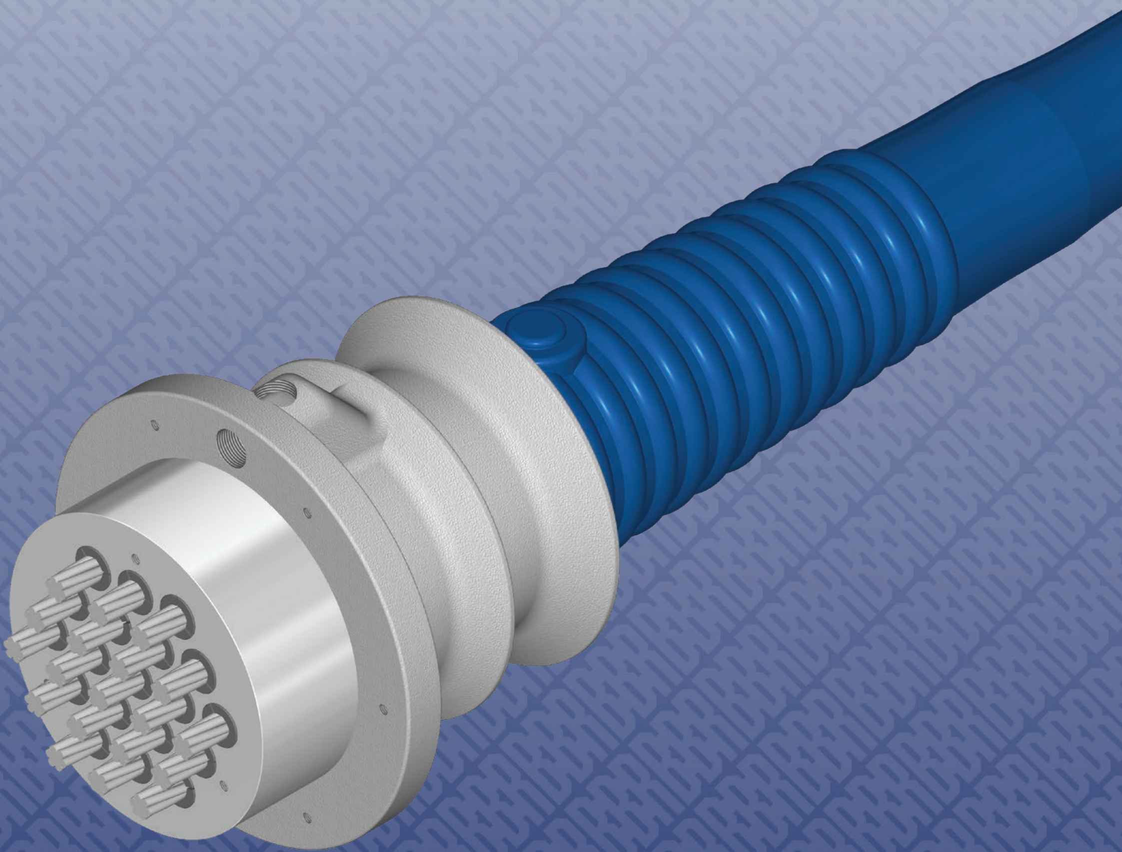
European Technical Assessment
ETA – 07/0168

CE

BBR VT CONA CME

External Post-tensioning System



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ETA-07/0168
BBR VT CONA CME
External Post-tensioning System

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SPECIMEN

Responsible BBR PT Specialist Company

The delivery note accompanying components of the BBR VT CONA CME Post-tensioning System will contain the CE marking.

Assembly and installation of BBR VT CONA CME tendons must only be carried out by qualified BBR PT Specialist Companies. Find the local BBR PT Specialist Company by visiting the BBR Network website www.bbrnetwork.com.

European Organisation for Technical Approvals
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ETAG 013	Guideline for European Technical Approval of Post-tensioning Kits for Prestressing of Structures
CWA 14646	Requirements for the installation of post-tensioning kits for prestressing of structures and qualification of the specialist company and its personnel

BBR E-Trace is the trading and quality assurance platform of the BBR Network linking the Holder of Approval, BBR VT International Ltd, BBR PT Specialist Companies and the BBR Manufacturing Plant. Along with the established BBR Factory Production Control, BBR E-Trace provides effective supply chain management including installation, delivery notes and highest quality standards, as well as full traceability of components.

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ETA-07/0168 of 18.12.2017

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	BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands
Product family to which the construction product belongs	Post-tensioning kit for external prestressing of structures
Manufacturer	BBR VT International Ltd Ringstrasse 2 8603 Schwerzenbach (ZH) Switzerland
Manufacturing plant	BBR VT International Ltd Ringstrasse 2 8603 Schwerzenbach (ZH) Switzerland
This European Technical Assessment contains	63 pages including Annexes 1 to 33, 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, 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 approval ETA-07/0168 with validity from 20.12.2012 to 19.12.2017.

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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 PT system

BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands,

comprising the following components, see Annex 1 and Annex 2.

– Tendon

  External tendon with 04 to 61 tensile elements

– Tensile element

  7-wire prestressing steel strand with nominal diameters and maximum characteristic tensile strength as given in Table 1.

  7-wire prestressing steel strands with nominal diameters and maximum characteristic tensile strength as given in Table 1, factory-provided with a corrosion protection system, comprising corrosion protection filling material and HDPE-sheathing – Monostrand.

  Tendon with monostrands is installed in one common duct and grouted prior to stressing.

Table 1 Tensile elements

Nominal diameter	Nominal cross-sectional area	Maximum characteristic tensile strength
mm	mm^2	MPa
15.3	140	1 860
15.7	150	

NOTE 1 MPa = 1 N/mm^2

– Anchorage of the prestressing steel strands with ring wedges

[1] ETA-07/0168 was firstly issued in 2006 as European technical approval with validity from 25.08.2006, extended in 2011 with validity from 05.07.2011, amended in 2013 with validity from 04.03.2013, converted in 2016 to European Technical Assessment ETA-07/0168 of 20.12.2012 to 19.12.2017, and amended in 2017 to European Technical Assessment ETA-07/0168 of 18.12.2017

- End anchorage

  Fixed (passive) anchor or stressing (active) anchor as end anchorage (SA, FA) for tendons with 04, 07, 09, 12, 15, 19, 22, 24, 27, 31, 37, 42, 43, 48, 55, and 61 prestressing steel strands

  Fixed (passive) anchor or stressing (active) anchor as end anchorage for replaceable tendons (SAR, FAR) with 04, 07, 09, 12, 15, 19, 22, 24, 27, 31, 37, 42, 43, 48, 55, and 61 prestressing steel strands

  Fixed (passive) anchor or stressing (active) anchor for electrically isolated tendons (SAE, FAE) with 04, 07, 09, 12, 15, 19, 22, 24, 27, and 31 prestressing steel strands

  Fixed (passive) anchor or stressing (active) anchor for replaceable and electrically isolated tendons (SAER, FAER) with 04, 07, 09, 12, 15, 19, 22, 24, 27, and 31 prestressing steel strands

- Fixed or stressing coupler

  Single plane coupler (FK, SK) for tendons with 04, 07, 09, 12, 15, 19, 22, 24, 27, and 31 prestressing steel strands

  Sleeve coupler (FH, SH) for tendons with 04, 07, 09, 12, 15, 19, 22, 24, 27, 31, 37, 42, 43, 48, 55, and 61 prestressing steel strands

  Sleeve coupler (FHE, SHE) for electrically isolated tendons with 04, 07, 09, 12, 15, 19, 22, 24, 27, and 31 prestressing steel strands

- Bearing trumplate for tendons with 04, 07, 09, 12, 15, 19, 22, 24, 27, 31, 37, 42, 43, 48, 55, and 61 prestressing steel strands
- Helix and additional reinforcement in the region of the anchorage
- Ducts in steel or plastic
- Corrosion protection for tensile elements, couplers, and anchorages

PT system

1.2 Designation and range of anchorages and couplers

1.2.1 Designation

End anchorage, e.g. S A (E) CONA CME 1906-150 1860

Stressing (S) or fixed (F)

Anchor head (A)

Optional tendon use
None ( ), Electrically isolated (E), Replaceable (R),
Electrically isolated and replaceable (ER)

Designation of the tendon
with information on number, cross-sectional area, and characteristic tensile strength of the prestressing steel strands

Coupler, e.g. F K (E) CONA CME 1906-150 1860

Fixed (F) or stressing (S)

Coupler anchor head (K or H)

Optional tendon use
None ( ), Electrically isolated (E)

Designation of the tendon
with information on number, cross-sectional area, and characteristic tensile strength of the prestressing steel strands

Anchor head A is supported on bearing trumplate A that transmits the force to the structural concrete. In the region of the anchorage, the structural concrete is confined with helix and additional reinforcement.

1.2.2 Anchorage

1.2.2.1 General

Anchorage of prestressing steel strands is achieved by wedges and anchor heads A, see Annex 1, Annex 2, and Annex 3. The anchor heads A of stressing and fixed anchorages are identical. A differentiation is needed for the construction works.

The wedges of inaccessible fixed anchors are secured with either a wedge retaining plate or springs and a wedge retaining plate. An alternative is pre-locking each individual prestressing steel strand with ~ 0.5 · F_{pk} and applying a wedge retaining plate.

Where

F_{pk} .... N.............. Characteristic value of maximum force of one single prestressing steel strand

1.2.2.2 Restressable tendon

For tendons remaining restressable throughout the working life of the structure, grease, wax, or an equivalent soft material is used. This is applicable to

- Bare strands in a common duct and
- Monostrands, grouted in a common duct.

Bare strands, grouted in a common duct are not restressable.

Significant to a restressable tendon is the excess length of the prestressing steel strands, see Annex 1. The extent of the excess length depends on the jack used for restressing and where applicable, the elongation for a full release of the prestressing force of the tendon. The protrusions of the prestressing steel strands require a permanent corrosive protection and an adapted protection cap.

1.2.2.3 Exchangeable tendon

Exchanging tendons in general is available for

- Bare strands with grease, wax, or an equivalent soft material in a common duct
- Monostrands, grouted in a common duct, see Clause 1.3
- Bare strands, grouted in a common duct, can only be completely removed and subsequently replaced by a new tendon, see Annex 2, anchorages FAR and SAR for replaceable tendons. Inner trumpet A is placed in bearing trumplate A and trumpet A, extends up to anchor head A and provides a separating layer between structure and tendon. After full release of the

prestressing force, the complete tendon with inner trumpet A can be pulled out from the structure and replaced by a new tendon.

1.2.2.4 Electrically isolated tendon

The anchorage of an electrically isolated tendon, see Annex 2, comprises the following components.

- Fixed and stressing anchorage according to Clause 1.2.2.1.
- Steel ring E, see Annex 7
- Isolation ring E, see Annex 7
- Bearing trumplate E, see Annex 7
- Trumpet E, see Annex 7
- Plastic duct, see Annex 10
- Protection cap E, see Annex 7

Trumpet E continues through bearing trumplate E up to steel ring E. For electrically isolated tendon isolation ring E is placed between bearing trumplate E and steel ring E. Steel ring E supports the anchor head A. Protection cap E encases the anchorage and provides a port as inlet or vent that is sealed with a plug.

With electrically isolated tendon, the complete tendon, i.e. including prestressing steel strands, anchorages, and couplers, is fully encased with isolation material. The integrity of the electrical isolation can be verified and monitored via electrical resistance measurements between tendon and reinforcement of the structure.

1.2.2.5 Exchangeable and electrically isolated tendon

Exchanging electrically isolated tendons in general is available for

- Bare strands with grease, wax, or an equivalent soft material in a common duct
- Monostrands, grouted in a common duct, see Clause 1.3
- Bare strands, grouted in a common duct, can only be completely removed and replaced with a new tendon, see Annex 2, anchorages FAER and SAER for replaceable and electrically isolated tendons. Inner trumpet E, see Annex 8, is placed in bearing trumplate E and trumpet A, extends up to steel ring E and provides a separating layer between structure and tendon. Anchorage and tendon comprises the following components.
  - Steel ring E, see Annex 7
  - Isolation ring E, see Annex 7
  - Bearing trumplate E, see Annex 7
  - Trumpet A, see Annex 5, together with inner trumpet E, see Annex 8
  - Plastic duct, see Annex 10
  - Protection cap E, see Annex 7

  After full release of the prestressing force, the complete tendon with inner trumpet E can be pulled out from the structure and replaced by a new tendon.

1.2.3 Fixed and stressing coupler

1.2.3.1 Single plane coupler, FK, SK

The coupling is achieved by means of a coupler anchor head K, see Annex 1 and Annex 3. The prestressing steel strands of the first construction stage are anchored by means of wedges in machined cones, drilled in parallel. The arrangement of the cones of the first construction stage is identical to that of anchor head A of the stressing anchorage. The prestressing steel strands of the second construction stage are anchored in a circle around the cones of the first construction stage by means of wedges in machined cones, drilled at an inclination of 7 °. The wedges for the second construction stage are secured by springs and a cover plate.

The transition trumpet to duct in steel is provided with a 100 mm long and at least 3.5 mm thick PE-HD insert at the deviating point at the end of the trumpet. The insert is not required for plastic trumpets, where the ducts are slipped over the plastic trumpets.

1.2.3.2 Sleeve coupler, FH, SH

The coupler anchor head H, see Annex 1, Annex 2, and Annex 4, is of the same basic geometry as anchor head A of the fixed and stressing anchor. Compared to anchor head A of the fixed and stressing anchor, the coupler anchor head H is deeper and provide an external thread for the coupler sleeve H.

The connection between the coupler anchor heads H of first and second construction stage is achieved by means of a coupler sleeve H.

The transition trumpet to duct in steel is provided with a 100 mm long and at least 3.5 mm thick PE-HD insert at the deviating point at the end of the trumpet. The insert is not required for plastic trumpets, where the ducts are slipped over the plastic trumpets.

1.2.3.3 Electrically isolated fixed and stressing coupler

The electrically isolated fixed and stressing coupler, see Annex 2, is a sleeve coupler and comprises the following components.

- Electrically isolated stressing anchorage according to Clause 1.2.2.4 at the first construction stage with coupler anchor head H.
- Second construction stage and connection of first and second construction stage with a sleeve coupler according to Clause 1.2.3.2.
- Plastic housing to fully encase the fixed or stressing coupler with isolation material.

1.3 Tendon with monostrands

The tendon comprises monostrands in one common duct that is grouted prior to stressing. During grouting a sealing plate together with an activation plate is installed at the anchorage to arrange the monostrands and resist the grouting pressure. After grouting the monostrand ends are de-sheathed. For stressing, the anchor head A is placed on the grouted tendon.

Stressing can be commenced, once compressive strength of the grout is sufficiently developed. This is in general not before a compressive strength of $\geq$ 10 MPa is attained by the grout.

Tendon with monostrands allows for the smallest deflection radius of the tendon.

Exchange of tendons with monostrands is in general performed according to the Clauses 1.2.2.3 and 2.2.4.7. Tendons with straight tendon paths – or tendon paths that exhibit slight deviations only – can be exchanged in a strand-by-strand procedure, individually for each monostrand. However, after exchanging the prestressing steel strands, the monostrands are sufficiently completed with corrosion protection filling material.

1.4 Layout of the anchorage recesses

All bearing trumplates, anchor heads, and coupler heads are placed perpendicular to the axis of the tendon, see Annex 25.

The dimensions of the anchorage recesses are adapted to the prestressing jacks used. The ETA holder saves for reference information on the minimum dimensions of the anchorage recesses.

The formwork for the anchorage recess should be slightly conical for ease of removal. In case of anchorage fully embedded in concrete, the recess is designed so as to permit a reinforced concrete cover with the required dimensions and in any case with a thickness of at least 20 mm. In case of exposed anchorage, concrete cover of anchorage and bearing trumplate is not required. However, the exposed surfaces of bearing trumplate and steel cap are provided with corrosion protection.

1.5 Designation and range of the tendons

1.5.1 Designation

Tendon, e.g. CONA CME 19 06-150 1860

- External PT ← CONA CME
- Number of strands, 04 to 61 ← 19
- Prestressing steel strand ← 06
- Cross-sectional area of strand, 140 or 150 mm^2 ← 150
- Characteristic tensile strength of strand ← 1860

The tendons comprise 04 to 61 tensile elements, 7-wire prestressing steel strands according to Annex 12.

1.5.2 Range

1.5.2.1 General

Characteristic maximum force of tendon with 04 to 61 prestressing steel strands are listed in Annex 13 and Annex 14.

Prestressing and overstressing forces are applied according to the corresponding standards and regulations in force at the place of use. The maximum prestressing and overstressing forces according to Eurocode 2 are listed in Annex 15.

The tendons consist of 04, 07, 09, 12, 15, 19, 22, 24, 27, 31, 37, 42, 43, 48, 55, or 61 prestressing steel strands. By omitting prestressing steel strands in the anchorages and couplers in a radially symmetrical way, also tendons with numbers of strands lying between the numbers given above can be installed. Any unnecessary hole either remains undrilled or is provided with a short piece of prestressing steel strand and a wedge is inserted. For coupler anchor head K the cones of the outer pitch circle, second construction stage, may be equally redistributed if prestressing steel strands are omitted. However, the overall dimensions of the coupler anchor head K remain unchanged.

With regard to dimensions and reinforcement, anchorages and couplers with omitted prestressing steel strands remains unchanged compared to anchorages and couplers with a full number of prestressing steel strands.

1.5.2.2 CONA CMI n06-140

7-wire prestressing steel strand

Nominal diameter .... 15.3 mm
Nominal cross-sectional area .... 140 mm^2
Maximum characteristic tensile strength............... 1 860 MPa

Annex 13 lists the available tendon range for CONA CMI n06-140.

1.5.2.3 CONA CMI n06-150

7-wire prestressing steel strand

Nominal diameter ....15.7 mm

Nominal cross-sectional area ....150 mm^2

Maximum characteristic tensile strength.............. 1 860 MPa

Annex 14 lists the available tendon range for CONA CMI n06-150.

1.6 Duct

Ducts are either in plastic or in steel. The inner diameter of the duct meets the requirements of Table 2.

$$f = \frac{\text{cross-sectional area of prestressing steel}}{\text{cross-sectional area of inner diameter of duct}}$$

$$k_D = \frac{\text{Inner diameter of the duct}}{\sqrt{\text{cross-sectional area of prestressing steel}}}$$

Where

f .... — ....degree of filling

k_D .... — ....duct coefficient

Table 2 Degree of filling and duct coefficient

Duct	f	k_D 1)
Minimum 2)	0.45	1.68
Standard	0.40	1.79
Long tendons	0.30–0.35	2.05–1.90

1) Minimum value according to ENV 1992-1-5 [2], clause 1.6

2) Not for wax injection of PE-duct

Exemplary values of duct sizes are shown in Annex 10.

Jointing and sealing of the ducts can be performed by welding or by non welding jointing techniques, e.g. sleeves and collars. If the joints are resistant to the injection pressure according to ENV 1992-1-5, an internal pressure of at least 1 N/mm^2 is observed.

1.7 Friction losses

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

$$F_x = F_0 \cdot e^{-\mu \cdot \alpha}$$

Where

[2] Standards and Guidelines and other documents referred to in the European Technical Assessment are listed in Annex 32 and Annex 33.

F_x ....kN ....Prestressing force at a distance x along the tendon

F_0 ....kN ....Prestressing force at x = 0 m

μ .... rad^{-1} ....Friction coefficient, see Table 3

α .... rad............Sum of the angular displacements over the distance x, irrespective of direction or sign

x .... m.............Distance along the tendon from the point where the prestressing force is equal to F_0

NOTE 1 1 rad = 1 m/m = 1

NOTE 2 Wobble effects may be neglected for external tendons.

Table 3 Friction coefficient

Duct	Recommended values	Range of values
	μ	μ
	rad^{-1}	rad^{-1}
Bare strands in smooth steel duct	0.18	0.16–0.24
Bare strands in smooth plastic duct	0.12	0.10–0.14
Monostrands in duct and grouted	0.05	—

Table 4 Friction losses in anchorages

Tendon	ΔF_s
—	%
CONA CME 0406	1.2
CONA CME 0706	1.1
CONA CME 0906	1.0
CONA CME 1206 to 3106	0.9
CONA CME 3706 to 6106	0.8

Where

ΔF_s........ %.............Friction loss in anchorages and first construction stage of fixed couplers. This is taken into account for determination of elongation and prestressing force along the tendon.

1.8 Slip at anchorages and couplers

Slip at stressing anchorages, at fixed anchorages, and at fixed couplers, first and second construction stages, is 6 mm. At stressing anchorage and at first construction stage of fixed couplers the slip is 4 mm, provided a prestressing jack with a wedge system and a wedging force of around 25 kN per prestressing steel strand is used.

1.9 Centre spacing and edge distance for anchorages

In general, spacing and distances are not less than given in Annex 16, Annex 17, Annex 18, Annex 19, Annex 20, Annex 21, Annex 22, and Annex 23. However, centre spacing of tendon anchorages may be reduced in one direction by up to 15 %, but not smaller than the outside diameter of the helix and placing of additional reinforcement is still possible. In this case centre spacing in the perpendicular direction is increased by the same percentage, see also Annex 24. The corresponding edge distances are calculated by

$$a_e = \frac{a_c}{2} - 10\ \text{mm} + c$$

$$b_e = \frac{b_c}{2} - 10\ \text{mm} + c$$

Where

a_c ....mm ....Centre spacing

b_c ....mm ....Centre spacing in the direction perpendicular to a_c

a_e ....mm ....Edge distance

b_e ....mm ....Edge distance in the direction perpendicular to a_e

c ....mm ....Concrete cover

The minimum values for a_c, b_c, a_e, and b_e are given in Annex 16, Annex 17, Annex 18, Annex 19, Annex 20, Annex 21, Annex 22, and Annex 23.

Standards and regulations on concrete cover in force at the place of use are observed.

1.10 Minimum radii of curvature

In Annex 10 the minimum radii of curvature of the tendon, R_{min}, are given versus the number of prestressing steel strands in the tendon.

The tendon with monostrands, grouted prior to stressing, provides the smallest radius of curvature.

For smaller radii, stresses in tensile elements and wear of the duct need to be verified.

1.11 Concrete strength at time of stressing

Concrete in conformity with EN 206 is used.

At the time of stressing, the mean concrete compressive strength, $f_{cm,0}$, is at least according to Table 5. The concrete test specimens are subjected to the same hardening conditions as the structure.

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

Table 5 Compressive strength of concrete

Mean concrete strength, $f_{cm,0}$								
Cube strength 150 mm cube	$f_{cm,0,cube}$	MPa	23	28	34	38	43
Cylinder strength, 150 mm cylinder diameter	$f_{cm,0,cylinder}$	MPa	19	23	28	31	35

Helix, additional reinforcement, centre spacing, and edge distance corresponding to the concrete compressive strengths are taken from Annex 18, Annex 19, Annex 20, Annex 21, Annex 22, and Annex 23, see also the Clauses 1.14.8 and 2.2.3.4.

1.12 Deviator

1.12.1 General

The deviator transfers the forces generated by the tendon, transversal (radial to the deviator) and longitudinal (tangential to the deviator), to the structure. Moreover, the deviator provides a smooth surface for the tendon. The deviator can be made of concrete, steel, or of other material, equivalent in terms of structural and surface requirements. Permanent inserts for deviators of concrete can be made of PE-HD, steel, or of equivalent material to meet the surface requirements.

To avoid any kinking of the tendon, it is recommended to provide an additional deviation, $\Delta\alpha$, of e.g. ≥ 3 °, see Annex 9.

For grouting or for filling the ducts with corrosion protection filling material, vents are provided or vacuum grouting is applied.

1.12.2 Pre-installed single tube deviator

The deviator is a pre-bent tube that is part of the tendon conduit, see Annex 9. The duct of the tendon is jointed to both ends of the tube.

Jointing between duct and deviator can be by sleeves, collars, or by welding

1.12.3 Double tube deviator

The deviator is a pre-formed recess unit of the structure that is not part of the tendon conduit. The duct of the tendon is passed through the recess unit, see Annex 9.

Components

1.13 Prestressing steel strand

Only 7-wire prestressing steel strands with characteristics according to Table 6 are used, see also Annex 12. The corrosion protection system of the monostrands, comprising corrosion protection filling material and HDPE-sheathing, is as specified in Clause 1.18.

Table 6 Prestressing steel strands and monostrands

Maximum characteristic tensile strength [1)]	f_{pk}	MPa	1 860	
Nominal diameter	d	mm	15.3	15.7
Nominal cross-sectional area	A_p	mm²	140	150
Mass of prestressing steel	M	kg/m	1.093	1.172
Monostrands				
Mass of monostrand		kg/m	1.23	1.31
External diameter of HDPE-sheathing		mm	≥ 19.5	≥ 20

[1)] Prestressing steel strands with a characteristic tensile strength below 1 860 MPa may also be used.

In a single tendon, only prestressing steel strands spun in the same direction are used.

In the course of preparing the European Technical Assessment, no characteristic has been assessed for the prestressing steel strands. In execution, a suitable prestressing steel strand that conforms to Annex 12 and is according to the standards and regulations in force at the place of use is taken.

1.14 Anchorage and coupler

1.14.1 General

The components of anchorages and couplers are in conformity with the specifications given in Annex 3, Annex 4, Annex 5, Annex 6, Annex 7, and Annex 8 and the technical file[3]. Therein the component dimensions, materials, and material identification data with tolerances are given.

1.14.2 Anchor head

The anchor head A is made of steel and provides regularly arranged conical holes, drilled in parallel to accommodate prestressing steel strands and wedges, see Annex 3. In addition, threaded bores may be provided to attach protection caps and wedge retaining plates. At the back of the anchor head A there may be a step for ease of centring the anchor head A on bearing trumplate A or E, or on steel ring E.

1.14.3 Bearing trumplate

The bearing trumplate, made of cast iron, transmits the force via 3 anchorage planes to the concrete. Air-vents are situated at the top and at the interface plane to the anchor head. A ventilation tube can be fitted to these air-vents. On the tendon sided end, there is an inner thread to take the trumpet.

There are two bearing trumplates. Firstly, bearing trumplate A with trumpet A, see Annex 4, and secondly, bearing trumplate E, see Annex 7, for electrically isolated tendons with trumpet E.

1.14.4 Trumpet

The conical trumpets A, K, and H, see Annex 5, are made either of steel, PE, or PP, and the conical trumpet E, inner trumpet A, and inner trumpet E, see Annex 8, are made of PE or PP. Inner trumpet A and inner trumpet E are used together with trumpet A in PE or PP.

The trumpets manufactured in steel have a corrugated or plain surface. In case the transition from trumpet to duct is made in steel, a 100 mm long and at least 3.5 mm thick PE-HD insert is installed at the deviating point of the prestressing steel strands.

The conical trumpets made of PE may have either a corrugated or a plain surface. At the duct-side end, there is a radius for the deviation of the prestressing steel strands and a smooth surface, to ensure a good transition to the duct. The opposite end is connected to the bearing trumplate.

1.14.5 Coupler anchor head K and H

Coupler anchor head K, see Annex 3, for the single plane coupler is made of steel and provide in the inner part for anchorage the prestressing steel strands of the first construction stage the same arrangement of holes as the anchor head A for the stressing or fixed anchorages. In the outer pitch circle, there is an arrangement of holes with an inclination of 7 ° to accommodate the prestressing steel strands of the second construction stage. A cover plate is fastened by means of additional threaded bores.

Coupler anchor head H, see Annex 4, for the sleeve coupler H is made of steel and has the same basic geometry as the anchor head A of the stressing or fixed anchorages. Compared to the anchor head A of the fixed and stressing anchor, coupler anchor head H is deeper and provides

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[3] PL2 and PL3 are protection levels according to fib bulletin 33.

an external thread for coupler sleeve H. Wedge retaining plate H is fastened by means of additional threaded bores.

The coupler sleeve H is a steel tube with an inner thread and provided with ventilation holes.

At the back of the coupler anchor heads K and H there is a step for ease of centring the coupler anchor head on bearing trumplates A or E, or on steel ring E.

1.14.6 Components for electrically isolated anchorage and coupler

Electrically isolation is achieved by an isolation ring E placed between bearing trumplate E and steel ring E, see Annex 2 and Annex 7. Steel ring E serves for load distribution of the prestressing force from anchor head A via isolation ring E to bearing trumplate E.

For full encapsulation of the tendon with isolation material, trumpet E or inner trumpet E, see Clause 1.2.2.4 and Clause 1.2.2.5, extend up to steel ring E.

1.14.7 Ring wedges

The ring wedges, see Annex 3, are in either two pieces or three pieces. Four different ring wedges are used.

- Ring wedge H in three pieces, fitted with spring ring, is available in two different materials
- Ring wedge F in three pieces, without spring ring or fitted with spring ring, is made of one material.
- Ring wedge Z in two pieces, without spring ring or fitted with spring ring, is made of one material.

Within one anchorage or coupler, only one of these ring wedges is used.

In the case of fixed anchors and couplers, the wedges are held in place by a wedge retaining plate, by springs with a wedge retaining plate, or by springs with a cover plate. An alternative is pre-locking each individual prestressing steel strand with ~ $0.5 \cdot F_{pk}$ and applying a wedge retaining plate as per Clause 1.2.2.1.

Where

F_{pk} ....N..............Characteristic value of maximum force of one single prestressing steel strand

1.14.8 Helix and additional reinforcement

Helix and additional reinforcement are made of ribbed reinforcing steel. The end of the helix on the anchorage side is welded to the next turn. The helix is placed exactly in the tendon axis. The helix dimensions conform to the values specified in Annex 18, Annex 19, Annex 20, Annex 21, Annex 22, and Annex 23.

If required for a specific project design, the reinforcement given in Annex 18, Annex 19, Annex 20, Annex 21, Annex 22, and Annex 23 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.

1.14.9 Protection caps

1.14.9.1 General

Recessed and exposed anchorages without permanent protection caps with vents are not executed. All inaccessible or accessible fixed anchorages FA are equipped with protection caps to ensure a fully continuous corrosion protection of the tendon, from all wedges of the one end to all wedges of the other end.

1.14.9.2 Protection caps, long protection cap

The protection caps A and E, and the long protection cap, see Annex 1, Annex 2, Annex 6, and Annex 7, are provided with an air-vent and attached to the anchorage with screws or threaded rods. The protection caps are permanent. Protection cap A is made of steel or plastic, protection cap E is made of plastic, and the long protection cap is made of steel or plastic.

Protection cap A in steel fully encases anchor head A with ring wedges and is left in place after filling. The permanent steel cap is used for inaccessible and accessible fixed anchorages FA, and for stressing anchorages SA and SAR.

Protection cap A in plastic, see Annex 6, is a UV-protected plastic cap that fully encases anchor head A and ring wedges. The protection cap is permanent and for one-time use only. The protection cap is used for inaccessible and accessible fixed anchorages FA, and for stressing anchorages SA and SAR.

Protection cap E in plastic, see Annex 7, is a permanent UV-protected plastic cap that fully encases anchor head A and ring wedges. The protection cap is permanent and for one-time use only. Protection cap E is used for electrically isolated tendons. In particular it is attached to electrically isolated inaccessible and accessible fixed anchorages FAE and stressing anchorages SAE and SAER. After filling, all inlet and outlet ports of the electrically isolated tendon are sealed with suitable plugs to provide fully electrically isolation.

The long protection cap in steel, see Annex 6, fully encases anchor head A with ring wedges and is left in place after filling. The permanent steel cap is used for restressable and exchangeable tendons at the stressing anchorages SA and SAR to protect the strand protrusions. The long protection cap is also available in plastic.

1.15 Ducts

1.15.1 Plastic duct

Plastic ducts conform to EN 12201-1 and, if not installed in a closed hollow box girder, are resistant to UV radiation. In general, for tendons with a maximum of 12 prestressing steel strands, ducts made of PE 80 or PE 100, class PN 10 may be used, while for larger tendons class PN 6 is sufficient. A frequently used method for jointing is mirror welding.

The minimum wall thicknesses given in Annex 10 are appropriate for the minimal radius and grout or corrosion protection filling material. It is permitted to reduce these values by 15 % for a radius $R \geq 1.5 \cdot R_{min}$. In case of injection of wax as corrosion protection filling material, the values are increased by 15 %, see Annex 10.

1.15.2 Steel duct

Steel ducts conform to EN 10255, EN 10216-1, EN 10217-1, EN 10219-1, or EN 10305-5.

Minimum wall thicknesses of steel ducts are given in Annex 10.

1.16 Material specifications

In Annex 11 the material specifications of the components are given.

1.17 Permanent corrosion protection

In the course of preparing the European Technical Assessment, no characteristic has been assessed for components and materials of the corrosion protection system. In execution, all components or materials are 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, Annex C.1, should be deemed as acceptable.

To protect the tendons from corrosion, ducts, couplers, and anchorages are completely filled with grout according to EN 447 or special grout according to ETAG 013, corrosion protection filling material according ETAG 013, Annex C.4.1 or Annex C.4.2, as applicable at the place of use.

However, applicable corrosion protection filling materials are grout as rigid material and grease, wax, or an equivalent soft material.

In case of anchorages fully embedded in concrete, the recesses are designed as to permit a reinforced concrete cover with the required dimensions and in any case with a thickness of at least 20 mm. With exposed anchorages or with anchorages with insufficiently thick concrete cover, the surfaces of bearing trumplates and steel caps are provided with corrosion protection.

1.18 Monostrand

Tendons with monostrands are installed in one common duct and grouted prior to stressing.

Monostrand is a prestressing steel strand that is factory-provided with a corrosion protection filling material and an extruded HDPE sheathing. The monostrand conforms to ETAG 013, Annex C1.

The corrosion protection filling material for monostrands is specified in ETAG 013, Annex C.1, or an equivalent soft material. Material and thickness of the sheathing conforms to ETAG 013, Annex C.1.

As an alternative, monostrands, including corrosion protection filling material and sheathing, according to the standards and regulations in force at the place of use may be applied.

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 prestressing of structures. The specific intended uses are listed in Table 7.

Table 7 Intended uses

Line №	Use category
Use categories according to tendon configuration and material of structure	
1	External tendon for concrete structures with a tendon path situated outside the cross section of the structure or member but inside its envelope
Optional use categories	
2	Restressable external tendon
3	Exchangeable external tendon
4	Electrically isolated tendon
5	Tendon for use in structural composite construction as external tendon
6	Tendon for use in structural masonry construction as 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.

- During transport of prefabricated tendons, a minimum diameter of curvature of 1.6 m for tendons up to CONA CMI 1506 and 1.70 m for larger tendons is observed.
- Temporary protection of prestressing steel and components in order to prevent corrosion during transport from production site to job site
- Transportation, storage, and handling of prestressing steel and other components in a manner as to avoid damage by mechanical or chemical impact
- Protection of prestressing steel and other components from moisture
- Keeping tensile elements separate from areas where welding operations are performed

2.2.3 Design

2.2.3.1 General

Design of the structure permits correct installation and stressing of the tendons. The reinforcement in the anchorage zone permits correct placing and compacting of concrete.

At the anchorages and couplers, the tendon layout provides a straight section over a length as specified in Annex 9 beyond the end of the trumpet.

Couplers are situated in straight tendon sections.

Design of the structure should consider protection of the external tendons against damage by e.g. impact of vehicles, vibrations, etc..

2.2.3.2 Anchorage Recess

Clearance is required for handling of prestressing jacks and for stressing. The dimensions of the anchorage recess are adapted to the prestressing jack used. The ETA holder keeps available information on prestressing jacks and appropriate clearance behind the anchorage.

The anchorage recess is designed with such dimensions as to ensure the required concrete cover and at least 20 mm at the protection cap in the final state.

In case of failure, the bursting out of prestressing steels is prevented. Sufficient protection is provided by e.g. a cover of reinforced concrete.

2.2.3.3 Maximum prestressing force

The prestressing and overstressing forces are specified in the respective standards and regulations in force at the place of use. Annex 15 lists the maximum prestressing and overstressing forces according to Eurocode 2.

2.2.3.4 Centre spacing, edge distance, and reinforcement in the anchorage zone

Centre spacing, edge distance, helix, and additional reinforcement given Annex 16, Annex 17, Annex 18, Annex 19, Annex 20, Annex 21, Annex 22, and Annex 23 are adopted.

Verification of transfer of prestressing forces to structural concrete is not required if centre spacing and edge distances of the tendons as well as grade and dimensions of additional reinforcement, see Annex 16, Annex 17, Annex 18, Annex 19, Annex 20, Annex 21, Annex 22, and Annex 23, are conformed to. In the case of grouped anchorages, the additional reinforcement of the individual anchorages can be combined, provided appropriate anchorage is ensured. However, number, cross-sectional area, and position with respect to the bearing trumplates remains unchanged.

NOTE Centre spacing and edge distances as well as concrete strength and reinforcement for larger tendons in terms of number, nominal diameter, and strength of prestressing steel strands are as well applicable to smaller tendons. For example, it is fully applicable to fit a tendon CONA CME 1906-140 1860 into an anchorage zone, detailed and executed for a CONA CME 2406-150 1860 tendon.

The reinforcement of the structure is not employed as additional reinforcement. Reinforcement exceeding the required reinforcement of the structure may be used as additional reinforcement, provided appropriate placing is possible.

The forces outside the area of the additional reinforcement are verified and, if necessary, dealt with by appropriate reinforcement.

If required for a specific project design, the reinforcement given in Annex 18, Annex 19, Annex 20, Annex 21, Annex 22, and Annex 23 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.

2.2.3.5 Fixed coupler

The prestressing force at the second construction stage is at no time greater than at the first construction stage, neither during construction, nor in the final state, nor due to any load combination.

2.2.3.6 Tendons in masonry structures – Load transfer to the structure

Load transfer of prestressing force to masonry structures is via concrete or steel members, designed according to the European Technical Assessment, in particular according to the Clauses 1.9, 1.11, 1.14.8, and 2.2.3.4 or according to Eurocode 3 respectively.

The concrete or steel members have such dimensions as to permit a force of $1.1 \cdot F_{pk}$ being 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.

Deviators are made of concrete or steel. The transfer of the forces from the deviator to the masonry is verified according to Eurocode 6 as well as to the respective standards and regulations in force at the place of use.

2.2.4 Installation

2.2.4.1 General

Assembly and installation of tendons are only carried out by qualified PT specialist companies with the required resources and experience in the use of external multi strand post-tensioning systems, see ETAG 013, Annex D.1 and CWA 14646. The respective standards and regulations in force at the place of use are considered. The company's PT site manager has a certificate, stating that she or he has been trained by the ETA holder and that she or he possesses the necessary qualifications and experience with the external PT system BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands.

The tendons may be manufactured on site or in the factory – prefabricated tendons.

Bearing trumplate, anchor head, and coupler anchor head are placed perpendicular to the tendon's axis.

Installation is carried out according to Annex 25, Annex 26, Annex 27, and Annex 28.

In case of single plane coupler K, the prestressing steel strands are provided with markers to be able to check the depth of engagement.

2.2.4.2 Monostrand tendons

The monostrands are threaded in one common duct, see Annex 26.

Prior to stressing, the monostrand tendon is grouted.

After grouting, the sealing plate and activation plate are removed. The protruding monostrands are de-sheathed and the anchor head A is placed for stressing.

Stressing can be commenced, once compressive strength of the grout is sufficiently developed. This is in general not before a compressive strength of $\geq$ 10 MPa is attained by the grout.

After stressing, protection cap A is fastened with screws on the anchorage. Protection cap A encases the anchorage and is filled with corrosion protection filling material to complete the corrosion protection. After filling, the inlet port of protection cap A is sealed with a plug.

2.2.4.3 Electrically isolated tendon

For electrical isolation, isolation ring E together with steel ring E are placed between bearing trumplate E and anchor head A, see Annex 2. Trumpet E and inner trumpet E extend through bearing trumplate E. Steel ring E is screwed on trumpet E or inner trumpet E

Voids in bearing trumplate E are filled with polymeric material to enhance electrical isolation.

After stressing, protection cap E is fastened with screws on the anchorage. Protection cap E encases the anchorage and provides a port as inlet or vent. After filling, all inlet and outlet ports of the electrically isolated tendon are sealed with suitable plugs to provide fully electrical isolation.

With electrically isolated tendon, the complete tendon, i.e. including prestressing steel strands, anchorages, and couplers, is fully encased with isolation material. The integrity of the electrical isolation is verified via electrical resistance measurements between tendon and reinforcement of the structure.

2.2.4.4 Stressing operation

With a mean concrete compressive strength in the anchorage zone according to the values laid down in Annex 18, Annex 19, Annex 20, Annex 21, Annex 22, and Annex 23 full prestressing may be applied.

Stressing and, if applicable, wedging is carried out using a suitable prestressing jack. The wedging force corresponds to approximately 25 kN per wedge.

Elongation and prestressing forces are continuously checked during the stressing operation. The results of the stressing operation are recorded and the measured elongations compared with the prior calculated values.

After releasing the prestressing force from the prestressing jack, the tendon pulls the prestressing steel strands by the amount of the slip into the anchor head.

Information on the prestressing equipment has been submitted to Österreichisches Institut für Bautechnik. The ETA holder keeps available information on prestressing jacks and appropriate clearance behind the anchorage.

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

2.2.4.5 Restressing

Restressing of tendons in combination with release and reuse of wedges is permitted, whereas the wedges bite into a least 15 mm of virgin strand surface and no wedge bite remains inside the final length of the tendon between anchorages.

For tendons remaining restressable throughout the working life of the structure, soft corrosion protection filling material according to Clause 1.17 is used. Moreover, a strand protrusion at the stressing anchor remains with a length, compatible with the prestressing jack used. The protruding prestressing steel strands are provided with an appropriate corrosion protection and a long protection cap is attached to the anchorage, see Annex 1.

2.2.4.6 Filling operations

2.2.4.6.1 Grouting

Grouting accessories such as inlets, outlets, caps, vents, etc. require compatibility with the PT system and provide sufficient tightness. Protection caps are always used to ensure proper grouting of tendon and to avoid voids around the wedges. Grout is injected through the inlet holes until it escapes from the outlet tubes with the same consistency. To avoid voids in the hardened grout special measures are applied for long tendons, tendon paths with distinct high points or inclined tendons. All vents and grouting inlets are sealed immediately after grouting. In case of K-couplers, the holes of the second construction stage, together with wedges and springs are checked for cleanness before and immediately after grouting the first construction stage.

The standards, observed for cement grouting in prestressing ducts, are EN 445, EN 446, and EN 447 or the standards and regulations in force at the place of use applies for ready mixed grout.

The results of the grouting operation are recorded in the grouting records.

2.2.4.6.2 Filling with corrosion protection filling material

The specifications in ETAG 013, Annex C.4, and the recommendations of the supplier are relevant for corrosion protection filling material.

Filling with corrosion protection filling material follows a similar procedure as the one specified for grouting.

The results of the filling operation are recorded in the filling records.

2.2.4.7 Exchange of tendons

Specifications for exchangeable tendons are defined during the design phase. Subject of exchange is either

– The prestressing steel strands either the complete tendon or stand by strand

– The complete tendon including prestressing steel strands, duct, and inner trumpet

Unless special procedures are considered already in the design phase of the structure, strand protrusions remain at the stressing anchor with a length compatible with the prestressing jack and allowing for release of the complete prestressing force. Moreover, soft corrosion protection filling material according to Clause 1.17 is applied.

Tendons with bare strands, grouted in a common duct, can only be completely removed and subsequently replaced by a new tendon. After full release of the prestressing force, the complete tendon with inner trumpet A is pulled out from the structure and replaced by a new tendon.

Stressing and fixed anchorages are accessible and adequate space is provided behind the anchorages.

2.2.4.8 Welding

Ducts may be welded.

The helix may be welded to the bearing trumplate to secure its position.

After installation of the tendons, no further welding operations are carried out on the tendons. In case of welding operations near tendons, precautionary measures are required to avoid damage.

Plastic components may be welded even after installation of the tendons.

2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of the BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands of 100 years, provided that the BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands is subject to appropriate installation, use, and maintenance, see Clause 2.2. These provisions are based upon the current state of the art and the available knowledge and experience.

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

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

3.1 Essential characteristics

The performances of the PT system for the essential characteristics are given in Table 8 and Table 9. In Annex 31 the combinations of essential characteristics and corresponding intended uses are listed.

Table 8 Essential characteristics and performances of the product

№	Essential characteristic	Product performance
Product BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands Intended use The PT system is intended to be used for the prestressing of structures, Clause 2.1, Table 7, line № 1		
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.	—

[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.

№	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 9 Essential characteristics and performances of the product in addition to Table 8 for optional use categories

№	Additional essential characteristic	Product performance
Product BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands Optional use category Clause 2.1, Table 7, lines № 2, Restressable external tendon		
Basic requirement for construction works 1: Mechanical resistance and stability		
9	Practicability, reliability of installation	See Clause 3.2.4.1.
Product BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands Optional use category Clause 2.1, Table 7, lines № 3, Exchangeable external tendon		
Basic requirement for construction works 1: Mechanical resistance and stability		
10	Practicability, reliability of installation	See Clause 3.2.4.2.

№	Additional essential characteristic	Product performance
Product BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands Optional use category Clause 2.1, Table 7, lines № 4, Electrically isolated tendon		
Basic requirement for construction works 1: Mechanical resistance and stability		
11	Practicability, reliability of installation	See Clause 3.2.4.3.
Product BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands Optional use category Clause 2.1, Table 7, lines № 5, Tendon for use in structural composite construction as external tendon		
Basic requirement for construction works 1: Mechanical resistance and stability		
12	Load transfer to the structure	See Clause 3.2.1.3.
Product BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands Optional use category Clause 2.1, Table 7, lines № 6, Tendon for use in structural masonry construction as external tendon		
Basic requirement for construction works 1: Mechanical resistance and stability		
13	Load transfer to the structure	See Clause 3.2.4.4.

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 tendons with prestressing steel strands according to Annex 12 are listed in Annex 13 and Annex 14.

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 tendons with prestressing steel strands according to Annex 12 are listed in Annex 13 and Annex 14.

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 tendons with prestressing steel strands according to Annex 12 are listed in Annex 13 and Annex 14.

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 1.7.

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 1.10.

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

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 PT 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

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 Restressable external tendon – Practicability, reliability of installation

For restressable tendons, the PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.6-II(a).

3.2.4.2 Exchangeable external tendon – Practicability, reliability of installation

For exchangeable tendons, the PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.6-II(b).

3.2.4.3 Electrically isolated tendon – Practicability, reliability of installation

For electrically isolated tendons, the PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.6-II(f).

3.2.4.4 Tendons in masonry structures – Load transfer to the structure

For tendons for use in structural masonry construction as external tendons, the PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.3-II(h). See in particular Clause 2.2.3.6 for tendons in masonry structures. The characteristic values of maximum force, F_{pk}, of tendons with prestressing steel strands according to Annex 12 are listed in Annex 13 and Annex 14.

3.3 Assessment methods

The assessment of the essential characteristics in Clause 3.1 of the PT 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, and is based on the assessment for external PT systems.

3.4 Identification

The European Technical Assessment for the PT system is issued on the basis of agreed data[5] that identify the assessed product. Changes to materials, to composition, 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 PT 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 following items.

(a) The manufacturer shall carry out

- (i) factory production control;
- (ii) further testing of samples taken at the manufacturing plant by the manufacturer in accordance with the prescribed test plan[6].

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

[6] 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 BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands with regard to the essential characteristics.

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

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

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

At least once a year the manufacturer audits the manufacturers of the components given in Annex 30.

The basic elements of the prescribed test plan are given in Annex 29, conform to ETAG 013, Annex E.1, and are specified in the quality management plan of the BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands.

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 included in the declaration of performance for the corresponding intended use are given in Table 8 and Table 9. In Annex 31 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 BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands 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 30 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 BBR VT CONA CME – External Post-tensioning System with 04 to 61 Strands for independent testing. For the most important components, Annex 30 summarises the minimum procedures performed by the notified product certification body.

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The original document is signed by

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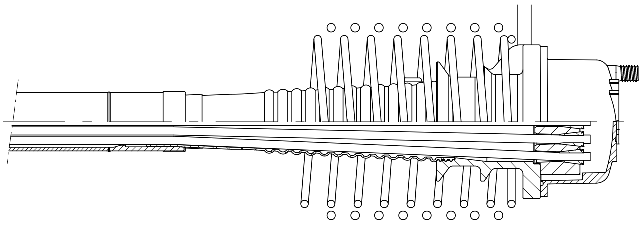
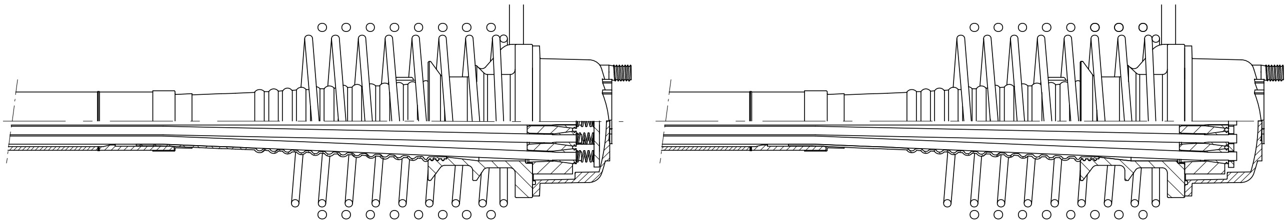
Managing Director

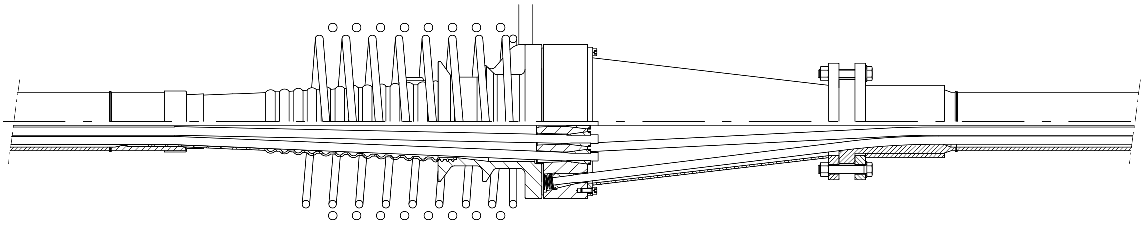
Stressing anchorage, accessible fixed anchorage SA, FA



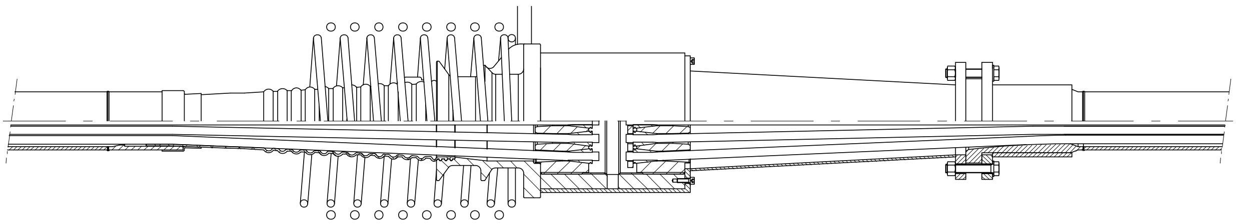
Inaccessible fixed anchorage FA



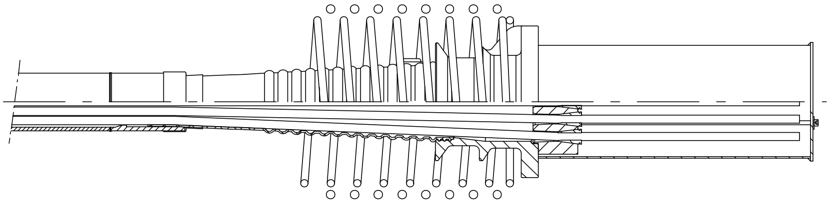
Fixed coupler FK



Fixed coupler FH

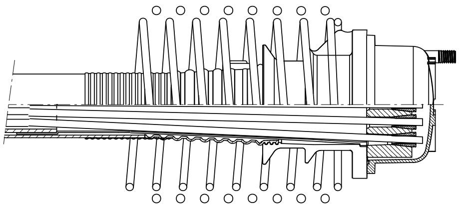


Restressable anchorage

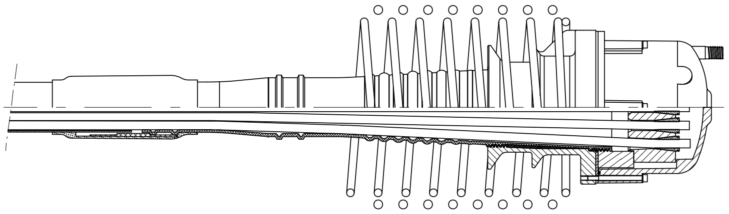


CONA CME	**External Post-tensioning System** Overview on anchorages and couplers	**Annex 1** of European Technical Assessment **ETA-07/0168** of 18.12.2017

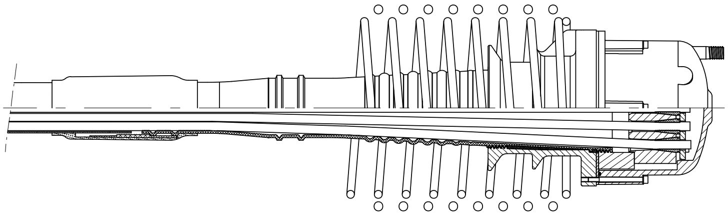
Stressing anchorage, accessible fixed anchorage, replaceable SAR



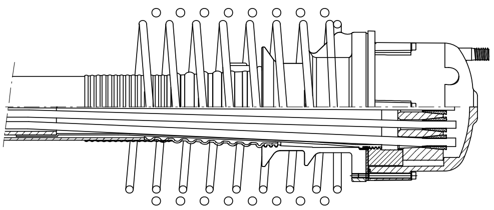
Electrically isolated stressing, accessible fixed anchorage SAE



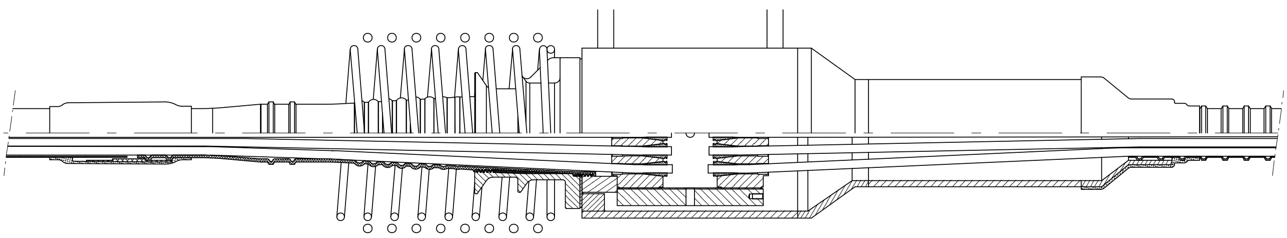
Electrically isolated inaccessible fixed anchorage FAE



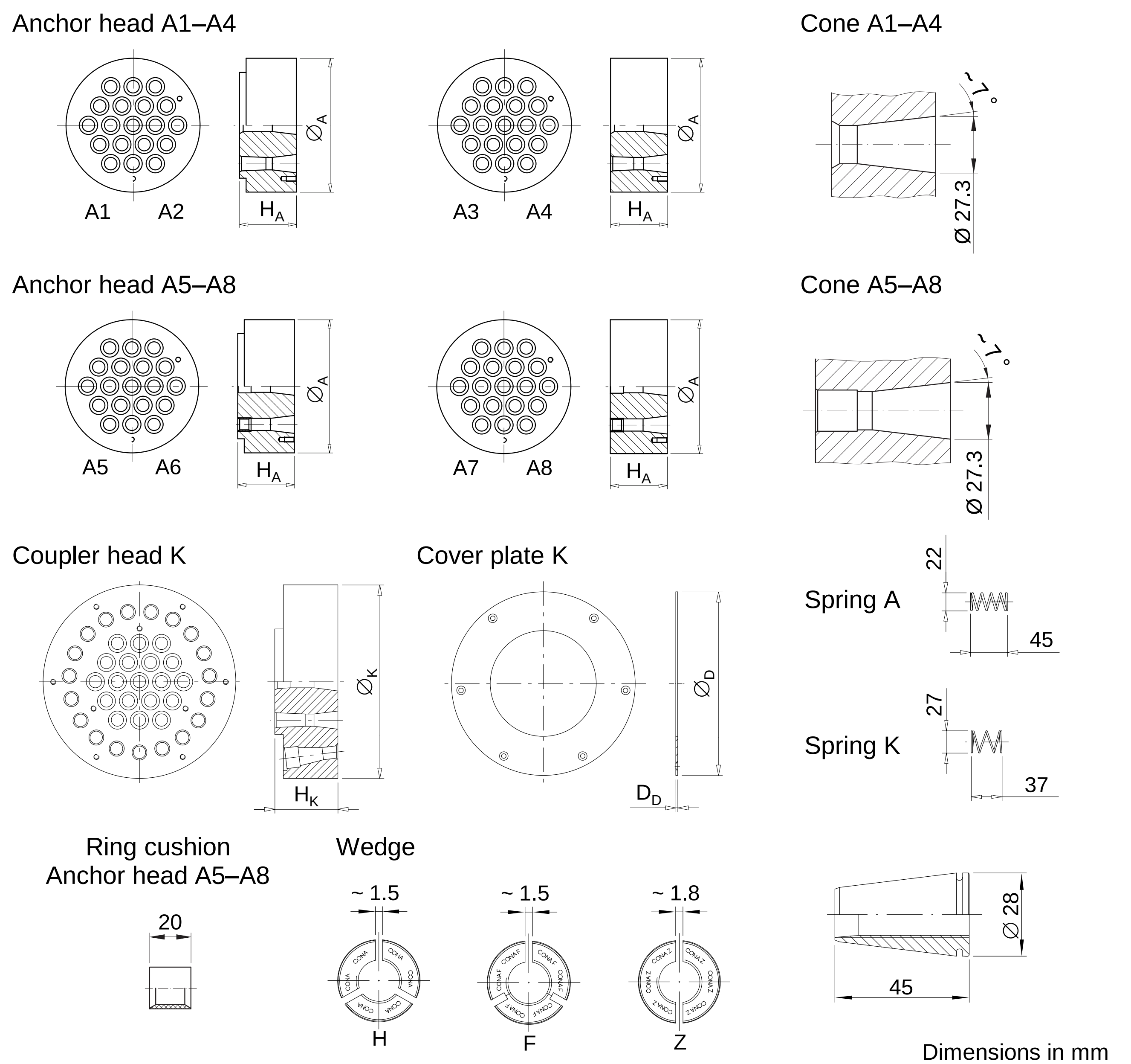
Electrically isolated, stressing, accessible fixed anchorage, replaceable SAER



Electrically isolated fixed and stressing coupler FHE, SHE



Member of EOTA



Dimensions in mm

Number of strands			04	07	09	12	15	19	22	24	27	31	37	42	43	48	55	61
Anchor head A																		
Diameter	$\varnothing_A$	mm	100	130	160	160	200	200	225	240	255	255	285	300	320	325	335	365
Height head A1–A4	H_A	mm	50	55	60	65	75	85	95	100	105	110	—	—	—	—	—	—
Height head A5–A8	H_A	mm	65	65	65	70	75	85	95	100	105	110	120	130	130	140	150	155
Coupler head K																		
Diameter	$\varnothing_K$	mm	195	210	250	250	290	290	310	340	390	390	—	—	—	—	—	—
Height	H_K	mm	85	85	90	90	90	95	105	120	125	130	—	—	—	—	—	—
Cover plate																		
Diameter	$\varnothing_D$	mm	182	207	246	246	286	286	306	336	386	386	—	—	—	—	—	—
Thickness	D_D	mm	3	3	3	3	3	3	5	5	5	5	—	—	—	—	—	—

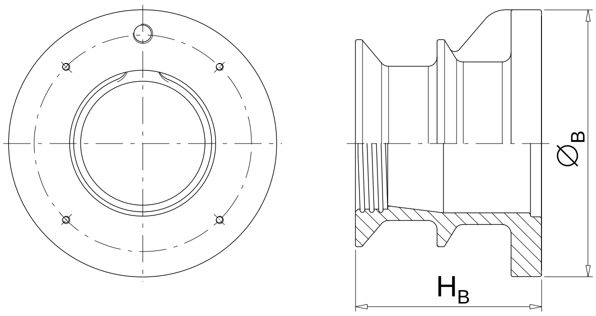
CONA CME

External Post-tensioning System
Components – Anchorage and coupler

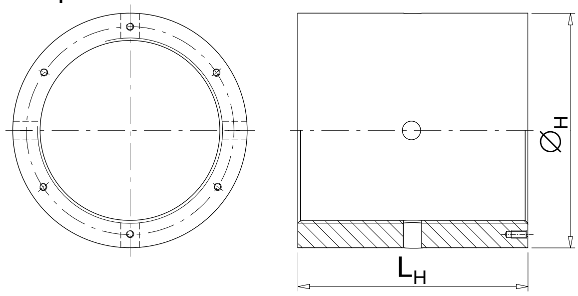
Annex 3
of European Technical Assessment
ETA-07/0168 of 18.12.2017

Member of EOTA

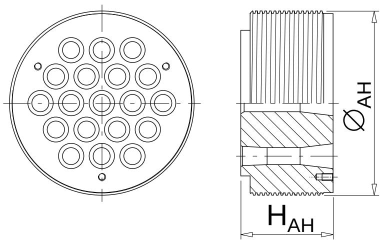
Bearing trumplate A



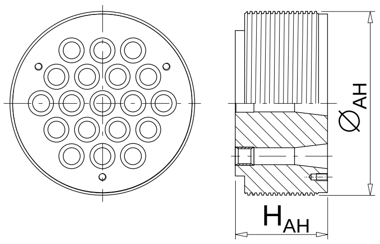
Coupler sleeve H



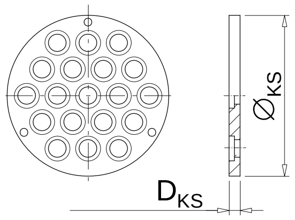
Coupler head H1



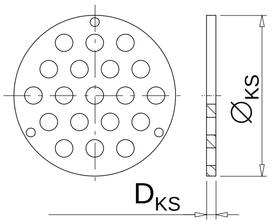
Coupler head H2



Wedge retaining plate H



Wedge retaining plate A



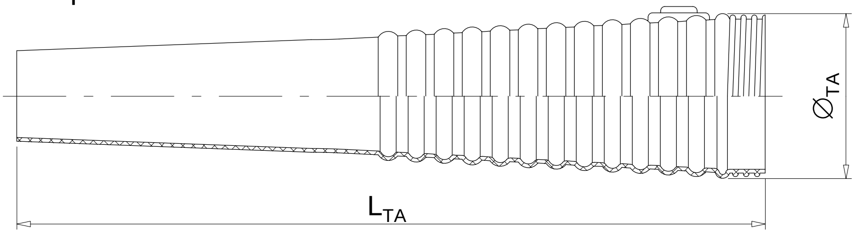
Number of strands			04	07	09	12	15	19	22	24	27	31	37	42	43	48	55	61
Bearing trumplate A																		
Diameter	$\varnothing_P$	mm	130	170	225	225	280	280	310	325	360	360	400	425	485	485	485	520
Height	H_P	mm	120	128	150	150	195	195	206	227	250	250	275	290	340	340	340	350
Coupler head H1 and H2																		
Nominal diameter	$\varnothing_{AH}$	mm	100	130	160	160	200	200	225	240	255	255	285	300	320	325	335	365
Height head H1	H_{AH}	mm	55	65	70	80	80	95	100	100	105	115	—	—	—	—	—	—
Height head H2	H_{AH}	mm	55	65	70	80	80	95	100	100	105	115	125	135	135	145	160	160
Coupler sleeve H																		
Minimum diameter	$\varnothing_H$	mm	130	170	203	213	259	269	296	312	330	338	370	392	410	422	440	472
Length	L_H	mm	180	200	210	230	240	270	270	280	300	320	320	340	360	380	410	410
Wedge retaining plate A																		
Diameter	$\varnothing_{KS}$	mm	75	103	145	145	175	175	182	210	210	210	240	275	275	275	310	310
Thickness	D_{KS}	mm	5	5	8	8	10	10	10	10	10	10	12	12	12	12	12	12
Wedge retaining plate H																		
Diameter	$\varnothing_{KS}$	mm	75	103	145	145	175	175	182	210	210	210	240	275	275	275	310	310
Thickness	D_{KS}	mm	10	10	12	12	15	15	15	15	15	15	15	15	15	15	15	15

CONA CME

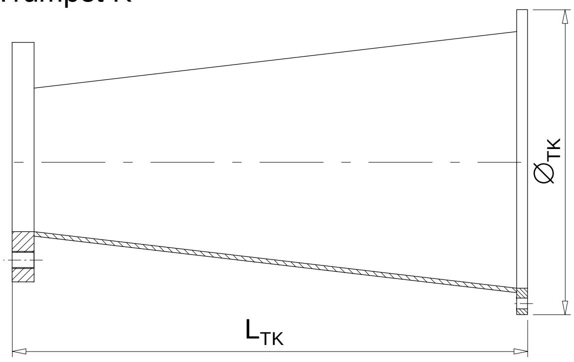
External Post-tensioning System
Components – Anchorage and coupler

Annex 4
of European Technical Assessment
ETA-07/0168 of 18.12.2017

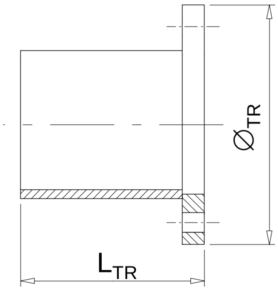
Trumpet A



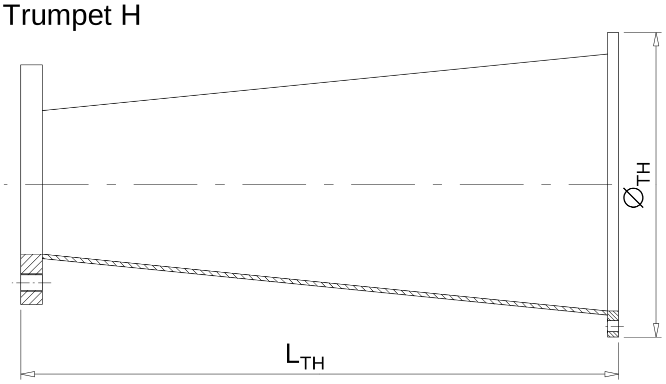
Trumpet K



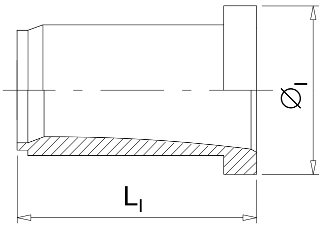
Tension Ring



Trumpet H



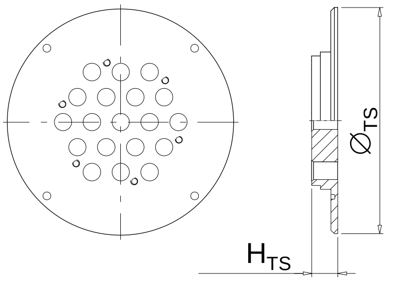
PE-Insert



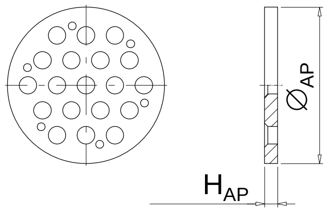
Number of strands			04	07	09	12	15	19	22	24	27	31	37	42	43	48	55	61
Trumpet A																		
Diameter	$\varnothing_{TA}$	mm	72	88	127	127	153	153	170	191	191	191	219	229	254	254	254	278
Length	L_{TA}	mm	200	328	623	508	694	579	715	866	866	751	1 060		1 244			1 290
Tension ring																		
Diameter	$\varnothing_{TR}$	mm	130	150	150	165	200	200	215	215	215	230	250	250	250	270	270	290
Length	L_{TR}	mm	95	95	135	135	168	168	168	168	168	168	168	168	168	168	168	168
PE-Insert																		
Diameter	$\varnothing_{I}$	mm	105	105	105	120	150	150	165	165	165	180	200	200	200	220	220	240
Length	L_{I}	mm	110	110	150	150	220	220	220	220	220	220	220	220	220	220	220	220
Trumpet H																		
Diameter	$\varnothing_{TH}$	mm	—	170	203	213	259	269	296	312	330	338	370	392	410	422	440	472
Length	L_{TH}	mm	—	190	570	390	480	480	550	820	820	660	930	890	1 080	910	980	1 070
Trumpet K																		
Diameter	$\varnothing_{TK}$	mm	195	210	250	250	290	290	310	340	390	390	—	—	—	—	—	—
Length	L_{TK}	mm	308	340	428	428	473	473	498	597	734	734	—	—	—	—	—	—

Member of EOTA

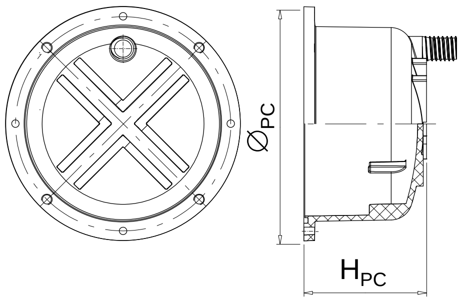
Temporary sealing plate



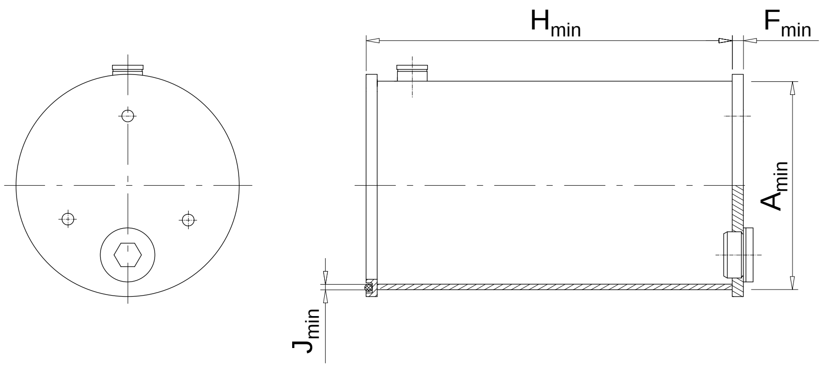
Activation plate



Protection cap A



Long protection cap



Number of strands			04	07	09	12	15	19	22	24	27	31	37	42	43	48	55	61
Temporary sealing plate																		
Diameter	$\varnothing_{TS}$	mm	129	169	225	225	260	260	290	305	330	330	380	405	465	465	465	500
Height	H_{TS}	mm	29	29	29	29	30	30	30	30	30	30	30	35	40	40	40	40
Activation plate																		
Diameter	$\varnothing_{AP}$	mm	90	120	150	150	180	180	200	220	220	220	265	280	300	300	315	345
Height	H_{AP}	mm	10	10	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Protection cap A																		
Diameter	$\varnothing_{PC}$	mm	116	146	218	218	260	260	290	305	320	320	360	380	400	400	400	440
Height	H_{PC}	mm	98	106	108	108	128	128	141	143	158	158	175	190	190	200	210	210
Long protection cap in steel																		
Minimum diameter	A_{min}	mm	110	140	170	170	210	210	240	250	270	270	300	310	330	340	350	370
Minimum wall thickness	J_{min}	mm	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Minimum cover thickness	F_{min}	mm	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

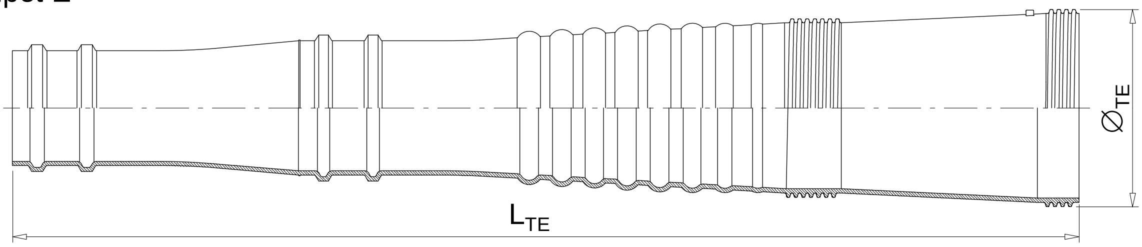
NOTES
H_{min} depends on the required excess length for the jack.
Long protection cap in plastic are with adapted dimensions for J_{min} and F_{min}.

CONA CME

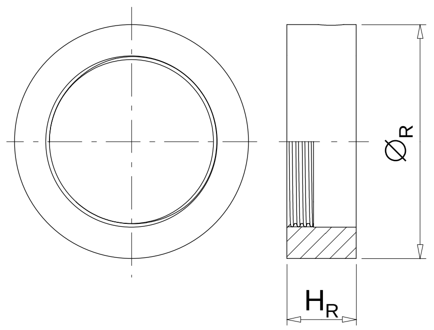
External Post-tensioning System
Components – Accessory

Annex 6
of European Technical Assessment
ETA-07/0168 of 18.12.2017

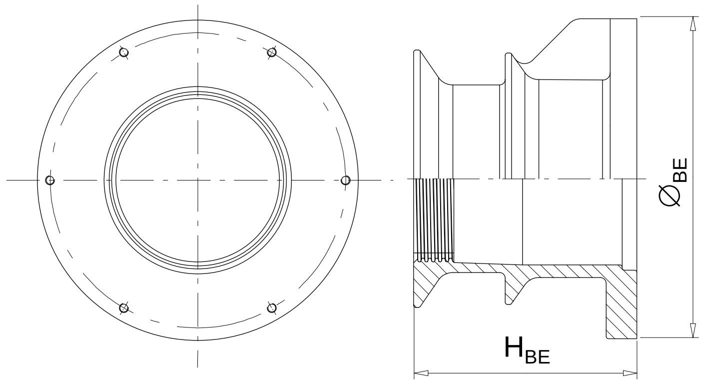
Trumpet E



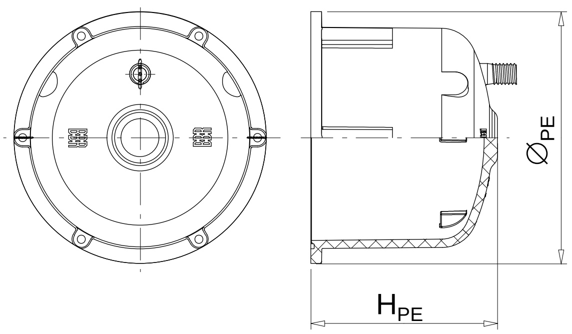
Steel ring E



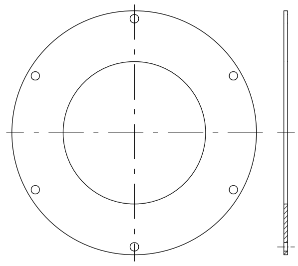
Bearing trumplate E



Protection cap E



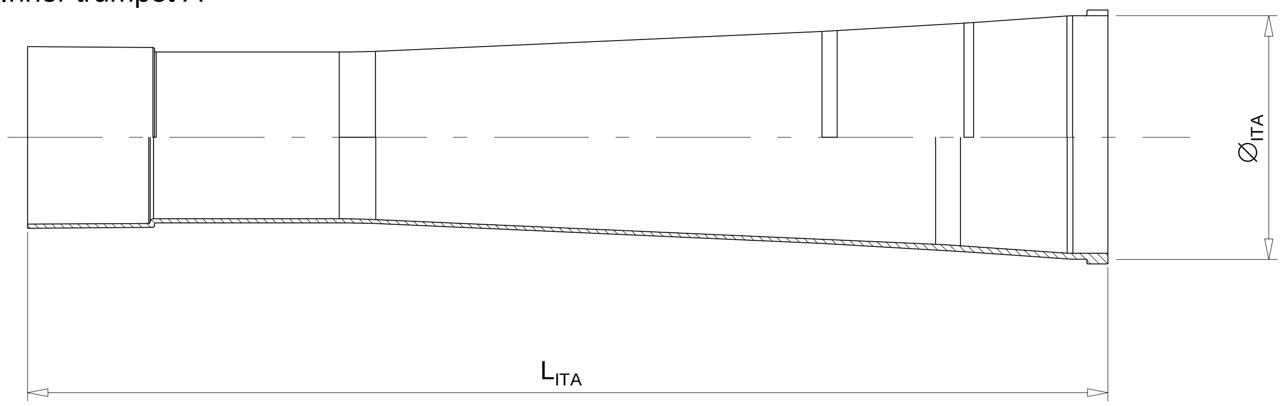
Isolation ring E



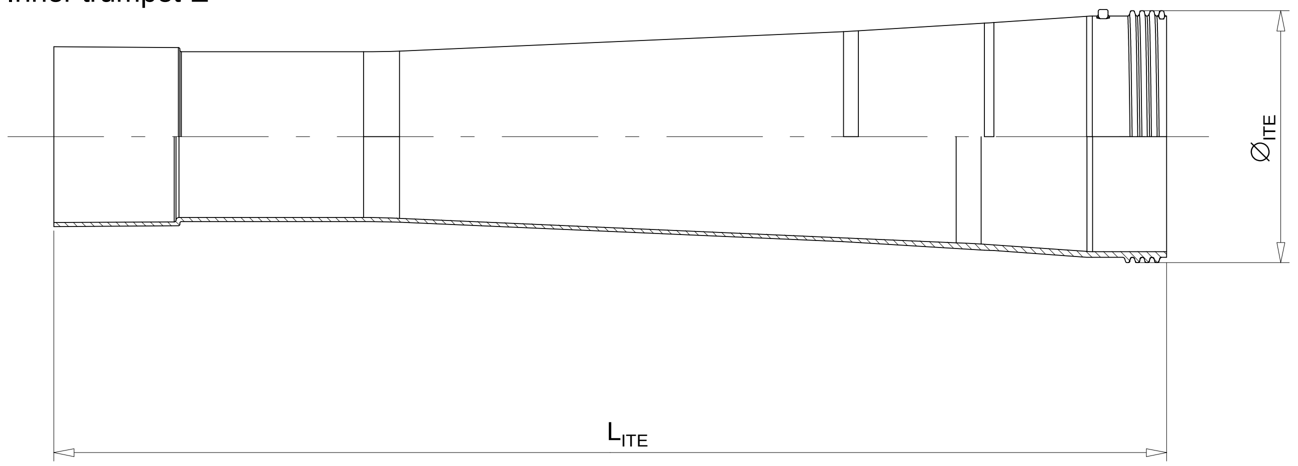
Number of strands			04	07	09	12	15	19	22	24	27	31
Trumpet E												
Diameter	$\varnothing_{TE}$	mm	74	93	128	128	157	157	178	191	201	201
Length	L_{TE}	mm	312	428	600	600	848	848	980	1 005	1 040	1 040
Steel ring E												
Diameter	$\varnothing_{R}$	mm	100	130	173	173	220	220	244	256	279	279
Height	H_{R}	mm	59	59	65	65	65	65	65	65	65	65
Bearing trumplate E												
Diameter	$\varnothing_{BE}$	mm	130	170	225	225	280	280	310	325	360	360
Height	H_{BE}	mm	120	128	150	150	195	195	206	227	250	250
Protection Cap E												
Diameter	$\varnothing_{PE}$	mm	143	168	229	229	276	276	306	316	348	348
Height	H_{PE}	mm	167	174	185	185	205	205	219	223	233	233

Member of EOTA

Inner trumpet A

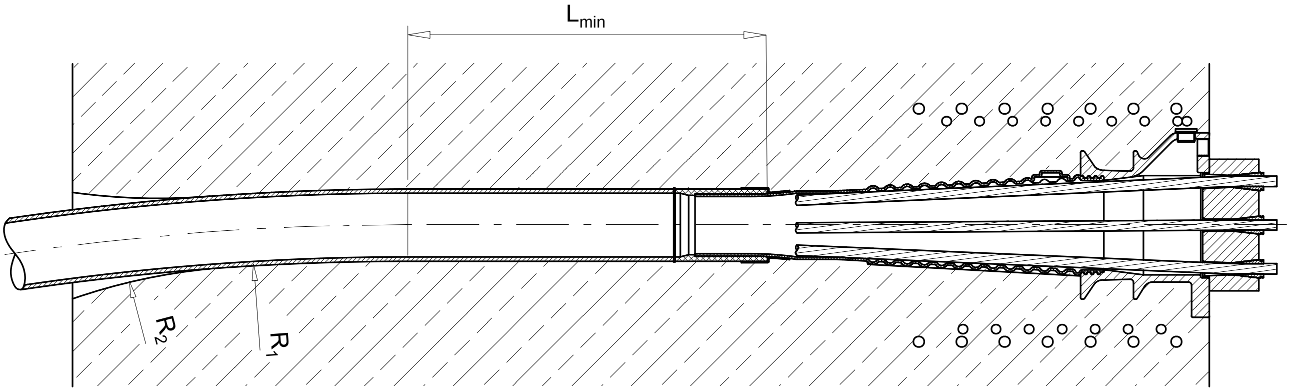


Inner trumpet E



Number of strands			04	07	09	12	15	19	22	24	27	31	37	42	43	48	55	61
Inner trumpet A																		
Diameter	$\varnothing_{ITA}$	mm	69	89	126	126	159	159	179	194	204	204	224	238	264	264	264	296
Length	L_{ITA}	mm	190	220	620	538	654	654	640	910	910	755	1 020	980	1 170	995	1 070	1 160
Inner trumpet E																		
Diameter	$\varnothing_{ITE}$	mm	74	93	128	128	156	156	178	191	201	201	—	—	—	—	—	—
Length	L_{ITE}	mm	220	250	650	568	684	684	670	940	940	785	—	—	—	—	—	—

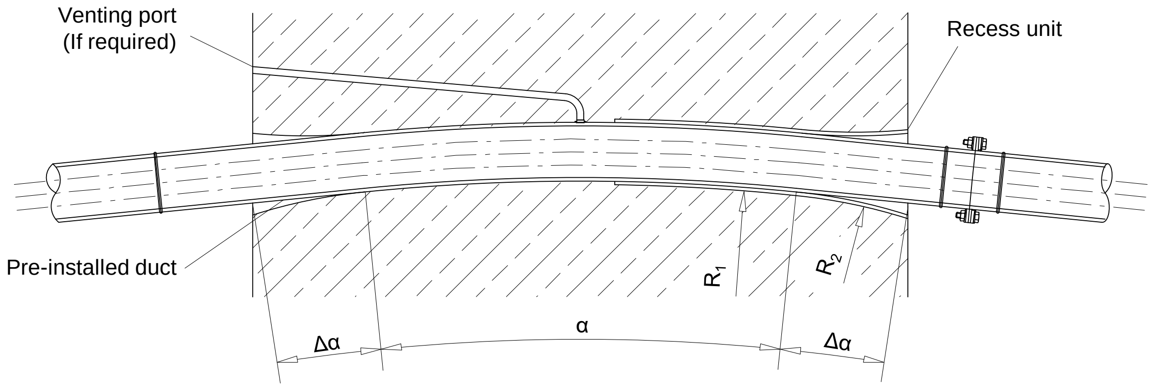
Straight length at fixed and stressing anchorage

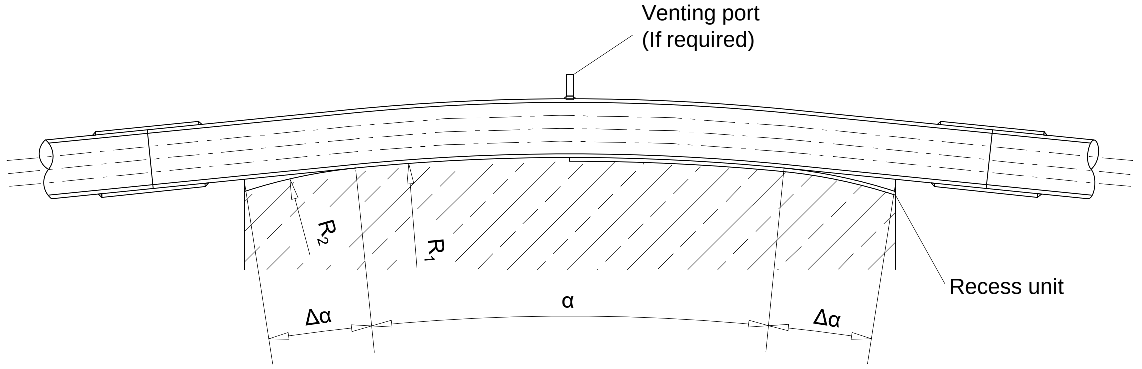


Degree of filling 0.35 $\leq f \leq 0.50$, minimum straight length $L_{min} = 5 \cdot d_i \geq 250$ mm
Degree of filling 0.25 $\leq f \leq 0.30$, minimum straight length $L_{min} = 8 \cdot d_i \geq 400$ mm

Where
f............—............. Degree of filling, see Clause 1.6
d_i.........mm............ Nominal inner diameter of duct

Deviator



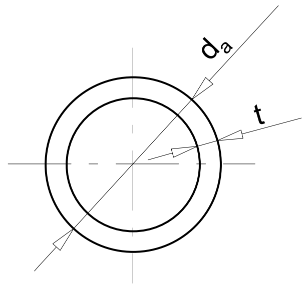


Key

$R_1 \geq R_2 \geq R_{min}$
Δα Additional deviation, e. g. 3 °
For R_{min} see Annex 10.

BBR CONA CME	**External Post-tensioning System** Deviator and straight length	**Annex 9** of European Technical Assessment **ETA-07/0168** of 18.12.2017

Duct



Number of strands				04	07	09	12	15	19	22	24	27	31	37	42	43	48	55	61
Bare strand																			
PE Duct	Minimum radii of curvature	R_{min}	m	2.0	2.0	2.2	2.5	2.7	3.0	3.2	3.3	3.5	3.7	4.0	4.5	4.5	4.5	5.2	5.5
PE Duct	Diameter	d_a	mm	50	75	75	90	110	110	125	125	125	140	140	160	160	180	180	200
PE Duct	Thickness	t	mm	3.7	5.6	5.6	5.4	5.3	5.3	6.0	6.0	6.0	6.7	6.7	7.7	7.7	8.6	8.6	9.6
PE Duct	Minimum radii of curvature	1.5 R_{min}	m	3.0	3.0	3.3	3.8	4.1	4.5	4.8	5.0	5.3	5.6	6.0	6.8	6.8	6.8	7.8	8.3
PE Duct	Diameter	d_a	mm	63	75	75	90	110	110	125	125	125	140	140	160	160	180	180	200
PE Duct	Thickness	t	mm	2.4	4.5	4.5	4.3	4.2	4.2	4.8	4.8	4.8	6.7	5.4	6.2	6.2	6.9	6.9	7.7
Steel duct	Minimum radii of curvature	R_{min}	m	2.0	2.0	2.2	2.5	2.7	3.0	3.2	3.3	3.5	3.7	4.0	4.5	4.5	4.5	5.2	5.5
Steel duct	Diameter	d_a	mm	48	64	73	83	89	102	114	114	127	127	141	168	168	168	168	168
Steel duct	Thickness	t	mm	1.5	1.5	1.5	1.5	2.0	2.0	2.0	2.0	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0
Monostrand																			
PE Duct	Minimum radii of curvature	R_{min}	m	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
PE Duct	Diameter	d_a	mm	75	90	90	110	125	125	140	140	140	160	180	180	180	200	225	225
PE Duct	Thickness	t	mm	5.6	5.4	5.4	5.3	5.3	5.3	5.4	5.4	5.4	6.2	6.9	6.9	6.9	7.7	8.6	8.6
Steel duct	Minimum radii of curvature	R_{min}	m	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Steel duct	Diameter	d_a	mm	57	76	83	95	114	114	127	140	152	159	168	178	178	194	219	219
Steel duct	Thickness	t	mm	1.5	1.5	1.5	1.5	2.0	2.0	2.0	2.0	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0

Material specifications

Component	Standard / Specification
Anchor head A CONA CME 0406 to 6106	EN 10083-1 EN 10083-2
Coupler anchor head K CONA CME 0406 to 3106	EN 10083-1 EN 10083-2
Coupler anchor head H CONA CME 0406 to 6106	EN 10083-1 EN 10083-2
Bearing trumplate A CONA CME 0406 to 6106	EN 1561 EN 1563
Bearing trumplate E CONA CME 0406 to 3106	EN 1561 EN 1563
Coupler sleeve H CONA CME 0406 to 6106	EN 10210-1
Wedge retaining plate A and H CONA CME 0406 to 6106	EN 10025-2
Cover plate K CONA CME 0406 to 3106	EN 10025-2
Trumpet A, K, and E	EN ISO 17855-1 EN ISO 19069-1
Trumpet A and K	EN 10025
Steel ring E	EN 10210-1
Isolation ring E	Composite material
Ring cushion	EN ISO 17855-1 EN ISO 19069-1
Protection cap A Protection cap E Long protection cap	EN ISO 17855-1
Protection cap A Long protection cap	EN 10025
Tension ring	EN 10210-1
Ring wedge H, F, and Z	EN 10277-2 EN 10084
Spring A, K	EN 10270-1
Helix	Ribbed reinforcing steel, $R_e \geq 500$ MPa
Additional reinforcement, stirrups	Ribbed reinforcing steel, $R_e \geq 500$ MPa
Duct	EN 10210-1 ETAG 013, Annex C.2

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7-wire strands according to prEN 10138-3[1)]

Steel designation			Y1770S7	Y1860S7	Y1770S7	Y1860S7
Tensile strength	R_m	MPa	1 770	1 860	1 770	1 860
Diameter	d	mm	15.3	15.3	15.7	15.7
Nominal cross-sectional area	A_p	mm^2	140	140	150	150
Nominal mass per metre	m	kg/m	1.093		1.172	
Permitted deviation from nominal mass		%	± 2			
Characteristic value of maximum force	F_{pk}	kN	248	260	266	279
Maximum value of maximum force	$F_{m,\,max}$	kN	285	299	306	321
Characteristic value of 0.1 % proof force [2)]	$F_{p0.1}$	kN	218	229	234	246
Minimum elongation at maximum force, $L_0 \geq 500$ mm	A_{gt}	%	3.5			
Modulus of elasticity	E_p	MPa	195 000 [3)]			

1) Suitable strands according to standards and regulations in force for at the place of use may also be used.
2) For strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.
3) Standard value

CONA CME n06-140

Number of strands	Nominal cross-sectional area of prestressing steel	Nominal mass of prestressing steel	Characteristic value of maximum force of tendon	
			f_{pk} = 1 770 MPa	f_{pk} = 1 860 MPa
n	A_p	M	F_{pk}	F_{pk}
—	mm²	kg/m	kN	kN
04	560	4.4	992	1 040
07	980	7.7	1 736	1 820
09	1 260	9.8	2 232	2 340
12	1 680	13.1	2 976	3 120
15	2 100	16.4	3 720	3 900
19	2 660	20.8	4 712	4 940
22	3 080	24.0	5 456	5 720
24	3 360	26.2	5 952	6 240
27	3 780	29.5	6 696	7 020
31	4 340	33.9	7 688	8 060
37	5 180	40.4	9 176	9 620
42	5 880	45.9	10 416	10 920
43	6 020	47.0	10 664	11 180
48	6 720	52.5	11 904	12 480
55	7 700	60.1	13 640	14 300
61	8 540	66.7	15 128	15 860

CONA CME n06-150

Number of strands	Nominal cross-sectional area of prestressing steel	Nominal mass of prestressing steel	Characteristic value of maximum force of tendon	
			f_{pk} = 1 770 MPa	f_{pk} = 1 860 MPa
n	A_p	M	F_{pk}	F_{pk}
—	mm^2	kg/m	kN	kN
04	600	4.7	1 064	1 116
07	1 050	8.2	1 862	1 953
09	1 350	10.5	2 394	2 511
12	1 800	14.1	3 192	3 348
15	2 250	17.6	3 990	4 185
19	2 850	22.3	5 054	5 301
22	3 300	25.8	5 852	6 138
24	3 600	28.1	6 384	6 696
27	4 050	31.6	7 182	7 533
31	4 650	36.3	8 246	8 649
37	5 550	43.4	9 842	10 323
42	6 300	49.2	11 172	11 718
43	6 450	50.4	11 438	11 997
48	7 200	56.3	12 768	13 392
55	8 250	64.5	14 630	15 345
61	9 150	71.5	16 226	17 019

Maximum prestressing and overstressing forces

Designation		CONA CME							
		n06-140		n06-150		n06-140		n06-150	
—		Maximum prestressing force [1)] $0.9 \cdot F_{p0.1}$				Maximum overstressing force [1), 2)] $0.95 \cdot F_{p0.1}$			
Characteristic tensile strength f_{pk}	MPa	1 770	1 860	1 770	1 860	1 770	1 860	1 770	1 860
—	—	kN	kN	kN	kN	kN	kN	kN	kN
n Number of strands	04	785	824	842	886	828	870	889	935
	07	1 373	1 443	1 474	1 550	1 450	1 523	1 556	1 636
	09	1 766	1 855	1 895	1 993	1 864	1 958	2 001	2 103
	12	2 354	2 473	2 527	2 657	2 485	2 611	2 668	2 804
	15	2 943	3 092	3 159	3 321	3 107	3 263	3 335	3 506
	19	3 728	3 916	4 001	4 207	3 935	4 133	4 224	4 440
	22	4 316	4 534	4 633	4 871	4 556	4 786	4 891	5 141
	24	4 709	4 946	5 054	5 314	4 970	5 221	5 335	5 609
	27	5 297	5 565	5 686	5 978	5 592	5 874	6 002	6 310
	31	6 082	6 389	6 529	6 863	6 420	6 744	6 891	7 245
	37	7 259	7 626	7 792	8 192	7 663	8 049	8 225	8 647
	42	8 240	8 656	8 845	9 299	8 698	9 137	9 337	9 815
	43	8 437	8 862	9 056	9 520	8 905	9 355	9 559	10 049
	48	9 418	9 893	10 109	10 627	9 941	10 442	10 670	11 218
	55	10 791	11 336	11 583	12 177	11 391	11 965	12 227	12 854
	61	11 968	12 572	12 847	13 505	12 633	13 271	13 560	14 256

1) The given values are maximum values according to Eurocode 2. The actual values are taken from the standards and regulations in force at the place of use. Conformity with the stabilisation and crack width criteria in the load transfer test was verified to a load level of $0.80 \cdot F_{pk}$

2) Overstressing is permitted if the force in the prestressing jack can be measured to an accuracy of ± 5 % of the final value of the overstressing force.

Minimum centre spacing of tendon anchorages

Tendon		Minimum centre spacing $a_c = b_c$				
$f_{cm, 0, cube, 150}$	MPa	23	28	34	38	43
$f_{cm, 0, cylinder, \varnothing 150}$	MPa	19	23	28	31	35
CONA CME 0406	mm	235	215	210	210	205
CONA CME 0706	mm	310	285	260	255	255
CONA CME 0906	mm	350	320	310	310	310
CONA CME 1206	mm	405	370	340	325	310
CONA CME 1506	mm	455	415	380	365	365
CONA CME 1906	mm	510	465	425	410	390
CONA CME 2206	mm	550	500	460	440	420
CONA CME 2406	mm	575	525	480	460	435
CONA CME 2706	mm	610	555	505	485	460
CONA CME 3106	mm	650	595	545	520	495
CONA CME 3706	mm	—	680	680	680	680
CONA CME 4206	mm	—	735	735	735	735
CONA CME 4306	mm	—	755	755	755	755
CONA CME 4806	mm	—	805	805	805	805
CONA CME 5506	mm	—	875	875	875	875
CONA CME 6106	mm	—	940	940	940	940

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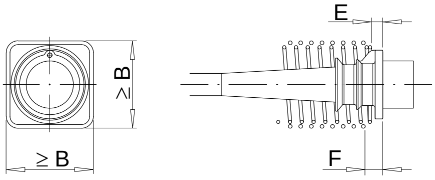
Minimum edge distance of tendon anchorages

Tendon		Minimum edge distance $a_e = b_e$				
$f_{cm, 0, cube, 150}$	MPa	23	28	34	38	43
$f_{cm, 0, cylinder, \varnothing 150}$	MPa	19	23	28	31	35
CONA CME 0406	mm	110 + c	100 + c	95 + c	95 + c	95 + c
CONA CME 0706	mm	145 + c	135 + c	120 + c	120 + c	120 + c
CONA CME 0906	mm	165 + c	150 + c	145 + c	145 + c	145 + c
CONA CME 1206	mm	195 + c	175 + c	160 + c	155 + c	145 + c
CONA CME 1506	mm	220 + c	200 + c	180 + c	175 + c	175 + c
CONA CME 1906	mm	245 + c	225 + c	205 + c	195 + c	185 + c
CONA CME 2206	mm	265 + c	240 + c	220 + c	210 + c	200 + c
CONA CME 2406	mm	280 + c	255 + c	230 + c	220 + c	210 + c
CONA CME 2706	mm	295 + c	270 + c	245 + c	235 + c	220 + c
CONA CME 3106	mm	315 + c	290 + c	265 + c	250 + c	240 + c
CONA CME 3706	mm	—	330 + c	330 + c	330 + c	330 + c
CONA CME 4206	mm	—	360 + c	360 + c	360 + c	360 + c
CONA CME 4306	mm	—	370 + c	370 + c	370 + c	370 + c
CONA CME 4806	mm	—	395 + c	395 + c	395 + c	395 + c
CONA CME 5506	mm	—	430 + c	430 + c	430 + c	430 + c
CONA CME 6106	mm	—	460 + c	460 + c	460 + c	460 + c

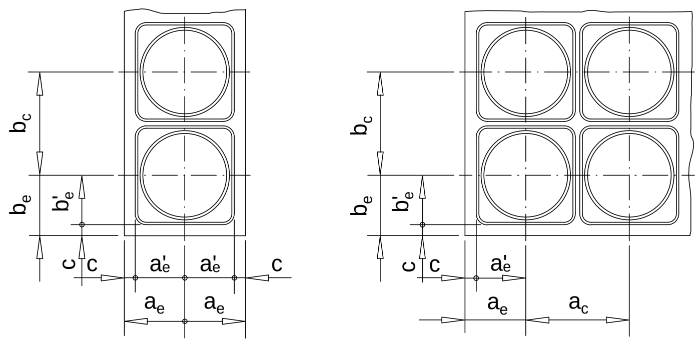
c.... Concrete cover in mm

Standards and regulations on concrete cover in force at the place of use are observed.

Stressing and fixed anchorage or coupler **Centre spacing and edge distance**



$a_e = a'_e + c$
$b_e = b'_e + c$
c … Concrete cover

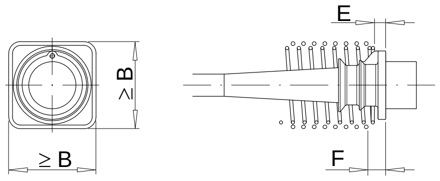


Technical data of anchorages																	
BBR VT CONA CME			**04**					**07**					**09**				
Strand arrangement																	
Strand [1]		**mm²**	**150**					**150**					**150**				
Cross-sectional area		mm²	600					1 050					1 350				
Charact. tensile strength	**R_m**	**MPa**	**1 860**					**1 860**					**1 860**				
Charact. maximum force	F_m	kN	1 116					1 953					2 511				
$0.90 \cdot F_{p0.1}$		kN	886					1 550					1 993				
$0.95 \cdot F_{p0.1}$		kN	935					1 636					2 103				
Helix and additional reinforcement																	
Min. concrete strength, cube	**$f_{cm,0}$**	**MPa**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**
Min. concrete strength, cylinder	**$f_{cm,0}$**	**MPa**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**
Helix																	
Outer diameter		mm	180	160	160	160	155	230	200	200	200	200	280	260	255	250	250
Bar diameter [2]		mm	10	10	10	10	10	12	12	12	12	12	14	12	12	12	12
Length, approx.		mm	185	185	185	185	185	254	256	231	231	231	282	281	281	281	281
Pitch		mm	45	45	45	45	45	45	50	50	50	50	50	50	50	50	50
Number of pitches		—	5	5	5	5	5	6	6	5	5	5	6	6	6	6	6
Distance	E	mm	15	15	15	15	15	18	18	18	18	18	20	20	20	20	20
Additional reinforcement																	
Number of stirrups		—	3	3	4	4	3	5	4	4	4	4	5	5	5	4	5
Bar diameter [2]		mm	12	12	10	10	12	14	14	12	14	14	12	14	12	14	14
Spacing		mm	60	55	45	45	55	55	60	55	55	55	60	55	55	65	55
Distance from bearing trumplate	F	mm	30	30	30	30	30	33	33	33	33	33	35	35	35	35	35
Outer dimensions	B × B	mm	220	200	190	190	190	290	270	240	240	240	330	300	290	290	290
Centre spacing and edge distance																	
Min. centre spacing	a_c, b_c	mm	235	215	210	210	205	310	285	260	255	255	350	320	310	310	310
Min. edge distance, plus c	a'_e, b'_e	mm	110	100	95	95	95	145	135	120	120	120	165	150	145	145	145

[1] Prestressing strand with nominal diameter of 15.3 mm, cross-sectional area of 140 mm² or with characteristic tensile strength below 1 860 MPa may also be used.
[2] Bar diameter of 14 mm can be replaced by 16 mm.

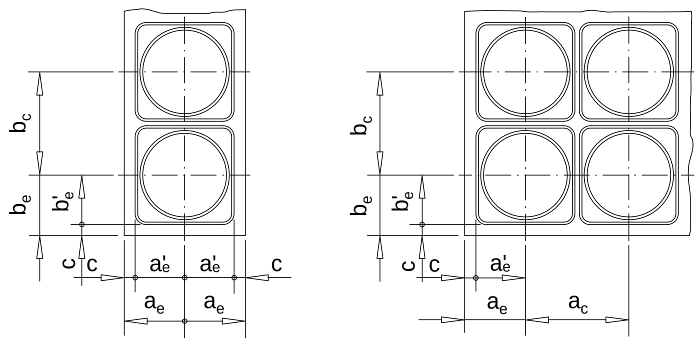
BBR CONA CME	**External Post-tensioning System** Anchorage zone – Dimensions Helix and additional reinforcement and spacing	**Annex 18** of European Technical Assessment **ETA-07/0168** of 18.12.2017

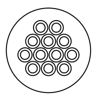
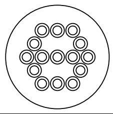
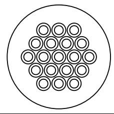
Stressing and fixed anchorage or coupler



$a_e = a'_e + c$
$b_e = b'_e + c$
c … Concrete cover

Centre spacing and edge distance



Technical data of anchorages																
BBR VT CONA CME		**12**					**15**					**19**				
Strand arrangement																
Strand [1)]	**mm²**	**150**					**150**					**150**				
Cross-sectional area	mm²	1 800					2 250					2 850				
Charact. tensile strength R_m	**MPa**	**1 860**					**1 860**					**1 860**				
Charact. maximum force F_m	kN	3 348					4 185					5 301				
0.90 · $F_{p0.1}$	kN	2 657					3 321					4 207				
0.95 · $F_{p0.1}$	kN	2 804					3 506					4 440				
Helix and additional reinforcement																
Min. concrete strength, cube $f_{cm,0}$	**MPa**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**
Min. concrete strength, cylinder $f_{cm,0}$	**MPa**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**
Helix																
Outer diameter	mm	330	280	275	260	250	375	330	315	305	305	420	360	360	330	325
Bar diameter [2)]	mm	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Length, approx.	mm	332	332	332	332	282	432	432	382	332	332	457	457	432	432	382
Pitch	mm	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Number of pitches	—	7	7	7	7	6	9	9	8	7	7	10	10	9	9	8
Distance E	mm	20	20	20	20	20	27	27	27	27	27	27	27	27	27	27
Additional reinforcement																
Number of stirrups	—	7	6	5	5	6	7	6	5	6	5	7	7	7	7	7
Bar diameter [2)]	mm	12	14	16	16	14	14	16	16	16	16	16	16	16	16	16
Spacing	mm	60	55	70	70	50	60	65	65	55	60	65	65	65	65	60
Distance from bearing trumplate F	mm	35	35	35	35	35	42	42	42	42	42	42	42	42	42	42
Outer dimensions B × B	mm	390	350	320	310	290	440	400	360	350	350	490	450	410	390	370
Centre spacing and edge distance																
Min. centre spacing a_c, b_c	mm	405	370	340	325	310	455	415	380	365	365	510	465	425	410	390
Min. edge distance, plus c a'_e, b'_e	mm	195	175	160	155	145	220	200	180	175	175	245	225	205	195	185

[1)] Prestressing strand with nominal diameter of 15.3 mm, cross-sectional area of 140 mm² or with characteristic tensile strength below 1 860 MPa may also be used.
[2)] Bar diameter of 14 mm can be replaced by 16 mm.

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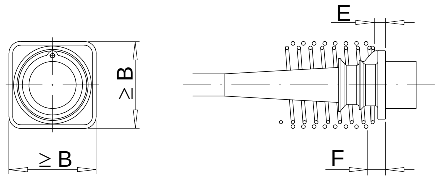
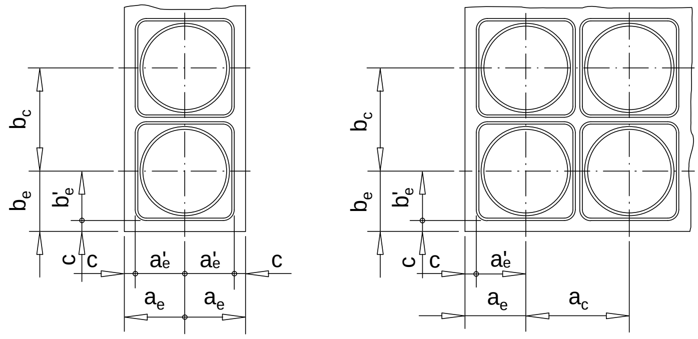
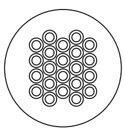
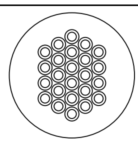
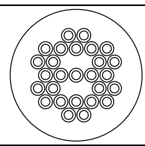
Stressing and fixed anchorage or coupler



$a_e = a'_e + c$
$b_e = b'_e + c$
c … Concrete cover

Centre spacing and edge distance



Technical data of anchorages																
BBR VT CONA CME		**22**					**24**					**27**				
Strand arrangement																
Strand [1)]	**mm²**	**150**					**150**					**150**				
Cross-sectional area	mm²	3 300					3 600					4 050				
Charact. tensile strength R_m	**MPa**	**1 860**					**1 860**					**1 860**				
Charact. maximum force F_m	kN	6 138					7 533					5 301				
$0.90 \cdot F_{p0.1}$	kN	4 871					5 314					5 978				
$0.95 \cdot F_{p0.1}$	kN	5 141					5 609					6 310				
Helix and additional reinforcement																
Min. concrete strength, cube $f_{cm,0}$	**MPa**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**
Min. concrete strength, cylinder $f_{cm,0}$	**MPa**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**
Helix																
Outer diameter	mm	475	420	390	360	340	475	430	410	360	360	520	475	440	420	390
Bar diameter [2)]	mm	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Length, approx.	mm	482	482	432	432	382	532	532	482	482	432	532	532	482	482	432
Pitch	mm	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Number of pitches	—	10	10	9	9	8	11	11	10	10	9	11	11	10	10	9
Distance E	mm	31	31	31	31	31	32	32	32	32	32	35	35	35	35	35
Additional reinforcement																
Number of stirrups	—	6	7	8	7	8	7	7	7	7	8	8	7	7	8	8
Bar diameter [2)]	mm	20	20	20	20	16	20	20	20	20	20	20	20	20	20	20
Spacing	mm	80	75	65	65	50	80	80	70	65	55	80	80	75	60	60
Distance from bearing trumplate F	mm	46	46	46	46	46	47	47	47	47	47	50	50	50	50	50
Outer dimensions B × B	mm	530	480	440	420	400	560	510	460	440	420	590	540	490	470	440
Centre spacing and edge distance																
Min. centre spacing a_c, b_c	mm	550	500	460	440	420	575	525	480	460	435	610	555	505	485	460
Min. edge distance, plus c a'_e, b'_e	mm	265	240	220	210	200	280	255	230	220	210	295	270	245	235	220

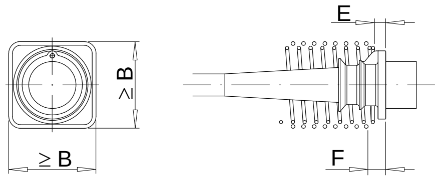
[1)] Prestressing strand with nominal diameter of 15.3 mm, cross-sectional area of 140 mm² or with characteristic tensile strength below 1 860 MPa may also be used.
[2)] Bar diameter of 14 mm can be replaced by 16 mm.

BBR
CONA CME

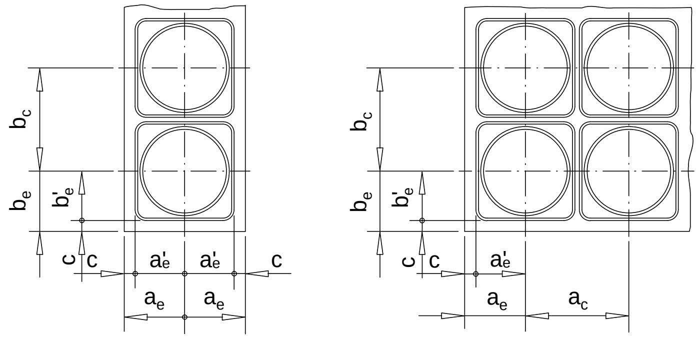
External Post-tensioning System
Anchorage zone – Dimensions
Helix and additional reinforcement and spacing

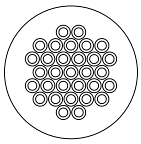
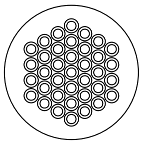
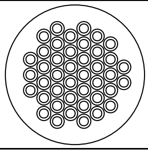
Annex 20
of European Technical Assessment
ETA-07/0168 of 18.12.2017

Stressing and fixed anchorage or coupler | **Centre spacing and edge distance**



$a_e = a'_e + c$
$b_e = b'_e + c$
c … Concrete cover



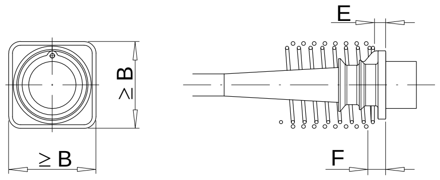
Technical data of anchorages																
BBR VT CONA CME		**31**					**37**					**42**				
Strand arrangement																
Strand 1)	**mm²**	**150**					**150**					**150**				
Cross-sectional area	mm²	4 650					5 550					6 300				
Charact. tensile strength R_m	**MPa**	**1 860**					**1 860**					**1 860**				
Charact. maximum force F_m	kN	8 649					10 323					11 718				
$0.90 \cdot F_{p0.1}$	kN	6 863					8 192					9 299				
$0.95 \cdot F_{p0.1}$	kN	7 245					8 647					9 815				
Helix and additional reinforcement																
Min. concrete strength, cube $f_{cm,0}$	**MPa**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**
Min. concrete strength, cylinder $f_{cm,0}$	**MPa**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**
Helix																
Outer diameter	mm	560	520	475	430	430	—	580	580	580	580	—	630	630	630	630
Bar diameter 2)	mm	14	14	14	14	14	—	16	16	16	16	—	16	16	16	16
Length, approx.	mm	532	532	582	482	432	—	533	533	533	533	—	583	583	583	583
Pitch	mm	50	50	50	50	50	—	50	50	50	50	—	50	50	50	50
Number of pitches	—	11	11	12	10	9	—	11	11	11	11	—	12	12	12	12
Distance E	mm	35	35	35	35	35	—	40	40	40	40	—	45	45	45	45
Additional reinforcement																
Number of stirrups	—	9	8	8	8	8	—	9	9	9	9	—	10	10	10	10
Bar diameter 2)	mm	20	20	20	20	20	—	20	20	20	20	—	20	20	20	20
Spacing	mm	80	75	70	65	60	—	70	70	70	70	—	70	70	70	70
Distance from bearing trumplate F	mm	50	50	50	50	50	—	50	50	50	50	—	55	55	55	55
Outer dimensions B × B	mm	630	580	530	500	480	—	660	660	660	660	—	720	720	720	720
Centre spacing and edge distance																
Min. centre spacing a_c, b_c	mm	650	595	545	520	495	—	680	680	680	680	—	735	735	735	735
Min. edge distance, plus c a'_e, b'_e	mm	315	290	265	250	240	—	330	330	330	330	—	360	360	360	360

1) Prestressing strand with nominal diameter of 15.3 mm, cross-sectional area of 140 mm² or with characteristic tensile strength below 1 860 MPa may also be used.
2) Bar diameter of 14 mm can be replaced by 16 mm.

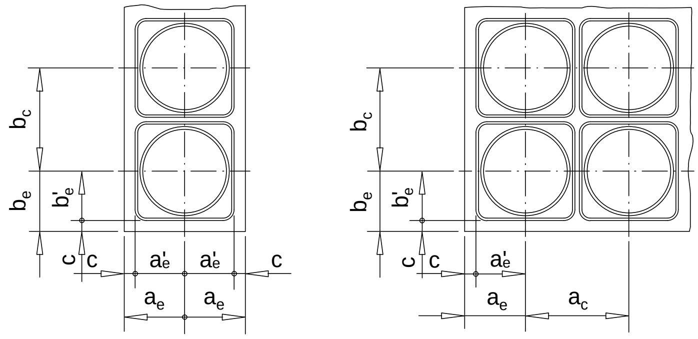
Member of EOTA

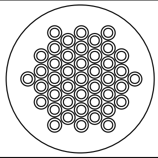
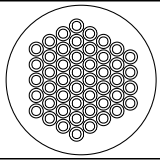
Stressing and fixed anchorage or coupler

Centre spacing and edge distance



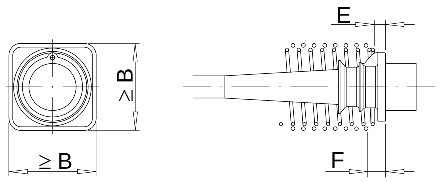
$a_e = a'_e + c$
$b_e = b'_e + c$
c … Concrete cover



Technical data of anchorages												
BBR VT CONA CMI			**43**					**48**				
Strand arrangement												
Strand [1)]		**mm²**	**150**					**150**				
Cross-sectional area		mm²	6 450					7 200				
Charact. tensile strength	R_m	**MPa**	**1 860**					**1 860**				
Charact. maximum force	F_m	kN	11 997					13 392				
$0.90 \cdot F_{p0.1}$		kN	9 520					10 627				
$0.95 \cdot F_{p0.1}$		kN	10 049					11 218				
Helix and additional reinforcement												
Min. concrete strength, cube	$f_{cm,0}$	**MPa**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**
Min. concrete strength, cylinder	$f_{cm,0}$	**MPa**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**
Helix												
Outer diameter		mm	—	670	670	670	670	—	710	710	710	710
Bar diameter [2)]		mm	—	16	16	16	16	—	16	16	16	16
Length, approx.		mm	—	583	583	583	583	—	633	633	633	633
Pitch		mm	—	50	50	50	50	—	50	50	50	50
Number of pitches		—	—	12	12	12	12	—	13	13	13	13
Distance	E	mm	—	45	45	45	45	—	45	45	45	45
Additional reinforcement												
Number of stirrups		—	—	10	10	10	10	—	11	11	11	11
Bar diameter [2)]		mm	—	20	20	20	20	—	20	20	20	20
Spacing		mm	—	70	70	70	70	—	70	70	70	70
Distance from bearing trumplate	F	mm	—	55	55	55	55	—	55	55	55	55
Outer dimensions	B × B	mm	—	740	740	740	740	—	790	790	790	790
Centre spacing and edge distance												
Min. centre spacing	a_c, b_c	mm	—	755	755	755	755	—	805	805	805	805
Min. edge distance, plus c	a'_e, b'_e	mm	—	370	370	370	370	—	395	395	395	395

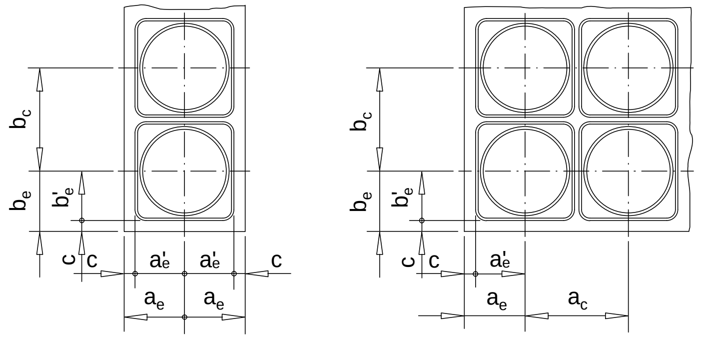
[1)] Prestressing strand with nominal diameter of 15.3 mm, cross-sectional area of 140 mm² or with characteristic tensile strength below 1 860 MPa may also be used.
[2)] Bar diameter of 14 mm can be replaced by 16 mm.

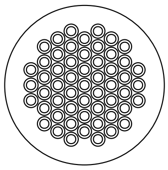
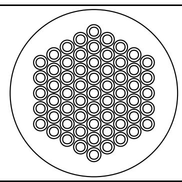
Stressing and fixed anchorage or coupler



$a_e = a'_e + c$
$b_e = b'_e + c$
c … Concrete cover

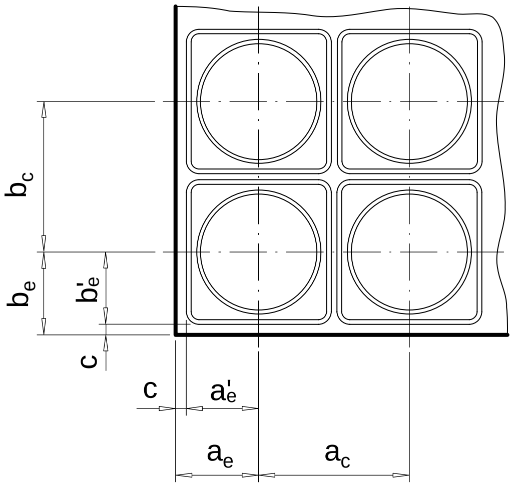
Centre spacing and edge distance



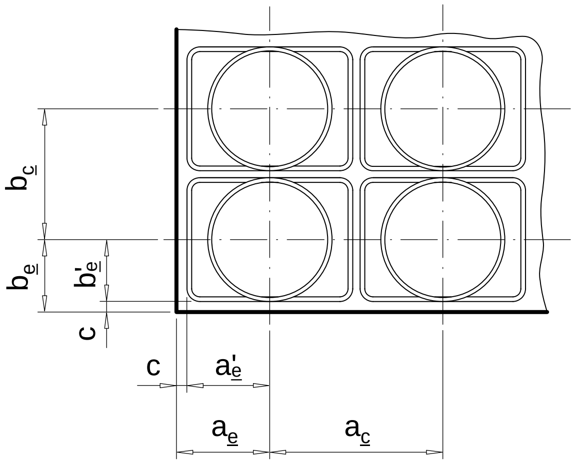
Technical data of anchorages													
BBR VT CONA CMI			**55**					**61**					
Strand arrangement													
Strand 1)		**mm²**	**150**					**150**					
Cross-sectional area		mm²	8 250					9 150					
Charact. tensile strength	**R_m**	**MPa**	**1 860**					**1 860**					
Charact. maximum force	F_m	kN	15 345					17 019					
$0.90 \cdot F_{p0.1}$		kN	12 177					13 505					
$0.95 \cdot F_{p0.1}$		kN	12 854					14 256					
Helix and additional reinforcement													
Min. concrete strength, cube	**$f_{cm,0}$**	**MPa**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**	
Min. concrete strength, cylinder	**$f_{cm,0}$**	**MPa**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**	
Helix													
Outer diameter		mm	—	780	780	780	780	—	850	850	850	850	
Bar diameter 2)		mm	—	20	20	20	20	—	20	20	20	20	
Length, approx.		mm	—	760	760	760	760	—	790	790	790	790	
Pitch		mm	—	60	60	60	60	—	60	60	60	60	
Number of pitches		—	—	13	13	13	13	—	14	14	14	14	
Distance	E	mm	—	50	50	50	50	—	55	55	55	55	
Additional reinforcement													
Number of stirrups		—	—	11	11	11	11	—	12	12	12	12	
Bar diameter 2)		mm	—	20	20	20	20	—	20	20	20	20	
Spacing		mm	—	75	75	75	75	—	75	75	75	75	
Distance from bearing trumplate	F	mm	—	55	55	55	55	—	60	60	60	60	
Outer dimensions	B × B	mm	—	860	860	860	860	—	920	920	920	920	
Centre spacing and edge distance													
Min. centre spacing	a_c, b_c	mm	—	875	875	875	875	—	940	940	940	940	
Min. edge distance, plus c	a'_e, b'_e	mm	—	430	430	430	430	—	460	460	460	460	

1) Prestressing strand with nominal diameter of 15.3 mm, cross-sectional area of 140 mm² or with characteristic tensile strength below 1 860 MPa may also be used.
2) Bar diameter of 14 mm can be replaced by 16 mm.

Centre spacing and edge distance



a_c, b_c
a_e, b_e



$a_{\underline{c}} \geq b_{\underline{c}}$
$a_{\underline{e}} \geq b_{\underline{e}}$

Modification of centre spacing and edge distance are in accordance with Clause 1.9.

$$b_{\underline{c}} \geq \begin{cases} 0.85 \cdot b_c \\ \text{and} \\ \geq \text{Helix, outside diameter}^{\ 1)} \end{cases}$$

$$a_{\underline{c}} \geq \frac{A_c}{b_{\underline{c}}}$$

$$A_c = a_c \cdot b_c \leq a_{\underline{c}} \cdot b_{\underline{c}}$$

Corresponding edge distances

$$a_{\underline{e}} = \frac{a_{\underline{c}}}{2} - 10\text{ mm} + c$$

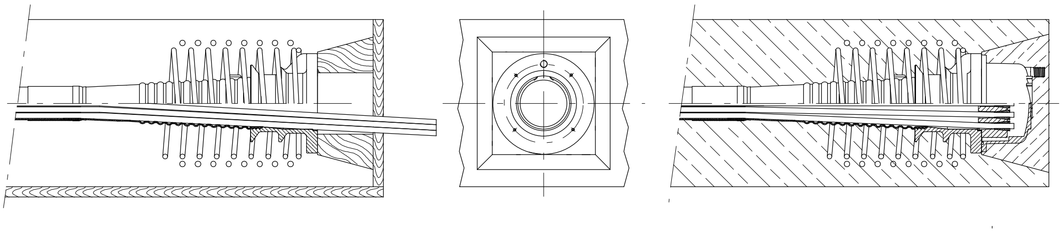
and

$$b_{\underline{e}} = \frac{b_{\underline{c}}}{2} - 10\text{ mm} + c$$

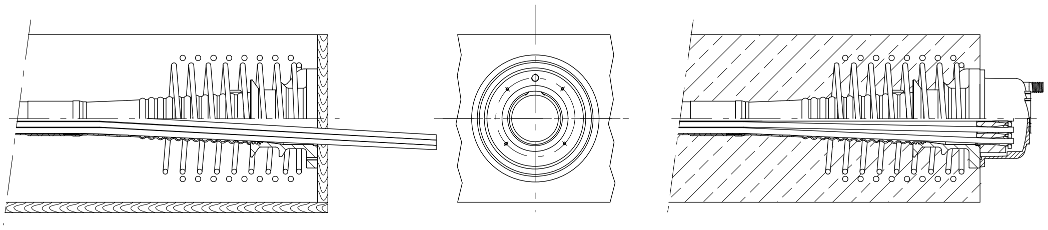
c..... Concrete cover

1) Except the dimensions of helix, which remain unchanged, the outer dimensions of additional stirrup reinforcement are adjusted accordingly. Further modifications of reinforcement are in accordance with the Clauses 1.14.8 and 2.2.3.4.

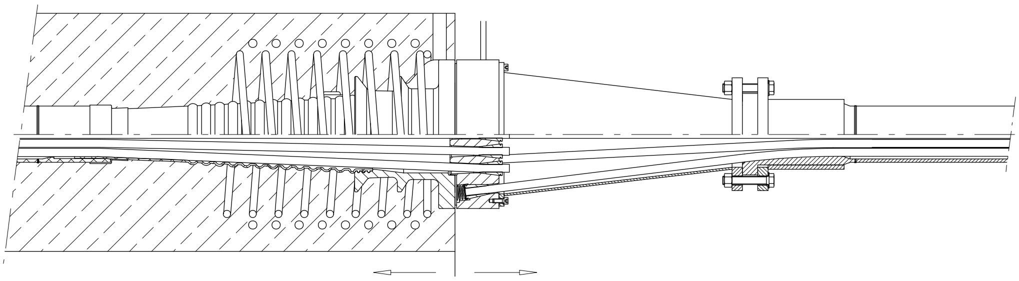
Stressing anchorage, recessed



Stressing anchorage, exposed



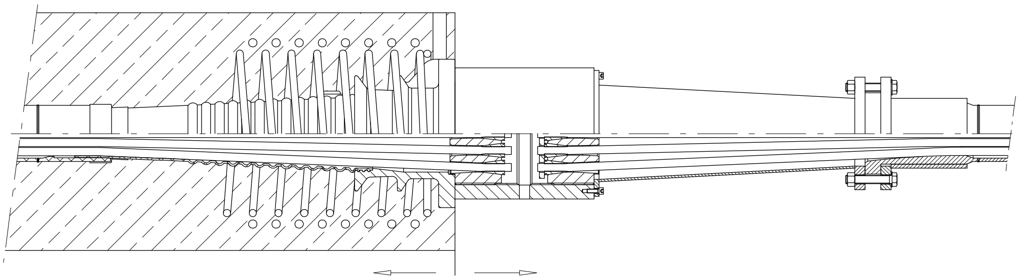
Fixed coupler FK



1. BA 2. BA

1st construction stage 2nd construction stage

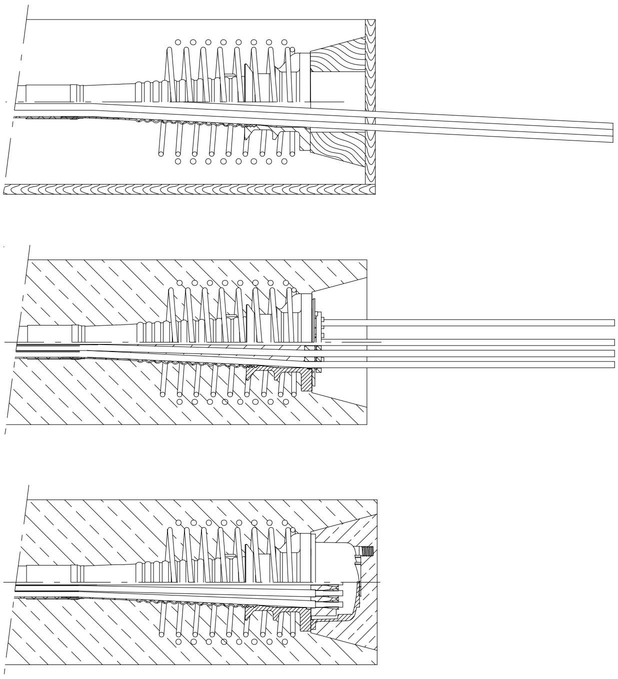
Fixed coupler FH



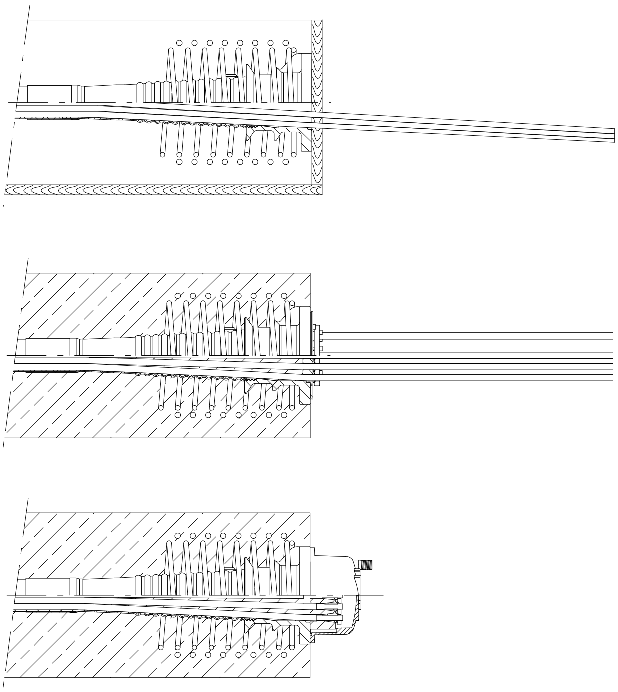
1. BA 2. BA

1st construction stage 2nd construction stage

Stressing anchorage with monostrand, recessed



Stressing anchorage with monostrand, exposed



1 Preparatory work

The components of the post-tensioning kit are stored so as to avoid any damage or corrosion.

2 Anchorage recesses

Adequate space to accommodate and to use the prestressing jack is ensured, see also the Clauses 1.4 and 2.2.3.2.

3 Fastening the bearing trumplates

Four holes are provided to fasten the bearing trumplates to the formwork. The trumpet is screwed into the bearing trumplate. The helix is either welded to the bearing trumplate by means of radial bars, see also the Clauses 1.14.8, 2.2.3.4, and 2.2.4.8, or positioned by fixing it to the existing reinforcement. The trumpet and a piece of the duct are connected in a waterproof way. In the final position the duct protrudes at least 100 mm out of the formwork.

4 Installation of deviators

For accurate installation it is recommended to use a guide wire or something equivalent between successive deviators for pre-adjustment. The deviator is properly connected to the formwork and the reinforcement mesh to avoid any movement during concreting. If required, recess units are inserted in the deviator to avoid deformations. The minimum radii of curvature complies with Clause 1.10.

5 Placing of ducts

The ducts are placed on supports with a spacing of 2 m to 4 m by taking into account the increase of weight due to the tensile elements. The ducts are jointed in a leak-proof way, see also the Clauses 1.6 and 2.2.4.8. In the case of plastic ducts at least one telescopic joint is installed do adjust the length of the duct to the tendon. This opening will be jointed after stressing.

6 Installation of tensile elements, prestressing steel

The prestressing steel is pushed or pulled into the duct before or after concreting of the structure.

7 Installation of the inaccessible fixed anchorages

After passing the strands through the anchor head, they are anchored individually in the cones by means of ring wedges. After assembling the wedges are secured in accordance with the Clauses 1.2.2.1 and 1.14.7.

8 Installation of fixed coupler anchor head 2.BA

The function of the fixed coupler is to connect two tendons, whereas the first tendon is stressed before the second tendon is installed and stressed.

The coupling is achieved by pushing the strands into the already tensioned coupler anchor head K, side 2.BA in the outer pitch circle, whereby the strands are marked to check the correct depth of engagement.

The coupler anchor head H, 2.BA is assembled with ring wedges which are secured in accordance with the Clauses 1.14.5 and 1.14.7. It is connected to the already tensioned coupler anchor head H, 1.BA by means of a threaded coupler sleeve.

9 Assembly of anchor head/coupler anchor head 1.BA

After passing the strands through the anchor head, they are anchored individually in the cones by means of ring wedges. The same applies for the coupler anchor head in case of fixed couplers in the first construction stage.

10 Prestressing

At the time of stressing the mean concrete compressive strength is at least according to Table 5 and the data of Clause 1.11. Stressing and possible wedging are carried out with a suitable prestressing jack and in accordance with Clause 2.2.4.2.

Elongation of the tendon and prestressing forces are checked and recorded systematically during the stressing operation.

Restressing the tendons is permitted in accordance with Clause 2.2.4.4.

11 Grouting the tendons

The grout is injected through the inlet holes until it escapes from the outlet tubes with the same consistency. All vents and grouting inlets are sealed immediately after grouting, see also Clause 2.2.4.6.1.

Grease and way are injected in accordance with ETAG 013 and the recommendations of the supplier, see also Clause 2.2.4.6.2.

More detailed information on installation can be obtained from the ETA holder.

Contents of the prescribed test plan

Component	Item	Test / Check	Trace-ability	Minimum frequency	Documen tation
Bearing trumplate, Bearing trumplate E	Material	Check	Full	100 %	"3.1" [1]
	Detailed dimensions	Test		3 % ≥ 2 specimens	Yes
	Visual inspection [2]	Check		100 %	No
Anchor head, Coupler anchor head	Material	Check	Full	100 %	"3.1" [1]
	Detailed dimensions [3]	Test		5 % ≥ 2 specimens	Yes
	Visual inspection [2, 4]	Check		100 %	No
Ring wedge	Material	Check	Full	100 %	"3.1" [1]
	Treatment, hardness [5, 6]	Test		0.5 % ≥ 2 specimens	Yes
	Detailed dimensions	Test		5 % ≥ 2 specimens	Yes
	Visual inspection [2, 7]	Check		100 %	No
Steel ring	Material	Check	Bulk	100 %	"2.2" [8]
	Detailed dimensions	Test		0.5 % ≥ 2 specimens	Yes
	Visual inspection [2]	Check		100 %	No
Coupler sleeve	Material	Check	Full	100 %	"3.1" [1]
	Detailed dimensions	Test		5 % ≥ 2 specimens	Yes
	Visual inspection [2]	Check		100 %	No
Steel duct	Material	Check	Bulk	100 %	"2.2" [8]
	Visual inspection [2]	Check		100 %	No
Strand [9]	Material	Check	Full	100 %	"CE" [9]
	Diameter	Test		Each coil	No
	Visual inspection [2]	Check		Each coil	No
Constituents of filling material as per EN 447	Cement	Check	Full	100 %	"CE"
	Admixtures, additions	Check	Bulk	100 %	"CE"
Components for EIT	Material	Check	Full	100 %	MC [10]
	Visual inspection [2]	Check		100 %	No

1) "3.1": Inspection certificate type "3.1" according to EN 10204
2) Visual inspections includes e.g. main dimensions, gauge testing, correct marking or labelling, appropriate performance, surface, fins, kinks, smoothness, corrosion, coating, etc., as detailed in the prescribed test plan.
3) Other dimensions than [4]
4) Dimensions: All conical bores of the anchor heads and coupler anchor heads regarding angle, diameter and surface condition, thread dimensions of all anchor heads and coupler anchor heads
5) Geometrical properties
6) Surface hardness
7) Teeth, cone surface
8) "2.2": Test report type "2.2" according to EN 10204
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 accompanies each delivery.
10) Certificate of the manufacturer of the material that allow for proof of conformity.

Full .... Full traceability of each component to its raw materials
Bulk......... Traceability of each delivery of components to a defined point

Audit testing

Component	Item	Test / Check	Sampling [2)] – Number of components per visit
Anchor head, Coupler anchor head, Bearing trumplate, Bearing trumplate E, Steel ring	Material according to specification	Test / Check	1
	Detailed dimensions	Test	
	Visual inspection [1)]	Check	
Coupler sleeve	Material according to specification	Test / Check	1
	Detailed dimensions	Test	
	Visual inspection [1)]	Check	
Ring wedge	Material according to specification	Test / Check	2
	Treatment	Test	2
	Detailed dimensions	Test	1
	Main dimensions, surface hardness and surface finish	Test	5
	Visual inspection [1)]	Check	5
Single tensile element test	Single tensile element test according to ETAG 013, Annex E.3	Test	1 series

1) Visual inspections means e.g. main dimensions, gauge testing, correct marking or labelling, appropriate performance, surface, fins, kinks, smoothness, corrosion protection, corrosion, coating, etc., as given in the prescribed test plan.

2) All samples are randomly selected and clearly identified.

№	Essential Characteristic	Clause	Intended use Line № according to Clause 2.1, Table 7					
			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	Practicability, reliability of installation	3.2.4.1	—	+	—	—	—	—
10	Practicability, reliability of installation	3.2.4.2	—	—	+	—	—	—
11	Practicability, reliability of installation	3.2.4.3	—	—	—	+	—	—
12	Load transfer to the structure	3.2.4.4	—	—	—	—	—	+

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.

Reference documents

Guideline for European Technical Approval

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

Standards

EN 206, 12.2013	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 1561, 10.2011	Founding – Grey cast irons
EN 1563, 12.2011	Founding – Spheroidal graphite cast irons
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 6	Eurocode 6: Design of masonry structures
EN 10025-2, 11.2004 EN 10025-2/AC, 06.2005	Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels
EN 10083-1, 08.2006	Steels for quenching and tempering – Part 1: General technical delivery conditions
EN 10083-2, 08.2006	Steels for quenching and tempering – Part 2: Technical delivery conditions for non alloy steels
EN 10084, 04.2008	Case hardening steels – 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 10216-1, 12.2013	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10217-1, 05.2002 EN 10217-1/A1, 01.2005	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10219-1, 04.2006	Cold formed welded structural hollow sections of non-alloy and fine grain steels – Part 1: Technical delivery conditions
EN 10255+A1, 04.2007	Non-Alloy steel tubes suitable for welding and threading – Technical delivery conditions
EN 10270-1, 10.2011	Steel wire for mechanical springs – Part 1: Patented cold drawn unalloyed steel wire
EN 10277-2, 03.2008	Bright steel products – Technical delivery conditions – Part 2: Steels for general engineering purposes

EN 10305-5, 01.2010	Steel tubes for precision applications – Technical delivery conditions – Part 5: Welded cold sized square and rectangular tubes
EN 12201-1, 09.2011	Plastics piping systems for water supply, and for drainage and sewerage under pressure – Polyethylene (PE) – Part 1: General
ENV 1992-1-5, 10.1994	Eurocode 2: Design of concrete structures – Part 1-5: General rules – Structures with unbonded and external prestressing tendons
EN ISO 17855-1, 10.2014	Plastics – Polyethylene (PE) moulding and extrusion materials – Part 1: Designation system and basis for specifications
EN ISO 19069-1, 03.2015	Plastics – Polypropylene (PP) moulding and extrusion materials – Part 1: Designation system and basis for specifications
prEN 10138-3, 09.2000	Prestressing steels – Part 3: Strand
prEN 10138-3, 08.2009	Prestressing steels – Part 3: Strand
CWA 14646, 01.2003	Requirements for the installation of post-tensioning kits for prestressing of structures and qualification of the specialist company and its personnel
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 posttensioning kits for the prestressing of structures, Official Journal of the European Communities L 201 of 17 July 1998, p. 112
305/2011	Regulation (EU) № 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, OJ L 88 of 4 April 2011, p. 5, amended by Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, OJ L 157 of 27.05.2014, p. 76 and Commission Delegated Regulation (EU) № 574/2014 of 21 February 2014, OJ L 159 of 28.05.2014, p. 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 27.05.2014, p. 76

Materialprüfungsamt Nordrhein-Westfalen
Prüfen · Überwachen · Zertifizieren

Certificate of constancy of performance
0432-CPR-00299-1.3 (EN)

Version 02

In compliance with Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 (the Construction products Regulation or CPR), this certificate applies to the construction product

BBR VT CONA CME -
External Post-tensioning System with 04 to 61 Strands

Post-tensioning kit for external prestressing of structures

placed on the market under the name or trade mark of

BBR VT International Ltd.
Ringstr. 2
CH-8603 Schwerzenbach (ZH) / Switzerland

and produced in the manufacturing plant(s)

BBR VT International Ltd.
Ringstr. 2
CH-8603 Schwerzenbach (ZH) / Switzerland

This certificate attests that all provisions concerning the assessment and verification of constancy of performance described in the

ETA 07/0168, issued on 18.12.2017

and

ETAG 013 - Post Tensioning Kits for prestressing of Structures

under **system 1+** for the performance set out in the ETA are applied and that the factory production control conducted by the manufacturer is assessed to ensure the

constancy of performance of the construction product.

This certificate was first issued on 10.03.2008 and will remain valid until 29.01.2028 as long as neither the ETA, the EAD, the construction product, the AVCP methods nor the manufacturing conditions in the plant are modified significantly, unless suspended or withdrawn by the notified product certification body.

Dortmund, 30.01.2023

by order

Dipl.-Ing. Becker
Head of Certification Body (Dep. 21.40)

Materialprüfungsamt Nordrhein-Westfalen MPA NRW 10

This Certificate consists of 1 page.

This Certificate replaces the Certificate no. 0432-CPR-00299-1.3 dated 05.02.2018, Version 01.

The original of this document was issued in German language.
In case of doubt only the German version is valid.

DAkkS Deutsche Akkreditierungsstelle D-ZE-11142-01-00

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