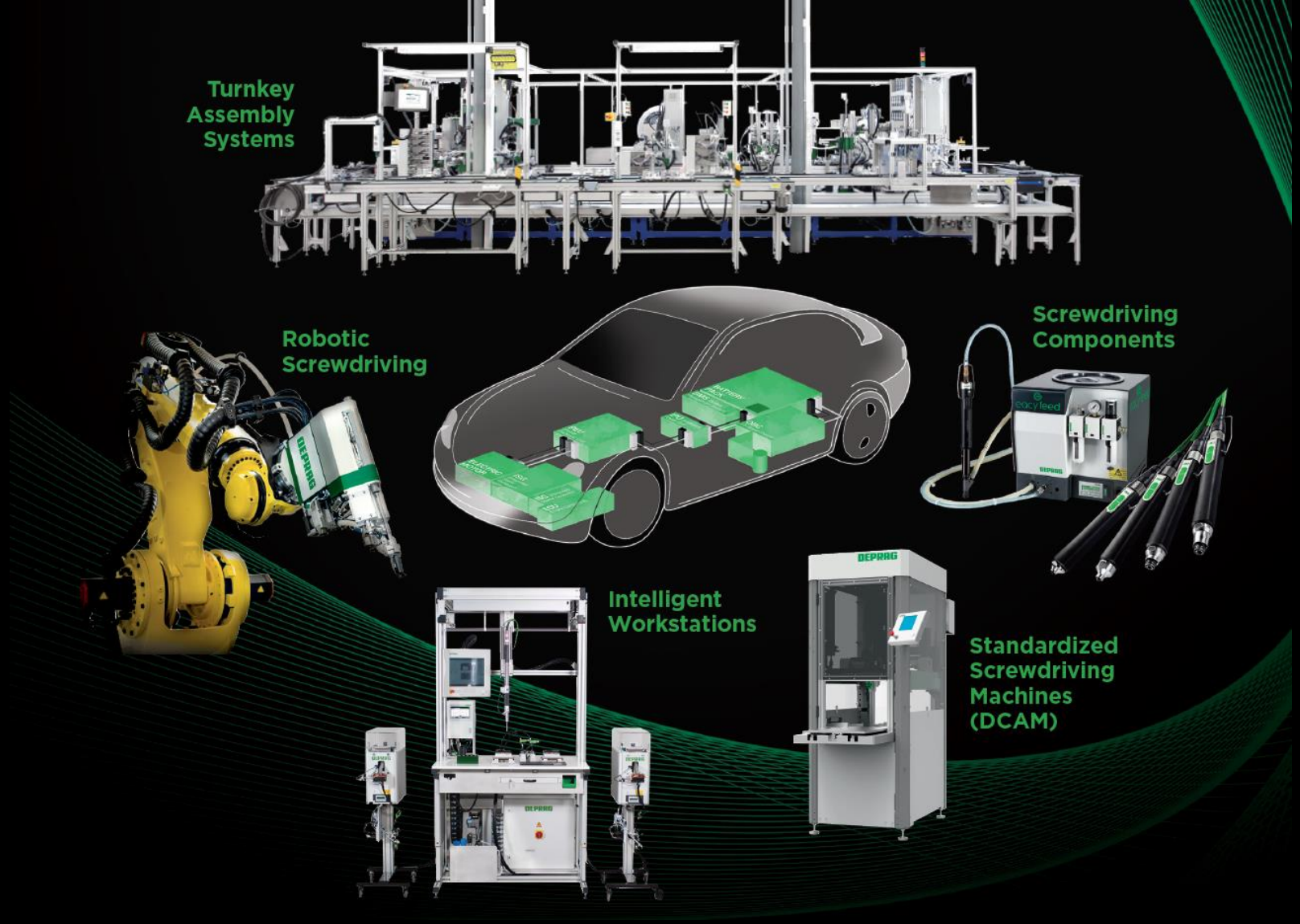

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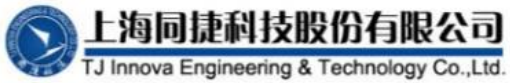
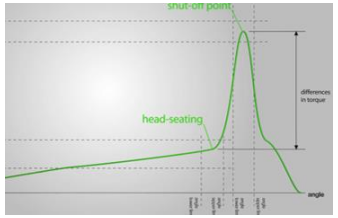


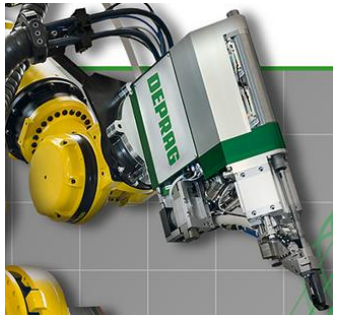
EV Assembly Challenges and Solution

- Self Tapping and Conductive Joints -Clamp Force Control (CFC)



- Assembly Cleanliness - Clean Feed Technology

- Dissimilar Martial Joining – Adaptive DFS



- Flexible Assembly – Tooling X-Changer

- Cross Threading - eSFM

Challenge: Self Tapping and Conductive Joints

Self Tapping or Thread Forming Joints bring unique challenges and Risks to the manufacturing environment.

In today's rapid design environment of EV's they can be found in:

- Control Modules
- Body Structure
- Closures
- Motor and Drive System

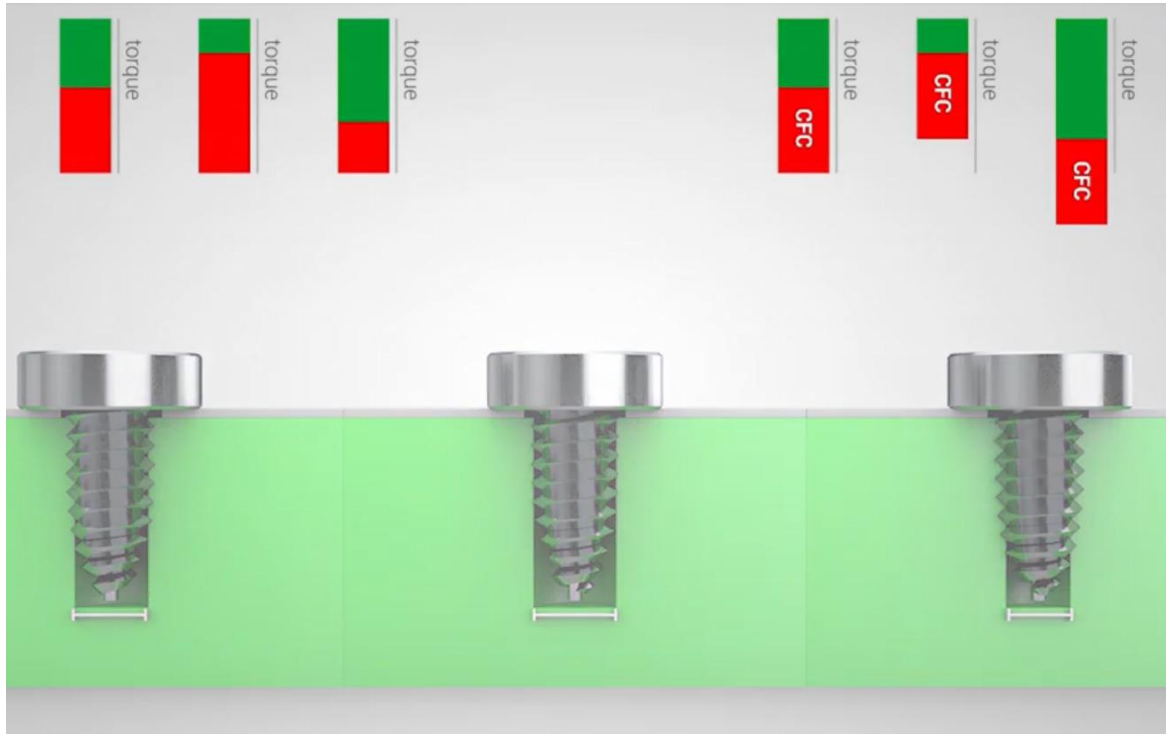
Clamp Force is the basic principle for which a "Screw" was originally design for, created by Rotational Torque/Thread Pitch.

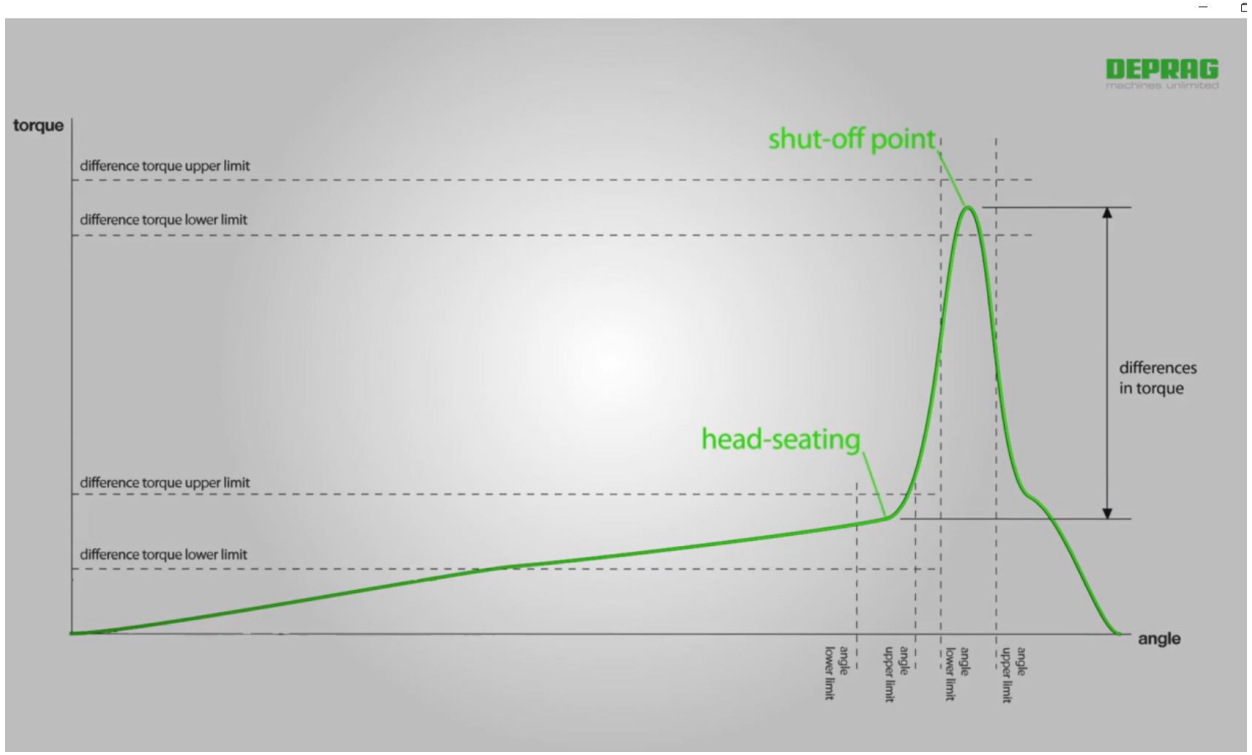
Self Tapping or Thread Forming Fasteners, in particularly in blind holes, fall far short of expectoration on the clamp load they create and can have huge variables in the Clamp Load.

Conductive Joints, for grounding and power leads can have consequential results if Clamp Load is not properly applied.

Solution: Clamp Force Control (CFC)

The Adaptive technology of CFC, actively measures the torque losses generated by the thread-forming or tapping process and adjusts the screwdriving parameters to over come these losses, during the driving process. The result is an accurate and repeatable clamp load on every joint.

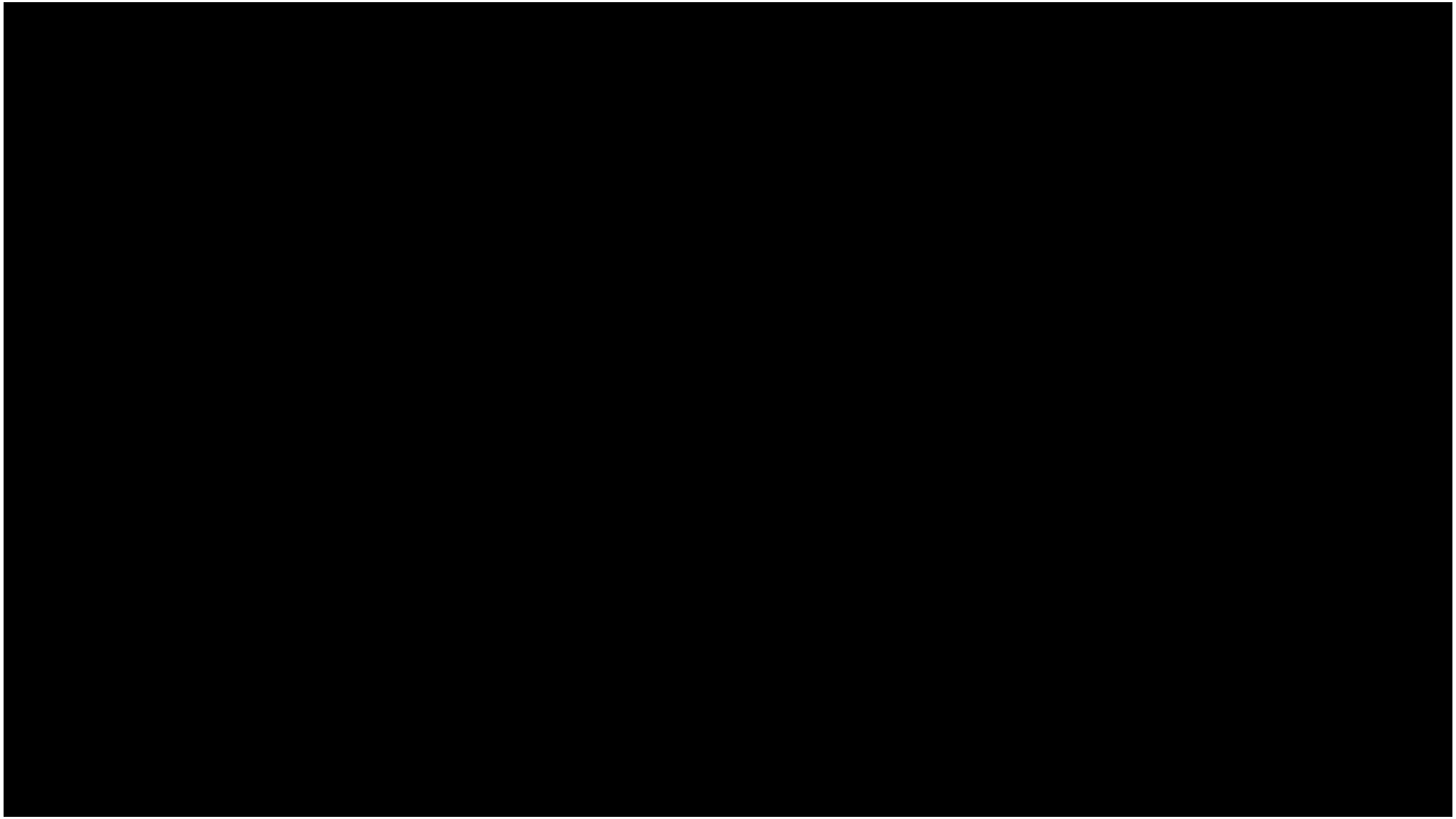




(video)

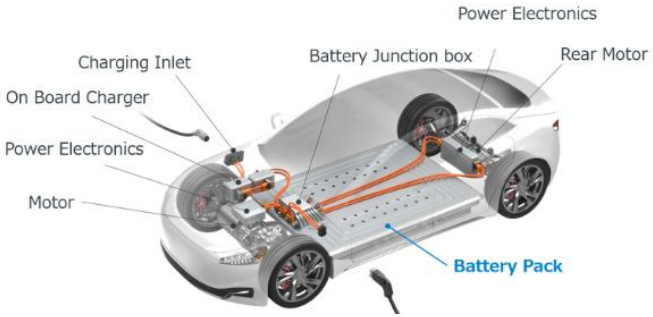
Solution: Clamp Force Control (CFC)

CFC Video

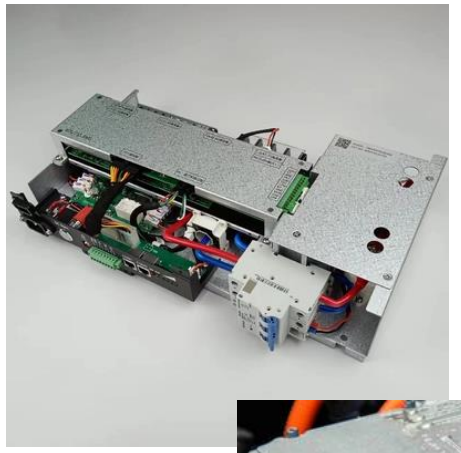


Challenge: Assembly Cleanliness

The quantity of various Electronic Modules in EV's is continuously increasing and are becoming more complex. With this, the need for eliminating particles has become a common requirement from automotive electronics manufacturers.



Muti-board assemblies, joined to each other or to complex enclosures, requires screw installation in very sensitive areas. If not properly approached, this screw installation process has a potential for introducing metallic contaminates, which could cause immediate failure during final testing or expensive in-use failures in the field.



With this, Technical Cleanliness in assembly operations has become a new necessity.

Solution: Clean Feed Technology

Clean Feed is a Concept incorporating various pieces of hardware, design methods, and specially fasteners, all in effort to minimize particles with an assembly.

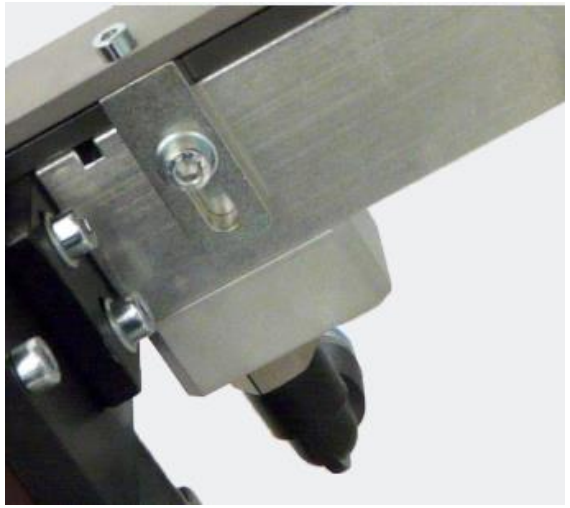
Picture courtesy of Arnold Fastening

- Special Screw cleaning and packaging process to ensure screws are particle free when packaged and do not generate particles during shipping is offered by screw manufacturers.

- Screw Feeding Systems like our Sword Feeder allow for handling of the screws without any vibration or moving a large bulk of screws. This minimizes the generation of particles within the feeder

Solution: Clean Feed Technology

- Vacuum connections at the feed rail will capture and remove particles as the screws leave the screw bin.

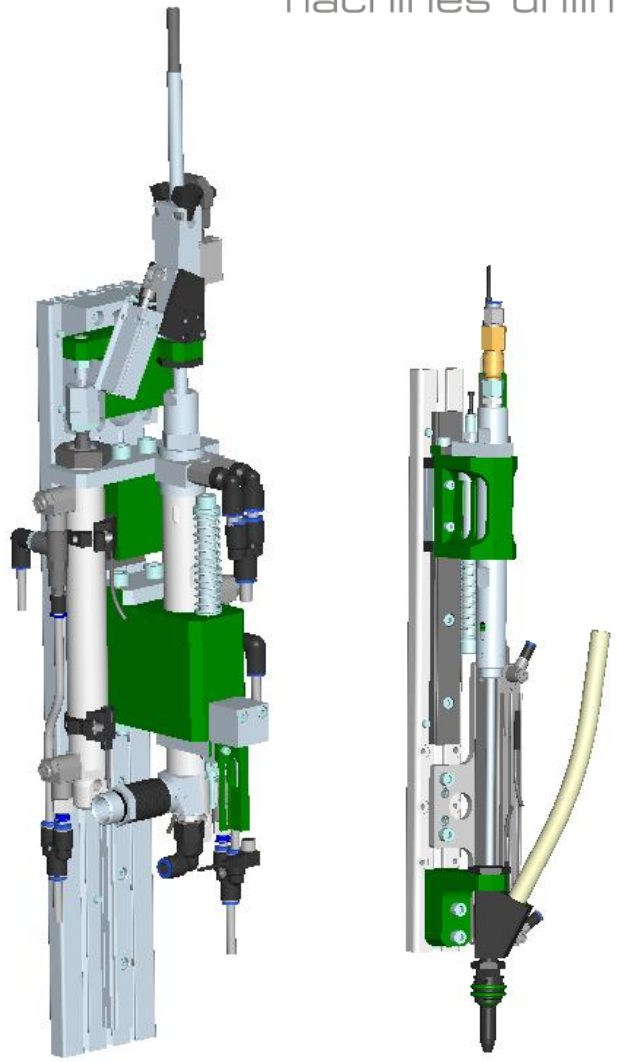


- Particle Killer, which mount in-line on the feed tube, close to the end point, can be used to eliminate particles generated by the screw manufacturing process or screw feeding process.

Solution: Clean Feed Technology

- Under-Floor Screwdriving Function Module (SFM) with blow feeding and vacuum tooling can eliminate particles by driving screws from below, allowing gravity to aid the process of removing particles.

- Light Robotic Ready Screwdriving Function Module (SFM) along with vacuum tooling can be used to capture particles, generated between the bit and screw engagement, during the screw driving process.



Challenge: Dissimilar Martial Joining

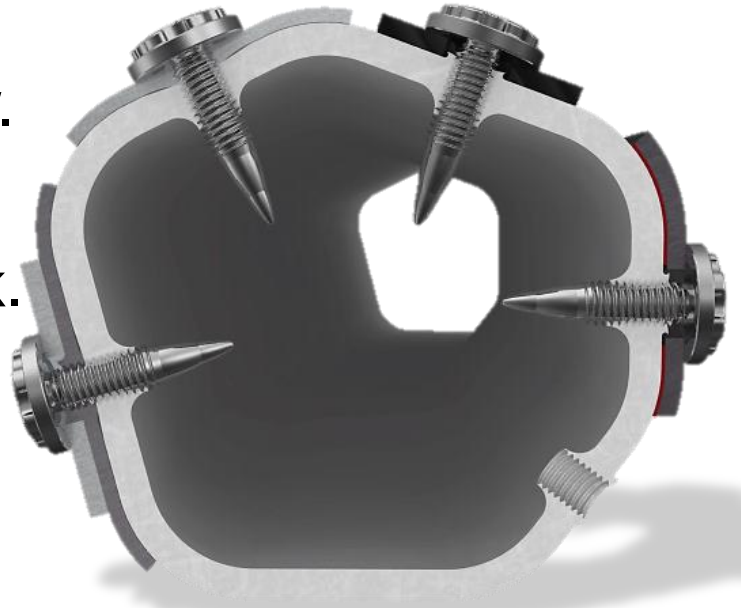
- Traditional Internal Combustion Vehicles (ICV) are traditionally manufactured from steel. This allows for welding majority of the joints.

- Most EV use various types of materials, include some Steel, Magnesium, Aluminum and Composites. This mix of material does not lend itself to the use of traditional joining using welding.

Solution: Flow Fastening Technology– Adaptive DFS

- For joining these dissimilar materials, one of the most common fastening solutions has become a Flow Drill Screw.
- Advantages of Flow Drill Screwdriving (FDS):

- It can join most type of dissimilar material up to ~7mm stack.
- Requires no predrilling holes on most joints.
- Can be used in conjunction with adhesives.
- Can be used on single sided access applications.
- High strength joint, due to extruding material (funnel)



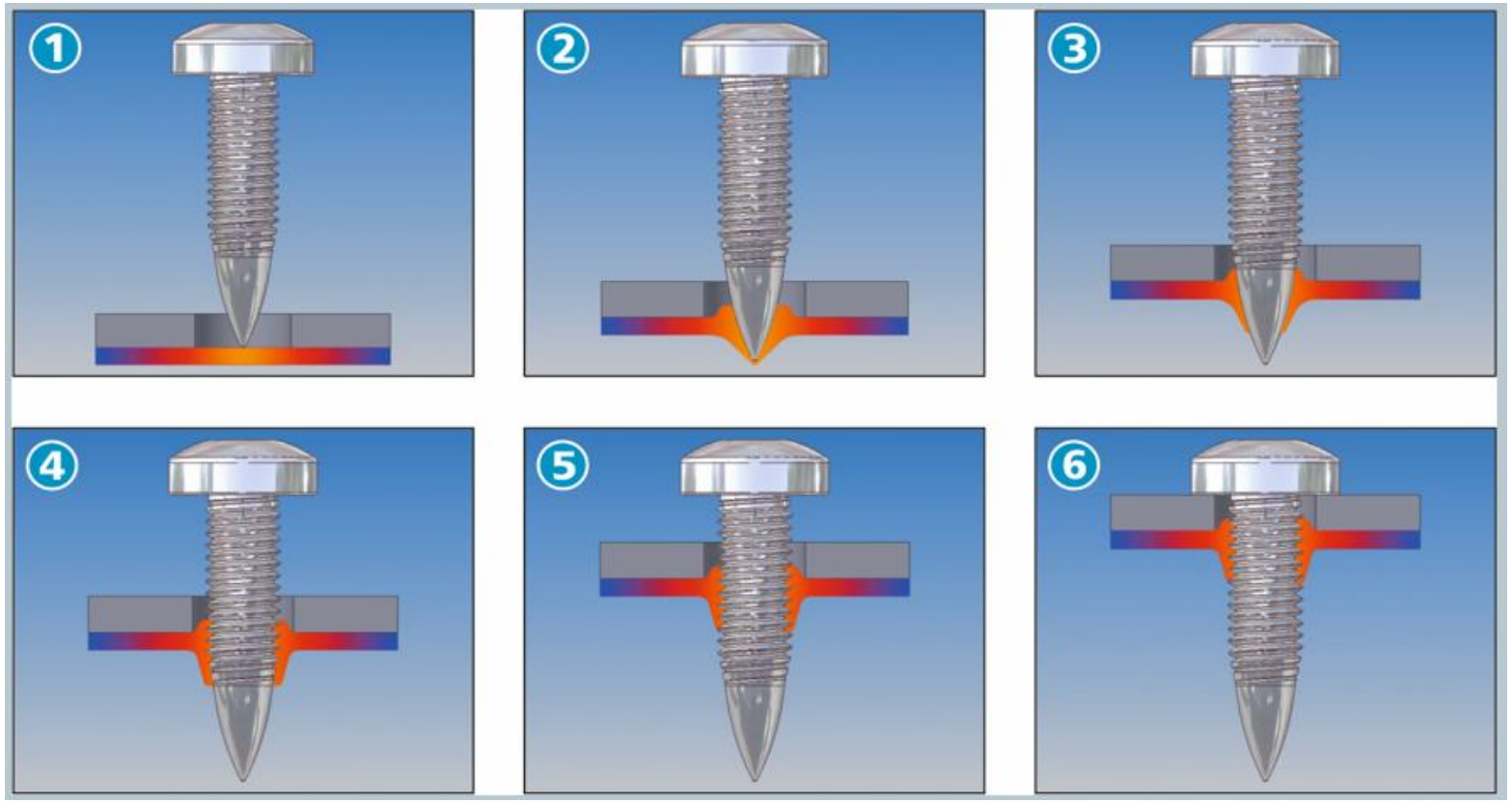
Picture courtesy of Arnold Fastening

Solution: Flow Fastening Technology– Adaptive DFS

Principle of a Flow Fastener: screw tip generates heat on the martial through friction, once the material becomes soft, the screw penetrates, threads rolls and is then driven to final torque.

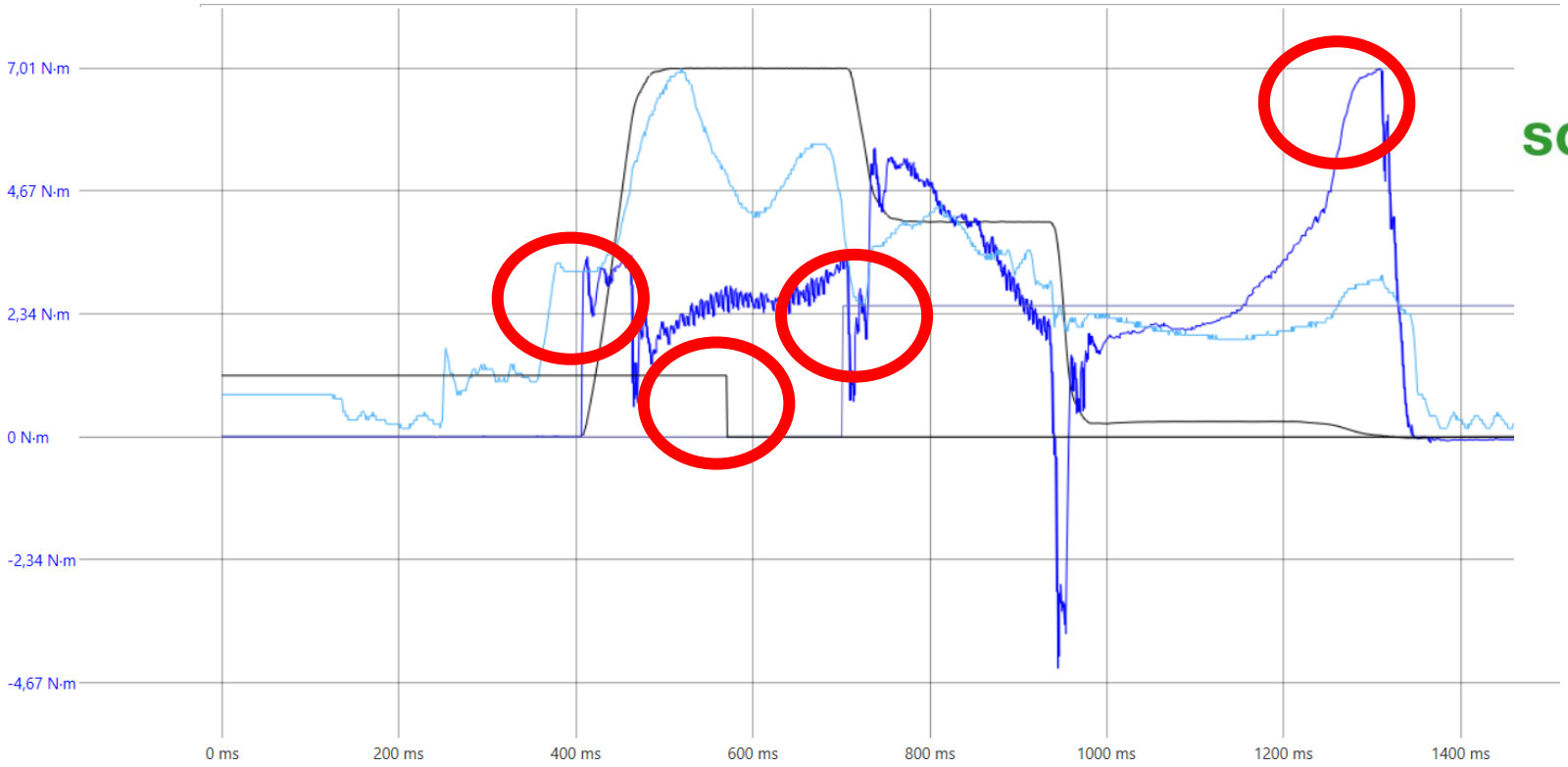
Each cycle includes the following steps:

- Step 1: Heating up
- Step 2: Penetrating
- Step 3: Funnel forming
- Step 4: Thread forming
- Step 5: Screwdriving
- Step 6: Tightening



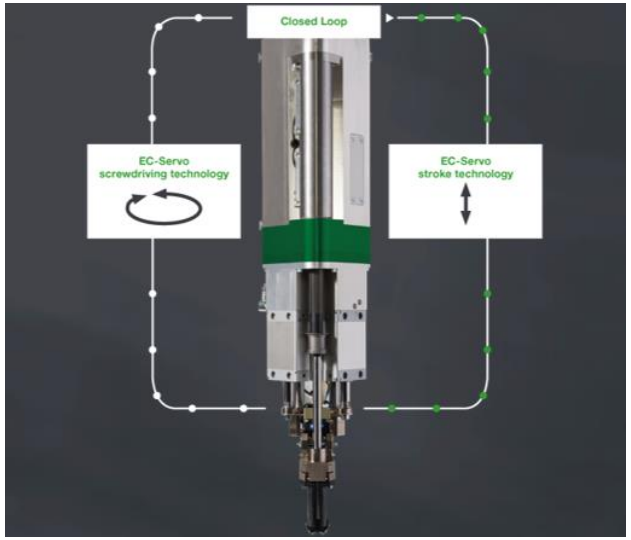
From step 1 to step 6 the parameters such as down force, feed rate and RPM change 5 times.

Solution: Flow Fastening Technology– Adaptive DFS



EC-Servo
screwdriving technology

EC-Servo
stroke technology

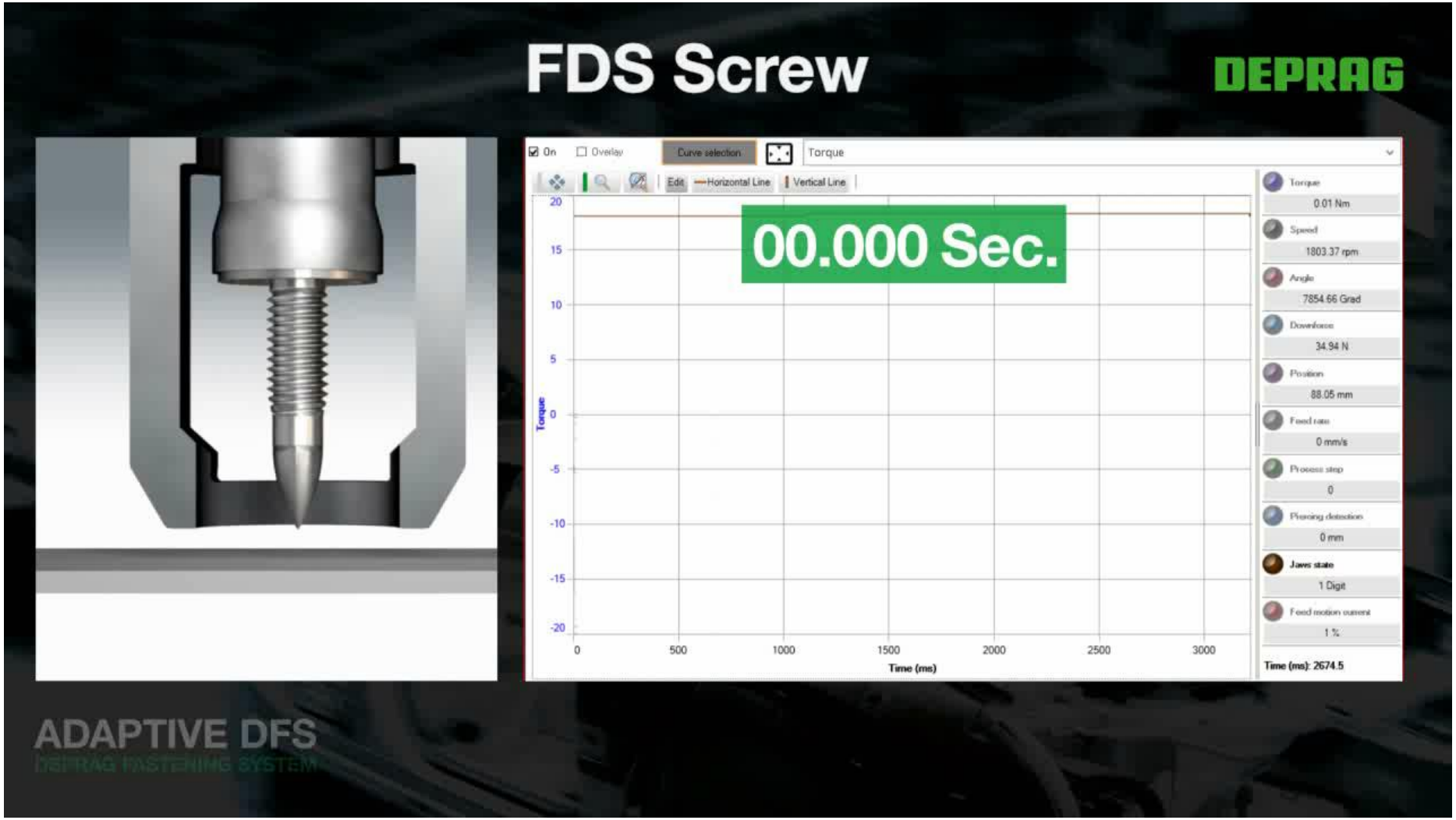


1. Adaptive Acceleration
2. Adaptive Guidance
3. Adaptive Penetration
4. Adaptive Seating Torque via CFC

(video)

Solution: Flow Fastening Technology– Adaptive DFS

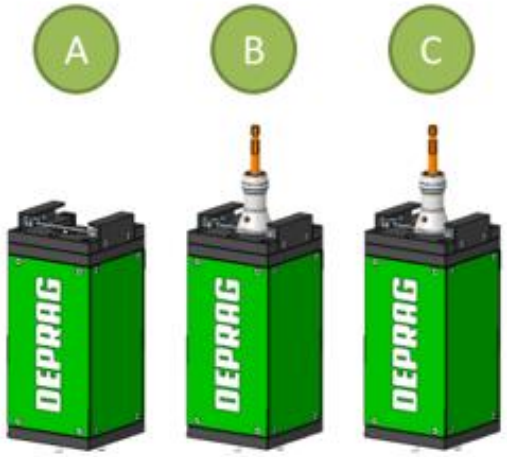
ADFS Video



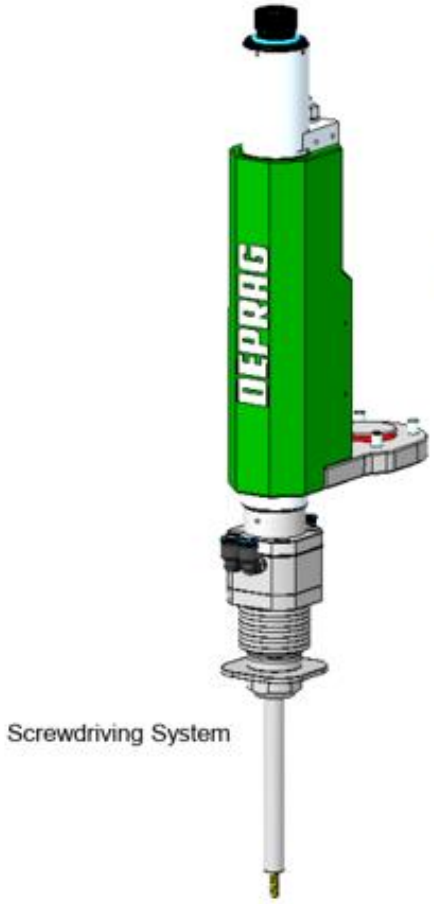
Challenge: Flexible Assembly

- **Application Requirements:**
- Automation
- High mix of fastener type
- Various head types and bit drives
- Various joint requirements, torque, soft & hard joints
- Data collection
- Smaller initial budget
- Low initial volume with expansion capability
- Clean Environment

Solution: Tooling X-Changer



Tool station



Screwdriving System

Picknest

Tool A
Screw: M4x10
Drive: TXP8

Tool B
Screw: M3x8
Drive: TXP6

Tool C
Screw: M5x25
Drive: PZD

(video)

Solution: Tooling X-Changer

Tooling X-Change Video

Challenge: Cross Threading into Aluminum

- **Application Description:**

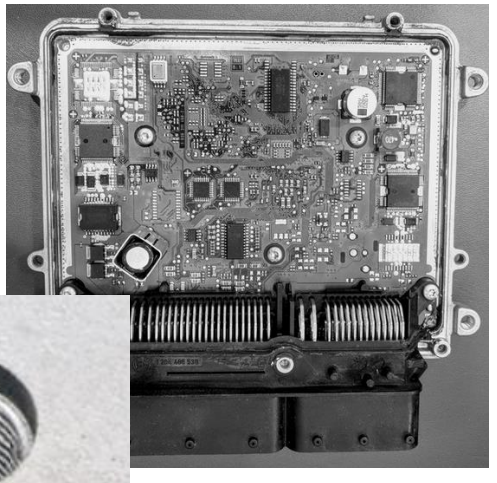
- Small shank screw size, <M4, commonly found in Electronic Control modules

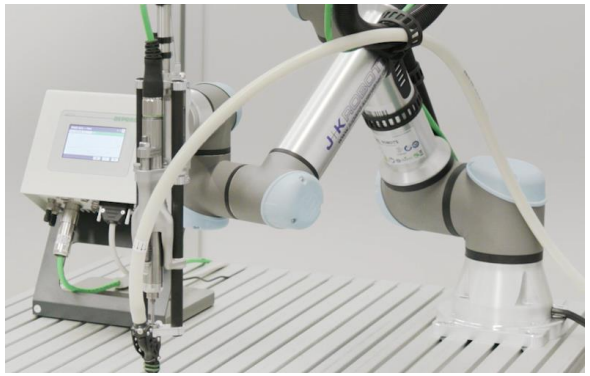
- Steel or Stainless-Steel Machine Screw

- Aluminum Part with pre-machined threaded hole

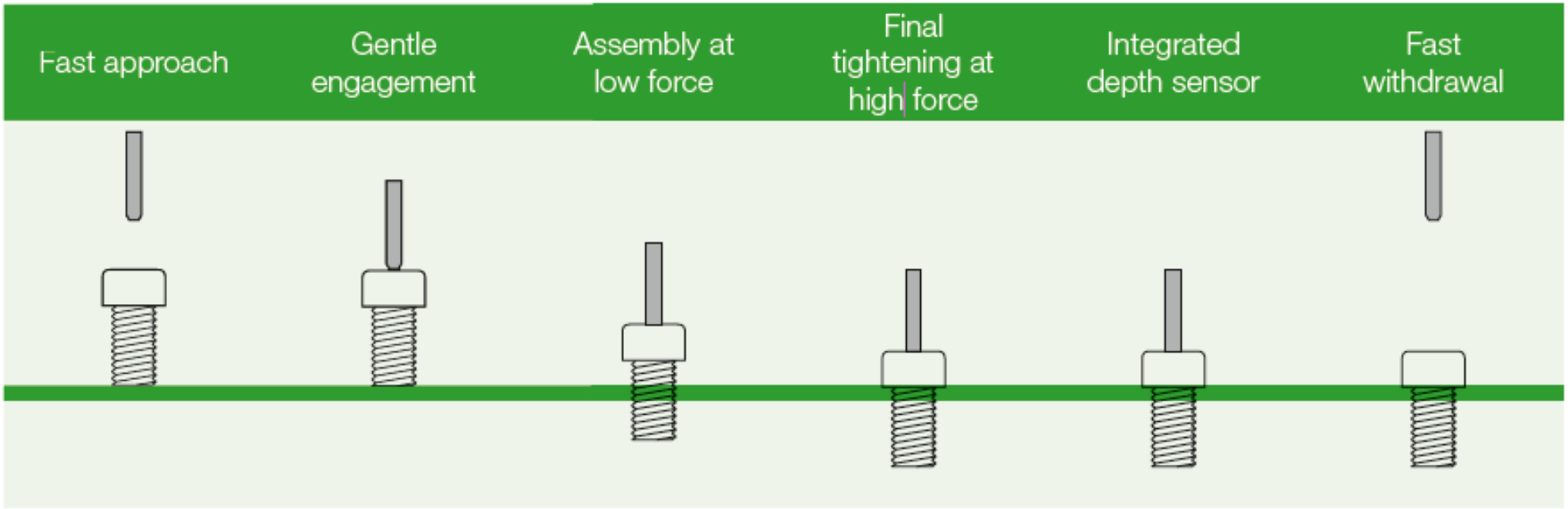
- High speed cycle time

- Robotic application with multiple positions.



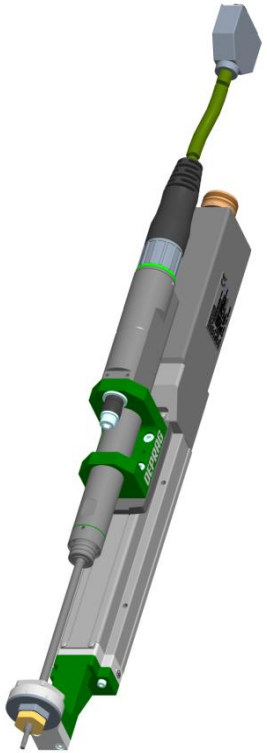


Solution: eSFM with Force and Speed control

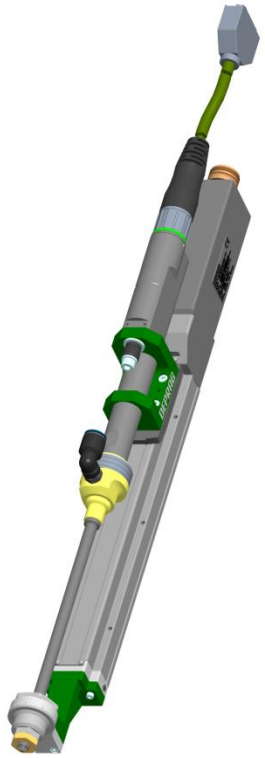


Solution: eSFM with Force and Speed control

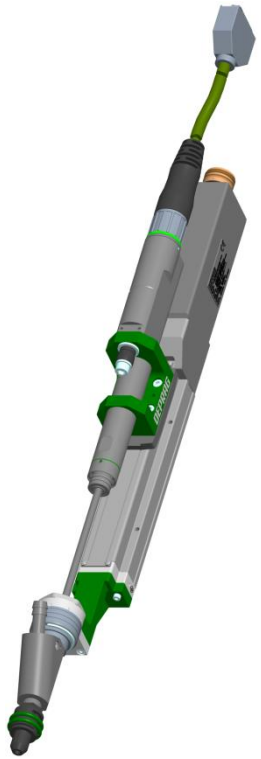
- E-SFM without feeding



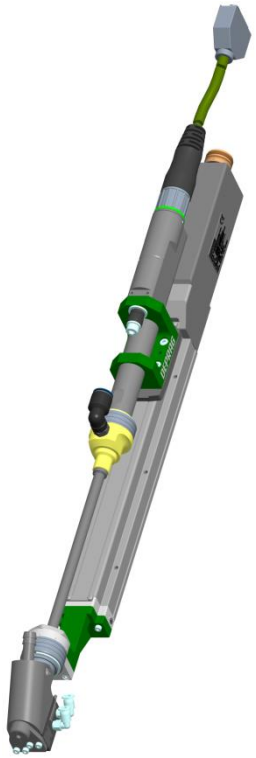
- E-SFM pick & place



- E-SFM with Blow Feeding



- E-SFM with Blow fFeeding & Vacuum



- Fully electric stroke
- Programable Force
- Programable Feed rate
- Programable position

THANK YOU!