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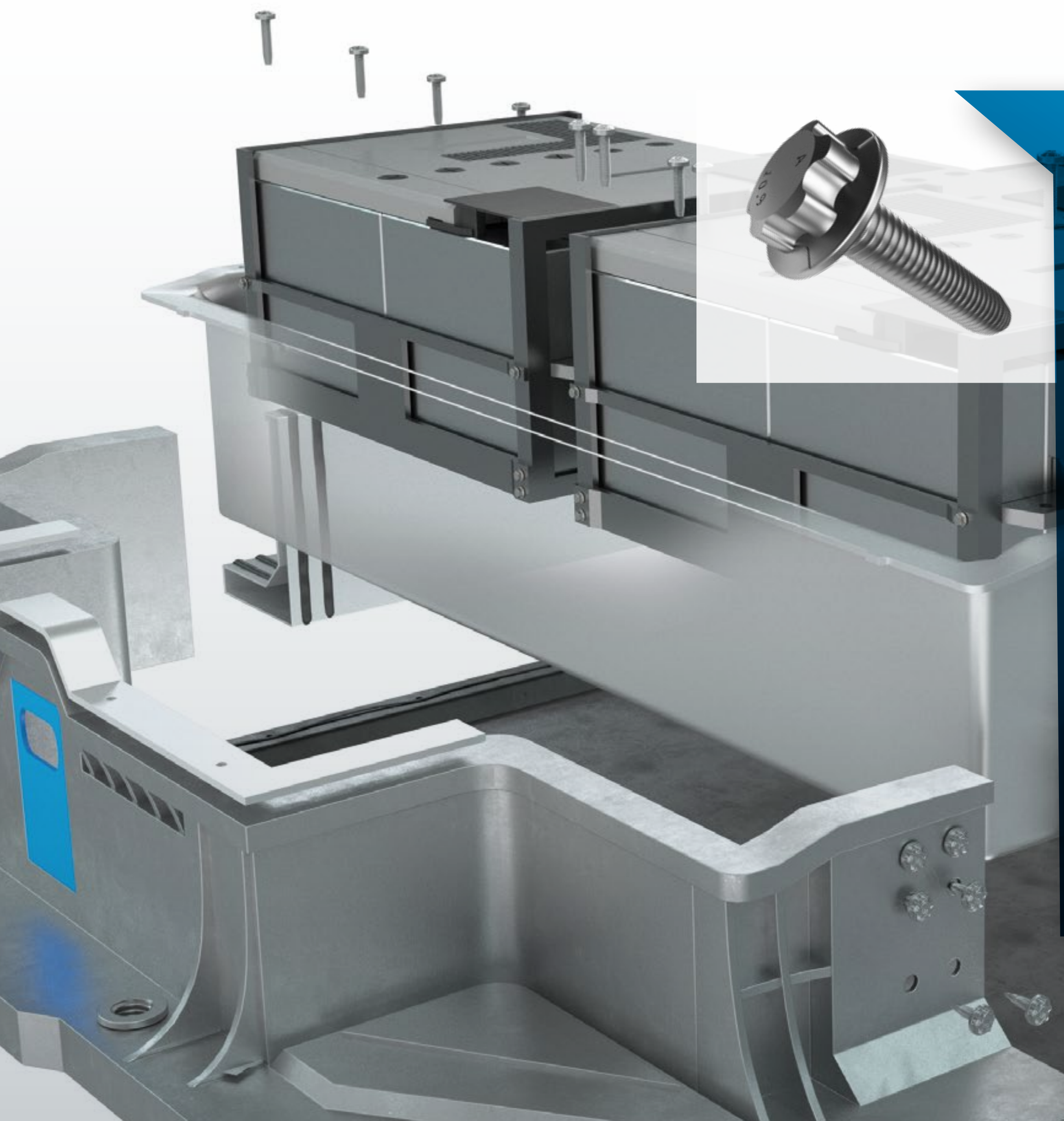
ARNOLD®
BlueFastening Systems



Powertite®

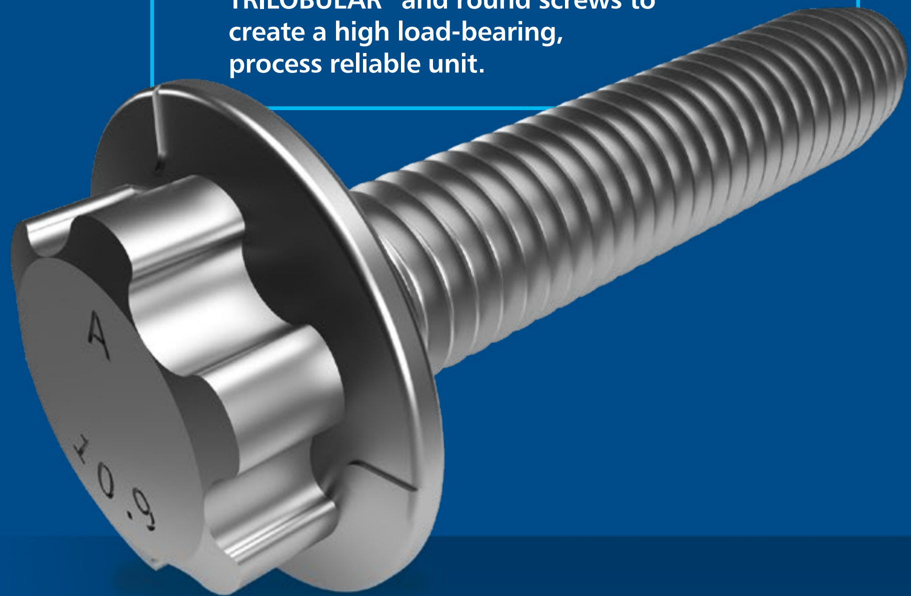
Next generation thread-forming – optimised for load capacity and climate friendly screw fastening

- High load capacity of the formed thread
- Preload at the level of metric screws
- Simplifies the manufacturing processes for cast core holes in light-weight metals
- Smaller size due to high preload level for over-elastic assembly
- Reduction of the screw-in depth for elastic assembly

20 %
more load capacity

For over 40 years the manufacturing industry has implemented thread-forming TRILOBULAR® screws. Such screws are distinctive for low thread-forming torque and excellent process reliability. For many years thread-forming screws with round cross section have likewise been used. These screws generate higher load capacities, but when it comes to thread-forming they offer less process reliability.

The recently developed Powertite® screw combines the individual strengths of TRILOBULAR® and round screws to create a high load-bearing, process reliable unit.



The Powertite® effect

Greater core hole tolerances optimise the casting process in lightweight metals

↘ The greater the core hole tolerance the greater the productivity in the casting process for lightweight metal components. With fewer strict preload requirements, Powertite® screws enable an increase in core hole tolerances by a significant margin thus simplifying the casting process.

Preload level similar to metric screw connections

↘ When combined with an optimised low-friction coating, it is possible to introduce a higher preload with Powertite® screws, compared to complete TRILOBULAR® screws. Preload at the level of metric screw connections are possible with this innovative screw familiy.

High load capacity in the formed nut thread

↘ Screw connections made with Powertite® screws have 20% more load-bearing capacity than conventional thread-forming screw connections with TRILOBULAR® cross-section.

High assembly reliability

↘ Powertite® screws generate a large difference (delta) between the thread-forming torque and tightening torque and between tightening torque and maximum torque. This results in greater assembly reliability.

ARNOLD BlueFastening Systems

Powertite® proven quality with new fields of application

The best of two worlds

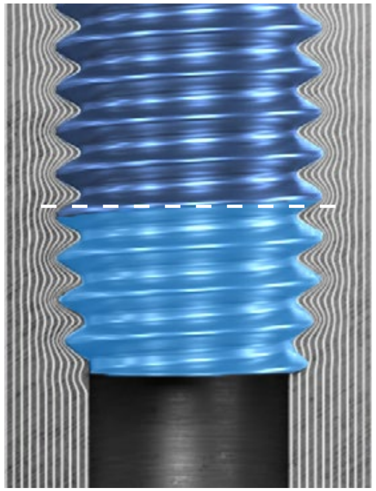
Powertite® screws achieve the proven quality characteristics of TRILOBULAR® thread-forming screws, such as low thread-forming torques, high assembly reliability and vibration resistance. However, Powertite® offers an abundance of other features, opening up new fields of application for thread-forming technology.

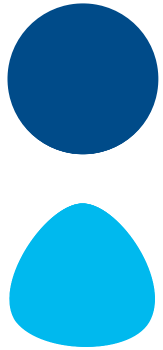
Round load cross-section

- The overlap of the external diameter of the thread is defined. This results in a high overlap between screw and the nut thread
- Powertite® makes better use of the nut material
- Optimised stress cross-section within tolerance specification
- Can achieve a preload level similar to metric screw connections
- Higher overlap allows greater core hole tolerances

TRILOBULAR® thread-forming zone

- Nut threads formed chip-free
- Low thread-forming torque and screw-in torque
- High level of process reliability during assembly





The technical benefits of Powertite®

Powertite®

Optimising the screw connection manufacturing process

Strength classes

8.8 for all coloured metals and light metal alloys up to Rm = 360 MPa
10.9 for all metals up to Rm = 415 MPa
E.H. for steel up to RM ~ 600 MPa
10.9 Corflex® I™ for steel up to Rm ~ 600 MPa*

Safety notice

All screws in strength class **Rm > 1000 Mpa** are at risk of hydrogen-induced brittle fracture.

Just a few steps to reach the goal – a comparison of assembly steps in aluminum cast components

When you use Powertite® screws, you save processing time and tooling and machinery costs. For example, there is no need for a process center including a washing unit, as is necessary for metric screws. Additional locking elements can often be dispensed with.

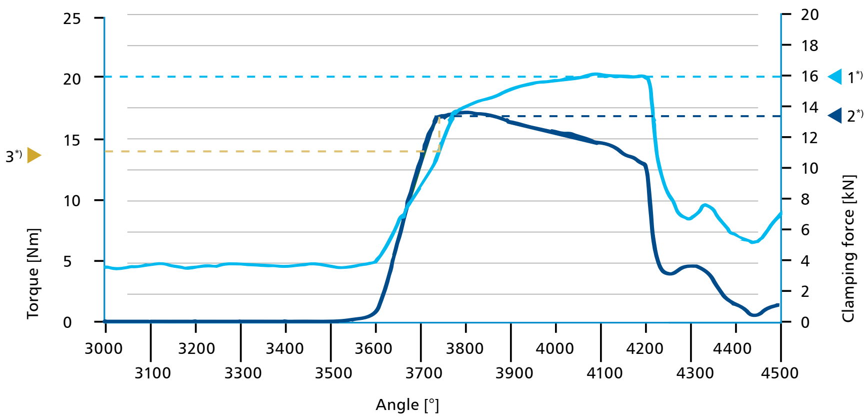
METRIC SCREWS

Casting	Drilling	Counter-sinking	Thread cutting	Cleaning	Inspection	Fastening / locking element	Mounting
Casting	Drilling	The benefit gained from using Powertite® for drilled core holes				Powertite®	Mounting
Casting	The benefit gained from using Powertite® for cast core holes					Powertite®	Mounting

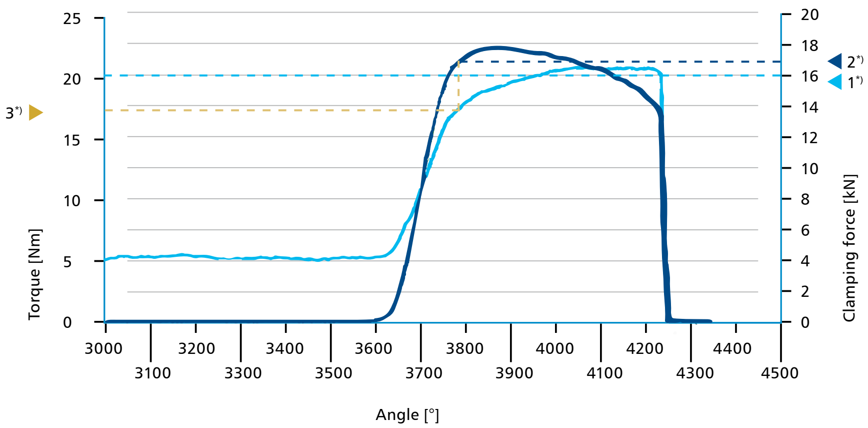
*) 10.9 with inductive hardened tip

Powertite® optimises load capacity and thread-forming torque

Conventional thread-forming M6x50 10.9 screw



Powertite® M6x50 10.9



- 1*) Typical minimum preload of metric screws during over-elastic assembly 16 kN
- 2*) Measured prelaod at yield point (F@yield in kN)
- 3*) Measured torque at yield point (F@yield in Nm)

Load capacity optimised at more demanding preload

The illustrations show a comparative destructive test on an alumimum EN AW 6082-T6 wrought alloy at a lower core hole tolerance and an effective screw-in depth of 9mm (1.5xd). The conventional thread-forming screw fails when the formed nut thread shears at the yield point force of 13.19 kN. In comparison, the Powertite® screw fails when the formed nut thread shears at the yield point force of 16.84 kN. In addition with Powertite® the preload level of metric 10.9 screws achieves the correspondingly typical OEM requirements.

Reduced screw-in torque

Due to the Powertite® screw's TRILOBULAR® thread-forming zone the screw-in torque is significantly reduced. This allows thread-forming torques compliant to DIN267-30, DIN267-31 and DIN7500-1.

	M@yield [Nm]	F@yield [kN]
Thread-forming M6x50	15.59	13.18
Powertite® M6x50	17.24	16.84
Difference Δ	1.65	3.65
Enhancement of Powertite® closed thread-forming screw [%]	10.6	27.7

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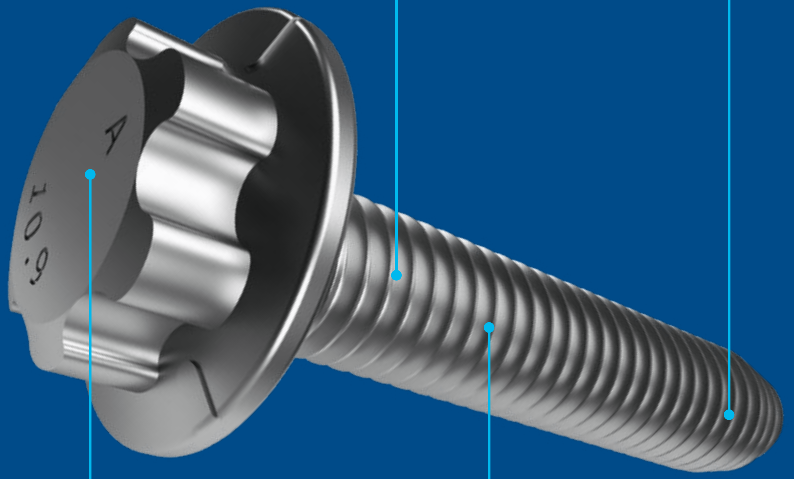
The actual values must be investigated on the original components.
Our Fastener Testing Center is available to you at any time.
For questions about the design of the core holes, please do not hesitate to contact our sales department.

Round load cross-section with defined oversize of thread's external diameter.

TRILOBULAR®
Thread-forming zone



Low Profile Head or pan head

Customized solutions can also be supplied

Load capacity significantly increased

with the 60° thread flank and defined oversize compared with the defined nominal dimension.

The geometry of Powertite®

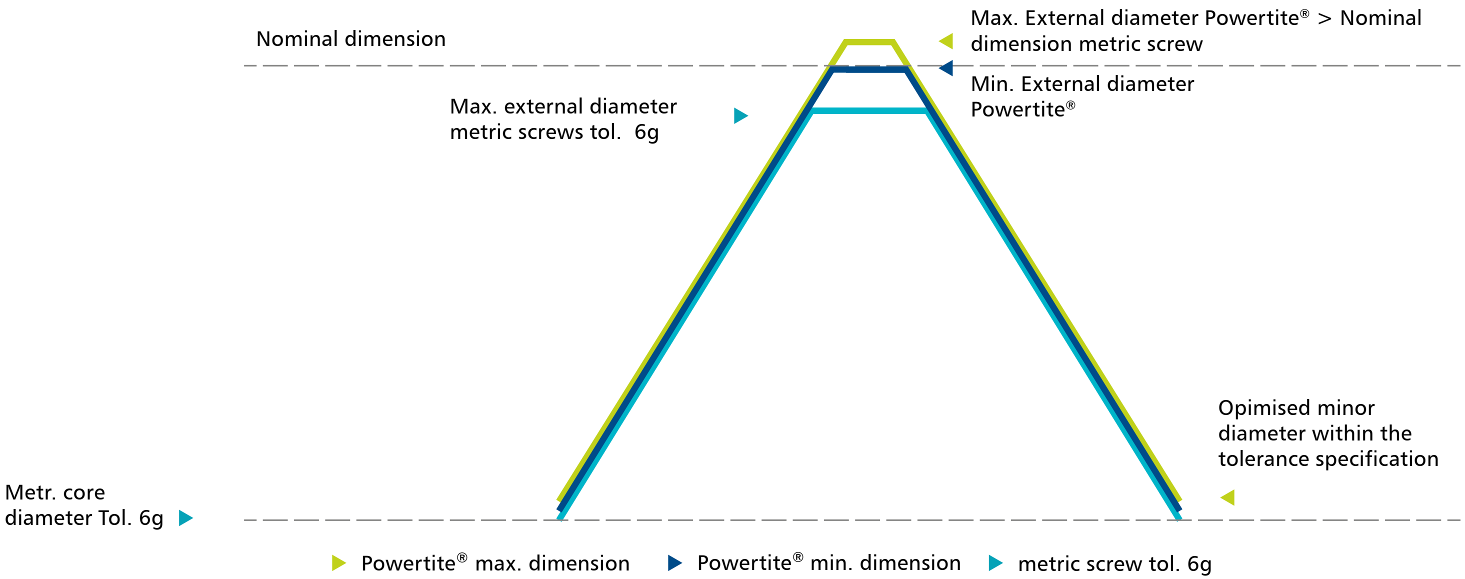
Powertite® combines the strengths of round and completly TRILOBULAR® screws. The load cross-section is round. This ensures that Powertite® screws have a high level of load capacity. Compared with complete TRILOBULAR® screws the round load cross-section, combined with a defined oversize of the thread's external diameter allows for good overlap between screw and nut thread.

Powertite® screws' thread-forming zone has limited dimensions. It uses the TRILOBULAR® cross-section only where it is truly needed - in the area of the screw where the thread is formed - the thread-forming zone. The TRILOBULAR® thread-forming zone is produced by means of a new and innovative manufacturing technique which moves away from the established method of making complete TRILOBULAR® screws.

The transition from round load cross-section to the TRILOBULAR® thread-forming zone is smooth. Powertite® screws are reliable and are impressive for their low thread-forming torques while at the same time maintaining a high level of preload and they form metric threads chipfree.

Thread profile and cross-section ensure better values

A comparison of thread tolerances



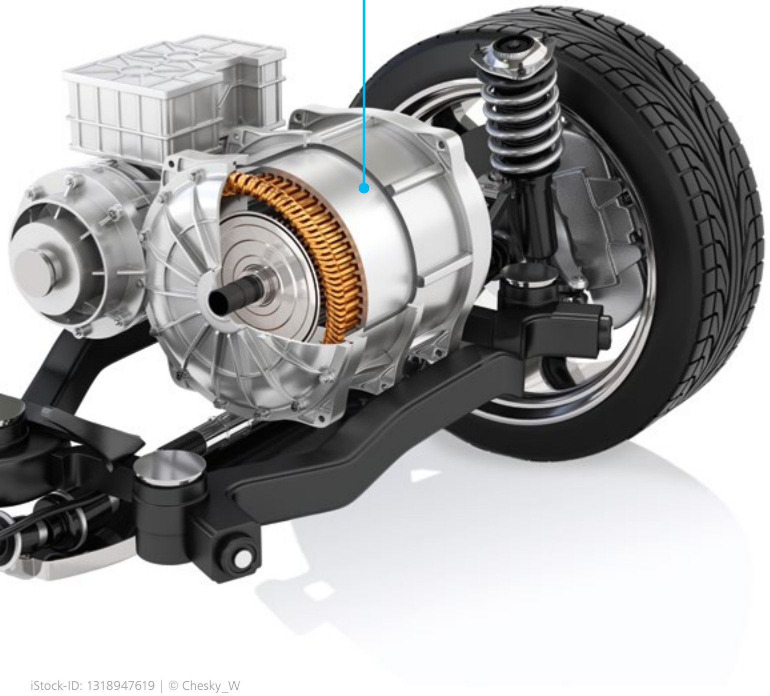
Powertite® screws have a 60° thread flank with a defined oversize compared with the defined nominal dimension and a round cross-section in the load area. It therefore increases the load capacity of the formed nut thread by up to 50% compared with established TRILOBULAR® thread-forming screws. The 60° thread flank is compatible with metric screws.

In the event of a repair being needed, the thread formed with Powertite® can accept a standard metric screw. The defined oversize ensures that metric screws can be fitted at a low screw-in torque. But in the event of a repair the Powertite® can be used multiple times, provided that the first assembly was not made in over-elastic area.

Powertite® Application fields for aluminum direct screw fastening

The actual values must be investigated on the original components. Our Fastener Testing Center is available to you at any time. For questions about the design of the core holes, please do not hesitate to contact our sales department.

Powertite® is used in various application areas. The effective screw-in depth ET_{eff} (total screw-in depth minus chamfer depth and length of the thread-forming zone) should be selected depending on the application case and assembly strategy.



- The "standard":
  ET_{eff} = 1.8 x nominal diameter of the screw for torque-controlled assembly.
  In this application the screw is tightened up to a maximum of 90% of its yield strength. ET_{eff} 1.8 x d corresponds to a saving on mounting space of about 10% of standard recommendations. At the same time the core hole diameter tolerance can be increased in a scale of 20-50%, thus simplifying the casting process.
  In many standard applications where metric screws are tightened in the elastic area, these installation recommendations can usually be used.
- Screw connections under high loads:
  ET_{eff} = 2.5 x nominal diameter of the screw for over-elastic assembly.
  When tightening angle-controlled in the over-elastic area, it is important to achieve a failure due to screw fracture. With the high screw-in depth, as a rule the shear force of the formed nut thread is higher than the screw fracture force. Thus, for example, on the e-motor gear unit shown on the left, a thread-forming M8x40-10.9 (tightened torque-controlled) could be replaced by a Powertite® M7x40-10.9 with angle-controlled tightening in an over-elastic area.
- Optimising installation space and simplifying the casting process:
  ET_{eff} = 1.2 x nominal diameter of the screw for torque controlled tighening.
  Where there is little availability of screw-in depth or where the castability is subject to higher requirements, these core hole recommendations can be used. This almost doubles the core hole tolerances and at the same time the screw-in depth is reduced by over 30%, compared with standard recommendations. This installation recommendation can only be used for screw fastenings with reduced requirements.

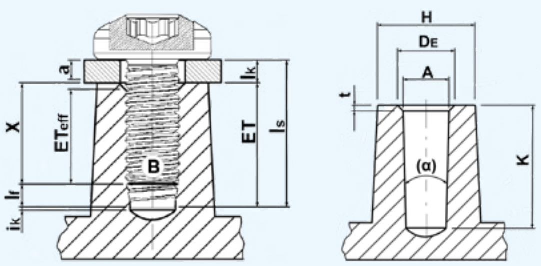
ARNOLD BlueFastening Systems

Core hole recommendations for applications in cast aluminium

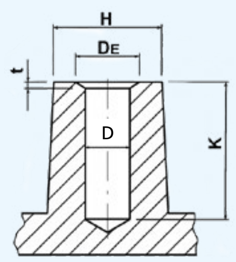
Nominal-Ø	*)	M5	M6	M7	M8	M10
	A [mm]	$4.70^{+0.10}$	$5.62^{+0.12}$	$6.66^{+0.14}$	$7.54^{+0.16}$	$9.47^{+0.18}$
	B [mm]	$4.53^{+0.10}$	$5.41^{+0.12}$	$6.42^{+0.14}$	$7.27^{+0.16}$	$9.13^{+0.18}$
	(α) [°]	1.1	1.1	1.1	1.1	1.1
	t [mm]	$0.70^{+0.2}$	$0.90^{+0.2}$	$0.90^{+0.2}$	$1.15^{+0.2}$	$1.40^{+0.2}$
cast effective screw-in depth = 1.8 x d	d_E [mm]	5.30	6.36	7.42	8.48	10.60
	ET [mm]	12.20	14.80	16.60	19.40	24.00
	l_f [mm]	2.40	3.00	3.00	3.75	4.50
	K_{min} [mm]**)	13.50	16.10	17.90	20.70	25.30
	x [mm]	9.80	11.80	13.60	15.65	19.50
	ET_{eff} [mm]***)	9.00	10.80	12.60	14.40	18.00
	H_{min} [mm]	8.30	10.00	11.70	13.30	16.60
drilled	D^{H11} [mm]	$4.63^{+0.08}$	$5.54^{+0.08}$	$6.55^{+0.09}$	$7.43^{+0.09}$	$9.32^{+0.09}$
	A [mm]	$4.77^{+0.10}$	$5.70^{+0.12}$	$6.76^{+0.14}$	$7.65^{+0.16}$	$9.61^{+0.18}$
	B [mm]	$4.53^{+0.10}$	$5.41^{+0.12}$	$6.42^{+0.14}$	$7.27^{+0.16}$	$9.13^{+0.18}$
	(α) [°]	1.1	1.1	1.1	1.1	1.1
	t [mm]	$0.7^{+0.2}$	$0.9^{+0.2}$	$0.9^{+0.2}$	$1.15^{+0.2}$	$1.4^{+0.2}$
cast effective screw-in depth = 2.5 x d	d_E [mm]	5.30	6.36	7.42	8.48	10.60
	ET [mm]	15.70	19.00	21.50	25.00	31.00
	l_f [mm]	2.40	3.00	3.00	3.75	4.50
	K_{min} [mm]**)	17.00	20.30	22.80	26.30	32.30
	x [mm]	13.30	16.00	18.50	21.25	26.50
	ET_{eff} [mm]***)	12.50	15.00	17.50	20.00	25.00
	H_{min} [mm]	8.30	10.00	11.70	13.30	16.60
drilled	D^{H11} [mm]	$4.63^{+0.08}$	$5.54^{+0,08}$	$6.55^{+0.09}$	$7.43^{+0.09}$	$9.32^{+0.09}$

Nominal-Ø		M5	M6	M7	M8	M10
	A [mm]	$4.65^{+0.16}$	$5.55^{+0.20}$	$6.58^{+0.20}$	$7.45^{+0.20}$	$9.36^{+0.22}$
	B [mm]	$4.53^{+0.16}$	$5.41^{+0.20}$	$6.42^{+0.20}$	$7.27^{+0.20}$	$9.13^{+0.22}$
	(α) [°]	1.1	1.1	1.1	1.1	1.1
	t [mm]	$0.7^{+0.2}$	$0.9^{+0.2}$	$0.9^{+0.2}$	$1.15^{+0.2}$	$1.4^{+0.2}$
cast effective screw-in depth = 1.2 x d	d_E [mm]	5.30	6.36	7.42	8.48	10.60
	ET [mm]	9.20	11.20	12.40	14.60	18.00
	l_f [mm]	2.40	3.00	3.00	3.75	4.50
	K_{min} [mm]**)	10.35	12.50	13.70	15.90	19.30
	x [mm]	6.80	8.20	9.40	10.85	13.50
	ET_{eff} [mm]***)	6.00	7.20	8.40	9.60	12.00
	H_{min} [mm]	8.30	10.00	11.70	13.30	16.60
drilled	D^{H11} [mm]	$4.60^{+0.08}$	$5.50^{+0.08}$	$6.50^{+0.09}$	$7.40^{+0.09}$	$9.30^{+0.09}$

Cast core hole



Drilled core hole



*\) For an explanation of terms please see page 22.

**\) The calculation for K_{min} was made with screw length tolerances ± 0.45 (M2.5), ± 0.55 (M3.5-M5), ± 0.65 (≥M6) For a precise calculation of K_{min} you need also to consider the clamping thickness tolerances and any differing screw length tolerances.

***\) Please see page 8 for effective screw-in depth recommendations

Powertite®
Application fields for magnesium direct screw fastening

The actual values must be investigated on the original components. Our Fastener Testing Center is available to you at any time. For questions about the design of the core holes, please do not hesitate to contact our sales department.

Powertite® is used in various application areas. The effective screw-in depth ET_{eff} (total screw-in depth minus chamfer depth and length of the thread-forming zone) should be selected depending on to the application case and assembly strategy.

- The "standard":
  ET_{eff} = 2.0 x nominal diameter of the screw for torque-controlled assembly.
  In this field, the screw is tightened up to a maximum of 90% of its yield strength. In many standard applications where metric screws are tightened in the elastic area, these installation recommendations can usually be used.
- Screw connections under heavy loads:
  ET_{eff} = 3.4 x nominal diameter of the screw for over-elastic assembly.
  For angle-controlled tightening in the over-elastic area, it is important to achieve a failure due to screw fracture. With the high drive depth, as a rule the shear force of the formed nut thread is higher than the screw-in force.
- Optimising installation space and simplifying the casting process:
  ET_{eff} = 1.5 x nominal diameter of the screw for torque controlled tighening.
  Where there is little availability of screw-in depth or where the castability is subject to higher requirements, these core hole recommendations can be used. This almost doubles the core hole tolerances and, at the same time, the screw-in depth is reduced by over 30%, compared with standard recommendations. This installation recommendation can only be used for screw fastenings with reduced screw utilisation.

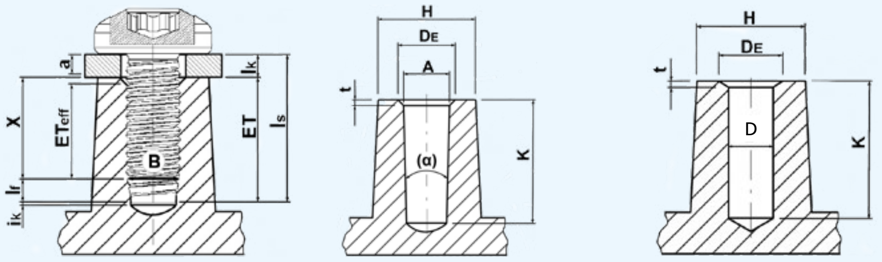
Core hole recommendations for applications in cast magnesium

Nominal-Ø	*)	M5	M6	M7	M8	M10
cast effective screw-in depth = 2 x d	A [mm]	$4.70^{+0.10}$	$5.61^{+0.12}$	$6.66^{+0.14}$	$7.53^{+0.16}$	$9.46^{+0.18}$
	B [mm]	$4.50^{+0.10}$	$5.38^{+0.12}$	$6.39^{+0.14}$	$7.23^{+0.16}$	$9.08^{+0.18}$
	(α) [°]	1.1	1.1	1.1	1.1	1.1
	t [mm]	$0.7^{+0.2}$	$0.9^{+0.2}$	$0.9^{+0.2}$	$1.15^{+0.2}$	$1.4^{+0.2}$
	d_E [mm]	5.30	6.36	7.42	8.48	10.60
	ET [mm]	13.20	16.00	18.00	21.00	26.00
	l_f [mm]	2.40	3.00	3.00	3.75	4.50
	K_{min} [mm]**)	14.35	17.30	19.30	22.30	27.30
	x [mm]	10.80	13.00	15.00	17.25	21.50
	ET_{eff} [mm]***)	10.00	12.00	14.00	16.00	20.00
drilled	D^{H11} [mm]	$4.58^{+0.08}$	$5.48^{+0.08}$	$6.49^{+0.09}$	$7.35^{+0.09}$	$9.22^{+0.09}$
cast effective screw-in depth = 3.4 x d	A [mm]	$4.80^{+0.10}$	$5.73^{+0.12}$	$6.80^{+0.12}$	$7.70^{+0.14}$	$9.67^{+0.16}$
	B [mm]	$4.50^{+0.10}$	$5.38^{+0.12}$	$6.39^{+0.12}$	$7.23^{+0.14}$	$9.08^{+0.16}$
	(α) [°]	1.0	1.0	1.0	1.0	1.0
	t [mm]	$0.7^{+0.2}$	$0.9^{+0.2}$	$0.9^{+0.2}$	$1.15^{+0.2}$	$1.4^{+0.2}$
	d_E [mm]	5.30	6.36	7.42	8.48	10.60
	ET [mm]	20.20	24.40	27.80	32.20	40.00
	l_f [mm]	2.40	3.00	3.00	3.75	4.50
	K_{min} [mm]**)	21.35	25.70	29.10	33.50	41.30
	x [mm]	17.80	21.40	24.80	28.45	35.50
	ET_{eff} [mm]***)	17.00	20.40	23.80	27.20	34.00
drilled	D^{H11} [mm]	$4.58^{+0.08}$	$5.48^{+0.08}$	$6.49^{+0.09}$	$7.35^{+0.09}$	$9.22^{+0.09}$

Nominal-Ø	*)	M5	M6	M7	M8	M10
cast effective screw-in depth = 1.5 x d	A [mm]	$4.65^{+0.16}$	$5.55^{+0.20}$	$6.59^{+0.20}$	$7.46^{+0.20}$	$9.37^{+0.22}$
	B [mm]	$4.50^{+0.16}$	$5.38^{+0.20}$	$6.39^{+0.20}$	$7.23^{+0.20}$	$9.08^{+0.22}$
	(α) [°]	1.1	1.1	1.1	1.1	1.1
	t [mm]	$0.7^{+0.2}$	$0.9^{+0.2}$	$0.9^{+0.2}$	$1.15^{+0.2}$	$1.4^{+0.2}$
	d_E [mm]	5.30	6.36	7.42	8.48	10.60
	ET [mm]	10.70	13.00	14.50	17.00	21.00
	l_f [mm]	2.40	3.00	3.00	3.75	4.50
	K_{min} [mm]**)	11.85	14.30	15.80	18.30	22.30
	x [mm]	8.30	10.00	11.50	13.25	16.50
	ET_{eff} [mm]***)	7.50	9.00	10.50	12.00	15.00
drilled	D^{H11} [mm]	$4.58^{+0.08}$	$5.48^{+0.08}$	$6.49^{+0.09}$	$7.35^{+0.09}$	$9.22^{+0.09}$

Cast core hole

Drilled core hole



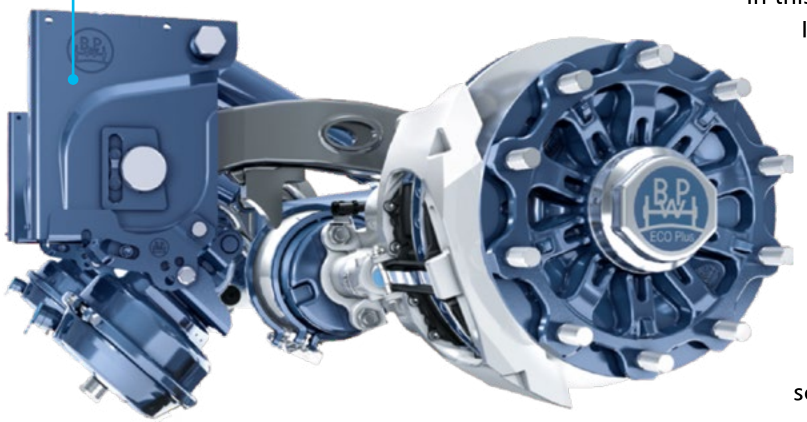
**) For an explanation of terms please see page 22.*

***) The calculation for K_{min} was made with screw length tolerances ± 0.45 (M2.5), ± 0.55 (M3.5-M5), ± 0.65 (≥M6) For a precise calculation of K_{min} you need also to consider the clamping thickness tolerances and any differing screw length tolerances.*

****) Please see page 10 for effective screw-in depth recommendations*

Powertite®
Application fields for steel direct screw fastening

In general, strength class 10.9 thread-forming screws with additional inductive hardening in the thread-forming zone are used when forming threads into steel, or applied in a case-hardened and tempered version. Powertite® is used in various application areas. The effective screw-in depth ET_{eff} (total screw-in depth minus chamfer depth and length of the thread-forming zone) should be selected depending on the application case and assembly strategy.



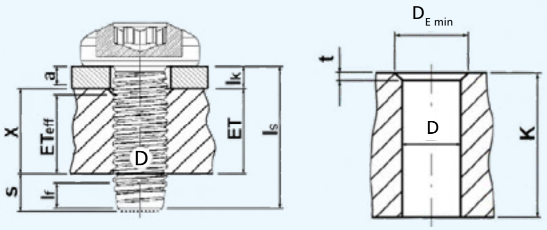
- The "standard":
  ET_{eff} = 0.75 x nominal diameter of the screw for torque-controlled assembly.
  In this application, the screw is tightened up to a maximum of 90% of its yield strength. In many standard applications where metric screws are tightened in the elastic area, these installation recommendations can usually be used.

- Screw connections under heavy loads:
  ET_{eff} = 1 x nominal diameter of the screw for over-elastic assembly.
  For angle-controlled tightening in the over-elastic area, it is important to achieve a failure caused by screw fracture. With the high screw-in depth, the shear force of the formed nut thread is generally higher than the screw fracture force.

- Screw fastenings with reduced load resistance:
  ET_{eff} = 0.5 x nominal diameter of the screw for torque controlled tighening.
  If there is little screw-in depth available cost optimised screw connections with reduced screw utilisation can be used.

Core hole recommendations for applications in solid steel

Drilled core hole



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For questions about the design of the core holes, please do not hesitate to contact our sales department.

Direct screw fastening into solid steel with blind hole are also possible.

Nominal-Ø*)	M5	M6	M7	M8	M10
lf [mm]	2.40	3.00	3.00	3.75	4.50
t_{min}[mm]	0.40	0.50	0.50	0.60	0.70
$D_{e\ min}$ [mm]	5.30	6.36	7.36	8.48	10.60
$s_{min\text{-}COI}$ [mm]	4.00	5.00	5.00	6.25	7.50
s_{min} [mm]	2.40	3.00	3.00	3.75	4.50
K=0.5xd	2.50	3.00	3.50	4.00	5.00
ET_{eff} [mm]**)	2.10	2.50	3.00	3.40	4.30
D [mm]	$4.60^{+0.08}$	$5.50^{+0.08}$	$6.50^{+0.09}$	$7.40^{+0.09}$	$9.30^{+0.09}$
K=0.75xd	3.75	4.50	5.25	6.00	7.50
ET_{eff} [mm]**)	3.35	4.00	4.75	5.40	6.80
D [mm]	$4.62^{+0.08}$	$5.53^{+0.08}$	$6.52^{+0.09}$	$7.42^{+0.09}$	$9.32^{+0.09}$

For M5 and M6 with inductive hardened tip, through-hardening in the area of the thread-forming zone cannot be excluded.The application must be considered here.

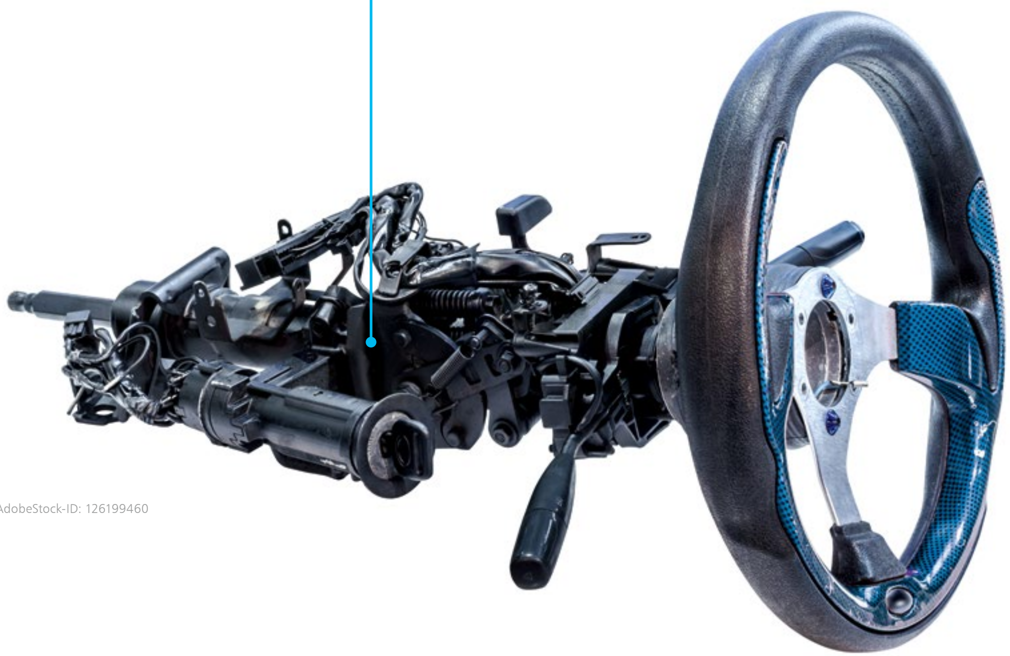
Note: Length of heat affected zone of the screw tip is max. 5 x p

Nominal-Ø*)	M5	M6	M7	M8	M10
K=1.0xd	5.00	6.00	7.00	8.00	10.00
ET_{eff} [mm]**)	4.60	5.50	6.50	7.40	9.30
D [mm]	$4.64^{+0.08}$	$5.55^{+0.08}$	$6.54^{+0.09}$	$7.44^{+0.09}$	$9.34^{+0.09}$
K=1.25xd	6.25	7.50	8.75	10.00	12.50
ET_{eff} [mm]**)	5.85	7.00	8.25	9.40	11.80
D [mm]	$4.66^{+0.08}$	$5.57^{+0.08}$	$6.56^{+0.09}$	$7.46^{+0.09}$	$9.36^{+0.09}$

**) For an explanation of terms please see page 22.*

***) Please see page 12 for effective screw-in depth recommendations*

Powertite®
Application fields for steel sheet direct screw fastening



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Applications in sheet steel

For thread-forming into steel sheet metal rim holes thread-forming screws are usually used in a case-hardened and tempered version or screws screws in strength class 10.9 with additional inductive hardening in the thread-forming zone are used. Powertite® screws in this version can generally be implemented into steel materials up to Rm ~ 600 MPa.

Applications using insert or pierce-clinch nuts without thread

For highly stressed screw connections, it is possible to use press-in or pierce-clinch nuts without thread.
This can include the following threadless nuts:

- Pias KP
- Pias HN
- Rivtex

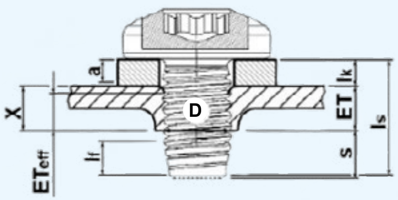
With Powertite® screws in strength class 10.9 with inductive hardened thread-forming zone, it is possible to form a metric thread into these insert or pierce-clinch elements.

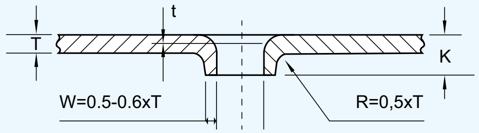
The benefits:

- Saving of the thread cutting operation
- Avoids cross-threading during assembly
- Increased self-locking in the formed thread

ARNOLD BlueFastening Systems

Core hole recommendations for applications in steel sheet metal rim holes





The actual values must be investigated on the original components. Our Fastener Testing Center is available to you at any time. For questions about the design of the core holes, please do not hesitate to contact our sales department.

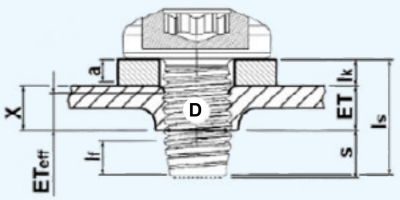
Nominal-Ø*)	M5									
T [mm]	0.80	1.00	1.20	1.50	1.80	2.00	2.20	2.50	3.00	4.00
K [mm]**)	1.44	1.80	2.16	2.70	3.24	3.60	3.96	4.50	5.40	7.20
t [mm]	0.24	0.30	0.36	0.45	0.54	0.60	0.66	0.75	0.90	1.20
ET_{eff} [mm]***)	1.20	1.50	1.80	2.25	2.70	3.00	3.30	3.75	4.50	6.00
D [mm]	$4.53^{+0.08}$	$4.53^{+0.08}$	$4.53^{+0.08}$	$4.53^{+0.08}$	$4.53^{+0.08}$	$4.53^{+0.08}$	$4.56^{+0.08}$	$4.56^{+0.08}$	$4.58^{+0.08}$	$4.58^{+0.08}$
$S_{min\text{-}COI}$ [mm]	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
S_{min} [mm]	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40

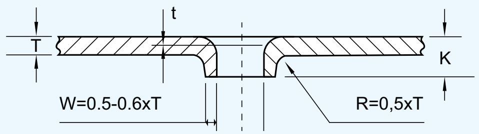
Nominal-Ø*)	M6								
T [mm]	1.00	1.20	1.50	1.80	2.00	2.20	2.50	30	4.00
K [mm]**)	1.80	2.16	2.70	3.24	3.60	3.96	4.50	5.40	7.20
t [mm]	0.30	0.36	0.45	0.54	0.60	0.66	0.75	0.90	1.20
Et_{eff} [mm]***)	1.50	1.80	2.25	2.70	3.00	3.30	3.75	4.50	6.00
D [mm]	$5.40^{+0.1}$	$5.40^{+0.1}$	$5.40^{+0.1}$	$5.40^{+0.1}$	$5.40^{+0.1}$	$5.40^{+0.1}$	$5.40^{+0.1}$	$5.43^{+0.1}$	$5.43^{+0.1}$
$S_{min\text{-}COI}$ [mm]	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
S_{min} [mm]	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

**) For an explanation of terms please see page 22.*

***) Effective screw-in depth depends on sheet thickness T*

Core hole recommendations for applications in steel sheet metal rim holes





The actual values must be investigated on the original components. Our Fastener Testing Center is available to you at any time. For questions about the design of the core holes, please do not hesitate to contact our sales department.

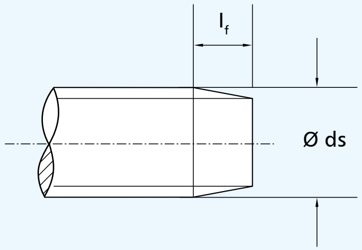
Nominal-Ø*)	M8							
T [mm]	1.20	1.50	1.80	2.00	2.20	2.50	3.00	4.00
K [mm]**)	2.16	2.70	3.24	3.60	3.96	4.50	5.40	7.20
t [mm]	0.36	0.45	0.54	0.60	0.66	0.75	0.90	1.20
ET_{eff} [mm]***)	1.80	2.25	2.70	3.00	3.30	3.75	4.50	6.00
D [mm]	$7.27^{+0.12}$	$7.27^{+0.12}$	$7.27^{+0.12}$	$7.27^{+0.12}$	$7.27^{+0.12}$	$7.27^{+0.12}$	$7.27^{+0.12}$	$7.27^{+0.12}$
$S_{min\text{-}COI}$ [mm]	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
S_{min} [mm]	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75

Nominal-Ø*)	M10						
T [mm]	1.50	1.80	2.00	2.20	2.50	3.00	4.00
K [mm]**)	2.70	3.24	3.60	3.96	4.50	5.40	7.20
t [mm]	0.45	0.54	0.60	0.66	0.75	0.90	1.20
ET_{eff} [mm]***)	2.25	2.70	3.00	3.30	3.75	4.50	6.00
D [mm]	$9.13^{+0.12}$	$9.13^{+0.12}$	$9.13^{+0.12}$	$9.13^{+0.12}$	$9.13^{+0.12}$	$9.13^{+0.12}$	$9.13^{+0.12}$
$S_{min\text{-}COI}$ [mm]	7.50	7.50	7.50	7.50	7.50	7.50	7.50
S_{min} [mm]	4.50	4.50	4.50	4.50	4.50	4.50	4.50

**) For an explanation of terms please see page 22.*

***) Effective screw-in depth depends on sheet thickness T*

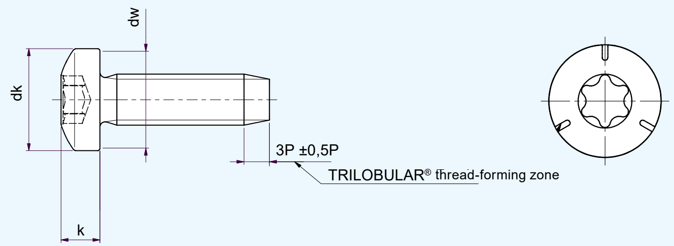
The optimised thread geometry of Powertite®



Nominal Ø thread Powertite®	M5	M6	M7	M8	M10
Length of TRILOBULAR® thread-forming zone l_f [mm]	2.40	3.00	3.00	3.75	4.50
Tolerance l_f [mm]	±0.40	±0.50	±0.50	±0.625	±0.75
Pitch p [mm]	0.80	1.00	1.00	1.25	1.50
External diameter of thread ds max. [mm]	5.15	6.15	7.15	8.15	10.15
External diameter of thread ds min. [mm]	5.00	6.00	7.00	8.00	10.00

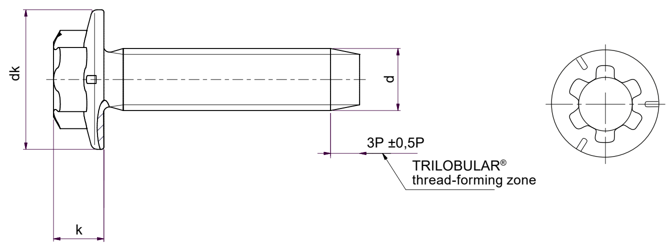
ARNOLD Factory Standards

Pan head screw AWN-07-01-02



Nominal Ø d		M5	M6	M7	M8	M10
Head diameter dk [mm]		$9.50_{-0.36}$	$12.00_{-0.43}$	$14.00_{-0.43}$	$16.00_{-0.43}$	$20.00_{-0.52}$
Diameter of head bearing d_w min. [mm]		8.74	11.07	13.07	15.07	18.98
Head height k [mm]		$3.70_{-0.18}$	$4.60_{-0.30}$	$5.50_{-0.30}$	$6.00_{-0.30}$	$7.50_{-0.36}$
TORX®	Size	T25	T30	T40	T45	T50
TORX PLUS® AUTOSERT®	Size	25IP	30IP	40IP	45IP	50IP

AWN-07-01-08 external TORX® screw



Nominal Ø d	M5	M6	M7	M8	M10
Head diameter dk [mm]	12.00	14.00	16.00	18.00	22.00
Diameter of head bearing d_w min [mm]	10.00	12.00	14.00	16.00	20.00
Head height k [mm]	$5.00_{-0.30}$	$5.60_{-0.30}$	$6.00_{-0.30}$	$7.50_{-0.36}$	$8.90_{-0.50}$
External TORX PLUS® Low Profile	8EP	12EP	14EP	14EP	18EP

Head geometry suitable for plastically stressed assembly.

ARNOLD BlueFastening Systems

What length screw for which thread Ø?

Nominal -Ø thread Powertite®	M5	M6	M7	M8	M10
Length L [mm]	12-50	16-60	18-65	20-65	25-80
5 ±0.375					
6 ±0.375					
8 ±0.45					
10 ±0.45					
12 ±0.55	■				
(14) ±0.55	■				
16 ±0.55	■	■			
18 ±0.55	■	■	■		
20 ±0.65	■	■	■	■	
(22) ±0.65	■	■	■	■	
25 ±0.65	■	■	■	■	■
(28) ±0.65	■	■	■	■	■
30 ±0.65	■	■	■	■	■
35 ±0.80	■	■	■	■	■
40 ±0.80	■	■	■	■	■
45 ±0.80	■	■	■	■	■
50 ±0.80	■	■	■	■	■
55 ±0.95		■	■	■	■
60 ±0.95		■	■	■	■
65 ±0.95			■	■	■
70 ±0.95					■
80 ±0.95					■

**) Differing lengths on request*

Intermediate lengths on request.
Lengths in brackets should be avoided as far as possible.

Not for counter-sunk heads

Eco-Sert® Aluminum inserts
Optimal results in combination with Powertite®

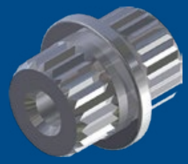
Aluminum inserts for challenging connections

In practice, aluminum inserts are mainly used for joining plastics. They are used to stiffen components (tube supports) or as the counterpart for a direct fastening. With an appropriate choice of geometry and alloy, they obtain outstanding fastening results when combined with Powertite®. The advantages of aluminum inserts as a metal-to-metal connection are particularly evident in components subject to vibration or operating at high temperatures.

Pressed Insert

Embedded insert

FASTENING PLASTICS

After Molding/In Molding	After Molding/In Molding	In Molding	In Molding
Version 1 combined with standard Eco-Sert®	**Version 2 combined with Eco-Sert® with indent**	**Version 3 combined with Eco-Sert® with center collar**	**Version 4 combined with Eco-Sert® with dual collar**
			

ARNOLD BlueFastening Systems

The Powertite® as a climate protector

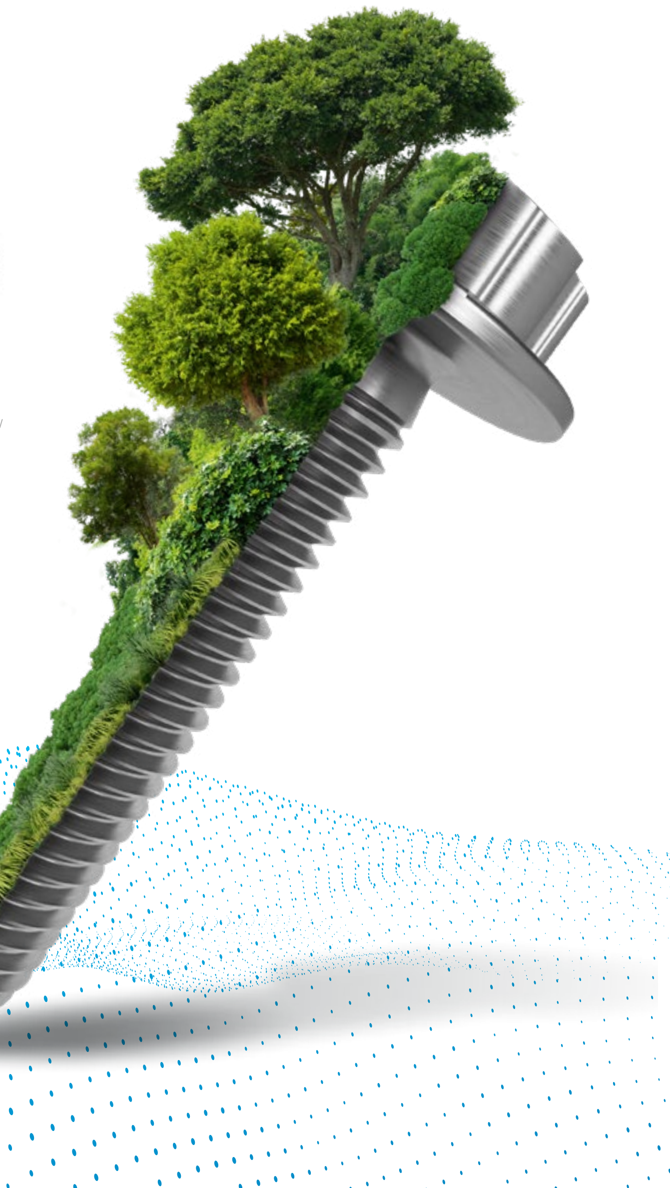
Approx. 20 % of CO_2 saved

By downsizing an M8x40 screw to an M7x40 screw (relating to 6 million screws used annually in an electric motor gear unit).

iStock-ID: 1318947619 | © Chesky_W

Sustainable and climate-protecting

Compared with conventional thread-forming screws, Powertite® screws benefit the environment. They save on resources with the option to downsize. For example, replacing an M8x40 screw with an M7x40 Powertite® in an electric motor gear unit resulted in a weight reduction. Related to the total production of 50,000 vehicles, this represented a weight saving of over 8.5 tons, and a decrease in CO_2 of more than 20 %.

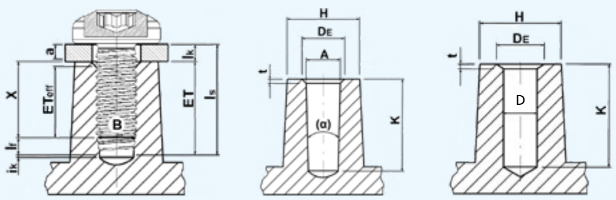


Explanation of terms:
Core hole recommendations for direct screw fastening

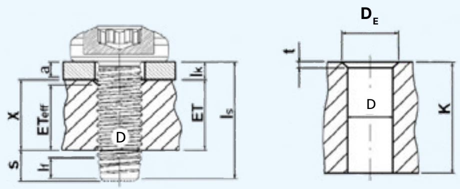
Term	Explanation
A	Core hole diameter in depth t [mm]
a	Length of thread runout in Powertite® [mm]
B	Core hole diameter in cast hole (in depth x) [mm]
D	Core hole diameter in cylindrical hole [mm]
d	Nominal screw diameter [mm]
D_E	Chamfer diameter [mm] As an option cylindrical centering holes are also permitted
ET	Screw-in depth = screw length - clamping thickness [mm]
ET_{eff}	Effective screw-in depth = ET - l_f - t [mm]
l_k	Clamping thickness [mm]
i_k	Distance of threaded end to base of core hole [mm]
K	Core hole depth / height of sheet-metal flanged hole

Term	Explanation
T	Sheet thickness
t	Depth of relief bore [mm]
l_f	Length of thread-forming zone (tolerance median) ~ 3 x p [mm]
l_s	Screw length [mm]
s_{min}	Recommended minimum projection for 8.8, 10.9 or EH, so that the thread-forming zone lies outside the force transmitting area [mm]
$s_{min\text{-}COI}$	Recommended minimum projection for 10.9I (inductive hardened thread-forming zone), so that the heat affected zone lies outside the force transmitting area [mm]
x	Depth of first fully load-bearing thread pitch
α	Total demolding angle [°] (information only)

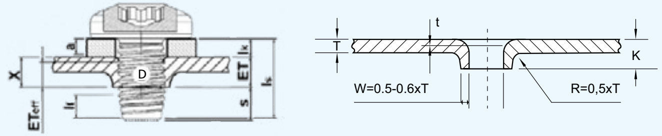
Blind hole screw fastening



Rim hole screw fastening



Sheet metal rim hole screw fastening



ARNOLD BlueFastening Systems

Notes

The ARNOLD GROUP

www.arnold-fastening.com

Wherever customers need us.

ARNOLD – this name is internationally renowned for efficient and sustainable fastening systems at the highest level.

With a foundation of many years of expertise in the production of intelligent fastening systems and very complex extruded parts, the ARNOLD GROUP has developed over a number of years into a comprehensive supplier and development partner for complex fastening systems. With our positioning of "BlueFastening Systems", this development process will continue under a united and harmonised structure. Engineering, services, fasteners and functional parts, together with feeding and processing systems, all from a single source – efficient, sustainable and international.

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