

E7000 Main Machine



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E7000 Main Machine



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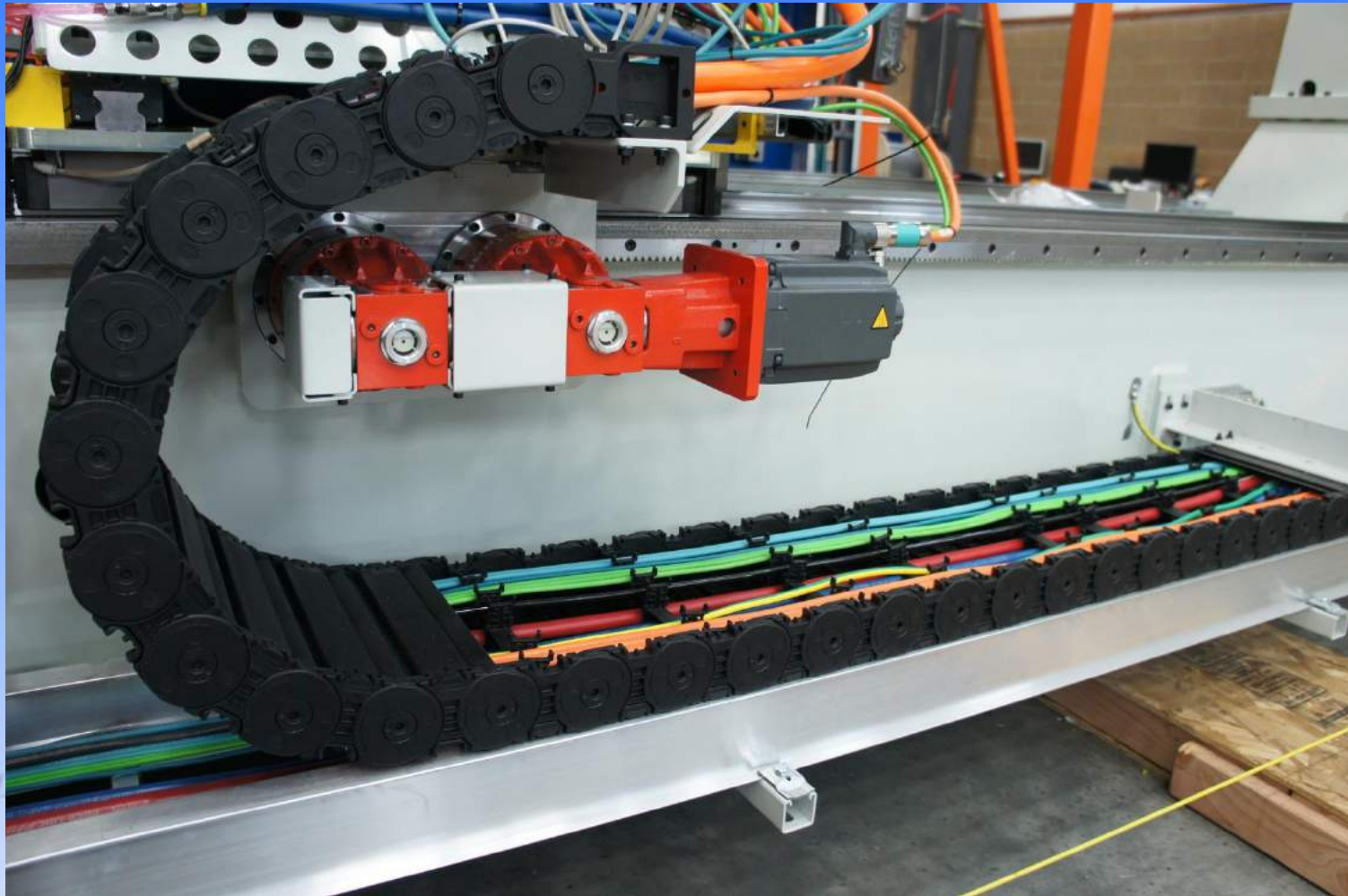
Tandem X Axis Drive for Best Machine Accuracy



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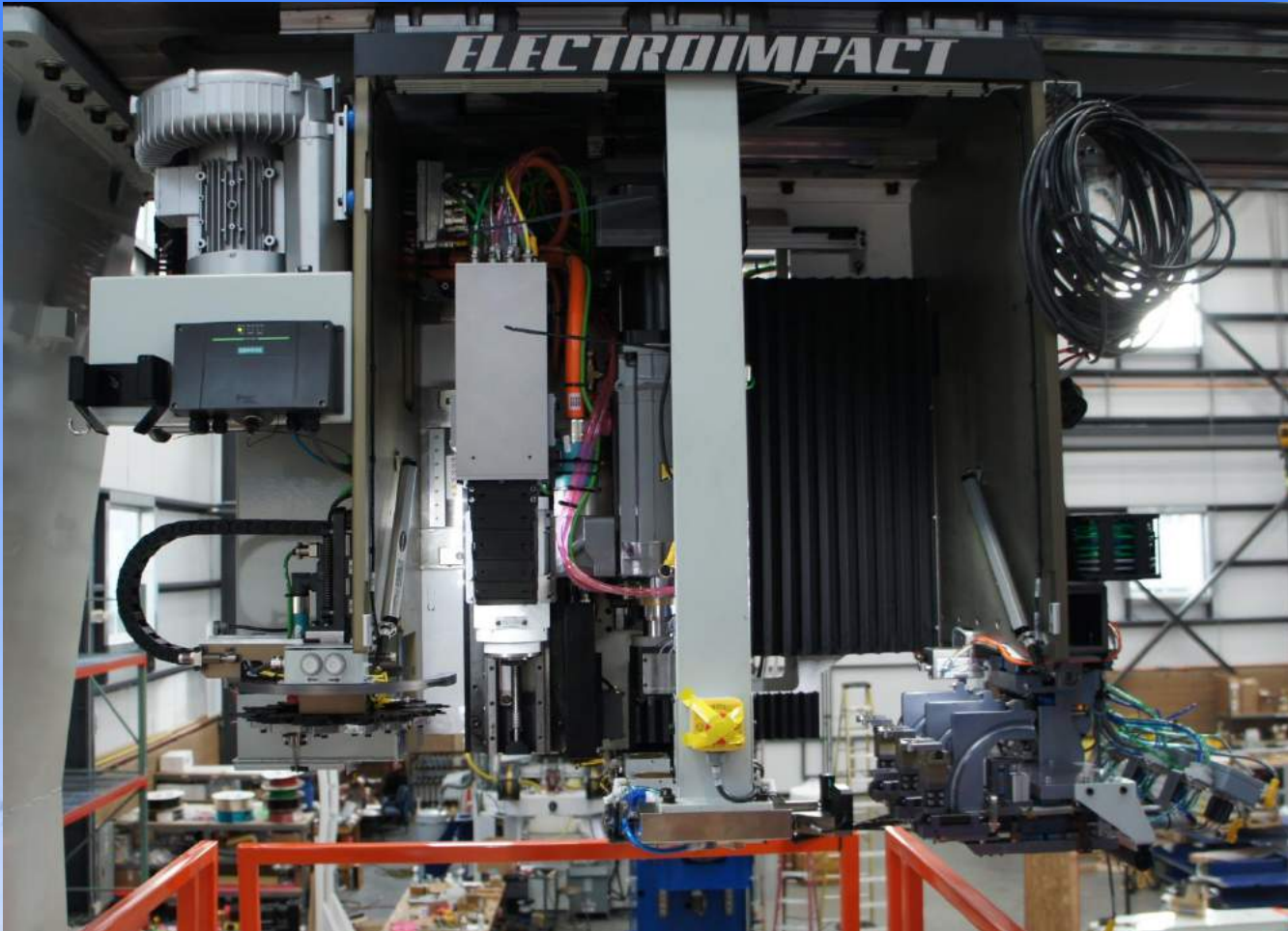
Dual-Drive Gearboxes on Y Axis

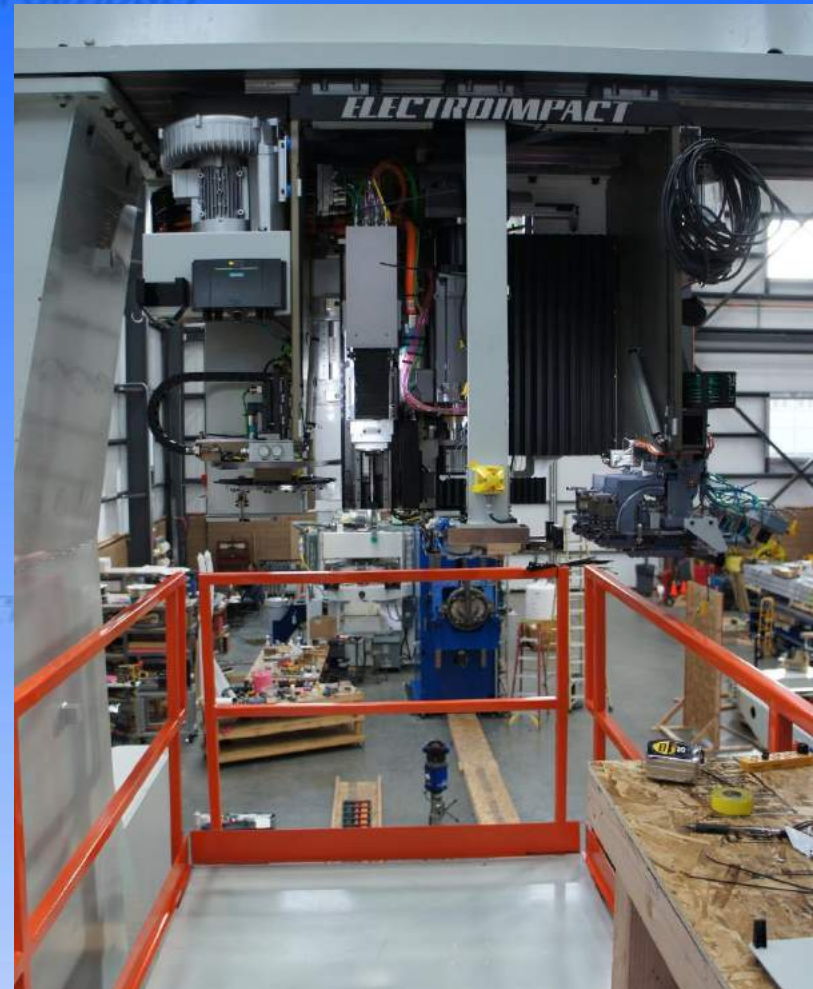
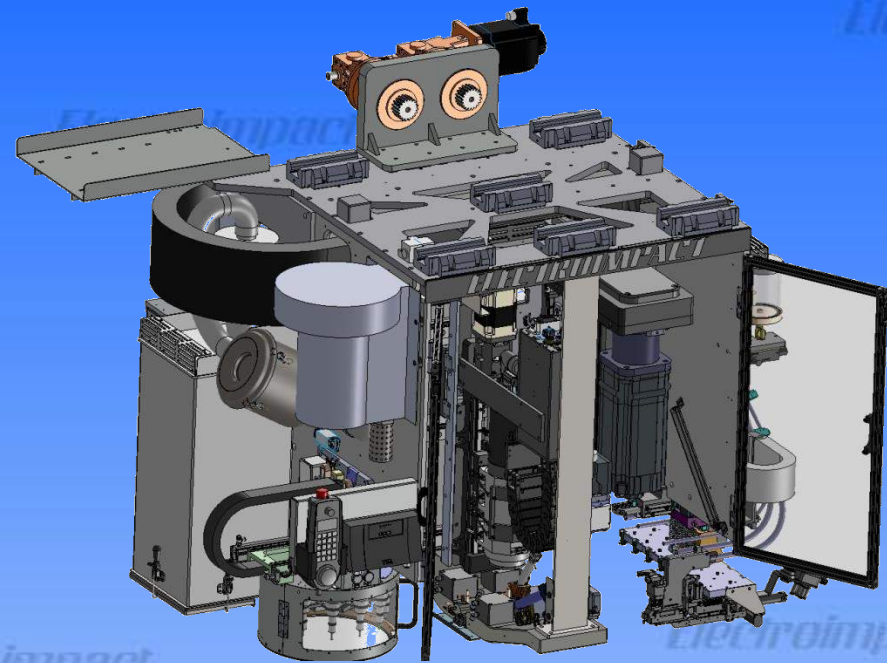


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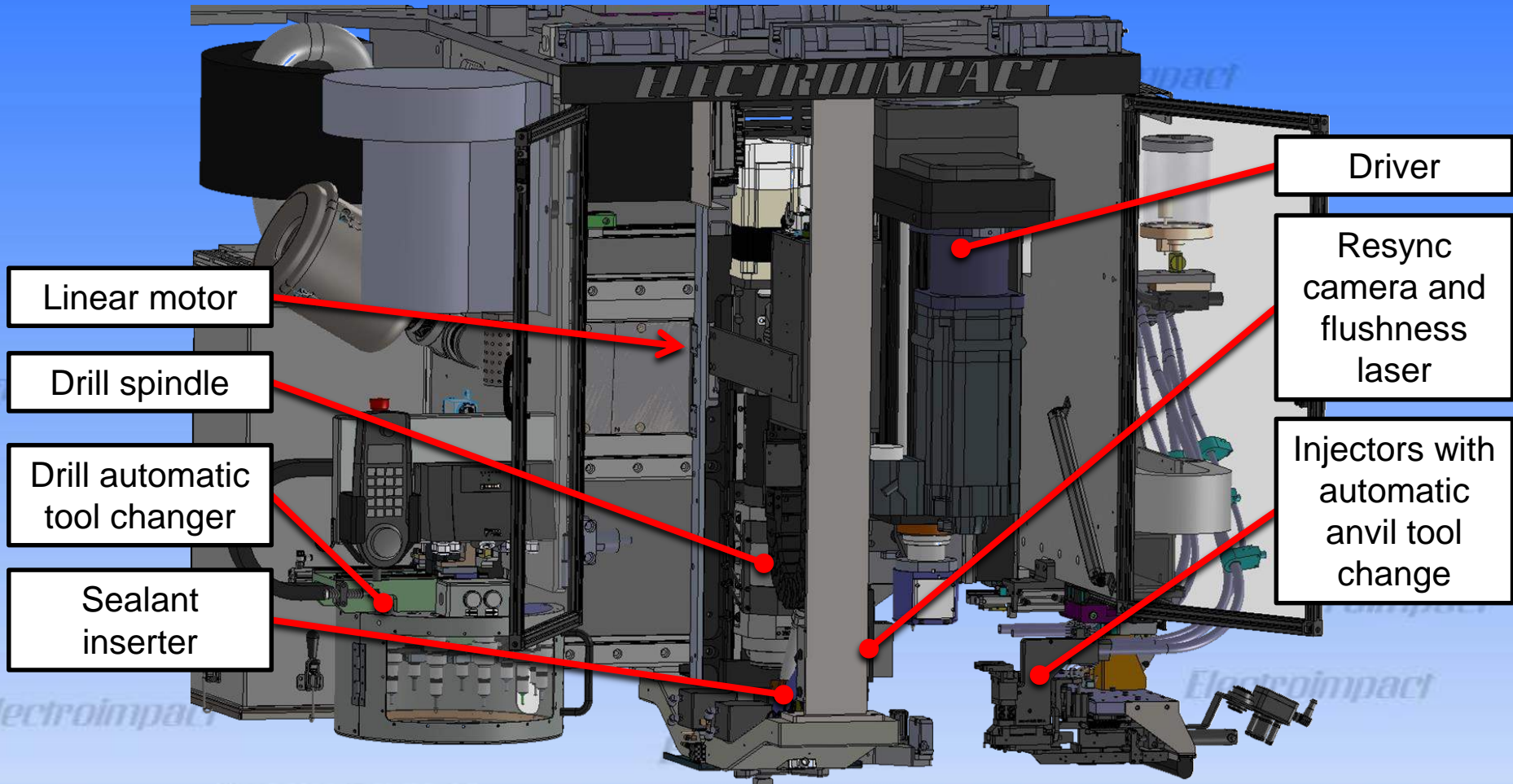
Upper Process Head





- Completely open head design for easy access to process tools

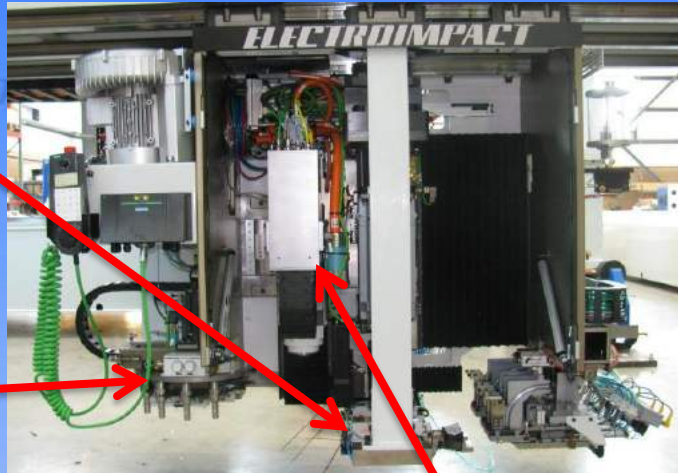
Upper Riveting Head



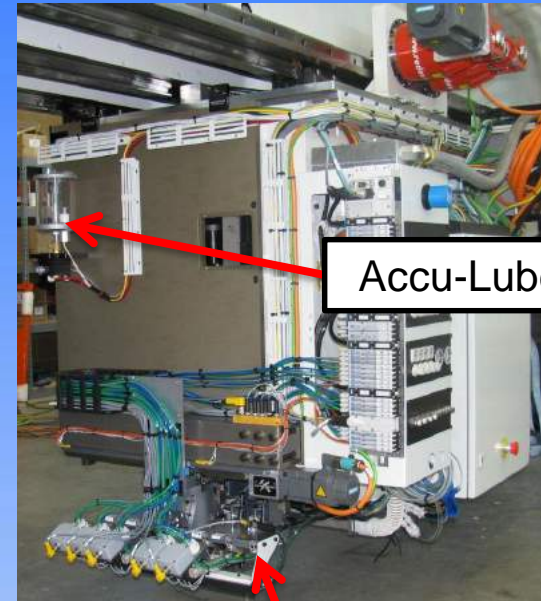
Upper Head Overview

Headstone Assembly

Automatic Tool Changer



Process tools mounted on a linear motor controlled shuttle table

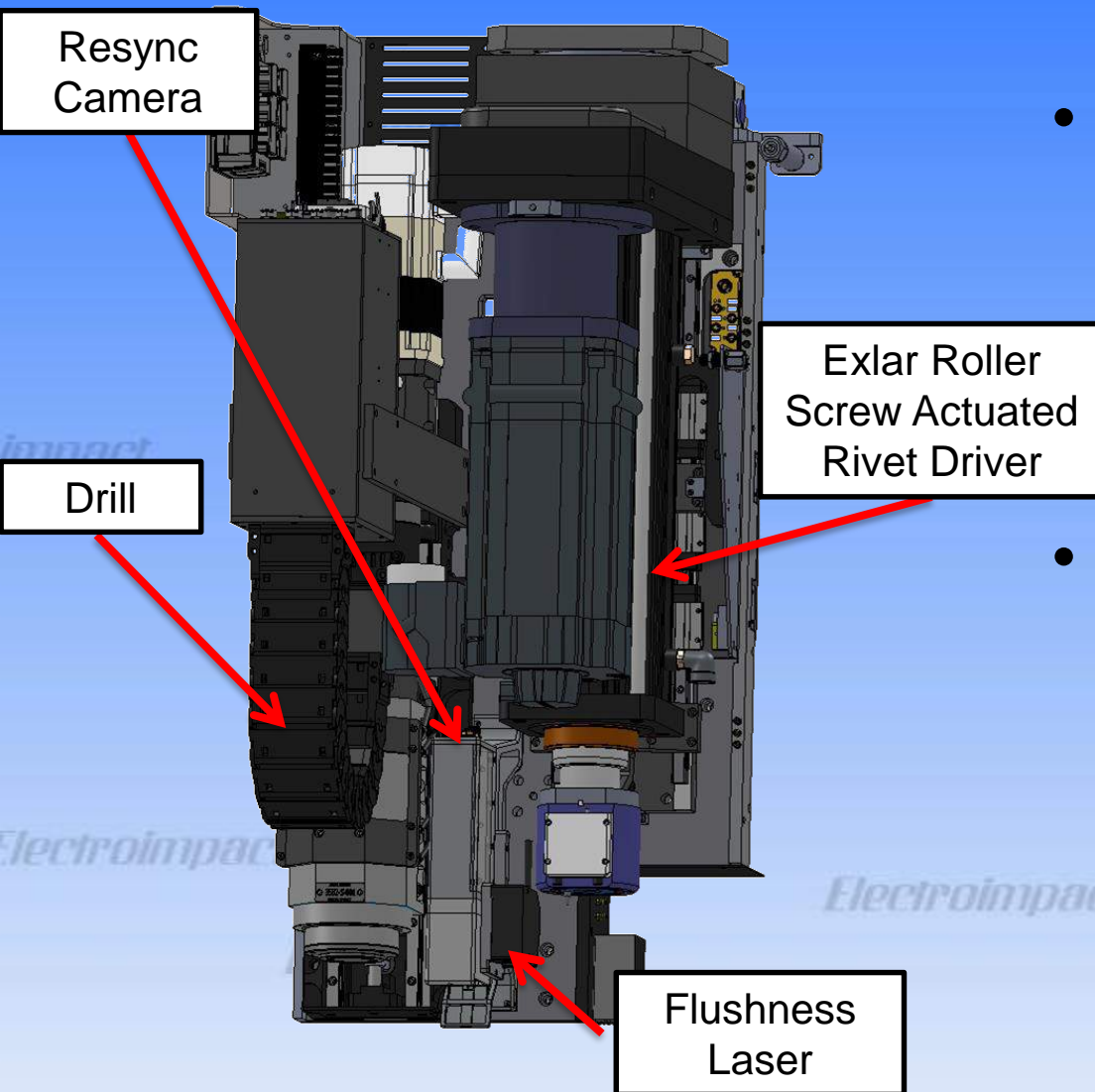


Accu-Lube unit

Automatic fastener injector modules

Chip vacuum system

Process Tool Layout

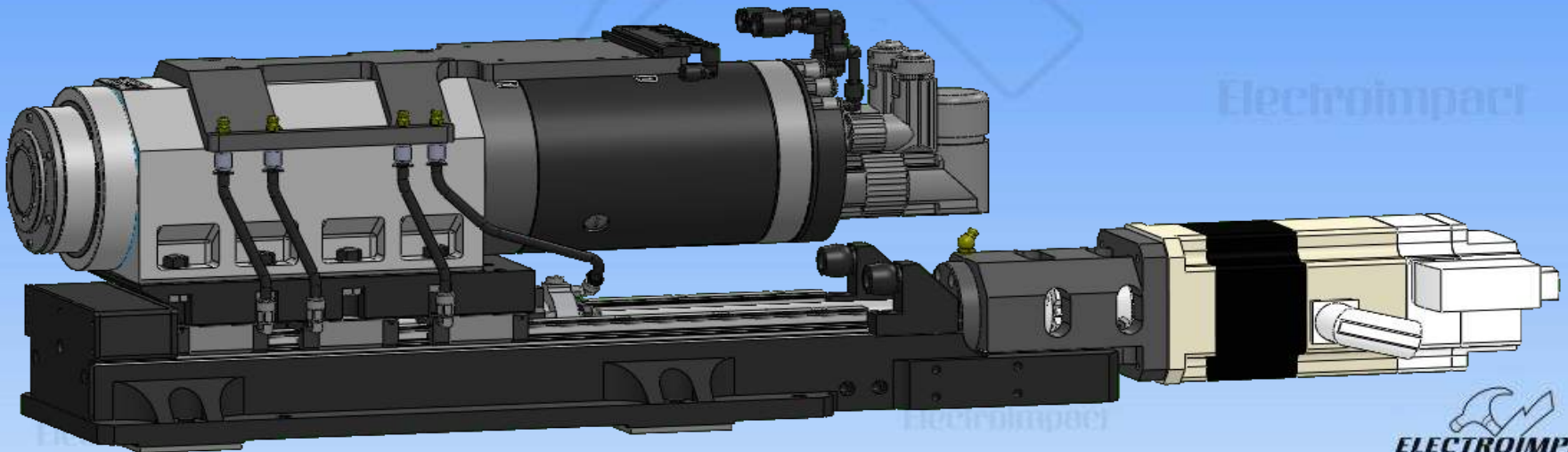


- Very fast tool shuttling time
 - 250 ms transition from drill to buck tool
- 244 mm from drill to buck tool

Spindle

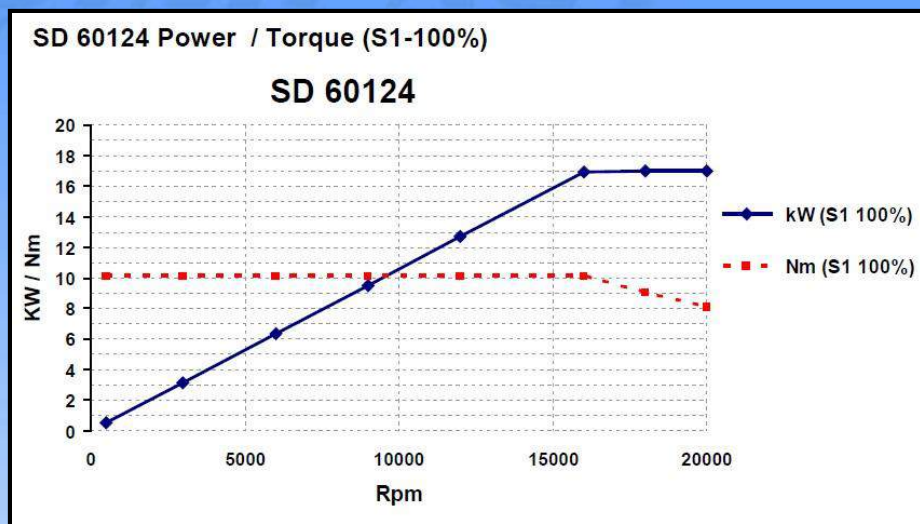
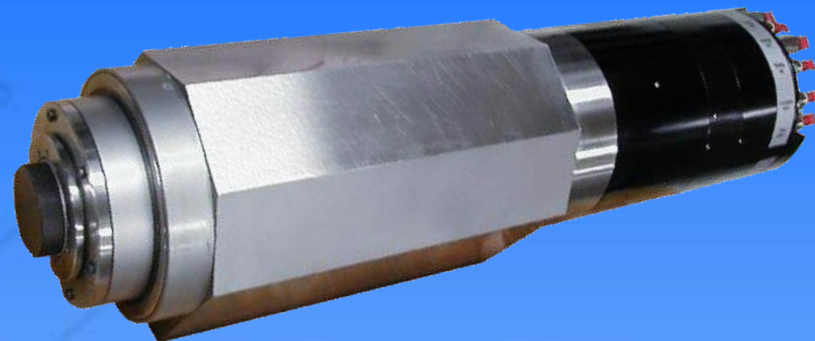
Spindle Assembly

- Precise SD60124 E1107 spindle cartridge
- Heidenhain LC495S absolute linear encoder (5 μ m accuracy)
- Bosch-Rexroth 20x10R rolled ball screw, size 15 linear bearings
- 1FK7042-2AK71-1CH1 Siemens servo motor with brake (feed axis)
- Self-contained connectorized electrical bulkhead
- A&A Gortite bellows for chip protection
- Easy-access remote greasing for bearings
- Tribos HSK-40E tool holder

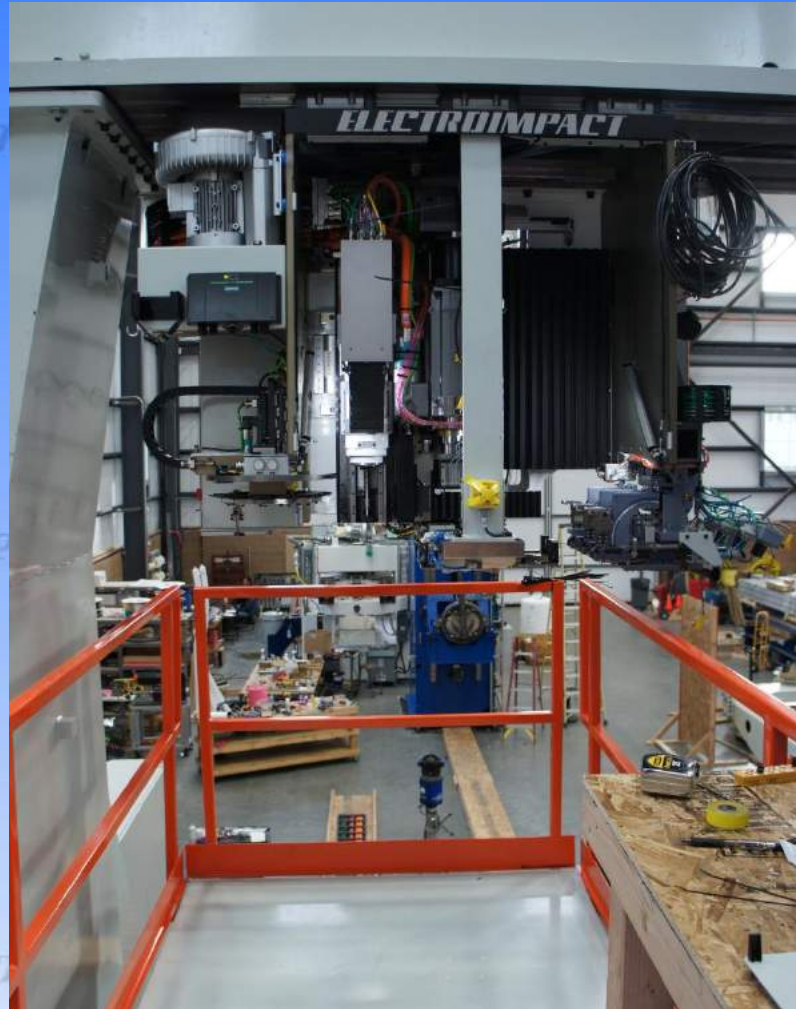


SD60124 Spindle Cartridge

- Fischer-Precise SD 60124 spindle with custom housing:
 - AC synchronous, 3-phase, 4-pole motor
 - Speed range of 500 - 20,000rpm
 - 10.1 N-m (89.4 in-lb) nominal torque
 - 17 kW (22.8 hp) at full speed
 - 4 angular-contact, hybrid-ceramic bearings
 - Permanent grease lubrication
 - Dowtherm liquid coolant circulation through housing
 - PTC thermistor and PT100 temperature sensors
 - HSK 40-E clamping system with spring-loaded drawbar (pneumatic release)
 - Integrated PNP proximity sensors to detect tool holder
- EI has supplied nearly 45 spindle assemblies over 10 projects that use this cartridge



Upper Head Maintenance Access



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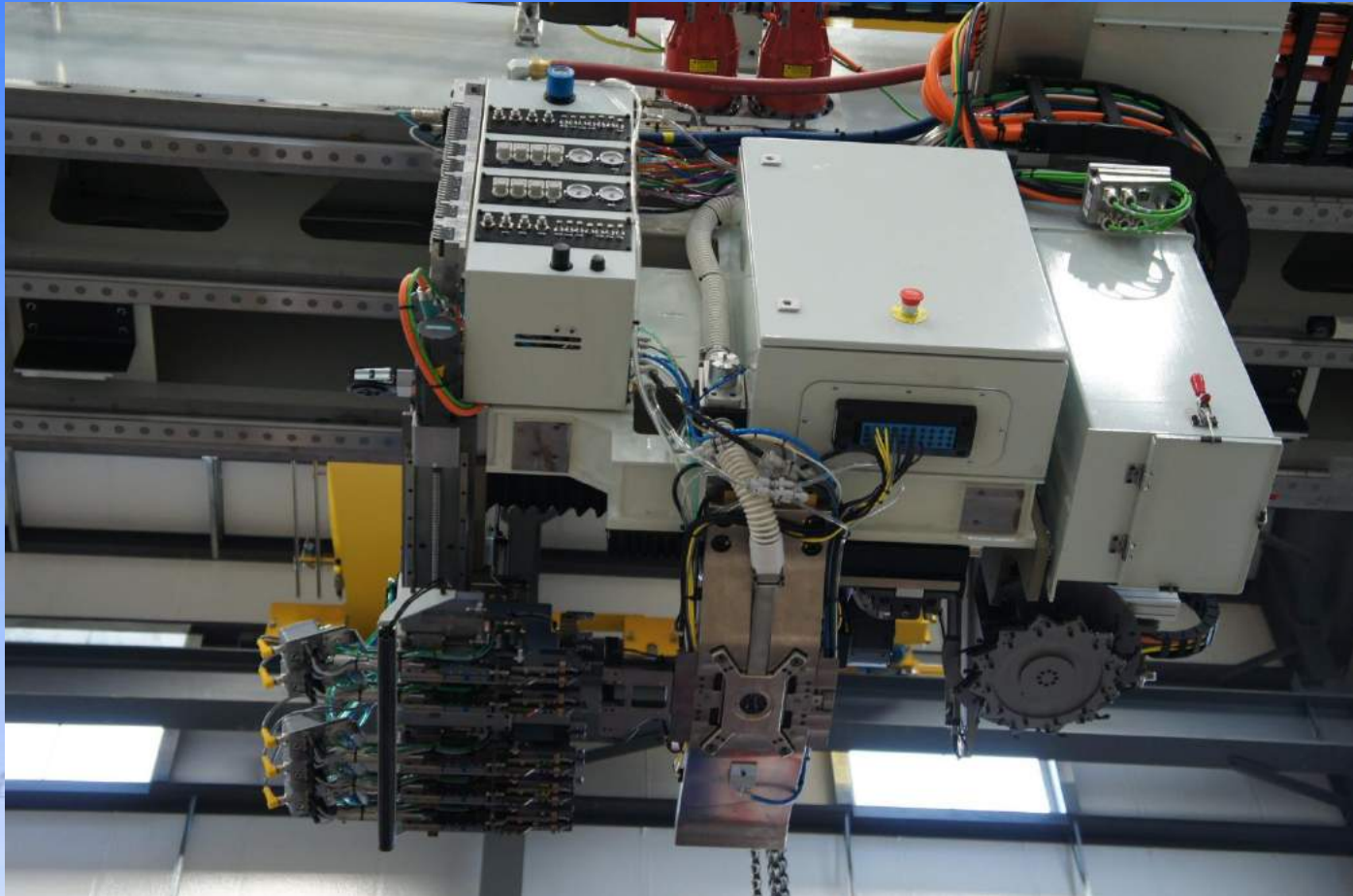
Upper Head in Maintenance Position



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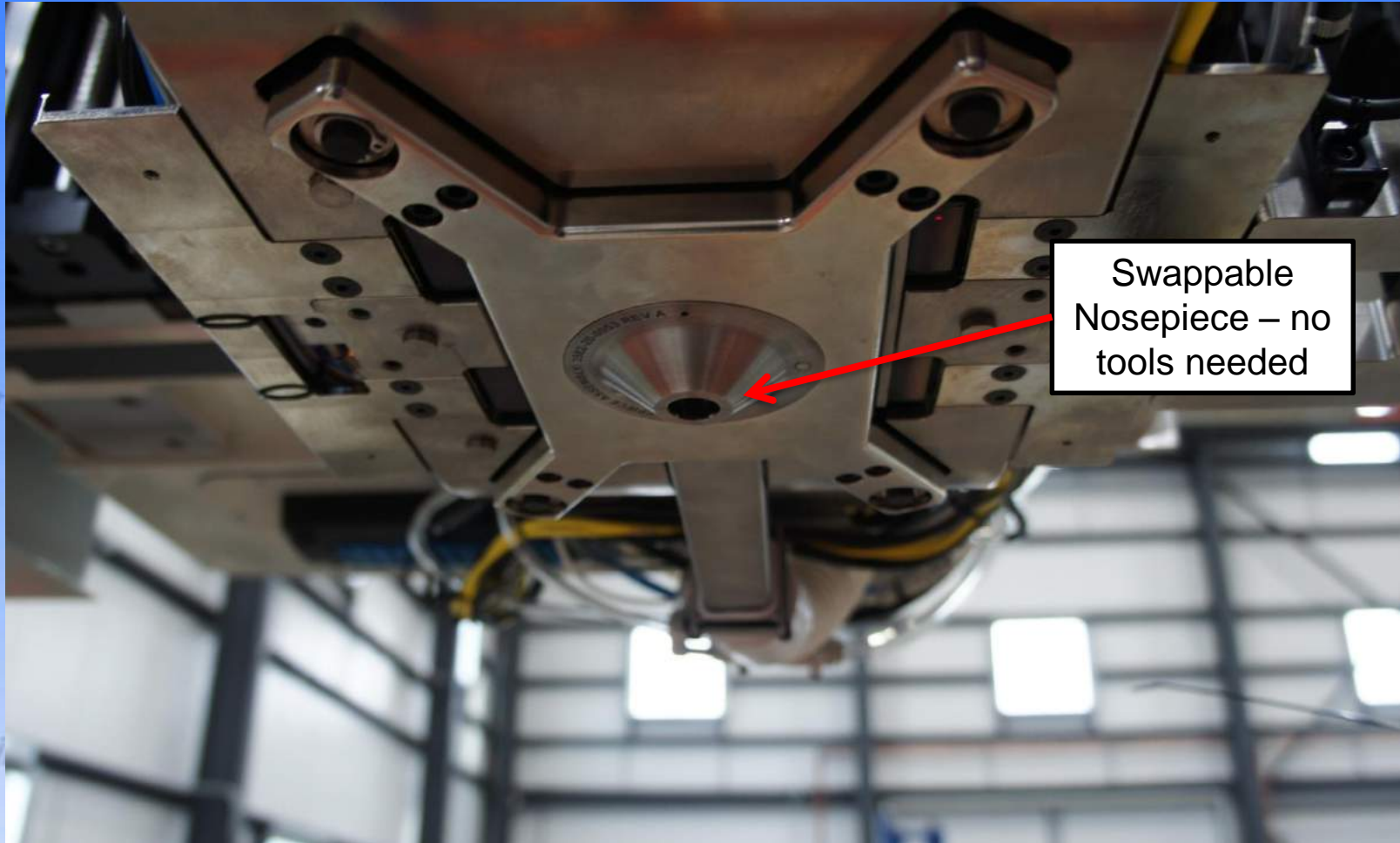
Headstone and Pressure Plate



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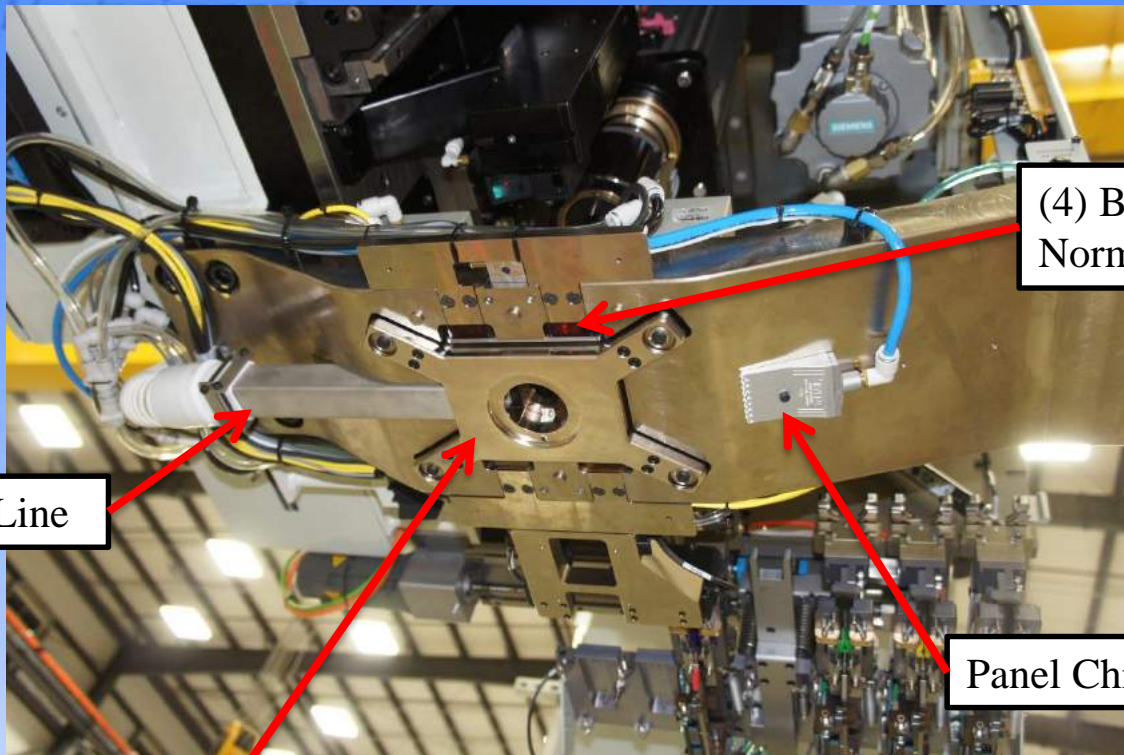
Upper Pressure Plate



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Headstone



Chip Vacuum Line

(4) Baumer Laser
Normality Sensors

Panel Chip Blow-Off

Pressure Foot (moves independently
from surrounding headstone structure)

Headstone

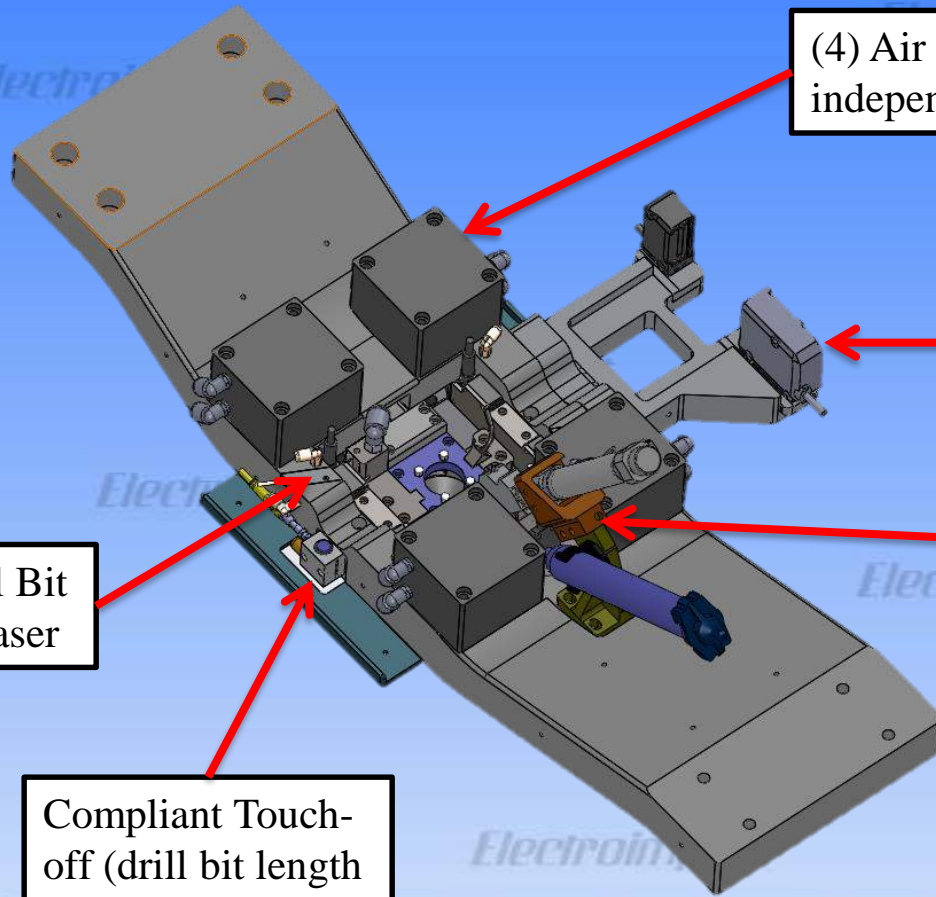
(4) Air Cylinders control the independent pressure foot

Rivet Length
Check Laser

Sealant Inserter

Broken Drill Bit
Detection Laser

Compliant Touch-
off (drill bit length
measurement)



Existing Upper Head Features



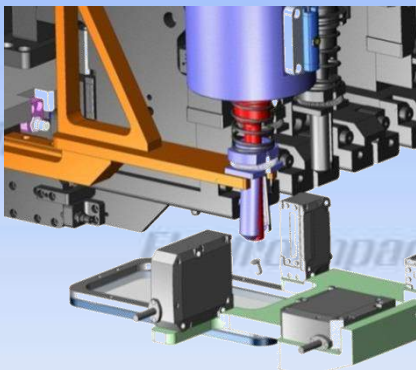
Length Check Laser

- Light curtain measures length of rivet/bolt in fingers
- Also senses if rivet is not present



Bomb Bay Doors

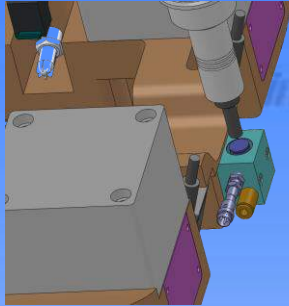
- Automatically ejects backwards fasteners or multiple fasteners



Auto Fastener Eject

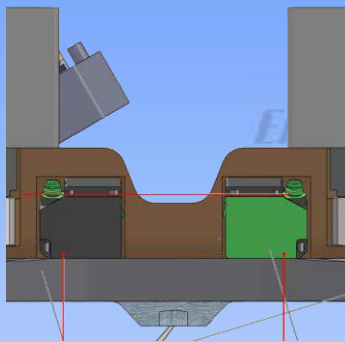
- Incorrect fastener is automatically rejected

Existing Upper Head Features



Compliant Touch Off

- Cutter length measurement
- Prox switch detects touch off and records the cutter length



Broken Drill Bit Detection

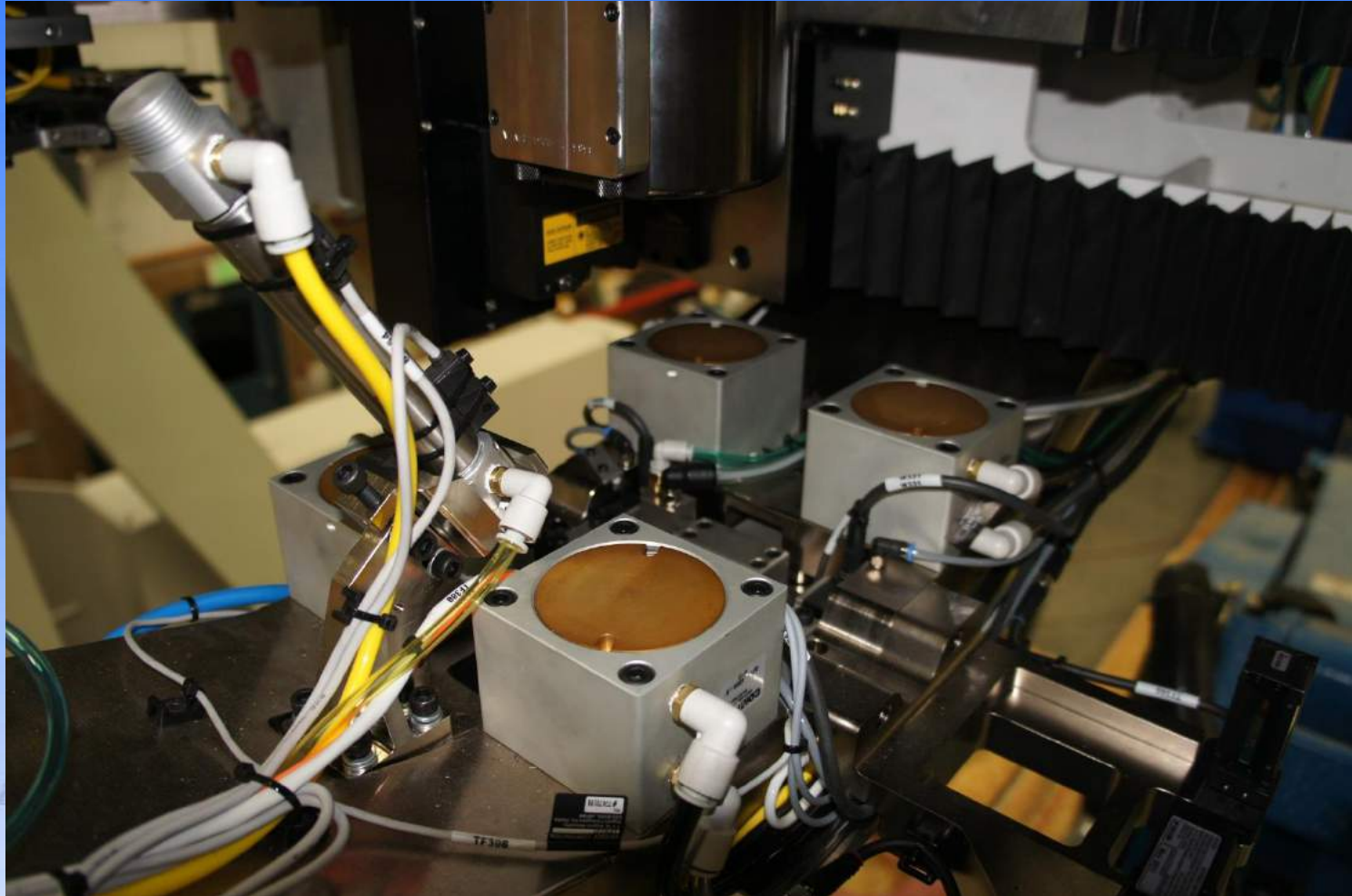
- Drill bit breaks beam before drill extends to panel
- Automatic feed hold if the drill bit detected is not the correct length



Air Gap Panel Protection

- Can detect tipped rivets without damaging the panels

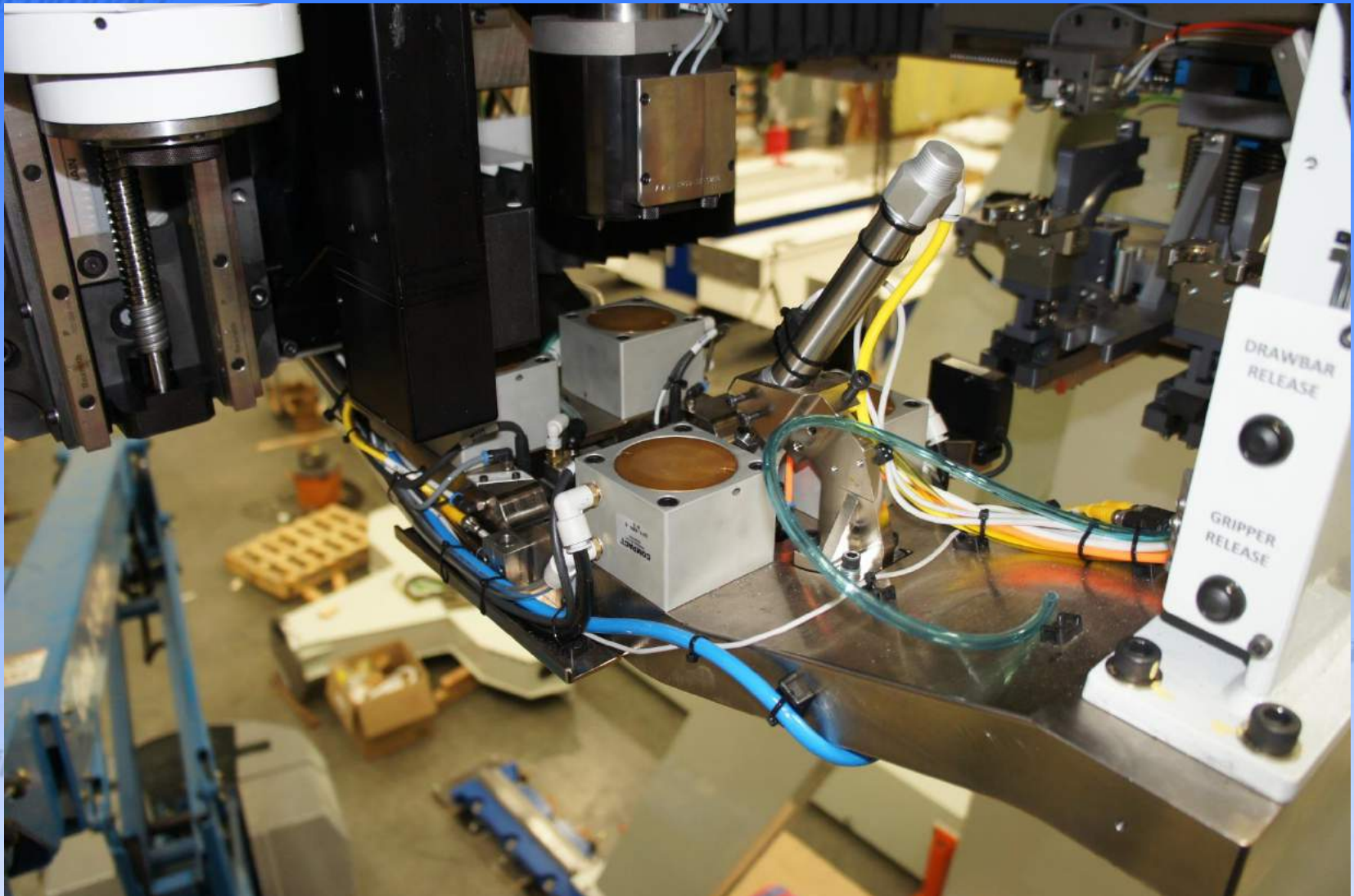
Inside Headstone



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Inside Headstone



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Pneumatic Clamp Extended



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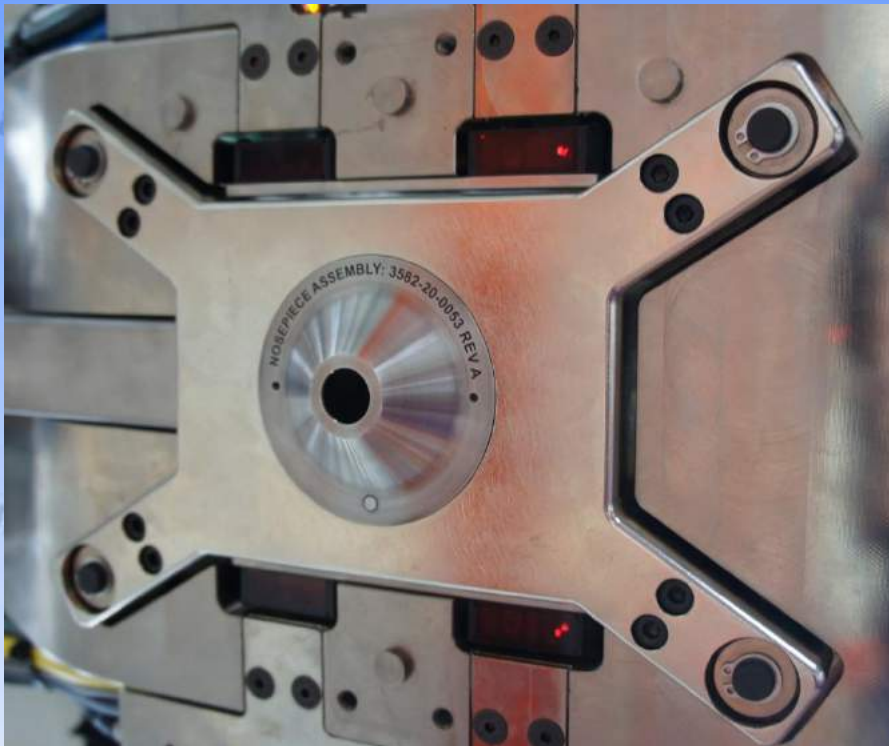
Pneumatic Clamp Retracted



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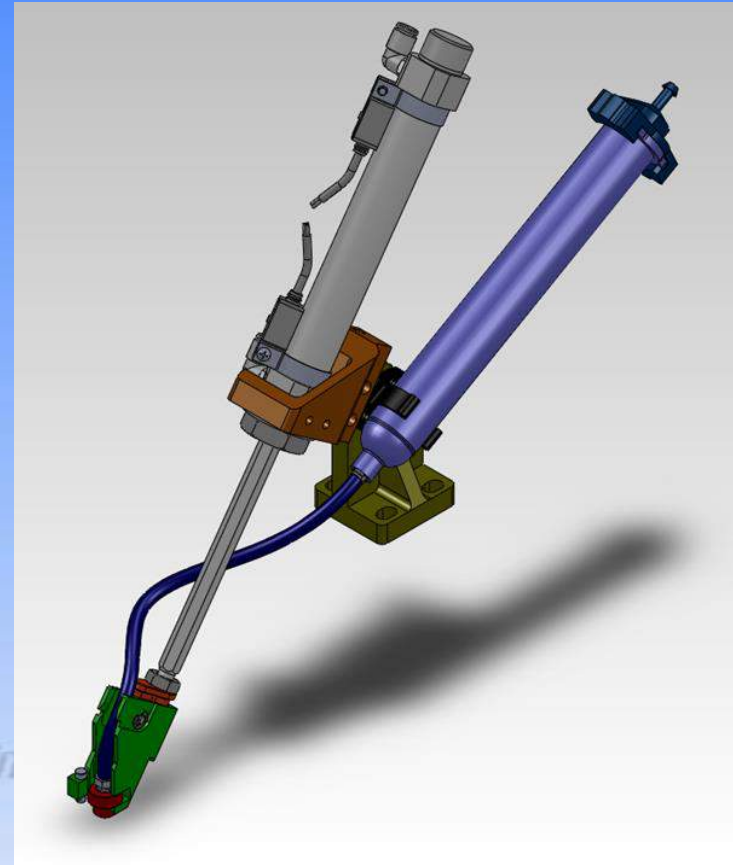
Laser Normality Sensors



- Baumer OADM laser distance measuring sensors
- Normalizes panel and maintains constant fly height
- 16-120mm measuring range

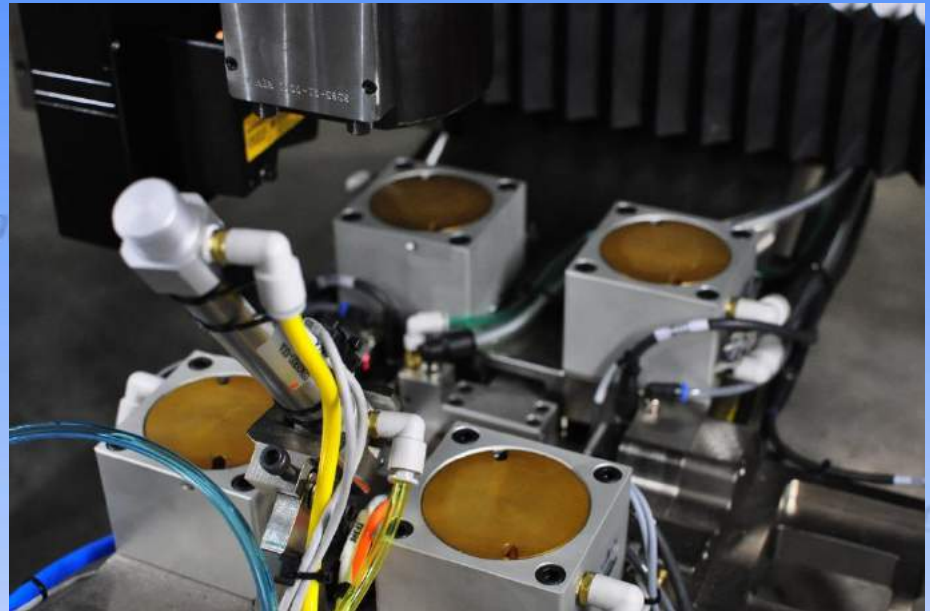
Sealant Inserter

- Headstone Mounted
- Pneumatically Controlled Dispense
- Convenient Consumables Management
- Single Cylinder Delivery

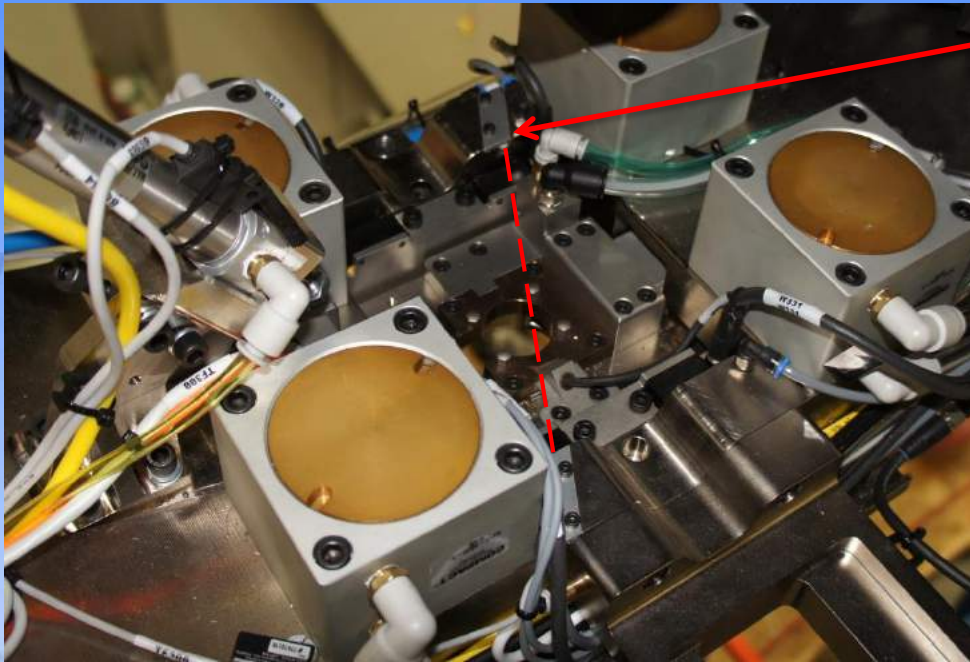


Sealant Inserter Headstone Mounting

- Minimal to no impact on cycle time
- Sealant injected during Drill -> Driver shuttle move
- Total sealant cycle time 200-500ms

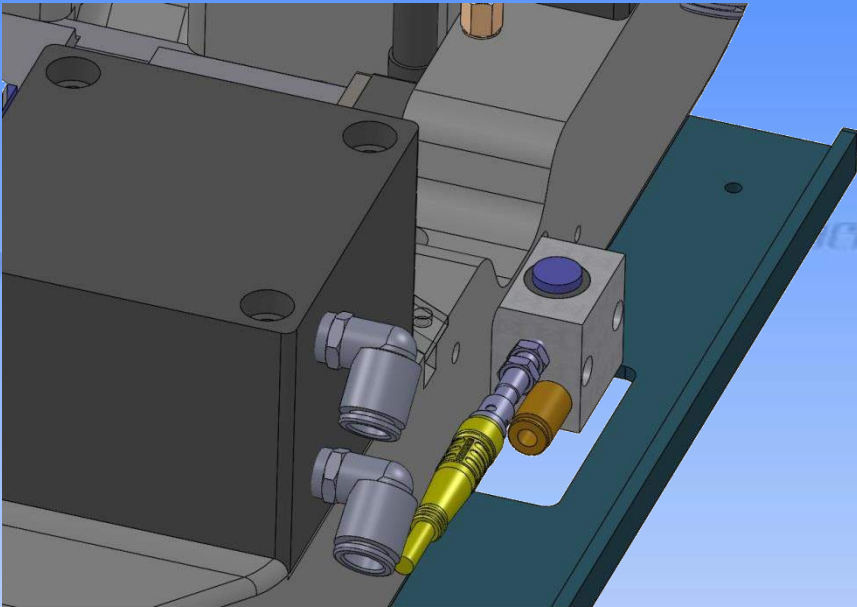


Broken Drill Bit Detection



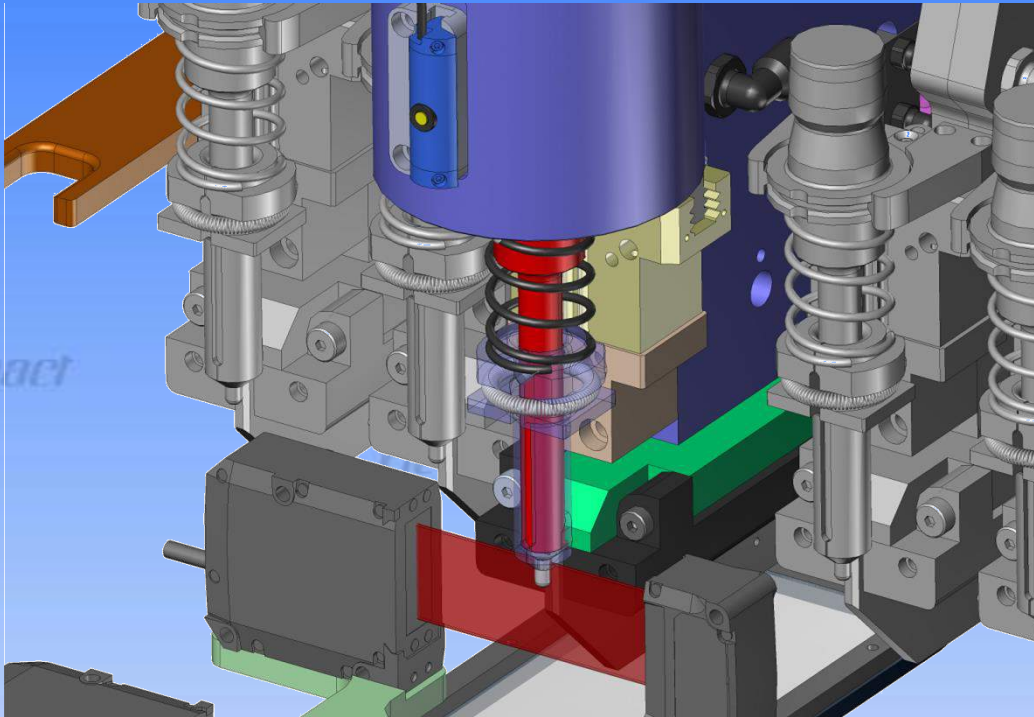
- Drill bit breaks beam before drill extends to panel

Compliant Touch Off



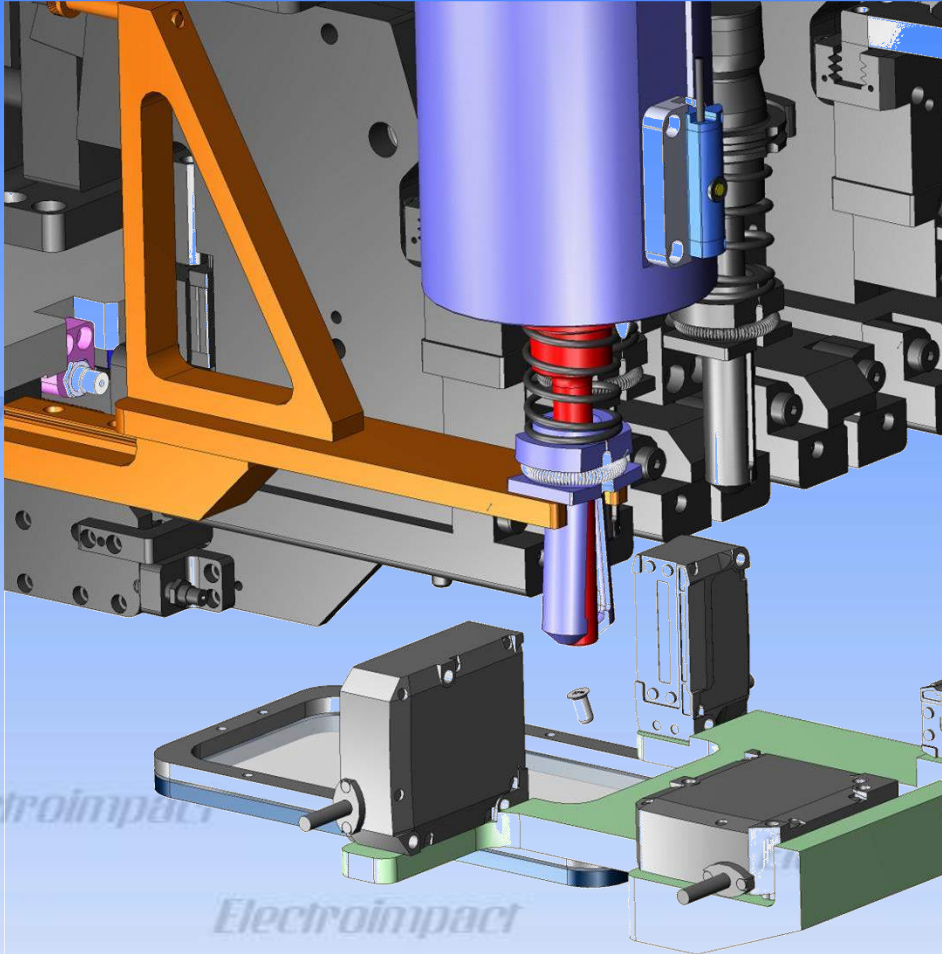
- Cutter length measurement
- Blue button floats in housing
- Prox switch detects touch off and records cutter length

Fastener Length Verification



- Light curtain measures length of rivet/bolt in fingers
- Also senses if rivet is not present

Fastener Eject



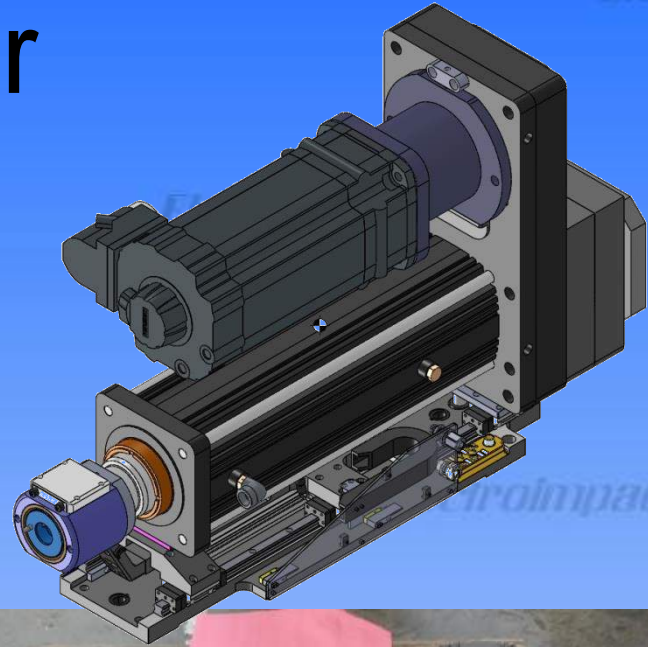
Incorrect fastener is
automatically rejected

Rivet/Bolt Driver Tool

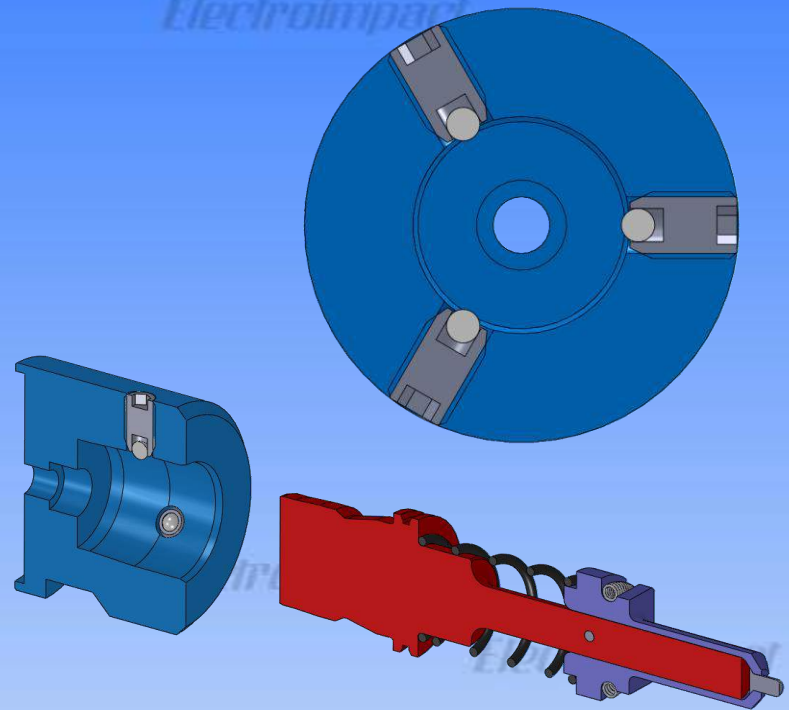
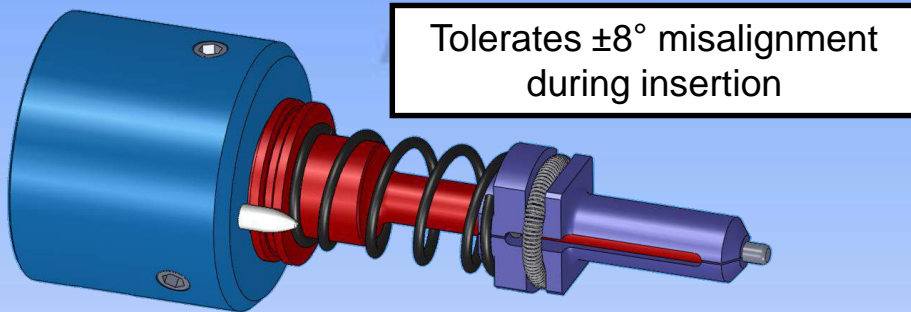
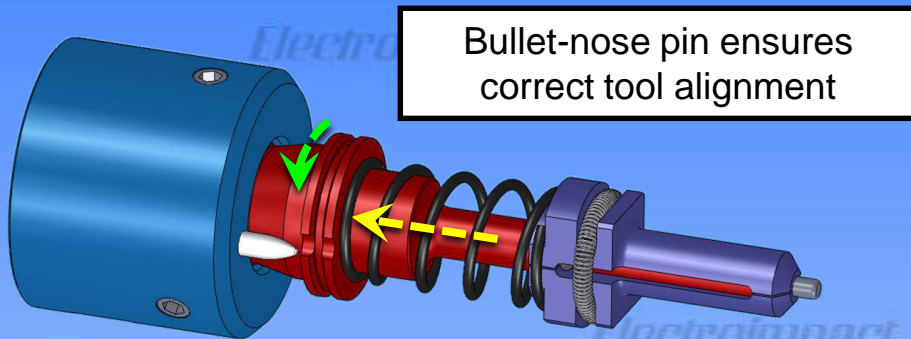


Driver

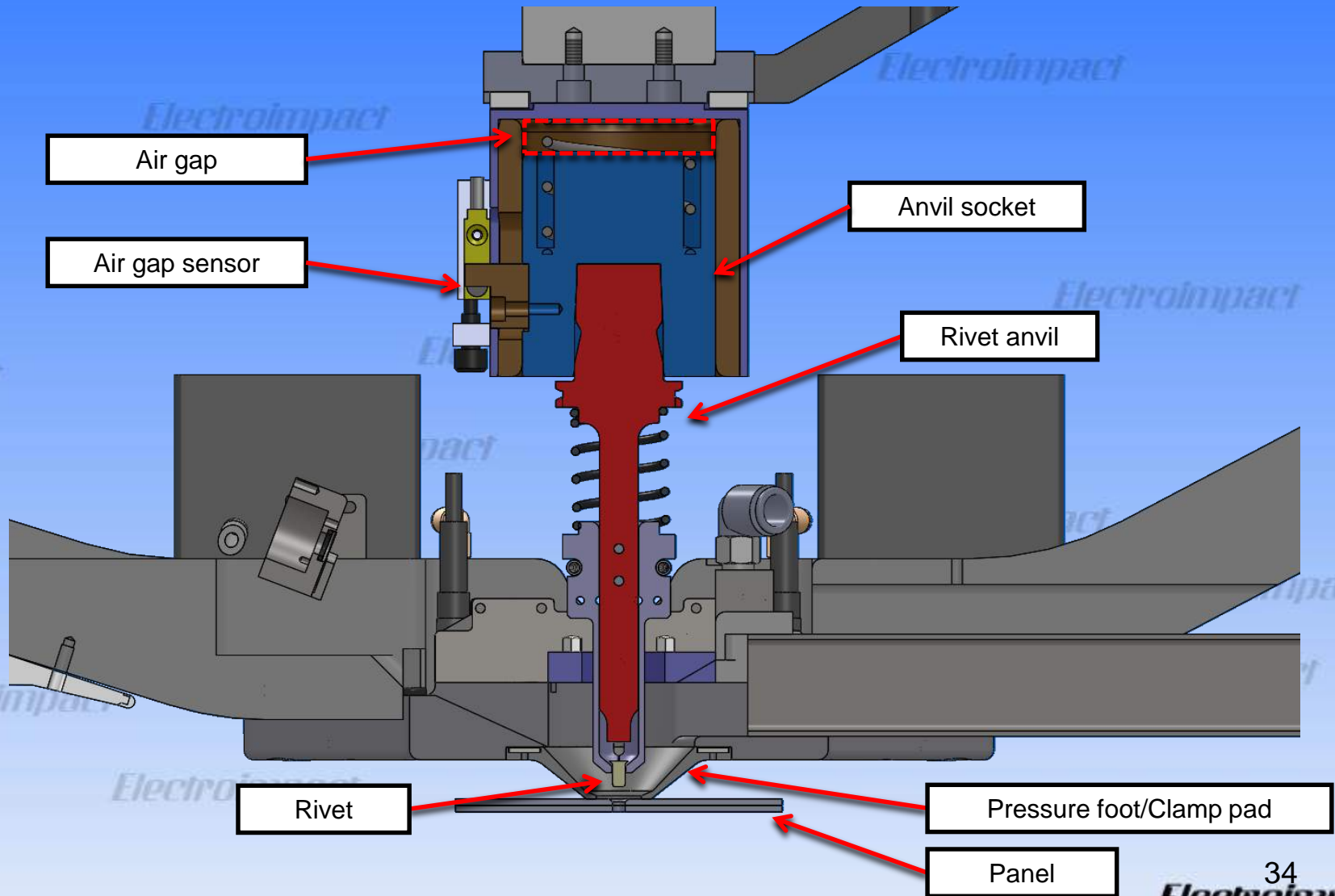
- Design based around the Exlar FT60 series linear actuator



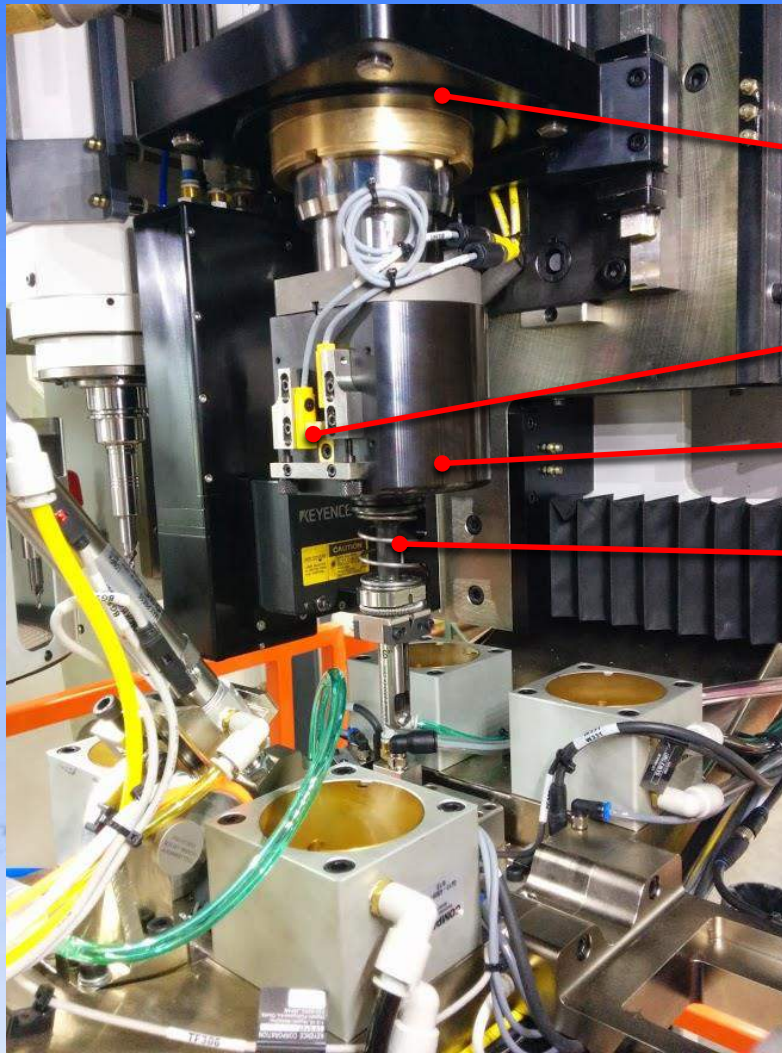
Anvil Socket



Air Gap Panel Protection



Air Gap Panel Protection



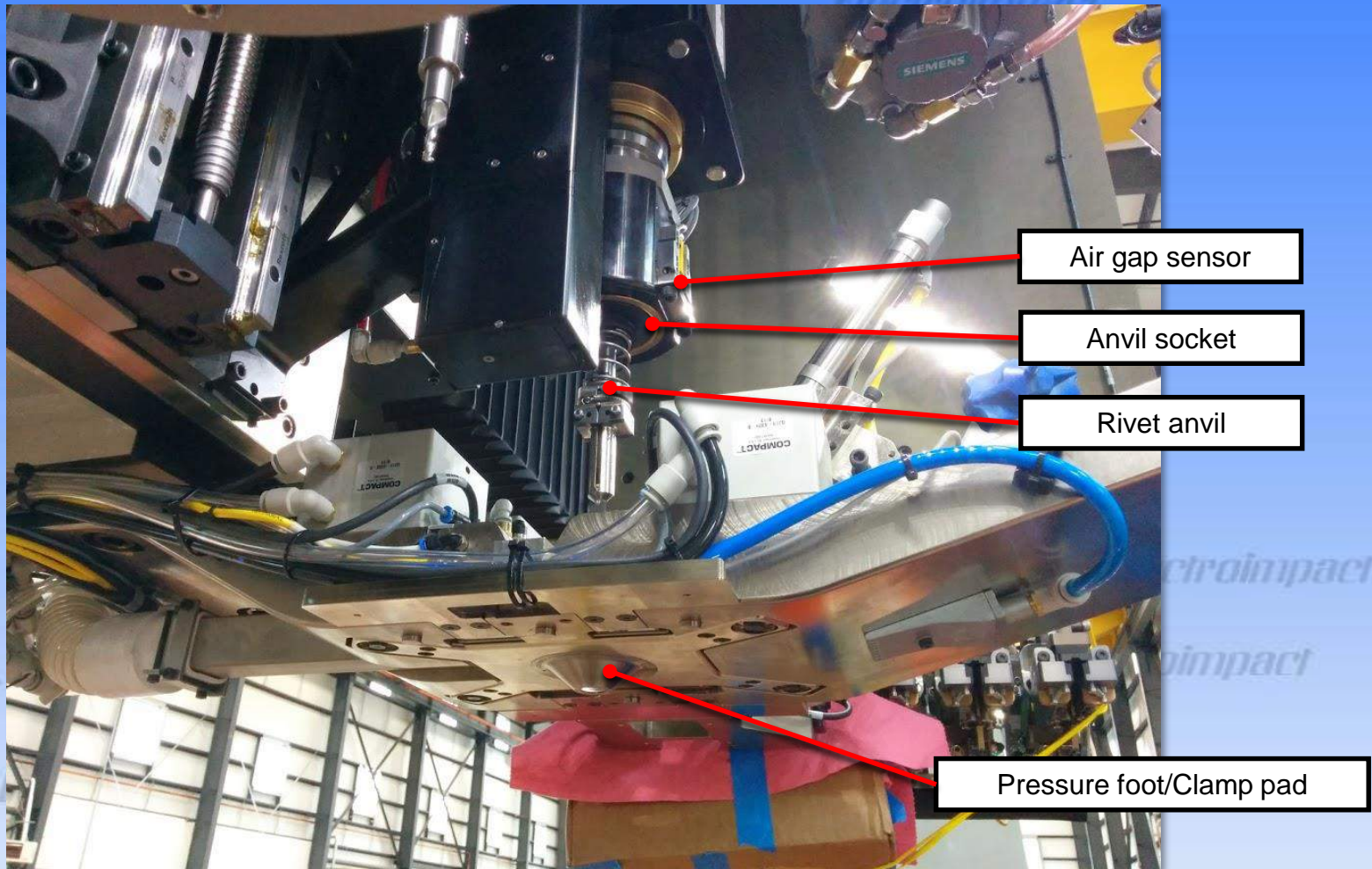
Rivet inserter

Air gap sensor

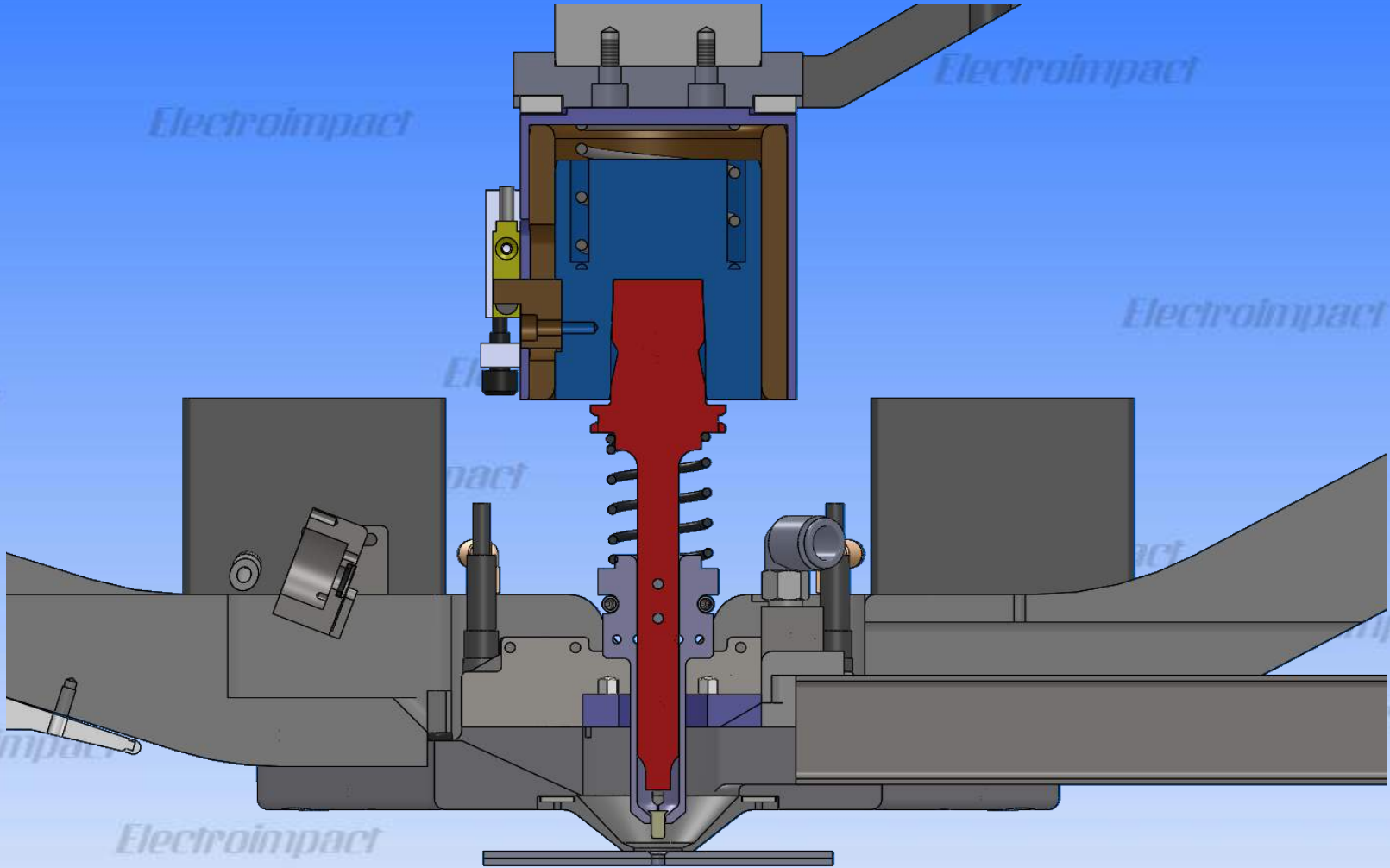
Anvil socket

Rivet anvil

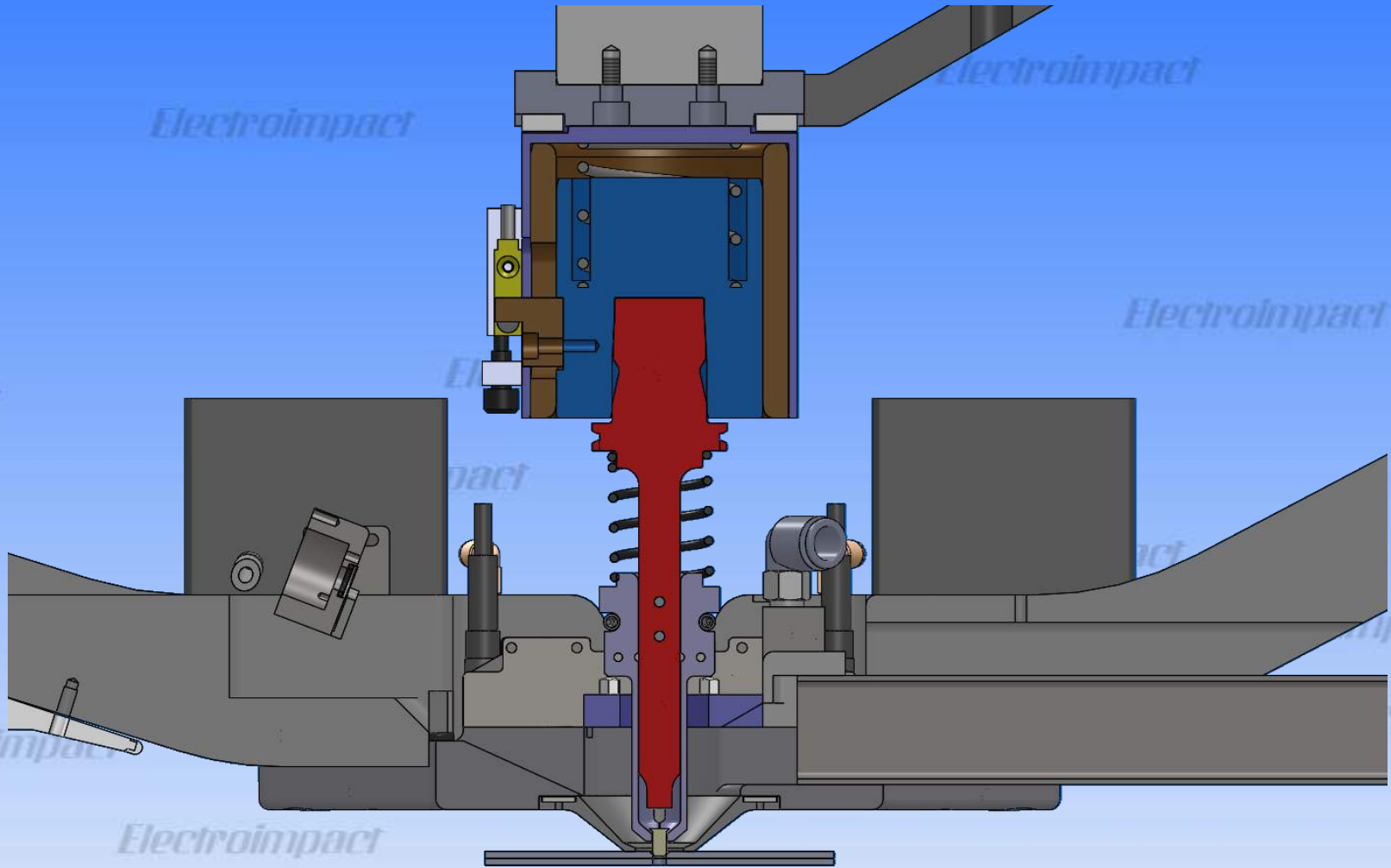
Air Gap Panel Protection



Normal Rivet Insertion

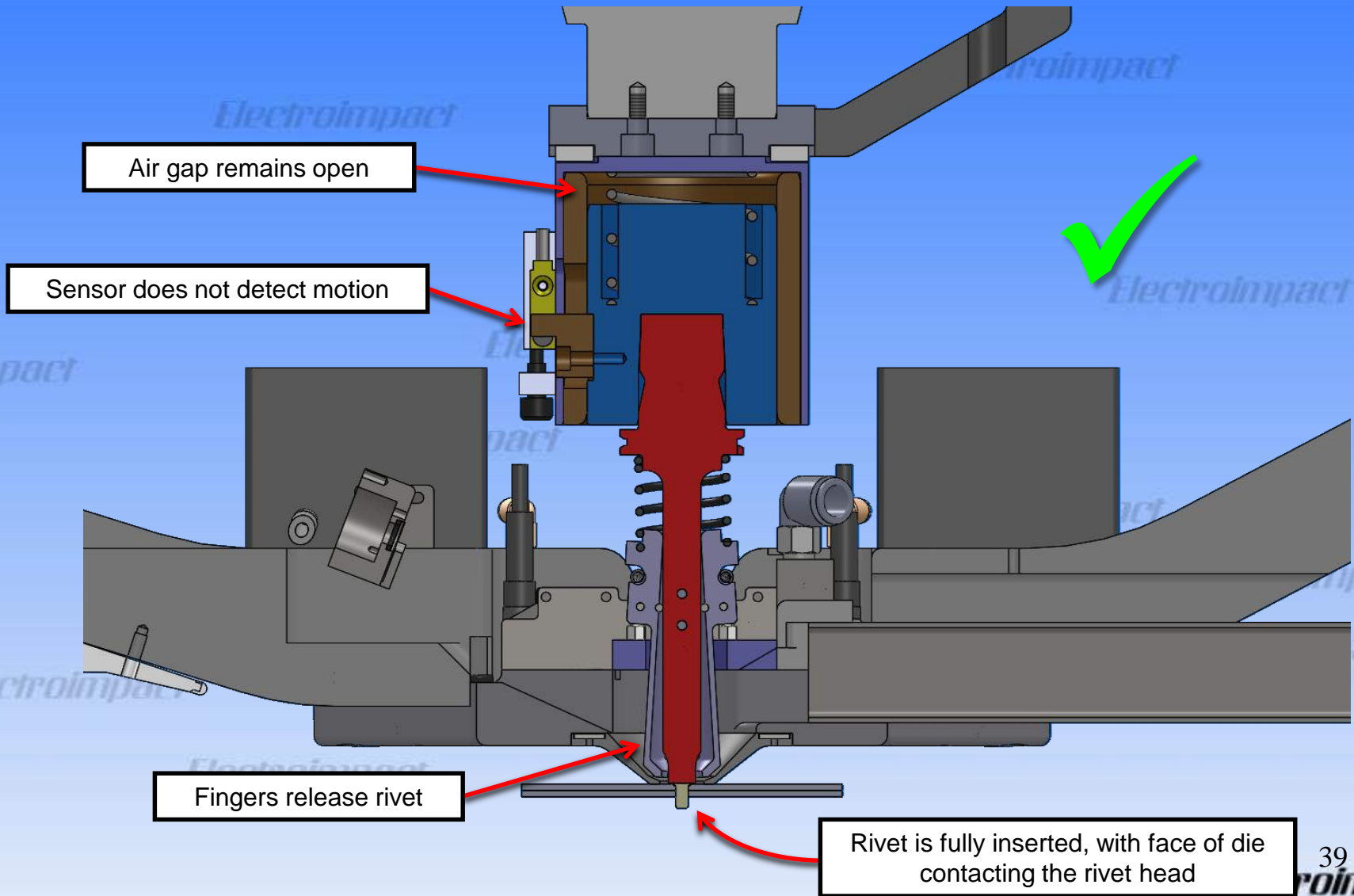


Normal Rivet Insertion

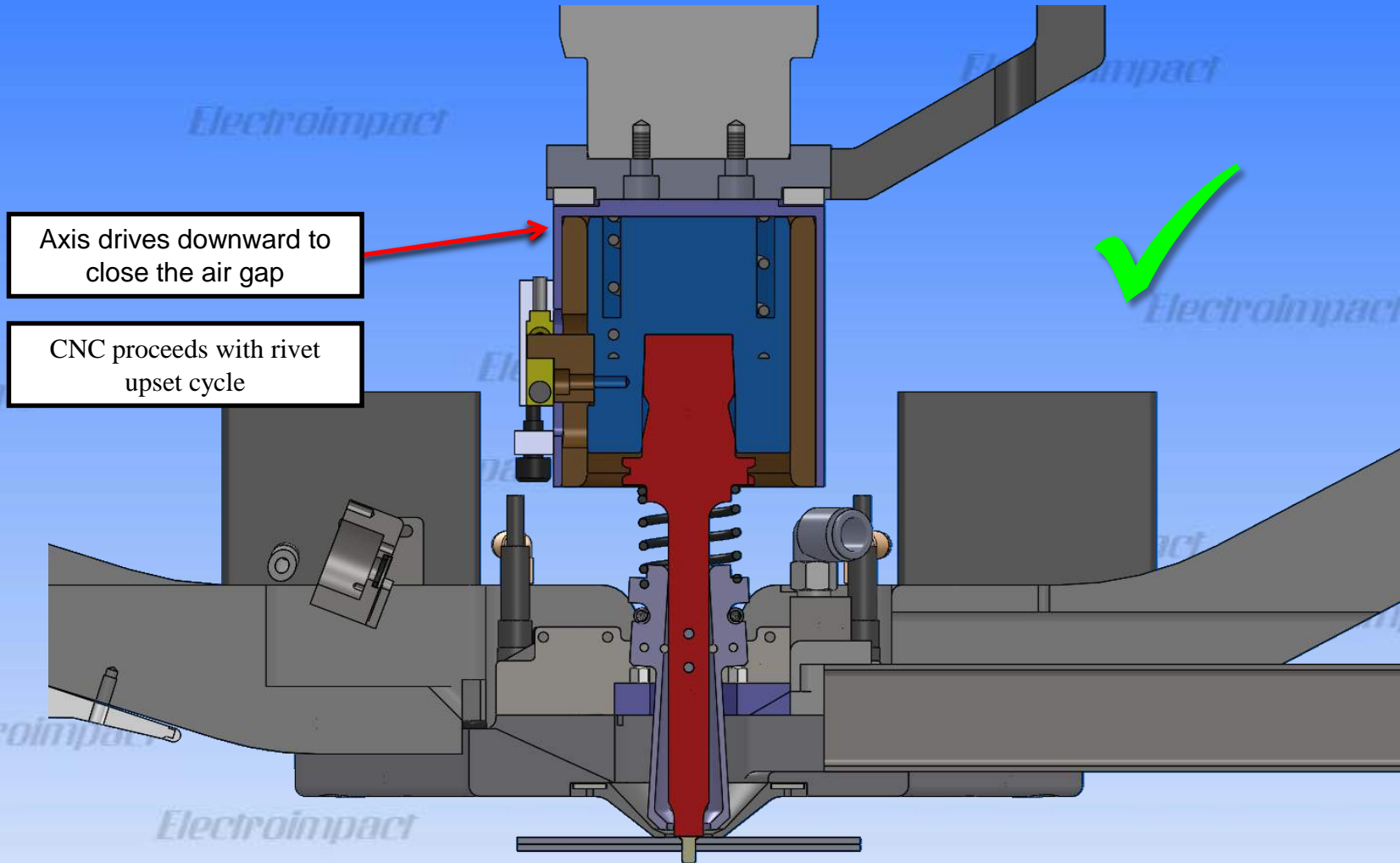


Rivet tail inserted into hole correctly

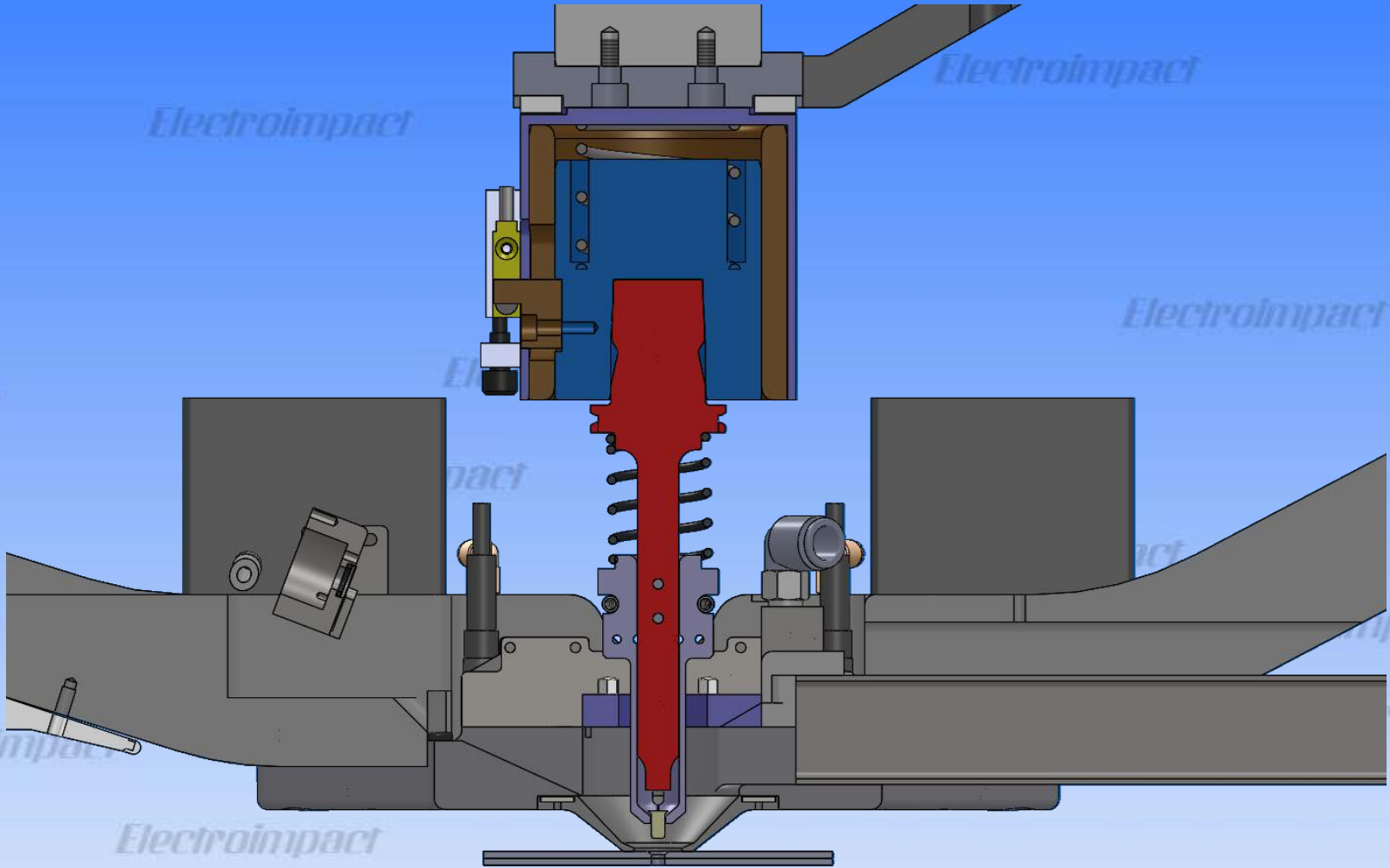
Normal Rivet Insertion



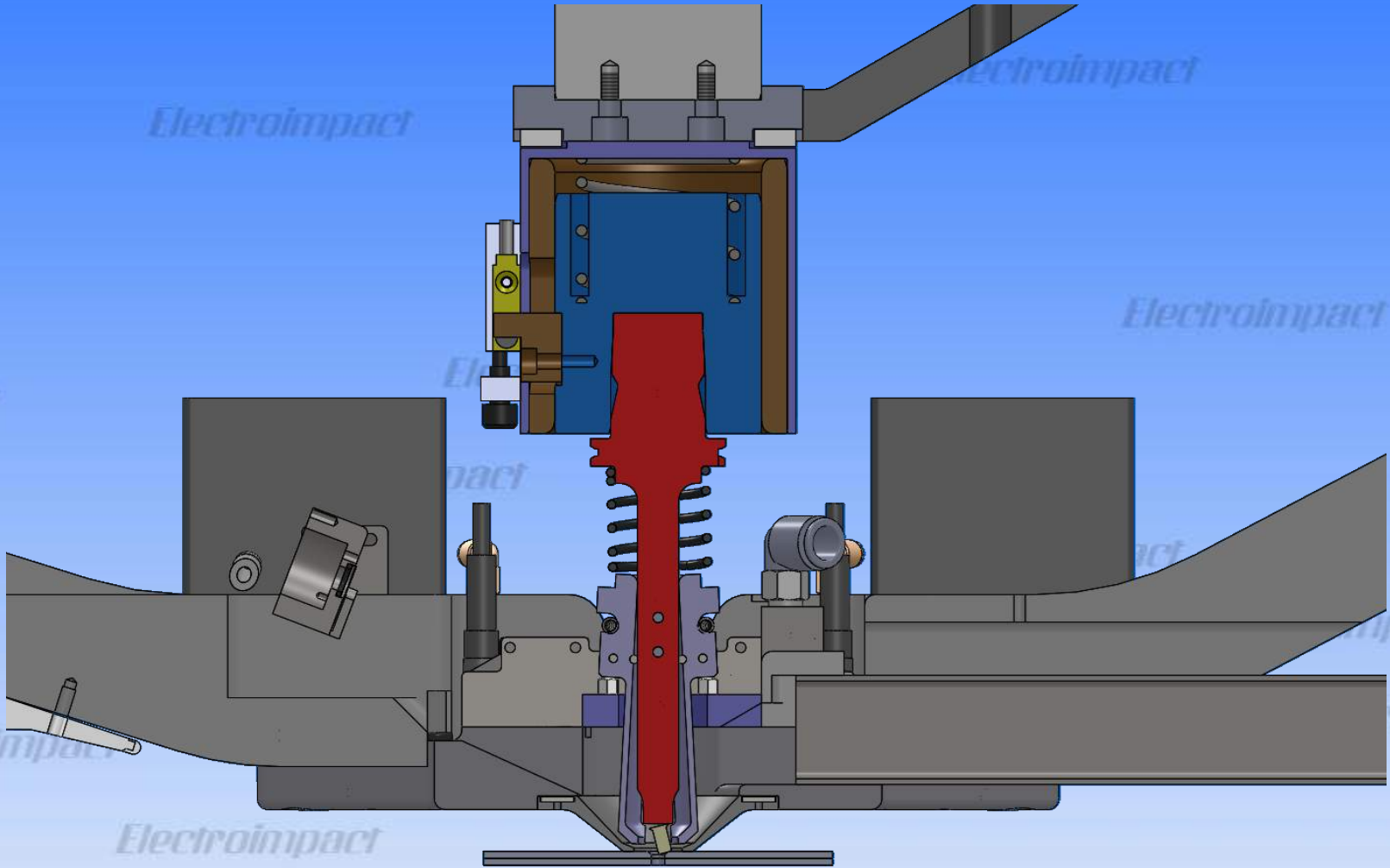
Normal Rivet Insertion



Failed Insertion - Jammed

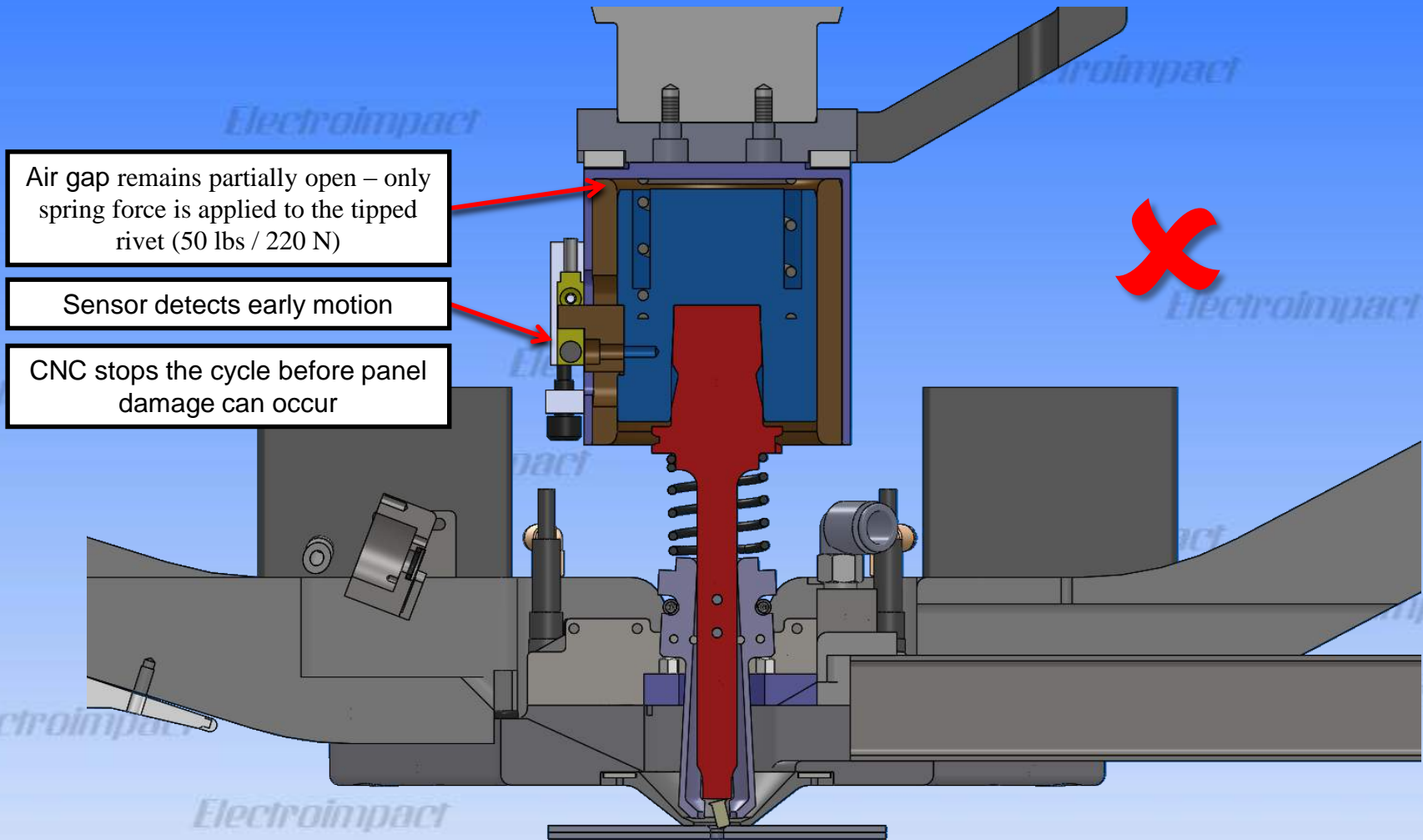


Failed Insertion - Jammed

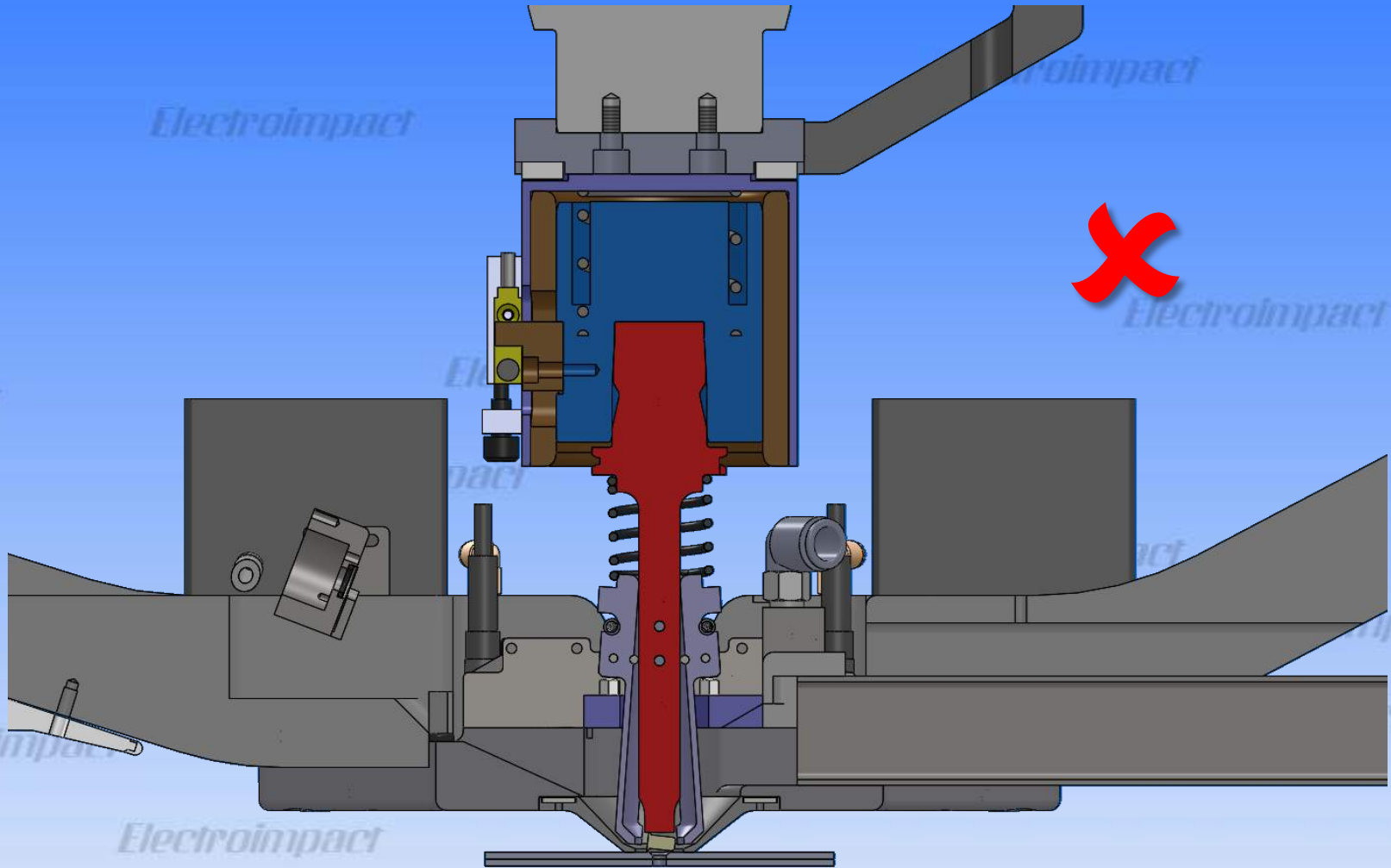


Rivet tail hits countersink, jamming between the panel and the die face

Failed Insertion - Jammed

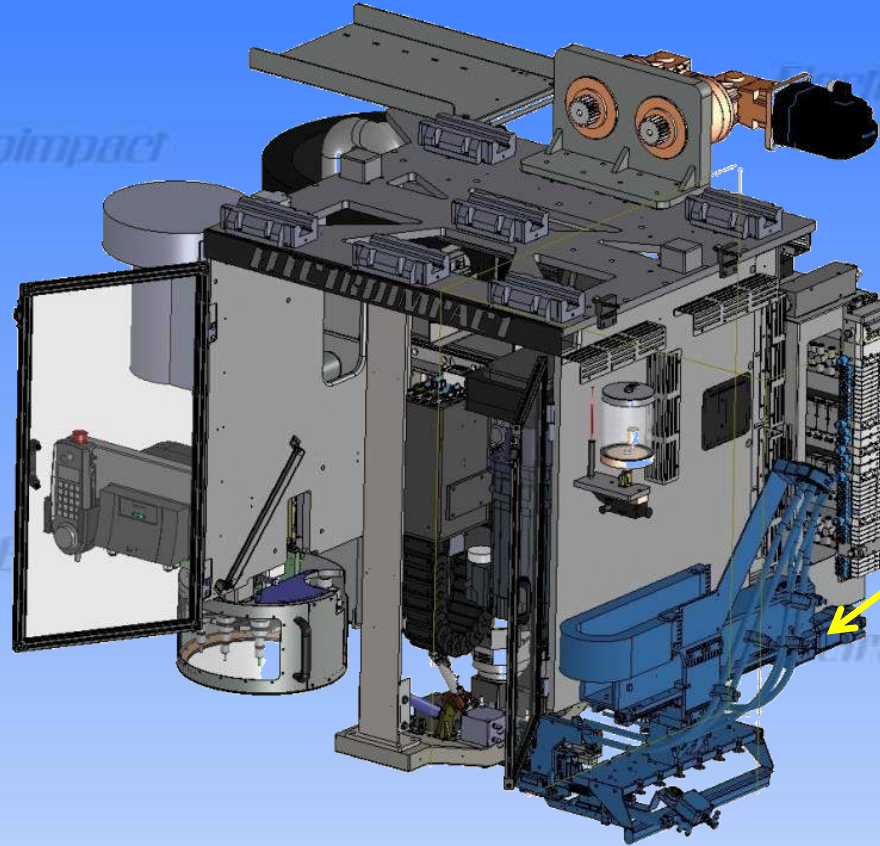


Failed Insertion - Laid-down



Air gap system also protects against a laid-down rivet

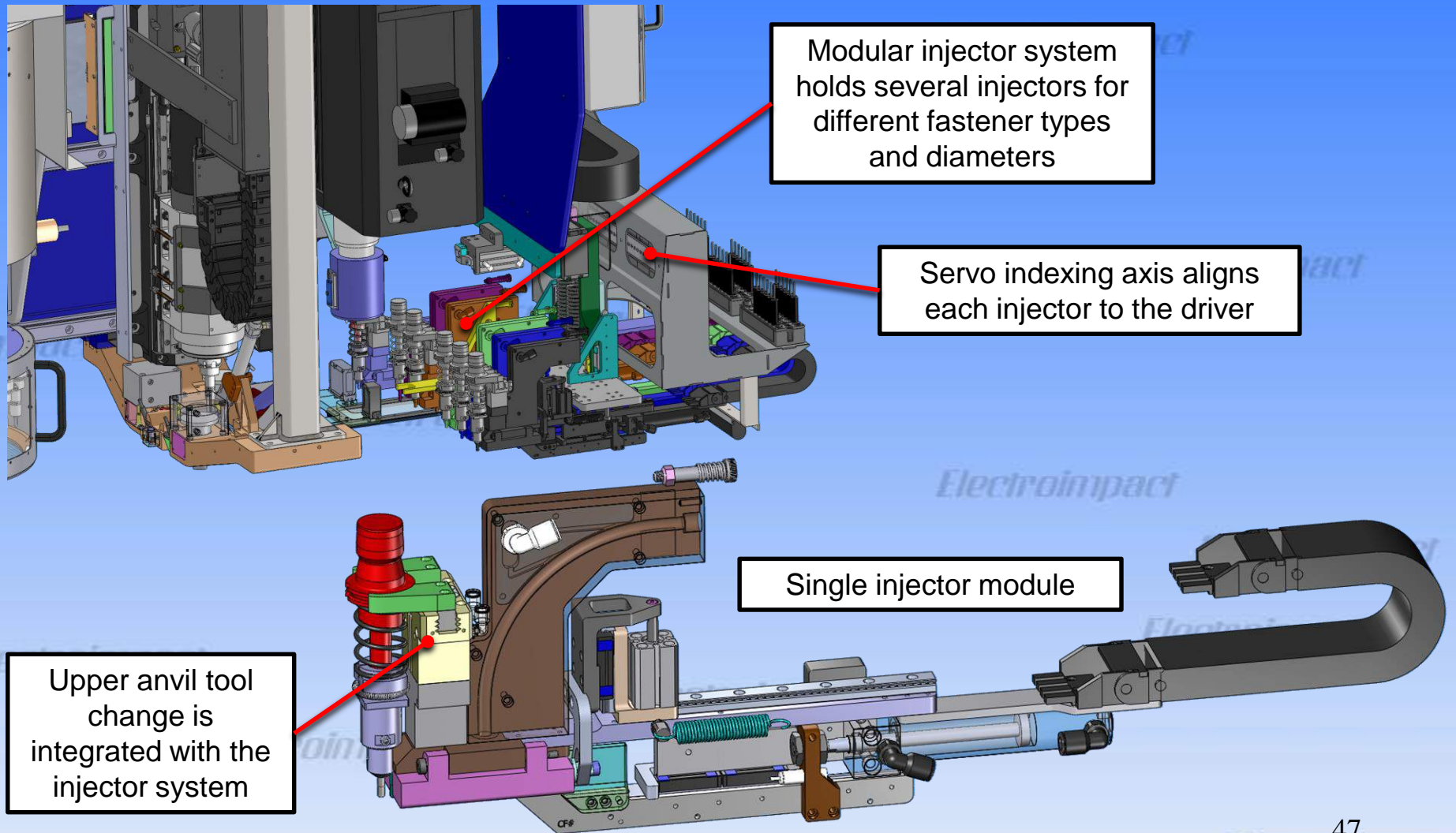
Bolt/Rivet Injector with Integrated Tool Changer



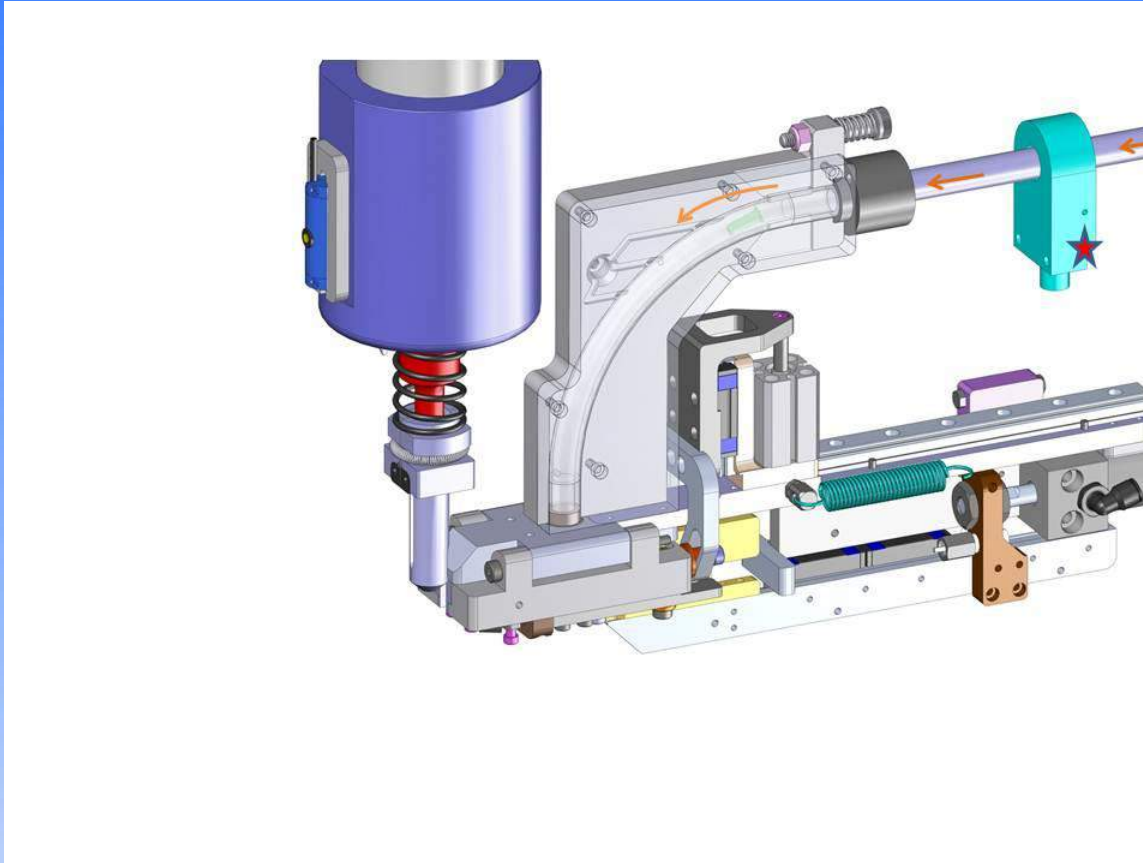
Rivet/Bolt Injector



Injectors & Anvil ATC

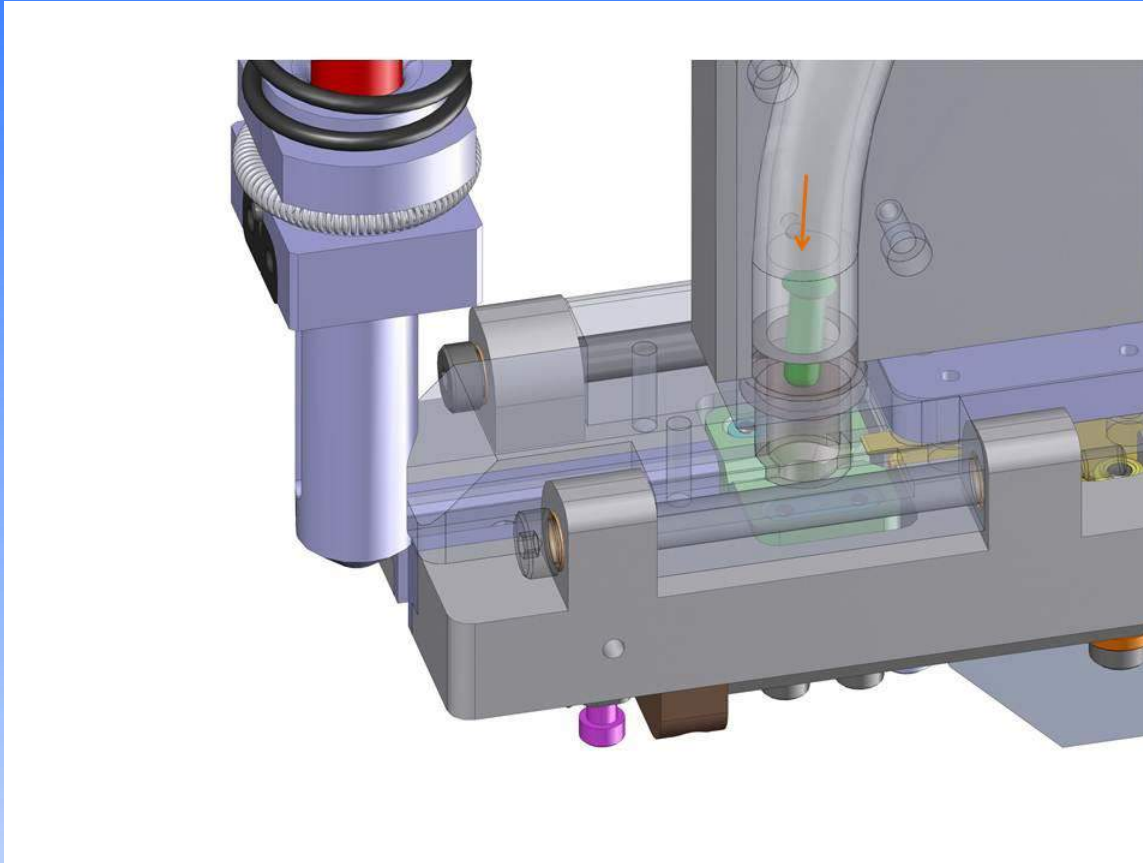


HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



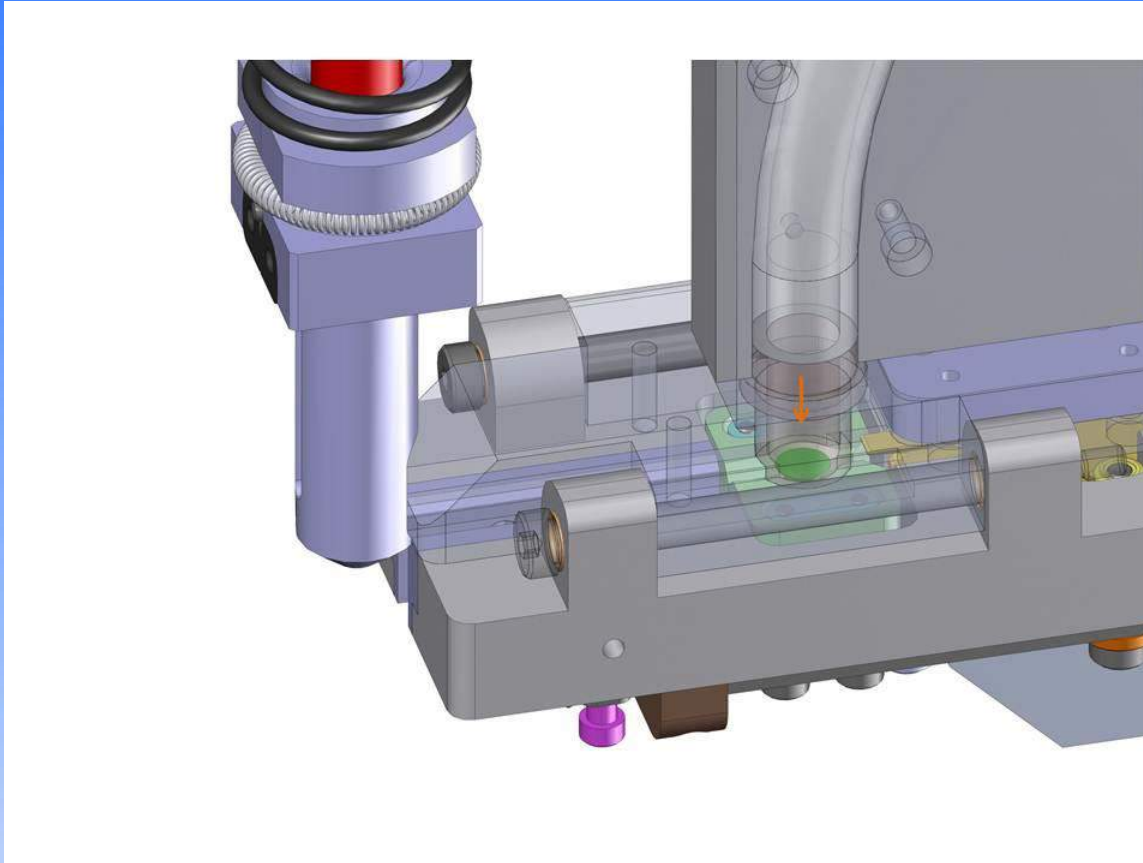
Fastener sent to Injector through feed tubes
Sensor detects fastener's arrival at Injector

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



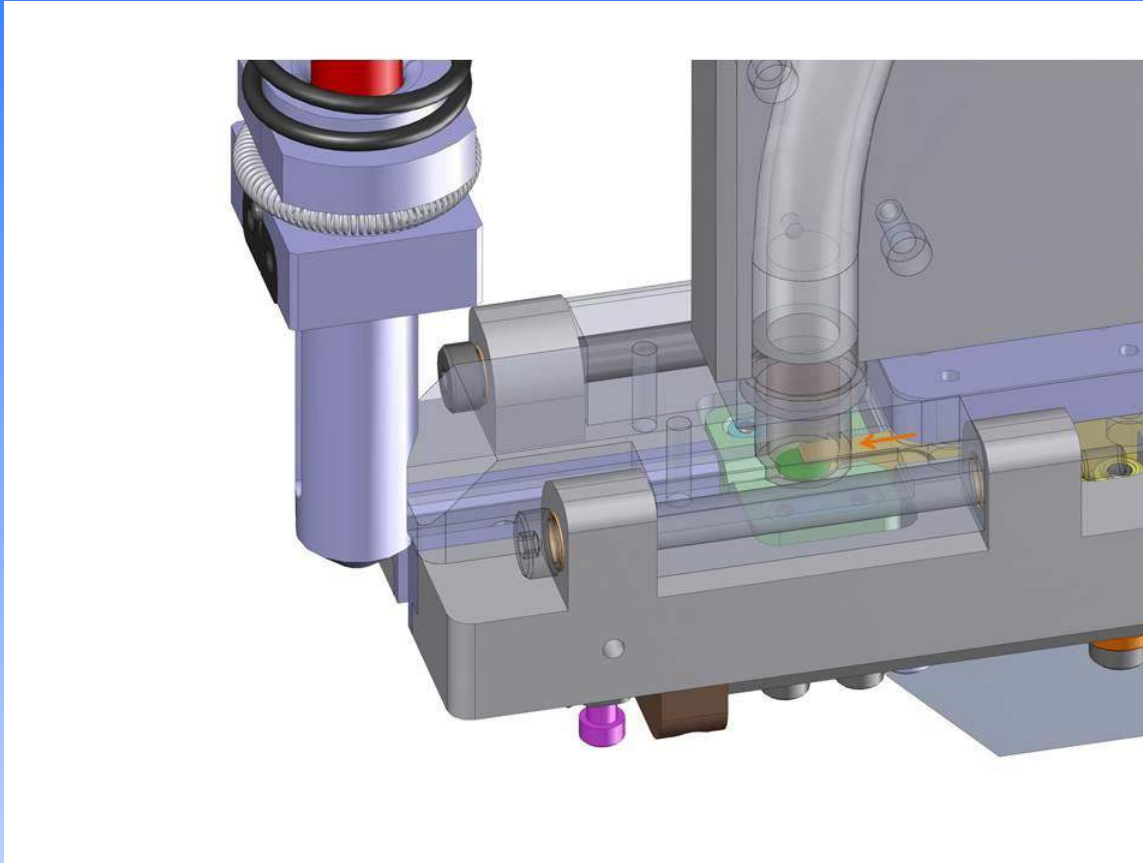
Fastener enters Chamber

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



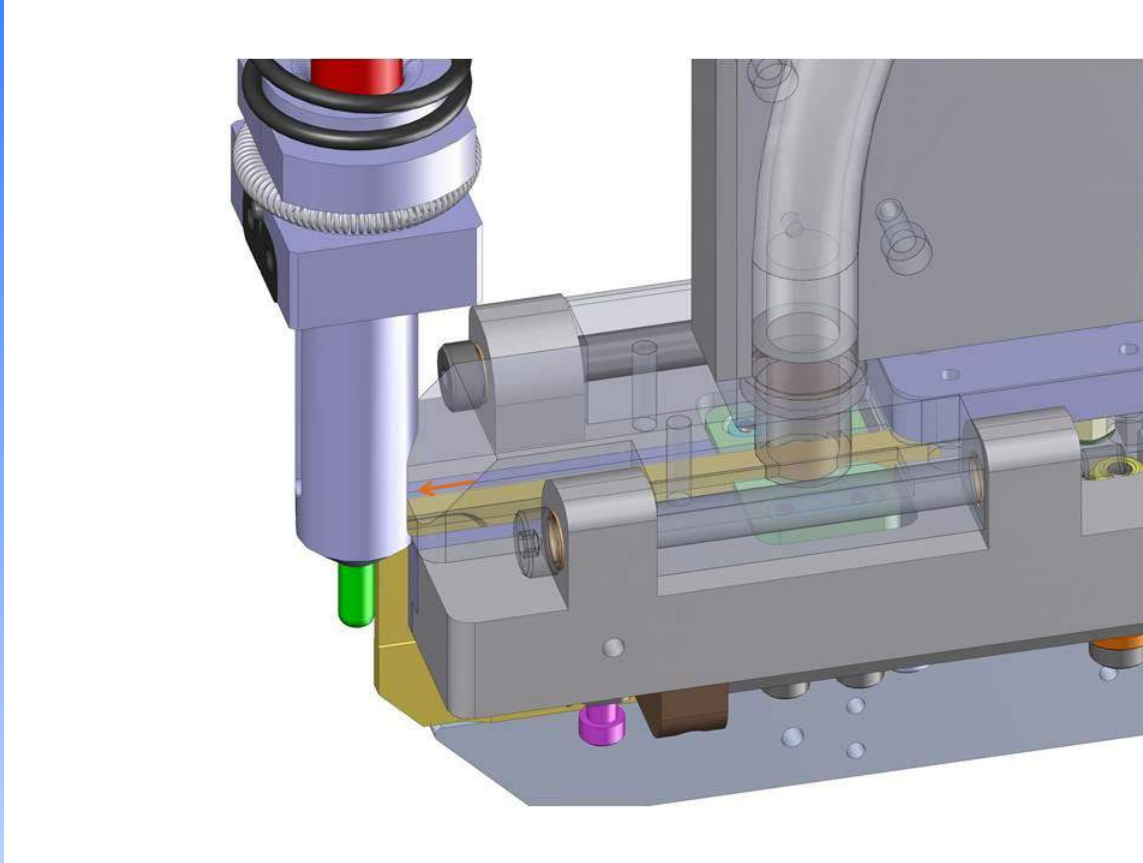
Fastener settles in Catch Blocks

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



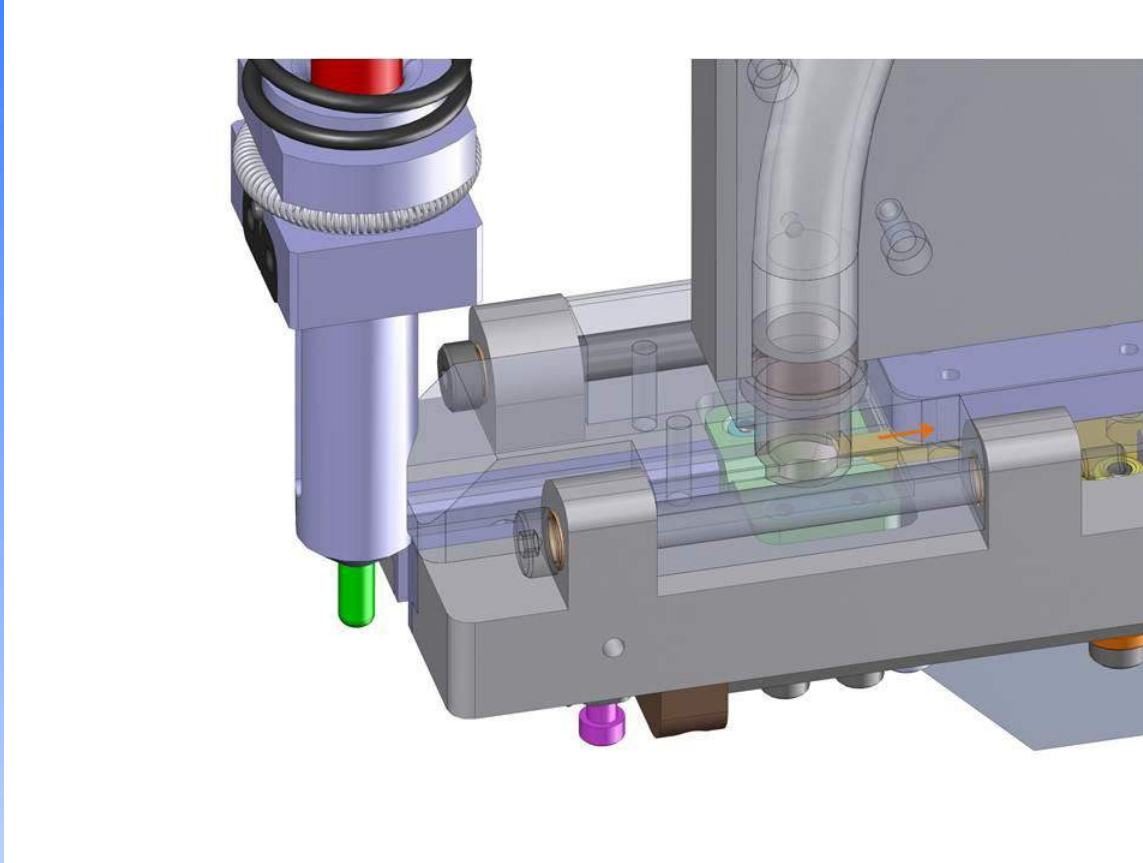
Injector Pusher extends and engages fastener's head and begins pushing towards Fingers

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



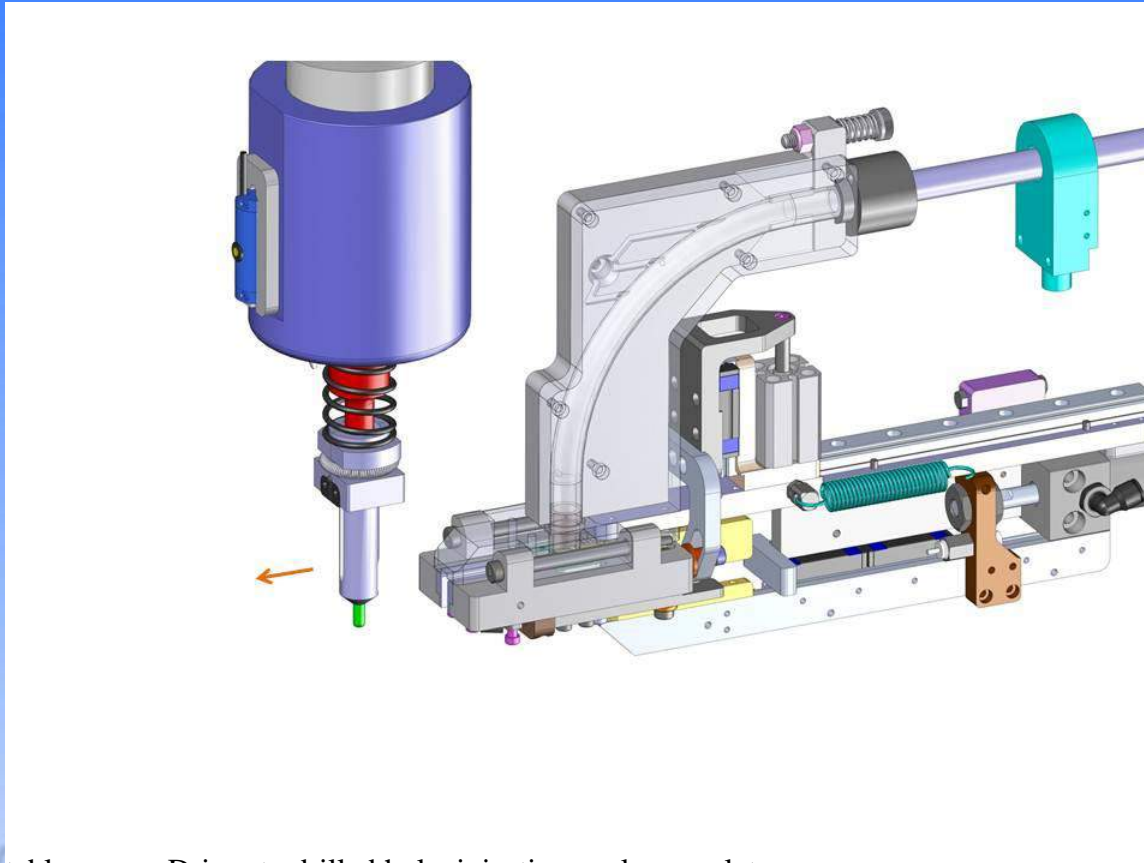
Pusher extends fully and snaps fastener into Fingers

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



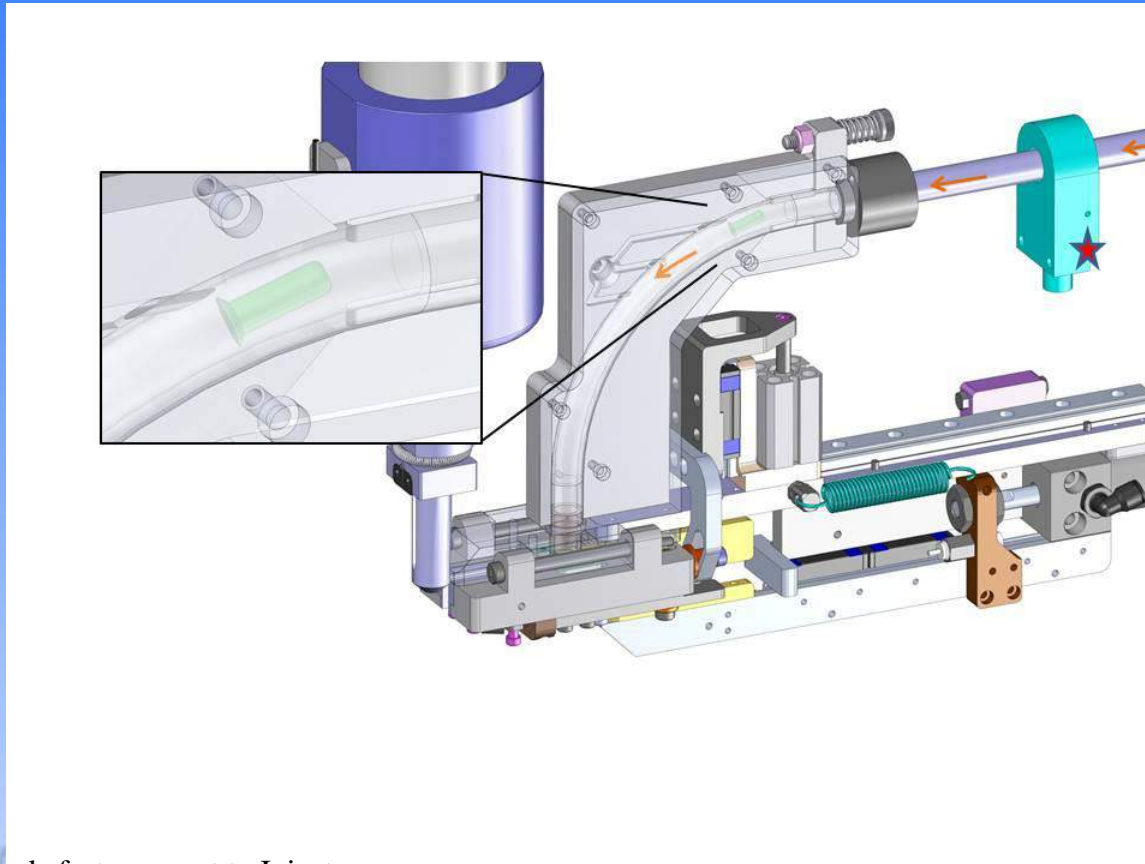
Pusher retracts and Injector is reset for next cycle

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



Shuttle table moves Driver to drilled hole, injection cycle complete

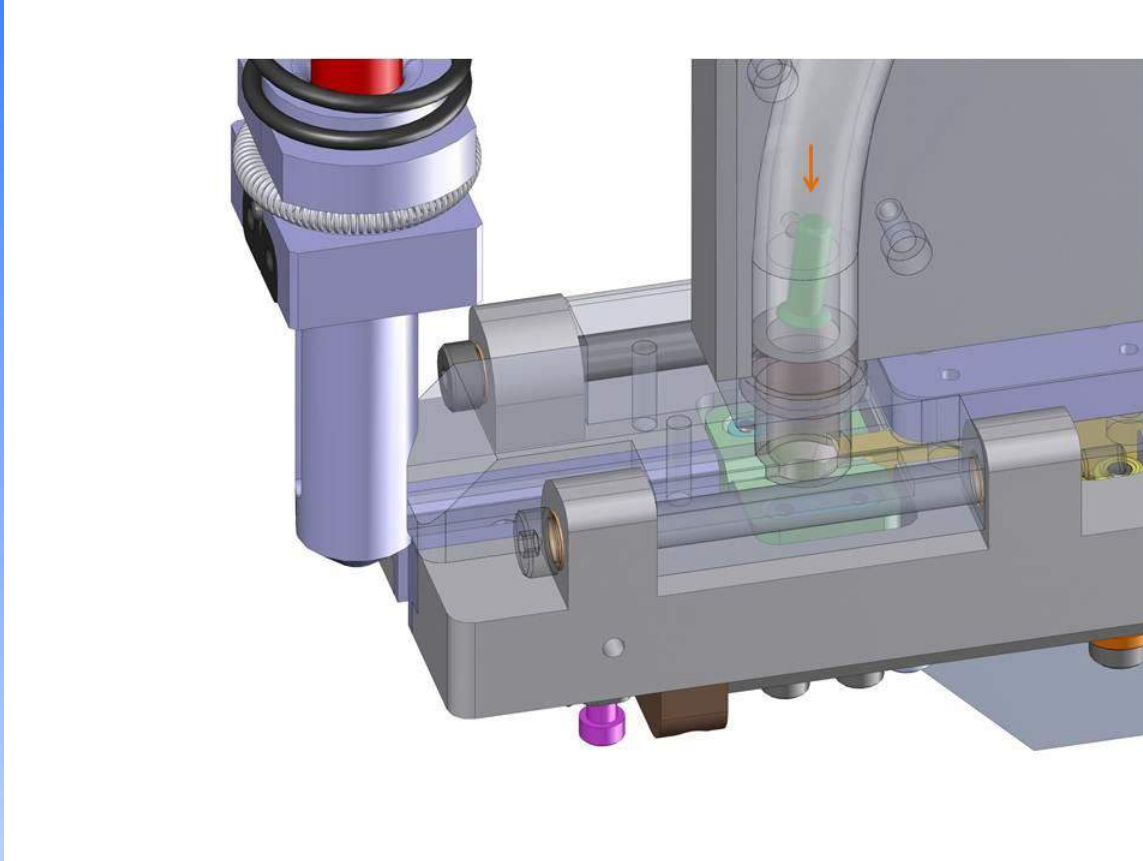
INJECTOR EJECTION EXAMPLE



Backwards fastener sent to Injector

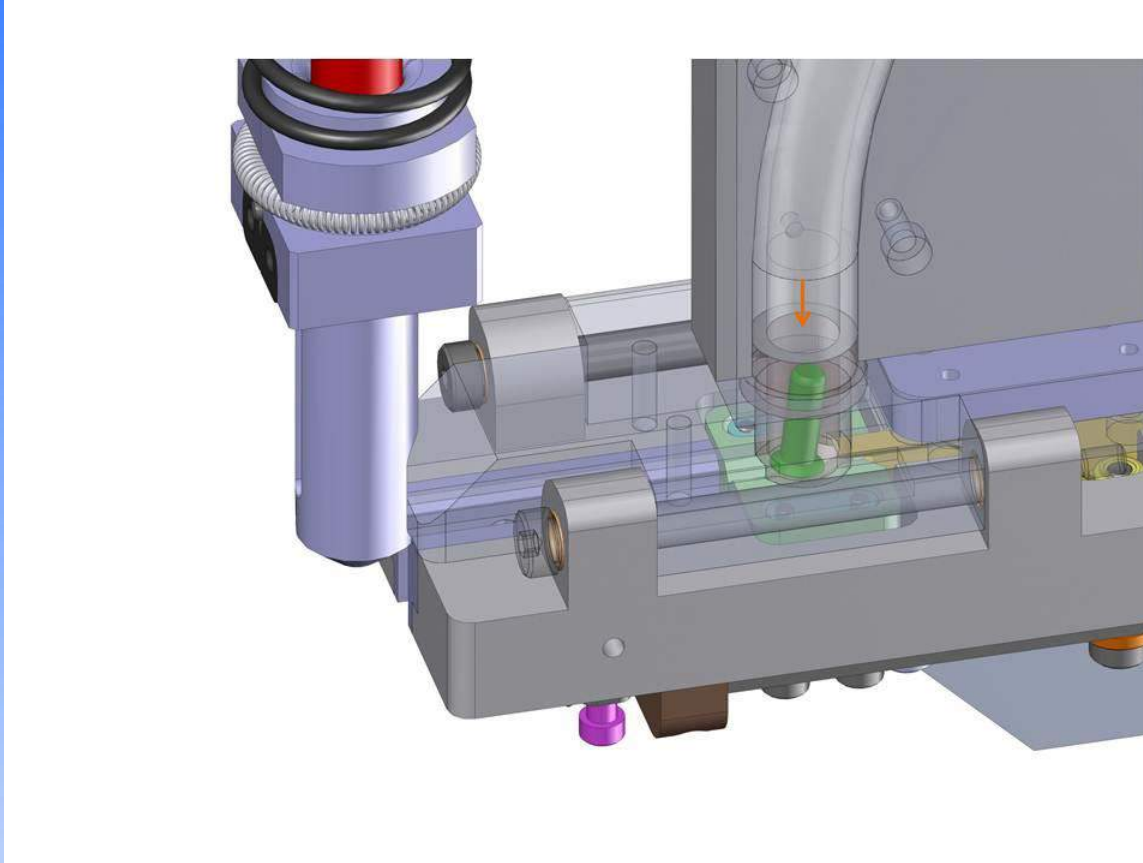
(Same procedure occurs for multiple fasteners sent, etc.)

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



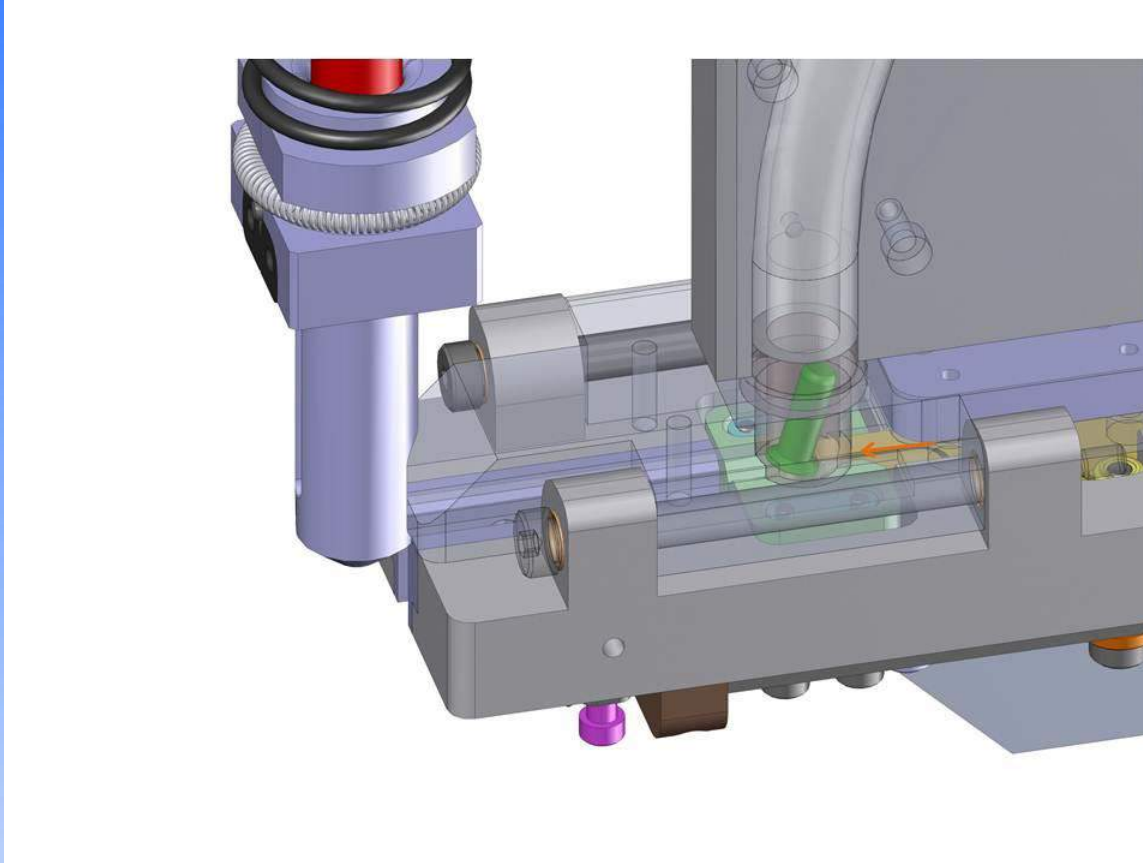
Backwards fastener enters Chamber

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



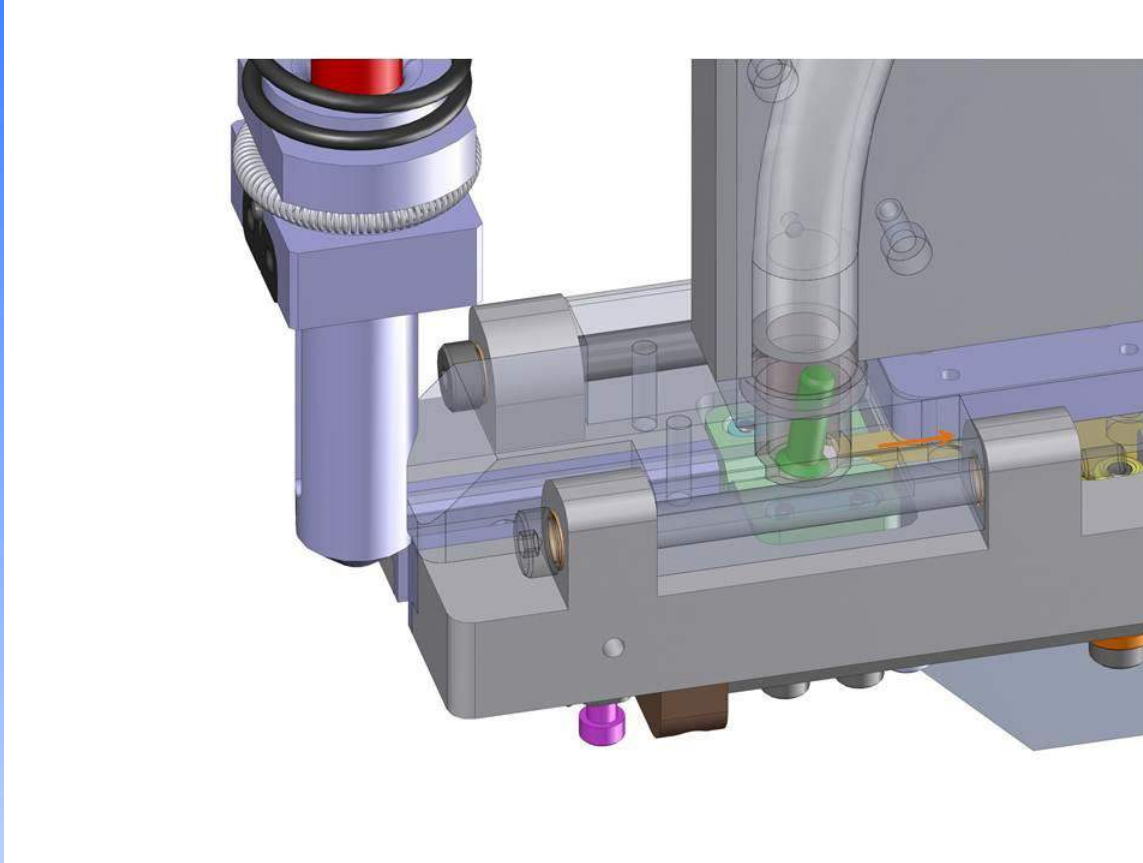
Backwards fastener settle on Catch Blocks

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



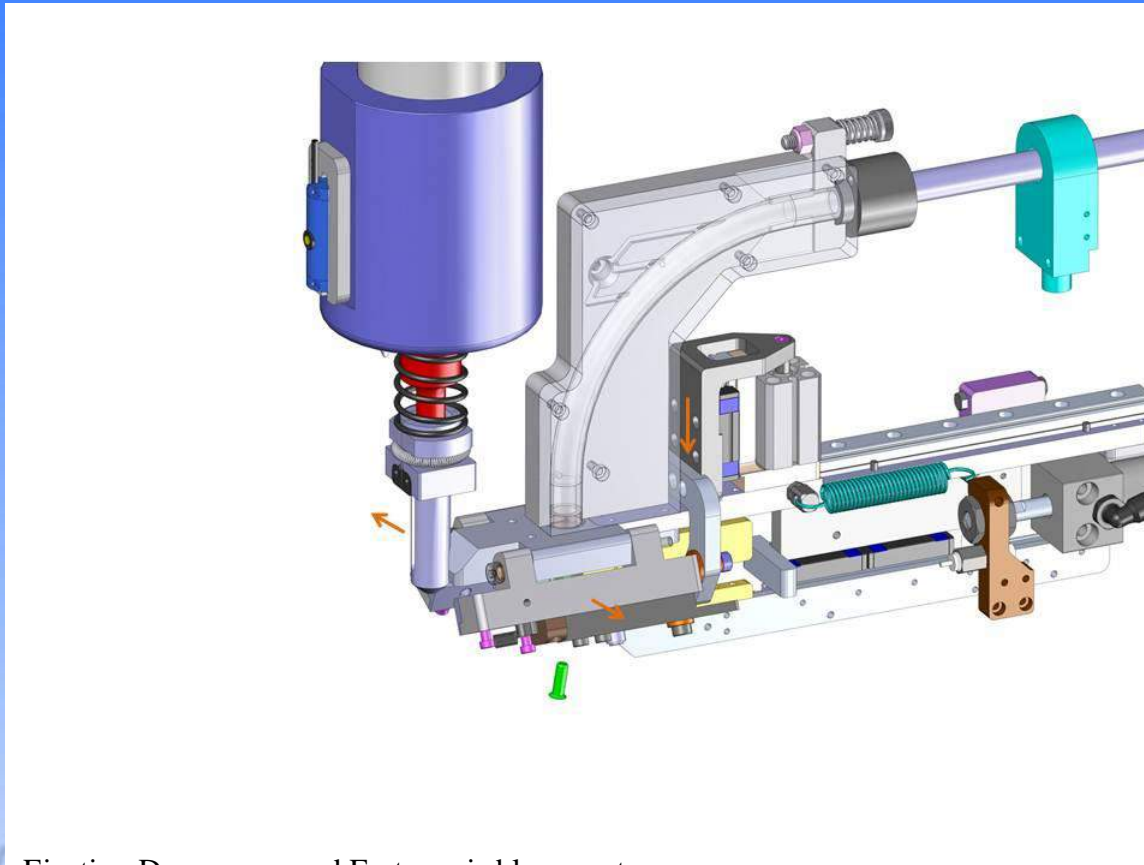
Pusher attempts to extend but cannot extend due to backwards fastener
(Same happens when multiple fasteners are sent at the same time)

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



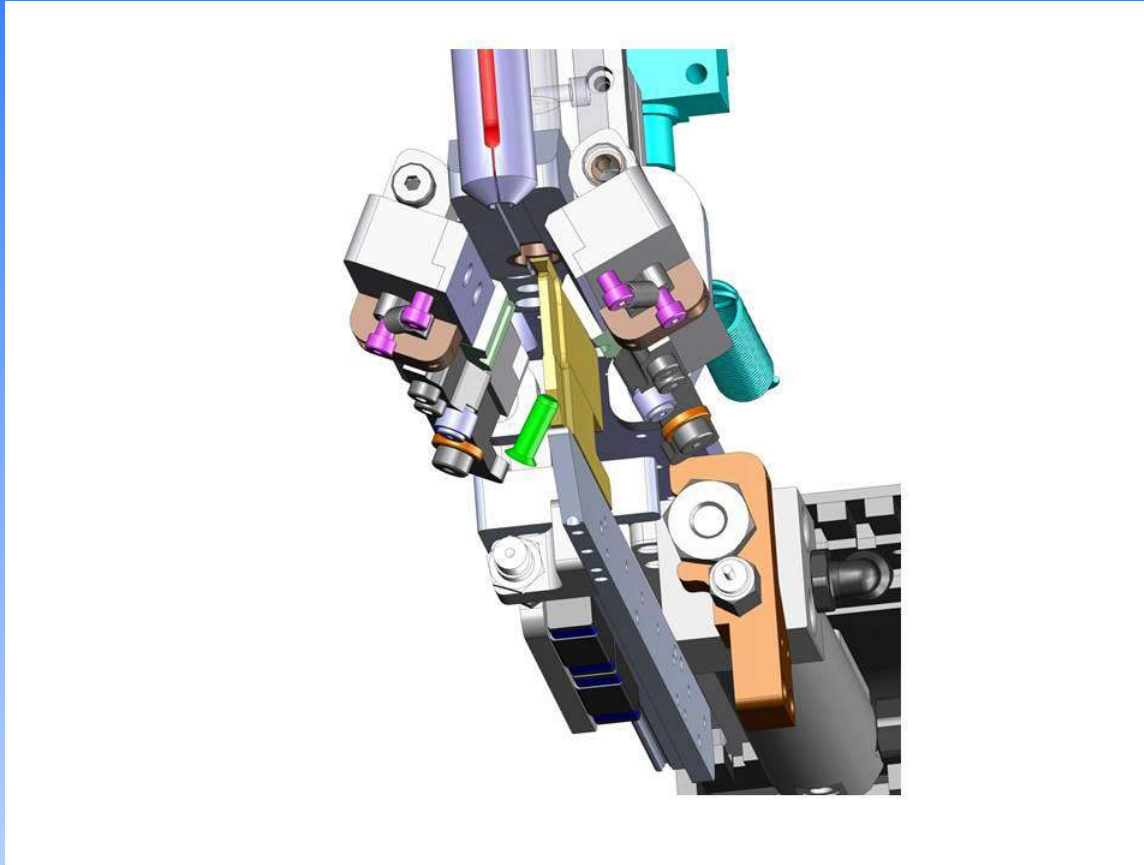
After a timeout which indicates a jam, the Pusher retracts.

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



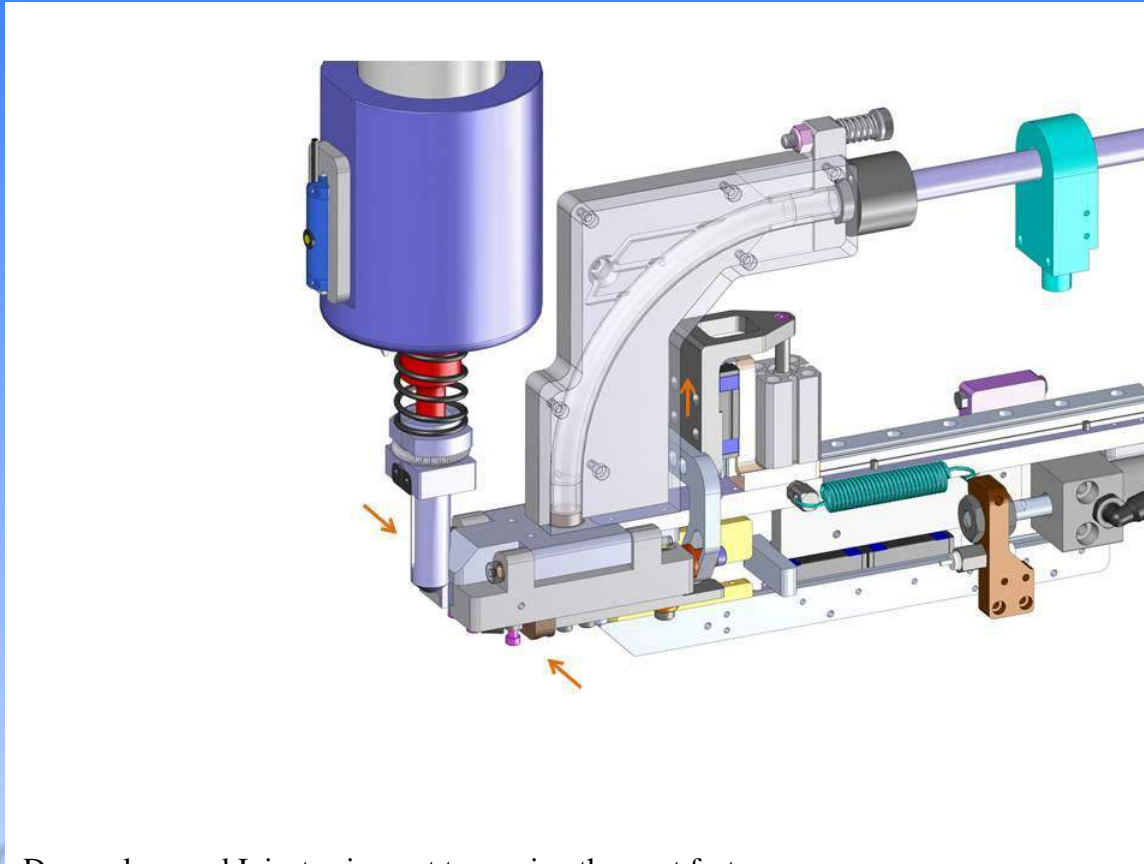
Bombay Ejection Doors open and Fastener is blown out
(In the case of multiple fasteners fed, all fasteners are cleared from the Injector at this point)

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



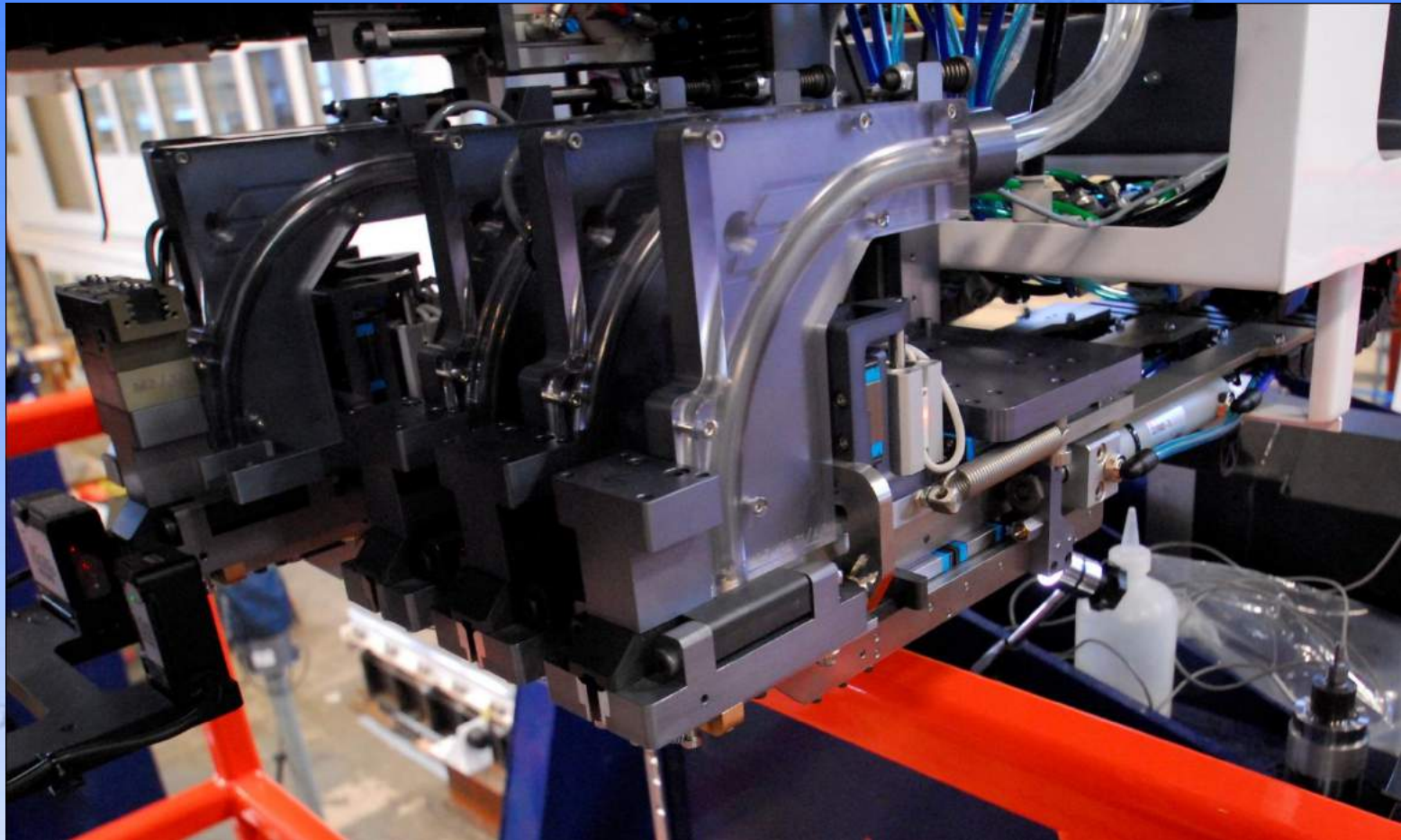
Bottom view of Injector with Bombay Doors open

HORIZONTAL RIVETING MACHINE INJECTOR OVERVIEW



Bombay Doors close and Injector is reset to receive the next fastener

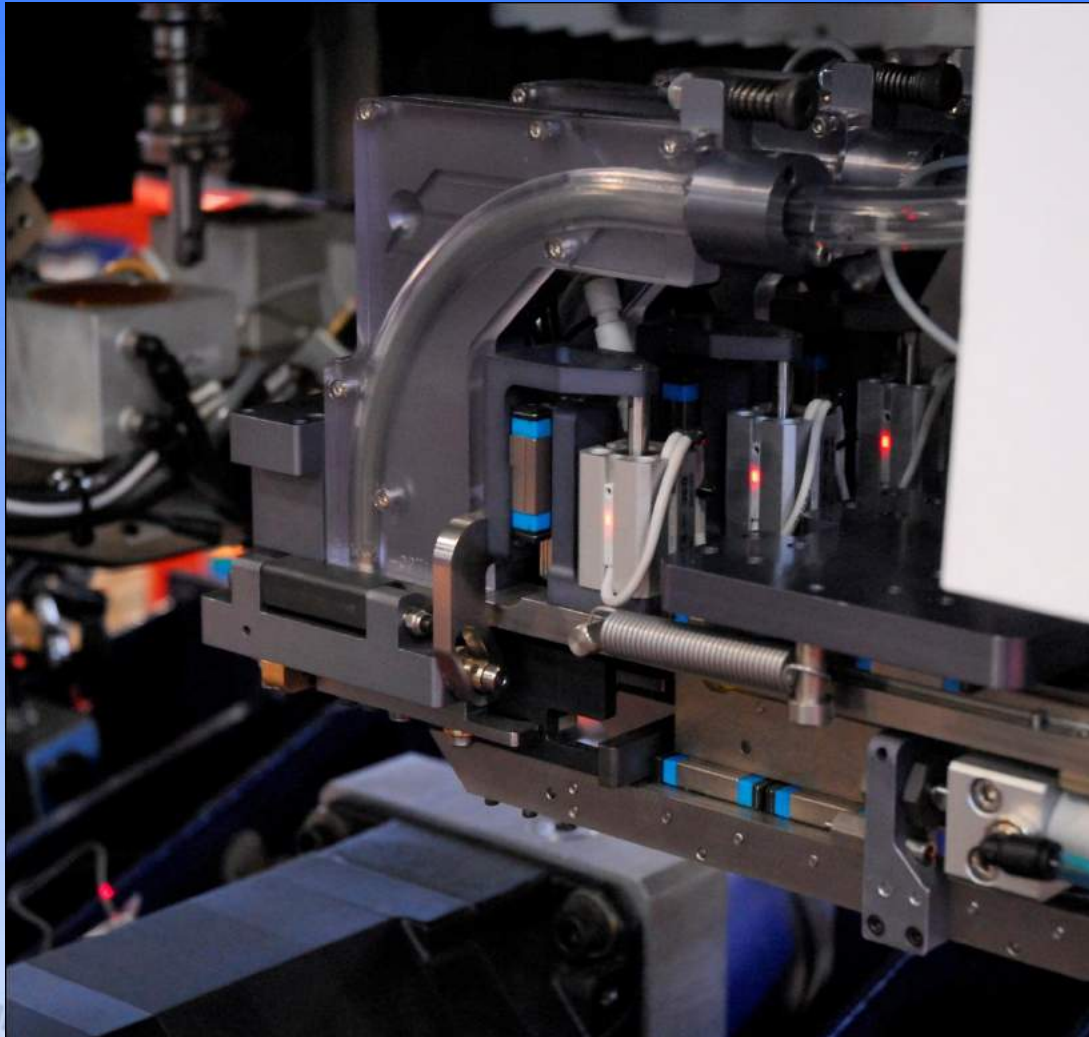
Rivet Injector Bomb Bay Doors Closed



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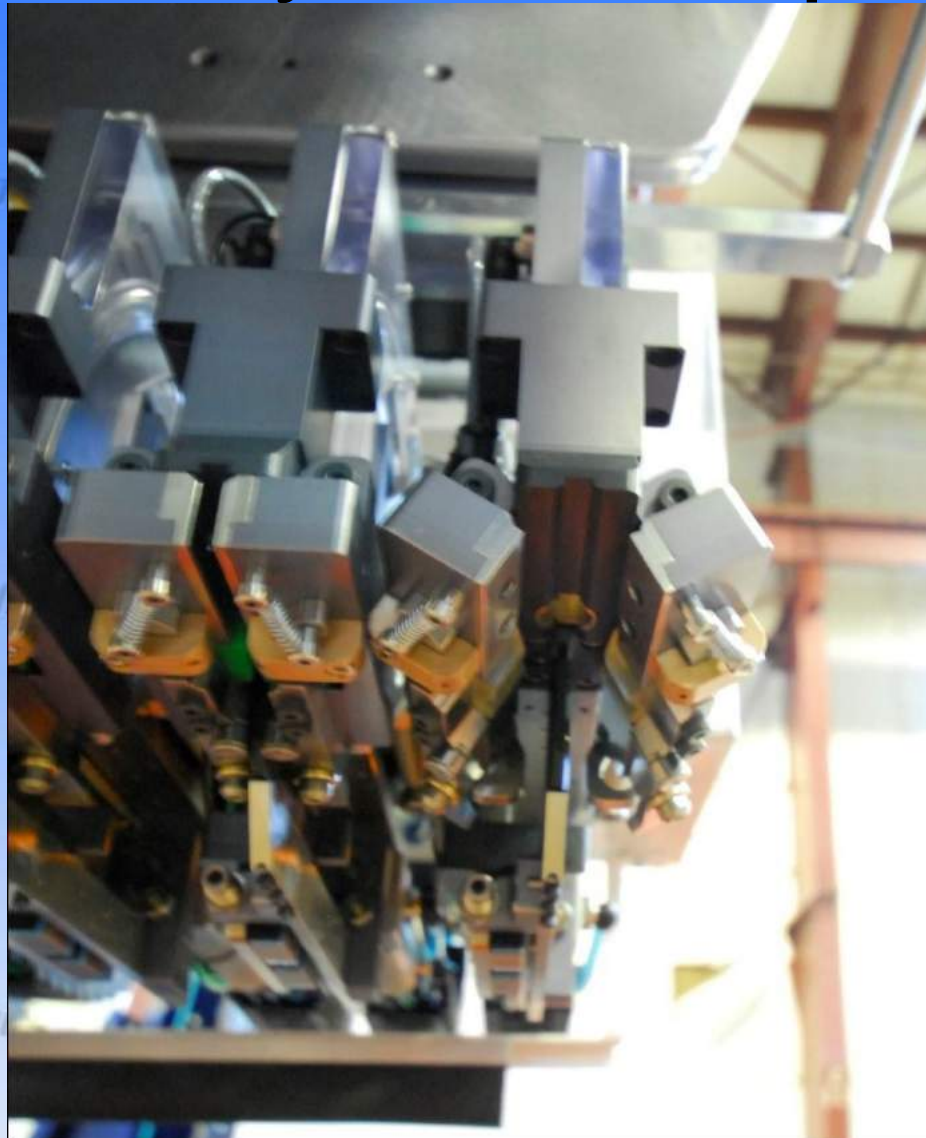
Bomb Bay Doors Closed



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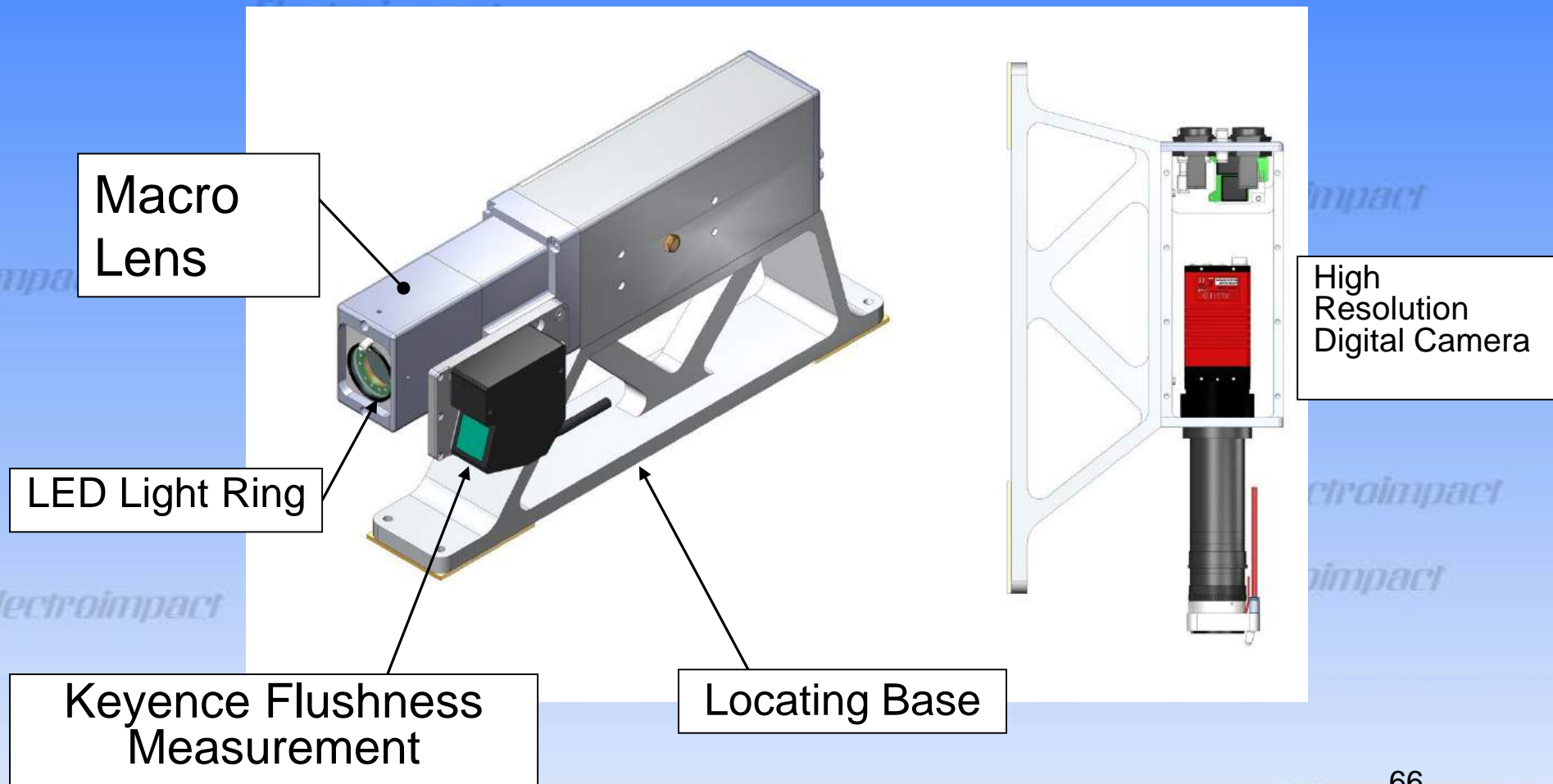
Bomb Bay Doors Open



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Resync Camera System

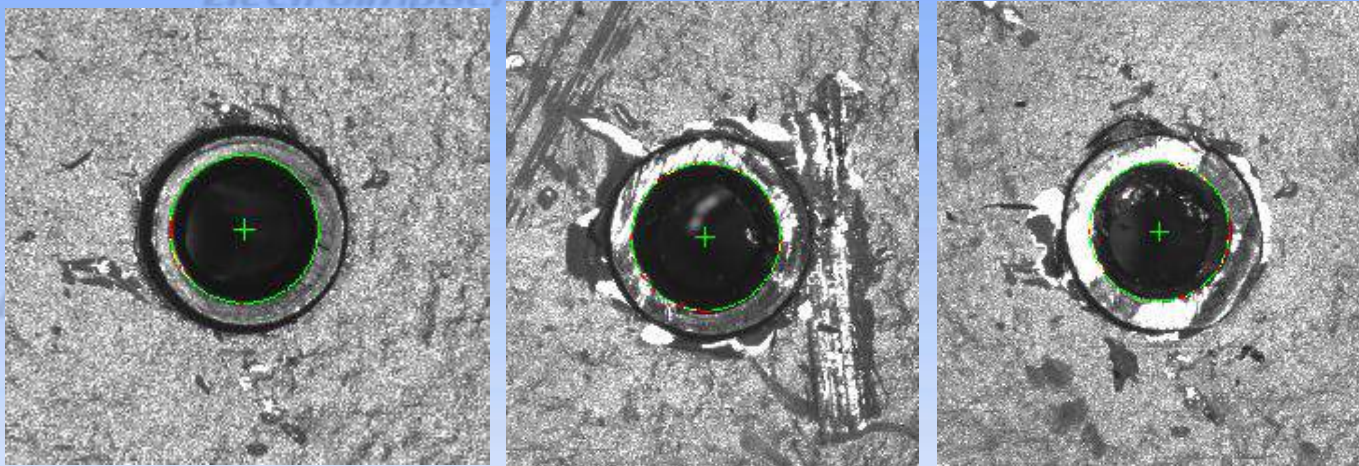


Automatic Resync on Tacks or Drilled holes

- Cognex VisionPro Software
- Color Camera
- Variable LED brightness



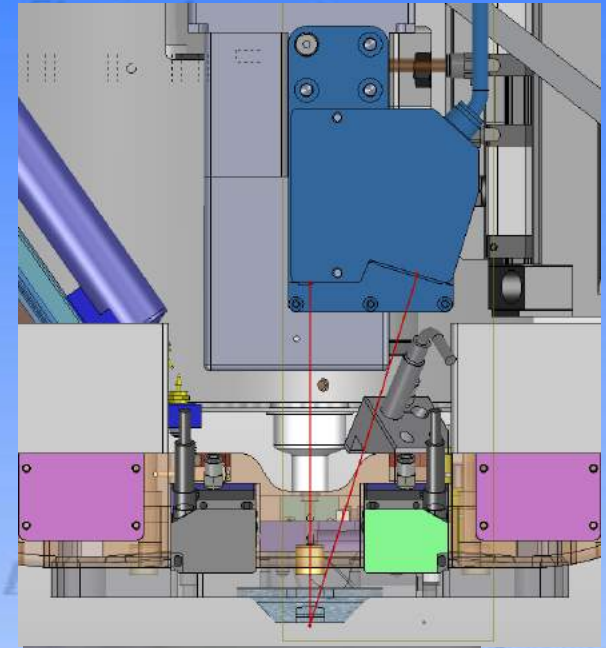
Tacks detected even with poor surface conditions



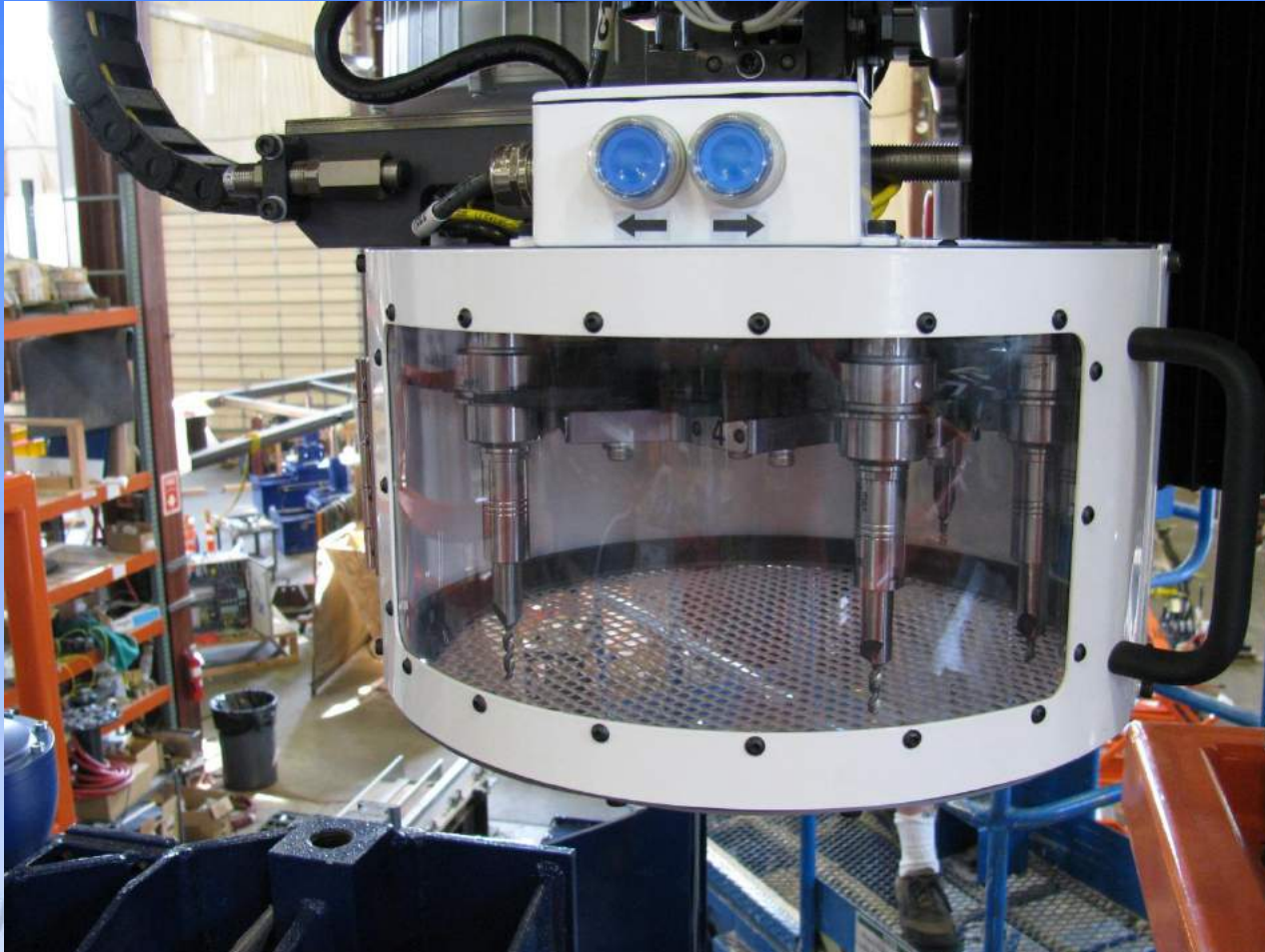
OPTIONAL:

Rivet Flushness Measurement

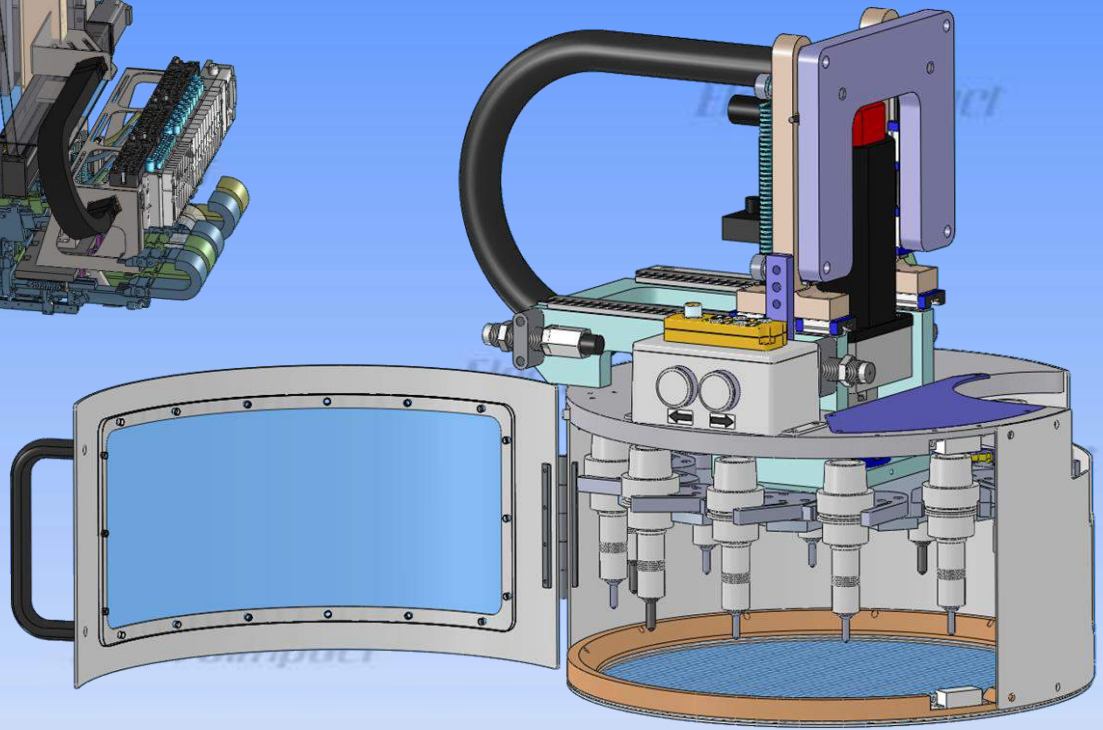
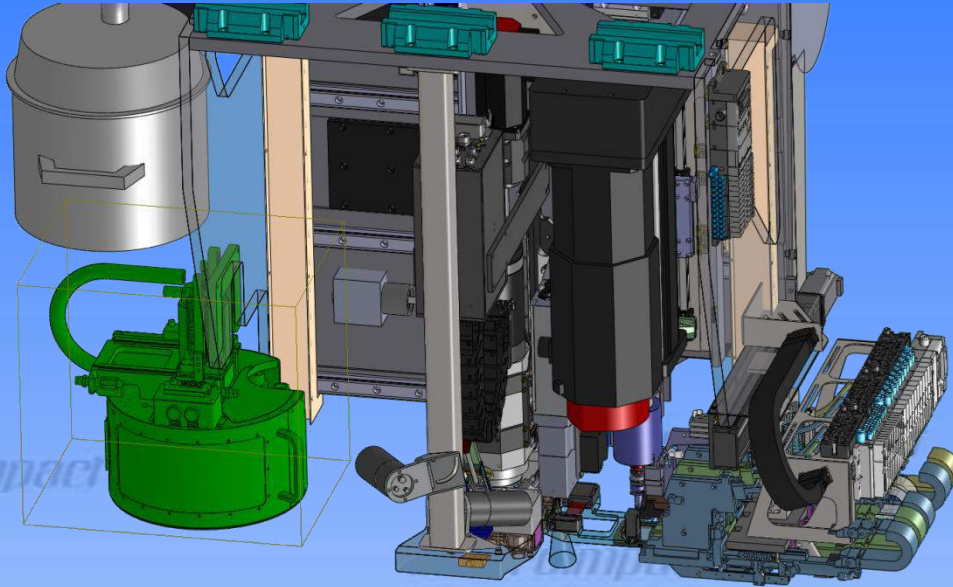
- High Accuracy Laser displacement sensor
- Red laser with CCD sensor
- 150mm +/- 40mm measurement range
- 0.12mm x 4.2mm beam spot
 - Wide spot reduces surface roughness noise
- 0.25µm repeatability
- Sample rates of 2.5-1000µs (selectable)
- IP 67
- Robust measurement technology
 - high-end optics and controller perform repeatably under varying light and surface conditions



OPTIONAL: Drill ATC

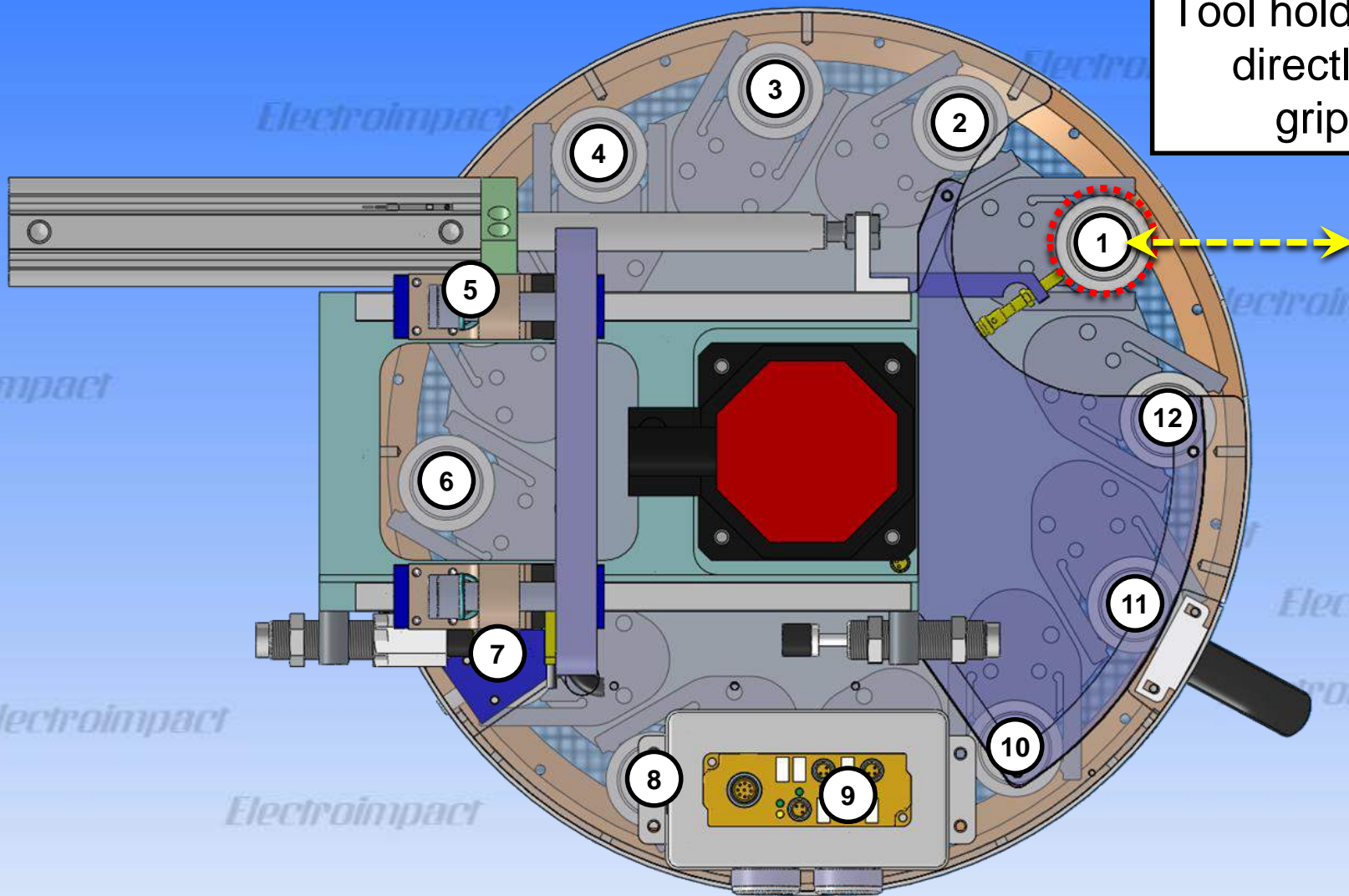


Automatic Drill Tool Changer

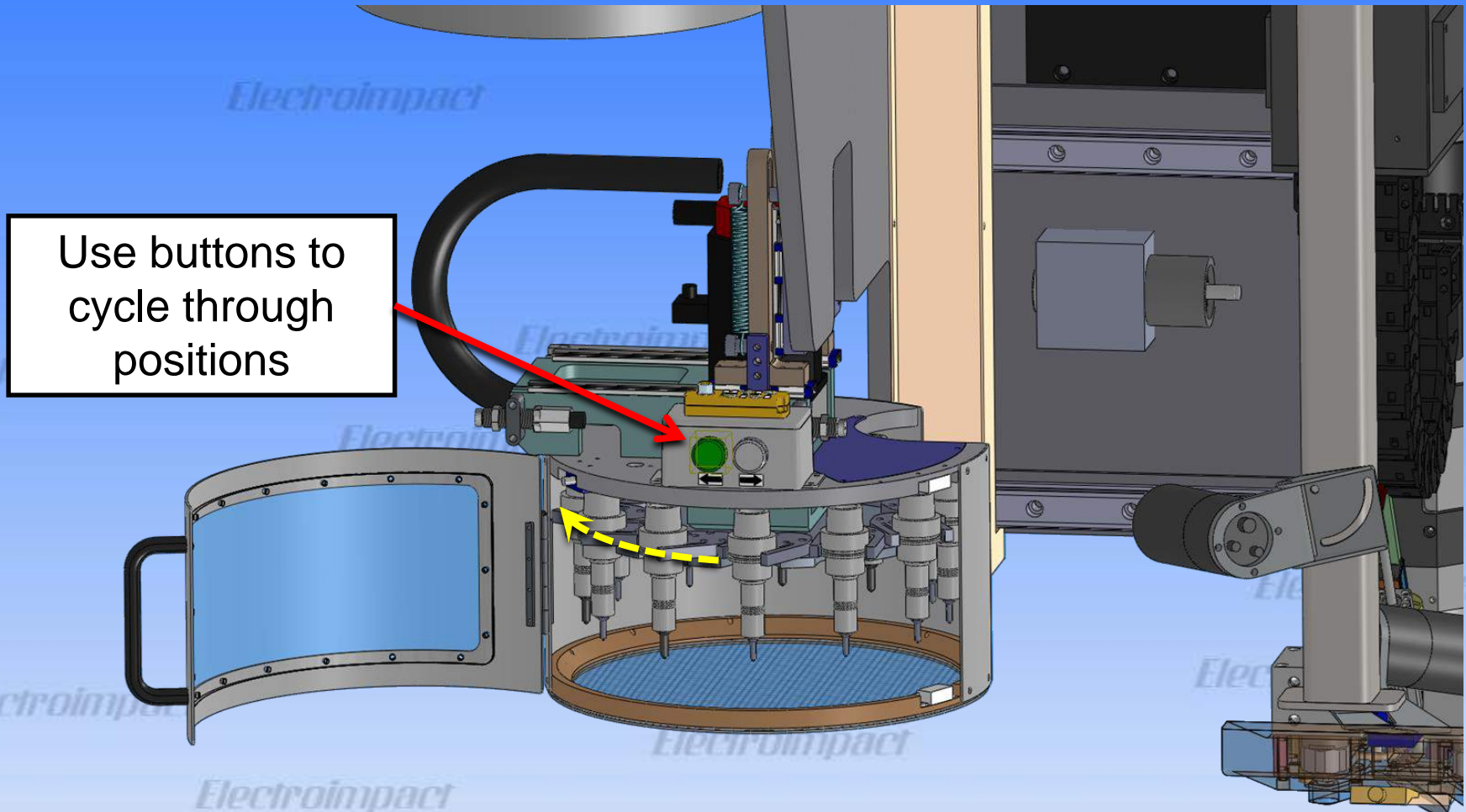


Drill ATC

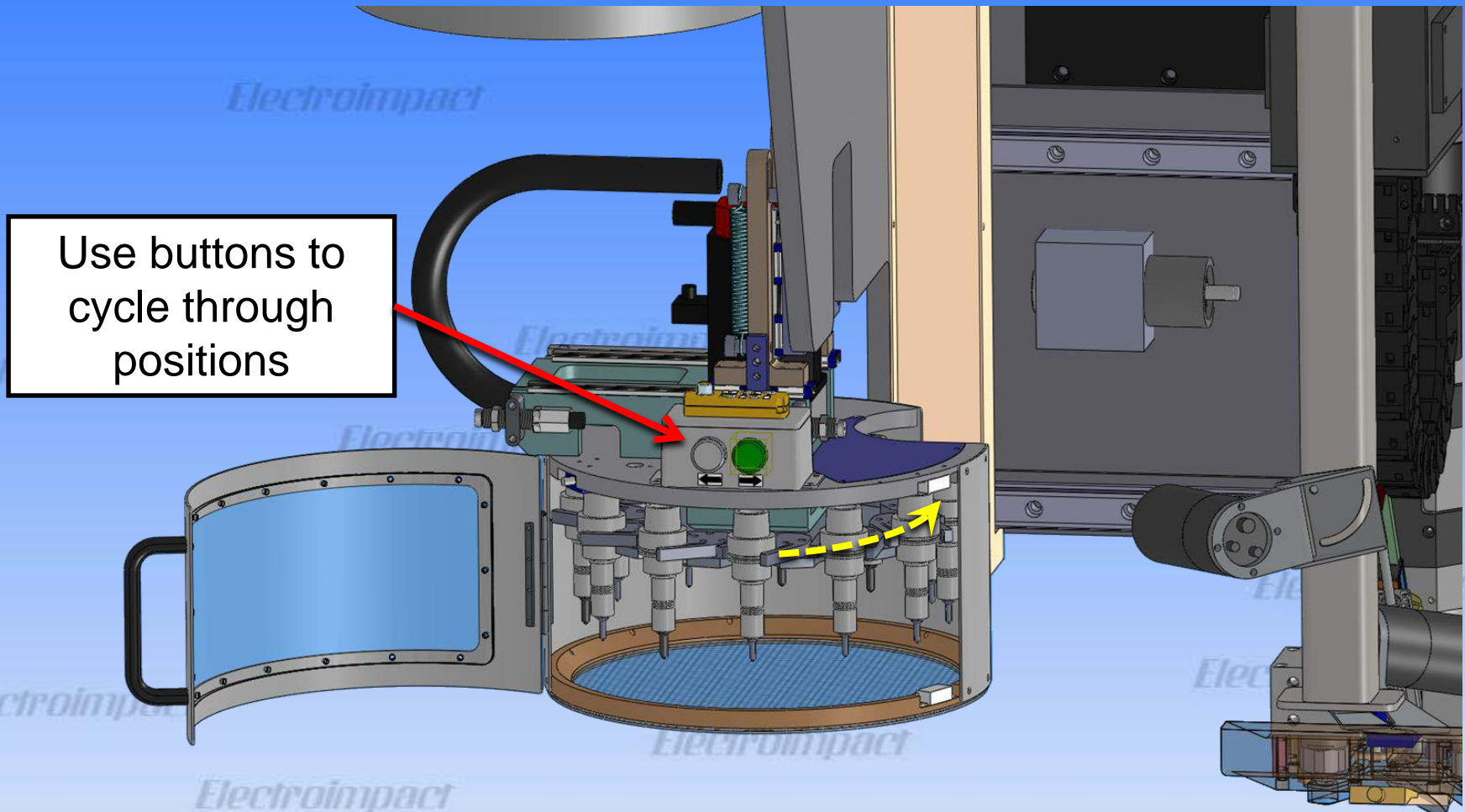
Tool holder slides
directly into
gripper



ATC Loading



ATC Loading



Lower Ram

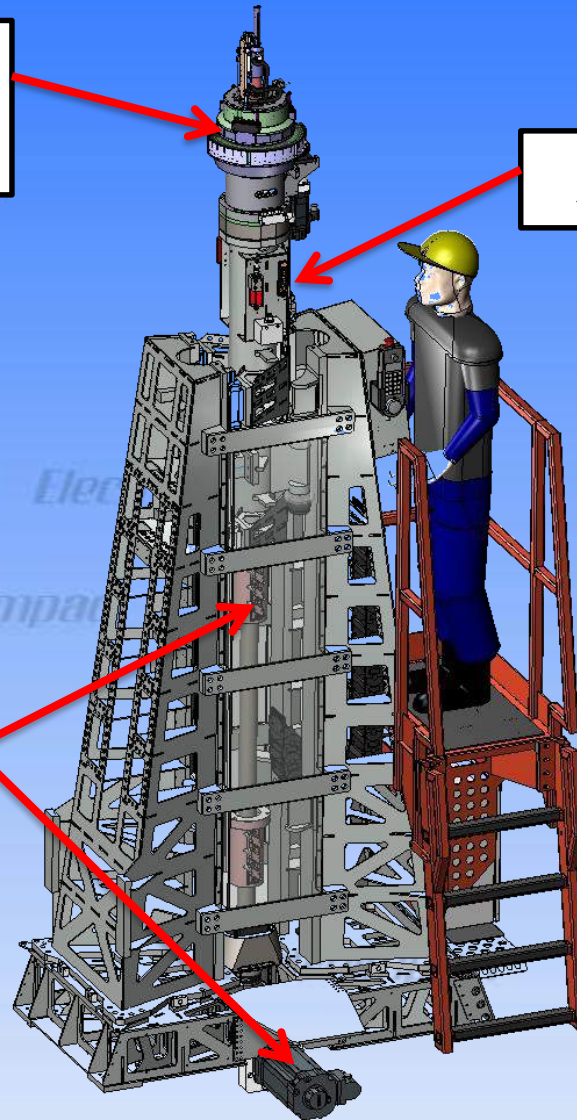


MAJOR COMPONENTS

Lower process
head assembly

Z-sled

Z-axis drivetrain



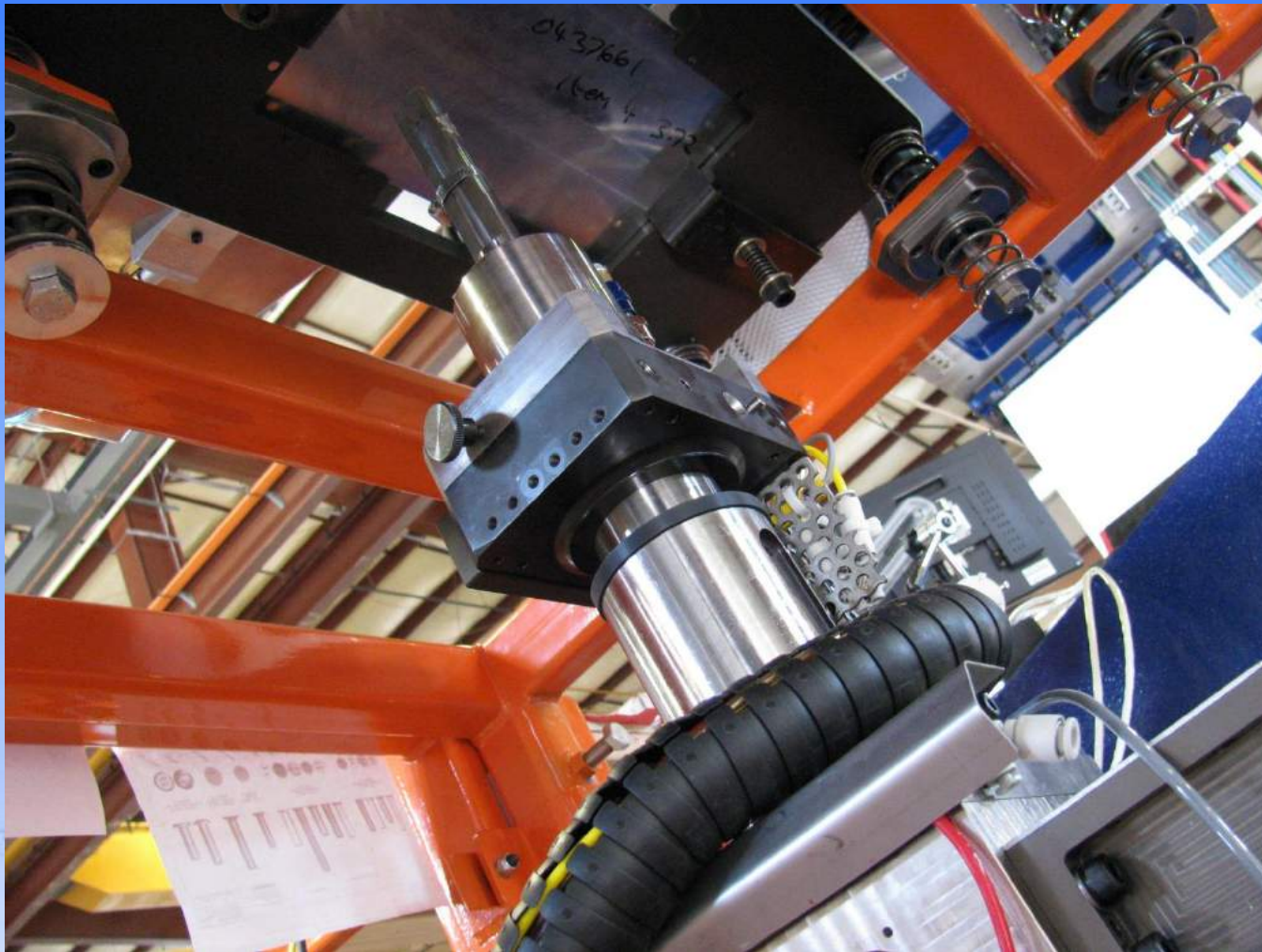
Lower Tool 1/4in



Images and Content Proprietary of
Electroimpact Inc and may not be
reused without written consent
Electroimpact Proprietary

Electroimpact

Lower 1/4in Tool

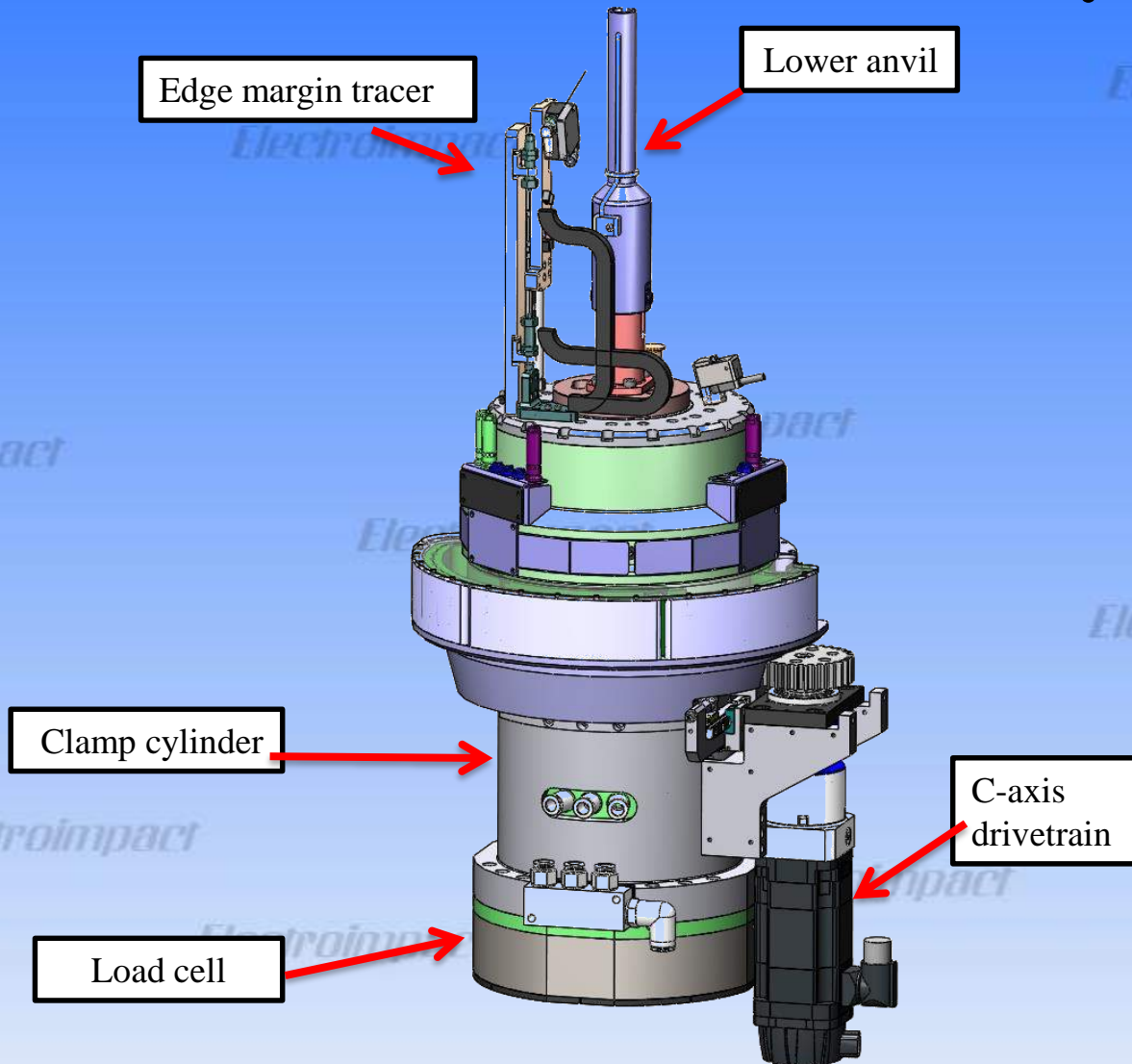


Images and Content Proprietary of
Electroimpact Inc and may not be
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Electroimpact Proprietary

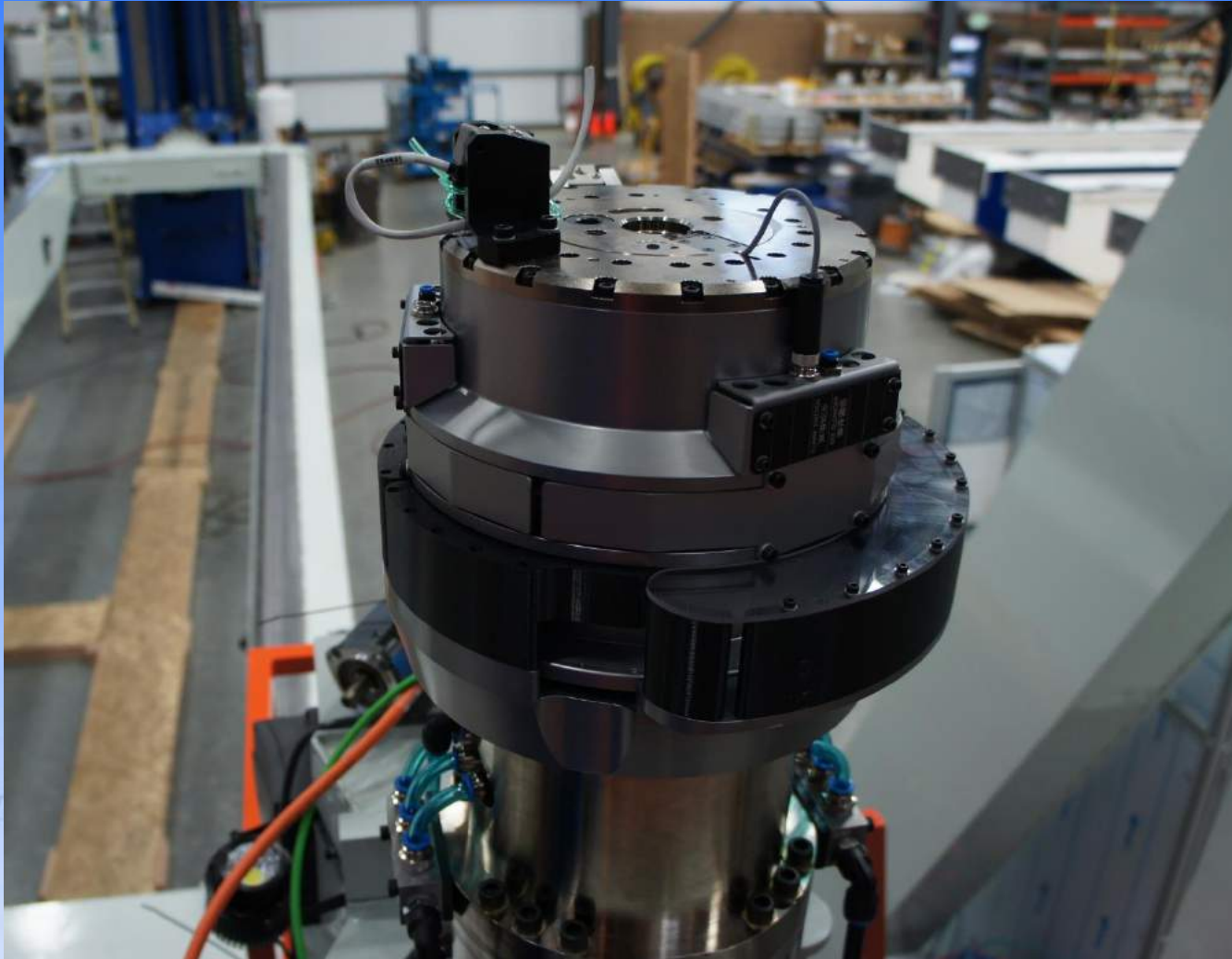
Electroimpact

LOWER PROCESS HEAD

- C axis rotation of +/- 190deg

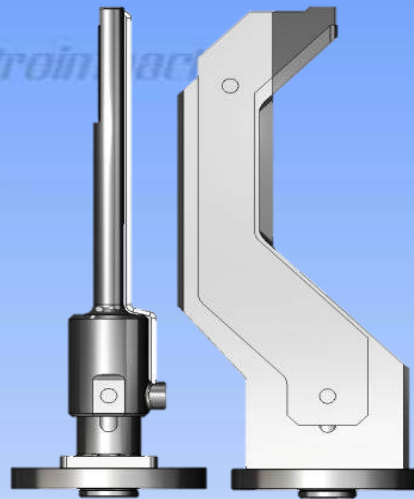


Lower Process Head

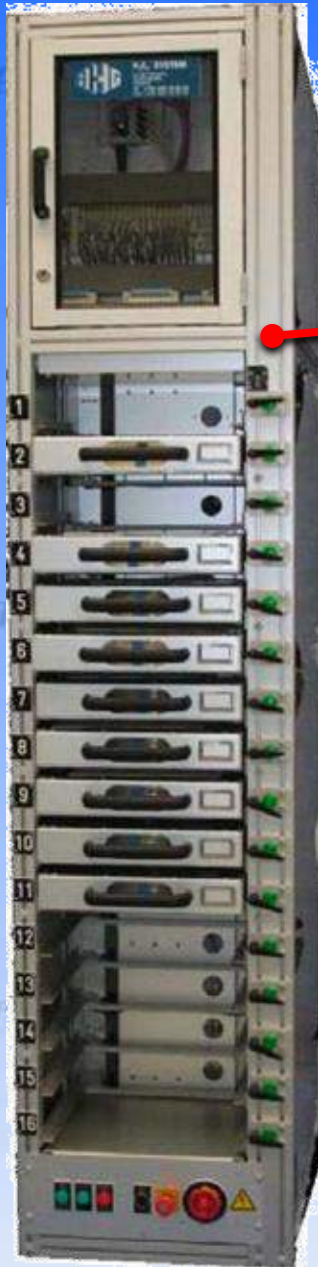


Lower Anvil Tools

- Electroimpact will provide straight tooling and offset tooling for 5/32" , 6/32" & 8/32" riveting



Fastener Feed System



F2C2 fastener feed 16 slot
cartridge rack

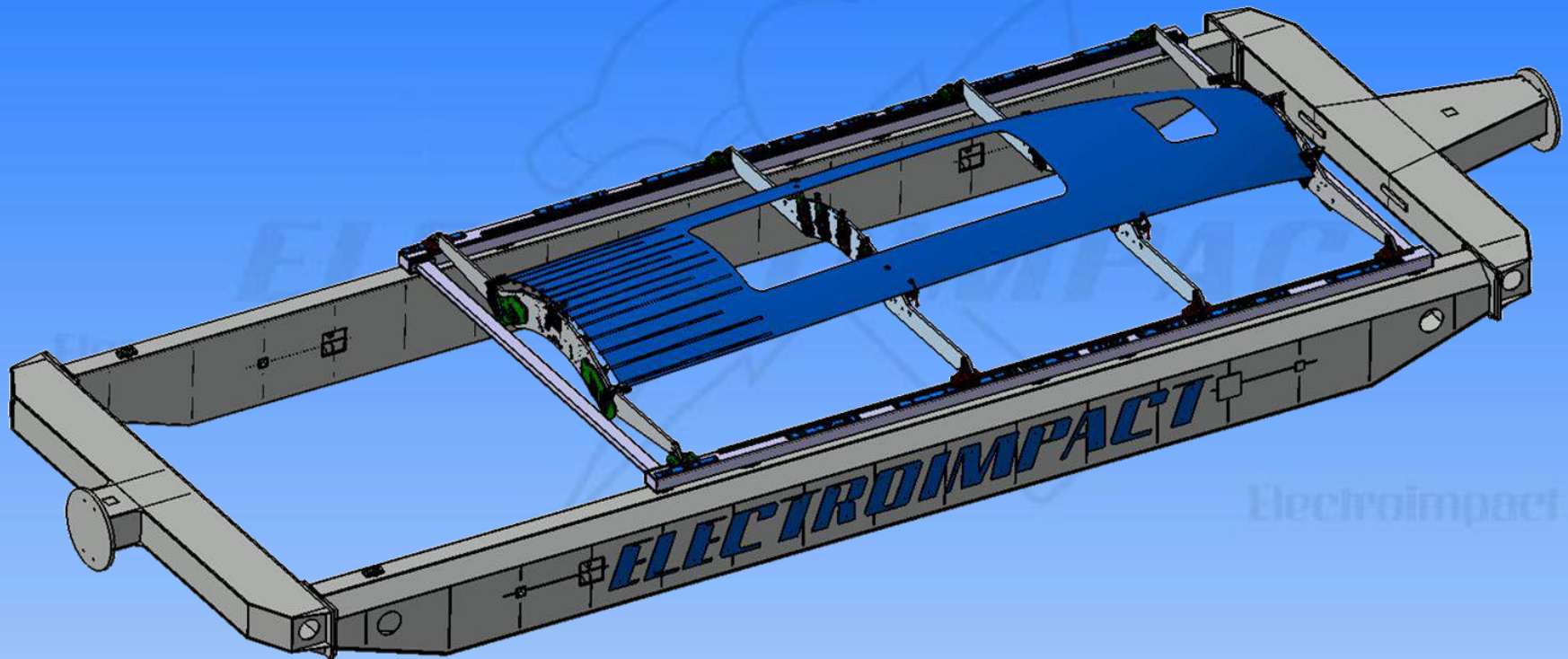
Cartridge filling station with
vibratory bowls



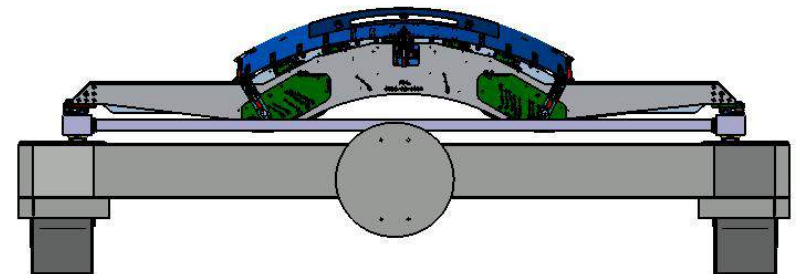
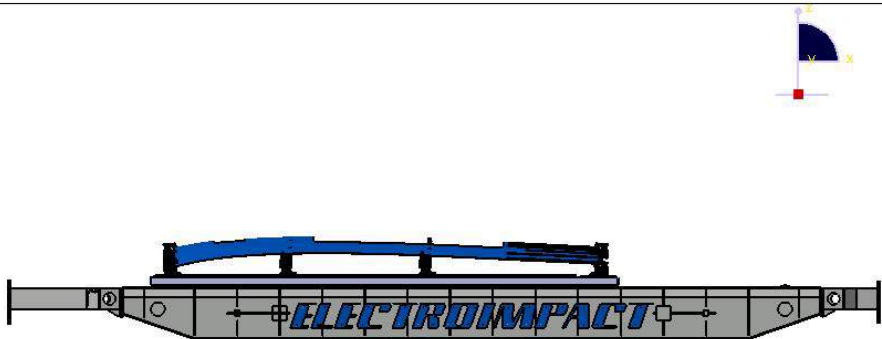
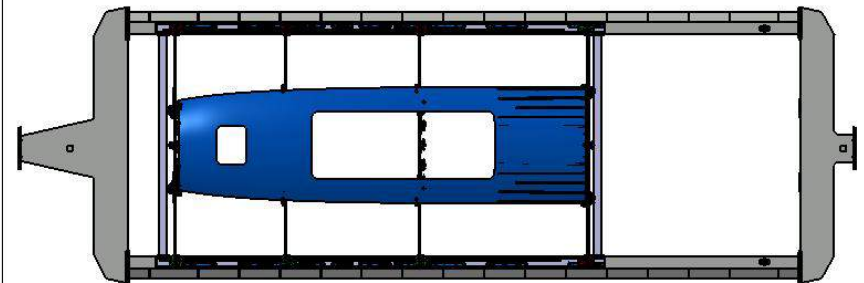
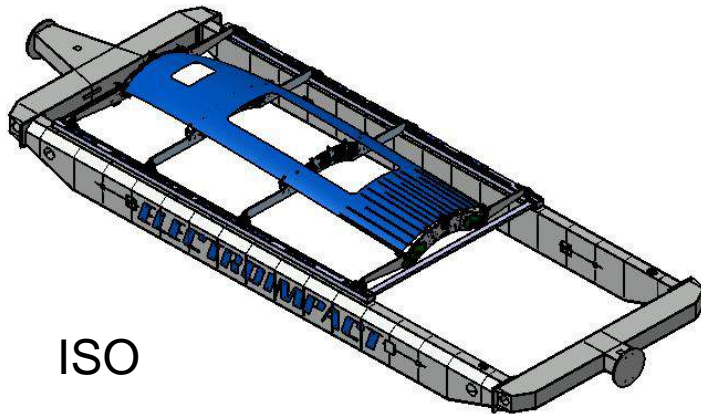
Electroimpact Panel Riveting Dept.

Removable/Adjustable Part Holding Fixture

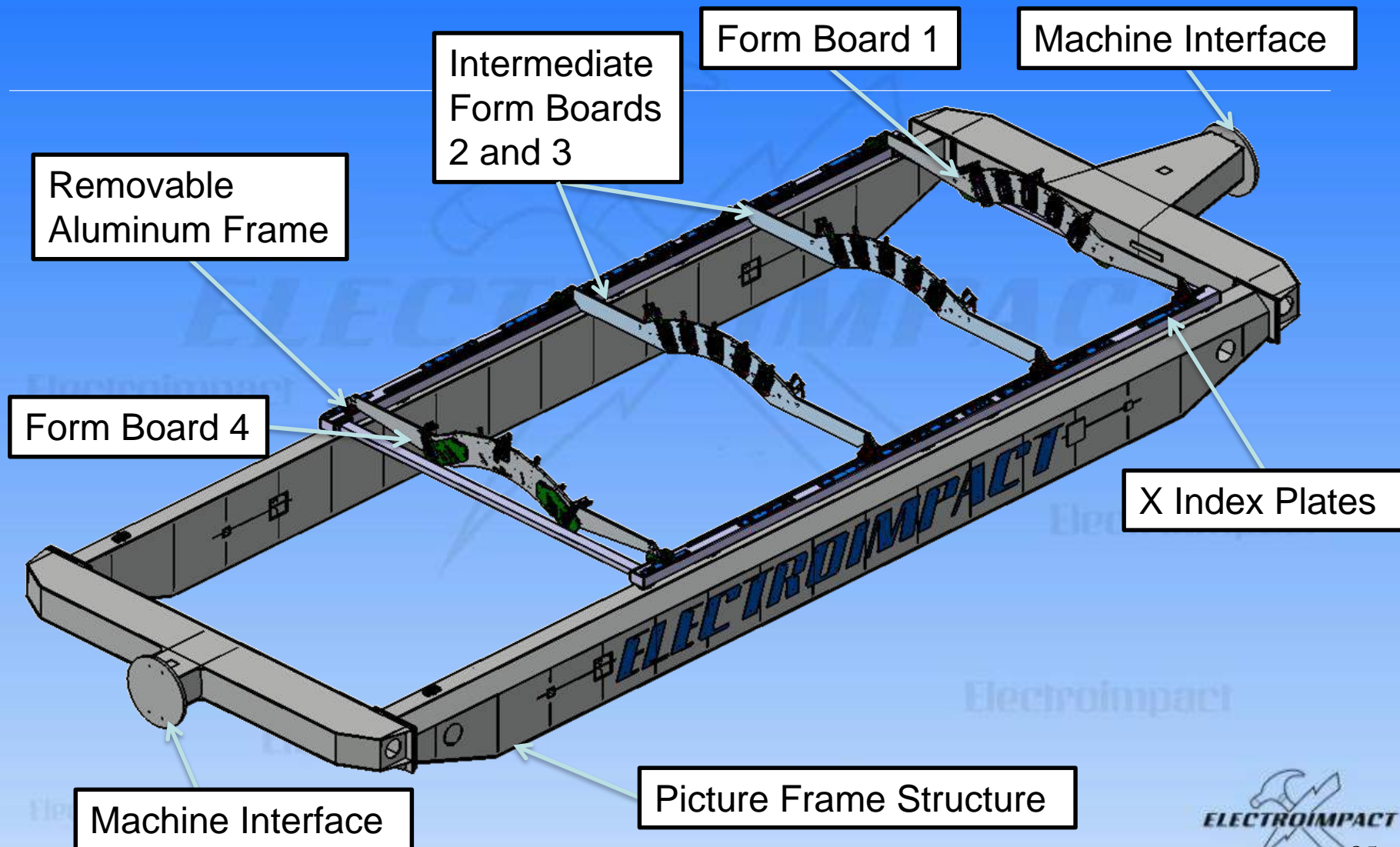
Picture Frame



Picture Frame



Overview



Overview

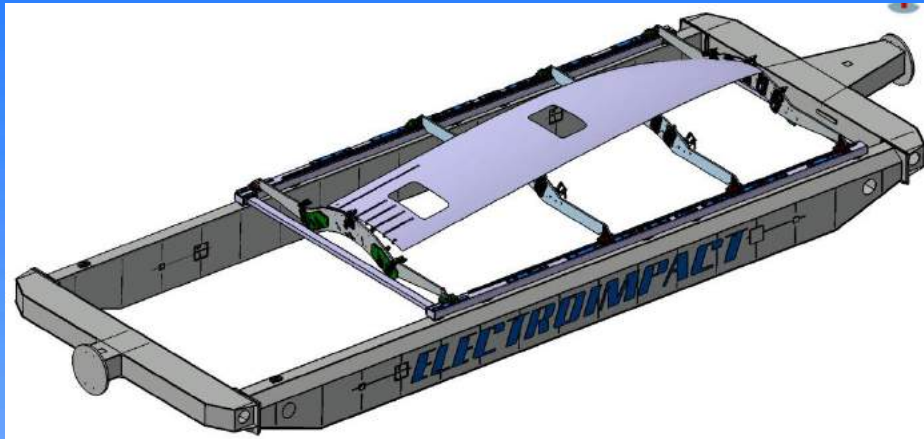


Current ARJ machine part holding fixture

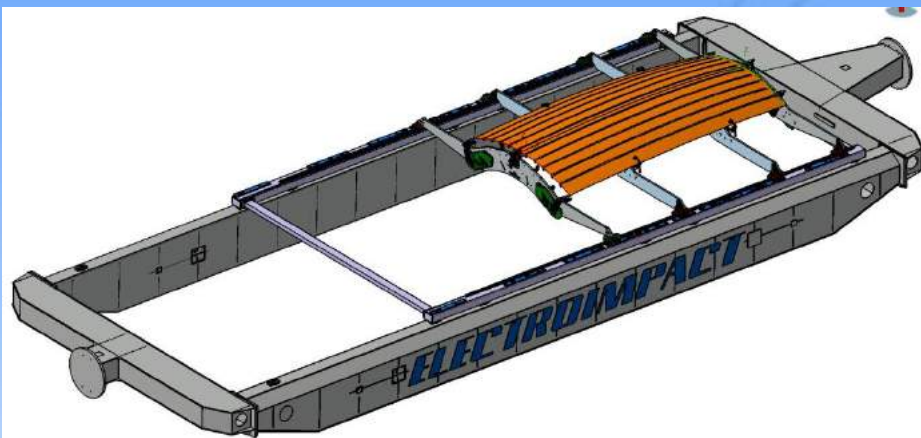
Overview



Flexible Part Holding System



Tapered Panel



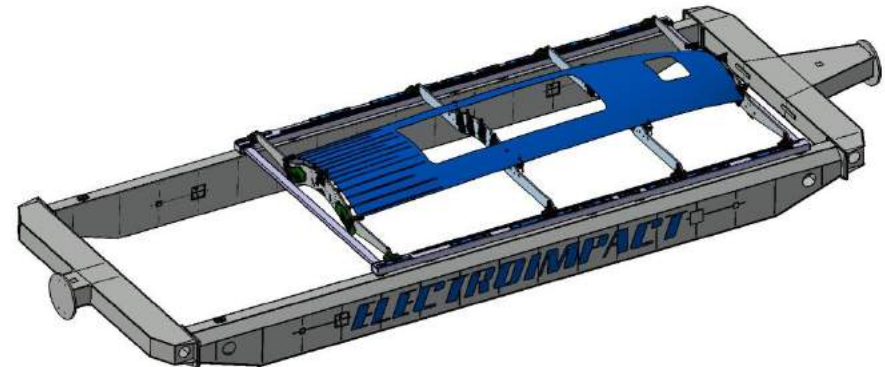
Crown Fuse Panel

Part Holding adapts to parts

Index Boards and Intermediate Boards slide along the structure

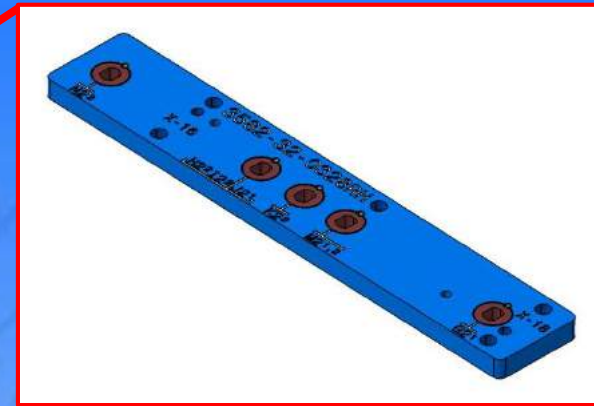
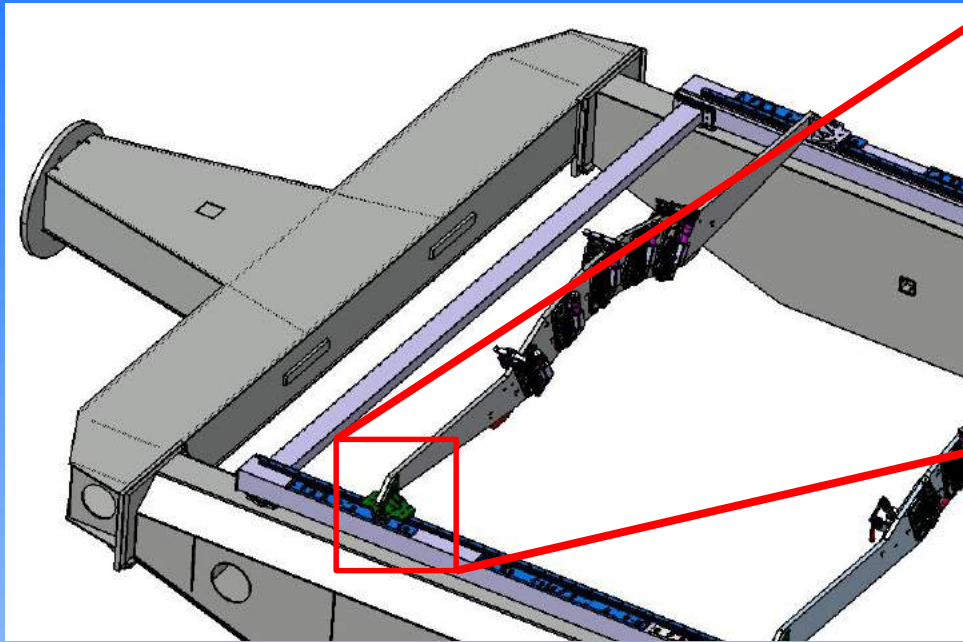
Boards will index to specific locations for different panels

Aluminum frame holds Boards and can be removed from structure

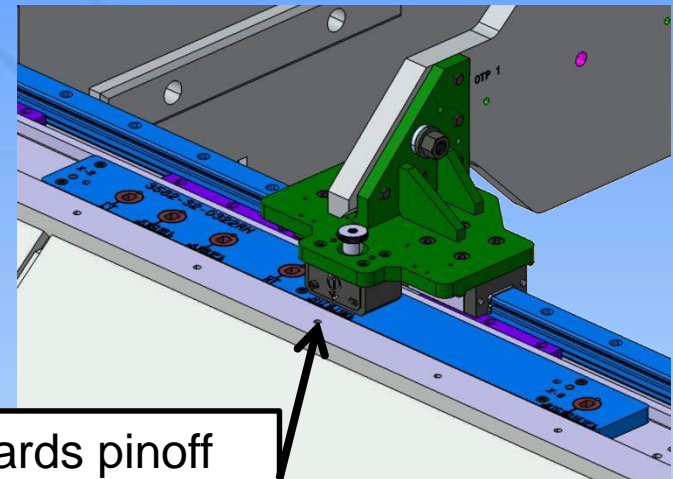


Largest Panel

Form Board Location Index

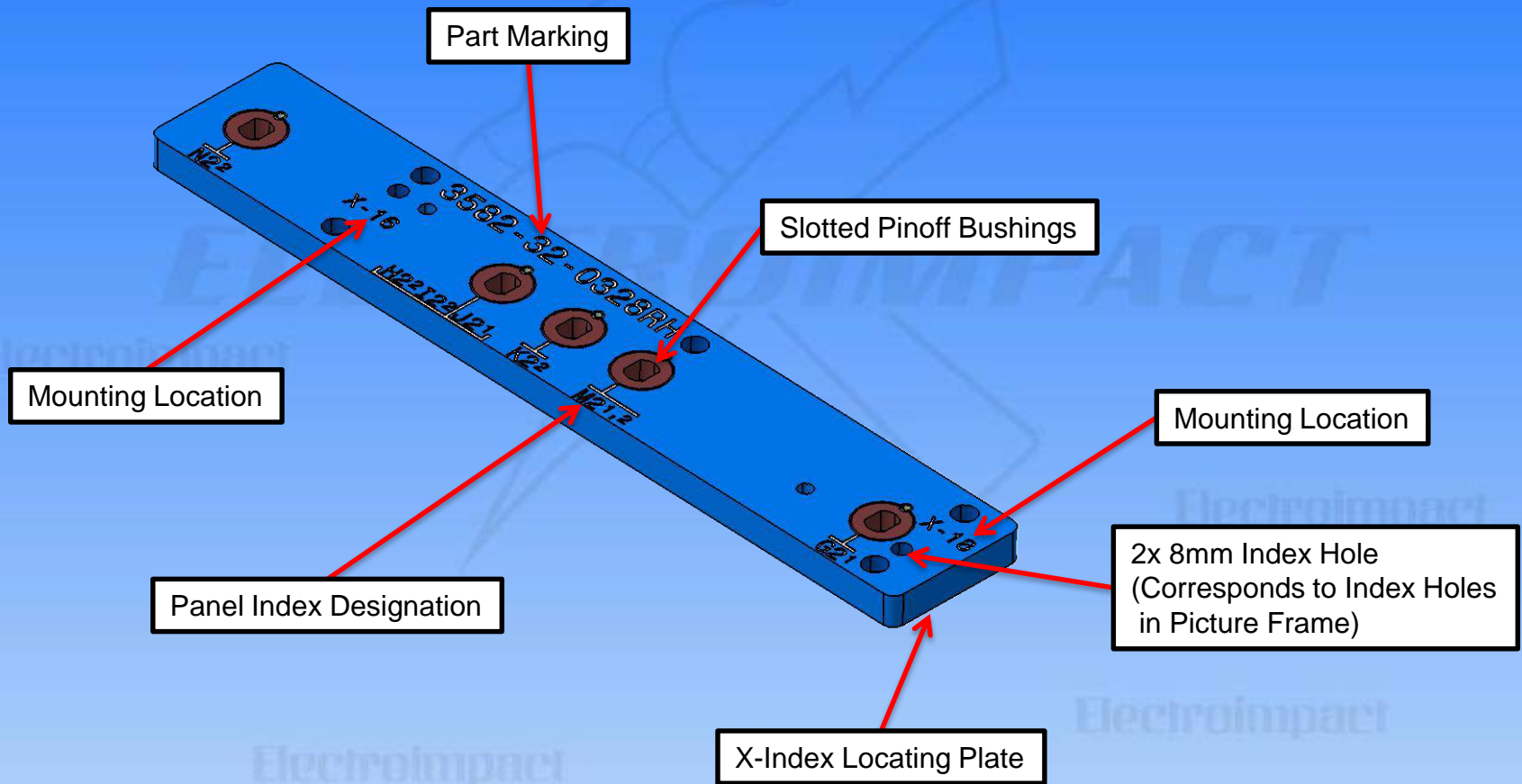


Index Plates can be re-machined to add index locations



Form Boards pinoff at index locations

Form Board Location Index



Form Board Overview

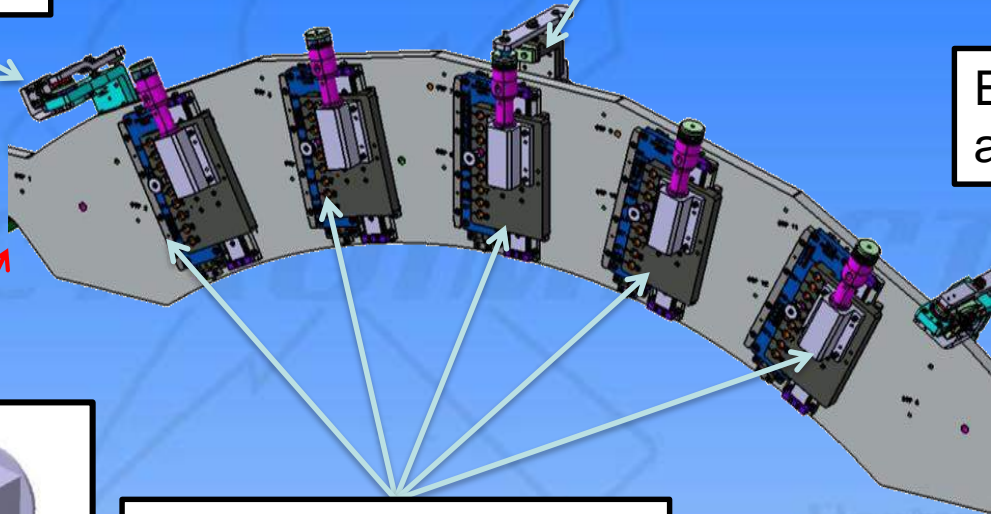
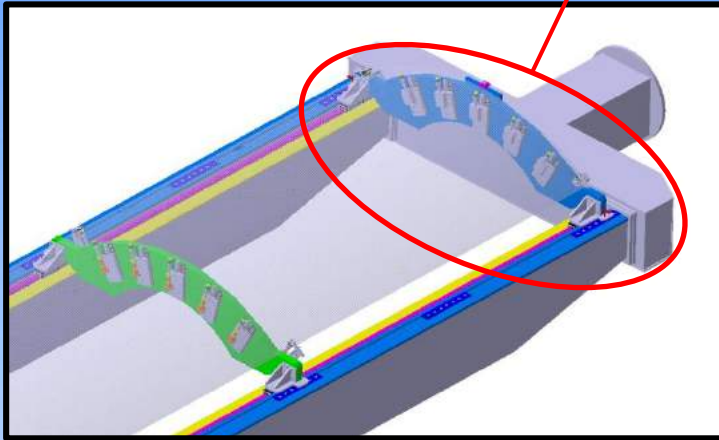
Edge Index
and Clamp

FWD Surface Index

Edge Index
and Clamp

Sliding Surface Indexes

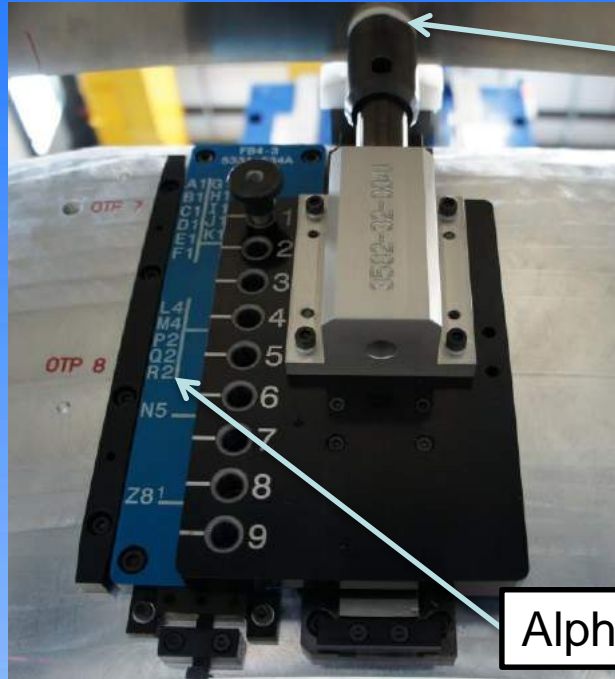
Form Board
Location Index



Form Board Overview



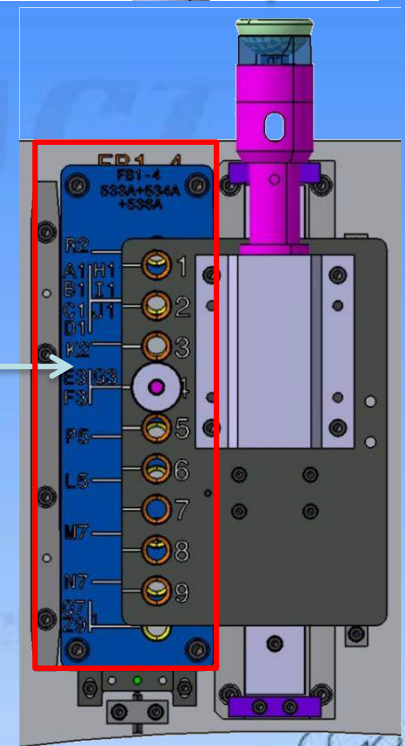
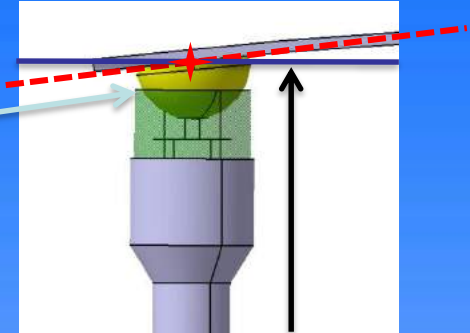
Sliding Indexes



Sphere Surface Index

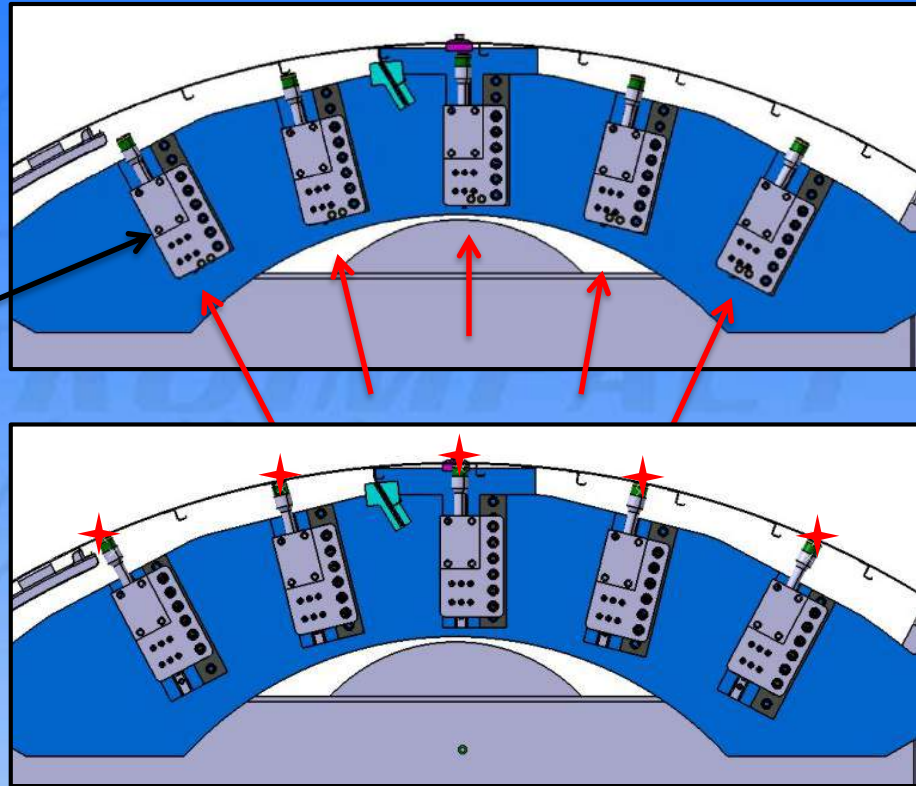
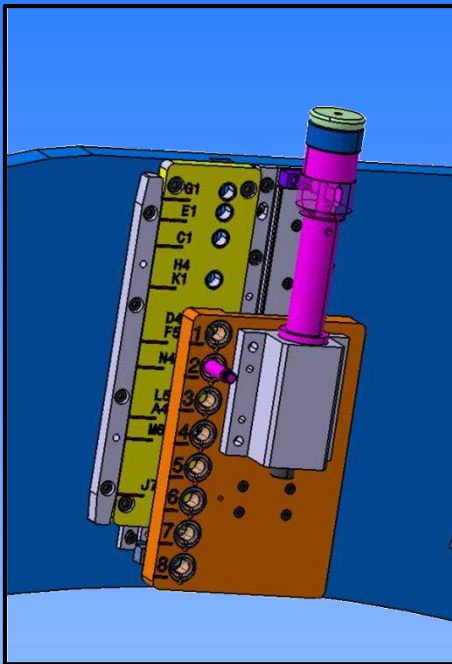
Sphere Index allows for misalignment of part, while still providing index along its axis

Alpha Numerical Index Locations



- Each sliding index has multiple index locations for different panel sizes. Each panel style is assigned a letter.
- Plates can be removed and new index locations can be added

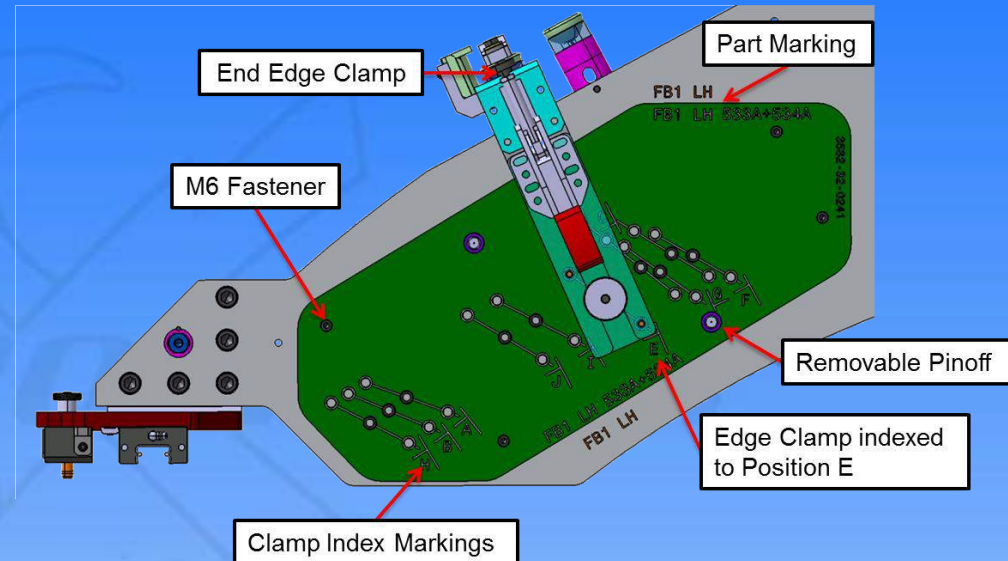
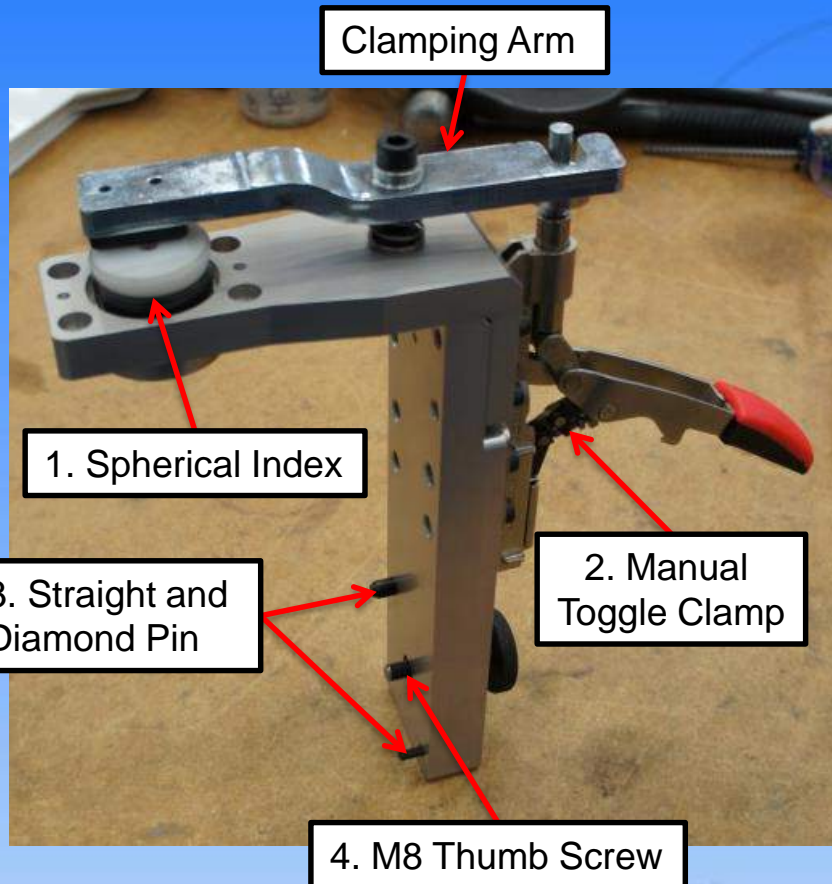
Sliding Index



Sliding Indexes move to contact surface

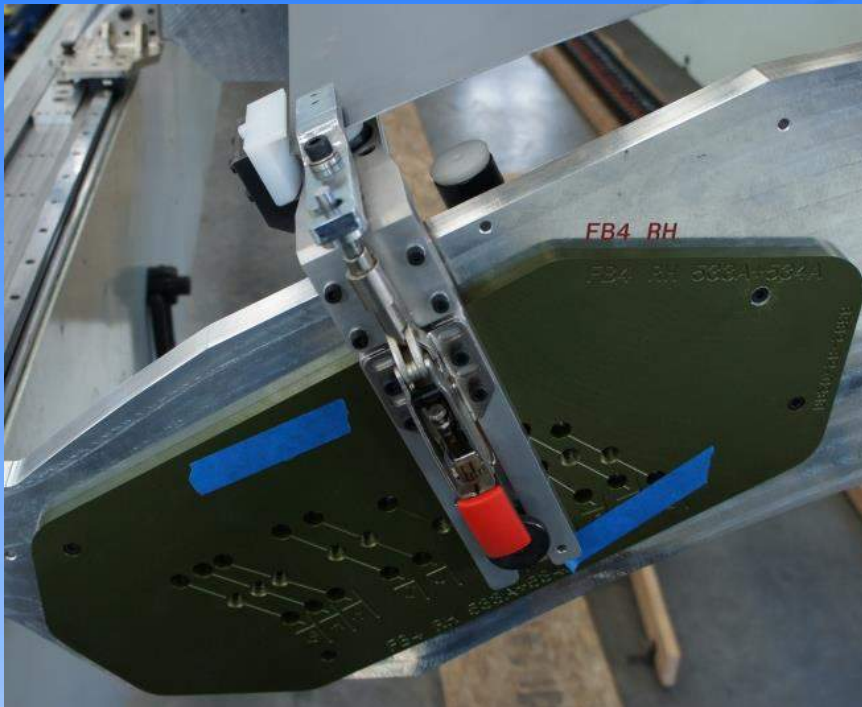
Different index locations for each panel

Edge Index Clamp

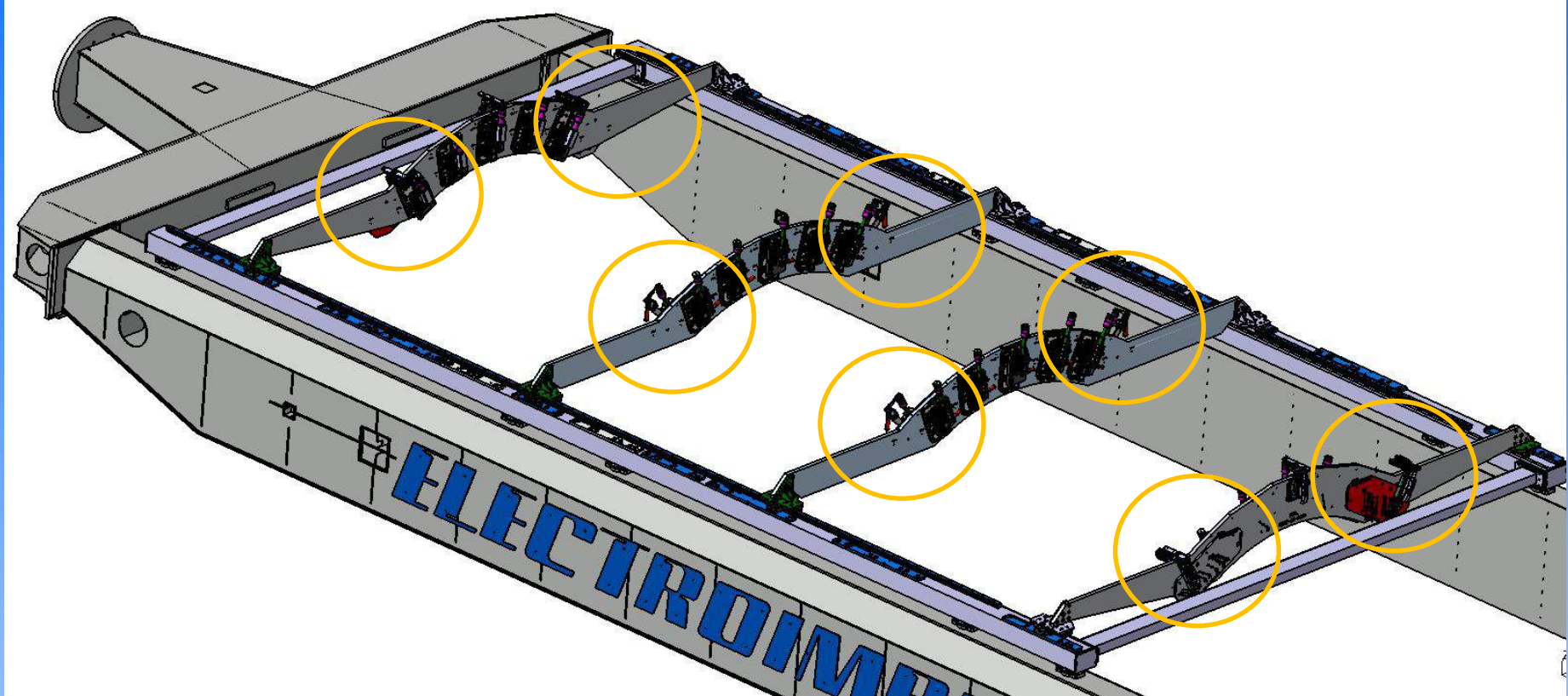


- Clamp shown providing index to edge of panel
- Clamp will locate off of edge clamp index plate (shown above)
- Edge clamp index plates can be re-machined to allow for new panels

Edge Index Clamp

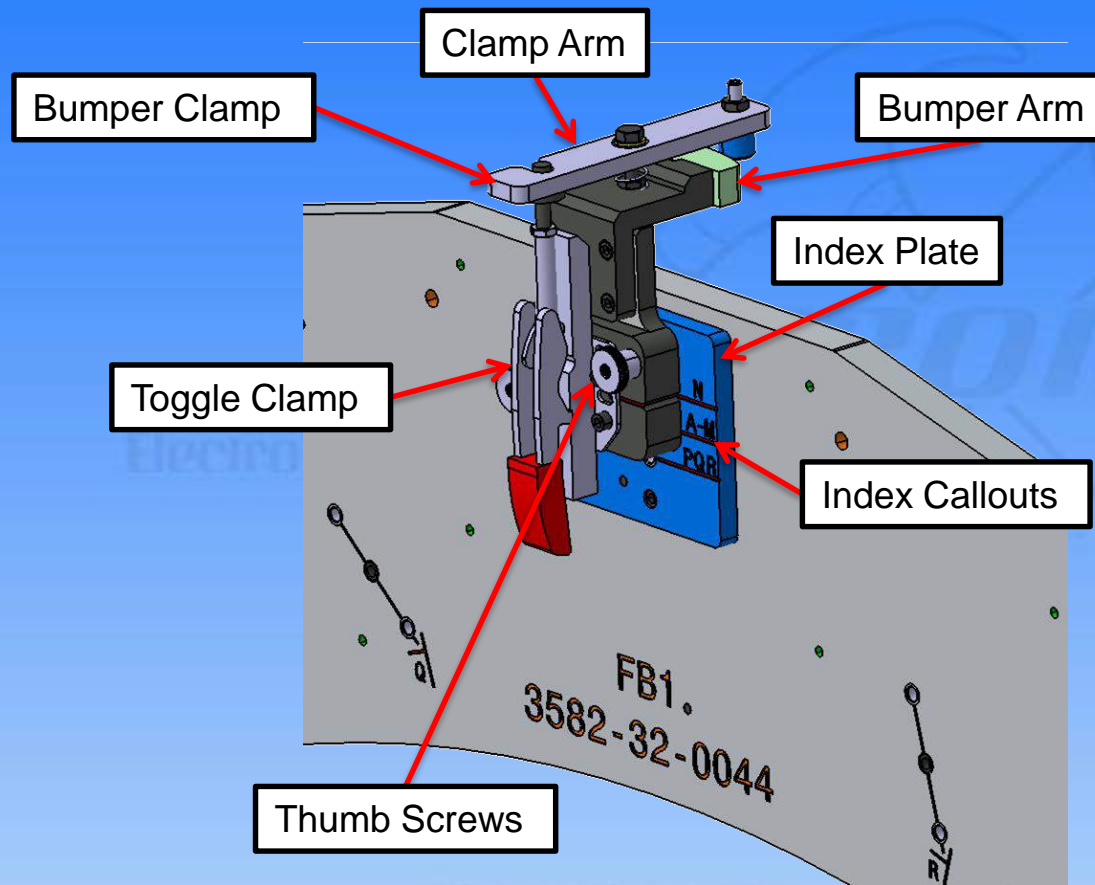


Edge Clamp



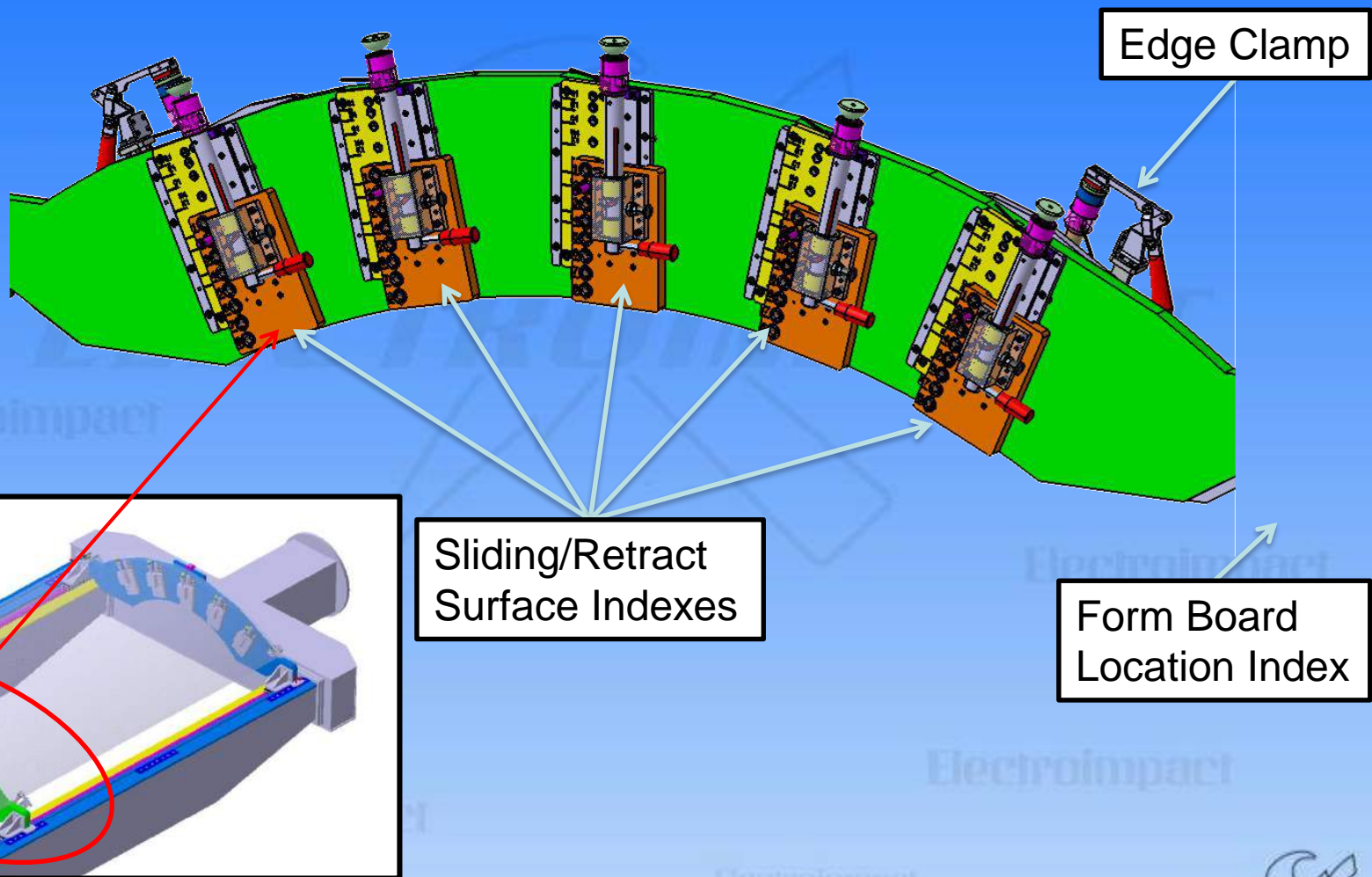
- Similar clamps will be used on all form boards to clamp the edges of the panel
- Total of 8x per panel

FWD Edge Clamp



Clamps can also be replaced with Lug Indexes depending on customer requirements

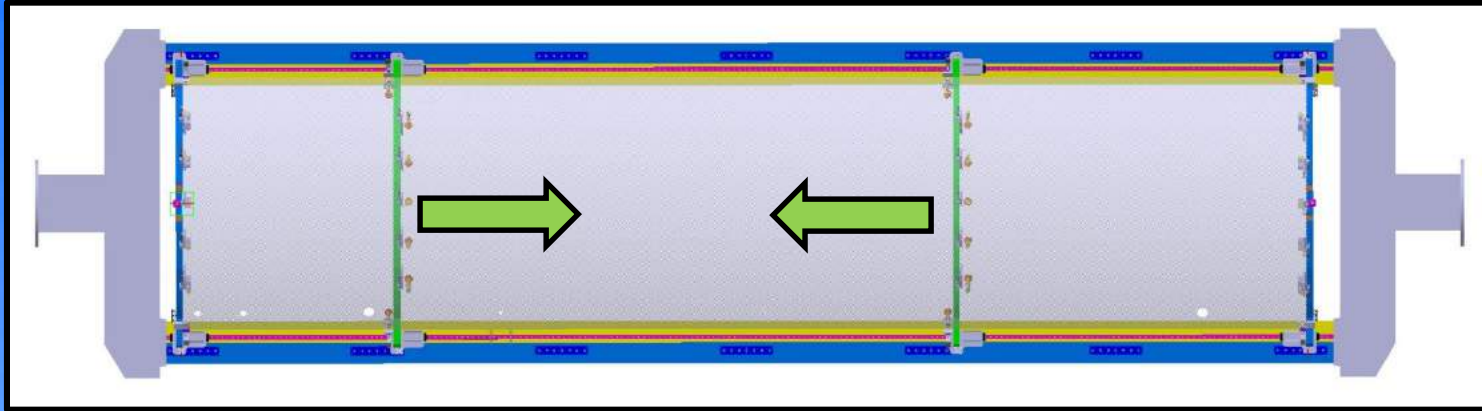
Intermediate Form Board



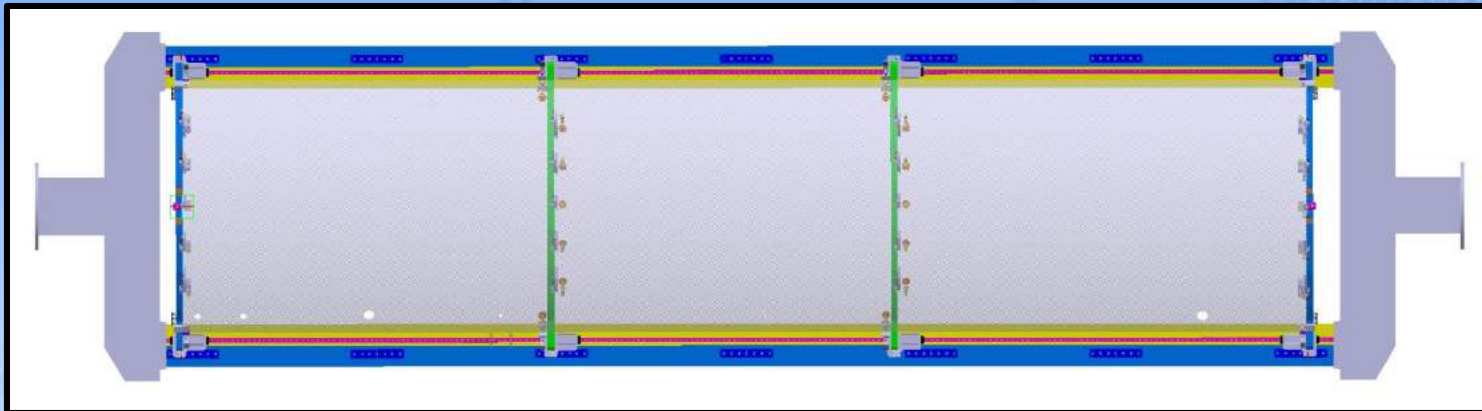
Form Board Overview



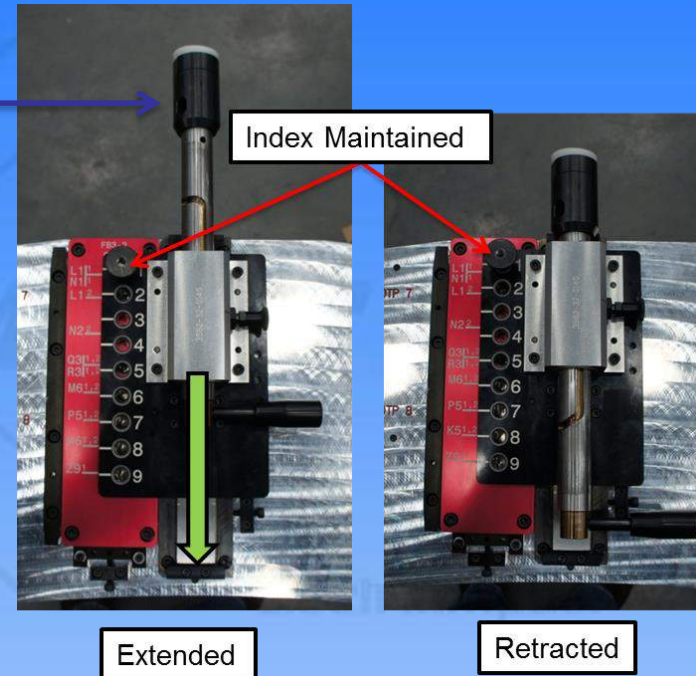
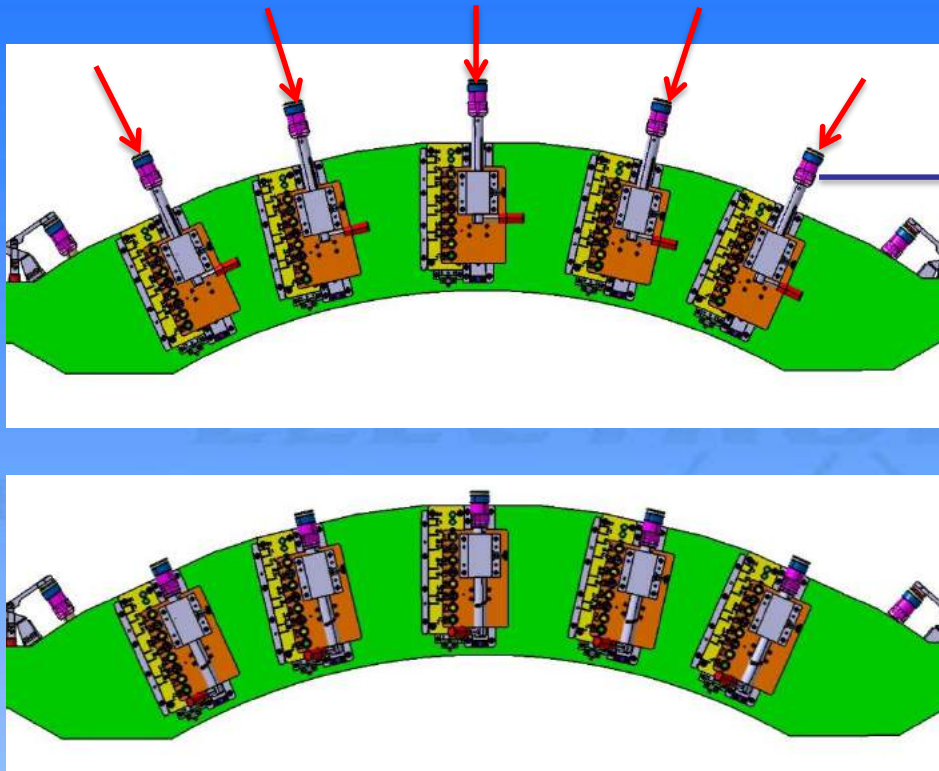
Intermediate Form Boards



Because the intermediate form boards are under the panels, they block hole locations during drilling.
They need to be moved after the first machine pass to allow machine to drill all holes.



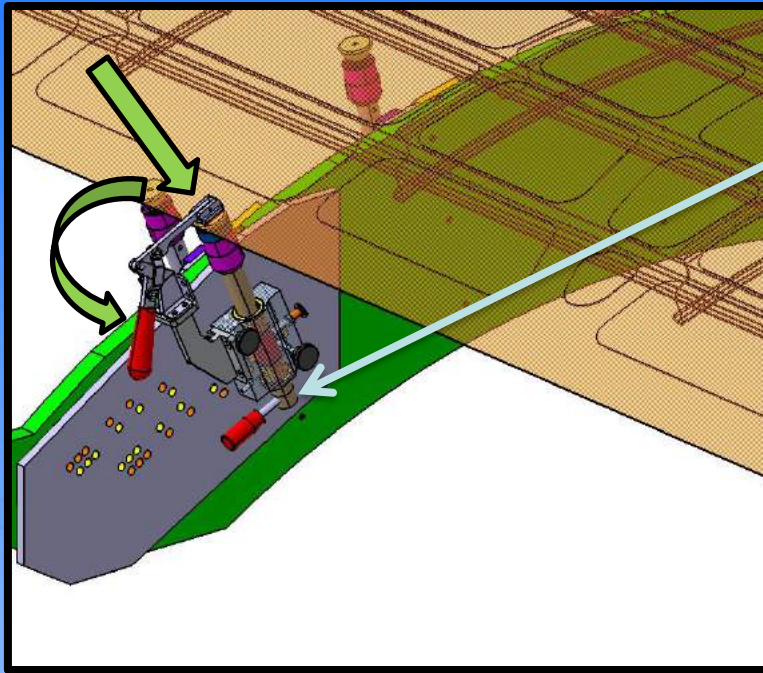
Sliding/Retract Surface Index



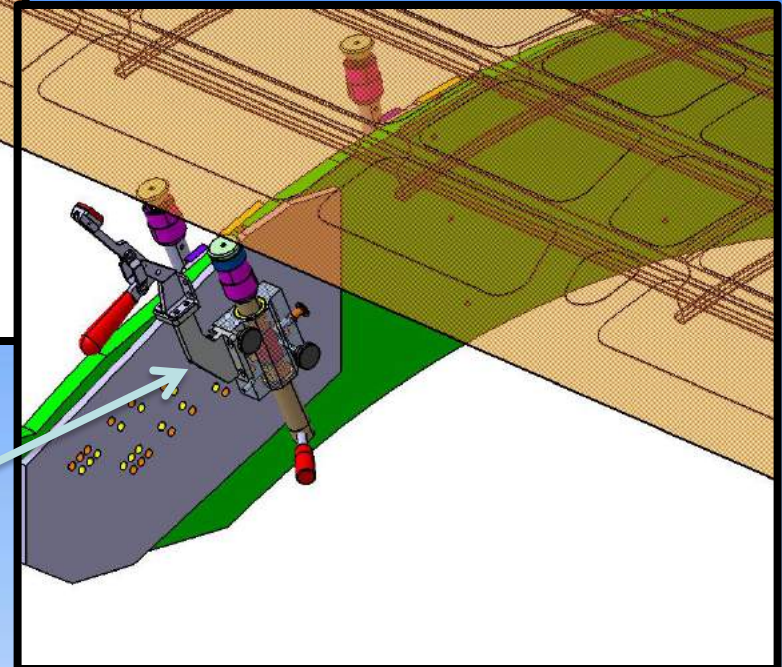
Sphere Index can be retracted 100mm, while the slider plate remains in position.

This allows the Intermediate board to move while under a panel after first machine pass.

Intermediate Edge Clamp



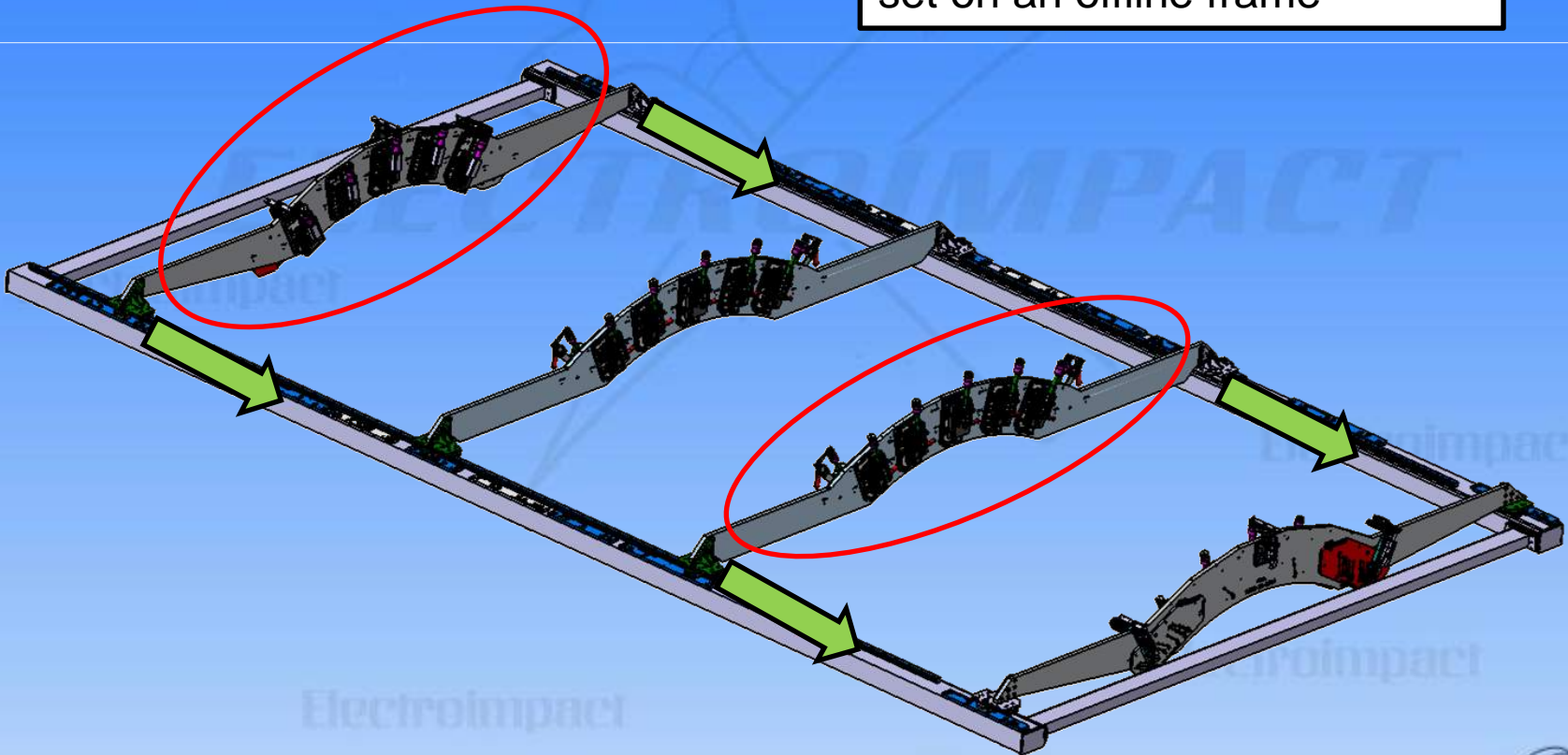
Edge clamps on these boards also have retract feature



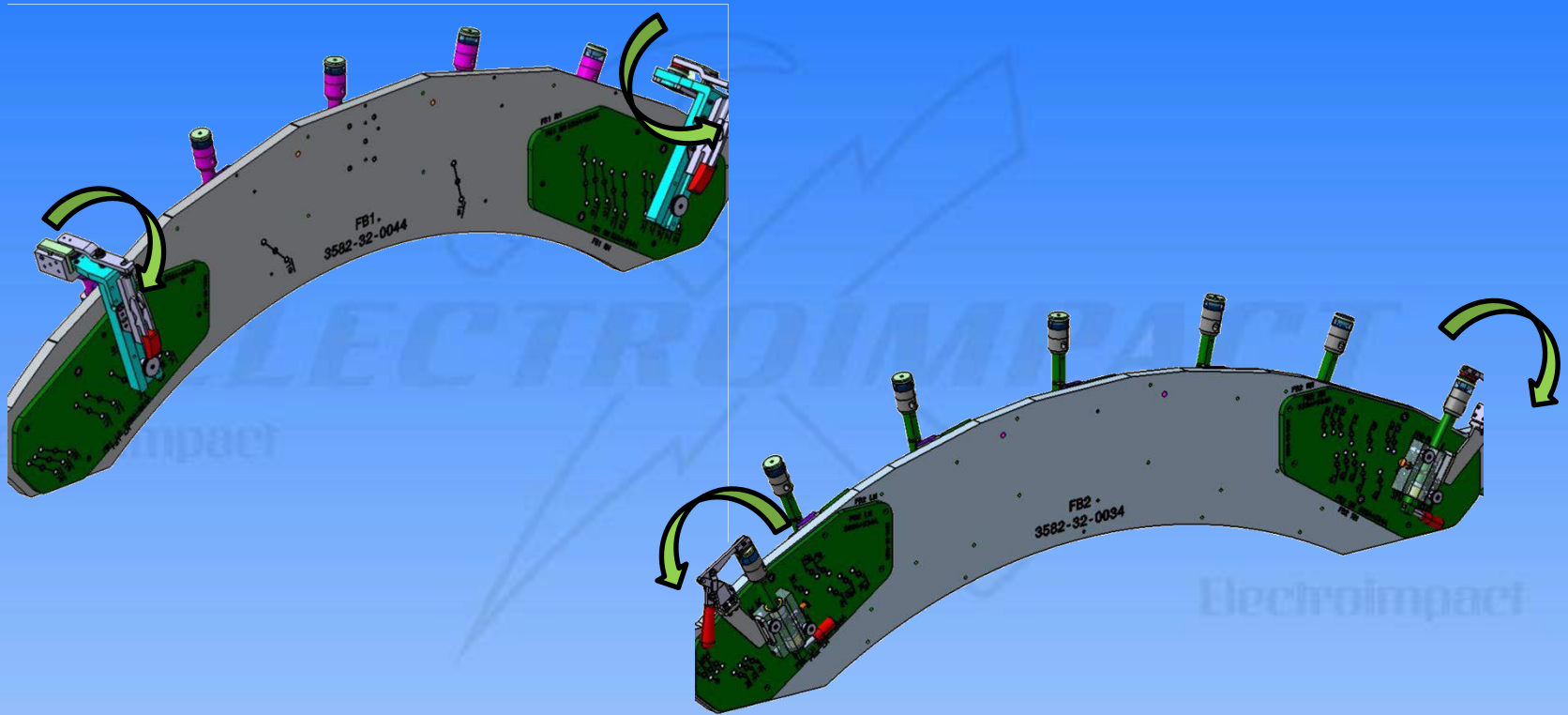
Clamp is now open and retracted, ready for form board to move to next location

Loading Method

Step 1: All index locations are set on an offline frame

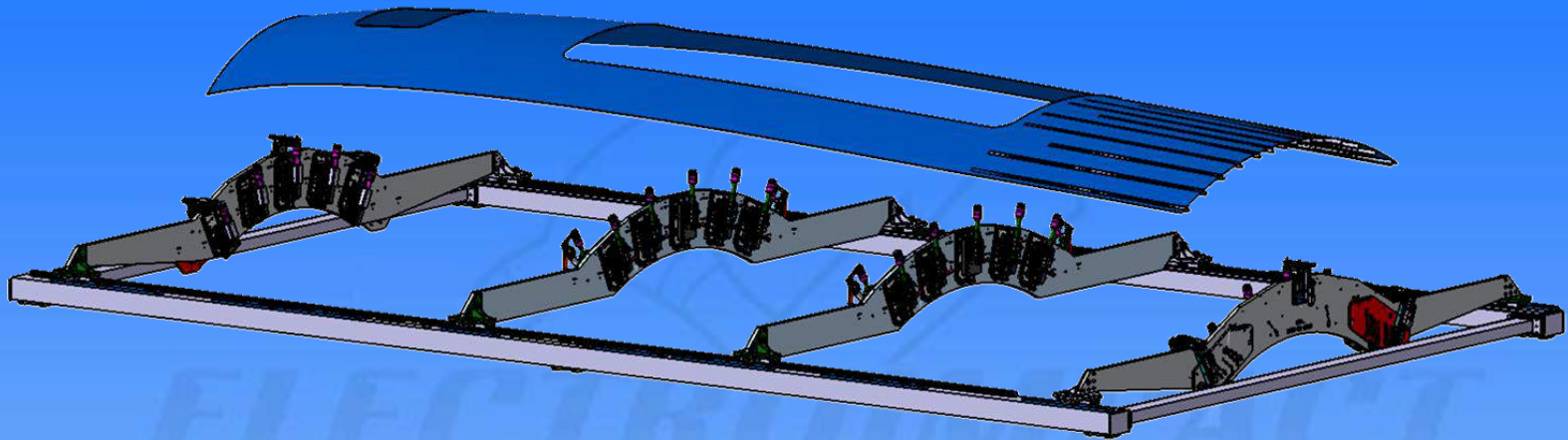


Loading Method



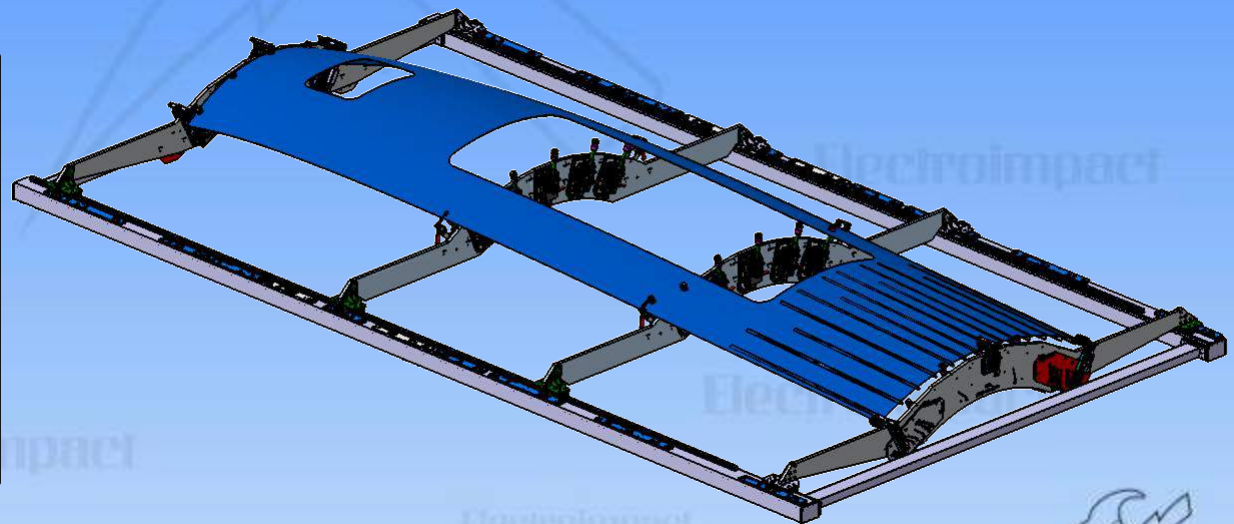
All edge clamps are opened

Part Loading

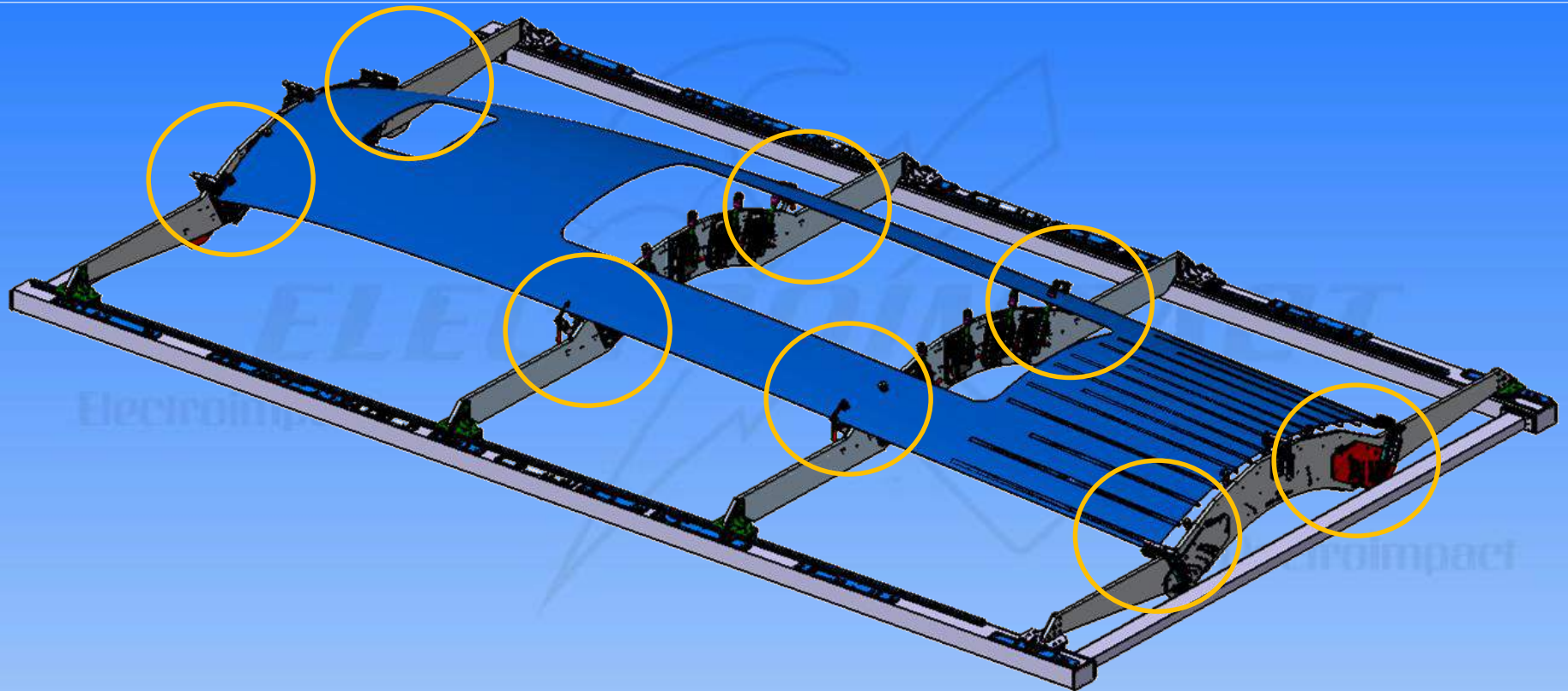


Panel is loaded into the frame VIA crane or by hand.

Lugs or Edge Indexes can be used to locate in the fixture



Edge Clamp



Clamps can now be applied to secure the panel