Dated 10/2021
www.arnold-fastening.com

ARNOLD®
BlueFastening Systems

REMFORM®
REMFORM® II™ HS

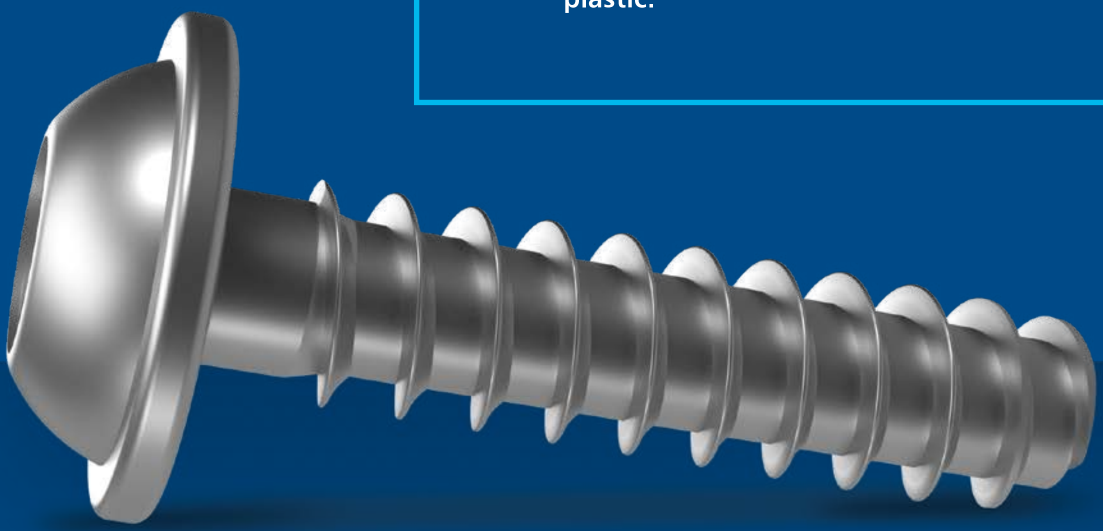
Thread-forming screws for plastics

- Asymmetric thread
- Optimised material flow
- Minimum tube load
- High pre-load force
- High dynamic load
- High level of process reliability

ARNOLD TV PRESENTS
ARNOLD TV PRÄSENTIERT

Asymmetric thread flank

The asymmetric thread profile is perfectly matched to the material properties of the plastic.



The REMFORM® effect

Optimised material flow

↘ The radius profile steers the plastic directly to the load bearing flank during the screw-in process.

Minimum tube load

↘ Small load bearing flank angles reduce the radial stress and ensure improved material displacement.

High dynamic load capacity

↘ The special thread geometry increases vibration resistance and ensures high loosening resistance.

High level of process reliability

↘ Low screw-in torques and high overtorques ensure a high level of fastening reliability.

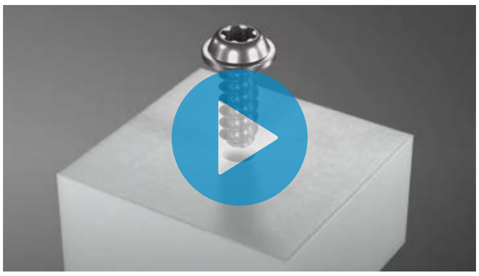
REMFORM® and REMFORM® II™ HS
Innovative fastening systems for plastics

Direct plastic screw fastenings save on weight, costs and process time

Plastic: a versatile material

In our increasingly complex world, we can hardly imagine what it would be like without plastics. Nowadays, we come across plastics in use where just a few years ago only metals were to be found. Moreover, the material properties of the latest plastics and state of the art production technologies allow us to implement designs that could not be achieved in metal. With plastics, we can integrate the widest variety of processes and functions into a single component, and manufacture that component in a single production step.

However, at some point in the design process, we arrive at the point where the manufactured component needs to be connected to the greater whole.
When you designed your component, if you answered "yes" to the questions about whether the fastening needs to be detachable, or whether a defined pre-load force was required, there's no getting round the need for a screw fastening.

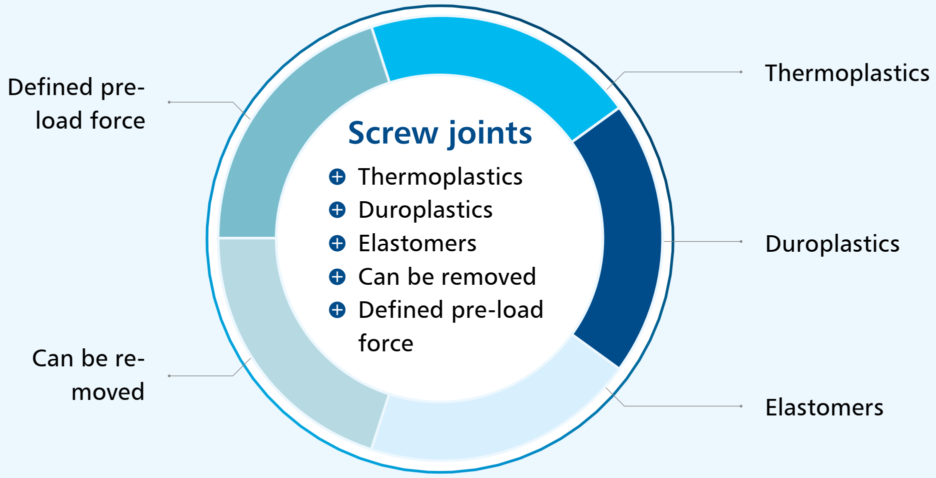


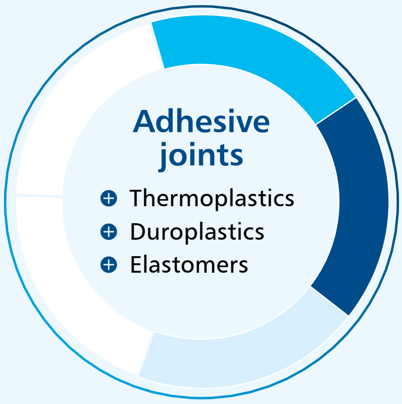
How does REMFORM® work?

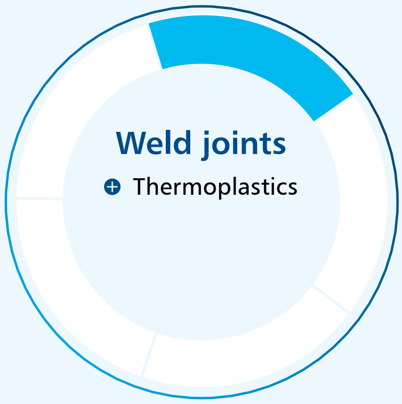
Plastic components can be manufactured in a single production step.

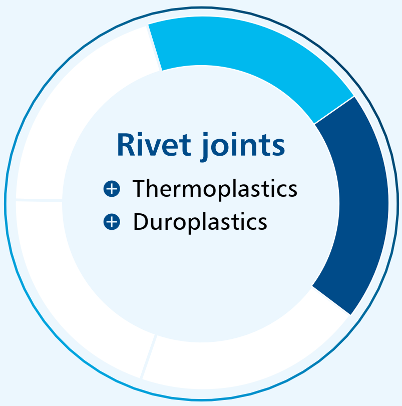
Modern polymers create designs that could not be achieved with metals.

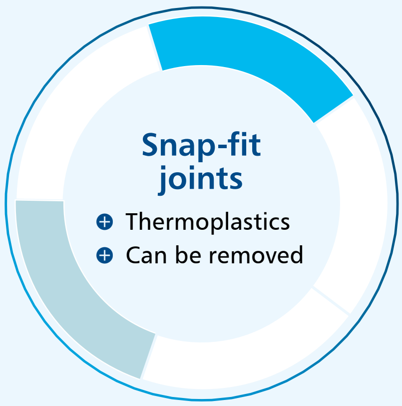
Comparison of 5 joining techniques for plastics











Summary:
The screw fastening is the only joining method that meets all five selection criteria.

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Direct screw fastening or insert?

REMFORM® and REMFORM® II™ HS

Advantages over inserts

- No additional joining element
- No additional insert process
- No risk of tool tilting when closing
- Greatly reduced cycle time

Affordable and reliable fastening

Our response to the requirement for a well-priced and reliable connection is direct plastic screw fastenings under the REMFORM® and REMFORM® II™ HS brands.
The thread-forming screw with its asymmetric thread profile, which is screwed into pre-formed holes, is realised in a type of assembly that is cost effective, recyclable and which can be undone.

Direct plastic screw fastening with **REMFORM® / REMFORM® II™ HS** →	Your benefit		Injection process	REMFORM® / REMFORM® II™ HS	Assembly
Process with **insert and metric screw** →	Insert	Insertion process	Injection process	Fastening element	Assembly

REMFORM® and REMFORM® II™ HS Recommendations for use

Plastics should be designed according to their deforming capacity.

Plastic and metal – different properties

If plastics are subject to load, sooner or later the tension will start to decrease due to creep and relaxation. Over time, this allows the pre-load force in the fastening to drop. As opposed to most metals, plastics must not be designed to the greatest tension they can bear, but to their deforming capacity.

	REMFORM®	REMFORM® II™ HS
Base polymers	●	●
Tensile modulus 3000 MPa E.g.: PE, PA 6, ABS, ASA, PSU, PET, POM		
Standard polymers	○	●
Tensile modulus 3000–7000 MPa E.g.: PA 6 GF30, PP T40, PEEK, PMMA, PC GF, PBT/ASA GF, PSU GF20		
Technical polymers	○	●
Tensile modulus 7000–10000 MPa E.g.: PA6 GF35, PPA GF20, PBT GF30, PP GF40		
High performance polymers		●
Tensile modulus > 10,000 MPa E.g.: PET GF30, PA6 GF50, PPA GF40, PPS GF40, PET GF50		

● Ideal/recommended ○ Suitable

Areas of application for direct plastic screw fastenings

Wherever vibration resistance, loosening resistance or pull-out force are required

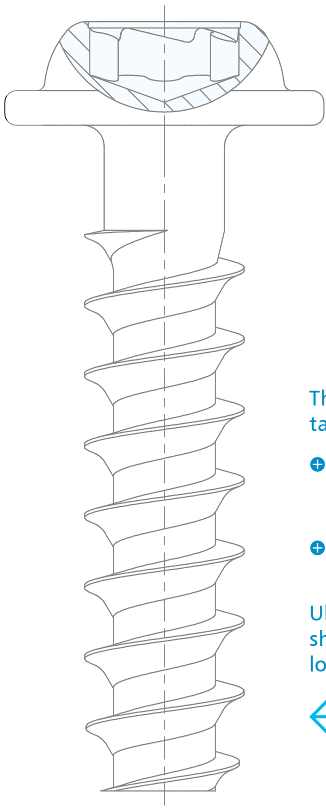
Direct plastic screw fastenings are less used where the pre-load force at assembly needs to be maintained throughout the component's service life, but rather where the focus is on vibration resistance, loosening resistance or pull-out force. But many insert solutions can be replaced with an improved design.

Areas of application

- Interior
- Headlamps
- Wing mirrors
- On-board electronics
- Oil filter
- Housing fasteners
- Stators
- Pumps of all types
- PCB fasteners
- Multimedia

REMFORM®
Asymmetric thread geometry makes all the difference

The choice of thread geometry can have a considerable influence on the quality of the screw fastening.



The thread fulfils two tasks:

- **Forming tool during thread forming**
- **Form-locking fastening**

Ultimately, the screw should not become loose of its own accord.

Special load bearing flank and radius profile

As the screw is inserted, the heat created makes the plastic malleable. To keep the stresses as low as possible, particular attention needs to be paid to the flank angle.
Small flank angles produce less radial force, so less load is created on the tube during the screw-in process. This is why normal plastic screws indicate small flank angles of approximately 30°. The **asymmetric thread geometry** of REMFORM®screws offers a further important advantage:

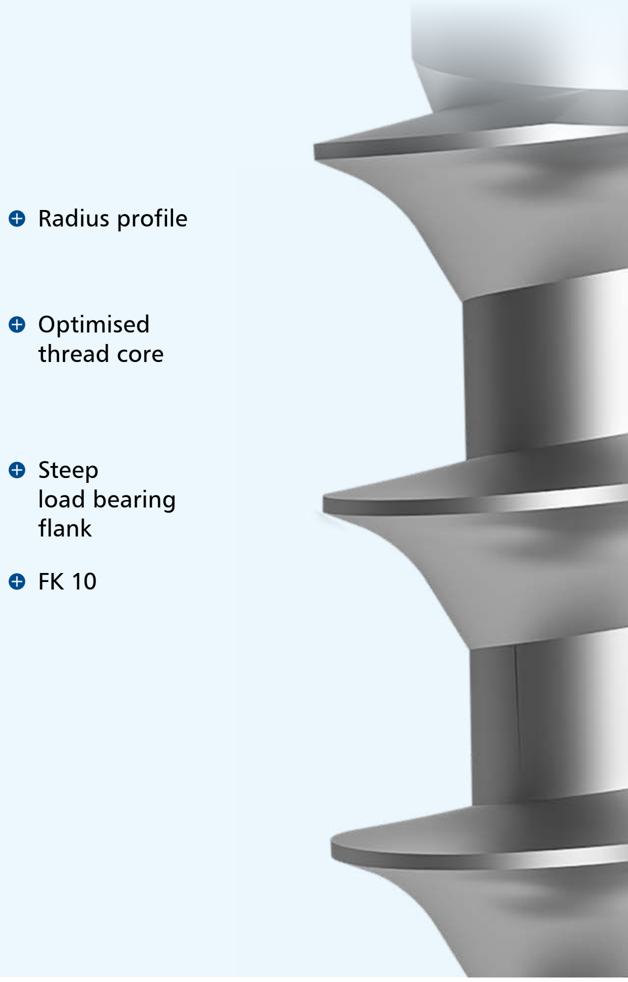
At approx. 12°, the angle of the load bearing flank reduces the radial force to a minimum during the tightening process. In addition, the radius profile produces a torque that steers the plastic directly to the steep flank during the screw-in process.

- **The asymmetric geometry thus reduces the radial force and increases the axial force,** which signifies a much higher pull-out force compared with a symmetric profile.

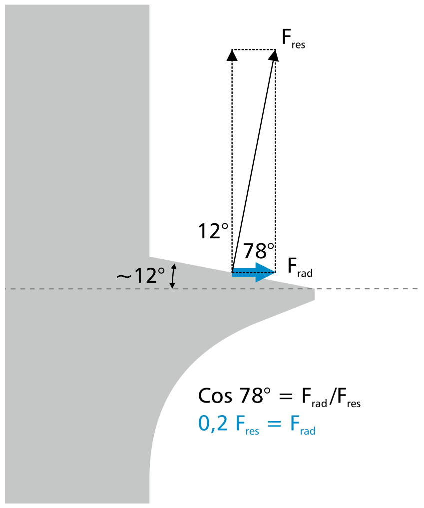
REMFORM®

Advantages at a glance

- Optimum plastic flow due to radius profile
- High pull-out forces
- High pre-load forces with low load on the nut material
- Better process reliability
- High delta between screw-in torque and overtorque
- High tensile and torsion strength
- Repeatable screw fastening possible

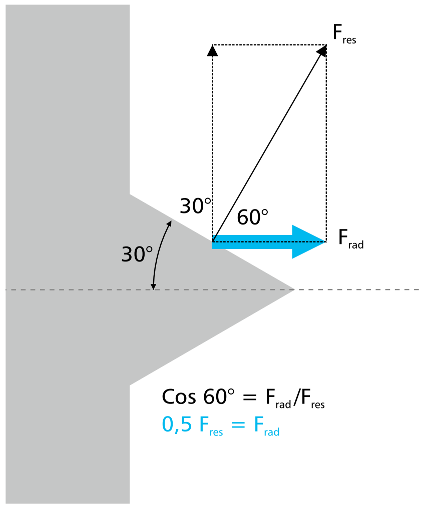


REMFORM®



F_{rad} = radial force
F_{res} = resultant force

Sheet-metal screw



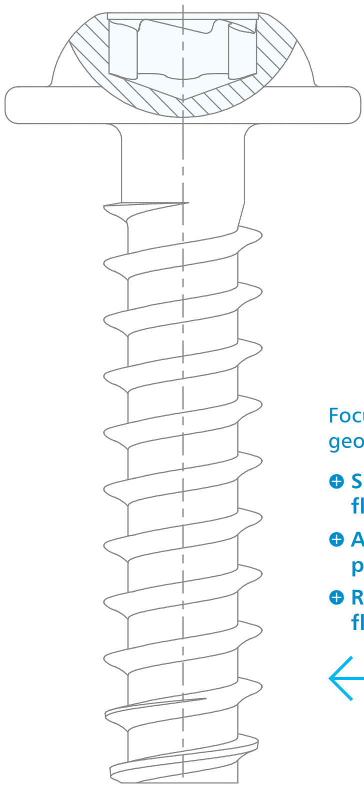
F_{rad} = radial force
F_{res} = resultant force

REMFORM® II™ HS
For demanding fastening applications

The rising popularity of high performance plastics

Metals are increasingly being replaced by high performance plastics. In the automotive industry in particular, high strength plastics are being used in applications requiring higher pre-load force, vibration resistance and temperature resistance.

The perfect fastener for direct plastic screw fastening of high strength thermoplastics



Focusing on thread geometry:

- **Small load bearing flank angle 10°**
- **Asymmetric thread profile**
- **Rounded thread flanks**

Special load bearing flank and radius profile

ARNOLD offers the perfect fastener for direct plastic screw fastening of high strength thermo-plastics: the REMFORM® II™ HS (HS = High Strength).
Thanks to the greater screw core diameter, the connection is stronger and more durable than connections using conventional plastic screws. The optimised thread pitch ensures more load bearing thread turns, giving the **screw joint a higher load bearing capacity.** During the screw-in process, the asymmetric thread profile and the rounded thread flank ensure optimum plastic flow. At the same time, the small load bearing flank angle of 10° reduces the radial component for **improved material displace-ment.**

- The thread geometry of the REMFORM® II™ HS was **developed especially to cope with the loads in high strength thermoplastics.**

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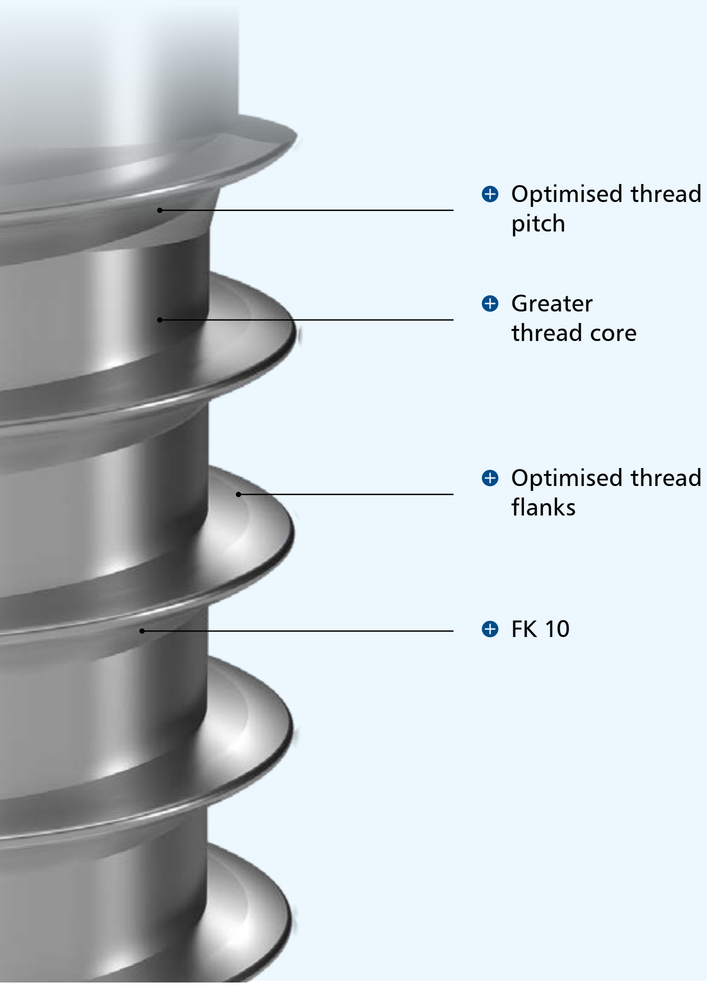
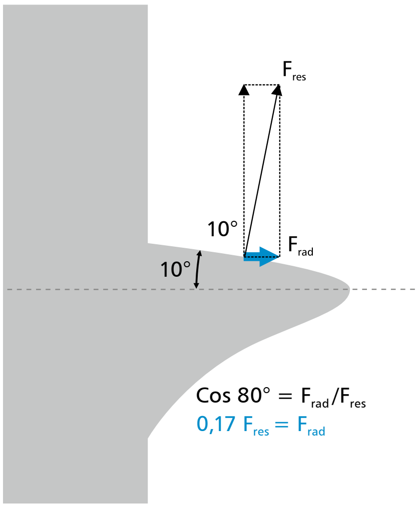


REMFORM® II™ HS

Advantages at a glance

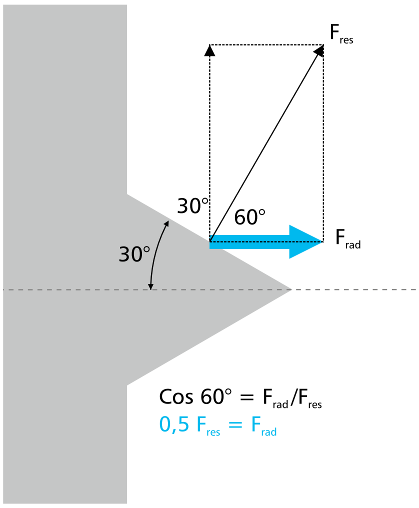
- Minimised tube load thanks to extremely small angle of the load bearing flank
- Optimum plastic flow due to radius profile
- High pull-out forces
- High pre-load forces with low load on the nut material
- High delta between screw-in torque and overtorque
- High breaking torque thanks to optimised core diameter
- High tensile and torsion strength
- Repeatable screw fastening possible
- High dynamic load capacity of the fastening

REMFORM® II™ HS



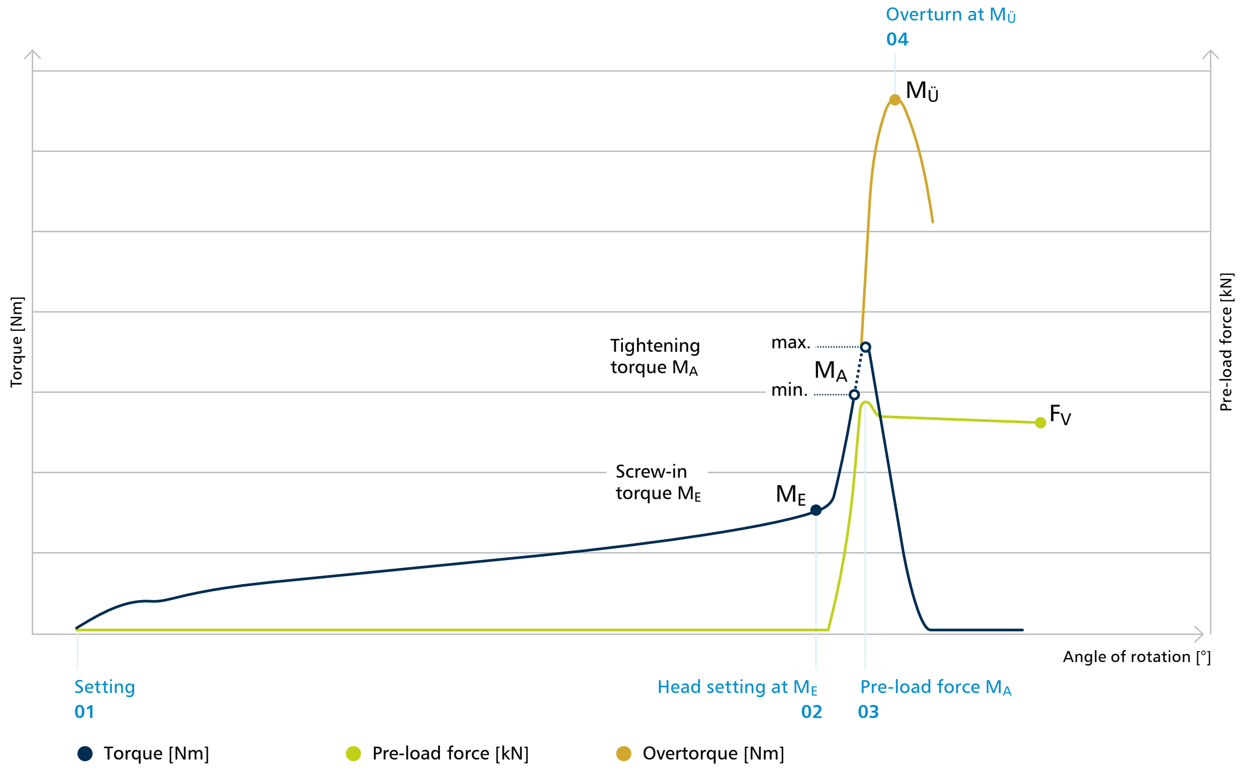
F_{rad} = radial force
F_{res} = resultant force

Sheet-metal screw



F_{rad} = radial force
F_{res} = resultant force

Assembly parameters
Torque as an auxiliary value



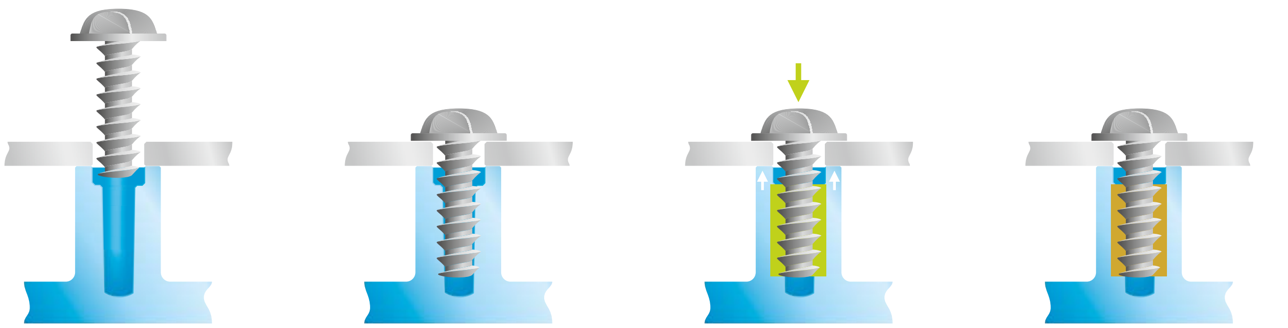
Example of screw curve for REMFORM®

In series production, it is not possible to monitor the actual target pre-load force value (F_V) – or only at unreasonably high cost. This is why we use the torque as an auxiliary value or aid. The REMFORM® screw curve given as an example shows this relationship.

Determination of the residual clamping force using long term observation

Test steps to determine the pre-load force

In tests, we determine the pre-load force by applying a test socket or with the aid of ultrasound technology. This enables us to assign a specific force to every torque recorded. For example, the residual clamping force can be determined by means of a long term observation under the influence of temperature (static or cyclic).



01 **Setting**

02 **Head setting at M_E**

03 **Pre-load force at M_A**

04 **Overturn at $M_Ü$**

Example of a screw-in curve for **standard polymers**

Nominal diameter of thread

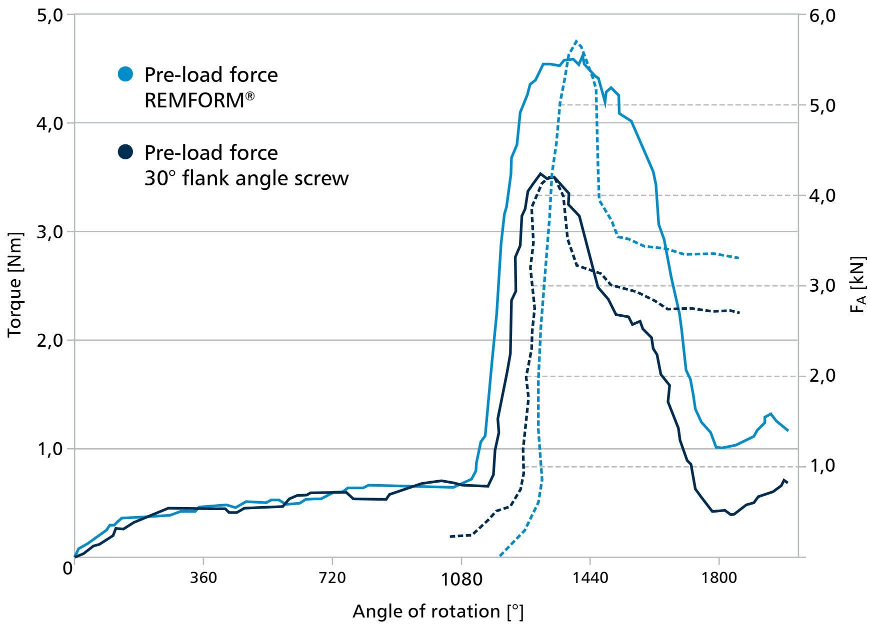
5.0 mm

Standard polymer
Tensile modulus

< 7000 MPa

REMFORM®

Compared directly with a conventional 30° screw, REMFORM® represents a definite advantage for your assembly process in terms of **process reliability, increased stability during driving, higher load capacity** and a **higher quality fastening.**



	Screw with 30° flank angle	REMFORM®	Change
Max. screw-in torque $M_{E\ max}$	0.70 Nm	0.73 Nm	+4.30 % ↑
Min. overtorque $M_{Ü\ min}$	3.48 Nm	4.56 Nm	+31.03 % ↑
Min. pull-out force F_A	3.27 kN	4.96 kN	+36.45 % ↑
Differential $M_Ü - M_E$	2.78 Nm	3.83 Nm	+37.76 % ↑
Ratio $M_Ü$ / M_E	4.97	6.25	+25.75 % ↑

Example of a screw-in curve for **high performance polymers**

Nominal diameter of thread

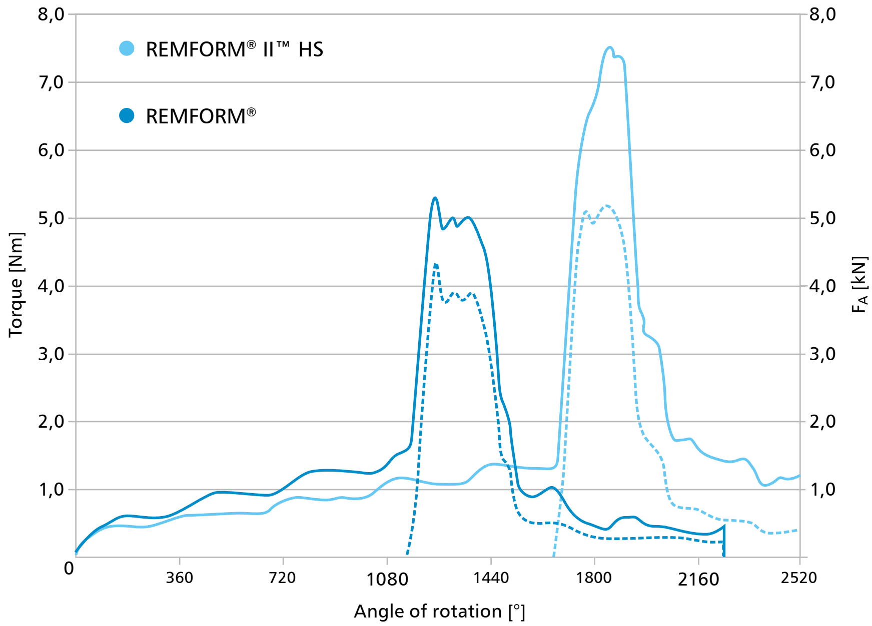
5.0 mm

High performance polymer Tensile modulus

> 8000 MPa

REMFORM® II™ HS

When it comes to high performance polymer screw fastenings, REMFORM® II™ HS ensures significantly **higher pull-out forces and overtorques. A high level of process reliability and load capacity** of the joint is achieved.



	REMFORM®	REMFORM® II™ HS	Change
Max. screw-in torque $M_{E\,max}$	1.45 Nm	1.52 Nm	+5 % ↑
Min. overtorque $M_{\ddot{U}\,min}$	5.98 Nm	7.01 Nm	+17 % ↑
Min. pull-out force F_A	4.03 kN	4.87 kN	+21 % ↑
Differential $M_{\ddot{U}} - M_E$	4.53 Nm	5.49 Nm	+21 % ↑
Ratio $M_{\ddot{U}} / M_E$	4.12	4.61	+12 % ↑

How to design your **insertion tubes**

Insertion tubes are cylindrical holes with no internal thread

Prerequisite for an optimum fastening

To optimise your fastening, you also need to design the counterpart to the screw to suit the fastening. In most cases, the insertion tube is a cylindrical hole with no internal thread, moulded when the injection-moulded components are manufactured. The core holes will vary according to the material.

- To ensure optimum hole design for REMFORM® and REMFORM® II™ HS screws, we have **determined some factors for specific plastics** (see page 17). You can multiply these by the screw diameter when you are designing the component.

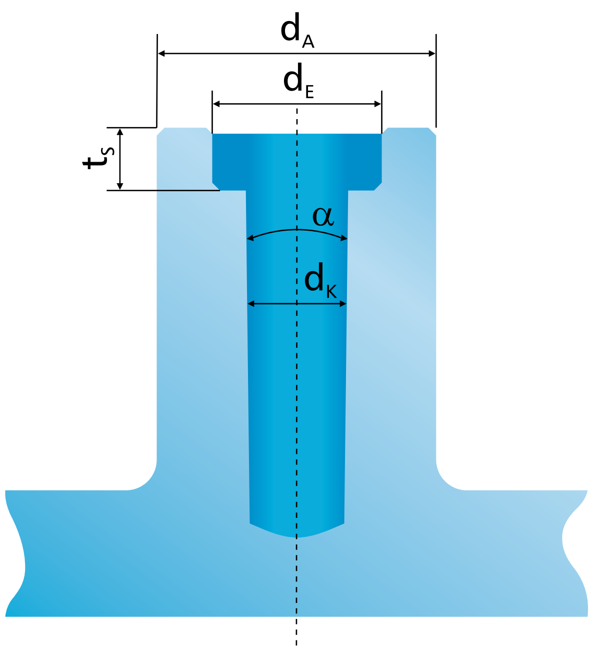
Materials and core hole factors on page 17

Note

We ascertained the core hole factors on test pieces under laboratory conditions.

The tests were based on a driving depth corresponding to twice the nominal diameter of the screw. It is important to establish the precise values for core holes, driving depth, tightening torque and other important factors by performing the relevant tests on plastic parts. We recommend performing driving tests on original parts so that you can also take into account the processing effects (e.g. seams, fibre distribution, distance to injection point, etc.).

Example illustration of the pilot hole
with dimensions



d_A
External diameter of tube

d_E
Relief hole diameter

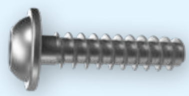
d_K
Core hole diameter

t_S
Relief hole depth

α
Demoulding angle

The core hole diameter is specific to the material. **However, α should not exceed 1°.**

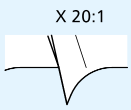
Core hole factors for plastics
for multiplying by the screw diameter

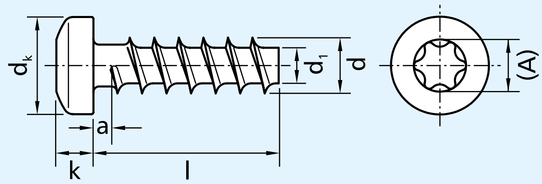


	REMFORM®		REMFORM® II™ HS	
Material	Material factor O	Recommended driving depth	Material factor O	Recommended driving depth
ABS	0.74 × d	2.50 × d	0.75 × d	2.30 × d
ASA	0.74 × d	2.50 × d	0.75 × d	2.30 × d
PA 6	0.74 × d	2.50 × d	0.75 × d	2.30 × d
PBT	0.78 × d	2.50 × d	0.80 × d	2.30 × d
PC	0.78 × d	2.50 × d	0.80 × d	2.30 × d
POM	0.77 × d	2.50 × d	0.78 × d	2.30 × d
PP	0.72 × d	2.50 × d	0.75 × d	2.30 × d
PA 6 GF 30	0.82 × d	2.00 × d	0.83 × d	2.00 × d
PA 6 GF 60	0.85 × d	2.00 × d	0.86 × d	2.00 × d
PA 6.6 GF 20	0.81 × d	2.30 × d	0.82 × d	2.00 × d
PA 6.6 GF 40	0.86 × d	2.00 × d	0.86 × d	2.00 × d
PBT GF 30	0.82 × d	2.00 × d	0.83 × d	2.00 × d
PEEK	0.84 × d	2.00 × d	0.85 × d	2.00 × d
PEI GF 30	0.84 × d	2.00 × d	0.85 × d	2.00 × d
PET GF 40	0.84 × d	2.00 × d	0.85 × d	2.00 × d
PMMA	0.82 × d	2.00 × d	0.82 × d	2.30 × d
PP GF 50	0.85 × d	2.00 × d	0.86 × d	2.00 × d
PP T40	0.80 × d	2.30 × d	0.81 × d	2.00 × d
PPA GF 30	0.82 × d	2.00 × d	0.83 × d	2.00 × d
PPS	0.80 × d	2.00 × d	0.80 × d	2.00 × d
PPS GF 40	0.86 × d	2.00 × d	0.87 × d	2.00 × d
PS	0.77 × d	2.30 × d	0.80 × d	2.00 × d
PSU GF 20	0.84 × d	2.00 × d	0.85 × d	2.00 × d
PVC-U	0.80 × d	2.30 × d	0.80 × d	2.00 × d
SAN	0.80 × d	2.30 × d	0.80 × d	2.00 × d

Factory standard REMFORM®

AWN-03-01-02





Thread d		2.5+0.10	3.0+0.10	3.5+0.10	4.0+0.10	5.0+0.15	6.0+0.15	8.0+0.15	10+0.15
d1		1.47+0.20	1.90+0.20	2.22+0.20	2.55+0.20	3.19+0.25	3.84+0.25	5.12+0.25	6.40+0.25
P (thread pitch)		1.15	1.35	1.55	1.75	2.25	2.65	3.50	4.50
a max.	l > 3×d	1.70	2.00	2.30	2.60	3.35	3.95	5.25	6.75
	l ≤ 3×d	1.15	1.35	1.55	1.75	2.25	2.65	3.50	4.50
d_k Nom. dimension =	max.	4.40	5.30	6.20	7.00	8.80	10.50	14.00	16.00
	min.	4.10	5.00	5.90	6.65	8.45	10.10	13.60	15.60
k Nom. dimension =	max.	1.90	2.40	2.75	3.00	3.70	4.30	6.00	6.40
	min.	1.70	2.15	2.50	2.70	3.40	4.00	5.60	6.00
r	max.	0.45	0.50	0.50	0.60	0.70	0.80	1.00	1.20
r_f	~	4.00	5.00	6.00	6.50	8.00	9.00	13.00	16.00
TORX®	Size	T8	T10	T15	T20	T25	T30	T40	T40
	(A)	2.40	2.80	3.35	3.95	4.50	5.60	6.75	6.75
Penetration depth	min.	0.75	1.00	1.14	1.27	1.39	1.65	2.28	2.70
	max.	0.89	1.35	1.40	1.66	1.78	2.03	2.67	3.20
TORX PLUS® AUTOSERT®	Size	8IP	10IP	15IP	20IP	25IP	30IP	40IP	40IP
	(A)	2.39	2.82	3.35	3.94	4.52	5.61	6.76	6.76
Penetration depth	min.	0.69	1.10	1.14	1.34	1.55	1.63	2.30	2.64
	max.	0.83	1.30	1.37	1.62	1.85	2.02	2.77	3.11
Standard length	min.	5.00	6.00	7.00	8.00	10.00	12.00	14.00	18.00
	max.	25.00	30.00	37.00	40.00	50.00	60.00	80.00	100.00

Strength class 10

Nominal diameter	2	2.5	3	3.5	4	5	6	7	8
Breaking torque* min. (Nm)	0.33	0.65	1.35	2.14	3.2	6.19	10.7	16.9	25.2
Material	20MnB4 (1.5525) to EN 10263-4								
Strength class	FK10								
Hardness	320 to 380 HV10								
Surface hardness	MAX: 390 HV0.3								

→ Optionally stainless steel 1.4567

Surface variants: galvanised, zinc alloys

Other materials and surfaces on request

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Factory standard REMFORM®

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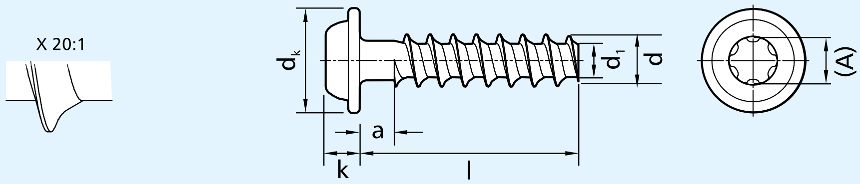


Thread d			$2.5^{+0.10}$	$3.0^{+0.10}$	$3.5^{+0.10}$	$4.0^{+0.10}$	$5.0^{+0.15}$	$6.0^{+0.15}$	$8.0^{+0.15}$	$10^{+0.15}$
d1			$1.47^{+0.20}$	$1.90^{+0.20}$	$2.22^{+0.20}$	$2.55^{+0.20}$	$3.19^{+0.25}$	$3.84^{+0.25}$	$5.12^{+0.25}$	$6.40^{+0.25}$
P (thread pitch)			1.15	1.35	1.55	1.75	2.25	2.65	3.50	4.50
a max.	l > 3×d		1.70	2.00	2.30	2.60	3.35	3.95	5.25	6.75
	l ≤ 3×d		1.15	1.35	1.55	1.75	2.25	2.65	3.50	4.50
d_k	Nom. dimension =	max.	5.00	6.00	7.00	8.00	10.00	12.00	16.00	20.00
		min.	4.52	5.52	6.42	7.42	9.42	11.30	15.30	19.16
k	Nom. dimension =	max.	1.80	2.10	2.40	2.50	3.20	4.00	5.20	6.40
		min.	1.66	1.96	2.26	2.36	3.02	3.82	5.02	6.18
r		max.	0.45	0.50	0.50	0.60	0.70	0.80	1.00	1.20
r_f		~	0.60	0.70	0.80	0.90	1.10	1.30	1.70	2.20
TORX®		Size	T8	T10	T15	T20	T25	T30	T40	T40
		(A)	2.40	2.80	3.35	3.95	4.50	5.60	6.75	6.75
	Penetration depth	min.	0.75	1.01	1.04	0.96	1.39	1.52	2.03	2.60
		max.	0.89	1.27	1.30	1.35	1.78	1.91	2.42	3.00
TORX PLUS® AUTOSERT®		Size	8IP	10IP	15IP	20IP	25IP	30IP	40IP	40IP
		(A)	2.39	2.82	3.35	3.94	4.52	5.61	6.76	6.76
	Penetration depth	min.	0.69	1.10	1.14	1.14	1.55	1.63	1.96	2.64
		max.	0.83	1.30	1.37	1.42	1.85	2.02	2.43	3.11
Standard length		min.	5.00	6.00	7.00	8.00	10.00	12.00	14.00	18.00
		max.	25.00	30.00	37.00	40.00	50.00	60.00	80.00	100.00

Strength class 10

Nominal diameter	2	2.5	3	3.5	4	5	6	7	8
Breaking torque* min. (Nm)	0.33	0.65	1.35	2.14	3.2	6.19	10.7	16.9	25.2
Material	20MnB4 (1.5525) to EN 10263-4								
Strength class	FK10								
Hardness	320 to 380 HV10								
Surface hardness	MAX: 390 HV0.3								

→

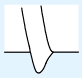
Optionally stainless steel 1.4567

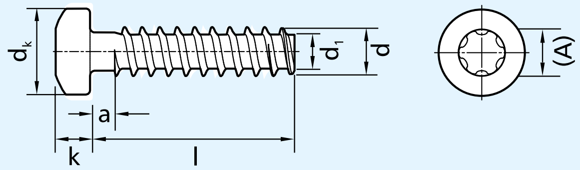
Surface variants: galvanised, zinc alloys

Other materials and surfaces on request

Factory standard REMFORM® II™ HS

X 20:1





Thread Ød		2.5+0.10	3.0+0.10	3.5+0.10	4.0+0.10	5.0+0.15	6.0+0.15
Ød1	min.	1.64	2.01	2.37	2.73	3.43	4.16
P (thread pitch)		0.95	1.12	1.29	1.46	1.80	2.14
a max. (first mark)		1.30	1.50	1.80	2.00	2.50	3.00
Ød$_k$	max.	4.40	5.30	6.10	7.00	8.80	10.50
	min.	4.10	5.00	5.74	6.64	8.44	10.07
k	max.	2.02	2.42	2.82	3.25	3.65	4.35
	Nom. dimension	1.90	2.30	2.70	3.10	3.50	4.20
	min.	1.78	2.18	2.58	2.95	3.35	4.05
r	max.	0.35	0.40	0.45	0.50	0.60	0.70
	Nom. dimension	0.25	0.30	0.35	0.40	0.50	0.60
	min.	0.15	0.20	0.25	0.30	0.40	0.50
(R)		4.00	5.00	6.00	6.50	8.00	9.00
TORX PLUS® AUTOSERT®	Size	8IP	10IP	15IP	20IP	25IP	30IP
	(A)	2.39	2.82	3.35	3.94	4.52	5.61
Penetration depth	min.	0.80	1.00	1.20	1.40	1.60	1.80
	max.	0.98	1.30	1.54	1.81	2.08	2.30
Standard length	min.	5.00	6.00	7.00	8.00	10.00	12.00
	max.	25.00	30.00	35.00	40.00	50.00	60.00

Strength class 10

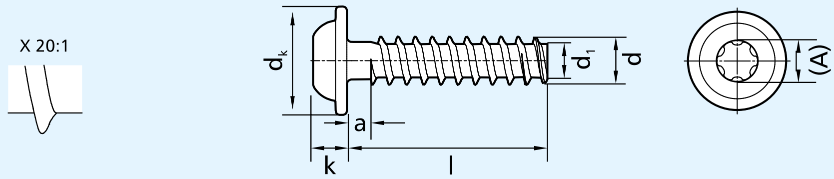
Nominal diameter	2	2.5	3	3.5	4	5	6	7	8
Breaking torque* min. (Nm)	0.41	0.85	1.55	2.52	3.83	7.5	13.3	21.5	32.4
Material	20MnB4 (1.5525) to EN 10263-4								
Strength class	FK10								
Hardness	320 to 380 HV10								
Surface hardness	MAX: 390 HV0.3								

Optionally stainless steel 1.4567

Surface variants: galvanised, zinc alloys

Other materials and surfaces on request

Factory standard REMFORM® II™ HS



Thread Ød		2.5$^{+0.10}$	3.0$^{+0.10}$	3.5$^{+0.10}$	4.0$^{+0.10}$	5.0$^{+0.15}$	6.0$^{+0.15}$
Ød1	min.	1.64	2.01	2.37	2.73	3.43	4.16
P (thread pitch)		0.95	1.12	1.29	1.46	1.80	2.14
a max. (first mark)		1.30	1.50	1.80	2.00	2.50	3.00
Ød$_k$	max.	5.50	6.50	7.50	9.00	11.00	13.50
	min.	5.02	5.92	6.92	8.42	10.30	12.80
k	max.	2.02	2.42	2.82	3.25	3.65	4.35
	Nom. dimension	1.90	2.30	2.70	3.10	3.50	4.20
	min.	1.78	2.18	2.58	2.95	3.35	4.05
r	max.	0.35	0.40	0.45	0.50	0.60	0.70
	Nom. dimension	0.25	0.30	0.35	0.40	0.50	0.60
	min.	0.15	0.20	0.25	0.30	0.40	0.50
(R)		0.70	0.80	0.90	1.00	1.20	1.40
TORX PLUS® AUTOSERT®	Size	8IP	10IP	15IP	20IP	25IP	30IP
	(A)	2.39	2.82	3.35	3.94	4.52	5.61
Penetration depth	min.	0.80	1.00	1.20	1.40	1.60	1.80
	max.	0.98	1.30	1.54	1.81	2.08	2.30
Standard length	min.	5.00	6.00	7.00	8.00	10.00	12.00
	max.	25.00	30.00	35.00	40.00	50.00	60.00

Strength class 10

Nominal diameter	2	2.5	3	3.5	4	5	6	7	8
Breaking torque* min. (Nm)	0.41	0.85	1.55	2.52	3.83	7.5	13.3	21.5	32.4
Material	20MnB4 (1.5525) to EN 10263-4								
Strength class	FK10								
Hardness	320 to 380 HV10								
Surface hardness	MAX: 390 HV0.3								

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Optionally stainless steel 1.4567

Surface variants: galvanised, zinc alloys

Other materials and surfaces on request

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