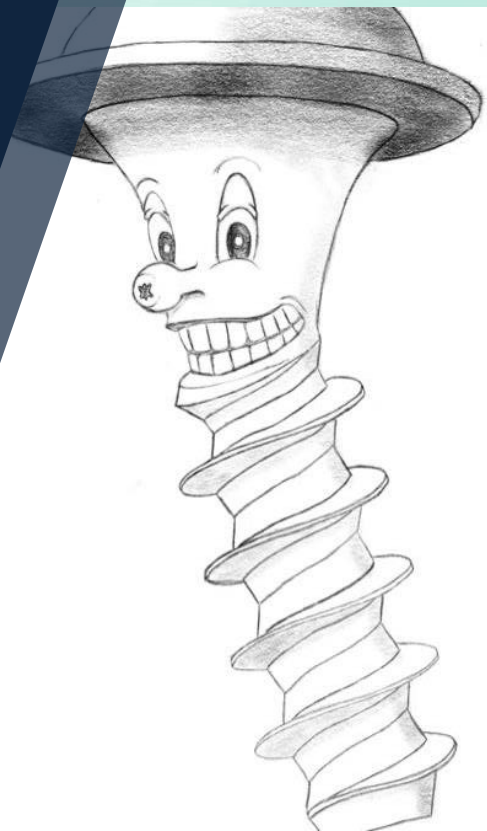
EVO PT®: EVO PT®: The Self-Tapping Evolution in Clamp Load Generation for Highly Engineered Plastics

September 6th -8th, 2023

Thiago Kalife

Presentation Overview

- Why Self-Tapping?
- EVO PT®
  - Evolution of Thread cutting Fasteners
  - Features
  - Low Installation Torque
  - The “EVO” Effect
  - Boss Guidelines
- Torque Curve Explanation
- Test Data for Ultra – Low Temperature Garolite G-10
  - EVO PT® 50 vs DELTA PT® 50 4.5mm Hole
  - EVO PT® 50 vs DELTA PT® 50 4.5mm& 4.6mm Hole
  - EVO PT® 50 4.5mm & 4.6mm Hole Multiple Thread Engagements
  - EVO PT® 50 4.4mm & 4.5mm Hole Multiple Thread Engagements
- Test Data for PA66
  - EVO PT® 40 vs DELTA PT® 40
- EVO PT® Benefits
- Potential Applications
- Applications Laboratory Services



Why Self-Tapping?

Improved Performance

- Eliminates class of fit issues between internal and external threads
- Improved vibration resistance
- Eliminates cross threading
- Minimum 10 repeat assemblies

Lowest In Place Joint Cost

- Optimizes the joint and provides lowest place cost
- Eliminates tapping/secondary operations
- Eliminates need for adding shank slot to fasteners
- Eliminates components such as brass/steel inserts
- Eliminates need for locking elements
  - Patches, plugs, prevailing torque nuts

Why Self-Tapping into Plastic? Eliminate Costly Brass Inserts

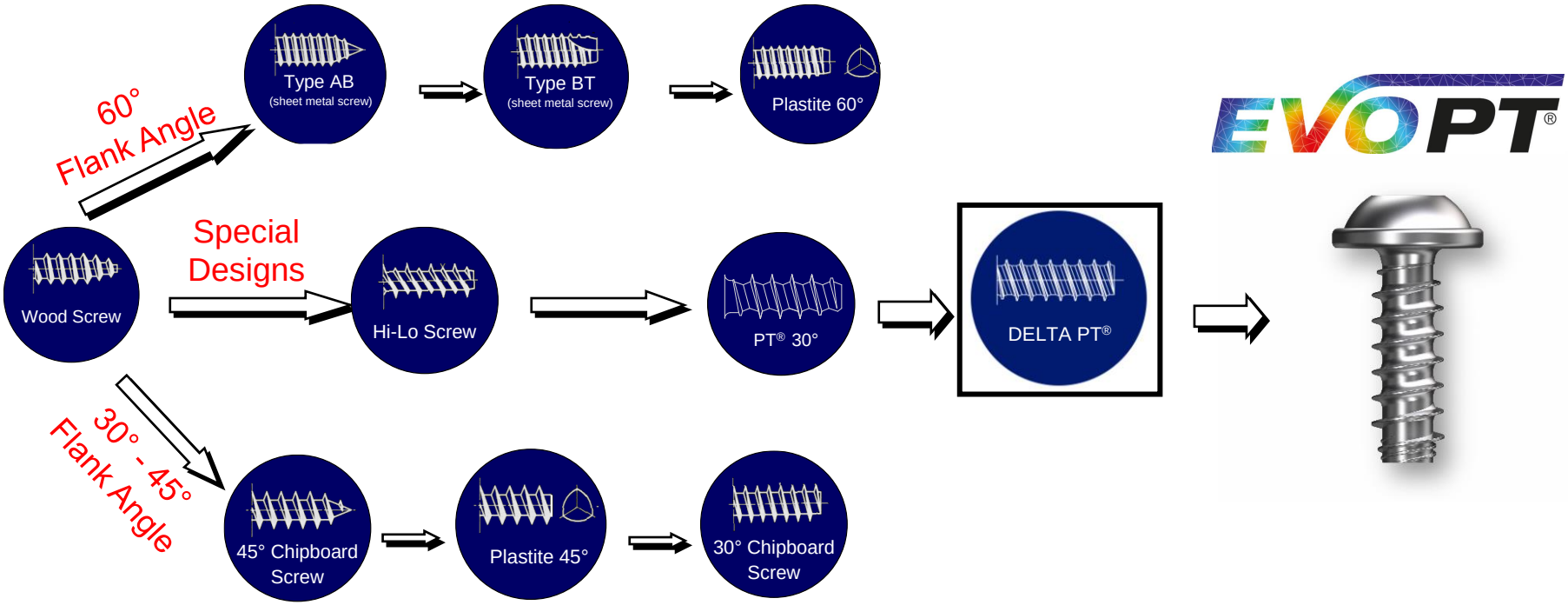
Improve Quality and Reduce Cost by using EVO PT®

- Plastic cracking, partially seated
- Plastic flows over the top of the insert
- Plastic fills threaded bore of the insert
- Eliminate chasing inserts with a tap after molding
- Eliminate secondary operations to drive the insert
- Reduce mold cycle times
- Eliminate inserts not molded/driven flush
- Excess sorting costs to guarantee molded correctly
- Increasing brass costs
- Improved joint quality and performance
- Eliminate recycling issues

EVOPT®

The evolution of self tapping into thermoset

Evolution of Self-Tapping Fasteners?

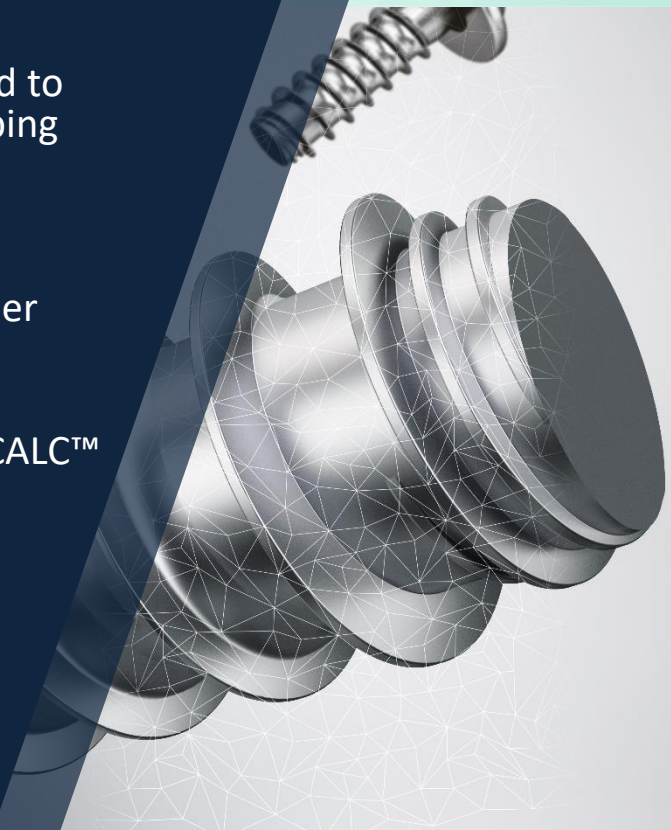


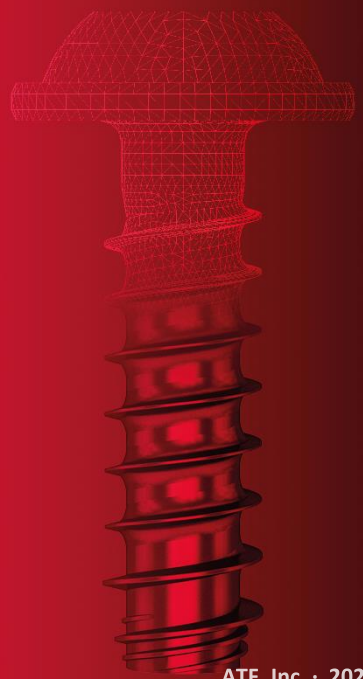
EVOPT®

EVO PT®

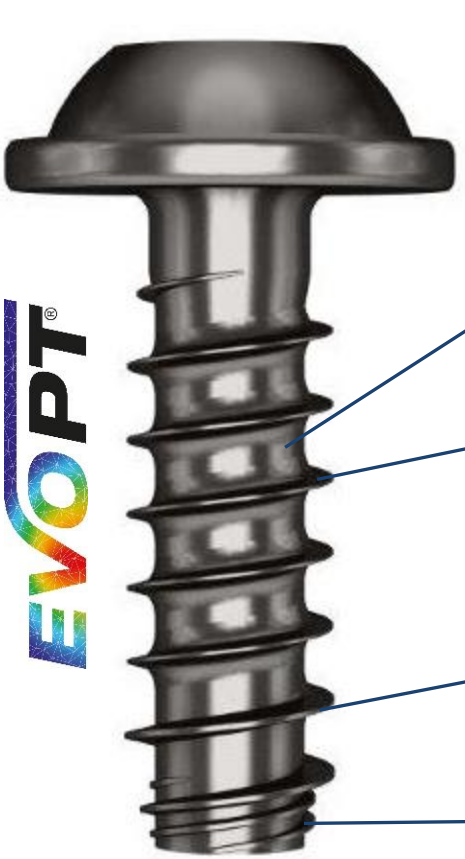
ATF

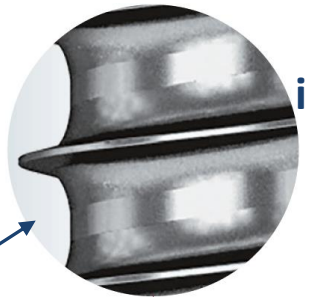
- Successor of DELTA PT®
- First fastener completely designed though FEA simulations
- Advanced functionality compared to previous generations of self-tapping fasteners for thermoset and thermoplastic
- High versatility allowing for further standardization at end users
- Computer Simulation with EVO CALC™
  - New relaxation module (numerical)
  - New CAE/FEM services





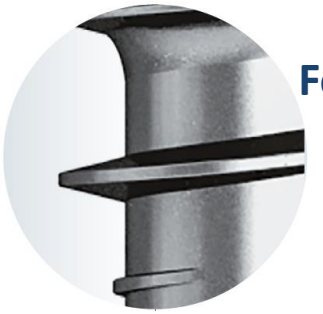
EVO PT® -Features





Thread design
inspired by nature

26° Flank angle

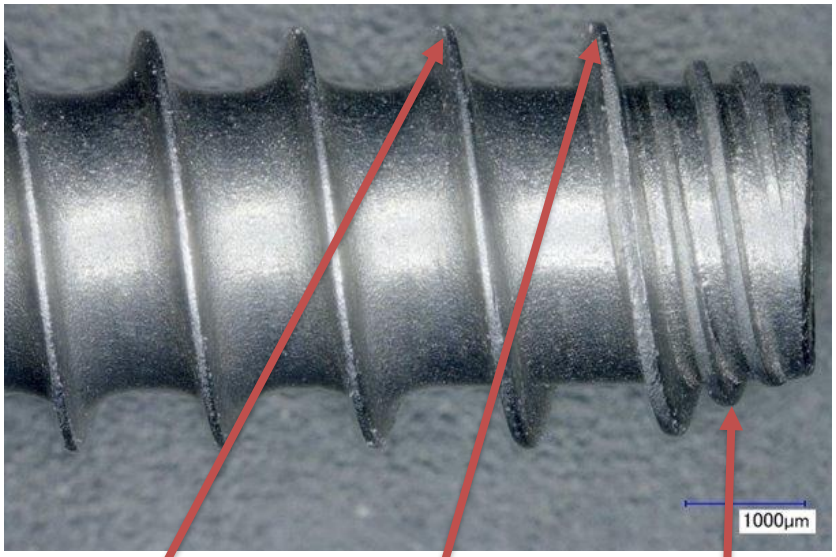


Forming thread

Lead-in threads

Low Installation Torque

- **Triple lead thread start helps with**
  - Self-alignment
  - Straightens off-angle approach
- **Special thread forming zone**
  - Oversized lead forming thread
  - Main thread almost free of friction during installation



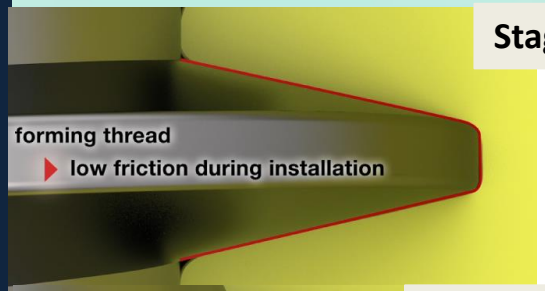
Main Thread

Forming Thread

Triple Lead Thread Start

The “EVO-Effect”

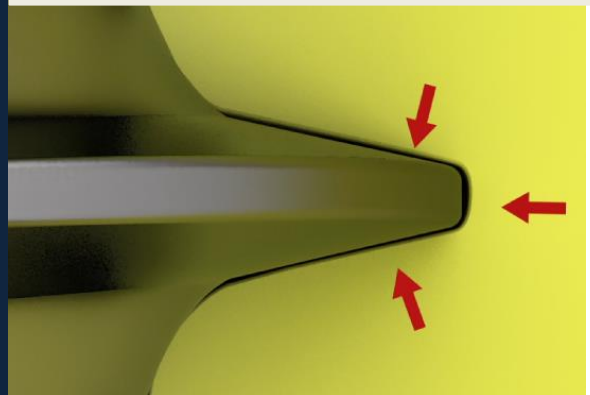
- Special thread forming zone
- Oversized forming (tapping) thread
- Main thread almost free of friction during installation
- Full thread engagement

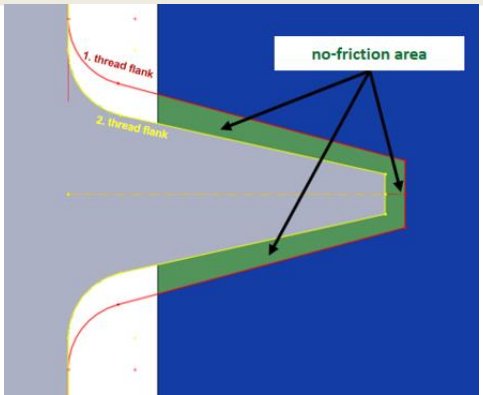


Stage 1: Forming thread creates 1st thread

Stage 2: Following threads have no interference

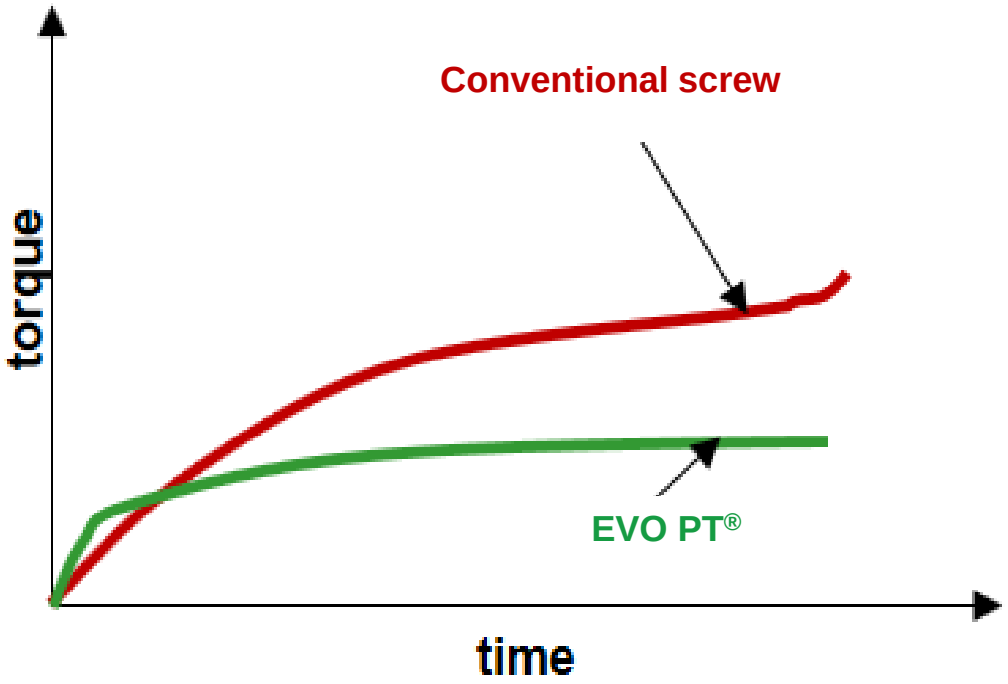
Stage 3: Plastic springs back (elasticity) to give a form-fit (Thermoplastic), for Thermoset main thread does not make contact creating friction, resulting in higher clamp load





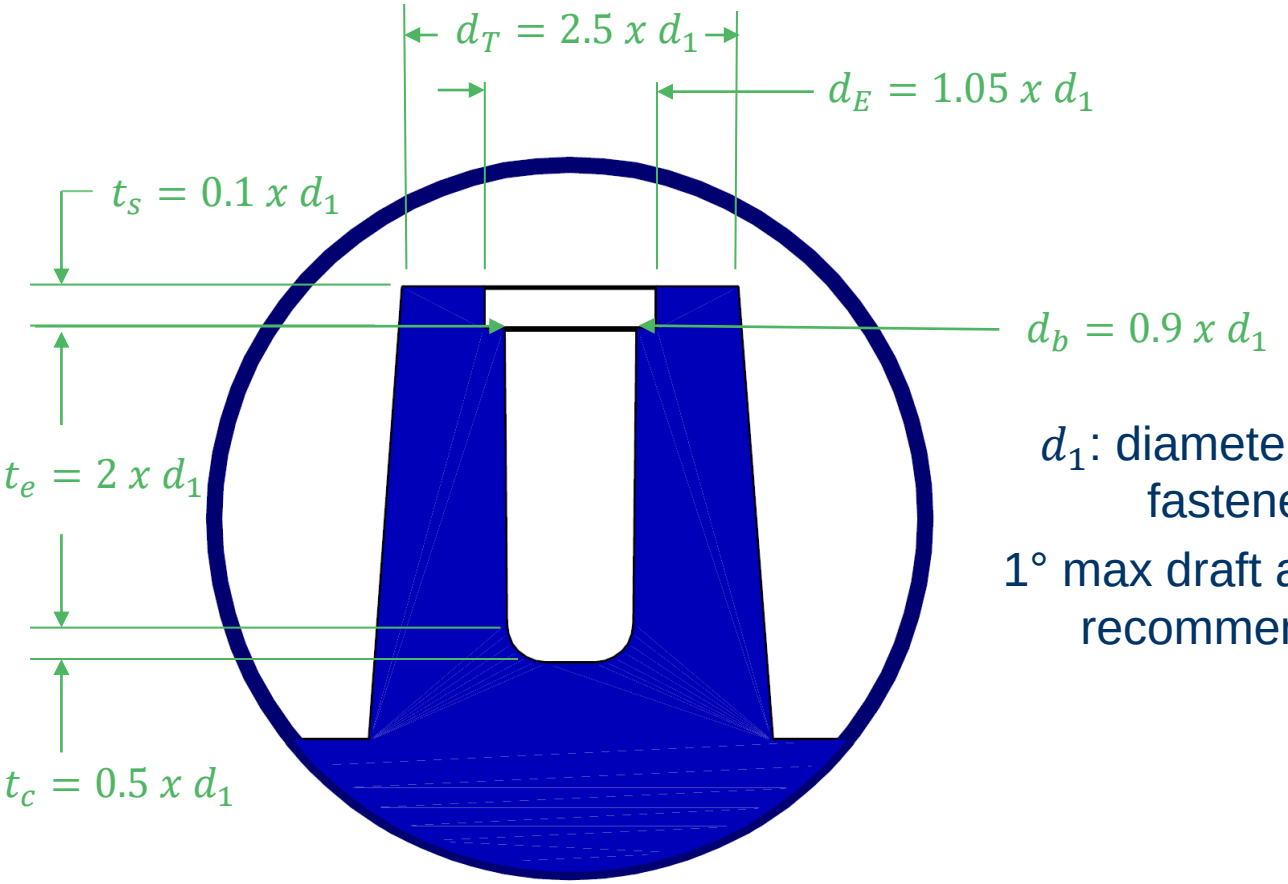
The “EVO-Effect”

- Installation torque almost independent of installation depth
- Lower temperature enchances the stability of boss material (thermoplastics)
- Less friction means lower installation torque
- Cooler plastic means increased stripping torque
- Cooler plastic means Increased Clamp Load
- Standardization of multiple joint stack ups to one fastener



EVO PT® Boss Design Guidelines for Thermoset Materials

Installation Speed
Fasteners should be installed in the range of 300-600 RPM for the best results



d_1: diameter of fastener

1° max draft angle recommended

Torque Curve Explanation

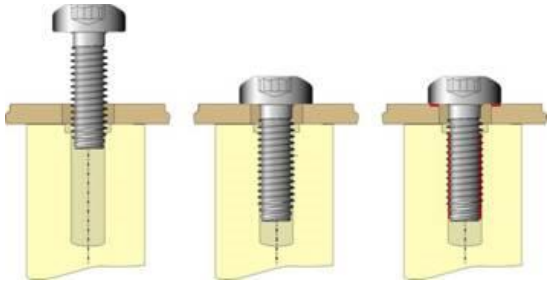
Typical Curve for thread forming fastener into Blind Hole

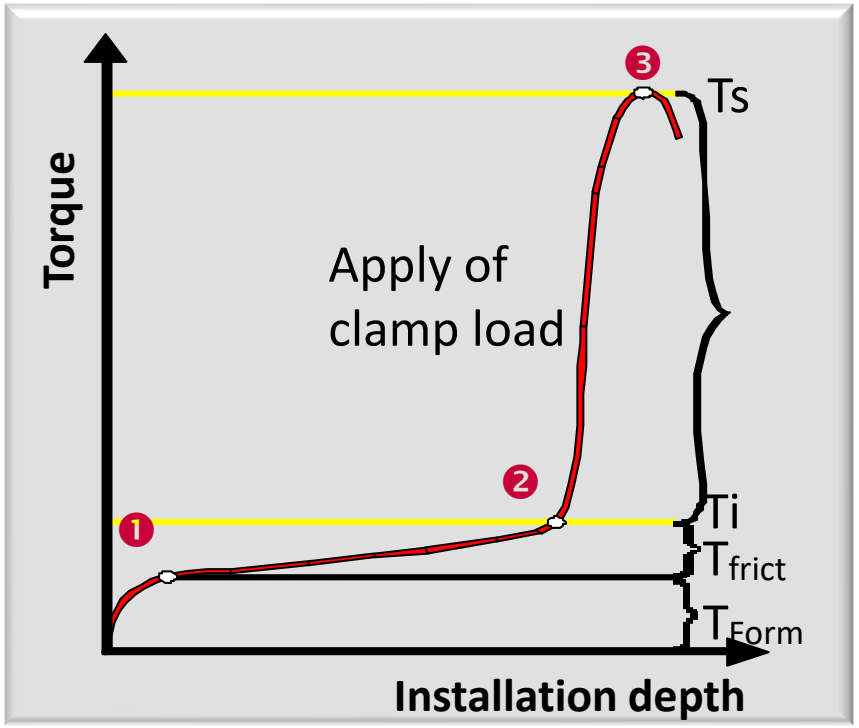
Explanation of Installation Process:

❶
Thread forming T_{Form}

❷
Head contact without clamp load
- Installation torque T_I
  (T_{FORM} + $T_{frict\ (thread)}$)

❸
Destruction of screw joint
- Stripping torque T_S
  (T_{FORM} + $T_{frict\ (thread)}$ + $T_{frict\ (head)}$)



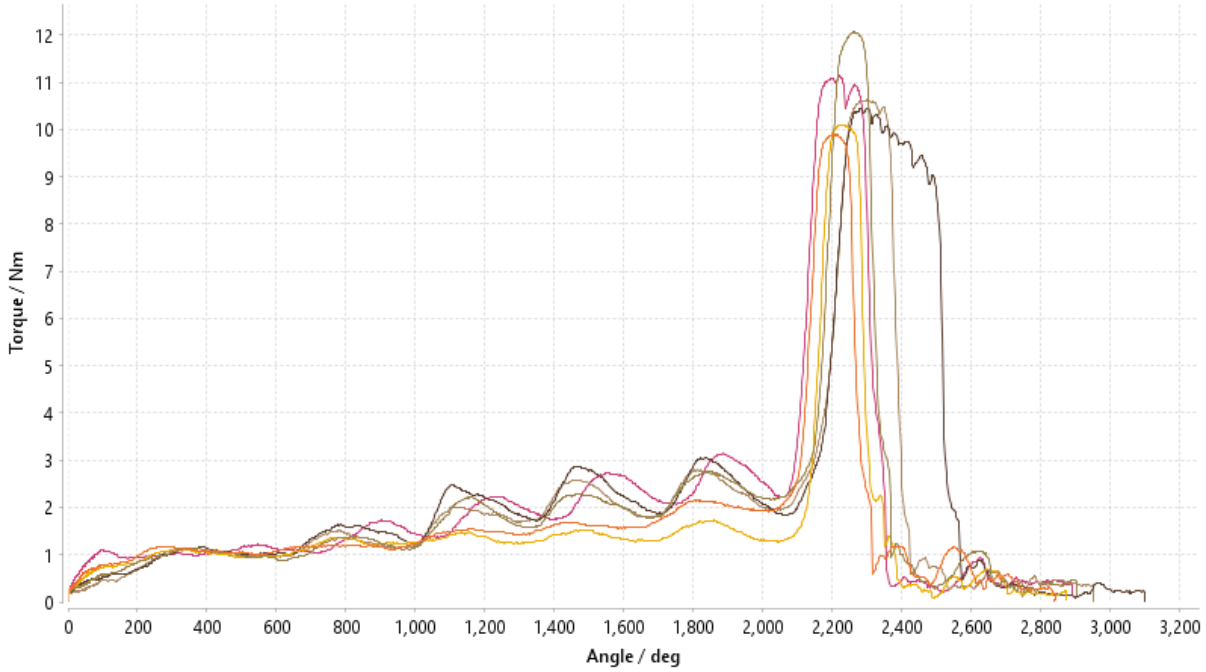


EVO PT® INTO THERMOSET

TORQUE TEST DATA REVIEW

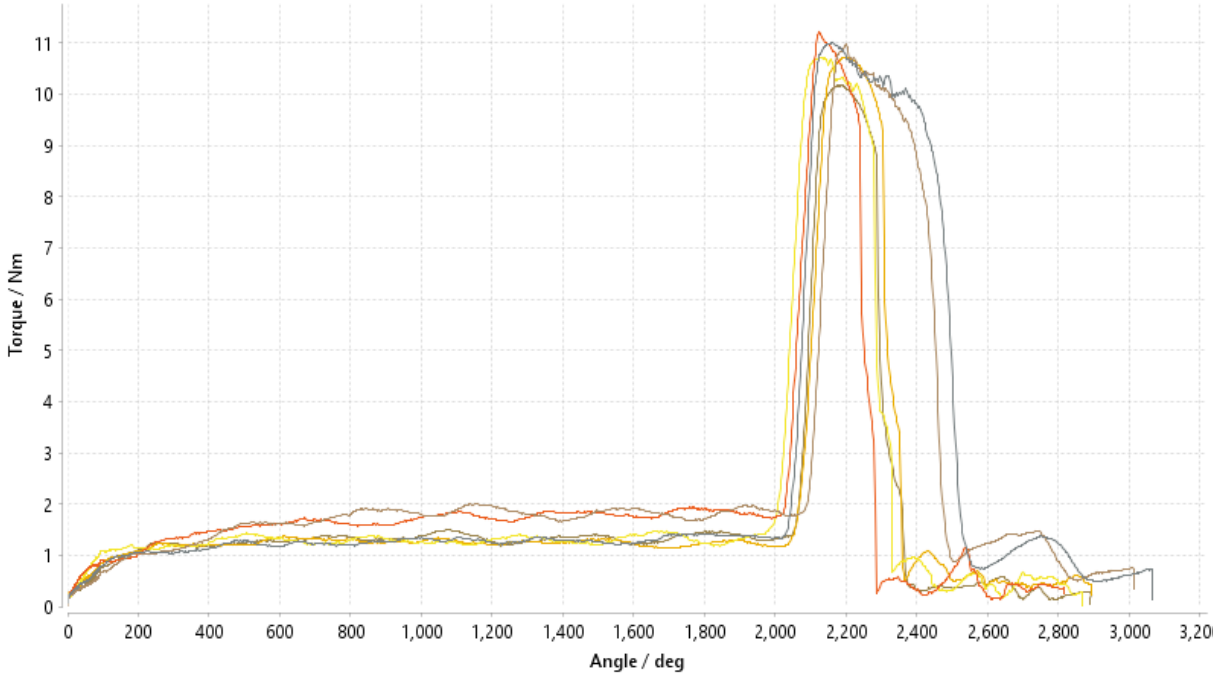
EVO PT® 50 vs DELTA PT ® 50 Comparison Data

Material: Ultra– Low Temperature Garolite
Tensile Strength: ~40,000 psi
Impact Strength: 8-10 ft-lbs/in
Screw Type: DELTA PT® 50
Hole Size: 4.5mm
Installation Depth: 12mm



EVO PT® 50 vs DELTA PT ® 50 Comparison Data

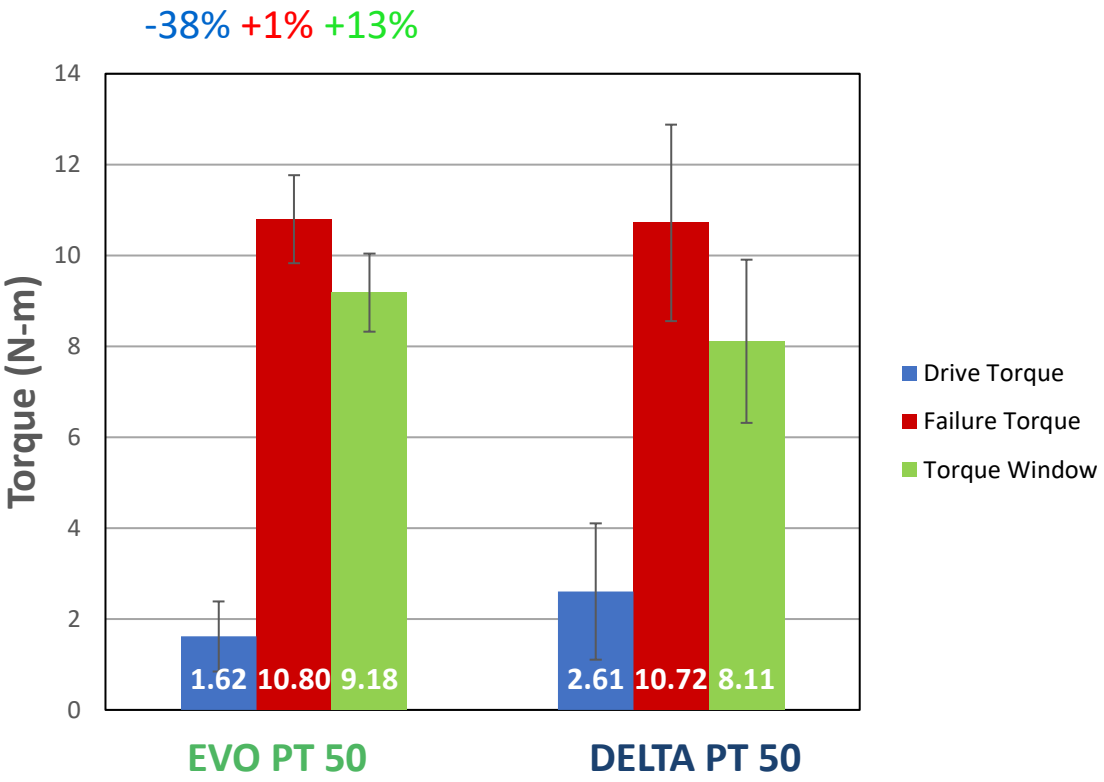
Material: Ultra– Low Temperature Garolite
Tensile Strength: ~40,000 psi
Impact Strength: 8-10 ft-lbs/in
Screw Type: EVO PT® 50
Hole Size: 4.5mm
Installation Depth: 12mm



EVO PT® 50 vs DELTA PT ® 50 Comparison Data

Material: Ultra– Low Temperature Garolite
Tensile Strength: ~40,000 psi
Impact Strength: 8-10 ft-lbs/in
Hole Size: 4.5mm
Installation Depth: 12mm

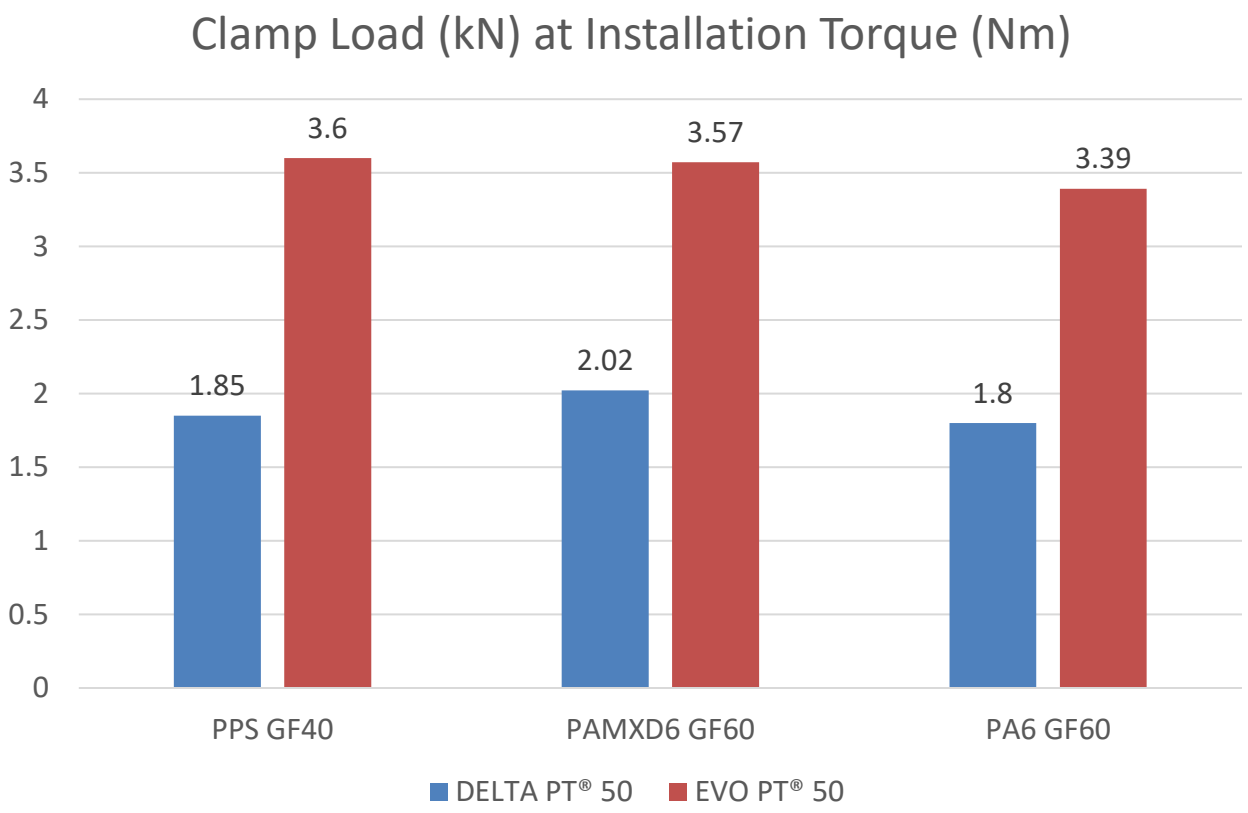
*Drive Torque standard deviation: -48%
*Failure Torque standard deviation: -55%
*Torque Window 6 sigma difference: -52%



EVO PT®

CLAMP LOAD DATA REVIEW

EVO PT® 50 vs DELTA PT ® 50 Comparison Data



M5 x 15mm Round Washer Head Screw

Clamp Load at recommended tightening torque

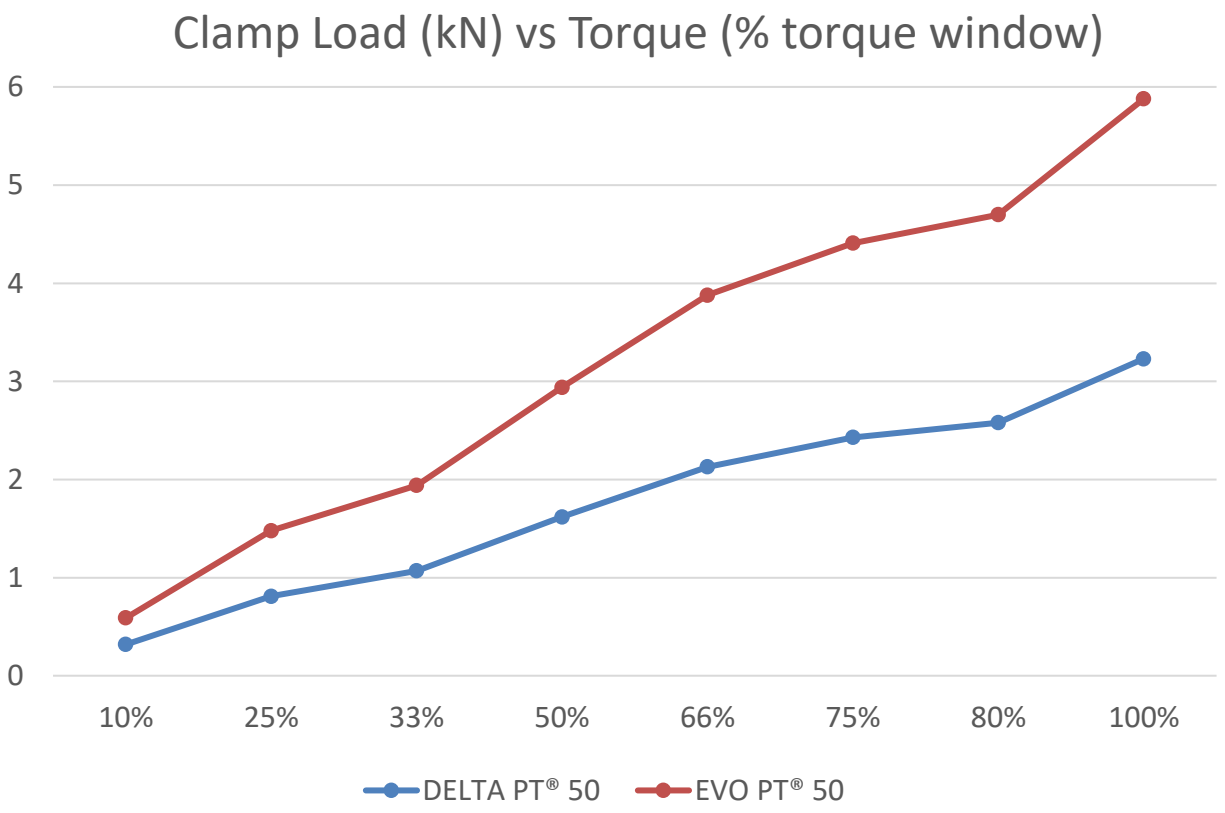
DELTA PT® - 50% of Torque window

EVO PT® - 60% of Torque Window

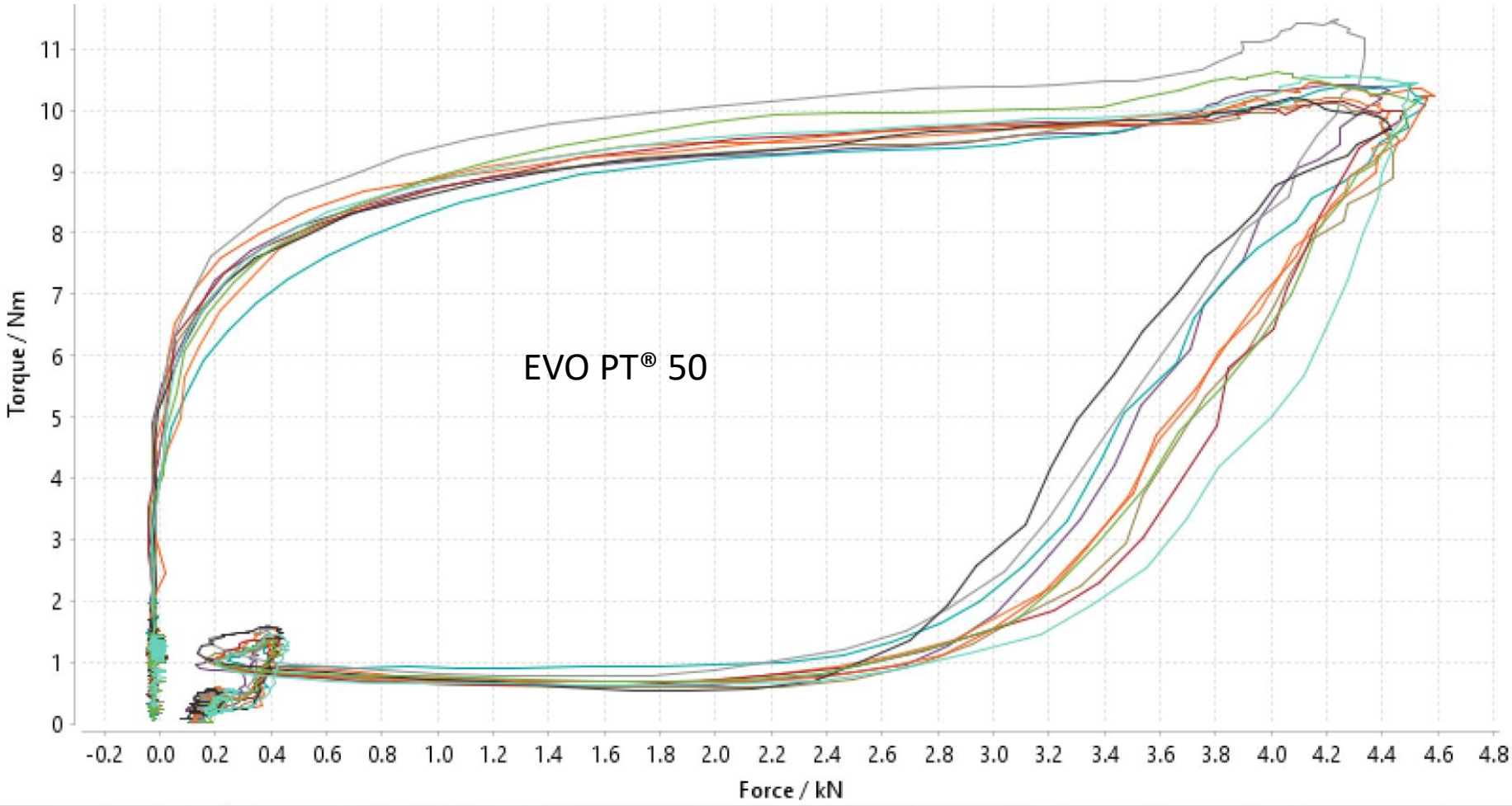
EVO PT® 50 vs DELTA PT ® 50 Comparison Data

Clamp Load at common tightening torque

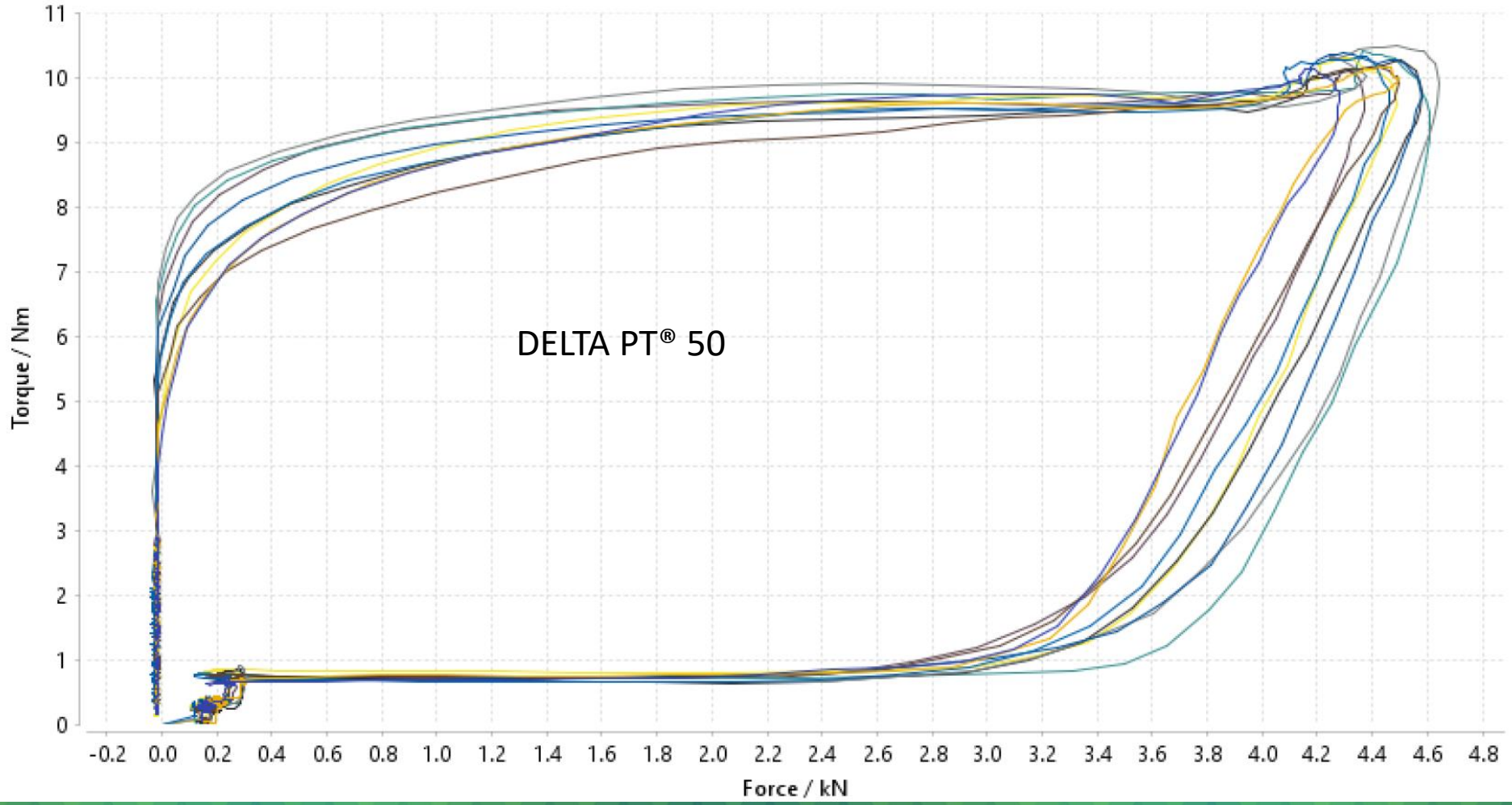
Material: BMC UP MD59+GF20
ID: 4.5mm
Installation Depth: 12mm



EVO PT® 50 vs DELTA PT ® 50
TORQUE vs CLAMP LOAD CURVES



EVO PT® 50 vs DELTA PT ® 50
TORQUE vs CLAMP LOAD CURVES

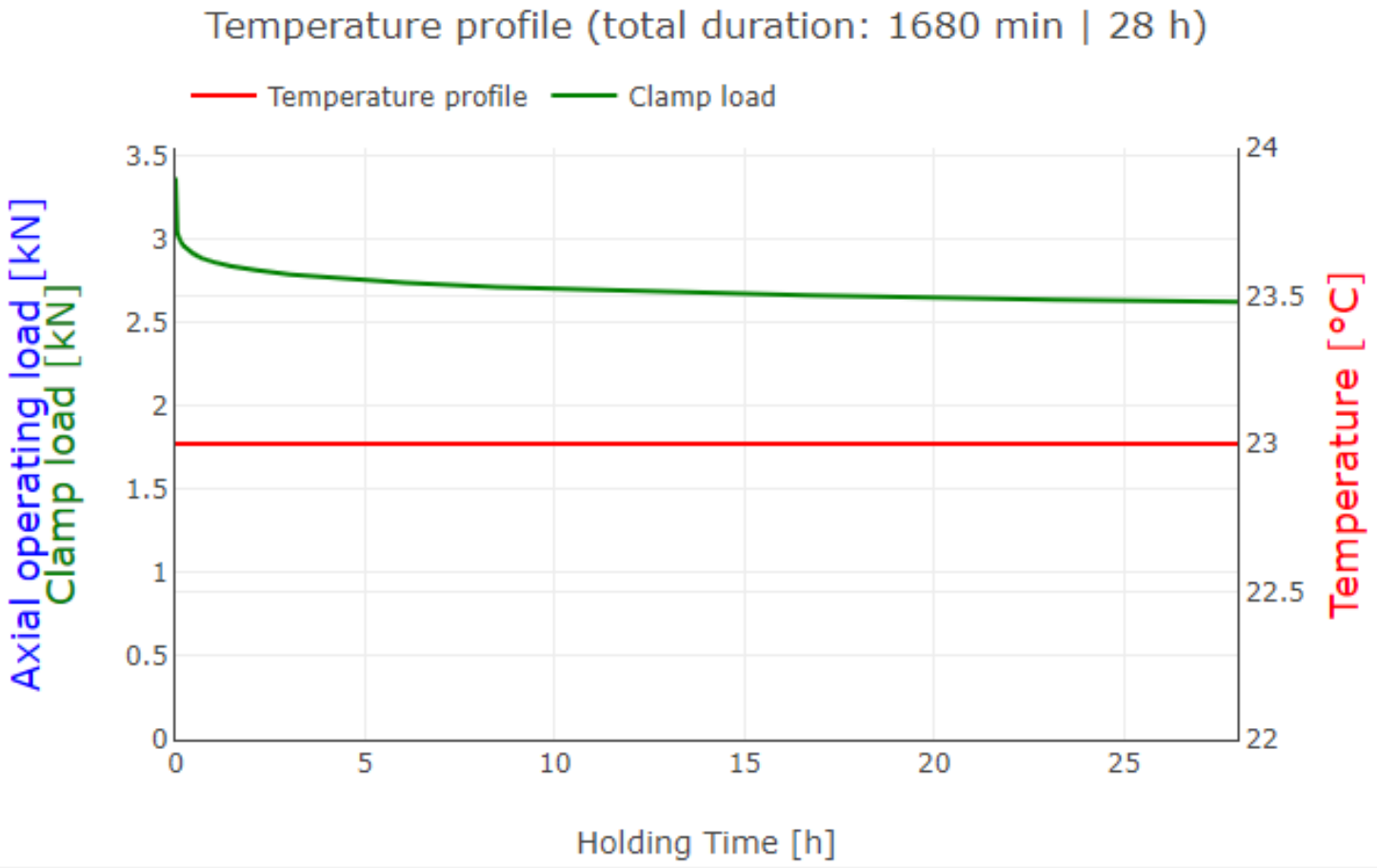


EVO PT® 50 Relaxation and Retained Clamp Load

Clamp Load at recommended tightening torque for PPS GF40

EVO PT®:
78% clamp load retained

Equivalent DELTA PT®:
57% clamp load retained

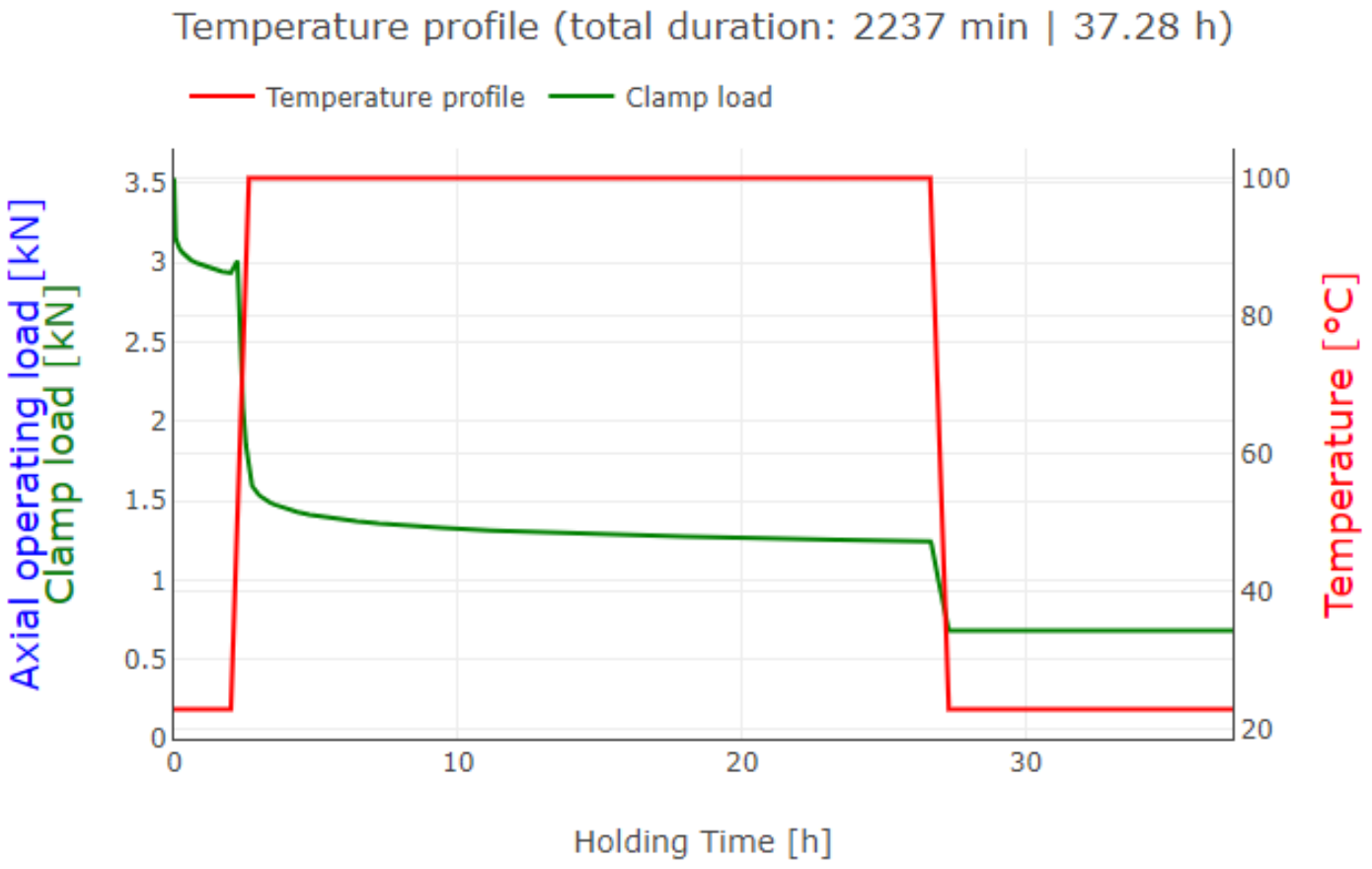


EVO PT® 50 Relaxation and Retained Clamp Load

Clamp Load at recommended tightening torque for PPS GF40

EVO PT®:
19% clamp load retained

Equivalent DELTA PT®:
11% clamp load retained

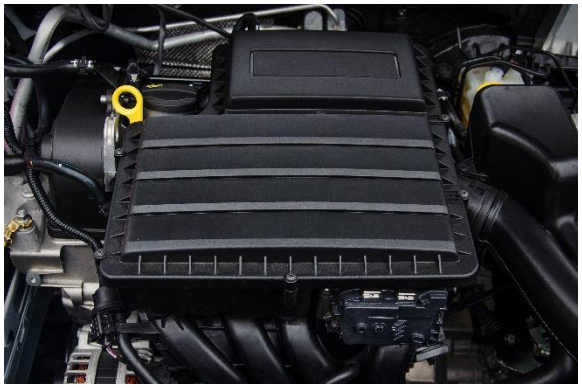


Benefits

- Self – Aligning
- The “EVO” Effect
- Improved Drive to Strip Ratio
- Standardization
- EVO Calc including Relaxation forecast with temperature cycle
- Simple Boss Design

Potential Applications

- Air Bag Modules
- Trunk and Door Latches
- Power Window Motors
- Tail Lamps
- Head Lamps
- Fuel Rails
- Air Flow Sensors
- Cooling Fans
- Seatbelt Housings
- Instrument Panels
- Battery Housings
- Garbage Disposals
- Power Distribution
- Throttle Body Housing
- Manifold Covers
- Pump Housing Covers
- Whitegoods/Housing Appliances



Applications
Laboratory Services

- Fastener Design Recommendations
- Boss Design Recommendations
- Drive and Strip Torque Testing
- Micro screw Drive Strip Testing
- Clamp Load Testing
- Thermal Cycling Testing
- Serviceability Testing
- Tensile, Compression, and Shear Force Testing
- 3D printing
- Vibration Testing (Available Q3-2022)
- Thermal Shock (Available Q3-2022)
- Sealing Testing

Best Practices to reduce Challenges

Get ATF applications engineering involved early in design to:

- Run analysis on the joint design
- Identify correct fastener type for application
- Design fastener to application specifications and address manufacturability
- Perform validation testing in ATF's application lab
- Provide optimal and best solution to customer while reducing in place fastener cost.

We want to work and develop solutions for tomorrow's challenges with you!!

EVOPT®

The evolution of self tapping into thermoset