Module Assembly and Alignment Systems

- AGCs / AGVs
- 7th Axis Robots
- Brake / Rotor Assembly
- Conveyors
- Corner Module Assembly
- Front/Rear Module Assembly
- Lateral Runnout
- Lift Assists / Torque Tooling
- Module Alignment
- Module Assembly WIP
- Press Systems
- RGCs / RGVs
- Steering Gear Assembly

LOCATIONS: USA, MEXICO, BRAZIL, GERMANY, INDIA, CHINA & KOREA

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AGCs / AGVs for Assembly Systems

Bulk material handling within the automotive industry has become an issue in regards to cost and safety. Fori was tasked to design a flexible, low cost vehicle that would be a suitable forklift replacement. The vehicles were built to fit within an existing plant environment and material flow strategy. The tuggers are required to locate within +/- 10 mm and once in station, the vehicle interfaces with a material handling cart on casters. Each vehicle included a coupling device that is used for auto-coupling. This was accomplished using a two stage pin assembly.

The driving factor for moving to a fully automated material flow was based on the safety concerns around the current process. Utilizing an AGV increased safety and decreased the potential for product damage and personnel injuries. The vehicles utilized a vehicle management system for traffic control and mag-gyro (inertial) for guidance throughout the plant.

7th Axis Robots

The Fori 7th Axis robot uses a linear belt that eliminates backlash. The systems is capable or 5, 512 lbs / 2,500 kg at 6.5 ft / 2 m per second. The robot loads and unloads the modules to and from the aligners.
Brake / Rotor Assembly


Conveyors

- Any Length
- One Piece Aluminum Extrusion Side Rails
- No Crossover Conveyors Required for Turns
- Minimized Amount of Motors
- Pallet lift and locate
- Minimal Lubrication
- Higher Weights can be Moved at Slower Speeds
- Lower Weights can be Moved at Higher Speeds
- Built in Cable Tray
- Conveyor lane diverter.
- Cushioned Stops with Anti-Backup Devices
- Conveyor hinge out section.
- Elevators & Lowerator

Fori Automation can design and manufacture the conveyor system including all material handling (over head rails lift assists), material transfer (conveyors and AGV’s), tooling (fixtureing, presses, pallets and gauging), data collection (error proofing), line side presentation material, controls (PC or PLC), Quality control (vision) and ability to process (efficiency rates, tooling capacity, cycle time data, tooling concepts and throughput studies). Conveyor systems can be of any length, loops, exit spurs, connecting lanes, forward and reverse, over / under conveyors, walk on conveyors, lift and tilt sections, lift and locate units, elevators and lowerators and rotate tables. Pallets can be customized to accommodate almost any product variance.
Conveyor Features

**Diverter**
The diverters allow for the conveyor to utilize less floor space as well as streamline the system.

**Pallet Stop**
The Fori pallet stop cushions the pallet and its load. The stop incorporates an adjustable buffer to allow the pallet to be stopped without jarring the pallet as well as an anti-backup feature that ensure the product only travels in one direction.

**Drive Through Corners**
Fori’s patented drive through corners streamline the conveyor system and improve system performance while reducing floor space. The drive through corner eliminates corner lift and transfers which historically are the largest source of downtime. The drive through corner system ensures the pallet orientation stays the same throughout the process.

**Lift & Rotate**
The Fori lift and rotate station allows the operator to assemble the opposite side of the pallet. A motor lifts the pallet then rotates in 180° then lowers it back onto the conveyor.

**Hinge Out**
A hinge out section allows operator access to closed areas in the plant. The lifts are balanced to allow ergonomic movement.

**Elevator / Lowerator**
The over / under conveyor layout allows for multiple pallets to be utilized while taking up less plant floor space. The empty pallets return to the elevator which lifts it into position to begin the assembly sequence. Once complete a lowerator lowers the empty pallet and it travels on the bottom return conveyor back to the elevator. The system can be configured to raise and return well above the assembly conveyor.

**Pallet Switch**
Pallet switch allows the pallet to be manually rotated and locked in a multitude of positions for part access / load. The release handle moves the lock pin which allows the pallet to turn on the bearing.

**Lift & Fasten**
The friction roller conveyor uses a scissor lift to elevate the pallet and part to a fastening station. When the fastening is complete the pallet and part lowers back onto the conveyor.
Corner Module Assembly

- Manual or automatic fastening
- Fori’s twin strand conveyor
- Fori’s RGCs or AGCs
- Presses can be built in the conveyor line

Assembly fixtures are designed for ease of assembly & Poka Yoke
- Ergonomic fastening utilizing lift assists
- Complete system is flexible to volume adjustments

Front & Rear Suspension Module Assembly

- Assembly fixtures are designed for ease of assembly & Poka Yoke
- Ergonomic fastening utilizing lift assists
- Complete system is flexible to volume adjustments
- Manual or automatic fastening
- Part delivery by Fori twin strand conveyor or RGCs

Fori’s suspension assembly systems are designed to accommodate any level of automation and volume. Assembly fixtures are designed for ease of assembly & poke-yoke. The modular assembly systems can contain any or all of the following: manual assembly, semi-auto assembly, fully auto assembly, manual transfer, automatic transfer, manual fastening, semi-auto fastening, fully automatic fastening, fully automatic alignment, and full birth certificate.
Suspension Module Assembly

Complete Turnkey Systems - from conception to design to production ready – Fori Develops the Process, Engineers the Equipment & Install the System for Production.

Lateral Run-Out Stations

Single or Dual automatic rotor TIR (Total Indicated run-out) test cells available. Inline or freestanding available to fit your needs. These machines are servo controlled and utilize high resolution linear probes with force apply for the most demanding requirements. This machine will validate - pass/fail and store/report quantitative data. Brake drag can be evaluated with this machine as required.
Lift Assists / Torque Tooling

Manual / Conveyor slide Mount

Fori equipment is designed to meet cycle time & handle the torque requirements for modules being assembled. This is done with various devices: torque tubes, torque slides, special torque reaction devices, jib arms, trombone tools, multiple spindles, & socket trays.

Auto Torque Station

Robotic / Auto Torque

- A wide variety of Nut Runner suppliers have been integrated to suite the customer’s requirements
- Many styles of Torque Tube designs available to suite customer torque requirements with manual or semi-automatic tooling
- Wide array of Torque reaction devices for special operations
- Robot / Auto Torque stations offer a compelling pay-back opportunity over semi-auto stations depending on your internal business case
Module Alignment

- Front & rear suspension module alignment
- Dynamic measuring under load
  System rotates wheels measuring run-out while exercising the suspension under full vehicle spring load
- Designed for flexible part loading (Conveyor, Robotic or Manual Lift Assist)
- Capable of running any suspension module with large travel & jounce load
- Standardized structural design
- Modular design will accommodate all suspension types
- System is built to allow new product with tooling change, the only components that require changing are the upper and lower tooling plates that are removed as one unit, which will allow direct capital reutilization

In a typical sequence the module is loaded into the machine and lowered onto the fixture. The main center slide lowers down to within 5-10 mm above the body mount bushings. Locking cylinders in the lower fixture raise the module up until the body mount bushings contact the upper locators. The alignment heads locate and secure the wheel corners and move them up to vehicle curb / height. Locking cylinders in the strut / spring locator advance and position the strut / spring in the proper position. Camber and or toe tooling advance and engage the bolts while the alignment heads begin jouncing. The measuring heads can move a total of 9.8 in / 250 mm to simulate vehicle jounce. When the jouncing is complete the measuring heads rotate the corners and measure toe, camber and run out. The camber and toe tooling then automatically adjusts the module to within specification. The measuring heads and torque tools then release and return to their home positions. When all units are home the module is removed either by manual lift assist, conveyor, AGV/AGC or robot.
Module Alignment

- 60-80 second cycle time / vertical module cycle time & jounce + stroke of jounce pending sequence
- Jounce load: 2,000 lbs / 910 kg or actual spring force at jounce
- Programmable servo driven jounce travel - Jounce speed = 1 ft per second / 225mm per second
- Main servo driven center slide maximum travel: 47 in / 1193.8 mm for part load & unload access
- Main center slide maximum travel: 47 in / 1193.8 mm
- Measuring head servo drive slide maximum travel: 41 in / 1041.1 mm
- Standardized structural design
- Machine height is adjustable by adding columns, which would allow a conveyor to pass through
- System can be loaded by robot, floor level conveyor or table top conveyor in all four (4) directions
- Mixed model production is possible with these machines for significant capital savings.
Module Alignment Measuring Heads

The measuring head slide consists of X - Y float, Induction motor, 3 jaw chuck, linear transducers, toe / camber pivots, servo regulated air compliance and multi power cylinder for the chuck devise.

Controls Software

- Advanced Parameter System tree editor supports Drag & Drop editing between any historical version of the setup file and the current setup file.
- Editing can also be performed between vehicle types on current file.
- This editing can be done at any level:
  - Entire data file
  - Module type
  - Individual parameter entry
- Advanced parameter supports detailed changed log of activities.
- Difference Reports:
  - File to File
  - Type to Type in File

4 - Way Part Flow Orientation

Designed for flexible part loading (Conveyor, Robotic or Manual Lift Assist) from all four directions.

System is built to allow new product with tooling change, the only components that require changing are the upper and lower tooling plates that are removed as one unit, which will allow direct capital re-utilization.
Module Assembly WIP

Fori will create special material handling equipment to present parts to the line to aid in the assembly process. This is done to handle space issues as well as throughput issues.

Many line side material delivery options:

- Line side Flow racking
- Line side rack handling systems (Lift & Tilt, Lift & Rotate etc.)
- Special Means Racking For:
  - Line side part staging
- Gravity and Power conveyance for sequencing and buffering parts to the line.
Press Systems

F-20Kn
- Stroke: 120mm
- Speed: 0-57 mm / sec
- Linear Accuracy: +/- .03 mm
- Force Repeatability: +/- .12% of Load
- Maximum Load Capacity: 25Kn
- Measuring Range: 0-20 Kn

F-50Kn
- Stroke: 300mm
- Speed: 0-100 mm / sec
- Linear Accuracy: +/- .03 mm
- Force Repeatability: +/- .10% of Load
- Maximum Load Capacity: 62.5Kn
- Measuring Range: 0-50 Kn

F-100Kn
- Stroke: 300mm
- Speed: 0-100 mm / sec
- Linear Accuracy: +/- .03 mm
- Force Repeatability: +/- .10% of Load
- Maximum Load Capacity: 125Kn
- Measuring Range: 0-100 Kn

Fori designs and builds its’ own presses: bearing, bushing, cradle, hub, knuckle & ring with three different spindle options. Designed to accommodate the customers specifications and tolerances. Can be stand alone or mounted inline on a conveyor system. Can be Electromechanical, Pneumatic, Air Over Oil or Hydraulic.
Coil Over Shock Press

- RH/LH/Mixed model capable Coil Over Strut assembly machine available with common or independent bases
- Auto spring compress rams, servo ball-screw spring compress systems
- Center single automatic guide pin units - providing programmable tuning, certified fixture, quick interchange R&L tooling
- Automatic Torque Top nut, pneumatic powered vertical slide system
- Available COS part extractor. Unit grips finished part, unloads part from machine and presents to operator. Allows operator to load and initiate next cycle before unloading finished part improving machine utilization
- Spring location detection switch
- Optional manual pull down slide for spring positioning.
- COS Fixtures are designed for ease of assembly & utilizes checks to protect proper part loading by mechanical end electrical means
- Handles Range of Springs Lengths and Shapes
- Can be a Dual or Single Machine
- Can be Stand Alone or Conveyor Mounted

RGCs / RGVs

Versatile RGC with 1,500 lb. / 680 kg Capacity

Utilizing a flex rail system and RGCs provides the utmost flexibility for customers who need to be able to accommodate changes easily. The ability to be flexible in the automotive world means less downtime, cost & reduced infrastructure during installation. This level of flexibility is now becoming the norm in majority of our Automotive Assembly Systems. The RGC system can easily be modified, whether it be adding a station or a product impact change.
RGCs Specifications

- RGC top speed 2 ft / 0.6 meters/second
- Carrying Load: Load up to 1,500 lbs / 680 kg.
- Encoder positioning feedback +/- 0.5mm linear.
- Position accuracy: +/- 1mm
- Waypoint Control: RFID Reader
- Power supply: (2) Sealed lead acid gel batteries.
- Wireless WLAN: IEEE 802.11a/b/g.
- Safety Bumpers
  - Integral Station buttons on cart
    - (2) Cycle complete
    - (1) E-Stop
- PLC Controlled configuration
- Open controls architecture using standard components
- Track Switches
- Cart Positioners - Verify exact cart positioning

Cart Features

- 360º Assembly access
- Simple path configurability / modifications
- Inside & outside line access
- Modular assembly line configuration
- Quick setup times
- RGC Length can be modified to fit the applications need
- On Board expandable I/O Poke Yoke accommodation
- Low maintenance costs
- Efficient maintainability
- Almost unlimited tooling tray configurations
- Quick setup
- Flexible line configuration
- Simple quick process change menu drive PLC configuration thru single line traffic controller

Power / Energy Options

Fori offers a wide variety of different power options depending on the RGC configuration and required throughput. A power source is generally selected once the process has been determined and a few factors are known such as: number of shifts/moves, current throughput, environmental conditions, available charge versus run time and required system voltage.
RGC Control Configuration
Main Control Enclosure

Steering Gear Servo / Ball Rod End Set Assembly

Precision servo set tool for locating Steering Gear Rod End. Manually loaded Station. Manually Torqued once Rod End is Located Properly.