Version 01.2017
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ARNOLD®
BlueFastening Systems

ARNOLD-TV
presents

Just how does direct screw fastening into synthetic materials work?

REMFORM®

More secure when joining plastics

- asymmetric thread
- optimised material flow
- minimum tube load
- reliable planning
- Fast Designer *PLASTICS*
- high level of process reliability

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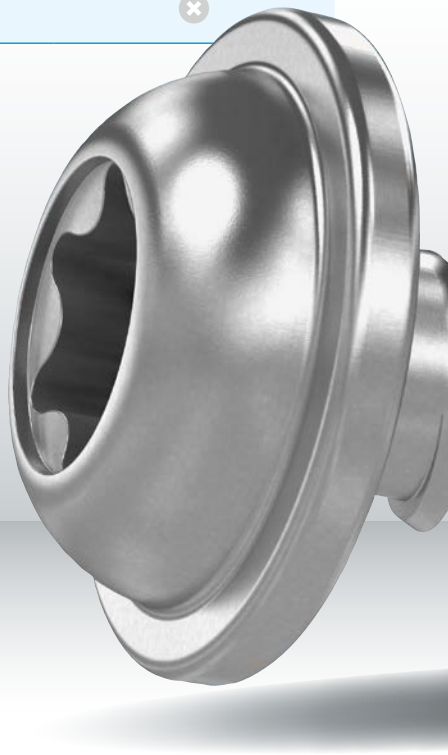
Joining techniques for plastics

In our increasingly complex world, we can hardly imagine what it would be like without plastics. Nowadays we are finding plastics in use where just a few years ago only metals were to be found.Moreover, the material properties of the latest plastics and the 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 to the questions about whether the fastening needs to be detachable, or whether a defined preload force was required, there's no getting round the need for a screw fastening.

Joining plastics				**Possible selection criteria**	
	Thermoplastics	Duroplastics	Elastomers	Can be removed	Defined preload force
Screws	✓	✓	✓	✓	✓
Adhesive	✓	✓	✓	✗	✗
Welding	✓	✗	✗	✗	✗
Riveting	✓	✓	✗	✗	✗
Snap-fit	✓	✗	✗	✓	✗

✓ positive ✗ negative

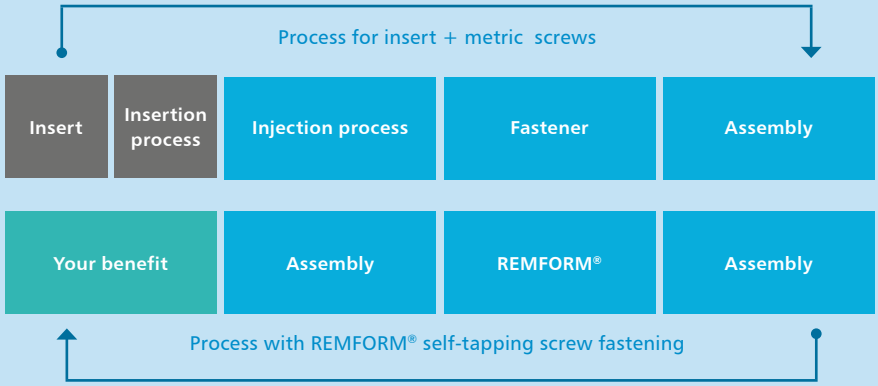


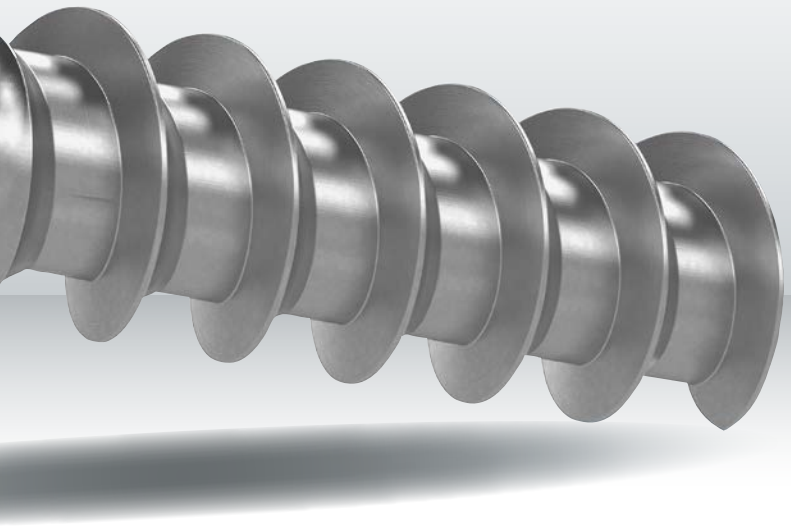
Self-tapping or insert

Our response to the requirement for a well-priced and reliable connection is self-tapping direct screw fastenings under the REMFORM® brand. The thread-rolling screw with its asymmetric thread profile, which is screwed into pre-formed bores, is realised in a type of assembly that is economical, recycling-friendly, and which can be undone.

Compared with insert solutions, REMFORM® saves you time and money:

- no additional elements needed
- no additional insertion process
- no risk of your tool tilting when closing
- greatly reduced cycle time

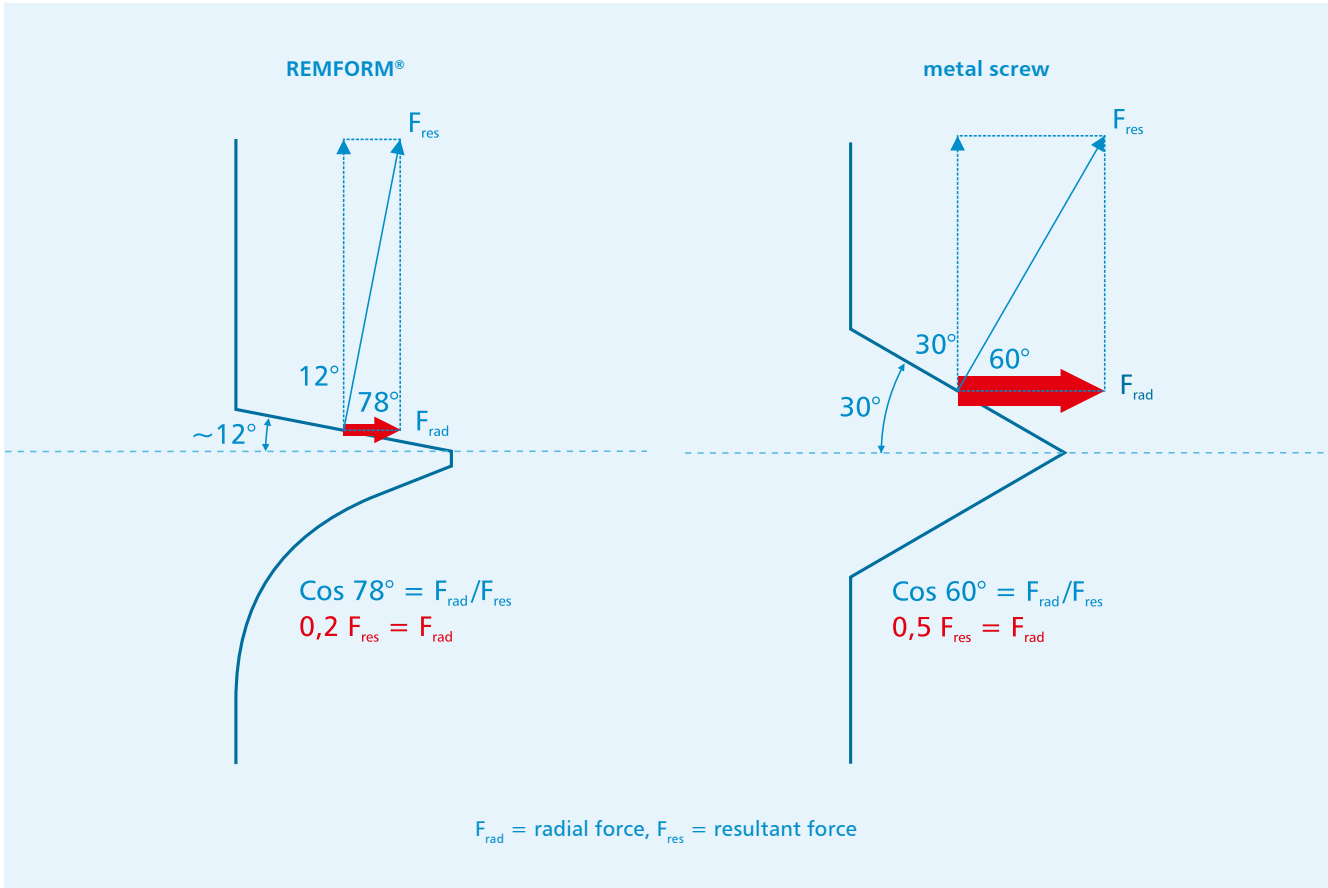




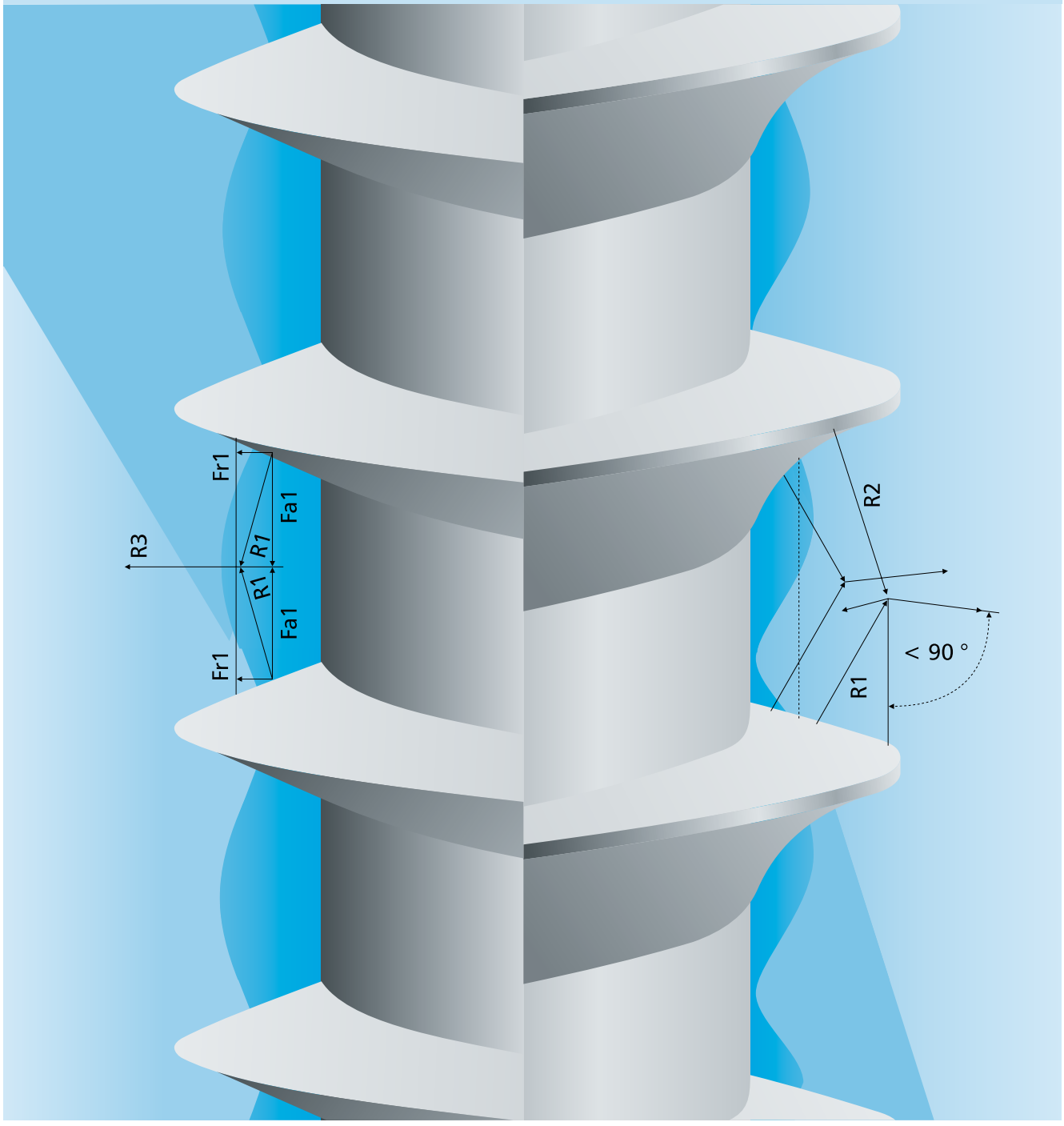
Benefit from the clever thread technology of a REMFORM® screw

The choice of thread geometry can have a considerable influence on the quality of the screw fastening. Here, the thread fulfils two tasks: Firstly, it serves as the forming tool when tapping, secondly it is a form-fit connection. And lastly, the screw will not come undone of its own accord.

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°. Here, the asymmetrical thread geometry of REMFORM® screws offers a further important advantage: At 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. Compared to a symmetric profile this signifies a much higher pull-off force.



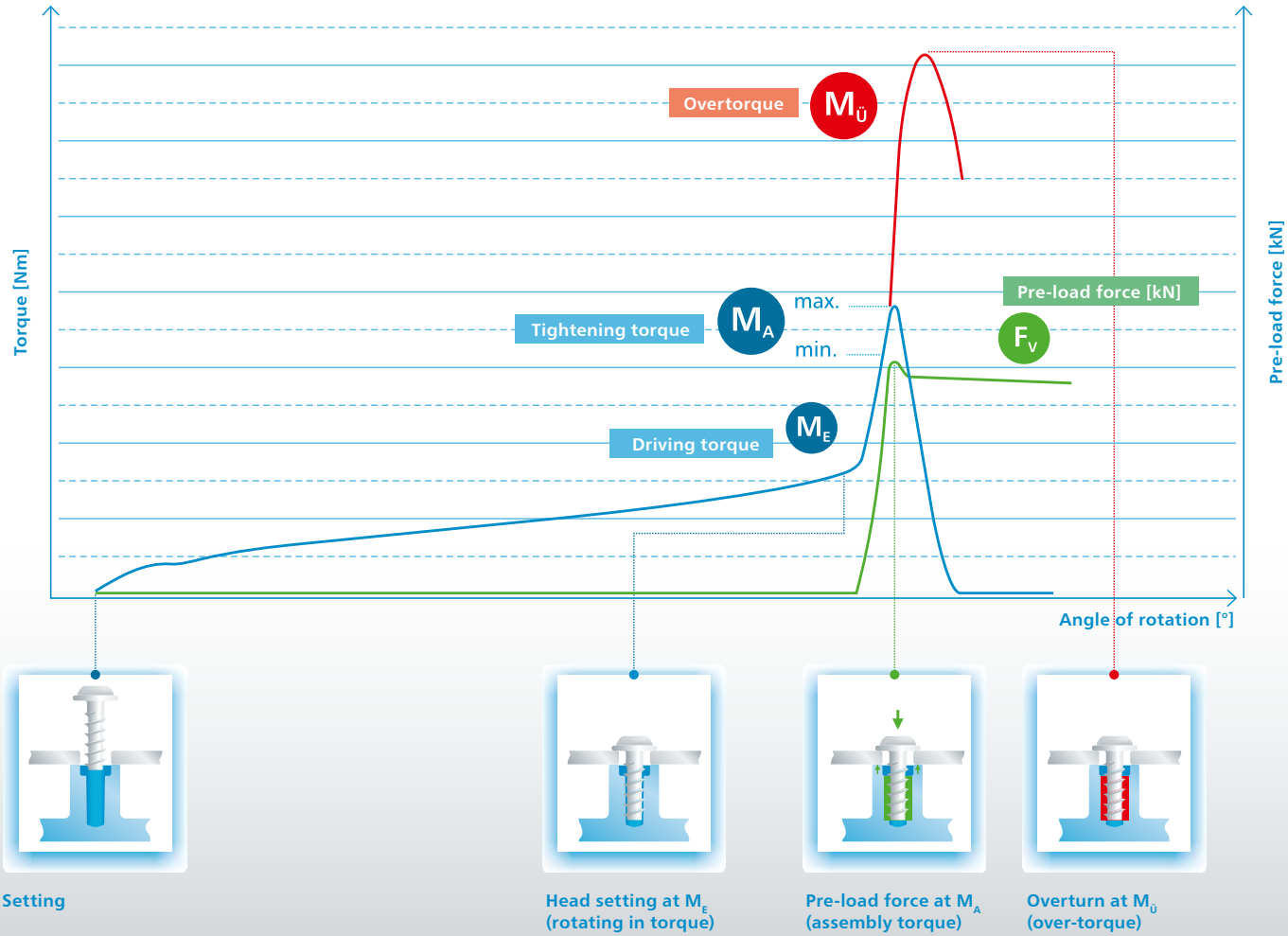
The optimised material flow of the plastic means that the nut material takes a great deal less load, making the connection suitable for the plastic material. The high thread engagement also ensures that the cutting surface is bigger. This increases the fastening's over-torque. The lower load on the nut material also allows higher pre-load forces, creating a long-lasting connection at maximum residual pre-load force.



Your assembly parameters

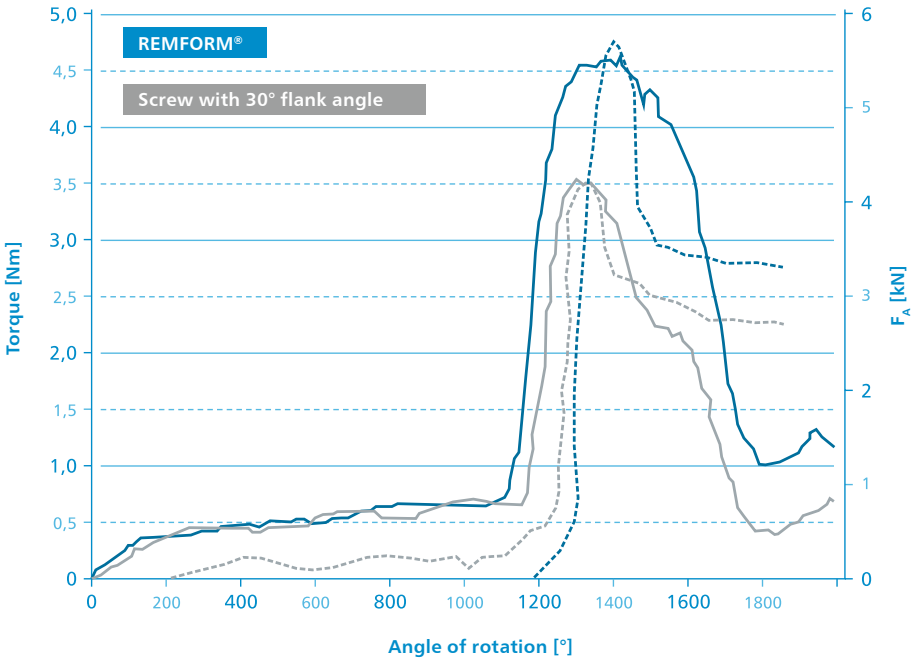
In series production it is not possible to monitor the actual target preload force value (F_V) - or only at an unreasonably high cost. This is why we use the torque as an aid.
The REMFORM® graph given as an example shows this relationship. In tests we determine the preload force by applying a test socket or with the aid of ultra-sound 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).



Example of drive graph

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



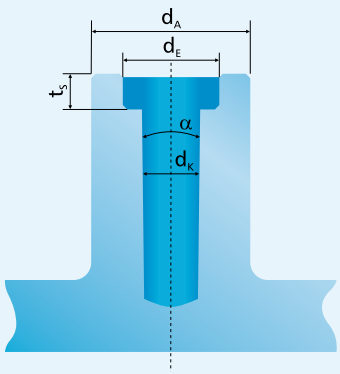
Comparison in absolute figures

	Screw with 30° angled flank	REMFORM® screw	% change
max. driving torque $M_{E\ max.}$ [Nm]	0.70	0.73	4.30
min. overtorque $M_{Ü\ min.}$ [Nm]	3.48	4.56	31.03
min. pull-off force F_A [kN]	4.17	5.69	36.45
Difference $M_Ü - M_E$ [Nm]	2.78	3.83	37.76
Ratio $M_Ü / M_E$	4.97	6.25	25.75

Nom. Ø thread 4.0 mm; core hole Ø 3.30 mm
Screw-in depth 8 mm, material PA 6 GF 30

How to design your insertion tubes

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 receiving bore with no internal thread, moulded when the injection-moulded components are manufactured. The core holes will vary according to the material. To ensure optimum bore design for the REMFORM screw, we have determined some factors for specific plastics. You can multiply these by the screw diameter when you are designing the component.



d_A = external diameter of tube
d_E = relief bore diameter
d_K = core hole diameter
t_S = depth of relief bore
α = demoulding angle

The draft is specific to the material.
However α should not exceed 1°.

Material	Factor
ABS	0.78
ASA	0.78
PA 6	0.80
PA 6 GF 30	0.82
PA 6 GF 50	0.87
PA 6,6	0.80
PA 6.6 GF 20	0.82
PA 6.6 GF 30	0.84
PA 6.6 GF 40	0.86
PBT	0.78
PBT GF 30	0.82
PBT GF 40	0.85
PC	0.83
PC GF 30	0.86

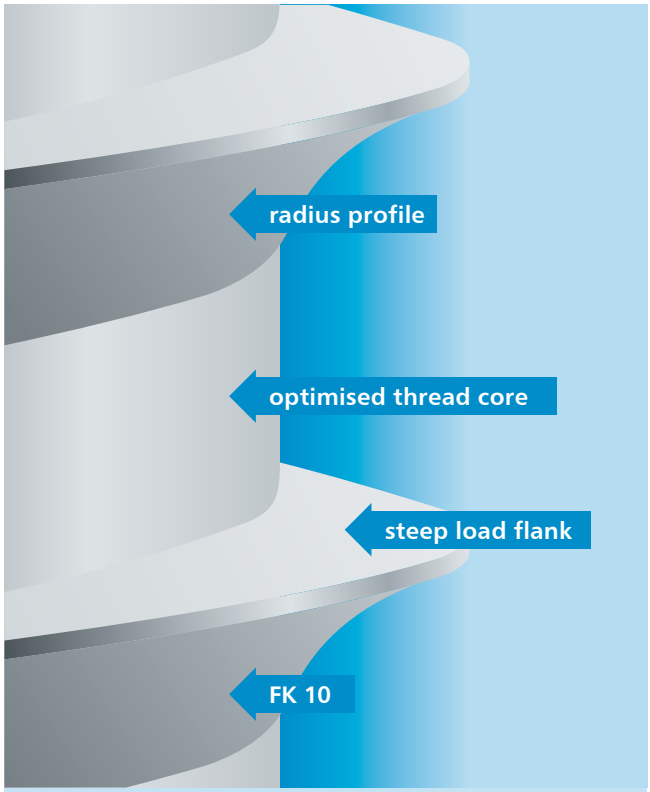
Material	Factor
PE	0.79
PE GF 30	0.85
PE GF 40	0.86
PET	0.75
PET GF 30	0.83
PET GF 40	0.86
PNMA	0.85
POM	0.77
PP	0.80
PP GF 30	0.84
PF GF 40	0.86
PPO	0.83
PVC	0.80
PS	0.80

Example illustration of the driving dome with dimension data (left) and factors for multiplication with the screw diameter (right).

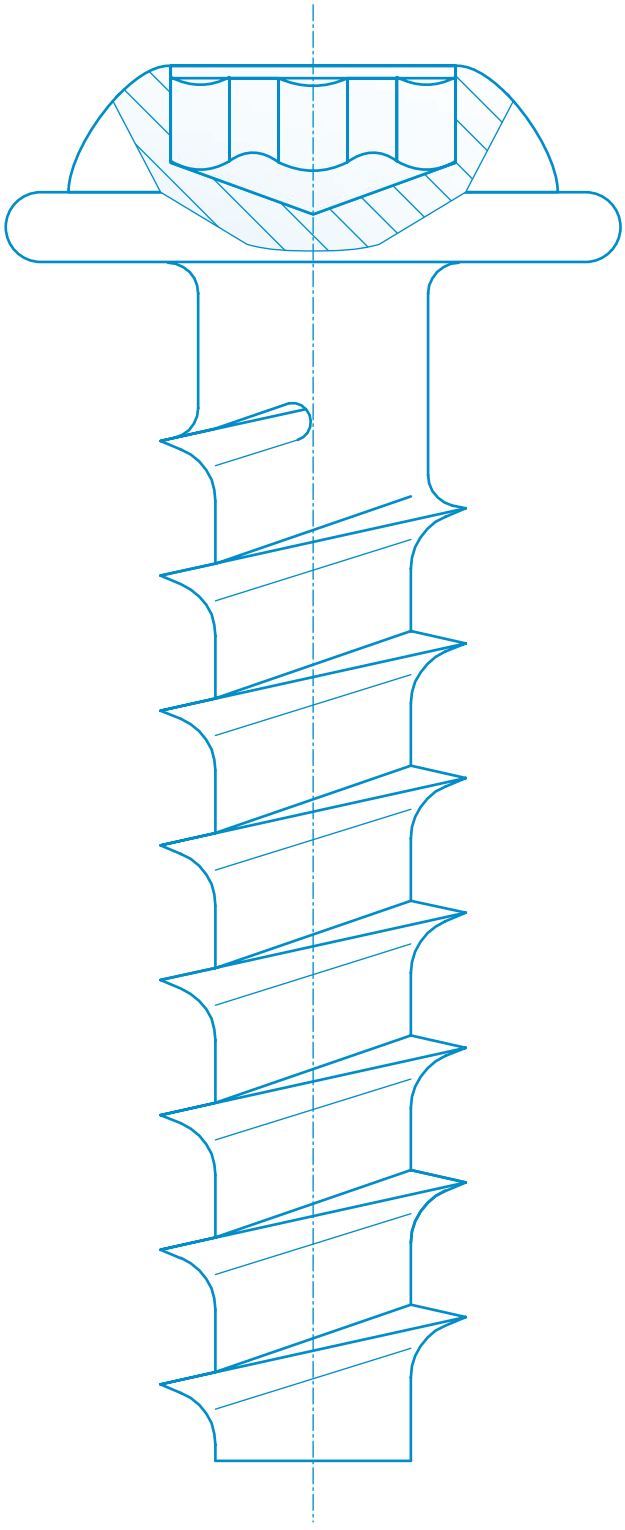
Note:

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 making the relevant tests on plastic parts. We recommend making driving tests on original parts so that you can also take into account the effects of manufacture (e.g. seams, fibre distribution, removal from injection point etc.).

The advantages of REMFORM® at a glance.



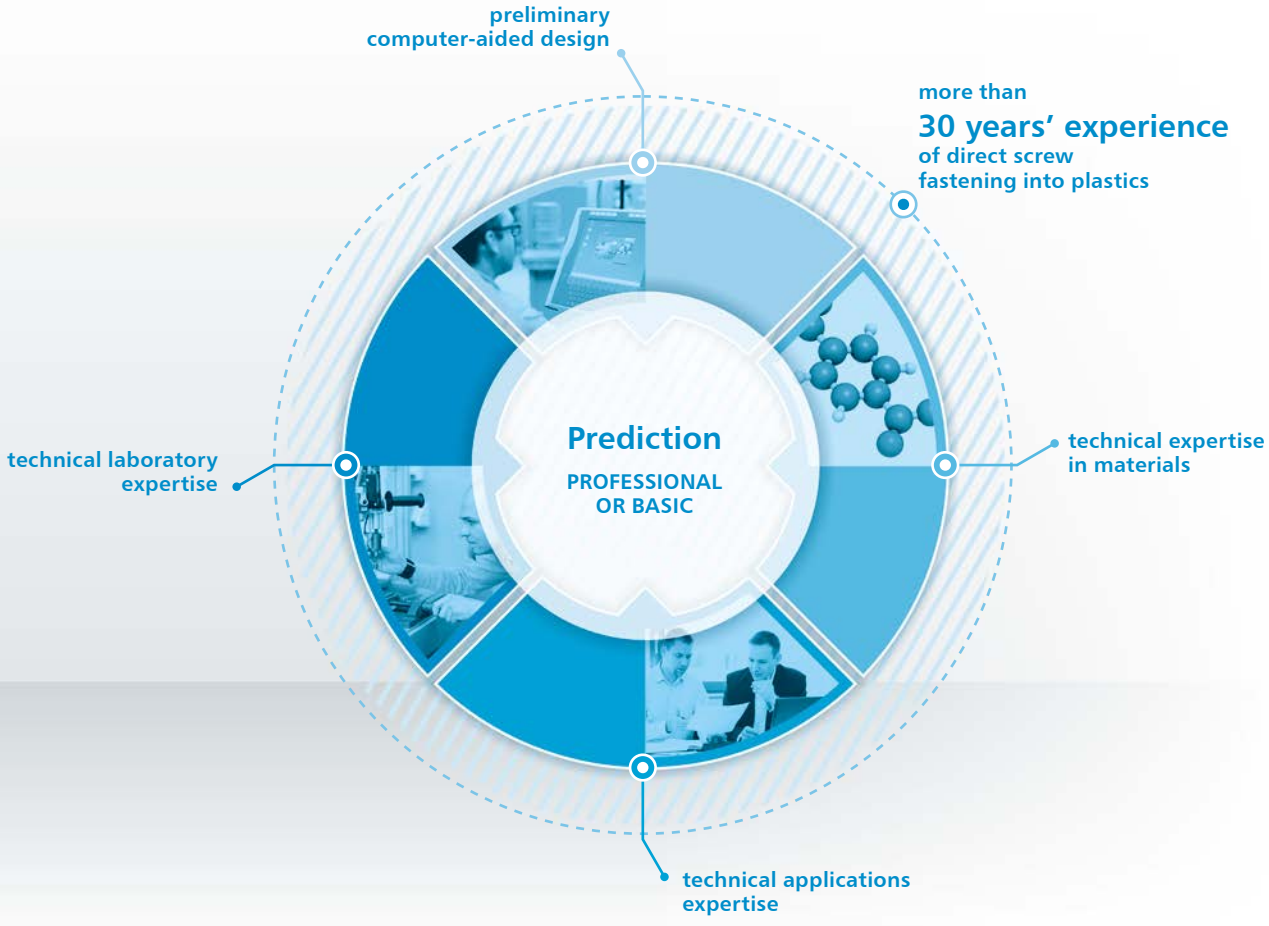
- minimal load on tube due to very small angle of the bearing flank
- optimum material flow due to radius profile
- high pull-off forces
- high pre-load forces with low load on the nut material
- better process reliability
- high delta between screw-in torque and over-torque
- high failure moment due to the optimised core diameter
- high tensile and torsion strength
- design reliability with Fast Designer *PLASTICS*
- repeatable screw fastening possible
- fastening has high dynamic load



Fast Designer *PLASTICS* – Make use of our expertise

When developing a new product or redesigning an existing one, the aim is to achieve a solution that is technically excellent and economical to manufacture. The design work consists principally in selecting the materials and the manufacturing process, and in calculating the strength and the design of the moulded component. When designing a plastic self-tapping screw fastening you cannot draw on the principles of metric screw fastenings, because these do not take account of the visco-elastic behaviour of plastics. The two main variables of strong anchoring, pre-load, and pull-off force depend on the plastic used as well as on time, temperature and load. The pre-load force generated during assembly gradually reduces by relaxation processes.
The reliability of the structure of your plastic parts therefore depends to a large degree on the residual clamping force that remains in the fastening after the stress has reduced.

You need to be aware of this residual clamping force. We are delighted to help you with any questions you may have concerning self-tapping screw fastenings, with our Fast Designer *PLASTICS* service: With our 30 years of experience in self-tapping fastenings into plastics, combined into our Fasteneering - that's what we call our development partnership with our customers - we are able to forecast the performance of your screw fastening into the future. Or we can help you to achieve the correct dimensions with the materials pairing you have selected. By talking to us you will be reducing your development costs at an early stage, and will be able to rely on planning, because your engineering design can be oriented to the pre-load force that we determine for its entire service life.



Better reliability with long-term characteristics prediction

ARNOLD BlueFastening Systems

The ARNOLD prediction service delivers valuable data.

Basic Prediction

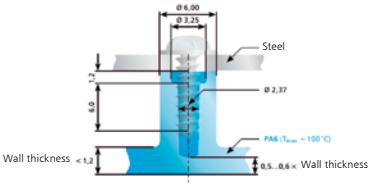
- Diagram showing shape of insertion tube
- Mounting parameter (M_E, M_A, $M_Ü$)
- Torque (urve shown in graph form
- Pre·load force at M_A

Professional Prediction

- All that basic version delivers, plus
- Clamping force by time, temperature and dynamic loading
- Thread and below-head friction (diagram)
- Master curve Torque and pre-load force including continuing torque
- Diagram showing long-term clamping force

Extract fram the *Basic* Prediction service

» Design recommendation: Insertion tube

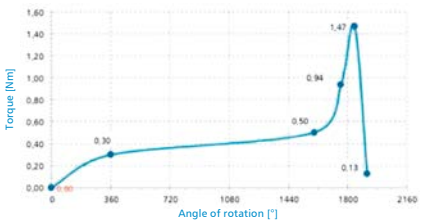


REMFORM® Ø 3 x 10 – Fkl. 10 AWN-03-01-03			
Hole diameter	d_{KL}	[mm]	2.37
Screw-in length	ET	[mm]	6.00
Reverse zone depth	H	[mm]	1.20
Relief bore diameter	d_{EB}	[mm]	3.25
External diameter	B	[mm]	6.00

» Prediction: Mounting parameters

Mounting recommendation			
Mounting torque	M_A	[Nm]	0.94
Driving torque	M_E	[Nm]	0.50
Overtorque	$M_Ü$	[Nm]	1.47
Pre-load force	F_V	[kN]	577
Speed	n	[rpm]	500

» Torque curve

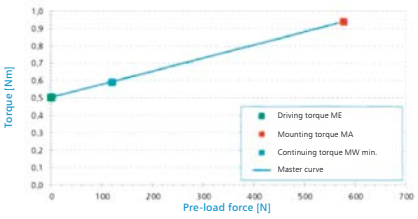


Extract from the *Professional* Prediction service

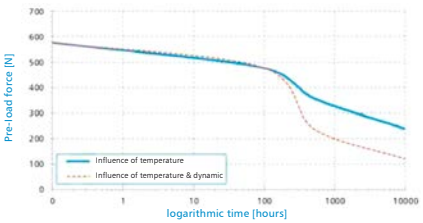
Detailed calculations			
Calculated mounting torque	M_A	[Nm]	0.94
Assembty reliability	S	[–]	1.93
Permitted screwdriver control	v	±[%]	27.38
Calculated driving torque	M_E	[Nm]	0.50
Calculated overtorque	$M_Ü$	[Nm]	1.47
Driving torque (from trial)	$M_{E\,actual}$	[Nm]	0.42
Failure torque (from trial)	$M_{V\,actual}$	[Nm]	1.66

Preload force by time	$F_{V\,long\text{-}term}$	[N]	238.45
Preload force by time and dynamic	$F_{V\,dyn.\ long\text{-}term}$		119.22
Tension in the thread ($F_V$nom)	S_{thread}	[N/mm²]	0.12
Surface pressure under screw head	P_{head}	[N/mm²]	0.13
Surface pressure on tube frontal surface	$P_{front\ face}$	[N/mm²]	0.10
Tension in the thread (F_V arithmetic)	$S_{thread\ effective}$	[N/mm²]	35.84

» Master curve M/FV and continuing torque



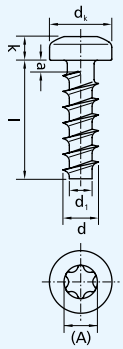
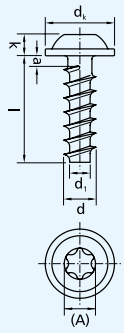
» Pre-load force progression



ARNOLD UMFORMTECHNIK GmbH & Co. KG
Carl-Arnold-Straße 25 · 74670 Forchtenberg-Ernsbach · T +497947821-0 · F +497947821-111 · info@fast-designer.de · www.arnold-fastening.com

Perhaps you are designing a plastic component that needs to be screw-fastened to another component. But how will the plastics perform in the long-term with regard to stability and clamping force? Which fastening method is the most economical? Our prediction tool, Fast Designer *PLASTICS*, provides the answer by forecasting the performance of your fastening throughout its entire service life. The service gives you access to over 30 years of expertise that we have built up in laboratory techniques, application technology and plastics, and are constantly expanding. With just a few details, such as the nominal diameter, the materials pairing and the force to be transferred, we are able to provide valuable data to help with your development work.

ARNOLD Factory Standard

	Thread d		2.5 +0.10	3.0 +0.10	3.5 +0.10	4.0 +0.10	5.0 +0.10	6.0 +0.10	8.0 +0.10	10.0 +0.10
X 20:1	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 > 3xd	1.70	2.00	2.30	2.60	3.35	3.05	5.25	6.75
		l ≤ 3xd	1.15	1.35	1.55	1.75	2.25	2.65	3.50	4.50
	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
AWN-03-01-02	d_k	max.	4.40	5.30	6.20	7.00	8.80	10.50	14.00	16.00
	k	max.	1.90	2.40	2.75	3.00	3.70	4.30	6.00	6.40
	r	max.	0.45	0.50	0.50	0.60	0.70	0.80	1.00	1.20
	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	1.00	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 (A)	8IP	10IP	15IP	20IP	25IP	30IP	40IP	40IP
			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
AWN-03-01-03	d_k	max.	5.00	6.00	7.00	8.00	10.00	12.00	16.00	20.00
	k	max.	1.80	2.10	2.40	2.50	3.20	4.00	5.20	6.40
	r	max.	0.45	0.50	0.50	0.60	0.70	0.80	1.00	1.20
	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 (A)	8IP	10IP	15IP	20IP	25IP	30IP	40IP	40IP
			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.	0.89	1.30	1.37	1.42	1.85	2.02	2.43	3.11

Length l	3 > l ≤ 6	6 > l ≤ 10	10 > l ≤ 18	18 > l ≤30	30 > l ≤ 50	50 > l ≤ 80
Tolerance	± 0.375	± 0.45	± 0.55	± 0.65	± 0.80	± 0.95

Hardened and tempered strength class 10										
Nominal diameter	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0	10.0
Failure moment	0.52	1.46	2.23	3.33	4.89	6.65	11.33	17.37	25.95	52.75
Tensile strength	> 1040 N/mm²									
Hardness	320 to 380 HV 10									
Surface hardness	max. 390 HV 0.3									

Optionally stainless steel 1.4567
Surface variants: galvanized, zinc alloy
Other materials and surfaces on request

REMFORM®, REMFORM® "F" are registered trademarks of CONTI Fasteners AG
TORX®, TORX PLUS® are registered trademark of Acument Global Technologies Inc.

FAST CREATOR

The component is defined on the basis of your requirements and our expertise. Depending on the degree of these requirements, we can configure the component from one of our standard Eurofasteners or from our own ProRange. And of course we offer further help with developing parts from your drawings (customised fastener).

Our range		Diameter							
Length (mm)	Permissible deviation [mm]	M2,5	M3	M3,5	M4	M5	M6	M8	M10
5.0	± 0.375								
6.0									
7.0	± 0.45								
8.0									
10.0									
12.0	± 0.55								
14.0									
16.0									
18.0									
19.0	± 0.65								
20.0									
22.0									
25.0									
30.0									
35.0	± 0.80								
40.0									
45.0									
50.0									
60.0	± 0.95								
70.0									
80.0									
90.0									
100.0									

Eurofastener

Your benefits at a glance

- Industry standard formultifunctional applications
- Many PDF data sheets available
- 2D / 3D models available free of charge within 24 hours
- Individual drawings for download
- Installation recommendations
- Comprehensive store of samples
- Short delivery time for bulk quantities

ProRange Fastener

Your benefits at a glance

- For customised applications
- Free configuration from standard program
- Different head/drive combinations
- Selectable materials, surfaces, colours
- Short delivery time for samples and manufactured items

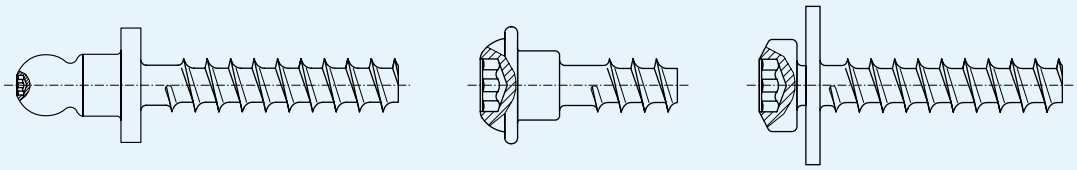
Customized Fastener

Your benefits at a glance

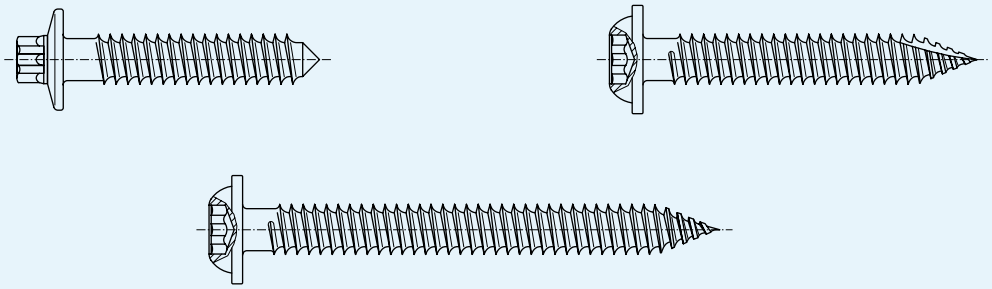
- Maximum customisation
- Total design freedom
- Unlimited drawings upload
- Bulk manufacturing check at early design stage
- Producing samples with ARNOLD Fastener Express

Further fastening options with the REMFORM® thread

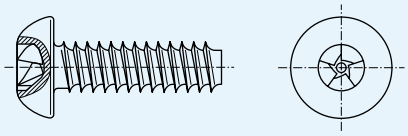
Examples of special parts with REMFORM® thread



Examples of special parts with REMFORM® F-thread



Examples of special parts with special drive: REMFORM® + LocTec® locking drive



Examples of components with REMFORM® thread

plastic injection moulded area

© Eberle Spritzgiesstechnik

Fields of application for REMFORM®

If plastics are subject to load, sooner or later the tension will start to decrease, and this in turn will allow the pre-load force in the fastening to drop. As opposed to most metals, plastics must not be designed to the greatest tension it can bear, but to its deforming capacity. Accordingly, self-tapping 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 vibration resistance, pressure resistance or pull-off forces prevail. But many insert solutions can be replaced without problem and designed to be better.

ARNOLD®
BlueFastening Systems

www.arnold-fastening.com

The ARNOLD GROUP

Wherever customers need us.

The ARNOLD GROUP

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 new positioning of "BlueFastening Systems" this development process will now continue under a united and harmonised structure. Engineering, fastenings, and functional parts, together with feeder processing systems, all from a single source – efficient, sustained and international.

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