schmid schrauben hainfeld

RAPID® T-Lift
lifting system

Operating instructions | Ultimate limit state calculation
Application information

1. Introduction

The RAPID® T-Lift lifting system consists of:
> RAPID® T-Lift – spherical head anchor for up to 1.3 t or 2.5 t
> with the self-drilling RAPID® T-Lift screw
  ø 12 mm x length l according to ETA-12/0373
  ø 16 mm x length l according to ETA-12/0373

The lifting system complies to the EC Machinery Directive 2006/42/EC, Annex II 1A (EN 13001-1, EN ISO 12100:2011-03, VDI/BV-BS 6205:2012-04). Production is externally approved and monitored.

Basics:
EN 1995-1-1, ETA-12/0373
BGR 500 and UVV-VBG 9a (accident prevention regulation)

2. Safety information and intended use

Before using the RAPID® T-Lift lifting system, read these operating instructions carefully. They must be accessible to the user for reference during operation.

Lifting processes using the RAPID® T-Lift lifting system described shall only be carried out by experienced users (called “users” in these instructions). Users must be instructed on how to use the system correctly in theory and in practice before commissioning it for the first time. The RAPID® T-Lift lifting system offers the highest level of safety when it is used properly.

The RAPID® T-Lift screw can only be screwed once and can be subjected to stress multiple times in this position. Lifting multiple times in the plant until relocation to the job site is permitted. Leave used screws in the component or dispose of them. Always be aware of the exact weight of the components that you are planning to lift.

Only RAPID® T-Lift screws, as calculated under point 6, may be used.

2. 1. RAPID® T-Lift spherical head anchor 1.3 t and 2.5 t

The RAPID® T-Lift spherical head anchor must be visually inspected for damage by the user before each use. The RAPID® T-Lift spherical head anchor must be checked once a year by experienced persons or by a safety officer from the user company. The level of wear and damage should be assessed during this check.

> Visual check for cracks in the sphere and connector
> Visual check for deformations – e.g. bent chain links, indentations, deformations, dents caused by lifting equipment, etc.
> Check whether permissible wear limits are exceeded or not reached. If the upper limit “h” is exceeded or the lower limit “m” is not reached, do not continue to use the RAPID® T-Lift lifting system in question.
> Modifications and repairs, especially by means of welding, are prohibited.

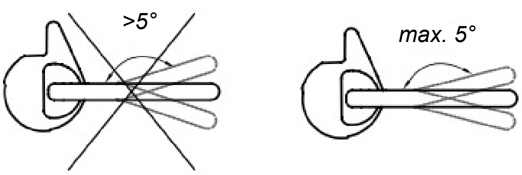


Fig. 1: Bent chain link

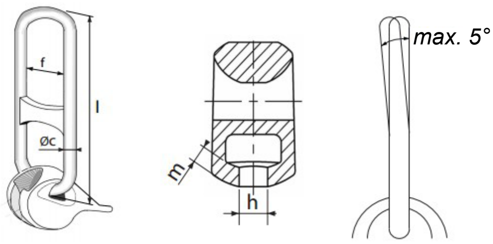


Fig. 2: Limits for continued use of the RAPID® T-Lift spherical head anchor to be checked on a yearly basis as well as other informative values

Yearly inspection measurements (document with identification number for compliance)					
Load group	m (min.)	h (max.)	Ø c	max. wear Ø c	max. deformation
1.3 t	5.5 mm	13.0 mm	10.5	10 % = 1.1 mm	5°
2.5 t	6.0 mm	18.0 mm	12.5	10 % = 1.3 mm	5°

Table 1: Inspection measurements for the RAPID® T-Lift spherical head anchor 1.3 t and 2.5 t

2. 2. Self-drilling RAPID® T-Lift screw Ø 12 mm and Ø 16 mm

SFS SR-T-Hx-xx-Lift

The RAPID® T-Lift screw shall only be used once with the RAPID® T-Lift spherical head anchor. Leave used screws in the component or dispose of them. Reused screws are at risk of malfunctioning!

Standard screw lengths

> 12 x 60/48
> 12 x 80/68
> 12 x 100/85
> 12 x 120/105
> 12 x 140/125
> 12 x 160/145
> 12 x 180/165
> 12 x 220/205
> 12 x 300/285
> 12 x 380/365
> 16 x 180/155
> 16 x 240/215
> 16 x 280/255
> 16 x 320/295
> 16 x 400/375
> 16 x 600/575

The screws must not be screwed into shrinkage cracks, seams or the like.
Do not use RAPID® T-Lift lifting systems in lifting processes or transport involving helicopters.

Bar-shaped components (beams) must be lifted with at least two RAPID® T-Lift screws; at least three RAPID® T-Lift screws must be used for slab-shaped parts.

3. Intended use of the RAPID® T-Lift lifting system

The RAPID® T-Lift spherical head anchor, made of high-quality steel, is intended for the safe and easy lifting of timber parts made of solid wood, cross-laminated timber or wood-based materials (cf. the materials listed in ETA-12/0373). Timber parts are understood to mean:

> bar-shaped components
> slab-shaped parts or
> assembled structures (e.g. frameworks, prefabricated house walls or floor panels)

The RAPID® T-Lift spherical head anchor for the load group up to 1.3 t or up to 2.5 t must only be used with the self-drilling RAPID® T-Lift screw certified under ETA-12/0373, Ø 12 mm or Ø 16 mm.

The self-drilling RAPID® T-Lift screw Ø 12 mm or Ø 16 mm may be screwed into softwood without pre-drilling (see ETA-12/0373, e.g. solid wood, veneers, cross-laminated timber, wooden boards and beams etc.). But fully or partially pre-drilling (e.g. for guidance or orientation) with max. Ø 7 mm for Ø 12 mm screws or max. Ø 10 mm for Ø 16 mm screws is possible too.
Hardwood must be pre-drilled with Ø 7 mm or Ø 10 mm before use. For cross-laminated timber walls, observe the information in the document "RAPID® T-Lift - lifting capacity for CLT wall elements".

The permissible mounting positions are listed under point 7 and must be observed.
Screws must not be screwed into cracks, seams, etc.

4. Handling the RAPID® T-Lift lifting system

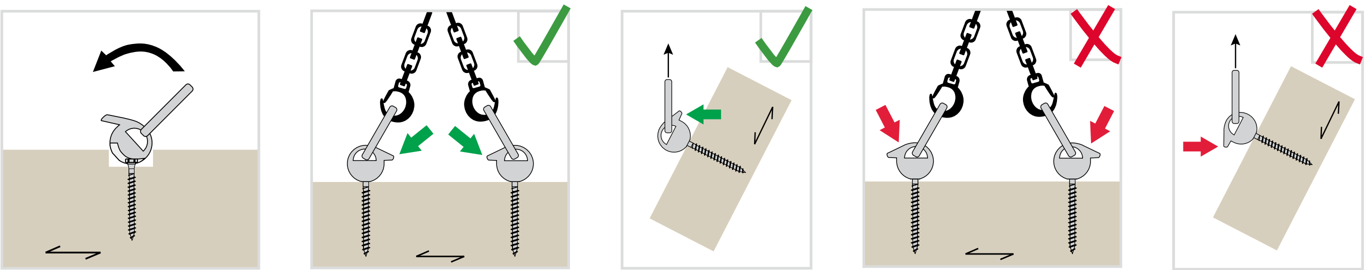


Fig. 3: Connecting the RAPID® T-Lift lifting system correctly (i.e. the lug on the sphere must point inward)

Lifting capacity: Permissible angles of inclination must be taken into account for load lifting; see point 7.
The RAPID® T-Lift screw can be left in timber, screwed in and fully countersunk or completely unscrewed and disposed of (ATTENTION: do not reuse!).

5. Bases of assessment for lifting with the crane

The ultimate limit state of the RAPID® T-Lift lifting system is based on the minimum ultimate limit states of the RAPID® T-Lift spherical head anchor (1.3 t or 2.5 t) and the RAPID® T-Lift screw (Ø 12 mm or Ø 16 mm).

The weight force of the timber part to be lifted opposite the ultimate limit state must be determined according to EN 1991, national standards (e.g. DIN 1055-1), or specific manufacturer's information.

If the timber elements are lifted professionally, the weight forces that act upon the RAPID® T-Lift lifting system, $F_{ax, Ed}$ can be interpreted as quasi-static loading. As such, the limitation of the RAPID® T-Lift screw defined in ETA-12/0373 can be considered satisfied on predominantly static loads.

Dynamic effects while lifting can be simplistically factored in through equivalent oscillation coefficients. It is recommended to multiply acting forces by the oscillation coefficients φ given in Table 3.

Recommended oscillation coefficients		
Lifting device	**Lifting speed**	**Oscillation coefficients φ**
Stationary crane, revolving crane or rail crane	≤ 90 m/minute	1.0–1.1
Stationary crane, revolving crane or rail crane	> 90 m/minute	> 1.3
Lifting and transport on even terrain	—	> 1.65
Lifting and transport on uneven terrain	—	> 2.0

Table 3: Recommended oscillation coefficients φ

The suspension gear is defined by the quantity of RAPID® T-Lift screws used. Statically indeterminate suspension gear essentially has more than 3 strands on which the load is unevenly distributed using suitable measures, e.g. compensating cross beams, compensators etc.

Statically indeterminate suspension gear must be designed with consideration for UVV-VBG 9a so that two anchor points can take up the entire load. The loads acting on the anchor points are determined according to triangle of forces.
Using suitable measures (e.g. compensating cross beams), fastenings with more than three anchor points can be designed as statically determinate. For statically determinate suspension gear, all anchor points can be used to take up the load.

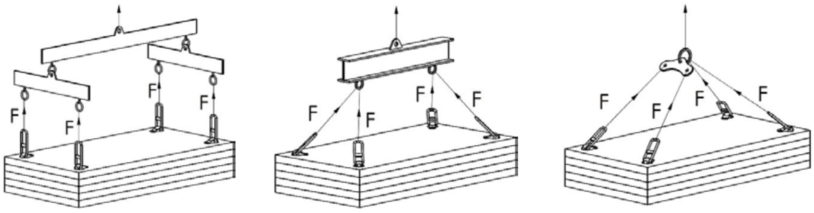


Fig. 4: Three examples of statically determinate suspension gear

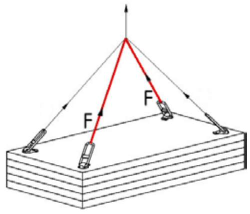


Fig. 5: Statically indeterminate suspension gear

6. Bases of assessment for RAPID® T-Lift - stressed in axial direction

The minimum distance of the RAPID® T-Lift screws to each other in direction of the grain and to the end grain should be selected as ≥ 25d (≥ 300 mm for d = 12 mm and ≥ 400 mm for d = 16 mm).

The distance to the unloaded edge perpendicular to the grain should be selected as ≥ 3d. This results in a minimum timber component width of 72 mm (Ø 12 mm) or 96 mm (Ø 16 mm).
Douglas fir wood requires a 50% increase in the minimum distance in direction of the grain.

The withdrawal resistance of the RAPID® T-Lift screw is essentially defined by the outer thread diameter d and the screw-in depth or thread length l_{ef}.

Key:

d	outer thread diameter [mm]
l_{ef}	effective thread length in the timber component [mm]
ρ_k	characteristic density of the timber element [kg/m³]
$F_{ax,Rk}$	characteristic value of load-bearing capacity of the RAPID® T-Lift screw [N]
$F_{ax,Rd}$	design value of the load-bearing capacity [N]
$F_{ax,Ek}$	characteristic value of the load on each screw [N]
$F_{ax,Ed}$	design value of the load on each screw [N]
k_{mod}	strength modification factor
$\gamma_{M,wood}$	partial factor
φ	oscillation coefficient
M	lifting load (proportion of actual dead load) per RAPID® T-Lift [kg]

Calculation of the characteristic load-bearing capacity in [N] e.g. for (C24, ρ_k = 350 kg/m³):

ø 12mm $\quad F_{ax,Rk} = 11.2\ [N/mm^2] \times d \times l_{ef} = 134.4 \times l_{ef}$
ø 16mm $\quad F_{ax,Rk} = 11.0\ [N/mm^2] \times d \times l_{ef} = 176.0 \times l_{ef}$

These formulars apply to screws placed at an angle of 45° ≤ α ≤ 90° (α is the angle between the screw axis and the direction of the grain). For cross-laminated timber walls, observe the information in the document "RAPID® T-Lift - lifting capacity for CLT wall elements".

Note: Use with an angle of less than 45° is not recommended due to the high reduction required!

The effective thread length l_{ef} shall be at least 48 mm (Ø 12 mm) or 64 mm (Ø 16 mm)!

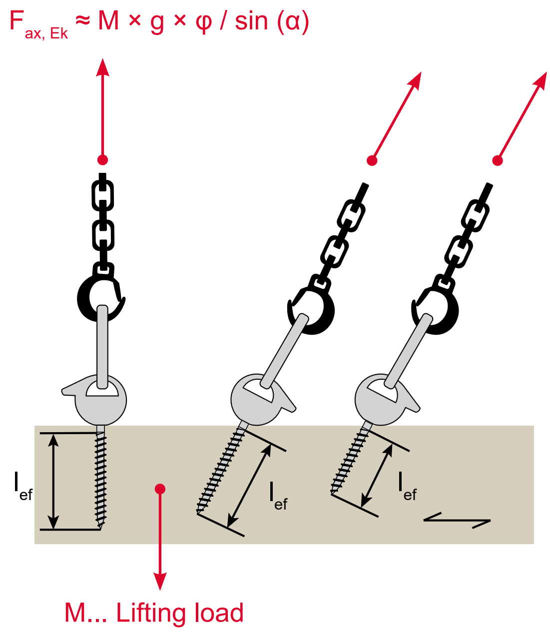


Fig. 6: Load in the screw in its axial direction and effective thread length, $l_{ef} \geq 4d$

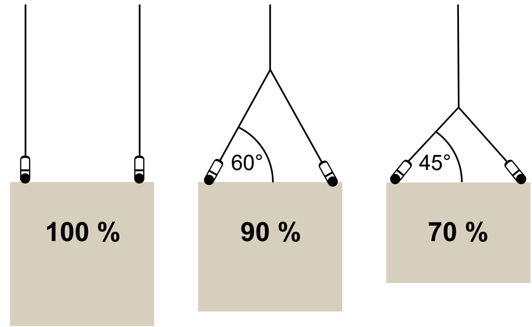


Fig. 7: The possible lifting capacity is reduced based on the hanging angle (screw's ultimate limit state remains the same)

Calculation of the design value of the load-bearing capacity e.g. for C24, ρ_k = 350 kg/m³:

$F_{ax,Rd} = k_{mod} / \gamma_{M,wood} \times F_{ax,Rk}$

k_{mod} = 0.9 (for wood moisture content ≤ 20%). Additional values for k_{mod} can be found in EN 1995-1-1. The value k_{mod} = 1.1 for load duration of action "very short" was not applied to increase safety!

$\gamma_{M,wood}$ = 1.3 (Note: in Italy, this factor is equal to 1.5!)

Calculation of maximum load-bearing capacity $F_{ax, Rd}$ per RAPID® T-Lift screw in [N]:

ø 12mm $F_{ax,Rd} = 93.05 \times l_{ef}$
ø 16mm $F_{ax,Rd} = 121.8 \times l_{ef}$

These values apply to a characteristic density of the timber of ρ_k = 350 kg/m³. The load-bearing capacity determined for deviating densities must be corrected with the factor $k_{dens} = (\rho_k / 350)^{0.8}$ (ρ_k in kg/m³).

Verification is carried out by comparing the load-bearing capacity $F_{ax,Rd}$ with the design value of the load per screw $F_{ax,Ed}$:

ø 12mm $F_{ax,Ed} = 1.35 \times F_{ax, Ek} \leq F_{ax,Rd} = 93.05 \times l_{ef}$
ø 16mm $F_{ax,Ed} = 1.35 \times F_{ax, Ek} \leq F_{ax,Rd} = 121.8 \times l_{ef}$

For exact values of the load capacity of the RAPID® T-Lift lifting system, please refer to our lifting capacity tables.

Note: At a thread length of 220 mm or more, the withdrawal capacity of the Ø 12 mm screw is already is higher than that of the RAPID® T-Lift spherical head anchor.

Two RAPID® T-Lift spherical head anchor must be used to lift one component. Under axial load, one RAPID® T-Lift screw is required per anchor point. In accordance with ETA-12/0373, timber components must have a minimum thickness t and a minimum width b. Observe the values in Table 4 as minimum distances.

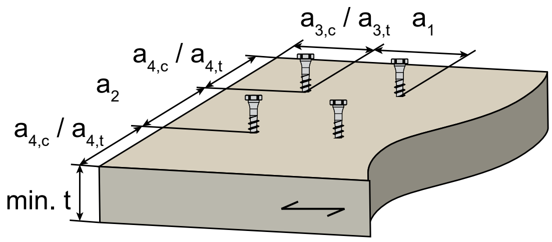


Fig. 8: Screw distances of the RAPID® T-Lift screw

Minimum distances for RAPID® T-Lift screw			
		Distance Ø 12 mm	Distance Ø 16 mm
Between the screws parallel to grain	$a_1 \geq 25 \times d$	300 mm	400 mm
Between the screws perpendicular to grain	$a_2 \geq 5 \times d$	60 mm	80 mm
To the unloaded edge perpendicular to grain	$a_{4,c} \geq 3 \times d$	36 mm	48 mm
To the loaded edge perpendicular to grain	$a_{4,t} \geq 10 \times d$	120 mm	160 mm
To the unloaded end parallel to grain	$a_{3,c} \geq 15 \times d$	180 mm	240 mm
To the loaded end parallel to grain	$a_{3,t} \geq 25 \times d$	300 mm	400 mm

Table 4: Minimum distances of RAPID® T-Lift screws in accordance with ETA-12/0373

Minimum dimensions for RAPID® T-Lift screw			
		Ø 12 mm	Ø 16 mm
Minimum thickness of CLT floors	t	60 mm	80 mm
Minimum component width of beams	b_{min}	72 mm	96 mm
Minimum component width of CLT walls	$b_{min\ CLT\ walls}$	60 mm	80 mm

Table 5: Minimum widths according to ETA-12/0373 or lifting capacity

Lifting a horizontal element (wall, floors etc.) with Ø 12 mm RAPID® T-Lift screw

Avoid bending the RAPID® T-Lift screw while lifting (e.g. by lowering the spherical head). Due to the combined load, the screw's load-bearing capacity must be verified as described under point 7.2.

NOTE on Fig. 9: It shall be to checked whether an additional full-thread screw is required to provide protection against tensile stress perpendicular to the grain.

Minimum thickness t = 156 mm for Ø 12 mm
Minimum thickness t = 208 mm for Ø 16 mm

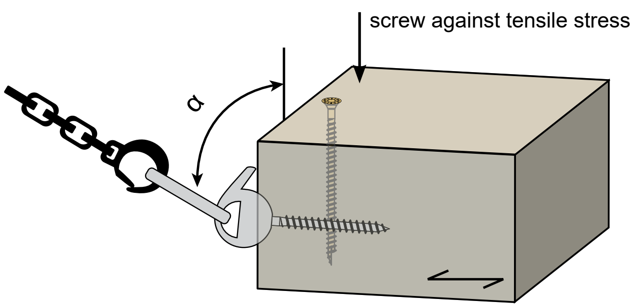


Fig. 9: Lifting a horizontal element (α = 0°) or under oblique tension

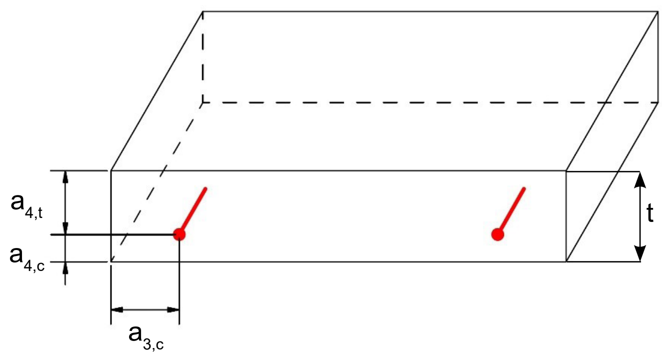


Fig. 10: Assembly of the RAPID® T-Lift screws on the narrow or side surface (not at the end grain)

7. Mounting positions with the various resulting loads

The RAPID® T-Lift screw can be mounted in 3 different variants.

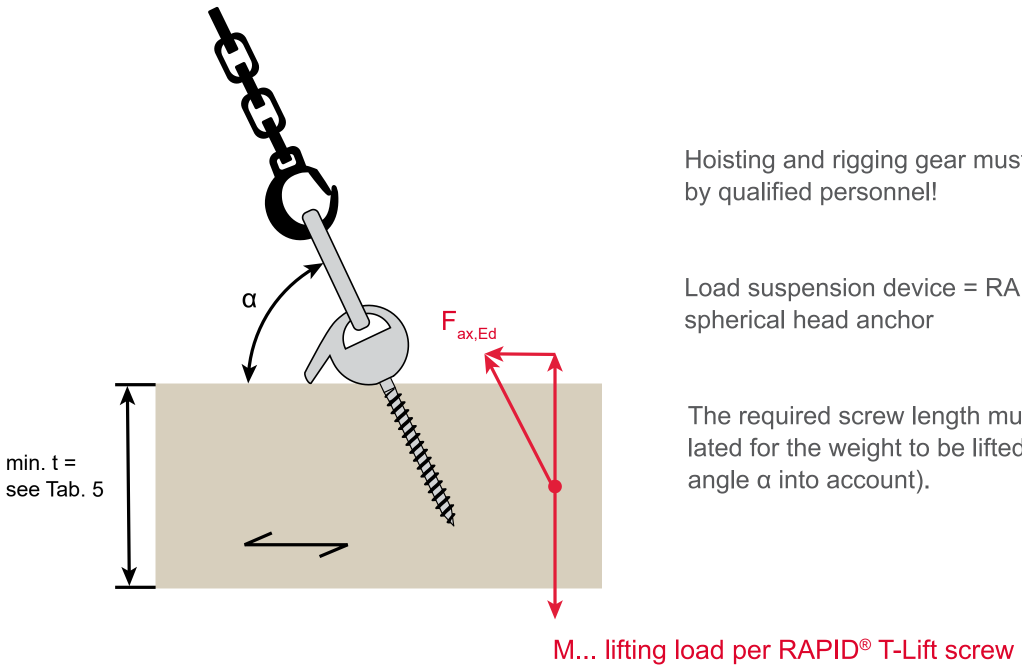
They are:

7.1. Axial tension loading of the screw
7.2. Oblique tension loading of the screw
7.3. Oblique tension loading with a recess drilled to fit the spherical head perfectly

7. 1. Axial tension loading of the RAPID® T-Lift screw

If the screw is subjected to ideal axial tension load in its axial direction, this is called an axial loading (see Fig. 11).

Formula: $\mathbf{F_{ax,\,Ed} = F_{ax,Ek} \times 1.35 = M \times g \times \varphi / \sin\alpha \times 1.35}$… applies to angles α = 45° to 90° for each anchor point



Hoisting and rigging gear must be specified by qualified personnel!

Load suspension device = RAPID® T-Lift spherical head anchor

The required screw length must be calculated for the weight to be lifted (taking angle α into account).

Fig. 11: Axial loading of the RAPID® T-Lift screw

The load-bearing capacities per anchor point can be found in our lifting capacity tables, *RAPID® T-Lift for CLT wall elements* and *RAPID® T-Lift for floor elements and beams*, on our homepage: *www.schmid-screw.com/en/downloadcenter*

7. 2. Oblique tension loading of the RAPID® T-Lift screw

If the RAPID® T-Lift screw is subjected to axial tension and shear loads simultaneously, this is called oblique tension loading (see Fig. 12). The angle α must be at least 60°.

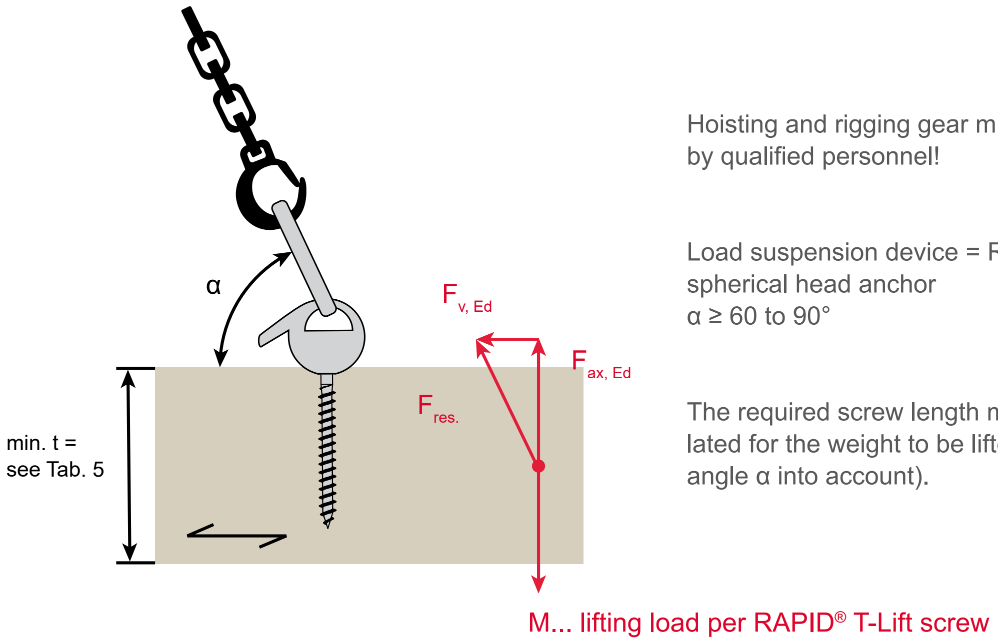
For the calculation of the characteristic load-bearing capacity in case of a shear load on the screw, the failure mechanism is assumed to be a single shear, thin steel-to-timber connection in accordance with EN 1995-1-1.

$$F_{\mathrm{v,Rk}} = min\begin{Bmatrix} 0.4 * f_{\mathrm{h,k}} * t_1 * \mathrm{d} \\ 1.15 * \sqrt{2 * M_{\mathrm{y,Rk}} * f_{\mathrm{h,k}} * d} + \frac{F_{\mathrm{ax,Rk}}}{4} \end{Bmatrix} \quad \ldots [N]$$

$$F_{\mathrm{v,Rd}} = \frac{F_{\mathrm{v,Rk}} * k_{\mathrm{mod}}}{\gamma_{\mathrm{M,Holz}}} \ldots [N]$$

Verification is carried out using the formula:

$$\left(\frac{F_{\mathrm{ax,Ed}}}{F_{ax,Rd}}\right)^2 + \left(\frac{F_{v,\mathrm{Ed}}}{F_{v,Rd}}\right)^2 \leq 1$$



Hoisting and rigging gear must be specified by qualified personnel!

Load suspension device = RAPID® T-Lift spherical head anchor
α ≥ 60 to 90°

The required screw length must be calculated for the weight to be lifted (taking angle α into account).

Fig. 12: Oblique tension loading of the RAPID® T-Lift screw

> Characteristic yield moment of the screw:
  $M_{y,k}$ = 48,500 Nmm (for Ø 12 mm) or $M_{y,k}$ = 112,900 Nmm (for Ø 16 mm)
> Modification factor for timber and wood-based materials k_{mod} = 0.9
> Partial factor for timber and wood-based materials γ_M = 1.3 (Italy 1.5)

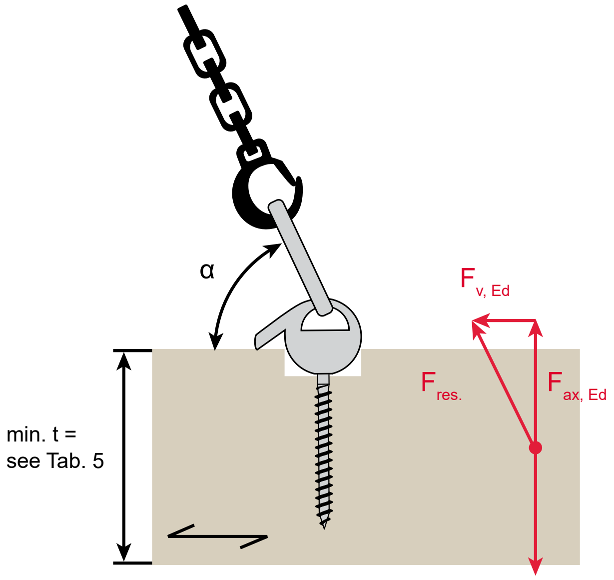
$f_{h,\alpha,k}$ = *0.082 ×* ρ_k × $d^{-0.3}$ */ (2.5 ×* $\cos^2\alpha$ + $\sin^2\alpha$*)* ... cf. ETA-12/0373

With a characteristic density of at least ρ_k = 350 kg/m³ for screws placed vertically into the side face (**α** = 90°):

$f_{h,90°,k}$ = *0.082 × 350 x* $d^{-0.3}$ = *28.7 ×* $d^{-0.3}$

7. 3. Oblique loading with a recess drilled to fit the spherical head perfectly

When a recess is drilled to fit the spherical head perfectly, under oblique tension loading, the horizontal portion of the force is transferred directly to the timber through the spherical head. The load at the screw therefore corresponds to axial tensile loading and may be verified as specified in point 7.1.



Hoisting and rigging gear must be specified by qualified personnel!

Load suspension device = RAPID® T-Lift spherical head anchor
$\alpha \geq$ 45 to 90°

The required screw length must be calculated for the weight to be lifted (taking angle α into account).

Fig. 13: Axial load at a RAPID® T-Lift screw with a recess drilled to fit the sherical head perfectly.

The recess for the spherical head must be drilled according to the following information using a Forstner drill bit or a similar tool, as shown e.g. in Fig. 14.

Ø 12 mm	drilled hole d = 60-70 mm, 30 mm deep
Ø 16 mm	drilled hole d = 75-85 mm, 30 mm deep

Tip: Pre-mount the RAPID® T-Lift screws in the factory.

Fig. 14: Recess

8. Markings for the RAPID® T-Lift lifting system

8. 1. RAPID® T-Lift spherical head anchor for up to 1.3 t or 2.5 t

A serial number is engraved in the RAPID® T-Lift spherical head anchor so that test results can be unambiguously assigned.

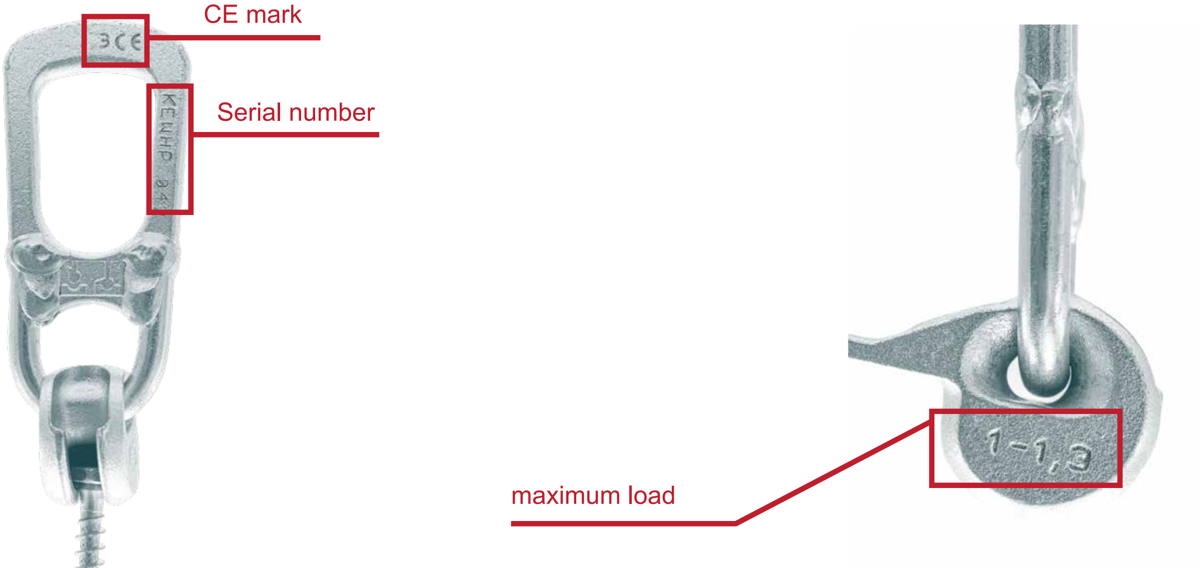


Fig. 15: CE mark, serial number and maximum load on the RAPID® T-Lift spherical head anchor

8. 2. RAPID® T-Lift screw Ø 12 mm or Ø 16 mm

In accordance with ETA-12/0373, the manufacturer's embossing is clearly identifiable on the head. Traceability is possible via the label number.

Head embossing on RAPID® T-Lift screws

The German original of this document shall apply in the event of any doubt.

Experience
We have been specialists in the manufacture of wood construction screws since 1842.

Sustainability
We take care of our environment and manufacture according to ISO 14001 and ISO 50001.

Always available
Our warehouse is always stocked with our extensive range.

Your screw - Your brand
We manufacture screws exactly according to your wishes.

Special hardening
Our screws are viscoplastic and bendable by at least 45° - elastic and high-strength.

Service orientation
Whether with calculations, expertise or experience - we are there for our customers.

Statics
Our screws have above-average mechanical values for pull-out and head pull-through.

Safety
Our screws are approved according to ETA-12/0373.

Highest quality
We manufacture to ISO 9001 specifications.

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