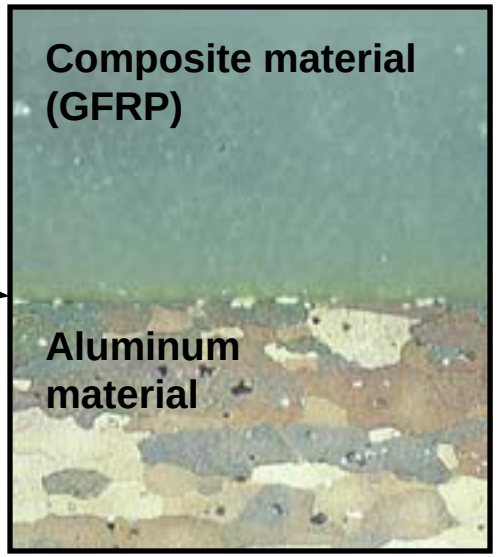
New materials & processes:
High modulus fiber, RFI, AFP

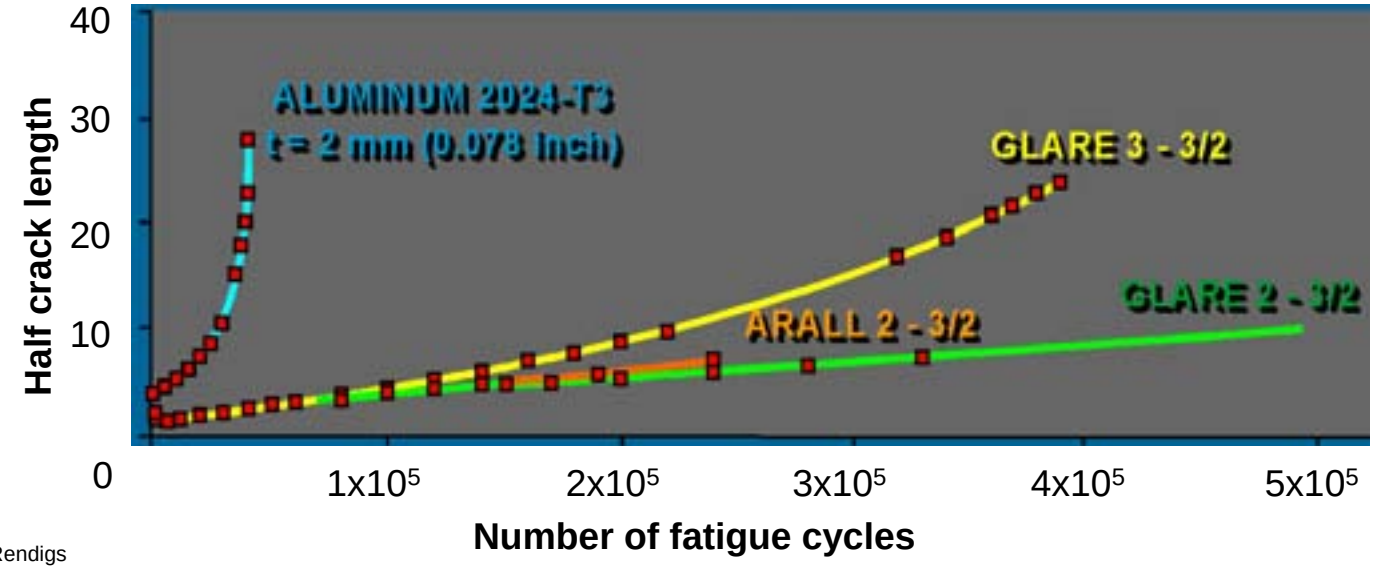
Fibre Metal Laminates: Example GLARE®





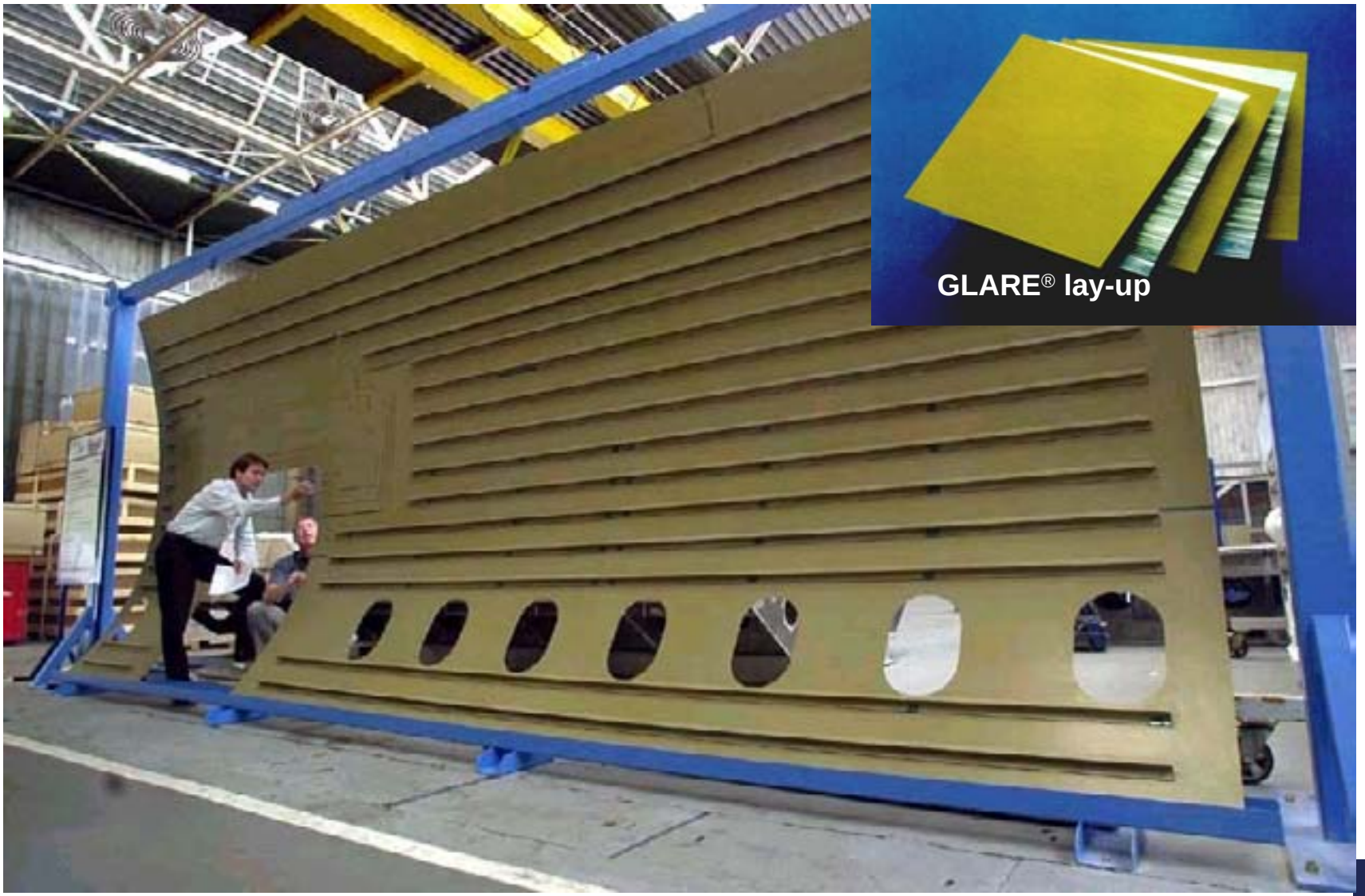
GLARE® Micrograph



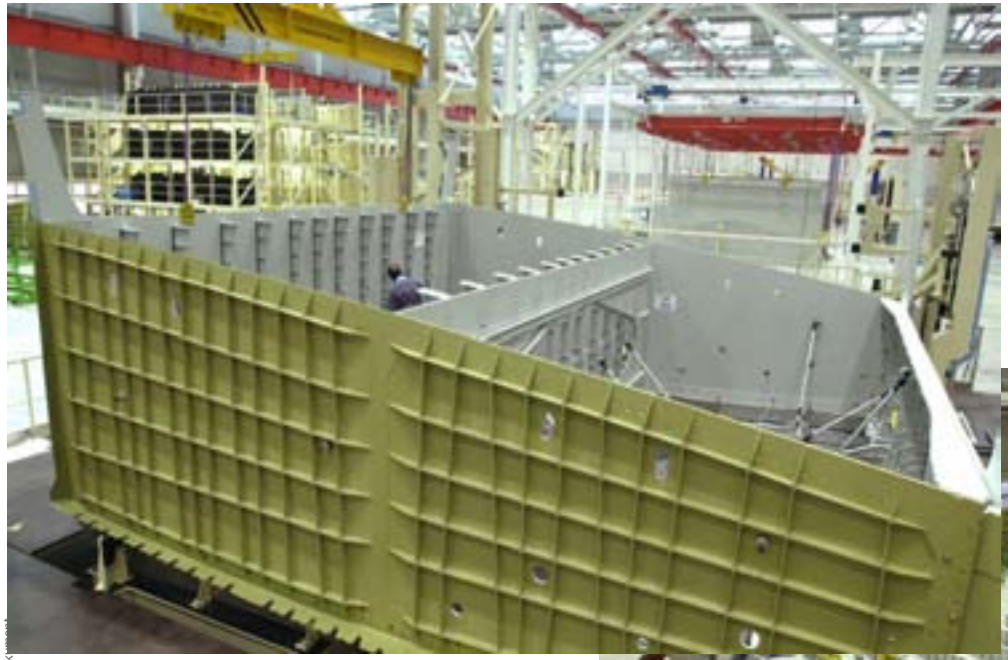


GLARE® - Fuselage Panel

Airbus - Nordenham



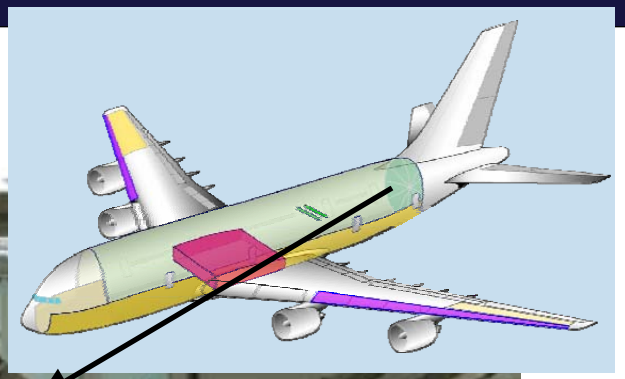
A380 Centre Wing Box - CFRP



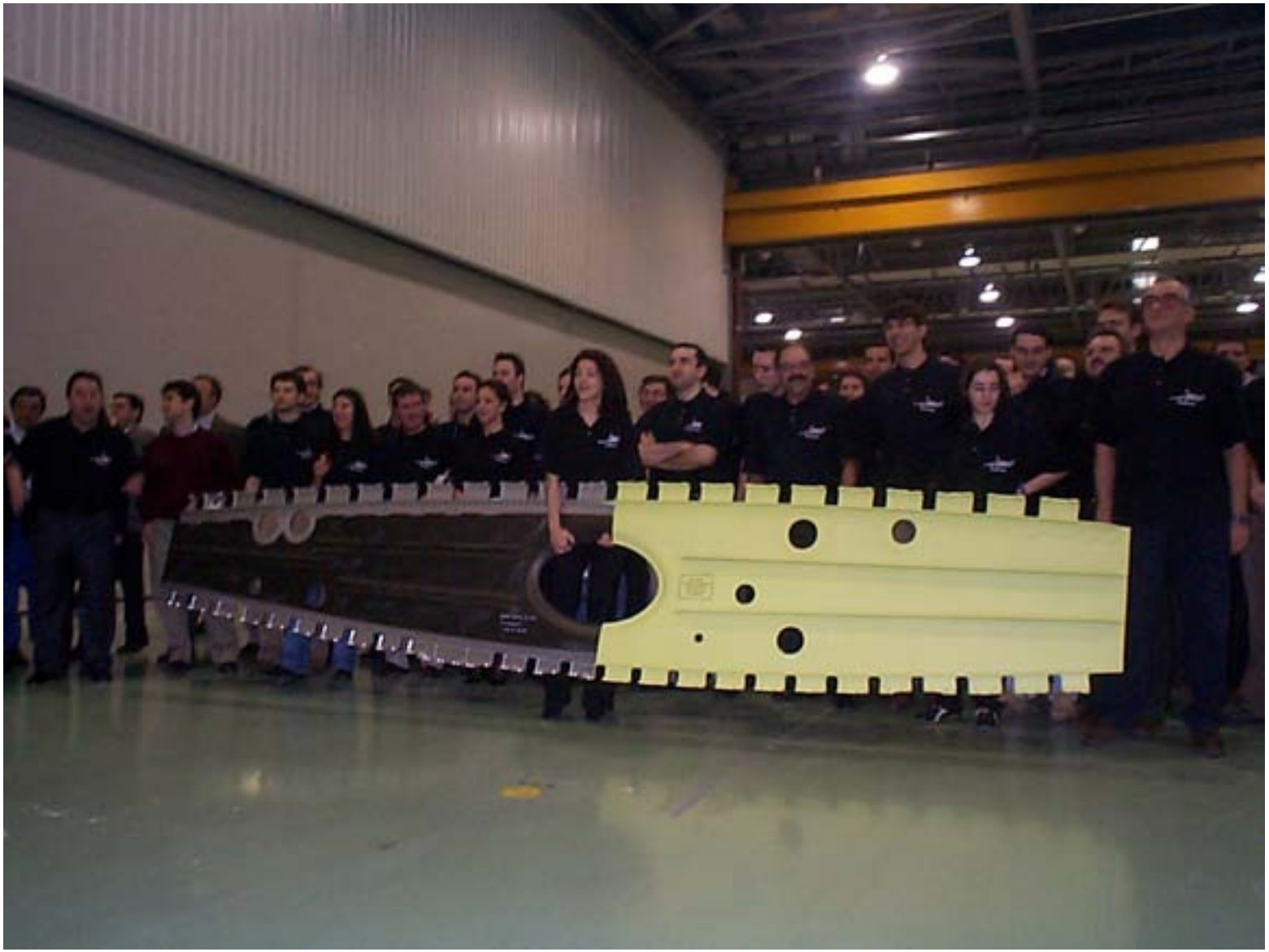
Airbus - Nantes

A380 Rear Pressure Bulkhead - CFRP

Airbus - Stade



A380 Wing Rib - CFRP



Airbus - Broughton

Contents

A350 Hybrid Airframe Decision

Major structural components material breakdown

Friction Stir Welding

Developed at TWI, UK
Patented 1991

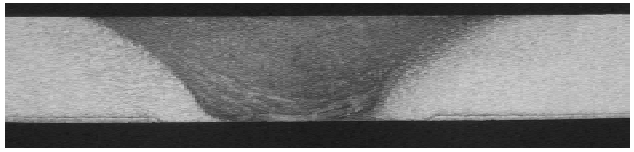
→ AIRBUS is Member and Licencee

FSW process :

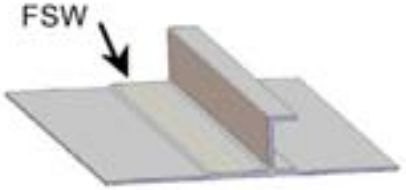
Frictional heating and plastic deformation provided by a rotating and profiled tool (shoulder and pin), which is plunged into and traversed along the joint line between two surfaces causes the material to soften and flow. High forging forces help to consolidate the joint.

Friction Stir Welding

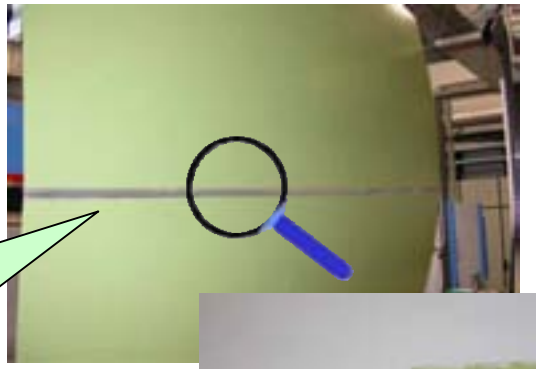
Main BENEFITS



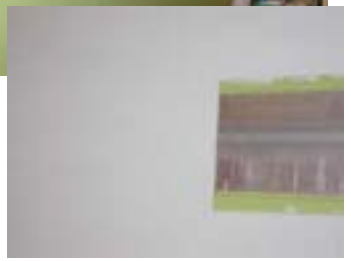
Reduced Weight
- No fasteners, No sealant, No doublers, No Crack-stoppers
- Larger panels (less splices)
- Higher mechanical properties (no stress concentration)



Improved Corrosion Behaviour
- Absence of holes & rivets
- No overlap joint and No crevice



Improved Aerodynamics
- No external rivet heads
- No overlap – smooth outside

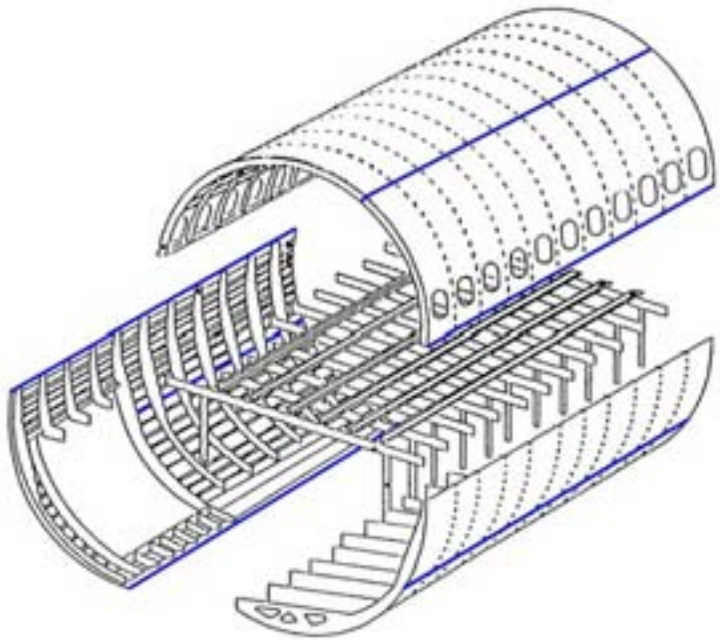


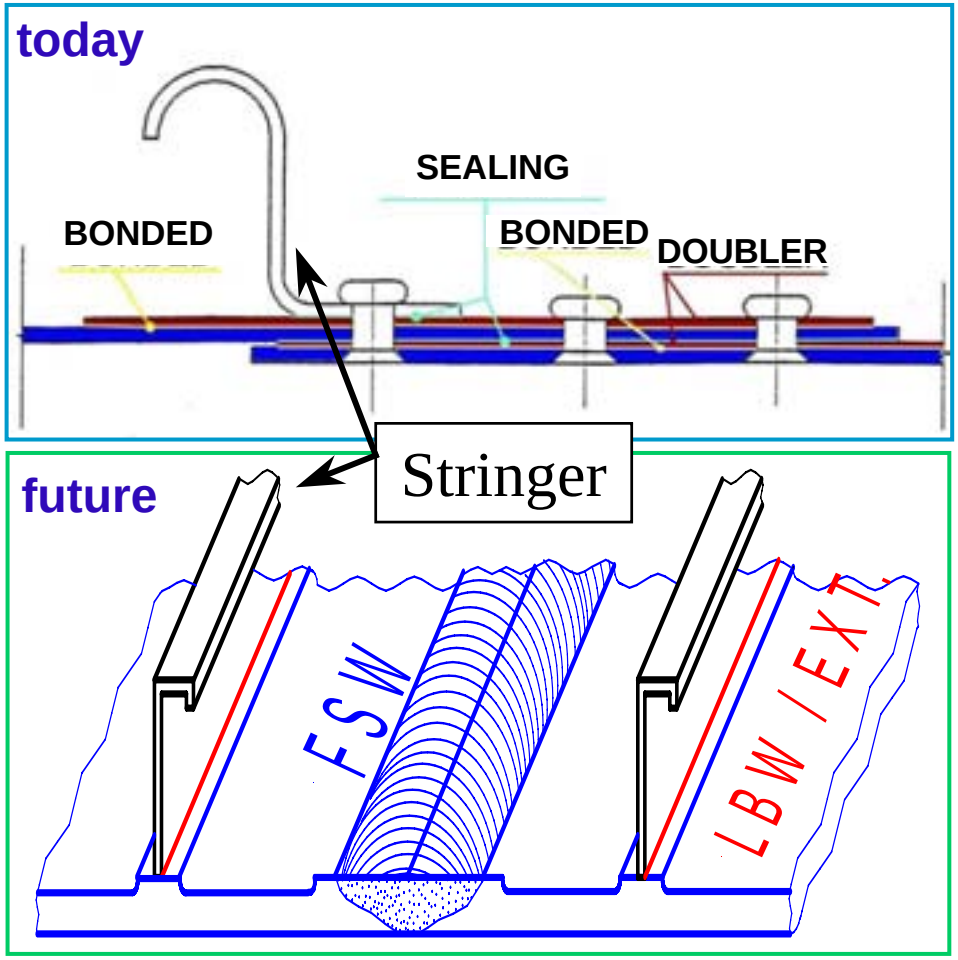
Reduced Manufacturing Cycles
- Reduced material consumption
- Faster than riveting
- Simpler assembly
- Easy to automate

Friction Stir Welding

Future application fuselage

Longitudinal welds





Perspectives - New Aluminium Developments

- New 2XXX / 7XXX alloys for 15 to 30 % increase of strength
- AlMgSc alloys for improved corrosion behaviour
- New Al-Li alloys offering lower density, weldability and high damage tolerance
- Extruded panels
- Advanced Fibre-Metal Hybrides
- Premium castings

Beyond 2020 ;-)

Thank you for your attention !