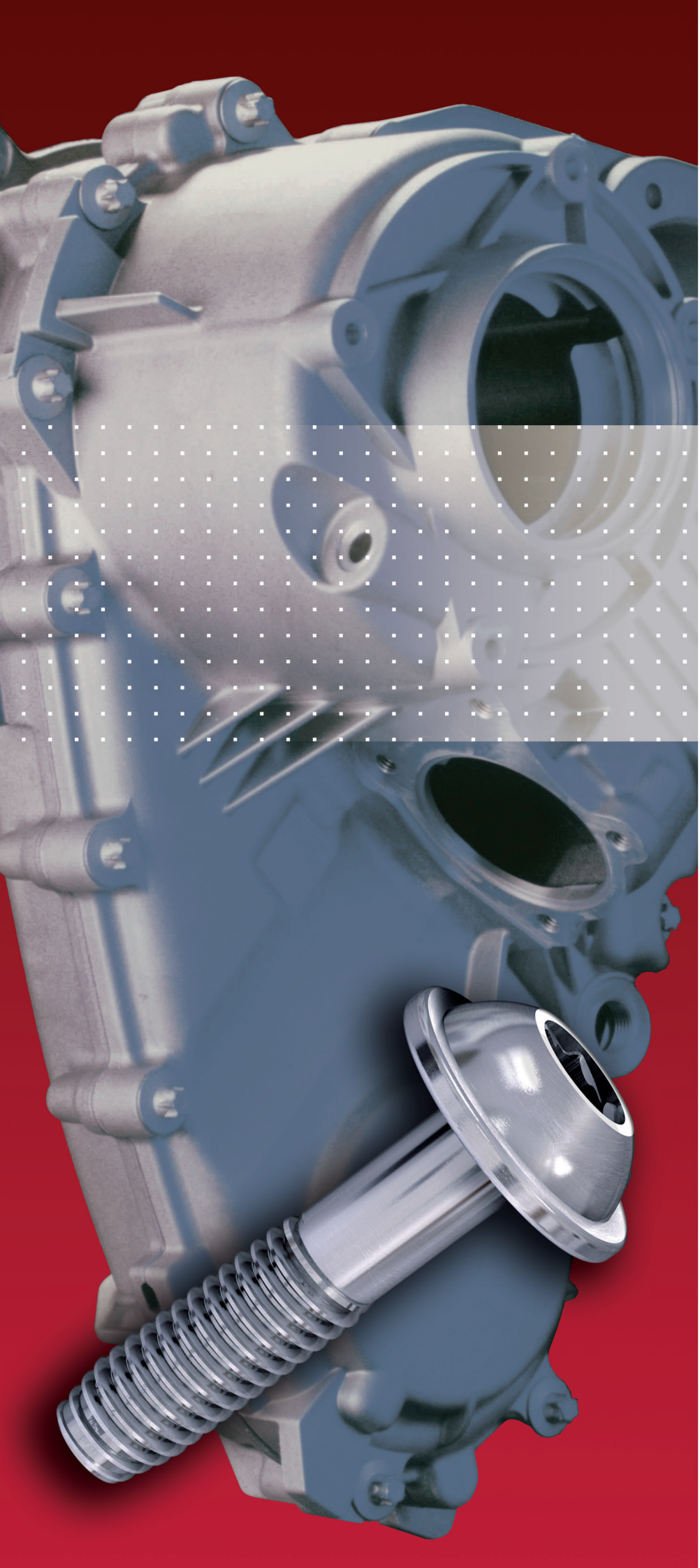

ALtracs® Plus

The Selftapping Fastener for Light Alloys

Imprint
Editor:
EJOT GmbH & Co. KG
Industrial Fasteners Division
D-57334 Bad Laasphe
Germany

Print:

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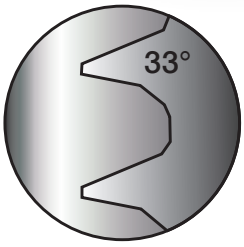
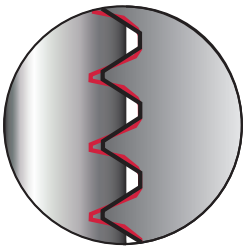
All technical data may be subject to technical improvements.

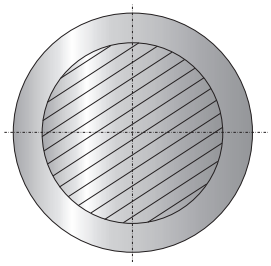
ALtracs® Plus screws are thread-forming fasteners developed for maximum strength values in light alloy assemblies and other non-ferrous metals such as zinc, copper, brass etc., up to 140 HB.



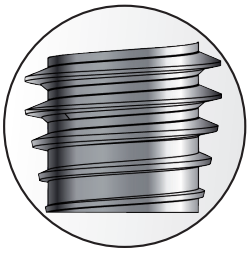
flank angle of 33°



metric compatibility



circular thread
cross section

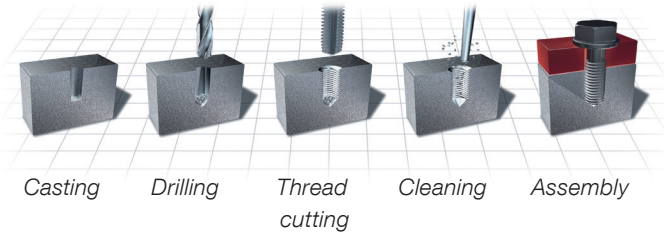


conical
thread forming zone

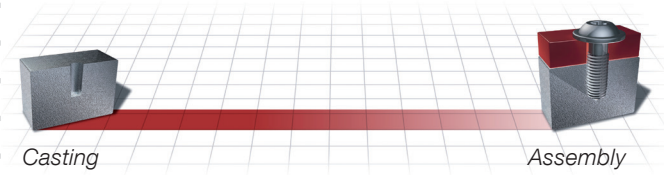
ALtracs® Plus

Comparison of Total Costs

Metric Screw



ALtracs® Plus Screw

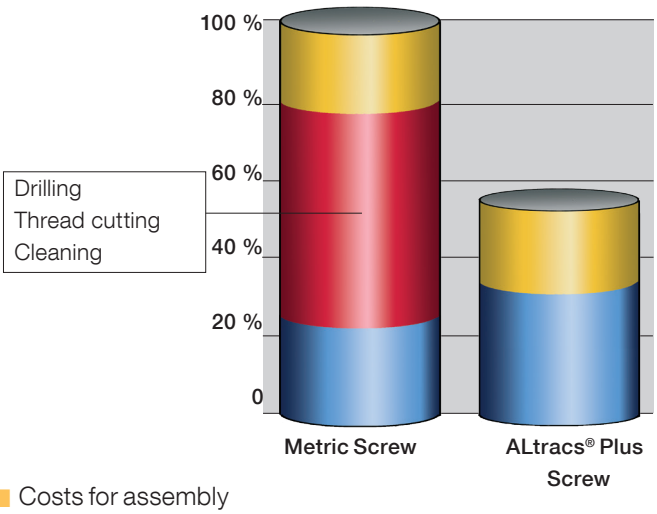


ALtracs® Plus vs. Metric Threads

Compared to metric screws cost savings of up to 40% can be achieved with threadforming fasteners.

Self-tapping screws can be directly assembled into cast holes as opposed to the pre-drilling, thread cutting and subsequent cleaning of metal chips necessary for metric screws. This financial and time expense can be saved with the use of self-tapping fasteners.

An ALtracs® Plus screw joint achieves strength values which are comparable to the metric screw joint strength value 10.9.



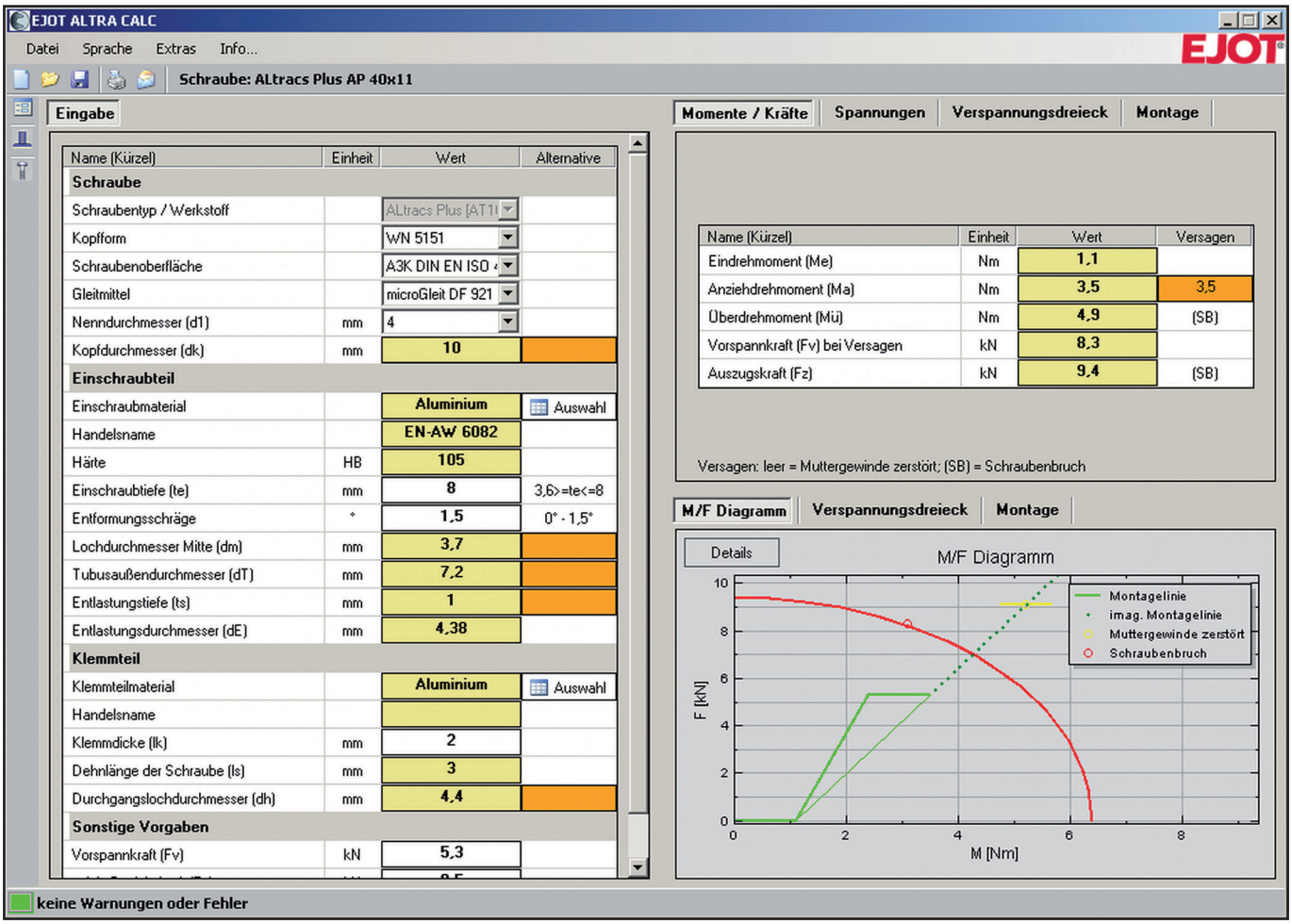
- Costs for assembly
- Costs for handling / processing
- Costs for material

ALtracs® Plus vs. other Thread-Forming Screws

ALtracs® Plus can be directly assembled into cast holes - additional drilling due to high casting tolerances is usually not necessary. The ability of compensating for bigger hole tolerances also leads to a certain immunity against casting flaws like drill drift and porosity.

Due to the high thread engagement per thread, shorter installation depths are possible without any drawbacks concerning the quality of the joint - consequently shorter core pins for casting can be used.

All this leads to cost savings at the casting tools and longer service intervals.



Clamp load oriented design in light metal

With the ALtra CALC® prognosis programme, you can theoretically estimate screw joint strength in light metal. By taking the mechanical properties of the mating material together with screw surface and screw material into account, a prognosis of the torque, clamp load, pull-out force and failure mode is carried out.

In accordance with VDI 2230, a clamp load oriented design is possible.

The results are documented in an extensive report.

The ALtra CALC® **prognosis programme enables dimensioning of screw joints for the future. That adds safety during the design stage. A practical test with the components can be done in the ATF Applications Lab.**

For further information about the ALtra CALC® **prognosis programme, please contact our product line specialist.**

Zack Lanman
Phone: 312-206-9031
E-Mail: zlanman@atf-inc.com

ALtra CALC® test report

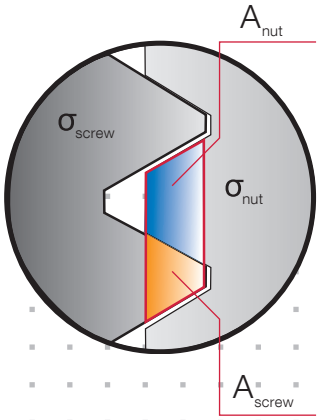
Thread Design

Thread Flank Design

The thread design plays a key roll for direct assemblies into light alloy.

In order to maximise the overall performance of the screw joint, the load capacity of the female thread needs to be improved.

Different material strengths of steel and alloy require a specific design of the steel screw for use in light alloy.

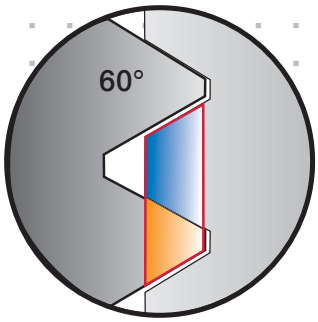


Material strength ratio light alloy assemblies:

$$\frac{\sigma_{screw}}{\sigma_{nut}} \approx \frac{3}{1}$$

An optimum stability ratio between male and female thread requires:

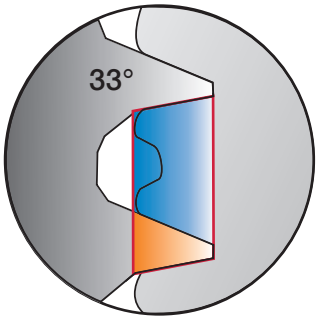
$$\frac{A_{nut}}{A_{screw}} \approx \frac{3}{1}$$



60° Thread

A screw joint with a 60° flank angle allows only a stability ratio of:

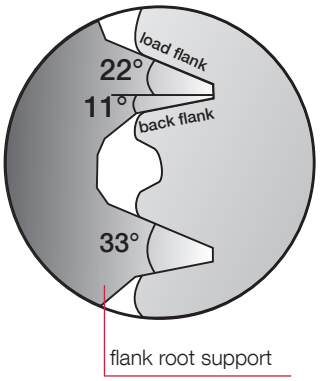
$$\frac{A_{nut}}{A_{screw}} \approx \frac{1{,}5}{1}$$



ALtracs® Plus Thread

The ALtracs® Plus thread geometry achieves a desirable stability ratio of:

$$\frac{A_{nut}}{A_{screw}} \approx \frac{3}{1}$$

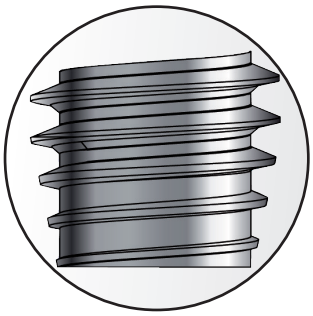


The thread flank angle of 33° forms a considerably stronger female thread in the alloy compared to a 60° thread. The female thread in the weaker alloy material is strengthened by the larger thread root formed by the ALtracs® Plus thread form. This ensures that the desired balanced stability ratio has been achieved for optimum strength.

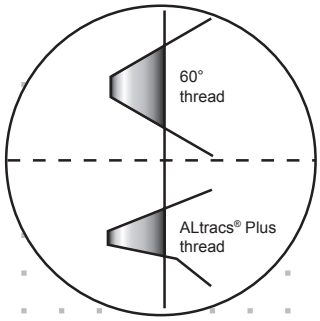
The asymmetric thread flank results in an optimal material displacement and creates a large thread engagement area between the screw thread and the mating material. In addition the flank root support gives extra stability to the thread in high clamp load conditions. The flank root support is specifically designed to allow unhindered material flow during the thread forming process.

Thread Forming Zone

The conical thread forming zone enables good alignment and easy insertion of the ALtracs® Plus fastener.

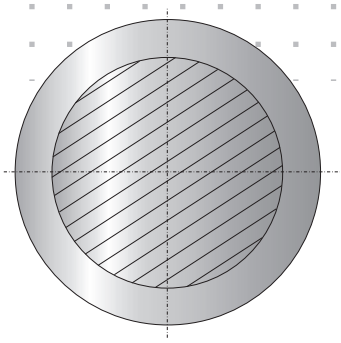


The forming zone in conjunction with the 33° flank angle generates lower installation torque due to the small displacement volume.



Thread Cross Section

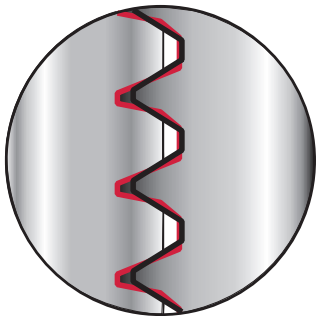
The circular cross section is designed for maximized thread engagement compared to non-circular cross sections or tapped metric threads. The ALtracs® Plus geometry has a favourable influence on load capacity and long-term stability.



Metric Compatibility

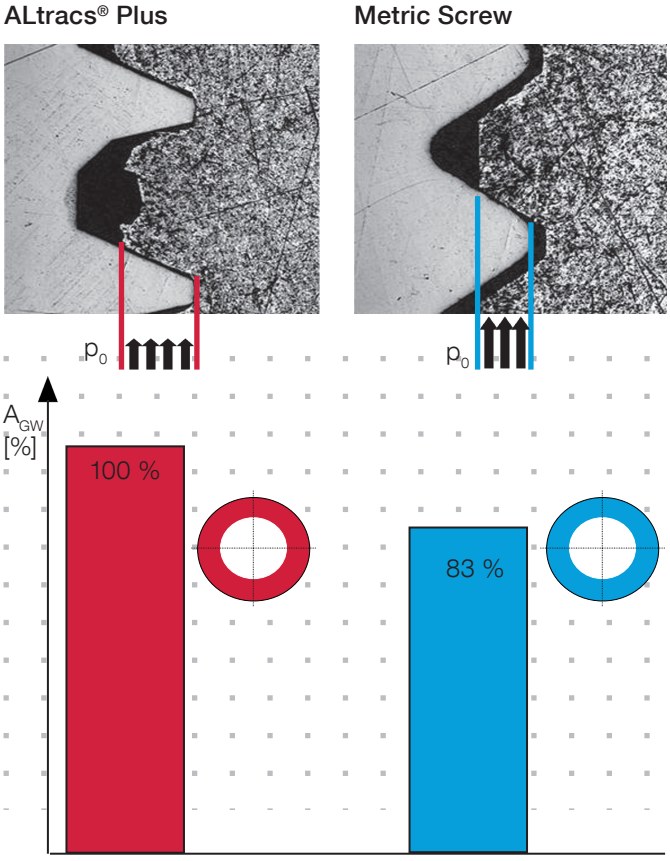
The thread pitch and dimensions ensure metric compatibility and a common metric screw can be used in case of future maintenance or repair.

ALtracs® Plus and metric screws of the same diameter are completely interchangeable if required



ALtracs® Plus thread
metric thread

Load-Carrying Capacity Compared to Metric Fasteners



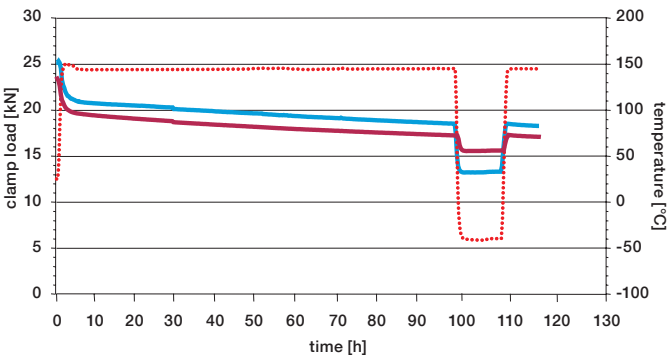
A_{th} = thread engagement
p_0 = surface load

ALtracs® Plus forms a tight-fitting female thread in light metal alloy. Compared to pre-cut metric threads with a minus tolerance at the bolt and a plus tolerance at the female thread ALtracs® Plus achieves a higher thread engagement per thread pitch.

Along with the **geometrically reinforced female thread** the result is a higher load capability of every single ALtracs® Plus turn of thread compared to pre-cut metric screw joints.

The ALtracs® Plus thread withstands high dynamic stress conditions without extra locking features (e.g. lok-king patch, under-head profiles).

Load Retention of ALtracs® Plus vs. Metric Threads



Material: EN AC-46000 (AlSi9Cu3)
Hole diameter: tapped metric thread M8
die cast hole ø 7,6 mm
Tightening torque: 37 Nm

— ALtracs® Plus AP 80
— metric screw 10.9, M8
..... graph temperature

Neutral test institutes certify adequate values for ALtracs® Plus screws compared to high strength screw joints grade 10.9 concerning clamp load torque and fatigue limit.

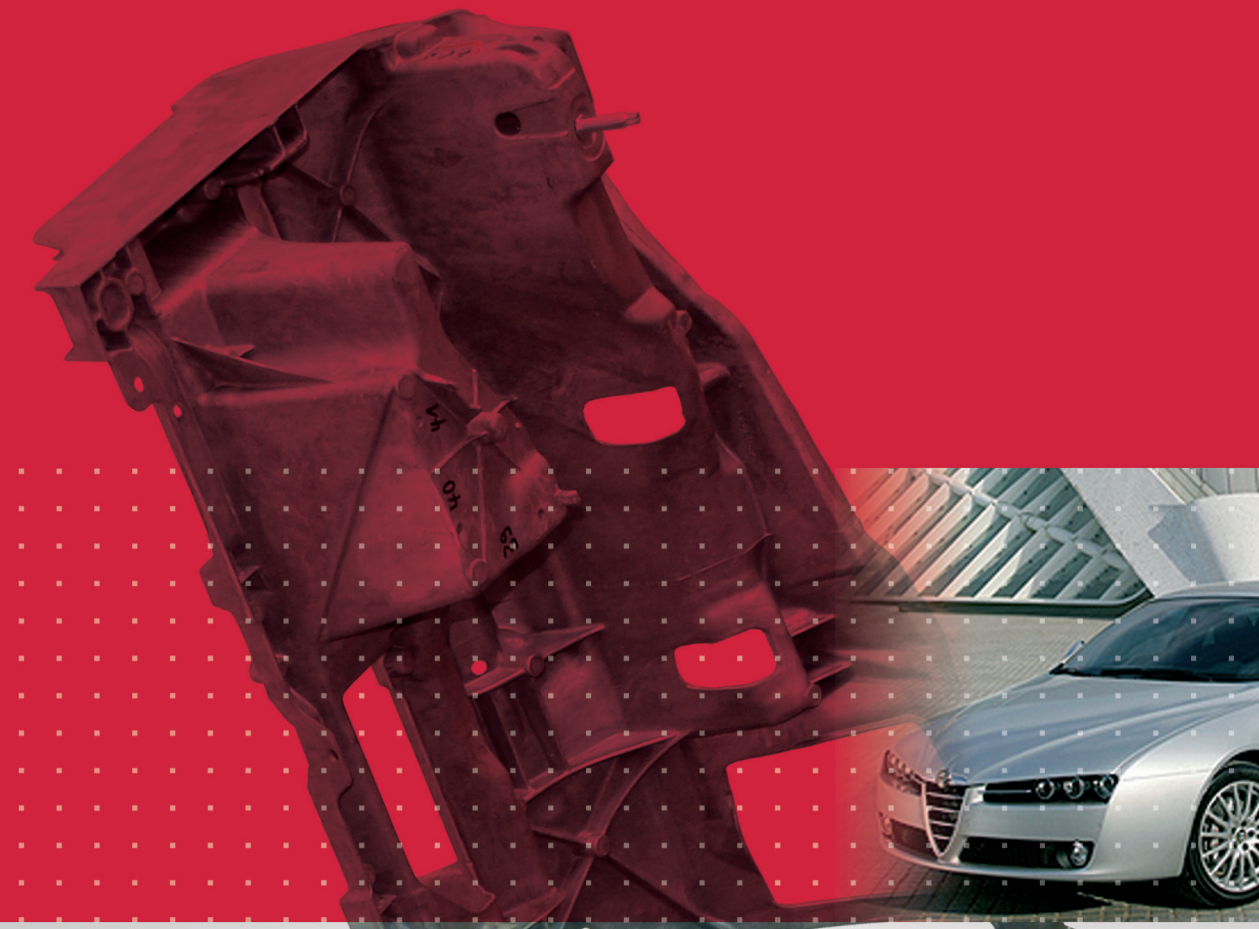
Assemblies of ALtracs® Plus in aluminium die cast

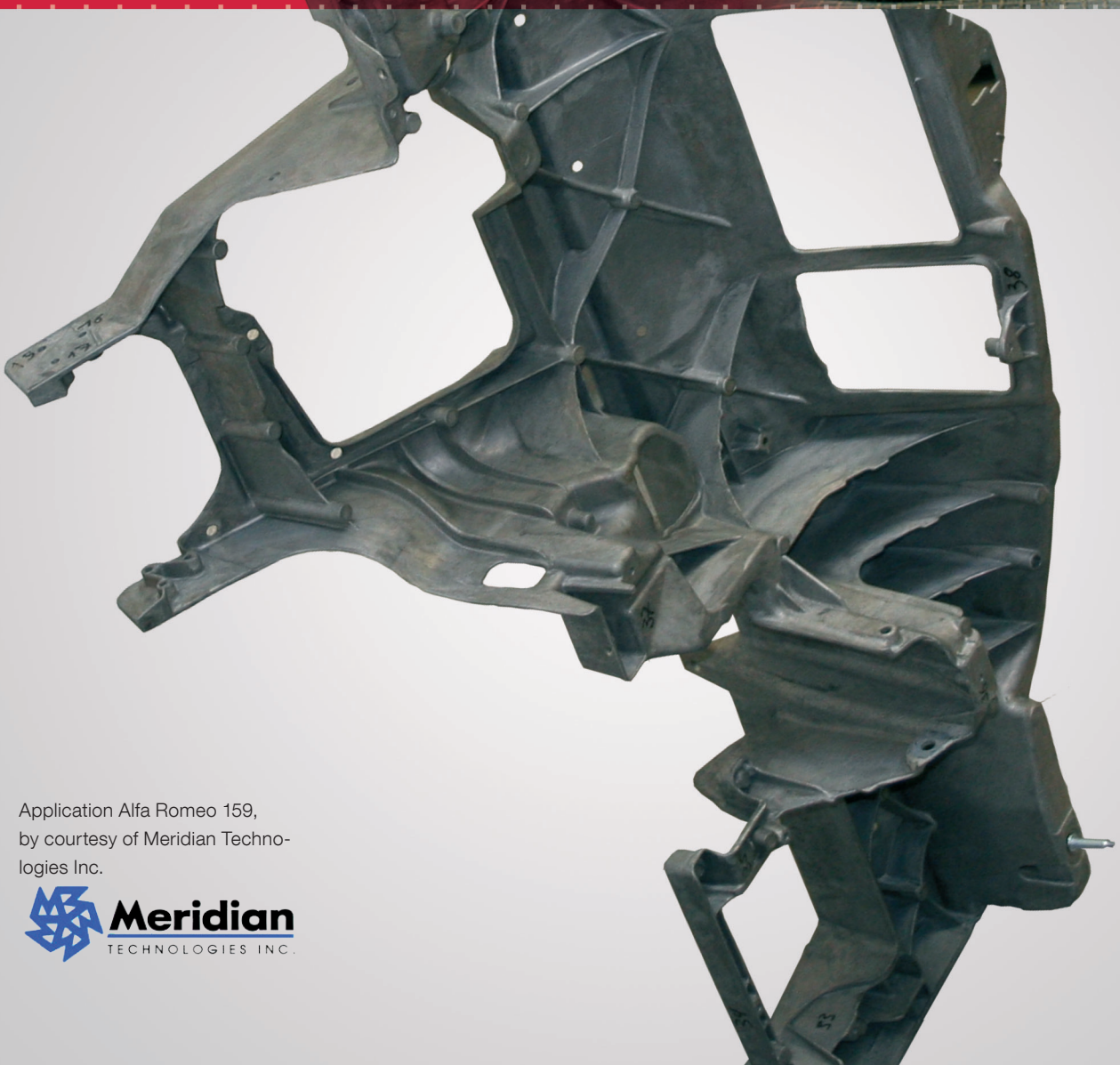
a) with **equal** tightening torque show:

- comparable clamp load
- equal or better break loose torque
- equal or better long term behavior; that is similar loss of clamp load under temperature and dynamic stress as high strength screw joints according to VDI 2230, class 10.9
- higher pull-out force

b) with **higher** tightening torque (to compensate for the installation torque) show:

- higher clamp load
- higher break loose torque
- higher pull-out force



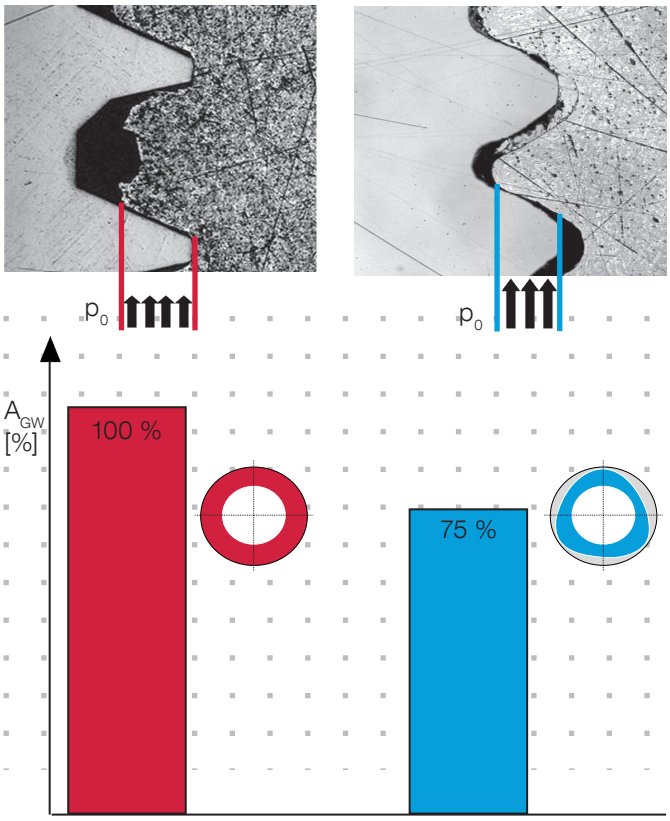


Application Alfa Romeo 159,
by courtesy of Meridian Techno-
logies Inc.

Meridian
TECHNOLOGIES INC.

Load Capacity
Compared to non-circular Fasteners

ALtracs® Plus **Non-circular Screw**



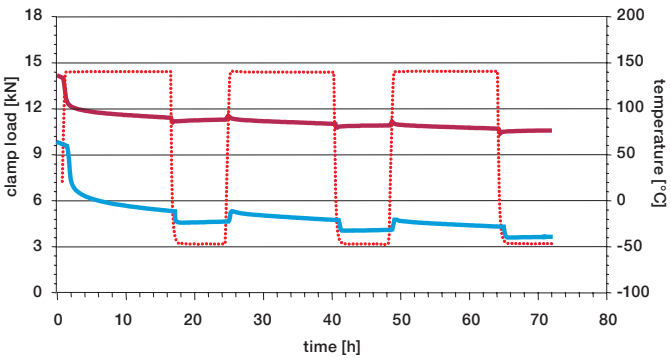
A_{th} = thread engagement
p_0 = surface load

Due to the ALtracs® Plus thread form the **mating material properties are used most effectively**.

This means:

- high assembly safety due to high stripping torque
- high and stable clamp loads due to reinforced female thread flank
- minor creeping due to larger thread flank engagement during thermal/dynamic stress
- possible reduction of insertion depth, resulting shorter screws, smaller component sizes, less weight, and reduced wear and tear of the die casting tools.
- excellent repeat assembly properties
- high vibration resistance

Load Retention of ALtracs® Plus vs. Non-circular Threads



Material: EN AC-46000 (AlSi9Cu3)
Hole diameter: 5,6 mm (blind hole)
Tightening torque: 12,5 Nm

— ALtracs® Plus AP 60
— selftapping screw M6
····· graph temperature

Unlike various other thread designs, the ALtracs® Plus thread with its circular cross section is completely engaged and can be fully loaded. In conjunction with the higher load capacity of the **geometrically reinforced female thread** this leads to:

- improved stripping torque
- improved clamp load
- improved long-term behavior (remaining clamp load, dynamic safety)
- improved break loose torque
- improved pull out force

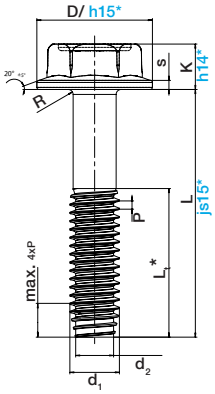
Test results for ALtracs® Plus show advantages of up to 60% in remaining clamp load compared to other self-tapping fasteners, especially under thermal and dynamic stress.

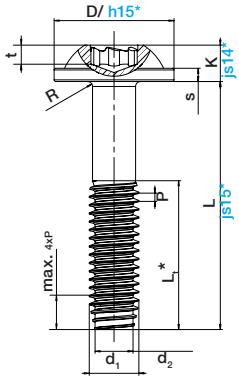
Application Audi,
by courtesy of TCG Unitech

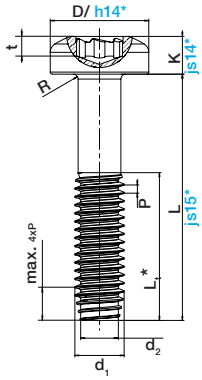
TCG

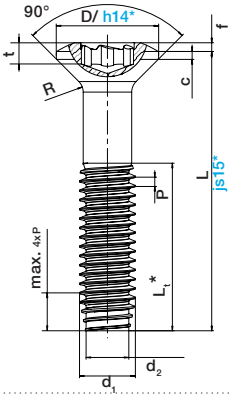
Designs

WN 5117	WN 5151	WN 5152	WN 5153

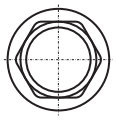




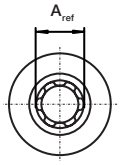




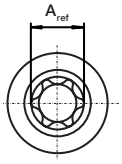
Drives



Hexagon Flange Head

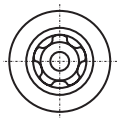


TORXplus® / AUTOSERT®



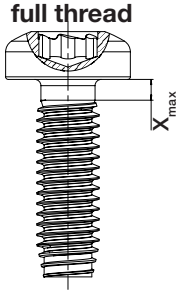
TORX®

Security Drive



Tamper Resistant TORXplus®

Thread run-out of full thread



ALtracs® Plus																	
Nominal Ø		**16**	**18**	**20**	**22**	**25**	**30**	**35**	**40**	**50**	**60**	**[70]**	**80**	**[90]**	**100**	**120**	**140**
External thread-Ø	d_1	1,60	1,80	2,00	2,20	2,50	3,00	3,50	4,00	5,00	6,00	7,00	8,00	9,00	10,00	12,00	14,00
Core-Ø	d_2	1,12	1,32	1,45	1,61	1,88	2,30	2,66	3,02	3,87	4,59	5,56	6,23	7,20	7,86	9,86	11,86
Thread pitch	P	0,35	0,35	0,40	0,45	0,45	0,50	0,60	0,70	0,80	1,00	1,00	1,25	1,25	1,50	1,75	2,00
Thread run-out	X_{max}	0,70	0,70	0,80	0,90	0,90	1,00	1,20	1,40	1,60	2,00	2,00	2,50	2,50	3,00	3,50	4,00

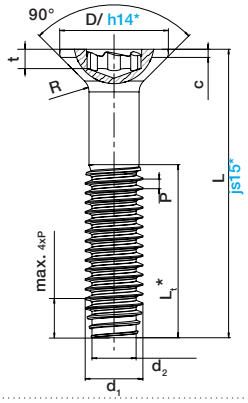
WN 5117																	
Head-Ø	D	**no manufacturing at present**								11,50	14,00	upon request	18,00	upon request			
Width across flats	SW									8,00	10,00		13,00				
Head height	K									4,80	5,50		7,50				
Washer thickness	s									1,00	1,10		1,20				
Radius	R_{max}									0,40	0,50		0,70				

WN 5151																	
Head-Ø	D	upon request	5,00	5,50	6,00	7,50	9,00	10,00	11,50	14,50	upon request	19,00	upon request				
Head height	K		1,50	1,60	2,00	2,25	2,50	2,90	3,40	4,40		5,70					
Washer thickness	s		0,60	0,60	0,60	0,70	0,80	1,00	1,20	1,60		2,00					
Radius	R_{max}		0,30	0,30	0,30	0,40	0,40	0,50	0,50	0,60		0,80					
TORXplus® / AUTOSERT®			6IP	7IP	8IP	10IP	15IP	20IP	25IP	30IP		40IP					
	A_{Ref}		1,75	2,05	2,40	2,80	3,35	3,95	4,50	5,60		6,75					
Penetration depth	t min.		0,65	0,70	0,90	1,00	1,10	1,30	1,50	1,90		2,60					
	max.		0,85	0,85	1,10	1,30	1,40	1,65	1,85	2,30		3,10					

TORX PLUS®/AUTOSERT® is used as a standard recess.
All TORX® recesses from size 8 are available with combi recess.
Other recesses on request.

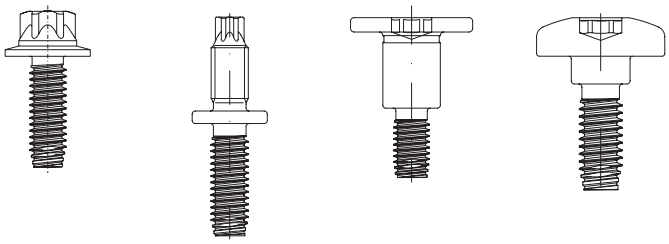
Example of Ordering:
Description of ALtracs® Plus screws with TORX PLUS®/AUTOSERT® recess, nominal Ø 6,0 mm and shaft length 25 mm, thread length 18 mm WN5151
ALtracs® Plus screw WN5151, AP 60 x 25/18

WN 5154



*** see page 14 tolerance**

Specials / Examples



Material:

- through hardened steel AT10 according WN5161, part 2 (analog metric, steel grade 10.9)
- stainless steel grade A2 / A4

Chrome VI Free Platings:

- zinc clear / blue passivated*
- zinc / thick film passivation*
- ZnFe or ZnNi / transparent passivated* (with or without black top coat)
- ZnNi / black passivated*
- zinc flake coatings (for example DELTA PROTEKT)

* Additional sealing possible

Lubrication as Standard
(Dimensions Ø < 3 mm upon request)

Different platings and special design upon request.

Zack Lanman
Phone: 312-206-9031
E-Mail: zlanman@atf-inc.com

ALtracs® Plus																	
Nominal Ø		**16**	**18**	**20**	**22**	**25**	**30**	**35**	**40**	**50**	**60**	**[70]**	**80**	**[90]**	**100**	**120**	**140**
External thread-Ø	d_1	1,60	1,80	2,00	2,20	2,50	3,00	3,50	4,00	5,00	6,00	7,00	8,00	9,00	10,00	12,00	14,00
Core-Ø	d_2	1,12	1,32	1,45	1,61	1,88	2,30	2,66	3,02	3,87	4,59	5,56	6,23	7,20	7,86	9,86	11,86
Thread pitch	P	0,35	0,35	0,40	0,45	0,45	0,50	0,60	0,70	0,80	1,00	1,00	1,25	1,25	1,50	1,75	2,00
Thread run-out	X_{max}	0,70	0,70	0,80	0,90	0,90	1,00	1,20	1,40	1,60	2,00	2,00	2,50	2,50	3,00	3,50	4,00

WN 5152														
Head-Ø	D	upon request	4,00	4,40	5,00	6,00	7,00	8,00	10,00	12,00	upon request	16,00	upon request
Head height	K		1,50	1,60	2,00	2,40	2,70	3,10	3,80	4,60		6,00	
Radius	R_{max}		0,30	0,30	0,30	0,40	0,40	0,50	0,50	0,60		0,80	
TORXplus® / AUTOSERT®			6IP	7IP	8IP	10IP	15IP	20IP	25IP	30IP		40IP	
	A_{Ref}		1,75	2,05	2,40	2,80	3,35	3,95	4,50	5,60		6,75	
Installation depth t	min.		0,65	0,70	0,90	1,10	1,10	1,50	1,75	2,20		2,60	
	max.		0,85	0,85	1,10	1,30	1,40	1,80	1,90	2,60		3,10	

WN 5153														
Head-Ø	D	upon request	3,80	4,40	4,70	5,60	6,50	7,50	9,20	11,0	upon request	14,50	upon request
Cyl. head height	c_{max}		0,35	0,45	0,55	0,55	0,55	0,65	0,75	0,85		0,90	
Calotte height	≈ f		0,50	0,60	0,60	0,75	0,90	1,00	1,25	1,00		2,00	
Radius	R_{max}		0,50	0,60	0,70	0,80	1,00	1,00	1,30	1,60		2,00	
TORXplus® / AUTOSERT®			6IP	7IP	8IP	10IP	15IP	20IP	25IP	30IP		40IP	
	A_{Ref}		1,75	2,05	2,40	2,80	3,35	3,95	4,50	5,60		6,75	
Installation depth t	min.		0,65	0,70	0,90	1,10	1,10	1,50	1,50	1,90		2,60	
	max.		0,85	0,85	1,15	1,30	1,40	1,80	1,85	2,30		3,10	

WN 5154														
Head-Ø	D	upon request	3,80	4,40	4,70	5,50	7,30	8,40	9,30	11,30	upon request	15,80	upon request
Cyl. head height	c_{max}		0,35	0,45	0,55	0,55	0,65	0,70	0,75	0,85		0,95	
Radius	R_{max}		0,50	0,60	0,70	0,80	0,95	1,00	1,30	1,60		2,00	
TORXplus® / AUTOSERT®			6IP	7IP	8IP	10IP	15IP	20IP	25IP	30IP		40IP	
	A_{Ref}		1,75	2,05	2,40	2,80	3,35	3,95	4,50	5,60		6,75	
Installation depth t	min.		0,50	0,70	0,70	0,80	0,95	1,10	1,25	1,55		1,90	
	max		0,65	0,85	0,90	1,05	1,20	1,45	1,60	2,00		2,40	

Manufacturing Range

Nominal Value [mm]								
Tolerance		over 3	over 6	over 10	over 18	over 30	over 50	over 80
	to 3	to 6	to 10	to 18	to 30	to 50	to 80	to 120
h 14	0 - 0,25	0 - 0,30	0 - 0,36	0 - 0,43	0 - 0,52			
h 15	0 - 0,40	0 - 0,48	0 - 0,58	0 - 0,70	0 - 0,84			
js 14	± 0,12	± 0,15	± 0,18	-	-	-	-	-
js 15	± 0,20	± 0,24	± 0,29	± 0,35	± 0,42	± 0,50	± 0,60	± 0,70

ALtracs® Plus Screw	16	18	20	22	25	30	35	40	50	60	70	80	90	100	120	140
External-Ø d_1																
External-Ø tolerance	1,6	1,8	2,0	2,2	2,5	3,0	3,5	4,0	5,0	6,0	7,0	8,0	9,0	10,0	12,0	14,0
Core-Ø tolerance	±0,04	±0,04	±0,04	±0,04	±0,05	±0,05	±0,05	±0,06	±0,06	±0,07	±0,07	±0,07	±0,09	±0,09	±0,09	±0,09
Partial thread L-toler.	+0,12	+0,12	+0,12	+0,12	+0,14	+0,14	+0,14	+0,16	+0,16	+0,18	+0,18	+0,18	+0,22	+0,22	+0,22	+0,22
	-0,70	-0,70	-0,80	-0,90	-0,90	±0,50	±0,60	±0,70	±0,80	±1,00	±1,00	±1,25	±1,25	±1,50	±1,75	±2,00

For full tread please note run-out x_{max}.
Manufacturing range and thread length (figures in dark-grey field = thread length).
Partical thread length for counter sunk heads on request or in the EJOT Service Area under www.ejot.com.

ALtracs® Plus Screw	16	18	20	22	25	30	35	40	50	60	70	80	90	100	120	140
d_1 [mm]	1,6	1,8	2,0	2,2	2,5	3,0	3,5	4,0	5,0	6,0	7,0	8,0	9,0	10,0	12,0	14,0
Length L [mm]																
3,5 ± 0,24	3,5															
4 ± 0,24	4	4	4													
4,5 ± 0,24	4,5	4,5	4,5	4,5												
5 ± 0,24	5	5	5	5	5											
6 ± 0,24	5	6	6	6	6	6										
7 ± 0,29	5	6	6	7	7	7	7									
8 ± 0,29	5	6	6	7	8	7	8	8								
9 ± 0,29	5	6	6	7	8	7	9	9								
10 ± 0,29	5	6	6	7	8	9	9	10	10							
12 ± 0,35	5	6	6	7	8	9	11	10	12	12						
14 ± 0,35	5	6	6	7	8	9	11	12	12	14	14					
16 ± 0,35	5	6	6	7	8	9	11	12	15	14	16	16				
18 ± 0,35		6	6	7	8	9	11	12	15	14	16	18	18			
20 ± 0,42			6	7	8	9	11	12	15	18	16	19	20	20		
22 ± 0,42				7	8	9	11	12	15	18	21	19	21	22		
25 ± 0,42					8	9	11	12	15	18	21	24	21	23	25	
30 ± 0,42						9	11	12	15	18	21	24	27	23	28	30
35 ± 0,50							11	12	15	18	21	24	27	30	28	32
40 ± 0,50								12	15	18	21	24	27	30	36	32
50 ± 0,50									15	18	21	24	27	30	36	42
60 ± 0,60										18	21	24	27	30	36	42
70 ± 0,60											21	24	27	30	36	42
80 ± 0,60												24	27	30	36	42
90 ± 0,70													27	30	36	42
100 ± 0,70														30	36	42

≙ min. length (counter sunk head length "L" + 0,6 x d_1)

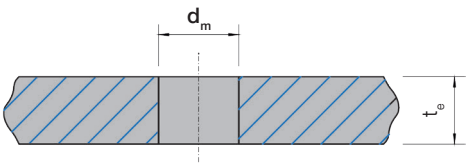
≙ max. length

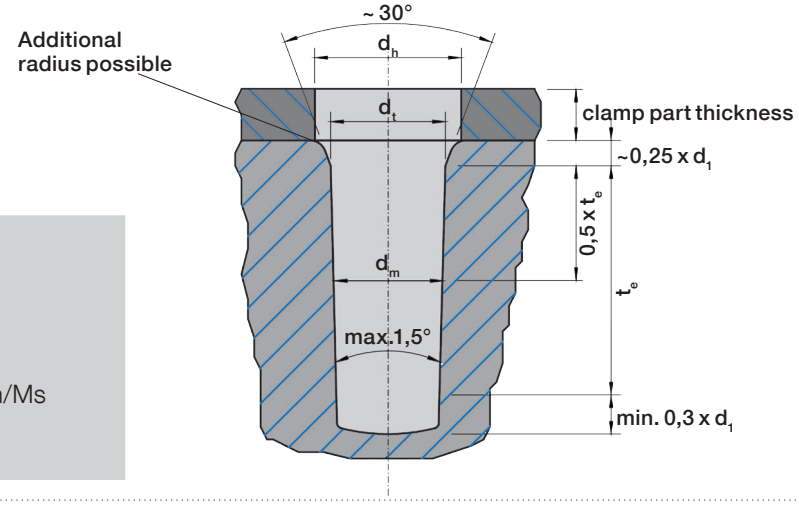
with alternative thread forming zone available

Manufacturing range does not necessarily indicate stock items.

Special length on request!

Design Recommendations





d_1 = nominal diameter of screw
d_m = hole diameter middle
d_t = hole diameter top
t_e = insertion depth
d_h = hole diameter through hole (ca. 1,1 x d_1)
Min. external diameter boss: -ca. 1,8 x d_1 bei Al/Zn/Ms
-ca. 2 x d_1 bei Mg
All indications in mm

Pre-hole recommendation for aluminum, magnesium, zinc, copper, brass, bronce up to hardness of 140 HB

Hardness	Al, Zn, Cu up to 55 HB Mg (up tp 90 HB)			Al, Zn, Cu 55-115 HB -				Al, Zn, Cu 115-140 HB -		
t_e	1,0 x d_1	1,5 x d_1	2,0 x d_1	0,5 x d_1	1,0 x d_1	1,5 x d_1	2,0 x d_1	0,5 x d_1	1,0 x d_1	1,5 x d_1
d_1	d_m	d_m [d_t]*	d_m [d_t]*	d_m	d_m	d_m [d_t]*	d_m [d_t]*	d_m	d_m	d_m [d_t]*
1,6	1,46	1,48 [1,51]	t_{emax}= 1,5 x d_1	1,46	1,48	1,49 [1,52]	t_{emax}= 1,5 x d_1	1,48	1,49	1,51 [1,54]
1,8	1,63	1,65 [1,69]	t_{emax}= 1,5 x d_1	1,63	1,65	1,67 [1,71]	t_{emax}= 1,5 x d_1	1,65	1,67	1,68 [1,72]
2,0	1,83	1,85 [1,89]	t_{emax}= 1,5 x d_1	1,83	1,85	1,87 [1,91]	t_{emax}= 1,5 x d_1	1,85	1,87	1,89 [1,93]
2,2	1,98	2,00 [2,04]	2,03 [2,09]	1,98	2,00	2,03 [2,07]	t_{emax}= 1,5 x d_1	2,00	2,03	2,05 [2,09]
2,5	2,20	2,25 [2,30]	2,30 [2,37]	2,20	2,25	2,30 [2,35]	2,35 [2,42]	2,25	2,30	2,35 [2,40]
3,0	2,65	2,70 [2,76]	2,75 [2,83]	2,65	2,70	2,75 [2,81]	2,80 [2,88]	2,70	2,75	2,80 [2,86]
3,5	3,10	3,15 [3,22]	3,20 [3,29]	3,10	3,15	3,20 [3,27]	3,25 [3,34]	3,15	3,20	3,25 [3,32]
4,0	3,55	3,60 [3,68]	3,65 [3,75]	3,55	3,60	3,65 [3,73]	3,70 [3,80]	3,60	3,65	3,70 [3,78]
5,0	4,40	4,50 [4,60]	4,60 [4,73]	4,40	4,50	4,60 [4,70]	4,70 [4,83]	4,50	4,60	4,70 [4,80]
6,0	5,30	5,40 [5,52]	5,50 [5,66]	5,30	5,40	5,50 [5,62]	5,60 [5,76]	5,40	5,50	5,60 [5,72]
7,0	6,20	6,30 [6,44]	6,40 [6,58]	6,20	6,30	6,40 [6,64]	6,60 [6,78]	6,30	6,40	6,60 [6,74]
8,0	7,00	7,20 [7,36]	7,40 [7,61]	7,00	7,20	7,40 [7,56]	7,50 [7,71]	7,20	7,40	7,50 [7,66]
9,0	7,90	8,10 [8,28]	8,30 [8,54]	7,90	8,10	8,30 [8,48]	8,40 [8,64]	8,10	8,30	8,40 [8,59]
10,0	8,80	9,00 [9,20]	9,20 [9,46]	8,80	9,00	9,20 [9,40]	9,40 [9,66]	9,00	9,20	9,40 [9,60]
12,0	10,60	10,80 [11,04]	11,00 [11,31]	10,60	10,80	11,00 [11,24]	11,20 [11,51]	10,80	11,00	11,20 [11,44]
14,0	12,30	12,60 [12,87]	12,90 [13,27]	12,30	12,60	12,90 [13,17]	13,20 [13,57]	12,60	12,90	13,20 [13,47]

* d_t calculated with 1,5°

Effect of Surface Treatments

Different surface treatments lead to varying friction coefficients. Therefore we recommend assembly tests with screws including definite plating.

Recommended Pre-hole Tolerances

d_1	pre-hole tolerance
1,6 - 2,0	± 0,03
2,2 - 3,5	± 0,04
4,0 - 5,0	± 0,05
6,0 - 7,0	± 0,07
8,0 - 14,0	± 0,10

Advice for Insertion Depth t_e

- safe assembly process (excl. forming point screw) — min. 0,5 x d_1
- vibration safe screw joint (incl. forming point screw) — min. 1,5 x d_1
- high-strength screw-joint (property class 10.9) (incl. forming point screw) — min. 2,0 x d_1

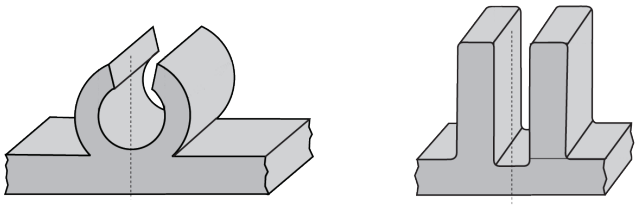
Insertion depth > 2,5 x d_1 is not recommended.

Advice for Assembly

Pneumatic or EC-screw drivers are mandatory for the assembly process. The recommended driver speed complies with the screw diameter (reference values: ≤ Ø 3 mm ~ 700 rpm, Ø 5 mm ~ 500 rpm, ≥ Ø 8 mm ~ 300 rpm).
It is recommended to check out slower or faster assembly speeds prior to production.
Fastening can be carried out using common tightening strategies (controlled by torque or torque/angle or yield strength) Torque/angle or yield strength controlled tightening needs consideration during screw joint design (screw fracture).

Assembly in Extruded Profiles

- Our extensive data base can assist during design process.
  Please contact ATF.
- Installation depth $t_e \geq 1{,}5 \times d_1$



The stated design recommandations are suitable for light alloys and other non-ferrous metals with tensile strength ≤ 470 MPa, hardness ≤ 140 HB. Higher material hardness requires an increased hardness of the thread point. In this case we recommend an inductive hardened ALtracs® Plus screw (EJOT® HardTip).

The detailed hole sizes in the previous table are based on laboratory tests. Due to possible deviations from these values in reality, tests on actual parts prior to start of production are recommended. ATF is running extensive test facilities, the ATF Applications Lab, in order to carry out those evaluations.

Our application engineers are pleased to assist your design team in their planning, developing and assembling needs in order to arrive with a high quality product, assembled in the most cost effective way.

Please contact Zack Lanman for application engineering support.

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