

National Technical Approval

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Approval No.:

Z-9.1-511

Period of validity:

from: **31th December 2010**

to: **31th December 2015**

Applicant:

SPAX International GmbH & Co.KG

Kölner Straße 71-77

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Product:

SPAX® screws

for the fastening of roof insulation above the rafters

National Technical Approval has herewith been granted for the above named product.

This National Technical Approval comprises 7 pages and 1 appendix.

This National Technical Approval replaces the National Technical Approval No. Z-9.1-511 dated 9th December 2005. The product was first granted National Technical Approval on 17th November 2000.

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I GENERAL PROVISIONS

- 1 The National Technical Approval certifies the suitability and applicability of the product pursuant to the building regulations of the Federal States of Germany.
- 2 Wherever demands are placed upon the particular expertise and experience of the persons assigned to undertake the manufacture of construction products and construction types according to Section 17, Paragraph 5 of the Model Building Regulation respective state rules in the National Technical Approvals, it must be taken into account that this expertise and experience can also be proved by means of equivalent evidence from other member states of the European Union. This may also apply for equivalent evidence presented within the context of the Agreement on the European Economic Area (EEA) or other bilateral agreements.
- 3 The National Technical Approval shall not exempt the holder from acquiring all approvals, permissions and certificates legally required for the completion of the relevant building project.
- 4 The National Technical Approval is granted without prejudice to the rights of third parties, in particular private property rights.
- 5 Irrespective of other regulations laid down in the “Special Regulations”, the manufacturer and distributor of the approved product must forward copies of the National Technical Approval to the user of the approved product and inform him that a copy of the National Technical Approval must be kept available at the location at which the product is used. On request, all authorities involved in the realisation of the construction project must be handed a copy of the National Technical Approval.
- 6 The National Technical Approval may only be reproduced in its entirety. The publication of this document is only permitted with the explicit consent of Deutsches Institut für Bautechnik. Texts and graphics in printed promotional material shall not contradict the National Technical Approval. Translations of the National Technical Approval must bear the following notice: “Translation of the original German document; translation not examined by Deutsches Institut für Bautechnik”.
- 7 The National Technical Approval can be revoked at any time. The terms and regulations governing National Technical Approvals may be amended, and extended at any time, especially if this is warranted as a result of technological development.

II SPECIAL PROVISIONS

1 Approved Product and Area of Application

1.1 Approved Product

SPAX® screws according to this National Technical Approval are special self-tapping wood screws made from high-carbon steel or from stainless steel with a major diameter d_1 between 6.0 mm and 7.0 mm according to the National Technical Approval No. Z-9.1-235, or with a major diameter of d_1 between 8.0 mm and 10.0 mm according to the National Technical Approval No. Z-9.1-449 designed for the fastening of roof insulation systems above rafters made of solid timber, glue-laminated timber and block board (see Appendix 1).

The transfer of the forces from the counter-batten/counter-board to the wood substructure takes place via tensile forces in the screws and associated compressive forces in the insulation.

1.2 Area of Application

The SPAX® screws according to 1.1 can be used for fastening thermal insulation systems with a maximum thickness of 300 mm on roofs, where the insulation is placed above the rafters made of solid timber, glue-laminated timber or block board.

The angle between the screw axis and the longitudinal axis of the rafter (screw angle) must be $65^\circ \pm 5^\circ$.

2 Provisions for SPAX® screws, counter-battens, rafters and the insulation material for roof insulation systems installed above the rafters

2.1 Properties

2.1.1 SPAX® screws

The SPAX® screws with a major diameter d_1 between 6.0 mm and 7.0 mm must conform to the special provisions of the National Technical Approval No. Z-9.1-235; the screws with a major diameter d_1 between 8.0 mm and 10.0 mm as well as the washers must conform to the special provisions of the National Technical Approval No. Z-9.1-449.

The shape, dimension and tolerance of the screws and of the washers must conform to the respective appendices of this stated National Technical Approval.

2.1.2 Counter-battens

The counter-battens of the roof-mounted insulation systems must be manufactured from solid timber (pine wood) according to DIN 4074-1¹ or DIN EN 14081-1¹ in combination with DIN V 20000-5³ that at least conforms to Grade S 10.

They must be at least 40 mm thick and at least 60 mm wide.

If screws with the National Technical Approval No. Z-9.1-449 and with a major diameter d_1 of 8 mm are used, the counter battens may also be 50 mm wide, provided that the distance between one screw and the next, and between a screw and the end grain edge is not less than $25 \cdot d_1$.

1	DIN 4074-1:2003-06	Grading of wood according to load bearing capacity – Part 1: Sawn timber
2	DIN EN 14081-1:2006-03	Timber structures – strength-graded structural timber with rectangular cross section for supporting purposes – Part 1: General requirements
3	DIN V 20000-5:2009-02	Use of construction products in structures – Part 5: Strength-graded structural timber with rectangular cross section for supporting purposes

2.1.3 Timber product boards made from counter-boards

The following may be used as counter-boards that are to be attached to the roof-mounted insulation system:

- Plywood according to DIN EN 13986⁴ (DIN EN 636⁵) and DIN V 20000-1⁶ or according to National Technical Approval,
- Synthetic-bonded chipboard according to DIN EN 13986 (DIN EN 312⁷) and DIN V 20000-1 or according to National Technical Approval
- Type OSB/3 and OSB/4 OSB boards (Oriented Strand Board) according to DIN EN 13986 (DIN EN 300⁸) and DIN V 20000-1 or according to national technical approval
- Laminated veneer lumber according to National Technical Approval provided that they are suitable for this field of application.

They must be at least 22 mm thick.

2.1.4 Wood substructure

The wood substructure may consist of the following timber materials

- Solid timber (pine wood) according to DIN 4074-1 or DIN EN 14081-1 in combination with DIN V 20000-5 that at least conforms to Grade S10,
- Glue-laminated timber according to DIN 1052⁹
- Laminated wood beams according to National Technical Approval
- Board plywood according to National Technical Approval

It must be at least 60 mm wide.

2.1.5 Thermal insulation materials

The heat-insulating materials must be suitable for use as over rafter insulation according to National Technical Approval and must comply with the DAD field of application (roof and ceiling) according to DIN 4108-10¹⁰.

The thermal insulation materials must have a compressive modulus of at least $\sigma_{(10\%)} = 0.05 \text{ N/mm}^2$ at a compression rate of 10 % (tested in accordance with DIN EN 826¹¹).

The heat-insulating materials may have a maximum thickness of 300 mm.

2.2 Identification

The packaging or the delivery documents of the SPAX® screws for roof-mounted insulation systems including the washers are to be labelled according to the National Technical Approval No. Z-9.1-235 or Z-9.1-449.

Alternatively, the packaging or the delivery documents must bear the designation of the approved product according to this National Technical Approval, and the approval No. Z-9.1-511.

4	DIN EN 13986:2005-03	Timber products for use in construction – characteristics, evaluations of conformity and labelling
5	DIN EN 636:2003-11	Plywood – requirements
6	DIN V 20000-1:2005-12	Use of construction products in structures – Part 1: Timber products
7	DIN EN 312:2003-11	Chipboard – requirements
8	DIN EN 300:2006-09	Boards made of long, flat, oriented chips (OSB) – definitions – classification and requirement
9	DIN 1052:2008-12	Design, calculation and dimensioning of timber structures; general dimensioning rules for building construction
10	DIN 4108-10:2004-06	Heat insulation and energy-saving in buildings – application-related requirements placed upon heat insulating materials – Part 10: Factory made heat insulation materials
11	DIN EN 826:1996-05	Heat insulation materials for construction – Determination of compression behaviour

2.3 Proof of conformity

The proof of conformity is subject to the provisions of the National Technical Approval No. Z-9.1-235 or No. Z-9.1-449, Sections 2.3.

3 Provisions for design and dimensioning

3.1 General

- 3.1.1 DIN 1052 or DIN EN 1995-1-1¹² in combination with DIN EN 1995-1-1/NA¹³ apply with regard to the design and dimensioning of the fastenings for roof-mounted insulating systems located on rafters using SPAX® screws according to Section 2.1.1 unless otherwise stipulated.

The applicability of the standards is determined by the building regulations and the technical building provisions of the Federal States.

- 3.1.2 When dealing with the structural verification, the structural system stated in Appendix 1 may be assumed.

- 3.1.3 The counter-battens must be suitably dimensioned.

Compression between the counter battens and the thermal insulation material must not exceed $\sigma_{c,d} = 1.1 \cdot \sigma_{(10\%)}$.

- 3.1.4 Proof must be provided for sufficient resistance to wind suction forces according to DIN 1055-4¹⁴ and for adequate bending strength of the counter battens in the event of wind suction.

Where necessary, additional screws perpendicular to the longitudinal axis of the rafter (screw-in angle $\alpha = 90^\circ$) are to be fitted. The dimensioning of the screws is to be carried out according to National Technical Approval No. Z-9.1-235 and Z-9.1-449.

3.2 Pulling load of screws

3.2.1 Dimensioning according to DIN 1052:2008-12 or DIN EN 1995-1-1 in combination with DIN EN 1995-1-1/NA

- 3.2.1.1 When dimensioning over rafter insulating systems according to Section 1.2 with regard to the quantity and distance of the screws, the following characteristic value of the extraction resistance of the screws may be taken into account:

$$R_{ax,k} = f_{1,k} \cdot d_1 \cdot l_{ef} \cdot k_1 \cdot k_2 \quad (\text{in N}) \quad (1)$$

wherein $f_{1,k}$ = characteristic value of the extraction parameter in N/mm²,
for screws with $d_1 \leq 8.0$ mm:

$$f_{1,k} = 100 \cdot 10^{-6} \cdot \rho_k^2 \quad (\text{in N/mm}^2) \quad (2)$$

12	DIN EN 1995-1-1:2010-12	Eurocode 5: Dimensioning and construction of timber structures – Part 1-1: General information – General rules and rules for building
13	DIN EN 1995-1-1/NA:2010-12	National annex - Nationally determined parameters - Eurocode 5: Dimensioning and construction of timber structures – Part 1-1: General information – General rules and rules for building
14	DIN 1055-4:2006-03	Impacts on structures – Part 4: Wind loads in conjunction with Corrigenda 1: 2006-03

for screws with $d_1 = 10.0$ mm:

$$f_{1,k} = 80 \cdot 10^{-6} \cdot \rho_k^2 \quad (\text{in N/mm}^2) \quad (3)$$

ρ_k = characteristic gross density of the timber material in kg/m³,

α = angle between the screw and grain direction ($60^\circ \leq \alpha \leq 70^\circ$)

d_1 = outer thread diameter of the substructure in mm

l_{ef} = thread length in the wood substructure in mm, with
 $40 \text{ mm} \leq l_{ef} \leq 80 \text{ mm}$, $l_{ef} \geq 80 \text{ mm}$ may not be taken into account

$$k_1 = \min \left\{ \begin{array}{l} 1 \\ \frac{220}{d_{D\ddot{a}}} \end{array} \right. \quad (4)$$

$$k_2 = \min \left\{ \begin{array}{l} 1 \\ \frac{\sigma_{10\%}}{0.12} \end{array} \right. \quad (5)$$

$d_{D\ddot{a}}$ = insulation layer thickness in mm

$\sigma_{(10\%)}$ = compressive modulus of the insulation material at a compression rate of 10 %
in N/mm²

The pulling strength of the screw F_{ax} must be calculated without consideration of the friction force.

3.2.1.2 However, due to the risk of head pull-through, the characteristic value of the extraction resistance may amount to a maximum of

$$R_{ax,k} = f_{2,k} \cdot d_k^2 \quad \text{in N} \quad (6)$$

Wherein:

$f_{2,k}$ = characteristic value of the head pull-through parameter in N/mm² for washer head, pan head and hexagon head screws with flange as well as washers and counter-battens made from solid pine timber:

$$f_{2,k} = 100 \cdot 10^{-6} \cdot \rho_k^2 \quad (7)$$

for flat countersunk head and hexagonal screws without flange and counter-battens made from solid pine timber:

$$f_{2,k} = 80 \cdot 10^{-6} \cdot \rho_k^2 \quad (8)$$

for counter-boards according to Section 2.1.3:

$$f_{2,k} = 10.0 \text{ N/mm}^2$$

with ρ_k = characteristic gross density of the counter-battens in kg/m³,

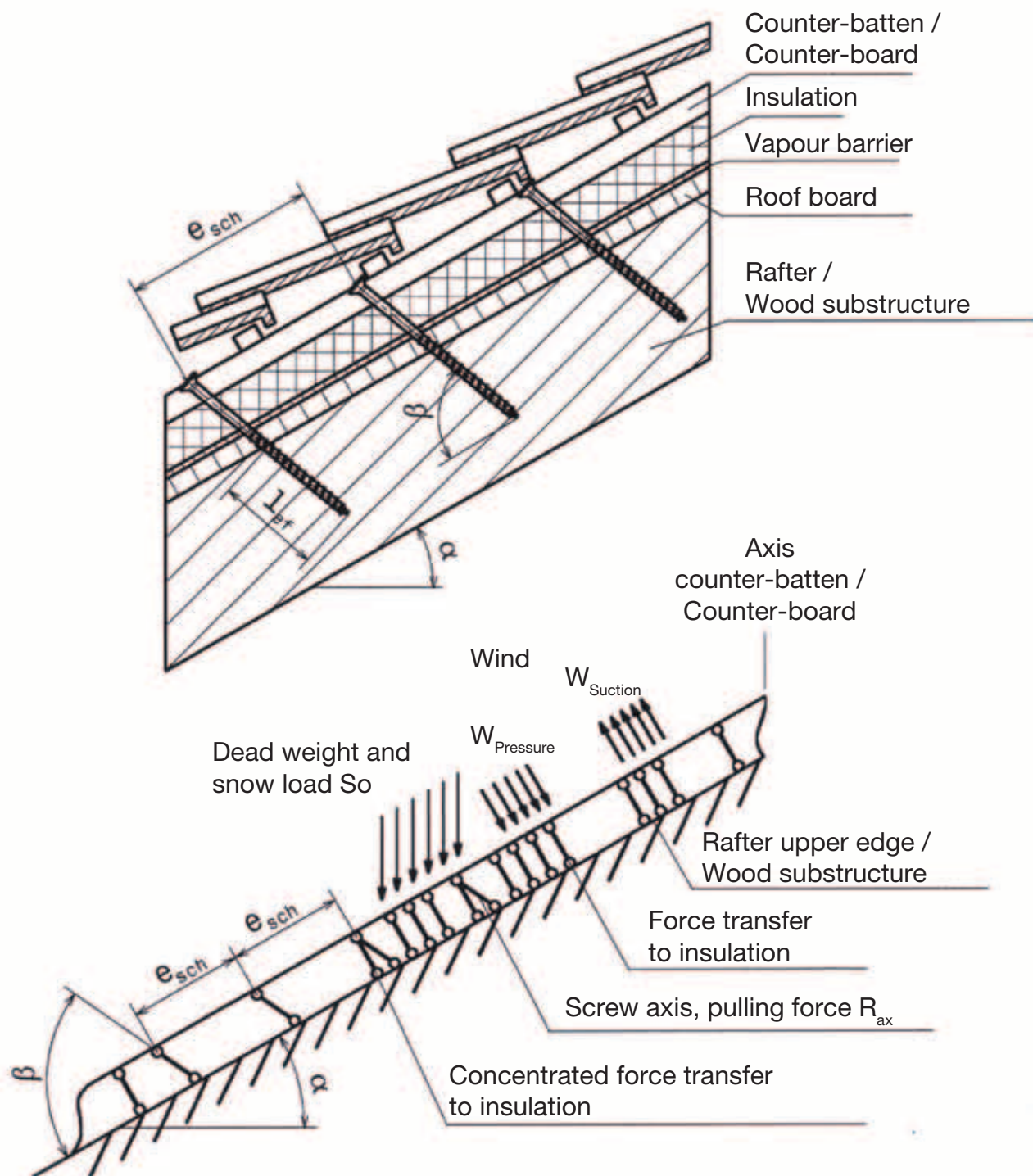
d_k = head diameter of the screw or outer diameter of the washer in mm, d_k may be taken into account with a maximum of 25 mm.

4 Provisions for the production of fastening joints

4.1 For the implementation of the fastening of roof-mounted insulation systems using SPAX® screws, DIN 1052 or DIN EN 1995-1-1 in combination with DIN EN 1995-1-1/NA as well as the National Technical Approval No. Z-9.1-235 and No. Z-9.1-449 apply unless otherwise stipulated below.

- 4.2 The screws must be placed as shown in appendix 1.
The screw angle (i.e. angle between the screw axis and the longitudinal axis of the rafter) must be $67^\circ \pm 5^\circ$. Screws that are additionally fitted for the anchoring of wind suction forces may be screwed in at a screw-in angle of $\alpha = 90^\circ$.
The distance e_{Sch} between two screws should not exceed 1.75 m.
- 4.3 The screws must be screwed through the counter-battens or counter-boards located above the insulating material that run parallel to the rafters and then through the insulating material and into the rafters in a single work sequence without pre-drilling.

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Head of Division



α = roof pitch

β = angle between the screw axis and the rafter axis

e_{Sch} = distance between screws

l_{ef} = screw-in depth in rafter

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SPAX® screws
for the fastening of roof
insulation above the rafters
System diagram

Appendix 1 to National
Technical Approval No.
Z-9.1-511 dated
11th March 2011