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European Technical Assessment

ETA-11/0138 of 26.09.2018

General part

Technical Assessment Body issuing the European Technical Assessment	Österreichisches Institut für Bautechnik (OIB) Austrian Institute of Construction Engineering
Trade name of the construction product	Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm
Product family to which the construction product belongs	Kit for micropile – Kit with thread bars
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	55 pages including Annexes 1 to 27, which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with Regulation (EU) № 305/2011, on the basis of	EAD 200077-00-0103, European Assessment Document for Kit for micropile – Kit with thread bars.
This European Technical Assessment replaces	European technical approval ETA-11/0138 with validity from 30.06.2013 to 29.06.2018.

Table of contents

Remarks

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Specific parts

1 Technical description of the product

1.1 General

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

Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm,

comprising the following components.

– Load-bearing element

The load-bearing element of the micropile is a continuously threaded steel bar. The continuous thread is provided by ribs, hot rolled over the entire length of the bar – thread bar. Due to the continuous thread the thread bar can be jointed and the anchorage can be placed at any given point.

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

Table 1 Nominal diameters and strength characteristics of thread bar

Nominal diameters $\varnothing_s$	Nominal yield strength $R_{p0.2}$	Nominal tensile strength R_m
mm	N/mm²	N/mm²
28, 30, 35, 43, 50, 57.5, and 63.5	670	800

NOTE 1 MPa = 1 N/mm²

Due to its characteristics, the steel is classified as reinforcing steel, but compared to common reinforcing steel, the steel bar features higher strength.

– Pile head

At the pile head three variants of anchorages are available. These variants comprise

– a square anchor plate in steel, locked with anchor nuts or lock nuts
– a square anchor plate in steel, locked with anchor nuts or lock nuts and with adhesive at the nuts
– an anchor piece in steel, locked with anchor nut or lock nut.

[1] ETA-11/0138 was firstly issued in 2011 as European technical approval with validity from 17.10.2011, amended in 2013 with validity from 30.06.2013, and converted in 2018 to European Technical Assessment ETA-11/0138 of 26.09.2018.

- Splice

  The thread bars can be jointed in four splice variants. These variants comprise

  - a coupler in steel, locked with lock nuts
  - a coupler in steel with adhesive, locked without nuts
  - a coupler in steel, locked without nuts
  - a contact coupler in steel, locked without nuts for only compression loading

- Corrosion protection

  Corrosion protection of the micropile can be attained with four techniques. These techniques comprise

  - a body of cement mortar with an appropriate thick cover of cement mortar for temporary micropiles and for permanent micropiles with standard corrosion protection.
  - sacrificial corrosion and disregarding the protection of a cover of cement mortar for semi-permanent micropiles.
  - hot dip galvanising of the steel bar and where required of the other components of the micropile.
  - a corrosion protection according to EN 1537[2] with a cover of cement grout encased in a corrugated plastic sheathing.

- Cement mortar

  Cement mortar is inherent in the micropile system and completes the micropile to transfer the load from thread bar to bore hole wall and to take a part of the corrosion protection.

Micropile System

1.2 General

The micropile is installed by placing the thread bar, possibly jointed with couplers, in the centre of a pre-drilled borehole. The annular void between thread bar and bore hole wall is injected with cement mortar. At the protruding part of the thread bar, the anchorage at the pile head is screwed on and locked. An overview on the various micropile assemblies are given in the following Annexes.

- Annex 1 for temporary micropile
- Annex 2 for semi-permanent micropile
- Annex 3 for permanent micropile with standard corrosion protection
- Annex 4 for permanent micropile with corrosion protection according to EN 1537
- Annex 6 for micropiles with anchor piece and additional bonded length

The micropile can be assigned to micropiles according to EN 14199.

1.3 Designation and range of micropiles

The micropile of the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm, is designated by the nominal diameter of the thread bar. The micropile system includes micropiles with the following nominal diameters of the thread bar, $\varnothing_s$ = 28, 30, 35, 43, 50, 57.5, and 63.5 mm.

The characteristic values of maximum force of thread bars are given in Annex 10.

[2] Standards and other documents referred to in the European Technical Assessment are listed in Annex 26 und Annex 27.

1.4 Anchorage

The anchorage at the pile head comprises the following components, fastened to the thread bar, see Annex 1, Annex 2, Annex 3, Annex 4, and Annex 6. In Table 2 anchorages available for the modes of loading are given.

- Flat square anchor plate, locked with nuts

  For tension loading and for compression loading the anchorage is locked with anchor nut and lock nut. For alternating loading the anchorage is locked with two anchor nuts.

- Flat square anchor plate, locked with nuts and an adhesive

  For tension loading and for compression loading the anchorage is locked with anchor nut and lock nut. Anchor nut and lock nut are provided with adhesive prior to locking. After locking the adhesive sets and hardens.

- Anchor piece locked with a nut

  For tension loading and for compression loading the anchorage is locked with a lock nut. For alternating loading the anchorage is locked with an anchor nut. An additional bonded length is provided to reduce slip.

At the pile head, the anchorage zone of the foundation is without or with additional reinforcement. Dimensions of anchorages and anchorage components are given in Annex 6, Annex 7, Annex 8, Annex 15, and Annex 16. Torque of anchor plate and anchor piece is specified in Annex 7.

Table 2 Anchorages and condition of loading

Anchorage	Loading		
	Tension	Compression	Alternating
Square anchor plate in steel, locked with nuts	+	+	+
Square anchor plate in steel, locked with nuts and with an adhesive at the nuts	+	+	—
Anchor piece in steel, locked with nut	+	+	+

Key
+ .... Anchorage available
—... Anchorage not available

1.5 Load transfer to the foundation

Load transfer from anchorage at the pile head to foundation is without or with additional reinforcement. Additional reinforcement, if applicable, is placed at the anchorage axially with regard to the thread bar. The additional reinforcement confines the concrete and absorbs bursting forces due to spreading of the load from anchorage to foundation – bursting 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.

- Compressive strength of concrete $f_{cm,\,0,\,cube\,150} \geq 25$ N/mm^2 or ≥ 30 N/mm^2
- Minimum concrete strength class according to EN 206 $\geq$ C 20/25 or $\geq$ C 25/30
- Centre spacing and edge distances of the micropile without or with additional reinforcement according to Annex 7 and Annex 8

- Additional reinforcement in ribbed reinforcing steel $R_e \geq 500$ N/mm^2 according to Annex 7 and Annex 8
- The forces outside the additional reinforcement require verification and, in general, are covered by appropriate reinforcement.

For load transfer without additional reinforcement, the zone around the centric pile with external dimensions corresponding to the centre spacing of Annex 7 and Annex 8 is reinforced as follows.

- The reinforcement is at least 50 kg/m^3.
- With respect to tension or compression piles, or piles under alternating load, only the loaded depth of the structure down from the anchor plate is considered.
- The reinforcement already placed in that area but required for other reasons may be fully taken into account.
- The reinforcement need not to be detailed and placed as bursting reinforcement.
- The forces outside the zone with external dimensions corresponding to the centre spacing require verification and, in general, are covered by appropriate reinforcement.

Punching of the anchorage needs to be considered in any case.

1.6 Pile neck protection tube

1.6.1 Temporary micropile, semi-permanent micropile, and permanent micropile with standard corrosion protection

Temporary micropiles with a form-fit and force-fit connection between body of cement mortar and structural concrete of the foundation do not require a pile neck protection tube. Semi-permanent and permanent micropiles with standard corrosion protection and with a form-fit and force-fit connection between body of cement mortar and structural concrete of the foundation are provided with a corrugated plastic sheathing as pile neck protection tube. The corrugated plastic sheathing is shown in Annex 20.

A form-fit and force-fit connection is achieved by removing impurities and loose cement laitance of poor quality from the cement mortar and wetting the cement mortar before the foundation is concreted.

Without a form-fit and force-fit connection between body of cement mortar and structural concrete of the foundation, a pile neck protection tube is always required. Micropiles under tensile loading are provided with a corrugated plastic sheathing according to Annex 20. With micropiles under compression loading or alternating loading a steel tube according to Annex 20 is installed at the borehole wall to absorb the bursting forces resulting from the load transfer to the body of cement mortar.

Micropiles subjected to proof loading in compression and subsequently used as structural micropiles are fitted with a steel tube according to Annex 20 as pile neck protection tube.

Table 3 lists the required pile neck protection tubes for temporary micropile, semi-permanent micropile, and permanent micropile with standard corrosion protection.

1.6.2 Permanent micropile with corrosion protection according to EN 1537

Micropiles with corrosion protection according to EN 1537 and form-fit and force-fit connection between body of cement mortar and structural concrete of the foundation do not require an additional pile neck protection tube.

Form-fit and force-fit connection is achieved by removing impurities and loose cement laitance of poor quality from the body of cement mortar and wetting the body of cement mortar before the foundation is concreted.

Without form-fit and force-fit connection between body of cement mortar and structural concrete of the foundation, micropiles under compression loading or alternating loading are provided with a steel tube according to Annex 20. The steel tube is installed at the borehole wall to absorb the bursting forces resulting from the load transfer to the body of cement mortar.

Micropiles subjected to proof loading in compression and subsequently used as structural micropiles are fitted with a steel tube according to Annex 20 as pile neck protection tube.

Table 3 Pile neck protection tubes in steel [1)] or plastic [2)] for temporary micropiles, semi-permanent micropiles, and for permanent micropiles with standard corrosion protection

Way of loading of the micropile [3)]	Construction joint body of cement mortar to structural concrete of foundation			
	With form-fit and force-fit connection [4)]		Without form-fit and force-fit connection	
	Temporary micropile	Semi-permanent and permanent [5)] micropile	Temporary micropile	Semi-permanent and permanent [5)] micropile
Tension	—	Plastic tube [6)]	Plastic tube [6)]	Plastic tube [6)]
Compression	—	Plastic tube [6)]	Steel tube [6), 7)]	Steel tube [6), 7)]
Alternating load	—	Plastic tube [6)]	Steel tube [6), 7)]	Steel tube [6), 7)]
Proof loading in compression [8)]	Steel tube [7)]	Steel tube [7)]	Steel tube [7)]	Steel tube [7)]

1) Pile neck protection tube as steel tube, see Annex 20, to absorb bursting forces
2) Corrugated plastic sheathing according to Annex 20 for corrosion protection
3) If the pile is subjected to compressive proof loading and subsequently used as structural micropile, it is fitted with a pile neck protection steel tube.
4) Form-fit and force-fit connection between body of cement mortar and structural concrete of the foundation. For this, impurities and loose cement laitance of poor quality are removed and the body of cement mortar is wetted before the foundation is concreted.
5) Permanent micropile with standard corrosion protection
6) The pile neck protection tube in plastic or steel is extended for at least ≥ 100 mm into the structural concrete of the foundation.
7) Steel tube according to Annex 20
8) Micropiles subjected to proof loading in compression and subsequently used as structural micropiles are fitted with a steel tube according to Annex 20 as pile neck protection tube.

1.7 Splice

The splice joints two thread bars and comprises the following components, see Annex 1, Annex 2, Annex 3, and Annex 4. In Table 4 splices available for the modes of loading are given.

- Coupler in steel, locked with lock nuts

  For tension loading, the splice is locked with two short lock nuts. For compression and alternating loading, the splice is locked with two long lock nuts.

- Coupler in steel with adhesive, locked without nuts

  For tension, compression, and alternating loading, the splice is locked without nuts by direct contact of both end faces of the thread bars. In case of compression and alternating loading, the two end faces are square cut with a tolerance of ± 0.5 ° to the axis of the thread bars. The coupler is provided with an adhesive prior to locking. After locking the adhesive sets and hardens.

– Coupler in steel, locked without nuts

  For tension, compression, and alternating loading, the splice is locked without nuts by direct contact of both end faces of the thread bars. In case of compression and alternating loading, the two end faces are square cut with a tolerance of ± 0.5 ° to the axis of the thread bars.

– Contact coupler in steel, locked without nuts for only compression loading

  For compression loading the splice is locked without nuts by direct contact of both end faces of the thread bars. The two end faces are square cut with a tolerance of ± 0.5 ° to the axis of the thread bars.

  NOTE Contact coupler TR 3006 may be replaced by contact coupler, cast TR 3006 C in all applications, see Annex 1, Annex 2, Annex 3, Annex 4, and Annex 5.

Dimensions of components of the splices are given in Annex 16 and Annex 17. Torque of anchorage is specified in Annex 7.

Coupler locked without nuts is secured against unscrewing, e.g. with a heat shrink sleeve.

Table 4 Splices and condition of loading

Splice	Loading		
	Tension	Compression	Alternating
Coupler in steel, locked with lock nuts	+	+	+
Coupler in steel with adhesive, locked without nuts	+	+	+
Coupler in steel, locked without nuts	+	+	—, + [1)]
Contact coupler in steel, locked without nuts for only compression loading	—	+	—

Key
+ .... Splice available
—... Splice not available
[1)] .... Available for temporary and semi-permanent micropile

1.8 Corrosion protection system

1.8.1 General

In general, the thread bar in the centre of the micropile is covered by a layer of cement mortar that passivates the steel surface, provided crack widths are limited and there is an absence of spalling of cover of cement mortar in service. Minimum cover of cement mortar for micropiles is 20 mm on the thread bar. Corrosion protection of the micropile that includes additional measures to obtain the intended working life is specified in the Clauses 1.8.2, 1.8.3, 1.8.4, 1.8.5, and 1.8.6.

Corrosion protection of the anchorage at the pile head is by concrete of the foundation.

1.8.2 Temporary micropile, Annex 1

Temporary micropiles are protected against corrosion by an at least 20 mm thick cover of cement mortar on the thread bar. The minimum cover of cement mortar is ≥ 15 mm. The thickness of the cover of cement mortar is ensured by spacers, spacing ≤ 3.0 m.

The pile neck in the area of the joint ground to foundation is protected according to Table 3.

1.8.3 Semi-permanent micropile, Annex 2

1.8.3.1 General

For cover of cement mortar on the thread bar, Clause 1.8.2 applies.

The following procedures are applied to ensure the intended working life of the pile foundation.

- Definition of corrosion rates for sacrificial corrosion dependent on the ground conditions for bare thread bars, disregarding the system-inherent encapsulation by a body of cement mortar.
- Definition of corrosion rates for sacrificial corrosion dependent on the ground conditions for hot dip galvanised thread bars, disregarding the system-inherent encapsulation by a body of cement mortar. The applied thickness of the zinc coating usually is ≥ 150 µm. If zinc coating of a smaller thickness is applied, this is taken into consideration for determining the losses in cross-sectional area, see Annex 21.
- The pile neck in the area of the joint ground to foundation is protected according to Table 3.

1.8.3.2 Corrosion load

The corrosion load in soils acting on metallic materials is evaluated in accordance with EN 12501-1 and EN 12501-2. The corrosion load is classified as low, medium, or high.

The most important physical and chemical soil parameters are defined in EN 12501-2. Annex B of that standard lists detailed specifications on the collection of data for soil classification.

The various corrosion loads are assessed on the basis of an informative listing of the most important soil parameters. They are summarised in Table 5. Based on these, the respective corrosion depth of the micropile is defined.

Table 5 Criteria to evaluate the corrosion load in soils

Soil parameter	**Corrosion load in soils**		
	low	**medium**	**high**
Ventilation	Moderate to very good	Poor to moderate	Very poor to poor
Soil composition	Predominantly sand, gravel, crushed rock (coarse to medium grained)	High contents of silt, fine sand (medium to fine grained)	Possibly contents of organic substances, high contents of clay (fine grained), industrial waste, de-icing salt
Water content	Low (drainable)	Generally medium (moist)	Generally high, oscillating water tables
Neutral salt contents	Low	Possibly increased	Possibly high
pH values	5 to 8	5 to 8	5 to 8
Specific soil resistance in Ωm	> 70	10 to 70	< 10

With pH values of < 5 for bare steel and galvanised steel and

with pH values of > 8 for galvanised steel,

the corrosion load is assigned to the next higher corrosion load, i.e.

low → medium

medium → high

high → limited working life or special solutions

1.8.3.3 Surface coating by hot dip galvanising

A special means to influence the corrosion depths is hot dip galvanising of the components of the micropile, i.e. thread bar and accessories. Corrosion of the hot dip galvanised micropile only commences after the zinc coating has worn off, delaying corrosion of the steel and thus increasing its working life.

The micropiles are hot dip galvanised according to the requirements of EN ISO 1461. The thickness of zinc coating is usually ≥ 150 µm. Smaller zinc coating thicknesses may be applied but have to be taken into consideration accordingly.

1.8.3.4 Corrosion depth, sacrificial corrosion

The micropile system defines corrosion rates – sacrificial corrosion – for a working life of maximum 50 years dependent on the ground conditions and without taking into consideration the system-inherent cover of cement mortar.

Considered are

- Bare micropiles and
- Hot dip galvanised micropiles.

Additional corrosion protection requirements are considered, based on a critical evaluation of the structure and environmental conditions. In particular, a redundant construction ensures that the load-bearing capacity of the pile foundation is not impaired even in the case of premature failure of individual elements.

In order to prevent the formation of macro-elements, an electro conductive connection between micropile and reinforcement of the adjacent structure is avoided in moist soils according to Table 5. If required, additional measures are applied, e.g. the installation of separating layers with plastic tube coverings.

For semi-permanent micropiles the following items require consideration.

- The soil can be classified according to Clause 1.8.3.2 in corrosion load low, medium or high.
- Dependent on the soil parameters and in particular the corrosion load of the soil, classified according to Clause 1.8.3.2, the corrosion depth (sacrificial corrosion) is determined for the intended working life of the micropile. Thereby, the potential loss in cross-sectional area is taken into consideration. Annex 14 includes data on the losses in cross-sectional area of the micropile due to corrosion.
- For a “high” corrosion load according to Table 5, an electro conductive contact between the reinforcement of the foundation and the micropile is avoided in order to prevent macro-element formation. For “medium” corrosion load according to Table 5, an electro conductive contact between the reinforcement of the foundation and the micropile should avoided.
- The transition zone of the micropile at the joint ground to foundation is covered with a pile neck protection tube made of steel or plastic according to Clause 1.6.1 and Table 3. The annular ring between the thread bar and the pile neck protection tube is filled completely with cement mortar.

Annex 2, Annex 21, and Table 6 list guide values for the corrosion depth of bare and hot dip galvanised micropiles in soils, based on the results of long-term exposures. The corrosion depth is defined for a low, medium, and high corrosion load and a working life of 2, 7, 30, and 50 years. The round-off value is about 0.1 mm.

If a higher loss in cross section is assumed, the load-bearing capacity of the micropile decreases and hence the working life increases accordingly.

The maximum corrosion depth for design is limited to ≤ 1.0 mm for micropiles of all nominal diameters, i.e. 28 to 63.5 mm.

Table 6 Guide values for corrosion depth

Working life in years	Micropile	Corrosion depth in mm		
		low	medium	high
2	A B	0 0	0 0	0.2 0
7	A B	0.2 0	0.2 0	0.5 0.4
30	A B	0.4 0	0.6 0.2	D
50	A B	0.5 0.2 or D	1.0 0.5 or D	D

Key

A..... Bare steel

B..... Hot dip galvanised steel, zinc coating thickness ≥ 150 µm

D ..... Corrosion protection according to EN 1537 with corrugated plastic sheathing

In Annex 14, information on the loss in cross-sectional area due to corrosion is given. Corrosion of the coupler is considered. Separate verification thereof is not required.

1.8.4 Permanent micropile with standard corrosion protection, Annex 3

Corrosion protection of permanent micropiles with standard corrosion protection is achieved by encapsulation with a body of cement mortar. Dependent on the exposure classes according to EN 206, the required cover of cement mortar is defined based on the relevant geotechnical standards. The crack widths under tensile load are thereby limited to ≤ 0.2 mm. The pile neck at the joint ground to foundation is protected according to Table 3.

Dependent on the soil conditions on site, the required cover of cement mortar is specified based on the relevant geotechnical standards, see Table 7.

Table 7 Guide values for minimum cover of cement mortar

Corrosion load of soil	Cover of cement mortar	
	Compression and alternating loads [1]	Tensile loads
	mm	mm
low	25	35
medium	30	40
high	35 [2]	45 [2]

[1] A minimum cover of cement mortar of ≥ 0.8 · $\varnothing_s$ is applied

[2] For information. Corrosion protection according to EN 1537 is recommended.

For permanent micropiles with standard corrosion protection the following items are observed.

– The thickness of the cover of cement mortar according to Table 7 is ensured by spacers, spacing ≤ 3.0 m.

- Pile neck protection tube according to Clause 1.6.1 and Table 3 is installed.
- Possible macro-element formation is considered according to Clause 1.8.3.
- Corrosion protection of splice is ensured according to Clause 1.8.6.

Crack widths in cement mortar, under a tensile stress in the thread bar of $\sigma \leq 480$ N/mm^2, corresponding to 60 % of the characteristic value of maximum force, $0.6 \cdot F_{m,\,nom}$, or 72 % of the force at characteristic yield strength, $0.72 \cdot F_{p0.2,\,nom}$, remain below 0.2 mm.

1.8.5 Permanent micropile with corrosion protection according to EN 1537, Annex 4

Permanent micropiles according to EN 1537 are protected against corrosion with a 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. 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 at the manufacturing plant according to defined operating procedures. The sheathed and grouted micropile is kept in place until the cement grout has sufficiently set and hardened. This is attained not before 24 hours after grouting.

Annex 4 shows a permanent micropile, corrosion protected according to EN 1537 and specifications on the corrosion protection. The most important components for the corrosion protection are.

- The thread bar is encased within a corrugated plastic sheathing with a wall thickness of ≥ 1.0 mm and an inner cover of cement grout of ≥ 5 mm between thread bar and corrugated plastic sheathing.
- Outer cover of cement mortar is ≥ 10 mm between corrugated plastic sheathing and borehole wall.
- For aggressive soils the exposure classes according to EN 206 apply.
- Corrosion protection of the pile neck is provided by the corrugated plastic sheathing of the thread bar, extending down from to the pile head to the bottom end of the micropile.
- The splice is protected according to Clause 1.8.6 with a heat shrinking sleeve. The inner side of the heat shrinking sleeve is provided with corrosion protection material.
- The bottom end of the micropile is closed with a plastic cap.

1.8.6 Corrosion protection of splice

Corrosion protection of splice is listed in Table 8 and shown in Annex 5. Overlap of heat shrinking sleeve and adjacent elements, i.e. thread bar or corrugated plastic sheathing, is at least 75 mm.

Table 8 Corrosion protection of splice

Splice	Intended use of micropile			
	Temporary micropile	Semi-permanent micropile	Permanent micropile	
			Standard corrosion protection	Corrosion protection according to EN 1537
Coupler in steel, locked with lock nuts	—[1)]	—[1)]	—[1)]	Heat shrinking sleeve
Coupler in steel with adhesive, locked without nuts	—[1)]	—[1)]	Heat shrinking sleeve [2)]	Heat shrinking sleeve

Splice	Intended use of micropile			
	Temporary micropile	Semi-permanent micropile	Permanent micropile	
			Standard corrosion protection	Corrosion protection according to EN 1537
Coupler in steel, locked without nuts	—[3]	—[3]	Heat shrinking sleeve	Heat shrinking sleeve
Contact coupler in steel, locked without nuts for only compression loading	—[3]	—[3]	—[3]	Heat shrinking sleeve

[1] No particular corrosion protection for splice.
[2] For micropile with small nominal diameter heat shrinking sleeve is not required, see Annex 5.
[3] No particular corrosion protection for splice. Measures to prevent unscrewing are required, see Clause 1.7.

Components

1.9 General

The components of the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm, conform to drawings and dimensions in Annex 9, Annex 12, Annex 15 Annex 16, Annex 17 Annex 18, Annex 19, and Annex 20 and material specifications in Annex 10, Annex 11, Annex 12, and Annex 13. 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.

1.10 Load-bearing element – Thread bar in steel

The load-bearing element is the SAS 670/800 steel bar, a hot rolled and in-line heat treated steel bar with nominal diameters from 28 to 63.5 mm and with a continuous right-hand thread along the entire length of the steel bar, provided by hot rolled ribs – thread bar.

The thread bar is in particular suitable for special applications in geotechnical engineering. Welding and bending are possible in principle, but not intended for micropiles. The characteristic strength values of the thread bar are higher than those of common reinforcing steel while maintaining a high ductility. The characteristics of the thread bar are defined according to the requirements for reinforcing steel following EN 1992-1-1, Annex C, and are given in Annex 9 and Annex 10.

Due to corrosion depth for sacrificial corrosion, the cross-sectional area of the thread bar will be reduced and causes decrease in load-bearing capacity. In Annex 14 losses of cross-sectional area are given for several corrosion depths. Corrosion of the coupler is considered. Separate verification thereof is not required.

1.11 Nuts

The following nuts are available.

- Anchor nut
- Lock nuts short
- Lock nuts long

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

Anchor nut and lock nut are used to lock the square anchor plate and the anchor piece. The coupler can be locked with lock nuts. The most important dimensions of the nuts are given in Annex 15 and Annex 16.

1.12 Square anchor plate

The square anchor plate in steel is fastened at the thread bar and locked with nuts. Torque of anchor plate is specified in Annex 7. The most important dimensions of the anchor plate are given in Annex 15.

1.13 Anchor piece

The anchor piece in steel is fastened at the thread bar and locked with a nut. Torque of anchor piece is specified in Annex 7. The most important dimensions of the anchor piece are given in Annex 16.

1.14 Coupler

The thread bars are jointed with a coupler in steel. The coupler is locked with nuts or locked without nuts. Splice with coupler locked without nuts is secured against unscrewing, see Clause 1.7. Torque of splice is specified in Annex 7. The most important dimensions of the coupler are given in Annex 17 as minimum dimensions, i.e. coupler greater in length and larger outer diameter are available. However, the greater diameter is considered with regard to cover of cement mortar and in execution.

1.15 Heat shrinking sleeve

After shrinking, wall thickness of heat shrinking sleeve is ≥ 1 mm. The inner side of the heat shrinking sleeve is provided with corrosion protection material. See Annex 12 and Annex 18 for the specification of the heat shrinking sleeve.

1.16 Corrugated plastic sheathing

The corrugated plastic sheathing has a wall thickness of ≥ 1 mm. The most important dimensions of the corrugated plastic sheathing are given in Annex 18.

1.17 Pile neck protection tube

The pile neck protection tube is a steel tube or a plastic tube. The most important dimensions of the pile neck protection tube are given in Annex 20.

1.18 Inner grout

The corrugated plastic sheathing is grouted in the manufacturing plant with inner grout. Inner grout conforms to EN 447. Cover of inner grout on thread bar is at least 5 mm. See Annex 11 for the specification of inner grout.

1.19 Cement mortar

Cement mortar is inherent in the micropile system. 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.

Cement mortar conforms to the specifications of EN 14199. The water to cement ratio is adapted to the conditions on site. However, concrete according to EN 14199 is not used instead of cement mortar.

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

1.20 Ancillary components

For the outer cover of cement mortar, adequate spacers provide the necessary distance between load-bearing element and borehole wall, see Annex 17.

To provide a defined internal cover of grout inside the corrugated plastic sheathing, a plastic cord is wound helically around the thread bar or plastic spacers are installed, see Annex 19.

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.

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

2.1 Intended uses

The Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm is intended to be used for pile foundation of buildings and civil engineering works according to the principles for execution of geotechnical works. The structural functions of the micropile are

- to transfer loads to the underlying layers of the ground and
- to limit deformations.

The micropile is suitable for tensile, compression and alternating loads. Design of pile foundations assumes axial loading of the micropiles only. Pile foundations are designed so as to form a redundant system.

Micropiles are temporary, semi-permanent, or permanent according to Table 9.

Table 9 Intended uses of the micropile

Line №	Intended use		Working life
1	Temporary micropile		Up to 2 years
2	Semi-permanent micropile	Bare micropile	Up to 50 years
3	Semi-permanent micropile	Hot-dip galvanised micropile	Up to 50 years
4	Permanent micropile with standard corrosion protection		Up to 100 years
5	Permanent micropile with corrosion protection according to EN 1537		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 steel bars and components in order to prevent damaging corrosion during transportation from the production site to the job site. Light surface rust is acceptable.

- Transportation, storage, and handling of steel bars and components in a manner as to avoid damage by mechanical or chemical impact
- Protection of steel bars and components from moisture

2.2.3 Design

Design is according to the Eurocodes.

For verification of micropile applications with the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm, the following items are considered.

- The micropiles are subjected to only axial tensile, compressive and alternating loads.
- The load-bearing capacity of the micropile, comprising the components thread bar, coupler and anchorage, is 100 % relative to $F_{m,\,nom}$ of the thread bar. The values in Annex 10 are taken as a basis.
- The micropile foundation is designed as to form a redundant structure according to EN 1990. Micropile foundation with only one single micropile is not executed.
- The stress ranges of Table 10 at coupling and anchorage of the micropile have been tested in fatigue with an upper load of $0.65 \cdot F_{p0.2,\,nom}$ and up to $2 \cdot 10^6$ load cycles.
- Parameters for S-N curve of coupler and anchorage with anchor plate and anchor piece are given in Table 11.

Table 10 Resistance to fatigue

Nominal diameters $\varnothing_s$	**Stress range at**	
	Splice and anchorage with anchor plate	**Anchorage with anchor piece**
mm	**N/mm²**	**N/mm²**
28 to 63.5	55	55

Table 11 Parameters for S-N curve for splice and anchorage with anchor plate and anchor piece

Nominal diameters $\varnothing_s$	**Parameters of S-N curve for** **Splice** **Anchorage with anchor plate** **Anchorage with anchor piece**
mm	—
28 to 63.5	S-N curve with $\Delta\sigma_{Rsk} = 55$ N/mm² at $N = 2 \cdot 10^6$ $k_1 = 4$, $k_2 = 5$ $N^* = 1 \cdot 10^7$

Where

$\Delta\sigma_{Rsk}$ .... N/mm² ..... Stress range

N ..... — ..... Number of load cycles

k_1, k_2 ..... — ..... Stress exponents of S-N curve as defined in EN 1992-1-1, Table 6.3N

N* ..... —..... Number of load cycles at transition from k_1-branch to k_2-branch

- The connection micropile to structure is designed according to Eurocode 2 for load transmission from the steel bar to the foundation through the anchorage at the pile head. Minimum centre spacing and edge distance of the micropile are given in Annex 7 and Annex 8 for a concrete cube compressive strength of ≥ 25 N/mm² or ≥ 30 N/mm² and without and with additional reinforcement. If centre spacing and edge distance, concrete compressive strength, additional reinforcement, and additional bonded length are conformed to, verification of load transfer to structural concrete has been delivered. The forces outside the area of additional reinforcement are verified and, if necessary, covered by appropriate reinforcement.
- For load transfer without additional reinforcement, the zone around the centric pile with external dimensions corresponding to the centre spacing of Annex 7 and Annex 8 is reinforced according to Clause 1.5.
- Annex 1Annex 1, Annex 2, Annex 3, Annex 4, and Annex 6 show the anchorage at the pile head, embedded in concrete with pile neck protection tube, taking the way of loading into consideration.
- Punching of the anchorage needs to be considered in any case.
- In verification of deformations, slip values according to Table 12 and Table 13 are applied for anchorages and splices.

Table 12 Slip at splice

Splice	**Nominal diameter of therad bar** $\varnothing_s$ **mm**	**Slip mm**
Coupler, locked with lock nuts	28, 30, 35, 43 50, 57.5, 63.5	0.1 0.2
Coupler with adhesive, locked without nuts	28 30, 35, 43 50, 57.5 63.5	0.1 0.2 0.3 0.4
Coupler, locked without nuts	28 30, 35, 43 50, 57.5 63.5	0.4 1.2 1.5 2.9
Contact coupler, locked without nuts for only compression loading	28, 30, 35 43 50, 57.5, 63.5	0.1 0.1 0.2

Table 13 Slip at anchorage

Anchorage	Nominal diameter of therad bar $\varnothing_s$ mm	Slip mm
Square anchor plate, locked with nuts	28, 30, 35, 43 50, 57.5, 63.5 with TR 2138 50, 57.5, 63.5 with TR 2139	0.1 0.6 0.8
Square anchor plate in steel, locked with nuts and with an adhesive at the nuts	28 30, 35, 43, 50, 57.5, 63.5	0.3 0.4
Anchor piece in steel, locked with nut	28, 30, 35, 43, 50, 57.5, 63.5 with additional bonded length	0.1 [1)]

[1)] Slip at anchor piece, without slip at additional bonded length.

- For compression loading, verification of buckling of the micropile is required. For ground that does not prevent lateral deflection of the micropile, the stability under compressive load is verified either by calculation or proof loading. Potential imperfections are taken into consideration. For verification by calculation, bending stiffness of the micropile is taken as follows.
  - Steel bar only, for micropiles with cement mortar in a borehole
  - Steel bar together with the cement grout, for steel bar encased in a corrugated plastic sheathing
  - The entire composite cross section, comprising steel bar, cement mortar, and an outer steel tube.
  - The supporting effect of the ground in the area of the buckling shape may be taken into consideration.
  - Splices with couplers locked without nut, splices with contact coupler locked without nuts, and splices with adhesive are not installed in the central third of the buckling length.
- For a cylinder compressive strength of cement mortar of ≥ 40 N/mm^2 the characteristic bond strength is 6 N/mm^2.
- If sacrificial corrosion is taken into consideration, the losses in cross-sectional area are taken into account in the verification of the load-bearing capacity. The respective values are listed in Annex 14.

2.2.4 Installation

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 Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm, is only carried out by appropriately qualified specialist companies with the required resources and experience in the execution of geotechnical works.

The principles for the application and execution of micropile foundations are specified in the standard EN 14199, a code of practice for micropiles, including comprehensive information on the execution of pile foundations, ground investigations, construction materials and construction products, and further considerations on design and installation of micropiles, as well as on supervision, testing and monitoring are given.

The required length of the micropile is achieved by jointing the necessary number of thread bars with couplers. At splices and anchorages, minimum engagement depth is observed and splices and anchorages are locked to the specified torque, see Annex 7.

The micropile is installed in the centre of a pre-drilled borehole. Thereby, the geotechnical conditions are taken into consideration. The centric position of the thread bar is ensured with spacers. Cement mortar is injected in the residual annular void between borehole wall and thread bar or corrugated plastic sheathing. An injection hose is used to inject the cement mortar into the predrilled holes from bottom to top. In poor soils, post-grouting can be carried out to improve soil conditions.

During installation, procedures to prevent damage to thread bar, anchorage, splice, and corrosion protection are implemented. If not locked with lock nuts, measures to prevent unscrewing of splices are applied.

All installed micropiles have a system-inherent body of cement mortar between borehole wall and thread bar or corrugated plastic sheathing. The cement mortar conforms to EN 14199. The cement is selected taking into consideration the aggressiveness of the ground. Thereby, the water to cement ratio is adjusted to the actual conditions of the construction site. Alternatively, cement grout according to EN 445, EN 446, and EN 447 can be used.

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 can be determined according to EN 206.

The body of cement mortar is specified in particular regarding thickness and minimum compressive strength, however dependent on the conditions of use. EN 14199 contains basic data on the required minimum cement mortar cover, taking into account the exposure classes according to EN 206. Additional data are listed in Eurocode 2. For permanent micropiles with standard corrosion protection subjected to compressive or alternating load, the cover of cement mortar is always $\geq 0.8 \cdot \varnothing_s$, where $\varnothing_s$ is the nominal diameter of the thread bar.

If required, a pile neck protection tube is installed before the cement mortar has set. Dependent on the loading of the micropile and the conditions on site, a steel tube or a corrugated plastic sheathing is applied.

The anchorage at the pile head is installed and locked after the cement mortar has sufficiently set and hardened.

2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm of up to 2 years for temporary micropiles, 50 years and less than 50 years for semi-permanent micropiles, and up to 100 years for permanent micropiles, provided that the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm, is subject to appropriate installation, use, and maintenance, see Clause 2.2.

In normal use conditions, the real working life may be considerably longer without major degradation affecting the basic requirements for construction works[4].

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.

[4] 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.

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

3.1 Essential characteristics

The performances of the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm for the essential characteristics are given in Table 14. In Annex 24 and Annex 25 the combinations of essential characteristics and corresponding intended uses are listed.

Table 14 Essential characteristics and performances of the micropile

№	Essential characteristic	Product performance
Basic requirement for construction works 1: Mechanical resistance and stability		
1	Resistance to static load at anchorages and splices	See Clause 3.2.1.1.
2	Slip at anchorages and splices	See Table 12 and Table 13.
3	Resistance to fatigue at anchorages and splices	See Clause 3.2.1.2.
4	Load transfer to the structure	See Clause 3.2.1.3.
5	Load transfer to the micropile	See Clause 3.2.1.4.
6	Corrosion protection of temporary micropile	See Clause 3.2.1.5.
7	Corrosion protection of semi-permanent micropile	See Clause 3.2.1.6.
8	Corrosion protection of permanent micropile	See Clause 3.2.1.7.
9	Crack width in cement mortar	See Clause 1.8.4.
Thread bar		
10	Cross-sectional area	See Annex 9.
11	Mass per metre	See Annex 9.
12	Surface geometry	See Annex 9.
13	Strength characteristics	See Annex 10.
14	Modulus of elasticity	See Annex 10.
15	Elongation at maximum force	See Annex 10.
16	Resistance to fatigue	See Annex 10.
17	Bond strength	See Annex 10.
18	Hot-dip galvanising	See Clause 3.2.1.8.

№	Essential characteristic	Product performance
Nuts, couplers, and anchor plates		
19	Shape	See Annex 15, Annex 16, and Annex 17.
20	Dimensions	See Annex 15, Annex 16, and Annex 17.
21	Material	See Annex 13.
22	Hardness	See Clause 3.2.1.9.
23	Hot-dip galvanising	See Clause 3.2.1.8.
Inner grout		
24	Content of aggressive components	See Annex 11.
25	Residue on sieve	See Annex 11.
26	Fluidity, cone	See Annex 11.
27	Fluidity, grout spread	See Annex 11.
28	Bleeding, wick-induced	See Annex 11.
29	Bleeding, inclined tube	See Annex 11.
30	Volume change	See Annex 11.
31	Compressive strength	See Annex 11.
32	Setting time	See Annex 11.
33	Fluid density	See Annex 11.
34	Crack width of inner grout	See Annex 11.
Heat shrinking sleeve with inner coating		
35	Thickness after shrinking	See Annex 12.
36	Mass per unit area of adhesive	See Annex 12.
37	Tensile strength	See Annex 12.
38	Elongation at break	See Annex 12.
39	Peel strength layer to layer	See Annex 12.
40	Peel strength to steel surface	See Annex 12.
41	Thermal ageing resistance	See Annex 12.
42	Indentation resistance	See Annex 12.
43	Impact resistance	See Annex 12.
44	Saponification value	See Annex 12.
45	Microbiological resistance	See Annex 12.
46	Water absorption	See Annex 12.
47	Softening point of adhesive	See Annex 12.
48	Oxygen stability of adhesive	See Annex 12.

№	Essential characteristic	Product performance
49	Resistance to salt spray of adhesive	See Annex 12.
50	Content of aggressive components of adhesive	See Annex 12.
Corrugated plastic sheathing		
51	Shape	See Annex 18.
52	Dimensions	See Annex 18.
53	Material	See Annex 13.
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 at anchorages and splices

The Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm as described in the ETA meets the acceptance criteria of EAD 200077-00-0103, Clause 2.2.1. The characteristic values of yield strength, $R_{e,\,nom}$, and tensile strength, $R_{m,\,nom}$, of the steel bar are given Annex 10.

3.2.1.2 Resistance to fatigue at anchorages and splices

For resistance to fatigue for anchorage and splice see Clause 2.2.3.

3.2.1.3 Load transfer to the structure

The Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm, as described in the ETA, meets the acceptance criteria of EAD 200077-00-0103, Clause 2.2.3. The characteristic values of yield strength, $R_{e,\,nom}$, and tensile strength, $R_{m,\,nom}$, of the steel bar are given Annex 10.

3.2.1.4 Load transfer to the micropile

The dimensions of the pile neck protection tubes are given in Annex 20. Length of the tube is applicable for extending 100 mm into the structure, see Annex 2, Annex 3, and Annex 6.

The field of application of the pile neck protection tube is specified in Table 3.

3.2.1.5 Corrosion protection of temporary micropile

Corrosion protection of the temporary micropile is described in the Clauses 1.8.2 and 1.8.6.

3.2.1.6 Corrosion protection of semi-permanent micropile

Corrosion protection of the semi-permanent micropile is described in the Clauses 1.8.3 and 1.8.6.

3.2.1.7 Corrosion protection of permanent micropile

Corrosion protection of the permanent micropile is described in the Clauses 1.8.4, 1.8.5, and 1.8.6.

3.2.1.8 Hot-dip galvanising

Thread bar and components are hot-dip galvanised according to the requirements of EN ISO 1461. The mean thickness of the hot-dip galvanised coating is ≥ 85 µm. The mean thickness of the hot-dip galvanised coating of the components is at least the coating thickness of the thread bar.

NOTE Other coating thicknesses may be applied and are considered in determining corrosion depths, see Clause 1.8.3.3.

3.2.1.9 Hardness

For hardness of the components see Table 15.

Table 15 Hardness of components

Component	Hardness HBW
Anchor nut Lock nut	≥ 140
Plate	≥ 127
Coupler	≥ 140
Pile neck protection tube	≥ 127

3.3 Assessment methods

The assessment of the essential characteristics in Clause 3.1 of the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm, for the intended uses, and in relation to the requirements for mechanical resistance and stability, in the sense of the basic requirements for construction works № 1 of Regulation (EU) № 305/2011, has been made in accordance with EAD 200077-00-0103, Kit for micropile – Kit with thread bars.

3.4 Identification

The European Technical Assessment for the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm, is issued on the basis of agreed data that identify the assessed product[5]. Changes to materials, to composition, or to characteristics of the product, or to the production

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

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 98/214/EC the system of assessment and verification of constancy of performance to be applied to the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm is System 2+. System 2+ is detailed in Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, Annex, point 1.3., and provides for the following items.

(a) The manufacturer shall carry out

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

(ii) factory production control;

(iii) testing of samples taken at the manufacturing plant by the manufacturer in accordance with the prescribed test plan[6].

(b) The notified factory production control certification body shall decide on the issuing, restriction, suspension or withdrawal of the certificate of conformity of the factory production control on the basis of the outcome of the following assessments and verifications carried out by that body

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

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

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

Manufacturers undertaking tasks under System 2+ shall consider the European Technical Assessment issued for the construction product in question as the assessment of the performance of that product. Manufacturers shall therefore not undertake the tasks referred to in Clause 4.1, point (a) (i).

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

5.1 Tasks for the manufacturer

5.1.1 Factory production control

In the manufacturing plant, the manufacturer establishes and continuously maintains a factory production control. All procedures and specifications adopted by the manufacturer are documented in a systematic manner. Purpose of factory production control is to ensure the constancy of performances of the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm with regard to the essential characteristics.

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

[6] The prescribed test plan has been deposited with Österreichisches Institut für Bautechnik and is handed over only to the notified factory production control 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.

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 factory production control 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, couplers, and anchor pieces.

The basic elements of the prescribed test plan are given in Annex 22 and Annex 23.

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 conformity of the factory production control issued by the notified factory production control 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 14**.** In Annex 24 and Annex 25 the combinations of essential characteristics and corresponding intended uses are listed.

5.2 Tasks for the notified factory production control certification body

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

The notified factory production control certification body verifies the ability of the manufacturer for a continuous and orderly manufacturing of the Micropile System SAS with thread bar S 670/800, diameter 28 to 63.5 mm according to the European Technical Assessment. In particular, the following items are appropriately considered.

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

5.2.2 Continuing surveillance, assessment and evaluation of factory production control

The notified factory production control 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, couplers, and anchor pieces 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 factory production control certification body to Österreichisches Institut für Bautechnik. When the provisions of the European Technical Assessment or the prescribed test plan are no longer

fulfilled, the certificate of conformity of the factory production control is withdrawn by the notified factory production control certification body.

Issued in Vienna on 26 September 2018
by Österreichisches Institut für Bautechnik

The original document is signed by

Rainer Mikulits
Managing Director

Member of EOTA

Max Aicher GmbH & Co. KG
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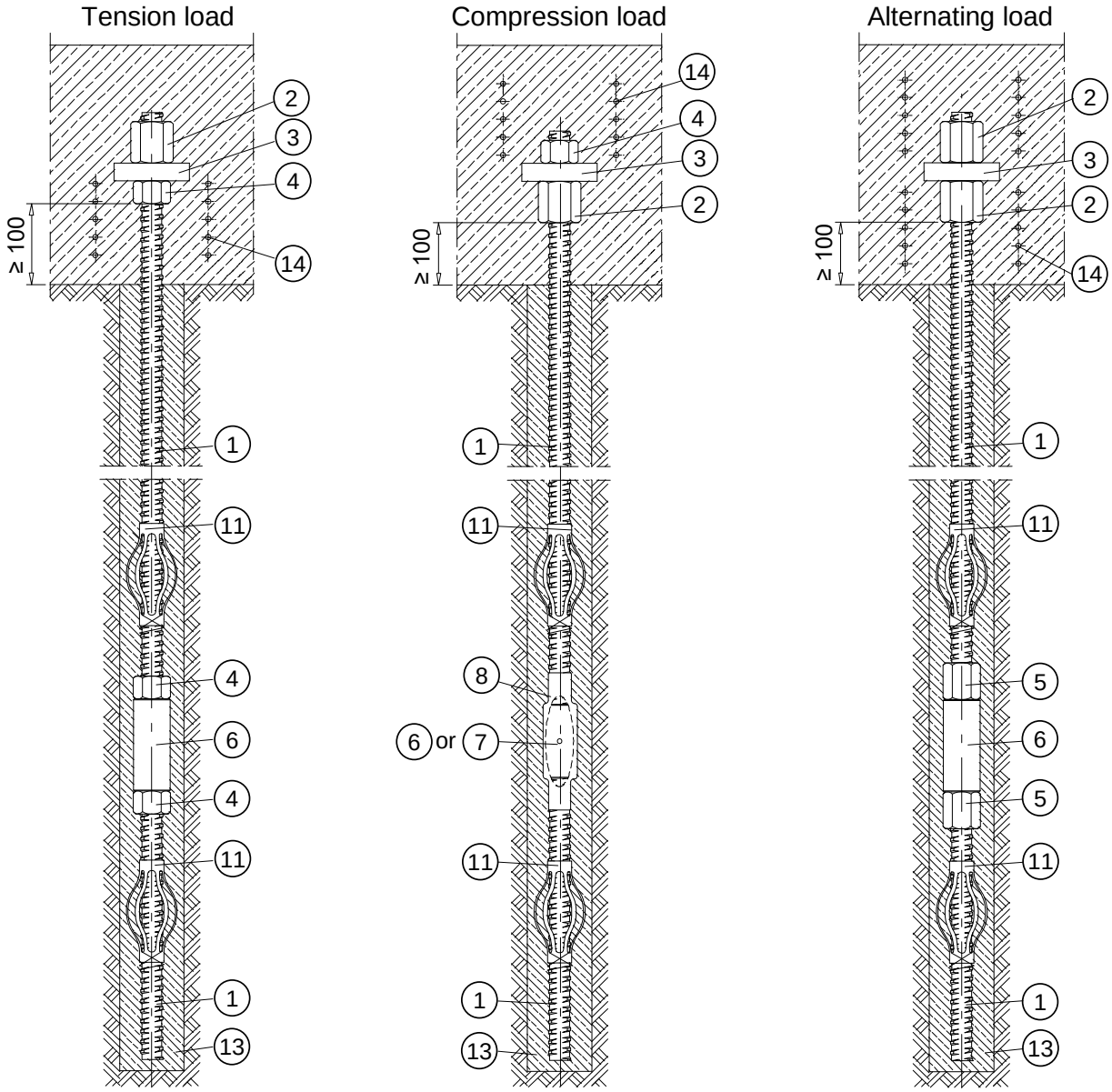
Micropile system SAS 670

Thread bar S 670, ∅s 28–63.5 mm

Temporary micropile

Annex 1
of European Technical Assessment
ETA-11/0138 of 26.09.2018



(1) Thread bar
(2) Anchor nut
(3) Anchor plate
(4) Lock nut, short
(5) Lock nut, long
(6) Coupler
(7) Contact coupler
(8) Heat shrinking sleeve
(11) Basket spacer
(13) Cover of cement mortar
(14) Additional reinforcement

Thread bar ∅s in mm	Min. borehole-∅ in mm Temporary pile without coupler	with coupler
28	75	80
30	75	85
35	80	95
43	90	110
50	95	120
57.5	105	135
63.5	110	145

Working life in years	Pile	Corrosion depth in mm for corrosion load low	medium	high
up to 2	A	0	0	0.2
	B	0	0	0

A Bare steel
B Galvanised steel, thickness ≥ 150 µm zinc

For available splices and corrosion protection of splices see Annex 5.

Pile neck protection tube according to Clause 1.6.1 and Table 3

Dimensions in mm

Member of EOTA

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

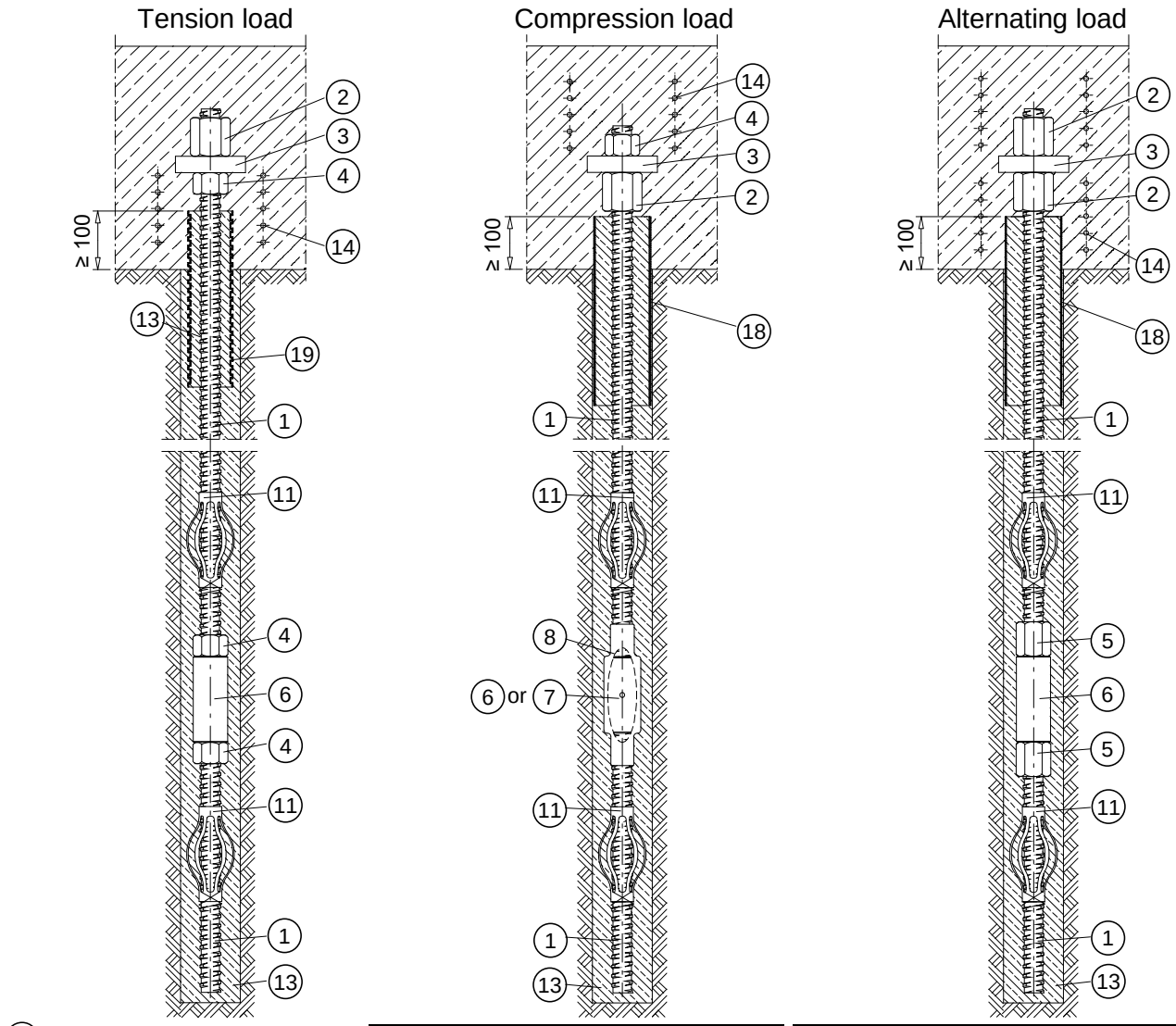
Micropile system SAS 670

Thread bar S 670, ∅s 28–63.5 mm

Semi-permanent micropile

Annex 2

of European Technical Assessment
ETA-11/0138 of 26.09.2018



1 Thread bar
2 Anchor nut
3 Anchor plate
4 Lock nut, short
5 Lock nut, long
6 Coupler
7 Contact coupler
8 Heat shrinking sleeve
11 Basket spacer
13 Cover of cement mortar
14 Additional reinforcement
18 Pile neck tube, steel tube
19 Pile neck sheathing, corrugated plastic sheathing

Thread bar ∅s in mm	Min. borehole-∅ in mm Semi-permanent pile	
	without coupler	with coupler
28	75	80
30	75	85
35	80	95
43	90	110
50	95	120
57.5	105	135
63.5	110	145

Working life in years	Pile	Corrosion depth in mm for corrosion load					
		low		medium		high	
2–7	A	0.2		0.2		0.5	
	B	0		0		0.4	
7–30	A	0.4		0.6		D	
	B	0		0.2			
30–50	A	0.5	or D	1.0	or D	D	
	B	0.2		0.5			

A Bare steel
B Galvanised steel, thickness ≥ 150 µm zinc
D Corrosion protection according to EN 1537 for all diameters and anchorages. For details see Annex 4.

For available splices and corrosion protection of splices see Annex 5.

Pile neck protection tube according to Clause 1.6.1 and Table 3

Dimensions in mm

Member of EOTA

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

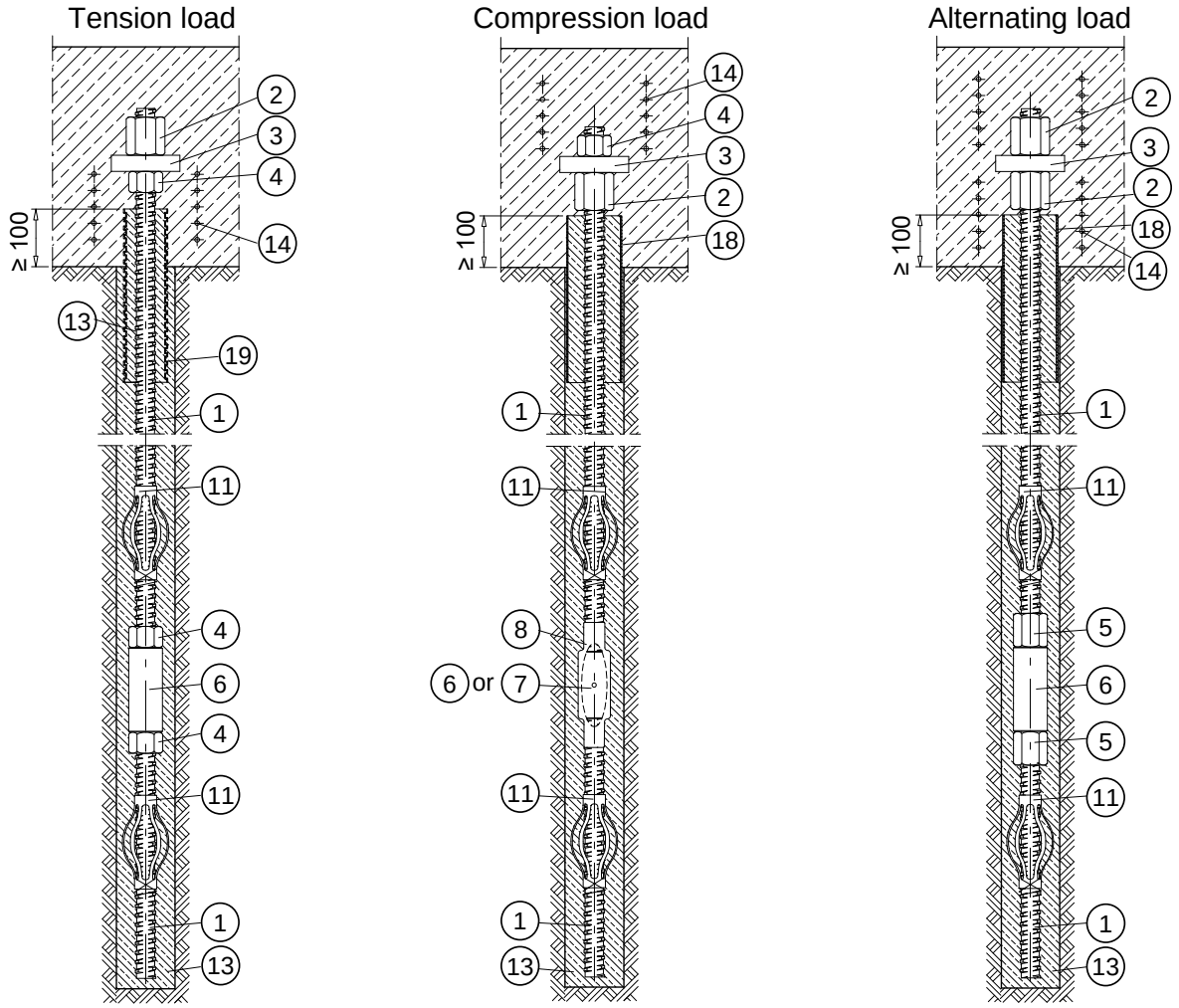
Micropile system SAS 670

Thread bar S 670, ∅s 28–63.5 mm

Permanent micropile with standard corrosion protection

Annex 3

of European Technical Assessment
ETA-11/0138 of 26.09.2018



(2) Anchor nut
(3) Anchor plate
(4) Lock nut, short
(5) Lock nut, long
(6) Coupler
(7) Contact coupler
(8) Heat shrinking sleeve
(11) Basket spacer
(13) Cover of cement mortar
(14) Additional reinforcement
(18) Pile neck tube, steel tube
(19) Pile neck tube, corrugated plastic sheathing

For available splices and corrosion protection of splices see Annex 5.

	Thread bar ∅s in mm	Minimum borehole ∅ in mm – Permanent micropile					
		Tension		Compression		Alternating	
		without coupler	with coupler	without coupler	with coupler	without coupler	with coupler
Low corrosion load [2]	28	105	120	85	100	105	120
	30	105	125	85	105	105	125
	35	110	135	95	125	110	135
	43	120	150	120	150	120	150
	50	125	160	135	170	135	170
	57.5 [1]	135	175	155	195	155	195
	63.5 [1]	140	185	170	220	170	220
Medium corrosion load [2]	28	115	130	95	110	115	130
	30	115	135	95	115	115	135
	35	120	145	100	125	120	145
	43	130	160	120	150	130	160
	50	135	170	135	170	135	170
	57.5 [1]	145	185	155	195	155	195
	63.5 [1]	150	195	170	220	170	220

[1] Only for anchorage with anchor piece according to Annex 6
[2] For high corrosion load, corrosion protection according to EN 1537 is recommended.

Pile neck protection tube according to Clause 1.6.1 and Table 3

Dimensions in mm

Member of EOTA

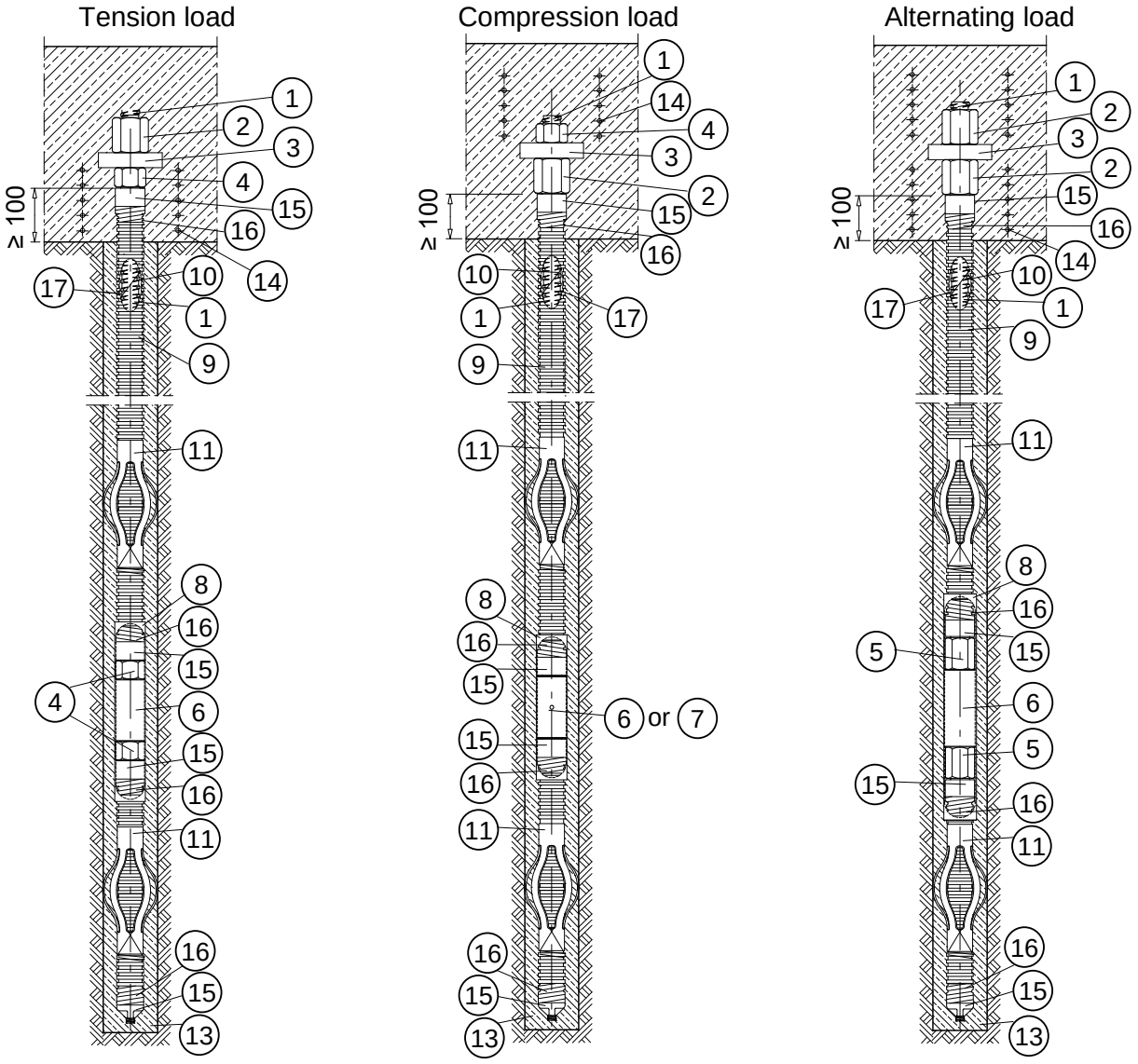
Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

Micropile system SAS 670

Thread bar S 670, ∅s 28–63.5 mm

Permanent micropile with corrosion protection according to EN 1537

Annex 4
of European Technical Assessment
ETA-11/0138 of 26.09.2018



1 Thread bar
2 Anchor nut
3 Anchor plate
4 Lock nut, short
5 Lock nut, long
6 Coupler
7 Contact coupler
8 Heat shrinking sleeve
9 Corrugated plastic sheathing
10 Inner spacer
11 Basket spacer
13 Cover of cement mortar
14 Additional reinforcement
15 Injection cap and end cap
16 Adhesive tape
17 Inner grout

For available splices and corrosion protection of splices see Annex 5.

Pile neck protection tube according to Clause 1.6.2

Thread bar ∅s in mm	Min. borehole-∅ in mm Permanent pile with corrosion protection according to EN 1537	
	without coupler	with coupler
28	70	70
30	80	80
35	85	85
43	100	100
50	100	110
57.5 [1)]	120	125
63.5 [1)]	120	135

[1)] Only with anchorage with anchor piece according to Annex 6

Dimensions in mm

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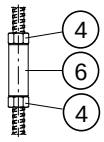
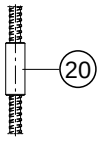
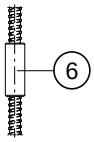
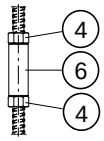
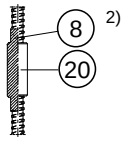
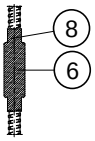
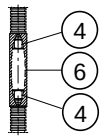
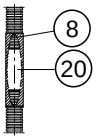
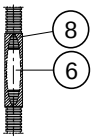
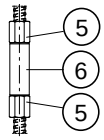
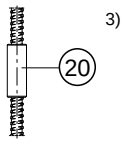
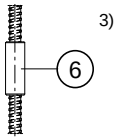
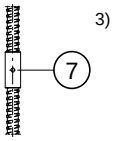
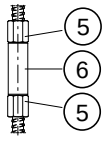
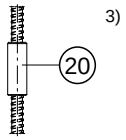
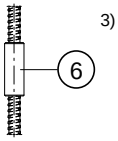
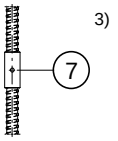
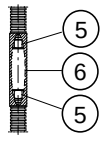
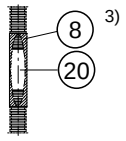
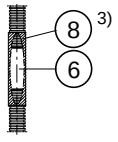
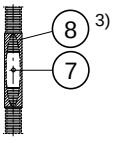
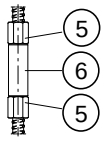
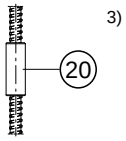
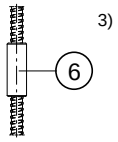
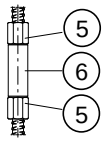
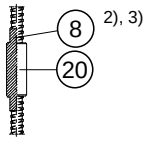
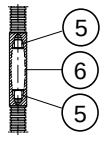
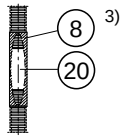
Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Splice – Corrosion protection

Annex 5
of European Technical Assessment
ETA-11/0138 of 26.09.2018

		Locked coupler	Coupler with adhesive	Coupler locked without nuts [1]	Contact coupler [1]
Tension loading	Temporary and semi-permanent				—
	Standard corrosion protection				—
	Corrosion protection according to EN 1537				—
Compression loading	Temporary and semi-permanent				
	Standard corrosion protection				
	Corrosion protection according to EN 1537				
Alternating loading	Temporary and semi-permanent				—
	Standard corrosion protection			—	—
	Corrosion protection according to EN 1537			—	—

[1] Measures to prevent unscrewing of the splice are implemented, e.g. with heat shrinking sleeve
[2] Corrosion protection with heat shrinking sleeve for nominal diameter > 43 mm
[3] Square cut end faces of thread bars according to Clause 1.7

(4) Lock nut, short
(5) Lock nut, long
(6) Coupler
(7) Contact coupler
(8) Heat shrinking sleeve
(20) Coupler with adhesive

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83404 Ainring–Hammerau

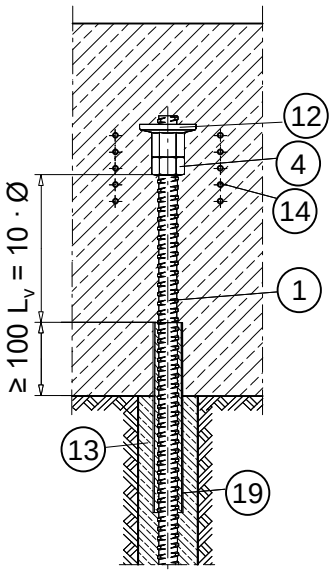
Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Anchorage with anchor piece and additional bonded length

Annex 6
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Semi-permanent and Permanent pile with Standard corrosion protection

Tension load



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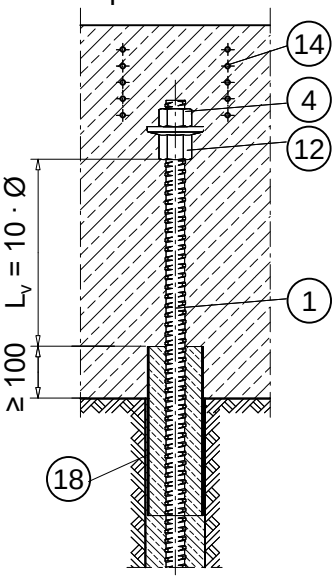
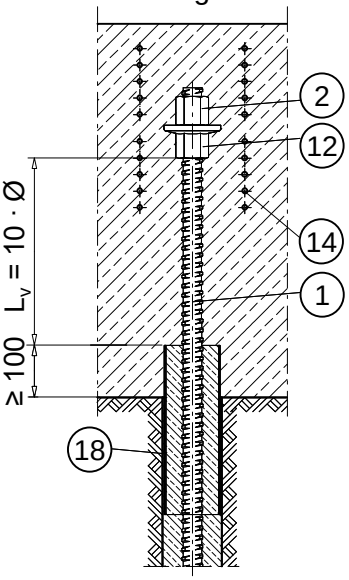
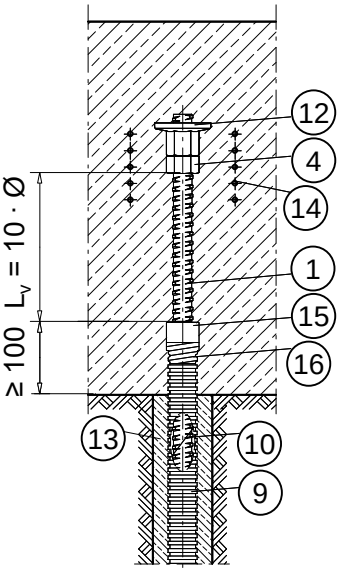


Alternating load

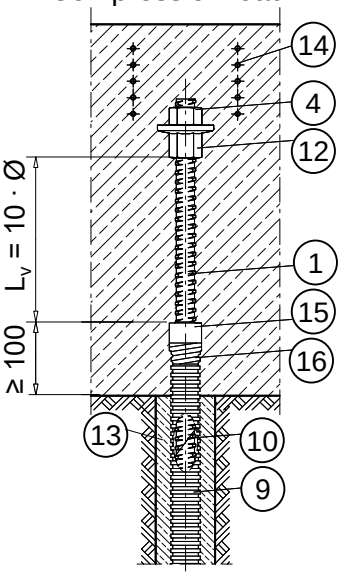


Permanent pile with sheathing according to EN 1537

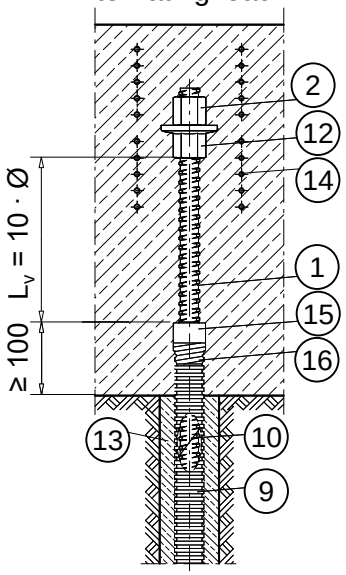
Tension load



Compression load



Alternating load



(1) Thread bar
(2) Anchor nut
(4) Lock nut, short
(9) Corrugated plastic sheathing
(10) Inner spacer
(12) Anchor piece
(13) Cement mortar
(14) Additional reinforcement
(15) Injection cap and end cap
(16) Adhesive tape
(18) Pile neck tube, steel tube
(19) Pile neck tube, corrugated plastic sheathing

Dimensions in mm

Pile neck protection tube according to Clause 1.6.1, Table 3 and Clause 1.6.2

Max Aicher GmbH & Co. KG
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Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Centre spacing and edge distance, additional reinforcement – Torque

Annex 7
of European Technical Assessment
ETA-11/0138 of 26.09.2018

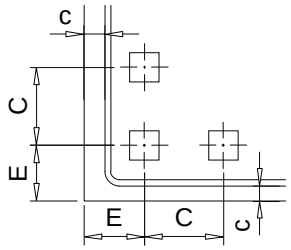
Centre spacing and edge distances, additional reinforcement

Actual concrete strength ≥ 25 N/mm², minimum concrete strength class ≥ C20/25

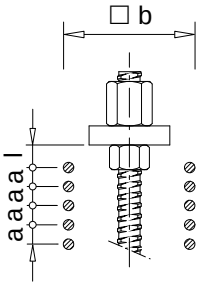
Anchorage with square anchor plate, without additional reinforcement [1)]

Thread bar ∅s	Plate anchorage [2)] TR 2139-∅		Plate anchorage [2)] TR 2138-∅	
	Centre spacing C	Edge distance E	Centre spacing C	Edge distance E
mm	mm	mm	mm	mm
28	250	115 + c	250	115 + c
30	270	125 + c	270	125 + c
35	310	145 + c	310	145 + c
43	380	180 + c	380	180 + c
50	440	210 + c	440	210 + c
57.5	510	245 + c	510	245 + c
63.5	575	280 + c	575	280 + c

Centre spacing
Edge distance



Additional reinforcement



Anchorage with square anchor plate, with additional reinforcement of ribbed reinforcing steel $R_e \geq 500$ N/mm²

Thread bar ∅s	Plate anchorage [2)] TR 2139-∅							Plate anchorage [2)] TR 2138-∅						
	Centre spacing	Edge distance	Additional reinforcement					Centre spacing	Edge distance	Additional reinforcement				
	C	E	n	∅	a	b	l	C	E	n	∅	a	b	l
mm	mm	mm	—	mm	mm	mm	mm	mm	mm	—	mm	mm	mm	mm
28	180	80 + c	3	10	45	160	50	170	75 + c	3	10	50	150	50
30	190	85 + c	4	10	40	170	50	185	85 + c	4	10	50	165	50
35	220	100 + c	4	10	45	200	60	205	95 + c	4	10	50	185	60
43	270	125 + c	4	12	55	250	70	260	120 + c	4	12	65	240	70
50	310	145 + c	5	16	55	290	80	300	140 + c	5	16	65	280	80
57.5	350	165 + c	5	16	60	330	90	345	165 + c	5	16	70	325	90
63.5	390	185 + c	5	16	65	370	100	375	180 + c	5	16	75	355	100

Torque for splice and anchorage

Thread bar ∅s	Torque [3)]	Torque [4)]	Torque [5)]
mm	kNm	kNm	kNm
28	1.4	0.4	0.2
30	1.6	0.6	0.2
35	3.0	0.6	0.3
43	6.0	0.6	0.3
50	9.0	0.8	0.3
57.5	12.0	0.8	0.4
63.5	16.0	0.8	0.5

Key
- n ..... Number of stirrups
- ∅ .... Nominal diameter of reinforcing steel of stirrups
- a ..... Axis distance of stirrups
- b ..... External dimensions of stirrup
- l ..... Distance from anchor plate
- c ..... Concrete cover of reinforcement according to standards and regulations in force at the place of use and exposure classes according to EN 206 where required

[1)] ..... The area around the pile is reinforced according to Clause 1.5.

[2)] ..... Minimum strength class of concrete ≥ C20/25

[3)] ..... Anchorage with square anchor plate, locked with nuts and anchor piece, locked with nut and splice with coupler, locked with nuts

[4)] ..... Anchorage with square anchor plate, locked with nuts and with adhesive at the nuts, splice with coupler with adhesive, locked without nuts, and coupler, locked without nuts

[5)] ..... Contact coupler, locked without nuts

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Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Centre spacing and edge distance, additional reinforcement

Annex 8
of European Technical Assessment
ETA-11/0138 of 26.09.2018

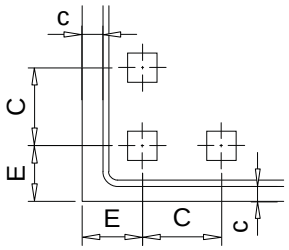
Centre spacing and edge distance, additional reinforcement

Actual concrete strength ≥ 25 N/mm² or ≥ 30 N/mm²
Minimum concrete strength class ≥ C20/25. For anchorage with anchor piece without additional reinforcement ≥ C25/30

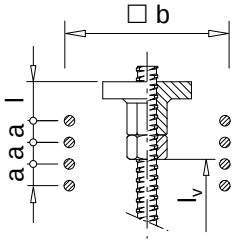
Anchorage with anchor piece, without additional reinforcement [1)]

Thread bar ∅s	Anchorage with anchor piece and additional bonded length $l_v = 10 \cdot ∅_s$ [2)]	
	Centre spacing C	Edge distance E
mm	mm	mm
28	440	210 + c
30	480	230 + c
35	550	265 + c
43	680	330 + c
50	800	390 + c
57.5	900	440 + c
63.5	1000	490 + c

Centre spacing
Edge distance



Additional reinforcement



Anchorage with anchor piece, with additional reinforcement of ribbed reinforcing steel $R_e \geq 500$ N/mm²

Thread bar ∅s	Anchorage with anchor piece and additional bonded length $l_v = 10 \cdot ∅$ [3)]						
	Centre spacing	Edge distance	Additional reinforcement				
	C	E	n	∅	a	b	l
mm	mm	mm	—	mm	mm	mm	mm
28	310	145 + c	5	10	60	290	60
30	340	160 + c	6	10	60	320	55
35	390	185 + c	6	12	80	370	60
43	480	230 + c	8	12	70	460	55
50	580	280 + c	11	12	60	560	90
57.5	640	310 + c	13	12	55	620	90
63.5	710	345 + c	15	12	50	690	105

Key
n .....Number of stirrups
∅ ....Nominal diameter of reinforcing steel of stirrups
a .....Axis distance of stirrups
b .....External dimensions of stirrup
l.....Distance from anchor plate
c.....Concrete cover of reinforcement according to standards and regulations in force at the place of use and exposure classes according to EN 206 where required
[1)] .....The area around the pile is reinforced according to Clause 1.5.
[2)] .....Minimum strength class of concrete ≥ C25/30
[3)] .....Minimum strength class of concrete ≥ C20/25

Member of EOTA

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

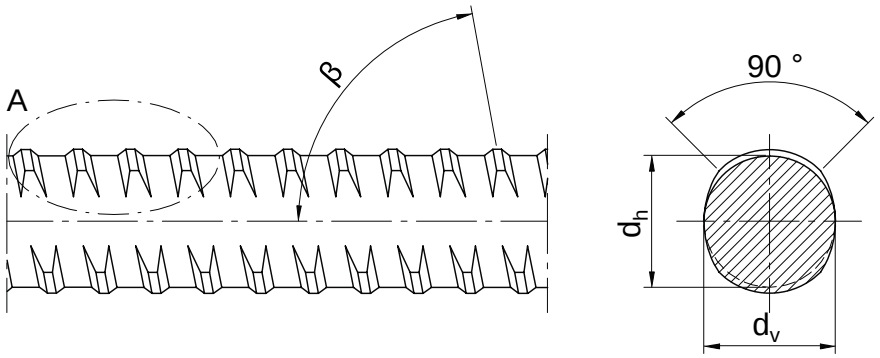
Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Thread bar – Nominal dimensions, mass, and rib geometry

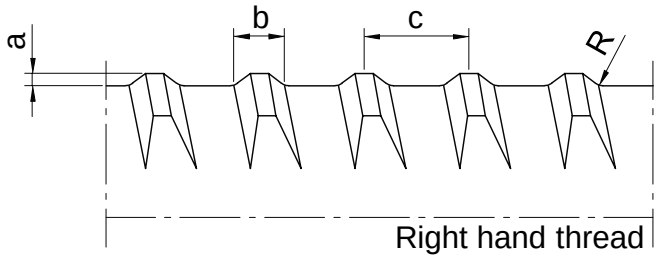
Annex 9
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Thread bar

Geometry



Detail A



Nominal diameter	Mass per metre [1]	Nominal cross-sectional area	Core diameter		Ribs, right hand thread				
					Height	Width	Pitch	Angle	Radius
$\varnothing_s$	G	A_s	d_h	d_v	min. a	b	c	β	R
mm	kg/m	mm^2	mm	mm	mm	mm	mm	°	mm
28	4.83	616	27.3	26.9	1.45	5.6	11.0	83.4	1.5
30	5.55	707	29.5	29.1	1.50	5.6	11.0	83.9	1.5
35	7.55	962	34.3	33.8	1.70	6.3	14.0	83.3	2.0
43	11.40	1 452	42.4	41.9	2.00	8.0	17.0	83.4	2.0
50	15.40	1 963	49.2	48.7	2.00	8.5	18.0	83.6	2.5
57.5	20.38	2 597	56.2	55.7	2.40	9.8	20.0	83.3	2.5
63.5	24.86	3 167	62.4	60.7	2.40	10.5	21.0	84.4	2.5

[1] Tolerance on nominal mass ± 4.5 %

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Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Thread bar – Mechanical technological characteristics

Annex 10
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Thread bar

Thread bar nominal diameter	Characteristic	
	force at yield strength	maximum force
$\varnothing_s$	$F_{p0.2}$	F_m
mm	kN	kN
28	413	493
30	474	565
35	645	770
43	973	1 162
50	1 315	1 570
57.5	1 740	2 077
63.5	2 122	2 534

Characteristic yield strength [1]	$R_{p0.2}$	N/mm²	670
Characteristic tensile strength [1]	R_m	N/mm²	800
Ratio	$\frac{R_m}{R_{p0.2}}$	—	≥ 1.10
Elongation at maximum force $A_{gt} = A_g + \frac{R_m}{E} \cdot 100$ [2]	A_{gt}	%	≥ 5
Relative rib area	f_R	—	≥ 0.075
Resistance to fatigue [3] at an upper stress of $\sigma_{up} = 0.7 \cdot R_{p0.2}$ and up to $2.0 \cdot 10^6$ load cycles Tested stress range for			
$\varnothing_s$ 18 to 43 mm	$2 \cdot \sigma_A$	N/mm²	150
$\varnothing_s$ 50 to 63.5 mm		N/mm²	120
Suitability for bending		—	Not designated
Suitability for welding		—	Not designated
Characteristic bond strength, cylinder compressive strength of cement mortar of 40 N/mm²		N/mm²	6

1) 5-% fractile
2) Modulus of elasticity E ≈ 200 000 N/mm² and A_g as plastic extension at maximum force
3) Results of fatigue tests according to EN ISO 15630-1

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Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Inner grout – Specification

Annex 11
of European Technical Assessment
ETA-11/0138 of 26.09.2018

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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Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Heat shrinking sleeve – Specification

Annex 12
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Heat shrinking sleeve
P 7029

Characteristics		—	P7029
Thickness after shrinking		mm	≥ 1.0
Mass per unit area of adhesive		g/m²	≥ 600
Tensile strength		N/mm	≥ 20
Elongation at break		%	≥ 600
Peel strength layer to layer		N/mm	≥ 1.5
Peel strength to steel surface		N/mm	≥ 1.0
Thermal ageing resistance	$\frac{S_{100}}{S_0}$, $\frac{E_{100}}{E_0}$	—	≤ 1.25 ≥ 0.75
	$\frac{S_{100}}{S_{70}}$, $\frac{E_{100}}{E_{70}}$		≥ 0.8
	$\frac{P_{100}}{P_T}$, $\frac{A_{100}}{A_T}$		≥ 0.75
	$\frac{P_{100}}{P_{70}}$, $\frac{A_{100}}{A_{70}}$		≥ 0.8
Indentation resistance – Residual wall thickness		mm	≥ 0.6
Impact resistance		—	C [1)]
Saponification value		$\frac{\text{mg KOH}}{\text{g}}$	14
Microbiological resistance	$\frac{S_6}{S_0}$, $\frac{E_6}{E_0}$	—	≥ 0.8
	$\frac{A_6}{A_T}$		≥ 0.8
Water absorption		%	≤ 0.05
Softening point of adhesive		°C	120
Oxygen stability of adhesive		min	20
Resistance to salt spray of adhesive, 168 h			No corrosion
Content of aggressive components of adhesive	Cl^-	mg/kg	≤ 50
	NO^{-3}		≤ 50
	NO^{-2}		≤ 10
	SO_4^{2-}		≤ 50
	S^{-2}		≤ 10

1) According to EN 12068

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Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Components – Material specifications

Annex 13
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Component		Standard / Specification
SAS 670	Thread bar in steel	Annexes 9 and 10
TR 2002	Anchor nut ∅ 28, 30, 35, and 43 mm ∅ 50, 57.5, and 63.5 mm	 EN 10277-2 EN 10210
TR 2073	Anchor piece ∅ 28, 30, 35, 43, 50, 57.5, and 63.5 mm	 EN 10293
TR 2003	Lock nut, long ∅ 28, 30, 35, and 43 mm ∅ 28, 30, 35, 43, 50, 57.5, and 63.5 mm ∅ 50, 57.5, and 63.5 mm	 EN 10277-2 EN 10083-2 EN 10210
TR 2040	Lock nut, short ∅ 28, 30, 35, and 43 mm ∅ 28, 30, 35, 43, 50, 57.5, and 63.5 mm ∅ 50, 57.5, and 63.5 mm	 EN 10277-2 EN 10083-2 EN 10210
TR 3003	Coupler, standard ∅ 28, 30, and 35 mm ∅ 43, 50, 57.5, and 63.5 mm	 EN 10025 EN 10210
TR 3006	Contact coupler ∅ 28, 30, 35, and 43 mm ∅ 50, 57.5, and 63.5 mm	 EN 10025 EN 10210
TR 3006 C	Contact coupler, cast ∅ 28, 30, 35, 43, 50, 57.5, and 63.5 mm	 EN 10293
—	Additional reinforcement	Ribbed reinforcing steel, $R_e \geq 500$ N/mm^2
P 7029	Heat shrinking sleeve	Annex 12
—	Corrugated plastic sheathing	PVC-U

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Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Loss of cross-sectional area due to corrosion

Annex 14
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Thread bar – Loss of cross-sectional area due to corrosion

Thread bar ∅s mm	Corrosion depth in mm						
	0.0	0.2	0.4	0.5	0.6	0.8	1.0
	Loss of cross-sectional area due to corrosion in %						
28	0.0	2.9	5.7	7.1	8.4	11.0	14.0
30	0.0	2.7	5.3	6.6	7.9	10.4	13.0
35	0.0	2.3	4.5	5.6	6.7	8.8	11.0
43	0.0	1.9	3.7	4.6	5.5	7.2	9.0
50	0.0	1.6	3.2	4.0	4.7	6.3	7.8
57.5	0.0	1.4	2.8	3.4	4.1	5.6	7.0
63.5	0.0	1.3	2.5	3.1	3.7	5.0	6.3

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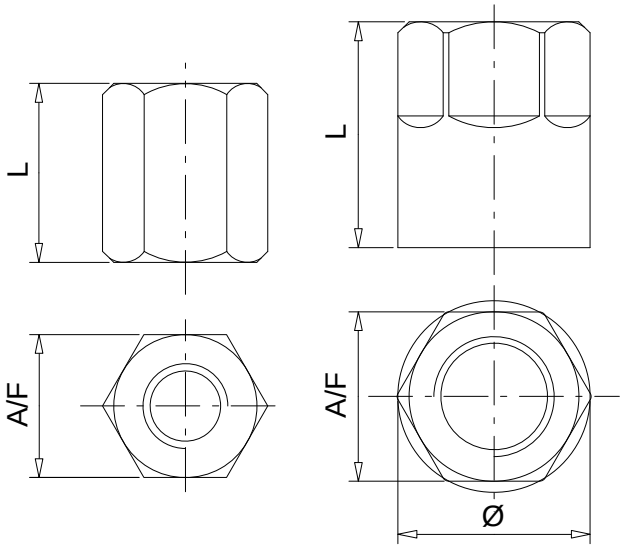
Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Anchor nut, anchor plates – Dimensions

Annex 15
of European Technical Assessment
ETA-11/0138 of 26.09.2018

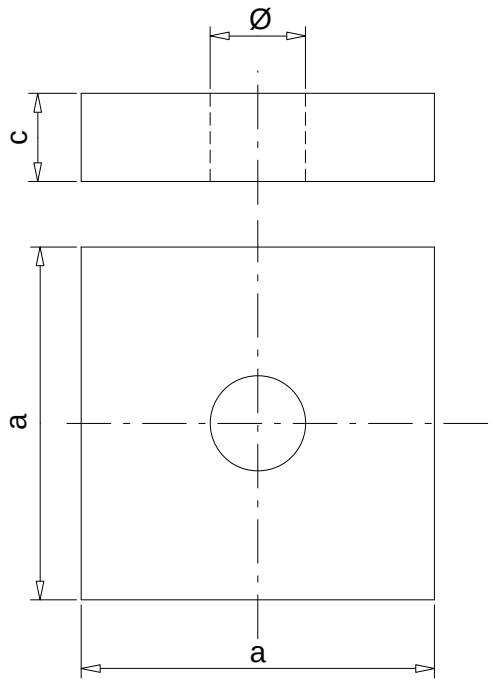
Anchor nut
TR 2002-∅

∅ 28 to 43 ∅ 50 to 63.5



Thread bar ∅s	A/F	L	∅
mm	mm	mm	mm
28	50	60	—
30	55	65	—
35	65	70	—
43	80	90	—
50	80	100	—
57.5	90	120	102
63.5	100	145	114

Anchor plate
TR 2139-∅



Thread bar ∅s	a	c	∅
mm	mm	mm	mm
28	120	30	34
30	130	35	36
35	150	40	42
43	185	55	50
50	215	60	60
57.5	245	65	67
63.5	270	70	74

Anchor plate
TR 2138-∅

Thread bar ∅s	a	c	∅
mm	mm	mm	mm
28	115	30	34
30	130	30	36
35	150	35	42
43	185	45	50
50	215	50	60
57.5	250	55	67
63.5	265	60	74

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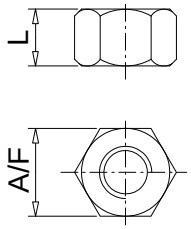
Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Lock nuts, anchor piece – Dimensions

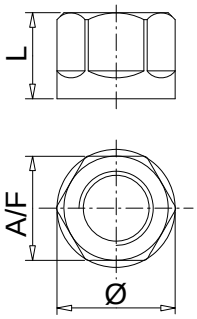
Annex 16
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Lock nut, short
TR 2040-∅

∅ 28 to 43



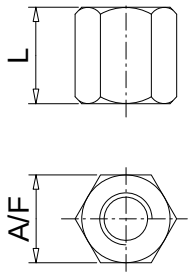
∅ 50 to 63.5



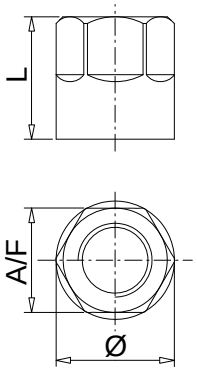
Thread bar ∅s	A/F	L	∅
mm	mm	mm	mm
28	46	30	—
30	50	30	—
35	55	40	—
43	70	50	—
50	80	50	—
57.5	90	60	102
63.5	100	70	114

Lock nut, long
TR 2003-∅

∅ 28 to 43

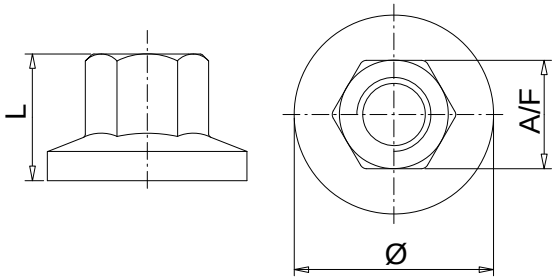


∅ 50 to 63.5



Thread bar ∅s	A/F	L	∅
mm	mm	mm	mm
28	46	55	—
30	50	60	—
35	55	65	—
43	70	80	—
50	80	90	—
57.5	90	100	102
63.5	100	115	114

Anchor piece
TR 2073-∅



Thread bar ∅s	A/F	L	∅
mm	mm	mm	mm
28	46	55	85
30	50	60	90
35	60	70	105
43	70	85	130
50	80	100	150
57.5	90	115	175
63.5	100	125	190

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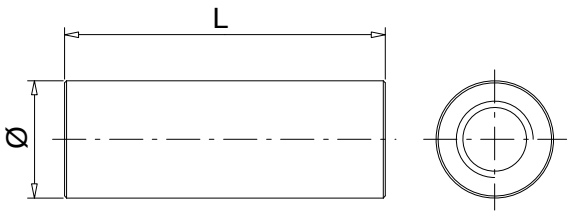
Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Couplers, spacer – Dimensions

Annex 17
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Coupler
TR 3003-∅

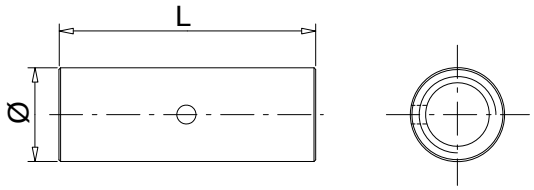


Thread bar ∅s	∅ 1)	L 1)
mm	mm	mm
28	50	140
30	55	150
35	65	180
43	80	200
50	90	210
57.5	102	250
63.5	114	300

1) Minimum dimensions. Couplers with larger diameter and greater in length are also available.

Contact coupler
TR 3006-∅

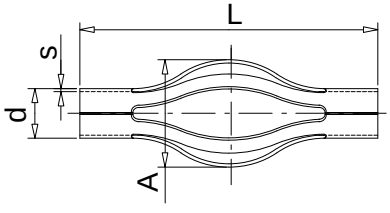
Contact coupler, cast
TR 3006-∅ C



Thread bar ∅s	∅ 1)	L 1)
mm	mm	mm
28	45	90
30	45	90
35	50	120
43	65	160
50	70	170
57.5	80	180
63.5	90	200

1) Minimum dimensions. Contact couplers with larger diameter and greater in length are also available.

Basket spacer



Thread bar ∅s	Temporary, Semi-permanent and Permanent pile with standard corrosion protection			Permanent pile with corrosion protection according to EN 1537		
	d × s	A	L	d × s	A	L
mm	mm	mm	mm	mm	mm	mm
28	32 × 1.9	70	150 to 175	55 × 3.0	≥ 100	250 to 290
30	40 × 3.0	≥ 90	250 to 290	63 × 3.0	≥ 110	
35				75 × 3.6	≥ 115	
43	50 × 3.0	≥ 100		90 × 2.7	≥ 140	
50	63 × 3.0	≥ 125				
57.5				110 × 3.2		
63.5	75 × 3.6	≥ 125				

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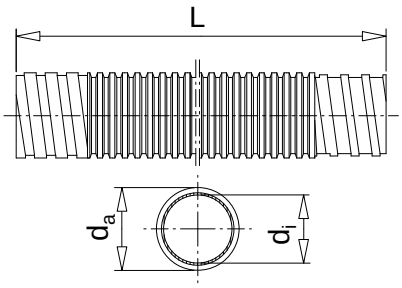
Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm
Corrosion protection according to EN 1537 – Corrugated plastic sheathing, heat shrinking sleeve – Dimensions

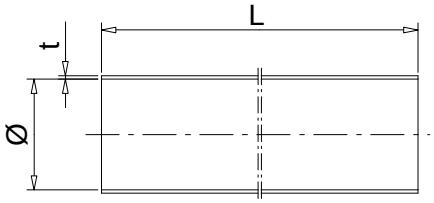
Annex 18
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Corrugated plastic sheathing



Thread bar ∅s	da / di	min t	L
mm	mm	mm	mm
28	50 / 43	1.0	as required
30	56 / 49		
35	65 / 57		
43	80 / 71		
50			
57.5	100 / 90		
63.5			

Heat shrinking sleeve
P 7029



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

Length of heat shrinking sleeve, L, as required. Overlap of adjacent parts of the micropile is ensured.

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Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Corrosion protection according to EN 1537
Inner spacers, caps – Dimensions

Annex 19
of European Technical Assessment
ETA-11/0138 of 26.09.2018

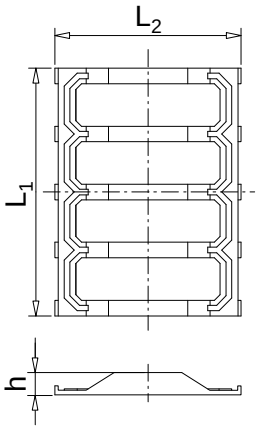
Inner spacer – PE-cord

Pitch ≤ 0.5 m

Thread bar ∅s	PE-cord min. d
mm	mm
28	6
30	
35	
43	
50	
57.5	9
63.5	

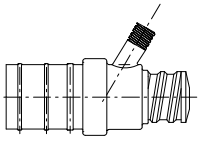
Mat spacer

Distance ≤ 1.0 m

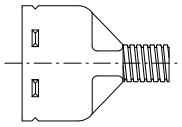


Thread bar ∅s	Mat spacer h	L1	L2	Number of ribs
35	6	112	124	3
43	8	132	124	3
50	8	132	124	3
57.5	11	170	165	4
63.5	11	220	165	5

Injection cap and end cap



alternative cap



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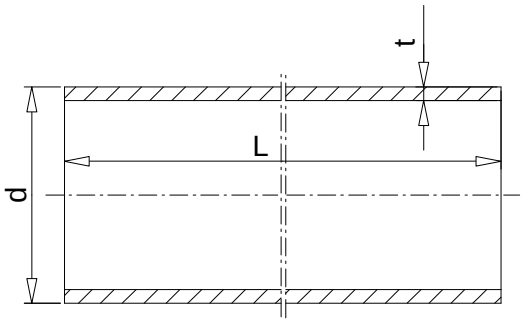
Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Pile neck protection tubes – Dimensions

Annex 20
of European Technical Assessment
ETA-11/0138 of 26.09.2018

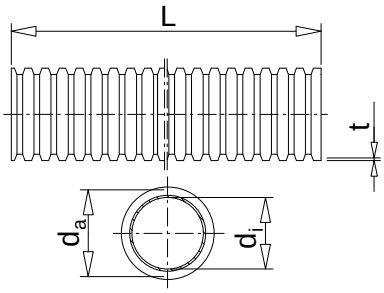
Pile neck protection tube
Steel tube



Thread bar ∅s	d	min t	min L [2)]
mm	mm	mm	mm
28	76.1	2.9	420
30	88.9	3.2	430
35	101.6	3.6	460
43	114.3	4.5	500
50	139.7	4.5	520
57.5	159.0	4.5	550
63.5	168.3	4.5	600

2) min L including required minimum embedment length, ≥ 100 mm, into the construction

Pile neck protection tube
Corrugated plastic sheathing



Thread bar ∅s	da / di	min t	min L [3)]
mm	mm	mm	mm
28	50 / 43	1.0	400
30	56 / 49		
35	65 / 57		
43	80 / 71		
50			
57.5	100 / 90		
63.5			

3) min L including required minimum embedment length ≥ 100 mm into the construction

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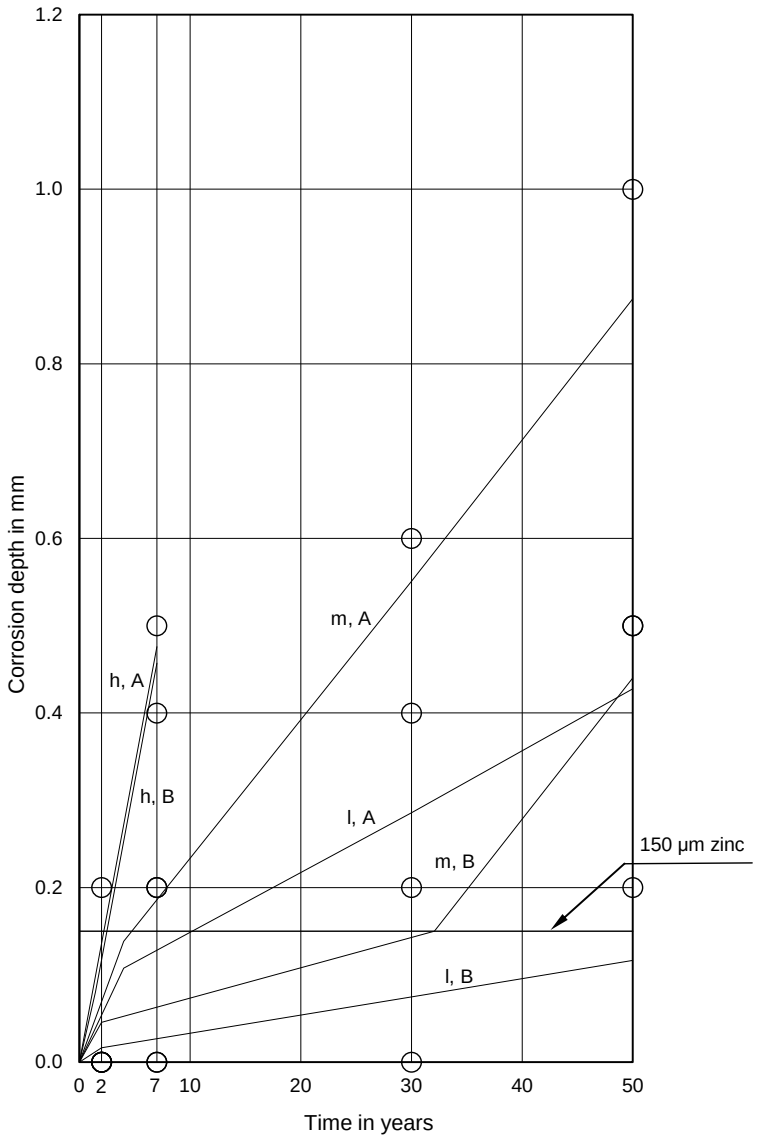
Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Corrosion behaviour of bare and galvanised steel

Annex 21
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Working life in years	Micropile	Corrosion depth in mm for corrosion load		
		low (l)	medium (m)	high (h)
2	A B	0 0	0 0	0.2 0
7	A B	0.2 0	0.2 0	0.5 0.4
30	A B	0.4 0	0.6 0.2	D
50	A B	0.5 0.2 or D	1.0 0.5 or D	D

A bare steel
B galvanised steel ≥ 150 µm zinc
D corrosion protection according to EN 1537



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Micropile system SAS 670

Thread bar S 670, $\varnothing_s$ 28–63.5 mm

Contents of the prescribed test plan

Annex 22
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
End anchorage, Splices	Static load test	Testing	[2]	0.2 % [3), 4)] ≥ 2 [4)]	per year
	Static load test including measurement of slip	Testing	[2]	3 [4)]	per year
	Resistance to fatigue [5)]	Testing	[2]	1 [4)]	per year
	Traceability	full			
Thread bar	Mass per metre, cross-sectional area, surface geometry [6)]	Testing	[2]	≥ 3 [7)]	per year
	Strength characteristics [6)] $\varnothing_{nom}$ < 57.5 mm $\varnothing_{nom}$ ≥ 57.5 mm	Testing	[2]	≥ 3 [7)] ≥ 1 [8)]	per year
	Elongation at maximum force [6)] $\varnothing_{nom}$ < 57.5 mm $\varnothing_{nom}$ ≥ 57.5 mm	Testing	[2]	≥ 3 [7)] ≥ 1 [8)]	per year
	Resistance to fatigue	Testing	[2]	≥ 5 [9)]	per year
	Visual inspection [10)]	Checking	[2]	100 %	per year
	Traceability	full			
Anchor nut, Anchor piece, Lock nut, long, Lock nut, short, Coupler, standard, Contact coupler, Anchor plate	Detailed dimensions	Testing	[2]	0.4 % [4), 11)] ≥ 2 [4)]	per year
	Hardness	Testing	[2]	0.1 % [11)] ≥ 2 [4)]	per year
	Material of simple square anchor plates	Checking	[2), 12)]	100 %	per year
	Material of components other than simple square anchor plates	Checking	[2), 13)]	100 %	per year
	Visual inspection [10)]	Checking	[2]	100 %	per year
	Inspection of all components manufacturer by the manufacturer of the kit				per year
	Traceability	full			
Inner grout		EN 445	EN 447	EN 446	

1) For two specified numbers of samples, the higher number applies.
2) Conformity with the specifications of the components
3) Percentage of produced anchorages or splices per diameter. After 5 years of successful manufacturing the frequency may be reduced to 0.1 %.
4) For at least 1 diameter. In case of a production of less than 20 subjects of 1 diameter per year, testing is not required. However, all diameters are tested within 5 years.
5) Not for end bearing splice with contact coupler and not for end bearing anchorage
6) Assessment of long-term quality level according to EN 10080, clause 8.5.
7) Per diameter and rolling batch, at least however, as specified in EN 10080, clause 8.1.
8) Per diameter and rolling batch, at least however, as specified in EN 10080, clause 8.1, with 1 specimen instead of 3 specimens.
9) Of one diameter. All diameters are tested within 5 years.
10) Successful visual inspection does not need to be documented.
11) Percentage of produced component per diameter and batch
12) Test report type “2.2” according to EN 10204.
13) Checking of relevant certificate, the certificate is an inspection report 3.1 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
Detailed 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, fins, kinks, smoothness, corrosion, etc.

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Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Contents of the prescribed test plan

Annex 23
of European Technical Assessment
ETA-11/0138 of 26.09.2018

Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
Heat shrinking sleeve	Detailed dimensions	Testing	[2]	0.5 % [3] ≥ 1 [3]	per year
	Material	Checking	[2], [4]	100 %	per year
	Thickness after shrinking	Testing	[2]	0.5 % [3] ≥ 1 [3]	per year
	Bond to steel surface	Checking	[5], [6]	0.5 % [3] ≥ 1 [3]	per year
	Mass per unit area of adhesive	Testing	[2]	1 [7]	per year
	Tensile strength	Testing	[2]	1 [7]	per year
	Elongation at break	Testing	[2]	1 [7]	per year
	Peel strength to steel surface	Testing	[2]	1 [7]	per year
	Chemical composition of adhesive	Checking	[2]	1 [7]	per year
	Peel strength layer to layer	Testing	[2]	2 [8]	Once every 5 years
	Thermal aging resistance	Testing	[2]	2 [8]	Once every 5 years
	Indentation resistance	Testing	[2]	2 [8]	Once every 5 years
	Impact resistance	Testing	[2]	2 [8]	Once every 5 years
	Saponification value	Testing	[2]	2 [8]	Once every 5 years
	Traceability	full			
Corrugated plastic sheathing	Detailed dimensions	Testing	[2]	0.1 % [3], [9] ≥ 2 [9]	per year
	Material	Checking	[2]	100 %	per year
	Visual inspection [10]	Checking	[2]	100 %	per year

[1] For two specified numbers of samples, the higher number applies.
[2] Conformity with the specifications of the components
[3] Percentage and minimum number for 1 diameter per year. All diameters are tested within 5 years.
[4] Test report type “2.2” according to EN 10204.
[5] Detailed visual inspection of work samples
[6] Visual inspection of applied heat shrinking sleeve regarding all-over adherence to steel surface, free of entrapped air and bond defects
[7] 1 size, all sizes are tested within 5 years. Sampling for peel strength appropriate to the test procedure.
[8] Samples from 2 sizes
[9] Per diameter. In case of a production of less than 20 subjects of 1 diameter per year, testing is not required. However, all diameters are tested within 5 years.
[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
Detailed 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, etc.

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Essential characteristics for intended uses

Annex 24
of European Technical Assessment
ETA-11/0138 of 26.09.2018

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

Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Essential characteristics for intended uses

Annex 25
of European Technical Assessment
ETA-11/0138 of 26.09.2018

№ [1]	Essential characteristic [1]	Product and intended use Line № according to Clause 2.1, Table 9				
		1	2	3	4	5
Basic requirement for construction works 1: Mechanical resistance and stability						
Heat shrinking sleeve						
35	Thickness after shrinking	—	—	—	+	+
36	Mass per unit area of adhesive	—	—	—	+	+
37	Tensile strength	—	—	—	+	+
38	Elongation at break	—	—	—	+	+
39	Peel strength layer to layer	—	—	—	+	+
40	Peel strength to steel surface	—	—	—	+	+
41	Thermal ageing resistance	—	—	—	+	+
42	Indentation resistance	—	—	—	+	+
43	Impact resistance	—	—	—	+	+
44	Saponification value	—	—	—	+	+
45	Microbiological resistance	—	—	—	+	+
46	Water absorption	—	—	—	+	+
47	Softening point of adhesive	—	—	—	+	+
48	Oxygen stability of adhesive	—	—	—	+	+
49	Resistance to salt spray of adhesive	—	—	—	+	+
50	Content of aggressive components of adhesive	—	—	—	+	+
Corrugated plastic sheathing						
51	Shape	—	—	—	—	+
52	Dimensions	—	—	—	—	+
53	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 14.

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Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Reference documents

Annex 26
of European Technical Assessment
ETA-11/0138 of 26.09.2018

EAD 200077-00-0103	Kit for Micropile – Kit with thread bars
EN 206+A1, 11.2016	Concrete – Specification, performance, production and conformity
EN 445, 10.2007	Grout for prestressing tendons – Test methods
EN 446, 10.2007	Grout for prestressing tendons – Grouting procedures
EN 447, 10.2007	Grout for prestressing tendons – Basic requirements
EN 1537, 07.2013	Execution of special geotechnical works – Ground anchors
EN 1990, 04.2002 EN 1990/A1, 12.2005 EN 1990/A1/AC, 04.2010	Eurocode – Basis of structural design
EN 1992-1-1, 12.2004 EN 1992-1-1/AC, 01.2008 EN 1992-1-1/AC, 11.2010 EN 1992-1-1/A1, 12.2014	Eurocode 2 – Design of concrete structures – Part 1-1: General rules and rules for buildings
EN 10025-series, 11.2004	Hot rolled products of structural steels – Series
EN 10080, 05.2005	Steel for the reinforcement of concrete – Weldable reinforcing steel – General
EN 10083-2, 08.2006	Steels for quenching and tempering – Part 2: Technical delivery conditions for non alloy steels
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 10277-2, 03.2008	Bright steel products – Technical delivery conditions – Part 2: Steels for general engineering purposes
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

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Max Aicher GmbH & Co. KG
83404 Ainring–Hammerau

Micropile system SAS 670
Thread bar S 670, ∅s 28–63.5 mm

Reference documents

Annex 27
of European Technical Assessment
ETA-11/0138 of 26.09.2018

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 14199, 05.2015	Execution of special geotechnical works – Micropiles
EN ISO 1461, 05.2009	Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods
EN ISO 15630-1, 10.2010	Steel for the reinforcement and prestressing of concrete – Test methods – Part 1: Reinforcing bars, wire rod and wire
98/214/EC	Commission decision 98/214/EC of 9 March 1998 on the procedure of attesting the conformity of construction products pursuant to article 20 (2) of Council Directive 89/106/EEC as regards structural metallic products and ancillaries, Official Journal L 80 of 18 March 1998, page 46, as amended by Commission Decision 2001/596/EG of 8 January 2001, Official Journal L 209 of 2 August 2001, page 33
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, Official Journal L 88 of 4 April 2011, page 5, as amended by Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, OJ L 157 of 27.5.2014, page 76 and Commission Delegated Regulation (EU) № 574/2014 of 21 February 2014, OJ L 159 of 28.5.2014, page 41
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