- **Mondragon Assembly Spain**
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- **Mondragon Assembly France**
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- **Mondragon Assembly Mexico**
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  76240 Querétaro (Mexico)

- **Mondragon Assembly Germany**
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  D-78315 Stahringen (Germany)

- **Mondragon Assembly China**
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- **Mondragon Assembly Brazil**
  Rodovia Anhanguera Km. 129 no. 5091, Bloco C
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- **Mondragon Assembly India**
  F-89/8, 1st&2nd Floor
  Okhla Industrial Area-Phase I
  110020 New Delhi (India)

MONDRAGON ASSEMBLY

Solutions for Photovoltaic System

HUMANITY AT WORK MONDRAGON

With us it´s possible

MONDRAGON ASSEMBLY

INDEX

Mondragon Corporation

Sales and production presence around the world in the industrial, financial, retail and knowledge sectors:

- Finance
- Industry
- Knowledge
- Retail

Mondragon is one of the leading Spanish business groups, integrated by autonomous and independent cooperatives with production subsidiaries and corporate offices in 41 countries and sales in more than 150.

11.875
IN TOTAL REVENUE (MILLION €)

260
BUSINESSES AND COOPERATIVES

74.117
EMPLOYEES

15
TECHNOLOGY CENTRES

Production plants (125) **Corporate offices (9)**

Mondragon Assembly

About us

Mondrago assembly solutions. The parent company in Spain was created in 1977, one of the pioneers in the development of production and assembly technologies. The Group currently has six production plants in Spain, Mexico, France, Germany, China and Brazil, and a subsidiary in India. We also have a strategic network of commercial offices in leading world economies.

Thanks to the continuing success of our customers, we operate in numerous sectors: solar energy, automotive, domestic appliance components, cosmetics, medical devices and electronic components.

- Over 300 employees around the world
- Over 50M€ in sales
- 6 production plants around the world
- 40 years experience
- Innovative production technology

WE ARE PART OF THE MONDRAGON CORPORATION, THE LARGEST COOPERATIVE GROUP IN THE WORLD. ESTABLISHED IN 1954, THIS CONSTANTLY EXPANDING GROUP INCLUDES OVER 260 COMPANIES EMPLOYING 75.000 PEOPLE.

QUALITY

All Mondragon Assembly products are manufactured using top quality materials and are subjected to stringent quality controls, ensuring the safety of the people that interact with our lines and the quality of all of our processes, in collaboration with companies and institutions that certify the quality of our products.

Certifications: ISO 9001, OSHAS, etc.

OUR CUSTOMERS

Our innovative spirit, management excellence and closeness to the customer are the three values that have made Mondragon Assembly a benchmark group for customers worldwide.

COMPANY SOCIAL RESPONSIBILITY

We are a socially responsible group committed to people and their environment. A group that makes a significant effort to develop new manufacturing applications and systems to reduce energy consumption, thereby increasing their efficiency and favouring sustainable development.

Solar Energy

Mondragon Assembly is an internationally recognized producer of equipment for the manufacture of solar panels. We design and provide turnkey production lines and machinery for photovoltaic systems. We have been providing innovative manufacturing technology for more than fifteen years.

Mondragon Assembly provide their clients with solutions and services throughout the entire value chain:

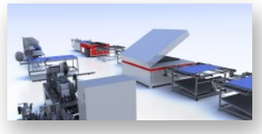
- Turnkey solutions with a capacity of between 15MW and 200MW per year
- Automatic and/or semi-automatic machinery: Tabber&Stringer + Layup, Interconnections, Cell Tester&Sorter, Laminators, Framing and machinery for Testing Photovoltaic Modules
- Design, specifications and sale of raw materials and consumables, development and certification of modules
- Training and know-how transfer
- Personalized solutions: Mondragon Assembly's engineering team offers their experience to help you develop your project

Exclusive product development

- Design and certification
  - ECO modules
  - Bifacial
  - BIPV
  - Desert tech
- Raw materials

MONDRAGON ASSEMBLY

Your technological partner



Automatic production line

- Tailored lines
- State-of-the-art technology
- Flexibility:
  - Product
  - Capacity
  - Automation level

100% GUARANTEE

100% SERVICE

100% SATISFACTION

Long term partnership

- Full installation and commissioning program
- Maintenance programs
- After sales service

KNOW HOW

Full Know how transfer

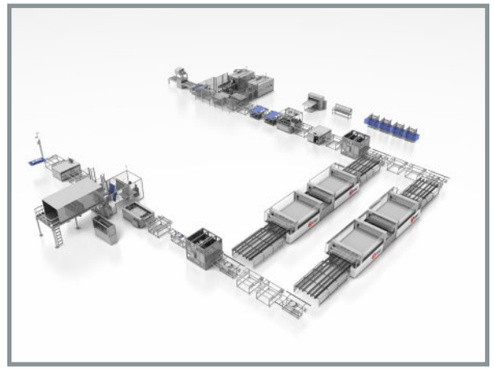
- Product and process engineering
- Full training program

Turnkey Solar Manufacturing Line

100-200MW

The 100-200MW manufacturing line is a high capacity automatic solution for the assembly of photovoltaic modules.

- State-of-the-art technology
- Fully automated industrial solution
- High quality, efficiency and capacity
- Quality control system: cells, strings, modules
- Rapid return on investment



Advantages

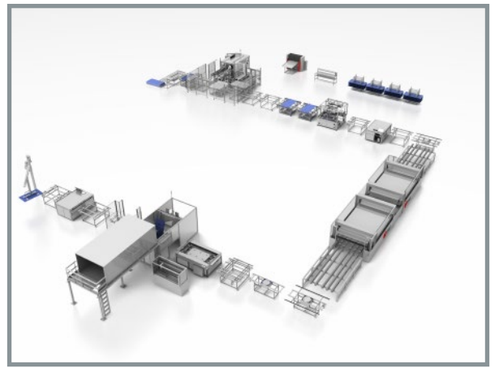
- Fully automated Tabber and Stringer
- Automatic interconnection
- Fully integrated lines
- Advanced lamination process
- Complete quality control system for cells, strings and modules
- Balanced production
- Full MES system

100 - 200 MW PRODUCTION LINE	
Installed Power	400 - 800 kW
Power Consumption	200 - 400 kW
Air Consumption	5.000 - 10000L/Min.
Required Area (L x W)	1750 - 3000
Operators	20 - 35
Modules/hour	60 - 120

50MW

The 50MW manufacturing line is a high capacity automatic solution for the assembly of photovoltaic panels.

- State-of-the-art technology
- Fully automated industrial solution
- High quality and efficiency
- Modular production and automation capacity
- Quality control system: cells, strings, modules



Advantages

- Fully automated Tabber and Stringer
- Automatic lay-up
- Fully integrated lines
- Complete quality control system for cells, strings and modules

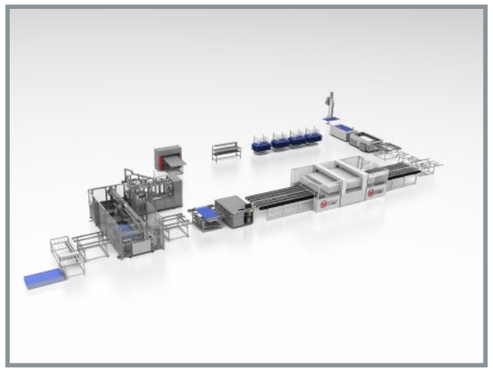
50 MW PRODUCTION LINE	
Installed Power	200 kW
Power Consumption	100 kW
Air Consumption	3000L/Min.
Required Area (L x W)	1250
Operators	15 - 18
Modules/hour	30

Turnkey Solar Manufacturing Line

30MW

The 30MW manufacturing line is a semi-automatic medium-capacity solution for the assembly of high quality photovoltaic panels.

- Medium production capacity
- High quality and efficiency
- Production capacity and modular automation
- Fully automated critical processes
- Flexibility to manufacture different types of modules



Advantages

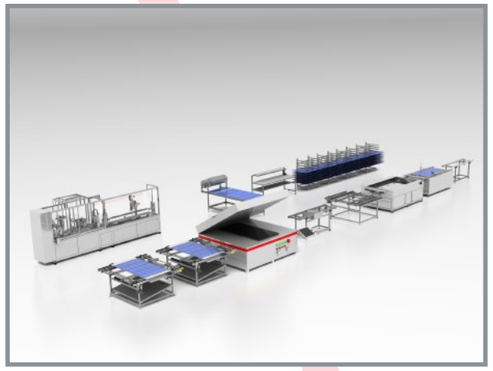
- Fully automated Tabber and Stringer
- Automatic lay-up
- Fully integrated lines
- Complete quality control system for cells, strings and modules

30 MW PRODUCTION LINE	
Installed Power	150 kW
Power Consumption	75 kW
Air Consumption	2500L/Min.
Required Area (L x W)	500
Operators	10 - 12
Modules/hour	20

15MW

The 15MW manufacturing line is a semi-automatic solution to assemble high quality solar panels.

- Cost effective investment
- Production capacity and modular automation
- Fully automated critical processes
- Flexibility to manufacture different types of modules



Advantages

- Fully automatic Tabber and Stringer and cell quality control system
- Fully integrated lines

15 MW PRODUCTION LINE	
Installed Power	80 kW
Power Consumption	40 kW
Air Consumption	1500L/Min.
Required Area (L x W)	250
Operators	6 - 9
Modules/hour	10

Solar Manufacturing Equipment

Tabber and Stringer

Tabber and Stringer GTS18

Easily configurable Tabber and Stringer with state-of-the-art technology. Capacity of 60MW/year.

Function

The main function of the Tabber and Stringer is to make cell strings, interconnection electrically the PV cells with ribbon by mean of contactless IR tech. Quality of both, cells and strings are checked during the process.

Description

Mondragon Assembly's Tabber and Stringer is ergonomic, simple, and has a high production capacity.

Thanks to our knowledge and experience in technological processes and solar equipment, our team offers modular designs with advanced functions, low cost and high performance.

The Tabber and Stringer has four main remarkable elements: Cell quality control using artificial vision, advanced control of the IR soldering process, servo-drives and up to 5 bus bar ribbon power systems.

Advantages

- Vision control systems to check the quality of the cells so that defective ones can be detected and regected
- Control of cell temperature to ensure good soldering
- Time control for correct self-diagnostics
- Unlimited number of process formulas, where the same model or module can assume different process parameters, depending on the materials used
- Flexibility for processing different cell models or sizes with a very short change time. We work with cut cells. Up to 1/2 of 6" cells

Cell Parameters	
Cell dimension range	Cut cells of 6": ½"; ¼", ⅛". Other to be studied
Cell thickness range	160 - 300 µm
Cell geometry	All
Tabs	
Number of tabs per cell	2 - 3 - 4 - 5
Tabs spacing (2 tabs)	Tab spacing: 2BB: 78 or 75; 3BB: 52; 4BB: 39; 5BB: 31,2 (Minimum 25mm)
Tab soldering process	Continuous
Strings	
Number of cells (125 x 125mm) per string	15
Number of cells (156 x 156mm) per string	12
Max. string length	1960mm
Distance between cells with string	2,5 - 160mm (longer on request)
Max. number of paralist strings in assembly unit	8
Max. module size (L x W)	2000 x 1100mm
Min. module size (L x W)	1400x600mm
Tabbing & Stringing	
Cell aligning	Vision system
Tabbing & stringing process	One step
Flux application method	Automatic, contactless
Soldering process	IR
Cell Transport System	
Tabbing & stringing	Walking Beam
Loading&Unloading	
Max. number of cells per casette (buffer)	200 cells (5 cassettes per buffer)
Cell loading	Adept S800 Scara Robot
String unloading	Layup on glass
Performance features	
Max./nominal throughput	700/650 cells/h
Average cell breakage ratio	<0,2 % (with certified cells)
Air&Power supply	
Compressed air pressure & flow	5 bar 750 Nl/min
Installed power	20 kW (3Ph, 380 - 420 V, 50 - 60 Hz)
Power consumption during heating	8 kWh
Power consumption	6 kWh
Dimensions	
Weight	3500kg
L x W x H	6,5 x 3,2 x 2,1m
System Control & Software	
Hardware	Beckhoff PLC with touch panel
Software allowing remote diagnosis	Yes
Acquired data compatible with Acess Excel	Yes

Solar Manufacturing Equipment

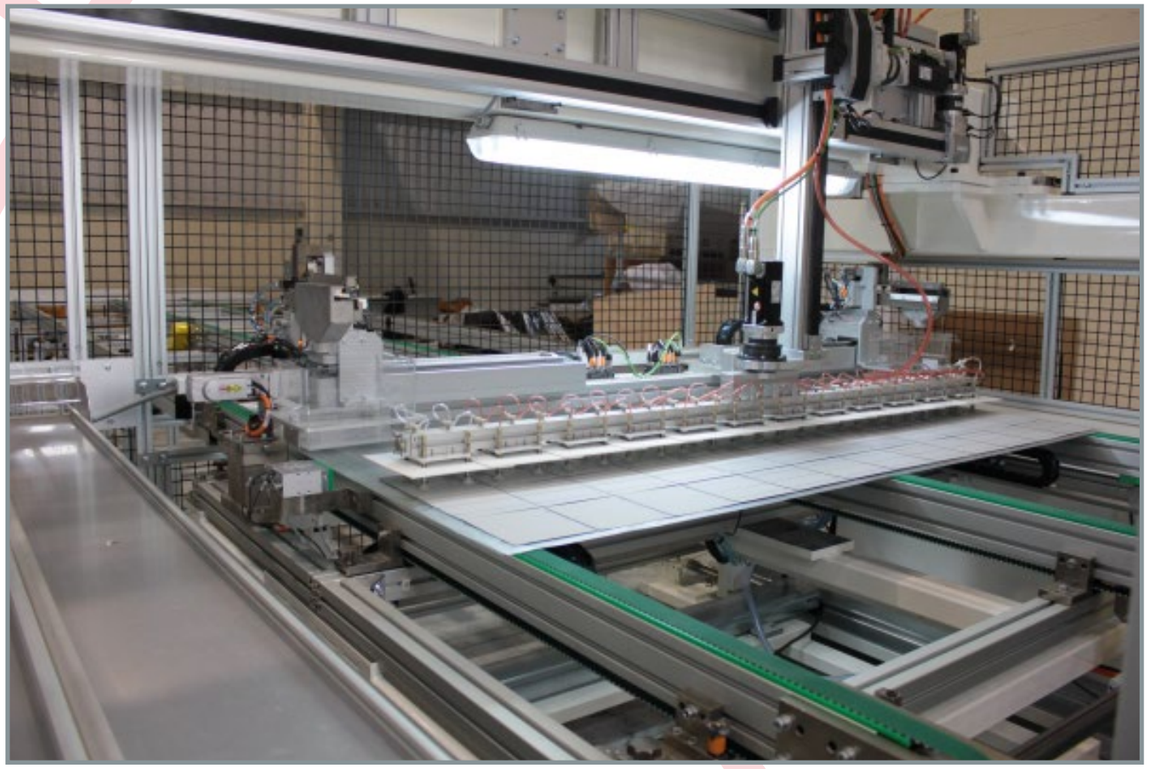
Tabber and Stringer + Layup

The layup manipulates and inspects the strings coming from the Tabber and Stringer using artificial vision and accurately positions them over the glass + EVA.

Mondragon Assembly's different layups adapt to the capacity of each Tabber and Stringer, from the compact machine with layup integrated into the customizable, to the GTS 18 with 6 axle robot, providing an extremely broad variety of options for our clients.

Layup Cartesian Robot	
Max. panel length	2000mm
Min. panel length	1400mm
Max. panel width	1100mm
Min. panel width	600mm
Máx. panel/h	40 (60 cells)
Camera pixel count	5 Mpx (only with string check camera option)
Reworked strings	2 positions
Máx. no - OK positions	3, programmable
Ends cut range	8 - 30 (only with cutting station option)

Layup Anthropomorphic Robot	
Max. panel length	2000mm
Min. panel length	1400mm
Max. panel width	1100mm
Min. panel width	600mm
Máx. panel/h	60 (60 cells)
Camera pixel count	5 Mpx (only with string check camera option)
Reworked strings	2 positions
Máx. no - OK positions	3, programmable
Ends cut range	8 - 30 (only with cutting station option)



Solar Manufacturing Equipment

Interconnection

Mondragon Assembly has the most advanced interconnection system on the market.

Advantages

Mondragon Assembly IC machine provides soldering with high accuracy and repeatability, by means of state-of-the-art vision cameras and induction soldering, which prevents human error as well as avoiding the formation of hot spots in the panel. Includes automatic feeding, forming and ribbon loading options. Enables a process without operators.

Features

We offer systems adapted to different production capacities:

Features	
Location of soldering point	Ribbon and tab alignment check included using high-resolution camera
Flux metering system	Contactless with pressure tank
Soldering	Induction, without contact or adding material
	Prevents hot spots
	Durable permanent soldering. Avoids tool wear
Ribbon loading	Manual loading of ribbon on inspection table
	Artificial vision check of ribbon position before soldering
Ribbon retention	Constant pressure and non-conductive materials, which prevents short-circuits
Cooling Circuit	Water closed circuit with cooler
Process formulas	There are many possible combinations of parameters
	On the configuration panel, different soldering and geometry parameters
	can be adjusted and selected
Loading and unloading	Automatic, with conveyor belts
Change-over	Immediately by software used with the touch panel
Compressed air supply	5 bar, 30 NL/min

	Model			
	IC150	IC40	IC20	IC10
For a production of	150MW	120MW	60MW	30MW
Maximum module size	2000 x 1100mm	2000 x 1100mm	2000 x 1100mm	2000 x 1100mm
Minimum module size	1400 x 600mm	1400 x 600mm	1400 x 600mm	1400 x 600mm
Soldering capacity	66 points/min (2BB, 3BB, 4BB, 5BB, 6BB)	36 points/min	18 points/min	9 points/min
Installed power (3 phases, 380 - 420 V, 50 - 60 Hz)	55kW	50 kW	29 kW	18 kW
Weight	3400Kg	3700kg	3500kg	3400kg
L x W × H (includes conveyor belts)	2.9 X 3 x 2 x 2m	3.0 x 3.2 x 2.0m	3.0 x 3.2 x 2.0m	2.9 x 3.2 x 2.0m
Computer software	Combined PLC and PC with touch panel			
Software	Allows remote diagnostics and data acquisition compatible with Access and Excel			

Solar Manufacturing Equipment

Solar Laminator

The laminator

Lamination is one of the most critical processes in the solar panel manufacturing line; it ensures the quality and durability of the photovoltaic module.

To ensure your products are top quality, Mondragon Assembly selects the best laminator for the production characteristics defined by the client, offering an optimised production line tailored to your needs.

Function

Encapsulation of the module by applying the right pressure and temperature to laminate the various components. The crucial factors in the laminating process are the raw materials, temperature, vacuum and pressure.

Description

The laminator consists of two chambers separated by a flexible diaphragm. The relevant materials are positioned on the glass of the photovoltaic module to be inserted into the laminator. Next, a vacuum is created in the chamber in order to remove the air from the front of the module, pressure and a previously-set temperature are applied, resulting in a compact laminate.

Features

- Uniformity of temperature
- Machine productivity and availability above 95%, VDI 3423.
- Optimised processes to avoid breakages
- Fast changing of membranes
- Easy integration into a solar panel manufacturing line
- Control panel formula monitoring
- Remote diagnosis

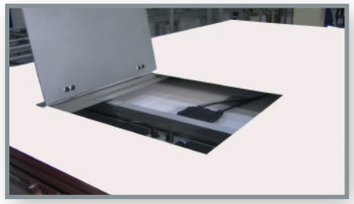
Production Lines	Capacity
15MW	2 modules per batch
30MW	4 modules per batch
60MW	4 modules per batch
120MW	8 modules per batch

Solar Manufacturing Equipment

PV Module Testing

EL Inspection

Mondragon Assembly provides systems for all types of applications, from manual laboratory systems to fully automatic online solutions, adapting the characteristics of these to each client's needs.



With their constant eagerness to improve the quality of their products, Mondragon Assembly has developed a new EL inspection system equipped with three high-definition cameras, enabling easy identification of defects that were previously invisible, such as micro cracks, dark areas, finger problems, and short-circuits as cells which may have errors are highlighted.

In the same station there is an option to add a "dark I-V" test.

Sun Simulator

We select the best sun simulator for the production characteristics defined by the client, offering an optimised production line tailored to your needs.

This machine performs a simple and direct resistance in series assessment in accordance with IEC891 and measures UV light at any radiation level point in the module. This calculates the module's power, archiving the measurement on the machine's computer and printing the module's label with its barcode and measured power. The solar simulators provided by Mondragon Assembly are rated AAA to A+A+A+. The following types can be provided: table or robotic tunnel type, Cartesian or manual.

HiPot Inspection

This equipment performs electrical isolation tests on the panel.

We comply with international standard IEC-61215 for design and approval certification.

It performs the following test types:

- Dielectric resistance
- Continuity and efficiency tests
- Insulation resistance

IR Inspection

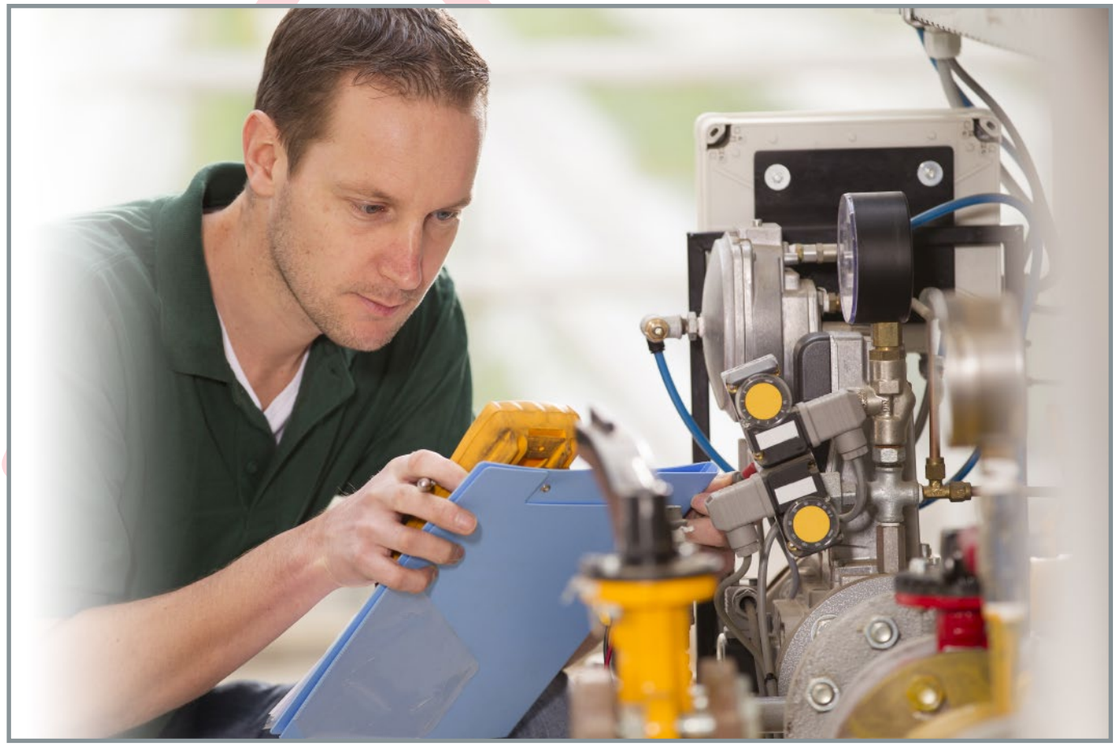
A thermographic image of the panel is acquired to locate hot spots and dark areas. Any electrical fault in the photovoltaic modules is shown.

Solar Services

Mondragon Assembly has an extensive worldwide partner network providing a fast and effective service. In recent years, we have substantially improved our technical support team, offering the best service to our customers, reducing down-time and guaranteeing the constant safety and functionality of our equipment.

Our technical support services include the following, amongst others:

- Over 50 technicians worldwide
- Remote diagnosis. Remote internet connection and diagnosis and solution for most incidents.
- Preventive maintenance programs. Qualified personnel visit to make machinery adjustments and give advice
- Supply of mechanical, electrical, etc., spares. Provision of supplies and raw materials when needed
- Emergency maintenance
- Facility status verification services
- Support and assistance during line commissioning
- Safety inspections and risk analysis
- Modernisation of facilities to revitalise and improve the productivity of older machinery
- Re-engineering of existing lines to improve their performance
- Simplification of the use and maintenance of older equipment by adding new controls
- Equipment and process optimisation
- EC certification for older machinery through modernisation and standard compliance adaptation
- Training programs



Technologies

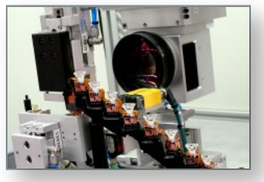
Mondragon Assembly integrates the most advanced technologies on the market into its solutions, pioneering the development of new automation applications.

We have a team of highly qualified and specialised engineers, with extensive product, process and technology experience. We offer automated solutions that best adapt to our customers' needs.

Mondragon Assembly's products include the following applied technologies: robotics, artificial vision systems, advanced linear motors, magnetic transfer systems, welding technology systems and collaborative robotics.

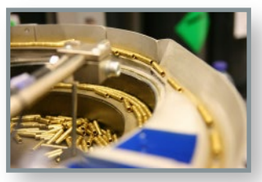
- Feeding technologies
- Handling systems
- Robotics
- Joining / forming technics
- Dispensing
- Marking and identification
- Transfers systems
- Vision systems
- Measurements and control
- Soldering and welding
- Product traceability systems
- Networks











References

Cooperation with research centers: