



precision components * smart solutions



DELTA PT[®]

A Superior Thread-former for Plastics



precision components * smart solutions

Plastic Joint Design Considerations

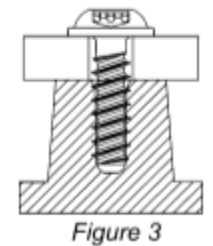
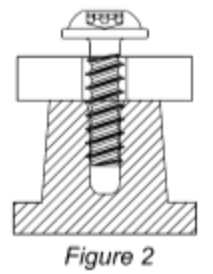
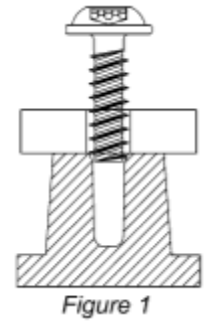
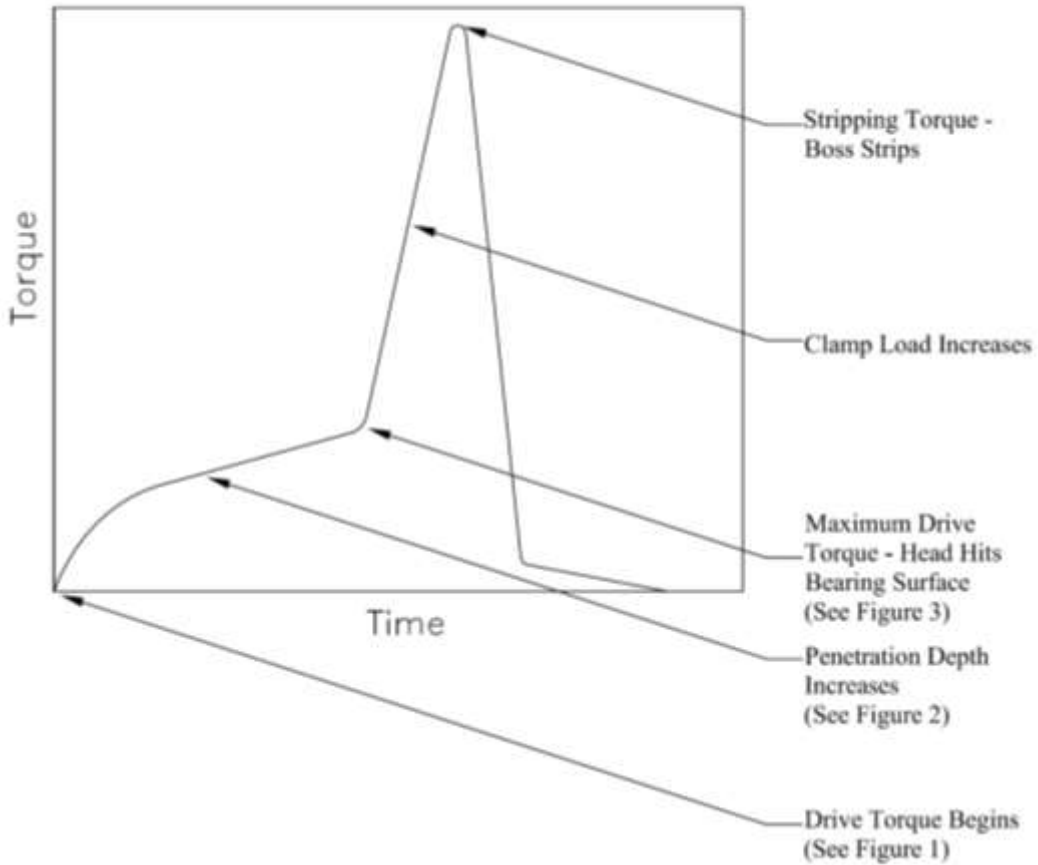


- Low radial stress
- Joint stability
- High mechanical strength
- Vibration resistance
- Serviceability
- High strip-to drive ratio



precision components * smart solutions

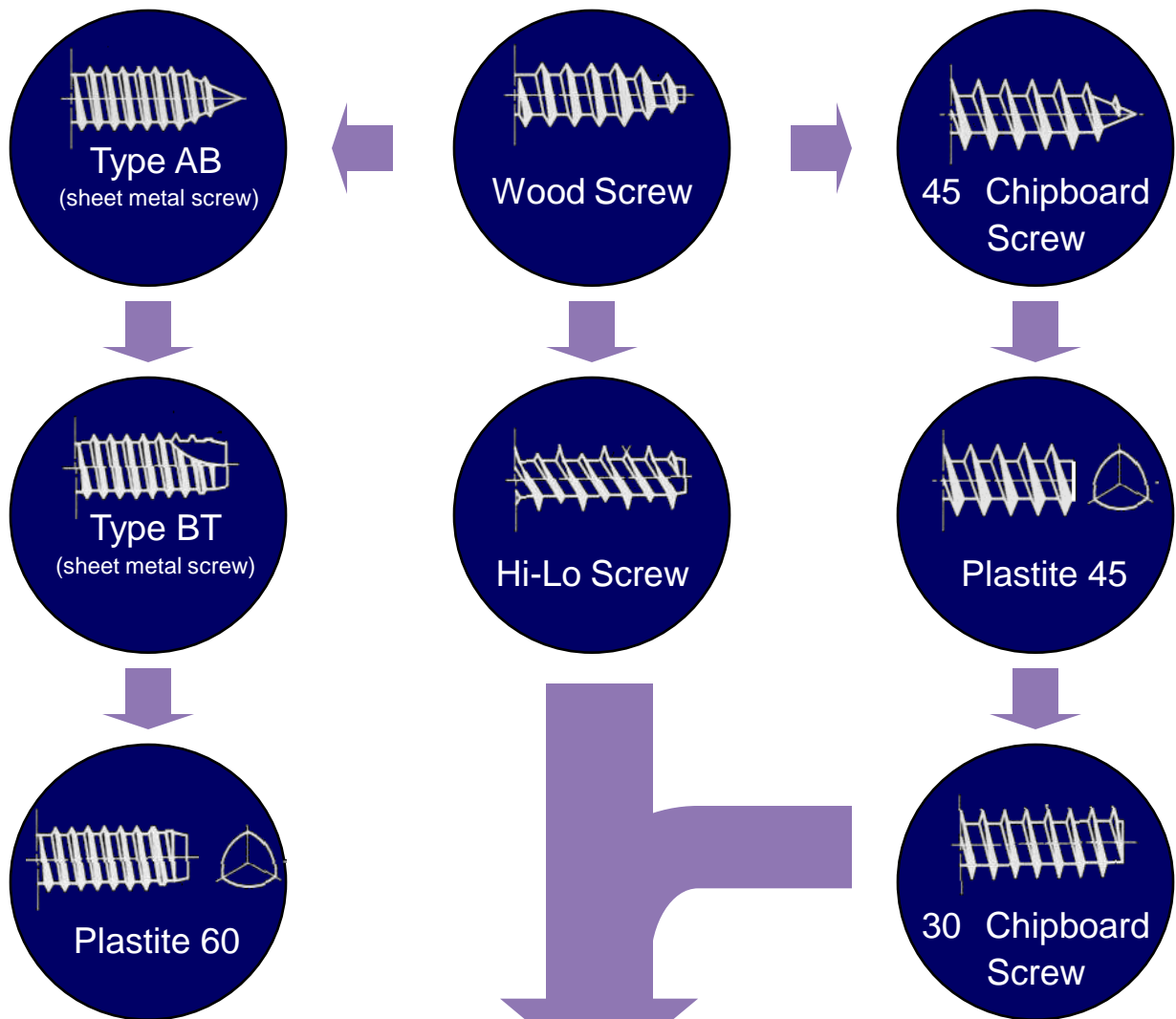
Drive and Strip Torque Explanation





precision components * smart solutions

Evolution of Thread-Forming Fasteners



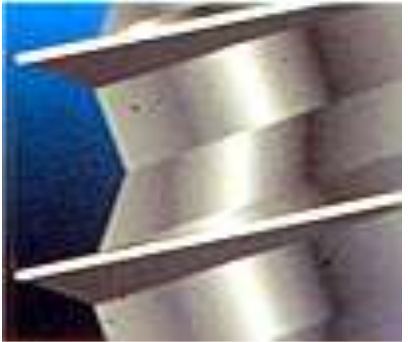
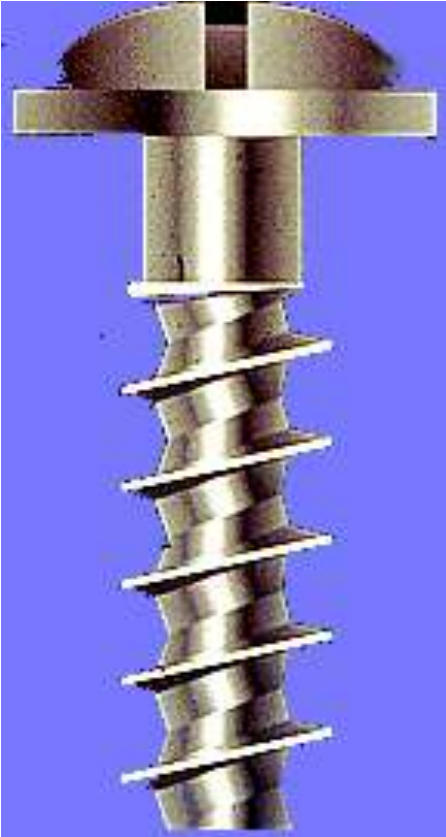


precision components * smart solutions

Evolution of Thread-Forming Fasteners



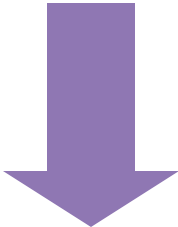
30° Flank Angle



Cored Root



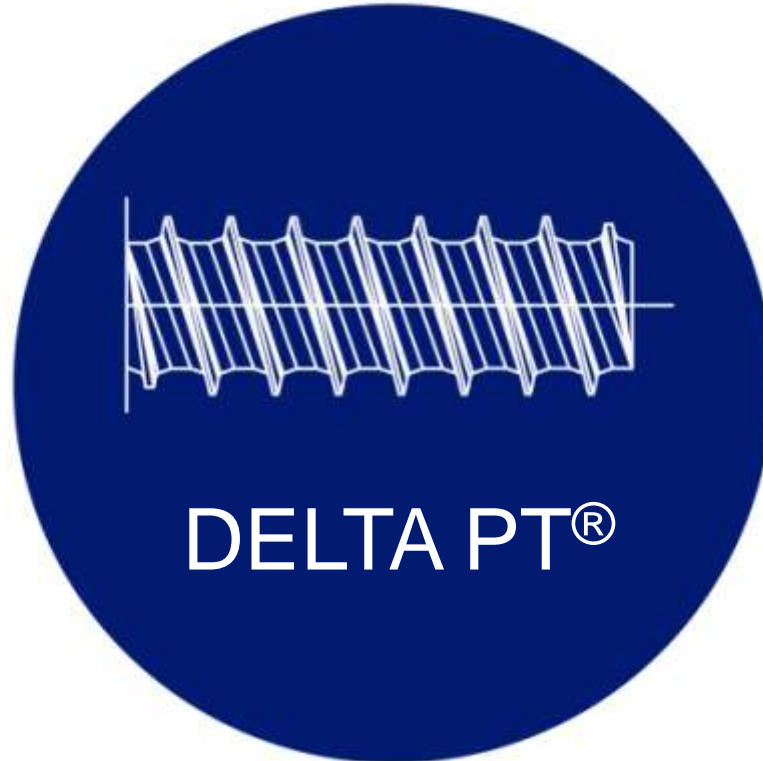
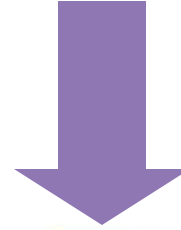
8° Helix Angle





precision components * smart solutions

Evolution of Thread-Forming Fasteners





precision components * smart solutions

DELTA PT[®] Features



- Innovative flank geometry
- Reinforced cored root
- Large minor diameter
- Refined helix angle
- Optimized head geometry



Reduced Radial Stress

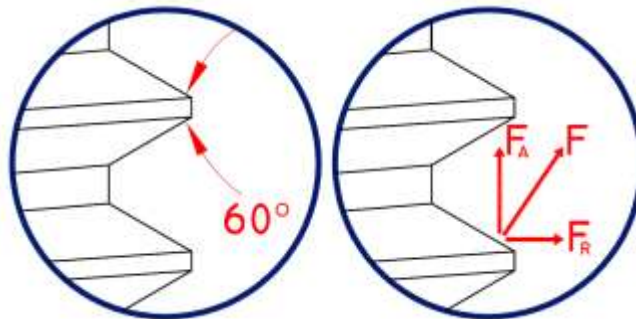
precision components * smart solutions

Innovative Flank Geometry

- allows reduced wall thickness (2xD)
- reduces sink marks
- permits shorter molding cycle times
- leads to significant material savings

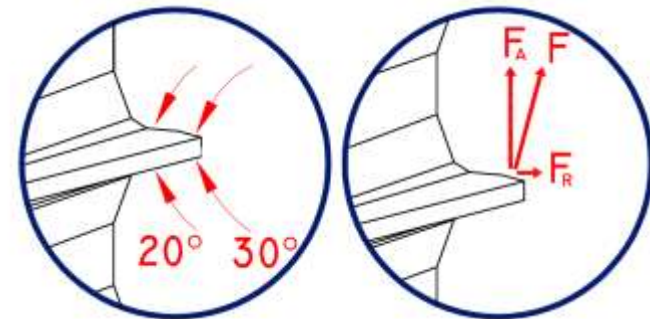


Other Thread-Formers



$$F_R = 0.50F$$

DELTA PT®



$$F_R = 0.26F$$



precision components * smart solutions

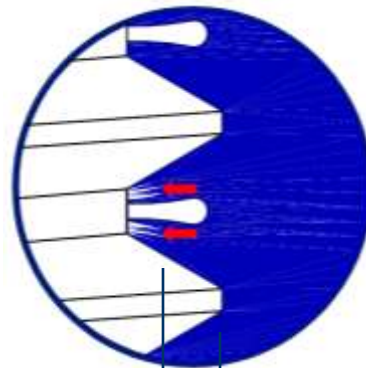
Increased Joint Stability

Reinforced cored root

- prevents material jam
- eliminates cracking due to stress concentrations
- provides nearly 100% flank engagement

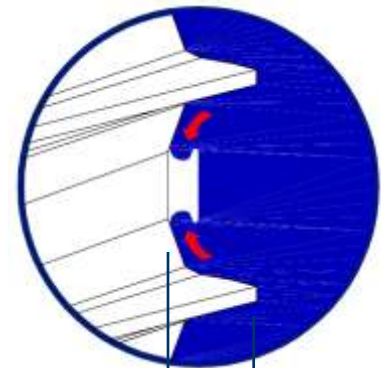


Other Thread-Formers



→ ← 60%

DELTA PT®



→ ← 100%

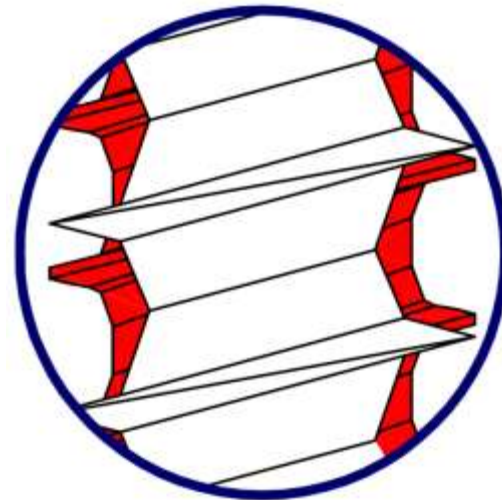


precision components * smart solutions

High Mechanical Strength

Large Minor Diameter

- increases torsional and tensile strength
- allows fastener to withstand the high torque requirements presented by thermoset and highly glass filled thermoplastic materials



 DELTA PT[®]
 PT[®]

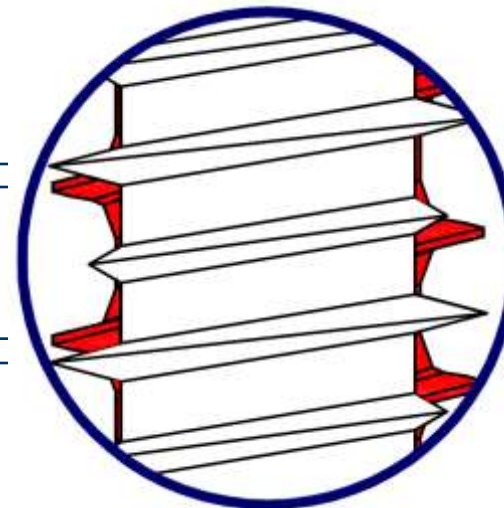


precision components * smart solutions

Superior Vibration Resistance

Refined helix angle (pitch)

- increases number of engaged threads by almost 30% compared to other thread formers at same penetration depth
- leads to a joint with high dynamic safety



 DELTA PT®
 Hi-Lo

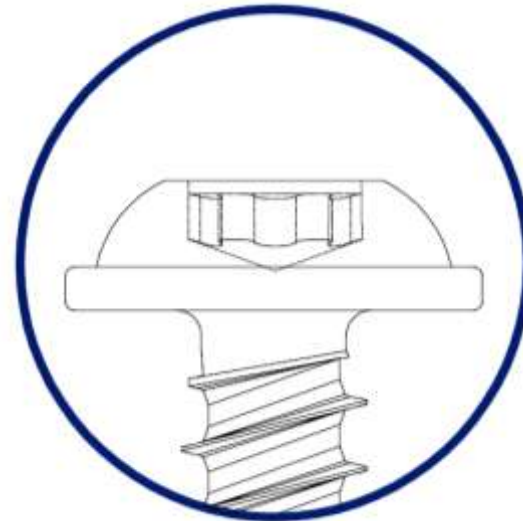


precision components * smart solutions

Excellent Serviceability

Optimized Head Geometry

- large bearing surface distribute pressure over large area to reduce creep and increase break-loose torque
- deep drive recess penetration eliminates possibility of recess stripping and allows for multiple installations and better in-line torque transfer





precision components * smart solutions

Boss Design

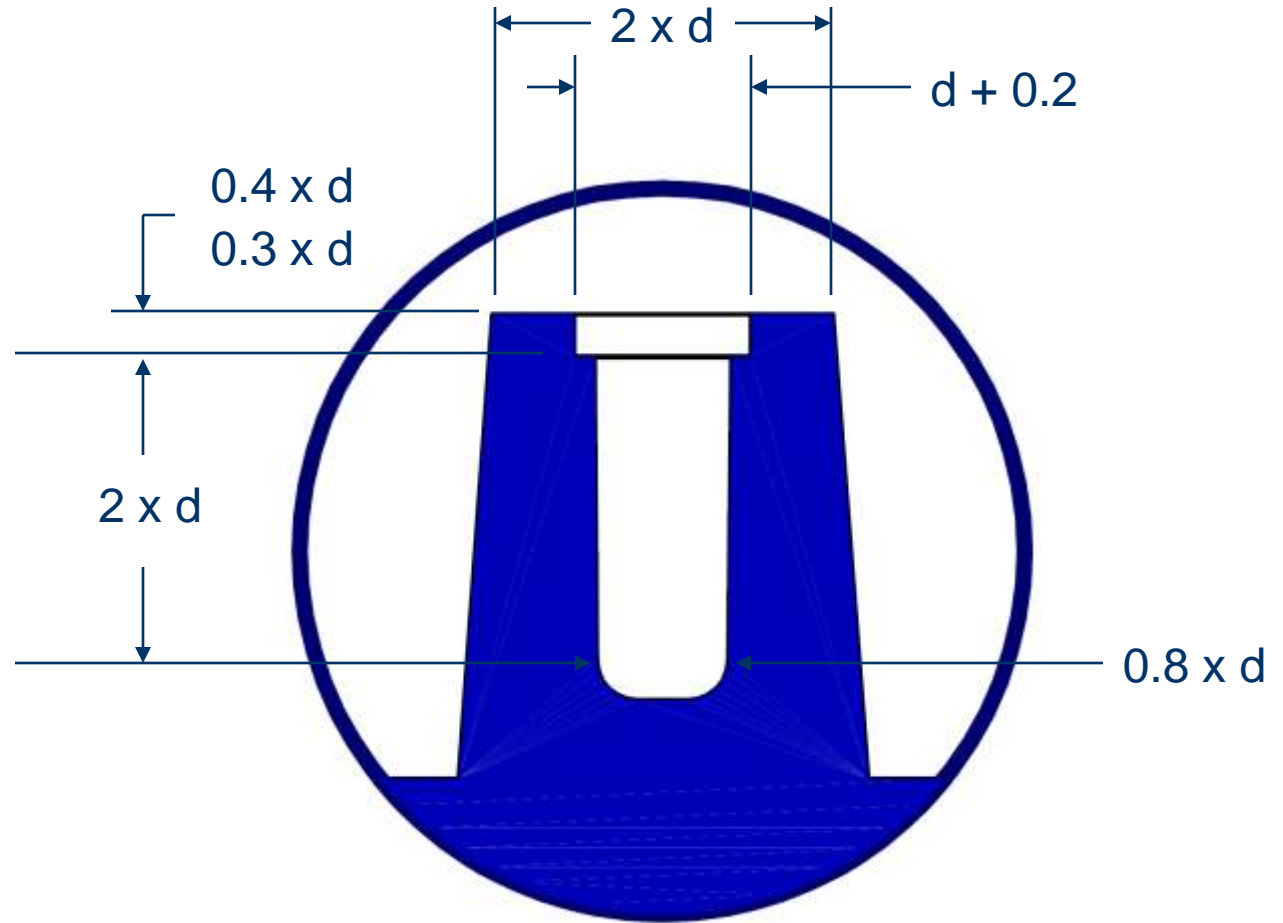


- Counterbore:
 - ensures favorable edge stress reduction and prevents cracking
 - acts as a guide during installation
- Deviations from $0.8 \times d$ hole recommendation may occur due to:
 - local textures caused by additives and filling
 - processing conditions of the material
 - design of the injection molding tool
 - distance to the injection point
 - formation of weld lines
 - variations in application components



Boss Design

precision components * smart solutions



d : diameter of fastener

1 max draft angle recommended



DELTA Calc

precision components * smart solutions



1999 Copyright© by EJOT GmbH & Co. KG

Zoomfaktor Bericht drucken ds20 bit

Schraube		Tubus		Auflage	
Schraubentyp	Delta-PT	Kunststoff	PA 6 GF30	Auflagematerial	Stahl
Außendurchmesser	do [mm] 5.00	Schraubloch	d [mm] 4.00	Durchgangsloch	d_l [mm] 5.20
Kopfdurchmesser	Dk [mm] 10.0	Tub. Außen Dmr.	D [mm] 10.0	Auflagedicke	l_k [mm] 10.00
Kopfform u. Oberfl.	Plan-Zink	kristallin (techn.Kunstst./Hochleist.-Polym)		freie Schr.-Länge	l_s [mm] 10.00
				Durchmesser des Ersatzzylinders nach VDI 2230 ermitteln	
				D_Ersatz	D_zyl [mm] 10.00
				gedr.Quersch.	A_ers [mm²] 57.3

Vorgaben	
Belastung	dynamisch
Verspannung	Druck

Verschrauben		Vorgaben		
Einschraubtiefe	te [mm] 10.00	mittel	min	max
Vorspannkraft	Fv [kN] 2.00	Anzieh-Ma [Nm] 4.03		
Betriebskraft (axial)	FA [kN] 5.00	Eindreh-Me [Nm] 2.09 1.90 2.29		
Restklemmkraft	FA [kN] 1.35	Überdreh-MÜ [Nm] 6.31 5.49 7.13		

Auswertung		kein Ausfall		
Versagen bei:	Fv [kN]	mittel	min	max
		Threadstrip [kN] 4.34 3.83 4.86		
Lastwechsel [1x10 ⁷]	62			

Relaxation	
Zeit(min. Lebens.)	t_rel [h] bzw. [J] 88000 10.1
Vorspannung	s_v [N/mm²] 56.34
Verlustspannung	s_ver [N/mm²] 14.33
Vorspannkraft-Rest	FA [kN] 0.51

Montage		zul. Schraubertol.		
Schraubertol. [%] 10%		41.1%		
BAYER FV_min		Schrauber		
MA_max [Nm]	3.36 2.80 5.49	5.49		
MA_mittel [Nm]	3.05 2.55 4.99	3.89		
MA_min [Nm]	2.75 2.29 4.49	2.29		
FV_mont_max [kN]	1.10 0.52 3.30	3.30		
FV_mont_mittel [kN]	0.79 0.26 2.79	1.65		
FV_mont_min [kN]	0.47 0.00 2.27	0.00		

M/Fv-Diagramm Delta-PT

Y-axis: Fv [kN] (0.0 to 14.0)
X-axis: M [Nm] (0 to 9)

Legend: Montage-Linie (green), Delta PT Bruch (red), Threadstrip (yellow), Tubus_Stauchen (cyan), Ausfall (red circle), Tolerance (red line)

Verspannungsdreieck

Y-axis: Kräfte [kN] (0.0 to 8.0)
X-axis: Federwege 0,01 mm (0 to 7.0)

Montage

Y-axis: MA [Nm] (0.0 to 6.0)
X-axis: Fv [kN] (0.0 to 6.0)

Legend: Programm (pink), BAYER (red), FV_min (orange), FV_max (yellow), Schrauber (blue), MA_Kanal (green), Mtl_min (cyan), Mc_max (black), Ms_Prog (light blue)



DELTA PT[®] vs AB Screw

Strip-to-Drive Ratio

precision components * smart solutions

Boss Material: ABS Axial Thread Engagement: 10 mm



	DELTA PT[®] 35	M3.5 AB Screw
Average Driving Torque (Nm)	0.23	0.27
Average Stripping Torque (Nm)	1.69	1.56
Strip-to-Drive Ratio	7.54	5.82

Boss Material: Nylon Axial Thread Engagement: 10 mm

	DELTA PT[®] 40	M4.2 AB Screw
Average Driving Torque (Nm)	0.27	0.33
Average Stripping Torque (Nm)	1.63	0.92
Strip-to-Drive Ratio	6.09	2.79



precision components * smart solutions

DELTA PT[®] vs HiLo Screw

Strip-to-Drive Ratio



Boss Material: PC/ABS

Axial Thread Engagement: 20 mm

	DELTA PT[®] 40	M4.2 HiLo Screw
Average Driving Torque (Nm)	0.54	1.24
Average Stripping Torque (Nm)	3.55	3.68
Strip-to-Drive Ratio	6.60	2.98

Boss Material: 20% Glass Filled Polypropylene

Axial Thread Engagement: 20 mm

	DELTA PT[®] 45	M4.2 HiLoScrew
Average Driving Torque (Nm)	1.12	1.12
Average Stripping Torque (Nm)	6.36	2.54
Strip-to-Drive Ratio	5.68	2.27

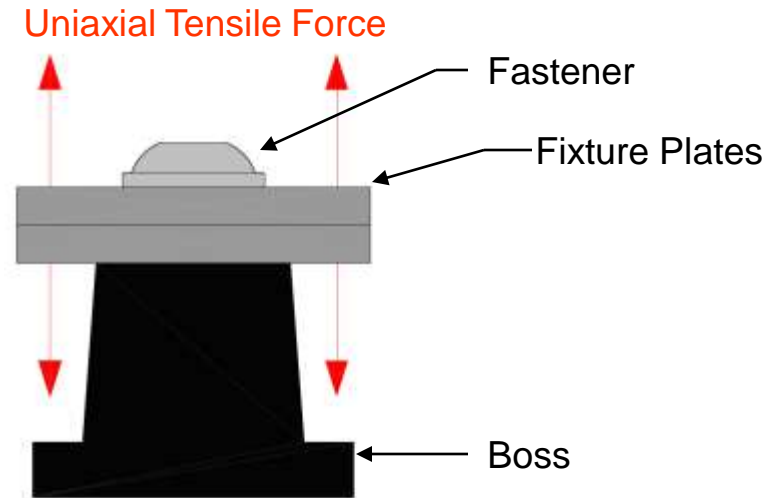


precision components * smart solutions

DELTA PT[®] vs AB and HiLo Screws

Pull-Out Force

Testing Setup



Boss Material: PC/ABS

Axial Thread Engagement: 8 mm

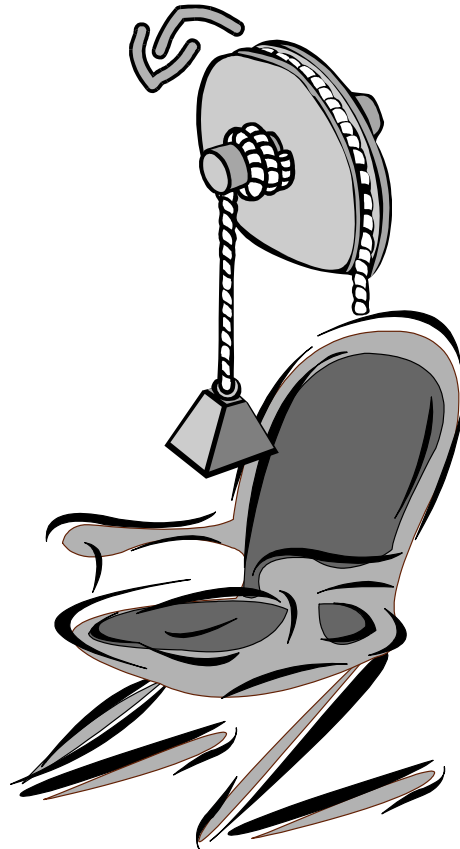
Installation Torque: 1.32 Nm

	DELTA PT[®] 40	M4.2 AB Screw	M4.2 HiLo Screw
Average Pull-Out Force (lbs)	675	495	542
Average Pull-Out Force (N)	3003	2202	2411



precision components * smart solutions

Performance Testing



Office Chair

Material: Polypropylene

Requirements: Cyclic loading

Screw: Delta PT® 60

Fastener requirement:

100,000 cycles with 1000 N testing force.

-On average, the K thread PT® withstood **14,500** cycles.

-- The DELTA PT® screw lasted for **259,000** cycles (due to higher mechanical strength) .



Clamp Load Testing Capabilities

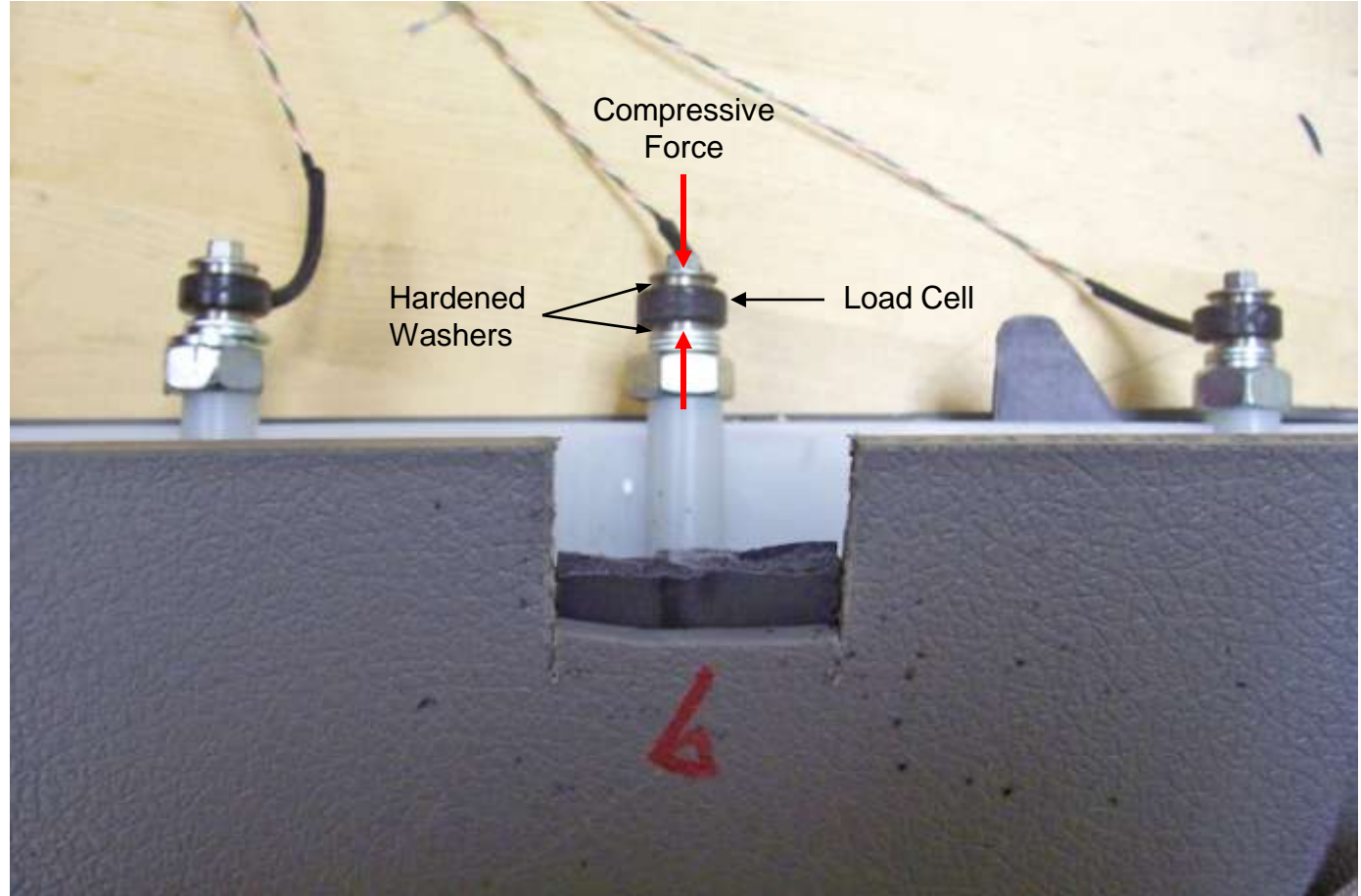
precision components * smart solutions





Clamp Load Testing Capabilities

precision components * smart solutions

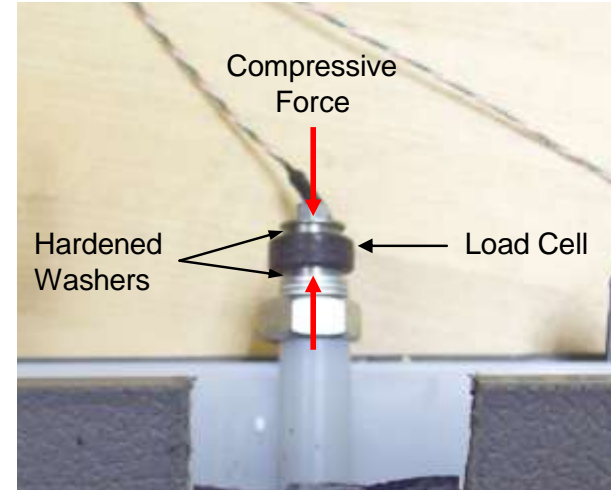




precision components * smart solutions

DELTA PT[®] vs AB and HiLo Screws Clamp Load

Testing Setup



Boss Material: PC/ABS

Testing Conditions Requested: 8 hour thermal variation from 60°C to -20°C

Installation Torque: 1.32 Nm

	DELTA PT[®] 40	M4.2 AB Screw	M4.2 HiLo Screw
Initial Clamp Load (lbs)	346.19	151.83	119.47
Final Clamp Load (lbs)	221.55	20.46	44.61
Percent Retention of Clamp Load	64%	13%	37%



Clamp Load Retention Test Results

precision components * smart solutions



Fastener	Average Tightening Torque	Average Break-Loose Torque	Average Initial Clamp Load	Average Final Clamp Load	Percent Retention of Clamp Load
DELTA PT[®] 40	5.13 in-lbs (0.58 Nm)	4.25 in-lbs (0.48 Nm)	128 lbs (570 N)	88 lbs (391 N)	69%
M4.2 Hi-Lo	9.73 in-lbs (1.10 Nm)	2.12 in-lbs (0.24 Nm)	78 lbs (348 N)	35 lbs (156 N)	45%

Average Thread Engagement

DELTA PT[®] 40 : 11.5 mm

M4.2 Hi-Lo: 13.8 mm

Testing Conditions

Eight hour thermal variation from 60°C to -20°C



precision components * smart solutions

DELTA PT[®]

Serviceability Testing: 100x Repeat Assembly with Oil



Fastener Tested

DELTA PT[®] 60 x 2.14 x 30 Torx Round Washer Head w/Dog Point (P2996002)

Application

Air Cleaner Housing (manufactured by Denso for use on GM vehicle)

Test Procedure

- 1) On 1st assembly, tighten (3.8 Nm) without oil, leave to cool for 5 minutes, then loosen.
- 2) Apply oil to screws, then tighten (3.8 Nm) and loosen 3 times, then allow to cool for 5 minutes (use blower to assist cooling of the material and gun).
- 3) Repeat steps 1-2 100 times, but apply oil every 9th iteration.
Record Break-loose Torque every 10th iteration.



precision components * smart solutions

DELTA PT®

Serviceability Testing: 100x Repeat Assembly with Oil

Test Results



	1st Trial		2nd Trial		3rd Trial		4th Trial	
Drive #	Installation Torque (N-m)	Removal Torque (N-m)	Installation Torque (N-m)	Removal Torque (N-m)	Installation Torque (N-m)	Removal Torque (N-m)	Installation Torque (N-m)	Removal Torque (N-m)
1	3.81	4.18	3.82	4.12	3.83	4.16	3.81	4.04
10	3.82	2.52	3.82	2.46	3.83	2.38	3.81	2.16
20	3.81	2.08	3.81	2.14	3.82	2.03	3.82	1.90
30	3.83	2.01	3.83	1.98	3.82	1.76	3.83	1.75
40	3.82	1.79	3.82	1.82	3.83	1.66	3.82	1.69
50	3.84	1.71	3.83	1.69	3.82	1.59	3.82	1.65
60	3.83	1.57	3.82	1.87	3.82	1.61	3.82	1.38
70	3.82	1.79	3.83	2.11	3.84	1.78	3.83	1.70
80	3.82	1.67	N/A	N/A	3.83	1.60	3.83	1.59
90	3.83	1.68	N/A	N/A	3.83	1.45	3.83	1.55
100	3.83	1.83	N/A	N/A	3.82	1.86	3.82	1.83
	Stripped at 103 rd drive		Stripped at 73 rd drive		Stripped at 105 th drive		Stripped at 104 th drive	
Average	3.82	2.08	3.82	2.27	3.83	1.99	3.82	1.93
Standard Deviation	0.01	0.75	0.01	0.78	0.01	0.76	0.01	0.73

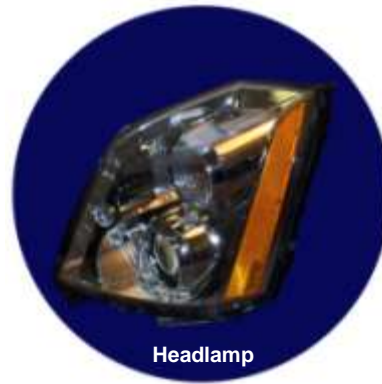


precision components * smart solutions

Applications



- **Air Bag Modules**
- **Trunk and Door Latches**
- **Door Panels**
- **Power Window Motors**
- **Tail Lamps**
- **Fuel Rails**
- **Air Flow Sensors**
- **Cooling Fans**
- **Seatbelt Housings**
- **Instrument Panels**
- **Battery Housings**





precision components * smart solutions

Applications Laboratory Services

- Fastener Design Recommendations
- Boss Design Recommendations
- Drive and Strip Torque Testing
- Clamp Load Testing
- Environmental Testing
- Tensile Testing
- Serviceability Testing



precision components * smart solutions

Applications Laboratory





DELTA PT[®]

A Superior Thread-former for Plastics