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of Screws and Fixings



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Asociación Española
de Codificación Comercial

ASEFI
Asociación de Fabricantes
de Fijaciones Metálicas

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ADVANTAGE
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CELO
DISTRIBUCIÓN, S.A.
AENOR
ER
Empresa
Registrada
ER-0078/1998
UNE-EN-ISO 9001:2000



CELO, S.A.
AENOR
ER
Empresa
Registrada
ER-0412/1996
UNE-EN-ISO 9001:2000

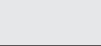
CELO, S.A.
AENOR
ER
Calidad en
Automoción
UNE-ISO/TS 16949
IATF 16949:2009
IATF 006362

APOLLO
AENOR
ER
Empresa
Registrada
ER-0412/1996
UNE-EN-ISO 9001:2000

Grupo CELO

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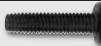
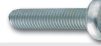
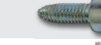
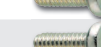
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***Thread forming
screws for
plastics***

Screws for plastics

CELOPLAST



CELOPLAST thread was designed at the beginning of the 1990s to be used in the assembly of plastic materials. CELOPLAST screws provide higher pull-out resistance, improve ergonomics and avoid deformation of plastic bosses, greatly enhancing the technical properties of self-tapping screws. These advantages are obtained thanks to a combination of technical features specifically designed for fixing plastic.

CELOPLAST is recommended for assemblies in plastics with a bending modulus between 500 and 30.000 kg/cm².

1. Technical features of CELOPLAST thread.

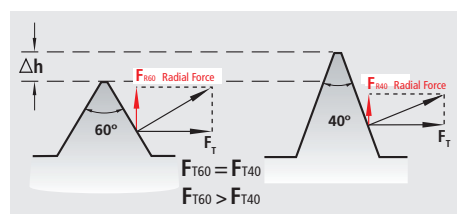


Fig.1. If we carry out a resolution of resultant forces, we see that 40° thread angle provides higher axial force (F_T) and lower radial force (F_R).

- **40° thread angle**

Changing the thread angle from 60° to 40° provides a 30% reduction in radial tension (F_R) during the threading process, which avoids damaging the plastic.

- **Increased thread height**

Rising the height of the thread gives 26% more penetration in plastic materials, improving pull-out resistance.

- **Increased thread pitch**

The volume of plastic material in the shearing zone (space between thread flanks) is much bigger than with a self-tapping screw. In this way, we create a more resistant nut member, and consequently increase the failure torque value.

- **Chamfered point.**

Allows for a **quick alignment of the screw**.

2. Advantages of CELOPLAST screw.

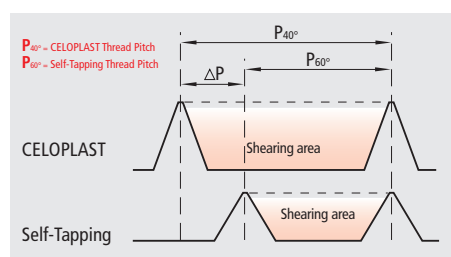


Fig.2. Increasing the screw thread pitch provides a larger shearing zone and a more resistant nut member in the plastic.

- **Less radial tension on plastic.** It allows for bosses with smaller diameter and reduces the problem of boss bursting.
- **Quick alignment of the screw before fixing,** thus reducing assembly time.
- **Lower thread forming torque,** which offers a more ergonomic assembly.
- **More resistant to pull-out and stripping,** which enables its use in assemblies with high pull-out resistance and/or compression requirements.
- The increase of surface contact between threads and nut member improves vibration loosening resistance.
- **Possibility to reuse the screw,** reducing the risk of stripping.

All of these advantages directly translate into a **more resistant assembly, greater safety** during threading and **lower costs** in assembly process.

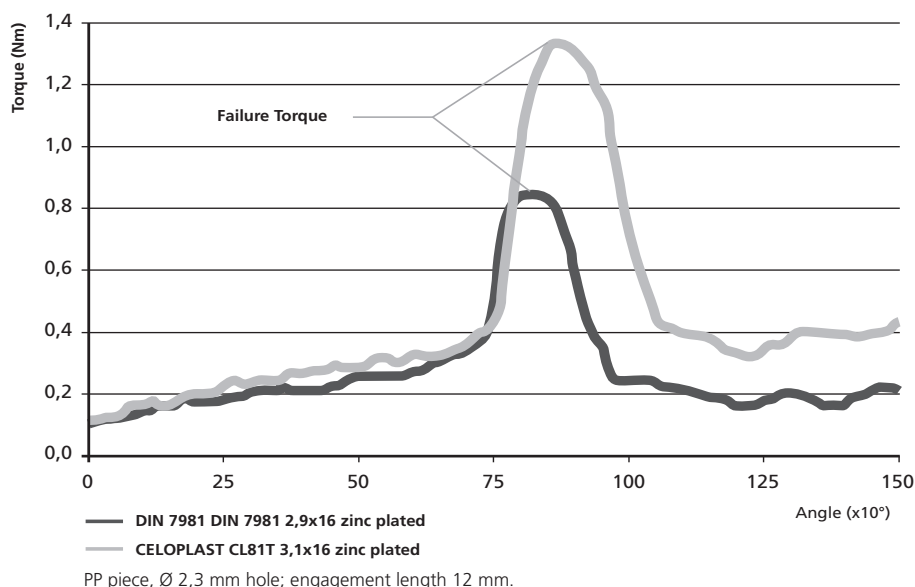
Screws for plastics

3. Threading curve of CELOPLAST screw.

CELOPLAST

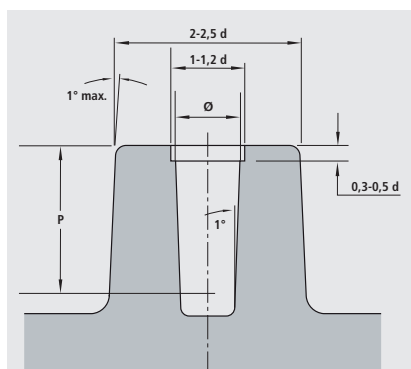
Minimum Breaking Torque	
d (mm)	Torque (Nm)
2,3	0,34
2,6	0,40
3,1	1,20
3,6	2,00
4,1	2,80
4,6	3,40
5,1	4,20
6,1	7,00
7,1	10,00

The assembly torque **shouldn't be higher than 70%** of the minimum breaking torque indicated.



Threading curve of CELOPLAST screw and self-tapping screw DIN 7981. Failure torque value is much higher with a CELOPLAST screw, giving safer assembly torque range (difference between thread forming torque and failure torque).

4. CELOPLAST boss design recommendations.



d= nominal diameter of the screw.

In order to assure a strong fixing and guarantee the clamping of the assembly, it is important to pay attention to the boss design, as this have to support mould extraction and cooling tension, as well as tension created during the insertion of the screw.

The following table indicates the recommended dimensions for hole's diameter and assembly depth in relation to the bending modulus of the plastic.

Bending modulus of the Plastic	Ø	P
Ductile plastics: < 20.000 kg/cm ² (PP, PE, PET, ...)	0,7d	2,50d
Medium plastics: 21.000-30.000 kg/cm ² (ABS, ABS/PC, PC, PPO, PS, PA6, PA6.6, ...)	0,80d	2,20d
(1) Hard plastics: 31.000-70.000 kg/cm ² (SAN, PC+10GF, POM+20GF, ...)	0,80d	2,00d
(2) Very hard plastics: > 70.000 kg/cm ² (PET30GF, PC30GF, PBT30GF, PA30GF, ...)	0,85d	1,75d

(1) In these cases, we recommend to use REMFORM®, REMFORM® II "HS" screws

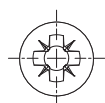
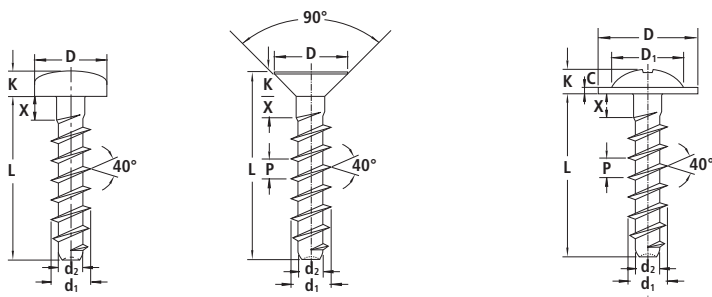
(2) In these cases, we recommend to use REMFORM® II "HS", IBI-ZAS or REMFORM® 'F' screws

This data is intended for guidance purposes. We advise doing tests beforehand with the recommended dimensions.

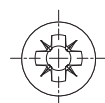
Contact our technical department in order to select the best screw suited to your technical requirements.

Screws for plastics

5. Technical data of CELOPLAST screws.



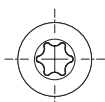
Ref. CL81Z



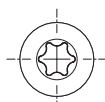
Ref. CL82Z



Ref. CL89Z



Ref. CL81T



Ref. CL82T



Ref. CL89T

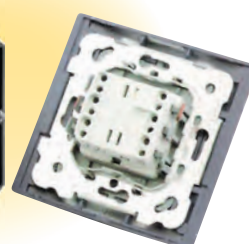
d	d ₁		d ₂	P	X		D	K	Pozi	Torx®	D	K	Pozi	Torx®	Pozi				Torx®			
	Max.	Min.			L > 3d	L < 3d									D	K	C	N°	D	K	C	N°
1,8	1,90	1,80	1,10	0,80	1,00	0,60	3,20	1,20	Z0	5IP*	-	-	-	-	-	-	-	-	-	-	-	-
2,0	2,10	2,00	1,15	1,00	1,20	0,80	3,20	1,40	Z0	5IP*	-	-	-	-	-	-	-	-	-	-	-	-
2,3	2,35	2,20	1,40	1,10	2,20	1,10	4,00	1,60	Z1	6IP*	3,80	1,20	Z1	IP6*	-	-	-	-	-	-	-	-
2,6	2,64	2,50	1,40	1,20	2,40	1,20	4,20	1,80	Z1	7IP*	5,00	1,70	Z1	IP7*	6,00	1,10	0,65	Z1	5,00	1,50	0,50	6IP*
3,1	3,16	3,00	2,00	1,35	2,80	1,40	5,60	2,20	Z1	T10	5,50	1,70	Z1	T10	7,50	1,60	0,70	Z1	6,00	2,10	0,60	T10
3,6	3,68	3,50	2,30	1,60	3,20	1,60	6,90	2,60	Z2	T15	6,50	2,20	Z2	T15	8,00	1,60	0,70	Z2	7,00	2,10	0,60	T10
4,1	4,18	4,00	2,55	1,80	3,60	1,80	7,50	2,80	Z2	T20	7,00	2,30	Z2	T20	9,00	2,20	0,70	Z2	8,00	2,80	0,60	T20
4,6	4,68	4,50	2,70	2,00	4,00	2,00	8,20	3,05	Z2	T20	7,50	2,40	Z2	T20	10,00	2,60	1,00	Z2	9,00	3,00	0,60	T20
5,1	5,20	5,00	3,00	2,20	4,40	2,20	8,20	3,05	Z2	T20	8,10	2,80	Z2	T20	10,00	2,60	1,00	Z2	10,00	3,20	0,80	T20
6,1	6,22	6,00	3,60	2,60	5,20	2,60	10,80	3,95	Z3	T25	10,80	3,60	Z3	T25	12,00	3,50	1,10	Z3	12,00	3,65	0,90	T25
7,1	7,22	7,00	4,00	3,20	6,40	3,20	12,50	4,40	Z3	T30	12,50	4,00	Z3	T30	15,00	4,00	1,70	Z3	14,00	5,35	1,00	T30

Dimensions in mm. The values shown are nominal. For tolerances and other data, please contact our technical department. * 

6. Applications of CELOPLAST screws.



Household appliances
Electric material
Electronics
Automotive



Lighting
Furniture
Construction
Toys

Screws for plastics

CL 81 Z

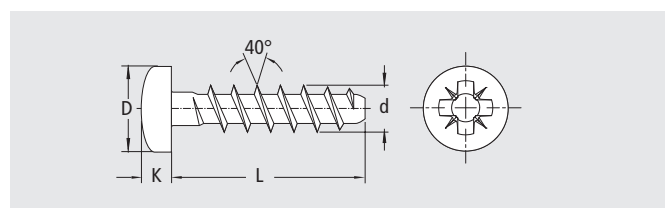


CELOPLAST

- Pan Head POZI



Packaged in bags.



Zinc Plated Cr (III)

d mm	1,8	2,0	2,3	2,6	3,1	3,6	4,1	4,6	5,1	6,1
D mm	3,2	3,2	4,0	4,2	5,6	6,9	7,5	8,2	8,2	10,8
K mm	1,2	1,4	1,6	1,8	2,2	2,6	2,8	3,05	3,05	3,95
	Z0	Z0	Z1	Z1	Z1	Z2	Z2	Z2	Z2	Z3

L mm	Ø1,8	Ø2	Ø2,3	Ø2,6	Ø3,1	Ø3,6	Ø4,1	Ø4,6	Ø5,1	Ø6,1
3	—	—	—	—	—	—	—	—	—	—
4	○	○	—	—	—	—	—	—	—	—
5	○	○	—	—	—	—	—	—	—	—
6	○	○	●	●	●	—	—	—	—	—
8	○	○	●	●	●	●	—	—	—	—
10	○	○	●	●	●	●	●	—	—	—
12	—	○	●	●	●	●	●	○	—	—
13	—	—	○	○	○	●	○	○	—	—
14	—	—	○	○	○	○	○	○	—	—
16	—	—	○	●	●	●	●	●	●	—
18	—	—	○	○	●	○	○	○	○	—
19	—	—	○	○	○	○	○	○	○	○
20	—	—	○	○	●	●	●	●	●	○
22	—	—	—	—	○	○	●	○	○	○
25	—	—	—	—	○	○	●	○	○	○
30	—	—	—	—	—	○	●	○	●	●
35	—	—	—	—	—	○	○	○	●*	○
40	—	—	—	—	—	○	○	○	○	○
50	—	—	—	—	—	○	○	○	○	○
60	—	—	—	—	—	—	○	○	○	○
70	—	—	—	—	—	—	○	○	○	○
80	—	—	—	—	—	—	—	—	○	○
90	—	—	—	—	—	—	—	—	○	○
100	—	—	—	—	—	—	—	—	○	○

● Product available in stock. ○ Product available upon request. * Available until end of stock.

Screws for plastics

CL 81 T

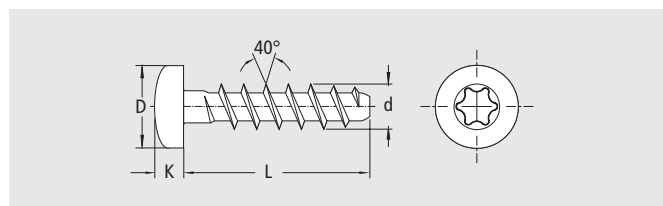


CELOPLAST

• Pan Head **TORX**®



Packaged in bags.



Zinc Plated Cr (III)

d mm	1,8	2,0	2,3	2,6	3,1	3,6	4,1	4,6	5,1	6,1
D mm	3,2	3,2	4,0	4,2	5,6	6,9	7,5	8,2	8,2	10,8
K mm	1,2	1,4	1,6	1,8	2,2	2,6	2,8	3,05	3,05	3,95
	T5 ¹	T5 ¹	T6 ¹	T7 ¹	T10	T15	T20	T20	T20	T25

L mm	Ø1,8	Ø2	Ø2,3	Ø2,6	Ø3,1	Ø3,6	Ø4,1	Ø4,6	Ø5,1	Ø6,1
3	—	—	—	—	—	—	—	—	—	—
4	○	○	—	—	—	—	—	—	—	—
5	○	○	—	—	—	—	—	—	—	—
6	○	●	●*	○	●	—	—	—	—	—
8	○	○	○	○	●	○	—	—	—	—
10	○	○	○	○	●	○	●	—	—	—
12	—	○	○	○	●	○	●	○	—	—
13	—	—	○	○	○	○	○	○	—	—
14	—	—	○	○	○	○	○	○	—	—
16	—	—	○	○	●	○	●	○	○	—
18	—	—	○	○	○	○	○	○	○	—
19	—	—	○	○	○	○	○	○	○	○
20	—	—	○	○	○	○	○	○	○	○
22	—	—	—	—	○	○	○	○	○	○
25	—	—	—	—	○	○	○	○	○	○
30	—	—	—	—	—	○	○	○	○	○
35	—	—	—	—	—	○	○	○	○	○
40	—	—	—	—	—	○	○	○	○	○
50	—	—	—	—	—	○	○	○	○	○
60	—	—	—	—	—	—	○	○	○	○
70	—	—	—	—	—	—	○	○	○	○
80	—	—	—	—	—	—	—	—	○	○
90	—	—	—	—	—	—	—	—	○	○
100	—	—	—	—	—	—	—	—	○	○

1 **TORX**® ● Product available in stock. ○ Product available upon request.. * Available until end of stock.

Screws for plastics

CL 82 Z

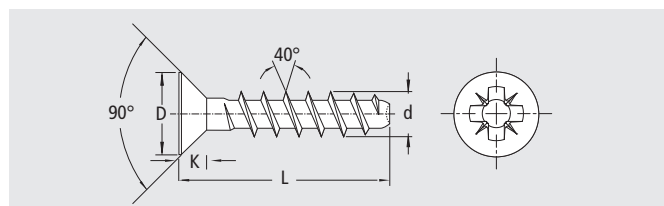


CELOPLAST

- Countersunk head POZI



Packaged in bags.



Zinc Plated Cr (III)

d mm	2,3	2,6	3,1	3,6	4,1	4,6	5,1	6,1
D mm	3,8	5,0	5,5	6,5	7,0	7,5	8,1	10,8
K mm	1,2	1,7	1,7	2,2	2,3	2,4	2,8	3,6
	Z1	Z1	Z1	Z2	Z2	Z2	Z2	Z3

L mm	Ø2,3	Ø2,6	Ø3,1	Ø3,6	Ø4,1	Ø4,6	Ø5,1	Ø6,1
6	○	○	○	—	—	—	—	—
8	○	○	●	●	—	—	—	—
10	○	●	●	●	○	—	—	—
12	○	○	●	○	●	○	—	—
13	○	○	○	○	○	○	—	—
14	○	○	○	○	○	○	—	—
16	○	○	○	●	●	○	○	—
18	○	○	○	○	○	○	○	—
19	○	○	○	○	○	○	○	○
20	○	○	○	○	○	○	○	○
22	—	—	○	○	○	○	○	○
25	—	—	○	○	○	○	○	○
30	—	—	—	○	●	○	○	○
35	—	—	—	○	○	○	○	○
40	—	—	—	○	○	○	○	○
50	—	—	—	○	○	○	○	○
60	—	—	—	—	○	○	○	○

● Product available in stock. ○ Product available upon request.

IP 81

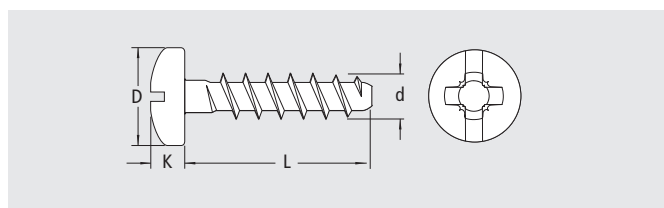


CELOPLAST

- Pan Head PHILIPS + SLOT



Packaged in bags.



Zinc plated

d mm	3,1
D mm	5,6
K mm	2,1
	—

L mm	Ø3,1
6,5	●
8	●
9,5	●
13	●

● Product available in stock.

Screws for plastics

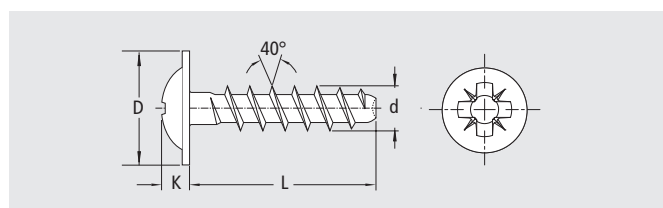
CL 89 Z



• Pan Head Flange POZI



Packaged in bags.



Zinc Plated Cr (III)

d mm	2,6	3,1	3,6	4,1	4,6	5,1	6,1
D mm	6,0	7,5	8,0	9,0	10,0	10,0	12,0
K mm	1,1	1,6	2,2	2,2	2,6	2,6	3,5
	Z1	Z1	Z2	Z2	Z2	Z2	Z3

L mm	Ø2,6	Ø3,1	Ø3,6	Ø4,1	Ø4,6	Ø5,1	Ø6,1
6	○	●	—	—	—	—	—
8	○	●	●	—	—	—	—
10	○	●	●	○	—	—	—
12	○	○	○	○	○	—	—
13	○	○	○	○	○	—	—
14	○	○	○	○	○	—	—
16	○	○	○	○	○	○	—
18	○	○	○	○	○	○	—
19	○	○	○	○	○	○	○
20	○	●	○	○	○	○	○
22	—	○	○	○	○	○	○
25	—	○	○	○	○	○	○
30	—	—	○	○	○	○	○
35	—	—	○	○	○	○	○
40	—	—	○	○	○	○	○
50	—	—	○	○	○	○	○
60	—	—	—	○	○	○	○
70	—	—	—	○	○	○	○
80	—	—	—	—	—	○	○
90	—	—	—	—	—	○	○
100	—	—	—	—	—	○	○

● Product available in stock. ○ Product available upon request.

Screws for plastics

REMFORM®



REMFORM® thread was designed for plastic assemblies with high mechanical requirements. It's recommended for assemblies with plastics with a bending modulus between 30.000 and 80.000 Kg/cm².

REMFORM® is a patented brand registered by CONTI FASTENERS AG and manufactured under license by CELO.

1. Technical features of REMFORM® thread.

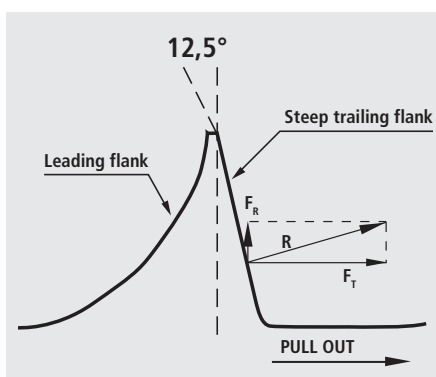


Fig.3. Asymmetrical thread form of the REMFORM® screw. The pressure flank minimizes radial stress F_R during thread forming and optimizes pull-out resistance.

• Asymmetric thread

This is the main feature of the REMFORM® thread. There are two noticeably different flanks with respect to the perpendicular:

- The **steep trailing** or **pressure flank**, with a 12,5° angle, minimizes radial force F_R during threading process, thereby reducing the risk of boss bursting. Under tensile stress, it optimises pull-out resistance.
- The **leading flank**, with a progressive angle, creates asymmetrical radial stress during threading, improving material flow towards the pressure flank. The larger contact surface increases resistance to stripping, vibrational loosening and pull-out.

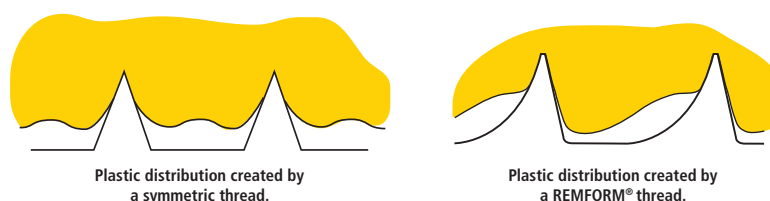


Fig.4. The leading flank improves material flow to the pressure flank, resulting in greater material contact and therefore providing better resistance to stripping, vibration loosening and pull-out.

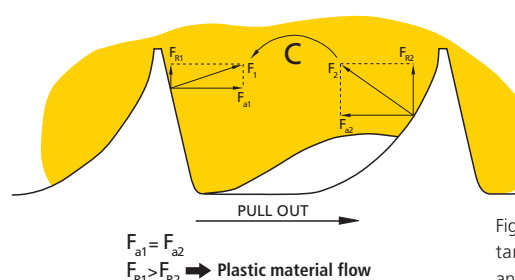
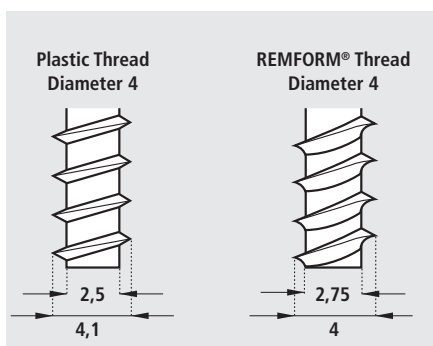


Fig.5. Resolution of resultant forces on pressure and leading flank.



• Larger core diameter

The increase in the core diameter with respect to conventional screws for plastic offers the possibility to work with higher assembly torque values without breaking the screw. This helps to guarantee fixing in deep assemblies with highly resistant plastics.

• Reduced thread diameter tolerance

The reduction of the diameter tolerance provides greater uniformity in threading torque.

Screws for plastics

2. Advantages of REMFORM® screw.



Fig.6. The reduction of radial tension during thread forming of REMFORM® screws helps to prevent boss bursting.



Fig.7. Assemblies with self-tapping screws on a polyester piece with 30% fiberglass cause cause boss cracking.

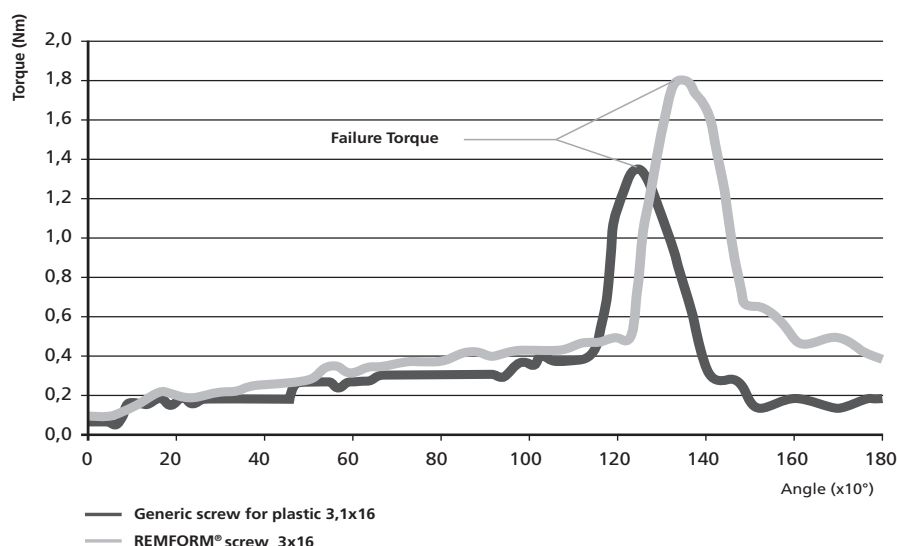
- **Less radial deformation on the plastic.** It reduces boss bursting problems and allows for bosses with less external diameter.
- The narrow 12,5° angle of REMFORM® screw pressure flank provides **very low thread forming torque values**, therefore more ergonomic assembly.
- **Strong pull-out resistance of the assembly.**
- The leading flank creates a larger surface contact between the screw and plastic material, **increasing resistance to vibration loosening and stripping.**
- **Highly secure assembly.** Low thread forming torque, together with high failure torque, results in a wide safe assembly torque range.
- **Higher breaking torque.** It allows for higher assembly torque and the possibility to work with deeper assemblies without increasing the diameter of the screw.

All of these technical advantages result in a **more resistant assembly**, with a **higher safe assembly torque range** and **savings on assembly costs**.

3. Threading curve of REMFORM® screws.

REMFORM®	
Minimum Breaking Torque	
d (mm)	Torque (Nm)
2,0	0,33
2,5	0,65
3,0	1,35
3,5	2,14
4,0	3,20
4,5	4,53
5,0	6,19
6,0	10,70
7,0	16,90
8,0	25,20

The assembly torque **shouldn't be higher than 70%** of the minimum breaking torque indicated.



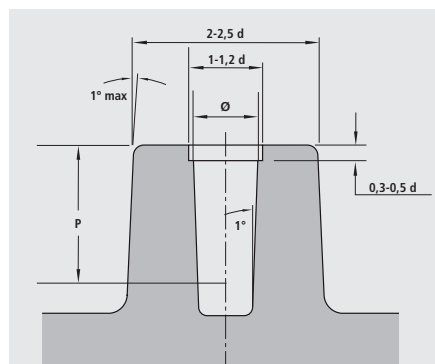
PC+20% GF, 2,4 mm hole size; engagement length 12 mm.

Threading curve of REMFORM® screw and generic screw for plastic. Resistance to the thread failure is higher for the REMFORM® screw, which provides a wider assembly torque range (difference between the thread forming torque and failure torque).

Screws for plastics

4. REMFORM® boss design recommendations.

The following table indicates the recommended dimensions for hole diameter and assembly depth in relation to the bending modulus of the plastic.



d=nominal diameter of the screw

Bending modulus of the Plastic	Ø	P
Ductile plastics: < 20.000 kg/cm ² (PP, PE, PET, ...)	0,75d	2,50d
Medium plastics: 21.000-30.000 kg/cm ² (ABS, ABS/PC, PC, PPO, PS, PA6, PA6.6, ...)	0,80d	2,00d
(1) Hard plastics: 31.000-70.000 kg/cm ² (SAN, PC+10GF, POM+20GF, ...)	0,83d	2,00d
(2) Very hard plastics: > 70.000 kg/cm ² (PET+30GF, PC+30GF, PBT+30GF, PA+30GF, ...)	0,85d	2,00d

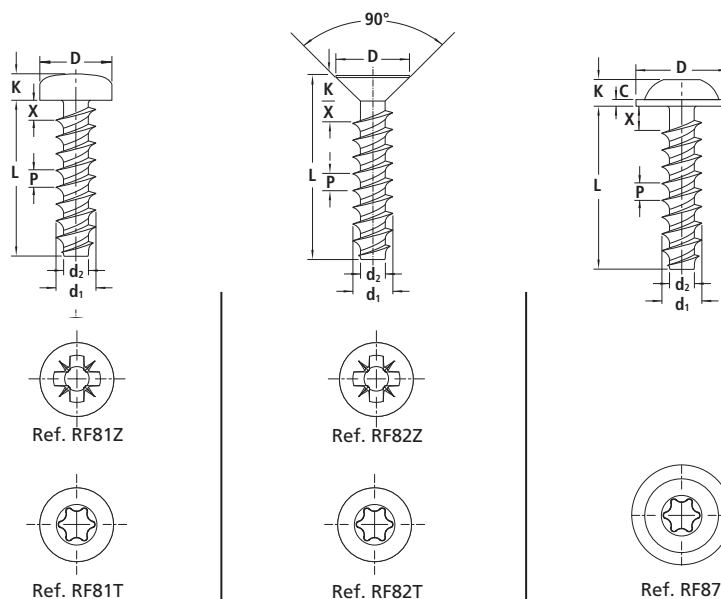
(1) In these cases we recommend to use REMFORM® II™ "HS"

(2) In these cases, we recommend to use REMFORM® II™ "HS", IBI-ZAS or REMFORM® 'F' screws.

This data is intended for guidance purposes. We advise doing tests beforehand with the recommended dimensions.

Contact our technical department in order to select the best screw suited to your technical requirements.

5. Technical data of REMFORM® screws.



d	d ₁ Max.	d ₁ Min.	P	X L > 3d	X L < 3d	D	K	Pozi	Torx®	D	K	Pozi	Torx®	D	K	C	Torx®
1,8	1,90	1,80	0,80	1,00	0,60	3,20	1,40	Z0	5IP*	-	-	-	-	-	-	-	-
2,0	2,10	2,00	1,00	1,20	0,80	3,6	1,40	Z0	6IP*	-	-	-	-	-	-	-	-
2,5	2,60	2,50	1,15	2,20	1,10	4,20	1,80	Z1	7IP*	5,00	1,70	Z1	7IP*	5,00	1,50	0,50	6IP*
3,0	3,10	3,00	1,35	2,80	1,40	5,60	2,20	Z1	T10	5,50	1,70	Z1	T10	6,00	2,10	0,60	T10
3,5	3,60	3,50	1,55	3,20	1,60	6,90	2,60	Z2	T15	6,50	2,20	Z2	T15	7,00	2,10	0,60	T10
4,0	4,10	4,00	1,75	3,60	1,80	7,50	2,80	Z2	T20	7,00	2,30	Z2	T20	8,00	2,80	0,60	T20
4,5	4,60	4,50	2,00	4,00	2,00	8,20	3,05	Z2	T20	7,50	2,40	Z2	T20	9,00	3,00	0,60	T20
5,0	5,15	5,00	2,25	4,40	2,20	9,50	3,55	Z2	T25	8,10	2,80	Z2	T25	10,00	3,20	0,80	T20
6,0	6,15	6,00	2,65	5,20	2,60	10,80	3,95	Z3	T30	10,80	3,60	Z3	T30	12,00	3,65	0,90	T25
7,0	7,15	7,00	3,10	6,20	3,10	12,50	4,55	Z3	T30	12,50	4,00	Z3	T30	14,00	5,35	1,00	T30

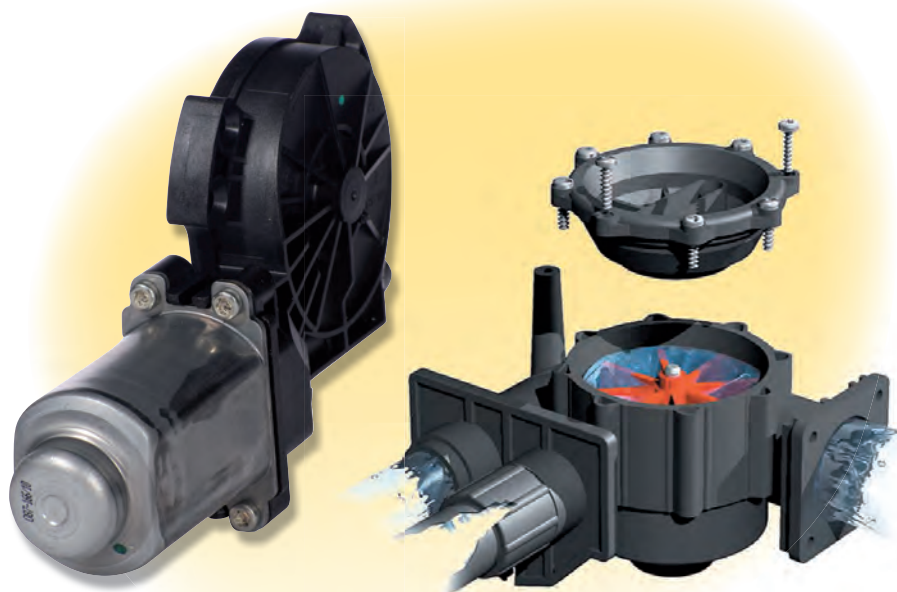
Dimensions in mm. The values shown are nominal. For tolerances and other data, please contact our technical department. * TORX®

Screws for plastics

6. Applications of REMFORM® screws.

REMFORM® screws are recommended in assemblies that require:

- High assembly torque, either for hard plastics, very deep assemblies or for compression or sealing requirements.
- High pull-out resistance.
- High resistance to vibration loosening.



Examples

Household appliances
Electric material
Electronics
Automotive

Lighting
Furniture
Construction
Toys

Screws for plastics

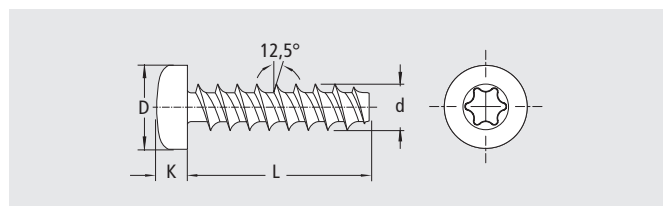
RF 81 T



• Pan Head **TORX®**



Packaged in bags.



Zinc Plated Cr (III) + Baked

d mm	1,8	2,0	2,2	2,5	3,0	3,5	4,0	4,5	5,0	6,0
D mm	3,2	3,6	4,0	4,2	5,6	6,9	7,5	8,2	9,5	10,8
K mm	1,4	1,4	1,6	1,8	2,2	2,6	2,8	3,05	3,55	3,95
	T5 ¹	T6 ¹	T6 ¹	T7 ¹	T10	T15	T20	T20	T25	T30

L mm	Ø1,8	Ø2	Ø2,2	Ø2,5	Ø3	Ø3,5	Ø4	Ø4,5	Ø5	Ø6
3	—	—	—	—	—	—	—	—	—	—
4	○	○	—	—	—	—	—	—	—	—
5	○	○	—	—	—	—	—	—	—	—
6	●	○	○	○	●	—	—	—	—	—
8	○	●	○	●	●	●	●	—	—	—
10	○	○	○	○	●	●	●	—	—	—
12	—	○	○	○	●	●	●	○	●	—
14	—	—	—	○	○	○	○	○	○	—
16	—	—	—	○	●	○	●	○	○	—
18	—	—	—	○	○	○	○	○	○	—
20	—	—	—	○	●	○	●	○	●	○
22	—	—	—	—	○	○	○	○	○	○
25	—	—	—	—	○	○	○	○	○	○
30	—	—	—	—	—	○	○	○	○	○
35	—	—	—	—	—	○	○	○	○	●
40	—	—	—	—	—	○	○	○	○	○
50	—	—	—	—	—	○	○	○	○	○
60	—	—	—	—	—	—	—	—	○	○
70	—	—	—	—	—	—	—	—	○	○
80	—	—	—	—	—	—	—	—	○	○
90	—	—	—	—	—	—	—	—	○	○
100	—	—	—	—	—	—	—	—	○	○

¹ TORXplus® ● Product available in stock. ○ Product available upon request.

Screws for plastics

RF 81 T N240 HNS

Black Zinc-Aluminum Flake Coating, non-Electrolytic

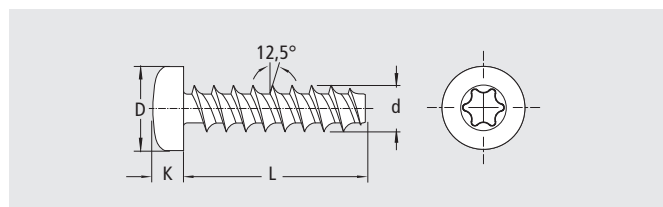


REMFORM®

• **Pan Head TORX®**



Packaged in bags.



BLACK ZINC-ALUMINUM

d mm	4,0	5,0	6,0
D mm	7,5	9,5	10,8
K mm	2,8	3,55	3,95
	T20	T25	T30

L mm	Ø4	Ø5	Ø6
10	●*	○	○
12	○	○	○
16	○	●*	●*
20	○	○	○

● Product available in stock. ○ Product available upon request.. * Available until end of stock.

Black Zinc-Aluminum Flake Coating.

- 240h red rust resistance (resistance up to 720h on demand).
- Non-Electrolytic coating, there is no risk of hydrogen embrittlement.
- According to European Environmental Regulations ELV and RoHS. Free of Cr (VI), Lead, Cadmium and Mercury.
- Conductive, non toxic and cathodic protection system.
- High mechanical and thermal resistance.

RF 82 T

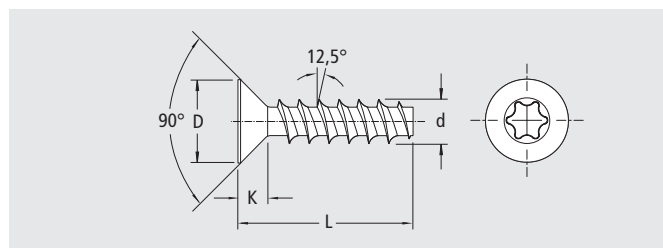


REMFORM®

• **Countersunk Head TORX®**



Packaged in bags.



Cincado Cr (III) + Baked

d mm	2,5	3,0	3,5	4,0	4,5	5,0	6,0
D mm	5,0	5,5	6,5	7,0	7,5	8,1	10,8
K mm	1,7	1,7	2,2	2,3	2,4	2,8	3,6
	T7 ¹	T10	T15	T20	T25	T25	T30

L mm	Ø2,5	Ø3	Ø3,5	Ø4	Ø4,5	Ø5	Ø6
6	○	●	—	—	—	—	—
8	○	●	○	○	—	—	—
10	○	○	●	○	—	—	—
12	○	●	●	●	○	—	—
14	○	○	○	○	○	—	—
16	○	●	○	●	○	○	—
18	○	○	○	○	○	○	—
20	○	○	○	○	○	○	○
22	—	○	○	○	○	○	○
25	—	○	○	○	○	○	○
30	—	—	○	○	○	○	○
35	—	—	○	○	○	○	○
40	—	—	○	○	○	○	○

¹ TORXplus® ● Product available in stock. ○ Product available upon request.

Screws for plastics

RFX 81 T

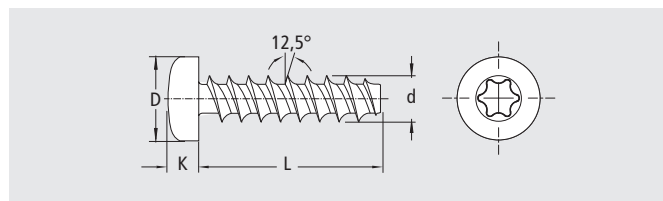


REMFORM®

- Pan Head **TORX®**
Stainless Steel A2



Packaged in bags.



Stainless Steel A2

d mm	3,0	3,5	4,0	5,0	6,0
D mm	5,6	6,5	7,0	8,2	10
K mm	2,2	2,4	2,6	3,05	3,55
	T10	T10	T15	T20	T25

L mm	Ø3	Ø3,5	Ø4	Ø5	Ø6
6	○	—	—	—	—
8	●	●*	—	—	—
10	○	○	●	—	—
12	●	○	○	—	—
14	○	○	○	○	—
16	○	○	●	○	—
18	○	○	○	○	○
20	○	○	○	●	○
22	—	○	○	○	○
25	—	○	○	○	○
30	—	○	○	○	○
35	—	○	○	○	○
40	—	—	○	○	○
50	—	—	○	○	○

● Product available in stock. ○ Product available upon request.. * Available until end of stock.

RF 87 T

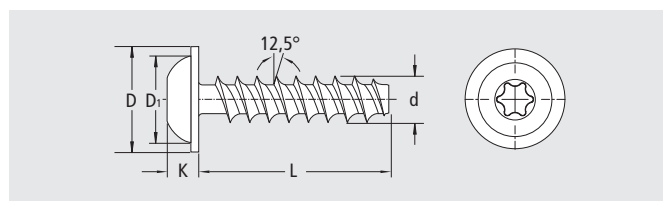


REMFORM®

- Pan Head Flange **TORX®**



Packaged in bags.



Zinc Plated Cr (III) + Baked

d mm	2,5	3,0	3,5	4,0	4,5	5,0	6,0
D mm	5,0	6,0	7,0	8,0	9,0	10,0	12,0
K mm	1,5	2,1	2,1	2,8	3,0	3,2	3,65
	T6 ¹	T10	T10	T20	T20	T20	T25

L mm	Ø2,5	Ø3	Ø3,5	Ø4	Ø4,5	Ø5	Ø6
6	○	○	—	—	—	—	—
8	○	●	○	○	—	—	—
10	○	●	○	○	—	—	—
12	○	●	○	●	○	—	—
14	○	○	○	○	○	—	—
16	○	○	○	●	○	○	—
18	○	○	○	○	○	○	—
20	○	○	○	●	○	●	●
22	—	○	○	○	○	○	○
25	—	○	○	○	○	○	○
30	—	—	○	○	○	○	●
35	—	—	○	○	○	○	○
40	—	—	○	○	○	○	○
50	—	—	○	○	○	○	○

¹ TORXplus® ● Product available in stock. ○ Product available upon request.

Screws for plastics

REMFORM® II™



REMFORM® II™ thread is based on the benefits of REMFORM® and offers additional advantages because of its improved design in thread geometry. It's recommended for the assembly of wide range of plastics.

REMFORM® II™ is a patented brand registered by CONTI FASTENERES AG and produced by CELO under license.

1. Technical Features of REMFORM® II™ screws.

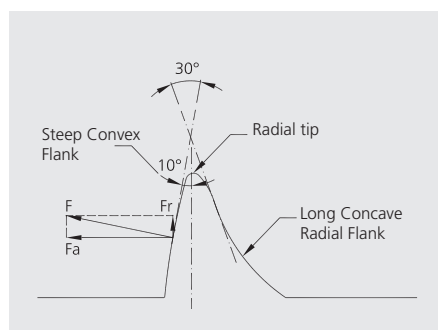


Fig.9. During thread forming, the Steep Convex Flank transfers most of the tightening load in the axial direction (F_a), minimizing radial force (F_r) and consequently plastic deformation.

• Asymmetric thread design of 30°

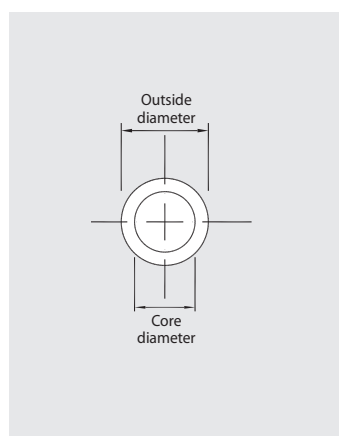
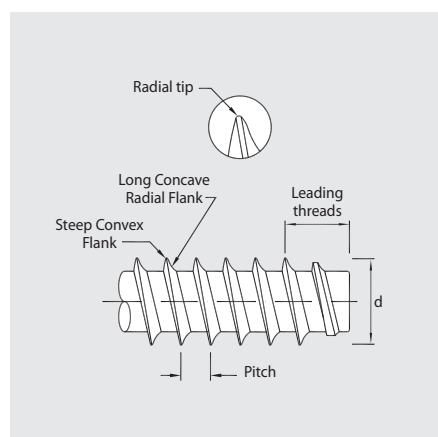
Unique Radius Flank™ asymmetrical thread design remains the main characteristic of REMFORM® II™ thread. Its optimized design **reduces hoop stress** generated in the plastic during thread forming and consequently the risk of boss bursting.

• **Radial Tip** helps to create better internal thread and reduces hoop stress in the plastic.

2. Advantages of REMFORM® II™ screws.

- The optimized design of asymmetrical thread reduces boss bursting and allows for bosses with less external diameter.
- It applies the boss design recommendations specified for REMFORM® screws

3. Technical data of REMFORM® II™.



REMFORM® II™

d	Pitch	Outside D		Core D
		Max.	Min.	Min.
2	1,00	2,10	2,00	1,20
2,5	1,15	2,60	2,50	1,51
3	1,35	3,10	3,00	1,93
3,5	1,55	3,60	3,50	2,25
4	1,75	4,10	4,00	2,57
4,5	2,00	4,60	4,50	2,89
5	2,25	5,15	5,00	3,20
6	2,65	6,15	6,00	3,84
7	3,10	7,18	7,00	4,48
8	3,50	8,18	8,00	5,11

Dimensions in mm.

4. Applications of REMFORM® II™ screws.

REMFORM® II™ screws are recommended for the assembly of wide range of plastics in automotive, electric material, electronics and household appliances.

It's a custom-made screw. For further information, please contact our sales department.

Screws for plastics

REMFORM® II™ "HS"



REMFORM® II™ "HS" (High Strength) screws have been developed using all the benefits of the original REMFORM® while offering additional advantages by new design in the thread geometry.

REMFORM® II™ "HS" screws are specially recommended for the assembly of high strength or fiber reinforced materials.

REMFORM® II™ "HS" is a patented brand registered by CONTI FASTENERES AG and produced by CELO under license.

1. Technical Features of REMFORM® II™ "HS" screws.

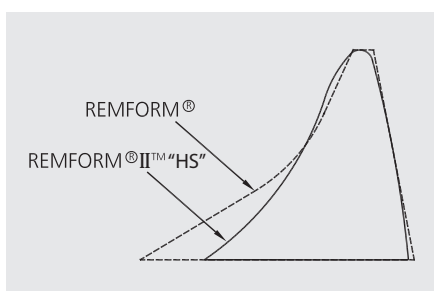


Fig.8. Asymmetrical thread of REMFORM® II™ "HS" and REMFORM®.

• Asymmetric thread design of 30°

Unique Radius Flank™ asymmetrical thread design remains the main characteristic of REMFORM® II™ "HS" thread. Its optimized design **reduces hoop stress** generated in the plastic during thread forming and consequently the risk of boss bursting.

It consists of:

Steep Convex Flank also known as Trailing Pressure Flank. It has a subtle radius designed to **increase resistance to pull-out forces**, whether they are applied by a tensile load or induced by torque. It provides excellent material contact which results in a **high resistance to stripping**.

Long Concave Radial Flank also known as Leading Thread Flank. Its special radius form produces forces of variable directions which promotes efficient material displacement and material flow. Major surface contact with nut member material **increases vibration loosening resistance**.

Radial Tip helps to create better internal thread and reduces hoop stress in the plastic.

• Optimized core diameter

It provides a **higher torsional strength**, usually required when assembly in fiber reinforced or high strength materials.

• Optimized core distance

It allows more threads to be in contact with the plastic material increasing vibration loosening resistance.

The optimized core diameter and pitch distance allow a better flow of material toward the trailing flank. This higher amount of material between threads provides a **higher pull-out resistance**.

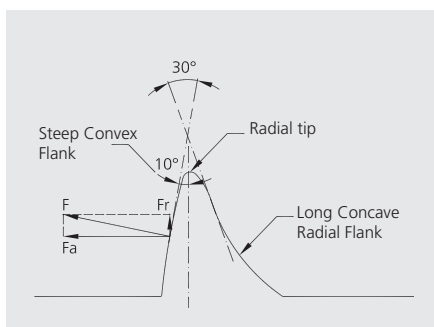


Fig.9. During thread forming, the Steep Convex Flank transfers most of the tightening load in the axial direction (F_a), minimizing radial force (F_r) and consequently plastic deformation. The axial force (F_a) is over 4,5 times greater than radial force (F_r).

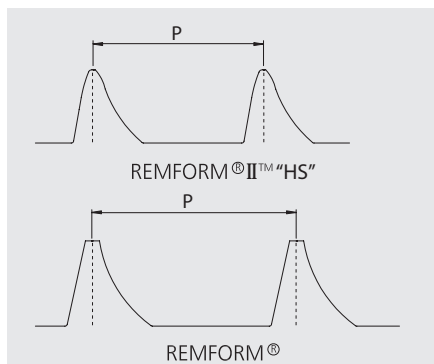


Fig.10. For the same thread diameter, the smaller pitch of REMFORM® II™ "HS" increase pull-out resistance.

Screws for plastics

2. Advantages of REMFORM® II™ "HS" screws.

- The optimized design of asymmetrical thread **increases resistance to pull-out forces, vibration loosening and stripping.**
- Higher core diameter provides a **higher breaking torque.**
- In hard and fiber reinforced plastics, the assembly torque range improves with respect to REMFORM® screw.
- Low radial forces minimize the risk of overstressing and cracking of the plastic material.

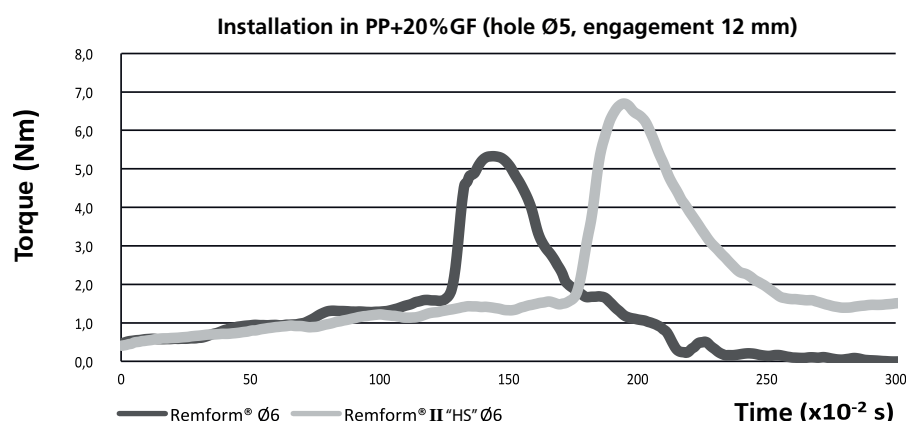
3. Threading curve of REMFORM® II™ "HS" screws.

The graph below shows a comparison of threading curves for REMFORM® II™ "HS" Ø6 and REMFORM® screws diameter 6.

In fiber reinforced plastics, the smaller pitch of REMFORM® II™ "HS" screw greatly improves failure torque without a significant increase of threading torque. The higher amount of threading energy provides the assembly with a higher prevailing torque (area under the threading curve) which improves vibrational loosening resistance of the assembly.

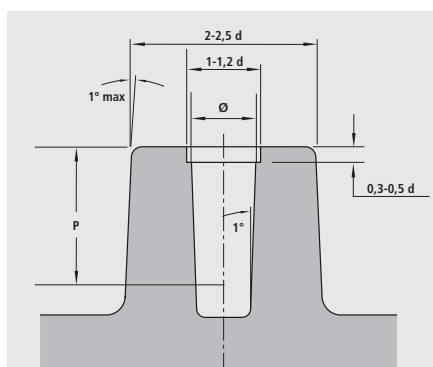
REMFORM® II™ "HS"

Minimum Breaking Torque	
d (mm)	Torque (Nm)
2	0.41
2.5	0.85
3	1.55
3.5	2.52
4	3.83
4.5	5.53
5	7.50
6	13.30
7	19.44
8	32.10



4. REMFORM® II™ "HS" boss design recommendations.

The following table indicates the recommended dimensions for hole diameter and assembly depth in relation to the bending modulus of the plastic.



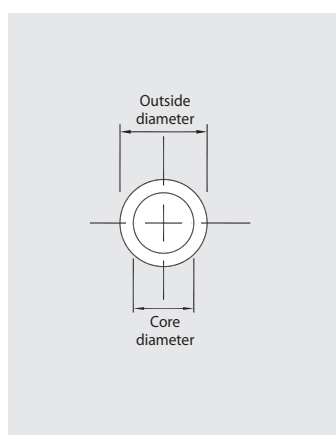
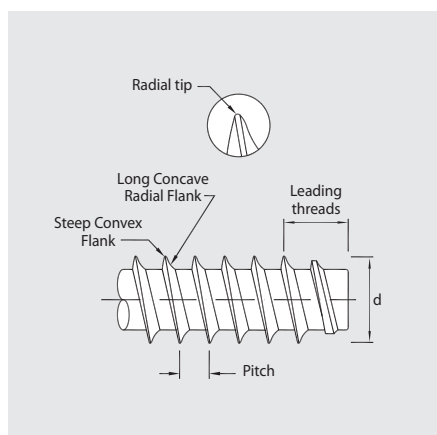
d= nominal diameter of the screw.

Bending modulus of the plastic	Ø	P
(1) ductile plastics: < 20.000 kg/cm ² (PP, PE, PET, ...)	0,75d	2,50d
Medium plastics: 21.000-30.000 kg/cm ² (ABS, ABS/PC, PC, PPO, PS, PA6, PA6.6, ...)	0,80d	2,00d
Hard plastics: 31.000-70.000 kg/cm ² (SAN, PC+10GF, POM+20GF, ...)	0,83d	2,00d
Very hard plastics: > 70.000 kg/cm ² (PET+30GF, PC+30GF, PBT+30GF, PA+30GF, ...)	0,85d	2,00d

(1) In these cases, we recommend to use REMFORM® or REMFORM® II™. This data is intended for guidance purposes. We advise doing tests beforehand with the recommended dimensions.

Screws for plastics

5. Technical data of REMFORM® II™ "HS".



REMFORM® II™ "HS"

d	Pitch	Outside D		Core D Min.
		Max.	Min.	
2	0,78	2,08	2,00	1,28
2,5	0,95	2,60	2,50	1,64
3	1,12	3,10	3,00	2,01
3,5	1,29	3,60	3,50	2,37
4	1,46	4,10	4,00	2,73
4,5	1,63	4,60	4,50	3,09
5	1,80	5,15	5,00	3,43
6	2,14	6,15	6,00	4,16
7	2,48	7,18	7,00	4,86
8	2,82	8,18	8,00	5,58

Dimensions in mm.

6. Applications of REMFORM® II™ "HS" screws.

REMFORM® II™ "HS" screws are recommended for the assembly of high strength or fiber reinforced materials that require:

- High assembly torque, either for hard plastics, very deep assemblies or for compression or sealing requirements.
- High pull-out resistance.
- High resistance to vibration loosening.

Examples:

Automotive, electric material, electronics and household appliances.

It's a custom-made screw. For further information, please contact our sales department.

Screws for plastics

RHS 81 P

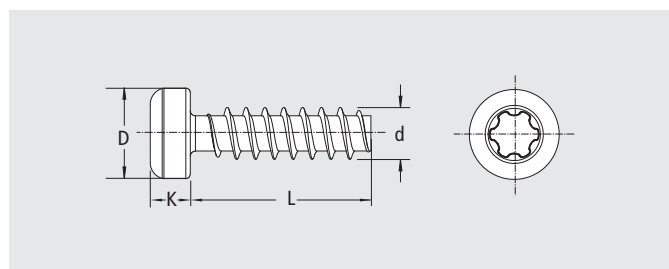


- Pan head **TORX^{plus}**



REMFORM® II™ "HS"

Packaged in bags



Zinc plated Cr (III) + Baked

d mm	2,5	3,0	4,0	5,0	6,0
D mm	4,2	5,6	7,5	9,5	10,8
K mm	1,8	2,2	2,8	3,55	3,95
	IP7	IP10	IP20	IP25	IP30

L mm	Ø2,5	Ø3	Ø4	Ø5	Ø6
3	—	—	—	—	—
4	—	—	—	—	—
5	—	—	—	—	—
6	○	●	—	—	—
8	○	●	●	—	—
10	○	●	●	—	—
12	○	●	●	●	—
14	○	○	○	○	—
16	○	●	●	○	—
18	○	○	○	○	—
20	○	●	●	●	○
22	—	○	○	○	○
25	—	○	○	○	○
30	—	—	○	○	○
35	—	—	○	○	○
40	—	—	○	○	○

● Product available in stock. ○ Product available upon request.

For other dimensions, please contact our sales department.

Screws for plastics

REMFORM® 'F'



REMFORM® 'F' thread employs the REMFORM® thread design, but with a smaller pitch. It is especially recommended for the assembly of particularly hard materials such as glass fiber-reinforced plastics, thermoset plastics, phenolic resin...

It is recommended for assemblies with plastics with a bending modulus higher than 80.000 kg/cm².

REMFORM® 'F' is a patented brand registered by CONTI FASTENERES AG and produced by CELO under license.

1. Technical features of REMFORM® 'F' thread.

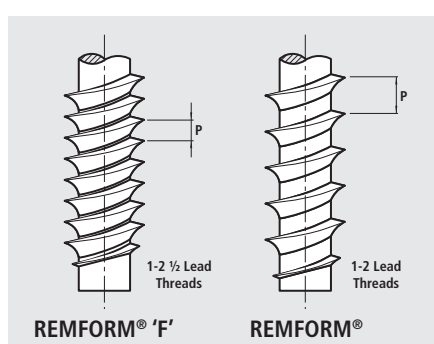


Fig.11. With the same diameter, the small pitch of the REMFORM® 'F' thread increases the number of contact points with the base material.

To the REMFORM® thread's features, REMFORM® 'F' has a **smaller pitch**.

The smaller pitch of the REMFORM® 'F' thread increases the number of threads along the shank of the screw. In this way, the number of contact points increases and consequently, pull-out resistance is greatly improved.

2. Advantages of REMFORM® 'F' screw.

In addition to the advantages provided by REMFORM® thread, REMFORM® 'F' thread offers:

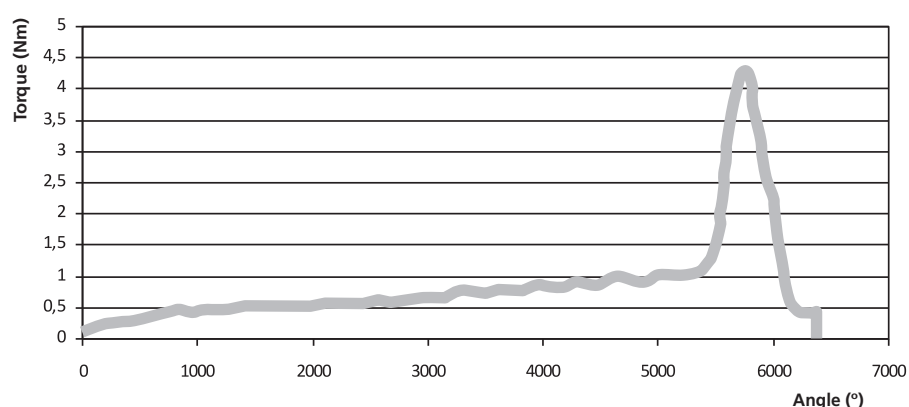
- **Improved pull-out resistance** in assemblies on thermoset materials .
- **Shorter engagement depth**, allowing for fixing in shallow holes and ensuring a greater clamping transmission and pull-out resistance.

3. Threading curve of REMFORM® 'F' screw.

REMFORM® 'F'

Minimum Breaking Torque	
d (mm)	Torque (Nm)
2,5	0,92
3,0	1,56
3,5	2,45
4,0	3,51
5,0	6,97
6,0	12,60
7,0	23,70
8,0	31,80

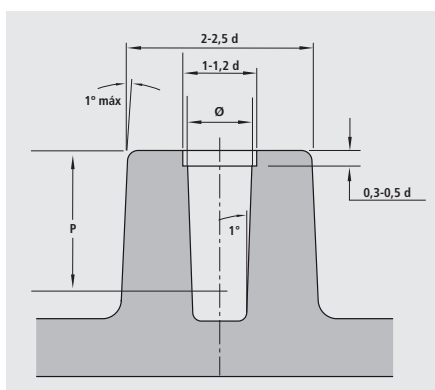
The assembly torque **shouldn't be higher than 70%** of the minimum breaking torque indicated.



Threading curve of screw FF81T 4x10 on PA reinforced 50% Glass Fiber, hole diameter 3,6 mm.

Screws for plastics

4. REMFORM® 'F' boss design recommendations.



d= nominal diameter of the screw.

To assure a proper assembly it's very important to consider the boss design. The following table indicates the recommended dimensions for hole's diameter and assembly depth for assemblies with plastic materials:

Bending Modulus of the Plastic	Ø	P
Medium plastics: 21.000-30.000 kg/cm ² (ABS, ABS/PC, PC, PPO, PS, PA6, PA6.6, ...)	0,82d	1,50d
Hard plastics: 31.000-70.000 kg/cm ² (SAN, PC+10GF, POM+20GF, ...)	0,85d	1,50d
Very hard plastics: > 70.000 kg/cm ² (PET+30GF, PC+30GF, PBT+30GF, PA+30GF, ...)	0,87d	1,50d

This data is intended for guidance purposes. We advise doing tests beforehand with the recommended dimensions.

5. Applications of REMFORM® 'F' screws.



Fig.12. Water pump (PA+ 50% GF)

Pumps for liquids
Automotive
Enclosures
Lighting
Furniture

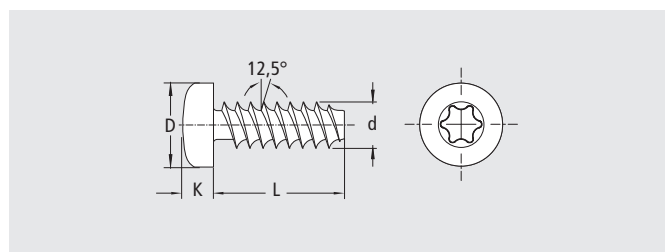
FF 81 T



• Pan Head **TORX®**



Packaged in bags.



Zinc Plated Cr (III) + Baked

d mm	3,0	3,5	4,0	5,0	6,0
D mm	5,6	6,9	7,5	9,5	10,8
K mm	2,2	2,6	2,8	3,55	3,95
	T10	T15	T20	T25	T30

L mm	Ø3	Ø3,5	Ø4	Ø5	Ø6
6	○	○	○	○	—
7	○	○	○	○	—
8	●	○	○	○	○
10	●	●	●	○	○
12	○	○	●	○	○
16	○	○	○	○	○
18	○	○	○	○	○
20	●	○	○	●	○
25	—	○	○	○	○
30	—	—	○	○	○
35	—	—	○	○	○
40	—	—	○	○	○
50	—	—	—	—	○

● Product available in stock. ○ Product available upon request.

Screws for plastics

PLASTITE®



TRILOBULAR® PLASTITE® thread was designed to provide solutions for assembling plastic materials. There are different types of PLASTITE® threads, depending on the requirements of the assembly: PLASTITE® 60, PLASTITE® 45 and PLASTITE® 48-2.

1. Technical features of PLASTITE® thread.

- **TRILOBULAR® thread section**

The three lobes on the thread exert localized stress on the hole, which **reduces friction during threading process**.

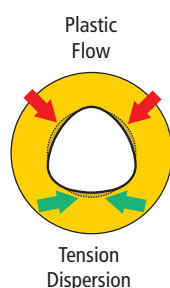


Fig.13. Material flows towards the interior. The space between the lobes absorbs and disperses the tension created during threading.

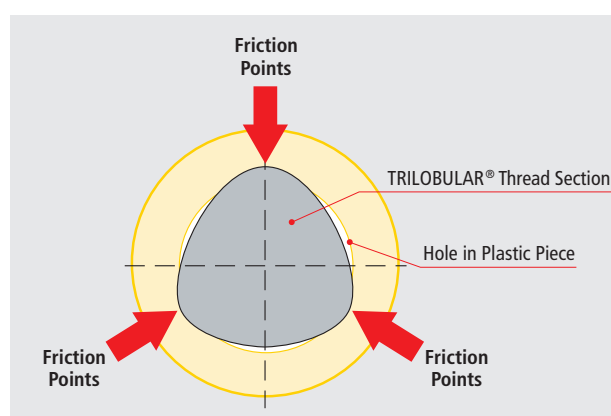


Fig.14. The three lobes contact points reduce friction during threading.

The TRILOBULAR® section allows the plastic material to flow in the space between the lobes, and therefore relieves the tension created during threading.

Unlike screws with a circular section, the stress generated on the plastic during threading is concentrated on three points, reducing radial stress and thread forming torque.

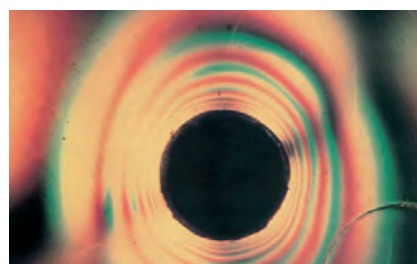


Fig.15. Stress created during fixing with a circular section screw.

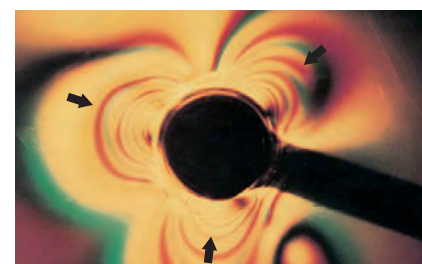


Fig.16. Stress created during thread forming with a TRILOBULAR™ section screw.

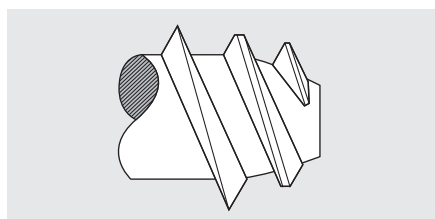


Fig.17. Flat crest lead thread detail.

- **Flat crest lead thread**

The shape of the lead threads eases alignment and material displacement during thread forming.

The following details the features of the different types of PLASTITE® thread.

Screws for plastics

PLASTITE® 48-2

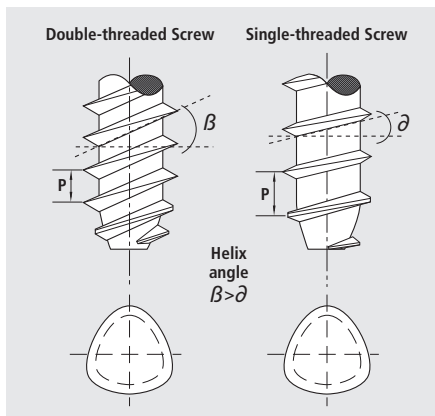
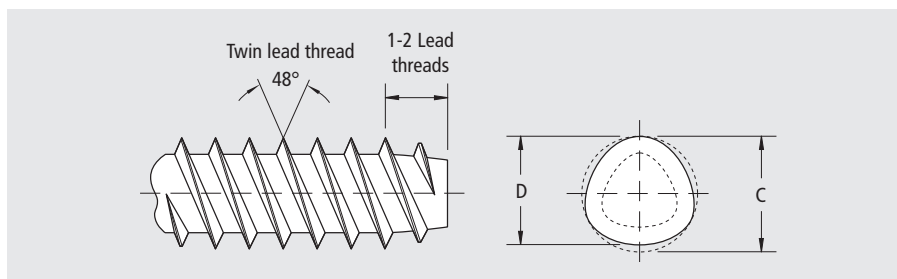


Fig.18. The helix angle from is higher in a double-lead screw (β) than a single lead screw (θ), resulting in a higher stripping resistance.

Technical features of PLASTITE® 48-2 screw

It is the first improvement on the PLASTITE® 60 design, aimed at reducing stress on the plastic materials during the threading process. Maintains PLASTITE® features like **TRILOBULAR® thread section** and **flat crest lead thread on the screw tip**.

- The **48° thread angle** reduces radial tension during the threading process.
- The **higher height of the thread** allows for deeper penetration into the plastic, increasing **clamping, pull-out resistance and vibration loosening resistance**.
- **Twin lead thread**. The steeper helix angle increases friction with the plastic material and, therefore, improves the failure torque value.



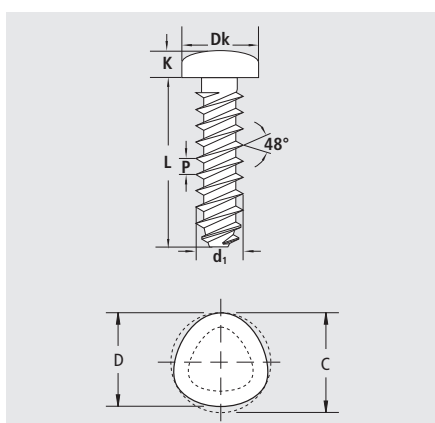
Advantages of PLASTITE® 48-2 compared to PLASTITE® 60

- **Less radial deformation** of the plastic.
- **Higher vibration loosening** resistance.
- **Increased pull-out** resistance and **stripping torque**.
- **Increased productivity** as the double thread provides faster assembly speed.

Technical data of PLASTITE® 48-2 screws

d	Dk	K	Pitch	Pozi	Torx®	C	D
2,2	4,0	1,60	0,9	Z1	IP6*	2,34	2,26
2,5	4,0	1,60	1,06	Z1	IP7*	2,79	2,69
2,9	5,6	2,20	1,27	Z1	T10	3,23	3,12
3,5	6,9	2,60	1,34	Z2	T15	3,73	3,63
3,9	7,5	2,80	1,41	Z2	T20	4,22	4,06
4,2	8,2	3,05	1,59	Z2	T20	4,70	4,55
4,5	8,2	3,05	1,7	Z2	T20	5,05	4,90
4,8	10,0	3,80	1,81	Z2	T25	5,38	5,28
5,5	10,8	3,95	2,3	Z2	T25	5,97	5,84

Dimensions in mm. The values shown are nominal. For tolerances and other data, please contact our technical department. * 



Screws for plastics

PLASTITE® 45

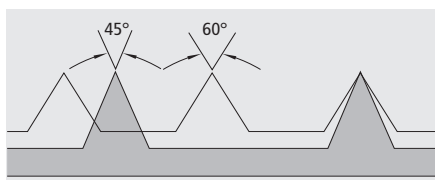
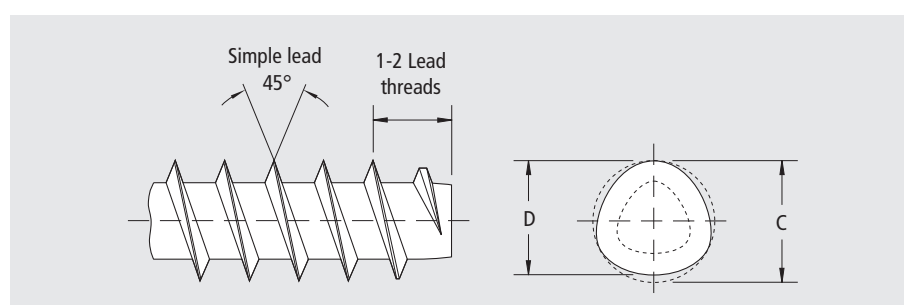


Fig.19. Comparison of pitch and thread height of PLASTITE® 60 and PLASTITE® 45 threads.

Technical features of PLASTITE® 45 screw

PLASTITE® 45 is the latest version of TRILOBULAR® screws for plastic.

- **The 45° thread angle** reduces stress caused during threading process, reducing radial tension and allowing a deeper penetration without increasing the thread forming torque.
- **The larger thread pitch** gives more tension relief over a larger plastic surface, resulting in an **increased pull-out and stripping resistance**.



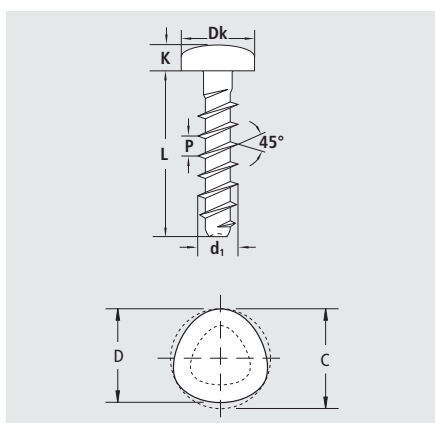
Advantages of PLASTITE® 45

- **Less radial deformation** on plastic.
- **Increased pull-out and stripping** resistance.
- **Reduced thread forming torque**, improving ergonomics of the assembly.

Technical data of PLASTITE® 45 screws

d	Dk	K	Pitch	Pozi	Torx®	C	D
2,5	4,0	1,60	1,4	Z1	IP7*	2,53	2,48
3	5,6	2,20	1,5	Z1	T10	3,04	2,99
3,5	6,9	2,60	1,65	Z2	T15	3,54	3,46
4	7,5	2,80	1,75	Z2	T20	4,04	3,94
4,5	8,2	3,05	2,0	Z2	T20	4,54	4,43
5	9,0	3,55	2,2	Z2	T20	5,04	4,94
6	10,0	3,95	2,5	Z3	T30	6,04	5,93

Dimensions in mm. The values shown are nominal. For tolerances and other data, please contact our technical department. * TORXplus®



Threading graph of PLASTITE® 45 screws

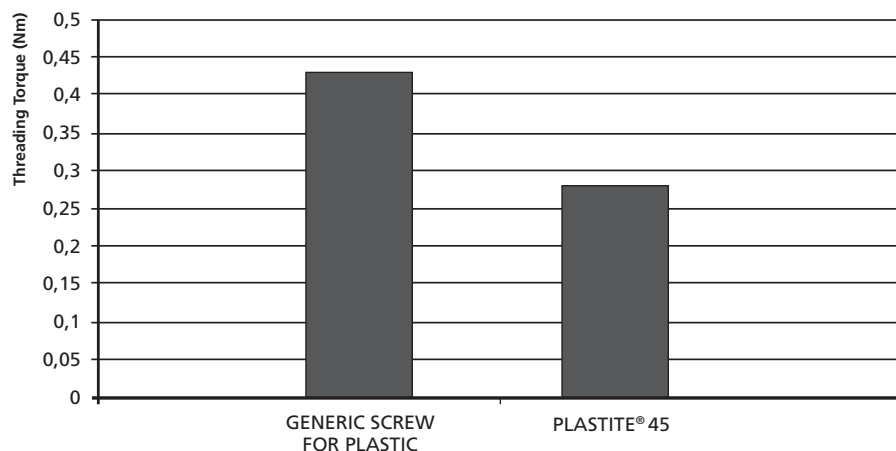
The following graph shows the threading curve of a generic screw for plastic and a PLASTITE® 45 screw, diameter 4 mm. The thread forming torque for the PLASTITE® 45 screw is considerably lower, resulting in a more ergonomic assembly.

Screws for plastics

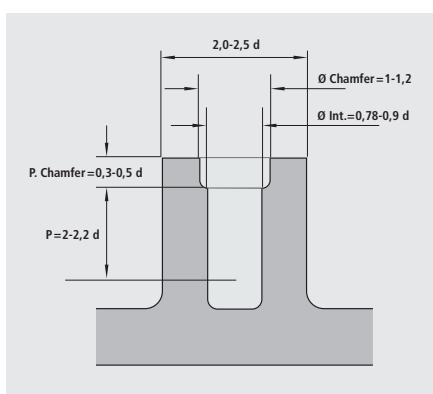
PLASTITE® 45

Minimum Breaking Torque	
d (mm)	Torque (Nm)
2,5	0,37
3,0	0,93
3,5	1,60
4,0	2,60
4,5	4,30
5,0	3,60
6,0	7,90

The assembly torque **shouldn't be higher than 70%** of the minimum breaking torque indicated.



2. PLASTITE® boss design recommendations.



d = nominal diameter of screw.

This data is intended for guidance purposes. We advise doing tests beforehand with the recommended dimensions.

To ensure the correct joint, it is very important to consider the boss design, as this has to support demoulding and cooling tension, resist the tension created during the insertion of the screw and guarantee the clamping of the assembly.

The table below gives the recommended boss dimensions for hole diameters and assembly depths for the different PLASTITE® threads with different types of plastics.

	Ductile plastics		Hard plastics	
	Ø Interior	Depth P	Ø Interior	Depth P
PLASTITE® 45	0,78d	2,2d	0,82d	2,2d
PLASTITE® 48-2	0,9d	2d	0,92d	2d
PLASTITE® 60	0,9d	2d	0,92d	2d

This is a custom-made screw. For further information, please contact our sales department.

3. Applications of PLASTITE® screws.

It's recommended for application with low threading torque requirement.

Examples

Household appliances
Electric material
Electronics
Automotive

Lighting
Furniture
Construction
Toys

Screws for plastics

PCB screw



PCB screws have been designed to solve assembly problems with thin hard plastic parts and for the assembly on printed circuit boards (PCB).

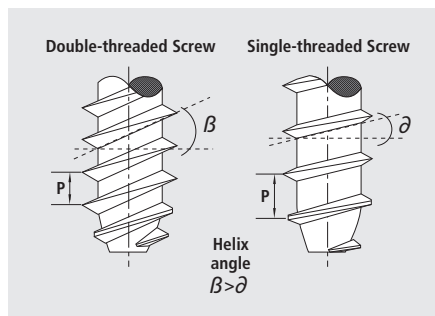
In the assembly of thin hard plastic parts with standard screws for plastic, the engagement length is not enough to avoid stripping and guarantee the pull-out resistance of the assembly.

Typical methods of assembly on PCB

- Inverted assembly. The assembly is done through the circuit and threading on the assembled part, for which a low assembly torque is necessary to avoid deformation of the printed circuit board. The head of the screw takes up a lot of space on the board.
- Welding.
- Use of plastic clips. The union can loosen in time due to the ageing of the plastic clips.

The PCB screw has been developed to solve assembly problems with the aforementioned methods.

1. Technical features of PCB screw.



The steeper helix angle from the double thread screws provides higher failure torque values.

- **40° thread angle**

The 40° thread angle reduces radial force F_R generated during threading process, thereby **avoiding bursting the plastic material and damaging the PCB.**

- **Special twin-lead thread**

It provides greater surface contact with the base material, which increases friction and reduces stripping risk.

- **Reinforced core**

The reinforced core allows for a higher assembly torque without breaking the screw and ensuring the resistance of the screw during assembly. This is essential when working with a hard base material.

- **Pan head flange**

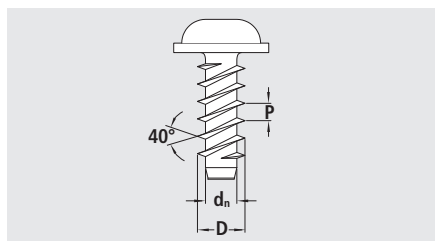
It increases surface friction, improving stripping resistance.

2. Advantages of PCB screw.

In the assembly of thin hard plastic parts:

- **Reduces boss bursting risk.**
- **Increases resistance to stripping.**
- **Improves breaking torque.**

Screws for plastics

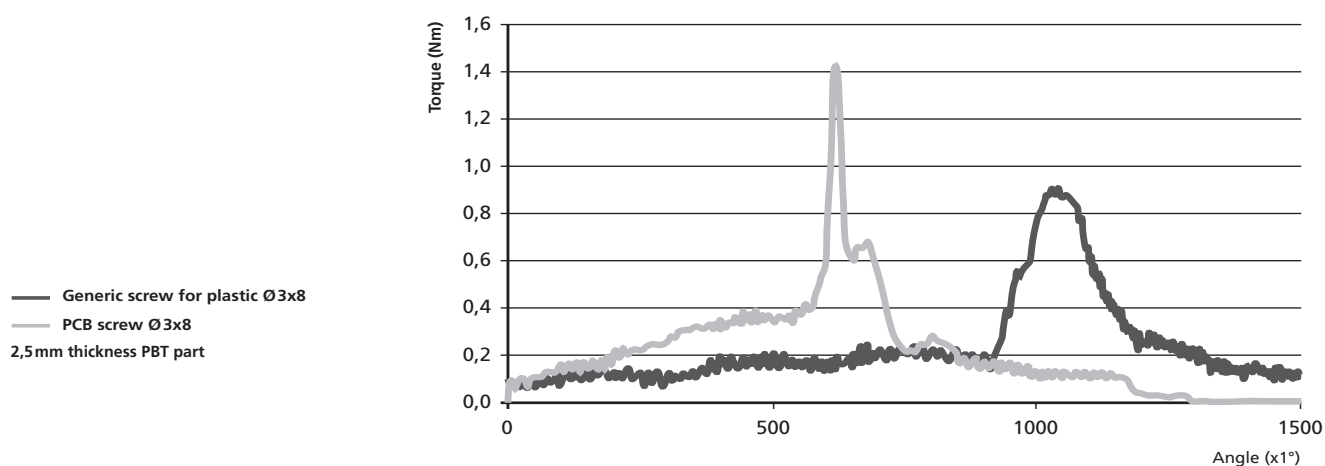


In the assembly on PCBs:

- The **head of the screw is set directly on the connector**, avoiding interference with the tracks.
- **Direct fixing** without damaging the PCB.
- **Higher resistance to vibrational loosening.**
- **Twin-lead thread increases threading speed.**

3. Threading curve of PCB screw.

PCB screw offers faster fixing speeds due to the twin lead thread and safer assembly torque range: The failure torque is much higher with a PCB screw and the thread forming torque values are similar in both cases.



4. PCB screw boss design recommendations.

We recommend to contact our technical department for hole dimension and boss geometry recommendations.

5. Applications of PCB screws.

Assemblies on thin hard plastic.

Assembly of components on printed circuit boards.

This is a custom-made screw. For further information, please contact our sales department.

Fig.20. PCB assembly connector with PCB screws.

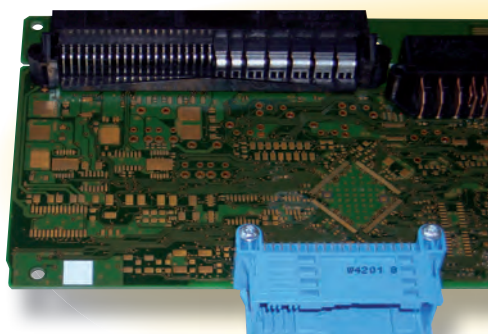


Fig.21. Assembly of a bathroom fan with PCB screws.

Screws for plastics

IBI-ZAS



IBI-ZAS thread has been designed to solve assembly problems with thermoset plastics. Due to the nature of these plastics, it is not recommended to use standard plastic screws, as the radial stress the base part is subjected to during thread forming can cause boss bursting.

The features of this thread make it also a good choice when assembling aluminum and metal alloy parts with cone-shaped holes.

1. Technical features of IBI-ZAS thread.

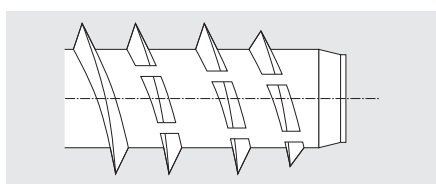


Fig.22. The cuts on the first three lead threads remove material during threading, reducing thread forming torque and boss bursting.

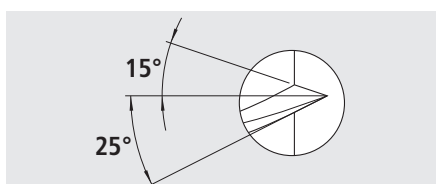


Fig.23. The asymmetric thread guarantees better pull-out and stripping resistance.

- **Cutting thread**

The first three lead threads of the screw have cuts that remove chips during threading process, **decreasing the thread forming torque** and the stress produced on the plastic material.

- **Asymmetric thread**

The leading flank angle of 25° and trailing flank angle of 15° provide:

- **Increased pull-out resistance.**
- **Increased stripping resistance** due to the harpoon effect of the threads.

- **Reinforced core**

It ensures screw resistance during assembly, an essential requirement due to the extreme hardness of the base material.

- **Reduced thread pitch**

It increases contact points with the base material, **increasing resistance to vibration loosening** and **thread failure**.

2. Advantages of IBI-ZAS screw.

- **Reduction of thread forming torque** offering a more ergonomic assembly.
- **Increased pull-out and thread failure resistance**, allowing for its use in assemblies with high pull-out requirements.
- **Improved breaking torque** due to the screw's reinforced core.
- **Reduction in assembly costs:**
 - The quality of the nut member **allows the screw to be reused**.
 - **It avoids the use of expensive metal inserts.**
- IBI-ZAS thread design **avoids threading problems** in cone-shaped holes (angle of mould extraction >4°) in **aluminum and metal alloys**.

Screws for plastics

3. Threading curve of IBI-ZAS screw.

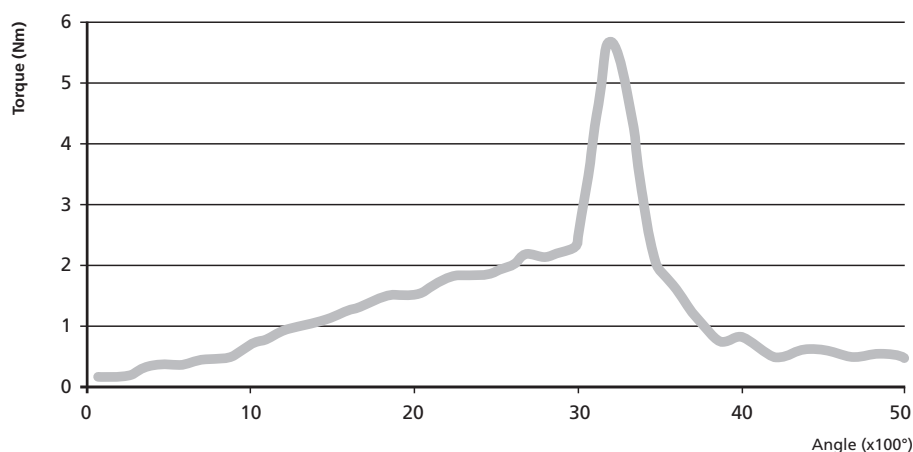
Threading curve of IBI-ZAS screw Ø5x13,5 hexagonal flange head on Bakelite material. The removal of material considerably reduces thread forming torque, offering a wide safe assembly torque range.

IBI-ZAS

Minimum Breaking Torque

d (mm)	Torque (Nm)
3,0	2,00
3,5	2,80
4,0	4,20
5,0	9,00
6,0	14,00

The assembly torque shouldn't be higher than 70% of the minimum breaking torque indicated.

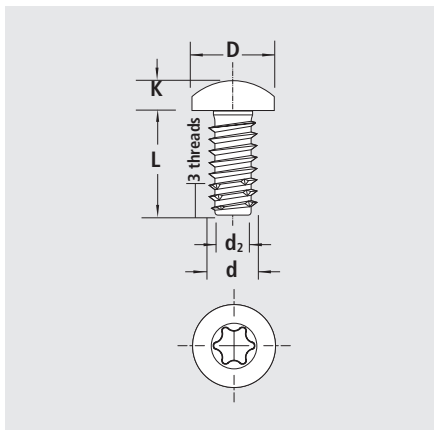


— IBI-ZAS Screw 5x13,5 Hole ø 4,6 mm, 9 mm engagement.

4. IBI-ZAS screw boss design recommendations.

The diameter of the hole should be smaller in comparison with a TAPTITE II® screw. Please, contact our technical department for further support.

5. Technical data of IBI-ZAS screw.

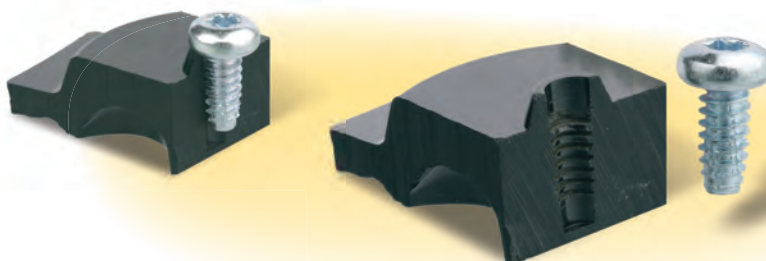


d	d ₂	Pitch	D Máx.	K Máx.	Torx®
3	2,18	0,8	5,6	2,4	T10
3,5	2,56	0,95	7	2,6	T15
4	2,93	1,05	7,5	2,8	T20
5	3,68	1,25	9,5	3,7	T25
6	4,42	1,4	11	4	T30

Dimensions in mm. The values shown are nominal. For tolerances and other data, please contact our technical department.

6. Applications of IBI-ZAS screw.

IBI-ZAS screw is designed for the assembly of thermoset plastics and bakelite parts. It can also be used for assembly on aluminum and metal alloy pieces with cone-shaped holes.



Screws for plastics

IZ 81 T

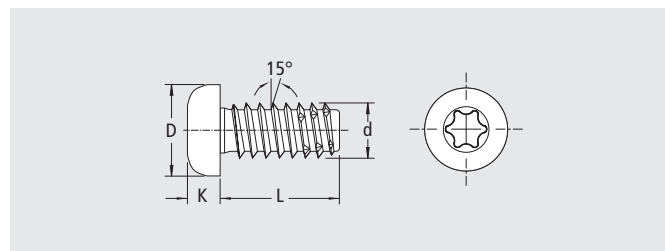


IBI-ZAS

- **Pan Head TORX®**



Packaged in bags.



Zinc Plated Cr (III) + Baked

d mm	3	3,5	4,0	5,0	6,0
D mm	5,6	7,0	7,5	9,5	11,0
K mm	2,4	2,6	2,8	3,7	4,0
	T10	T15	T20	T25	T30

L mm	Ø3	Ø3,5	Ø4	Ø5	Ø6
6	○	○	○	○	—
7	○	○	○	○	—
8	○	○	○	○	○
10	○	○	●*	○	○
12	○	○	○	○	○
16	○	○	○	○	○
18	○	○	○	○	○

● Product available in stock. ○ Product available upon request. * Available until end of stock.

Screws for plastics

TWINPLAST

TWINPLAST thread was developed by CELO to solve assembly problems on very thin plastics, especially blown plastic parts.

1. Technical features of TWINPLAST screws.

- **40° thread angle**

The 40° thread angle generates less radial tension (F_R) during threading; this helps to prevent cracks in the plastic.

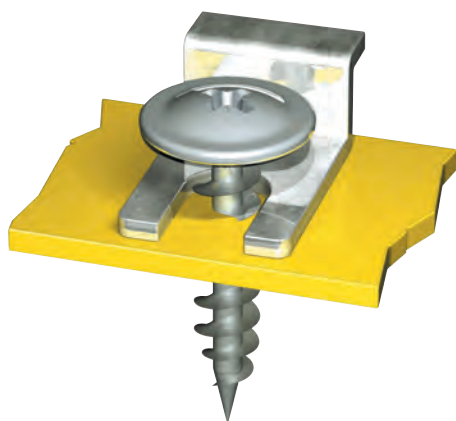


Fig. 25. The TWINPLAST screw is used to assemble thin plastic parts.

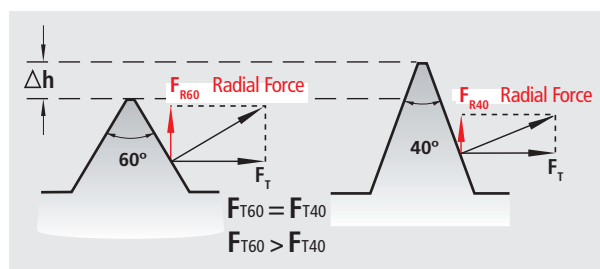


Fig. 24. Reduction of radial force (F_R) for 40° thread angle.

- **Twin lead thread**

The steeper angle **increases the failure torque value and improves assembly speed.**

- **Sharp point**

Allows for the **insertion of the screw with no pilot hole.**

Diameter d (mm)	Max. Width (mm)
3	2
3,5	2,5
4	3
5	3,5

The table shows the maximum material thickness to drill through based on TWINPLAST screw diameter.

- **Pan head flange**

Improves the distribution of tension on plastic material.

2. Advantages of TWINPLAST screw.

- Allows for assembly on plastic parts with a **minimum thickness of 1/3 the diameter** of the screw.
- **Prevents the design of bosses**, improving the plastic distribution during the blowing process.
- **Reduce thread forming torque**, offering a more ergonomic assembly.
- Provides assembly with **better pull-out resistance**.
- Higher stripping resistance, which **prevents repairing** during the assembly.
- The larger contact surface of the head allows for a **better stress distribution on the plastic**.
- Allows the **reuse of the screw**, reducing the risk of stripping.

Screws for plastics

3. Threading curve of TWINPLAST screw.

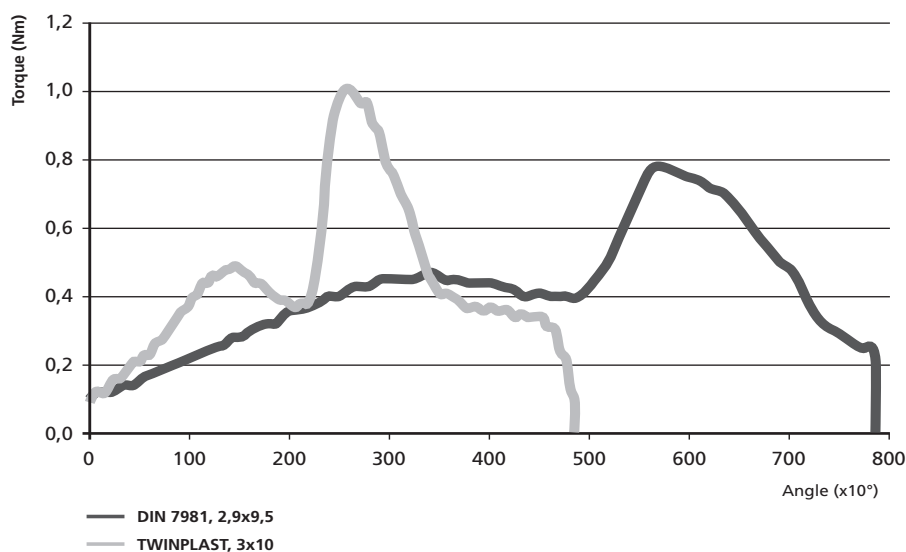
Threading curve of TWINPLAST screw and self-tapping screw on PE blown part.

TWINPLAST screw offers a safer assembly torque range, being that the threading torque is lower and the failure torque value is much higher when compared to a self-tapping screw.

TWINPLAST

Minimum Breaking Torque	
d (mm)	Torque (Nm)
3,0	1,60
3,5	2,30
4,0	3,25
4,5	4,6

The assembly torque **shouldn't be higher than 70%** of the minimum breaking torque indicated.



4. Applications of TWINPLAST screws.

Assemblies on blown plastic parts.

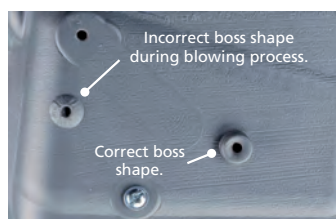


Fig.26. Flow problems with plastics in bosses for blown plastic parts. The use of TWINPLAST screw avoids the need to design bosses and ensures fixing on blown plastic parts.

Screws for plastics

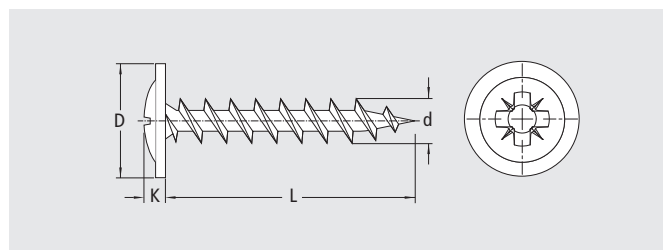
TP 88 Z



- **Pan Head Flange, POZI sharp point**



Packaged in bags.



Zinc Plated Cr (III)

d mm	3,0	3,5	4,0	4,5
D mm	7,0	8,0	9,0	10,0
K mm	1,7	2,1	2,2	2,6
	Z1	Z2	Z2	Z2

L mm	Ø3,0	Ø3,5	Ø4,0	Ø4,5
10	●	○	○	○
12	○	●	○	○
16	○	○	●	○
19	○	○	○	●

● Product available in stock. ○ Product available upon request.

TWINDRILL screw

In applications where the plastic thickness is higher and the sharper point is not enough for drilling holes in the plastic, there is the possibility to use the **TWINDRILL** screw. It is a TWINPLAST thread screw with a self-drilling point.

It is also recommended for the assembly of thin wooden parts.

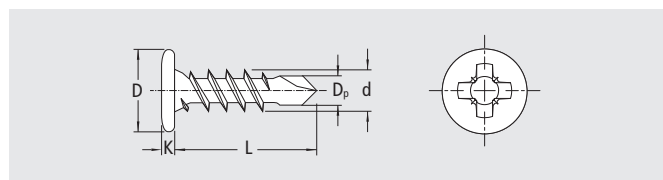
TWD



- **Low Head PHILIPS, Self-drilling point**



Packaged in bags.



Zinc Plated Cr (III)

d mm	4,0
D mm	8,0
K mm	1,3
	H2

L mm	Ø4,0
16	●

● Product available in stock.

Screws for plastics

PUSHTITE® II



The TRILOBULAR® PUSHTITE® thread was designed to be pressed into holes with a single, straight-line stroke, with the possibility to be removed without damaging the assembly.

1. Technical features of PUSHTITE® II thread.

- **TRILOBULAR® thread section**

Unlike screws with a circular section, the stress generated on the plastic during threading is concentrated on three points, reducing radial stress and thread forming torque.

The space between the lobes permits air to escape during insertion.

- **Asymmetric thread**

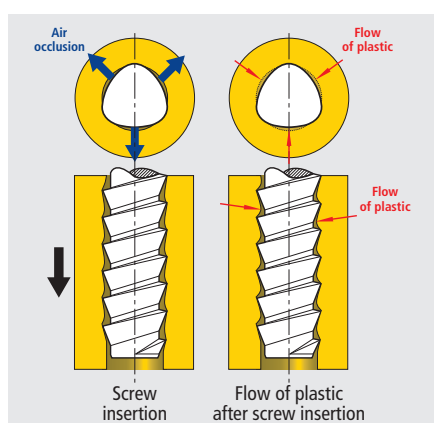
Leading flank of 70° for an easy entry of the screw.

Trailing flank of 10° for a high pull-out resistance.

- **Helical harpoon thread**

It permits displaced air to escape during insertion and allows the screw to be removed and inserted if necessary.

2. Advantages of PUSHTITE® II screws.



- **Time and cost savings** in assembly operations.
- The TRILOBULAR® thread section:
 - **Minimizes the stress during insertion, avoiding the boss bursting.**
 - **Eases the air to escape, providing a quick and efficient insertion.**
- **Prevents boss bursting** by air occlusion.
- **High pull-out resistance.**
- **Allows the reuse of the screw** without boss damaging.

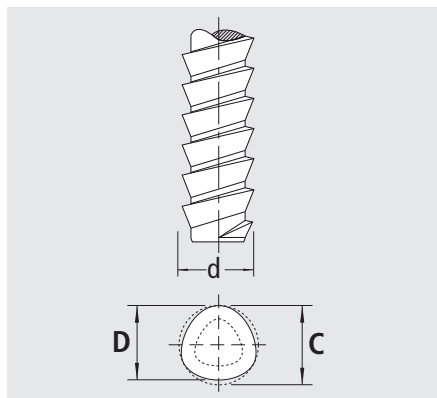
Fig.27. During screw insertion, the friction with the plastic material is reduced at three points. Once the screw is inserted, the plastic flows along the shank of the screw.

Screws for plastics

3. Technical data of PUSHTITE® II screws.

PUSHTITE® II screws can be supplied with a recess in case it's necessary to remove or adjust the screw.

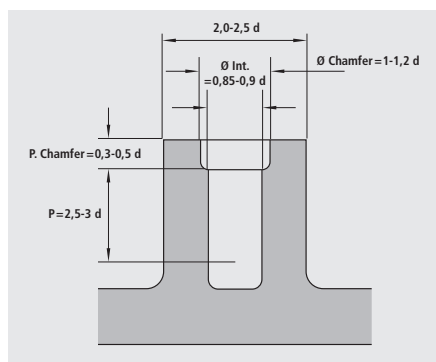
When this is not a request, they can be supplied without recess, being a tamper resistant screw.



d	Pitch	C	D
2,0	1,05	2,03	1,95
2,5	1,15	3,54	2,44
3,0	1,20	3,03	2,94
3,5	1,35	3,54	3,42
4,0	1,55	4,04	3,90
4,5	1,70	4,55	4,40
5,0	1,80	5,05	4,87
6,0	2,10	5,05	5,85

Dimensions in mm. The values shown are nominal. For tolerances and other data, contact our technical department.

4. PUSHTITE® II boss design recommendations.



d= nominal diameter of screw.

Material	Ø	P
Polyethylene (PE)	0,85d	2,5d
Polypropylene (PP)	0,87d	2,5d
ABS	0,90d	3,0d
Polyamide (PA)	0,90d	3,0d
Phenilene Polyoxide (PPO)	0,90d	3,0d

This data is intended for guidance purposes. We advise doing tests beforehand with the recommended dimensions.

5. Applications of PUSHTITE® II screws.

It's recommended for low mechanical requirements or Non-structural assemblies with DUCTILE plastics where it is needed to reduce the assembly time.

This is a custom-made screw. For more information, please contact our sales department.

Screws for plastics

Criteria for thread type selection

For the selection of a thread type, it is important to consider the type of plastic, the geometry of the parts to assemble and the different requirements of the application.

The table below is a guide to select the thread to use based on the listed selection criteria, but field tests will determine the best possible solution.

CELO offers the application laboratory at your disposal, where suitable tests are conducted (threading, failure torque, pull-out resistance, etc.) in order to recommend the type of thread that best meets the application requirements.

Thread type selection

Materials	Thread type									
	CELOPLAST	REMFORM®	REMFORM® II™ "HS"	REMFORM® 'F'	PLASTITE® 45	PLASTITE® 48-2	PUSHTITE®	TWINPLAST	IBI-ZAS	PCB
Ductile Plastic	●	●	-	-	●	●	-	●	-	-
Hard Plastic	-	●●	●●	●	●	-	-	-	-	●●
Very Hard Plastic	-	-	●●	●	-	-	-	-	●●	-
Phenolic Resin	-	-	-	●	-	-	-	-	●●	-
Blown Plastic	-	-	-	-	-	-	-	●●	-	-
Low Thickness Plastic	-	-	-	●	-	-	-	-	-	●●
Low Thickness Boss	-	●●	-	-	●	-	-	-	-	-
Deep Assemblies	-	●●	●	-	●	-	-	-	-	-
Shallow Holes	-	●	●	●●	-	●●	-	-	-	●●
High Tolerance Holes	●●	●●	●●	-	-	●●	-	-	-	-
Oversized Holes	-	●●	●●	-	-	-	-	-	-	-
Fast Assembly	-	-	-	-	-	●●	●●	-	●●	●●
Vibration Loosening Resistance	●	●●	●●	●●	●●	●	●	●	●●	●●
Pull-out Resistance	●	●●	●●	●●	●	●	●	●	●●	●●
Stripping Resistance	●	●●	●●	●●	●	●	-	●●	●	●●
High Assembly Torque Required	-	●●	●●	-	-	●	-	-	-	●
Low Threading Torque Required	●	●	●	-	●●	-	-	-	-	-
Reusable Screws	●	●●	●	-	●	-	-	-	-	-

● Correct ●● Optimal – Not recommended

Micro screws



Recent technological advances have made it possible to design smaller and smaller electronic components with a higher mechanical performance, requiring the appropriate assembly solution for each situation. The market has different options for assembling electronic components; mainly clips, welding and rivets.

For certain applications, where higher levels of pull-out and vibration loosening resistance are required, CELO offers TAPTITE II®, Machine, REMFORM®, REMFORM® II™ "HS" micro screws.

They can be produced with pan head, pan head flange and countersunk head, PHILIPS, POZI and TORX PLUS® recesses, being TORX PLUS® the most recommended.

These products are custom-made, therefore we recommend to contact our sales department for availability and minimum order quantities.

CELOPLAST screw



CELOPLAST screws are recommended for the assembly of thermoplastic materials with a bending modulus between 500 and 30.000 kg/cm².

The required assembly depth is between 1,5 and 3 times the diameter of the screw.

Production range:

- Ø1,8 x 2,5 mm to Ø1,8 x 12 mm.

REMFORM® and REMFORM® II™ "HS" screws



For the assembly of thermoplastic materials with glass fibres and bending modulus between 30.000 and 80.000 kg/cm². It is recommended for its use with shallow holes and requirement of high pull-out resistance.

The required assembly depth is between 1,5 and 3 times the diameter of the screw.

Production range:

- Ø1,8 x 2,5 mm to Ø1,8 x 12 mm.
- Ø2 x 3 mm to Ø2 x 12 mm.

TAPTITE II® screw



The screw creates its own nut member in ductile metal and metal alloys.

Production range:

- M2 x 5 mm to M2 x 15 mm.

MACHINE screw



Production range:

- M1,6 x 2 mm to M1,6 x 12 mm.
- M2 x 3 mm to M2 x 20 mm.



***Thread rolling
screws for
metal***



TAPTITE® TRILOBULAR® screws for metal



TAPTITE® TRILOBULAR® thread rolling screws **greatly reduce assembly costs** and provide assemblies with **high pull-out and vibration loosening resistance**.

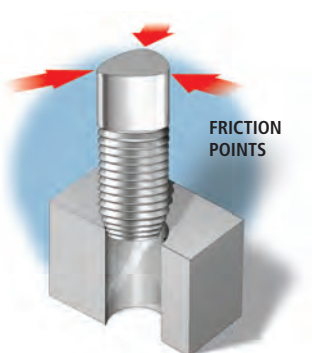
TAPTITE® TRILOBULAR® screws are used to **create a resistant and uniform thread into untapped holes** during the fixing process. Their use offers many advantages, both economically with an increase in productivity during assembly and by generally reducing costs, and technically, as they offer high mechanical performance during the assembly lifespan.

CELO, S.A. produces the following screws with a TRILOBULAR® section:

TAPTITE II®	FASTITE® 2000™
TAPTITE 2000®	KLEERLOK®
TAPTITE 2000® "SP"™	KLEERTITE®
TAPTITE 2000® "CA"™	POWERLOK®

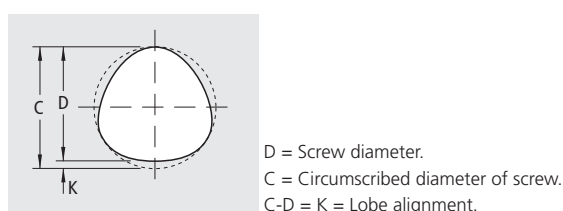
TAPTITE® is patented by the company CONTI Fasteners AG and made under license by CELO.

1. Technical features of TAPTITE® screws.



TRILOBULAR® TAPTITE® screws have a thread profile similar to that of a metric thread, with a 60° thread angle and a machine thread pitch, but with TRILOBULAR® section (three lobes).

- The TRILOBULAR® shape is defined in **two dimensions** instead of one, as with standard machine screws.



TRILOBULAR® effect during fixing

The lobe alignment, K value, is the difference between the screw diameter and circumscribed diameter. It affects the screw's performance. A low K value increases the strength of the assembly, but also means a high thread forming torque.

The stability in K value guarantees stable parameters while fixing the screws. Only with the use of TAPTITE® original screws you can ensure the stability of this parameter.

- The three lobes on the thread put localized pressure on the hole, which **reduces friction during the fixing process** and allows for more ergonomic assembly torque.

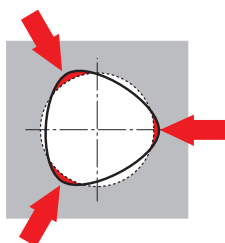


Fig.28. The three lobes put localized pressure at three points, reducing friction during thread forming.



Fig.29. The material displacement during threading flows between the lobes wrapping the shank of the screw.

Screws for metal

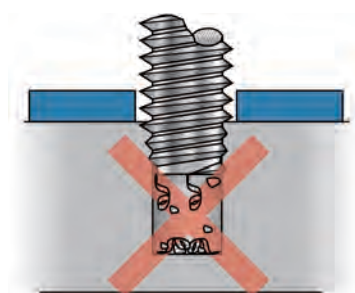


Fig.30. The thread formed by material lamination avoids chip creation.

- **The thread is formed by material lamination, without chips creation.** The material displaced during threading, flows to fill the space between the lobes, wrapping around the shank of the screw completely and eliminating the tolerance between the screw and the thread in the nut member.
- TRILOBULAR® TAPTITE II® screws form threads into untapped nut member with the tolerance of a machine thread. In this way it is possible to replace TAPTITE® screw with a standard machine screw.

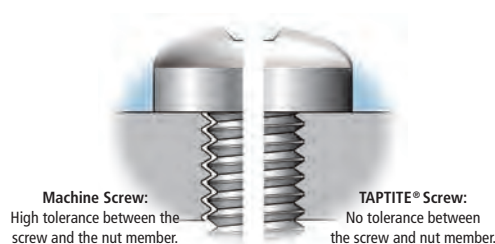


Fig.31. The TRILOBULAR® screw creates a thread in nut member without tolerance.

- The manufacturing process for the TRILOBULAR® screws includes heat treatment proces that will vary depending on the application and particular screw mechanical requirements. The most common heat treatments are case hardening and CORFLEX® 'N'. To assure the thread rolling feature of the screw, it is necessary to reach a surface hardness of at least 250 HV higher than the base material.

The surface and core hardness values are detailed later on for the different thread types.

The detailed features and associated advantages can only be achieved with TAPTITE® screws manufactured according to the manufacturing standards of CONTI Fasteners AG.

2. Advantages of TAPTITE® thread rolling screws.

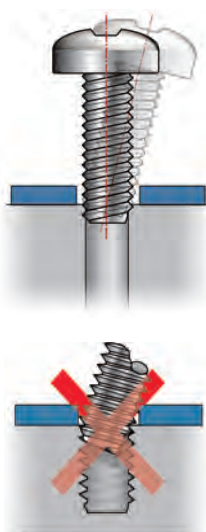


Fig.32. The progressive point facilitates axial alignment in holes and prevents cross threading.

- **Low threading torque** allowing for a more **ergonomic assembly**.
- Forming thread by lamination avoids chips creation, which is important for electronic applications and ensures a **high pull-out resistance** and **high stripping torque**.
- High values of **prevailing torque** ensuring **excellent vibration loosening resistance**.
- The **progressive point** allows for:
 - Easy insertion into the hole.
 - Low starting **end load**.
 - An ideal solution for automatic assembly.

Screws for metal

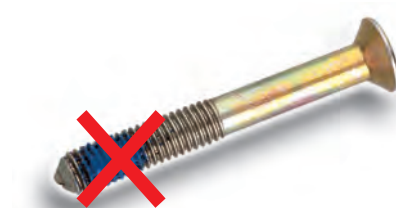


Fig.33. The adhesive patches on the thread are limited in temperature resistance and the screw cannot be reused.

TRILOBULAR TAPTITE® threaded screws **eliminate the problems of:**

- Misalignment of machine screws in tapped holes, avoiding the use of guiding components (screws with dog point...).
- Screw loosening due to vibrations:
 - Avoid the use of blocking elements (lock washers, adhesives patches, etc.).
 - **Eliminates retightening** (which does not prevent vibration loosening).

The TRILOBULAR® screws admit more variations in hole sizes than machine screws in tapped holes.

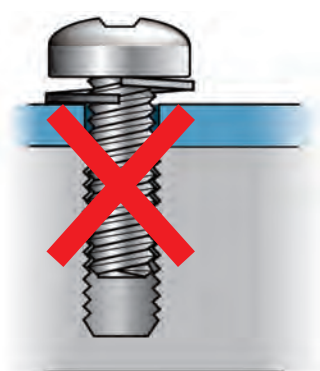
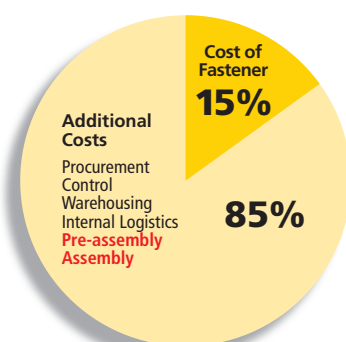


Fig.34. Use of the TRILOBULAR® screws prevents the use of grower washers. These are used to maintain compression after setting the screw, which does not prevent vibration loosening.

3. TAPTITE® thread rolling screws reduce assembly cost.



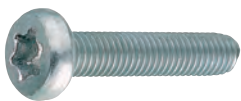
Only 15% of all assembly costs corresponds to the cost of the screw. The TRILOBULAR® TAPTITE® thread screws have been specially designed to reduce the remaining 85%.

The TRILOBULAR® TAPTITE® screws **eliminate separate tapping operations and associated costs:**

- Direct or indirect labour cost.
- Threading lubricants.
- Preparation.
- Cleaning of oils and chips.
- Inspection, loss or repair.

Screws for metal

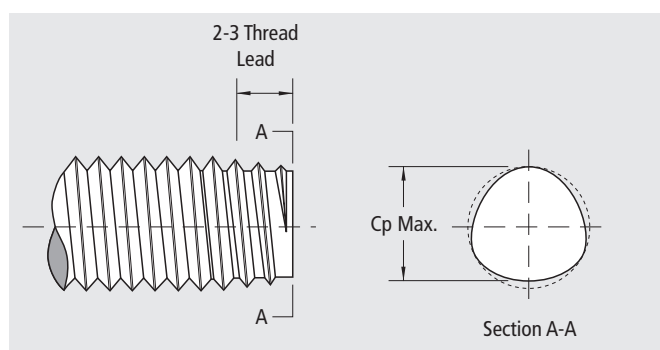
TAPTITE II®



TAPTITE II® screw is the most popular in the TRILOBULAR® family of self-threading screws. TAPTITE II® screws create a high performance nut into drilled, punched or extruded holes in steel and light alloys.

1. Technical features of TAPTITE II® screws.

- **TRILOBULAR® thread section.**
- **60° thread angle and machine thread configuration.** The nut created in the base material has the standard machine thread tolerance.
- **Progressive point** that reduces threading torque. TAPTITE II® thread has 2-3 thread leads that improve screw insertion and threading.



TAPTITE II® Hardness

Core	Surface
286-372 HV	446 HV

- **Case hardening, quenching and tempering** heat treatment in agreement with TAPTITE® manufacturing standards. Depending on the requirements of the screw, alternative heat treatments can be applied.
- In the last stage of the manufacturing process, a special **lubricant** is applied to make thread forming easier.

Due to the hardness of the screw, when electrolytic coatings are considered, it is necessary to apply baking treatment to avoid hydrogen embrittlement (page 106).

2. Advantages of TAPTITE II® screw.

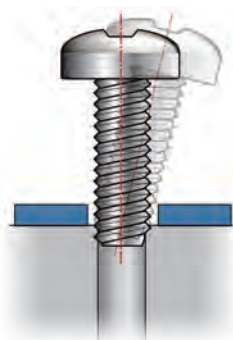


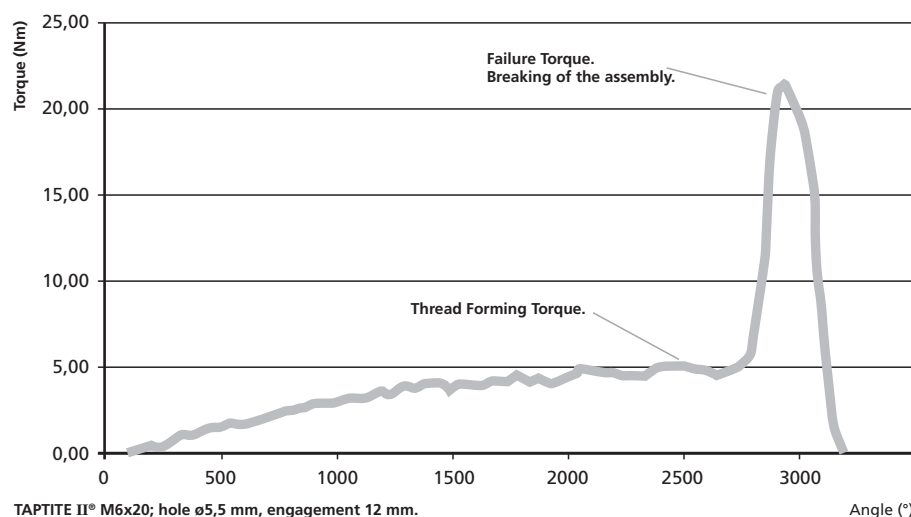
Fig.35. Thread leads facilitate axial alignment in the hole and threading.

- **Low threading torque**, even in deep holes, ensuring ergonomic assembly.
- **Axial alignment** of screw.
- High **Failure Torque Resistance**.
- High **pull-out Resistance**.
- High **Prevailing Torque**, which exceeds the level offered by machine screws with locking nuts.
- Excellent **vibration loosening resistance**, eliminating the need for complementary assembly systems.
- The nut created is compatible with machine screws.

Screws for metal

3. Threading curve of TAPTITE II® screw.

The graph shows the typical thread curve of a TAPTITE II® screw on aluminum sheet. The TRILOBULAR® shape offers a safe assembly torque range due to the wide margin between the low threading torque and high failure torque.



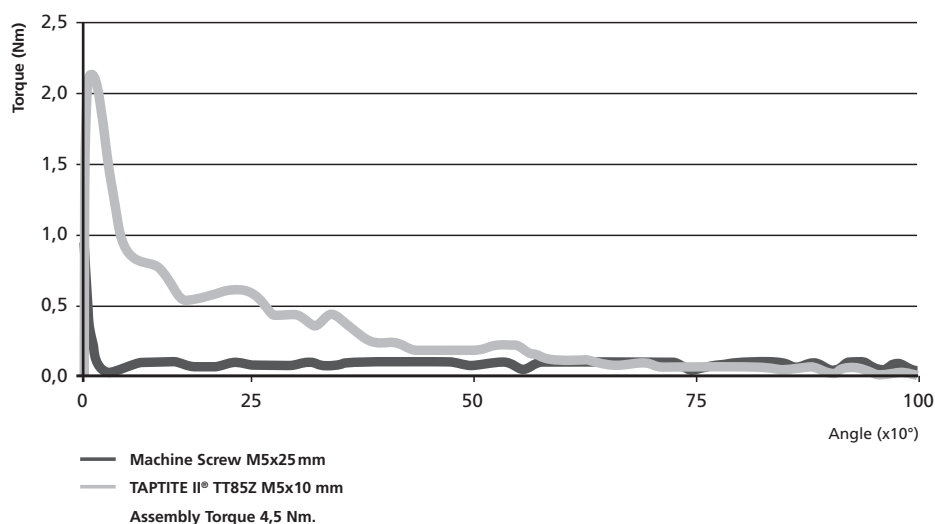
The following graph shows the loosening resistance of TAPTITE II® M5x10 screw compared with a machine screw M5x25. TAPTITE II® needs higher breakaway torque (2,15 Nm) than machine screw (1 Nm).

TAPTITE II®

Minimum Breaking Torque

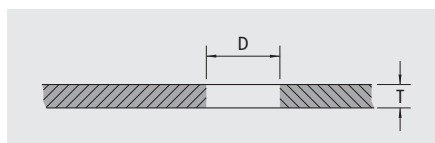
d	Torque (Nm)
M2	0,6
M2,5	1,2
M3	2,2
M3,5	3,4
M4	5,0
M5	10,0
M6	17
M8	41

The assembly torque shouldn't be higher than 70% of the minimum breaking torque indicated.



Screws for metal

4. Recommended hole diameter for TAPTITE II® screws on steel metal sheet.



This data is intended for guidance purposes. We advise doing tests beforehand with the recommended dimensions.

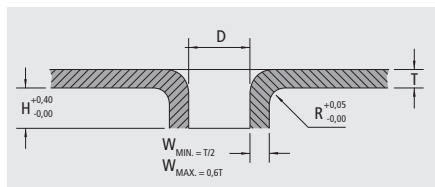
Screw diameter	Plate thickness T (mm)	Hole size D (mm)
M2,5x0,45	1,5-2,1	2,30
	2,1-2,7	2,31
	2,7-3,5	2,32
M3x0,50	1,7-2,7	2,77
	2,7-3,3	2,79
	3,3-4,0	2,80
M3,5x0,60	2,0-2,9	3,23
	2,9-3,8	3,25
	3,8-4,5	3,27
M4x0,70	2,4-3,3	3,68
	3,3-4,4	3,70
	4,4-5,5	3,73
M5x0,80	2,9-4,4	4,64
	4,4-5,9	4,66
	5,9-7,1	4,69
M6x1,00	3,6-4,9	5,55
	4,9-6,9	5,58
	6,9-8,1	5,61
M8x1,25	4,6-6,9	7,43
	6,9-8,9	7,47
	8,9-10,9	7,51

For other dimensions, please contact our technical department

5. Recommended extruded hole diameter for TAPTITE II® screws.

We recommend using FASTITE® 2000™ screws or extruded holes for assemblies in thin metal sheet. Extruded holes nearly double the length of thread engagement over original material thickness.

Table 1. Hole diameter on metal sheet with extruded holes.

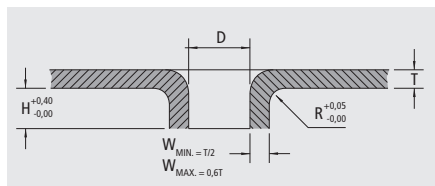


Screw diameter	Plate thickness T				
	0,50-0,69	0,70-0,99	1,00-1,49	1,50-2,49	2,50-3,00
M2,5x0,45	2,22	2,24	2,27	–	–
M3x0,50	2,70	2,72	2,76	2,82	–
M3,5x0,60	3,13	3,15	3,20	3,25	3,28
M4x0,70	3,55	3,57	3,60	3,64	3,68
M4,5x0,75	–	4,03	4,06	4,10	4,14
M5x0,80	–	4,48	4,51	4,53	4,56
M6x1,00	–	–	5,38	5,42	5,46
M8x1,25	–	–	–	7,25	7,30

Measurements expressed in mm.

Screws for metal

Table 2. Height and radius of extruded holes on metal sheet from a given hole diameter.

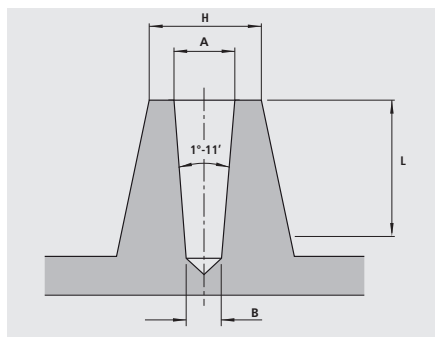


Hole diameter D	Plate thickness T											
	0,50-0,90		0,91-1,35		1,36-1,99		2,00-2,39		2,40-2,75		2,76-3,00	
	H	R	H	R	H	R	H	R	H	R	H	R
2,06-2,54	1,00	0,13	1,00	0,13	1,00	0,15	1,10	0,25	–	–	–	–
2,57-3,30	1,20	0,13	1,20	0,13	1,20	0,15	1,30	0,25	1,40	0,25	–	–
3,33-3,81	1,30	0,13	1,30	0,13	1,30	0,15	1,50	0,25	1,60	0,25	1,80	0,33
3,84-4,57	–	–	1,50	0,13	1,55	0,15	1,80	0,25	1,90	0,25	2,20	0,33
5,60-5,59	–	–	1,80	0,13	1,80	0,15	2,30	0,25	2,40	0,25	2,60	0,33
5,61-6,60	–	–	–	–	1,90	0,15	2,50	0,25	2,70	0,25	3,05	0,33
6,63-7,62	–	–	–	–	2,10	0,15	2,95	0,25	3,20	0,25	3,60	0,33

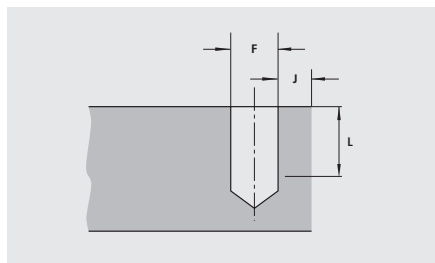
Measurements expressed in mm. The values shown in the table are to be used as a reference. Customer must conduct its own testing to prove suitability. The size of the extrusion can vary depending on the material used and tool design.

Example: Assembly on metal sheet of 0,6 mm thickness with M3 screw. Following the recommendations from Table 1, we should make 2,7 mm hole diameter, and as shown in Table 2, flange height (H) would be 1,2 mm and radius (R) 0,13 mm.

6. Recommended hole diameter for TAPTITE II® screws in light alloys die casting.



Injected hole.



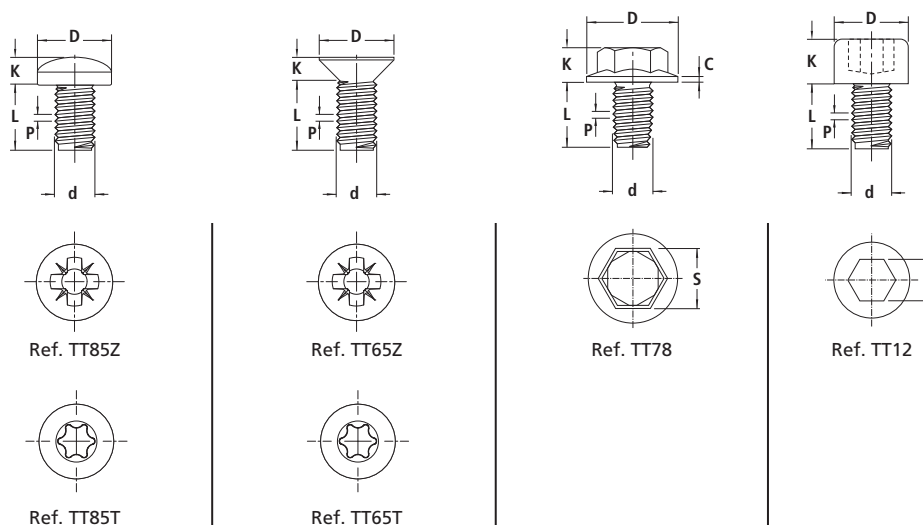
Drilled hole.

Screw diameter	Injected hole					Drilled hole		L Recommended
	Max.	A Min.	Max.	B Min.	H Min.	F	J Min.	
M2x0,40	1,91	1,83	1,81	1,73	3,32	1,81	1,00	4,00
M2,5x0,45	2,39	2,31	2,28	2,20	4,15	2,28	1,20	5,00
M3x0,50	2,90	2,82	2,76	2,68	4,98	2,76	1,30	6,00
M4x0,70	3,82	3,74	3,64	3,56	6,64	3,64	1,80	8,00
M5x0,80	4,80	4,72	4,58	4,50	8,30	4,58	2,10	10,00
M6x1,00	5,74	5,66	5,48	5,40	9,96	5,48	2,60	12,00
M8x1,25	7,69	7,61	7,35	7,27	13,28	7,35	3,30	16,00

Measurements expressed in mm. The values in the table should be used as a reference. Customer must conduct its own testing to prove suitability

Screws for metal

7. Technical data of TAPTITE II® screws.



Nominal diameter d	P Pitch	Progressive point	D Max.	K Max.	Torx®	Pozi	D Max.	K Ref.	Torx®	Pozi	D Max.	K Max.	C	S	D	K	S
M2	0,4	1,00	4,0	1,6	T6*	Z1	3,8	1,2	T6*	Z1	-	-	-	-	-	-	-
M2,5	0,45	1,13	5,0	2,0	T8	Z1	4,7	1,5	T8	Z1	-	-	-	-	-	-	-
M3	0,5	1,25	6,0	2,4	T10	Z1	5,6	1,65	T10	Z1	-	-	-	-	-	-	-
M3,5	0,6	1,50	7,0	2,7	T15	Z2	6,5	1,93	T15	Z2	-	-	-	-	-	-	-
M4	0,7	1,75	8,0	3,1	T20	Z2	7,5	2,2	T20	Z2	9,0	3,5	0,72	7,0	7,0	4,0	3,0
M5	0,8	2,00	10,0	3,8	T25	Z2	9,2	2,5	T25	Z2	11,0	4,5	0,82	8,0	8,5	5,0	4,0
M6	1	2,50	12,0	4,6	T30	Z3	11,0	3,0	T30	Z3	13,5	5,3	1,02	10,0	10,0	6,0	5,0
M8	1,25	3,13	16,0	6,0	T40	Z3	-	-	-	-	17,0	7,0	1,12	13,0	-	-	-

* We recommend  recess. Dimensions in mm. The values shown are nominal. For tolerances and other data, contact our technical department.

8. Applications of TAPTITE II® screws.

Cost saving and improvement of mechanical properties in:

- Assemblies on steel parts with drilled, punched or extruded holes.
- Assemblies subjected to vibrations and severe temperatures.
- Assemblies with free of chips contamination requirement.

Examples

Automotive components
Electric material
Electronics
Household appliances
Locks

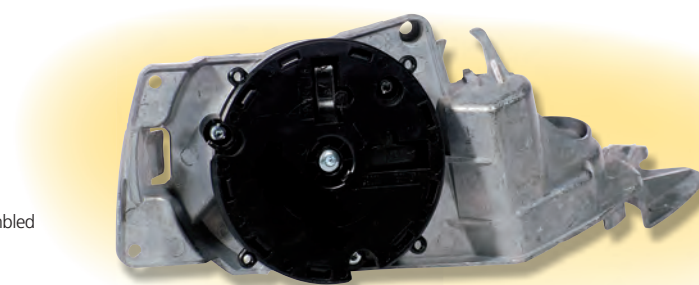
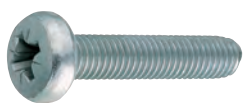


Fig.36. Rear-view mirror motor, assembled with TAPTITE II® screws.

Screws for metal

TT 85 Z

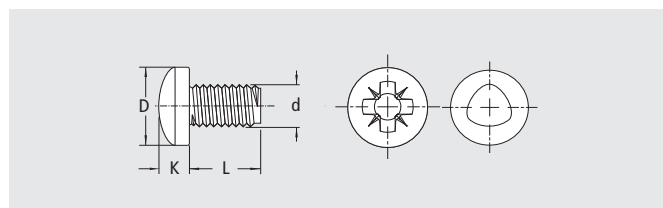


TAPTITE II®

- Pan Head POZI



Packaged in bags.



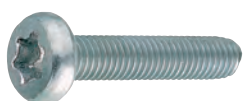
Zinc plated Cr (III) + lubricated + baking

d mm	M2	M2,5	M3	(M3,5)	M4	M5	M6
D mm	4,0	5,0	6,0	7,0	8,0	10,0	12,0
K mm	1,6	2,0	2,4	2,7	3,1	3,8	4,6
	Z1	Z1	Z1	Z2	Z2	Z2	Z3

L mm	Ø2	Ø2,5	Ø3	Ø3,5	Ø4	Ø5	Ø6
5	○	○	○	○	○	—	—
6	○	○	●	○	●	○	—
7	○	○	○	○	○	○	—
8	○	○	●	○	●	●	○
10	○	○	●	○	●	●	○
12	—	○	●	●	●	●	○
16	—	—	●	○	●	●	○
18	—	—	○	○	●	○	○
20	—	—	○	○	●*	○	○
25	—	—	—	○	○	●*	○
30	—	—	—	—	○	○	○
35	—	—	—	—	○	○	○
40	—	—	—	—	○	○	○
50	—	—	—	—	—	—	○

● Product available in stock. ○ Product available upon request. * Available until end of stock.

TT 85 T

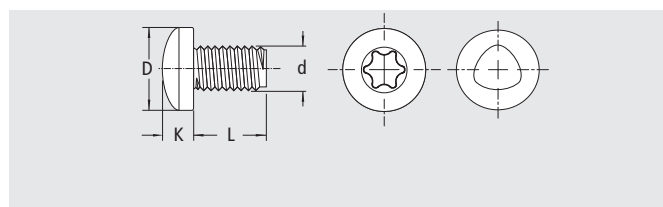


TAPTITE II®

- Pan Head TORX®



Packaged in bags.



Zinc plated Cr (III) + lubricated + baking

d mm	M2	M2,5	M3	(M3,5)	M4	M5	M6	M8
D mm	4,0	5,0	6,0	7,0	8,0	10,0	12,0	16,0
K mm	1,6	2,0	2,4	2,7	3,1	3,8	4,6	6,0
	T6	T8	T10	T15	T20	T25	T30	T40

L mm	Ø2	Ø2,5	Ø3	Ø3,5	Ø4	Ø5	Ø6	Ø8
5	●*	○	○	○	○	—	—	—
6	○	○	●	○	●	—	—	—
7	○	○	●*	○	○	○	—	—
8	○	○	●	○	●	○	○	—
10	○	○	●	○	●	●	●	—
12	—	○	●	○	●	○	●	—
16	—	—	●	○	●	○	●	—
18	—	—	○	○	○	○	○	—
20	—	—	○	○	●	○	●	—
25	—	—	—	○	●	○	●	—
30	—	—	—	—	○	○	○	○
35	—	—	—	—	○	○	○	○
40	—	—	—	—	○	○	○	○
50	—	—	—	—	—	—	○	○

1 TORX® ● Product available in stock. ○ Product available upon request. * Available until end of stock.

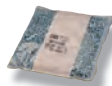
Screws for metal

TT 65 Z

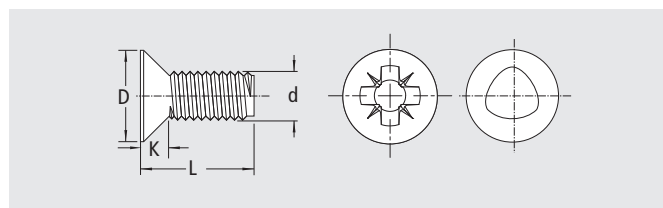


TAPTITE II®

- Countersunk Head POZI



Packaged in bags.



Zinc plated Cr (III) + lubricated + baking

d mm	M2	M2,5	M3	(M3,5)	M4	M5	M6
D mm	3,8	4,7	5,6	6,5	7,5	9,2	11,0
K mm	1,2	1,5	1,65	1,93	2,2	2,5	3,0
	Z1	Z1	Z1	Z2	Z2	Z2	Z3

L mm	Ø2	Ø2,5	Ø3	Ø3,5	Ø4	Ø5	Ø6
5	○	○	○	—	—	—	—
6	○	○	○	○	○	—	—
7	○	○	○	○	○	○	—
8	○	○	●	○	●	○	○
10	○	○	●*	○	●	○	○
12	—	○	○	○	●	○	○
16	—	—	○	○	●	○	○
18	—	—	○	○	○	○	○
20	—	—	○	○	○	○	○
25	—	—	—	○	○	○	○
30	—	—	—	—	○	○	○
35	—	—	—	—	○	○	○
40	—	—	—	—	○	○	○
50	—	—	—	—	—	—	○

● Product available in stock. ○ Product available upon request. * Available until end of stock.

TT 65 T

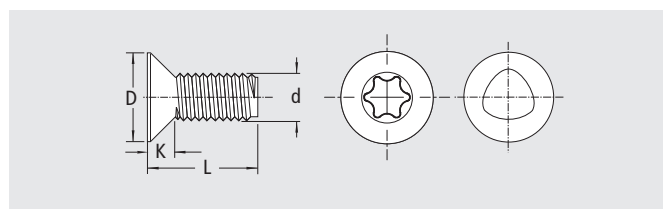


TAPTITE II®

- Countersunk Head TORX®



Packaged in bags.



Zinc plated Cr (III) + lubricated + baking

d mm	M2	M2,5	M3	(M3,5)	M4	M5	M6
D mm	3,8	4,7	5,6	6,5	7,5	9,2	11,0
K mm	1,2	1,5	1,65	1,93	2,2	2,5	3,0
	T6 ¹	T10	T10	T15	T20	T25	T30

L mm	Ø2	Ø2,5	Ø3	Ø3,5	Ø4	Ø5	Ø6
5	○	○	○	○	○	—	—
6	○	○	●	○	○	—	—
7	○	○	○	○	○	○	—
8	○	○	●	○	○	○	—
10	○	○	○	○	●	○	●
12	—	○	●	○	○	○	○
16	—	—	○	○	○	○	●
18	—	—	○	○	○	○	○
20	—	—	○	○	○	○	○
25	—	—	—	○	○	○	○
30	—	—	—	—	○	○	○
35	—	—	—	—	○	○	○
40	—	—	—	—	○	○	○

¹ TORXplus® ● Product available in stock. ○ Product available upon request. * Available until end of stock.

Screws for metal

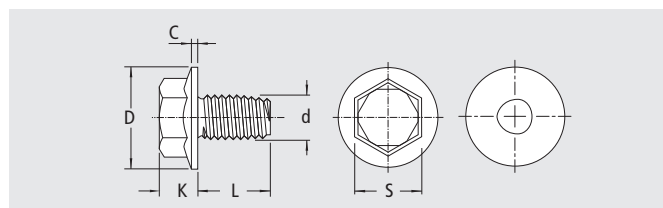
TT 78



- **Hex Head + Flange**



Packaged in bags.



Zinc plated Cr (III) + lubricated + baking

d mm	M4	M5	M6	M8
D mm	9,0	11,0	13,5	17,0
K mm	3,5	4,5	5,3	7,0
C mm	0,72	0,82	1,02	1,12
S mm	7,0	8,0	10,0	13,0

L mm	Ø4	Ø5	Ø6	Ø8
6	○	○	—	—
7	○	○	—	—
8	●	○	○	—
10	●	●	○	—
12	●*	●	●	—
16	●	○	●	—
18	○	○	○	—
20	○	○	○	—
25	○	○	○	—
30	○	○	○	○

● Product available in stock. ○ Product available upon request. * Available until end of stock.

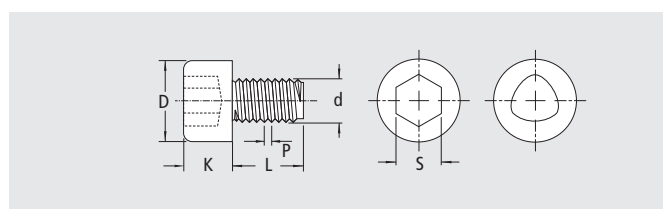
TT 12



- **Cylindrical socket head**



Packaged in bags.



ZINC PLATED + LUBRIFIED

d mm	M4	M5	M6
D mm	7,0	8,5	10,0
K mm	4,0	5,0	6,0
S mm	3,0	4,0	5,0

L mm	Ø4	Ø5	Ø6
8	○	○	○
10	○	●	○
12	○	○	○
16	○	○	○
18	○	○	○
20	○	○	●
22	○	○	○
25	○	○	○
30	○	○	○
35	○	○	○
40	○	○	○

● Product available in stock. ○ Product available upon request.

Screws for metal

TT 22 T

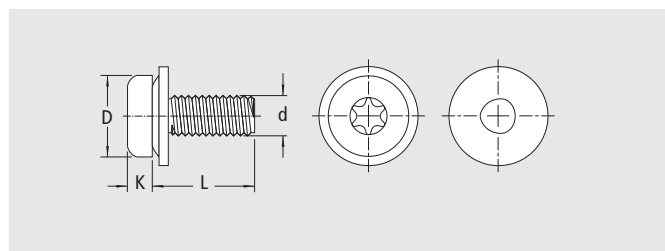


TAPTITE II®

- Pan head **TORX®** with conical washer



Packaged in bags.



Zinc plated Cr (III) + lubricated + baking

d mm	3,0	4,0	5,0
D mm	6,0	8,0	10,0
K mm	2,4	3,1	3,8
	T10	T25	T25

L mm	M3	M4	M5
8	●	○	–
10	○	○	–
12	○	○	○

● Product available in stock. ○ Product available upon request.



For further information on washer dimension, please, contact our sales department.

The conic washer offers the following advantages:

- **Increases the elasticity** of the assembly in applications subjected to **axial loads**.
- Prevents damage on the PCB during assembly.

Screws for metal

TAPTITE 2000®

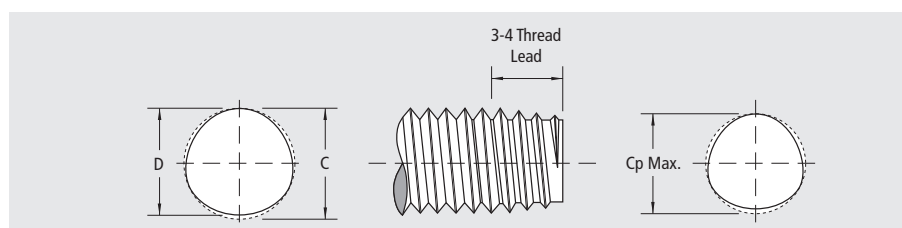


TAPTITE 2000® screws offer all the benefits of TAPTITE II® screws with an innovative Radius Profile™ thread and improved TRILOBULAR® thread, which improves the thread forming process and strengthens the assembly, increasing the vibration loosening resistance.

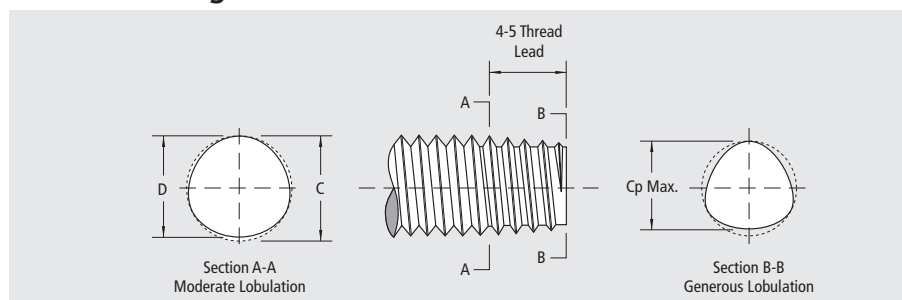
TAPTITE 2000® thread screws provide many opportunities to **reduce assembly costs** and offer excellent mechanical and assembly properties.

1. Technical features of TAPTITE 2000® thread.

For M5 and smaller



For M6 and larger



- **Reduced TRILOBULAR® thread**

TAPTITE 2000® thread section is **less TRILOBULAR®** than the TAPTITE II®, creating more surface contact between the screw and the nut member.

Double TRILOBULAR® thread design for **M6 and larger screws**:

The thread leads (Section B-B) have generous lobulation, which reduces friction during thread forming, providing a **more ergonomic assembly**.

The shank of the screw (Sección A-A) has moderate lobulation, which increases surface contact between the screw and nut member, **improving pull-out and vibration loosening resistance**.

- **Radius Profile™ thread**

It ensures the maximum surface contact between the screw and nut member, resulting in higher vibration loosening resistance.

- **Progressive point that reduces initial threading torque**

The thread leads enhance the screw insertion, resulting in low axial end load to initiate thread forming.

- **Machine thread configuration**

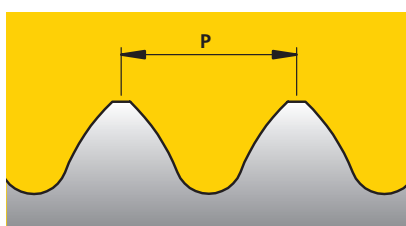


Fig.37. The Radius Profile™ thread increases surface contact between screw and nut member.

2. Advantages of TAPTITE 2000® screws.

- **Excellent Axial Alignment:**
 - Ergonomic insertion.
 - Low axial end load to initiate thread forming.
 - Ideal for automatic assembly.
- It allows a higher assembly torque, transmitting **higher clamping** to the assembly.
- High prevailing torque.
- High Strip-to-Drive ratio.
- Excellent **vibration loosening resistance**.

Double TRILOBULAR® thread for M6 and larger:

- **Reduces thread forming torque**, providing a more ergonomic assembly. For the same diameter, thread forming torque of TAPTITE 2000® is approximately 10%* lower than TAPTITE II®.
- **Improves pull-out resistance**.

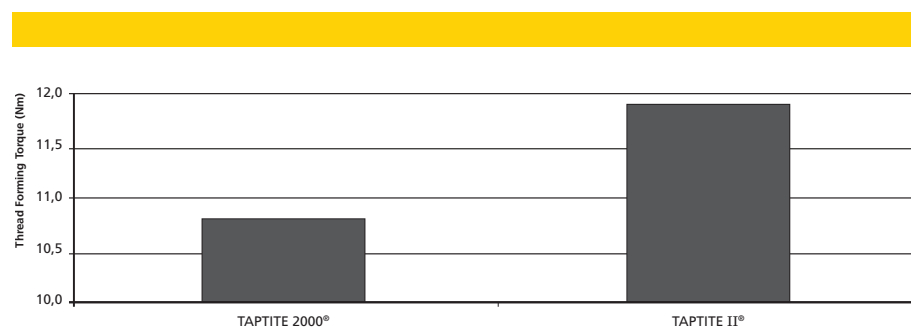
* Depending on the diameter of the screw.

3. Advantages of TAPTITE 2000® thread with respect to TAPTITE II®.

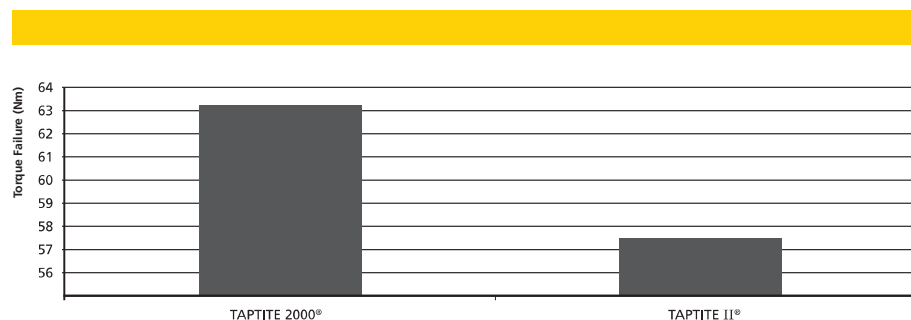
TAPTITE 2000® screw:

- provides for a **higher compression** applying the same assembly torque, while **optimizing mechanical properties** of the assembly.
- **improves ergonomics** as it displaces less material during threading process.

Tests done with TAPTITE 2000® and TAPTITE II® screws, M8x1,25.



The geometry of TAPTITE 2000® thread reduces threading torque by 9,25% in comparison with TAPTITE II® screw.

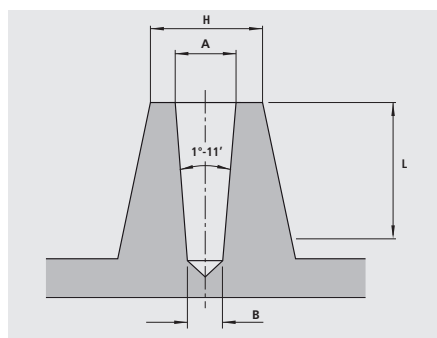


The geometry of TAPTITE 2000® thread increases torque failure by 10% in comparison with TAPTITE II® screw.

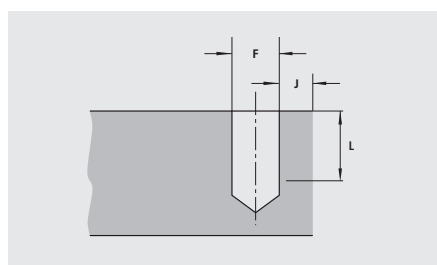
Screws for metal

4. Recommended hole diameter for TAPTITE 2000® screws.

For assemblies in metal sheet, please refer to the information given in TAPTITE II® screws section, page 49.



Injected hole



Drilled hole

Screw diameter	Injected hole					Drilled hole		L Recommended
	Max.	A Min.	Max.	B Min.	H Min.	F	J Min.	
M2x0,40	1,91	1,83	1,81	1,73	3,32	1,82	1,00	4,00
M2,5x0,45	2,39	2,31	2,28	2,20	4,15	2,29	1,20	5,00
M3x0,50	2,90	2,82	2,76	2,68	4,98	2,77	1,30	6,00
M4x0,70	3,82	3,74	3,64	3,56	6,64	3,68	1,80	8,00
M5x0,80	4,80	4,72	4,58	4,50	8,30	4,64	2,10	10,00
M6x1,00	5,74	5,66	5,48	5,40	9,96	5,54	2,60	12,00
M8x1,25	7,69	7,61	7,35	7,27	13,28	7,43	3,30	16,00

Measurements expressed in mm. The values in the table should be used as a reference. Customer must conduct its own testing to prove suitability.

5. Applications of TAPTITE 2000® screws.

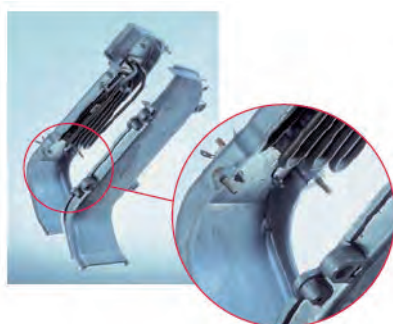


Fig.38. Washing machine heater assembled with TAPTITE 2000® screws.

TAPTITE 2000® screws have been specially designed for assemblies in steel and light alloys:

- Components that require a low threading torque.
- Structural components that need a high pull-out resistance.
- Components that require a high tightness level.

Examples

Automotive components
Electric material
Household appliances
Electronics

This is a custom-made product. Please, contact our sales department for further information.

Screws for metal

CORFLEX®-'N' heat treatment

TAPTITE 2000® CORFLEX®-'N' screws have neutral heat treatment that provides higher durability to screws, improving bending and heavy load cycles resistance. It has been specially designed for high demanding requirements assemblies in aluminum and light alloy.

Advantages

- Excellent resistance to alternating loads.
- Allows deep thread engagements.
- Can be adapted to specific hardness or toughness requirements.

Applications

CORFLEX®-'N' heat treatment treated screws can only be used in applications with **ALUMINUM** and **LIGHT ALLOYS, NEVER USED IN STEEL**.

CORFLEX®-'N' heat treatment is recommended for applications exposed to:

- Shear stress
- Corrosion
- Vibrations
- Alternating loads
- Severe temperature cycles

All TRILOBULAR® screws produced at CELO can be treated with CORFLEX®-'N' upon request.

NT85T family product combines the features of TAPTITE® 2000 with CORFLEX®-'N' heat treatment.

TAPTITE 2000® CORFLEX® N'Hardness

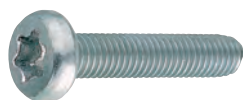
Core	Surface
327-382 HV	336 HV



Fig.39. Washing machine heater assembled with TAPTITE 2000® screws.

Screws for metal

NT 85 T CORFLEX®-'N'

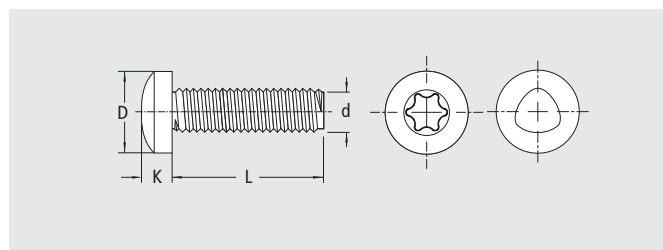


TAPTITE 2000®

- Pan Head **TORX®**



Packaged in bags.



Zinc plated Cr (III) + lubrifed + baking

d mm	M2	M2,5	M3	(M3,5)	M4	M5	M6
D mm	4,0	5,0	6,0	7,0	8,0	10,0	12,0
K mm	1,6	2,0	2,4	2,7	3,1	3,8	4,6
	T6 ¹	T8	T10	T15	T20	T25	T30

L mm	Ø2	Ø2,5	Ø3	Ø3,5	Ø4	Ø5	Ø6
5	○	○	○	○	○	—	—
6	○	○	●	○	○	○	—
7	○	○	○	○	○	○	—
8	○	○	●	○	●	○	○
10	○	○	○	○	●	●	○
12	—	○	●	○	●	●	●
16	—	—	●	○	●	○	○
18	—	—	○	○	○	○	○
20	—	—	○	○	○	○	●
25	—	—	—	○	○	○	○
30	—	—	—	—	○	○	○
35	—	—	—	—	○	○	○
40	—	—	—	—	○	○	○
50	—	—	—	—	—	—	○

1 **TORXplus** ● Product available in stock. ○ Product available upon request.

Screws for metal

TAPTITE 2000® "CA"



TAPTITE 2000® "CA" screws have a modification in the point design to improve performance in assemblies when clearance holes and pilot holes are not aligned.

1. Advantages of TAPTITE 2000® "CA" screw.

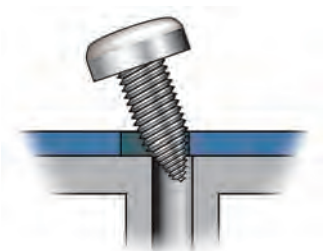


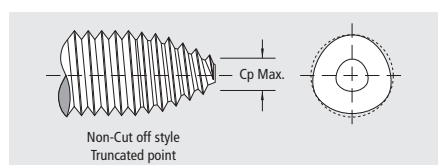
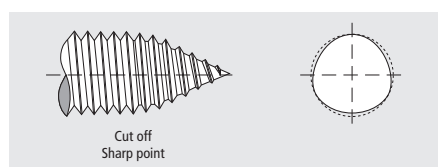
Fig.40. TAPTITE® "CA" screws allows for alignment in misaligned holes.

Additionally to the advantages offered by TAPTITE 2000® screws, TAPTITE 2000® "CA" screws have a gimlet point especially designed to:

- The perfect **alignment of the screw** in applications when clearance and pilot holes do not align and rapid hole finding is essential.
- Provides the assembly with more ergonomics by **lowering the initial threading torque**.

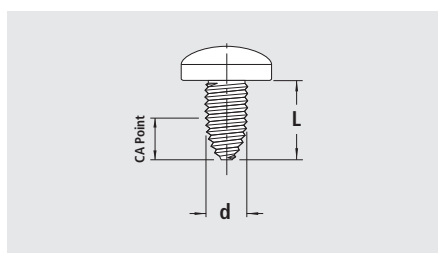
The **"CA" point** can be fitted with a sharp point (known as *cut off*) or with a truncated blunt point (*non-cut off*).

The **cut off point** is recommended for applications in which it is necessary to pierce into the material without making a pilot hole.



The **non-cut off point** is recommended for applications in which a sharp point could be a potential hazard to other assembly components, cables, assembly lines or for personnel safety.

2. Technical data of TAPTITE 2000® "CA" screws.



d	Pitch	"CA" point
M2,5	0,45	2,48
M3	0,5	2,75
M3,5	0,6	3,30
M4	0,7	3,85
M5	0,8	4,40
M6	1	5,50
M8	1,25	6,88

Dimensions in mm.

3. Applications of TAPTITE 2000® "CA" screws.

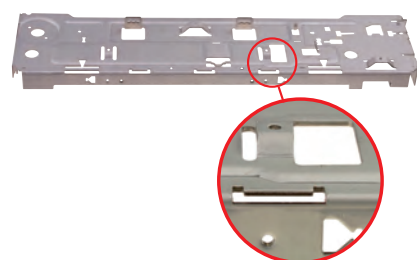


Fig.41. During the production of sheets with many holes and folds, small-sized variations can cause misalignment of the holes.

TAPTITE® "CA" screws are recommended for:

- Assemblies where the clearance and pilot holes are not aligned.
- Difficult access applications and deep holes.
- Assemblies where it is required to pierce material without making a pilot hole (*Cut Off point*).

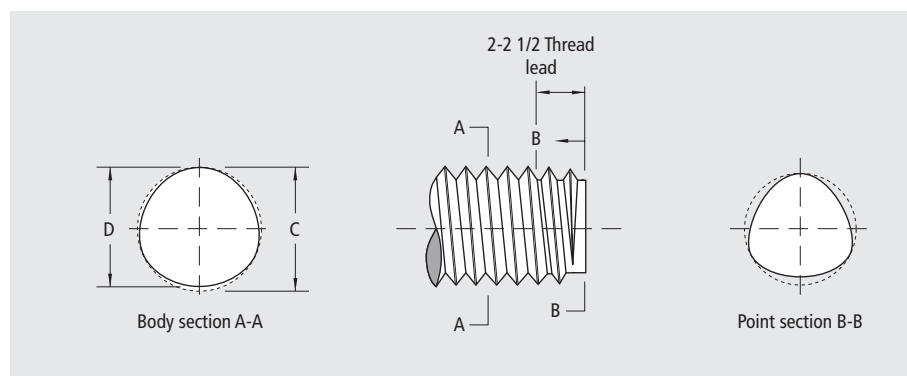
This is a custom-made product. Please, contact our sales department for further information.

Screws for metal

TAPTITE 2000® "SP"™



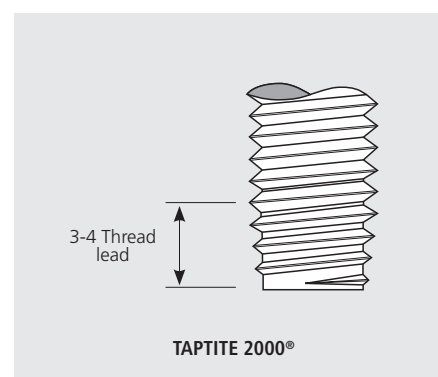
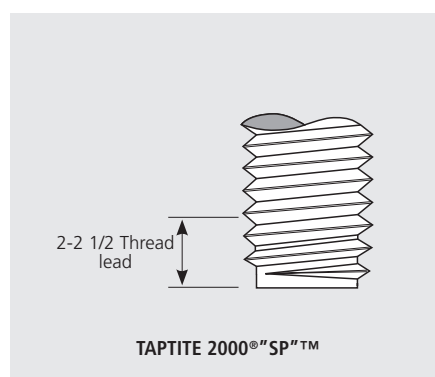
TAPTITE 2000® "SP"™ screws have shorter point than standard TAPTITE 2000® screws to maximize the full thread engagement in shallow blind holes or short length of engagement assemblies.



Shorter point in **TAPTITE 2000® "SP"™** screws, from 2-2 1/2 thread lead, maximizes full thread engagement in shallow blind holes or assemblies with short length of engagement. In these cases, an increase in contact points of full thread engagement is critical. In most cases, the failure mode changes from stripping to breaking of the screw, which is the desired result in die casting parts.

Recommended hole dimensioning in light alloys die casting are the same as detailed in TAPTITE 2000® screws (page 58)

This is a custom-made product. Please, contact our sales department for further information.



Screws for metal

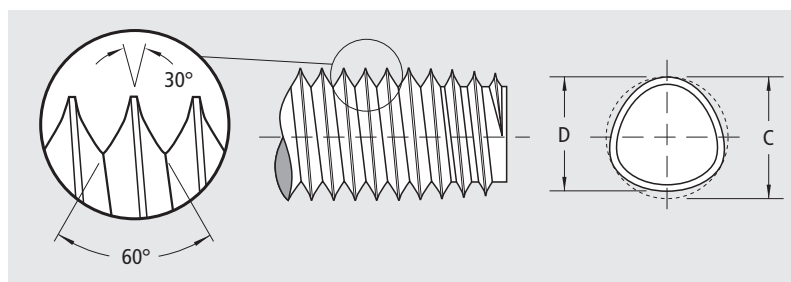
POWERLOK®



The TRILOBULAR® POWERLOK® thread was designed to provide **solutions to loosening problems in tapped holes**, especially in applications exposed to severe vibrations or cycles of expansion/contraction.

POWERLOK® thread is the only one with the **locking concept**: the thread design provides locking action over the entire length of the screw thread, independently of the base material and of the temperatures reached during assembly lifespan.

This is not a thread rolling screw, it is applied in tapped holes.



1. Technical features of POWERLOK® screw.

POWERLOK® Hardness

Core	Surface
327–382 HV	336 HV

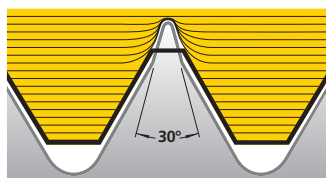


Fig.42. 30° thread interferes in the root of the nut thread, eliminating tolerance and locking the assembly.

- DUAL-ANGLE™ thread:
30° thread overlapped to the standard 60° thread interferes in the root of the nut thread, eliminating tolerance and providing “live-action” locking.
- TRILOBULAR® body:
 - **Reduces friction** during installation.
 - **Prevents vibrational loosening** by providing additional locking action.
- Neutral hardened in accordance to POWERLOK® manufacturing standards.
- POWERLOK® screws are lubricated to make the insertion process easier.
- Due to the hardness of the screw, it is necessary to apply baking treatment to avoid hydrogen embrittlement (page 106).

To ensure a correct performance of the screw, it should have higher hardness value than the nut member. We recommend to contact our technical department for the viability of POWERLOK® screws for each particular application.

2. Advantages of POWERLOK® screw.

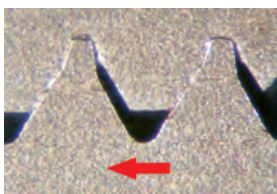


Fig.43. The spring effect of 30° thread crest maintains clamping.

- **Immediate and continuous locking action** over the entire length allowing for repeated insertions and removals without affecting its locking properties and independently of nut tolerance.
- **Excellent vibrational loosening**. It eliminates loosening problems in tapped holes and nuts without the use of additional locking elements (lock nuts, spring washers, adhesive patches, ...).
- The spring effect of 30° thread crest **maintains clamping**.
- **Cost reduction** by eliminating the need for additional locking elements.

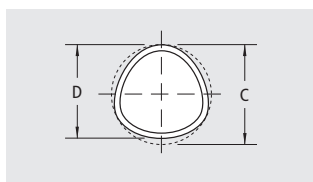
Screws for metal



Fig.44. The adhesive patch loses a large part of its locking properties and wears away when exposed to high temperatures. The screw cannot be reused and assembly costs are high.

- Meets **the standards of regulation IFI 524** concerning screws loosening resistance.
- Provides **high pull-out resistance** to the assembly.
- Locking action is not affected by temperature.
- Works with all finishes.

3. Technical data of POWERLOK® screws.



POWERLOK®	
Minimum breaking torque	
d	Torque (Nm)
M3	1,9
M4	4,4
M5	9,3
M6	16,0

The assembly torque **shouldn't be higher than 70%** of the minimum breaking torque indicated.

d	Pitch	C	D
M3	0,5	3,18	3,08
M3,5	0,6	3,69	3,57
M4	0,7	4,22	4,08
M5	0,8	5,26	5,10
M6	1	6,30	6,10

Dimensions in mm. The values shown are nominal. For tolerances and other data, contact our technical department.

4. Applications of POWERLOK® screws.

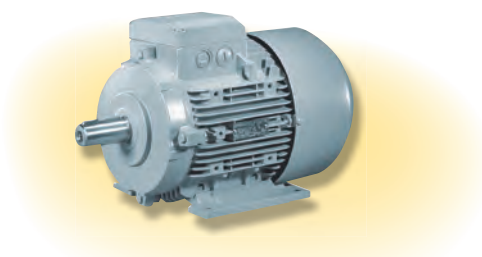
Assembly of components under severe vibration conditions or cycles of expansion/contraction in tapped holes.

Cost reduction and better performance eliminating the use of adhesive patches for metric screws and locking nuts.

Examples

Automotive
Household appliances
Motors

This is a custom-made product. Please, contact our sales department for further information.



Screws for metal

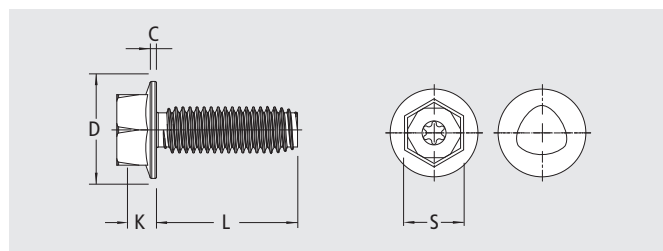
PL 78 T



- Hexagonal Flange **TORX®**



Packaged in bags.



Zinc plated 10 μ Cr (III) + sealant+ lubricated + baking

d mm	M5	M6
D mm	11	13,5
K mm	4,5	5,3
C mm	0,82	1,02
S mm	8	10
	T20	T25

L mm	Ø5	Ø6
16	○	●
20	●	●

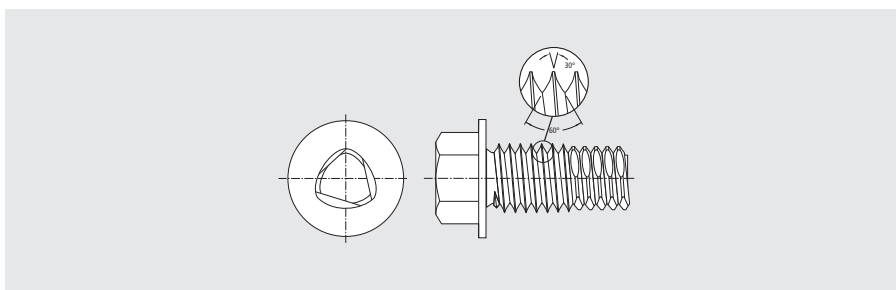
● Product available in stock. ○ Product available upon request.

KLEERLOK® thread



Occasionally, tapped holes are contaminated by paint, welding or enamel, which makes installation of the screw more difficult.

KLEERLOK® screws combine POWERLOK® thread with a special point designed to scrap material.



The special point design of **KLEERLOK®** screws helps POWERLOK® thread to carefully **clean the contaminated holes**, keeping acceptable ergonomic threading torque values.

Applications of **KLEERLOK®** screws:

Fry pans, anodized aluminum parts, storage shelves (painted frames)...

This is a custom-made product. Please, contact our sales department for further information.



Screws for metal

REMFORM® 'F'



REMFORM® 'F' thread employs the REMFORM® thread design, but with a smaller thread pitch. Additionally to the assembly of hard plastic (page 25), it's specifically designed for the assembly of **aluminum**, **magnesium** and other low ductility materials.

1. Advantages of REMFORM® 'F' thread.

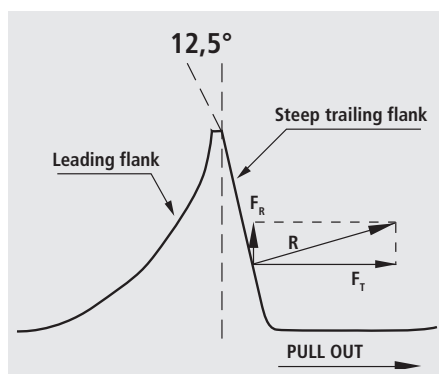


Fig.45. Asymmetrical thread form of the REMFORM® 'F' screw. The pressure flank minimizes radial stress F_R during thread forming and optimises pull-out resistance.

In addition to the advantages provided by REMFORM® thread, REMFORM® 'F' thread provides:

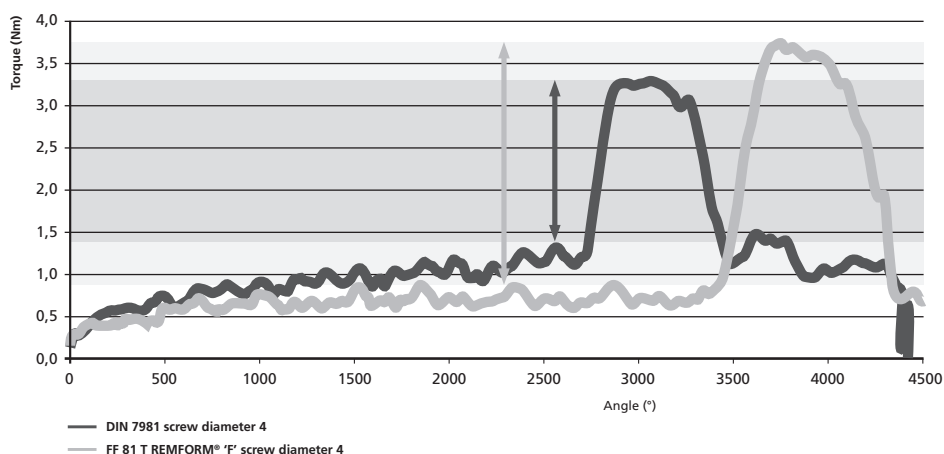
- **Less radial deformation of the plastic.** The narrow 12,5° angle of REMFORM® screw pressure flank reduces radial force during thread forming on low ductility materials.
- **Low thread forming torque values**, therefore more ergonomic assembly.
- **Strong pull-out** and stripping resistance of the assembly.
- **Shorter engagement depth**, allowing for fixing in shallow holes and ensuring a greater clamping transmission and pull-out resistance.

2. Threading curve of REMFORM® 'F' screw.

REMFORM® 'F'

Minimum breaking torque	
d (mm)	Torque (Nm)
2,5	0,92
3,0	1,56
3,5	2,45
4,0	3,51
5,0	6,97
6,0	12,6
8,0	31,8

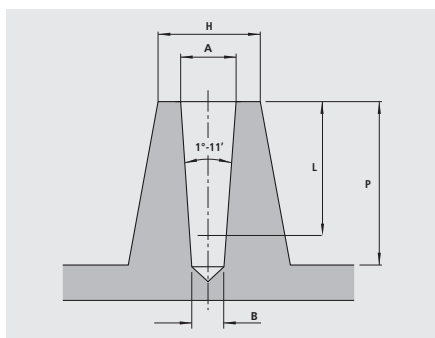
The assembly torque **shouldn't be higher than 70%** of the minimum breaking torque indicated.



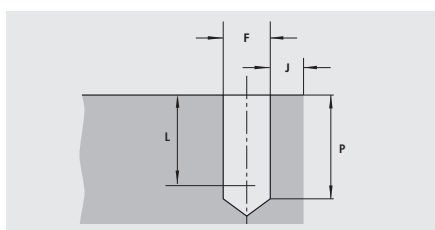
Threading curve of REMFORM® 'F' screw FF81T and DIN 7981 on extruded aluminum open hole. **REMFORM® 'F' screw provides a higher safe assembly torque range** than DIN 7981 screw.

Screws for metal

3. Recommended hole diameter for REMFORM® 'F' screws.



Injected hole



Drilled hole

d= nominal diameter of screw

For assemblies in magnesium, please use the recommendations indicated in the following table.

Assemblies in magnesium

d	Ø Hole								L Recommended
	Ø Injected hole					Ø Drilled hole			
	A Max.	Min.	B Max.	Min.	H Min.	F Max.	Min.	J Min.	
2,0	1,94	1,86	1,83	1,75	3,30	1,89	1,81	1,40	5,00
2,5	2,39	2,31	2,26	2,18	4,20	2,32	2,24	1,80	6,25
3,0	2,84	2,76	2,68	2,60	5,00	2,76	2,68	2,20	7,50
3,5	3,27	3,19	3,09	3,01	5,80	3,18	3,10	2,50	8,75
4,0	3,69	3,61	3,49	3,41	6,60	3,59	3,51	2,90	10,00
5,0	4,67	4,59	4,41	4,33	8,30	4,54	4,46	3,60	12,50
6,0	5,58	5,50	5,27	5,19	10,00	5,42	5,34	4,20	15,00
7,0	6,56	6,48	6,20	6,12	11,65	6,38	6,30	4,90	17,50
8,0	7,50	7,40	7,10	7,00	13,30	7,20	7,10	5,30	20

Dimensions in mm. This data is intended for guidance purposes. Customer must conduct its own testing to prove suitability.

For assemblies in aluminum, please use the recommendations indicated in the following table.

Assemblies in aluminum

d	Tolerance Ø	Open hole 60°		Open hole 90°		Open hole in U	
		Ø mm	L mm	Ø mm	L mm	Ø mm	L mm
2,5	±0,04	2,3	3-5	2,3	3-5	2,2	3-5
3	±0,04	2,75	4-6	2,75	4-6	2,65	4-6
3,5	±0,04	3,2	5-7	3,2	5-7	3,1	5-7
4	±0,05	3,65	6-8	3,6	6-8	3,55	6-8
5	±0,05	4,65	7-10	4,6	7-10	4,4	7-10
6	±0,07	5,55	9-12	5,5	9-12	5,3	9-12
8	±0,10	7,45	12-16	7,4	12-16	7,1	12-16

Dimensions in mm. This data is intended for guidance purposes. We advise doing tests beforehand with the recommended dimensions.

4. Applications of REMFORM® 'F' screws.



Fig.46. Magnesium piece with low deep bosses.

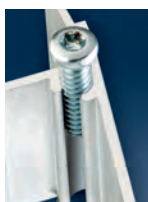


Fig.47. Extruded aluminum open hole piece.

REMFORM® 'F' screws are recommended for the assembly on:

- Magnesium parts with drilled, injected or punched holes
- Aluminum profiles with open holes.

Examples

Electronics
Automotive
Lighting

Screws for metal

FF 81 T

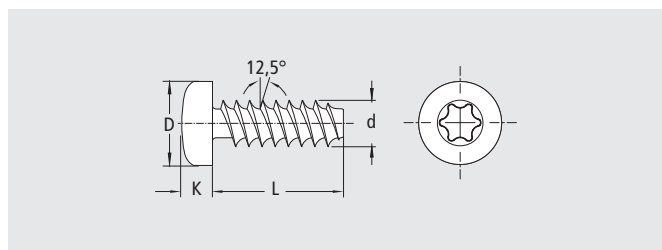


REMFORM® 'T'

- Pan Head **TORX®**



Packaged in bags.



Zinc Plated Cr (III) + Baked

d mm	3,0	3,5	4,0	5,0	6,0
D mm	5,6	6,9	7,5	9,5	10,8
K mm	2,2	2,6	2,8	3,55	3,95
	T10	T15	T20	T25	T30

L mm	Ø3	Ø3,5	Ø4	Ø5	Ø6
6	○	○	○	○	–
7	○	○	○	○	–
8	●	○	○	○	○
10	●	●	●	○	○
12	○	○	●	○	○
16	○	○	○	○	○
18	○	○	○	○	○
20	●	○	○	●	○
25	–	○	○	○	○
30	–	–	○	○	○
35	–	–	○	○	○
40	–	–	○	○	○
50	–	–	–	–	○

● Product available in stock. ○ Product available upon request.



***Screws for
thin metal
sheet***



Screws for thin metal sheet

FASTITE® 2000™



FASTITE® 2000™ thread rolling screws have been specially developed for the assembly on untapped thin metal sheets (thickness of less than 1/3 the diameter of the screw), guaranteeing strong mechanical joints with a minimum risk of stripping, while offering excellent pull-out and vibration loosening resistance.

FASTITE® 2000™ screws results in a cost-effective solution with increased failure torque and resistance to stripping, when compared to other screws and assemblies.

1. Technical features of FASTITE® 2000™ screw.

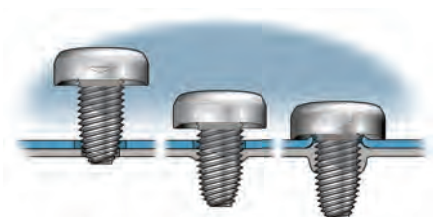


Fig.48. FASTITE® 2000™ screw starts straight and finishes straight, providing a secure, tight assembly. The twin-lead thread centers the screw in the hole.

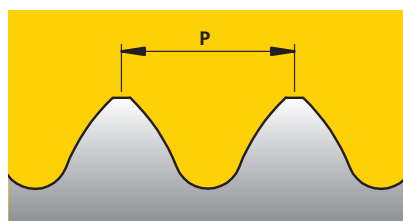
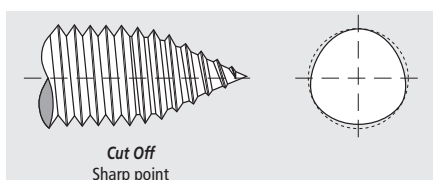
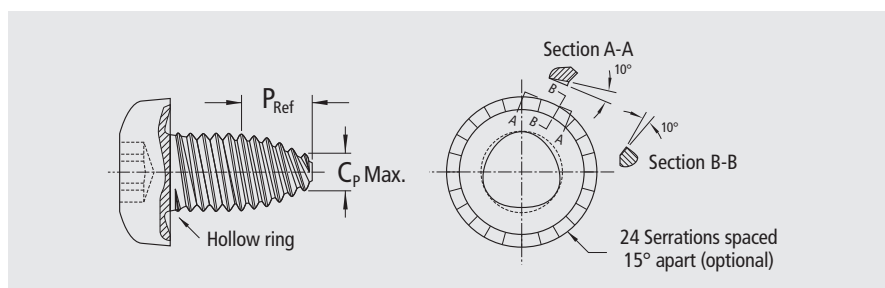
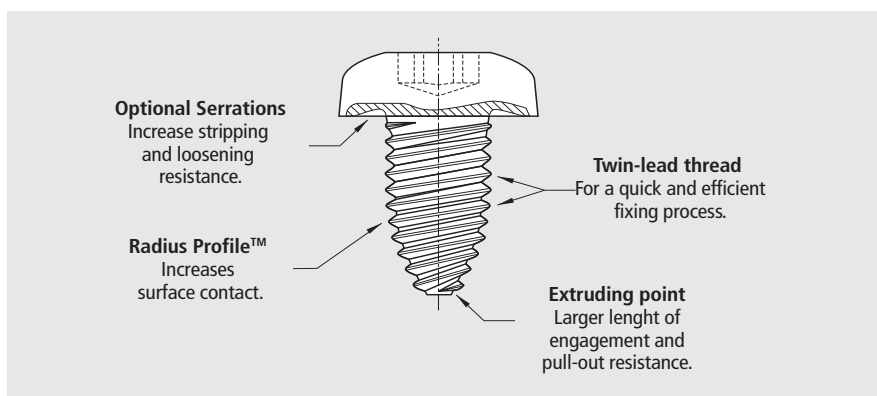


Fig.49. The **Radius Profile™** increases surface contact between the screw and nut member, providing higher pull-out and vibration loosening resistance.



- **Radius Profile™** of standard TAPTITE 2000® increases contact surface between the screw and nut member.
- **Twin-lead thread**, provides starting stability, which allows for a quick and efficient fixing process.
- **Fully threaded shank** to avoid clipping when joining thin metal sheets.
- Hollow ring under screw head to absorb the metal sheet deformation and allow for a perfect seal between screw head and sheet.
- The **serrations under the screw head** increase stripping and vibration loosening resistance.
- The special extruding point increases the thread engagement length during screw insertion.
- Cut off point (optional) permits piercing in sheets with no prepared hole without deforming the sheet. PG screw with cut off point available in stock.

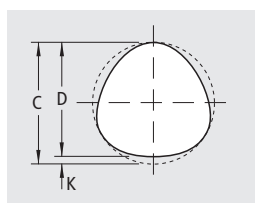


Screws for thin metal sheet

2. Advantages of FASTITE® 2000™ screw.

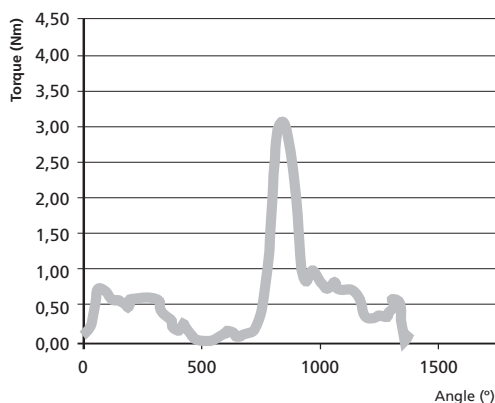
- TRILOBULAR® thread section offers low threading torque **improving ergonomics**.
- The Radius Profile™ and the extrusion created in the metal sheet provide **high pull-out and vibration loosening resistance**.
- Twin-lead thread increases stripping resistance by approx. 50% in comparison with a simple thread screw.
- **High prevailing torque.**
- **High clamping of the assembly.**
- Excellent alignment of screw in the hole, providing a **secure and tight assembly**.
- Profitable and cost-effective fixing solution in comparison to other types of screws and assembly solutions.

3. TRILOBULAR® effect during threading.

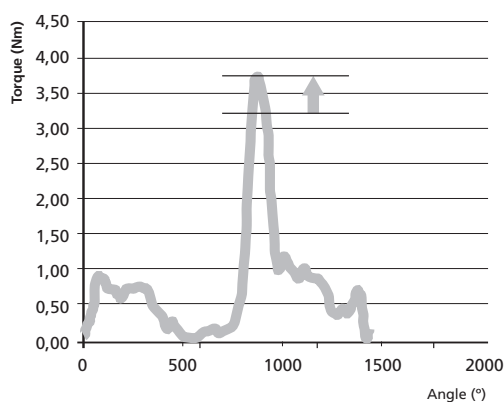


D = Screw diameter
C = Circumscribed diameter of screw
C-D = K = Lobe alignment

The K value (difference between the screw diameter and circumscribed diameter) affects the screw's performance. A low K value increases the strength of the assembly, but also results in a higher thread forming torque.



Thread curve of FASTITE® 2000™ 5x9 screw with optimal lobe alignment (K) in accordance with manufacturing standards.



Thread curve of FASTITE® 2000™ 5x9 with a reduced lobe alignment (K). In this case, the section is less TRILOBULAR®, with an increase in contact surface and consequently, an increase in threading torque and failure torque values.

The stability in K value guarantees stable parameters while fixing the screws. Only with the use of original screws you can ensure the stability of this parameter.

Screws for thin metal sheet

4. Threading curve of FASTITE® 2000™ screw.

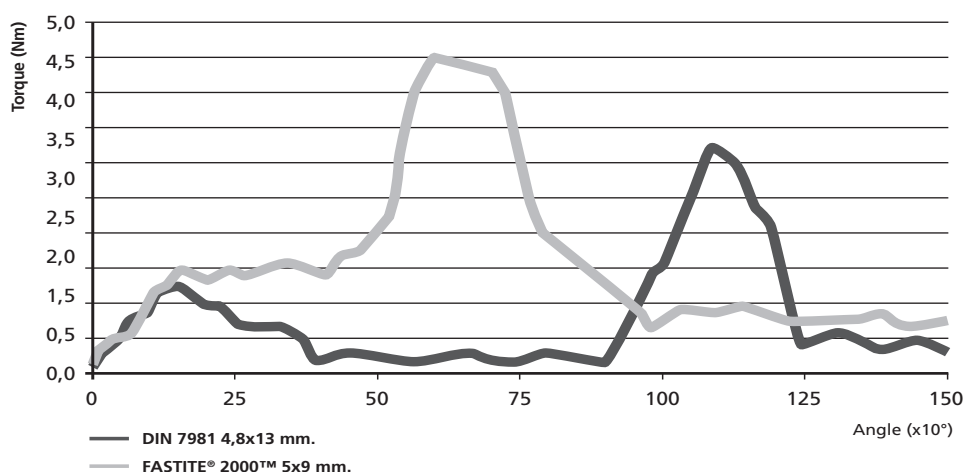
The following graph shows a comparison between DIN 7981 and FASTITE® 2000™ screw on aluminum sheet of 1,4 mm thickness.

Assembly with FASTITE® 2000™ screw offers a higher assembly torque range safety margin as well as a quicker fixing process. The twin-lead thread and larger engagement length provide a higher failure torque value.

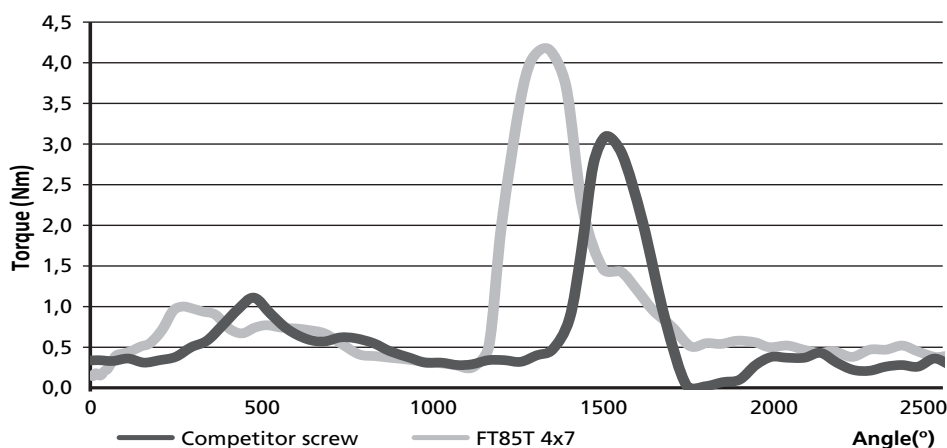
FASTITE® 2000™

Minimum breaking torque	
d (mm)	Torque (Nm)
2,5	1,2
3	2,2
4	5,2
5	10,5
6	17,7

The assembly torque **shouldn't be higher than 70%** of the minimum breaking torque indicated when fixing on aluminum sheets, and **80%** for steel sheets.



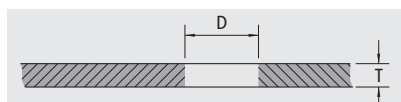
The following graph shows the threading curve of FASTITE® 2000™ 4x7 zinc plated screw (47FT85T) in comparison to another screw of similar characteristics, for the assembly of a reactancy on painted steel 0,5 mm thickness, hole diameter of 1,8 mm.



From the results obtained, we can conclude that FASTITE® 2000™ screw manufactured by CELO has a better performance. Lower threading torque (ergonomic assembly) and higher failure torque offer a higher assembly torque range safety margin during screw installation.

Screws for thin metal sheet

5. Recommended hole diameter for aluminum and steel thin sheets.



The following table shows the recommended hole diameter for different thicknesses of aluminum and steel sheets in relation to the nominal diameter of the screw.

Aluminum

Screw diameter	Material thickness		
	1	1,5	2
3	2,15-2,25	2,30-2,40	2,45-2,55
4	2,90-3,00	3,00-3,10	3,15-3,25
5	3,70-3,80	3,80-3,90	3,90-4,05
6	4,50-4,60	4,60-4,70	4,75-4,85

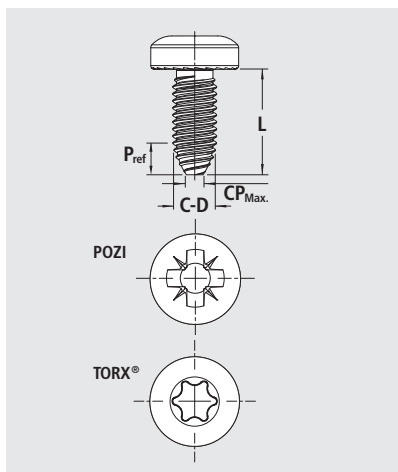
Dimensions in mm.

Steel

Screw diameter	Material thickness			
	0,5	1	1,5	2
3	2,15-2,25	2,35-2,45	2,50-2,60	–
4	2,90-3,00	3,00-3,10	3,15-3,25	3,25-3,35
5	–	3,80-3,90	3,95-4,05	4,10-4,20
6	–	4,65-4,75	4,80-4,90	5,00-5,10

Dimensions in mm. Hardness of the steel sheet considered: 125-150 HV.

6. Technical data of FASTITE® 2000™ screws.



Screw diameter	Pitch	C	D	P _{ref} Extruding point	Torx®	Pozi
2,5	0,45	2,5	2,45	2,03	T8	Z1
3	0,5	3,0	2,95	2,25	T10	Z1
3,5	0,6	3,5	3,44	2,70	T15	Z2
4	0,7	4,0	3,93	3,15	T20	Z2
5	0,8	5,0	4,92	3,60	T25	Z2
6	1	6,0	5,90	4,50	T30	Z3

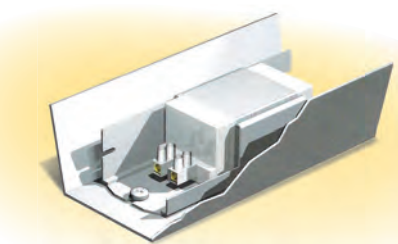
Dimensions in mm. The values shown are nominal.

7. Applications of FASTITE® 2000™ screws.

FASTITE® 2000™ screws have been specially designed for the assembly on untapped thin aluminum and steel sheets.

Examples

Automotive
Electronics
Electric material
Lighting
Assembly of household appliances frames
Small household appliances
Metallic constructions



Screws for thin metal sheet

FT 85 Z

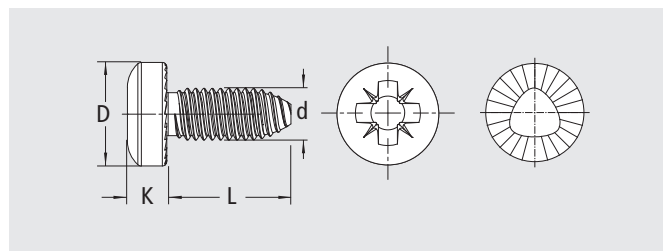


FASTITE® 2000™

- Pan head with serrations, **POZI**



Packaged in bags.



Zinc Plated Cr (III) + Baked

d mm	2,0	3,0	4,0	5,0	6,0
D mm	4,0	6,0	8,0	10,0	12,0
K mm	1,6	2,4	3,1	3,8	4,6
	Z1	Z1	Z2	Z2	Z3

L mm	Ø2	Ø3	Ø4	Ø5	Ø6
5	○	○	—	—	—
6	—	●	○	—	—
7	—	○	●	○	—
9	—	○	○	●	—
12	—	—	○	○	○

● Product available in stock. ○ Product available upon request.

FT 85 T

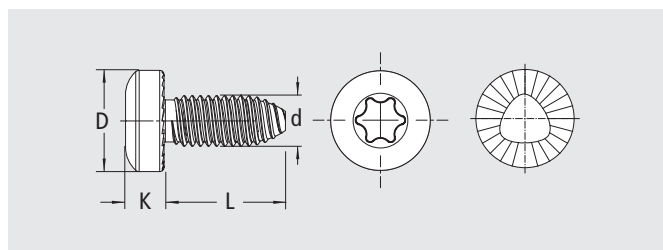


FASTITE® 2000™

- Pan head with serrations, **TORX®**



Packaged in bags.



Zinc Plated Cr (III) + Baked

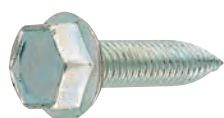
d mm	2,0	3,0	4,0	5,0	6,0
D mm	4,0	6,0	8,0	10,0	12,0
K mm	1,6	2,4	3,1	3,8	4,6
	T6 ¹	T10	T20	T25	T30

L mm	Ø2	Ø3	Ø4	Ø5	Ø6
5	○	○	—	—	—
6	—	●	●	—	—
7	—	○	●	—	—
9	—	○	○	●	—
10	—	○	○	○	—
12	—	—	●	●	●

¹ TORXplus® ● Product available in stock. ○ Product available upon request.

Screws for thin metal sheet

PG

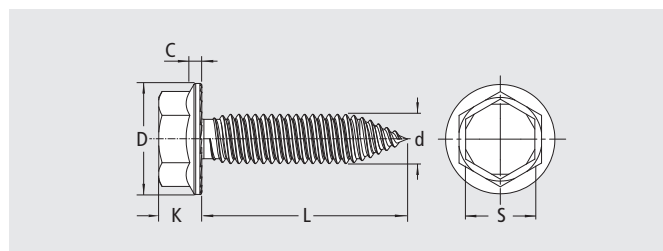


FASTITE® 2000™

- *Hexagonal flange head*



Packaged in bags.



Zinc Plated Cr (III) + Baked

d mm	6,0
D mm	13,0
K mm	5,0
S mm	10,0
L mm	Ø6
25	●

● Product available in stock.

Screws for thin metal sheet

FASTITE® 2000™ SELF-DRILLING screw.

FASTITE® 2000™ Self-drilling screw combines the features and advantages of FASTITE® 2000™ with a self-drilling point specially designed to drill and extrude thin metal sheets.

1. Advantages of FASTITE® 2000™ SELF-DRILLING screw.



There are some additional advantages to the standard FASTITE® 2000™ screw :

- It provides **cost reduction** opportunities, as it is no longer necessary to drill the two parts of the assembly.
- **Higher failure torque** compared with standard self-drilling screws.
- **Removable fixing**, providing the ability to remove the screw if necessary.

2. Applications of FASTITE® 2000™ SELF-DRILLING screw.



FASTITE® 2000™ Self-drilling screw is ideal for assemblies on metallic frames and substitution of rivets and caged nuts.

Maximum sheet thickness		Drilling speed
Aluminum (mm)	Steel (mm)	(rpm)
0,5-2,5	0,5-2,0	1200-1800

Examples

Metallic frames
Locks

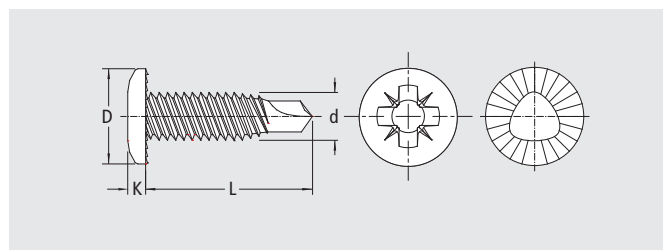
FTA



- **Low Pan head with serrations, POZI**



Packaged in bags.



Zinc Plated Cr (III) + Baked

d mm	4,0
D mm	8,0
K mm	2,3
S mm	Z2
L mm	Ø4
10	●

● Product available in stock.

Screws for thin metal sheet

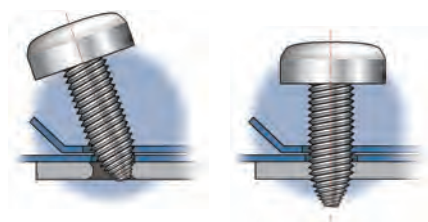
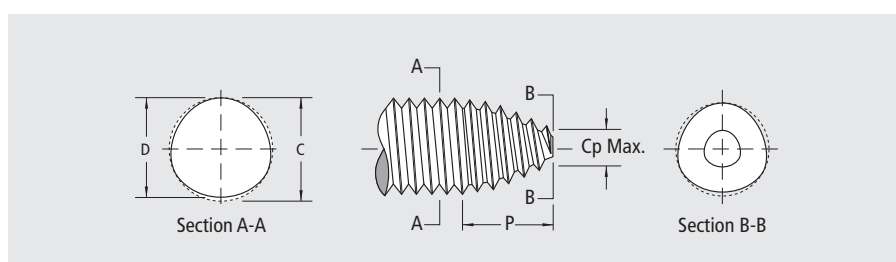
EXTRUDE-TITE®



Although **FASTITE® 2000™** screws offer exceptional performance in thin metal sheet assemblies, its use is not allowed in grounding applications and it's not recommended for assemblies with low threading torque requirements.

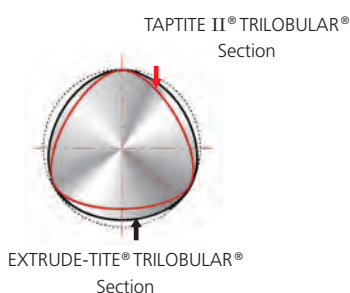
TRILOBULAR® **EXTRUDE-TITE®** screws have been designed to provide optimal performance in the assemblies previously mentioned, assuring ergonomic installation and according to existing norms.

1. Technical features of EXTRUDE-TITE® screw.



- Reduced TRILOBULAR® section guarantees larger contact surface with the nut member and increases pull-out resistance.
- Non-cut off point style for quick and effective insertion, ensuring the alignment of screw in the hole.

2. Advantages of EXTRUDE-TITE® screw.



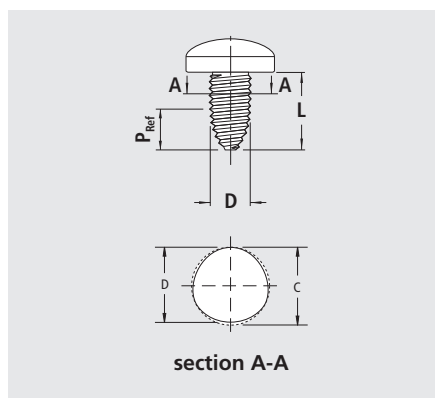
- Low thread forming torque guarantees an **ergonomic** fixing process.
- **High vibration loosening resistance.**
- High pull-out strength.
- The special point provides axial alignment of the assembly components, allowing its use in off-centred holes.
- Possibility of **piercing** thin materials with the optional *cut off* point.
- **Cost savings** as it:
 - Allows the assembly of thinner and lighter materials.
 - Eliminates the need of repairs due stripping and off-centred screws.

3. Recommended hole diameter for aluminum and steel sheets.

Please, refer to the information detailed on FASTITE® 2000™ pag. 73.

Screws for thin metal sheet

4. Technical data of EXTRUDE-TITE® screws.



Screw diameter	Pitch	C	D	Extruding point P _{ref}
2,5	0,45	2,57	2,52	2,48
3	0,5	3,07	3,02	2,75
3,5	0,6	3,58	3,52	3,30
4	0,7	4,08	4,01	3,85
5	0,8	5,09	5,01	4,40
6	1	6,10	6,00	5,50

Dimensions in mm. The values shown are nominal.

EXTRUDE-TITE®	
Minimum Breaking Torque	
d (mm)	Torque (Nm)
M2	0,6
M2,5	1,2
M3	2,2
M4	5,2
M5	10,5
M6	17,7

The assembly torque **shouldn't be higher than 70%** of the minimum breaking torque indicated.

5. Applications of EXTRUDE-TITE® screws.

EXTRUDE-TITE® screws are recommended for assemblies on thin metal sheets that require a screw with high mechanical performance and machine thread configuration.

Examples

Grounding connections
Household appliances

This is custom-made screw. For further information, please, contact our sales department.





***Screws
for special
solutions***



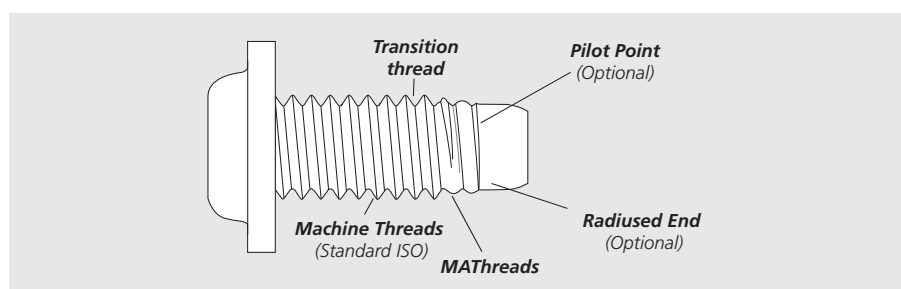
Screws for special solutions

MAThread®

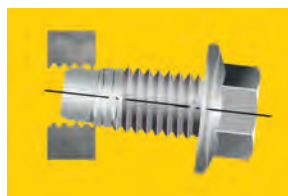


MAThread® point uses a patented thread design applied to machine screws to ease assembly process and avoid blocking and cross-threading problems. **MAThread®** point allows the rapid thread engagement on the assembly line, improving ergonomics and providing great opportunities for cost saving.

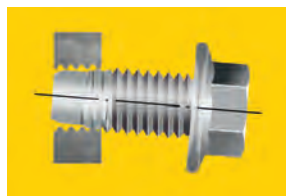
1. Technical features of MAThread®.



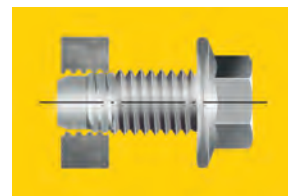
- **Perfect alignment of screw and nut.** Transition zone aligns the screw to fit into the nut member. MAThread® point engages with optimum interference into the nut to straighten the screw with misalignment up to 15°.
- Parts can be **made from all common forming steels**, copper and stainless.



1. Helix misalignment



2. **Mathread®** helps threads come into place



3. Threads drive normally into the nut

2. Advantages of MAThread®.

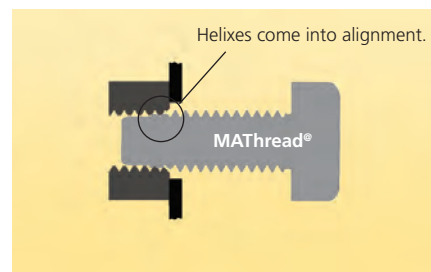
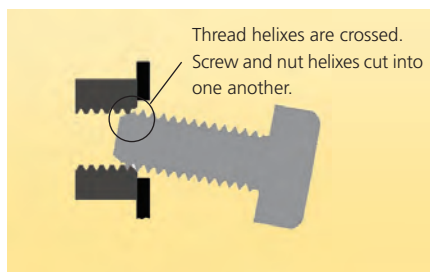
- MAThread® **improves the ergonomics** of the assembly by an easier insertion into the tapped hole or nut. It reduces operator stress during run-down.
- MAThread® performance is **unaffected by installation speed**.
- It **reduces the cost of assembly**: MAThread® reduces the screw installation time and eliminates the costs derived from downtime, rework and scrap associated with the assembly with standard screws.

Screws for special solutions

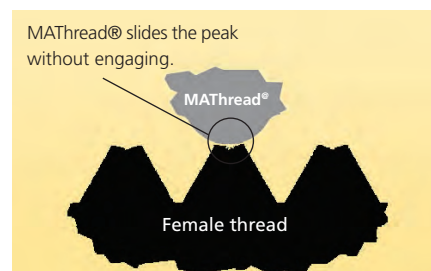
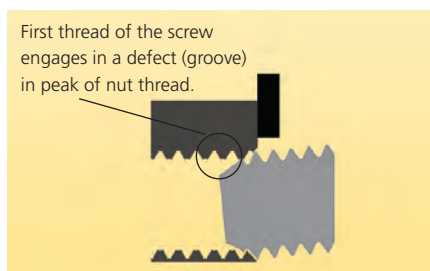
- It solves the problems of:

- **Cross-threading because of angular misalignment of screw and nut:**

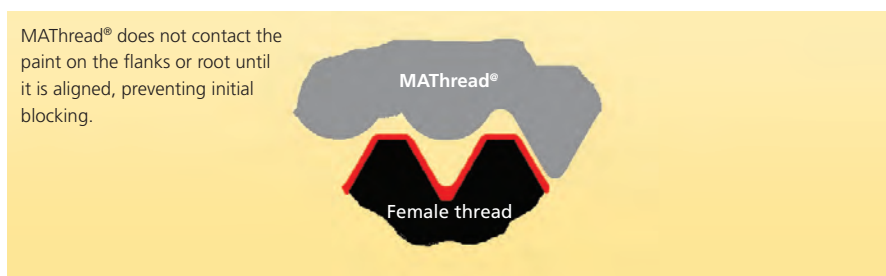
This happens when the second thread of the screw is engaged with the first thread of the nut.



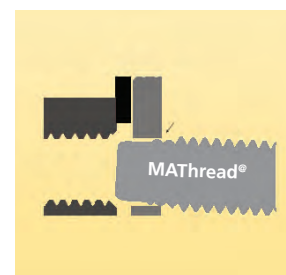
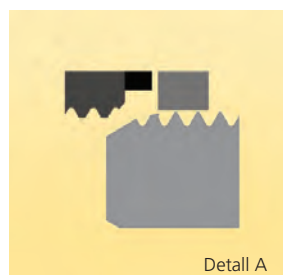
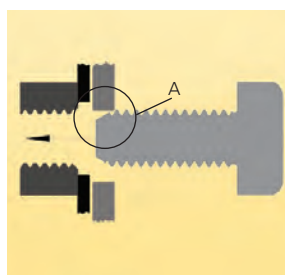
- **False threading:** Jamming with minimal or no angular misalignment. Peak of screw thread engages the groove and, during continued rotation, the nut thread is damaged and the screw is blocked. Thread strips, weakening the assembly.



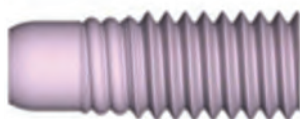
- **Galling:** Jamming due to excess paint or fit problems. When inserted at an angle, screw threads interfere with paint on flanks and friction builds up, causing thread failure.



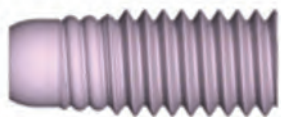
- **Winking:** Thread damage caused by component misalignment. Screw lead threads interfere with the component causing damaged thread. Round thread is not damaged by the first contact on insertion. Maththread® point helps the screw to align and fit better in the assembly when there's a misalignment between cover and base part which, in other situations could damage the screw thread.



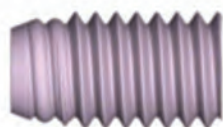
Screws for special solutions



Standard **MATHread**®



MATpoint®



VS Point®

There are different point designs adapted to the application requirements:

Standard **MATHread**®

- It absorbs misalignments up to 15° degrees.
- It's recommended for applications where the length of the point is not a problem.
- It's not recommended for the assembly of high weight cover parts which require positioning during the assembly process

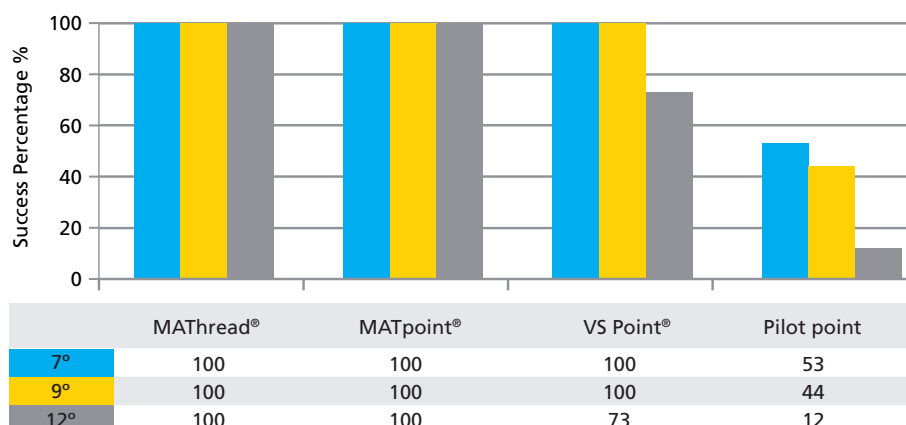
MATpoint®

- It's an optimized **MATHread**® point.
- It absorbs misalignments up to 12° degrees.
- It's compatible to the great majority of applications.

VS Point®

- It's a **MATHread**® point hardly without pilot point.
- It absorbs misalignments up to 7° degrees.
- It's recommended for applications where the engagement length is limited.

Anti-Cross-Thread Performance Comparison



3. Application of **MATHread**®.

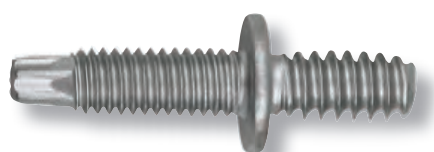
MATHread® point screws are recommended for assemblies on nuts or tapped holes in full automated feeding lines and applications susceptible to cross-threading problems.

This is a custom-made screw. For further information, please, contact our sales department.

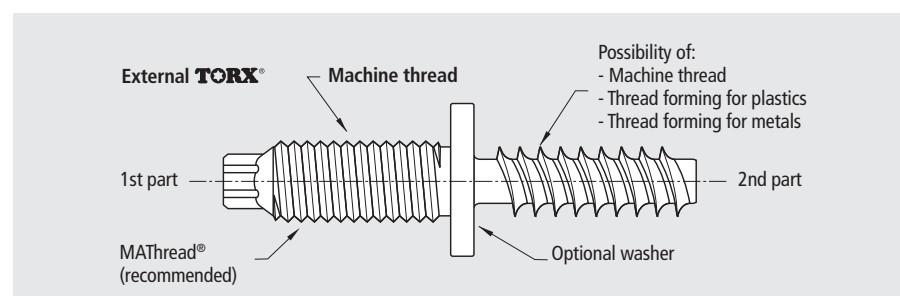
DOUBLE END STUDS

Double end studs are designed for individual applications when it's necessary to assemble two pieces, offering great possibilities for cost savings.

1. Technical features of DOUBLE END STUDS.



The Double ended stud combines two threads along both sides of its shaft, which may be the same thread type or different depending on the materials and the final requirements of the assembly:



1st part: Machine Thread + External recess.

Machine thread of the Double End Stud will be installed into a nut. We recommend to consider **MATHread®** point to allow the rapid thread engagement and avoid cross-threading problems. For further information on **MATHread®**, please refer to page 80.

Double End Studs can be driven by various methods, being **TORX®** recess the most popular solution (further information on page 102):

- TORX® STEM
- TORX PLUS® STEM
- TORX PLUS® Maxx

It is also possible to use an intermediate hexagonal washer to transmit the threading torque.

2nd part:

On the second part of the Double Ended Stud, there can be different threads, depending on the specific application:

- **REMFORM®II™ "HS", REMFORM®, REMFORM®'F' or REMFORM® II™ thread** for the assembly of plastic parts.
- **TAPTITE II® or TAPTITE 2000® thread** for the assembly of light alloy parts (Zamak, Aluminum,...).
- **MACHINE thread** for the assembly of metal parts with tapped holes or into a nut. In this case we also recommend to consider **MATHread®** point.

2. Advantages of DOUBLE END STUDS.

Double End Studs **enhance the assembly** of two parts as it has two sets of threads in one piece.

Firstly, thread rolling part is installed (part 2), leaving the machine thread (part 1) waiting to be mounted later to the final support.

In most of the applications using Double End Studs, the final assembly is done on automatic assembly lines, therefore it is recommended to incorporate the **Optical Sorting or Laser Sorting** system to the manufacturing process (refer to page 109).

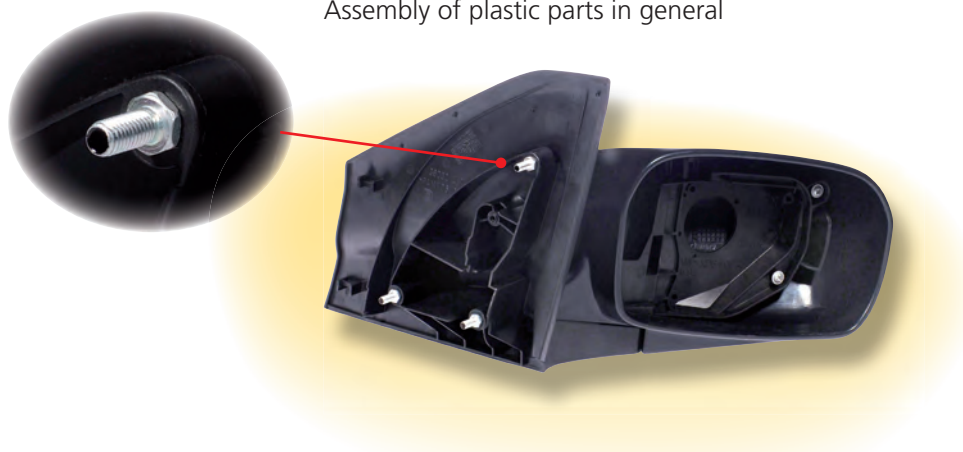
3. Applications of DOUBLE END STUDS.

Double end studs are designed to assemble two pieces and it offers great possibilities for cost savings.

Examples

Automotive

Assembly of plastic parts in general



This is a custom-made screw. For further information, please, contact our sales department.

MULTI-STATION parts



Based on specific application demands, the geometry of the component requires for multi-station cold forming manufacturing process (over 3 steps). Multi-station machines provide the possibility to manufacture complicated geometries with the highest quality demands and improved productivity, achieving significant cost savings in comparison with classical turned part manufacturing.

Depending on the type of product, we can manufacture parts with diameters from 3 up to 14 mm in our production facilities in Spain, China and United States.

Multi-station parts are produced from various materials that will depend on the application requirements, being tempered steel the most commonly used. When required, the parts can also be manufactured from stainless steel and aluminum.

The strength category is achieved through heat treatment process. This will depend on the mechanical requirements and the type of thread, being applicable the standard DIN ISO 898-1 for metric threads and REMINC standards for TAPTITE® and REMFORM® range of products.

Some of the most common parts produced in multi-station machines are listed below:

- ***Special Head Geometry or Large head-to-shank ratio Screws.***

The large surface contact increases friction and stripping resistance. It includes parts with multiple diameter, shoulders and blind/through holes.



- ***Rivets***

Rivets consist of a cylindrical shaft with a head on one end. Once the rivet is installed, it deforms allowing the permanent assembly of the two materials.



- ***Press-in studs***

Press-in studs provide permanent male threads in thin metallic sheets. Press-in stud transfers excellent push-out and its usage lowers assembly costs, improves product quality and reduces assembly time.



Screws for special solutions

• *Over-moulding parts*

Over-moulding parts consists of a shank and a special head design on which the plastic part is injected. The head is design to provide very high pull-out resistance.



• *Double end studs*

Double end studs are designed for these specific applications when it's necessary to assemble two pieces. One of the threads stays set in the first part, allowing the assembly of the second part with a nut.



• *Ball Studs*

Ball Studs consist of a spherical shape head and a threaded shank. The special head is designed to allow rapid assembly and disassembly. Likewise, the pieces assembled by ball studs remain attached with certain mobility.



Second Operations

When it's requested to make drill holes, balls, clearance grooves or undercuts, parts can be CNC machining finished.



These parts are specially designed for specific applications, its functionality provides many opportunities for cost saving.

These are custom-made parts. For further information, please, ask our sales department.

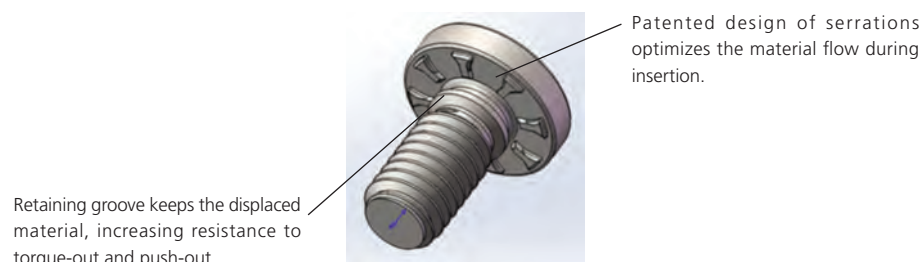
Screws for special solutions

CELOSTAMP®

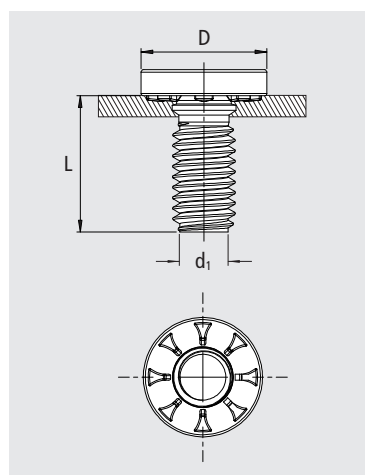


CELOSTAMP® is a solution for clinching of screws in thin metal sheets. CELOSTAMP® fasteners are a high-performance alternative solution when welding is not possible or undesirable, such as applications with dissimilar materials, special pre-coated materials, temperature sensitive joints ...

Installation of **CELOSTAMP®** screw is made by hydraulic or mechanical presses.



1. Technical features of CELOSTAMP® screws.



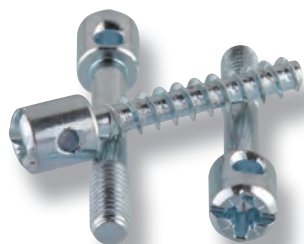
- The patented **curved and progressive radial design of the lobes** displaces material towards the hole during insertion. It reduces considerably the hole diameter in metal sheet during insertion. Moreover, the lobes oppose radially to the rotation of the screw and, in case of displacement, enable material to flow towards the groove, improving even more the retention.
- Retaining groove keeps the displaced material during insertion, assuring screw retention during handling.
- **Easy installation.**

2. Advantages of CELOSTAMP® screws.

- It requires low insertion force, **minimizing the risk of sheet deformation.**
- Lobes and retention groove design provide **high torque-out and push-out** during assembly shelf-life.
- It enables **joining of dissimilar materials.**
- **Minimizes risk of application materials damage.**
- **Lowers in-place costs.**

These are custom-made parts. For further information, please, contact our sales department.

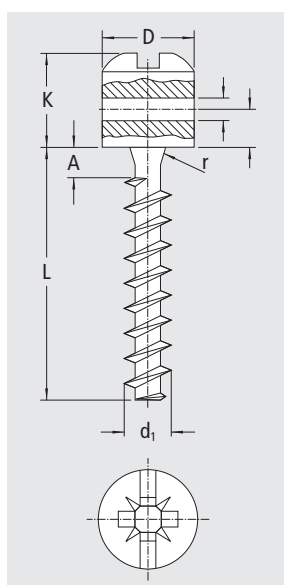
SEALING Screw



There are many industrial applications where it is necessary to ensure that the product is sealed to avoid any outside tampering by unauthorised personnel. We can find different sealing systems on the market, one of the most widely used solution is mechanical manufactured sealing screws. This solution has limitations with regard to thread and recess design, as well as materials used.

For this reason CELO propose the use of the SEALING screw made with cold stamping process.

1. Technical features of SEALING screws.



- **Head type**
 - Small or large cylindrical head.
 - Possibility to make one or two holes.
- **Recess type**
 - The stamping manufacturing process makes possible the combined recess POZI + SLOT.
 - In cases where the height of the head does not allow for a POZI recess, as it would interfere with the hole, a slot recess can be used.
- **Thread type**
 - The stamping manufacturing process makes it possible for self-threading screws for plastics (CELOPLAST, REMFORM®, REMFORM®II“HS”, REMFORM®‘F’), so no metal inserts are needed.
 - Machine and partial threaded.

2. Advantages of SEALING screws.

- Screws made of **steel** allow for **cost reduction**. Normally, mechanical manufactured sealing screws are made of nickel-plated brass.
- Screws made of steel offer **better mechanical properties**.
- The POZI + SLOT recess improves the assembly process on automatic assembly lines and makes the SLOT accessible for the installer.
- The plastic thread **eliminates the need** for metal inserts, offering:
 - **Cost reduction** for both the price of the insert and its insertion in the mould.
 - **Material can be easily recycled**. It is not necessary to separate the insert from the plastic to recycle the piece.
 - **Increased vibration loosening resistance**. For further information, please refer to CELOPLAST, REMFORM®, REMFORM®II“HS”, REMFORM®‘F’ information.

Screws for special solutions

3. Applications of SEALING screws.

Electrical boxes
Enclosures
Electric meters
Gas meters
Taximeters



This is a custom-made screw. For further information, please, contact our sales department.

Screws for special solutions

GROUNDING Screw



The screws used in grounding assemblies have to meet the requirements indicated in regulation **EN 60335-1:2002**, with the aim of offering a correct assembly and guaranteeing electrical conductivity.

Some of the existing possibilities for grounding assemblies are:

- Machine thread screw + washer + nut. Disadvantages: reduced automation, high component cost and vibrational loosening problems.
- TAPTITE II®. Disadvantages: reduced pull-out and torque failure resistance in thin metal sheets.

For grounding assembly we recommend the TRILOBULAR® **EXTRUDE-TITE®** screw (see description on page 70), with the inclusion of pointed serrations on the underside of the head to ensure electrical conductivity.

1. Technical requirements for **GROUNDING CONNECTIONS**.

Grounding connection

Minimum Breaking Torque	
d (mm)	Torque (Nm)
M3	0,5
M3,5	0,8
M4	1,2

The TRILOBULAR® **EXTRUDE-TITE®** screw meets all established standards in regulation **EN 60335-1:2002**, which are listed below:

- The screw should be tightened and loosened 5 times maintaining its initial properties and required clamping level.
- This test is conducted with the correct tool and using the assembly torque indicated on the table.

2. Advantages of **EXTRUDE-TITE®** screw.

- **Ergonomic threading process.**
- **High vibration loosening resistance.**
- **Superior pull-out resistance.**
- **Axial alignment** of assembly components, allowing for its use in off-centre holes.
- **Rapid** screw assembly.
- Allows for **automatic assembly** and reduction of references, with a subsequent **cost savings** in the assembly process.

This is a custom-made screw. For further information, please, contact our sales department.

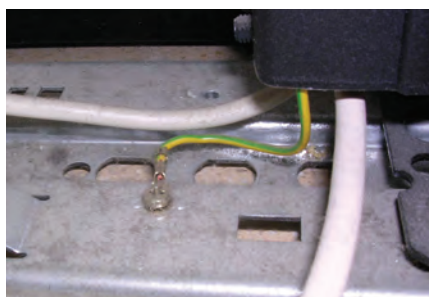


Fig.50. Grounding connection of a fridge.



CELO
Screws Technology

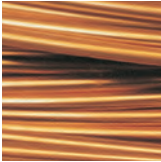
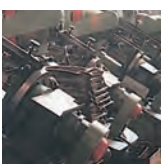
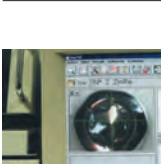


Technical information

Grupo CELO

Technical information

Screws manufacturing process

Stage	Description	Quality control
 WIRE RECEPTION	To manufacture cold forming screws, we start from wire rolls of different diameters and steel depending on the type of thread to produce.	The wire supplier certifies chemical composition and mechanical properties.
 TOOLING PREPARATION	During the heading and thread forming processes, different specific tools are used depending on the particular features of each screw.	All of the manufacturing orders incorporate a bar code system to identify the tools to be used in the production of each reference.
 COLD-FORMING	The heading process includes the wire deformation to make the head, recess and shaft of the screw. Depending on the shape of the screw, it's produced in machines of 2, 3, 4 or 5 blows. The captive washers are added afterwards.	All heading lines have process monitoring modules BRANKAMP to check heading pressure and detection of broken punches.
 THREAD FORMING	The thread forming process deforms the shaft of the screw by rolling in order to achieve a specific thread.	Most of the rolling lines have process monitoring modules BRANKAMP that assures in-process control. Dimensional verification is carried out at all levels and statistical Process Control (SPC).
 HEAT TREATMENT	Heat treatment of case hardening, quenching and tempering is applied in accordance with the technical specification of each family of products.	Measurement of hardness and mechanical properties.
 SURFACE TREATMENT	All screws have a surface coating to protect them from corrosion and to improve aesthetics. We can apply different coatings both electrolytic and organic. *See Coatings, page 106	Electrolytic coating: X-Ray measurement of coating thickness. Organic coating: Process control. When this is requested, Salt Spray Test (SST) is carried out to measure corrosion resistance.
 CELO Select OPTICAL SORTING CELO Select MECHANICAL SORTING LASER SORTING OPTICAL SORTING MECHANICAL SORTING	In general terms, CELO ensures a level of non-conformities of about 500 ppm. To achieve lower ppm level (min 50 ppm), Laser or Optical Sorting is carried out. To eliminate foreign or mixed parts, mechanical Sorting is carried out. *For further Information, refer to page 109.	Laser Sorting: 3D Laser 100% inspection of the specified characteristics. Optical Sorting: Optical inspection of the specified characteristics on 100% of the parts. Mechanical Sorting: Roller sorting on 100% of the parts
 PACKAGING	Packaging is carried out in accordance to product specifications, differentiating between catalogue and custom-made products.	The weight of the packages is checked in all cases.

Technical information

Head types

Description

The screw head houses the recess and transmits threading torque to the parts to be assembled.

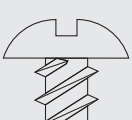
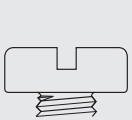
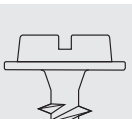
Screw head design

The head design will depend on its use and the surface it will be fixed to.

Dimensions

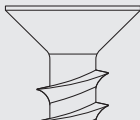
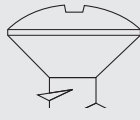
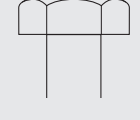
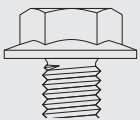
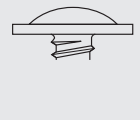
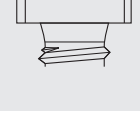
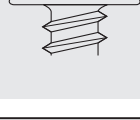
It is recommended to follow ISO/DIN standards for each type of screw. The ISO/DIN details the head dimensions for different types of recesses and threads and their quality requirements.

These recommendations can be modified in accordance with the needs of each use, reducing or increasing head height or diameter. In many cases, an oversized screw head, compared to the thread diameter, is requested. This may be due to a larger washer for higher surface contact, bigger head to avoid breaking during assembly, over-moulding screws or ball studs. In these cases, it is important to analyse the feasibility of the heading process, which could request for multistation process in 3, 4 or 5 dies. For more information on this multistation parts, please, refer to page 85.

Head Type	Description	Application
 ROUND	Semispherical shape. Normally made with slot recess.	It is mainly used for wood screws.
 PAN HEAD	The pan head is an improvement of the round head. Its technical features enable it to be used with all types of recesses.	The pan head can be used in all types of applications.
 PAN HEAD + WASHER	The larger surface contact with the assembly part provides better stress distribution, reducing the risk of cracking.	It is especially recommended for assemblies where distribution of pressure is necessary, soft plastics and oversized holes.
 CYLINDRICAL	The cylindrical shape can house either POZI or PHILLIPS recesses within a reduced head diameter. It also allows for the use of combined recesses.	This is especially recommended for screws used in small holes.
 CYLINDRICAL FLANGE	Cylindrical head with stamped washer to increase friction with assembly pieces.	Recommended for application that requires a reduced head diameter and better thread failure resistance.

Technical information

Head types

Head Type	Description	Application
 COUNTERSUNK	The standardised countersunk angle is at 90°. Its technical features allows its use with various types of recess. The housing design must be correct to ensure assembly compression. It is important to consider the recess depth.	Specially recommended for assemblies in which the screw head cannot stick out above the surface.
 OVAL COUNTERSUNK	Aesthetically improves countersunk design and permits the housing of deeper recesses.	Assembly of countersunk holes on iron fittings.
 HEX	Voluminous head with high mechanical resistance that requires the use of six socket or hex keys for fixing.	Recommended for use with very high assembly torques.
 HEXAGONAL FLANGE	Increases surface contact on the assembly.	Recommended for use with very high assembly torques.
 EXTRA LOW HEAD	Larger-diameter pan head that includes a small washer. Head height is lower than the standard pan head.	It is especially recommended for assemblies where the distribution of pressure is required, such as soft plastics and oversized holes.
 SQUARE	Square-shaped head without recess. The head fits perfectly in the housing.	Recommend for use on special assembly requirements.
 RIVET	Very low head with a minimum cone-shape under the head to improve aesthetics. Not possible to use with deep recesses. PHILIPS recesses can be used. Eliminates the need to countersink parts.	For use on application with head height restrictions without the need of countersunk housing.

Technical information

Types of recess

Description

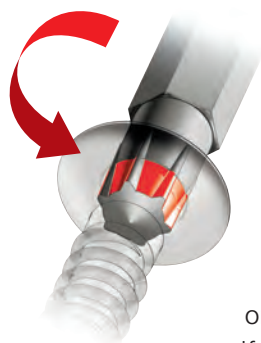
The recess is one of the main elements of a screw and is usually a notch or socket in the head, although there are other series of indented or concaved recesses that transmit the rotation of the screwdriver to the screw.

The recess is the junction point between the fastening system and screw. It's responsible for transmitting the rotation of the screwdriver to the screw. The turning force is measured by a scale known as torque and the recess absorbs the torque and transmits it to the screw.



Basic features

There are many parameters that define the performance of a recess. The following defines the most important factors to consider:



- **Torque transmission** is the most important recess feature. The less effort lost at the transition point in the recess, the better the torque transmission is. A higher torque transmission allows to save energy in the tightening process and avoids problems of rounding and damaging the recess and the driver bit.
- **CamOut** effect is a common problem with conventional, conical profiles, such as the cross-recessed profile. Camout greatly reduces torque transmission and make assembly difficult.
- **Alignment** feature in some recesses enhances guiding the screw along the rotation axis in order to ease its position into the hole, so that we can apply the proper end load on the self-drilling or self-piercing screws without slipping out.
- **Engagement speed** is the speed in which the bit of the screwdriver finds the recess and starts to transmit torque. Typically, the less you have to turn the bit to enter the recess, the higher the engagement speed will have. For this reason, six-lobed symmetrical recesses have a faster engagement speed than cross-shaped ones (with only four lobes).
- **Ageing:** Screwdriver bits are damaged over time. Friction or heavy workloads are some of the factors that weaken the bit. It is important to choose a recess that minimises the wear on bits due to their high cost. It is likewise important to ensure that the bit-recess system is used correctly.
- **Stick fit** is the ability of some bit-recess systems to connect without a magnetic bit holder. This ability is due to the friction created by the bit and the inner walls of the recess. This feature is very valuable in operations with low accessibility, and it is generally not used in automatic assembly lines.
- **Tamper-proof** recesses require specific bits to allow for adequate torque transmission.
- **One-way** recesses do not allow for removal once the screw is in place.

Technical information

Types of recess

Standards and patents

Companies have patented many of the existing recesses and other recesses follow standards defined by relevant international organisations. The best-known standardised recesses are PHILIPS and Six-Lobes recesses, but there are other widely used original patented designs that offer an improved tip-recess system. It is important to remember that the correct engagement is achieved by using the appropriate bit for each recess. Licensed recesses undoubtedly make up an essential part of the system if we do not want to reduce the crimping properties between them.

A small variation in tolerance, inner wall angle or depth of the recess can increase the wear on bits and cause ergonomic problems.

The following international standards define recesses:

DIN EN ISO 10664

DIN EN ISO 4757

The most common patented ones are:

TORX®

TORX PLUS®

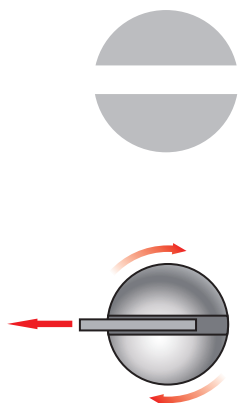
SIT®



Technical information

Types of recess

SLOT



Description

Diagonal cut in the screw head that is deep enough to transmit the required torque for threading the part.

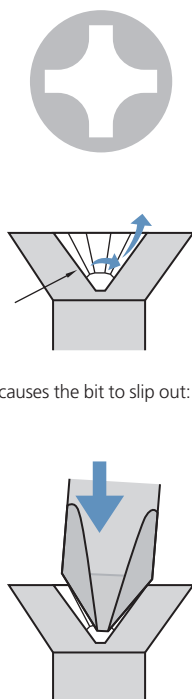
Disadvantages

- Being an open recess, the screwdriver bit slips easily. Therefore it cannot be used reliably in either automatic assembly or with electric or semi-automatic pneumatic tools.
- Low torque transmission.

Main applications

Slot screws are commonly used in the electric sector.

PHILIPS



The cone-shaped walls causes the bit to slip out: camout effect.

Force to compensate the camout effect.

Description

Cruciform and cone-shaped recess, PHILIPS recess can be combined with a slot or hex head.

Disadvantages

- **Camout effect.** Due to the conical shape of the internal walls, the screwdriver bits have the tendency to slip out of the screw head. The user has to counteract this cam-out effect by an additional application of axial force.
- The difficulty in bit engagement lowers the torque transmission.
- The end load required to compensate the camout effect reduces bit life and causes worker fatigue or injury.

Main applications

It is present in all sectors: automotive, metallic frames, toys, electric material, etc...

Types of recess

POZI



Description

Cruciform recess developed to improve the performance of the PHILIPS recess. The internal walls are less cone-shaped, reducing the camout effect. They are visually distinguishable from PHILIPS due to the four small points between the arms. It can be combined with a slot or hex head.

Advantages

- Improved torque transmission compared to PHILIPS recess.

Disadvantages

- Although performance has improved in comparison to the PHILIPS recess, the aforementioned cam-out effect still occurs.

Main applications

It is present in all sectors: automotive, metallic frames, toys, electric material, etc...

COMBI (POZI + SLOT or PHILIPS + SLOT)



Description

This is a POZI or PHILIPS recess combined with a slot. It is made by stamping, which greatly reduces costs compared with the slot recess.

Advantages

- Allows for the use of POZI or PHILIPS tips on assembly lines, leaving the SLOT for the installer.

Main applications

Mainly used in the electric sector.

SIT®



Description

Six lobes recess specially designed for portable electric tools. It is manufactured under license by AW® (Adolf Würth GmbH).

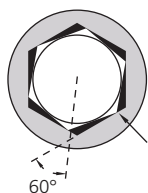
Advantages

- The vertical walls eliminate the camout effect, which provides optimal assembly torque transmission and less battery consumption.
- Internal conical shape of the lobe grants a perfect fitting in the recess, reducing bit damage.
- The SIT® recess is compatible with TORX® screwdriver bits, although a perfect fit is only possible with original SIT® screwdriver bits.

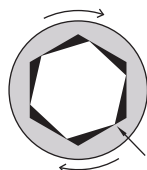
Technical information

Types of recess

SIX SOCKET



The points of contact may create stress and damage the driver bit and screw recess.



Description

Hexagonal recess with vertical walls.

Advantages

- Popular.
- The strength of the six socket bits allows for systems requiring a high assembly torque.

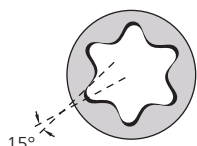
Disadvantages

- The 60° angle of incidence makes difficult the torque transmission.
- The screwdriver bit sporadically contacts the edges of the recess, resulting in recess damaging and stress risers to develop.
- To ensure efficient torque transmission, high recess depth and high head height is necessary.
- Not recommended for automatic assembly lines.

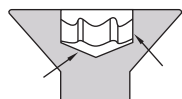
Main applications

It is recommended for high-resistance screws requiring high-assembly torque (class 12.9, 10.9, etc.), headless screws.

TORX®



The 15° angle greatly reduces the radial forces, increasing bits lifespan.



The vertical walls eliminate the camout effect.

Description

Straight sides prevent camout effect, increasing driver bit life and allowing more ergonomic threading.

The 15° angle of incidence greatly reduces the radial stress, increasing tool bit life and improving torque transmission.

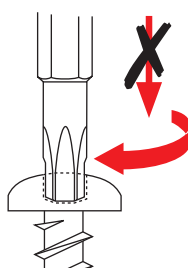
The six lobes allow for faster engagement speed.

Advantages

- Its great strength and resistance to recess damaging (with no possible camout effect) make it an excellent choice for uses that require **high-assembly torque**.
- The six lobes allow faster tool engagement, which makes it one of the best tip-recess systems for automatic and semi-automatic processes.

Disadvantages

- Tool may be difficult to align properly in high-speed assemblies.
- 15° drive angle still permits a small amount of radial stress, which can reduce bit life.
- Wide tolerances can result in a loose fit between fastener and tool bit.
- To ensure effective transmission, it needs to be a deeply cut notch.



There is no need to apply end load in the direction of the screw.

Technical information

Types of recess

Recess sizes

The size of the recess varies with the diameter of the screw and it can be modified

Machine thread / TAPTITE®

Head type	Screw diameter							
	2	2,5	3	3,5	4	5	6	8
Pan head	T6*	T8	T10	T15	T20	T25	T30	T40
Countersunk		T10						

CELOPLAST

Head type	Screw diameter								
	2,3	2,6	3,1	3,6	4,1	4,6	5,1	6,1	7,1
Pan head	T6*	T7*	T10	T15	T20	T20	T20	T25	T30
Pan head + washer	T6*	T6*		T10					
Countersunk	T6*	T7*		T10					

REMFORM®

Head type	Screw diameter								
	2-2,2	2,5	3	3,5	4	4,5	5	6	7
Pan head	T6*	T7*	T10	T15	T20	T20	T25	T30	T30
Pan head + washer	T6*	T6*		T10			T20	T25	
Countersunk	T6*	T7*		T15			T25	T30	

*We recommend to use TORX PLUS® recess.

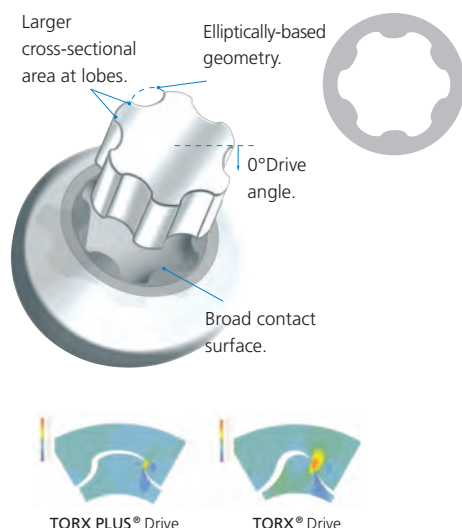
to the requirements of each use.

Main applications

Automotive sector, electric material, electronic and household appliances.

TORX® and TORX PLUS® are patented by the  company and manufactured under license by CELO, S.A.

TORX PLUS®



The TORX PLUS® geometry eliminates radial stresses to increase tool bit life.

Description

TORX PLUS® is an improvement of TORX® recess that provides larger cross-sectional area between the screwdriver bit and the recess allowing a faster tool engagement even at higher revolutions and increases torsional strenght.

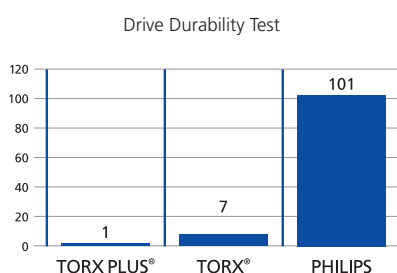
The vertical walls eliminate camout effect and offer perfect tool engagement, thereby reducing the risk of tool slippage and minimizing damage it can cause.

The elliptical base geometry increases surface contact and maximizes engagement between the driver bit and the recess, extending the lifetime of the bits.

The 0° angle of incidence eliminates the radial stress produced at the point-to-point contact, increases driver bit life and **ensures optimal assembly torque transmission**.

Technical information

Types of recess



The graph shows the number of bits to drive 150.000 screws.



TORX PLUS® drive bit
in TORX PLUS® recess



TORX® drive bit
in TORX PLUS® recess

Advantages

- **Optimal torque transmission.**
- The absence of Camout ensures an **ergonomic assembly.**
- The improvement in driver bit life **reduces assembly cost.**
- **Faster tool engagement.**
- TORX PLUS® Drive recess completely endoses the driver tip, **preventing tool slippage** and damage to the surrounding surfaces.
- Screws with TORX PLUS® recess can be used with TORX® drive bits.
- TORX PLUS® Drive significant improvements and cost savings make it one of the **best recess systems for automatic and robotic systems.**

Disadvantages

- It is not recommended for assembly with self-drilling screws.
- It requires a **deeply cut notch.**

Recess sizes

The sizes of recesses will vary based on the diameter of the screw.

Selection of the recess size can be modified according to the specific requirements of the application or product.

In table below you can find some guidelines for the different thread types depending on screw diameter and head design.

Recess sizes

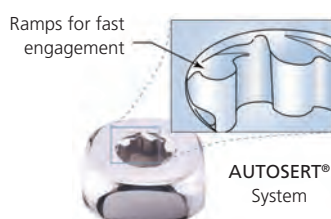
Thread	Head type	Screw diameter				
		1,5	1,8	2	2,2-2,3	2,5-2,6
Machine Thread / TAPTITE®	Pan head/Countersunk)	-	5IP	6IP	-	8IP
CELOPLAST	Pan head	4IP	5IP	5IP	6IP	7IP
	Pan head flange	-	-	-	-	6IP
	Countersunk	-	-	4IP	6IP	7IP
REMFORM®	Pan head	4IP	5IP	6IP	6IP	7IP
	Pan head flange	-	6IP	6IP	6IP	6IP
	Countersunk	-	-	6IP	6IP	7IP

For diameters larger than those shown in the table, use the same recommendations as for the TORX® recess

Main applications

Automotive sector, electronics sector and industry in general. We recommend using TORX PLUS® recess for screws with a thread diameter less than 2 mm.

TORX PLUS AUTOSERT®



TORX PLUS AUTOSERT® includes angle ramps that speeds engagement, reducing the assembly time and consequently, increasing productivity.

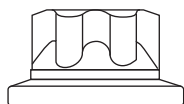
It's specially recommended for automated and robotic assembly lines, where the screwdriver is continuously rotating.

Screws with **TORX PLUS AUTOSERT®** recess are assembled with **TORX PLUS®** bits.

Technical information

Types of recess

TORX PLUS® External

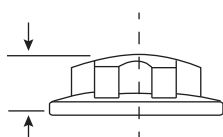


Description

Designed with the same elliptical configuration than **TORX PLUS®**, it allows maximum torque transmission.

For its assembly, it requires the usage of **TORX PLUS®** bits, it's not possible to use **TORX®**.

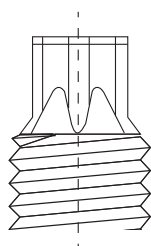
TORX PLUS® External LOW PROFILE



This version offers a high resistance and optimal torque transmission on low head height, similar to pan head or hexagonal design.

Its optimized design minimizes the volume of the head and reduces the bits wear. It requires special bits for its assembly.

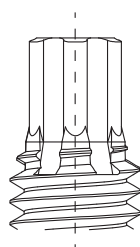
TORX PLUS® STEM



TORX PLUS® STEM recess corresponds to **TORX PLUS®** External recess formed at the end of double end studs.

The improved torsional strenght enhances the clamping of the parts.

TORX PLUS® MAXX



TORX PLUS® MAXX is an improvement of **TORX PLUS® STEM** recess which allows for a higher assembly torque.

This new version eliminates the transition area from the recess to the thread, increasing the breaking torque.

It requires special bits for its assembly.

Technical information

Types of recess

Tamper-proof recess

Tamper-proof recesses were developed to avoid any tampering of the screw after assembly. The manufacturer controls the distribution of the driver bits; therefore it is used only by authorised personnel.

TORX® Tamper-proof

Description



TORX® Tamper-proof recess has a solid post formed in the centre of the recess, blocking the use of a standard TORX® bit. It was developed to allow manufacturers to use the TORX® recess and, thanks to the controlled distribution of the driver bits, guarantee that end users cannot manipulate the screw.

Disadvantages

The post can be removed and a standard TORX® bit can be used to remove the screw.

TORX PLUS® Tamper-proof

Description



TORX PLUS® Tamper-proof recess has five lobes and a solid post formed in the centre of the recess.

Advantages

The screw is extremely difficult to remove without a special tamper-resistant TORX PLUS® Drive tool.

CELOK®

Description



The special TRILOBULAR® shape of the CELOK® recess ensures a high tamper-proof level as there is no conventional tool fitting in the recess. The distance between two opposite points is constant along the diameter perimeter, making impossible for any conventional screwdriver to be used on it.

Advantages

- **Good torque transmission.**
- CELO,S.A. sells special CELOK® screwdriver bits only to customers who buy CELOK® screws.
- **It has Stick-fit effect.**

Technical information

Types of recess

Comparative table

Drive system benefits	Recess				
	Slotted	Hex	Cruciform POZI/PHILIPS	TORX®	TORX PLUS®
Minimizes tool slippage	-	••	-	•••	•••
Appropriate for automated assembly	-	•	•	•••	•••
Maximizes tool engagement	-	-	-	•••	•••
Manual assembly	•••	•••	•••	••	••
Selfdrilling screws	-	-	•••	-	-
Drive angle	NA	60°	NA	15°	0°
Broad contact surface	-	•	•	••	•••
Torque transmission	-	•	•	••	•••
Minimal camout	-	•••	-	•••	•••
Minimal threading torque requirements	-	•••	-	•••	•••
Reduces radial stress	-	-	-	••	•••
Lengthens tool bit life	-	-	-	••	•••
Tooling readily available	•••	•••	•••	•••	•••

••• Optimal solution, •• Recommended solution, • Applicable solution, NA Non-applicable.

Technical information

Coating

Screws and other fixing elements made of steel and its alloys should have a coating to protect them against corrosion and improve aesthetics. The corrosion resistance is indicated in HSS (Hours Salt Spray).

There are many different coatings which corrosion resistance depends not only on the coating type itself but also on the reliability of the process applied. There are many available tests to evaluate their quality: thickness layer, climatic test, adherence test,... These are complementary tests and should be applied and used correctly to avoid wrong conclusions. In all cases, we recommend to follow the international standards.

Layer Thickness

There are many methods to determine the layer thickness. It will depend basically on the base material, coating applied, piece geometry, ... For screws and other fixing ferrous elements with complicated geometry (small flat surface), the X-rays measurement system is the most widely used for its rate and reliability. In this case, the coating layer must be homogeneous, e.g. Zinc, Nickel and Copper electrolytic coatings.

ISO 4042 standard describes the optimal thickness measurement point and the maximum values recommended according to the screw pitch and thread diameter.

It's commonly thought that the higher the thickness is, the better the corrosion resistance will be. This is not fully correct, as its efficiency depends on other factors like adherence, passivated quality and sealant presence. These parameters can't be evaluated by any thickness measurement technique and should be complemented by the following tests:

Salt Spray Chamber

Salt Spray Chamber (SSC) is a climatic test that tries to simulate the worst environmental conditions for a ferrous material, like the marine environment. This test allows for a total quality evaluation of the coating, but its long testing time (from 3 to 20 days depending on the coating) makes it not suitable for the daily quality control.

There are many reference standards like DIN 50.021, ISO 9227 and ATSM B-117, equivalent between them, which describes the chamber test dimensions, the fogging and the salt concentration (5% NaCl). On the other hand, there's no indication about samples distribution neither results evaluation.

The Salt Spray Chamber test evaluates the time (in hours) in which appears white and red corrosion. White corrosion indicates that Zinc oxidation has started. It will continue until Zinc is exhausted and iron oxidation starts when red corrosion appears. Red corrosion leads to the screw embrittlement and potential break may occur; therefore it's very important to prevent its appearance. White corrosion is only relevant in terms of aesthetics issues.

It is important to mention that there's no direct relationship between the hours resistance in Salt Spray Chamber to the corrosion resistance in real environment.



Technical information

Coating

Electrolytic coating

The electrolytic coating consists in a metallic protective layer deposited on the screw surface by immersion in an aqueous solution. The process is the following: electric current is applied between the negative electrode with the chemical element for the screws protection (Zn, Ni, Cu, Sn) and the positive electrode in contact with the pieces to coat. The screw is coated by electrolytic exchange.

The chemical element will depend on the coating performance desired: protection against oxidation, conductivity, aesthetics,...

For screws and other fixing elements, when high corrosion resistance is required, the chemical elements used are Zinc and its alloys Zn-Ni and Zn-Fe. The Zinc layer and its alloys are not enough resistant and it requires passivation, which will determine the final corrosion resistance and colour.

RoHS and ELV European Directives restrict the use of certain hazardous substances. Initially it was only applied in Automotive and Electronic equipment, but now it is widely applied in other sectors.

During the last years, new sealants have been developed for their application on electrolytic coatings (Zn, Zn-Ni and Zn-Fe) to improve the corrosion resistance.

Cr VI is the last Chrome oxidation stage and it provides very high corrosion resistance. According to RoHS requirements, Cr III is substituting Cr VI, but it needs sealants to reach the previous corrosion resistance. The aesthetic appearance of Cr III coatings is not as good as the obtained with Cr VI coatings.

The following table shows the most common electrolytic coating used:

Electrolytic coating

Coating	Thickness (μ)	White corrosion (h)	Red corrosion (h)	RoHS 
Zinc plated CrIII	5	24	72	YES
Zinc plated CrIII + sealant	5	48	96	YES
Zinc plated Iridiscent	8	72	168	YES
Zinc plated Iridiscent + sealant	8	96	240	YES
Clear Zn-Ni + sealant	8	240	720	YES
Black Zn-Ni + sealant	8	200	720	YES
Zinc plated 10 μ m+ sealant	10	48	144	YES
Black Zinc plated CrIII	10	48	120	YES
Nickel plated	3	-	-	YES

Hydrogen embrittlement

The hydrogenation is the occlusion of hydrogen atoms in the metallic structure of the steel during electrolytic coating, causing microscopic cracks and loose of ductility. When we apply a high assembly torque or the screw is under high loads, the hydrogen atom can move through the screw core, creating internal tensions and causing break of the screw. This is known as **hydrogen embrittlement** and it could be detected as the screw head is broken some hours after the assembly. The risk of hydrogen embrittlement increases with the screw surface hardness.

Technical information

To reduce the hydrogen embrittlement risk a tension relieving heat treatment is applied to the parts. This process is known as baking. ISO 4042 standard recommends to process the pieces between 200 and 230°C from 2 to 24h, depending on the type and geometry of the pieces, mechanical features and other processes applied.

The hydrogen embrittlement affects to high hardness screws, so baking process is recommended for all screws with hardness over 320HV. The Standard ISO 4042 establishes that is not possible to guarantee the complete elimination of hydrogen embrittlement risk. If further reduced probability is desired it is needed alternative procedures. Baking process in CELO is applied to the following families of screws:

- TRILOBULAR® TAPTITE® range of products (TAPTITE II®, TAPTITE 2000®, FASTITE® 2000™, POWERLOK® ...).
- REMFORM®, REMFORM®F', REMFORM®II™, REMFORM®II™HS'.
- IBI-ZAS.
- PLASTITE®.
- Screws Class 8.8, 10.9 and 12.9.
- Self-tapping screws under customer demand

Organic coating

Zinc-Aluminum flake coating.

Organic coating made of Zinc and Aluminum flakes in solvent based dispersion. It can be applied by dipping or spraying, depending on the size of the parts and needs post curing with high temperature.

For our product range, the organic coating is applied in a non-electrolytic dip-spin. It is recommended to apply a minimum of two layers to guarantee a uniform protective layer and the polymerisation takes place in the oven at 200°C. The final thickness of the coating is limited by the screw diameter, or, to be more exact, by the thread pitch. The Standard ISO 10683 specifies the maximum thickness for ISO machine threads according to their tolerance.

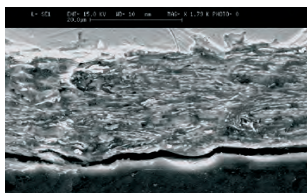
We differentiate the Base Coat in grey colour and the Top Coat, which can be in many different colours, being grey, black and blue the most widely used. The application process is the same for both coats. The Base Coat provides real corrosion protection. Black, blue or other colours need from one to two grey layers, resulting in 4 to 5 layers application. The higher the number of layers is, the higher the probability to block the thread and the recess. The colour and high corrosion resistance application requirement can affect the thread performance.

The organic coating accomplishes ELV and RoHS European Environmental Directives. It's free of Cr VI and heavy metals like Cadmium, Lead and Mercury.

Advantages

- **Excellent corrosion resistance.** Multiple Zn-Al lamellar flakes provide excellent corrosion resistance. The high Zinc content provides galvanic protection, which is maintained up to 200° C.
- **Good bimetallic corrosion resistance** thanks to the high Aluminum content.
- **No risk of hydrogen embrittlement.** Zn-Al flake coated products don't have risk of hydrogen embrittlement as it is not an electrolytic process.
- **Solvent resistance.** Once fully cured, Zn-Al flake coating is resistant to solvents, fuel and brake fluids.

Technical information



Zn-Al flake coating.



Standards

OEM Manufacturer	Standards
SEAT, AUDI, VW	TL 245/TL 233
BMW	GS 90010
DAIMLER CHRYSLER	DBL 9440, DBL 8440, DBL 9441
FORD	WSS M21 P10, WSS M21 P42 S303, 307
GENERAL MOTORS CORP.	GMW 3359
FIAT	9.57513
OPEL	GMW 3359, GMW00255
RENAULT	01-71-002
SAAB	GMW 3359
PSA	B153320
BOSCH	N67F827
ISUZU	GMW 3359

This table can be modified without previous notification.

The following table shows the most common coating used.

Coating	Thickness (μ)	Red corrosion (h)
Grey Zn-Al Flake Coating 240h	6-8	240
Grey Zn-Al Flake Coating 480h	8-10	480
Grey Zn-Al Flake Coating 720h	10-12	720
Black Zn-Al Flake Coating 120h	6-8	120
Black Zn-Al Flake Coating 240h	8-10	240
Black Zn-Al Flake Coating 480h	12-15	480
Black Zn-Al Flake Coating 720h	15-20	720
Blue Zn-Al Flake Coating 240h	6-8	240

Technical information

CELO Select®

CELO Quality System for automated assembly lines

The requirements on the quality of fixing elements have dramatically increased during the last decades. The need to produce more reliable products has been transferred into our factories, incorporating quality control systems in all production stages to maintain the process capability: Process Monitoring modules in Cold-Forming and Thread forming machines, controls for dimensional verification and Statistic Process Control (SPC) in all operations.

CELO Manufacturing Quality System assures 500 ppm non conformity pieces. Although this value is understood as general, the ppm level for every batch will depend on many factors: batch quantity pieces, piece geometry, coating, ... This value of 500 ppm is perfectly accepted by most of our customers.

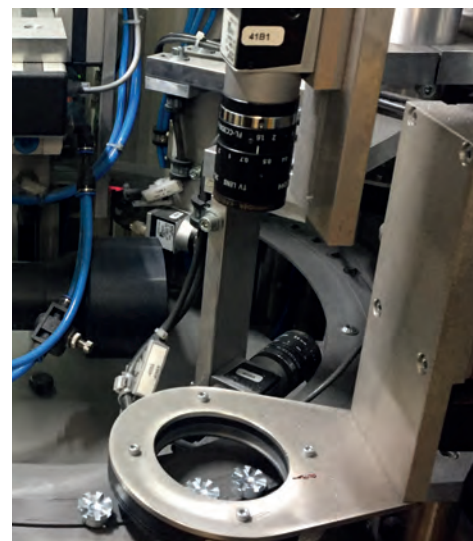
Nevertheless, for those customers with automatic assembly lines, even this low value of non conformity pieces can affect the productivity of the assembly line and increase its costs, requiring screws with higher quality level.

In these situations, CELO makes available the process **LASER SORTING, OPTICAL SORTING and MECHANICAL SORTING** depending on the application requirements.

These sorting processes are considered under special demand. For further information and quotation, please request to our sales department.

There are many characteristics that cannot be evaluated by ppm as cannot be inspected. Those are characteristics that require destructive tests, as corrosion resistance test, pull-out resistance ...

OPTICAL SORTING



OPTICAL SORTING is an automatic inspection process of 100% of the production batch that allows us to detect defects on the head, recess, shank and thread dimensions. By means of this inspection system, we guarantee the conformity of the pieces within the control parameters established according to the customer requirements.

OPTICAL SORTING control system, according to Standard **UNE-EN ISO 16426**, guarantees a quality level of 10 ppm for feature inspected.

CELO Select®

CELO Quality System for automated assembly lines

LASER SORTING



LASER SORTING control system is an automatic **3-D 100% inspection process** of production batch that allows us to detect defects on the head, recess, shank and thread dimensions on 360° . By means of this inspection system, we guarantee the conformity of the pieces within the control parameters established according to the customer requirements.

It uses the information from multiple laser beams to detect defects that may only be on one side of the part, such as damaged threads or cracks.

LASER SORTING control system, according to Standard **UNE-EN ISO 16426**, guarantees a quality level of **10 ppm** for feature inspected.

MECHANICAL SORTING



MECHANICAL SORTING is a verification process that allows us to detect problems of mixing or contamination of screws in any step of the production process, as well as any difference in the head diameter.

Packaging of screws for plastics

Ref. 87/88/89

Quantity per bag



Packaged in bags.

For your convenience, we offer you the following packaging systems:

PLASTIC BAGS:

The screw reference and production batch is printed on the bag label, allowing a perfect traceability of the pieces.

CARDBOARD BOXES:

For big quantities and special production screws, the product is presented in bulks packing. The quantity per box and its dimensions will depend on the weight of the screw.

d mm	2,2-2,3	2,5-2,6	3,0-3,1	3,5-3,6	4,0-4,1	4,5-4,6	5,0-5,1
6							
8							
10							
12		5.000 pcs					
14					2.500 pcs		
16							
18							
20							1.000 pcs
22							
25					1.250 pcs		
30							
35							
40							500 pcs
50							
60							
70							

Ref. 81/82

Quantity per bag

d mm	1,8	2,2-2,3	2,5-2,6	3,0-3,1	3,5-3,6	4,0-4,1	4,5-4,6	5,0-5,1	6,0-6,1
6									
8									
10									
12		5.000 pcs							
13									
14									
16					2.500 pcs				
18									
20							1.250 pcs		
22									
25									
30									
35							1.000 pcs		
40									
50								500 pcs	
60									
70									
80									
90									
100									

Packaging of screws for metals



Packaged in bags.

Quantity per bag

For your convenience, we offer you the following packaging systems:

PLASTIC BAGS:

The screw reference and production batch is printed on the bag label, allowing a perfect traceability of the pieces..

CARDBOARD BOXES:

For big quantities and special production screws, the product is presented in bulks packing. The quantity per box and its dimensions will depend on the weight of the screw.

d mm	2	2,5	3	4	5	6	8
3							
4							
5							
6							
7							
8							
10							
12							
15							
16							
18							
20							
22							
25							
28							
30							
35							
40							
45							
50							
55							
60							

TAPTITE II®

TAPTITE 2000®

FASTITE®2000™

PLASTITE®

POWERLOK®

REMFORM®

REMFORM® II™"HS"

CORFLEX®

REDUCTION OF IN-PLACE ASSEMBLY COSTS



Are Trade Mark by  Fasteners AG, and produced by CELO, S.A. under license.

General sales conditions

General Sales Conditions are published in our web: www.celofasteners.com

Additionally to the conditions detailed in the document, there will be applied the following conditions:

Minimum order amount

For purchase order less than 120€ there will apply a charge of 40€ as minimum order charge.

Minimum order quantity per reference

The minimum purchase order quantity per reference is the packaging unit. For special products, the minimum quantity will depend on the screw dimensions. Please, contact our sales department for further information.

Transport

For deliveries made by the customer transport agency, the agency will pick up the product in our warehouse.

Unless expresses negotiation, the freight of the goods shall be paid by the customer (Ex Works).

Payment conditions

Term of payments over 30 days will be provided by bank debit.

Payment documents should be submitted at the latest within 30 days after the date of the invoice.

Unless expresses negotiation, Confirming mode is not accepted.

Our computer system automatically detains order in case there is any unpaid or late receipt of payment documents (replenishment, notes, etc.).

The costs incurred for the purposes returned, for reasons not attributable to our society, will impact the customer always in an amount of 2.5% of nominal, with a minimum expenditure of 8€.

The payment terms for sales that are not insured by Crédito & Caución (Atradius Group) shall be paid in advance by bank transfer.

Funding

For renewal of effects or late payment thereof, there is a charge of 0.75% per month or part thereof.

Taxes

The offer price does not include Value Added Tax, which will be implemented directly on the invoice.



CERTIFICATE

IQNet and
AENOR
hereby certify that the organization

CELO, S.A.

PI PLA DE LA BRUGUERA, CL ROSELLÓ, 7.
08211 - CASTELLAR DEL VALLÈS
(BARCELONA)

CELO HUNGÁRIA KFT
BUDAI ÚT 1/C
TATABÁNYAI IPARI PARK(2851 KÖRNYE)
Hungria

for the following field of activities

Production of screws, parts and rivets by cold forming. Thread diameter up to 8MM.

has implemented and maintains a

Quality Management System

which fulfills the requirements of the following standard

ISO 9001:2008

First issued on: 1999-08-01

Last issued: 2017-03-01

Validity date: 2018-09-14

Registration Number: **ES-0412/1996**




Michael Drechsel
President of IQNet



Avelino BRITO
General Manager

AENOR

IQNet Partners:*

AENOR Spain AFNOR Certification France AIB-Vinçotte International Belgium ANCE Mexico APCER Portugal CCC Cyprus
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IQNet is represented in the USA by: AFNOR Certification, CISQ, DQS Holding GmbH and NSAI Inc.

* The list of IQNet partners is valid at the time of issue of this certificate. Updated information is available under www.iqnet-certification.com

AENOR

UNE-ISO/TS 16949 Certificate



RA02-0006/2008
IATF: 0181198

AENOR certifies that the organization

CELO, S.A.

has a quality management system according to the UNE-ISO/TS 16949:2009 Standard

at the following site of production: PI PLA DE LA BRUGUERA, CL ROSELLÓ, 7. 08211 - CASTELLAR DEL VALLES (BARCELONA)

for the following activities: Production of screws, parts and rivets by cold forming with thread diameter up to 8 mm for passenger cars, light commercial vehicles, heavy trucks, motorcycles, buses.

Exclusion: Product Design

Distant location of production: See Annex I

Last issued: 2017-03-01
Validity date: 2018-09-14



Avelino BRITO
General Manager



AENOR INTERNACIONAL, S.A.U.
Génova, 6. 28004 Madrid. España
Tel. 91 432 60 00 – www.aenor.com

Certificate

Standard **GB/T 19001-2008/ISO 9001:2008**

Certificate Registr. No. 01 100 085581

Certificate Holder: **Celo (Suzhou) Precision Fasteners Co., Ltd.**
 Organization Code: 77686982X
 Registration Address: Ningbo Road, Taicang Economic Development Area, Jiangsu Province 215400, P. R. China
 Operation Address: No. 166, Ningbo Road, Taicang Economic Development Area, Jiangsu Province 215400, P. R. China

Scope: Manufacturing of Cold-forging Fasteners

Proof has been furnished by means of an audit that the requirements of GB/T 19001-2008/ISO 9001:2008 are met.

Validity: The certificate is valid from 2016-05-18 until 2018-09-14.

This certificate information can be searched on CNCA official website <http://www.cnca.gov.cn>

2016-04-11



TÜV Rheinland Cert GmbH
 Am Grauen Stein · 51105 Köln

www.tuv.com



Certificate

Standard **ISO / TS 16949:2009**
(3rd edition, 2009-06-15)

Certificate Registr. No. 01 111 085581
IATF Certificate No. 0235908

Certificate Holder: **Celo (Suzhou) Precision Fasteners Co., Ltd.**
No. 166, Ningbo Road, Taicang Economic Development Area,
Jiangsu Province 215400, P. R. China

Scope: Manufacturing of Cold-forging Fasteners

Proof has been furnished by means of an audit that the requirements of ISO / TS 16949:2009 are met.

Issue date/Expiry date: The certificate is valid from 2016-04-11 until 2018-09-14.

Release date: 2016-04-11



TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln
Germany



2-IAO-QMC 01003

1 / 1

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TÜVRheinland®
Precisely Right.



ISO 9001:2008 CERTIFICATE OF REGISTRATION

This is to certify that

TRIDENT FASTENERS, INC.

**2929 32nd Street S.E.
Kentwood, MI 49512 USA**

**has successfully been assessed and found
to conform with the ISO 9001:2008
quality management system standard.**

The scope of this registration includes:

Manufacture of fasteners

Date of Registration: February 24, 2016
Date of Expiration: September 15, 2018
Date issued/revised : December 21, 2015

(Registered Since: February 23, 2001)

Certificate No. A-568



Steve Barfoot, President
Advantage International Registrar, Inc.



Notes

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[illegible]

Notes

[illegible]

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**GRUPO CELO Y APOLO
MEXICO S DE RL DE CV**

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