HAIRPIN TRACTION SOLUTIONS
WINDING AND ASSEMBLY TECHNOLOGY FOR E-MOBILITY
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IMA AUTOMATION IS THE SEGMENT OF IMA GROUP COMPOSED OF LEADING COMPANIES IN THE AUTOMATION AND ASSEMBLY INDUSTRY, WITH OVER 50 YEARS OF EXPERIENCE.

With its integrated network of companies which guarantees a worldwide coverage, IMA Automation designs and manufactures advanced technology lines for handling and assembling parts for different applications fields, such as Automotive, E-Mobility, Electrical Motors, Medical Devices, Eye Care, Caps & Closures, Electro Mechanics and Watchmaking.

IMA Automation companies have developed top-of-the-line technical skills, earning excellent market reputations and positioning themselves as leaders among those offering specialized technological solutions. IMA Automation hub is a perfect addition to the already consolidated packaging experience of IMA, allowing a synergy in the sharing of clients and widening our offer of technological solutions.

IMA, A SOLID LEADING GROUP IN PROCESSING, PACKAGING & AUTOMATION

Established in 1961, with the headquarters in Bologna, Italy, IMA is world leader in the design and manufacture of automatic machinery for processing, packaging and assembling products for several application fields. With a turnover of more than 1.600 million euros and 6000+ employees, the Group is present in about 80 countries, supported by a sales network made up of several branches, representative offices in central-eastern Europe and more than 50 agencies. IMA Group has more than 40 production plants in Italy, Germany, France, Switzerland, Spain, the UK, the USA, India, Malaysia, China and Argentina.
A WIDE NETWORK OF LEADING COMPANIES, 
A UNIQUE EXCELLENT OFFER.
While covering the full spectrum of technologies, IMA AUTOMATION ATOP is a state of the art player in hairpin, confirmed as the reference technology for large scale production of stators for traction electric motors. Focus on continuous e-traction technological development in hairpin stators and other winding technologies, with highest flexibility upon customer requirements.

Main applications of hairpin motors in e-mobility field, produced by IMA AUTOMATION ATOP equipment:

- **M-HEV** Mild Hybrid Electric Vehicle 48V
- **HEV** (Full) Hybrid Electric Vehicle
- **P-HEV** Plug-in Hybrid Electric Vehicle
- **BEV** Battery Electric Vehicle
- **FCEV** Fuel Cell Electric Vehicle
E-MOBILITY FIELD

From product design analysis and prototyping to series production:

- **Early entry in product design analysis aimed at optimizing the production (productivity and quality)**
- **Laboratory for samples production and product development validation**
- **Fully automatic stator line with high production rate**
PRODUCT DESIGN ANALYSIS

IMA AUTOMATION ATOP approach is based on a win-win cooperation with our customers.

FROM CUSTOMER NEEDS IDENTIFICATION

- Preliminary product design evaluation
- **PAMO: Product Analysis for Manufacturing Optimization**
- Manufacturing project definition from **LAB concept machines to Mass Production**
- **Dedicated facility for A,B,C stator** construction at IMA AUTOMATION ATOP
- Customer product definition & manufacturing process flow
Main applications of hairpin motors in e-mobility field, produced by ATOP equipment:

- M-HEV mild hybrid electric vehicle 48V
- HEV (full) hybrid electric vehicle
- P-HEV plug-in hybrid electric vehicle
- BEV battery electric vehicle
- FCEV fuel cell electric vehicle

TO PROJECT ACQUISITION

- Customer PO
- **Dedicated Project Management Team**
- Plant/machines Design review option
- Sourcing & parts manufacturing, equipment assembling, pre testing
- Commissioning at Customer & SAT
- Training and support to production
Tailored solutions with high technological content to meet specific customer requests, even the most complex, worldwide.
SLOT INSULATION ➔ HAIRPIN FORMING ➔ HAIRPIN INSERTING

ELECTRICAL TEST ➔ BUS-BAR ASSEMBLY AND WELDING ➔ HAIRPIN LASER WELDING ➔ WIRE CUTTING ➔ TWISTING ➔ WIDENING

HAIRPIN QUALITY CONTROL ➔ MANUAL OPERATIONS ➔ VISUAL INSPECTION ➔ PALLETIZING
A WIDE RANGE OF SOLUTIONS AT EVERY STEP OF MANUFACTURING PROCESS

Hairpin forming and inserting

**HIM**
Hairpin Insulating Machine

**HFM**
Hairpin Forming Machine

**HSI**
Hairpin Shuttle and Inserting

**HWT**
Hairpin Widening and Twisting

**HCM**
Hairpin Cutting Machine
A WIDE RANGE OF SOLUTIONS AT EVERY STEP OF MANUFACTURING PROCESS

**Stator Assembly**

- **Laser Welding**
- **Bus-Bar Assembly and Welding**
- **Electrical Testing**
- **Other Processes Integration**

**Other Processes Integration**

- **Hairpin Quality Control**
- **Manual Operations**
- **Visual Inspection**
- **Hairpin Palletizing Station**
AUTOMATIC MACHINE FOR SLOT INSULATION FORMING AND INSERTING.

HIM
HAIRPIN INSULATING MACHINE

- Paper forming unit based on insulation material specification and specific product design
- Stack length measurement for correct paper length
- Paper length cut through CN motor according to stack length
- Paper position guaranteed by the inserting process mechanism and by specific tooling
- Paper presence and final position (on one side only) controlled with a dedicated sensor
HAIRPIN FORMING MACHINE WITH CONDUCTOR FEEDING SYSTEM, LASER WIRE DECOATING, SINGLE HAIRPIN CREATING AND INSERTING STATIONS.

HFM

HAIRPIN FORMING MACHINE

- Machine capable to perform all hairpin, pitches, lengths, product specification
- Wire insulation removal
- IMA AUTOMATION ATOP proprietary flexible system for the creation of hairpins by means of robot manipulator with 6 brushless motors
- Robot system to transfer the formed hairpins towards the nest forming system
SHUTTLE WITH TRANSFER HEADS, MOVING NESTS TO THE INSERTION STATIONS THROUGH A PORTAL SYSTEM.

**HSI**

**Hairpin Shuttle and Inserting**

- Transfer heads move and insert inner and outer layer nests into the stator at the insertion stations
- Insertion stator tooling holding hairpins during insertion and protecting insulation
- A load/unload device transfers the stator between pallet and insertion station
- Different configurations are available
WIDENING AND TWISTING

AUTOMATIC MACHINE WITH HAIRPIN WIDENING AND TWISTING STATIONS INTEGRATED.

HWT
HAI R PIN  WIDENING AND  T WISTING

• Loading/unloading portal
• Widening group to widen the hairpins and prepare them for the twisting operation
• Twisting group bending the conductors according to the twisting angle as per customer’s diagram
• Motor torque monitored and limited to a max value
• 100% control stations for each process
THREE-STATION MACHINE FOR SINGLE WIRE CUTTING, STATOR TILTING AND MULTIPLE WIRE CUTTING.

HCM
HAIRPIN MULTIPLE CUTTING MACHINE

- Machine for multiple conductors cutting at constant length by means of NC mandrel

HRD
HAIRPIN REVOLVING DEVICE

- Machine for 180° stator revolving
HCM
HAIRPIN SINGLE CUTTING MACHINE

• Machine for single conductor ends cutting
HAIRPIN LASER WELDING

HAIRPIN LASER WELDING MACHINE WITH OPTICS USING LASER BEAM DEFLECTION WITH MOTORIZED MIRROR SYSTEM.

- Motorized mirror system on multi-axis device for correct laser beam orientation during welding
- Optical tracking system for accurate welding target detection with integrated camera in the welding head for welding position correction
- Two independent units gripping and holding each couple of conductors to guarantee a perfect junction and position
- The system allows to maintain each couple of wires under constant pressure
- Laser unit including generator, coaxial fiber, PFO head
- 6-axis robot moving the welding head
HBW

Hairpin Bus-bar Welding

- One robot for BUS-BAR pickup from tray and assembly
- One robot for laser welding
- Laser unit including generator, head for centering
- Optical tracking system or welding target with camera integrated into the welding head
- Welding quality checked by the 3D control system integrated into the robot arm
- Other customized solutions are available
ELECTRICAL TESTING

TESTING MACHINE, INSTRUMENTS, HW AND SW BASED ON IMA AUTOMATION ATOP KNOW-HOW AND TECHNOLOGY.

HTS
HAIRPIN TESTING STATION

- Stator electrical testing system operating on conveyor
- Hi-pot test up to 3500 V at 30 mA
- Surge test up to 6000 V
- RL test for resistance and field measurement
- Hi-current test up to 200 A
- Insulation resistance up to 200 MΩ
- NTC sensor measurement and insulation vs. winding test
- Partial discharge - surge test/high-voltage measurements
- Pyrometer/environmental sensor for temperature compensation
Based on customer request and product specification, IMA AUTOMATION ATOP proposes dedicated and customized process solution.

**HAIRPIN QUALITY CONTROL**

3D vision systems for stator inspection:
- In-process control
- End-of-line control

**MANUAL OPERATIONS**

Dedicated manual station based on customer request.

**VISUAL INSPECTION**

Manual station for stator inspection and rework.
HAIRPIN PALLETIZING STATION

Automatic systems for loading and unloading of stators and components.