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European Technical Assessment

ETA-13/0022 of 21.12.2018

General part

Technical Assessment Body issuing the European Technical Assessment	Österreichisches Institut für Bautechnik (OIB) Austrian Institute of Construction Engineering
Trade name of the construction product	Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm
Product family to which the construction product belongs	Kit for rock and soil anchors – Kit with thread bars in steel
Manufacturer	Stahlwerk Annahütte Max Aicher GmbH & Co. KG 83404 Ainring-Hammerau Germany
Manufacturing plant	Stahlwerk Annahütte Max Aicher GmbH & Co. KG 83404 Ainring-Hammerau Germany
This European Technical Assessment contains	48 pages including Annexes 1 to 28, which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with Regulation (EU) № 305/2011, on the basis of	EAD 160015-00-0102, European Assessment Document for Kit for rock and soil anchors – Kit with thread bars.
This European Technical Assessment replaces	European technical approval ETA-13/0022 with validity from 12.06.2013 to 11.06.2018.

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Specific parts

1 Technical description of the product

1.1 General

The European Technical Assessment[1] – ETA – applies to a kit, the

Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm,

comprising the following components.

– Tendon

The bar tendon of the rock and soil anchor is with one single tensile element.

– Tensile element

Tensile element is a continuously threaded steel bar. The continuous thread is provided by ribs, hot rolled along the entire length of the bar – thread bar. Due to the continuous thread, the individual thread bars can be anchored at any given point and to obtain the required tendon length, the thread bars can be coupled at any given point.

Nominal diameters and strength characteristics of the thread bar are given in Table 1.

Table 1 Tensile elements

Nominal diameter ∅	**Nominal yield strength** $R_{p0.2}$	**Nominal tensile strength** R_m
mm	**N/mm²**	**N/mm²**
18, 22, 25, 28, 30, 35, 43, 50, 57.5 and 63.5	670	800

NOTE 1 MPa = 1 N/mm²

– Anchorage

The thread bar is anchored with a domed nut in steel and a square anchor plate in steel. Load transfer to structural concrete is without or with additional reinforcement.

– Coupler

The thread bars are jointed with steel couplers that are secured against unscrewing.

[1] ETA-13/0022 was firstly issued in 2013 as European technical approval with validity from 12.06.2013 and converted and amended in 2018 to European Technical Assessment ETA-13/0022 of 21.12.2018.

- Corrosion protection system

  Temporary rock and soil anchors, temporary rock and soil anchors with extended working life, and permanent rock and soil anchors are provided with corrosion protection systems, adapted to the intended working life.

  - Fixed anchor length

    Corrosion protection of fixed anchor length is by a cover of cement mortar on the thread bar or by encapsulation with corrugated plastic sheathing and grouting the void between thread bar and corrugated plastic sheathing.

  - Free anchor length

    At free anchor length the thread bar is corrosion protected by smooth sheathing, corrosion protection coating with smooth sheathing, or encapsulation with corrugated plastic sheathing and grouting the void between thread bar and corrugated plastic sheathing. For debonding, the encapsulated thread bar is provided with a smooth sheathing. At the ends, the smooth sheathing is sealed to thread bar or corrugated plastic sheathing.

  - Transition anchorage to free anchor length

    On the anchor plate a steel tube is tightly welded. Steel tube and sheathing of the thread bar overlap. Except for temporary rock and soil anchors, a sealing is installed between smooth or corrugated plastic sheathing and the void between steel tube and thread bar is filled with corrosion protection filling material.

  - Anchorage

    At the anchorage, corrosion protection is applied on thread bar and domed nut and a cap is attached to the anchor plate. For temporary rock and soil anchors, corrosion protection of anchorage is only required for corrosive environments and aesthetic reasons.

  - Coupler assemblies

    Corrosion protection of coupler assemblies is provided by a cover of cement mortar, heat shrinking sleeve, or combinations of coupler tube sealed to adjacent sheathings and corrosion protection filling material.

- Ancillary components

  Ancillary components are spacers to provide cover of grout inside the corrugated plastic sheathing – inner grout –, to ensure the distance between thread bar or plastic sheathing and bore hole wall, and to facilitate grouting of the corrugated plastic sheathing.

Rock and soil anchor system

1.2 General

The rock and soil anchor is installed by placing the thread bar, possibly jointed with couplers, and provided with corrosion protection according to the intended working life in the centre of a pre-drilled borehole. Along the fixed anchor length, the annular void between rock and soil anchor and bore hole wall is injected with cement mortar. At the protruding part of the rock and soil anchor, the anchorage is installed. After stressing the rock and soil anchor, the final corrosion protection is applied.

1.3 Designation and range of rock and soil anchors

The rock and soil anchor of the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, is designated by the nominal diameter of the thread bar. The rock and soil anchor system includes rock and soil anchor with the following nominal diameters of the thread bar, ∅ = 18, 22, 25, 28, 30, 35, 43, 50, 57.5, and 63.5 mm.

The characteristic values of maximum force of thread bars are given in Annex 8.

1.4 Tendon

The tendon comprises a thread bar. The required length of the tendon is achieved by jointing the necessary number of thread bars with couplers. To attain the intended working life, the tendon is provided with appropriate corrosion protection.

Inherent to the installation of the rock and soil anchor, the fixed anchor length provides a body of cement mortar between tendon and borehole wall with a thickness of at least 10 mm. Concentric position of tendon and minimum thickness of body of cement mortar are ensured by spacers. The cement mortar meets the requirements of EN 1537[2], taking into consideration the exposure classes according to EN 206.

Along the free anchor length, a smooth sheathing is slipped over the tendon.

1.5 Anchorage

The anchorage comprises a domed nut and a square anchor plate, see Annex 11. As part of the corrosion protection system, a steel tube is tightly welded on the anchor plate. Steel tube and sheathing of free anchor length overlap and a sealing between steel tube and sheathing can be installed.

A larger angle deviation may be achieved using an angle compensation tube, see Annex 13. Boreholes with large diameters are spanned with load transfer plates in steel, see Annex 12.

1.6 Coupler assemblies

Tensile elements, i.e. thread bars, are jointed with couplers. The coupler is secured against unscrewing with screws. Overlap of heat shrinking sleeve and adjacent elements, i.e. thread bar or corrugated plastic sheathing, is at least 75 mm. Different versions of coupler assemblies are shown in Annex 4 and the dimensions of the couplers in Annex 12.

The installed coupler does not impede the free elongation of the tendon during stressing.

1.7 Load transfer to the structure

The load is transferred from the tendon via domed nut and anchor plate to the structure.

Concrete structures directly loaded by the anchorage are executed without or with additional reinforcement.

- Centre spacing and edge distance, concrete compressive strength, and additional reinforcement are specified in Annex 6.
- Additional reinforcement is placed at the anchorage, concentric with regard to the tendon. This reinforcement confines the concrete and absorbs bursting forces due to spreading of the load from the anchorage into the concrete structure – bursting reinforcement.
- For concrete structures without additional reinforcement, the area around the centric rock and soil anchor with outer dimensions corresponding to the centre distances specified in Annex 6, is reinforced as follows.
  - The reinforcement is at least 50 kg/m^3.
  - Only the loaded depth of the concrete structure down from the anchor plate is considered.
  - Reinforcement already placed in that area for other reasons may be fully taken into consideration.
  - The reinforcement does not need to be detailed and placed as bursting reinforcement.

If load transfer plates, see Annex 12, are designed and installed according to Clause 2.2.3, e.g. as shown in Annex 1, Annex 2, Annex 3, and Annex 6 a minimum concrete grade of ≥ C30/37 is used. However, the minimum centre and edge distances as specified in Annex 6 are not reduced.

[2] Standards and other documents referred to in the European Technical Assessment are listed in Annex 27 and Annex 28.

1.8 Corrosion protection systems

1.8.1 Temporary rock and soil anchor

The temporary rock and soil anchor is intended for up to 2 years working life. Annex 1 shows a schematic representation of the corrosion protection of temporary anchors. The most important components of the corrosion protection system are.

- Body of cement mortar, thickness ≥ 10 mm, between thread bar and borehole wall along the fixed anchor length. Concentric position of thread bar and minimum thickness of body of cement mortar are ensured by spacers.
- Smooth sheathing, thickness t ≥ 1.5 mm, in the free anchor length, sealed at the ends with an adhesive tape to prevent the ingress of water.
- Coupler in the free anchor length inside a coupler tube, thickness t ≥ 2 mm, sealed at the ends with heat shrinking sleeves.
- Coupler at the transition free anchor length to fixed anchor length.
- The steel tube welded onto the anchor plate overlaps the smooth sheathing at the end of the free anchor length.
- For temporary rock and soil anchors, corrosion protection of anchorage is only required for corrosive environments and aesthetic reasons.

1.8.2 Temporary rock and soil anchor with extended working life

The temporary rock and soil anchor with extended working life is intended for up to 7 years working life. Annex 2 shows a schematic representation of the corrosion protection of temporary anchors with extended working life. The most important components of the corrosion protection system are.

- Body of cement mortar, thickness ≥ 10 mm, between thread bar and borehole wall along the fixed anchor length. Concentric position of thread bar and minimum thickness of body of cement mortar are ensured by spacers.
- In the free anchor length, the thread bar is coated with corrosion protection material.
- Smooth sheathing, thickness t ≥ 1.5 mm, in the free anchor length, sealed at the ends with heat shrinking sleeves to prevent the ingress of water.
- Coupler in the free anchor length, coated with corrosion protection material, inside a coupler tube, thickness t ≥ 2 mm, sealed at the ends with heat shrinking sleeves.
- Coupler at the transition free anchor length to fixed anchor length.
- The steel tube welded onto the anchor plate overlaps the smooth sheathing at the end of the free anchor length and is sealed off against the smooth sheathing with a sealing ring.
- At the transition between anchorage and free anchor length the void between tendon and steel tube is filled with corrosion protection material.
- After tensioning, the thread bar protrusion is coated with corrosion protection material and a steel or plastic protective cap is tightly attached to the anchor plate.

1.8.3 Permanent rock and soil anchor

The permanent rock and soil anchor is intended for up to 100 years working life. Annex 3 shows a schematic representation of the corrosion protection of permanent anchors. The most important components of the corrosion protection system are.

- Permanent rock and soil anchors are protected against corrosion by encapsulating the thread bar in a corrugated plastic sheathing with a wall thickness of ≥ 1.0 mm. The bottom end of the rock and soil anchor is closed with a cap. Joints within the encapsulation are sealed with an adhesive tape. The annular void between thread bar and corrugated plastic sheathing is grouted according to EN 445, EN 446, and EN 447. The thickness of the cover of cement

grout on the thread bar inside the corrugated plastic sheathing is at least 5 mm. Concentric position of thread bar and minimum thickness of cover of cement grout are ensured by a plastic cord helically wound around the thread bar or by spacers. Encapsulation with grouting of the annular void is carried out at the manufacturing plant.

- Body of cement mortar, thickness ≥ 10 mm, between encapsulated tendon and borehole wall along the fixed anchor length. Concentric position of thread bar and minimum thickness of body of cement mortar are ensured by spacers.
- In the free anchor length, a smooth sheathing, thickness ≥ 1.5 mm, is slipped over the encapsulated tendon and sealed off against the corrugated plastic sheathing with an adhesive tape.
- Coupler in the free anchor length are placed inside a coupler tube, thickness t ≥ 2 mm, filled with corrosion protection material and sealed at the ends with heat shrinking sleeves.
- Coupler at the transition free anchor length to fixed anchor length is protected with a double layer of heat shrinking sleeve. Overlap of heat shrinking sleeve and adjacent elements, i.e. thread bar or corrugated plastic sheathing, is at least 75 mm.
- A steel tube is tightly welded onto the anchor plate. Steel tube and anchor plate are provided with an appropriate corrosion protection according to EN ISO 12944-5.
- The steel tube overlaps the corrugated plastic sheathing at the end of the free anchor length and is sealed off against the corrugated plastic sheathing with profile ring sealing. At the transition anchorage to free anchor length, the void between tendon and steel tube is filled with corrosion protection filling material.
- Following tensioning the rock and soil anchor,
  - a protective cap in steel, hot dip galvanised according to EN ISO 1461 or
  - a protective cap in steel, provided with an appropriate corrosion protection according to EN ISO 12944-5 or
  - a plastic protective cap is tightly attached to the anchor plate and filled with corrosion protection filling material.

  If the anchorage is embedded in concrete, a cap is not required.

Components

1.9 General

The components of the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, conform to representations and dimensions in Annex 7, Annex 11, Annex 12, Annex 13, Annex 14, Annex 15, Annex 16, Annex 17, Annex 18, and Annex 19 and material specifications in, Annex 8, Annex 9, Annex 10, and Annex 20. Component specifications and tolerances of the components not given in the Annexes are specified to the technical data given in the technical file[3] of the European technical approval.

1.10 Tensile element, thread bar in steel

The tensile element is a hot rolled, in-line heat treated steel bar S 670/800 with a continuous right-hand thread – thread bar.

The most important characteristics are, see Annex 7 and Annex 8.

- Nominal diameter 18, 22, 25, 28, 30, 35, 43, 50, 57.5, and 63.5 mm
- Characteristic yield strength $R_{p0.2}$ = 670 N/mm^2
- Characteristic tensile strength R_m = 800 N/mm^2

[3] The technical file of the European Technical Assessment is deposited at Österreichisches Institut für Bautechnik.

– Elongation at maximum force $A_{gt} \geq 5$ %

The thread bar is in particular suitable for geotechnical applications. Welding and bending are possible in principle, but not intended for rock and soil anchors.

1.11 Coupler

The tensile elements, thread bars, are jointed with couplers. The coupler is secured against unscrewing with screws. Different versions of coupler assemblies are shown in Annex 4 and the dimensions of the coupler in Annex 12.

The installed coupler does not impede the free elongation of the tendon.

1.12 Anchor plate

The anchor plate is a square steel plate with a centric bore. On one side a cone is machined to accommodate the domed nut. As part of the corrosion protection system a steel tube is tightly welded on the anchor plate.

Anchor plate with welded steel tube and with dimensions are shown in Annex 11.

1.13 Domed nut

The domed nut is in steel and anchors the thread bar. The spherical shape sitting in the cone of the anchor plate permits compensation of angular deviations.

Domed nut and dimensions are shown in Annex 11.

1.14 Corrosion protection components

Components of the corrosion protection system are corrugated and smooth plastic sheathing, heat shrinking sleeve, grout inside the corrugated plastic sheathing, sealing at the transition anchorage to free anchor length, coupler tube, corrosion protection filling material at the anchorage, and cap in steel or plastic.

Components of the corrosion protection system with specifications and dimensions are shown in Annex 9, Annex 10, Annex 13, Annex 14, Annex 15, Annex 16, Annex 17, and Annex 18.

1.15 Ancillary components

Spacers to provide cover of grout inside the corrugated plastic sheathing are a plastic cord or plastic mat spacers, see Annex 19. The plastic cord is helically wound around the thread bat with a pitch ≤ 0.5 m and the mat spacers are installed in a distance of ≤ 1.0 m.

In the fixed anchor length, basket spacers in plastic are fastened to thread bar or corrugated plastic sheathing in a distance of ≤ 1.5 m, see Annex 18. With the basket spacers the distance to the bore hole wall is ensured.

For grouting and to fully encase the thread bar, the corrugated plastic sheathing is completed with injection cap and end cap, see Annex 19.

Ancillary components are part of the kit, however, for them no essential characteristic is assessed.

1.16 Cement mortar

Cement mortar is inherent in the rock and soil anchor system. Along the fixed anchor length, the body of cement mortar between thread bar or corrugated plastic sheathing and borehole wall transfers the load from thread bar to bore hole wall and takes a part of corrosion protection.

The cement mortar meets the requirements of EN 1537, taking into consideration the exposure classes according to EN 206.

Cement mortar is provided on the construction site, is not subject ETA and no essential characteristic is assessed for cement mortar.

2 Specification of the intended uses in accordance with the applicable European Assessment Document (hereinafter EAD)

2.1 Intended uses

The Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, is intended to stabilise the construction ground by active introduction of prestressing forces according to the principles for the execution of geotechnical works. Construction ground refers to both, rock and soil.

Rock and soil anchors are temporary, temporary with extended working life, or permanent according to Table 2.

Table 2 Intended uses of the rock and soil anchor

Line №	Intended use	Working life
1	Temporary rock and soil anchor	Up to 2 years
2	Temporary rock and soil anchor with extended working life	Up to 7 years
3	Permanent rock and soil anchor	Up to 100 years

2.2 Assumptions

2.2.1 General

Concerning product packaging, transport, storage, maintenance, replacement, and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on transport, storage, maintenance, replacement, and repair of the product as he considers necessary.

2.2.2 Packaging, transport and storage

Advice on packaging, transport, and storage includes

- Temporary protection of thread bars and the other components in order to prevent damaging corrosion during transport from the production site to the job site. Light surface rust is acceptable.
- Transportation, storage, and handling of the thread bars and other components in a manner as to avoid damage by mechanical or chemical impact.
- Protection of thread bars and other components from moisture.

2.2.3 Design

Design is according to the Eurocodes.

For verification of rock and soil anchor applications with the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, the following items are considered.

- The rock and soil anchor is only subjected to axial tensile loading.
- The design value for the ultimate limit state of the rock and soil anchor is assumed according to Eurocode 2 with a partial safety factor of 1.15[4] against attainment of the characteristic force at yield strength, $F_{p0.2}$.
- The load-bearing capacity of the tendon, comprising the components thread bar, coupler, and anchorage, is 100 % relative to the characteristic maximum force, F_m, of the thread bar. The values in Annex 8 are taken as a basis.

[4] Recommended partial safety factor to be applied in the absence of applicable standards and regulations in force at the place of use.

- The capacity of the rock and soil anchors is determined according to Eurocode 7 and EN 1537, based on investigation, suitability, and acceptance tests.
- The construction works is designed as to form a redundant structure according to Eurocode 0. Structures with only one single rock and soil anchor is not executed.
- The stress ranges at coupler assembly and anchorage given Table 3 were determined in fatigue tests at an upper force of $0.65 \cdot F_m$ and up to $2 \cdot 10^6$ load cycles.

Table 3 Stress range verified in fatigue tests

Nominal diameter	Stress range	
∅	Coupler assembly	Anchorage with anchor plate
mm	N/mm²	N/mm²
18 to 43	55	55
50 to 63.5	40	40

- Minimum centre and edge distances are given in Annex 6 without and with additional reinforcement and for a concrete cube compressive strength of $f_{cm,\,0,\,cube\,150} \geq 25$ N/mm².
- For load introduction from the thread bar through the anchorage into the structure Eurocode 2 applies. Minimum centre spacing and edge distance are given in Annex 6 for a concrete cube compressive strength of ≥ 25 N/mm² and with and without additional reinforcement. If centre spacing and edge distance, concrete compressive strength, and additional reinforcement are conformed to, verification of load transfer to structural concrete has been delivered. The forces outside of the bursting reinforcement or the region with outer dimensions corresponding to the centre distances require verification and, where appropriate, are covered by appropriate reinforcement.
- For load transfer without additional reinforcement, the area around the rock and soil anchor is reinforced according to Clause 1.7.
- Punching of the anchorage needs to be considered in any case.
- Boreholes with large diameters are spanned with load transfer plates in steel. The load transfer plates are designed according to Eurocode 3 as to permit a force of $1.1 \cdot F_m$ being transferred into the substructure.

  Where

  F_m ..... Nominal maximum force of the thread bar, see Annex 8
- Alternatively the load can be transferred from the anchorage to the structure via a steel member designed according to Eurocode 3. The steel member has dimensions as to permit a force of $1.1 \cdot F_m$ being transferred into the structure.
- To verify elongations during stressing, a slip value of 3 mm is assumed for the coupler and 3 mm at the anchorage for load transfer from the jack to the structure.
- With a compressive strength of cement mortar of ≥ 40 N/mm², a characteristic bond strength of 6 N/mm² can be assumed.
- Recommended proof forces and lock-off forces are listed in Annex 5.

2.2.4 Installation

2.2.4.1 General

It is assumed that the product will be installed according to the manufacturer's instructions or – in absence of such instructions – according to the usual practice of the building professionals.

Assembly and installation of the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, is only carried out by appropriately qualified specialist companies with the required resources and experience in the execution of geotechnical works.

The principles for the application and installation of temporary and permanent rock and soil anchors are specified in EN 1537 that includes comprehensive information and data on site investigation, construction materials and construction products, design considerations, installation and execution as well as testing, supervision and monitoring.

According to the local conditions, bursting out of the tendon in case of a bar failure is prevented.

The length of the rock and soil anchor is obtained by jointing the necessary number of thread bars with couplers. The couplers are secured against unscrewing.

The rock and soil anchor is centrically installed into a pre-drilled borehole and along the fixed anchor length injected with cement mortar. Thereby, the existing geotechnical conditions are taken into consideration. The fixed anchor length of all installed rock and soil anchors have a system inherent body of cement mortar between thread bar or corrugated plastic sheathing and borehole wall. The cement mortar conforms to EN 1537. The cement type is selected dependent on the aggressiveness of the soil according to EN 206. The water to cement ratio is appropriate for the actual conditions on the construction site. Alternatively, grout in accordance with EN 445, EN 446 and EN 447 may be used. To improve the bonding strength to the ground, post-grouting can be carried out.

Chemical agents that are aggressive to the cement mortar are considered by use of suitable cements.

NOTE 1 Aggressive chemical agents to that cement mortar cannot resist are possible.

NOTE 2 The aggressiveness of the chemical agents may be determined according to EN 206.

After the cement mortar has set and sufficiently hardened, the anchorage is installed and the rock and soil anchor is stressed. See Annex 5 for the recommended lock-off force.

2.2.4.2 Temporary rock and soil anchor

The cover of cement mortar on the thread bar along the fixed anchor length is ≥ 10 mm. The cover of cement mortar is ensured by spacers at a distance of ≤ 1.5 m. A smooth sheathing is slipped over the tendon in the free anchor length. For further details on the corrosion protection and the installation of coupler assembly and anchorage see Clause 1.8.1 and Annex 1.

2.2.4.3 Temporary rock and soil anchor with extended working life

The cover of cement mortar on the thread bar along the fixed anchor length is ≥ 10 mm. The cover of cement mortar is ensured by spacers at a distance of ≤ 1.5 m. In the free anchor length, the thread bar is coated with a corrosion protection material and a smooth sheathing is slipped over the tendon. For further details on the corrosion protection and the installation of couplers and anchorages see Clause 1.8.2 and Annex 2.

2.2.4.4 Permanent rock and soil anchor

The tendon is encapsulated with a corrugated plastic sheathing in the free and fixed anchor length. The annular void between thread bar and corrugated plastic sheathing is grouted at the manufacturing plant. Corrugated plastic sheathing with a thickness of ≥ 1.0 mm and an inner cement grout layer of at least 5 mm between thread bar and corrugated plastic sheathing are applied. The thread bar is centred in the corrugated plastic sheathing with a plastic cord or plastic spacers. Grouting of the corrugated plastic sheathing is carried out according to defined operating procedures. The sheathed and grouted tendon is kept in place until the cement grout has sufficiently set and hardened. This is attained not before 24 hours after grouting.

Along the fixed anchor length, the cover of cement mortar on the encapsulated tendon is ≥ 10 mm. The cover of cement mortar is ensured by spacers at a distance of ≤ 1.5 m. A smooth sheathing is slipped over the encapsulated tendon in the free anchor length. For further details on the corrosion protection and the installation of couplers and anchorages see Clause 1.8.3 and Annex 3.

2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, of up to 2 years for temporary anchors, of up to 7 years for temporary anchors with extended working life, and of up to 100 years for permanent anchors, provided that the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, is subject to appropriate installation, use, and maintenance, see Clause 2.2. These provisions are based upon the current state of the art and the available knowledge and experience.

In normal use conditions, the real working life may be considerably longer without major degradation affecting the basic requirements for construction works[5].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee, neither given by the product manufacturer or his representative nor by EOTA nor by the Technical Assessment Body but are regarded only as a means for expressing the expected economically reasonable working life of the product.

3 Performance of the product and references to the methods used for its assessment

3.1 Essential characteristics

The performances of the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, for the essential characteristics are given in Table 4. In Annex 25 and Annex 26 the combinations of essential characteristics and corresponding intended uses are listed.

Table 4 Essential characteristics and performances of the rock and soil anchor

№	Essential characteristic	Product performance
Basic requirement for construction works 1: Mechanical resistance and stability		
1	Resistance to static load of anchorages and coupling assemblies	See Clause 3.2.1.1.
2	Resistance to fatigue of anchorages and coupling assemblies	See Clause 3.2.1.2.
3	Load transfer to the structure	See Clause 3.2.1.3.
4	Corrosion protection of temporary anchor	See Clause 3.2.1.4.
5	Corrosion protection of temporary anchor with extended working life	See Clause 3.2.1.5.
6	Corrosion protection of permanent anchor	See Clause 3.2.1.6.

[5] The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works are subject, as well as on the particular conditions of design, execution, use, and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the assumed working life.

№	Essential characteristic	Product performance
7	Transition anchorage to free length of temporary anchor	See Clause 3.2.1.7.
8	Transition anchorage to free length of temporary anchor with extended working life	See Clause 3.2.1.8.
9	Transition anchorage to free length of permanent anchor	See Clause 3.2.1.9.
10	Transition anchorage to free length – Tightness	See Clause 3.2.1.10.
11	Crack width in inner grout	See Annex 9.
Thread bar		
12	Cross-sectional area	See Annex 7.
13	Mass per metre	See Annex 7.
14	Surface geometry	See Annex 7.
15	Strength characteristics	See Annex 8.
16	Modulus of elasticity	See Annex 8.
17	Elongation at maximum force	See Annex 8.
18	Resistance to fatigue	See Annex 8.
19	Bond strength	See Clause 2.2.3.
Nut, anchor plate, and coupler		
20	Shape	See Annex 11 and Annex 12.
21	Dimensions	See Annex 11 and Annex 12.
22	Material	See Annex 20.
23	Hardness	See Clause 3.2.1.11.
Inner grout		
24	Content of aggressive components	See Annex 9.
25	Residue on sieve	See Annex 9.
26	Fluidity, cone	See Annex 9.
27	Fluidity, grout spread	See Annex 9.
28	Bleeding, wick-induced	See Annex 9.
29	Bleeding, inclined tube	See Annex 9.
30	Volume change	See Annex 9.
31	Compressive strength	See Annex 9.
32	Setting time	See Annex 9.
33	Fluid density	See Annex 9.

№	Essential characteristic	Product performance
Heat shrinking sleeve with inner coating		
34	Thickness after shrinking	See Annex 10.
35	Mass per unit area of adhesive	See Annex 10.
36	Tensile strength	See Annex 10.
37	Elongation at break	See Annex 10.
38	Peel strength layer to layer	See Annex 10.
39	Peel strength to the steel surface	See Annex 10.
40	Thermal ageing resistance	See Annex 10.
41	Indentation resistance	See Annex 10.
42	Impact resistance	See Annex 10.
43	Saponification value	See Annex 10.
44	Microbiological resistance	See Annex 10.
45	Water absorption	See Annex 10.
46	Softening point of adhesive	See Annex 10.
47	Oxygen stability of adhesive	See Annex 10.
48	Resistance to salt spray of adhesive	See Annex 10.
49	Content of aggressive components of adhesive	See Annex 10.
Corrugated plastic sheathing		
50	Shape	See Annex 16.
51	Dimensions	See Annex 16.
52	Material	See Annex 20.
Basic requirement for construction works 2: Safety in case of fire		
—	Not relevant. No characteristic assessed.	—
Basic requirement for construction works 3: Hygiene, health, and the environment		
—	No characteristic assessed.	—
Basic requirement for construction works 4: Safety and accessibility in use		
—	Not relevant. No characteristic assessed.	—
Basic requirement for construction works 5: Protection against noise		
—	Not relevant. No characteristic assessed.	—
Basic requirement for construction works 6: Energy economy and heat retention		
—	Not relevant. No characteristic assessed.	—

№	Essential characteristic	Product performance
Basic requirement for construction works 7: Sustainable use of natural resources		
—	No characteristic assessed.	—

3.2 Product performance

3.2.1 Mechanical resistance and stability

3.2.1.1 Resistance to static load of anchorages and coupling assemblies

The Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, as described in the ETA meets the acceptance criteria of EAD 160015-00-0102, Clause 2.2.1. The characteristic tensile strength, R_m, of the thread is given Annex 8.

3.2.1.2 Resistance to fatigue of anchorages and coupling assemblies

For resistance to fatigue of anchorages and coupling assemblies see Clause 2.2.3, Table 3

3.2.1.3 Load transfer to the structure

The Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, as described in the ETA meets the acceptance criteria of EAD 160015-00-0102, Clause 2.2.3. The characteristic tensile strength, R_m, of the thread is given Annex 8.

3.2.1.4 Corrosion protection of temporary anchor

Corrosion protection of the temporary rock and soil anchor is described in Clause 1.8.1.

3.2.1.5 Corrosion protection of temporary anchor with extended working life

Corrosion protection of the temporary rock and soil anchor with extended working life is described in Clause 1.8.2.

3.2.1.6 Corrosion protection of permanent anchor

Corrosion protection of the permanent rock and soil anchor is described in Clause 1.8.3.

3.2.1.7 Transition anchorage to free length of temporary anchor

Corrosion protection of transition anchorage to free length of the temporary rock and soil anchor is described in Clause 1.8.1.

3.2.1.8 Transition anchorage to free length of temporary anchor with extended working life

Corrosion protection of transition anchorage to free length of the temporary rock and soil anchor with extended working life is described in Clause 1.8.2.

3.2.1.9 Transition anchorage to free length of permanent anchor

Corrosion protection of transition anchorage to free length of the permanent rock and soil anchor is described in Clause 1.8.3.

3.2.1.10 Transition anchorage to free length – Tightness

The tightness of transition anchorage to free length of the permanent rock and soil anchor is 0.3 N/mm^2 without leakage.

3.2.1.11 Hardness of nut, anchor plate, and coupler

For hardness of nut, anchor plate, and coupler see Table 5.

Table 5 Hardness of components

Component	Hardness HBW
Domed nut	≥ 193
Square anchor plate	≥ 127
Coupler	≥ 140

3.3 Assessment methods

The assessment of the essential characteristics in Clause 3.1 of the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, for the intended uses, and in relation to the requirements for mechanical resistance and stability, in the sense of the basic requirements for construction works № 1 of Regulation (EU) № 305/2011, has been made in accordance with EAD 160015-00-0102, Kit for rock and soil anchors – Kit with thread bars.

3.4 Identification

The European Technical Assessment for the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, is issued on the basis of agreed data that identify the assessed product[6]. Changes to materials, to composition, or to characteristics of the product, or to the production process could result in these deposited data being incorrect. Österreichisches Institut für Bautechnik should be notified before the changes are introduced, as an amendment of the European Technical Assessment is possibly necessary.

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

4.1 System of assessment and verification of constancy of performance

According to Commission Decision 98/456/EC the system of assessment and verification of constancy of performance to be applied to the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, is System 1+. System 1+ is detailed in Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, Annex, point 1.1., and provides for the following items.

(a) The manufacturer shall carry out

(i) factory production control;

(ii) further testing of samples taken at the manufacturing plant by the manufacturer in accordance with the prescribed test plan[7].

[6] The technical file of the European Technical Assessment is deposited at Österreichisches Institut für Bautechnik.

[7] The prescribed test plan has been deposited with Österreichisches Institut für Bautechnik and is handed over only to the notified product certification body involved in the procedure for the assessment and verification of constancy of performance. The prescribed test plan is also referred to as control plan.

(b) The notified product certification body shall decide on the issuing, restriction, suspension, or withdrawal of the certificate of constancy of performance of the construction product on the basis of the outcome of the following assessments and verifications carried out by that body

(i) an assessment of the performance of the construction product carried out on the basis of testing (including sampling), calculation, tabulated values, or descriptive documentation of the product;

(ii) initial inspection of the manufacturing plant and of factory production control;

(iii) continuing surveillance, assessment, and evaluation of factory production control;

(iv) audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities.

4.2 AVCP for construction products for which a European Technical Assessment has been issued

Notified bodies undertaking tasks under System 1+ shall consider the European Technical Assessment issued for the construction product in question as the assessment of the performance of that product. Notified bodies shall therefore not undertake the tasks referred to in Clause 4.1, point (b) (i).

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

5.1 Tasks for the manufacturer

5.1.1 Factory production control

In the manufacturing plant, the manufacturer establishes and continuously maintains a factory production control. All procedures and specifications adopted by the manufacturer are documented in a systematic manner. Purpose of factory production control is to ensure the constancy of performances of the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, with regard to the essential characteristics.

The manufacturer only uses raw materials supplied with the relevant inspection documents as laid down in the control plan. The incoming raw materials are subjected to controls by the manufacturer before acceptance. Check of incoming materials includes control of inspection documents presented by the manufacturer of the raw materials.

Testing within factory production control is in accordance with the prescribed test plan. The results of factory production control are recorded and evaluated. The records are presented to the notified product certification body involved in continuous surveillance and are kept at least for ten years after the product has been placed on the market. On request, the records are presented to Österreichisches Institut für Bautechnik.

If test results are unsatisfactory, the manufacturer immediately implements measures to eliminate the defects. Products or components that are not in conformity with the requirements are removed. After elimination of the defects, the respective test – if verification is required for technical reasons – is repeated immediately.

At least once a year the manufacturer audits the manufacturers of nuts and couplers.

The basic elements of the prescribed test plan are given in Annex 21 and Annex 22.

5.1.2 Declaration of performance

The manufacturer is responsible for preparing the declaration of performance. When all the criteria of the assessment and verification of constancy of performance are met, including the certificate of constancy of performance issued by the notified product certification body, the manufacturer draws up the declaration of performance. Essential characteristics to be included in the declaration of performance for the corresponding intended use are given in Clause 3.1,

Table 4**.** In Annex 25 and Annex 26 the combinations of essential characteristics and corresponding intended uses are listed.

5.2 Tasks for the notified product certification body

5.2.1 Initial inspection of the manufacturing plant and of factory production control

The notified product certification body verifies the ability of the manufacturer for a continuous and orderly manufacturing of the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, according to the European Technical Assessment. In particular, the following items are appropriately considered.

- Personnel and equipment
- Suitability of the factory production control established by the manufacturer
- Full implementation of the prescribed test plan

5.2.2 Continuing surveillance, assessment, and evaluation of factory production control

The notified product certification body visits the factory at least once a year for routine inspection. Inspection of factory production control of thread bar in steel is twice a year. In particular the following items are appropriately considered.

- Manufacturing process including personnel and equipment
- Factory production control
- Implementation of the prescribed test plan

Each manufacturer of nuts and couplers is audited at least once in five years. It is verified that the system of factory production control and the specified manufacturing process are maintained, taking account of the prescribed test plan.

The results of continuous surveillance are made available on demand by the notified product certification body to Österreichisches Institut für Bautechnik. When the provisions of the European Technical Assessment and the prescribed test plan are no longer fulfilled, the certificate of constancy of performance is withdrawn by the notified product certification body.

5.2.3 Audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities

During surveillance inspections, the notified product certification body takes samples of components of the Rock and soil anchor system SAS with thread bars S 670, diameter 18 to 63.5 mm, for independent testing. For the most important components, Annex 23 and Annex 24 summarises the minimum procedures performed by the notified product certification body.

Issued in Vienna on 21 December 2018
by Österreichisches Institut für Bautechnik

The original document is signed by

Rainer Mikulits
Managing Director

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

Rock and soil anchor system SAS

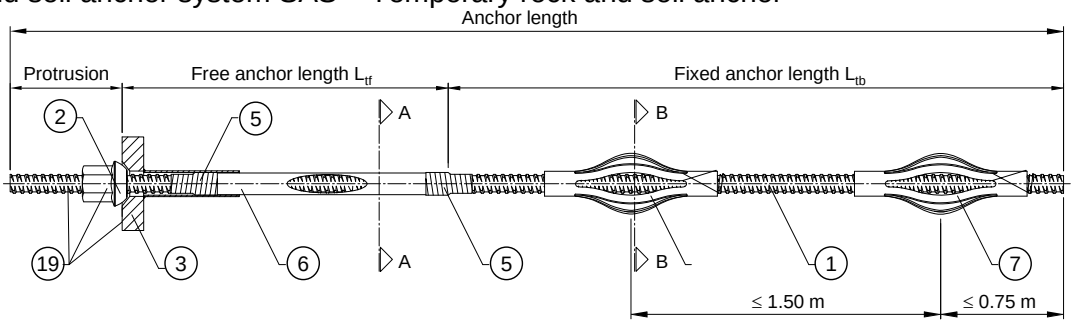
Thread bar S 670, ∅ 18–63.5 mm

Temporary rock and soil anchor

Annex 1

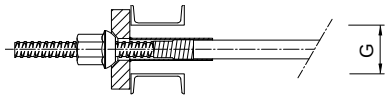
of European Technical Assessment
ETA-13/0022 of 21.12.2018

Rock and soil anchor system SAS – Temporary rock and soil anchor

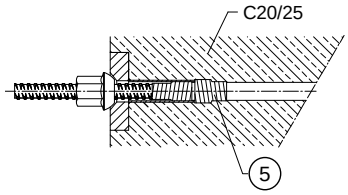


Anchor heads variants

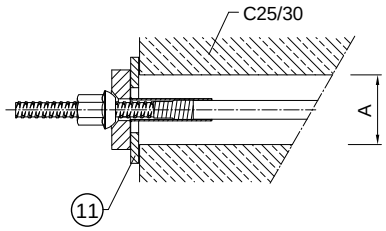
Steel bearing



Fully concreted

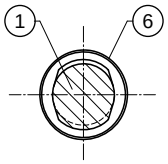


Bearing on larger borehole or distance

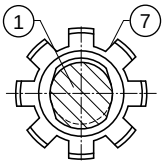


Sections

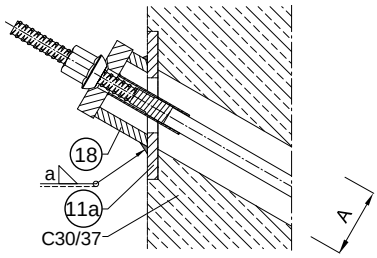
A – A, Cross section in L_{tf}



B – B, Cross section in L_{tb}



Angle compensation with tube



Thread bar nominal diameter ∅	Max. G for bearing on steel G	Max. A [1] for load transfer plate A	Fillet weld minimum thickness a	Minimum borehole diameter [2] at anchor head —	without coupler —	with coupler at $L_{tf} – L_{tb}$ [3] —	with coupler in L_{tf} —
mm	mm	mm	mm	mm	mm	mm	mm
18	80	160	3.5	55	50	60	70
22			3.5			65	70
25			5			70	75
28	90		5	60	60	75	85
30			5			80	85
35	100		6	70	65	90	95
43	130		6	90	80	105	110
50	140	160	7	100	90	115	130
57.5	150	200	8	100	90	125	130
63.5	160		10	115	105	135	145

[1] For load transfer plates to span larger distances, see Annex 6, a minimum concrete strength class according to EN 206 of ≥ C25/30 for Pos. 11 and ≥ C30/37 for Pos. 11a is required
[2] The minimum borehole diameter is based on the minimum cover of grout including an injection hose ∅ 10 mm
[3] Coupler at transition free anchor length, L_{tf}, to fixed anchor length, L_{tb}

1 Steel thread bar
2 Domed nut
3 Anchor plate with steel tube
5 Adhesive tape
6 Smooth sheathing
7 Basket spacer
11 Load transfer plate
11a Load transfer plate for angle compensation tube
18 Angle compensation tube
19 Corrosion protection coating

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

Rock and soil anchor system SAS

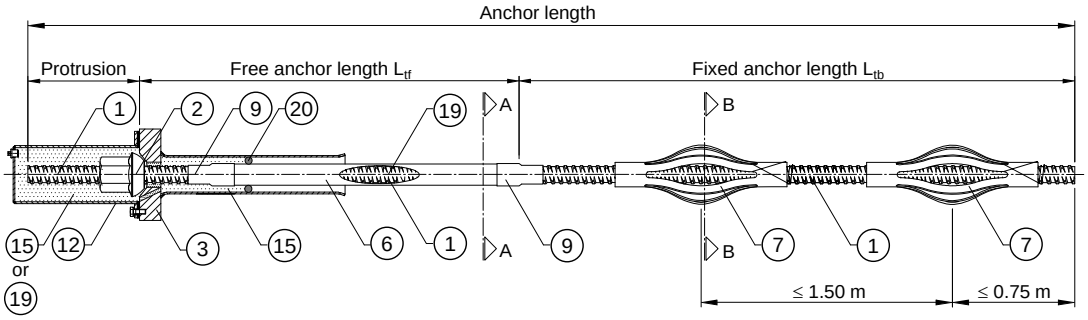
Thread bar S 670, ∅ 18–63.5 mm

Temporary rock and soil anchor with extended working life

Annex 2

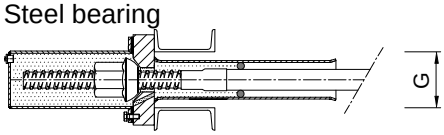
of European Technical Assessment
ETA-13/0022 of 21.12.2018

Rock and soil anchor system SAS – Temporary rock and soil anchor with an extended working life

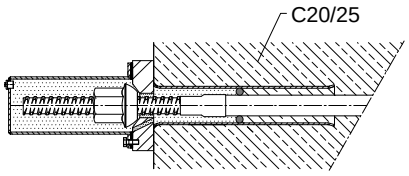


Anchor heads variants

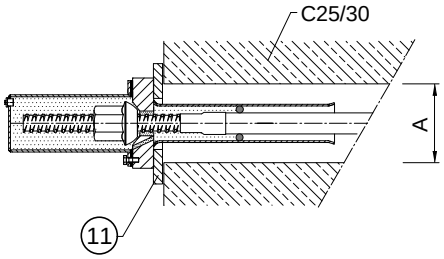
Steel bearing



Fully concreted

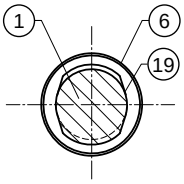


Bearing on larger borehole or distance

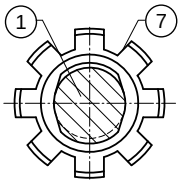


Sections

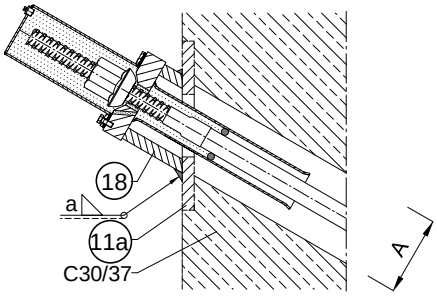
A – A, Cross section in L_{tf}



B – B, Cross section in L_{tb}



Angle compensation with tube



Thread bar nominal diameter ∅	Max. G for bearing on steel G	Max. A [1] for load transfer plate A	Fillet weld minimum thickness a	Minimum borehole diameter [2]			
				at anchor head —	without coupler —	with coupler at $L_{tf} – L_{tb}$ [3] —	with coupler in L_{tf} —
mm	mm	mm	mm	mm	mm	mm	mm
18	80	160	3.5	80	50	60	70
22			3.5			65	70
25			5			70	75
28	90		5	85	60	75	85
30			5	85		80	85
35	100		6	95	65	90	95
43	130		6	120	80	105	110
50	140	160	7	120	90	115	130
57.5	150	200	8	130	90	125	130
63.5	160		10	130	105	135	145

[1] For load transfer plates to span larger distances, see Annex 6, a minimum concrete strength class according to EN 206 of ≥ C25/30 for Pos. 11 and ≥ C30/37 for Pos. 11a is required
[2] The minimum borehole diameter is based on the minimum cover of grout including an injection hose ∅ 10 mm
[3] Coupler at transition free anchor length, L_{tf}, to fixed anchor length, L_{tb}

1 Steel thread bar
2 Domed nut
3 Anchor plate with steel tube
6 Smooth sheathing
7 Basket spacer
9 Heat shrinking sleeve
11 Load transfer plate
11a Load transfer plate for angle compensation tube
12 Steel cap or plastic cap
15 Corrosion protection grease
18 Angle compensation tube
19 Corrosion protection coating
20 Sealing ring

Member of EOTA

Max Aicher GmbH & Co. KG
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Rock and soil anchor system SAS

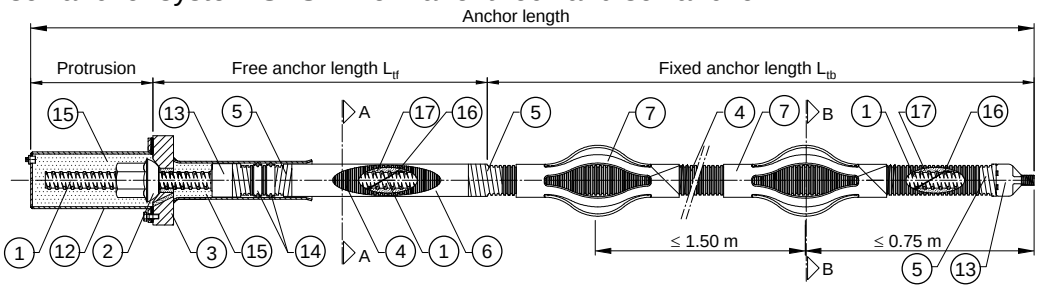
Thread bar S 670, ∅ 18–63.5 mm

Permanent rock and soil anchor

Annex 3

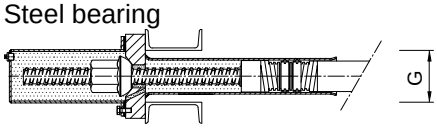
of European Technical Assessment
ETA-13/0022 of 21.12.2018

Rock and soil anchor system SAS – Permanent rock and soil anchor

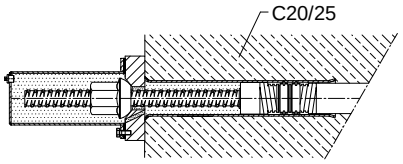


Anchor heads variants

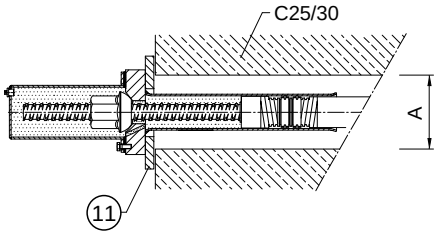
Steel bearing



Fully concreted

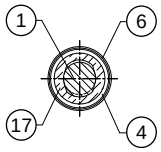


Bearing on larger borehole or distance

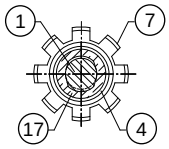


Sections

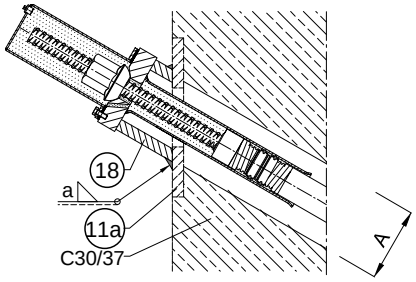
A – A, Cross section in L_{tf}



B – B, Cross section in L_{tb}



Angle compensation with tube



Thread bar nominal diameter ∅	Max. G for bearing on steel G	Max. A [1] for load transfer plate A	Fillet weld minimum thickness a	Minimum borehole diameter [2] at anchor head —	without coupler —	with coupler at $L_{tf} - L_{tb}$ [3] —	with coupler in L_{tf} —
mm	mm	mm	mm	mm	mm	mm	mm
18	80	160	3.5	80	70	70	85
22			3.5				
25			5				
28	90		5			75	
30			5	85	80	80	95
35	100		6	95	90	90	110
43	130		6	120	100	105	130
50	140	160	7	120	100	115	130
57.5	150	200	8	130	125	125	145
63.5	160		10	130	125	135	145

[1] For load transfer plates to span larger distances, see Annex 6, a minimum concrete strength class according to EN 206 of ≥ C25/30 for Pos. 11 and ≥ C30/37 for Pos. 11a is required
[2] The minimum borehole diameter is based on the minimum cover of grout including an injection hose ∅ 10 mm
[3] Coupler at transition free anchor length, L_{tf}, to fixed anchor length, L_{tb}

1 Steel thread bar
2 Domed nut
3 Anchor plate with steel tube
4 Corrugated sheathing
5 Adhesive tape
6 Smooth sheathing
7 Basket spacer
11 Load transfer plate
11a Load transfer plate for angle compensation tube
12 Steel cap or plastic cap
13 Injection cap or end cap
14 Profile ring
15 Corrosion protection grease
16 Inner spacer
17 Inner cement grout
18 Angle compensation tube

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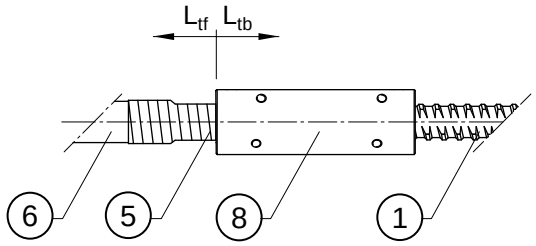
Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Coupling assemblies

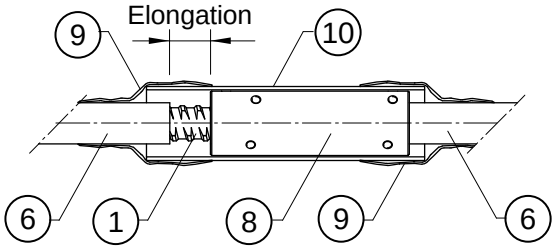
Annex 4
of European Technical Assessment
ETA-13/0022 of 21.12.2018

Coupling assemblies – Temporary rock and soil anchor

Transition free anchor length L_{tf} – fixed anchor length L_{tb}

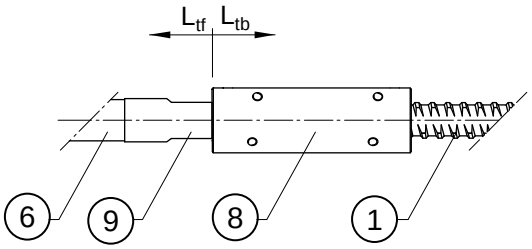


In free anchor length L_{tf}

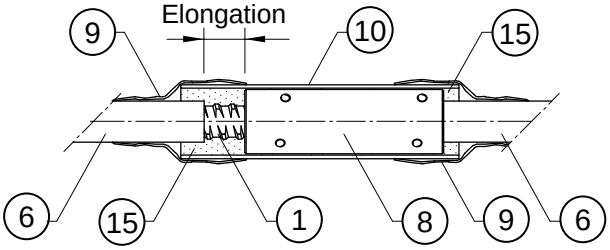


Coupling assemblies – Temporary rock and soil anchor with extended working life

Transition free anchor length L_{tf} – fixed anchor length L_{tb}

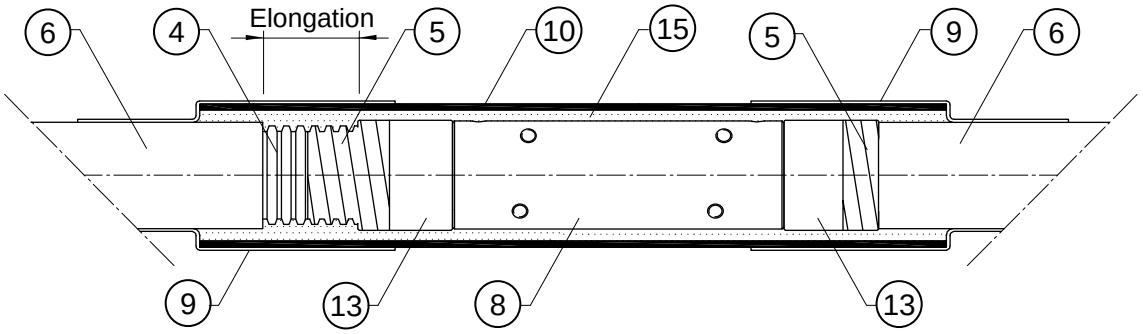


In free anchor length L_{tf}



Coupling assemblies – Permanent rock and soil anchor

In free anchor length L_{tf}



Coupler at transition
free anchor length, L_{tf}, to fixed anchor length, L_{tb}
The coupler is protected with a double layer of heat shrinking sleeve. Overlap of heat shrinking sleeve and adjacent elements, i.e. thread bar or corrugated plastic sheathing, is at least 75 mm.

Coupler in fixed anchor length, L_{tb}
In the fixed anchor length coupler are avoided. If a coupler is required in an exceptional case, the coupler is protected with a double layer of heat shrinking sleeve. Overlap of heat shrinking sleeve and adjacent elements, i.e. thread bar or corrugated plastic sheathing, is at least 75 mm.

1 Steel thread bar
4 Corrugated sheathing
5 Adhesive tape
6 Smooth sheathing
8 Coupler with set screws
9 Heat shrinking sleeve
10 Coupler tube
13 Injection cap or end cap
15 Corrosion protection grease

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Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Proof forces and lock-off forces

Annex 5
of European Technical Assessment
ETA-13/0022 of 21.12.2018

The specified proof forces and lock-off forces of the rock and soil anchor are recommended in the absent of applicable standards and regulations in force at the place of use.

Steel thread bar S 670/800, $R_{p0.2}$ = 670 N/mm², R_m = 800 N/mm²						
Thread bar nominal diameter	Characteristic force at yield strength	Characteristic maximum force	Maximum lock-off force [1]	Investigation test maximum proof force [2]	Suitability test maximum proof force [2]	Acceptance test maximum proof force [2]
∅	$F_{p0.2}$	F_m	—	—	—	—
mm	kN	kN	kN	kN	kN	kN
18	170	204	145	162 or 153	162 or 153	162 or 153
22	255	304	217	242 or 230	242 or 230	242 or 230
25	329	393	280	313 or 296	313 or 296	313 or 296
28	413	493	351	392 or 372	392 or 372	392 or 372
30	474	565	403	450 or 427	450 or 427	450 or 427
35	645	770	548	613 or 581	613 or 581	613 or 581
43	973	1 162	827	924 or 876	924 or 876	924 or 876
50	1 315	1 570	1 118	1 249 or 1 184	1 249 or 1 184	1 249 or 1 184
57.5	1 740	2 077	1 479	1 653 or 1 566	1 653 or 1 566	1 653 or 1 566
63.5	2 122	2 534	1 804	2 016 or 1 910	2 016 or 1 910	2 016 or 1 910

[1] Maximum lock-off force according to Eurocode 2 and Eurocode 7,
..... minimum $\begin{cases} 0.75 \cdot F_m \\ 0.85 \cdot F_{p0.2} \end{cases}$

[2] Maximum proof force in investigation, suitability, and acceptance test according to Eurocode 2 and Eurocode 7 ..... $\begin{cases} 0.95 \cdot F_{p0.2} \\ \text{or} \\ \text{minimum} \begin{cases} 0.80 \cdot F_m \\ 0.90 \cdot F_{p0.2} \end{cases} \end{cases}$

Proof force of $0.95 \cdot F_{p0.2}$ can only be applied, if the force in the prestressing jack can be measured to an accuracy of ± 5 % of the final value of the proof force. Otherwise, minimum $\begin{cases} 0.80 \cdot F_m \\ 0.90 \cdot F_{p0.2} \end{cases}$ is taken.

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Rock and soil anchor system SAS

Thread bar S 670, ∅ 18–63.5 mm

Centre spacing and edge distance
Additional reinforcement

Annex 6

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Mechanical anchorage without additional reinforcement

- Actual concrete compressive strength at time of stressing, $f_{cm,\,0,\,cube\,150} \geq 25$ N/mm²
- Minimum concrete compressive strength class according to EN 206 ≥ C20/25
- Reinforcement in the anchorage zone according to Clause 1.7.

Thread bar nominal diameter	Anchor plate TR 2011-∅		Anchor plate TR 2010-∅	
	Centre spacing	Edge distance	Centre spacing	Edge distance
∅	C	E	C	E
mm	mm	mm	mm	mm
18	170	75 + c	170	75 + c
22	200	90 + c	200	90 + c
25	220	100 + c	220	100 + c
28	250	115 + c	250	115 + c
30	270	125 + c	270	125 + c
35	310	145 + c	310	145 + c
43	380	180 + c	380	180 + c
50	440	210 + c	440	210 + c
57.5	510	245 + c	510	245 + c
63.5	575	280 + c	575	280 + c

Thread bar nominal diameter	Maximum diameter [1) 2)]
∅	∅s
mm	mm
18	63.5
22	
25	
28	
30	70.0
35	76.1
43	101.6
50	101.6
57.5	114.3
63.5	

Mechanical anchorage with additional reinforcement – bursting reinforcement

- Actual concrete compressive strength at time of stressing, $f_{cm,\,0,\,cube\,150} \geq 25$ N/mm²
- Minimum concrete compressive strength class according to EN 206 ≥ C20/25

Thread bar nominal diameter	Anchor plate TR 2011-∅				Anchor plate TR 2010-∅			
	Centre spacing	Edge distance	Additional reinforcement Ribbed reinforcing steel, $R_e \geq 500$ N/mm²		Centre spacing	Edge distance	Additional reinforcement Ribbed reinforcing steel, $R_e \geq 500$ N/mm²	
∅	C	E	n × ∅ / a / l [3)]	h × h [4)]	C	E	n × ∅ / a / l [3)]	h × h [4)]
mm	mm	mm	– × mm / mm / mm	mm × mm	mm	mm	– × mm / mm / mm	mm × mm
18	130	55 + c	3 × ∅10 / 30 / 20	110 × 110	130	55 + c	3 × ∅10 / 30 / 20	110 × 110
22	140	60 + c	3 × ∅10 / 40 / 20	120 × 120	140	60 + c	3 × ∅10 / 40 / 20	120 × 120
25	160	70 + c	3 × ∅10 / 45 / 20	140 × 140	160	70 + c	3 × ∅10 / 45 / 20	140 × 140
28	180	80 + c	3 × ∅10 / 45 / 20	160 × 160	170	75 + c	3 × ∅10 / 50 / 20	150 × 150
30	190	85 + c	4 × ∅10 / 40 / 20	170 × 170	185	85 + c	4 × ∅10 / 50 / 20	165 × 165
35	220	100 + c	4 × ∅10 / 45 / 20	200 × 200	205	95 + c	4 × ∅10 / 50 / 20	185 × 185
43	270	125 + c	4 × ∅12 / 55 / 20	250 × 250	260	120 + c	4 × ∅12 / 65 / 20	240 × 240
50	310	145 + c	5 × ∅16 / 55 / 20	290 × 290	300	140 + c	5 × ∅16 / 65 / 20	280 × 280
57.5	350	165 + c	5 × ∅16 / 60 / 35	330 × 330	345	165 + c	5 × ∅16 / 70 / 35	325 × 325
63.5	390	185 + c	5 × ∅16 / 65 / 35	370 × 370	375	180 + c	5 × ∅16 / 75 / 35	355 × 355

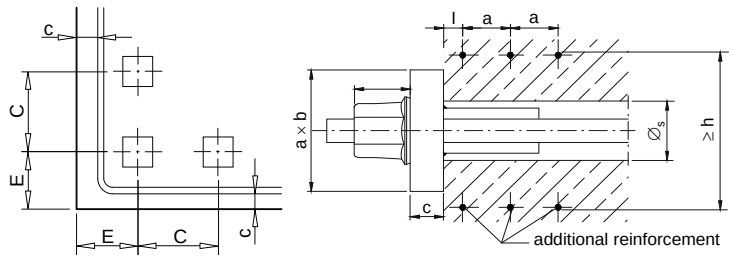
1) Maximum diameter for mechanical anchorage without and with additional reinforcement

2) Larger bearing distances are spanned with load transfer plates and the minimum concrete compressive strength class according to EN 206 is ≥ C25/30 and with angle compensation tube is ≥ C30/37.

3) n.....Number of stirrups
∅.....Nominal diameter of additional reinforcement
a.....Axis spacing of additional reinforcement
l.....Distance of first stirrup to anchor plate

4) h.....External dimensions of stirrups

c.....Concrete cover of reinforcement according to standards and regulations in force at the place of use. The exposure classes according to EN 206 are considered.



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Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Thread bar – Nominal dimensions and mass – Rib geometry

Annex 7
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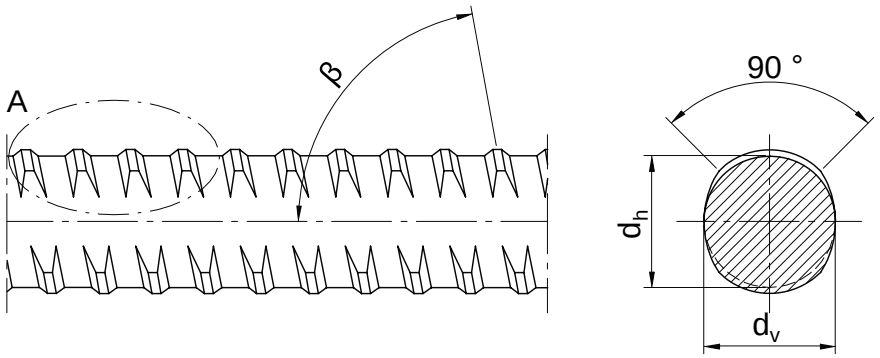
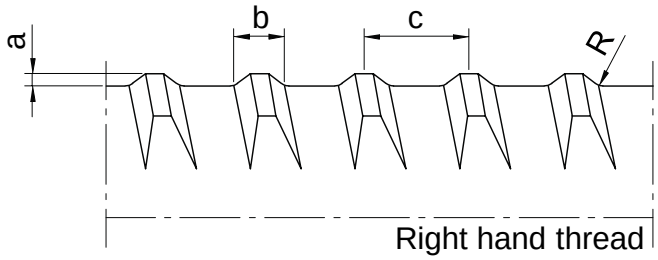
(1) Thread bar

Geometry



Detail A



Nominal			Core diameter		Ribs, right hand thread				
Diameter	Mass per metre [1]	Cross-sectional area			Depth	Width	Pitch	Gradient	Radius
∅	M	S_n	d_h	d_v	min a	b	c	β	R
mm	kg/m	mm^2	mm	mm	mm	mm	mm	°	mm
18	2.00	254	17.5	17.2	1.10	4.1	8.0	82.5	1.0
22	2.98	380	21.7	21.4	0.90	3.9	8.0	83.8	1.0
25	3.85	491	24.3	23.9	1.30	5.5	10.0	83.3	1.0
28	4.83	616	27.3	26.9	1.45	5.6	11.0	83.4	1.5
30	5.55	707	29.5	29.1	1.50	5.6	11.0	83.9	1.5
35	7.55	962	34.3	33.8	1.70	6.3	14.0	83.3	2.0
43	11.40	1 452	42.4	41.9	2.00	8.0	17.0	83.4	2.0
50	15.40	1 963	49.2	48.7	2.00	8.5	18.0	83.6	2.5
57.5	20.38	2 597	56.2	55.7	2.40	9.8	20.0	84.0	2.5
63.5	24.86	3 167	62.4	60.7	2.40	10.5	21.0	84.4	2.5

[1] Tolerance to nominal mass ± 4.5 %

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Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Thread bar – Mechanical technological characteristics

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(1) Thread bar

Characteristics and specifications

Nominal diameter ∅	Characteristic force at yield strength $F_{p0.2}$	Characteristic maximum force F_m
mm	kN	kN
18	170	204
22	255	304
25	329	393
28	413	493
30	474	565
35	645	770
43	973	1 162
50	1 315	1 570
57.5	1 740	2 077
63.5	2 122	2 534

Characteristic yield strength [1]	$R_{p0.2}$	N/mm²	670
Characteristic tensile strength [1]	R_m	N/mm²	800
Ratio	R_m / R_e	—	≥ 1.10
Elongation at maximum froce following $A_{gt} = A_g + \frac{R_m}{E} \cdot 100$ [2]	A_{gt}	%	≥ 5.0
Relative rib area	f_R	—	≥ 0.075
Fatigue resistance [3] at an upper stress of $\sigma_{up} = 0.7 \cdot R_{p0.2, nom}$ and up to $2.0 \cdot 10^6$ load cycles Tested stress range for			
∅ 18 to 43 mm	$2 \cdot \sigma_A$	N/mm²	150
∅ 50 to 63.5 mm			120
Suitability for bending		Not designated	
Suitability for welding		Not designated	

[1] 5 %-fractile
[2] Modulus of Elasticity E ~ 200 000 N/mm², A_g as plastic extension at maximum force
[3] Fatigue resistance of thread bar without anchorage and coupler

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Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Inner grout – Specification

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(17) Inner grout

Content of aggressive components	Cl^- SO_3^{2-} S^{2-}	%	≤ 0.1 ≤ 4.5 ≤ 0.01
Residue on sieve		—	≤ 0.01
Fluidity, cone	t_0 t_{30}	s s	≤ 25 ≤ 1.2 · t_0 ≥ 0.8 · t_0 ≤ 25
Fluidity, grout spread [1)]		—	—
Bleeding, wick-induced		%	≤ 0.3
Bleeding, inclined tube		%	≤ 0.3
Volume change		%	≥ – 1 ≤ + 5
Compressive strength		N/mm^2	≥ 30
Setting time		h	≥ 3 ≤ 24
Fluid density		kg/m^3	2 050
Crack width of inner grout at {60 % of R_m 85 % of $R_{p0.2}$.		mm	≤ 0.1 ≤ 0.2

[1)] Not relevant

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Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Heat shrinking sleeve – Specification

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(9) Heat shrinking sleeve
P 7029

Characteristics		—	P7029
Thickness after shrinking		mm	≥ 1.0
Mass per unit area of adhesive		g/m²	≥ 600
Tensile strength		N/mm	≥ 20
Elongation at break		%	≥ 600
Peel strength layer to layer		N/mm	≥ 1.5
Peel strength to steel surface		N/mm	≥ 1.0
Thermal ageing resistance	$\frac{S_{100}}{S_0}$, $\frac{E_{100}}{E_0}$	—	≤ 1.25 ≥ 0.75
	$\frac{S_{100}}{S_{70}}$, $\frac{E_{100}}{E_{70}}$		≥ 0.8
	$\frac{P_{100}}{P_T}$, $\frac{A_{100}}{A_T}$		≥ 0.75
	$\frac{P_{100}}{P_{70}}$, $\frac{A_{100}}{A_{70}}$		≥ 0.8
Indentation resistance	Residual thickness	mm	≥ 0.6
Impact resistance		—	C
Saponification value		$\frac{\text{mg KOH}}{\text{g}}$	15
Microbiological resistance	$\frac{S_6}{S_0}$, $\frac{E_6}{E_0}$	—	≥ 0.8
	$\frac{A_6}{A_T}$		≥ 0.8
Water absorption		%	≤ 0.05
Softening point of adhesive		°C	120
Oxygen stability of adhesive		min	20
Resistance to salt spray of adhesive			No corrosion
Content of aggressive components of adhesive	Cl^-	mg/kg	≤ 50
	NO^{-3}		≤ 50
	NO^{-2}		≤ 10
	SO_4^{2-}		≤ 50
	S^{-2}		≤ 10

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Rock and soil anchor system SAS

Thread bar S 670, ∅ 18–63.5 mm

Components – Domed nut, square anchor plate, welded steel tube – Dimensions

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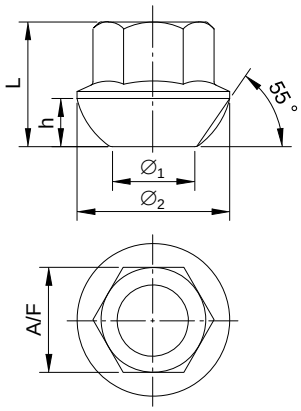
② Domed nut

TR 2001-∅

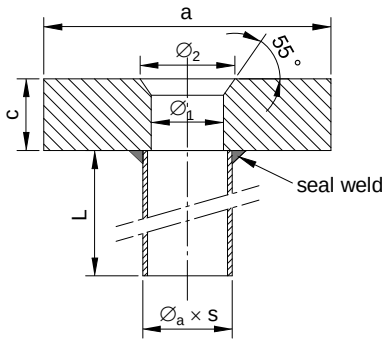


Thread bar ∅	A/F	L	$\varnothing_1$	$\varnothing_2$	h
mm	mm	mm	mm	mm	mm
18	32	35	24.5	43	13.5
22	36	45	28	53	17
25	41	50	31.5	60	19.5
28	46	55	35	67	22
30	50	60	35	71	24
35	60	70	43	83	29
43	70	85	52	102	36
50	80	100	60	116	43
57.5	90	115	67	137	50
63.5	100	125	73	151	56

③ Square anchor plate with steel tube

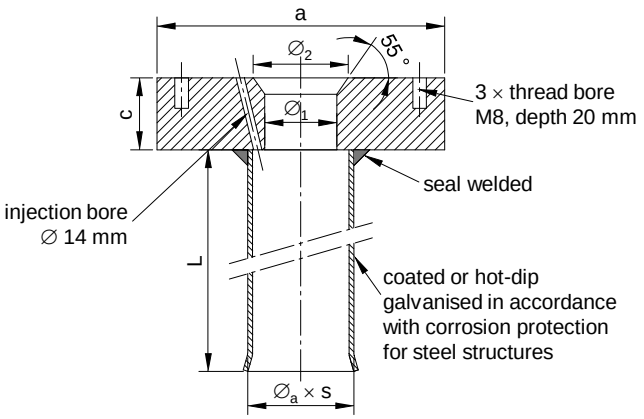
Temporary rock and soil anchor

TR 2111-∅



Temporary rock and soil anchor with extended working life
Permanent rock and soil anchor

TR 2110-∅



Thread bar	Anchor plate						Steel tube			
	TR 2011 - ∅		TR 2010 - ∅				Temporary rock and soil anchor		Temporary rock and soil anchor with extended working life – Permanent rock and soil anchor [1]	
∅	a	c	a	c	$\varnothing_1$	$\varnothing_2$	$\varnothing_a \times s$	L	$\varnothing_a \times s$	L
mm	mm	mm	mm	mm	mm	mm	mm × mm	mm	mm × mm	mm
18	100	25	100	20	27	39	44.5 × 2.3	150	63.5 × 2.6	300
22	110	30	110	25	32	47				
25	125	30	110	25	35	53				
28	135	35	115	30	40	59	48.3 × 2.3		70.0 × 2.6	
30	145	35	130	30	40	63				
35	170	40	150	35	47	73	60.3 × 2.3		76.1 × 2.6	
43	210	50	185	45	58	90	76.1 × 2.6		101.6 × 2.9	
50	240	55	210	50	70	110	88.9 × 2.9		101.6 × 2.9	
57.5	275	60	250	55	75	119	88.9 × 2.9		114.3 × 3.2	
63.5	300	65	265	60	82	131	101.6 × 2.9			

[1] For permanent rock and soil anchors the wall thickness of the steel tube is increased by 1 mm for high corrosion load according to EN 12501-1, -2.

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Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Components – Coupler with set screws, load transfer plates – Dimensions

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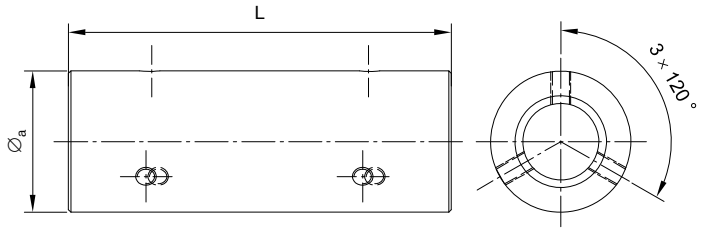
(8) Coupler with set screws

TR 3020-∅

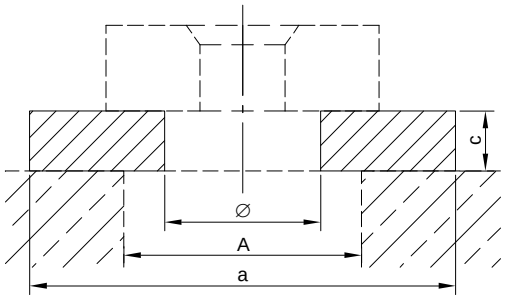
To prevent unscrewing, 3 set screws at both ends of the coupler
Hexagon socket set screws with flat point, EN ISO 4026



Thread bar ∅	∅a	L	Set screw
mm	mm	mm	mm
18	36	100	M 8
22	40	110	
25	45	130	
28	50	140	
30	55	150	
35	65	180	
43	80	200	
50	90	210	M 10
57.5	102	250	M 10
63.5	114	300	

(11) Load transfer plate [1] for large bore holes, recess tube

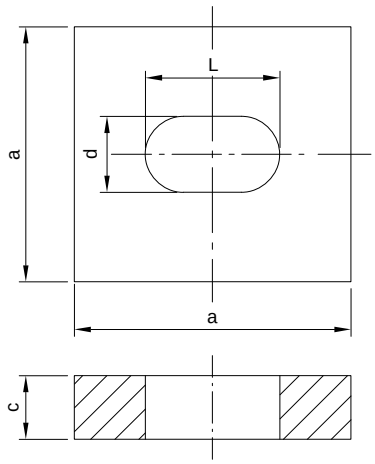
TR 2149-∅



Thread bar ∅	max. ∅ A or borehole	a	c	∅
mm	mm	mm	mm	mm
18	160	185	20	73
22				
25				
28		200	20	79
30				
35		210	20	86
43		230	15	111
50	160	270	15	111
57.5	200	300	15	124
63.5		320	15	124

(11a) Load transfer plate [1] for angle compensation tube

TR 2150-∅



Thread bar ∅	a	c	d	L
mm	mm	mm	mm	mm
18	185	20	73	104
22	185	20	73	105
25	185	25	73	107
28	200	25	79	116
30	200	30	79	116
35	210	30	86	124
43	230	30	111	153
50	270	30	111	153
57.5	300	30	124	168
63.5	320	30	124	168

[1] For permanent rock and soil anchors the exposed steel surfaces are coated or hot-dip galvanised as specified for corrosion protection of steel structures.

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Rock and soil anchor system SAS

Thread bar S 670, ∅ 18–63.5 mm

Components – Angle compensation tube, coupler tube – Dimensions

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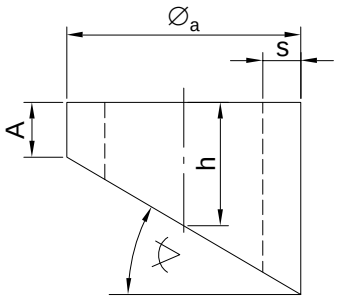
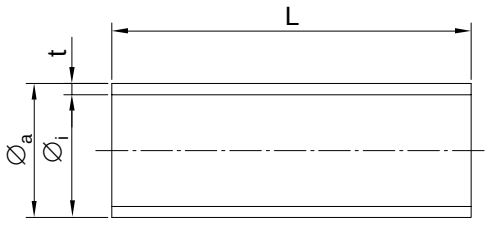
(18) Angle compensation tube [1)]



Thread bar ∅	Steel tube ∅a × s	A	h for an angle of					
			5 °	10 °	15 °	20 °	25 °	30 °
mm	mm × mm	mm	mm					
18	101.6 × 5.0	20	25	29	34	39	44	50
22	101.6 × 5.4	20	25	29	34	39	44	50
25	114.3 × 8.0	20	25	31	36	41	47	53
28	133.0 × 8.0	25	31	37	43	50	57	64
30	133.0 × 8.0	25	31	37	43	50	57	64
35	139.7 × 10.0	30	37	43	49	56	63	71
43	168.3 × 12.5	35	43	50	58	66	75	84
50	193.7 × 16.0	35	44	53	61	71	81	91
57.5	219.1 × 17.5	40	50	60	70	80	92	104
63.5	219.1 × 22.2	40	50	60	70	80	92	104

(10) Coupler tube



Thread bar ∅	Temporary rock and soil, Temporary rock and soil anchor with extended working life ∅a / ∅i	Permanent rock and soil anchor ∅a / ∅i	L [2)]	min. t
mm	mm	mm	mm	mm
18	50 / 44	63 / 57	450	2
22				
25	55 / 49			
28	63 / 59.2			
30		75 / 67.8		
35	75 / 67.8	90 / 84.6		
43	90 / 84.6	110 / 105	500	
50	110 / 105	110 / 105	500	
57.5	110 / 105	125 / 120	600	
63.5	125 / 120			

[2)] Elongation for a free anchor length of up to 18 m is considered

[1)] For permanent rock and soil anchors the exposed steel surfaces are coated or hot-dip galvanised as specified for corrosion protection of steel structures.

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Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Components – Steel cap – Dimensions

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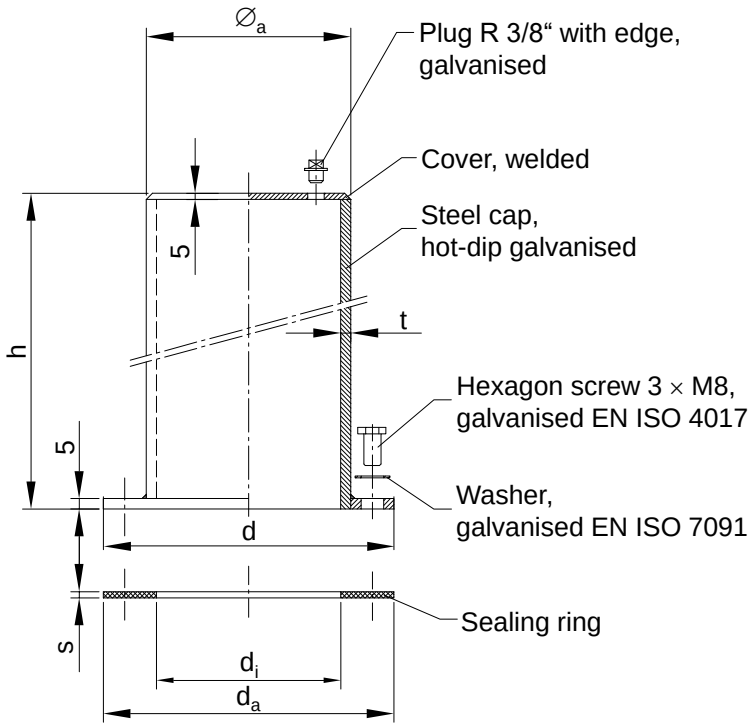
(12) Steel cap [1)]
with accessories



Dimensions in mm

Thread bar ∅	Steel tube ∅a × t	Flange d	Height h	Sealing ring da × di × s
mm	mm × mm	mm	mm	mm × mm × mm
18	60.3 × 3.2	100	≥ 200	100 × 54 × 3
22	63.5 × 3.2	110		110 × 57 × 3
25	76.1 × 3.2	115		115 × 70 × 3
28	88.9 × 3.2	135		135 × 82 × 3
30	88.9 × 3.2	135		135 × 82 × 3
35	101.6 × 3.2	148		148 × 95 × 3
43	114.0 × 3.6	160		160 × 107 × 3
50	127.0 × 3.6	171		171 × 119 × 3
57.5	152.4 × 3.6	205		205 × 144 × 3
63.5	168.3 × 3.6	220		220 × 161 × 3

[1)] For permanent rock and soil anchors the exposed steel surfaces are coated or hot-dip galvanised as specified for corrosion protection of steel structures.

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Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Components – Plastic cap with screw socket – Dimensions

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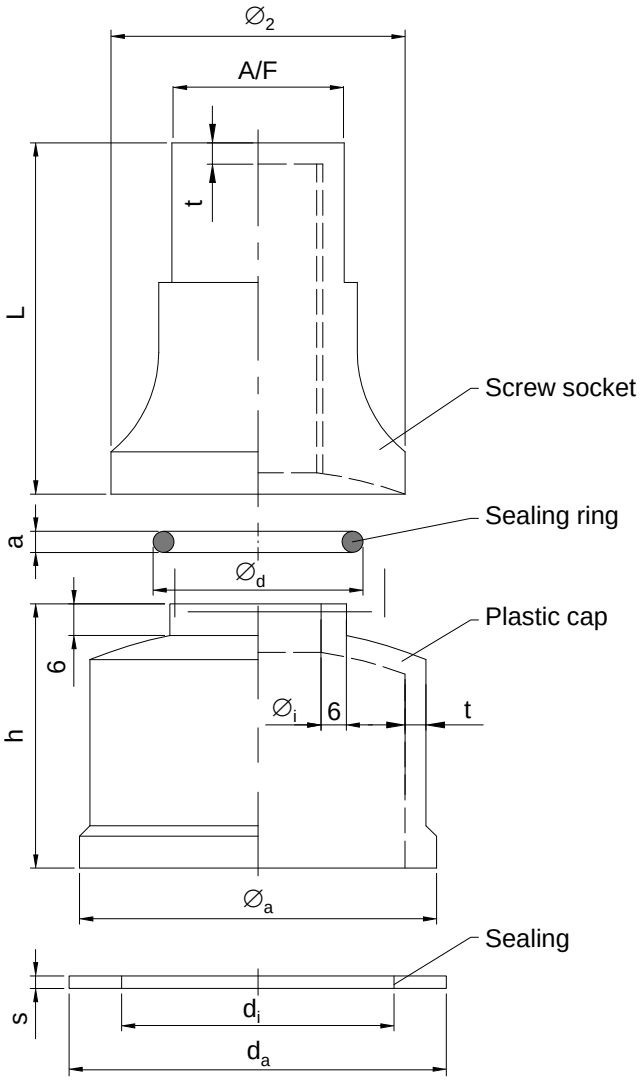
(12) Plastic cap
with accessories



Dimensions in mm

Thread bar	Plastic cap			Screw socket			Sealing ring	Sealing	
∅	t	$\varnothing_a \times h$	$\varnothing_1$	A/F	$\varnothing_2$	L	$\varnothing_d \times a$	d_a / d_i	s
mm	mm	mm × mm	mm	mm	mm	mm	mm × mm	mm / mm	mm
18–25	5	85 × 60	30	41	70	82	65 × 10	90 × 65	3
28–35	5	112 × 87	42	50	90	126	77 × 10	115 × 85	3
43	5	132 × 105	58	70	110	154	93 × 10	135 × 105	3
50–63.5	5	183 × 125	72	80	130	175	122 × 10	188 × 156	3

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Rock and soil anchor system SAS
Thread bar S 670, ∅ 18–63.5 mm

Components – Corrugated plastic sheathing, heat shrinking sleeve – Dimensions

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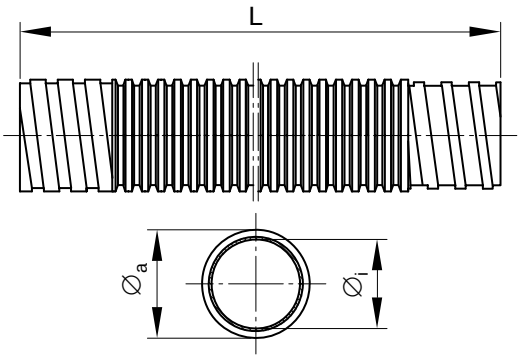
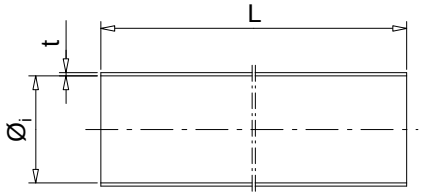
(4) Corrugated sheathing



Thread bar ∅	Dimensions [1] ∅a / ∅i	min. t
mm	mm / mm	mm
18	50 / 43	1.0
22		
25		
28		
30	56 / 49	
35	65 / 57	
43	80 / 71	
50		
57.5	100 / 90	
63.5		

[1] Length as required

(9) Heat shrinking sleeve
P 7029



Heat shrinking sleeve	∅i before shrinking	min t after shrinking
—	mm	mm
P7029-P40/15S	40	1.0
P7029-P50/20S	50	
P7029-P70/25S	70	
P7029-P90/30S	90	
P7029-P120/40S	120	
P7029-P170/80S	170	

Length of heat shrinking sleeve, L, as required. Overlap of adjacent parts of the rock and soil anchor is ensured.

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Components – Smooth sheathing – Dimensions

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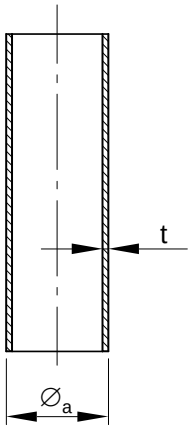
6 Smooth sheathing

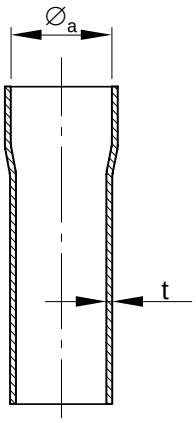
Temporary rock and soil anchor
Temporary rock and soil anchor with extended working life



Thread bar ∅	Dimensions [1] ∅a	t
mm	mm	mm
18	35	2.0
22		
25		
28	41	
30		2.0
35	46	
43	63	2.0 / 3.6
50	75	4.5
57.5	75	4.3
63.5	90	5.4

[1] Length as required

Permanent rock and soil anchor



Thread bar ∅	Dimensions [2] ∅a	min. t
mm	mm	mm
18	54.2	1.5
22		
25		
28		
30	60.1	
35	70.1	
43	84.9	
50	84.9	
57.5	105.4	
63.5		

[2] Length as required

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Thread bar S 670, ∅ 18–63.5 mm

Components – Basket spacer, profile ring, sealing ring – Dimensions

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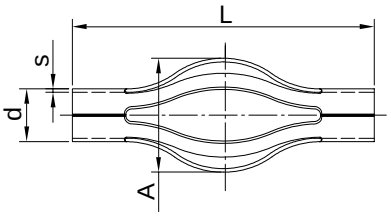
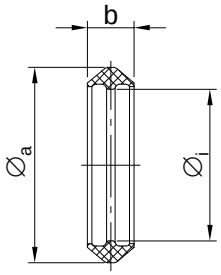
(7) Basket spacer



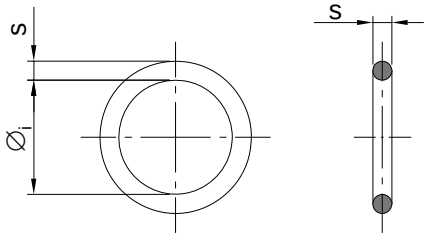
Thread bar ∅	Temporary rock and soil anchor Temporary rock and soil anchor with extended working life			Permanent rock and soil anchor		
	d × s	A	L	d × s	A	L
mm	mm × mm	mm	mm	mm × mm	mm	mm
18	20 × 1.5	> 70	150 to 175	55 × 3.0	> 100	250 to 290
22	25 × 1.8					
25	32 × 1.9					
28						
30	40 × 3.0	> 90	250 to 290	63 × 3.0	> 110	
35				75 × 3.6	> 115	
43	50 × 3.0	> 100		90 × 2.7	> 140	
50	63 × 3.0	> 125				
57.5				110 × 3.2		
63.5	75 × 3.6	> 125				

(14) Profile ring



Thread bar ∅	$\varnothing_a$	$\varnothing_i$	b
mm	mm	mm	mm
18	58.8	45.5	14
22			
25			
28			
30	65.0	49.5	20
35	71.5	58.0	20
43	96.0	75.0	23
50	96.0	75.0	23
57.5	109.0	92.5	21
63.5			

(20) Sealing ring



Thread bar ∅	$\varnothing_i$	s
mm	mm	mm
18	33	15
22		
25		
28	39	
30		12
35	44	15
43	61	18
50	73	12
57.5	73	18
63.5	88	12

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Components – Plastic cord, mat spacer, injection and end cap – Dimensions

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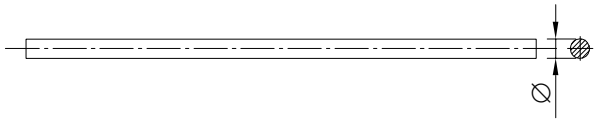
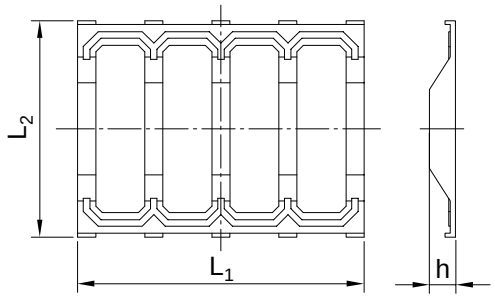
(16) Inner spacer
PE cord, pitch ≤ 0.5 m



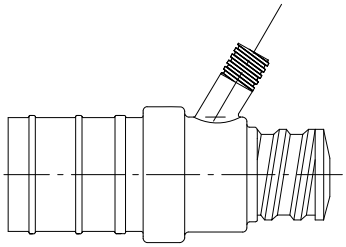
Thread bar ∅	PE cord min. ∅
mm	mm
18	6
22	
25	
28	
30	
35	
43	
50	
57.5	9
63.5	

Mat spacer
Distance ≤ 1.0 m

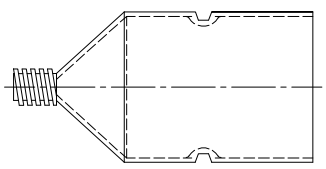


Thread bar ∅	Dimensions			Number of ribs
	h	L_1	L_2	
mm	mm	mm	mm	—
35	6	112	124	3
43	8	132	124	3
50	8	132	124	3
57.5	11	170	165	4
63.5	11	220	165	5

(13) Injection cap and end cap



Alternative cap



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Thread bar S 670, ∅ 18–63.5 mm

Material specifications

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Component	Standard / Specification
Thread bar	Annexes 7 and 8
Domed anchor nut, ∅ 18, 22, 25, 28, 30, 35, 43, 50, 57.5, and 63.5 mm	EN 10293
Solid plate, square	EN 10025
Steel tube	EN 10216-1 EN 10217-1
Coupler, ∅ 18, 22, 25, 28, 30, 35, and 43 mm	EN 10025
Coupler, ∅ 50, 57.5, and 63.5 mm	EN 10210
Load transfer plate	EN 10025
Angle compensation tube	EN 10210
Coupler tube	EN ISO 1163-1 EN ISO 17855-1
Steel cap	EN 10025
Smooth sheathing Plastic cap Injection cap End cap PE cord Mat spacer	EN ISO 17855-1
Corrugated sheathing Smooth sheathing Basket spacer	EN ISO 1163-1
Sealing ring Toroidal sealing ring Profile ring	Neoprene
Sealing ring Toroidal sealing ring Profile ring	Cellular rubber
Additional reinforcement	Ribbed reinforcing steel, $R_e \geq 500$ N/mm^2
Heat shrinking sleeve	Annex 10
Inner grout	Annex 9

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Thread bar S 670, ∅ 18–63.5 mm

Contents of the prescribed test plan

Annex 21

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Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
End anchorage, Coupling assembly	Static load test	Testing	[2]	0.2 % [3], [4], ≥ 2 [4]	Per year
	Resistance to fatigue	Testing	[2]	1 [4]	Per year
Thread bar	Mass per metre, cross-sectional area, surface geometry [5]	Testing	[2]	≥ 3 [6]	Continuous
	Strength characteristics [5] $\varnothing_{nom}$ < 57.5 mm $\varnothing_{nom}$ ≥ 57.5 mm	Testing	[2]	≥ 3 [6] ≥ 1 [7]	Continuous
	Elongation at maximum force [5] $\varnothing_{nom}$ < 57.5 mm $\varnothing_{nom}$ ≥ 57.5 mm	Testing	[2]	≥ 3 [6] ≥ 1 [7]	Continuous
	Resistance to fatigue	Testing	[2]	≥ 5 [8]	Per year
	Visual inspection [9]	Checking	[2]	100 %	Continuous
	Traceability	full			
Domed anchor nut, Coupler	Dimensions	Testing	[2]	0.4 % [10], [11], ≥ 2 [11]	Continuous
	Material	Checking [12]	[2]	100 %	Continuous
	Hardness	Testing	[2]	0.1 % [10], [11], ≥ 2 [11]	Continuous
	Visual inspection [9]	Checking	[2]	100 %	Continuous
	Inspection of all components manufacturer by the manufacturer of the kit [13]				1 per year
	Traceability	full			
Simple square anchor plate	Dimensions	Testing	[2]	0.4 % [10], [11], ≥ 2 [11]	Continuous
	Material	Checking [14]	[2]	100 %	Continuous
	Hardness	Testing	[2]	0.1 % [10], [11], ≥ 2 [11]	Continuous
	Visual inspection [9]	Checking	[2]	100 %	Continuous
	Traceability	full			

[1] For two specified numbers of samples, the higher number applies.
[2] Conformity with the specifications of the item
[3] Percentage of produced anchorages or coupling assemblies per nominal thread bar diameter. After 5 years of successful testing, the frequency may be reduced to 0.1 %.
[4] For at least 1 nominal thread bar diameter. In case of a production of less than 20 anchorages or coupling assemblies of 1 nominal thread bar diameter per year, testing that nominal thread bar diameter is not required. However, all nominal thread bar diameters shall be tested within 5 years.
[5] Assessment of long-term quality level according to EN 10080, clause 8.5.
[6] Per nominal thread bar diameter and rolling batch, at least however, as specified in EN 10080, clause 8.1.
[7] Per nominal thread bar diameter and rolling batch, at least however, as specified in EN 10080, clause 8.1, with 1 specimen instead of 3 specimens.
[8] Of one nominal thread bar diameter. All nominal diameters shall be tested within 5 years.
[9] Successful visual inspection does not need to be documented.
[10] Percentage of components per nominal thread bar diameter and batch of components
[11] Per nominal thread bar diameter and batch of components. In case of a production of less than 20 components of 1 nominal thread bar diameter per year, testing that nominal thread bar diameter is not required. However, all components of all nominal thread bar diameters shall be tested within 5 years.
[12] Inspection certificate type “3.1” according to EN 10204.
[13] Components other than simple anchor plates
[14] Test report type “2.2” according to EN 10204 for simple square anchor plates

Traceability	full	Full traceability of each component to its raw material.
Material		Defined according to technical specification deposited by the supplier
Dimensions		Measuring of all the dimensions and angles according to the specification given in the test plan
Visual inspection		Main dimensions, gauge testing, correct marking or labelling, appropriate performance, surface, corrosion, according to the component’s specification

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Contents of the prescribed test plan

Annex 22
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Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
Inner grout	Characteristics	EN 445	[2]	EN 446	EN 446
	Traceability	full			
Heat shrinking sleeve	Dimensions	Testing	[2]	0.5 % [3] ≥ 1 [3]	Continuous
	Material	Checking [4]	[2]	100 %	Continuous
	Thickness after shrinking	Testing	[2]	0.5 % [3] ≥ 1 [3]	Continuous
	Bond to steel surface	[5]	[6]	0.5 % [3] ≥ 1 [3]	Continuous
	Traceability	full			
Corrugated sheathing	Dimensions	Testing	[2]	0.1 % [7), 8)] ≥ 2 [7), 8)]	Continuous
	Material	Checking [9]	[2]	100 %	Continuous
	Visual inspection [10]	Checking	[2]	100 %	Continuous
	Traceability	full			

1) For two specified numbers of samples, the higher number applies.
2) Conformity with the specifications of the item
3) Percentage and minimum number for at least 1 size of heat shrinking sleeve per year. All sizes of heat shrinking sleeve shall be tested within 5 years.
4) Test report type “2.2” according to EN 10204
5) Detailed visual inspection of work samples regarding all-over adherence to steel surface, entrapped air, and bond defects
6) Applied heat shrinking sleeve with all-over adherence to steel surface, free of entrapped air, and free of bond defects
7) Percentage and minimum number per nominal diameter of corrugated sheathing
8) Per nominal diameter of corrugated sheathing. In case of less than 20 applications of a nominal diameter of corrugated sheathing per year, testing that nominal diameter of corrugated sheathing is not required. However, all nominal diameters of corrugated sheathing shall be tested within 5 years.
9) Inspection certificate type “3.1” according to EN 10204
10) Successful visual inspection does not need to be documented.

Traceability	full	Full traceability of each component to its raw material.
Material		Defined according to technical specification deposited by the supplier
Dimensions		Measuring of all the dimensions and angles according to the specification given in the test plan
Visual inspection		Main dimensions, correct marking or labelling, appropriate performance, surface, porosities, blisters, according to the component’s specification

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Audit testing

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Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
End anchorage, Coupling assembly	Static load test	Testing	[2]	3 [3]	Once per year
Thread bar	Mass per metre, cross-sectional area, surface geometry	Testing	[2]	[4]	Each inspection
	Strength characteristics	Testing	[2]	[4]	Each inspection
	Elongation at maximum force	Testing	[2]	[4]	Each inspection
	Visual inspection	Checking	[2]	[4]	Each inspection
Domed anchor nut, Coupler, Anchor plate	Dimensions	Testing	[2]	3 [5]	Each inspection [6]
	Material	Testing / Checking	[2]	3 [5]	Each inspection [6]
	Visual inspection	Checking	[2]	3 [7]	Each inspection [6]
Inner grout		EN 447	[2]	EN 447	Once per year [6]
Corrugated sheathing	Material	Testing / Checking	[2]	1 [8]	Each inspection [6]
	Dimensions	Testing	[2]	3 [9]	Each inspection [6]

1) All samples are taken at random and are clearly identified.
2) Conformity with the specification of the item
3) 1 nominal thread bar diameter, all nominal thread bar diameters shall be tested within 5 years.
4) According to EN 10080, clause 8.3.2.
5) Per kind of component. One nominal thread bar diameter is sampled. All nominal thread bar diameters shall be sampled within 5 years.
6) Inspection of kit manufacturer
7) Each kind of component for all nominal thread bar diameters
8) 1 nominal diameter of corrugated sheathing, all nominal diameters of corrugated sheathing shall be tested within 5 years.
9) All nominal diameters of corrugated sheathing. Number per nominal diameter of corrugated sheathing

Material	Defined according to technical specification deposited by the ETA holder at the Notified body
Dimension	Measuring of all the dimensions and angles according to the specification given in the test plan
Visual inspection	Main dimensions, gauge testing, correct marking or labelling, appropriate performance, surface, corrosion according to the component's specification

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Audit testing

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Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
Heat shrinking sleeve	Dimensions (thickness, diameter or size)	Testing	[2]	1 [3]	Once per year [4]
	Thickness after shrinking	Testing	[2]	1 [3]	
	Mass per unit area of adhesive	Testing	[2]	1 [3]	
	Tensile strength	Testing	[2]	1 [3]	
	Elongation at break	Testing	[2]	1 [3]	
	Peel strength to steel surface	Testing	[2]	1 [3]	
	Bond to steel surface	Testing	[5]	2 [6]	
	Chemical composition of adhesive	Testing	[2]	1 [3]	
	Conformity to relevant standard	Checking [7]	[2]	100 %	
	Peel strength layer to layer	Testing	[2]	2 [6]	Once every 5 years [4]
	Thermal aging resistance	Testing	[2]	2 [6]	
	Indentation resistance	Testing	[2]	2 [6]	
	Impact resistance	Testing	[2]	2 [6]	
	Saponification value	Testing	[2]	2 [6]	
	Chemical signature of the adhesive	Testing [8]	[2]	1 [3]	Once per year [4]

1) All samples are taken at random and be clearly identified.
2) According to the specification of the heat shrinking sleeve or adhesive
3) 1 size of heat shrinking sleeve, all sizes of heat shrinking sleeve shall be tested within 5 years. Sampling for peel strength is appropriate to the test procedure.
4) Inspection of kit manufacturer
5) Visual inspection of applied heat shrinking sleeve regarding all-over adherence to steel surface, free of entrapped air and bond defects
6) Samples from 2 sizes of heat shrinking sleeve
7) Test report type “2.2” according to EN 10204
8) Determination of infra-red spectrum according to DIN 51451.
This method is applied to identify that the product is the same as the one tested during the assessment of the essential characteristics of the product by the TAB.

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Essential characteristics for the intended uses

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№ [1]	Essential characteristic [1]	Product and intended use Line № according to Clause 2.1, Table 2		
		1	2	3
Basic requirement for construction works 1: Mechanical resistance and stability				
1	Resistance to static load of anchorages and coupling assemblies	+	+	+
2	Resistance to fatigue of anchorages and coupling assemblies	+	+	+
3	Load transfer to the structure	+	+	+
4	Corrosion protection of temporary anchor	+	—	—
5	Corrosion protection of temporary anchor with extended working life	—	+	—
6	Corrosion protection of permanent anchor	—	—	+
7	Transition anchorage to free length of temporary anchor	+	—	—
8	Transition anchorage to free length of temporary anchor with extended working life	—	+	—
9	Transition anchorage to free length of permanent anchor	—	—	+
10	Transition anchorage to free length – Tightness	+	+	+
11	Crack width in inner grout	—	—	+
Thread bar				
12	Cross-sectional area	+	+	+
13	Mass per metre	+	+	+
14	Surface geometry	+	+	+
15	Strength characteristics	+	+	+
16	Modulus of elasticity	+	+	+
17	Elongation at maximum force	+	+	+
18	Resistance to fatigue	+	+	+
19	Bond strength	+	+	+
Nuts, anchor pieces, couplers, and anchor plates				
20	Shape	+	+	+
21	Dimensions	+	+	+
22	Material	+	+	+
23	Hardness	+	+	+
Inner grout				
24	Content of aggressive components	—	—	+
25	Residue on sieve	—	—	+
26	Fluidity, cone	—	—	+
27	Fluidity, grout spread	—	—	+
28	Bleeding, wick-induced	—	—	+
29	Bleeding, inclined tube	—	—	+
30	Volume change	—	—	+
31	Compressive strength	—	—	+
32	Setting time	—	—	+
33	Fluid density	—	—	+

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Essential characteristics for the intended uses

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№ [1]	Essential characteristic [1]	Product and intended use Line № according to Clause 2.1, Table 2		
		1	2	3
Basic requirement for construction works 1: Mechanical resistance and stability				
Heat shrinking sleeve				
34	Thickness after shrinking	—	—	+
35	Mass per unit area of adhesive	—	—	+
36	Tensile strength	—	—	+
37	Elongation at break	—	—	+
38	Peel strength layer to layer	—	—	+
39	Peel strength to steel surface	—	—	+
40	Thermal ageing resistance	—	—	+
41	Indentation resistance	—	—	+
42	Impact resistance	—	—	+
43	Saponification value	—	—	+
44	Microbiological resistance	—	—	+
45	Water absorption	—	—	+
46	Softening point of adhesive	—	—	+
47	Oxygen stability of adhesive	—	—	+
48	Resistance to salt spray of adhesive	—	—	+
49	Content of aggressive components of adhesive	—	—	+
Corrugated plastic sheathing				
50	Shape	—	—	+
51	Dimensions	—	—	+
52	Material	—	—	+

Key
+..... Essential characteristic relevant for the intended use
— ..... Essential characteristic not relevant for the intended use
For combinations of intended uses, the essential characteristics of all intended uses composing the combination are relevant.
[1] Line numbers and essential characteristics correspond to Clause 3.1, Table 4.

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Max Aicher GmbH & Co. KG 83404 Ainring–Hammerau	**Rock and soil anchor system SAS** Thread bar S 670, ∅ 18–63.5 mm Reference documents	**Annex 27** of European Technical Assessment **ETA-13/0022** of 21.12.2018

EAD 160004-00-0301	Post-Tensioning Kits for Prestressing of Structures
EAD 160015-00-0102	Kit for rock and soil anchors – Kit with thread bars
EN 206+A1, 11.2016	Concrete – Specification, performance, production and conformity
EN 445, 10.2007	Grout for prestressing tendons – Test methods
EN 446, 10.2007	Grout for prestressing tendons – Grouting procedures
EN 447, 10.2007	Grout for prestressing tendons – Basic requirements
EN 1537, 07.2013	Execution of special geotechnical works – Ground anchors
Eurocode 0	Eurocode 0 – Basis of structural design
Eurocode 2	Eurocode 2 – Design of concrete structures
Eurocode 3	Eurocode 3 – Design of steel structures
Eurocode 7	Eurocode 7 – Geotechnical design
EN 10025-series, 11.2004	Hot rolled products of structural steels – Series
EN 10080, 05.2005	Steel for the reinforcement of concrete – Weldable reinforcing steel – General
EN 10204, 10.2004	Metallic products – Types of inspection documents
EN 10210-series, 04.2006	Hot finished structural hollow sections of non-alloy and fine grain steels – Series
EN 10216-1, 12.2013	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10217-1+A1, 01.2005	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10293, 01.2015	Steel castings – Steel castings for general engineering uses
EN 12501-1, 04.2003	Protection of metallic materials against corrosion – Corrosion likelihood in soil – Part 1: General
EN 12501-2, 04.2003	Protection of metallic materials against corrosion – Corrosion likelihood in soil – Part 2: Low alloyed and non alloyed ferrous materials
EN ISO 1163-1, 1999	Plastics – Unplasticized poly(vinyl chloride) (PVC-U) moulding and extrusion materials – Part 1: Designation system and basis for specifications
EN ISO 1461, 05.2009	Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods
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