Total Solution for Aircraft Automatic Assembly Lines
The World’s Most Comprehensive Range of Solutions for Aircraft Automatic Assembly Lines

- Turn Key Assembly Lines
- TPS, Tool positioning system
- Special Tooling & Moulds
- Moving Lines
- Flexible Drilling Head
- Software
MTORRES has developed over the years the widest range of systems to automate, with the highest flexibility and productivity, the Assembly of aircraft components. Ranging from Wings and Wing Box forming systems, Wing Integration systems, Fuselage Barrel forming solutions, Fuselages Sections Joining systems, to Moving Lines, Crawling Drilling and Riveting Systems, Moulds and Special Tooling, MTorres provides the most comprehensive, productive and well-proven range of solutions.

MTORRES extremely powerful Engineering and Project Management capabilities fully ensures the capacity to define, manage and successfully implement complex integrated projects and to provide Turn Key Solutions to our customers. This powerful engineering capabilities has allowed the development of a number of operative solutions, to form fuselage barrels, VTP and HTP as well as wing assembly systems, moving lines, crawling robots, etc, customized to match customer requirements and needs.

Every unit built includes customized Human Machine Interface (HMI) software for easy operation of the jig. A step by step workflow based software approach allows an error free operation, even in the highly automated and advanced solutions in production.

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Turn Key Assembly Lines

MTORRES has developed and successfully implemented at the Aerospace Industry worldwide, after carefully listening customer requirements a number of turnkey assembly lines, using state of the art technology and equipment that assures the required degree of flexibility and productivity that the industry demands.

MTORRES provides a complete solution covering every project phase, from the concept development to the Assembly Line Final Acceptance and production support.

MTORRES integrates at its jigs a wide range of technical solutions that goes, from the most simple assembly tooling to the highest and most sophisticated technology of reconfigurable assembly jigs, equipped with integrated ‘On Line’ measurement systems and a top performance range of automatic machines, controlled by powerful control & production software packages.

MTORRES has developed concept is designed to fulfill the most demanding customer requirements focusing on easy working procedures to maximize production rates, using the latest technology to boost flexibility via automation implementation, minimizing manufacturing process time, footprint minimization, flexibility on the steps to be implemented according to the production ratios increases, etc.

MTORRES powerful engineering and project management capabilities ensures a satisfactory project implementation from the early project steps, through a concurrent engineering phase, till the end with the customer operators training and full production support.

A350 PROGRAM S19
Turnkey assembly line installation for the A350 XWB fuselage Section 19 project. A total of 28 assembly stations are involved in an automatic pulse moving line concept regulated under Lean directives and prepared for a maximum Rate of 13 Aircraft per Month to be achieved on three different steps, 4, 7 and finally 13.

A wide range of technologies has been applied at this assembly line. They cover from the most traditional geometrical assembly jigs on a perfect match to the most advanced automated assembly technologies and automatic drilling and riveting process, managed from a customized control and production software.

Nearly all type of available assembly technologies are used at this assembly line to manufacture the latest Long Range aircraft generation. The most important ones are automatic pulse moving line, fully automated NC alignment system vision system for section positioning, TORRESmill TORRESriveter, 5 axis NC drilling column machines integrated in the assembly line.

Flexible Drilling Heads FDH and Flexible Drilling&Riveting Head FDRH are also included in the scope. One TORRESmill NC Surface Milling Machine for final tail connection with Special MTP Software and HMI for machines and automatic stations control.

MS 21 WING ASSEMBLY LINE
It is a full Turnkey Wing Assembly System that comprises the necessary equipment for manufacturing, test and later integration of the Outer Wing Box and Central Wing Box.

The complete project has been customized according to Customer needs in terms of performances and rate.

A total of 18 assembly stations are involved in an automatic pulse moving line concept regulated under Lean directives being the project conceived to allow progressive and flexible implementation of some of the systems involved.

Different tooling concept has been applied to assure the highest performances following the manufacturing process and flow designed by MTORRES, that includes also tolerance analysis and aircraft design modifications suggestions to increase the productivity.

Every MTORRES developed concept is designed to fulfill the most demanding customer requirements focusing on easy working procedures to maximize production rates, using the latest technology to boost flexibility via automation implementation, minimizing manufacturing process time, footprint minimization, flexibility on the steps to be implemented according to the production ratios increases, etc.

MTORRES powerful engineering and project management capabilities ensures a satisfactory project implementation from the early project steps, through a concurrent engineering phase, till the end with the customer operators training and full production support.

All technologies involved, from the traditional geometrical assembly jigs, flexible skin panel supporting tooling, the most advanced automated assembly technologies and the necessary test for final wing qualification (electric, hydraulic, leak and geometrical measurement) has been designed to assure a perfect match between performance and cost, being all processes managed from a customized control box thru a production software.

MTORRES TOTAL SOLUTION FOR AIRCRAFT AUTOMATIC ASSEMBLY LINES
Turn Key Assembly Lines

C919 FORWARD AND REAR FUSELAGE ASSEMBLY SYSTEM

It is a Full Turnkey Fuselage Assembly System that comprises the necessary equipment for manufacturing, the forward and rear fuselage, including the cargo and passenger doors.

The complete project has been customized according to Customer needs in terms of performances and rate, to assure the final market demand being a scalable assembly layout out regulated under Lean directives capable of an easy implementation without existing manufacturing process disturbance.

Different tooling concept has been applied to assure the highest performances following the manufacturing process and flow designed by MTORRES, that includes also tolerance analysis and aircraft design modifications suggestions to increase the productivity.

All technologies involved, from the traditional geometrical panel assembly jigs, flexible skin panel supporting tooling, massive panel to structure riveting systems, flexible integration TPS of the formed panels to achieve a high accuracy barrel sections, customized Flexible Drilling Head for panel joint, or robotic drilling cell for the panel manufacturing area assures the highest degree of quality and performance required for a new Single Aisle aircraft.

EMBRAER E 2 JETS CENTER FUSELAGE 2 & CENTER WING STUB

One of the newest project configuration provided for the last program launched to the market of Single Aisle sector. It is a full Turnkey central fuselage section and center wing stub assembly system that comprises the necessary equipment for manufacturing, under Lean directives a maximum Rate of 13 Aircraft per Month.

The complete project has been customized according to Customer needs in terms of performances and rate being the proposed solution flexible to accommodate different manufacturing rates 4-9-13 with the best optimized cost performance.

Different tooling concept has been applied to assure the highest performances following the manufacturing process and flow designed by MTORRES, that includes also tolerance analysis and aircraft design modifications suggestions to increase the productivity.

A wide range of technologies has been applied at this assembly line. They cover from the most traditional geometrical assembly jigs for singular pieces (panels, spars...) on a perfect match with the most advanced automated assembly technologies and automatic drilling, riveting and final wing interface milling process, managed from a customized control and production software.
When it comes to positioning systems technology, MTORRES is setting the pace. In terms of quality, design and sheer product innovation, we’re passionate about giving customer nothing but the best. So when it comes to developing jig less range, we talked to some real experts, our customer—and built the TPS based on the results of that research.

The MTORRES positioning system, TPS, is an in house developed system to accurately locate in space the aircraft components to allow the best fit among them. It is a new generation of reconfigurable assembly jigs equipped with integrated ‘on line’ measurement systems and using NC controlled reconfiguration axes for parts motion / repositioning.

It reduces the assembly time required in the jig and it is capable of producing highly consistent and traceable assemblies substantially rising the overall quality standards. MTORRES positioning systems as an integrated system designed to support measure and reposition the different parts involved at the final assembly position.

TPS positioning software is an MTORRES proprietary software package that defines and controls all the system parameters related to the parts positioning process.

Flexible Assembly Cells that allows the assembly of multi program fuselage sections versions at passenger and freighter configurations, in which the Process Flow and Lay Out definition are performed at concurrent engineering phase. Additional outsourced companies were included in the team under MTORRES supervision.

At that assembly line different concepts were used, joining the highest technology of reconfigurable assembly jigs equipped with integrated ‘On line’ measurement systems, with parts pre assembly and later transfer to final assembly jig.

High flexibility based in the capability to control up to 56 CNC axes on 28 TPS positioners, being the necessary reconfiguration performed from the HMI of the system in less than 1 minute. Two Laser Tracker units are included providing position readings to the MTORRES TPS Software which calculates the best fit.

All process and jig functionality are controlled from an operator control desk, ensuring the safety and the product quality.
**TPS**

**Torres positioning system**

**HORIZONTAL STABILIZER INTEGRATION SYSTEMS**

Automated assembly system to integrate/form Horizontal Stabilizers and later works as integration of the formed Horizontal Stabilizer in the Tail Cone.

Also all necessary material handling and transporting systems are part of the scope of work. Other technology, such as drilling and riveting could be added to the cell, automate further the process. All process and jig functionality are controlled from an operator control desk, ensuring the safety and the product quality.

One fixed Laser Tracker unit is included providing data to the MTORRES TPS Software which calculate the best fit, creating a specific part program, which will be executed, in an interpolated mode, to reposition the parts to its best geometrical position and helps the operator to have a smooth motion for part to part alignment.

This smooth motion is provided by 6 high accuracy TPS positioners in the system with a total of 12 CNC Axes. Depending on the part configuration different interfaces have been developed.

- Vacuum cup, with maximum tilt angle will be 10º in any direction, guarantee a suitable holding of the part.
- Multi-program interface frame, that allows to clamp by mechanical fixtures, different size of aircraft HS, without any modification.
- Customized clamping system.

**WING INTEGRATION CELLS**

Final Wing Integration Cells have been designed to assure the best balance between operation cost vs quality / geometrical performance.

A jigless concept, fully integrated with the Boxes manufacturing process, includes the most flexible and versatile positioning system TPS, based on movement and perfect positioning control of the wing parts.

WING INTEGRATION CELLS

- Real Joint Measurement processes, to be incorporated in the best fit calculations, reducing the joint gap and step and increasing the wing structural and aerodynamic performances.
- Automatic drilling process, with high performance in terms of capacity and accuracy, reducing the total recurring cost.
- Automatic milling process, as a result of the real measures taken at the joint, the pieces involved could be directly milled reducing the need of shimming, increasing the total structural wing capacity.

WING INTEGRATION CELLS

- System, easily scalable, has been designed to integrate the most complex wing design based at two or three parts by NC high accuracy controlled positioners and external position feedback system based at Laser Tracker.
- High capacity automated machining process, drilling/riveting/milling equipment TDRILL/TRIVETER/TMILL, has been incorporated to provide a highly powerful assembly cell, as the machines provide full automatic processes including:
  - Vacuum cup, with maximum tilt angle will be 10º in any direction, guarantee a suitable holding of the part.

**PROGRAMS**

- A350
- Airbus A380
- A400M
- B787
- Comac C919
- Falcon 7X
- Irkut MS21
Special Tooling & Moulds

MTORRES designs and manufactures a variety of conventional tooling and equipment.

The range of products in conventional tooling covers:
- Layup tools
- Trimming tools Composite moulds
- Material handling systems
- Transport tools
- Turning devices
- Applied tools
- Assembly fixtures

But our aim and the most significant efforts are focused on lean manufacturing principles, providing savings and cost reductions over the years.

Our commitment to support customers has kept us at the forefront of the technology for the aerospace industry for over 25 years.

PROGRAMS

- Airbus A320
- Airbus A340
- Eurofighter Typhoon
- Airbus A350
- Falcon 7X
- Airbus A380
- Irkut MS21
- B787
- CT7
- Comac C919
- Dornier 728
- Embraer E190/E170/E145

DESIGNED FOR YOUR BUSINESS

MTORRES TOTAL SOLUTION FOR AIRCRAFT AUTOMATIC ASSEMBLY LINES
Moving lines

Flexible and efficient planning with maximum performance

MTORRES moving lines range has been designed to outperform in every aspect. From ergonomic design that makes maintenance easy to vastly performance, the mtorres concepts allows flexible and efficient floor planning and maximum return per square meter of floor space.

MTORRES has developed and successfully implemented at the Aerospace Industry worldwide, a number of moving lines, using the state of the art technology and equipment that assures the required degree of flexibility and productivity that the industry demands, after carefully listening the customer requirement.

MTORRES provides a complete solution covering every project phase, from the concept development to the Assembly Line Final Acceptance and production support.

As a reference the moving line for A320 family fuselage final assembly, encompass A318, A319, A320 and A321 models. The MTORRES concept allows these different sizes and its customized requirements. It includes 10 transfer cars for fuselage, 14 working stations, and 2 transfer stations, in a non stop movement at 1m/h operational speed.

Design, performance and flexibility are the key features for the MTORRES moving line concept. With every design MTORRES can propose a wide range of accessories and options, to make the working area adapted to each regulations.

Clearly better, clearly built for success

PROGRAMS

• Airbus A320
• Airbus A380
• Airbus A350
• Embraer KC390
Flexible Drilling Head [FDH]

5 Axis Crawling Drilling and Riveting Machine

The FDH is a 5 interpolated axis drilling machine with modular design for easy system customization. Its principle is to ‘walk’ over the aircraft fuselage, holding on place by means of a set of vacuum cups. Once the FDH walks to position, gets locked with the vacuum cups and is ready to perform the drilling/riveting operation.

After drilling/riveting at the current area, the FDH walks one more step, by releasing the vacuum at half of the cups and moving them one step ahead, where it will lock them on place again getting ready for the next drilling/riveting operation.

The FDH does not need any additional guiding system mechanically engaged to the Aircraft to walk on its fuselage, irrespective of its position, even upside down.

FDH is a 5 axes autonomous platform that carries the necessary end-effectors for drilling and countersinking. A 5 minutes set up on place by 2 operators is enough.

The robot optimal design ensures the best drilling and countersinking positioning accuracy and a high speed performance at the lowest weight. A vision and laser system ensures that the FDH follows the desired path and corrects the CNC program from theoretical to real path. The FDH may work and walk on most of the current aircraft models from smaller aircraft to the largest jetliners. Applications are drilling and riveting circumferential, longitudinal and conical joints. A portable electric cabinet is provided, connected to the FDH by means of a minimum hosing/wiring harness.

A MTORRES developed control system allows the FDH to work without needing a conventional CNC system.

PROGRAMS

• Airbus A350
• Airbus A380
• Comac C919

MTORRES TOTAL SOLUTION FOR AIRCRAFT AUTOMATIC ASSEMBLY LINES
**HMI**

HMI applications are developed to create user-friendly interfaces that allow the machine operator to execute complex manufacturing processes.

MTORRES HMI’s are specifically designed for each application providing the maximum flexibility and quick learning curve for operators. The range of HMI solutions include Process and Machine User Interfaces, in which all the station processes are sequenced and displayed graphically in the form of a workflow.

These are the main features:

- **Process workflow.**
- **Integrated management of data and tools:** part programs, part measurements, tool life, tool wear.
- **Integrated management of measuring devices:** laser trackers, laser radar, indoor GPS, artificial vision cameras, NDI or contact probes.
- **Full system monitoring:** including maintenance / diagnosis visualizations: alarms, operational statuses of electrical circuit breakers, operational tests.
- **Process reports generation.**

The tasks in MTORRES HMI’s can be linked to MTORRES MES/PMS solution, in order to provide fully automatic real-time production management.

**TORRES POSITIONING SYSTEM**

MTORRES has developed a software package for the completely automatic assembly of aerospace components.

The Torres Positioning System, TPS kernel integrates a measuring system module, a path calculation module and a positioning control module. The main objective is to allow the positioning of parts of any size and shape in the space by means of the automatic calculation of trajectories for the elements that support the parts, avoiding any deformation during their movement.

Since 2000, TPS has been used successfully in several projects, and it has proved to achieve optimal results in the assembly of different aircraft structures: fuselage parts, wings and stabilizers. As a result of this experience, current versions include tens of positioning algorithms that can be applied out of the box to most of the positioning problems in the aerospace industry: best-fit assembly, wing/stabilizer integration matching both mechanical and aerodynamical criteria, etc.

These are the main features:

- **Automatic positioning:** TPS functionality can be controlled from customized screens that perform complex positioning tasks without additional operation from the user.
- **TPS software also optimizes manual operation with its Teach-in & Manual-movement modes. Teach-in functions can generate trajectories to go back to previously stored positions through well known paths. Other functions calculate rotations around programmable virtual axes through virtual or measured aircraft points. All these features can be controlled from a radio control or similar customized device, for ease of in-place visual alignment of aircraft parts.
- **Powerful:** TPS includes an array of powerful algorithms to solve almost any positioning problem.
- **Flexible & Scalable:** TPS can be integrated with different systems for data acquisition: gapman readers, laser trackers (Leica, FARO), vision cameras, indoor GPS, etc., it also supports the use of different configurable axis combinations.
- **Extensible:** TPS provides a general framework that makes easy to incorporate new functionality that matches our customer’s manufacturing requirements, thus reducing development costs and innovation risks.
- **Tested:** TPS is a mature product that has been successfully proven in different major projects for years.

**PRODUCTION MANAGEMENT/MES**

MTORRES has developed an easy to deploy MES solution (Manufacturing Execution System). MTORRES MES provides a complete tool to implement Lean Manufacturing strategies.

The main systems are:

- **Production Management System.**
- **Machine Data Analysis.**
- **Quality Data Management.**

MTORRES MES/MDA (Production Management System) is based on job templates which assign station processes to each section to be produced. These processes are entered as tasks. Production management is based on task planning and execution control. MTORRES MES allows real-time visualization of manufacturing progress and reporting of execution times.

MTORRES MDA (Machine Data Analysis) provides continuous information about the production output, quality and availability of manufacturing and assembly system. All relevant information is acquired in real time. Collected through OPC, and stored in relational databases. Real time acquisition allows displaying graphically an overview of the production line with current machine operating statuses color coded. Maintenance operators can navigate into the detail of machines statuses and alarms.

MTORRES QDM (Quality Data Management) provides quality data of the different machines and stations. All relevant information is acquired in real-time and stored in relational databases. Fully customizable reports can be generated with MTORRES QDM solution, which supports Excel, HTML, CSV. Additionally, quality data and master measurements are also available through standardized XML formats, which can be also easily transformed using XSLT technology.