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DELTA PT<sup>®</sup>

A Superior Thread-former for Plastics



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# Plastic Joint Design Considerations

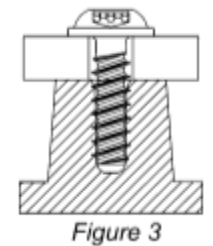
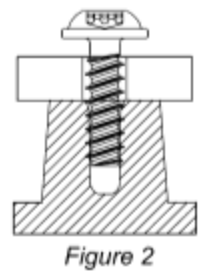
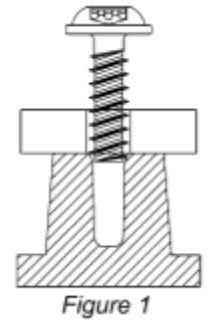
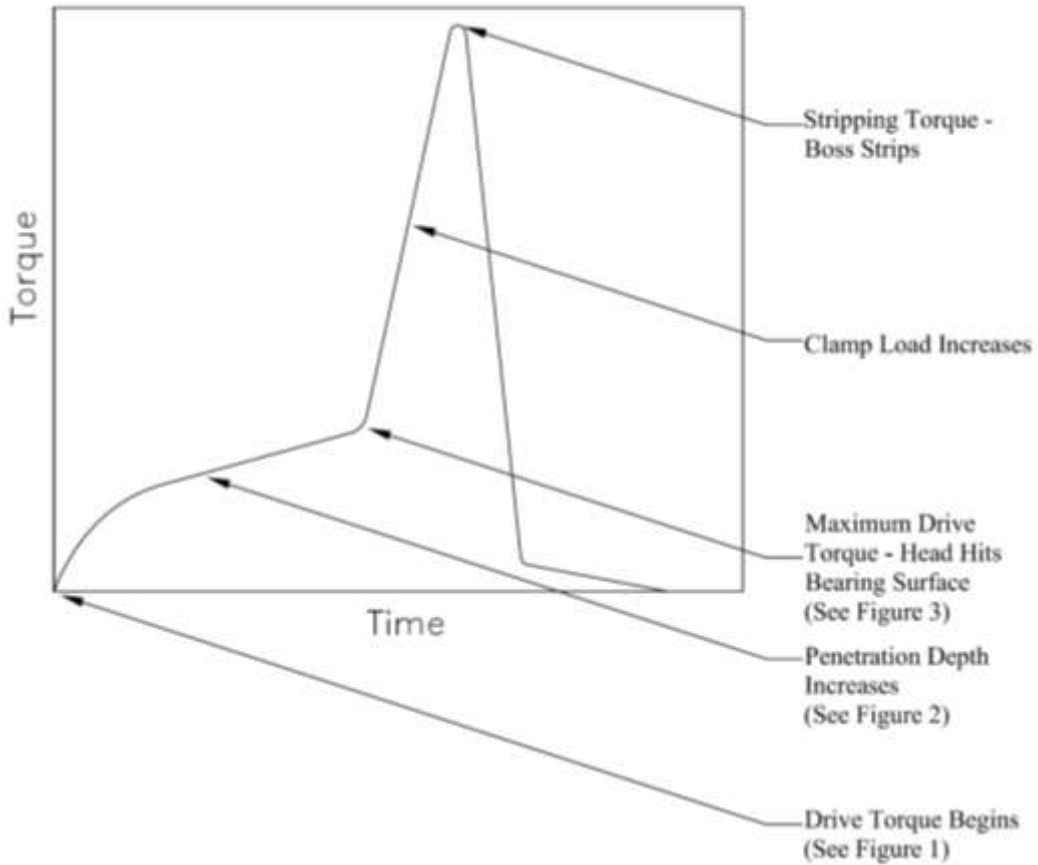


- Low radial stress
- Joint stability
- High mechanical strength
- Vibration resistance
- Serviceability
- High strip-to drive ratio



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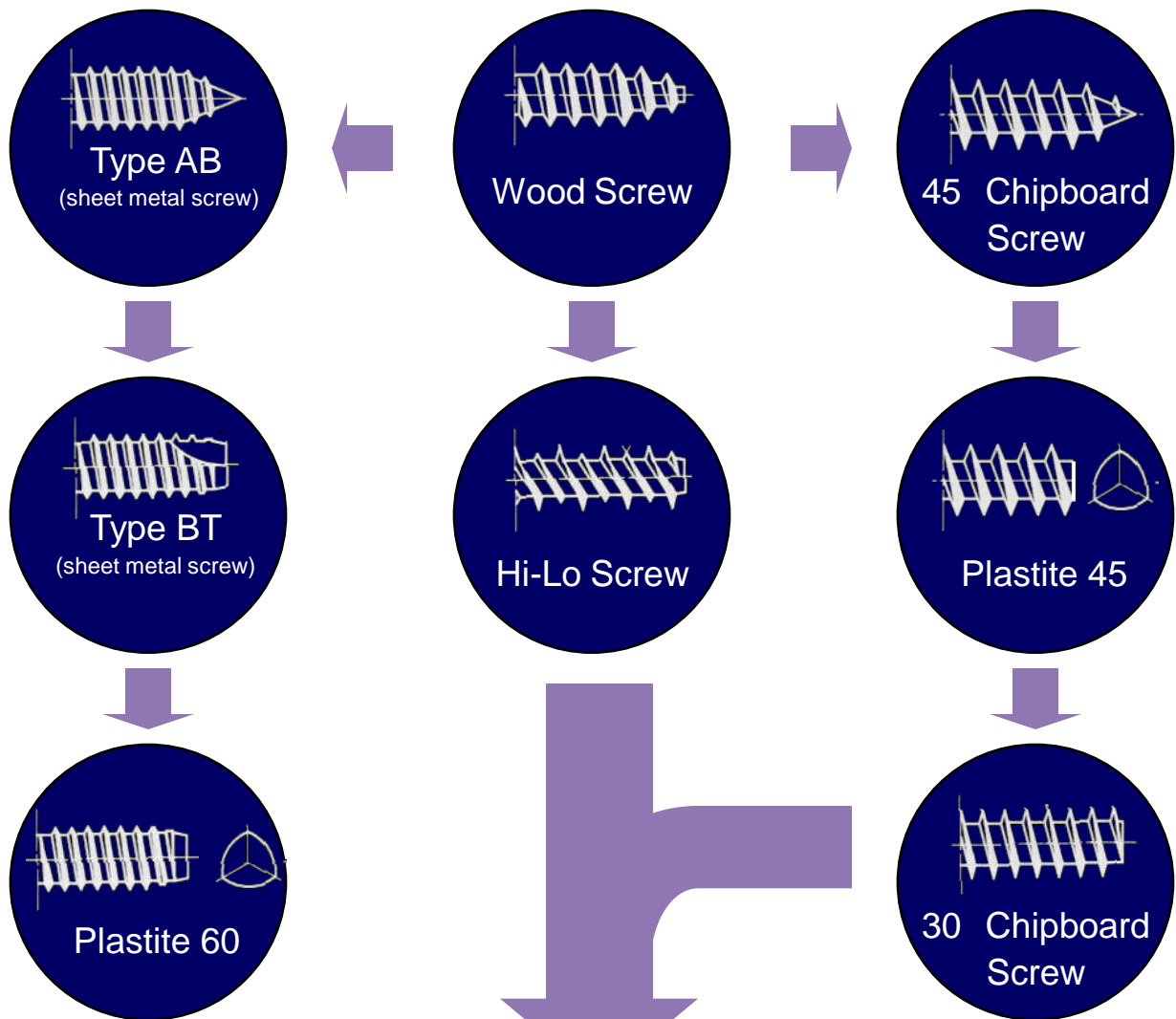
# Drive and Strip Torque Explanation





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# Evolution of Thread-Forming Fasteners



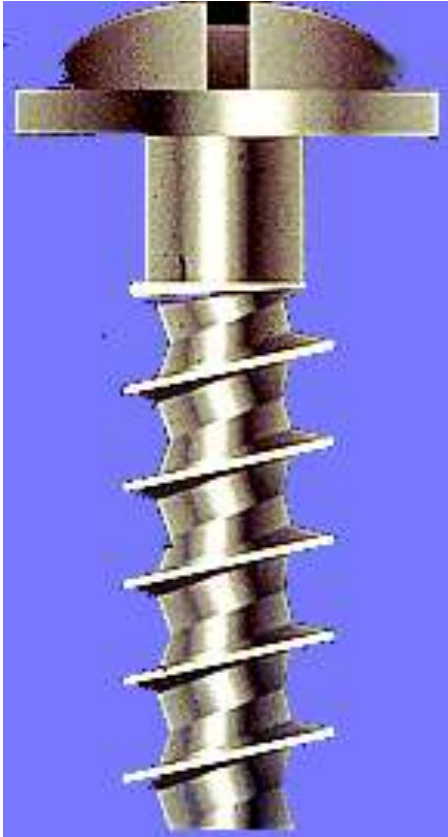


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# Evolution of Thread-Forming Fasteners



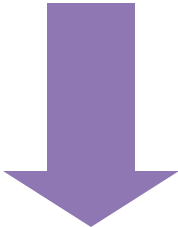
*30° Flank Angle*



*Cored Root*



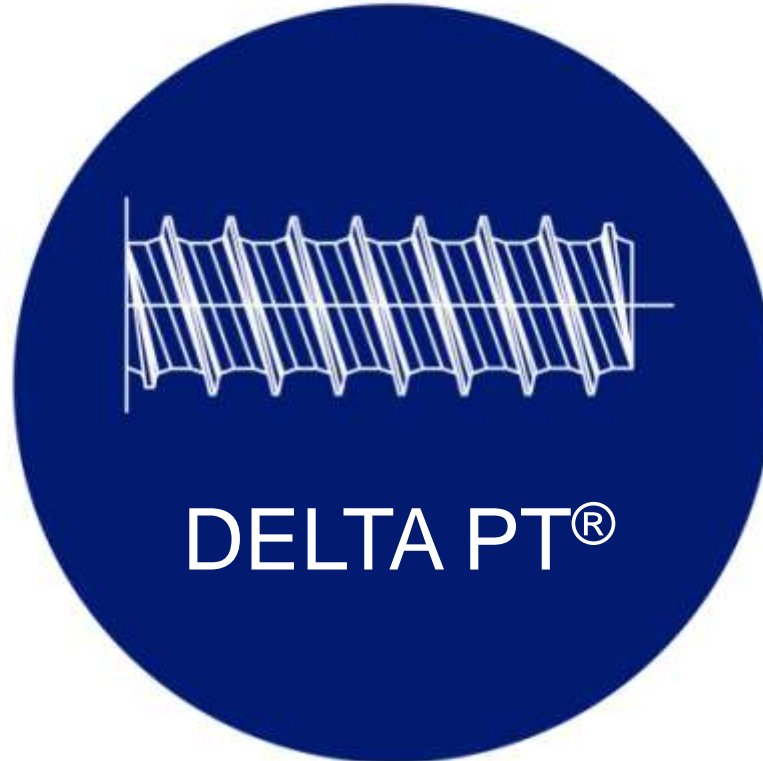
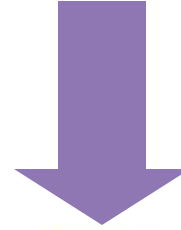
*8° Helix Angle*





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# Evolution of Thread-Forming Fasteners





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# DELTA PT<sup>®</sup> Features



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



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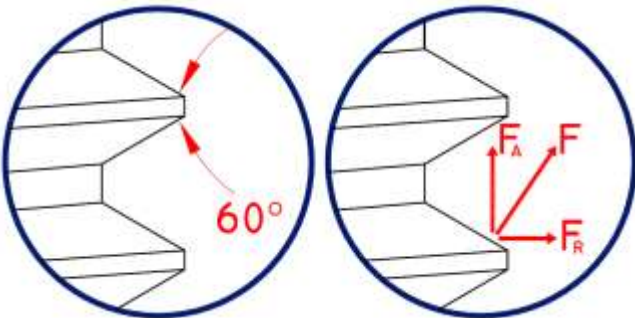
# Reduced Radial Stress

## Innovative Flank Geometry

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

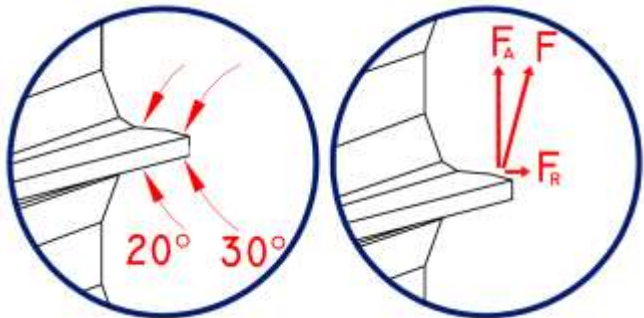


Other Thread-Formers



$$F_R = 0.50F$$

DELTA PT®



$$F_R = 0.26F$$



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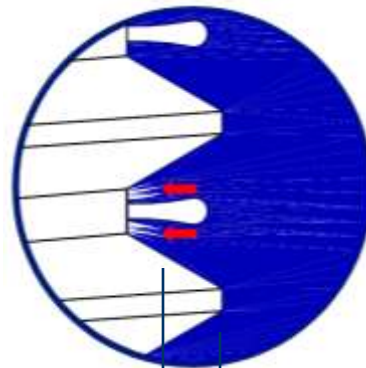
# Increased Joint Stability

## Reinforced cored root

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

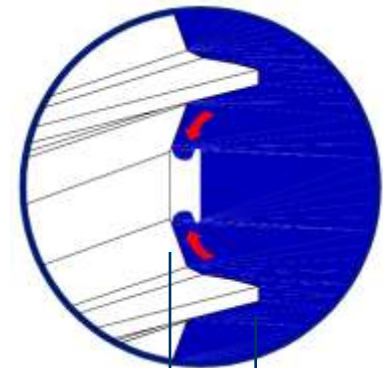


Other Thread-Formers



→ ← 60%

DELTA PT®



→ ← 100%

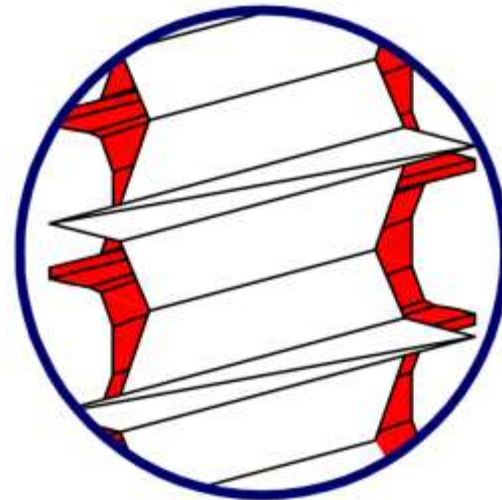


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# High Mechanical Strength

## 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®

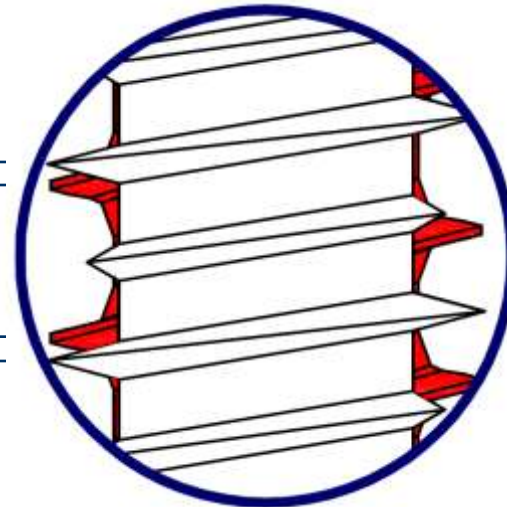


# Superior Vibration Resistance

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## 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

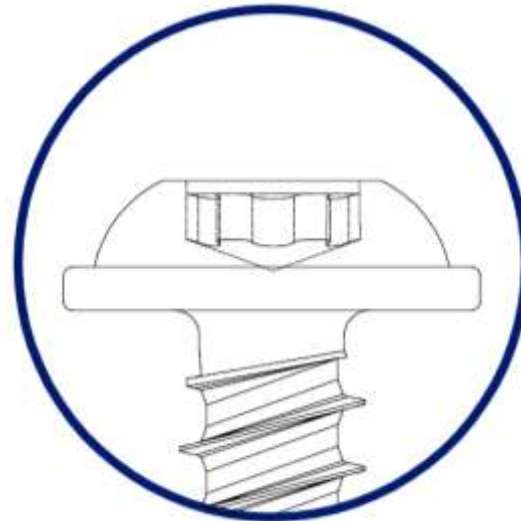


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# Excellent Serviceability

## 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





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# Boss Design

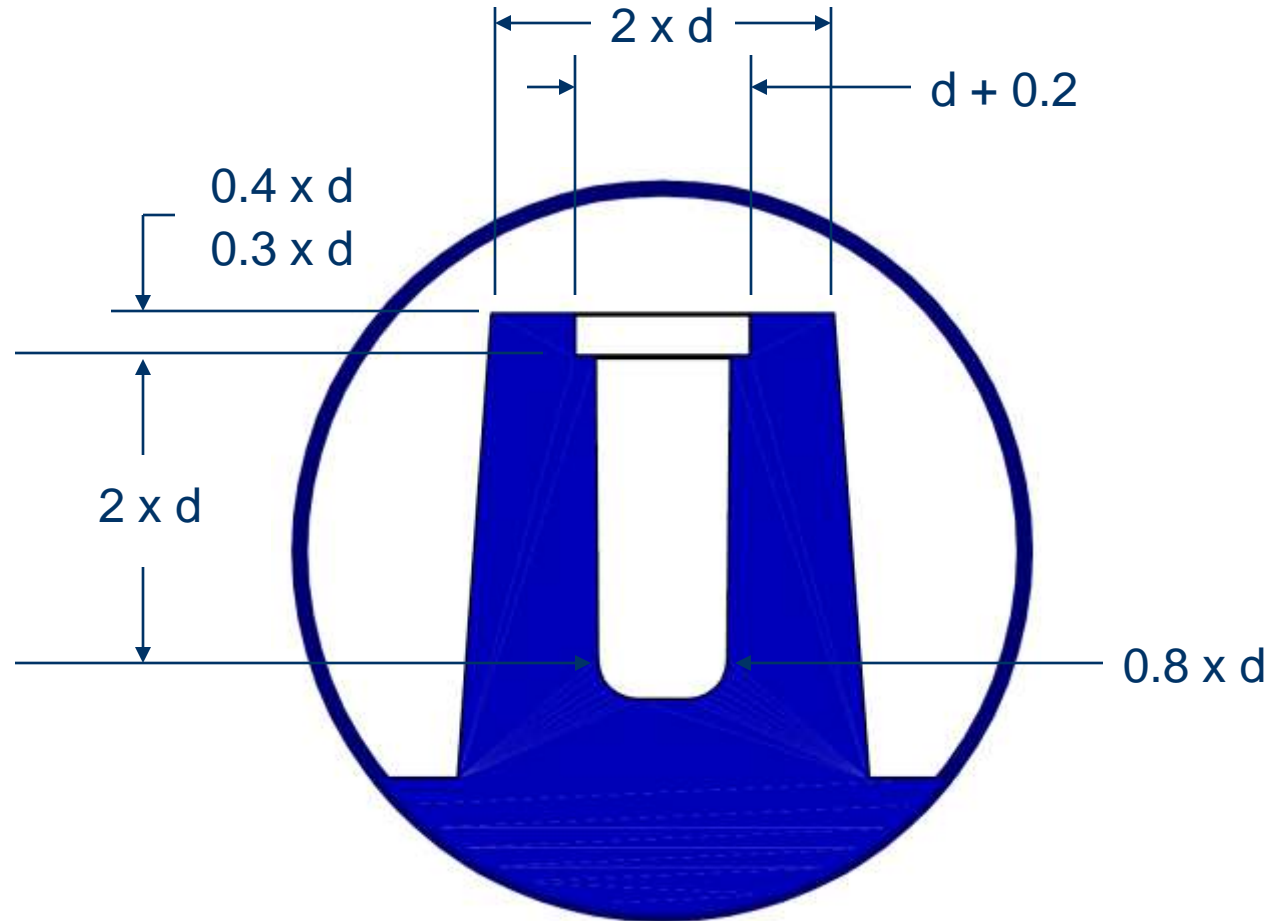


- Counterbore:
  - ensures favorable edge stress reduction and prevents cracking
  - acts as a guide during installation
- Deviations from 0.8 x d hole recommendation may occur due to:
  - local textures caused by additives and filling
  - processing conditions of the material
  - design of the injection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



# Boss Design

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$d$ : diameter of fastener

1 max draft angle recommended



# DELTA Calc

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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
Vorspannkraft	Fv [kN] 2.00			max
Betriebskraft (axial)	FA [kN] 5.00	Anzieh-Ma [Nm]	4.03	
Restklemmkraft	FA [kN] 1.35	Eindreh-Me [Nm]	2.09	1.90 2.29
		Überdreh-MÜ [Nm]	6.31	5.49 7.13

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

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. [%]		41.1%		
	BAYER	FV_min	FV_max	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 (0.0 to 7.0)

**Montage**

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

Legend: Programm (magenta), 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<sup>®</sup> vs AB Screw

## Strip-to-Drive Ratio

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**Boss Material: ABS Axial Thread Engagement: 10 mm**



	<b>DELTA PT<sup>®</sup> 35</b>	<b>M3.5 AB Screw</b>
<b>Average Driving Torque (Nm)</b>	0.23	0.27
<b>Average Stripping Torque (Nm)</b>	1.69	1.56
<b>Strip-to-Drive Ratio</b>	<b>7.54</b>	5.82

**Boss Material: Nylon Axial Thread Engagement: 10 mm**

	<b>DELTA PT<sup>®</sup> 40</b>	<b>M4.2 AB Screw</b>
<b>Average Driving Torque (Nm)</b>	0.27	0.33
<b>Average Stripping Torque (Nm)</b>	1.63	0.92
<b>Strip-to-Drive Ratio</b>	<b>6.09</b>	2.79



# DELTA PT<sup>®</sup> vs HiLo Screw

## Strip-to-Drive Ratio

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**Boss Material: PC/ABS**

**Axial Thread Engagement: 20 mm**



	<b>DELTA PT<sup>®</sup> 40</b>	<b>M4.2 HiLo Screw</b>
<b>Average Driving Torque (Nm)</b>	0.54	1.24
<b>Average Stripping Torque (Nm)</b>	3.55	3.68
<b>Strip-to-Drive Ratio</b>	<b>6.60</b>	2.98

**Boss Material: 20% Glass Filled Polypropylene**

**Axial Thread Engagement: 20 mm**

	<b>DELTA PT<sup>®</sup> 45</b>	<b>M4.2 HiLoScrew</b>
<b>Average Driving Torque (Nm)</b>	1.12	1.12
<b>Average Stripping Torque (Nm)</b>	6.36	2.54
<b>Strip-to-Drive Ratio</b>	<b>5.68</b>	2.27

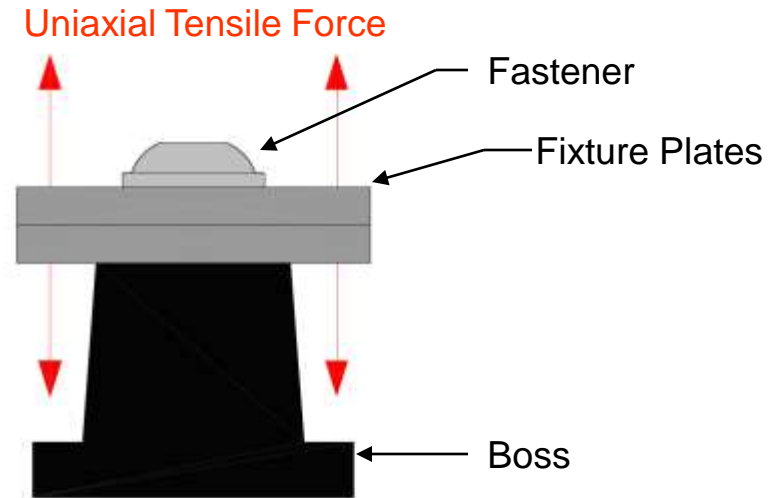


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# DELTA PT<sup>®</sup> vs AB and HiLo Screws

## Pull-Out Force

### Testing Setup



**Boss Material:** PC/ABS

**Axial Thread Engagement:** 8 mm

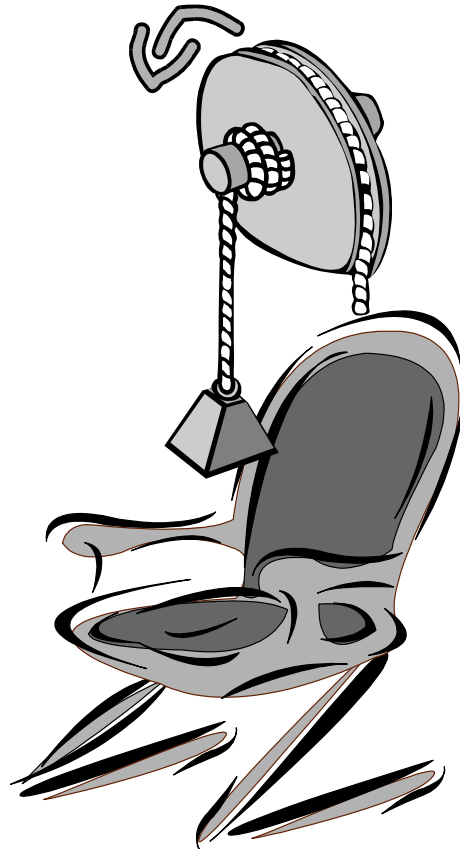
**Installation Torque:** 1.32 Nm

	<b>DELTA PT<sup>®</sup> 40</b>	<b>M4.2 AB Screw</b>	<b>M4.2 HiLo Screw</b>
<b>Average Pull-Out Force (lbs)</b>	675	495	542
<b>Average Pull-Out Force (N)</b>	3003	2202	2411



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# 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

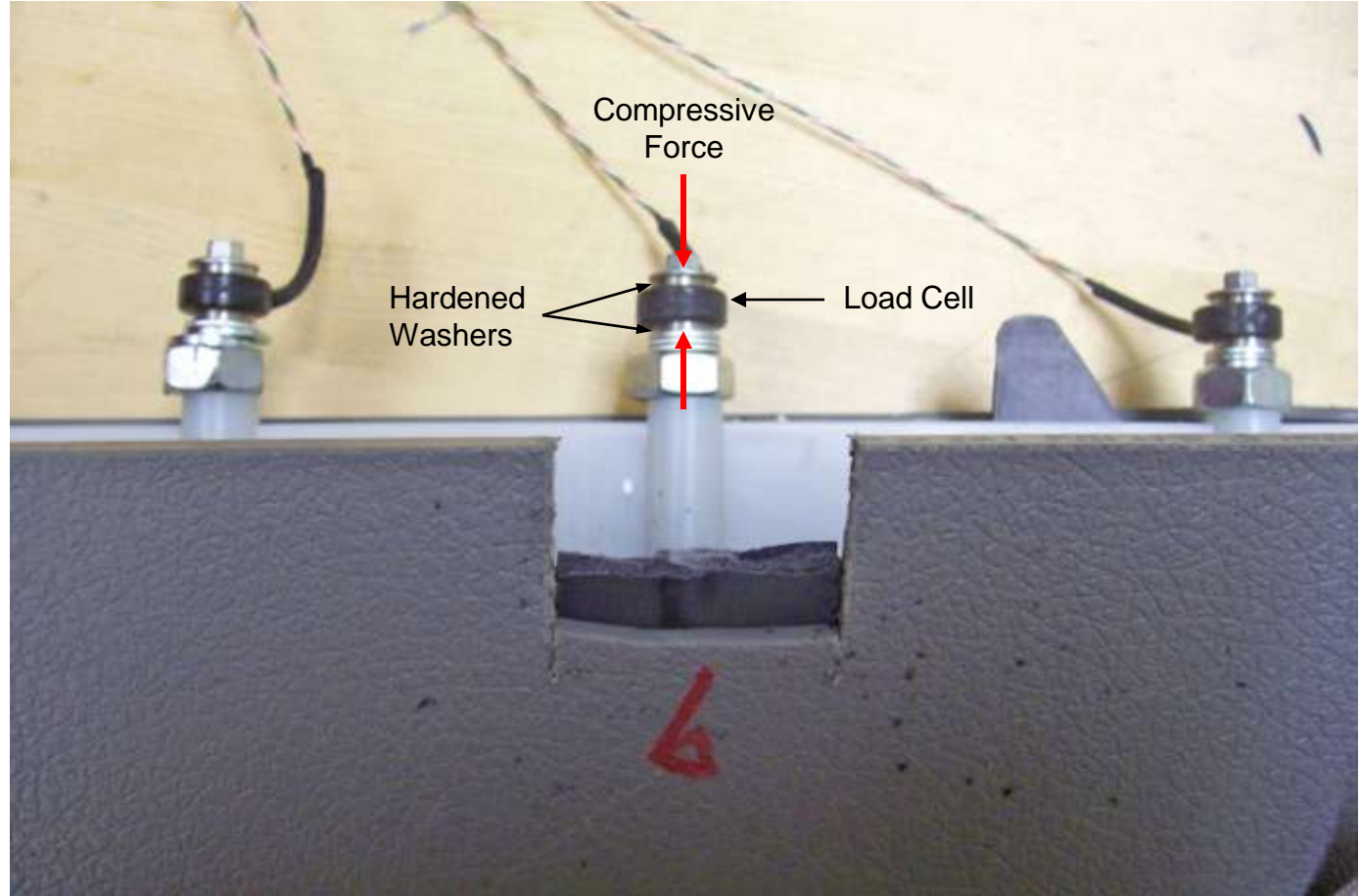
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# Clamp Load Testing Capabilities

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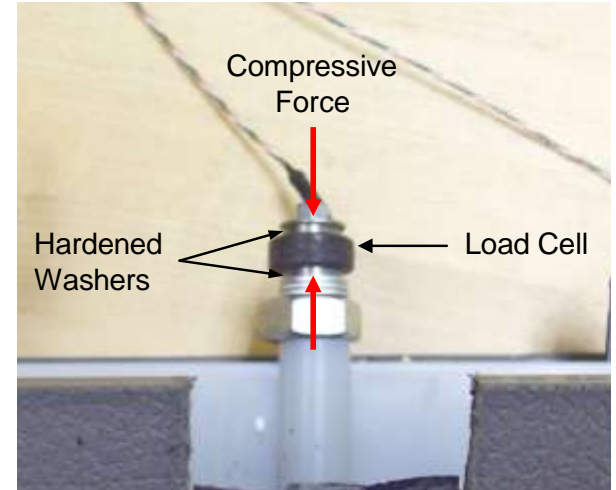




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# DELTA PT<sup>®</sup> vs AB and HiLo Screws Clamp Load

## Testing Setup



**Boss Material:** PC/ABS

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

**Installation Torque:** 1.32 Nm

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



# Clamp Load Retention Test Results

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Fastener	Average Tightening Torque	Average Break-Loose Torque	Average Initial Clamp Load	Average Final Clamp Load	Percent Retention of Clamp Load
<b>DELTA PT<sup>®</sup> 40</b>	5.13 in-lbs (0.58 Nm)	4.25 in-lbs (0.48 Nm)	128 lbs (570 N)	88 lbs (391 N)	69%
<b>M4.2 Hi-Lo</b>	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<sup>®</sup> 40 : 11.5 mm

M4.2 Hi-Lo: 13.8 mm

## Testing Conditions

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



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# DELTA PT<sup>®</sup>

Serviceability Testing: 100x Repeat Assembly with Oil



## Fastener Tested

DELTA PT<sup>®</sup> 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 1<sup>st</sup> 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 9<sup>th</sup> iteration.  
Record Break-loose Torque every 10<sup>th</sup> iteration.



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# 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 <sup>rd</sup> drive		Stripped at 73 <sup>rd</sup> drive		Stripped at 105 <sup>th</sup> drive		Stripped at 104 <sup>th</sup> drive	
<b>Average</b>	3.82	2.08	3.82	2.27	3.83	1.99	3.82	1.93
<b>Standard Deviation</b>	0.01	0.75	0.01	0.78	0.01	0.76	0.01	0.73



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# 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**





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# Applications Laboratory Services

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



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# Applications Laboratory





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