EUROPEAN TECHNICAL ASSESMENT
ETA-16/0286

BBV SYSTEMS
WIR SORGEN FÜR SPANNUNG | WE STRESS FOR STRENGTH

BBV 1030 STABSPANNVERFAHREN MIT VERBUND/ OHNE VERBUND/ EXTERN

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European Technical Assessment

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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	BBV 1030 post-tensioning bar tendon system, nominal diameter 32 to 50 mm
Product family to which the construction product belongs	Bars post-tensioning kit for prestressing of structures, internal bonded and unbonded, and external
Manufacturer	BBV Systems GmbH Industriestraße 98 67240 Bobenheim-Roxheim Germany
Manufacturing plant	BBV Systems GmbH Industriestrasse 98 67240 Bobenheim-Roxheim Germany
This European Technical Assessment contains	50 pages including Annexes 1 to 26, which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	ETAG 013, Guideline for European technical approval for Post-Tensioning Kits for Prestressing of Structures, edition June 2002, used according to Article 66 (3) of Regulation (EU) № 305/2011 as European Assessment Document.
This European Technical Assessment replaces	European Technical Assessment ETA-16/0286 of 12.11.2016.

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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

BBV 1030 post-tensioning bar tendon system, nominal diameter 32 to 50 mm,

comprising the following components.

- Bar tendon
  - Bonded bar tendon
  - Unbonded bar tendon with free tendon duct
  - Unbonded bar tendon without free tendon duct
  - External bar tendon
- Tensile element

  Thread bar and plain bar of prestressing steel, with nominal diameters and characteristic tensile strength as given in Table 1.

Table 1: Tensile elements

Designation	Nominal diameter	Nominal cross-sectional area	Characteristic tensile strength
	mm	mm^2	MPa
Thread bar			
32	32	804	1 030
36	36	1 018	
40	40	1 256	
50	50	1 964	

[1] In 2016 ETA-16/0286 was firstly issued as European Technical Assessment ETA-16/0286 of 18.07.2016 and amended to ETA-16/0286 of 12.11.2016, and in 2017 amended to ETA-16/0286 of 18.07.2017.

Designation	Nominal diameter	Nominal cross-sectional area	Characteristic tensile strength
	mm	mm^2	MPa
Plain bar			
32	32	804	1 030
36	36	1 018	
40	40	1 256	

NOTE 1 MPa = 1 N/mm^2

- Anchorage
  - Stressing and fixed anchorage with hybrid anchor plate, washer, and flat anchor nut
  - Stressing and fixed anchorage with hybrid anchor plate are without or with additional reinforcement in the anchorage zone.
  - Fixed anchorage with steel plate, provided with a threaded bore suitable to screw in the prestressing steel bar
  - Fixed anchorage with steel plate is without additional reinforcement in the anchorage zone.
- Coupling
  - Movable coupling with sleeve coupler
- Permanent corrosion protection systems for prestressing steel bar, anchorage, and coupling

PT system

1.2 Anchorage and coupling

1.2.1 Designation

The components of anchorage and coupling are designated by the nominal diameter in mm of the prestressing steel bar.

1.2.2 Anchorage

1.2.2.1 Stressing anchorage

The stressing anchorage, see Annex 1, comprises hybrid anchor plate, washer, and flat anchor nut. Optional threaded sleeves are provided in the hybrid anchor plate to attach a cap.

The structure adjacent to the hybrid anchor plate is without or with additional reinforcement. For details regarding the stressing anchorage see Annex 9, Annex 11, and Annex 13.

1.2.2.2 Fixed anchorage

The fixed anchorages are

- Fixed anchorage with hybrid anchor plate
- Fixed anchorage with steel plate

The fixed anchorage with hybrid anchor plate, see Annex 1, comprises same as the stressing anchorage a hybrid anchor plate, a washer, and a flat anchor nut. Threaded sleeves are

provided in the hybrid anchor plate to attach a cap where required. The structure adjacent to the hybrid anchor plate is without or with additional reinforcement.

The fixed anchorage with steel plate, see Annex 2, comprises a steel plate as anchor plate. The steel plate provides a threaded bore, suitable to screw in the prestressing steel bar. The angular deviation of prestressing steel bar and axis of the threaded bore of the steel plate does not exceed 1 °. Threaded blind bores are provided in the steel plate to attach a cap where required. The structure adjacent to the anchor plate in steel is without additional reinforcement.

For details regarding the fixed anchorage see Annex 9, Annex 10, Annex 11, Annex 12, Annex 13, and Annex 14.

1.2.3 Coupling

The coupling is a movable coupling. The coupling comprises a steel sleeve with an internal thread and a centre stop, sleeve coupler. The coupling connects two prestressing steel bars prior to stressing. A coupler housing is placed to allow for unimpeded movements of the coupler during stressing and considering tolerances. For details regarding the sleeve coupler see Annex 1 and Annex 17.

1.2.4 Range of tendons – Prestressing forces

Bar tendons with prestressing steel bars Y1030H according to prEN 10138-4[2] and nominal diameters of 32, 36, 40, and 50 mm are available. Prestressing and overstressing forces are specified in the respective standards and regulations in force at the place of use. Table 2 lists the respective maximum values according to Eurocode 2.

Table 2: Prestressing and overstressing forces

Designation	Nominal bar [1] diameter d_s	Nominal cross-sectional area S_n	Maximum prestressing force [2] $0.9 \cdot F_{p0.1}$	Maximum overstressing force [2), 3)] $0.95 \cdot F_{p0.1}$
	mm	mm^2	kN	kN
32	32	804	605	638
36	36	1 018	765	808
40	40	1 256	944	997
50	50	1 964	1 476	1 558

1) Prestressing steel bar Y1030H according to prEN 10138-4, see Annex 5.
2) The given values are maximum values according to Eurocode 2.
$F_{p0.1} = S_n \cdot f_{p0.1}$
3) Overstressing is permitted if the force in the prestressing jack can be measured to an accuracy of ± 5 % of the final value of the prestressing force.

1.2.5 Centre spacing and edge distance of anchorages

Centre spacing and edge distance of tendon anchorages are given in Annex 18, Annex 19, and Annex 20. They depend on the actual mean compressive strength of concrete at time of stressing, either cylinder strength, $f_{cm,\,0,\,cylinder}$ or cube strength, $f_{cm,\,0,\,cube}$.

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[2] Standards, Guidelines, and other documents referred to in the European Technical Assessment, are listed in Annex 25 and Annex 26.

Centre spacing and edge distance of anchorages given in Annex 18, Annex 19, and Annex 20 may be reduced in one direction by up to 15 %, but clearance of at least 20 mm between the hybrid anchor plates or anchor plates in steel is maintained and placing of additional reinforcement is still possible. In case of a reduction of the spacing in one direction, centre spacing and edge distance in the perpendicular direction are increased by the same percentage. The centric position of the additional reinforcement relative to the tendon axis is ensured by appropriate measures.

If required for a specific project design, the reinforcement given in Annex 19 and Annex 20 may be modified in accordance with the respective regulations in force at the place of use as well as with the relevant approval of the local authority and of the ETA holder to provide equivalent performance.

NOTE Concrete cover of the tendon may under no circumstances be less than 20 mm nor smaller than the concrete cover of the reinforcement installed in the same cross section. Concrete cover on the anchorage should be at least 20 mm. The respective standards and regulations on concrete cover in force at the place of use are considered.

1.2.6 Concrete strength at time of stressing

Concrete according to EN 206 is used. At the time of stressing the mean concrete compressive strength, $f_{cm,0}$, is at least as given in Annex 18, Annex 19, and Annex 20. Concrete test specimens for verification of mean concrete compressive strength are subjected to the same curing conditions as the structure.

For partial prestressing with 30 % of the full prestressing force, the actual mean value of concrete compressive strength is at least $0.5 \cdot f_{cm,0,cylinder}$ or $0.5 \cdot f_{cm,0,cube}$. Intermediate values may be interpolated linearly according to Eurocode 2.

1.2.7 Slip at anchorage and coupling

Slip at anchorages and couplings, see Table 3, is taken into consideration in design and for determining tendon elongation.

Table 3: Slip at anchorage and coupling

Nominal diameter		**mm**	**32–36**	**40–50**
Slip to be considered for tendon elongation at stressing	Typical slip value at fixed anchorage with hybrid anchor plate	mm	1.5–2.0	
	Typical slip at fixed anchorage with steel plate	mm	0.8	
	Typical slip value at coupling	mm	1.0	
Slip at load transfer from jack to anchorage (at stressing anchorage)	Single stress [1)]	mm	1.5	2.0
	Two or more stressing cycles [1)]	mm	0.6	0.7

[1)] When stressed with $0.7 \cdot f_{pk}$ to $0.75 \cdot f_{pk}$

The following information can be used to calculate the tendon elongation under forces of $0.7 \cdot F_{pk}$ to $0.75 \cdot F_{pk}$.

- Prestressing steel bar secant modulus of elasticity ($0.05 \cdot f_{pk}$ to $0.7 \cdot f_{pk}$) = 170 000 MPa approximately.
- Prestressing steel bar modulus of elasticity within elastic range = 182 000 MPa approximately.

1.3 Friction losses

For calculation of loss of prestressing force due to friction, Coulomb's friction law applies. Calculation of friction loss is by the equation

$$\Delta P_\mu(x) = P_{max} \cdot \left(1 - e^{-\mu \cdot (k \cdot x)}\right)$$

Where

$\Delta P_\mu(x)$ ...kN .....Loss of prestressing force at a distance x from the stressing anchorage along the tendon

P_{max}.....kN .....Prestressing force at the distance x = 0 m

μ ..... rad^{-1}.....Friction coefficient, μ = 0.65 rad^{-1} for thread bars and μ = 0.33 rad^{-1} for plain bars

k ..... rad/m.....Coefficient of unintentional angular deviation, $0.005 \leq k \leq 0.01$ rad/m

x ..... m.....Distance along the tendon from the point where the prestressing force is P_{max}

NOTE 1 1 rad = 1 m/m = 1

NOTE 2 Unbonded and external bar tendons are straight tendons only. Losses of prestressing force due to friction generally do not needed to be taken into account for such tendons.

Friction losses in anchorages are low and need not to be taken into consideration in design and execution.

1.4 Support of ducts

The ducts are secured in their positions. Spacing of duct support is up to 2.5 m.

1.5 Minimum radii of curvature

The tendons with prestressing steel bars are straight tendons only.

1.6 Tendons for steel, masonry, and timber structures

Anchorage of tendons for steel, masonry, and timber structures are with flat anchor nut and washer, supported by a hybrid anchor plate, see the Clauses 1.9.1, **1**.9.3, and 1.9.4.

Components

1.7 General

The components of anchorages and couplings conform to the specifications given in the Annexes and the technical file of the European Technical Assessment. Therein the components' dimensions, materials, material identification data with tolerances, and the materials used in corrosion protection are specified.

1.8 Prestressing steel bar

The prestressing steel bar is a thread bar or a plain bar of prestressing steel Y1030H according to prEN 10138-4. The thread bar is provided with a cold-rolled right-hand thread along the entire length of the prestressing steel bar. On the plain bar the right-hand thread is cold-rolled along a length at both ends to screw on the flat anchor nut, attach the prestressing jack, and allow for elongation during stressing operation. Standard thread lengths are given in Annex 5.

- Nominal diameters of the thread bar are 32, 36, 40, and 50 mm.
- Nominal diameters of the plain bar are 32, 36, and 40 mm.

The characteristics of the prestressing steel bar are given in Annex 5.

In the course of preparing the European Technical Assessment, no characteristic has been assessed for the prestressing steel bar. In execution, a suitable prestressing steel bar that conforms to Annex 5 and is according to the standards and regulations in force at the place of use is taken.

1.9 Components of anchorages and couplings

1.9.1 Hybrid anchor plate

One anchor plate is the hybrid anchor plate according to Annex 6 and Annex 7. The hybrid anchor plate is made of high-strength mortar and confined by either

- a steel ring around the high-strength mortar or
- a helix made of steel, embedded in the high-strength mortar.

All hybrid anchor plates provide a flat interface in steel to support the washer. The flat interface is either a steel plate or an insert in steel, see Annex 6 and Annex 7.

1.9.2 Anchor plate in steel with threaded bore

The second anchor plate is a square anchor plate in steel and provides a centric threaded bore to screw in the prestressing steel bar, see Annex 8.

1.9.3 Flat anchor nut, washer

Flat anchor nut and washer are made of steel, see Annex 3, and are used together with the hybrid anchor plate.

1.9.4 Sleeve coupler

The sleeve coupler is a steel sleeve with an internal thread and a centre stop, see Annex 4. The ends of both prestressing steel bars are screwed into the sleeve coupler up to the centre stop.

1.9.5 Additional reinforcement

Ribbed reinforcing steel is installed as additional reinforcement. Steel grade is given in Annex 21 and dimensions are given in Annex 19 and Annex 20.

The centric position of the additional reinforcement relative to the tendon axis is ensured by appropriate measures.

1.9.6 Welding

Welding is not intended for the BBV 1030 post-tensioning bar tendon system. In case of welding operations close to installed tendons or their components, precautionary measures are required to avoid damage.

1.9.7 Material specifications of the components

The material specifications of the components are given in Annex 21.

1.9.8 Corrosion protection

1.9.8.1 General

In the course of preparing the European Technical Assessment, no characteristic has been assessed for components and materials of the corrosion protection system referred to in the Clauses 1.9.8.2 to 1.9.8.4. In execution, all components or materials have to be selected

according to the standards and regulations in force at the place of use. In the absent of such standards or regulations, components and materials in accordance with ETAG 013 are deemed as acceptable.

1.9.8.2 Bonded tendon

For bonded tendons steel strip sheaths in accordance with EN 523 or corrugated plastic ducts in accordance with ETAG 013, Annex C.3 are used. In general, the prestressing steel bars are provided with ducts prior to installation. The steel strip sheaths are coupled using duct sleeves in accordance with EN 523 and the corrugated plastic ducts are coupled with couplers of the respective duct system. Joints between duct sections and duct to anchorage are sealed water tight.

After stressing the ducts are grouted with cement grout according to EN 447 or special grout according to ETAG 013 as applicable at the place of use.

The flat anchor nut is protected against corrosion with a cap, filled with grout, see Annex 13. The cap is fastened with a sealing ring onto the hybrid anchor plate with screws. Between prestressing steel bar and hybrid anchor plate an annular void can remain and is filled with grout.

The end of the prestressing steel bar at the fixed anchorage with steel plate is protected against corrosion with a cap filled with grout, see Annex 14. The cap is fastened with a sealing ring onto the anchor plate in steel with screws.

1.9.8.3 Unbonded and external tendons

Unbonded tendons are

- Unbonded tendons without free tendon duct
- Unbonded tendons with free tendon duct
- External tendons

The prestressing steel bars are sheathed with smooth plastic ducts, in general PE-tubes according to EN 12201-1. The void between duct and prestressing steel bar is completely filled with corrosion protection filling material. To maintain the distance between duct and prestressing steel bar spacers can be installed.

The void between connection tube and prestressing steel bar is filled with corrosion protection filling material. For filling the gap, the connection tube is provided with a corrosion protection filling material prior to slipping on the anchorage. To ensure correct filling, in case of accessible fixed anchorages the corrosion protection filling material penetrates below the flat anchor nuts during threading on of the anchorages and in case of stressing anchorages after stressing. Otherwise additional corrosion protection filling material is injected.

End anchorages are completely filled with the respective specified corrosion protection filling material. All joints and connections are carefully sealed.

For unbonded tendons with free tendon duct, the tendon duct is always dry. This is attained with appropriate measures.

The flat anchor nut is protected against corrosion with a cap, filled with corrosion protection filling material, see Annex 13. The cap is fastened with a sealing ring onto the hybrid anchor plate with screws.

The end of the prestressing steel bar at the fixed anchorage with steel plate is protected against corrosion with a cap filled with corrosion protection filling material, see Annex 14. The cap is fastened with a sealing ring onto the anchor plate in steel with screws.

1.9.8.4 Corrosion protection of exposed steel parts

All exposed steel parts of the hybrid anchor plates including connection tubes, if not sufficiently covered with concrete, are provided with an appropriate corrosion protection.

Where the anchor plate in steel of the fixed anchorage is exposed, i.e. the steel plate is not embedded in concrete with a sufficiently thick concrete cover, a corrosion protection system according to EN ISO 12944-5 is applied. The corrosion protection system is selected according to the on-site environment. Surface preparation is performed according to EN ISO 12944-4 and for execution of the protection systems EN ISO 12944-7 is considered.

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

2.1 Intended uses

The PT system is intended to be used for the internal and external prestressing of structures. The specific intended uses are listed in Table 4.

Table 4: Intended uses

Line №	Use category
Use category according to tendon configuration and material of structure	
1	Internal bonded tendon for concrete and composite structures
2	Internal unbonded tendon for concrete and composite structures
3	External tendon for concrete structures with a tendon path situated outside the cross section of the structure or the member but inside its envelope
Optional use categories	
4	Tendon for use in structural steel or composite construction as external tendon
5	Tendon for use in structural masonry construction as internal and/or external tendon
6	Tendon for use in structural timber construction as internal and/or external tendon

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 prestressing steel bars and components in order to prevent corrosion during transportation from the production site to the job site
- Transportation, storage, and handling of the prestressing steel bars and components in a manner as to avoid damage by mechanical or chemical impact

- Protection of prestressing steel bars and components from moisture
- Shielding of prestressing steel bars when welding operations are performed

2.2.3 Design

Design and reinforcement of the anchorage zone permits correct placing and compacting of concrete.

Verification of transfer of prestressing forces to the structural concrete is not required if centre spacing and edge distance of the tendons as well as grade and dimensions of additional reinforcement, see Annex 18, Annex 19, and Annex 20, are conformed to. The forces outside the area of the additional reinforcement are verified and, if necessary, covered by appropriate reinforcement. Reinforcement of the structure is not employed as additional reinforcement. Reinforcement exceeding the required reinforcement of the structure may be used as additional reinforcement if appropriate placing is possible.

Design of the structure permits correct installation and stressing of the tendons and correct application of the corrosion protection, in particular grouting and filling with corrosion protection filling material.

Tendons are with straight tendon paths only.

2.2.4 Installation

2.2.4.1 General

It is assumed that the BBV 1030 post-tensioning bar tendon system, nominal diameter 32 to 50 mm 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 tendons are only carried out by qualified PT specialist companies, which have the required resources and experience with the post-tensioning bar tendon system with hybrid anchor plate, see ETAG 013, Annex D.1.

2.2.4.2 Handling and checking of tendons

During installation, careful handling of the tendons is ensured. Prior to placing of concrete, the person responsible performs a final check of the installed tendons.

2.2.4.3 Concrete surfaces and placing of hybrid anchor plates

Concrete surfaces with major unevenness (e.g. spalling of concrete) should be evened out with mortar in order to achieve flat interfaces of hybrid anchor plates to structure.

The centric and perpendicular position of the hybrid anchor plate relative to the tendon axis is ensured by appropriate measures. Especially in case of inclined hybrid anchor plates this has to be observed carefully.

Prior to grouting or filling operations it is ensured that neither surface water nor dirt enter at the anchorage.

2.2.4.4 Concrete surfaces and placing of anchor plates in steel

Concrete surfaces with major unevenness (e.g. spalling of concrete) should be evened out with mortar in order to achieve flat interfaces of anchor plate in steel to structure.

The centric and perpendicular position of the anchor plate in steel relative to the tendon axis is ensured by appropriate measures. The angular deviation between concrete surface and anchor plate in steel does not exceed 1 °.

Prior to grouting or filling operations it is ensured that neither surface water nor dirt enter at the anchorage.

2.2.4.5 Anchorages – Bonded bar tendon

2.2.4.5.1 Stressing anchorages

The individual components of the stressing anchorage are delivered to the construction site and assembled on the prestressing steel bar.

On-site assembly comprises the following steps, depending on anchorage and structure.

- Hybrid anchor plate embedded in concrete

  The hybrid anchor plate is fastened onto the formwork – inside –, e.g. with bolts screwed into threaded sleeves of the hybrid anchor plate and the connection pipe is sealed against the corrugated duct with a chloride-free adhesive tape or a heat shrinking sleeve.

- Hybrid anchor plate placed on the structure

  After stripping the formwork, a sealing is placed onto the concrete surface of the structure. The hybrid anchor plate is placed on the sealing and clamped with washer and flat anchor nut.

Installation procedure for stressing anchorage can be applied to fixed anchorages as well.

2.2.4.5.2 Fixed anchorages

On-site assembly comprises the following steps.

- The duct is slipped into the connection pipe and sealed using a chloride-free adhesive tape or a heat shrinking sleeve. If the hybrid anchor plate or the anchor plate in steel is placed on the concrete surface of the structure, a sealing as for the stressing anchorage is applied.
- The fixed anchorage with hybrid anchor plate comprises hybrid anchor plate, washer, and flat anchor nut. The prestressing steel bar is connected with the hybrid anchor plate by means of the flat anchor nut.
- With the fixed anchorage with steel plate the connection is achieved by screwing the prestressing steel bar in the threaded bore of the steel plate.
- The fixed anchorage is sufficiently secured in its position as to avoid unfastening.

2.2.4.6 Anchorage – Unbonded and external bar tendon

2.2.4.6.1 General

For tendons with free tendon duct, the prestressing steel bar is usually provided with one anchorage prior to installation. The other anchorage is installed on the structure.

For tendons without free tendon duct, both anchorages are usually installed on the prestressing steel bar prior to installation.

2.2.4.6.2 Stressing anchorage

On-site assembly comprises the following steps.

- During installation, the corrosion protection filling material is applied in the hybrid anchor plate and connection tube.
- As to not damage the applied corrosion protection, the tendons are carefully handled. For unbonded tendons with free tendon duct, the tendons are lifted for insertion into the structure in order to prevent the tube from rubbing on the concrete edge at the beginning of the tendon. If required, an auxiliary insertion device is used.

- The bearing surface of the hybrid anchor plate is perpendicular to the tendon. If required, a compensating layer is applied. The hybrid anchor plate may be inclined up to 30 °, see Annex 6.
- In general, Clause 1.9.8 is observed for corrosion protection.

2.2.4.6.3 Fixed anchorage

For a tendon without free tendon duct, either a hybrid anchor plate or an anchor plate in steel is used at the fixed anchorage. In general the fixed anchor is without connection tube, see Annex 15 and Annex 16.

2.2.4.7 Sheathing

The sheathing consists of ducts and connection tubes.

On-site assembling considers the following items.

- All joints of the connected parts, e.g. at connection tubes and duct joints, are sealed with a chloride-free adhesive tape or a heat shrinking sleeve.
- In fastening the ducts, take care not to damage them by compression.
- Vent and grout connections are installed tension proof.
- If confusion is likely, the grouting hoses are clearly marked, e.g. with number plates.
- Prior to concrete placing, the sheathing is checked for damages.

2.2.4.8 Stressing and stressing records

2.2.4.8.1 Stressing

Upon attainment of the required mean compressive strength of the concrete in the anchorage zone, $f_{cm,\,0,\,cylinder}$ or $f_{cm,\,0,\,cube}$, the maximum prestressing force may be applied, see Annex 18, Annex 19, and Annex 20. For partial prestressing with 30 % of the full prestressing force the actual mean value of the concrete compressive strength is at least $0.5 \cdot f_{cm,\,0,\,cylinder}$ or $0.5 \cdot f_{cm,\,0,\,cube}$. Intermediate values may be interpolated linearly according to Eurocode 2. The respective standards and regulations in force at the place of use are considered.

Re-stressing of the tendons prior to final cutting of prestressing steel bar protrusions and prior to grouting is permitted.

Stressing comprises the following steps.

- A hydraulic jack is placed, resting on the hybrid anchor plate or a stressing chair, and connected to the prestressing steel bar.
- The prestressing steel bar is stressed.
- During stressing, the flat anchor nut is continuously tightened. Force and elongation are continuously monitored throughout the stressing procedure. The difference in length of the prestressing steel bar protrusion before and after stressing is determined as well.
- The measurement results in terms of prestressing force and elongation are recorded in the stressing record.

Until filling the tendon duct with cement grout, the prestressing force in the prestressing steel bar can be checked and corrected, if required, at any time.

2.2.4.8.2 Stressing records

All stressing operations are recorded for each tendon. In general, the required prestressing force is applied. The elongation is measured and compared with the calculated value.

2.2.4.8.3 Stressing equipment, space requirements, and safety-at-work

For stressing, hydraulic jacks are used. Information about the stressing equipment has been submitted to Österreichisches Institut für Bautechnik.

To stress tendons, clearance of approximately 1 m is considered directly behind the anchorages.

The safety-at-work and health protection regulations are complied with.

2.2.4.9 Corrosion protection

2.2.4.9.1 Grouting of bonded tendons

Grout is common grout according to EN 447 or special grout according to ETAG 013 as applicable at the place of use. For the grouting procedure EN 446 applies.

Following stressing, the grout is injected into the void between prestressing steel bar and duct. Thereby, corrosion protection and bond between prestressing steel bar and concrete is established. To ensure correct duct filling, the following is considered in addition to EN 446.

- Only mixing and grouting equipment as permitted by the ETA holder is used.
- All vents and inlets are sealed immediately after grouting to prevent escaping of grout from the duct. To ensure the duct is correctly filled up to the flat anchor nut at the stressing anchorage as well as at the fixed anchorage not embedded in concrete, grout penetrates through the hybrid anchor plate or the cap. Only then the vents may be closed, e.g. with plugs.

All grouting operations are recorded in detail in an injection data sheet. Obstructed, not fully grouted ducts are reported immediately to the person responsible.

2.2.4.9.2 Unbonded bar tendons with free tendon duct and external bar tendons

Corrosion protection is attained by filling the void between prestressing steel bar and PE-tube with warmed corrosion protection filling material.

All vents and inlets are immediately sealed with caps after finalising the filling procedure to prevent loss of corrosion protection filling material and ingress of water.

All filling operations are recorded in detail.

2.2.4.9.3 Unbonded tendons without free tendon duct

Directly behind and within the fixed anchorage embedded in concrete, the prestressing steel bar is protected by the concrete. Corrosion protection of prestressing steel bar is attained by means of a PE-tube filled with corrosion protection filling material.

At the fixed anchorage the PE-tube is sealed with a heat shrinking sleeve or a chlorid-free adhesive tape, see Annex 11 and Annex 12.

At the stressing anchorage the PE-tube is put into the connection tube and sealed the same way, see Annex 11 and Annex 12.

2.2.4.10 Safeguard against bursting out of the prestressing steel bar

Prevention of bursting out of the prestressing steel bar in case of a bar failure of unbonded and external bar tendons is ensured by appropriate measures. The safeguard devices are designed based on the expected impact force or energy.

2.2.4.11 Checking of tendons and repair of the corrosion protection

Before placing the concrete a final check of the installed tendons is carried out. Tendons with free tendon duct are usually installed after placing of concrete. Check and, if necessary, repair is ensured by the person responsible.

2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of the bar prestressing system of 100 years, provided that the bar prestressing system is subject to appropriate installation, use, and maintenance, see Clause 2.2. These provisions are based upon the current state of the art and the available knowledge and experience.

In normal use conditions the real working life may be considerably longer without major degradation affecting the basic requirements for works[3].

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

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

3.1 Essential characteristics

The performance of the bar prestressing system for the essential characteristics are given in Table 5 and Table 6. In Annex 24 the combinations of essential characteristics and corresponding intended uses are listed.

Table 5: Essential characteristics and performance of the product

№	Essential characteristic	Product performance
Product BBV 1030 post-tensioning bar tendon system, nominal diameter 32 to 50 mm Intended use The PT system is intended to be used for the prestressing of structures, Clause 2.1, Table 4, lines № 1 to 3.		
Basic requirement for construction works 1: Mechanical resistance and stability		
1	Resistance to static load	See Clause 3.2.1.1.
2	Resistance to fatigue	See Clause 3.2.1.2.
3	Load transfer to the structure	See Clause 3.2.1.3.
4	Friction coefficient	See Clause 3.2.1.4.
5	Deviation, deflection (limits)	See Clause 3.2.1.5.
6	Practicability, reliability of installation	See Clause 3.2.1.6.
Basic requirement for construction works 2: Safety in case of fire		
—	Not relevant. No characteristic assessed.	—

[3] 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 working life indicated above.

№	Essential characteristic	Product performance
Basic requirement for construction works 3: Hygiene, health, and the environment		
7	Content, emission, and/or release of dangerous substances	See Clause 3.2.2.
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.	—
Related aspects of serviceability		
8	Related aspects of serviceability	See Clause 3.2.3.

Table 6: Essential characteristics and performances of the product in addition to Table 5 for optional use categories

№	Additional essential characteristic	Product performance
Product BBV 1030 post-tensioning bar tendon system, nominal diameter 32 to 50 mm Optional use category Clause 2.1, Table 4, line № 4, Tendon for use in structural steel or composite construction as external tendon		
Basic requirement for construction works 1: Mechanical resistance and stability		
9	Load transfer to the structure	See Clause 3.2.4.1.

№	Additional essential characteristic	Product performance
Optional use category Clause 2.1, Table 4, line № 5, Tendon for use in structural masonry construction as internal and/or external tendon		
Basic requirement for construction works 1: Mechanical resistance and stability		
10	Load transfer to the structure	See Clause 3.2.4.2.
Optional use category Clause 2.1, Table 4, line № 6, Tendon for use in structural timber construction as internal and/or external tendon		
Basic requirement for construction works 1: Mechanical resistance and stability		
11	Load transfer to the structure	See Clause 3.2.4.3.

3.2 Product performance

3.2.1 Mechanical resistance and stability

3.2.1.1 Resistance to static load

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.1-I. The characteristic values of maximum force, F_{pk}, of the tendons with prestressing steel bars according to Annex 5 are listed in Annex 5.

3.2.1.2 Resistance to fatigue

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.2-I. The characteristic values of maximum force, F_{pk}, of the tendons with prestressing steel bars according to Annex 5 are listed in Annex 5.

3.2.1.3 Load transfer to the structure

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.3-I. The characteristic values of maximum force, F_{pk}, of the tendons with prestressing steel bars according to Annex 5 are listed in Annex 5.

3.2.1.4 Friction coefficient

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.4-I. For friction losses including friction coefficient see Clause 1.3.

3.2.1.5 Deviation, deflection (limits)

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.5-I. For minimum radii of curvature see Clause 1.5, i.e. straight tendon only.

3.2.1.6 Practicability, reliability of installation

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.6-I.

3.2.2 Hygiene, health, and the environment

3.2.2.1 Content, emission, and/or release of dangerous substances

Content, emission, and/or release of dangerous substances is determined according to ETAG 013, Clause 5.3.1. No dangerous substances is the performance of the bar prestressing system in this respect. A manufacturer's declaration to this effect has been submitted.

NOTE In addition to specific clauses relating to dangerous substances in the European Technical Assessment, there may be other requirements applicable to the product falling within their scope, e.g. transposed European legislation and national laws, regulations, and administrative provisions. These requirements also need to be complied with, when and where they apply.

3.2.3 Related aspects of serviceability

3.2.3.1 Related aspects of serviceability

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.7.

3.2.4 Mechanical resistance and stability

3.2.4.1 External tendon in structural steel or composite construction – Load transfer to the structure

Load transfer of prestressing force from the anchorages to steel structures is via steel members designed according to Eurocode 3.

The steel members supporting the anchorages have dimensions that permit a force of $1.1 \cdot F_{pk}$ to be transferred to the steel structure. The verification is performed according to Eurocode 3 as well as to the respective standards and regulations in force at the place of use. The characteristic values of maximum force, F_{pk}, of the tendon with prestressing steel bars according to Annex 5 are listed in Annex 5.

3.2.4.2 Internal and/or external tendon in structural masonry construction – Load transfer to the structure

Load transfer of prestressing force from the anchorages to masonry structures is via concrete or steel members designed according to the European Technical Assessment, especially according to the Clauses 1.2.5, 1.2.6 and 1.9.5 or Eurocode 3, respectively.

The concrete or steel members supporting the anchorages have dimensions that permit a force of $1.1 \cdot F_{pk}$ to be transferred into the masonry. The verification is performed according to Eurocode 6 as well as to the respective standards and regulations in force at the place of use. The characteristic values of maximum force, F_{pk}, of the tendon with prestressing steel bars according to Annex 5 are listed in Annex 5.

3.2.4.3 Internal and/or external tendon in structural timber construction – Load transfer to the structure

Load transfer of prestressing force from the anchorages to timber structures is via steel members designed according to Eurocode 3.

The steel members supporting the anchorages have dimensions that permit a force of $1.1 \cdot F_{pk}$ to be transferred to the timber structure. The verification is performed according to Eurocode 5 as well as to the respective standards and regulations in force at the place of use. The characteristic values of maximum force, F_{pk}, of the tendon with prestressing steel bars according to Annex 5 are listed in Annex 5.

3.3 Assessment methods

The assessment of the essential characteristics in Clause 3.1 of the bar prestressing system for the intended uses and in relation to the requirements for mechanical resistance and stability, and

for hygiene, health, and the environment in the sense of the basic requirements for construction works № 1 and 3 of Regulation (EU) № 305/2011 has been made in accordance with the Guideline for European technical approvals of "Post-Tensioning Kits for Prestressing of Structures", ETAG 013, edition June 2002, used according to Article 66 (3) of Regulation (EU) № 305/2011 as European Assessment Document, based on the assessment for an external, and an internal bonded and unbonded PT system.

3.4 Identification

The European Technical Assessment for the bar prestressing system is issued on the basis of agreed data that identify the assessed product[4]. Changes to materials, to composition, or to characteristics of the product, or to the production process could result in these deposited data being incorrect. Österreichisches Institut für Bautechnik should be notified before the changes are introduced, as an amendment of the European Technical Assessment is possibly necessary.

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

4.1 System of assessment and verification of constancy of performance

According to Commission Decision 98/456/EC the system of assessment and verification of constancy of performance to be applied to the bar prestressing system is System 1+. System 1+ is detailed in Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, Annex, point 1.1., and provides for the items listed blow.

(a) The manufacturer shall carry out

  (i) factory production control;

  (ii) further testing of samples taken at the manufacturing plant by the manufacturer in accordance with the prescribed test plan[5].

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

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

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

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

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

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

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

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

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

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

5.1 Tasks for the manufacturer

5.1.1 Factory production control

In the manufacturing plant the manufacturer establishes and continuously maintains a factory production control. All procedures and specifications adopted by the manufacturer are documented in a systematic manner. Purpose of factory production control is to ensure the constancy of performances of the BBV 1030 post-tensioning bar tendon system, nominal diameter 32 to 50 mm with regard to the essential characteristics.

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

Testing within factory production control is in accordance with the prescribed test plan. The results of factory production control are recorded and evaluated. The records are kept at least for ten years after the product has been placed on the market and are presented to the notified product certification body involved in continuous surveillance. 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 the components given in Annex 23.

The basic elements of the prescribed test plan are given in Annex 22 and conform to ETAG 013, Annex E.1.

5.1.2 Declaration of performance

The manufacturer is responsible for preparing the declaration of performance. When all the criteria of the assessment and verification of constancy of performance are met, including the certificate of constancy of performance issued by the notified product certification body, the manufacturer draws up the declaration of performance. Essential characteristics to be included in the declaration of performance for the corresponding intended use are given in Table 5 and Table 6. In Annex 24 the combinations of essential characteristics and corresponding intended uses are listed.

5.2 Tasks for the notified product certification body

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

The notified product certification body verifies the ability of the manufacturer for a continuous and orderly manufacturing of the BBV 1030 post-tensioning bar tendon system, nominal diameter 32 to 50 mm according to the European Technical Assessment. In particular the following items are appropriately considered.

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

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

The notified product certification body visits the factory at least once a year for routine inspection. 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 the components given in Annex 23 is audited at least once in five years. It is verified that the system of factory production control and the specified manufacturing process are maintained, taking account of the prescribed test plan.

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

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

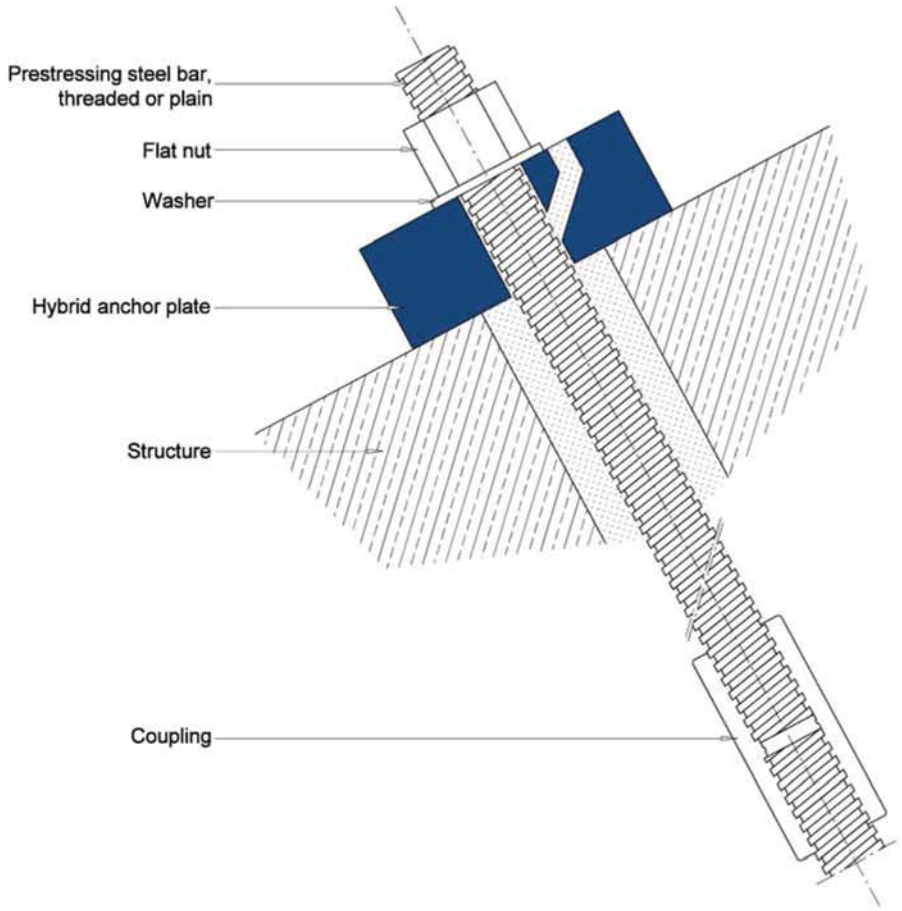
During surveillance inspections the notified product certification body takes samples of components of the BBV 1030 post-tensioning bar tendon system, nominal diameter 32 to 50 mm for independent testing. For the most important components Annex 23 summarises the minimum procedures performed by the notified product certification body.

Issued in Vienna on 18 July 2017
by Österreichisches Institut für Bautechnik

The original document is signed by

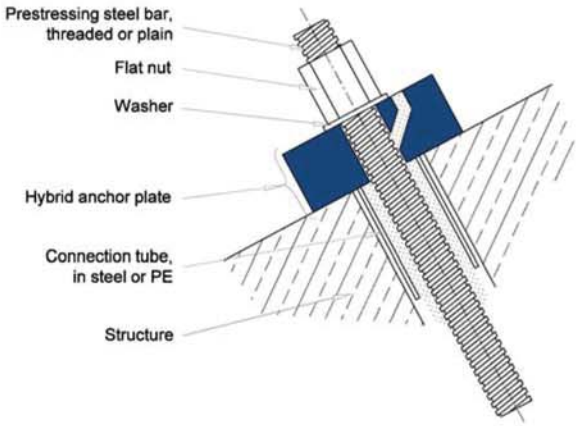
Rainer Mikulits
Managing Director

Bonded bar tendon with hybrid anchor plate

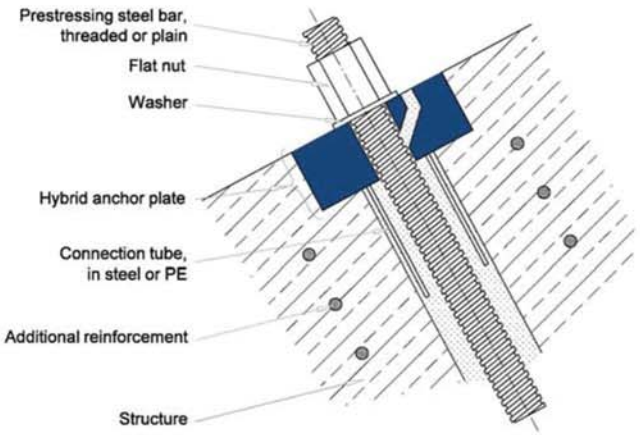


Unbonded and external bar tendon with hybrid anchor plate

Concrete Plate, HA-CoP

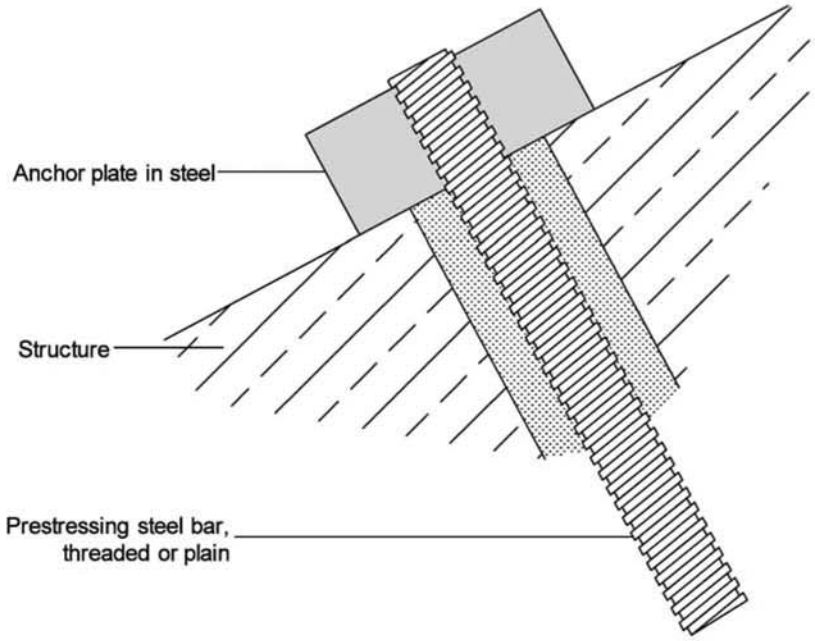


Concrete Anchor Body, HA-CAB

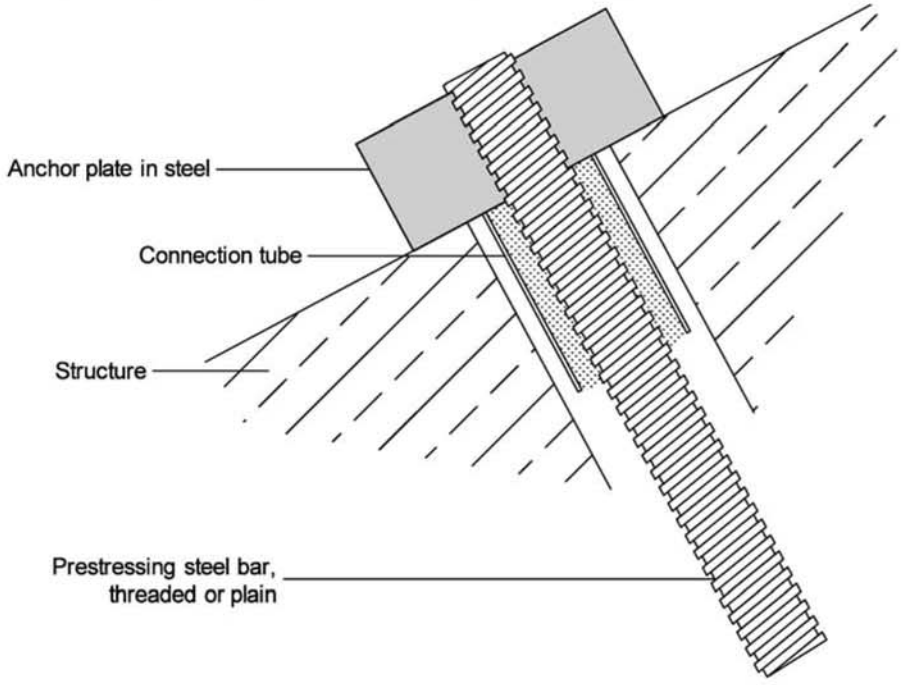


BBV SYSTEMS	**Bar post tensioning system** Bar tendon with hybrid anchor plate Overview	**Annex 1** of European Technical Assessment **ETA-16/0286** of 18.07.2017

Bonded bar tendon with anchor plate in steel [1)]



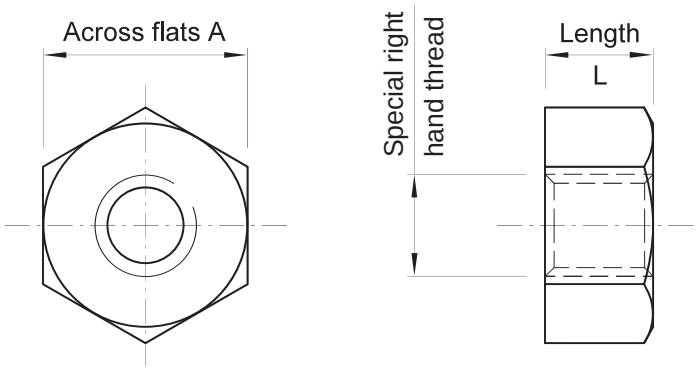
Unbonded and external bar tendon with anchor plate in steel [1)]



[1)] The anchor plate in steel provides a threaded bore to screw in the prestressing steel bar.

BBV SYSTEMS	**Bar post tensioning system** Bar tendon with anchor plate in steel – Overview	**Annex 2** of European Technical Assessment **ETA-16/0286** of 18.07.2017

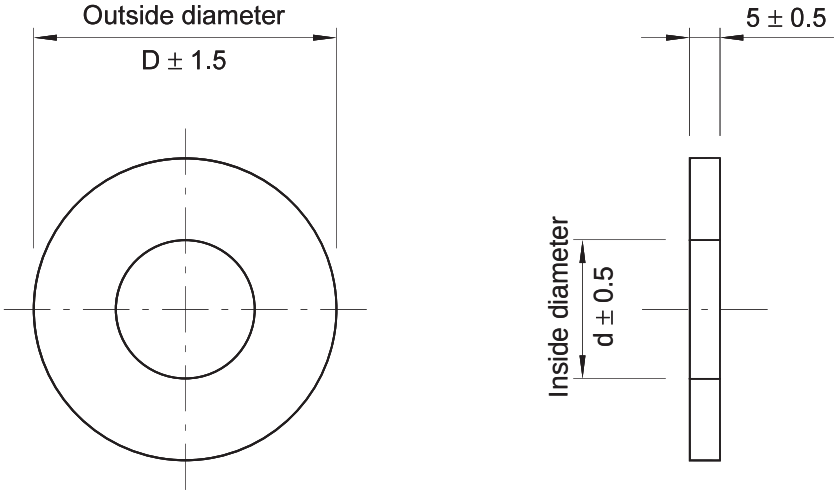
Flat anchor nut



Designation			32	36	40	50
Width across flats	A	mm	$56^{+0.0}_{-1.9}$	$62^{+0.0}_{-1.9}$	$72^{+0.0}_{-1.9}$	$90^{+0.0}_{-2.2}$
Length	L	mm	43.0 ± 2.5	48.0 ± 2.5	53.0 ± 2.5	73.5 ± 3.0
Concentricity of thread axis		mm	2.0	2.0	2.0	2.0
Chamfer diameter [1)]		mm	38.0	42.0	48.0	58.0

[1)] A 45 ° chamfer is made at both ends of the bore to the diameters given

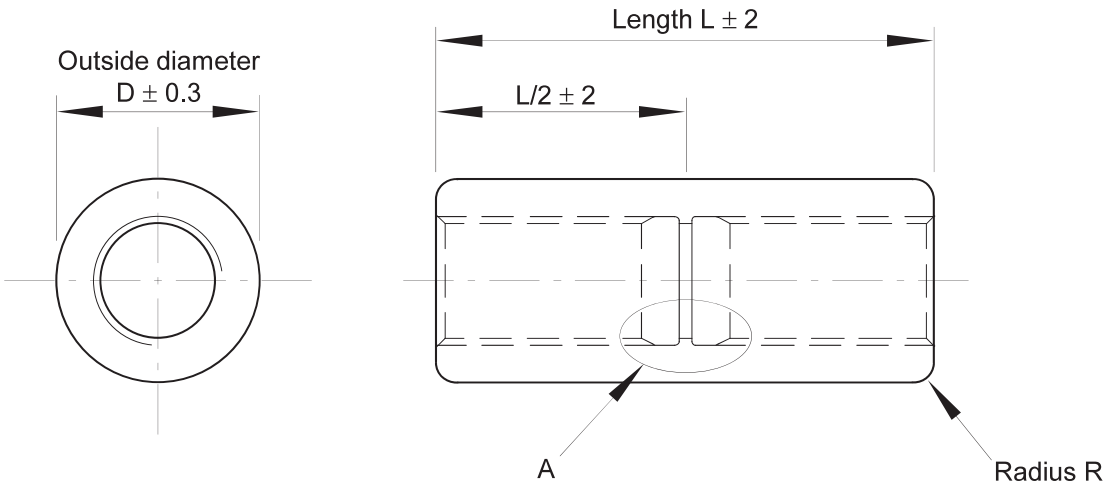
Washer



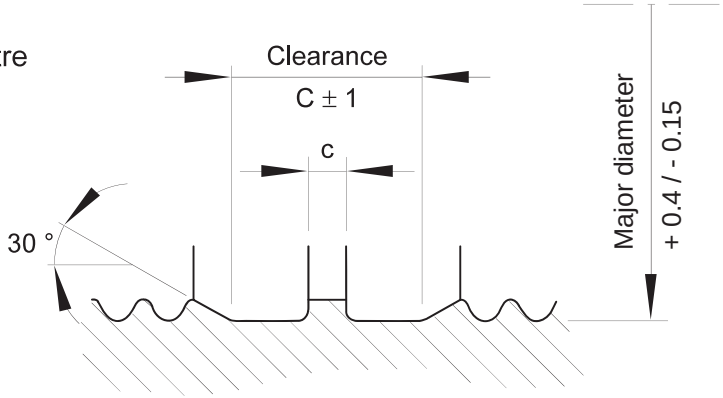
Dimensions in mm

Designation			32	36	40	50
Outside diameter	D	mm	70	75	90	105
Inside diameter	d	mm	38	42	47	57

Sleeve



Detail A at centre



Dimensions in mm

Designation			32	36	40	50
Outside diameter	D	mm	50	57.5	61.5	76
Length	L	mm	115	130	140	170
Clearance length	C (c)	mm	15 (6 + 3 + 6)	15 (6 + 3 + 6)	20 (8 + 4 + 8)	20 (8 + 4 + 8)
End radius	R	mm	4	4	5	6

Mechanical characteristics

Y1030H according to prEN 10138-4

Designation	Nominal diameter	Nominal mass per metre	Nominal cross-sectional area	0.1 %-proof stress	Tensile strength	Characteristic		Maximum value of maximum force
						0.1 %-proof force	Maximum force	
—	d_s	M	S_n	$R_{p0.1}$	R_m	$F_{p0.1}$	F_{pk}	$F_{m,\,max}$
—	mm	kg/m	mm^2	N/mm^2	N/mm^2	kN	kN	kN
32	32	6.313	804	835	1 030	672	828	953
36	36	7.990	1 018			850	1 048	1 206
40	40	9.860	1 256			1 049	1 294	1 488
50	50	15.42	1 964			1 640	2 022	2 326

Additional characteristics

Y1030H according to prEN 10138-4

Minimum elongation at maximum force for $L_0 \geq 200$ mm	A_{gt}	%	3.5
Force range at upper $F_{up} = 0.70 \cdot F_{m,\,a}$ and $N = 2 \cdot 10^6$ load cycles	F_r	—	Thread bar $180\ N/mm^2 \cdot S_n$ Plain bar $200\ N/mm^2 \cdot S_n$
Isothermal stress relaxation Losses from an initial force of $0.70 \cdot F_{m,\,a}$ after 1 000 h	—	%	≤ 4

Standard thread lengths for plain bars

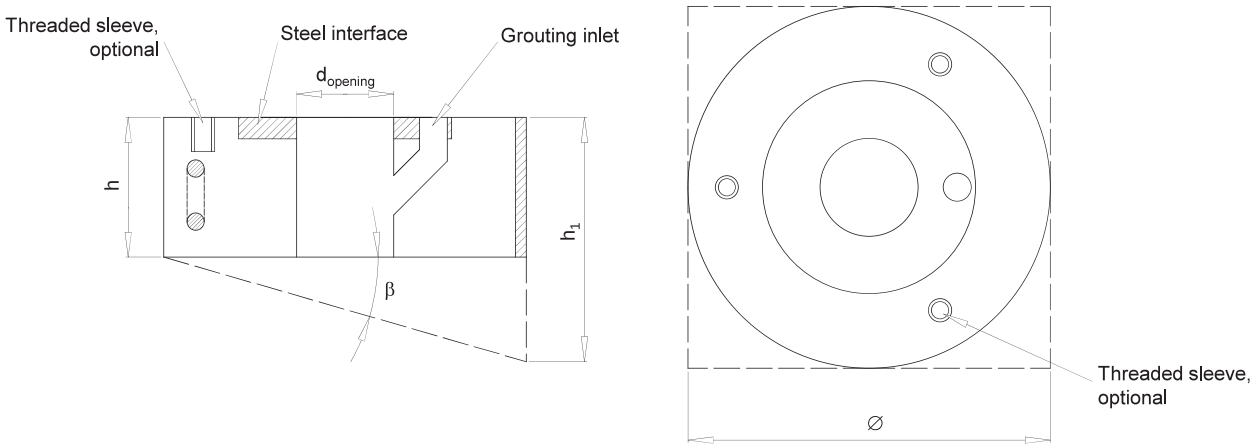
Nominal diameter of plain prestressing steel bar	mm	32	36	40
End at stressing anchorage [1)]	mm	250	250	250
End at passive anchorage	mm	100	100	100
End at coupling	mm	60	65	75

[1)] Standard thread length for bar tendons up to 18 m long

Hybrid anchor plate HA-CoP

Placing of hybrid anchor plate

Additional reinforcement	Hybrid anchor plate	
	Embedded in concrete	Placed on concrete surface of the structure
With additional reinforcement	HA-CAB	HA-CoP
Without additional reinforcement	HA-CoP	HA-CoP



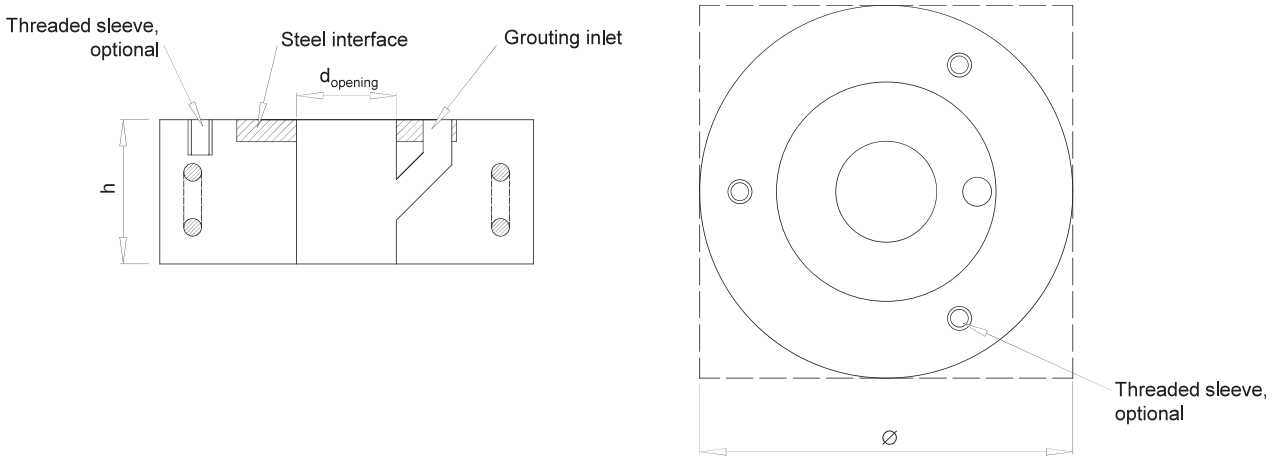
Nominal diameter of prestressing steel bar			32	36	40	50
Diameter [1], HA-CoP with internal confinement	Ø	mm	190	210	230	285
Diameter, HA-CoP with external confinement	Ø	mm	193.7	219.1	229.0	292.0
Height [2], HA-CoP	h	mm	85	90	90	110
Opening	$d_{opening}$	mm	41	45	51	61
Inclination, HA-CoP	max. β	°	30	30	30	30

1) Dimension of side length for square layout
2) $h_1 = h + Ø \cdot \tan(\beta)$

Hybrid anchor plate HA-CAB with internal confinement

Placing of hybrid anchor plate

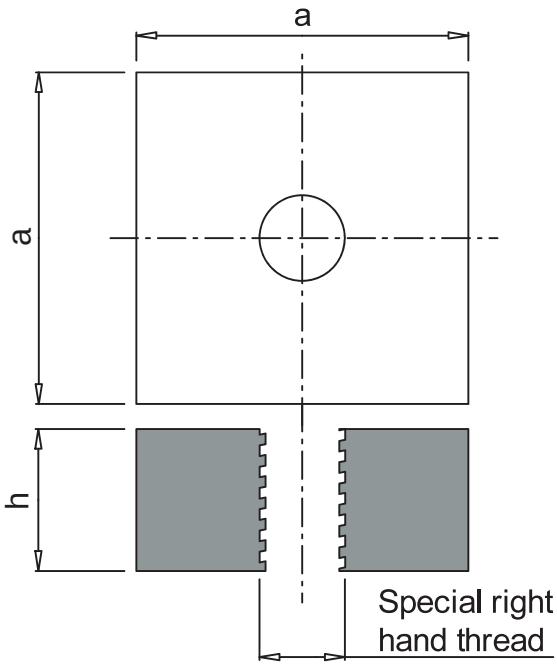
Additional reinforcement	Hybrid anchor plate	
	Embedded in concrete	Placed on concrete surface of the structure
With additional reinforcement	HA-CAB	HA-CoP
Without additional reinforcement	HA-CoP	HA-CoP



Nominal diameter of prestressing steel bar			32	36	40	50
Diameter [1], HA-CAB with internal confinement	Ø	mm	155	165	190	220
Height, HA-CAB	h	mm	55	65	65	75
Opening	$d_{opening}$	mm	41	45	51	61

[1] Dimension of side length for square layout

Anchor plate in steel

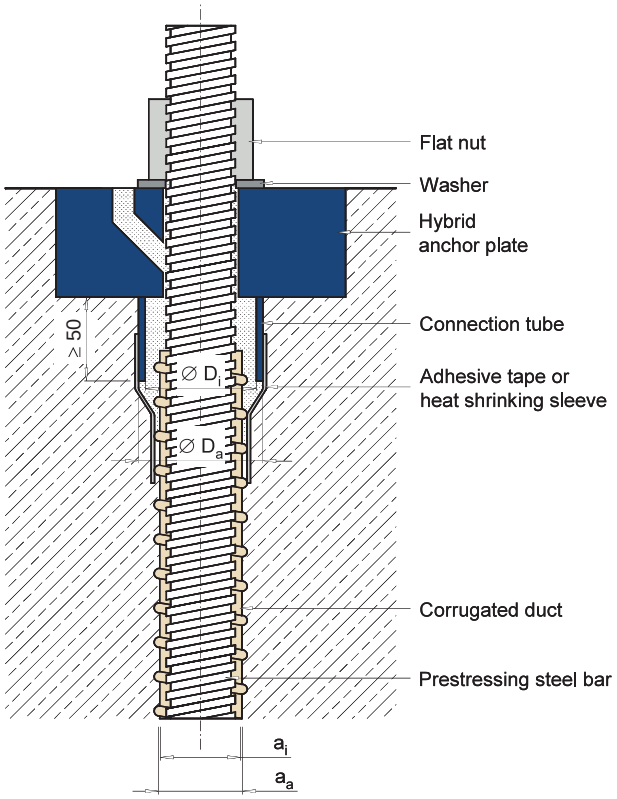


The anchor plate in steel provides a centric threaded bore to screw in the prestressing steel bar.

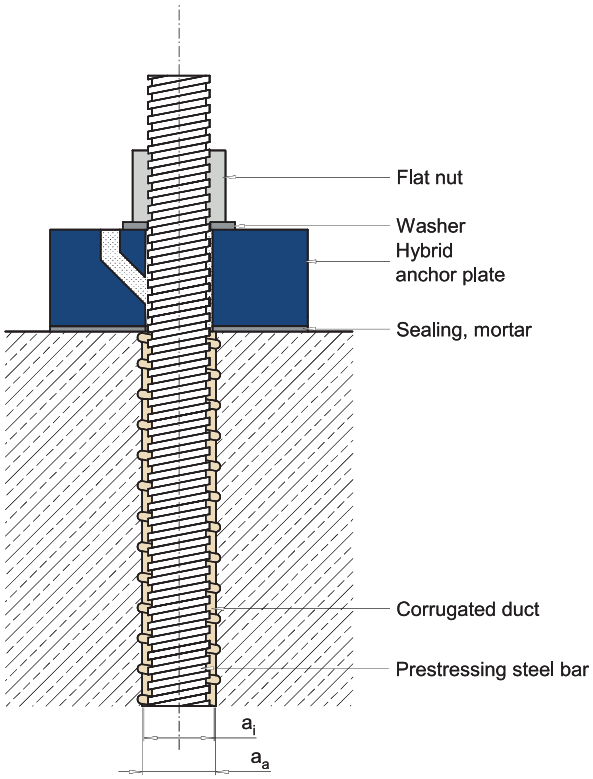
Nominal diameter of prestressing steel bar			32	36	40	50
Side length	a	mm	190	210	230	285
Height	h	mm	55	60	70	85
Threaded height	—	mm	55	60	70	85

Bonded bar tendon

Hybrid anchor plate
Embedded in concrete, HA-CoP or HA-CAB



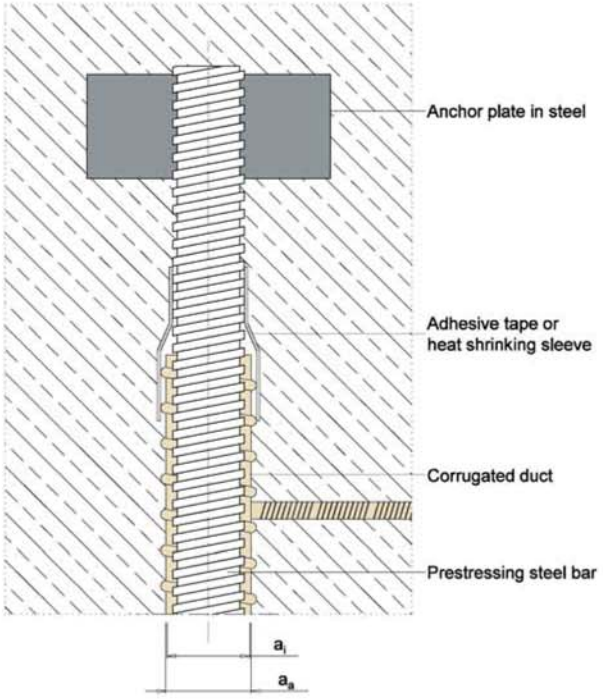
Hybrid anchor plate
Placed on concrete surface, HA-CoP



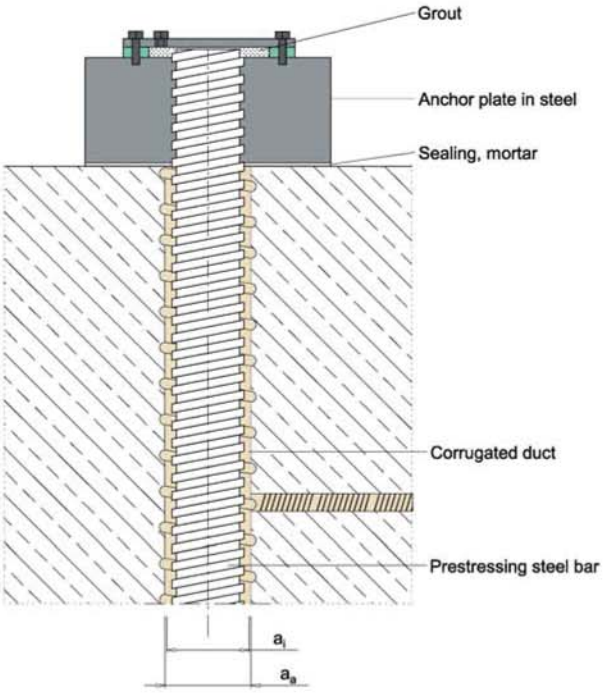
Nominal diameter of prestressing steel bar		mm	32	36	40	50
Connection tube, PE	Ø D_a	mm	63	75.0	75.0	90.0
	Ø D_i	mm	55.8	70.4	70.4	85.6
Corrugated duct, PE or steel	a_a	mm	51	56	61	72
	a_i	mm	45	50	55	65
Corrugated duct for coupler	a_a	mm	72	82	87	97
	a_i	mm	65	75	80	90

Bonded bar tendon

Anchor plate in steel
Embedded in concrete



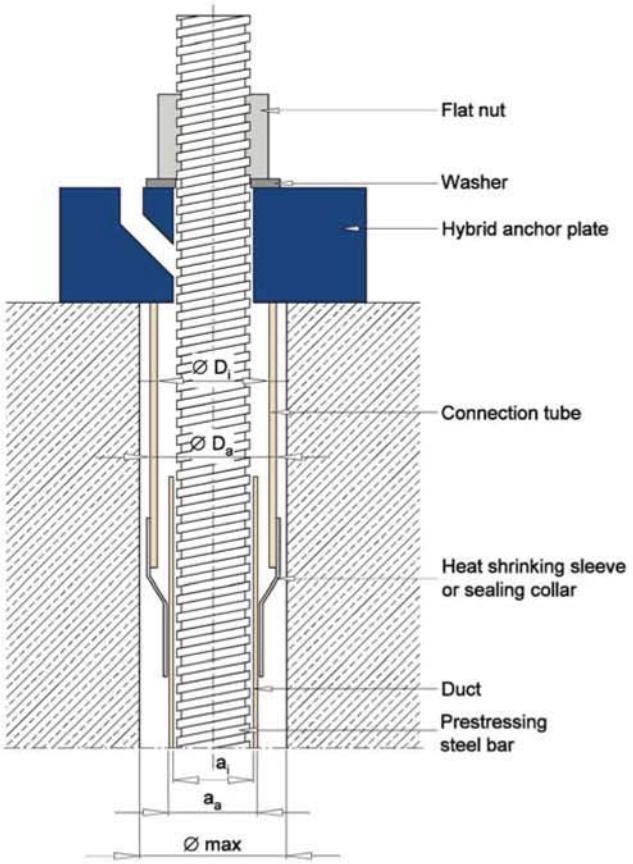
Anchor plate in steel
Placed on concrete surface



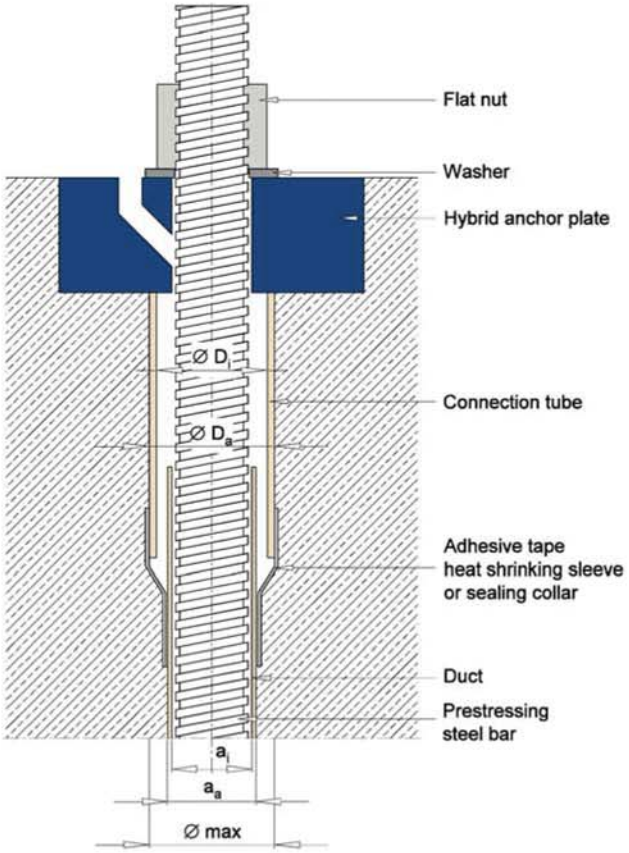
Nominal diameter of prestressing steel bar		**mm**	**32**	**36**	**40**	**50**
Corrugated duct, PE or steel	a_a	mm	51	56	61	72
	a_i	mm	45	50	55	65

Unbonded and external bar tendon

Hybrid anchor plate
With free tendon duct – External bar tendon



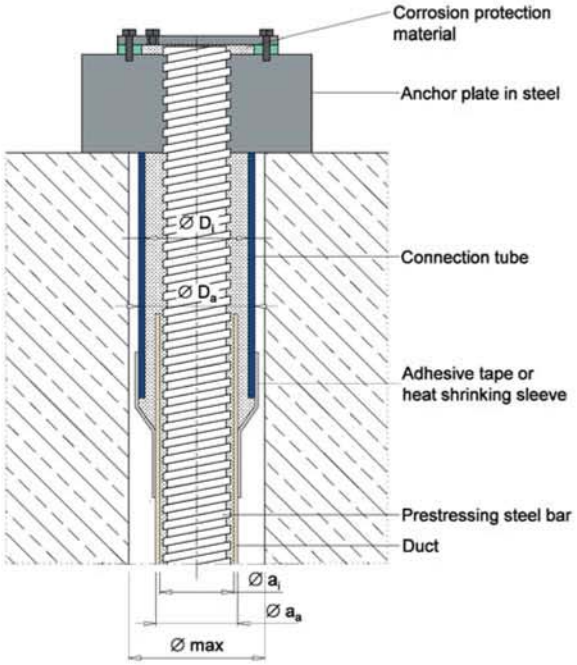
Hybrid anchor plate
Without free tendon duct



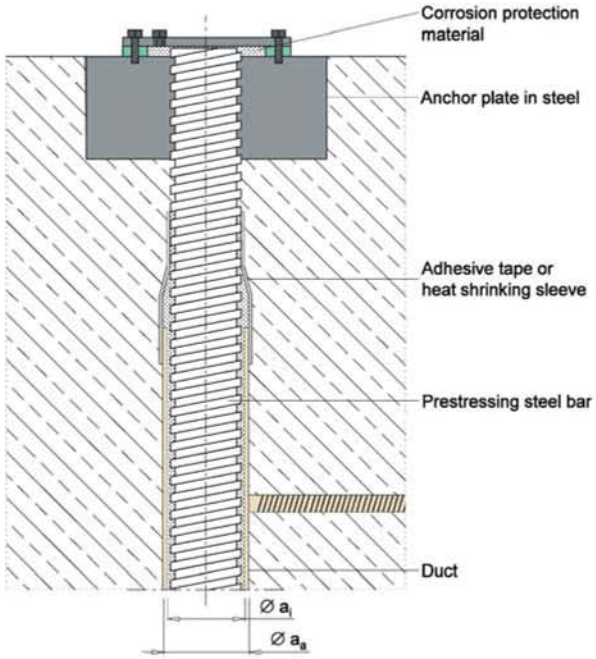
Nominal diameter of prestressing steel bar			**mm**	**32**	**36**	**40**	**50**
Connection tube, PE		Ø D_a	mm	63	75.0	75.0	90.0
		Ø D_i	mm	55.8	70.4	70.4	85.6
Duct, PE or steel		max. a_a	mm	50.0	63.0	63.0	75.0
		min. a_i	mm	44.2	55.8	55.8	66.4
Opening in concrete	HA-CoP	max Ø	mm	90	90	90	110
	HA-CAB	max Ø	mm	75	75	90	90

Unbonded and external bar tendon

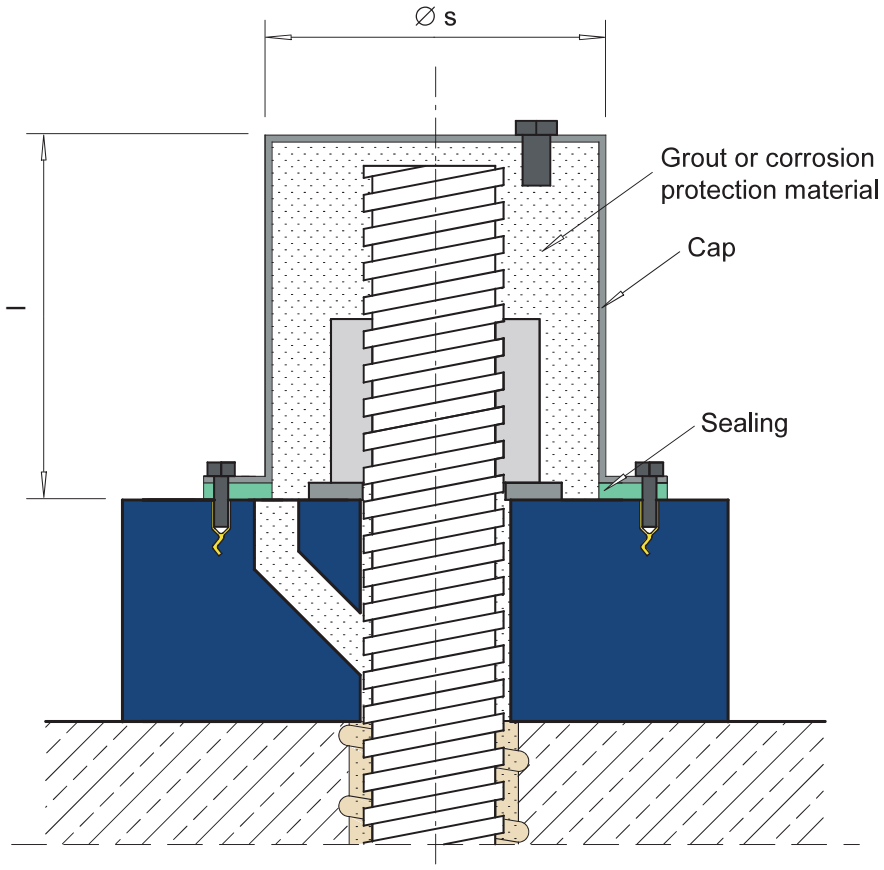
Anchor plate in steel
With free tendon duct – External bar tendon



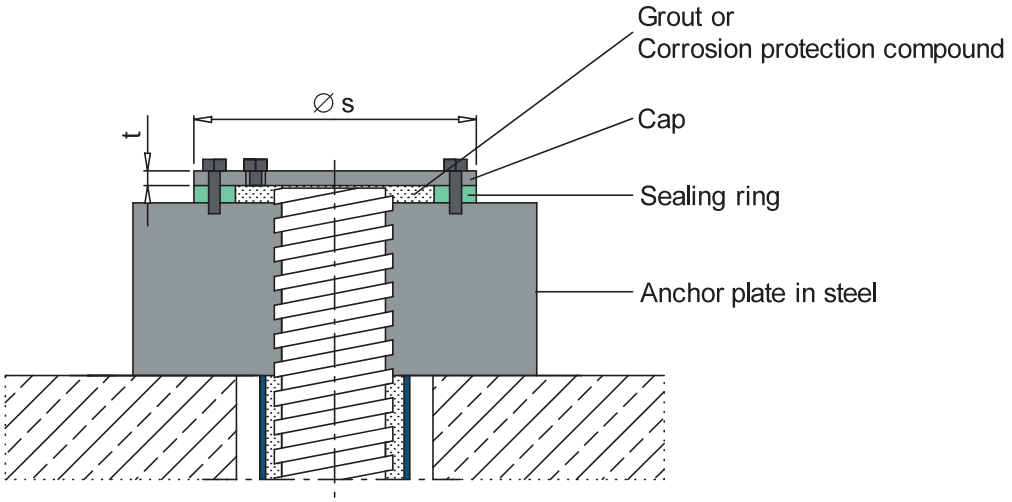
Anchor plate in steel
Without free tendon duct



Nominal diameter of prestressing steel bar		**mm**	**32**	**36**	**40**	**50**
Connection tube, steel	Ø D_a	mm	60.3	70.0	70.0	82.5
	Ø D_i	mm	55.7	65.4	65.4	77.3
Duct, PE or steel	max. a_a	mm	50.0	63.0	63.0	75.0
	min. a_i	mm	44.2	55.8	55.8	66.4
Opening in concrete	max Ø	mm	90	90	90	110



Nominal diameter of prestressing steel bar		mm	32	36	40	50
Steel cap	Ø s	mm	133	133	152.4	168
	min. l	mm	146	146	176	176

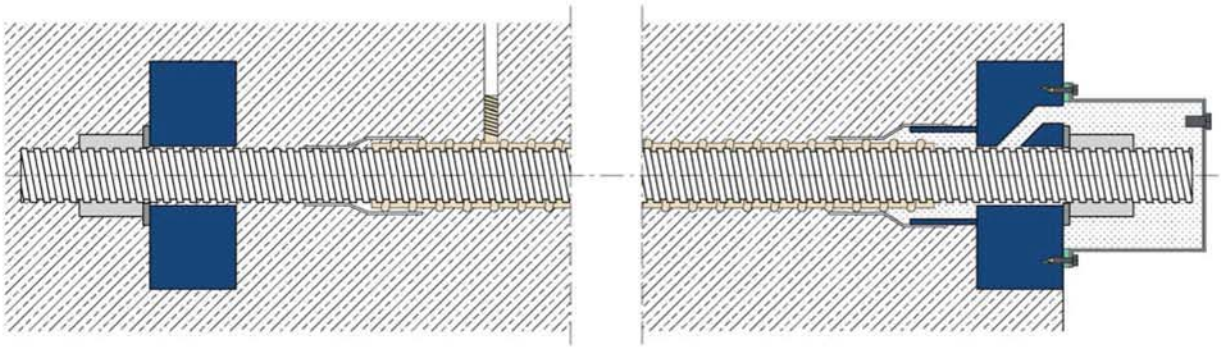


Nominal diameter of prestressing steel bar		mm	32	36	40	50
Steel cap	Ø s	mm	150	150	150	200
	min. t	mm	5	5	5	5

Installation examples with Hybrid anchor plate

Bonded bar tendon

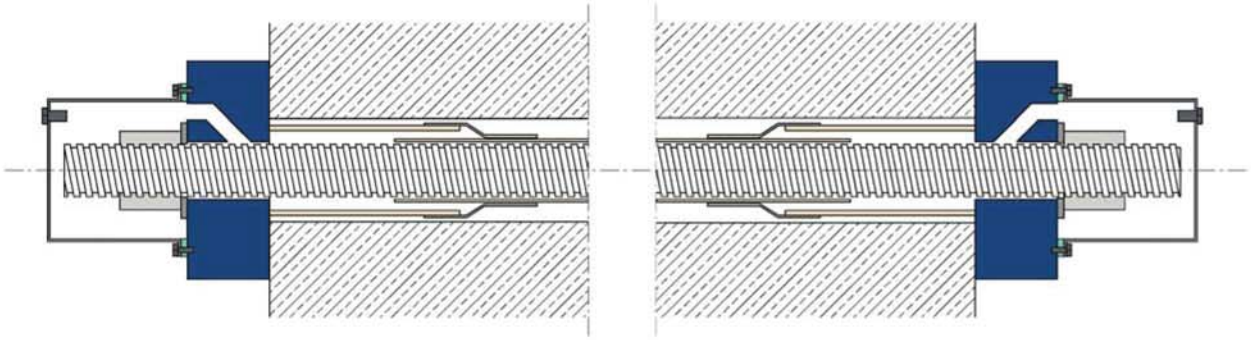
Fixed anchorage | Stressing anchorage



Unbonded or external bar tendon

Fixed anchorage | Stressing anchorage

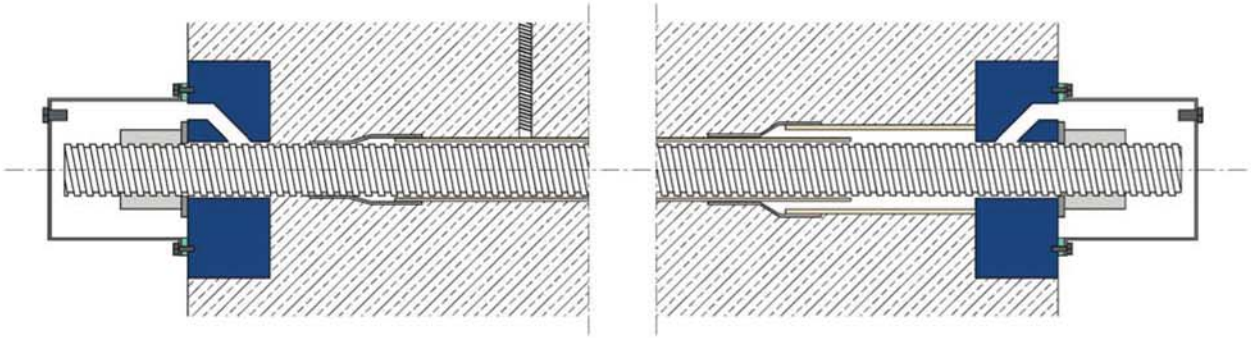
With free tendon duct, external bar tendon



Unbonded bar tendon

Fixed anchorage | Stressing anchorage

Without free tendon duct



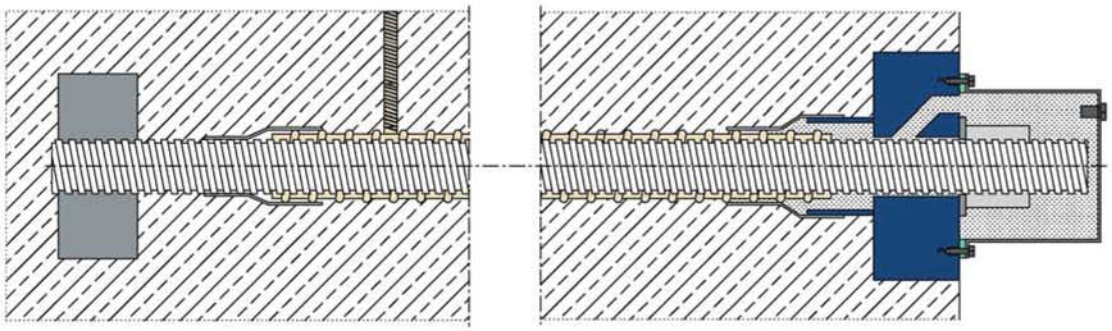
BBV SYSTEMS	**Bar post tensioning system** Bonded, unbonded, and external bar tendon – Installation example – Fixed anchor with hybrid anchor plate	**Annex 15** of European Technical Assessment **ETA-16/0286** of 18.07.2017

Installation examples with Hybrid anchor plate and anchor plate in steel

Bonded bar tendon

Fixed anchorage

Stressing anchorage

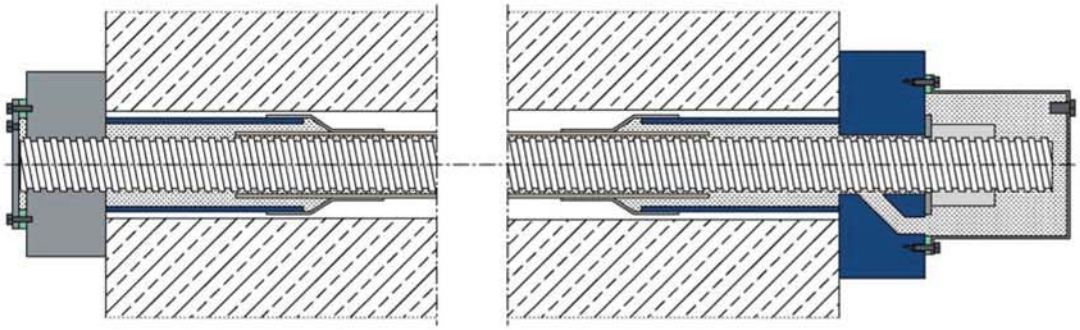


Unbonded or external bar tendon

Fixed anchorage

Stressing anchorage

With free tendon duct, external bar tendon

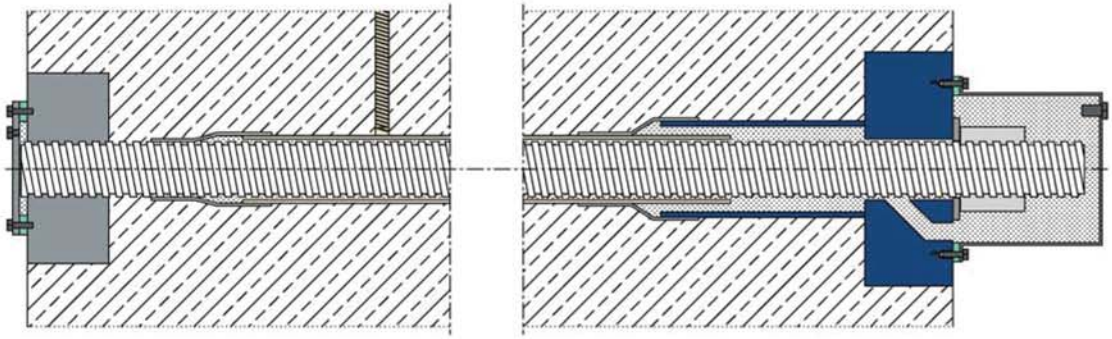


Unbonded bar tendon

Fixed anchorage

Stressing anchorage

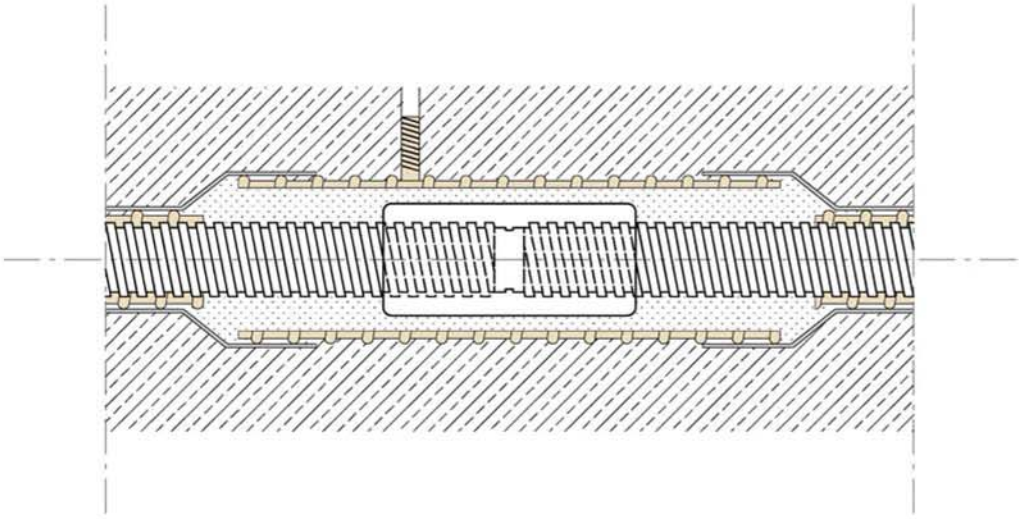
Without free tendon duct



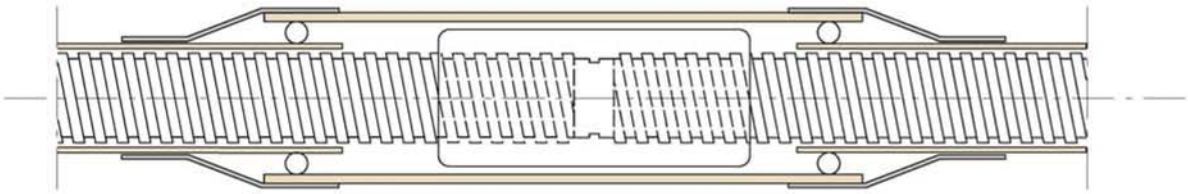
BBV SYSTEMS	**Bar post tensioning system** Bonded, unbonded, and external bar tendon – Installation example – Fixed anchor with anchor in plate steel	**Annex 16** of European Technical Assessment **ETA-16/0286** of 18.07.2017

Installation examples

Bonded bar tendon – Coupling

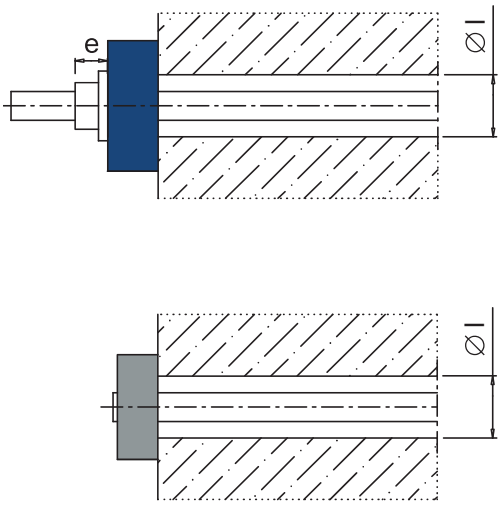


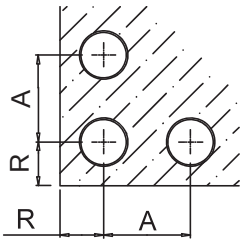
Unbonded and external bar tendon – Coupling

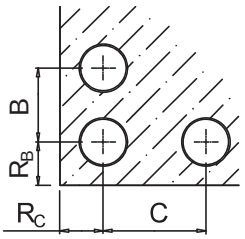


BBV SYSTEMS	**Bar post tensioning system** Coupling Installation example	**Annex 17** of European Technical Assessment **ETA-16/0286** of 18.07.2017

Without additional reinforcement,
Hybrid anchor plate HA-CoP and anchor plate in steel



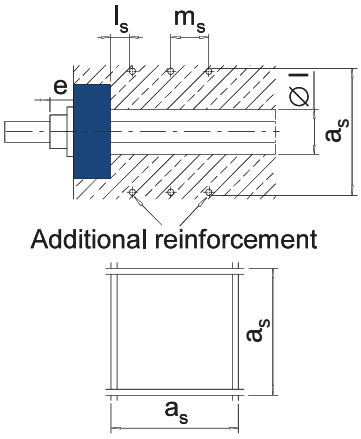


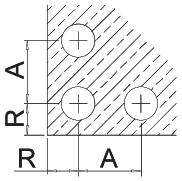


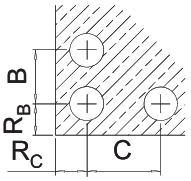
Nominal diameter of prestressing steel bar	mm	32				36				40				50			
Flat anchor nut e	mm	48				53				58				79			
Max. Ø l	mm	90				90				90				110			
Min. concrete strength [1] $f_{cm,\,0,\,cyl}$	MPa	25	28	33	38	25	28	33	38	25	28	33	38	25	28	33	38
$f_{cm,\,0,\,cube}$	MPa	30	34	42	48	30	34	42	48	30	34	42	48	30	34	42	48
Centre spacing A	mm	330	310	275	255	370	345	305	280	410	380	335	310	510	475	415	385
Centre spacing B × C	mm	(B · C) ≥ (A · A) with B = (0.85 to 1.00) · A															
Minimum spacing A, B, and C	mm	Diameter of hybrid anchor plate + 20 mm Dimension of anchor plate in steel + 20 mm															
Edge distance R	mm	0.5 · centre spacing + concrete cover – 10 mm															

[1] Minimum actual concrete strength at time of stressing

With additional reinforcement, hybrid anchor plate HA-CAB embedded in concrete





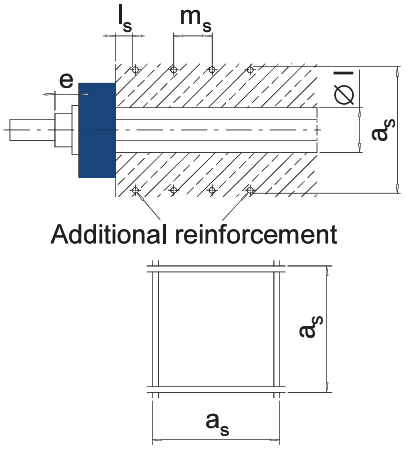


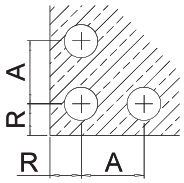
Nominal diameter of prestressing steel bar		mm	32	36	40	50
Flat anchor nut	e	mm	48	53	58	79
	Max. Ø l	mm	75	75	90	90
Min. concrete strength [1]	$f_{cm,\,0,\,cyl}$	MPa	≥ 28			
	$f_{cm,\,0,\,cube}$	MPa	≥ 34			
Centre spacing	A	mm	195	215	240	295
Centre spacing	B × C	mm	(B · C) ≥ (A · A), where B = (0.85 to 1.00) · A			
Minimum spacing	A, B, and C	mm	Diameter of hybrid anchor plate + 20 mm			
Edge distance	R, R_B, and R_C	mm	0.5 · centre spacing + concrete cover – 10 mm			
Additional reinforcement						
Number [2]		—	3	3	4	6
Bar diameter		mm	12	14	14	16
Distance	l_s	mm	45	45	45	50
Spacing	m_s	mm	45	55	50	50

[1] Minimum actual concrete strength at time of stressing

[2] Dimension, $a_s \geq$ (A or B or C) – 20 mm

With additional reinforcement, hybrid anchor plate HA-CoP placed on concrete surface of structure





Nominal diameter of prestressing steel bar		mm	32	36	40	50
Flat anchor nut	e	mm	48	53	58	79
	Max. Ø l	mm	90	90	90	110
Min. concrete strength [1]	$f_{cm,\,0,\,cyl}$	MPa	≥ 28			
	$f_{cm,\,0,\,cube}$	MPa	≥ 34			
Centre spacing	A	mm	210	230	250	305
Minimum spacing	A	mm	Diameter of hybrid anchor plate + 20 mm			
Edge distance	R	mm	0.5 · centre spacing + concrete cover – 10 mm			
Additional reinforcement			Stirrups	Stirrups	Stirrups	Stirrups
Number [2]		—	3	3	4	6
Bar diameter		mm	12	14	14	16
Distance	l_s	mm	45	45	45	50
Spacing	m_s	mm	45	55	50	50

[1] Minimum actual concrete strength at time of stressing

[2] Dimension, $a_s \geq A - 20$ mm

Component	Standard / Specification
Hybrid anchor, HA-CoP or HA-CAB	Confined high strength mortar
Anchor plate in steel	EN 10025
Flat anchor nut	EN ISO 898-2
Washer	EN 10025
Sleeve	EN 10083-1
Additional reinforcement	Ribbed reinforcing steel, $R_e \geq 500$ N/mm²
Steel ring	EN 10210-1
Helix	Ribbed reinforcing steel, $R_e \geq 500$ MPa
Steel strip sheath	EN 523
Duct fittings	EN 10139 EN ISO 17855-1
PE-duct	ETAG 013, Annex C.3
Sealing ring	Elastomeric material
Grout cap	EN 10130

Component	Item	Test / Check	Traceability	Minimum frequency [1]	Documentation
Hybrid anchor plate	Compressive strength of high strength mortar [2]	Test	Full [3]	≥ 3 specimens per batch	Yes
Flat anchor nut, Sleeve, Anchor plate in steel, Washer	Material	Check	Full [3]	100 %	"3.1" [4]
	Detailed dimensions [5]	Test		5 % [6] ≥ 2 specimens	Yes
	Strength [7]	Test		0.5 % ≥ 2 specimens per batch	Yes
	Visual inspection [8]	Check		100 %	No
Thread bar [9], Plain bar [9]	Material	Check	"CE"	100 %	"CE"
	Diameter	Test		Each bundle	No
	Visual inspection [8]	Check		Each bundle	No
	Thread form	Check		Each bundle	No
Steel ring, Steel interface	Material	Check	Bulk [3]	100 %	"3.1" [4]
	Detailed dimensions [5]	Test		≥ 3 specimens per batch	Yes
	Visual inspection [8]	Check		100 %	No
Steel strip sheath	Material	Check	"CE"	100 %	"CE"
	Visual inspection [8]	Check		100 %	No
Materials of the corrosion protection systems	Material	Check	Full [3]	100 %	"2.2" [10]
Components of the corrosion protection system (tube, cap, etc.)	Visual inspection [8]	Check	Full [3]	100 %	No

1) All samples shall be randomly selected and clearly identified.
2) Cube compressive strength: Test of strength of high strength mortar according to the prescribed test plan.
3) Full: Full traceability of each component to its raw material.
Bulk: Traceability of each delivery of components to a defined point.
4) "3.1": Inspection certificate "3.1" according to EN 10204.
5) Detailed dimensions: Measurement of all external dimensions and angles according to the specification given in the prescribed test plan.
6) In case of a continuous manufacture without retooling of at least 1 000 parts, the frequency may be reduced to 1 % with at least 1 specimen per shift. The stability of the process of the continuous manufacture shall be verified.
7) Strength: Determination of strength by means of hardness tests or similar.
8) Visual inspection: E.g. main dimensions of threads, gauge testing, correct marking or labelling, surfaces, ribs, kinks, smoothness, corrosion protection, corrosion, notches, coating, accordance of batch with documentation, as given in the prescribed test plan.
9) As long as the basis for CE marking for prestressing steel is not available, an approval or certificate according to the respective standards and regulations in force at the place of use shall accompany each delivery.
10) "2.2": Test report "2.2" according to EN 10204.

Component	Item	Test / Check [1]	Sampling – Number of components per visit
Hybrid anchor plate	Detailed dimensions	Test	1
	Compressive strength of high strength mortar	Test	3
Anchor plate in steel	Material according to specification	Test / Check	2
	Detailed dimensions	Test	1
	Visual inspection [2]	Check	5
Flat anchor nut, Sleeve, Washer	Material according to specification	Test / Check	2
	Detailed dimensions	Test	1
	Visual inspection [2]	Check	5
Single tensile element test	According to ETAG 013, Annex E.3	Test	1 series

1) All samples shall be randomly selected and clearly identified.
2) Visual inspection: E.g. main dimensions of threads, gauge testing, correct marking or labelling, surfaces, ribs, kinks, smoothness, corrosion protection, corrosion, notches, coating, as given in the prescribed test plan.

Essential characteristics for the intended uses of the PT system

№	Essential characteristic	Clause	Intended use Line № according to Clause 2.1, Table 4					
			1	2	3	4	5	6
1	Resistance to static load	3.2.1.1	+	+	+	+	+	+
2	Resistance to fatigue	3.2.1.2	+	+	+	+	+	+
3	Load transfer to the structure	3.2.1.3	+	+	+	—	—	—
4	Friction coefficient	3.2.1.4	+	+	+	+	+	+
5	Deviation, deflection (limits)	3.2.1.5	+	+	+	+	+	+
6	Practicability, reliability of installation	3.2.1.6	+	+	+	+	+	+
7	Content, emission, and/or release of dangerous substances	3.2.2	+	+	+	+	+	+
8	Related aspects of serviceability	3.2.3	+	+	+	+	+	+
9	Load transfer to the structure	3.2.4.1	—	—	—	+	—	—
10	Load transfer to the structure	3.2.4.2	—	—	—	—	+	—
11	Load transfer to the structure	3.2.4.3	—	—	—	—	—	+

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 combinations are relevant.

Reference documents

Guideline for European Technical Approval

ETAG 013 (06.2002)	Guideline for European Technical Approval of Post-Tensioning Kits for Prestressing of Structures

Eurocodes

Eurocode 2	Eurocode 2: Design of concrete structures
Eurocode 3	Eurocode 3: Design of steel structures
Eurocode 4	Eurocode 4: Design of composite steel and concrete structures
Eurocode 5	Eurocode 5: Design of timber structures
Eurocode 6	Eurocode 6: Design of masonry structures

Standards

EN 206 (12.2013)	Concrete – Specification, performance, production and conformity
EN 446 (10.2007)	Grout for prestressing tendons – Grouting procedures
EN 447 (10.2007)	Grout for prestressing tendons – Basic requirements
EN 523 (08.2003)	Steel strip sheaths for prestressing tendons – Terminology, requirements, quality control
EN 10025-Series (11.2004)	Hot rolled products of structural steels – Series
EN 10083-1 (08.2006)	Steels for quenching and tempering – Part 1: General technical delivery conditions
EN 10130 (12.2006)	Cold-rolled low carbon steel flat products for cold forming – Technical delivery conditions
EN 10139 (11.1997)	Cold rolled uncoated mild steel narrow strip for cold forming – Technical delivery conditions
EN 10204 (10.2004)	Metallic products – Types of inspection documents
EN 10210-1 (04.2006)	Hot finished structural hollow sections of non-alloy and fine grain steels – Part 1: Technical delivery conditions
EN 12201-1 (09.2011)	Plastics piping systems for water supply, and for drainage and sewerage under pressure – Polyethylene (PE) – Part 1: General
EN ISO 898-2 (03.2012)	Mechanical properties of fasteners made of carbon steel and alloy steel – Part 2: Nuts with specified property classes – Coarse thread and fine pitch thread
EN ISO 12944-4 (05.1998)	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 4: Types of surface and surface preparation
EN ISO 12944-5 (09.2007)	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 5: Protective paint systems
EN ISO 12944-7 (05.1998)	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 7: Execution and supervision of paint work
EN ISO 17855-1 (10.2014)	Plastics – Polyethylene (PE) moulding and extrusion materials – Part 1: Designation system and basis for specifications
prEN 10138-4 (08.2009)	Prestressing steels – Part 4: Bars

98/456/EC	Commission Decision 98/456/EC of 3 July 1998 on the procedure for attesting the conformity of construction products pursuant to Article 20(2) of Council Directive 89/106/EEC as regards post-tensioning kits for the prestressing of structures, Official Journal L 201 of 17 July 1998, page 112
305/2011	Regulation (EU) № 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, 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

VORSPANNUNG MIT VERBUND, Typ i
ZULASSUNG Z-13.1-114
ETA-05/0202

EXTERNE VORSPANNUNG, TYP E
ZULASSUNG Z-13.3-131
ETA-11/0123

VORSPANNUNG OHNE VERBUND, Typ L1P + Lo
ZULASSUNG Z-13.2-70
ZULASSUNG Z-13.2-132
ETA-13/0810

EXTERNE VORSPANNUNG, TYP EMR
ZULASSUNG Z-13.3-99

ANZAHL DER LITZEN	SPANNSTAHL-QUERSCHNITT A_P [mm²]		VORSPANNKRAFT P_{max} [kN] St 1570/1770		VORSPANNKRAFT P_{max} [kN] St 1660/1860	
	140 mm²	150 mm²	140 mm²	150 mm²	140 mm²	150 mm²
3	420	450	567	608	605	648
4	560	600	756	810	806	864
5	700	750	945	1013	1008	1080
7	980	1050	1323	1418	1411	1512
9	1260	1350	1701	1823	1814	1944
12	1680	1800	2268	2430	2419	2592
15	2100	2250	2835	3038	3024	3240
19	2660	2850	3591	3848	3830	4104
22	3080	3300	4158	4455	4435	4752
27	3780	4050	5103	5468	5443	5832
31	4340	4650	5859	6278	6250	6696
L1P	140	150	189	203	202	216
Lo1	140	150	186 [1)]	199 [1)]		
Lo3	420	450	567	608	605	648
Lo4	560	600	756	810	806	864
Lo5	700	750	945	1013	1008	1080
Lo7	980	1050	1323	1418	1411	1512
Lo9	1260	1350	1701	1823	1814	1944
9	1260		1673 [1)]			
12	1680		2230 [1)]			
15	2100		2788 [1)]			
16	2240		2974 [1)]			
17	2380		3159 [1)]			
19	2660		3531 [1)]			

STABSPANNGLIEDER MIT/OHNE VERBUND
ETA-07/0046
ETA-16/0286

STABDURCH-MESSER [mm]	STAHLGÜTE	STAHL-QUERSCHNITT A_P [mm²]	STAHL-GEWICHT [kg/m]	VORSPANNKRAFT P_{max} [kN]
25	835 / 1030	491	4,07	369
26,5	835 / 1030	552	4,56	414
32	835 / 1030	804	6,66	604
36	835 / 1030	1018	8,45	765
40	835 / 1030	1257	10,41	944
50	835 / 1030	1963	16,02	1476

Gerne schicken wir Ihnen auch unsere weiteren Zulassungsbescheide. Bitte wenden Sie sich hierzu an die untenstehende Adresse.

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www.bbv-systems.com

Die maximale Vorspannkraft am Spannglied während des Spannvorgangs P_{max} nach DIN EN 1992-1-1 errechnet sich zu:

$P_{max} = 0{,}90^{2)} \cdot f_{p0,1k} \cdot A_p$

mit $f_{p0,1k}$ = 1500 N/mm² bei St 1570/1770
mit $f_{p0,1k}$ = 1600 N/mm² bei St 1660/1860
mit $f_{p0,1k}$ = 835 N/mm² bei St 835/1030

Hinweis: Wenn es am Ort der Verwendung zulässig ist, darf für $f_{p0,1k}$ ein größerer Wert verwendet werden.

1) Ausnahme: Typ Lo1 und Typ EMR:

$P_{max} = 0{,}75 \cdot f_{pk} \cdot A_p$ mit f_{pk} = 1770 N/mm² bei St 1570/1770

2) k_2 = 0,90 bzw. k_3 = 0,95: siehe DIN EN 1992-1-1 Abschnitt 5.10.2.1(2)

WIR SORGEN FÜR SPANNUNG
WE STRESS FOR STRENGTH