Austrian Institute of Construction Engineering
Schenkenstrasse 4 | T +43 1 533 65 50
1010 Vienna | Austria | F +43 1 533 64 23
www.oib.or.at | mail@oib.or.at

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European Technical Assessment

ETA-12/0601 of 23.11.2023

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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 mm
Product family to which the construction product belongs	Kit for rock and soil anchors – Kit with thread bars of prestressing 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	51 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	European Assessment Document (EAD) 160045-00-0102 – Kit for rock and soil anchors – Kit with thread bars of prestressing steel.
This European Technical Assessment replaces	European Technical Assessment ETA-12/0601 of 21.12.2018

Table of contents

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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 of prestressing steel Y1050H according to prEN 10138-4[2]. 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 in prestressing steel are given in Table 1.

Table 1: Tensile elements

Nominal diameter ∅	**Nominal yield strength** $R_{p0.1}$	**Nominal tensile strength** R_m
mm	**N/mm²**	**N/mm²**
17.5, 26.5, 32, 36, 40, and 47	950	1050

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.

– 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.

[1] ETA-12/0601 was firstly issued in 2013 as European technical approval with validity from 12.06.2013, converted and amended in 2018 to European Technical Assessment ETA-12/0601 of 21.12.2018, and amended in 2023 to European Technical Assessment ETA-12/0601 of 23.11.2023.

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

- 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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, ∅ = 17.5, 26.5, 32, 36, 40, and 47 mm.

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

1.4 Tendon

The tendon comprises one single 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, 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.

Larger angular 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.

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 stressing, the thread bar protrusion is coated with corrosion protection material and a steel or plastic protective cap is tightly attached to the anchor plate. Corrosion protection of anchor plate is only required for corrosive environments and aesthetic reasons.

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.

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 stressing the rock and soil anchor,

- a protective cap in steel 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.

All exposed or outside surfaces of steel parts, e.g., steel tubes, anchor plate, anchorage components, and caps, insufficiently covered with concrete are protected against corrosion.

- In general, one of the protection systems in accordance with EN ISO 12944-5 is applied. Surfaces are prepared in accordance with EN ISO 12944-4. For execution of the corrosion protection, EN ISO 12944-7 is observed.
- As an alternative, anchor plates and caps exposed to corrosivity categories C1 to C3 according to EN ISO 14713-1 are hot dip galvanised according to EN ISO 1461. Mean coating thickness of hot dip galvanised coating is appropriate to the corrosivity categories and the assumed working life. In EN ISO 14713-1, guide values for coating thickness are specified.

  NOTE Corrosion protection by hot dip galvanising relies on coating deterioration of the hot dip galvanised coating in the course of time. However, local corrosive exposure may cause substantially intensified coating deterioration and a clearly reduced time of protection by the hot dip galvanised coating. If such local corrosive exposure is possible, it will be considered in the corrosion protection evaluation.

Components

1.9 General

The components of the Rock and soil anchor system SAS with prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 Assessment.

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

1.10 Tensile element, thread bar in prestressing steel

The tensile element is a hot rolled, in-line heat treated, stretched and tempered prestressing steel bar Y1050H with a continuous right-hand thread – thread bar.

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

- Nominal diameter ..... 17.5, 26.5, 32, 36, 40, and 47 mm
- Characteristic yield strength ..... $R_{p0.1}$ = 950 N/mm^2
- Characteristic tensile strength ..... R_m = 1 050 N/mm^2
- 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. It is available in two different materials.

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 of 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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, $F_{p0.1}$.
- The load-bearing capacity of the tendon, comprising the components thread bar, coupler, and anchorage, is 100 % relative to the characteristic maximum force, F_{pk}, of the thread bar. The values in Annex 8 are taken as a basis.
- 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 are not executed.
- The stress ranges at coupler assembly and anchorage given Table 3 were determined in fatigue tests at an upper force of $0.65 \cdot F_{pk}$ and up to $2 \cdot 10^6$ load cycles.
- The parameters of the S-N curve for coupler and anchor head with anchor plate are specified in EN 1992-1-1 and given in Table 4.
- 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/mm^2.
- 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/mm^2 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 $1.1 \cdot F_{pk}$ being transferred into the substructure.

  Where

  F_{pk}.....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 $1.1 \cdot F_{pk}$ 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.

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

- 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.

Table 3 Stress range verified in fatigue tests

Nominal diameter Ø	Stress range	
	Coupler assembly	Anchorage with anchor plate
mm	N/mm²	N/mm²
17.5 to 47	80	80

Table 4 Parameter of the S-N curve for coupler and anchor head with anchor plate

Nominal diameter Ø	Parameter of the S-N curve Coupler Anchor head with anchor plate
mm	—
17.5 to 47	S-N curve with $\Delta\sigma_{Rsk}$ = 80 N/mm² with N = 2 · 10⁶ k_1 = 5, k_2 = 5 N* = 1 · 10ⁿ, n = 6

Where

$\Delta\sigma_{Rsk}$ .....Stress range

N.....Number of load cycles

k_1, k_2 .....Stress exponents of the S-N curve according to EN 1992-1-1, Table 6.4N

N*.....Number of load cycles at the transition from k_1 to k_2

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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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.

Bursting out of the tendon in case of a bar failure is prevented according to local conditions.

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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 mm, for the essential characteristics are given in Table 5. In Annex 25 and Annex 26 the combinations of essential characteristics and corresponding intended uses are listed.

Table 5 Essential characteristics and performances of the rock and soil anchor

№	Essential characteristic	Method of assessment	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.	See Clause 3.2.1.1.
2	Resistance to fatigue of anchorages and coupling assemblies	EAD 160045-00-0102, Clause 2.2.2	See Clause 3.2.1.2.
3	Load transfer to the structure	See Clause 3.2.1.3.	See Clause 3.2.1.3.
4	Corrosion protection of temporary anchor	EAD 160045-00-0102, Clause 2.2.4	See Clause 3.2.1.4.
5	Corrosion protection of temporary anchor with extended working life	EAD 160045-00-0102, Clause 2.2.5	See Clause 3.2.1.5.
6	Corrosion protection of permanent anchor	EAD 160045-00-0102, Clause 2.2.6	See Clause 3.2.1.6.
7	Transition anchorage to free length of temporary anchor	EAD 160045-00-0102, Clause 2.2.7	See Clause 3.2.1.7.
8	Transition anchorage to free length of temporary anchor with extended working life	EAD 160045-00-0102, Clause 2.2.8	See Clause 3.2.1.8.

[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	Method of assessment	Product performance
9	Transition anchorage to free length of permanent anchor	EAD 160045-00-0102, Clause 2.2.9	See Clause 3.2.1.9.
10	Transition anchorage to free length – Tightness	EAD 160045-00-0102, Clause 2.2.10	See Clause 3.2.1.10.
11	Crack width in inner grout	EAD 160045-00-0102, Clause 2.2.11	See Annex 9.
Thread bar of prestressing steel			
12	Cross-sectional area	EAD 160045-00-0102, Clause 2.2.12	See Annex 7.
13	Mass per metre	EAD 160045-00-0102, Clause 2.2.13	See Annex 7.
14	Surface geometry	EAD 160045-00-0102, Clause 2.2.14	See Annex 7.
15	Strength characteristics	EAD 160045-00-0102, Clause 2.2.15	See Annex 8.
16	Modulus of elasticity	EAD 160045-00-0102, Clause 2.2.16	See Annex 8.
17	Elongation at maximum force	EAD 160045-00-0102, Clause 2.2.17	See Annex 8.
18	Resistance to fatigue	EAD 160045-00-0102, Clause 2.2.18	See Annex 8.
19	Stress relaxation	EAD 160045-00-0102, Clause 2.2.19	See Annex 8.
20	Constriction at break	EAD 160045-00-0102, Clause 2.2.20	See Annex 8.
21	Stress corrosion resistance	EAD 160045-00-0102, Clause 2.2.21	See Annex 8.
Nut, anchor plate, and coupler			
22	Shape	EAD 160045-00-0102, Clause 2.2.22	See Annex 11 and Annex 12.
23	Dimensions	EAD 160045-00-0102, Clause 2.2.23	See Annex 11 and Annex 12.
24	Material	EAD 160045-00-0102, Clause 2.2.24	See Annex 20.
25	Hardness	EAD 160045-00-0102, Clause 2.2.25	See Clause 3.2.1.11.

№	Essential characteristic	Method of assessment	Product performance
Inner grout			
26	Content of aggressive components	EAD 160045-00-0102, Clause 2.2.26	See Annex 9.
27	Residue on sieve	EAD 160045-00-0102, Clause 2.2.27	See Annex 9.
28	Fluidity, cone	EAD 160045-00-0102, Clause 2.2.28	See Annex 9.
29	Fluidity, grout spread	EAD 160045-00-0102, Clause 2.2.29	See Annex 9.
30	Bleeding, wick-induced	EAD 160045-00-0102, Clause 2.2.30	See Annex 9.
31	Bleeding, inclined tube	EAD 160045-00-0102, Clause 2.2.31	See Annex 9.
32	Volume change	EAD 160045-00-0102, Clause 2.2.32	See Annex 9.
33	Compressive strength	EAD 160045-00-0102, Clause 2.2.33	See Annex 9.
34	Setting time	EAD 160045-00-0102, Clause 2.2.34	See Annex 9.
35	Fluid density	EAD 160045-00-0102, Clause 2.2.35	See Annex 9.
Heat shrinking sleeve with inner coating			
36	Thickness after shrinking	EAD 160045-00-0102, Clause 2.2.36	See Annex 10.
37	Mass per unit area of adhesive	EAD 160045-00-0102, Clause 2.2.37	See Annex 10.
38	Tensile strength	EAD 160045-00-0102, Clause 2.2.38	See Annex 10.
39	Elongation at break	EAD 160045-00-0102, Clause 2.2.39	See Annex 10.
40	Peel strength layer to layer	EAD 160045-00-0102, Clause 2.2.40	See Annex 10.
41	Peel strength to the steel surface	EAD 160045-00-0102, Clause 2.2.41	See Annex 10.
42	Thermal ageing resistance	EAD 160045-00-0102, Clause 2.2.42	See Annex 10.
43	Indentation resistance	EAD 160045-00-0102, Clause 2.2.43	See Annex 10.
44	Impact resistance	EAD 160045-00-0102, Clause 2.2.44	See Annex 10.

№	Essential characteristic	Method of assessment	Product performance
45	Saponification value	EAD 160045-00-0102, Clause 2.2.45	See Annex 10.
46	Microbiological resistance	EAD 160045-00-0102, Clause 2.2.46	See Annex 10.
47	Water absorption	EAD 160045-00-0102, Clause 2.2.47	See Annex 10.
48	Softening point of adhesive	EAD 160045-00-0102, Clause 2.2.48	See Annex 10.
49	Oxygen stability of adhesive	EAD 160045-00-0102, Clause 2.2.49	See Annex 10.
50	Resistance to salt spray of adhesive	EAD 160045-00-0102, Clause 2.2.50	See Annex 10.
51	Content of aggressive components of adhesive	EAD 160045-00-0102, Clause 2.2.51	See Annex 10.
Corrugated plastic sheathing			
52	Shape	EAD 160045-00-0102, Clause 2.2.52	See Annex 16.
53	Dimensions	EAD 160045-00-0102, Clause 2.2.53	See Annex 16.
54	Material	EAD 160045-00-0102, Clause 2.2.54	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.		—
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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 mm, as described in the ETA meets the acceptance criteria of EAD 160045-00-0102, Clause 2.2.1. The characteristic tensile strength, R_m, of the prestressing steel thread bars is given in 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 mm, as described in the ETA meets the acceptance criteria of EAD 160045-00-0102, Clause 2.2.3. The characteristic tensile strength, R_m, of the prestressing steel thread bars is given in 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 6.

Table 6: 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 160045-00-0102, Kit for rock and soil anchors – Kit with thread bars of prestressing steel.

3.4 Identification

The European Technical Assessment for the Rock and soil anchor system SAS with prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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].

(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).

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[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.

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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 5**.** 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 steel bar 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 prestressing steel thread bars Y1050H, diameter 17.5 to 47 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 23 November 2023
by Österreichisches Institut für Bautechnik

The original document is signed by:

Georg Kohlmaier
Deputy Managing Director

Member of EOTA

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

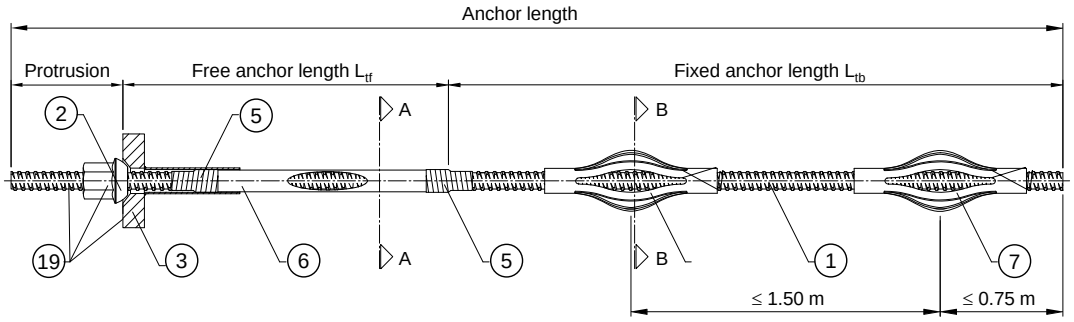
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Temporary rock and soil anchor

Annex 1

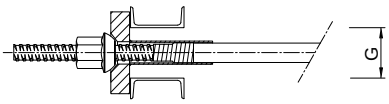
of **ETA-12/0601** of 23.11.2023

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

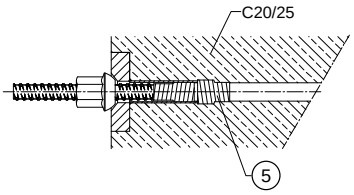


Anchor heads variants

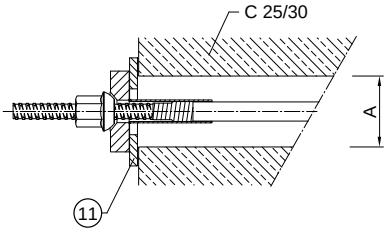
Steel bearing



Fully concreted

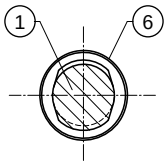


Bearing on larger borehole or distance

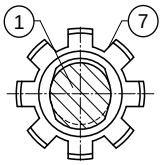


Sections

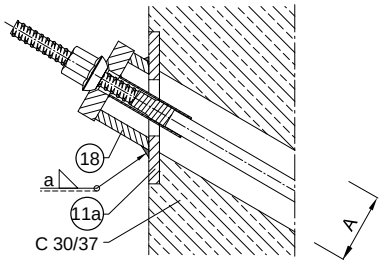
A – A, Cross section in L_{tf}



B – B, Cross section in L_{tb}



Angle compensation with tube



Prestressing steel bar nominal diameter ∅	Maximum G for bearing on steel G	Maximum 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
17.5	80	160	3.5	55	50	60	70
26.5	90		5	65	60	75	85
32	100		6	70	65	85	95
36	130		7	70	65	90	110
40			8	90	80	95	110
47			8	100	90	110	130

[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 Prestressing steel 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

Member of EOTA

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

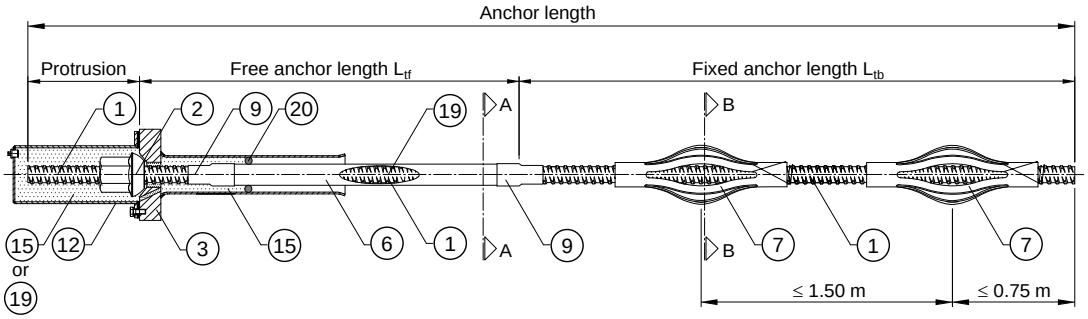
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Temporary rock and soil anchor with extended working life

Annex 2

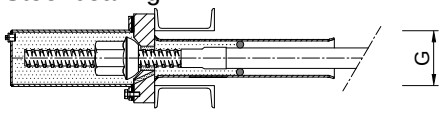
of **ETA-12/0601** of 23.11.2023

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

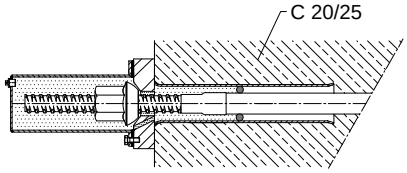


Anchor heads variants

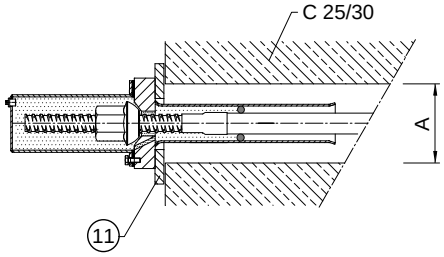
Steel bearing



Fully concreted

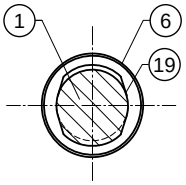


Bearing on larger borehole or distance

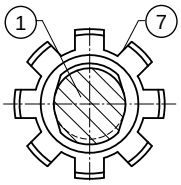


Sections

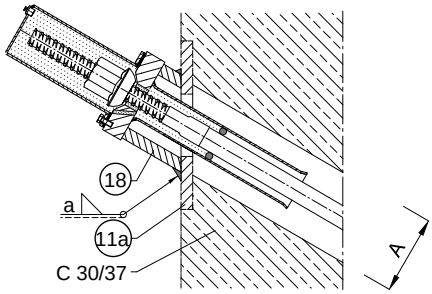
A – A, Cross section in L_{tf}



B – B, Cross section in L_{tb}



Angle compensation with tube



Prestressing steel bar nominal diameter ∅	Maximum G for bearing on steel G	Maximum 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
17.5	80	160	3.5	80	50	60	70
26.5	90		5	80	60	75	85
32	100		6	85	65	85	95
36	130		7	95	65	90	110
40			8	95	80	95	110
47			8	120	90	110	130

[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 Prestressing steel 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 filling material
18 Angle compensation tube
19 Corrosion protection coating
20 Sealing ring

Member of EOTA

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

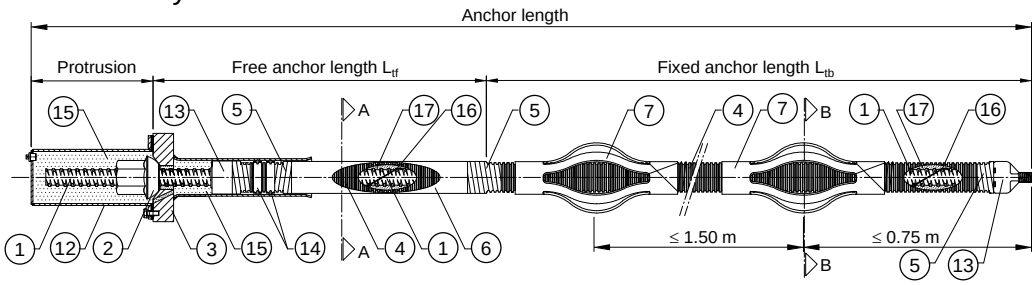
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Permanent rock and soil anchor

Annex 3

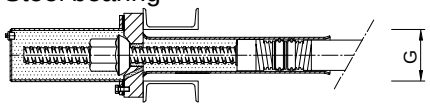
of **ETA-12/0601** of 23.11.2023

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

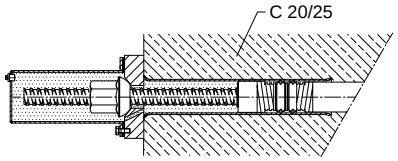


Anchor heads variants

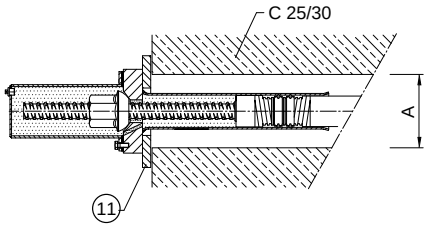
Steel bearing



Fully concreted

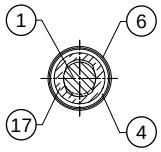


Bearing on larger borehole or distance

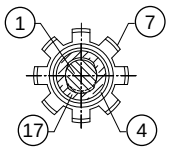


Sections

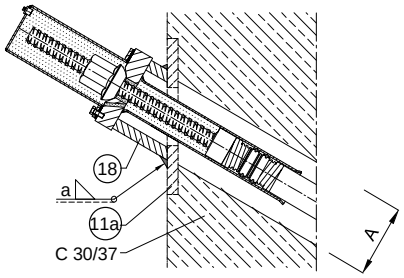
A – A, Cross section in L_{tf}



B – B, Cross section in L_{tb}



Angle compensation with tube



Prestressing steel bar nominal diameter ∅	Maximum G for bearing on steel G	Maximum 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
17.5	80	160	3.5	80	70	70	85
26.5	90		5	80	70	75	85
32	100		6	85	80	85	95
36	130		7	95	85	90	110
40			8	95	85	95	110
47			8	120	100	110	130

[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 Prestressing steel 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 filling material
16 Inner spacer
17 Inner cement grout
18 Angle compensation tube

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

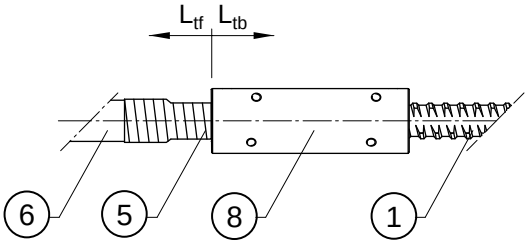
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Coupling assemblies

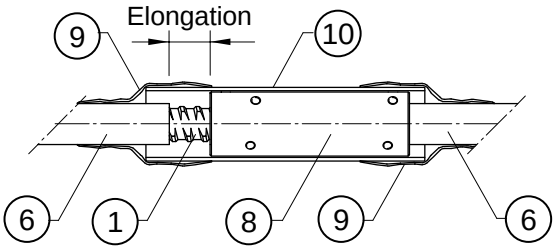
Annex 4

of **ETA-12/0601** of 23.11.2023

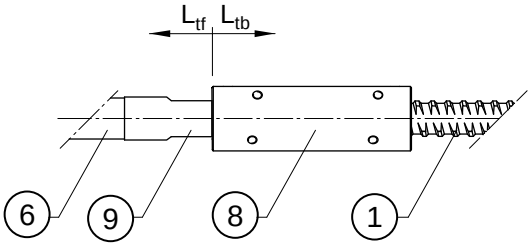
Coupling assemblies – Temporary rock and soil anchor
Transition free anchor length L_{tf} – fixed anchor length L_{tb}



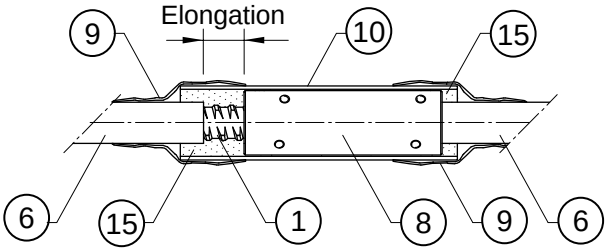
In free anchor length L_{tf}



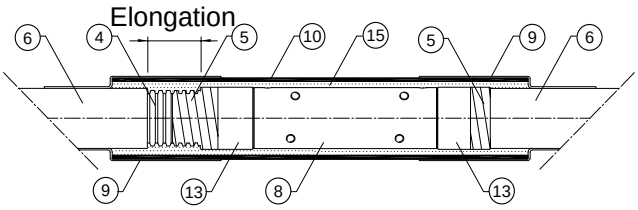
Coupling assemblies – Temporary rock and soil anchor with extended working life
Transition free anchor length L_{tf} – fixed anchor length L_{tb}



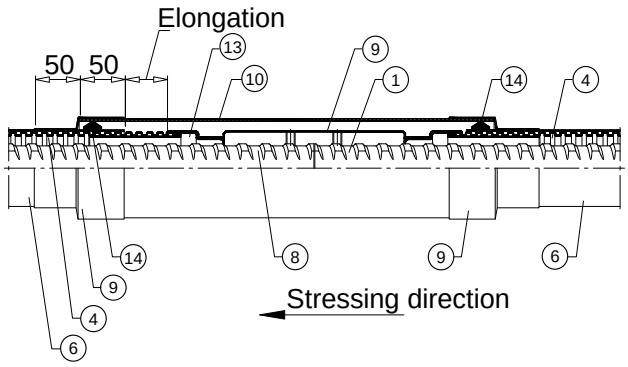
In free anchor length L_{tf}



Coupling assemblies – Permanent rock and soil anchor
In free anchor length L_{tf}



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., prestressing steel 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., prestressing steel bar or corrugated plastic sheathing, is at least 75 mm.

1 Prestressing steel 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
14 Profile ring, optional
15 Corrosion protection filling material

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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Proof forces and lock-off forces

Annex 5

of **ETA-12/0601** of 23.11.2023

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.

Prestressing steel bar Y1050H, $R_{p0.1}$ = 950 N/mm², R_m = 1 050 N/mm²						
Prestressing steel 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]
∅	$F_{p0.1}$	F_{pk}	—	—	—	—
mm	kN	kN	kN	kN	kN	kN
17.5	230	255	191	219 or 204	219 or 204	219 or 204
26.5	525	580	435	499 or 464	499 or 464	499 or 464
32	760	845	634	722 or 676	722 or 676	722 or 676
36	960	1 070	803	912 or 856	912 or 856	912 or 856
40	1 190	1 320	990	1 131 or 1 056	1 131 or 1 056	1 131 or 1 056
47	1 650	1 820	1 365	1 568 or 1 456	1 568 or 1 456	1 568 or 1 456

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

[2] Maximum proof force in investigation, suitability, and acceptance test according to Eurocode 2 and Eurocode 7 ..... $\begin{cases} 0.95 \cdot F_{p0.1} \\ \text{or} \\ \text{minimum} \begin{cases} 0.80 \cdot F_{pk} \\ 0.90 \cdot F_{p0.1} \end{cases} \end{cases}$

Proof force of $0.95 \cdot F_{p0.1}$ 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 $\begin{cases} 0.80 \cdot F_{pk} \\ 0.90 \cdot F_{p0.1} \end{cases}$ is taken.

NOTE For crack width in inner grout see Annex 9.

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Rock and soil anchor system SAS

Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Centre spacing and edge distance
Additional reinforcement

Annex 6

of **ETA-12/0601** of 23.11.2023

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.

Prestressing steel bar nominal diameter	Centre spacing	Edge distance
∅	C	E
mm	mm	mm
17.5	200	90 + c
26.5	280	130 + c
32	340	160 + c
36	380	180 + c
40	420	200 + c
47	500	240 + c

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.

Prestressing steel bar nominal diameter	Maximum diameter [1), 2)]
∅	$\varnothing_s$
mm	mm
17.5	63.5
26.5	
32	70.0
36	76.1
40	
47	101.6

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

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

Prestressing steel bar nominal diameter	Anchor plate WR 2011-∅			
	Centre spacing	Edge distance	Additional reinforcement Ribbed reinforcing steel, $R_e \geq 500$ N/mm²	
∅	C	E	n × ∅ / a / l [3)]	h × h [4)]
mm	mm	mm	– × mm / mm / mm	mm × mm
17.5	160	70 + c	5 × 10 / 30 / 20	140 × 140
26.5	240	110 + c	4 × 12 / 60 / 20	220 × 220
32	300	140 + c	5 × 12 / 60 / 20	280 × 280
36	340	160 + c	6 × 12 / 60 / 20	320 × 320
40	380	180 + c	6 × 12 / 60 / 20	360 × 360
47	440	210 + c	7 × 12 / 60 / 35	420 × 420

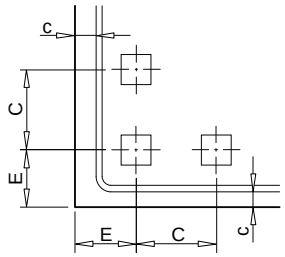
[1)] Maximum diameter for mechanical anchorage without and with additional reinforcement

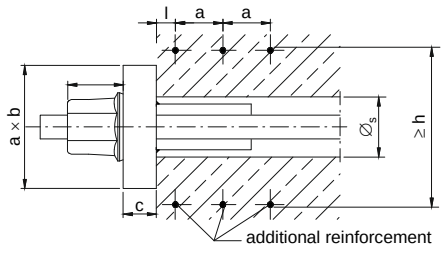
[2)] Larger bearing distances are spanned with load transfer plates and the minimum concrete compressive strength class according to EN 206 is ≥ C25/30 and with angle compensation tube is ≥ C30/37.

[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
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

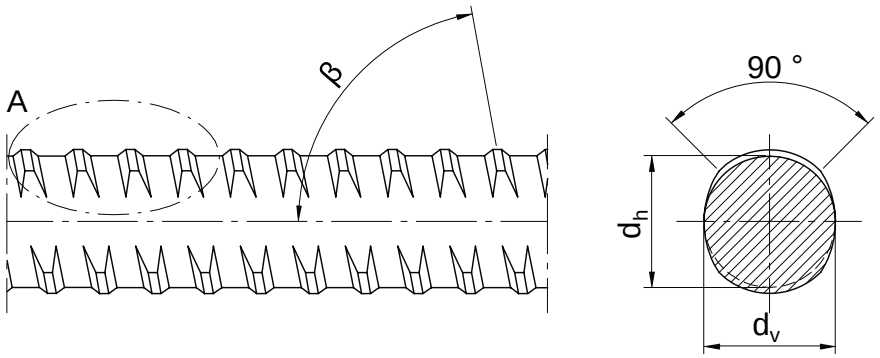
Prestressing steel bar – Nominal dimensions and mass – Rib geometry

Annex 7

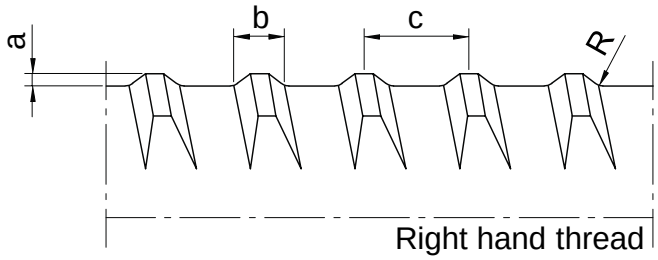
of **ETA-12/0601** of 23.11.2023

(1) Prestressing steel 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
17.5	1.96	241	17.4	17.2	1.1	4.1	8	82.5	1.8
26.5	4.48	552	26.4	25.9	1.7	6.2	13	81.5	2.6
32	6.53	804	31.9	31.4	1.9	7.6	16	81.5	3.2
36	8.27	1 018	35.9	35.4	2.1	8.7	18	81.5	3.6
40	10.21	1 257	39.7	38.9	2.1	9.6	20	81.5	4.0
47	14.10	1 735	46.6	45.8	2.4	10.5	21	82.5	4.0

[1)] Nominal mass per metre, including 3.5 % of non load-bearing ribs

Tolerance to nominal mass $\begin{cases} +\ 6\ \% \\ -\ 2\ \% \end{cases}$

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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Prestressing steel bar – Mechanical technological characteristics

Annex 8

of **ETA-12/0601** of 23.11.2023

(1) Prestressing steel bar

Prestressing steel bar nominal diameter ∅	Characteristic force at yield strength [1] $F_{p0.1}$	Characteristic maximum force [1] F_{pk}
mm	kN	kN
17.5	230	255
26.5	525	580
32	760	845
36	960	1 070
40	1 190	1 320
47	1 650	1 820

[1] 5 % fractile

Characteristic yield strength [1]	$R_{p0.1}$	N/mm²	950
Characteristic tensile strength [1]	R_m	N/mm²	1 050
Elongation at maximum force $A_{gt} = A_g + \frac{R_m}{E} \cdot 100$ [2]	A_{gt}	%	≥ 3.5
Constriction at break Ductile break, reduction of area after fracture	Z	%	≥ 10
Fatigue resistance [3] at an upper stress of $\sigma_{up} = 0.7 \cdot R_{m,\,act}$ and up to $2.0 \cdot 10^6$ load cycles. Tested stress range for ∅ 17.5 to 32 mm ∅ 36 and 40 mm ∅ 47 mm	$2 \cdot \sigma_A$	 N/mm² N/mm² N/mm²	 180 137 120
Stress relaxation With an initial stress of $0.7 \cdot R_{m,\,act}$	—	%	≤ 4
Stress corrosion resistance Within a test series at a stress of $0.8 \cdot R_{m,\,act}$ ∅ 17.5 mm, duration to fracture { individual result ∅ 17.5 mm, duration to fracture { median ∅ 26.5 mm, duration to fracture { individual result ∅ 26.5 mm, duration to fracture { median	—	 h h h h	 ≥ 20 ≥ 250 ≥ 100 ≥ 400

[1] 5 % fractile
[2] Modulus of elasticity E ≈ 205 000 N/mm², A_g as plastic extension at maximum force
[3] Fatigue resistance of prestressing steel bar without anchorage and coupler

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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Inner grout – Specification

Annex 9

of **ETA-12/0601** of 23.11.2023

(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		mm	≤ 0.1

1) Not relevant

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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Heat shrinking sleeve – Specification

Annex 10

of **ETA-12/0601** of 23.11.2023

(9) Heat shrinking sleeve
P 7029

Characteristics		—	P7029-C	P7029-D	P7029-P
Thickness after shrinking		mm	≥ 1.0	≥ 1.0	≥ 1.0
Mass per unit area of adhesive		g/m²	≥ 500	≥ 100	≥ 600
Tensile strength		N/mm	≥ 30	≥ 70	≥ 20
Elongation at break		%	≥ 500	≥ 500	≥ 600
Peel strength layer to layer		N/mm	≥ 8.0	≥ 2.0	≥ 1.5
Peel strength to steel surface		N/mm	≥ 1.0	≥ 4.0	≥ 1.0
Thermal ageing resistance	$\frac{S_{100}}{S_0}$, $\frac{E_{100}}{E_0}$	—	≤ 1.25 ≥ 0.75	≤ 1.25 ≥ 0.75	≤ 1.25 ≥ 0.75
	$\frac{S_{100}}{S_{70}}$, $\frac{E_{100}}{E_{70}}$		≥ 0.9	≥ 1.0	≥ 0.8
	$\frac{P_{100}}{P_T}$, $\frac{A_{100}}{A_T}$		≥ 0.75	≥ 0.75	≥ 0.75
	$\frac{P_{100}}{P_{70}}$, $\frac{A_{100}}{A_{70}}$		≥ 1.0	≥ 0.8	≥ 0.8
Indentation resistance	Residual thickness	mm	≥ 3.7	≥ 1.0	≥ 0.6
Impact resistance [1)]		—	C	C	C
Saponification value		$\frac{\text{mg KOH}}{\text{g}}$	10	13	15
Microbiological resistance	$\frac{S_6}{S_0}$, $\frac{E_6}{E_0}$	—	≥ 0.9	≥ 0.8	≥ 0.8
	$\frac{A_6}{A_0}$		≥ 0.4	—[2)]	≥ 0.8
Water absorption		%	≤ 4.65	≤ 0.45	≤ 0.05
Softening point of adhesive		°C	120	120	120
Oxygen stability of adhesive		min	20	20	20
Resistance to salt spray of adhesive		—	No corrosion	No corrosion	No corrosion
Content of aggressive components of adhesive	Cl^-	mg/kg	≤ 50	≤ 50	≤ 50
	NO_3^-		≤ 50	≤ 50	≤ 50
	NO_2^-		≤ 10	≤ 10	≤ 10
	SO_4^{2-}		≤ 50	≤ 50	≤ 50
	S^{2-}		≤ 50	≤ 50	≤ 50

1) According to EN 12068.
2) Characteristic not assessed.

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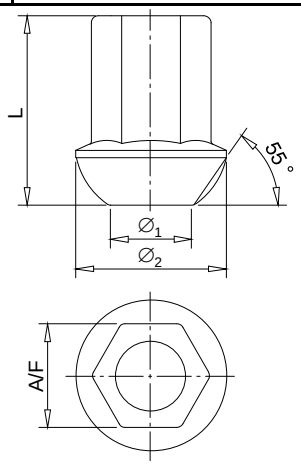
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

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

Annex 11

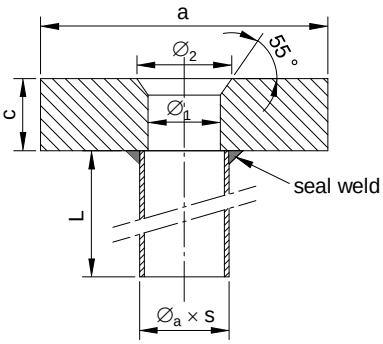
of **ETA-12/0601** of 23.11.2023

② Domed nut
WR 2001-∅

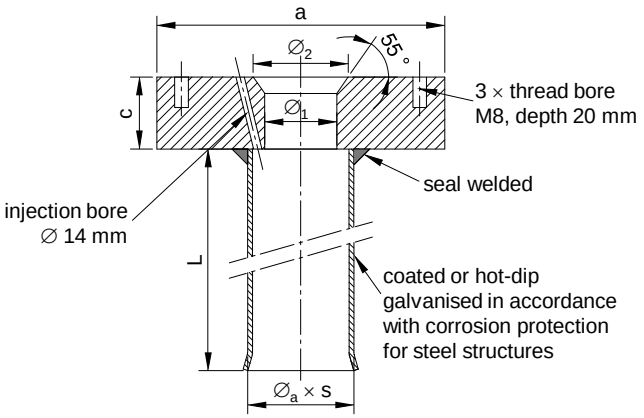


Prestressing steel bar ∅	A/F	L	∅1	∅2
mm	mm	mm	mm	mm
17.5	36	55	31	50
26.5	50	75	44	72
32	60	90	48	80
36	65	100	50	90
40	70	115	55	100
47	80	135	65	110

③ Square anchor plate with steel tube
Temporary rock and soil anchor
WR 2111-∅



Temporary rock and soil anchor
with extended working life
Permanent rock and soil anchor
WR 2110-∅



Prestressing steel bar	Anchor plate				Steel tube: Temporary rock and soil anchor		Steel tube: Temporary rock and soil anchor with extended working life Permanent rock and soil anchor [1)]	
∅	a	c	∅1	∅2	∅a × s	L	∅a × s	L
mm	mm	mm	mm	mm	mm × mm	mm	mm × mm	mm
17.5	110	30	28	45	44.5 × 2.3	150	63.5 × 2.6	300
26.5	150	35	39	72	51.0 × 2.3			
32	180	40	45	82	57.0 × 2.3		70.0 × 2.6	
36	200	45	49	92	60.3 × 2.3		76.1 × 2.6	
40	220	45	54	100	76.0 × 2.6			
47	260	50	64	110	88.9 × 2.9		101.6 × 2.9	

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

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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

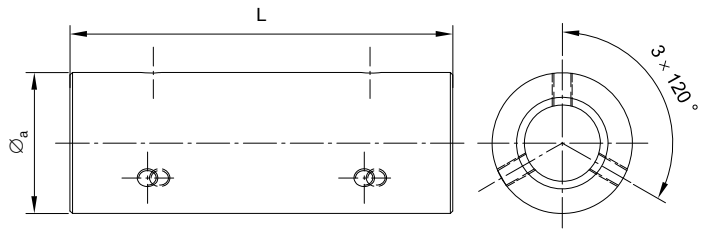
Components – Coupler with set screws, load transfer plates – Dimensions

Annex 12

of **ETA-12/0601** of 23.11.2023

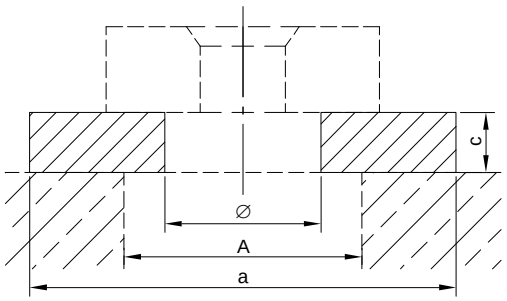
(8) Coupler with set screws
WR 3020-∅

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



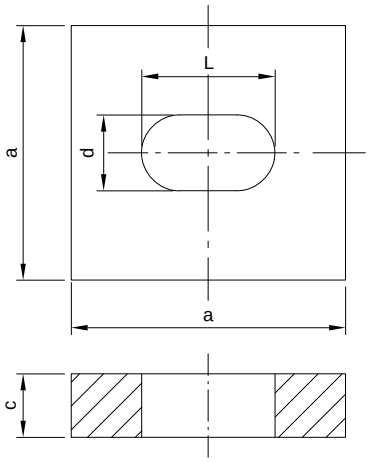
Prestressing steel bar ∅	∅a	L	Set screw
mm	mm	mm	mm
17.5	36	100	M 8
26.5	50	170	
32	60	200	
36	68	210	
40	70	245	M 10
47	83	270	

(11) Load transfer plate [1] for large bore holes, recess tube
WR 2149-∅



Prestressing steel bar ∅	max. ∅ A or borehole	a	c	∅
mm	mm	mm	mm	mm
17.5	160	180	20	73
26.5		195	20	73
32		215	20	79
36		230	15	86
40		240	15	86
47		270	15	111

(11a) Load transfer plate [1] for angle compensation tube
WR 2150-∅



Prestressing steel bar ∅	a	c	d	L
mm	mm	mm	mm	mm
17.5	180	20	73	102
26.5	195	25	73	104
32	215	30	79	114
36	230	30	79	114
40	240	30	86	122
47	270	30	111	151

[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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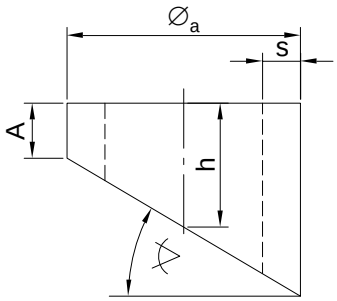
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Components – Angle compensation tube, coupler tube – Dimensions

Annex 13

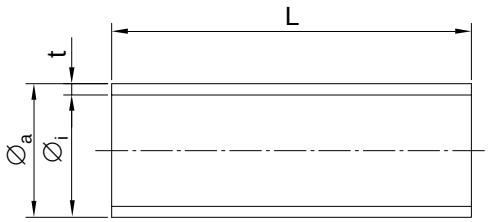
of **ETA-12/0601** of 23.11.2023

(18) Angle compensation tube [1)]



Prestressing steel bar ∅	Steel tube ∅a × s	A	h for an angle of					
			5 °	10 °	15 °	20 °	25 °	30 °
mm	mm × mm	mm	mm					
17.5	101.6 × 5.0	25	30	34	39	44	49	55
26.5	133.0 × 8.0	30	36	42	48	55	62	69
32	139.7 × 12.5	30	37	43	49	56	63	71
36	139.7 × 16.0	35	42	48	54	61	68	76
40	168.3 × 16.0	35	43	50	58	66	75	84
47	219.1 × 16.0	35	45	55	65	75	87	99

(10) Coupler tube



Prestressing steel bar ∅	Temporary rock and soil, Temporary rock and soil anchor with extended working life ∅a / ∅i	Permanent rock and soil anchor ∅a / ∅i	L [3)]	min. t
mm	mm	mm	mm	mm
17.5	50 / 44	63 / 57	450	2
26.5	63 / 57	63 / 57		
32	75 / 67.8	75 / 67.8	500	
36	90 / 84.6	90 / 84.6		
40	90 / 84.6	90 / 84.6	600	
47	110 / 105	110 / 105		

3) 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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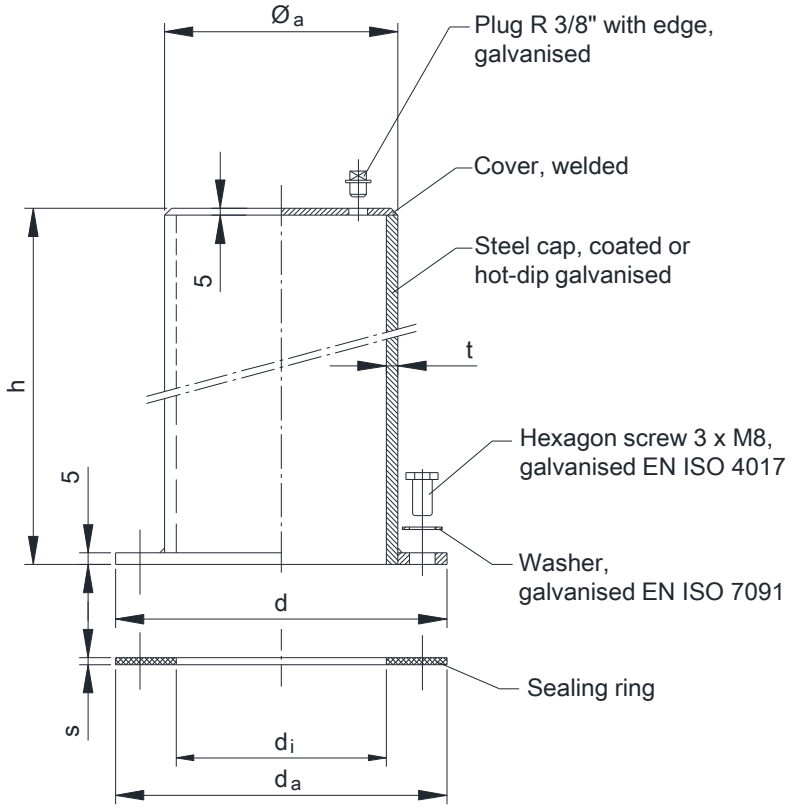
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Components – Steel cap – Dimensions

Annex 14

of **ETA-12/0601** of 23.11.2023

(12) Steel cap [1)]
with accessories



Dimensions in mm

Prestressing steel bar ∅ mm	Steel tube $\varnothing_a \times t$ mm × mm	Flange d mm	Height h mm	Sealing ring $d_a \times d_i \times s$ mm × mm × mm
17.5	63.5 × 3.2	110	≥ 200	110 × 57 × 3
26.5	88.9 × 3.2	135		135 × 82 × 3
32	95.0 × 3.2	142		142 × 88 × 3
36	101.6 × 3.2	148		148 × 94 × 3
40	114.0 × 3.6	148		148 × 107 × 3
47	127.0 × 3.6	171		171 × 120 × 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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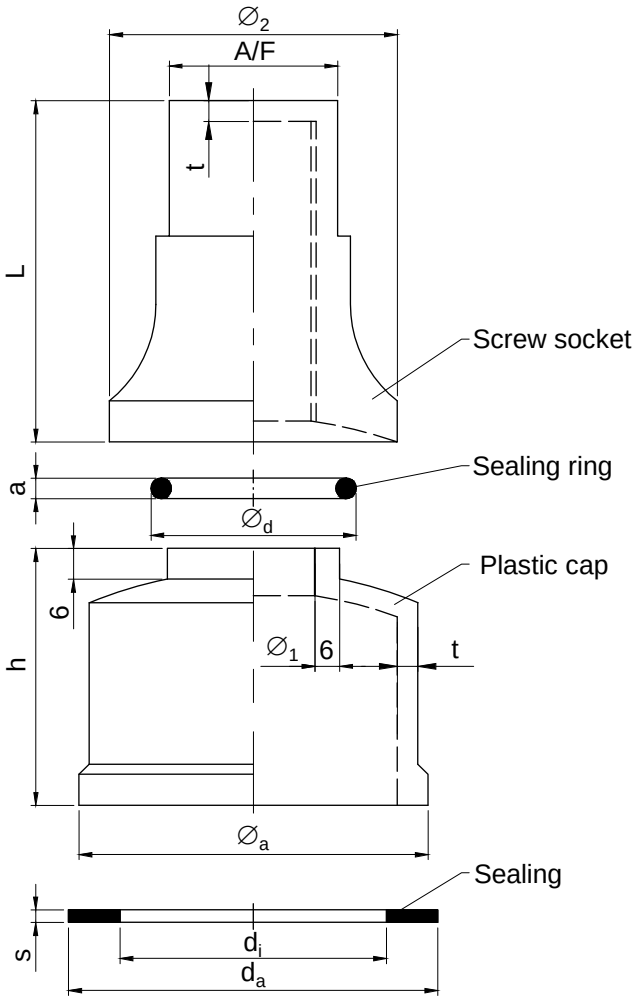
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Components – Plastic cap with screw socket – Dimensions

Annex 15

of **ETA-12/0601** of 23.11.2023

(12) Plastic cap
with accessories



Dimensions in mm

Prestressing steel bar	Plastic cap			Screw socket				Sealing ring	Sealing	
∅	t	∅a × h	∅1	t	A/F	∅2	L	∅d × a	da / di	s
mm	mm	mm × mm	mm	mm	mm	mm	mm	mm × mm	mm / mm	mm
17.5	5	85 × 60	30	5	41	70	107	65 × 10	90 / 65	3
26.5–32	5	112 × 87	42	5	50	90	115	77 × 10	115 / 85	3
36–40	5	132 × 105	58	5	70	110	154	84 × 8	135 / 105	3
47	5	183 × 125	72	5	80	130	175	98 × 8	188 / 156	3

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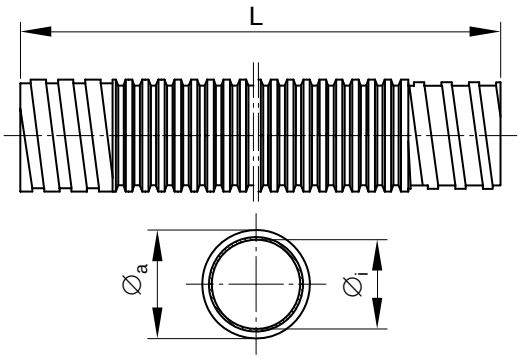
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Components – Corrugated plastic sheathing, heat shrinking sleeve – Dimensions

Annex 16

of **ETA-12/0601** of 23.11.2023

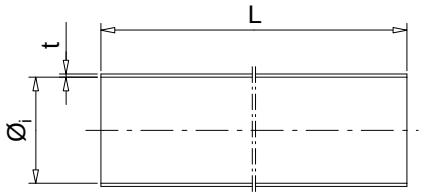
4 Corrugated sheathing



Prestressing steel bar ∅	Dimensions [1] ∅a / ∅i	min. t
mm	mm / mm	mm
17.5	50 / 43	1.0
26.5		
32	56 / 49	
36	65 / 57	
40		
47	80 / 71	

[1] Length as required

9 Heat shrinking sleeve
P 7029



Heat shrinking sleeve	∅i before shrinking	min t after shrinking
—	mm	mm
P7029-C50/16	50	1.0
P7029-C75/22	75	
P7029-C95/29	95	
P7029-C140/42	140	
P7029-C180/60	180	
P7029-D50/16	50	
P7029-D63/19	63	
P7029-D75/22	75	
P7029-D95/30	95	
P7029-D115/34	115	
P7029-D140/42	140	
P7029-D165/50	165	
P7029-P40/15S	40	
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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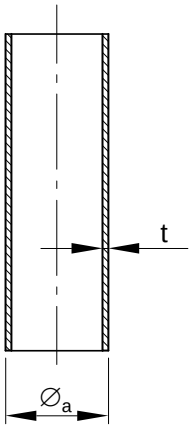
Max Aicher GmbH & Co. KG 83404 Ainring–Hammerau	**Rock and soil anchor system SAS** Prestressing steel bar Y1050H, ∅ 17.5–47 mm Components – Smooth sheathing – Dimensions	**Annex 17** of **ETA-12/0601** of 23.11.2023

6 Smooth sheathing

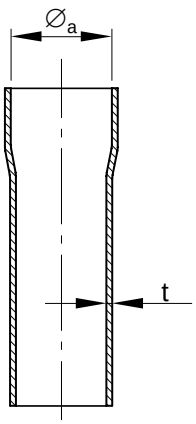
Temporary rock and soil anchor
Temporary rock and soil anchor with extended working life



Prestressing steel bar	Dimensions [2]	
∅	∅a	t
mm	mm	mm
17.5	35	2.0
26.5	41	
32	46	
36	50	
40	63	2.0 / 3.6
47	75	4.3

[2] Length as required

Permanent rock and soil anchor



Prestressing steel bar	Dimensions [3]	
∅	∅a	min. t
mm	mm	mm
17.5	54.2	1.5
26.5		
32	60.1	
36	70.1	
40		
47	84.9	

[3] Length as required

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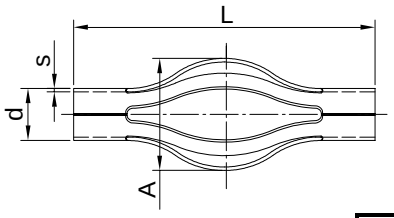
Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

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

Annex 18

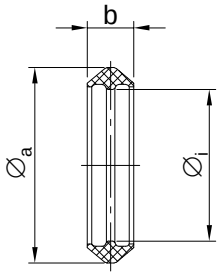
of **ETA-12/0601** of 23.11.2023

7 Basket spacer



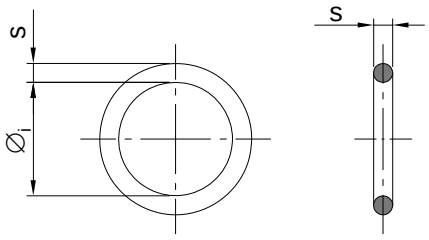
Prestressing steel bar ∅	Temporary rock and soil anchor, Temporary rock and soil anchor with extended working life			Permanent rock and soil anchor		
	d × s	A	L	d × s	A	L
mm	mm × mm	mm	mm	mm × mm	mm	mm
17.5	20 × 1.5	> 70	150 to 175	55 × 3.0	> 100	250 to 290
26.5	32 × 1.9					
32	40 × 3.0	> 90	250 to 290	63 × 3.0	> 110	
36				75 × 3.6	> 115	
40	50 × 3.0	> 100				
47				90 × 2.7	> 140	

14 Profile ring



Prestressing steel bar ∅	$\varnothing_a$	$\varnothing_i$	b
mm	mm	mm	mm
17.5	58.8	45.5	14
26.5			
32	65.0	49.5	20
36	71.5	58.0	20
40			
47	96.0	75.0	23

20 Sealing ring



Prestressing steel bar ∅	$\varnothing_I$	s
mm	mm	mm
17.5	33	15
26.5	39	12
32	44	12
36	48	15
40	61	8
47	73	15

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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

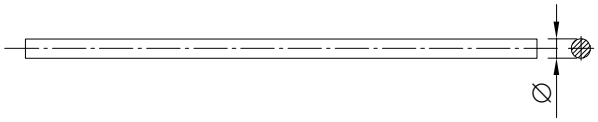
Components – Plastic cord, mat spacer, injection and end cap – Dimensions

Annex 19

of **ETA-12/0601** of 23.11.2023

(16) Inner spacer

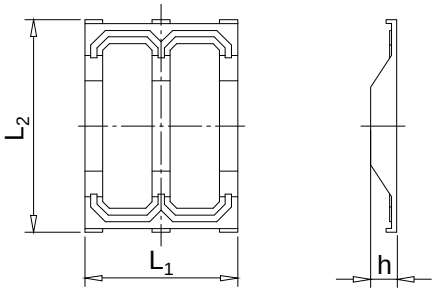
PE cord, pitch ≤ 0.5 m



Prestressing steel bar ∅	PE cord min. ∅
mm	mm
17.5	6
26.5	
32	
36	
40	
47	

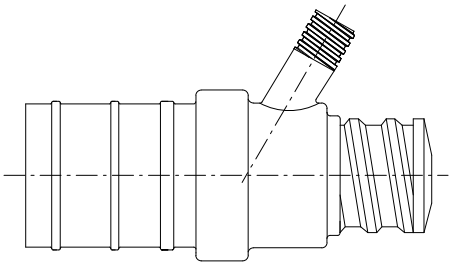
Mat spacer

Distance ≤ 1.0 m

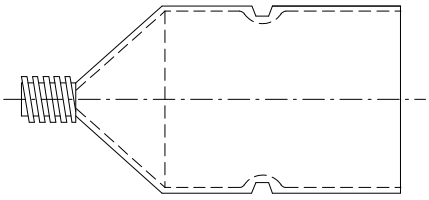


Prestressing steel bar ∅	Dimensions h	L_1	L_2	Number of ribs
mm	mm	mm	mm	—
36	6	112	124	3
40	6	112	124	3
47	8	132	124	3

(13) Injection cap and end cap



Alternative cap



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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Material specifications

Annex 20

of **ETA-12/0601** of 23.11.2023

Component	Standard / Specification
Prestressing steel bar	Annex 7 and Annex 8
Domed anchor nut, ∅ 17.5, 26.5, 32, 36 mm	EN 10025
Domed anchor nut, ∅ 40, 47 mm	EN 10293 EN ISO 683-2
Solid plate, square	EN 10025
Steel tube	EN 10216-1 EN 10217-1
Coupler, ∅ 17.5, 26.5, 32, 36 mm	EN ISO 683-1
Coupler, ∅ 40, 47 mm	Deposited at Österreichisches Institut für Bautechnik
Load transfer plate	EN 10025
Angle compensation tube	EN 10210
Coupler tube	EN ISO 21306-1 EN ISO 17855-1 EN ISO 19069-1
Steel cap	EN 10025
Corrugated sheathing Smooth sheathing Plastic cap Injection cap End cap	EN ISO 17855-1 EN ISO 19069-1 EN ISO 21306-1
PE cord Mat spacer	EN ISO 17855-1 EN ISO 19069-1
Basket spacer	EN ISO 21306-1
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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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Contents of the prescribed test plan

Annex 21

of **ETA-12/0601** of 23.11.2023

Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
Anchorage, Coupling assembly	Static load test on anchorage and coupling assembly	Testing	[2]	0.2 % [3, 4] ≥ 2 [4]	Per year
	Resistance to fatigue of anchorage and coupling assembly	Testing	[2]	1 [4]	Per year
Prestressing steel bar	Mass per metre, cross-sectional area, surface geometry	Testing	[2]	≥ 1 [5] ≥ 3 [6]	Continuous
	Strength characteristics [7] Elongation at maximum force [7] Constriction at break	Testing	[2]	≥ 1 [5] ≥ 3 [6]	Continuous
	Visual inspection [8]	Checking	[2]	100 %	Continuous
	Traceability	full			
Domed anchor nut, Coupler	Dimensions	Testing	[2]	5 % [9, 10] ≥ 2 [9, 10]	Continuous
	Strength [11]	Testing	[2]	0.5 % [9] ≥ 2 [9]	Continuous
	Material	Checking [12]	[2]	100 %	Continuous
	Visual inspection [8]	Checking	[2]	100 %	Continuous
	Inspection of all components manufacturer by the manufacturer of the kit				1 per year
	Traceability	full			
Simple square anchor plate	Dimensions	Testing	[2]	3 % [9, 10] ≥ 2 [9, 10]	Continuous
	Material	Checking [13]	[2]	100 %	Continuous
	Visual inspection [8]	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 prestressing steel bar diameter. After 5 years of successful testing, the frequency may be reduced to 0.1 %.
[4] For at least 1 nominal prestressing steel bar diameter. In case of a production of less than 20 anchorages or coupling assemblies of 1 nominal prestressing steel bar diameter per year, testing that nominal prestressing steel bar diameter is not required. However, all nominal prestressing steel bar diameters shall be tested within 5 years.
[5] Per nominal prestressing steel bar diameter and 15 to
[6] Per nominal prestressing steel bar diameter and heat
[7] Assessment of long-term quality level according to prEN 10138-1, Clause 8.3.2.3.
[8] Successful visual inspection does not need to be documented.
[9] Percentage of produced component or minimum number of specimens per nominal prestressing steel bar diameter and batch of component
[10] In case of a continuous manufacture without retooling of at least 1 000 parts, the frequency may be reduced to 1 % with at least 1 specimen per shift. The stability of the process of the continuous manufacture is verified.
[11] Strength determined by means of hardness
[12] Inspection certificate type “3.1” according to EN 10204
[13] Test report type “2.2” according to EN 10204

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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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Contents of the prescribed test plan

Annex 22

of **ETA-12/0601** of 23.11.2023

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	Testing [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 or 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 or 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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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Audit testing

Annex 23

of **ETA-12/0601** of 23.11.2023

Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
Anchorage, Coupling assembly	Single element tensile test	EAD 160004-00-0301, Annex C.7			Once per 5 years
Prestressing steel bar	Mass per metre, Cross-sectional area, Surface geometry, Strength characteristics, Elongation at maximum force, Modulus of elasticity, Constriction at break, Visual inspection	Testing	[2]	8 [3], [4]	4 per year
	Resistance to fatigue	Testing	[2]	1 [3]	4 per year
	Stress relaxation	Testing	[2]	1 [3]	4 per year
	Stress corrosion resistance	Testing	[2]	1 series [3]	4 per year
Domed anchor nut, Coupler	Dimensions	Testing	[2]	1 [5]	Each inspection [6]
	Material	Testing / Checking	[2]	2 [5]	Each inspection [6]
	Visual inspection	Checking	[2]	5 [7]	Each inspection [6]
Simple square anchor plate	Dimensions	Testing	[2]	1 [5]	Each inspection [6]
	Material	Testing / Checking	[2]	1 [5]	Each inspection [6]
	Visual inspection	Checking	[2]	1 [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 specifications of the item
[3] One nominal prestressing steel bar diameter. The nominal prestressing steel bar diameter alternates from sampling to sampling. All nominal prestressing steel bar diameters shall be sampled within 5 years.
[4] After 5 years of successful testing, the number of samples may be reduced to 5.
[5] Per kind of component. One nominal prestressing steel bar diameter is sampled. All nominal diameters shall be sampled within 5 years.
[6] Inspection of kit manufacturer
[7] Each kind of component for all nominal prestressing steel 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

Max Aicher GmbH & Co. KG
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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Audit testing

Annex 24

of **ETA-12/0601** of 23.11.2023

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	[2], [7]	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 are 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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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Essential characteristics for the intended uses

Annex 25

of **ETA-12/0601** of 23.11.2023

№ [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	—	—	+
Prestressing steel 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	Stress relaxation	+	+	+
20	Constriction at break	+	+	+
21	Stress corrosion resistance	+	+	+
Nuts, anchor pieces, couplers, and anchor plates				
22	Shape	+	+	+
23	Dimensions	+	+	+
24	Material	+	+	+
25	Hardness	+	+	+
Inner grout				
26	Content of aggressive components	—	—	+
27	Residue on sieve	—	—	+
28	Fluidity, cone	—	—	+
29	Fluidity, grout spread	—	—	+
30	Bleeding, wick-induced	—	—	+
31	Bleeding, inclined tube	—	—	+
32	Volume change	—	—	+

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Rock and soil anchor system SAS
Prestressing steel bar Y1050H, ∅ 17.5–47 mm

Essential characteristics for the intended uses

Annex 26

of **ETA-12/0601** of 23.11.2023

№ [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				
Inner grout				
33	Compressive strength	—	—	+
34	Setting time	—	—	+
35	Fluid density	—	—	+
Heat shrinking sleeve				
36	Thickness after shrinking	—	—	+
37	Mass per unit area of adhesive	—	—	+
38	Tensile strength	—	—	+
39	Elongation at break	—	—	+
40	Peel strength layer to layer	—	—	+
41	Peel strength to steel surface	—	—	+
42	Thermal ageing resistance	—	—	+
43	Indentation resistance	—	—	+
44	Impact resistance	—	—	+
45	Saponification value	—	—	+
46	Microbiological resistance	—	—	+
47	Water absorption	—	—	+
48	Softening point of adhesive	—	—	+
49	Oxygen stability of adhesive	—	—	+
50	Resistance to salt spray of adhesive	—	—	+
51	Content of aggressive components of adhesive	—	—	+
Corrugated plastic sheathing				
52	Shape	—	—	+
53	Dimensions	—	—	+
54	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 5.

Max Aicher GmbH & Co. KG 83404 Ainring–Hammerau	**Rock and soil anchor system SAS** Prestressing steel bar Y1050H, ∅ 17.5–47 mm Reference documents	**Annex 27** of **ETA-12/0601** of 23.11.2023

EAD 160004-00-0301	Post-Tensioning Kits for Prestressing of Structures
EAD 160045-00-0102	Kit for rock and soil anchors – Kit with Prestressing steel bars
EN 206+A2, 03.2021	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
EN 1992-1-1, 2004 EN 1992-1-1/AC, 2008 EN 1992-1-1/AC, 2010 EN 1992-1-1/A1, 2014	Eurocode 2 – Design of concrete structures – Part 1-1: General rules and rules for buildings
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 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, 04.2019	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 1: Electric welded and submerged arc welded non-alloy steel tubes with specified room temperature properties
EN 10293, 01.2015	Steel castings – Steel castings for general engineering uses
EN 12068, 08.1998	Cathodic protection – External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection – Tapes and shrinkable materials
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 683-1, 06.2018	Heat-treatable steels, alloy steels and free-cutting steels – Part 1: Non-alloy steels for quenching and tempering
EN ISO 683-2, 06.2018	Heat-treatable steels, alloy steels and free-cutting steels – Part 2: Alloy steels for quenching and tempering
EN ISO 1461, 05.2009	Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods

Max Aicher GmbH & Co. KG 83404 Ainring–Hammerau	**Rock and soil anchor system SAS** Prestressing steel bar Y1050H, ∅ 17.5–47 mm Reference documents	**Annex 28** of **ETA-12/0601** of 23.11.2023

EN ISO 4017, 06.2014	Fasteners – Hexagon head screws – Product grades A and B
EN ISO 4026, 05.2004	Hexagon socket set screws with flat point
EN ISO 7091, 06.2000	Plain washers – Normal series – Product grade C
EN ISO 12944-4, 12.2017	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 4: Types of surface and surface preparation
EN ISO 12944-5, 10.2019	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 5: Protective paint systems
EN ISO 12944-7, 12.2017	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 7: Execution and supervision of paint work
EN ISO 14713-1, 05.2017	Zinc coatings – Guidelines and recommendations for the protection against corrosion of iron and steel in structures – Part 1: General principles of design and corrosion resistance
EN ISO 17855-1, 11.2014	Plastics – Polyethylene (PE) moulding and extrusion materials – Part 1: Designation system and basis for specifications
EN ISO 19069-1, 03.2015	Plastics – Polypropylene (PP) moulding and extrusion materials – Part 1: Designation system and basis for specifications
EN ISO 21306-1, 04.2019	Plastics – Unplasticized poly(vinyl chloride) (PVC-U) moulding and extrusion materials – Part 1: Designation system and basis for specifications
prEN 10138-1, 08.2009	Prestressing steels – Part 1: General requirements
prEN 10138-4, 08.2009	Prestressing steels – Part 4: Bar
DIN 51451, 02.2020	Testing of petroleum products and related products – Analysis by infrared spectrometry – General working principles
98/456/EC	Commission Decision 98/456/EC of 3 July 1998 on the procedure for attesting the conformity of construction products pursuant to Article 20(2) of Council Directive 89/106/EEC as regards post-tensioning kits for the prestressing of structures, Official Journal L 201 of 17 July 1998, page 112
305/2011	Regulation (EU) № 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, OJ L 88 of 4 April 2011, p. 5, amended by Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, OJ L 157 of 27.05.2014, p. 76, Commission Delegated Regulation (EU) № 574/2014 of 21 February 2014, OJ L 159 of 28.05.2014, p. 41, and Regulation (EU) 2019/1020 of the European Parliament and of the Council of 20 June 2019, OJ L 169 of 15.06.2019, p. 1
568/2014	Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014 amending Annex V to Regulation (EU) № 305/2011 of the European Parliament and of the Council as regards the assessment and verification of constancy of performance of construction products, OJ L 157 of 27 May 2014, page 76