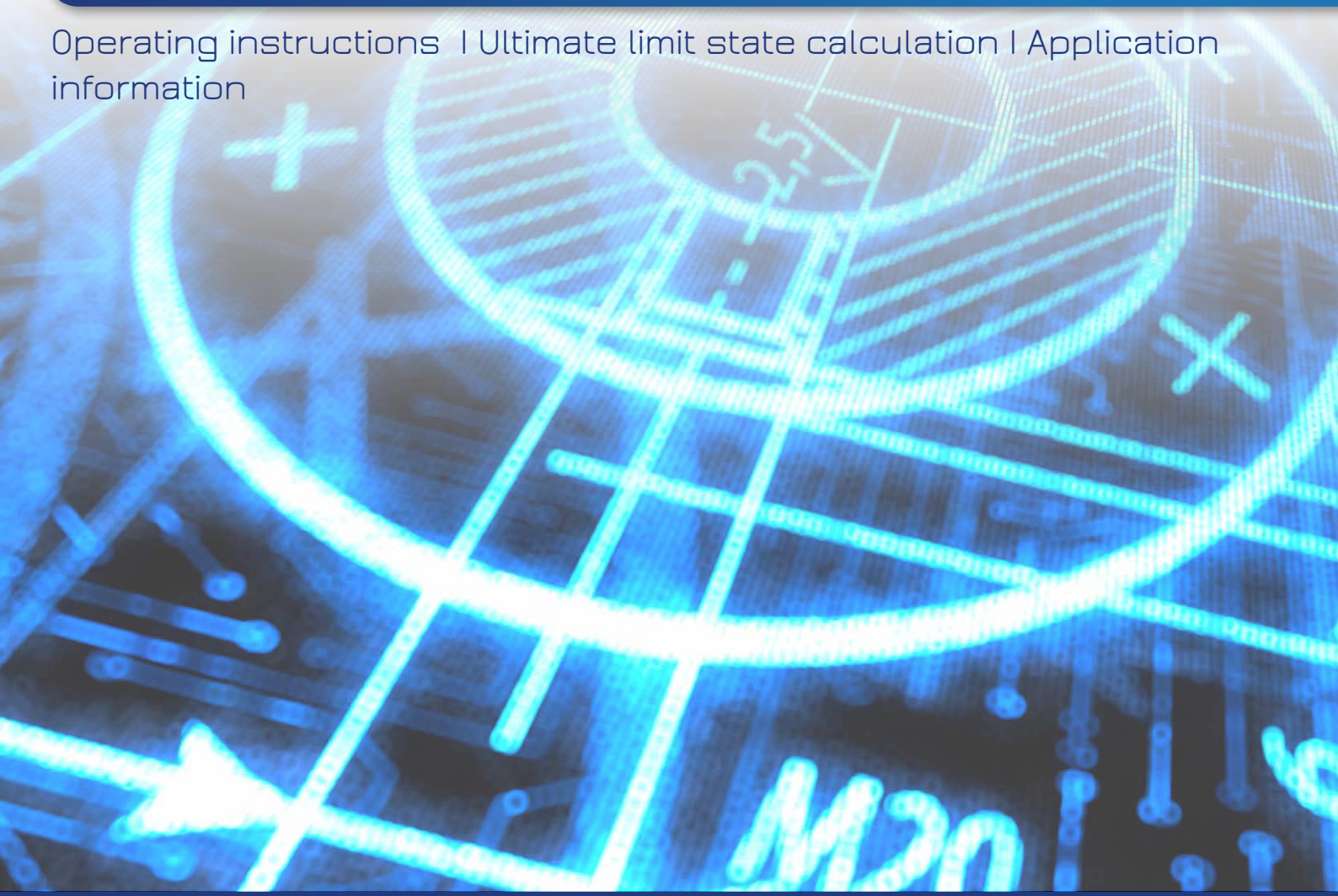
schmid schrauben hainfeld

RAPID® T-Lift lifting system

Operating instructions I Ultimate limit state calculation I Application information



1. Introduction

The RAPID® T-Lift lift lifting system consists of:
RAPID® T-Lift – ball head lifting system for up to 1.3 t or 2.5 t
with the self-drilling **RAPID® T-Lift – screw**

ø12 mm × length l according to ETA-12/0373

ø16 mm x length l according to ETA-12/0373

Corresponds 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 may 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.

It reliably excludes the possibility of prior overload. **The RAPID® T-Lift screw can only be screwed once and can be subjected to stress multiple times in this position** (meaning that 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 ball head lifting system 1.3 t and 2.5 t

The RAPID® T-Lift ball head lifting systems must be visually inspected for damage by the user before each use. The RAPID® T-Lift ball head lifting systems 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 ball and connector
- Visual check for deformations in the plastic – 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.

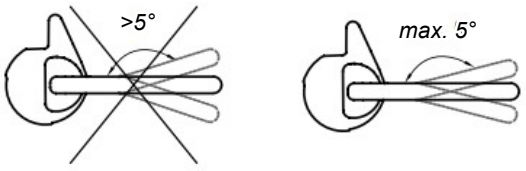


Fig. 1: Bent chain link

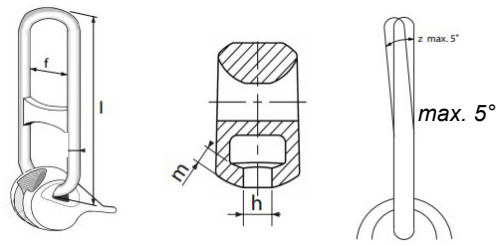


Fig. 2: Limits for continued use of the RAPID® T-Lift to be checked on a yearly basis as well as other informative values

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 ball head lifting system 1.3 t and 2.5 t

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

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

Standard screw lengths

- 12 × 60/48
- 12 × 80/68
- 12 x 120/105
- 12 x 140/125
- 12 x 160/145
- 12 x 180/165
- 12 x 220/205

Other dimensions available by request, e.g.:

- 16 x 180/155
- 16 x 240/215
- 16 x 280/255
- 16 x 320/295

The screws may 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 ball head lifting system, 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 ceiling panels)

The RAPID® T-Lift ball head lifting system for the load group up to 1.3 t or up to 2.5 t may only be used with the self-drilling RAPID® T-Lift screw certified under ETA-12/0373, Ø 12 mm or Ø 16 mm. The length of the screw thread is the limiting factor for the RAPID® T-Lift lifting system's ultimate limit state.

The self-drilling RAPID® T-Lift screw Ø 12 mm (Ø 16 mm) must be screwed into coniferous wood without pre-drilling (see ETA-12/0373, e.g. solid wood, veneers, cross-laminated timber, wooden boards and beams etc.), but drilled holes for guidance or orientation, for example, max. Ø 7 mm (Ø 10mm) can be fully or partially pre-drilled.
Solid wood must be pre-drilled with Ø 7 mm (Ø 10mm) before use. For cross-laminated timber walls, observe the information in the load lifting table for walls (narrow edge).

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

4. Handling the RAPID® T-Lift lifting system

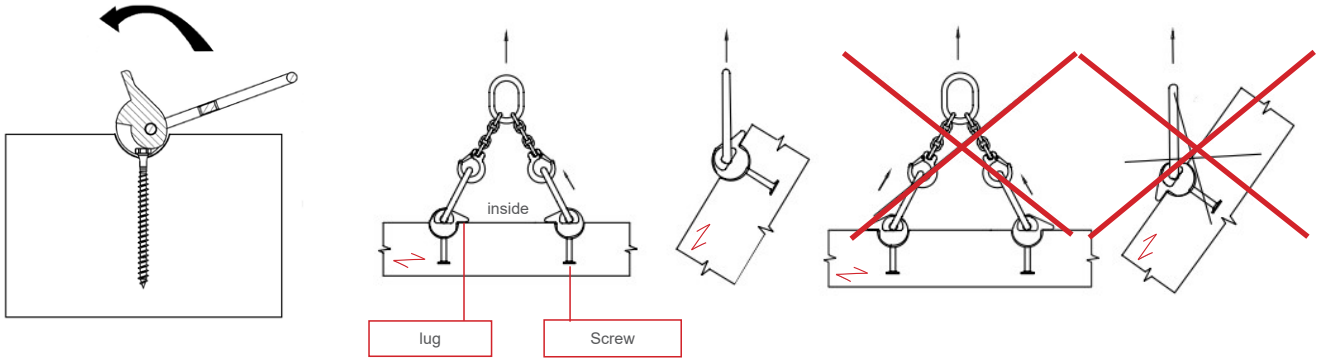


Fig. 3: Connecting the RAPID® T-Lift transport lifting system correctly (i.e. the lug on the ball must point inward)

Lifting loads: Permissible angles of inclination must be taken into account for load lifting; see Point 7 a) to c).

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

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

Dynamic loads 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 must be used to take up the load.

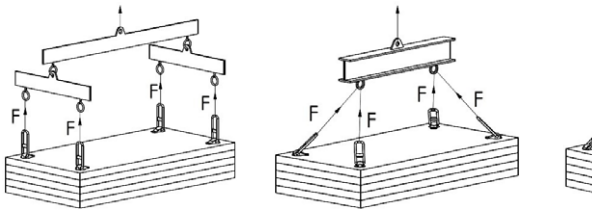


Fig. 4: Three examples of statically determinate suspension gear

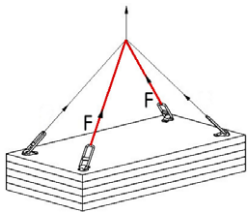


Fig. 5: Statically indeterminate suspension gear

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 the grain direction and to the end grain wood should be selected as 25*d (≥ 300 mm for d=12mm and ≥ 400 mm for d=16mm).

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

The extensible 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 in mm
l_{ef}	effective thread length in the timber component incl. threaded tip in mm
ρ_k	characteristic value of the timber's bulk density
$F_{ax,Rk}$	characteristic extensible resistance of the RAPID® T-Lift screw in N
$F_{ax,Rd}$	axial extensible resistance in the measured condition in N
$F_{ax,Ek}$	characteristic design value of the load on each screw in N
$F_{ax,Ed}$	load on each screw in its measured condition in N
k_{mod}	modification factor
$\gamma_{M,wood}$	partial factor
φ	dynamic additional value
M	Lifting load (actual dead load) per RAPID® T-Lift in kg

Calculation of the characteristic extensible resistance in [N] E.g. for (C24, ρ_k = 350 kg/m³):

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

These formulae apply to screws bolted in at an angle of 45° ≤ α ≤ 90° (α is the angle between the screw axis and the grain direction). For cross-laminated timber walls, observe the information in the load lifting table for walls (narrow edge).

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

The effective thread length l_{ef} must be at least 48 mm (ø12mm) or 64 mm (ø16mm)!

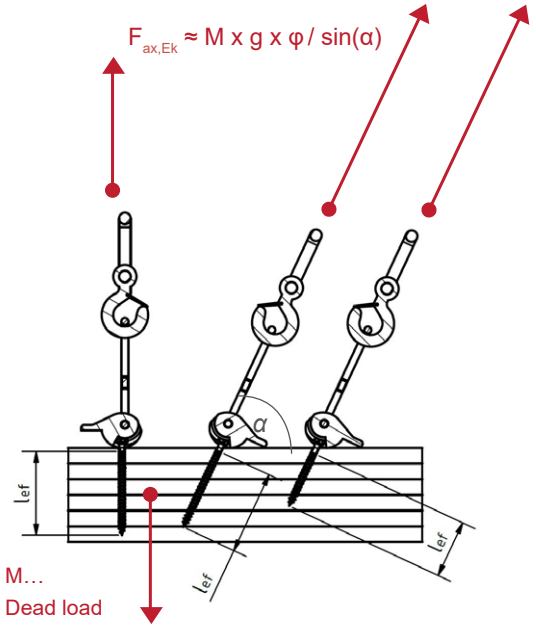


Fig. 6: Load in the screw in its axial direction and effective thread length, $l_{ef} \geq 4d$

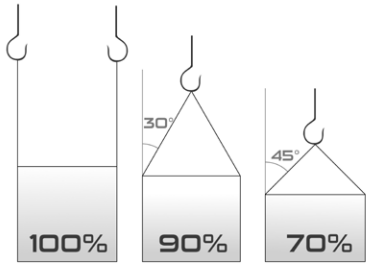


Fig. 7: The possible lifting load is reduced based on the hanging angle (screw's ultimate limit state remains the same)

Calculation of the design value of extensible resistance (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 LADC "very short" was not applied to increase safety!

$\gamma_{M,wood}$ = 1.3 (in Italy, this factor should be used with 1.5!)

Calculation of maximum extensible resistance $F_{ax,Rd}$ per RAPID® T-Lift ball head lifting system in [N]:

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

A characteristic bulk density of ρ_k = 350 kg/m³ applies. The ultimate limit state determined for deviating bulk densities must be corrected with the factor $k_{tens} = (\rho_k / 350)^{0.8}$ (ρ_k in kg/m³).

Verification is carried out by comparing the extensible resistance $F_{ax,Rd}$ with the measured load value $F_{ax,Ed}$:

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

Please refer to our load table below for exact load values of the RAPID® T-Lift screw.

Note: Even at a thread length of 220 mm or more, the ultimate limit state of the thread for Ø 12mm in the timber is higher than that of the RAPID® T-Lift ball head lifting system.

Two RAPID® T-Lift ball head lifting systems must be used to lift one component. Under axial load, one RAPID® T-Lift screw is required per anchor point. In accordance

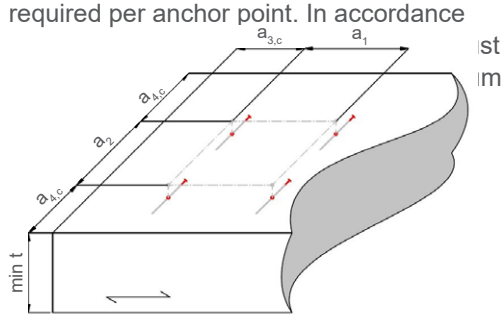


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Fig. 8: Screw distances of the RAPID® T-Lift screw

Minimum distances and dimensions for RAPID® T-Lift screw			
		Distance Ø 12 mm	**Distance Ø16 mm**
From each other in grain direction	$a_1 \geq 25 \times d$	300 mm	400 mm
From each other at right angle to grain direction	$a_2 \geq 5 \times d$	60 mm	90 mm
To the unloaded edge at right angle to grain direction	$a_{4,c} \geq 4 \times d$	36 mm	48 mm
To the loaded edge at right angle to grain direction	$a_{4,t} \geq 10 \times d$	120 mm	160 mm
To the loaded edge in grain direction	$a_{3,t} \geq 25 \times d$	300 mm	400 mm
Minimum thickness of CLT ceilings	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 4: Minimum distances of RAPID® T-Lift transport lifting system screws in accordance with ETA-12/0373

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

$a_{4,t}$ (loaded edge, ≥ 10 × d) = 120 mm
$a_{4,c}$ (unloaded edge, ≥ 3 × d) = 36 mm
} min. t = 156mm

NOTE on Fig. 9: A mathematical verification must be used to check whether an additional full-thread screw is required to provide protection against tensile stress.
Avoid bending the RAPID® T-Lift transport lifting system screw while lifting (e.g. by lowering the ball head). Due to the combined load, the screw's ultimate limit state must be verified as described under point 7.2.

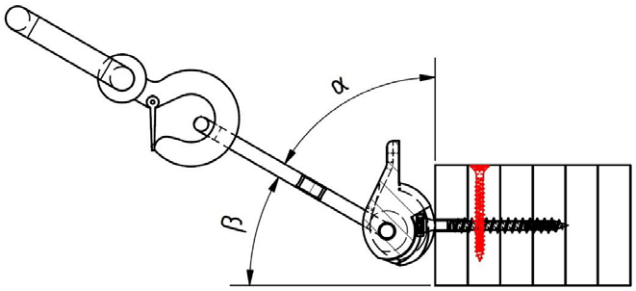


Fig. 9: Lifting a horizontal element (α = 0°) or under oblique tension

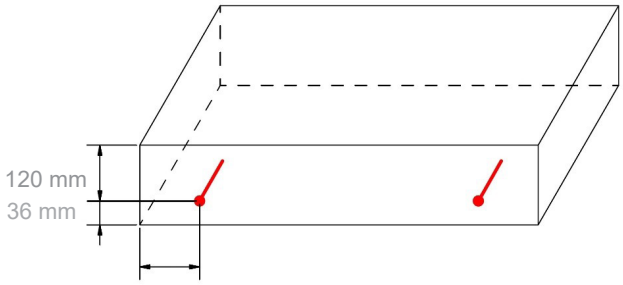


Fig. 10: Assembly of the RAPID® T-Lift transport lifting system screws on the narrow or side surface (not on the front face)

7. Mounting positions with the various resulting loads

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

They are:

7.1. Stress on the screw under axial tension
7.2. Stress on the screw under oblique tension
7.3. Oblique tension stress on the screw with a recess drilled to fit the ball head perfectly

7.1. Stress on the RAPID® T-Lift screw under axial tension

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

Formula: $F_{ax,Ed} = F_{ax,Ek}$ **x 1.35 = M x g x φ / sin α x 1.35**… applies to screw-in angles α = 45° to 90° for each anchor point

Note: according to ETA-12/0373, the minimum timber thickness is 80 mm. It is recommended to screw the thread fully into the timber.

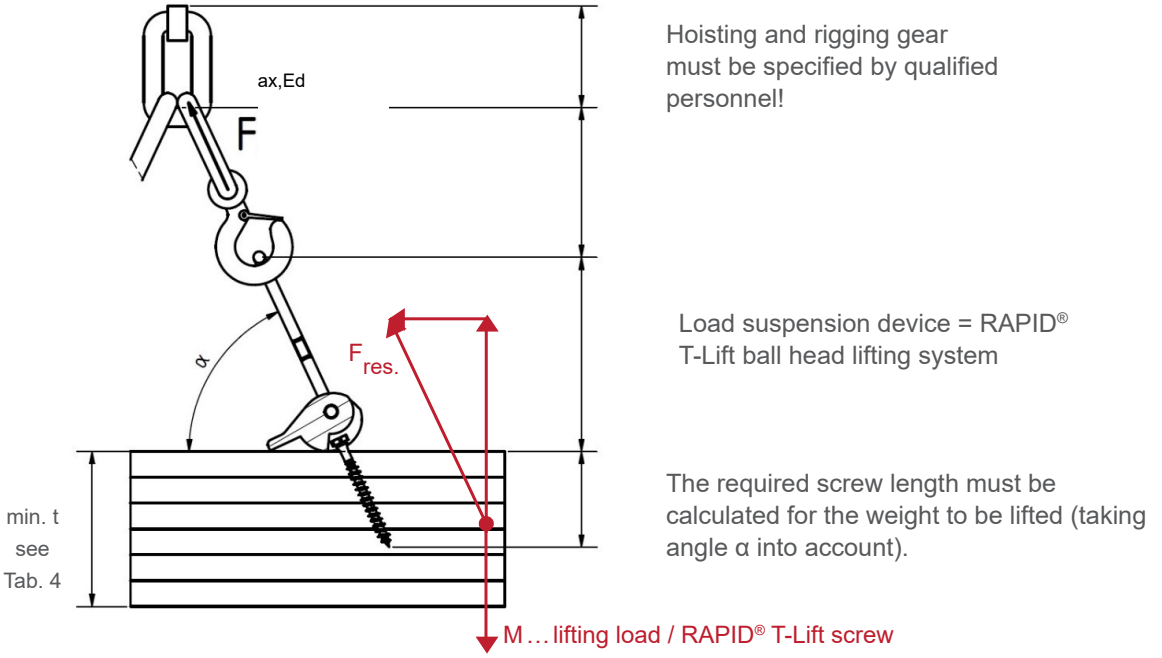


Fig. 11: Axial tension load of the RAPID® T-Lift screw

The exact transport weights for each anchor point can be found in our lifting load tables, *RAPID® T-Lift for CLT Walls* and *RAPID® T-Lift for Ceilings and Beams*, on our homepage at www.schrauben.at/downloadcenter

7. 2. Stress on the RAPID® T-Lift screw under oblique tension

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

To calculate the screw's characteristic shear resistance, the failure mechanism is assumed to be a single shear, thin steel-to-timber connection in accordance with EN 1995-1-1, because the wall thickness of the RAPID® T-Lift ball head lifting system is 5.5 mm.

$$F_{v,Rk} = \min \begin{cases} 0{,}4\, f_{h,k}\, t_1\, d \\ 1{,}15\sqrt{2 M_{y,Rk}\, f_{h,k}\, d} + \dfrac{F_{ax,Rk}}{4} \end{cases}$$

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

Verification is carried out using the formula:

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

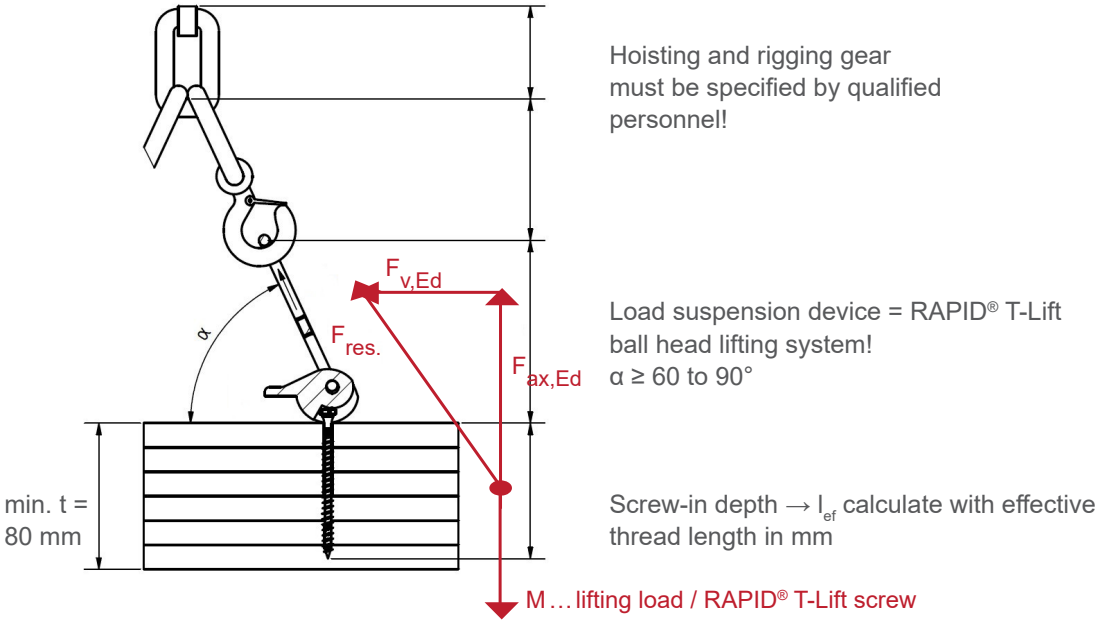


Fig. 12: Oblique tension load

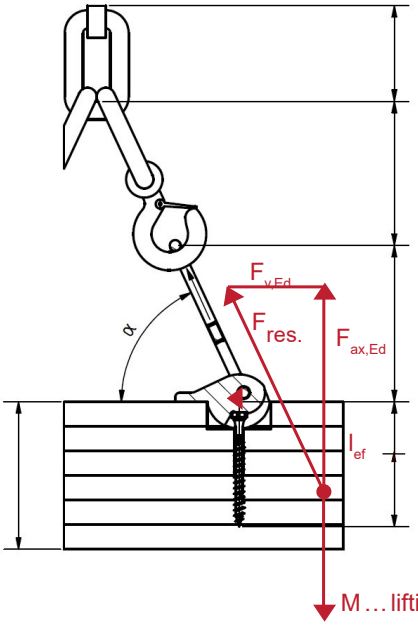
- Screw's characteristic yield moment:
  $M_{y,k}$ = 48,500 Nmm (Ø 12mm) or $M_{y,k}$ = 112,900 Nmm (with Ø 16 mm)
- Nominal diameter d_1 = 12 mm or 16 mm
- Modification factor for timber and wood-based materials k_{mod} = 0.9
- Partial factor for timber and wood-based materials γ_M = 1.3 (Italy 1.5)
- φ dynamic additional value

With a characteristic bulk density of at least ρ_k = 350 kg/m³ for screws screwed vertically into the side wood surface

$f_{h,\alpha,k} = 0.082 \times \rho_k \times d^{-0,3} / (2.5 \times \cos^2\alpha + \sin^2\alpha)$ ... **α** = 90° cf. ETA-12/0373

7. 3. Oblique tension stress on the RAPID® T-Lift screw with a recess drilled to fit the ball head perfectly

When a recess is drilled to fit the ball head perfectly, under oblique tension, the horizontal force is transferred directly to the timber through the ball head. The stress on the screw therefore corresponds to axial tensile stress and must be implemented as specified under point 7.1.



Hoisting and rigging gear must be specified by qualified personnel!

Load suspension device = RAPID® T-Lift ball head lifting system!
α ≥ 45 to 90°

Screw-in depth → calculate with effective thread length l_{ef} in mm

min. t = see Tab. 4

Fig. 13: Axial load on a RAPID® T-Lift transport lifting system with a recess drilled

The recess for the ball head must be drilled according to the dimensions from Fig. 13 using a Forstner bit or a similar tool, as shown e.g. in Fig. 14.

ø 12 mm drilled hole d = 60-70 mm, 30 mm deep, optional positioning bore with 5xd length
ø 16 mm drilled hole d = 75-85 mm, 30 mm deep, optional positioning bore with 5xd length

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 ball head lifting system for up to 1.3 t or 2.5 t

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

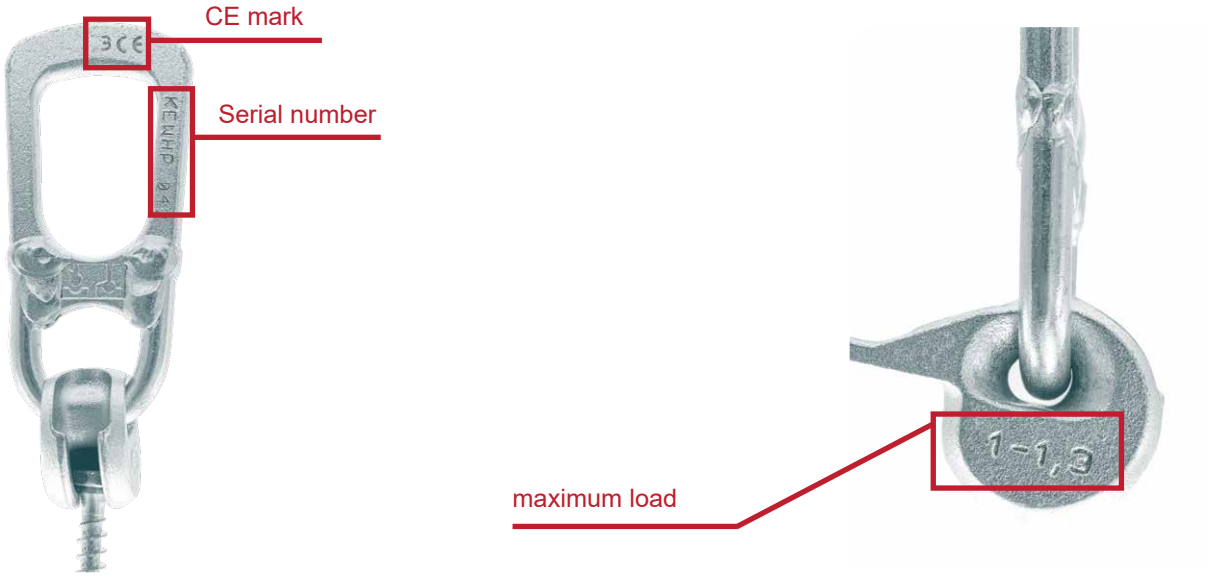


Fig. 15: CE mark, serial number and maximum load on the RAPID® T-Lift ball head lifting system

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

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

Head embossing on RAPID® T-Lift screws

Schmid Schrauben, Hainfeld, June 2021

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(c) Rubner Holzbau / photo by Alexander Maria Lehmann

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Service

Our technicians are happy to help you with any questions: info@schrauben.at

Safety

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

Statics

Our screws have above-average mechanical values for pull-out and screwhead pull-through strength.

Experience

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

Special hardening

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

Highest quality

We manufacture to ISO 9001 specifications.

Sustainability

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

Your screw - Your brand

We manufacture screws exactly according to your wishes.

Always available

Our warehouse is always stocked with our extensive range.

Service orientation

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

ETA-12/0373

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