Semblex

EVO PT®

EVOPT® screw

The evolution of direct fastening into plastic

EVO PT®

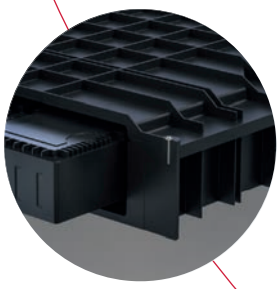
Evolutionary advantages for your plastic components

The EVO PT® is the evolutionary development of the self-tapping screw for thermoplastics. With this innovative fastening solution, EJOT has successfully combined production and application technology knowledge with new methods based on physical computer simulations for the first time. The result is a screw which sets completely new standards in direct fastening into plastic.

More reliable positioning, high fastening quality
The newly developed "start-of-thread" of the EVO PT® allows for an easy and straight positioning in the screw hole. The special positioning thread thus generates an equal load distribution over the circumference of the thread flanks in installed condition, since the screw is centered automatically in the screw hole during the installation. This ensures a high repeat accuracy and a significantly higher fastening quality.

Reduced parts variety, increased economic efficiency
During the installation phase, the innovative forming thread turn creates a torque curve which is virtually independent of the installation depth. This enables smaller installation spaces or a standardisation of screw lengths and tightening torques which directly have an impact on your process chain.

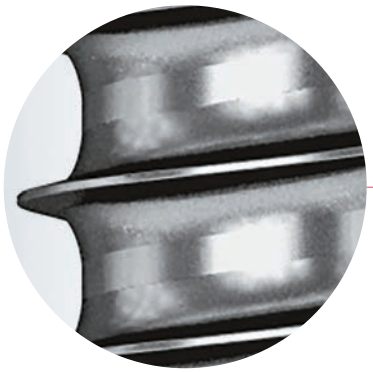
Digital service for optimised components
The digital calculation service EVO CALC® offers you the possibility to pre-calculate the torques and clamp loads as well as the clamp load relaxation under temperature and time. Furthermore, EJOT provides you with an individual, FEM-based component analysis with which you save time and money - beginning with the design of your component.

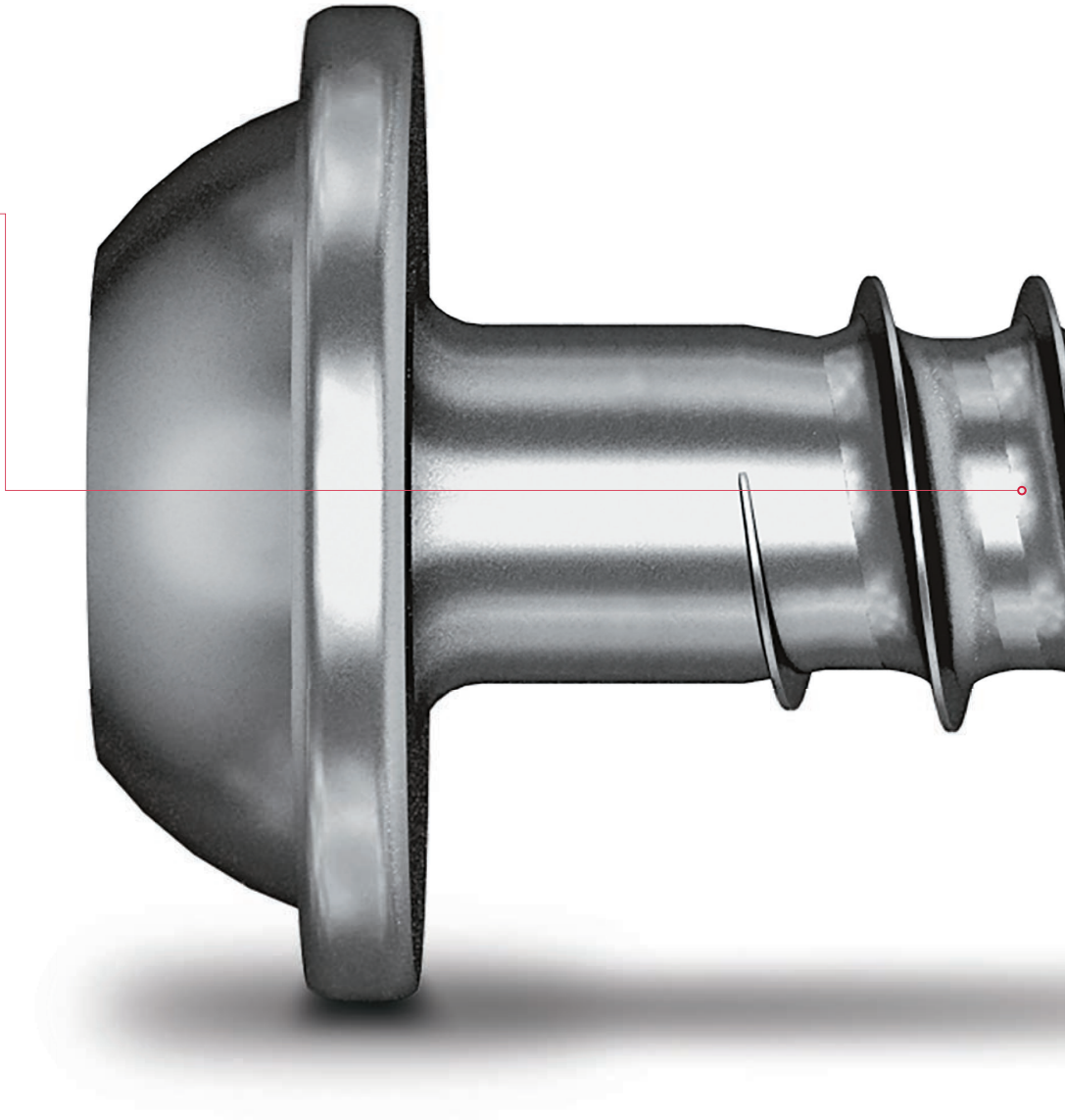


The first intelligent thread!

Characteristics and features of the EVO PT® screw

The EJOT team developed the EVO PT® drawing on vast experience and a genuine passion for fastening technology. Nothing has been left to chance, everything consistently geared to your benefit. The key features at a glance:

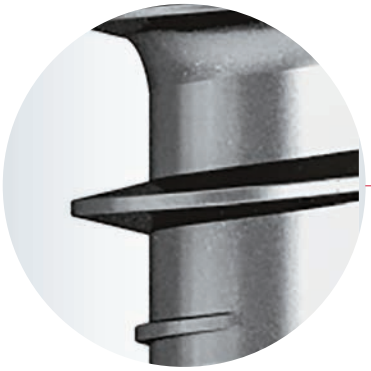




Bionic contour

Safety margins for challenging applications

- Higher fatigue strength
- Higher breaking torque
- Higher tensile breaking stress



Thread forming zone

Reduced friction during thread forming
- Thread forming torque is virtually independent of the installation depth
- Installation-depth-independent tightening torques
- Reduced parts variety - one screw, one tightening torque per assembly group
- Uniform tube design
- Supports carry-over part strategies

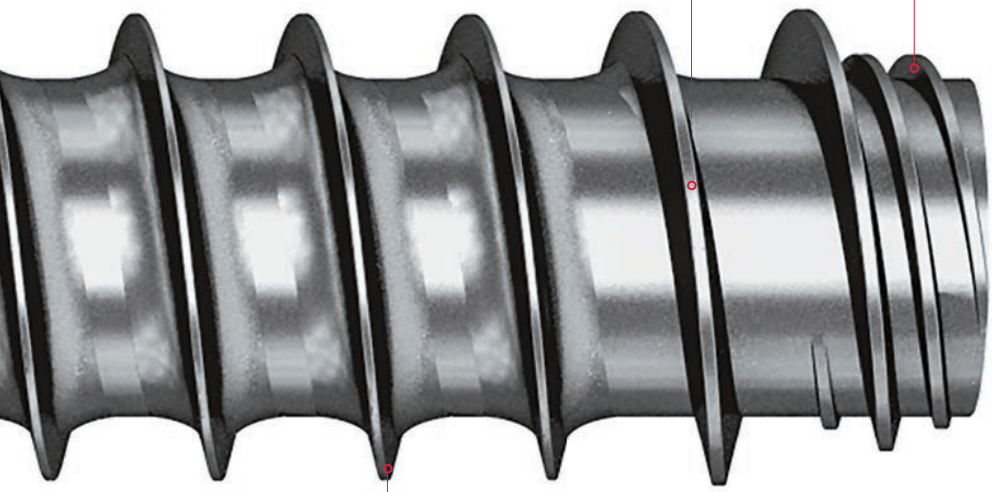
Large torque window thanks to small installation torque T_i
- High installation reliability
- High plant availability
- Compensation of process fluctuations

Lead-in thread

Automatic centring of the screw in the screw hole
- Stable installation process during initial assembly
- Line-integrated, fully automated repeat assembly
- Constant, low-stress surface connection

Smaller counterbore depth
- Less installation space required
- Usage of purchased parts possible without unloading

Automatic compensation in case of axial misalignment (screw/screw hole)
- Compensation of component tolerances

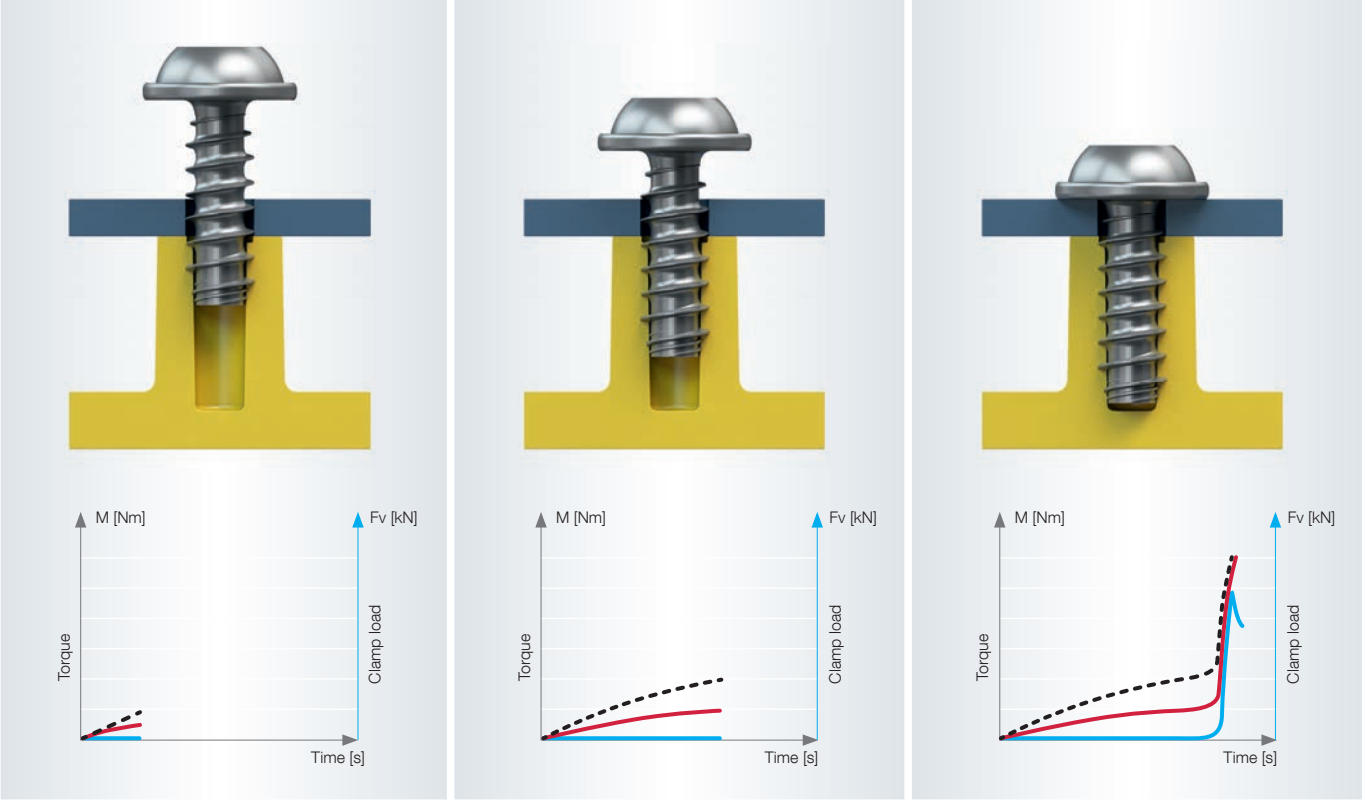


26° flank angle

Excellent plastic forming
- One flank geometry, suitable for all common thermoplastics
- Reduced radial load in the component

Constant torque over the installation depth

Installation of the EVO PT®



1 Application and forming of the first thread

2 Thread forming

3 Final tightening

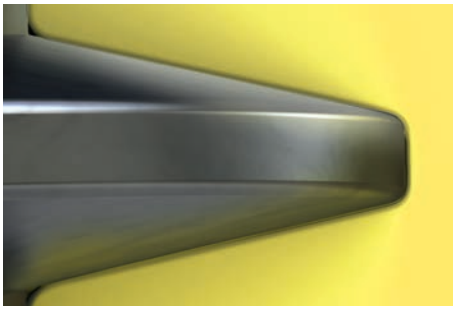
- Conventional torque curve in Nm
- Torque EVO PT® in Nm
- Clamp load in kN

The thread forming process

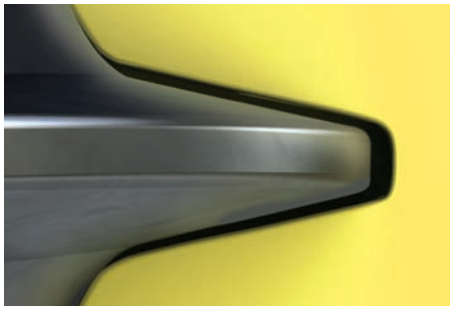
The unique thread forming zone of the EVO PT® allows for an almost constant installation torque over the installation depth.

The thread forming zone forms a thread turn in the female material which is slightly larger than the clearance that the following thread turns require. Thus, the EVO PT® creates a precisely calculated clearance so that the following thread turns can penetrate into the plastic without any appreciable friction. You can recognize this by the flattening installation torque curve with increasing installation depth (picture 1 and 2).

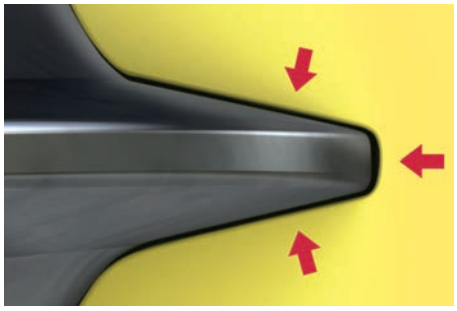
The clearance created through the pre-forming with the forming thread turn has a size which approximately corresponds to the elastic recovery of the used plastic material. This means that the plastic re-attaches to the thread flanks after the screw has been completely inserted (picture 3).



Thread forming zone forms thread turn into the material

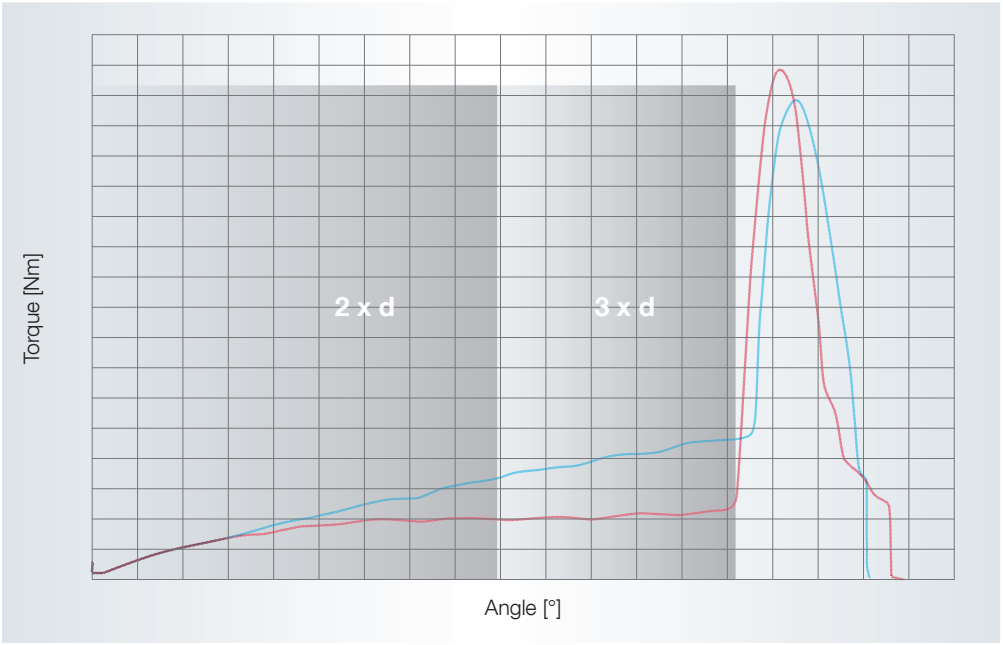


Clearance for following thread turns



Elastic recovery of the plastic material

This effect opens up completely new possibilities of component design and extended fields of application, since the complex and uneconomic compensation of different installation depths in the component for varying clamp part thicknesses can be omitted. You benefit from a significant reduction of parts variety and a standardised component design.



Torque curve of conventional direct fastening into plastic compared to the EVO PT®

— Conventional direct fastening into plastic
— EVO PT®

Advantages
- Variable installation depth
- Compensation of different clamping part thicknesses
- Reduction of part variety

EJOT EVO PT® – is all about you

Everyone is taken care of

It's part of our role to support your design work even before your customer places the order. Together, we can incorporate the positive benefits of direct fastening into plastic into your assembly application at an early stage. Since at the end of the day, the new EJOT EVO PT® is all about you, a better result for your customer and ultimately, your economic success.

We want you to
- plan and produce in a cost- and time-optimised way
- produce process-reliably and without errors
- enthuse your customers with your quality before and after the order placement
- receive the order
- quickly have your product ready for serial production

As a manufacturer of products and components, you not only have to control your production. Every process in your company has an impact on your overall success. That's why we keep an eye on the requirements of all persons involved in the overall process and provide you with measureable advantages thanks to the EVO PT®.

Advantages for

Design engineers

- Maximum mechanical safety
- Precise performance forecasting
- No thread inserts necessary
- Relieving the time budget

Advantages for

Process engineers

- Maximum plant availability
- Maximum process reliability
- Consolidation of parts
- Error avoidance
- Harmonised assembly concepts

Advantages for

Quality managers

- Reduced effort for sampling, series and inspection
- Low error potential
- Consolidation of parts

Advantages for

Purchasers

- Competitive purchase prices
- Consolidation of quantities
- Reduced complexity
- Low total project costs
- Consolidation of suppliers

Design recommendation

Simple and universal design recommendation for EVO PT® screws

The recommended counterbore depth is 0.1 x nominal diameter of the screw d_1.
A compensation of different clamping part thicknesses by means of different counterbore depths is eliminated, since the forming thread turn generates a virtually constant forming torque.

Since injection-moulded pre-holes are assumed, they usually have a draft angle of 1°, resulting in an pre-hole diameter of 0.85 x d_1, measured at the top of the pre-hole.

If component constraints mean that the design recommendation cannot be implemented in individual cases, the EVO CALC® calculation software offers the opportunity to assess these situations and make recommendations.

For a better measurability, the pre-hole diameter d_b at the top of the pre-hole is given as 0.85 × d_1.

Nominal diameter
of the screw in mm: d_1

Counterbore diameter:
$d_E = d_1 \times 1.05$

Hole diameter:
$d_b = 0.85 \times d_1 \pm 0.05$ mm

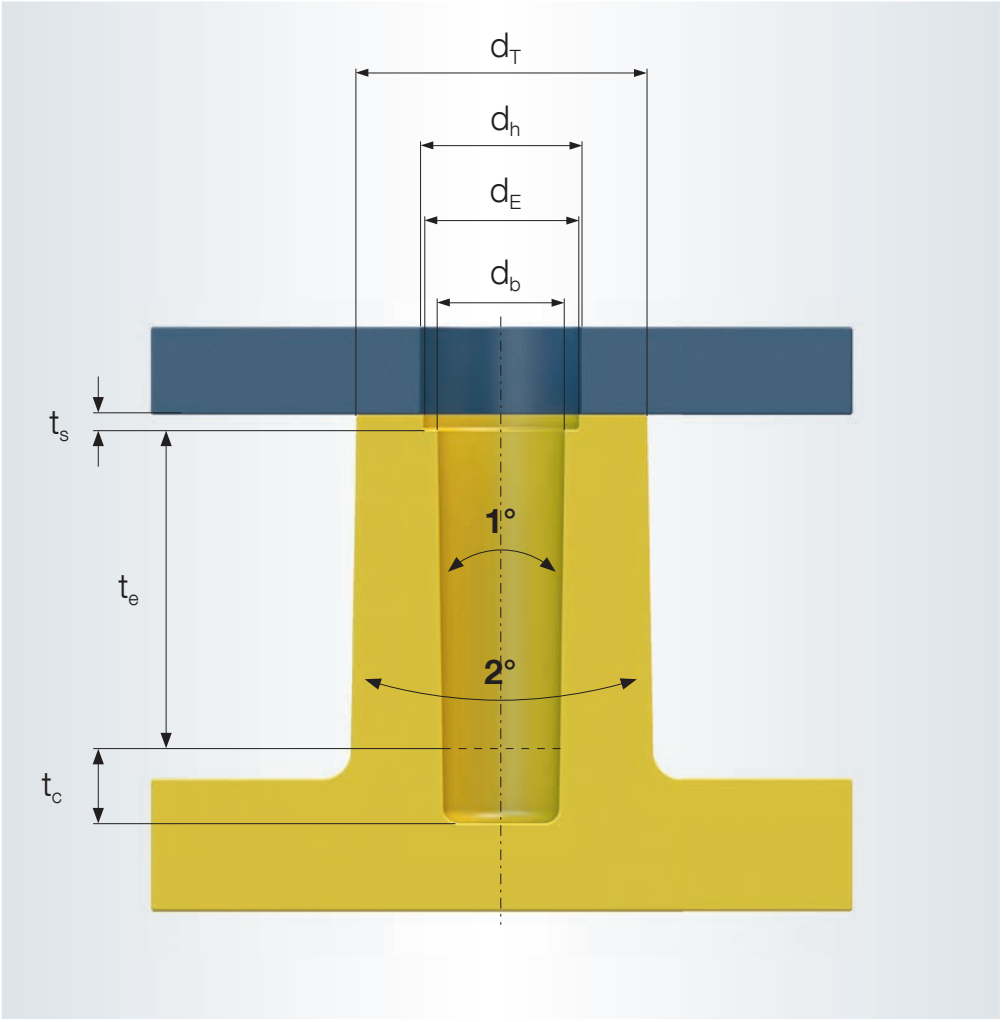
Installation depth:
t_e = 2 x d_1 or deeper

External boss Ø:
$d_T = 2 \times d_1$

Clearance hole Ø:
d_h = 1.05 bis 1.1 x d_1

Counterbore depth:
$t_s = 0.1 \times d_1$

Hole depth allowance:
$t_c = 0.5 \times d_1$



A screw goes digital

Your intelligent planning services

When configuring and using EVO PT® screws, you may benefit from these exclusive services:

EVO CALC® | **FEM** | **CAE**

Preliminary design of your screw joint with EVO CALC®

The prognosis program EVO CALC® especially developed for this screw enables the fast and precise determination of all values and information concerning the installation of the EVO PT® which are important for your project.

This comprises, for example, the creation of a design recommendation, the calculation of the relevant torques, the determination of different forces such as the clamp load at the tightening torque as well as the presentation of possible failure modes in case of overload. The results provide you with immediate information on whether your assembly group is already optimally designed for your requirements or what has to be done to achieve your optimum.

If you have any further questions, please do not hesitate to contact your application engineer.

Detail taken from the prognosis program EVO CALC®

Advantages

- Prediction of torques and clamp loads
- Early identification of failure risks
- Downsizing suggestion
- Saving of component tests

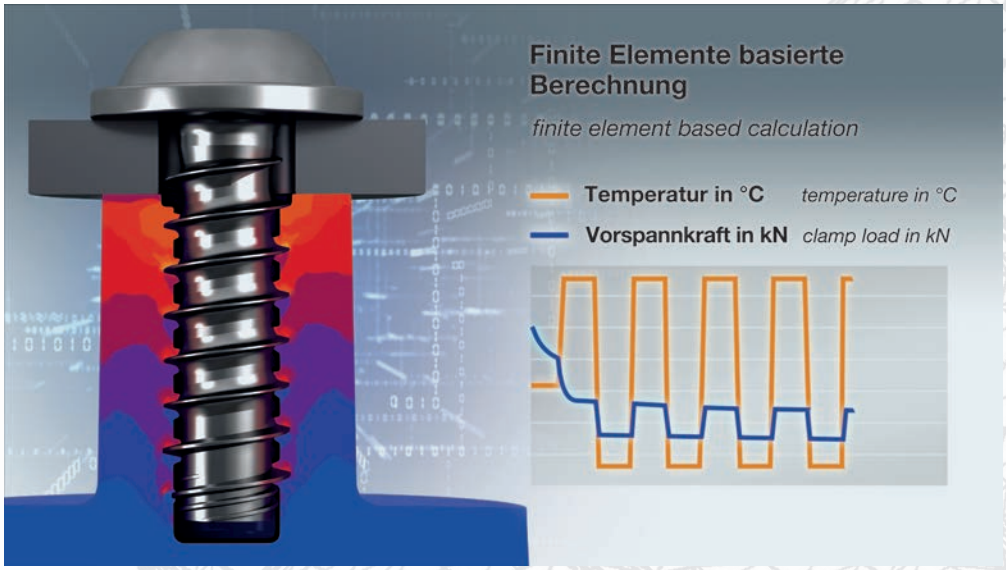
FEM

Even more planning safety with numeric calculation

The calculation of design and assembly parameters can be ensured quickly and with sufficient accuracy using analytical calculation methods. Often, however, the question arises as to how the clamp load will behave when loaded after the assembly. In the case of direct fastening into plastic, especially the relaxation, which means the time- and temperature-dependent loss of clamp load, must be taken into account.

Conventional analytical mathematical models are simplistic and eventually too imprecise to reliably predict this process. Therefore, EVO CALC® has been equipped with an interface with a numerically calculating FEM system (Finite Element Method). With this program, it is possible to create a temperature profile to be simulated, which means to define the corresponding load case and to pass it to the numeric calculation together with the relevant initial conditions and design parameters.

In conjunction with complex material models, the FEM system calculates the anticipated clamp load curve and eventually the final residual clamp load. Time-consuming and cost-intensive temperature tests can thus be reduced to a minimum.



FEM analysis of the screw joint

Advantages

- Precise prediction of the relaxation behaviour
- Information on the clamp load retention under operating conditions
- Reduction of time-consuming and cost-intensive temperature tests

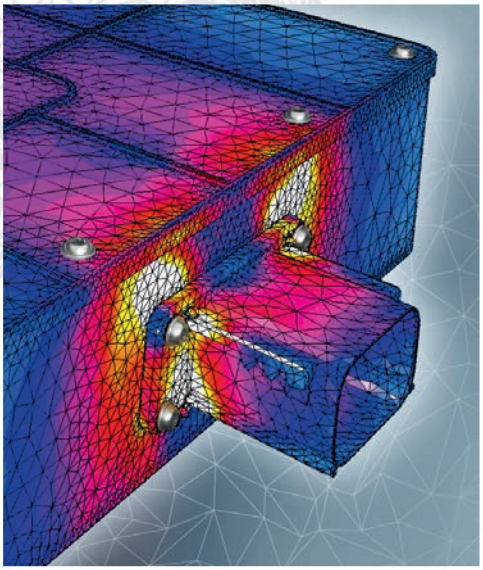
CAE

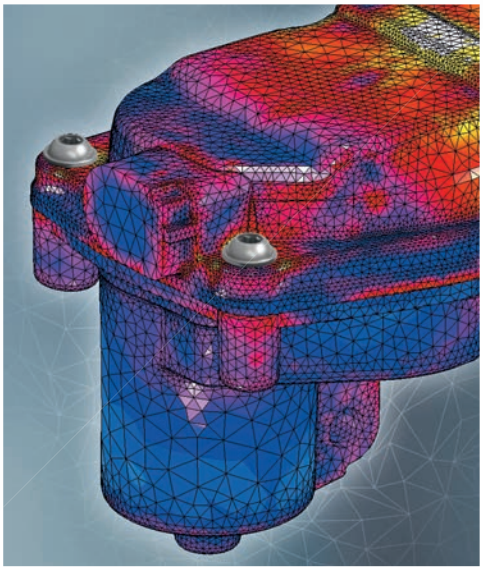
Computer-aided engineering for complete assembly groups

EVO CALC® is aimed at examining the individual fastening points. However, questions as to how different load cases (temperature, operating forces etc.) might affect the entire assembly group also arise frequently. An example of this is the load on the screwed parts due to an internal pressure and the question of which pressure the connection is able to tolerate before it opens up so far that there is no more tightness or even the most heavily loaded fastening point fails.

These and other questions can be answered with the help of our powerful CAE services. On the basis of the calculated results we show possible downsizing potentials and develop precise recommendations for the best possible and stable connection together with you.

With these special engineering services, we bundle all our ompetencies in the field of direct fastening into plastic. You save precious development time and costs.





Stress analysis in the component under load

Advantages

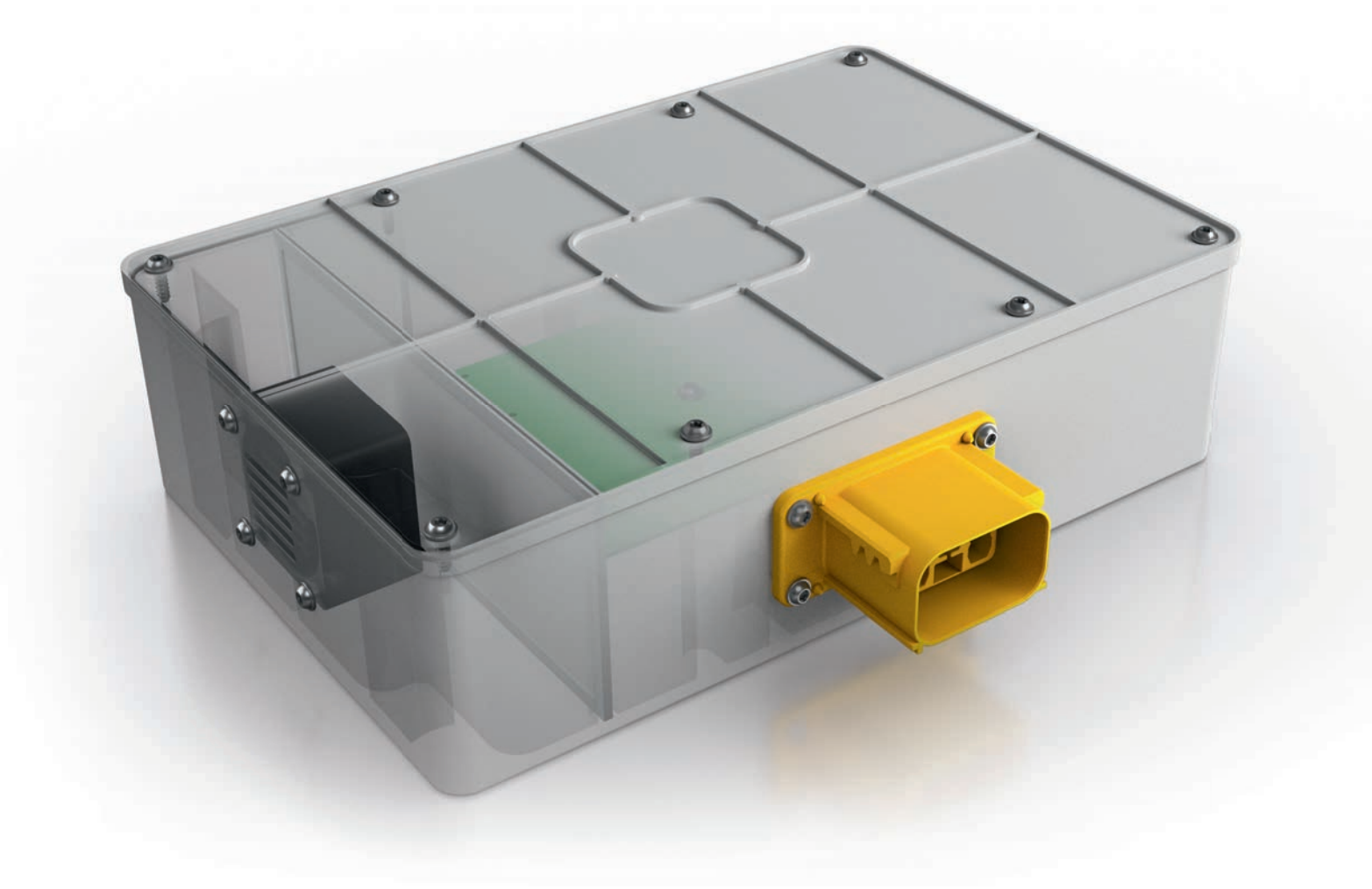
- Inspection of multi-screw connections
- Information on the most heavily loaded fastening point
- Simulation under operating load
- Relief of engineering resources

EJOT

Practically unbeatable

Optimisation approaches with the EVO PT® screw using a case study

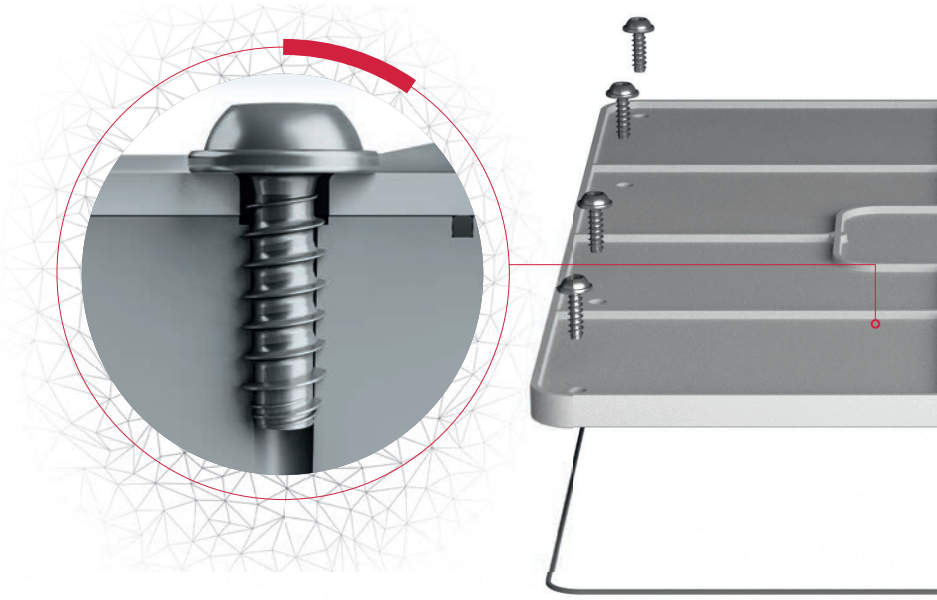
The design example shown here is a conventional and professional component design according to standard design guidelines for direct fastening into plastic. The assembly group and its components are analysed with regard to an optimisation of the screw joint. It will be shown if factors such as dimensioning or component diversity can be optimised.



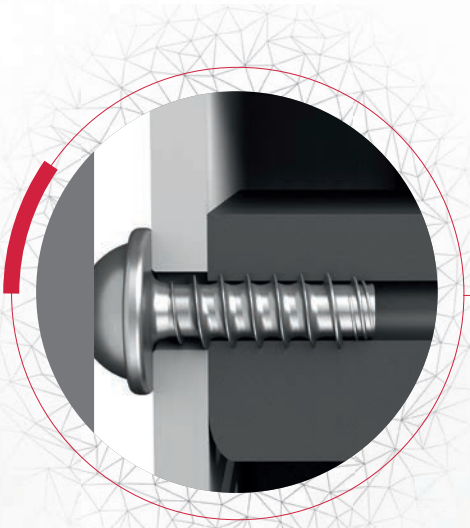
Cover

Detailed analysis:

- Validation and determination of forces in screw joints
- Assessment of the exhaustion of downsizing potentials with EVO CALC®, thus a reduction of the screw size is possible
- Saving of expensive and time-consuming component tests



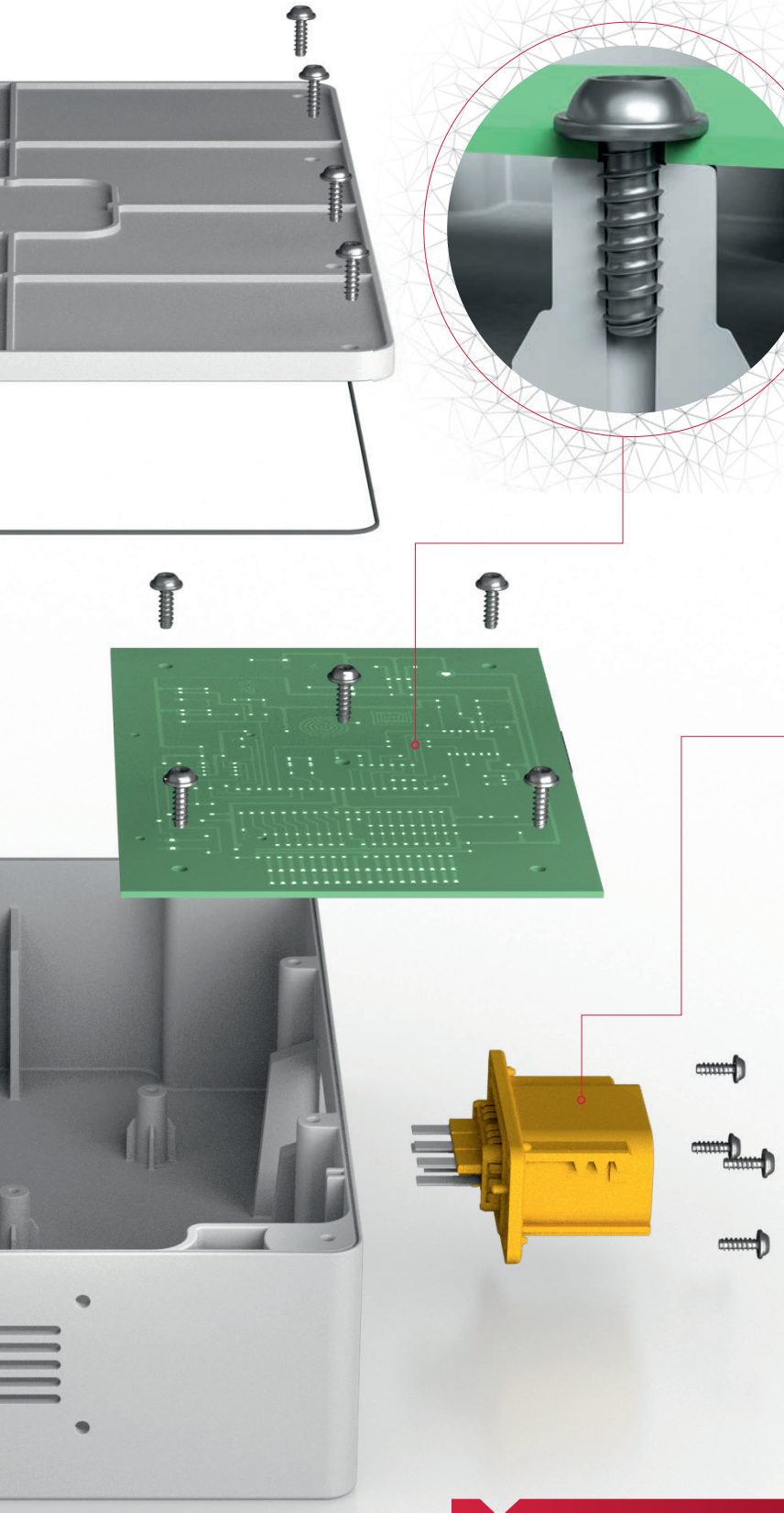
Analysis



Fan

Detailed analysis:

- Lead-in thread facilitates the assembly of the screw in the component without counterbore
- Straight application of the screw, the positioning thread takes over a finding function in the pre-hole, which otherwise is ensured by the counterbore
- Usage of catalogue parts without counter-bore, no new design necessary
- Reliable joining



Circuit board

Detailed analysis:

- Longer screw, but same tightening torque M_a with more installation depth
- Recommending a longer screw for standardisation reasons (same tightening torque/same screw) to avoid confusion in the production

Plug

Detailed analysis:

- Usage of a tube design with significantly reduced counterbore depth
- Increased installation depth is thus available
- Alternatively, the screw length can be reduced
- Usage of the small counterbore depth and possibility to pre-calculate the design with EVO CALC® in order to standardise the design to an EVO PT® screw 40 x 12.

Conclusion
The same tube design is consistently used throughout the whole assembly group. The varying installation depths, resulting from the different clamping part thicknesses, are no problem thanks to the functionality of the forming thread turn. This reduces the effort for the designer and the process engineer:
One tube design, one tightening torque, one screw.

The EVO PT® effect

Instead of four different screw variants, one EVO PT® screw can be used for all positions in the design example. The calculated savings potential of 20 % only refers to the individual item „screw“.
There are additional cost savings through optimised production, logistics, warehousing and quality processes.

Bill of materials for the example: 100,000 housings per year

Conventional component design

Screws	Fastening to	Clamping part	Quantity	Demand per year	Delivery
5.0 x 14	Housing	Cover	8	800,000	80,000
4.0 x 12	Fan	Housing	4	400,000	40,000
4.0 x 15	Housing	Plug	4	400,000	40,000
3.5 x 10	Housing	Circuit board	5	500,000	50,000

The consequent application of the EVO PT® features

- **Lead-in thread**
- **Forming thread turn**
- **EVO CALC®**

leads to error prevention and consolidation of required quantities thanks to the usage of one screw for different installation depths. This results in uniform assembly conditions.

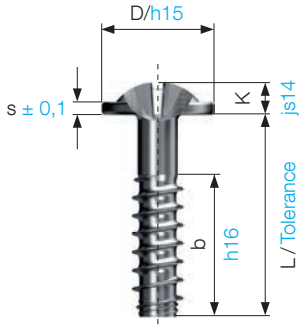
20 %

Optimised design with EVO PT® screws

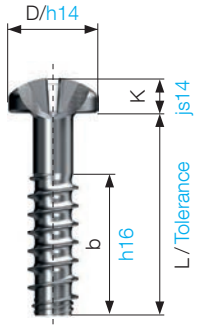
Screws	Fastening to	Clamping part	Quantity	Demand per year	Delivery
40 x 12	Housing	Cover	21	2,100,000	210,000
	Fan	Housing			
	Housing	Plug			
	Housing	Circuit board			

Standard versions with tolerances

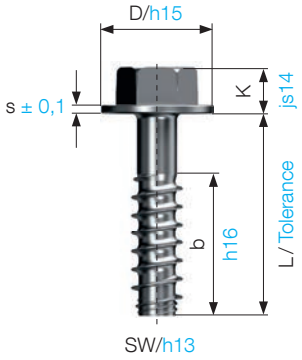
WN 7411



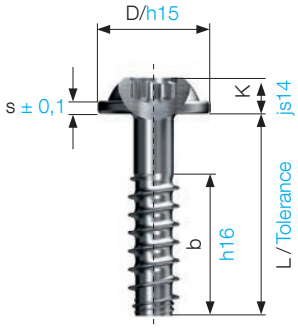
WN 7412



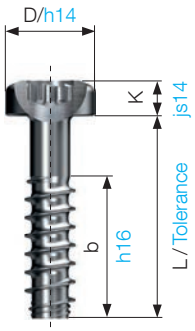
WN 7447



WN 7451



WN 7452



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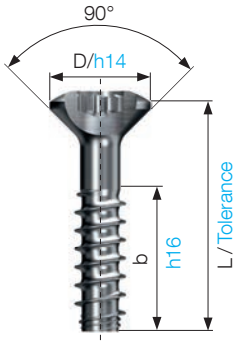
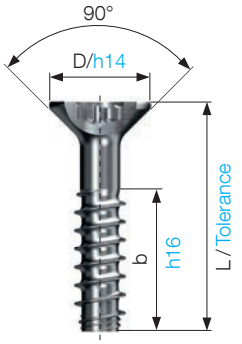


WN 7454



Tolerance ranges **Nominal size ranges (mm)**

	up to 3	more than 3 up to 6	more than 6 up to 10	more than 10 up to 18	more than 18 up to 30	more than 30 up to 50	more than 50 up to 80	more than 80 up to 120
h 13	0	0	0	0		All dimensions are valid before coating!		
	- 0.14	- 0.18	- 0.22	- 0.27				
h 14	0	0	0	0	0			
	- 0.25	- 0.30	- 0.36	- 0.43	- 0.52			
h 15	0	0	0	0	0			
	- 0.40	- 0.48	- 0.58	- 0.70	- 0.84			
h 16	0	0	0	0	0	0	0	0
	- 0.60	- 0.75	- 0.90	- 1.10	- 1.30	- 1.60	- 1.90	- 2.20
js 14	± 0.12	± 0.15	± 0.18					
Tolerance for L at ($d_1 \leq 5$)		± 0.38	± 0.45	± 0.45	± 0.55	± 0.65	± 0.80	± 0.80
Tolerance for L at ($d_1 > 5$)				± 0.55	± 0.65	± 0.80	± 0.80	± 0.80

* rounded up

All cross and TORX® drives are also available as combi drives with additional slot. Special drives upon request.


H cross recess


Z cross recess


TORX®


TORX PLUS®/ AUTOSERT®


Security TORX PLUS®


Hexagon head

Order example
Description of an EVO PT® screw with pan head and TORX PLUS® drive, nominal Ø 4.0 mm and a length L = 20 mm
EVO PT® screw WN 7452 40 x 20

EVO PT® screws

Reference dimension		30	35	40	45	50	60	70	80	90	100
External thread Ø nom.	d_1	3.00	3.50	4.00	4.50	5.00	6.00	7.00	8.00	9.00	10.00
Tolerance Ø		+ 0.06	+ 0.08	+ 0.08	+ 0.10	+ 0.10	+ 0.12	+ 0.14	+ 0.16	+ 0.18	+ 0.20
Thread core Ø	d_2	2.13	2.53	2.84	3.24	3.61	4.40	5.03	5.83	6.50	7.29
Tolerance Ø		± 0.06	± 0.08	± 0.08	± 0.08	± 0.10	± 0.10	± 0.12	± 0.12	± 0.12	± 0.12
Thread pitch	P	1.08	1.26	1.44	1.62	1.80	2.16	2.52	2.88	3.24	3.60

WN 7411		30	35	40	45	50	60	70	80	90	100
Head Ø	D	6.50	7.50	9.00	10.00	11.00	13.50	15.50			
Head height	K	2.10	2.40	2.50	2.50	3.20	4.00	4.60			
Washer thickness	s	0.80	0.90	1.00	1.00	1.20	1.40	1.60			
Radius	R_{max}	0.50	0.50	0.60	0.60	0.70	0.80	0.90			
Cross size H/Z		1	2	2	2	2	3	3			

WN 7412		30	35	40	45	50	60	70	80	90	100
Head Ø	D	5.30	6.10	7.00	7.50	8.80	10.50	12.30			
Head height	K	2.30	2.70	3.10	3.20	3.50	4.20	5.10			
Radius	R_{max}	0.50	0.50	0.60	0.60	0.70	0.80	0.90			
Cross size H/Z		1	2	2	2	2	3	3			

WN 7447		30	35	40	45	50	60	70	80	90	100
Head Ø	D	6.50		9.00		11.00	13.50		18.00		
Head height	K	2.80		3.50		4.50	5.20		7.00		
Washer thickness	s	0.07		0.90		0.90	1.10		1.30		
Radius	R_{max}	0.50		0.60		0.80	0.80		1.00		
Width across flats	A/F	5.00		5.50		7.00	8.00		10.00		

WN 7451		30	35	40	45	50	60	70	80	90	100
Head Ø	D	6.50	7.50	9.00	10.00	11.00	13.50	15.50	18.00		
Head height	K	2.30	2.70	3.10	3.20	3.50	4.20	4.90	5.60		
Washer thickness	s	0.80	0.90	1.00	1.10	1.20	1.40	1.60	1.80		
Radius	R_{max}	0.50	0.50	0.60	0.60	0.70	0.80	0.90	1.00		
TORX PLUS®/AUTOSERT®		10IP	15IP	20IP	20IP	25IP	30IP	30IP	40IP		
Installation depth t	min	1.00	1.10	1.40	1.40	1.50	1.90	2.30	2.60		
	max	1.30	1.50	1.80	1.80	1.90	2.40	2.90	3.20		

WN 7452		30	35	40	45	50	60	70	80	90	100
Head Ø	D	5.30	6.10	7.00	7.50	8.80	10.50	12.30	14.10		17.00
Head height	K	2.30	2.70	3.10	3.20	3.50	4.20	4.90	5.60		6.60
Radius	R_{max}	0.50	0.50	0.60	0.60	0.70	0.80	0.90	1.00		1.10
TORX PLUS®/AUTOSERT®		10IP	15IP	20IP	20IP	25IP	30IP	30IP	40IP		50IP
Installation depth t	min	1.00	1.10	1.40	1.40	1.50	1.90	2.30	2.60		3.00
	max	1.30	1.50	1.80	1.80	1.90	2.40	2.90	3.20		3.70

WN 7453		30	35	40	45	50	60	70	80	90	100
Head Ø	D	6.00	7.00	8.00	9.00	10.00	12.00	14.00	16.00		20.00
Cyl. head height	c_{max}	0.55	0.65	0.70	0.70	0.75	0.85	0.90	0.95		1.10
Storm washer height	≈f	0.70	0.80	1.00	1.00	1.20	1.20	1.30	1.40		1.60
Radius	R_{max}	1.20	1.40	1.60	1.80	2.00	2.40	2.60	3.20		4.50
TORX PLUS®/AUTOSERT®		10IP	15IP	20IP	20IP	25IP	30IP	30IP	40IP		50IP
Installation depth t	min	1.00	1.10	1.40	1.40	1.50	1.90	2.30	2.60		3.00
	max	1.30	1.50	1.80	1.80	1.90	2.40	2.90	3.20		3.70

WN 7454		30	35	40	45	50	60	70	80	90	100
Head Ø	D	6.00	7.00	8.00	9.00	10.00	12.00	14.00	16.00		20.00
Cyl. head height	c_{max}	0.55	0.65	0.70	0.70	0.75	0.85	0.90	0.95		1.10
Radius	R_{max}	1.20	1.40	1.60	1.80	2.00	2.40	2.60	3.20		4.50
TORX PLUS®/AUTOSERT®		10IP	15IP	20IP	20IP	25IP	30IP	30IP	40IP		50IP
Installation depth t	min	0.75	0.95	1.10	1.25	1.25	1.50	2.30	2.40		3.00
	max	1.00	1.30	1.45	1.70	1.65	2.00	2.90	2.90		3.70

All dimensions in mm.

Manufacturing range of screws with supported head*

EVO PT®	30	35	40	45	50	60	70	80	90	100
Ø d_1 [mm]	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0
Screw length [L]	Partial thread lengths [mm]									
6	5									
7	6	6								
8	7	7	7							
9	8	8	8	8						
10	9	9	9	9	9					
11	9	10	10	10	10					
12	9	10	10	11	11	11				
13	12	10	12	11	12	12				
14	12	10	12	13	12	13	12			
15	12	14	12	13	12	14	13			
16	12	14	12	13	15	14	14	14		
17	12	14	16	13	15	14	14	15		
18	12	14	16	13	15	14	16	16	16	
19	12	14	16	18	15	18	16	17	17	
20	12	14	16	18	15	18	16	18	18	18
21	12	14	16	18	20	18	16	18	19	19
22	12	14	16	18	20	18	16	18	20	20
23	12	14	16	18	20	18	21	18	21	21
24	12	14	16	18	20	18	21	18	21	22
25	12	14	16	18	20	24	21	18	21	23
26	12	14	16	18	20	24	21	24	21	23
28	12	14	16	18	20	24	21	24	21	23
30	12	14	16	18	20	24	28	24	28	23
32		14	16	18	20	24	28	24	28	30
35		14	16	18	20	24	28	32	28	30
36			16	18	20	24	28	32	28	30
40			16	18	20	24	28	32	36	30
45				18	20	24	28	32	36	40
50					20	24	28	32	36	40
60						24	28	32	36	40
70							28	32	36	40
80								32	36	40
90									36	40
100										40

The given values are to be understood as manufacturing ranges (no stock articles).
The grey fields mark the next partial thread step.
Partial thread lengths for countersunk heads upon request.

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