

GREAT DESIGNS IN **STEEL**

Development and Benefits of Mechanically Attached Fasteners for Press Hardened Steel

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Introduction to PROFIL

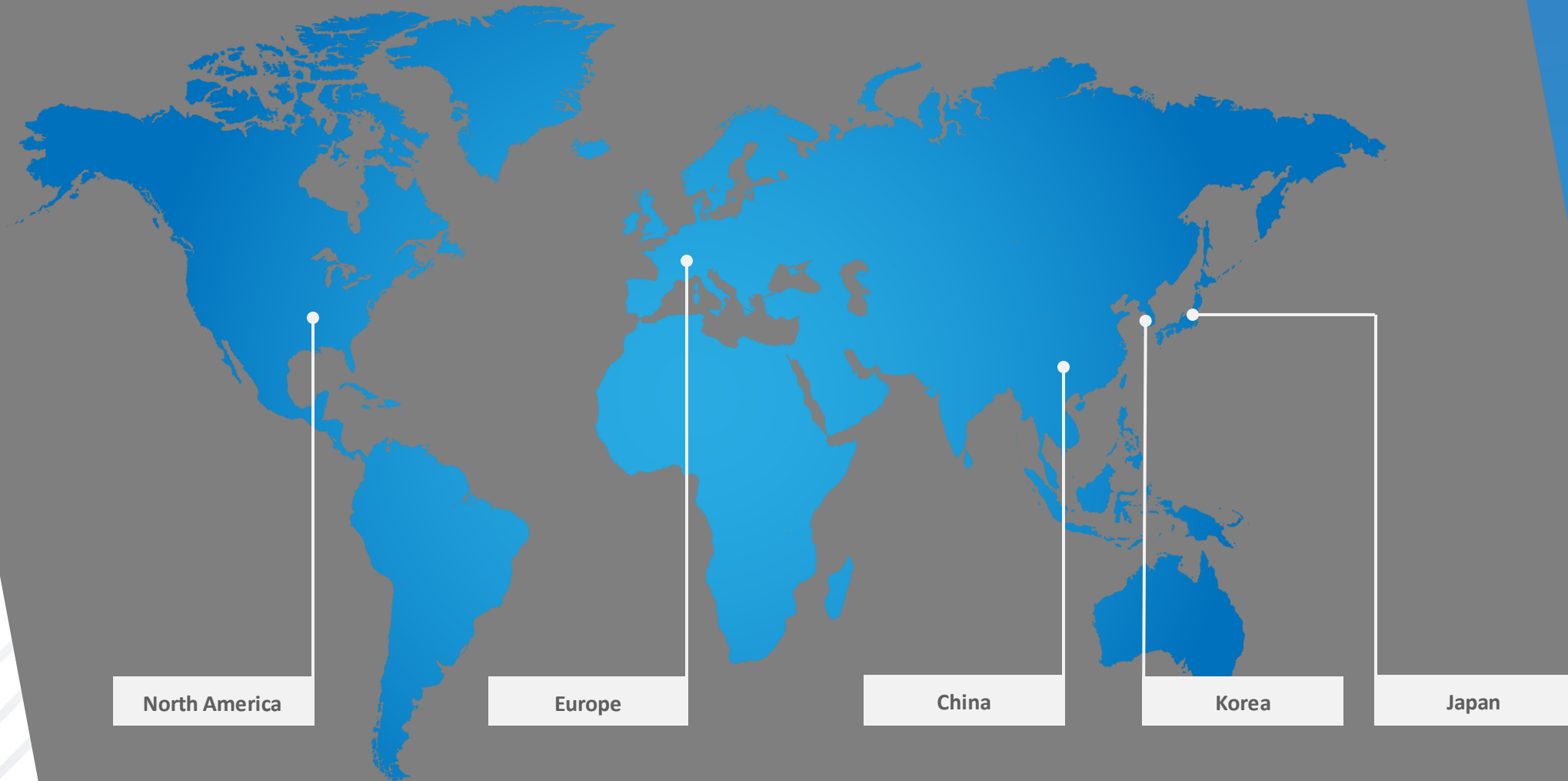
PROFIL is a global developer and manufacturer of automotive Mechanically Attached Fasteners (MAF). MAF are fasteners that are attached using rivet or clinching joint technology. MAF are advantageous over weld fasteners in several fundamental ways.

- Installed in-die rather than off-line, no secondary operation
- No material limitations, Al through 2000 MPa steel
- No Heat Affected Zone (HAZ), consistency of joint
- Mechanically sealed joints, no additives, IP67 compliant

PROFIL fasteners are widely used throughout body and battery tray applications.

Introduction to PROFIL

GDIS



North America

Europe

China

Korea

Japan

1.8 Billion fasteners installed globally in 2023

Purpose and Objective

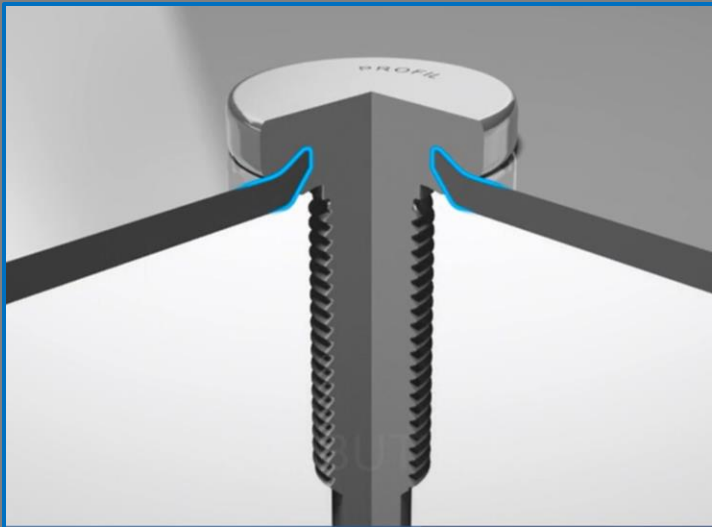
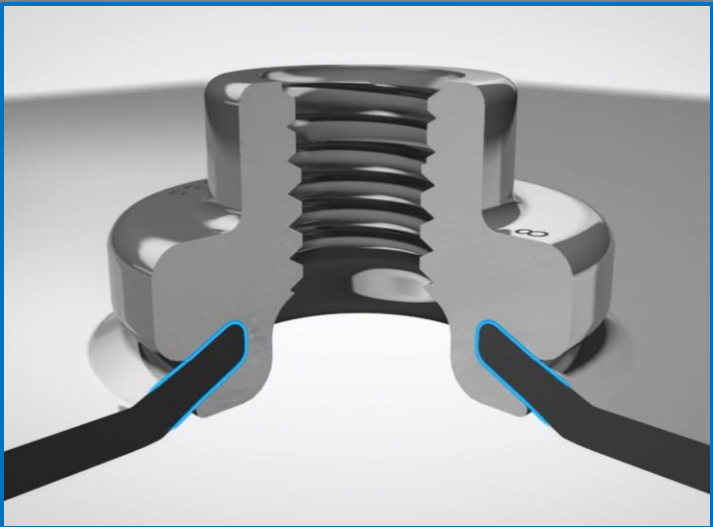
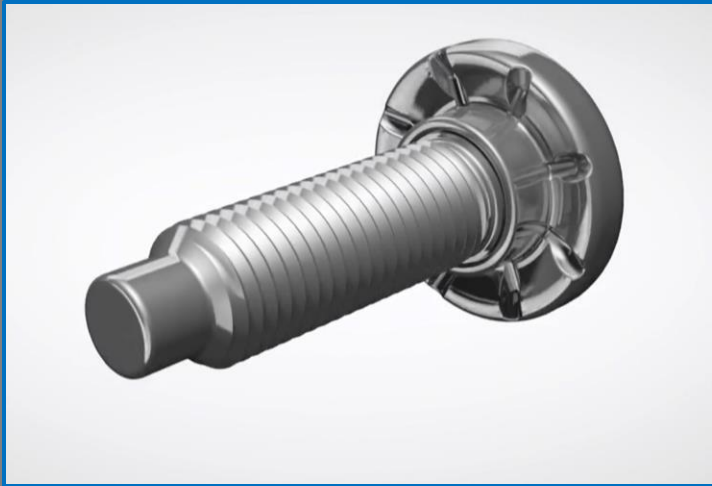
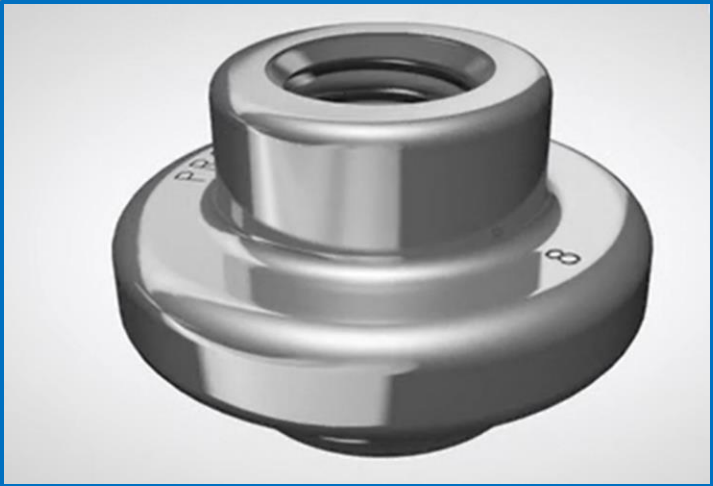
Purpose:

1. Realize a nut and stud solution to be used in PHS, +1500 MPa, without post-quench piercing, eliminating microfracturing.
2. Realize a nut and stud solution that have no HAZ, no effect on the panel metallurgical properties.

Objective:

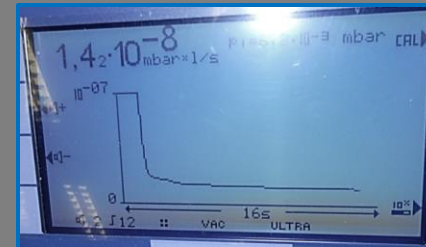
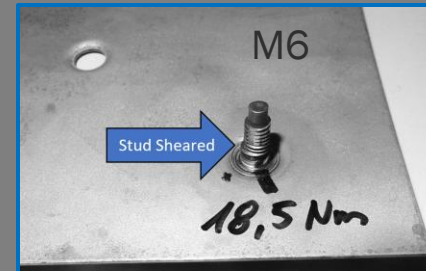
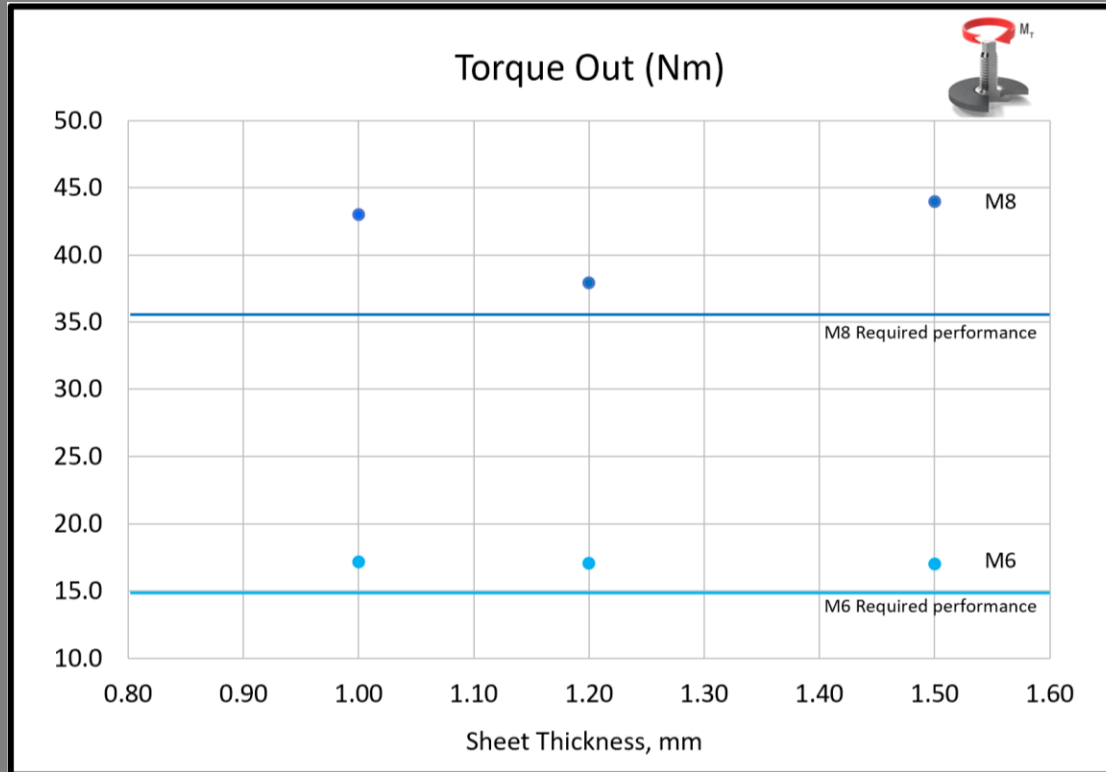
Provide an absolutely reliable joint and a cost efficient process of installation.

Elements

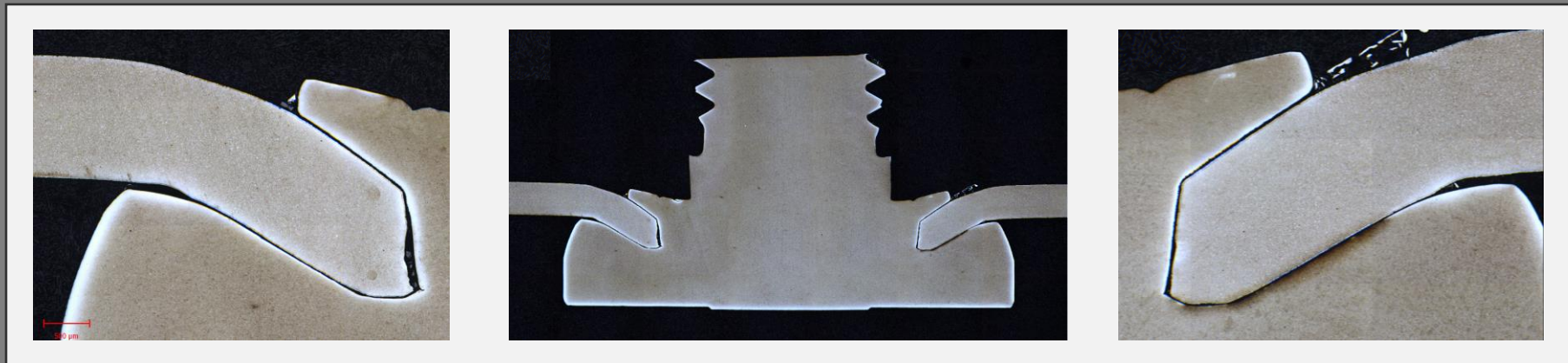




Performance

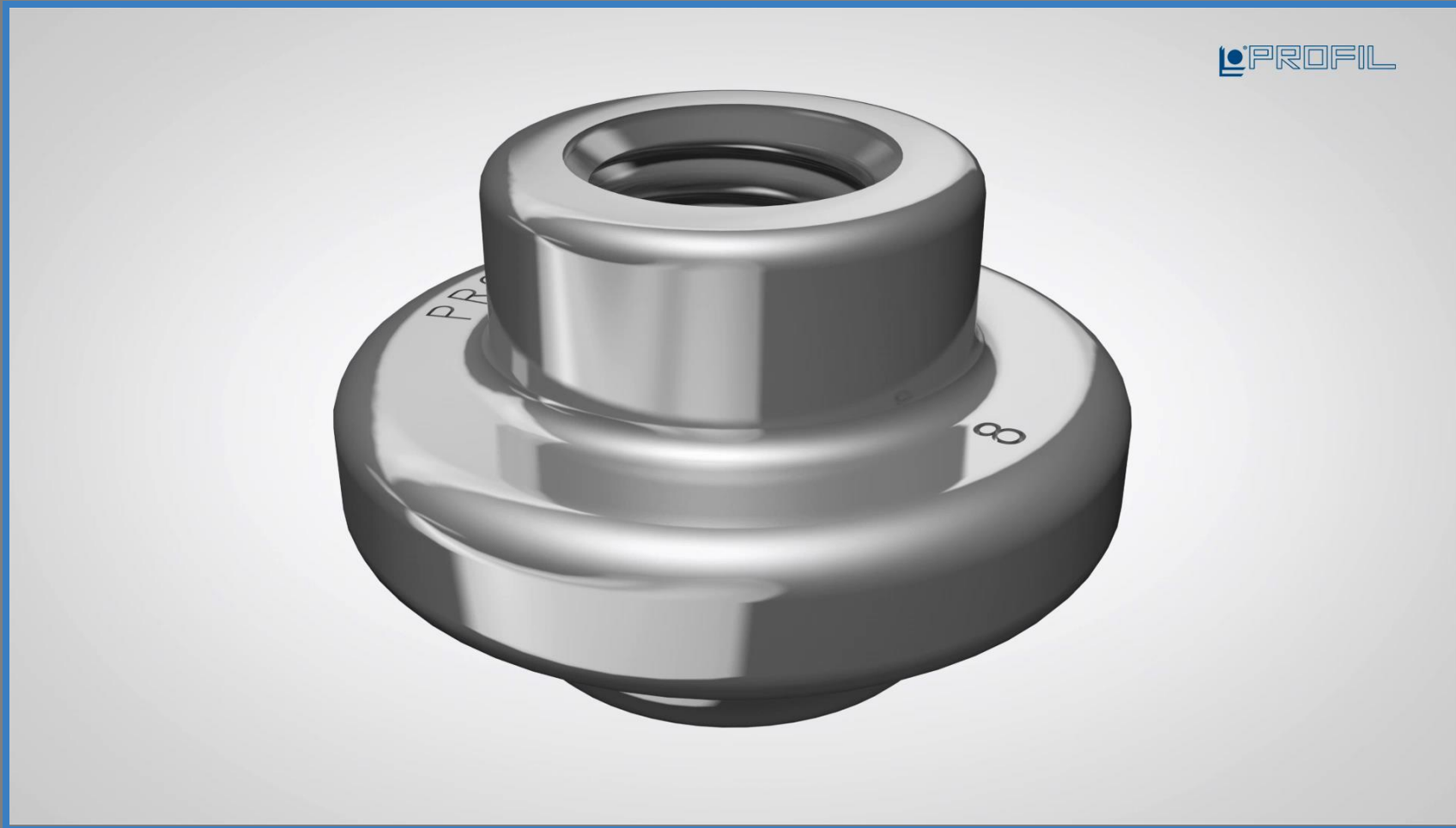


- Sheet Material: 22MnB5 (1500 MPa)
- Property Class: 8.8
- Post quenching installations

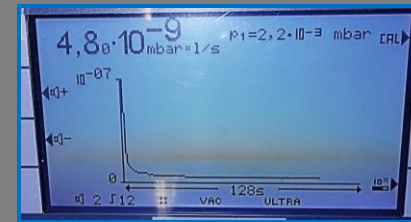
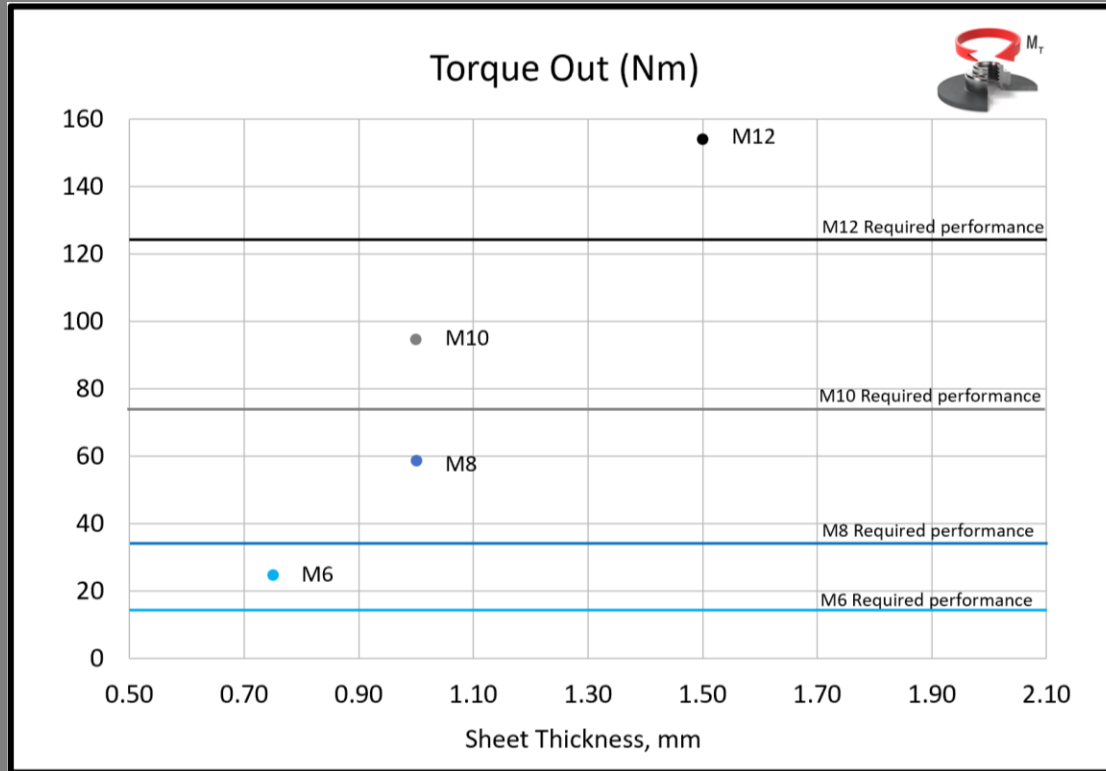


Performance

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Performance



- Sheet Material: 22MnB5 (1500 MPa)
- Property Class: 10
- Post quenching installations

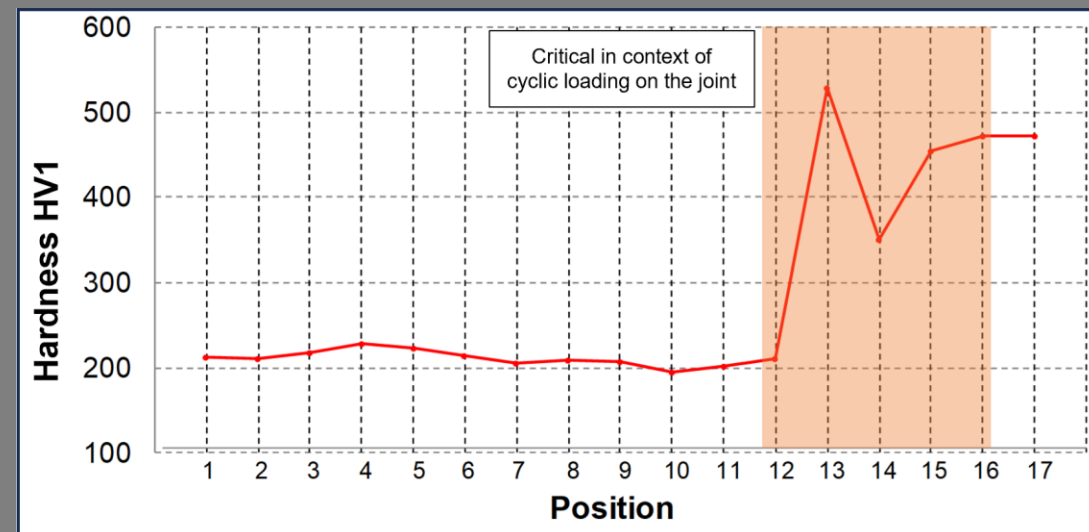
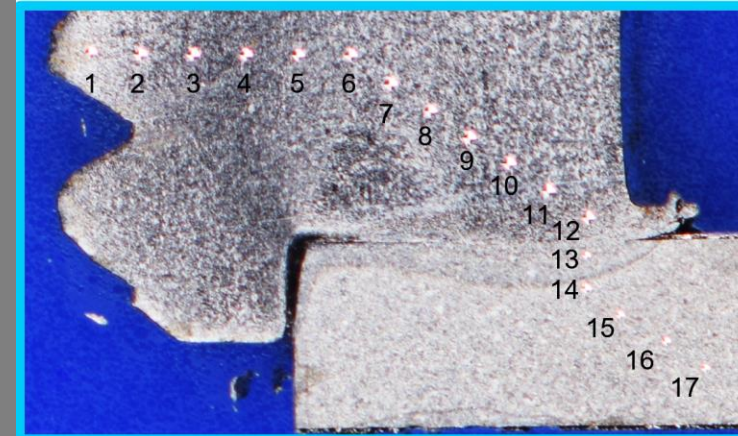
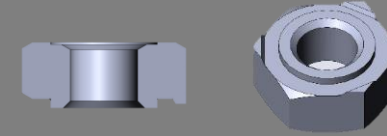
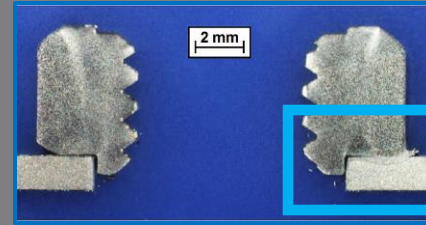


Product Development

- HAZ is not good
- Mechanically Attached Fasteners using rivet joining cause no HAZ and no microfracture
- Premium reliable joint is achieved

Parameter	Value / Description
Joining Method	Resistance Welding
System	Capacitor Discharge
Electrode Force	6 kN
Energy Charging	8 V
Welding Current	34 kA
Welding Time / Energy	4.7 ms / 1300 Ws
Fastener	Projection Weld Nut
Panel Material	22MnB5 +AS150
Panel Thickness	1.5 mm

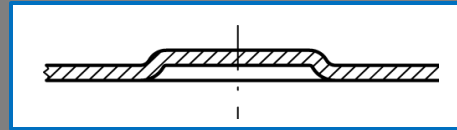
HAZ of Projection Weld Nut



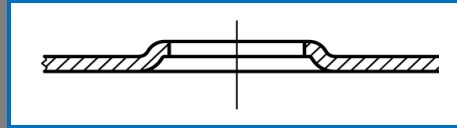
Panel Preparation

Laser Cutting HAZ

- HAZ from laser cut hole, $\approx 0.2\text{mm}$ to 0.3 mm
- Hardness is reduced due to cutting
- Laser cutting HAZ is used as an engineered benefit to maximize engagement of anti-rotational-features



1 - Emboss at forming

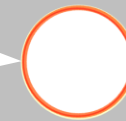


2 - Hole made at laser cutting



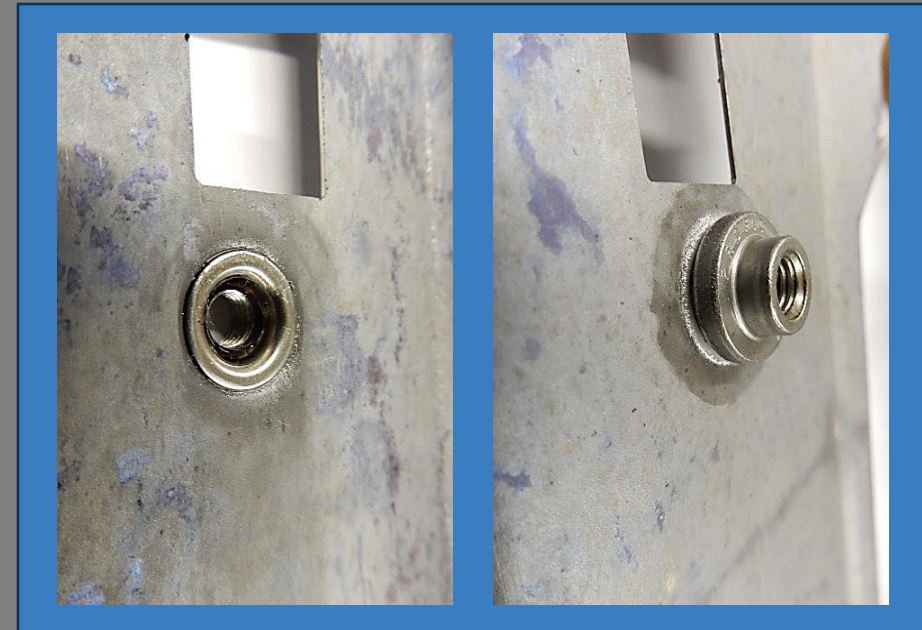
HAZ created by laser cutting

Laser cut hole



Panel Preparation

- Piercing at blanking is possible with some panel geometries
- Concentricity of pierced hole and emboss are important, yet not hyper critical
- Eccentricity resulting from blank piercing and hot forming emboss are accepted
- Fastener position is located by panel to installation tool registration, rather than fastener to hole location



Installation Methods

Cell Integrated or Semi In-Die

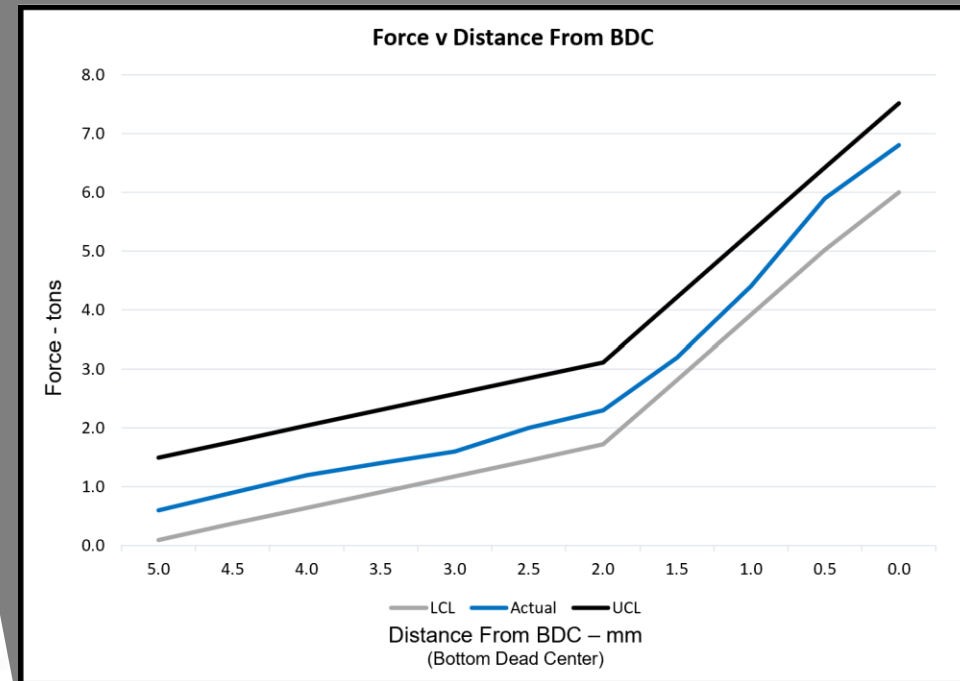
No additional processing time or cost

- Integrated into core process takt time
- Automated process, no additional labor

No additional handling

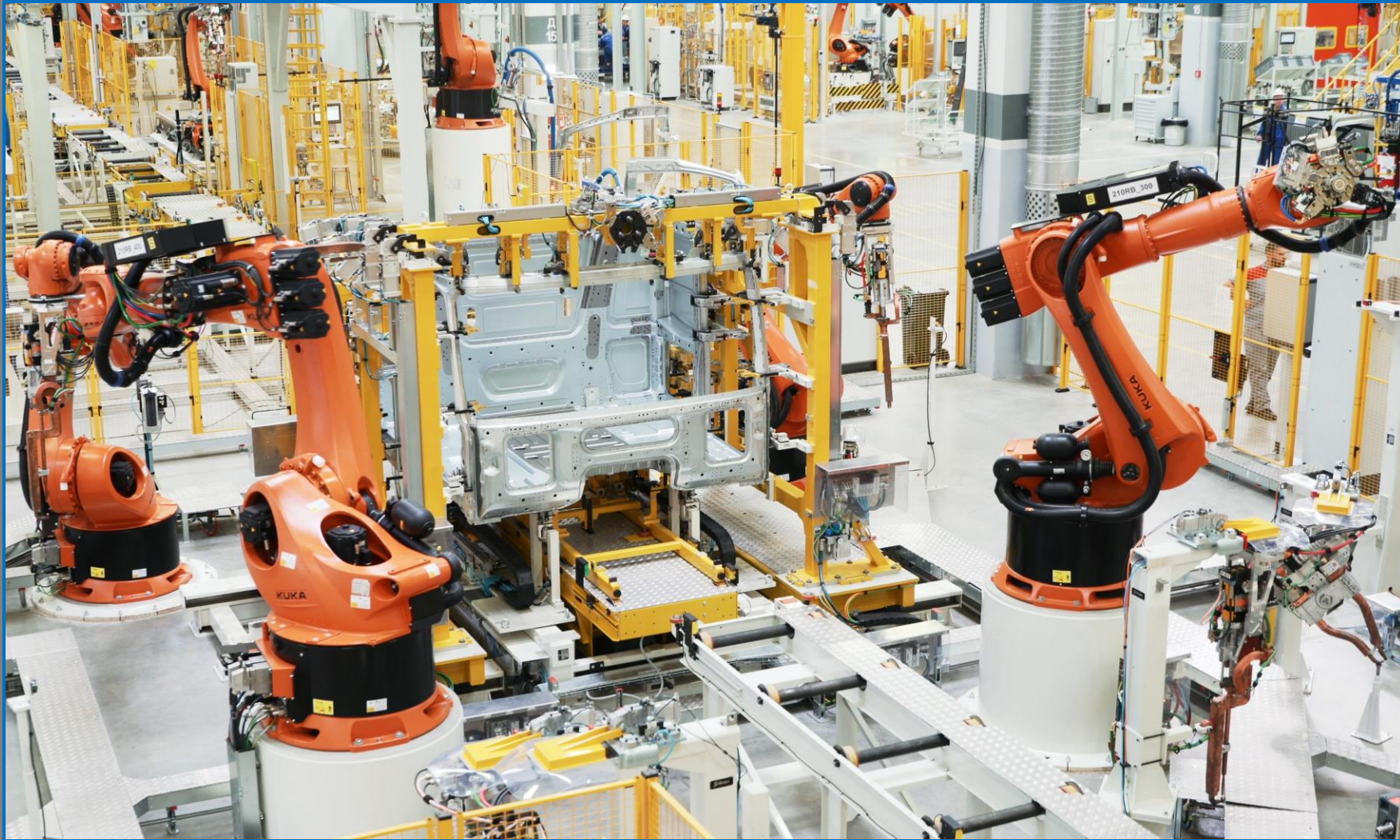
- No WIP for fastener installation, incorporated into assembly or forming process
- No additional space or containers

- Realtime process monitoring
- Absolute joint reliability



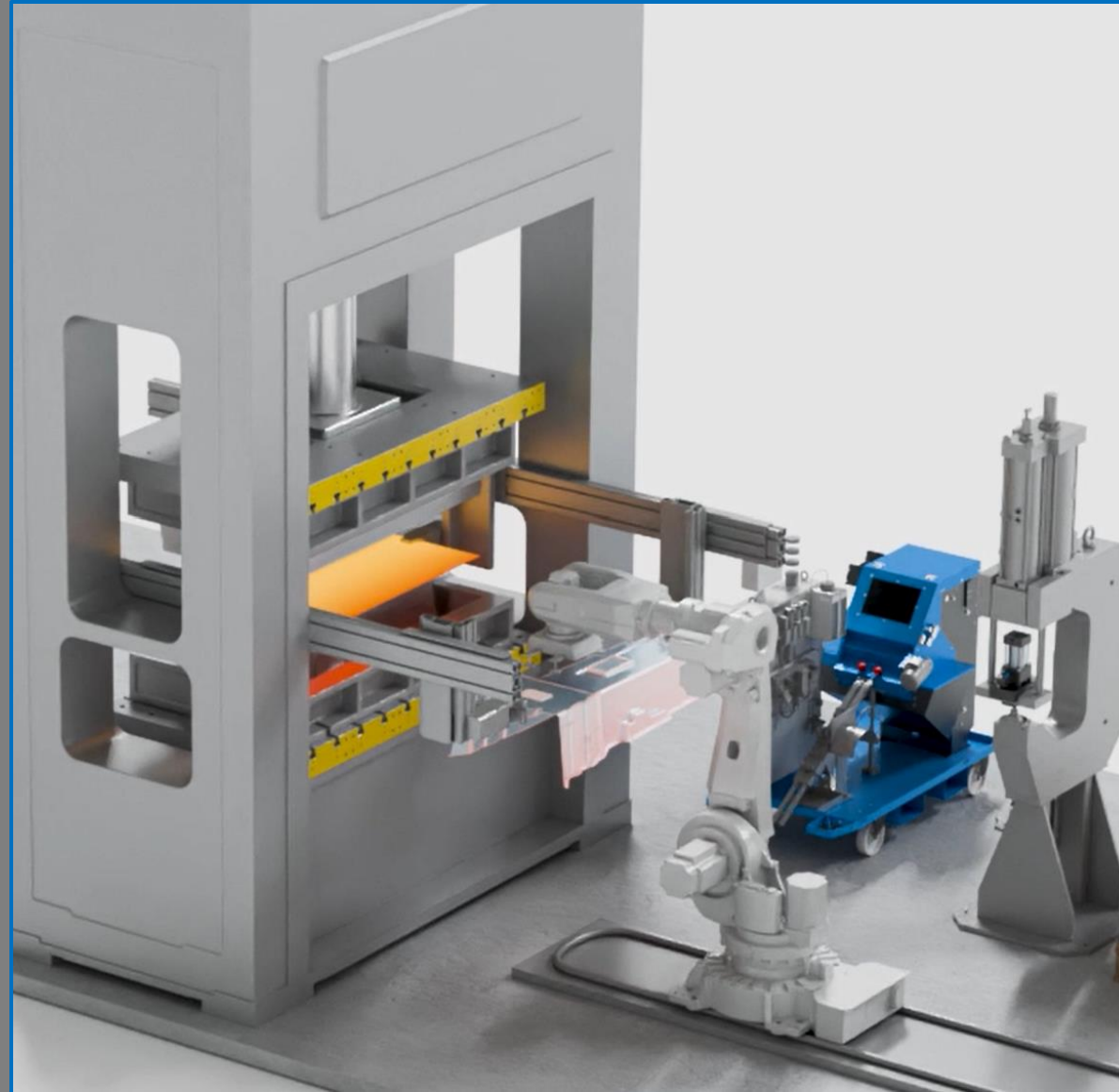
Cell Integrated

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Semi In-Die

GDIS



Benefits

Installing a weld fastener on a PHS panel is deteriorating the PHS value

In other words:

- The weld fastener creates a HAZ that deteriorates the value of the PHS panel
- MAF creates no HAZ
- *No cold welds*



Benefits

Common challenges of welding projection fasteners to PHS are eliminated

- Fasteners are extremely soft compared to PHS material
- Projection height inconsistency
- Generally not Property Class graded
- Fastener coating adds complexity to weld schedule
- AlSi coating inconsistent across the part, and batch to batch
- Longer weld times at low currents make it difficult to deliver enough heat to the base material, often vaporizing the projections without welding

Benefits

MAF in PHS is the **ONLY** proper technical match

- Consistent
- Strong

Cost Save

- Average 18 PHS fasteners per vehicle
- Savings of \$0.15 per installation

Save \$2.7 per vehicle

Conclusions

- Nut and stud solution in PHS, +1500 MPa, without post-quench piercing, without microfracturing have been developed
 - Nut and stud solutions that have no HAZ, no effect on the panel metallurgical properties have been developed
 - Absolutely reliable, high quality joints are realized in PHS with multiple and flexible cost-effective installation methods
- Mission accomplished!

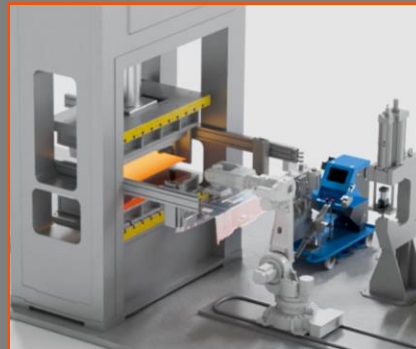
Hot Installation

In-Die



Semi In-Die

Localized Heating

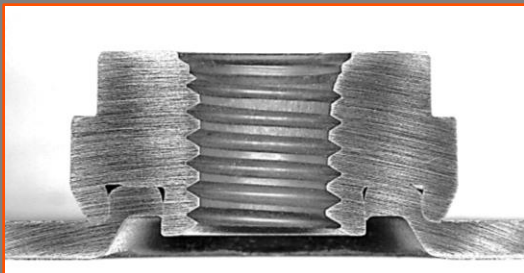


Cell Integrated

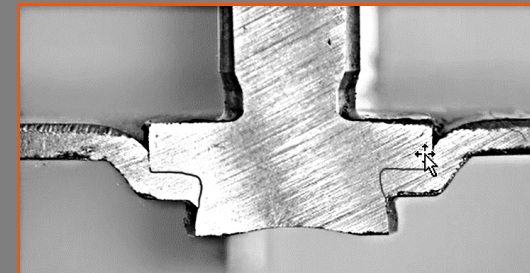
Localized Heating



Self Piercing Nut



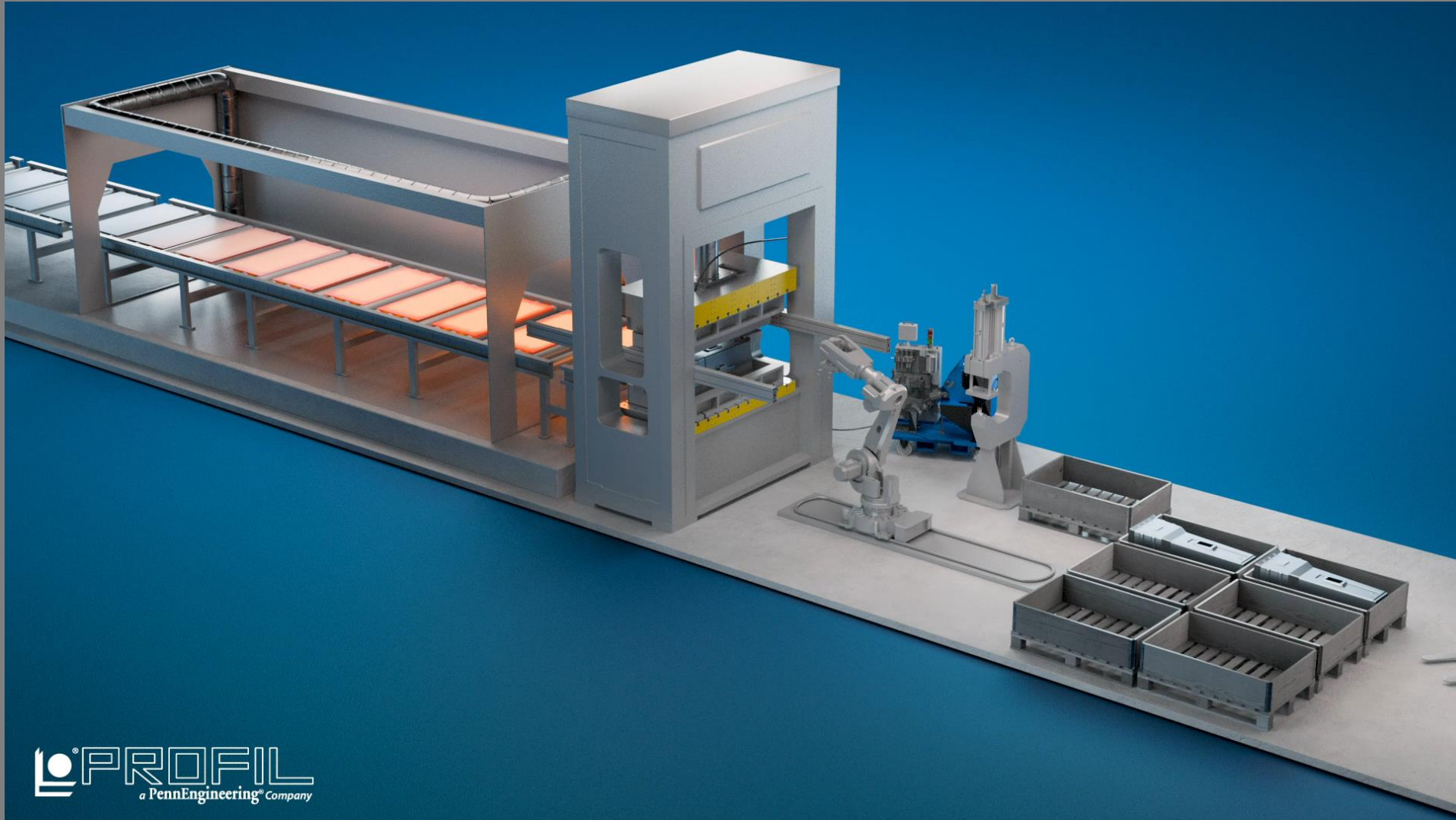
Self Piercing Stud



Next Generation

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Hot Installation



Thank You for Your Attention

Danke, Gracias, Dziękuję Ci, Merci, Grazie

Děkuji, 감사합니다, ありがとう

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