







MCE GmbH Aerospace and Special Projects



AGENDA







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Positioning Jigs (PJ)



- Measurement Assisted Assembly (MAA)
- Automated Guided Vehicle (AGV)
- Automated Drilling & Riveting (ADR)
- Equipment Pulse Line (EPL)
- Geometric Pallets (GEP)
- e o **Preparation Pallets (PPA)**
- 33 (****) Engine Installation Tools (EIT)
- P Logistics (LOG)
- **Digital Factory (DiF)** Ŀŋ
- Integrated Test Equipment (ITE)



Positioning Jigs (PJ)





A350XWB Prefal | Positioning station - sideshell



A350XWB Prefal | Positioning station - Section 19





A350XWB Prefal | Sideshells 16/19

Positioning Jigs



are used for positioning of big product parts for different steps of the assembly process.

- fix movements defined by the building process
- manual movements, defined by the operator
- calculated movements based on actual measurement values = measurement assisted assembly

Load values can be monitored or used for real-time control of the positioning jigs (e.g., Force/weight balancing, stress free movement, force limitation to avoid damages or to apply necessary forces or stress,....)





A350XWB Prefal | Sideshells 16/19

Main Requirements



Interface to the product: direct connected, cup& cone, special fittings, safe vacuum system

Positioning stroke based on AC assembly process (100 - 1500mm)

Load capacity based on (1 – 100kN):

- weight of handled parts
- additional loads (Workers, inner platforms, logistics..)
- loads resulting of assembly process (e.g., friction between parts during assembly, preload for assembly,...)
- safety factors

Drive speed based on process and safety requirements (0-1200mm/min)

Special functions (driven, floating, driven + floating, floating + brake, electric floating,....)

Precise positioning and good repeatability according to process equirements (down to 0,05mm)

Rigid, tough design, proved technique, high technical availability

Fullfill all requirements in term of safety

High modularity, re-configurable architecture

Standardized Solutions



References





A350XWB Positioning Stations Lower & Upper Shell, Floor grid, Section 19

more than 60 positioning jigs realized

Nominal load: 1-40kN

Stroke: up to 1000mm

Interface: cup&cone







A350XWB Positionings Stations Side Shell

48 towers realized

Nominal load: 1-25kN Stroke: up to 1200mm Inteface: cup&cone, fittings, vacuum



References





A350XWB Finishing Stations





Concept development for Ariane 6 Production

Nominal load: 35kN

Stroke: 100mm

Interface: cup&cone, fittings

Nominal load: 40kN Stroke: 400mm Interface: fittings, contour cradles



Measurement Assisted Assembly (MAA)





A350XWB Prefal | Measurement Position of Sideshells 16/19

A350XWB Prefal | Measurement Position of Section 19



Measurement Assisted Assembly



Measurement-assisted assembly (MAA) is a key concept for the modernisation of assembly processes of high-complexity products as it encompasses the

development and the use of positioning jigs smartly integrated with innovative measurement technologies. Such processes include:

- Predictive fettling/shimming in which component measurements are used to predict gaps and interferences prior to assembly, and these predictions are used to enable a right-first-time assembly
- Assemble-Measure-Move (AMM) processes where a component is positioned approximately in an assembly, the position of the component is measured and then it is moved towards its specified position. This process may be iterated a number of times before the component is within its specified position.
- Active tooling is a form of assembly fixture which does not rely on inherent dimensional stability to provide an accurate location for components but rather uses frequent measurements to facilitate in active compensation.
- improving the efficiency
- better positioning accuracy
- reducing the manufacturing costs



Measurement Assisted Assembly

To achieve these objectives, a high precision metrology system that automatically inspects and corrects the pose of the positioning jig or product during the assembly operations is of great importance. Depening on the Station volume and the required tolerance we are able to choose the matching system.

- Laser tracker (Leica, Faro, API)
- Laser radar (Leica, Faro)
- Indoor GPS (Amrikart)
- Measurement adapters customized for the measurement system and the AC characteristic.
- Referencing methods / flexible rating of monument targets and/or product parts and/or waterline,...
- Programmable assembly movements (6DOF) for joining process / solid movements
- Untwisting of parts / for correct shaping adjustable forces and geometric limits / force & weight balance









Measurement Assisted Assembly

MCE Experience - 8 Stations for A350 fuselages realized











Automated Guided Vehicle (AGV)

- Automated Guided Vehicle's (AGV's) are used for transport of:
- · product parts on cycle jigs or pallets
- Assembly system components (platforms, jigs, automatic subsystems
- improving the efficiency
- Less investment in rails
- Flexible routing easy to adapt
- Main requirements:
- Proven and safe technique with high technical availability
- High modularity, re-configurable architecture
- Standardized interfaces
- Depending on the transport requirements and specified other circumstances MCE chooses the suitable solution.
- · Dimensions, loads and interfaces
- Kinematics, driving needs (Omnidirectional, stroke, speed, ramp angel
- Maximum floor load and hangar floor specification
- In- and/or Outdoor use
- Drive system and Power supply (Electric, Electric + Hydraulic, Combustion engine, Hybrid,...)
- Duty cycle / charging philosophie (exchangeable battery, docking station or manual plugged cable)
- Safety (Laser scanner or bumper) and control (full automatic or operator driven / wired or wireless)
- Navigation Methode (optic, inductive, magnetic or transponder)







Automated Guided Vehicle

Design concepts - Different concepts fulfilling the different needs:

- Omnidirectional wheels (mercantum wheels) with electric drives .
- Omnidirectional steering wheels with electric drives •
- Omnidirectional steering wheels with hydraulic drives ٠ (battery, combustion engine or hybrid system)



Source: Scheuerle Fahrzeugfabrik



Source: Kuka AG



Source: Mototok International GmbH



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Automated Drilling & Riveting (ADR)

Automated Drilling & Riveting (ADR) Systems covers following process steps:

- Automatic referencing and optimized hole pattern
- One shot drilling incl. countersinking
- Measure and insert sealed rivets
- All parameters controlled and monitored
- Special Function: One step assembly
- Increase Productivity / reduce Lead Time
- Improve Quality
- Minimize Non-ergonomic task

Main requirements:

- Proven technique, high technical availability
- High modularity, re-configurable architecture
- Safety concept / Envelope restrictions
- Clean floor / No special foundation necessary

Additional features:

- Automated drill or cutter change
- · Tool management with RFID technology
- Quick-release coupling for end-effector exchange
- Controllable pressure-foot (process monitoring)
- Probe for quality control







Automated Drilling & Riveting

Functional requirements:

- Working envelope x meters (depends on aircraft part) and work area accessibility ٠
- Stiffness (to comply the process and drilling/hole requirements), positioning accuracy and pose repeatability ٠
- Technical availability and maturity •

Design concepts:

- 6 axis Robot with multifunctional endeffector •
- Flex track drilling machine ٠
- customized 6 axis NC-manipulator with multifunctional endeffector ٠





Source: Electroimpact Inc

Source: Ascent Aerospace







Source: Loxine





Equipment Pulse Line (EPL)





A350XWB | Section 16/19 and Section 13/14





Equipment Pulse Line

Equipment Pulse Line (EPL) is a state of the art solution for aircraft fuselage assembly lines.

- improving the efficiency
- better accessibility & ergonomics
- optimized logistics flows
- reducing the manufacturing costs

Cycle jig

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- access to the Aircraft work areas with customized plattforms
- · stressless support of the aircraft section according the product requirements

Logistic Plattform

Preparation works, line side storage (logistic) integrated test equipment

Cycle process:

- (1) AGV transport the cycle jig (incl. fuselage section) into the pulse line
- (2) Cycle jigs moving from station to station on wheels and rails
- (3) Optimized workload distribution per station
- (4) Quality and Customer Inspection at the end of the line
- (5) AGV transport cycle jig and finished section to unloading area
- (6) AGV transporting cycle jig and new section to the beginning of line

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Geometric Pallets (GEP)





Structural Pulse Line | A320 | Section 15/21

Structural Pulse Line | A320 | Section 15/21



Geometric Pallets



Geometric Pallets (GEP) are used as geometric jigs in pulselines. The product parts stays in the same geometric jig for severall production steps.

- Reduced handling effort & less damage risk due to loading and unloading
- Increased Productivity





Geometric Pallets



Overview Geometric Pallet

- (1) Rail systems on ground floor
- (2) Rigid steel frame
- (3) Geometric interfaces to AC parts
- (4) Integrated Access platforms
- (5) Mobile steps



Overview Geometric Pallet and Station

- (1) Geometric pallet
- (2) 1st floor
- (3) 2nd floor
- (4) Access flaps (on both levels)





Preparation Pallets (PPA)



are used for loading of panels to a pre-position (mostly split position) on a pallet next to the positioning station.

- Transfer of workload from complex expensive positioning station to a simple station
- Saving time in the positioning station / Quick and easy overtaking of wellprepared parts in the Positioning station
- Better accessibility
- Buffer function for big parts







Source: Airbus | Electrical bootstrap



Source: Hydro System KG | Hydro Cobra tool



Engine Installation Tools (EIT)

Different equipment's for **Engine Installation** are available on the market. Depending on the delivery status and the required access for installation works we integrate the best solution.

- Hydro Systems Engine installation tool "Cobra"
- · Airbus electrical bootstrap tool
- Manual Bootstrap tool
- · Customized mobile crane
- Hangar crane + special engine handling device



Source: 52 Aerospace Ltd | Manual bootstrap tool



Source: Airbus | Customized local Crane



Source: Airbus | Hangar Crane



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Customized Logistic Concepts optimize the material flow:

- · Identification of all logistic requirements based on the AC building process
- Definition of logistic areas at the station
- Definition of logistic principles
- Definition of transport means
- Definition of logistic routes
- Integration of logistic concept in layout and station design

Logistic concept transport between Logistic warehouse and stations



Logistics (LOG)



Logistic evolution process



Logistics









Logistics



















Integrated Test Equipment (ITE)



Test box (access on cycle jig)



Test box in operating position (access on cycle jig)



Test box in park position (under cycle jig)

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Fix installed test box





Cabinet test and installation trolley





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