European Technical Assessment
ETA – 12/0076

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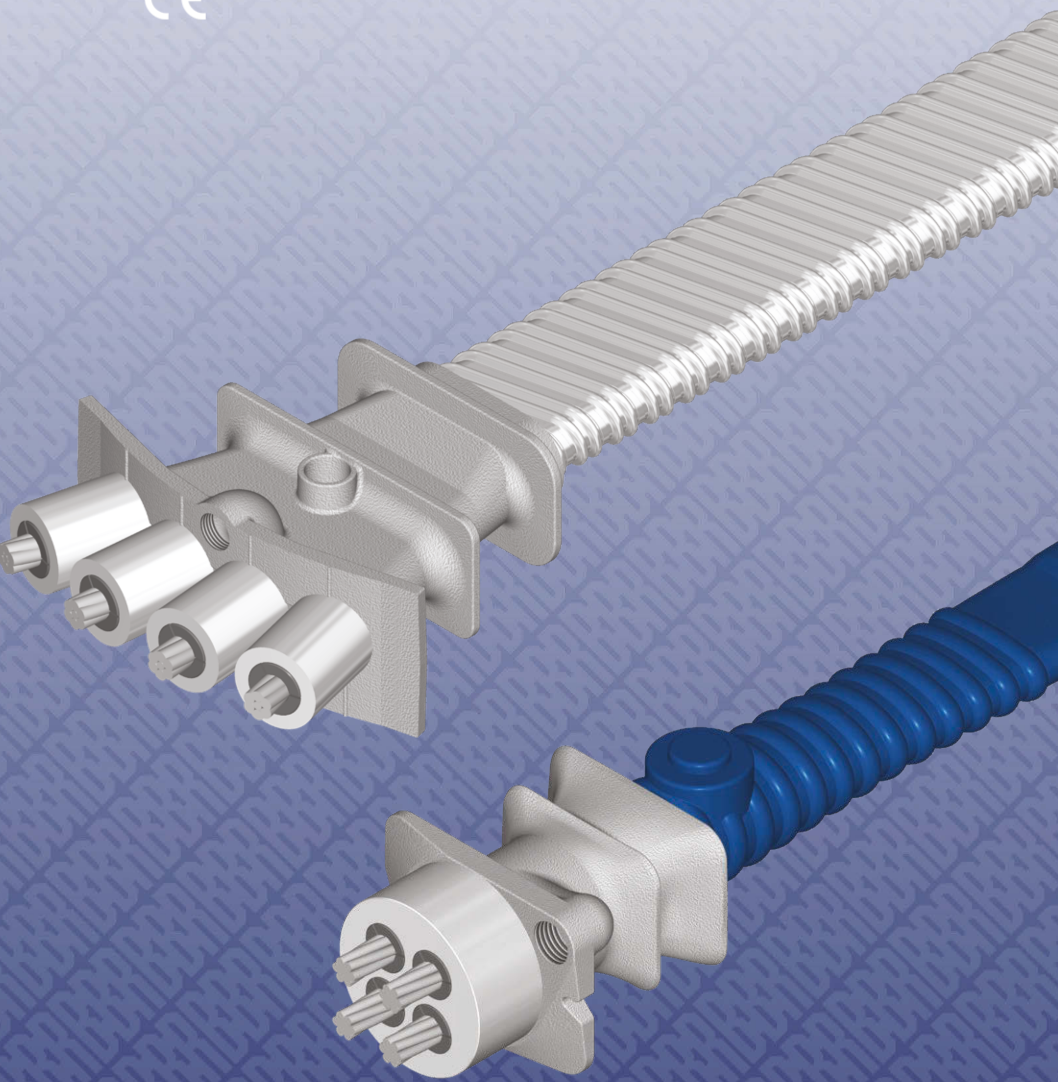

BBR VT CONA CMF BT
Internal Post-tensioning System with Flat Anchorages

BBR A Global Network of Experts
www.bbrnetwork.com

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0432

ETA-12/0076
BBR VT CONA CMF
Internal Post-tensioning System with
Flat Anchorages and 02, 03 and 04 Strands

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SPECIMEN

Responsible BBR PT Specialist Company

CE

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

Assembly and installation of BBR VT CONA CMF 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
Europäische Organisation für Technische Zulassungen
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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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European Technical Assessment

ETA-12/0076 of 23.09.2019

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 CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands
Product family to which the construction product belongs	Post-tensioning kit for prestressing of structures with internal bonded or unbonded strands
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	71 pages including Annexes 1 to 40, which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with Regulation (EU) № 305/2011, on the basis of	EAD 160004-00-0301, European Assessment Document for Post-tensioning kit for prestressing of structures with internal bonded or unbonded strands.
This European Technical Assessment replaces	European Technical Assessment ETA-12/0076 of 14.12.2017.

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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 CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands,

comprising the following components, see Annex 1, Annex 2, and Annex 3.

– Tendon

Bonded tendons with 02, 03, 04, 05, and 06 tensile elements

Internal unbonded tendons with 02, 03, 04, 05, and 06 tensile elements

– Tensile element

Table 1 Tensile elements

Designation	Nominal diameter	Nominal cross-sectional area	Maximum characteristic tensile strength [1)]
—	mm	mm²	MPa
05	12.5	93	1 860
	12.9	100	
06	15.3	140	
	15.7	150	

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

NOTE 1 MPa = 1 N/mm²

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

Unbonded monostrand, i.e. 7-wire prestressing steel 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.

NOTE Monostrands are either individual monostrands or bands.

[1] ETA-12/0076 was firstly issued in 2012 as European technical approval with validity from 29.06.2012, converted in 2017 to European Technical Assessment ETA-12/0076 of 19.05.2017, amended in 2017 to European Technical Assessment ETA-12/0076 of 14.12.2017 and in 2019 to European Technical Assessment ETA-12/0076 of 23.09.2019.

- Anchorage and coupler

  Anchorage of the prestressing steel strands with ring wedges or in fixed anchorage by bond in combination with bulb-ends (onions) [2]

  End anchorage

  - S1 fixed (passive) anchor or stressing (active) anchor as end anchorage series 1 for tendons with 02, 03, and 04 prestressing steel strands
  - S2 fixed (passive) anchor or stressing (active) anchor as end anchorage series 2 for tendons with 02, 03, 04, 05, and 06 prestressing steel strands
  - Inaccessible fixed (passive) anchor [2] with bulb-ends (onions) and bulb-strand spacers for tendons with 02, 03, 04, 05, and 06 prestressing steel strands

  Fixed or stressing coupler

  S1 sleeve coupler series 1 for tendons with 02, 03, and 04 prestressing steel strands

  Movable coupler

  S1 sleeve coupler series 1 for tendons with 02, 03, and 04 prestressing steel strands
- S1 bearing trumplate series 1 for tendons with 02, 03, and 04 prestressing steel strands
- S2 bearing trumplate series 2 for tendons with 02, 03, 04, 05, and 06 prestressing steel strands
- Helix and additional reinforcement or only additional reinforcement without helix in the region of the anchorage, series 1
- Additional reinforcement without helix in the region of the anchorage, series 2
- Corrosion protection for tensile elements, anchorages, and couplers

PT system

1.2 Designation and range of anchorage and coupler

1.2.1 General

End anchorage can be fixed or stressing anchorage. Coupler is stressing, fixed or movable. The principal dimensions of anchorage and coupler are given in Annex 5, Annex 6, Annex 7, Annex 8, Annex 23, Annex 24, Annex 25, and Annex 26.

There are three series of anchorages. The available tendon ranges, in terms of number of prestressing steel strands, anchorages, and couplers are given in Annex 4.

- Anchorage series 1, designated S1, for tendons with 02, 03, and 04 prestressing steel strands. These series comprise cylindrical anchor heads and a common bearing trumplate for all tendon sizes. Fixed, stressing and movable couplers also belong to these series.

  An overview on anchorages and couplers of series 1 is given in Annex 1, Annex 2, Annex 3, and Annex 21.
- Anchorage series 2, designated S2, for tendons with 02, 03, 04, 05, and 06 prestressing steel strands. These series comprise cylindrical mono barrels to individually anchor each prestressing steel strand. The mono barrels of a tendon are supported by a particularly shaped bearing trumplate.

  An overview on anchorages and couplers of series 2 is given in Annex 1, Annex 2, and Annex 22.

[2] Fixed anchorage according to ETA-15/0808, BBR VT CONA CMO Bonded Post-tensioning System with 02 to 06 Strands

– Anchorage series for only inaccessible fixed anchorage, effective by bond and bulb-ends and designated CMO, for tendons with 02, 03, 04, 05, and 06 prestressing steel strands.

An overview on anchorages and couplers of these series is given in Annex 1 and Annex 22.

NOTE In general, anchorages and couplers of all anchorage series can be combined within one tendon. However, the particularities of each anchorage series have to be considered. Ask ETA holder for advice prior to thinking about such combined tendons.

1.2.2 Designation

End anchorage, e.g. S A CONA CMF BT S1-0206 – 150 1860

- Fixed (F) or stressing (S) ← S
- Anchor head (A) ← A
- Internal PT ← CONA CMF BT
- Anchor series 1 (S1) or series 2 (S2) ← S1
- Designation of tendon ← 0206 – 150 1860
  with information on number, cross-sectional area, and characteristic tensile strength of the prestressing steel strands

Coupler, e.g. F H CONA CMF BT S1-0206 – 150 1860 – 1. BA

- Fixed (F), stressing (S) or movable (B) ← F
- Coupler anchor head (H) for sleeve coupler ← H
- Designation of tendon ← CONA CMF BT S1-0206 – 150 1860
  Internal PT with information on series 1 (S1), number, cross-sectional area, and characteristic tensile strength of the prestressing steel strands
- Construction stage 1 (1. BA) or stage 2 (2. BA) ← 1. BA

1.2.3 Anchorage

1.2.3.1 General

Anchorage of prestressing steel strand is achieved by either wedges in anchor head or by bond in combination with bulb-ends (onions).

Anchorage by wedges and anchor head in fixed and stressing anchorage is identical, see Annex 1, Annex 2, and Annex 3. A differentiation is needed for execution of the construction works.

The wedges of inaccessible fixed anchor series 1 are secured with either a wedge retaining plate or springs. An alternative is pre-locking each individual prestressing steel strand with ~ $0.5 \cdot F_{pk}$ and applying a wedge retaining plate.

Steel strip sheaths are slipped over the plastic trumpets at the anchorages.

For series 2, each individual prestressing steel strand is pre-locked with ~ $0.5 \cdot F_{pk}$ and the wedges are secured with wedge retaining plate or wedge holding rings and an integrated protection cap. An alternative is applying wedge retaining plate, wedge holding rings, together with an integrated protection cap.

Where

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

Anchorage of prestressing steel strands by bond and bulb-ends, CMO, is an inaccessible fixed anchorage only, see Annex 1 and Annex 22.

1.2.3.2 Restressable and exchangeable tendon

Tendon remaining restressable or exchangeable throughout the working life of the structure is an unbonded tendon. Grease, wax, or an equivalent soft filling material is used for corrosion protection with such tendon. This is applicable to

- Bare prestressing steel strand in a duct and
- Monostrands and bands.

Significant to a restressable and an exchangeable tendon is the excess length of the prestressing steel strands. The extent of the excess length depends on the jack used for restressing or releasing. The protrusions of the prestressing steel strands require a permanent corrosion protection and an adapted cap, see Annex 1 and Annex 2.

Anchorage by bond and bulb-ends, CMO, is unsuitable for restressable and exchangeable tendon.

1.2.4 Fixed and stressing coupler

1.2.4.1 General

The prestressing force at the second construction stage may not be greater than that at the first construction stage, neither during construction, nor in the final state, nor due to any load combination.

1.2.4.2 Sleeve coupler, FH, SH

The tendon of construction stage 2 is coupled by screwing the coupler sleeve entirely on the threaded part of the coupler anchor head 1. BA, construction stage 1, see Annex 1 and Annex 2. Coupler anchor head 2. BA, construction stage 2, is prelocked with a prelocking force as specified in Clause 1.8 and the wedges are secured with a wedge holding plate, see Annex 1 and Annex 2.

The coupler anchor head H is of the same basic geometry as the anchor head of the fixed and stressing anchor. The connection between the coupler anchor head H of the first and second construction stage is achieved by means of a coupler sleeve.

Steel strip sheaths are slipped over the plastic trumpets at the couplers.

1.2.5 Movable coupler, BH

The movable coupler is a sleeve coupler in a coupler sheathing box made of steel or plastic. Length and position of the coupler sheathing box are for the expected strain displacement, see Clause 2.2.4.2. Both coupler anchor heads are prelocked with a prelocking force as specified in Clause 1.8 and the wedges are secured with a wedge holding plate, see Annex 1.

The coupler anchor heads and the coupler sleeves of the movable couplers are identical to the coupler heads and the coupler sleeves of the fixed couplers, see Clause 1.2.4.2.

Steel strip sheaths are slipped over the plastic trumpets at the couplers.

1.2.6 Layout of the anchorage recess

All anchor heads and coupler anchor heads 1. BA, construction stage 1, are placed perpendicular to the axes of the tendons, see Annex 21 and Annex 22.

The dimensions of the anchorage recess are adapted to the prestressing jack used. The ETA holder saves for reference information on the minimum dimensions of the anchorage recess. 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 on anchorage and bearing trumplate is not required. However, the exposed surfaces of bearing trumplate and cap are provided with corrosion protection.

1.3 Designation and range of the tendons

1.3.1 Designation

Tendon, e.g. CONA CMF BT S1-02 06 – 150 1860

- Internal PT ← CONA CMF BT
- Anchor series 1 (S1) or series 2 (S2) ← S1
- Number of prestressing steel strands, 02 to 06 ← 02
- Prestressing steel strand, *05* or 06 ← 06
- Cross-sectional area of prestressing steel strand, 93, 100, 140, or 150 mm^2 ← 150
- Characteristic tensile strength of the prestressing steel strand ← 1860

The tendon comprises 02, 03, 04, 05, or 06 tensile elements, 7-wire prestressing steel strands, monostrands, or bands according to Annex 36.

1.3.2 Tendon ranges

1.3.2.1 General

Prestressing and overstressing forces are given in 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 19 and Annex 20.

Available tendons in terms of prestressing steel strand, number of strands, anchorages and couplers, and ducts are listed in Annex 4.

1.3.2.1.1 Bonded tendon

The bonded tendon comprises 02, 03, 04, 05, or 06 prestressing steel strands, grouted within a corrugated duct either in plastic or steel. A smooth steel duct may be used if permitted at the place of use.

1.3.2.1.2 Unbonded tendon

The unbonded tendon comprises 02, 03, 04, 05, or 06 prestressing steel strands within a smooth duct either in plastic or steel. If monostrands are used, they are factory-provided with a corrosion protection system comprising corrosion protection filling material and HDPE-sheathing.

NOTE Monostrands are either individual monostrands or bands.

1.3.2.2 CONA CMF BT *n05* – 93

7-wire prestressing steel strand

Nominal diameter	12.5	mm
Nominal cross-sectional area	93	mm^2
Maximum characteristic tensile strength	1 860	MPa

Prestressing steel strand with HDPE-sheathing and corrosion protection filling material – Monostrand or band

Mass of sheathed and filled strand	≥ 0.85	kg/m
External diameter of strand sheathing	≥ 16.5	mm

Annex 11 lists the available tendon ranges for CONA CMF BT *n05* – 93.

1.3.2.3 CONA CMF BT *n05* – 100

7-wire prestressing steel strand

Nominal diameter .... 12.9 mm

Nominal cross-sectional area .... 100 mm^2

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

Prestressing steel strand with HDPE-sheathing and corrosion protection filling material – Monostrand or band

Mass of sheathed and filled strand .... ≥ 0.90 kg/m

External diameter of strand sheathing .... ≥ 17.0 mm

Annex 11 lists the available tendon ranges for CONA CMF BT *n05* – 100.

1.3.2.4 CONA CMF BT 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

Prestressing steel strand with HDPE-sheathing and corrosion protection filling material – Monostrand or band

Mass of sheathed and filled strand .... ≥ 1.23 kg/m

External diameter of strand sheathing .... ≥ 19.5 mm

Annex 12 lists the available tendon ranges for CONA CMF BT n06 – 140.

1.3.2.5 CONA CMF BT 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

Prestressing steel strand with HDPE-sheathing and corrosion protection filling material – Monostrand or band

Mass of sheathed and filled strand .... ≥ 1.31 kg/m

External diameter of strand sheathing .... ≥ 20.0 mm

Annex 12 lists the available tendon ranges for CONA CMF BT n06 – 150.

1.4 Duct

1.4.1 Use of duct

1.4.1.1 General

Ducts are used for tendons in either bonded or unbonded applications. Tendons with monostrands or bands are unbonded tendons only.

1.4.1.2 Bonded tendon

For a bonded tendon a corrugated duct in steel or in plastic is used.

Corrugated duct in steel is a steel strip sheath according to EN 523[3]. Alternatively, a smooth plastic duct or a smooth steel duct may be used, if permitted at the place of use.

1.4.1.3 Unbonded tendon

For an unbonded tendon, corrugated or smooth duct in steel or plastic, or monostrand or band can be used.

1.4.2 Degree of filling

For bonded and unbonded tendon, other than monostrand tendon in circular duct, the degree of filling, f, is generally between 0.25 and 0.35. The minimum radii of curvature can be defined with the equation given in Clause 1.5. Typical degrees of filling, f, and corresponding minimum radii of curvature, R_{min}, are given in Annex 13, Annex 14, Annex 15, and Annex 16.

The degree of filling is defined by the equation

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

1.4.3 Circular steel strip sheath

Steel strip sheath in conformity with EN 523 is used. The degree of filling, f, is according to Clause 1.4.2 and the minimum radii of curvature to Clause 1.5.

Annex 13 and Annex 14 give internal duct diameters and minimum radii of curvature, in which the pressure under the prestressing steel strand, p_R, has been set to 130 kN/m, 150 kN/m, 200 kN/m, and 230 kN/m respectively. Further duct diameters and smaller radii of curvature are acceptable according to the respective standards and regulations in force at the place of use.

1.4.4 Flat steel duct

For tendon with 02, 03, 04, 05, or 06 prestressing steel strands flat duct, either smooth or corrugated, may be used, whereas EN 523 applies accordingly. The flat duct is free of any kinks.

Annex 15 and Annex 16 give minor and major internal flat duct dimensions and minimum radii of curvature, both minor and major, in which the pressure under the prestressing steel strand, p_R, has been set to 130 kN/m, 150 kN/m, 200 kN/m, and 230 kN/m respectively. Further duct dimensions and smaller radii of curvature are acceptable according to the respective standards and regulations in force at the place of use.

1.4.5 Pre-bent smooth circular steel duct

If permitted at the place of use, smooth steel duct according to EN 10255, EN 10216-1, EN 10217-1, EN 10219-1, or EN 10305-5 can be used. The degree of filling, f, conforms to Clause 1.4.2 and the minimum radii of curvature to Clause 1.5. The duct is pre-bent and free of any kink. The minimum wall thickness of steel duct meets the specification of Annex 17.

Further internal diameters or wall thicknesses are acceptable according to the respective standards and regulations in force at the place of use.

1.4.6 Plastic duct

Corrugated plastic ducts or smooth plastic ducts according to EN 12201 are in general available for a bonded or unbonded tendon. Use of such ducts and minimum radii of curvature, R_{min}, are according to the standards and regulations in force at the place of use. Minimum wall thicknesses are given in Annex 17.

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[3] Reference documents are listed in Annex 39 and Annex 40.

Further internal diameters or wall thicknesses are acceptable according to the respective standards and regulations in force at the place of use.

1.5 Minimum radii of curvature of internal tendons

1.5.1 Minimum radii of curvature for bonded and unbonded tendons, other than monostrand tendons

The minimum radii of curvature for prestressing steel strands, R_{min}, given in Annex 13 and Annex 14, correspond to

- a prestressing force of the tendons of $0.85 \cdot F_{p0.1}$
- a nominal diameter of the prestressing steel strands of d_{strand} = 12.5 mm to d_{strand} = 15.7 mm
- a characteristic tensile strength of the prestressing steel strand of 1 860 MPa
- a maximum pressure under the prestressing steel strands of $p_{R,\,max}$ = 130 kN/m, 150 kN/m, 200 kN/m, and 230 kN/m
- a concrete compressive strength of $f_{cm,\,0,\,cube} \geq 21$ MPa

In case of different tendon parameters or a different pressure under the prestressing steel strands, the calculation of minimum radii of curvature of tendons for circular ducts can be carried out with the following equation.

$$R_{min} = \max \begin{cases} \geq \dfrac{F_{pm,\,0}}{p_R} \cdot k_n \\ \text{and} \\ \geq \dfrac{400 \cdot d_{strand}}{3\,000} \end{cases}$$

Where

R_{min}.......... m .... Minimum radii of curvature

$F_{pm,\,0}$....... kN .... Prestressing force of the tendon

p_R .... kN/m .... Design pressure under the prestressing steel strands

k_n............—........... Factor to account for number of prestressing steel strands and duct diameter, see Table 2

d_{strand}.......mm.......... Nominal diameter of the prestressing steel strand

n.............—........... Number of prestressing steel strands

f..............—........... Degree of filling

Table 2 Factor k_n

Number of strands n	Factor k_n		
	f ~ 0.25	f ~ 0.30	f ~ 0.35
02	0.68	0.87	—
03	0.61	0.71	0.88
04	0.65		

For tendons with predominantly static loading, reduced minimum radii of curvature can be used. Recommended maximum pressure under the prestressing steel strands, $p_{R,\,max}$, is

$p_{R,\,max}$ = 130–230 kN/m for internal bonded tendons

$p_{R,\,max}$ = 800 kN/m for smooth steel duct and predominantly static loading

In case of a reduced minimum radius of curvature, the degree of filling, f, as defined in Clause 1.4.2, is between 0.25 and 0.30 to allow for proper tendon installation. Depending on the concrete strength at the time of stressing, additional reinforcement for splitting forces may be required in the areas of reduced minimum radii of curvature.

Standards and regulations on minimum radii of curvature or on the pressure under the prestressing steel strands in force at the place of use are observed.

1.5.2 Minimum radii of curvature for tendons with monostrands

The minimum radius of curvature R_{min} of internal tendons with monostrands or bands is 2.5 m. If this radius is adhered to, verification of prestressing steel outer fibre stresses in curved sections is not required. The minimum radius of curvature for deviation of tendons with multistrand anchorages in the anchorage zone, after the transition pipes is 3.5 m.

For tendons with nearly straight tendon layout, an HDPE sheathing with a thickness of 1 mm may be used if acceptable at the place of use.

For free tendon layout in slabs with a thickness of ≤ 45 cm see Annex 29 and Annex 30.

1.6 Support of tendons

1.6.1 Support of bonded and unbonded tendons, other than monostrand tendons

Spacing of supports is between 1.0 to 1.8 m. In the region of maximum tendon curvature, a spacing of 0.8 m is applied and 0.6 m in case the minimum radii of curvature is smaller than 4.0 m. The tendons are systematically fastened in their position so that they are not displaced by placing and compacting the concrete.

1.6.2 Support of monostrand tendons

The individual monostrands or bands are fastened in their position. Spacing of supports is.

1 Normally

Tendons with 02, 03, or 04 monostrands or bands .... 1.00 to 1.30 m

2 Free tendon layout in ≤ 45 cm thick slabs

In the transition region between

a) High tendon position and anchorage, e.g. cantilever.. ≤ 1.50 m

b) Low and high tendon position or low tendon position and anchorage .... ≤ 3.00 m

In regions of high or low tendon position the tendons are connected in an appropriate way to the reinforcement mesh, at least at two points with a spacing of 0.3 to 1.3 m. The reinforcement mesh is fixed in its position. Special supports for tendons are therefore not required. For details see Annex 29 and Annex 30.

1.7 Friction losses

For calculation of loss of prestressing force due to friction Coulomb's law applies. The calculation of friction losses is carried out using the equation

$$F_x = F_0 \cdot e^{-\mu \cdot (\alpha + k \cdot x)}$$

Where

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 angular displacements over distance x, irrespective of direction or sign k .... rad/m...........Wobble coefficient, see Table 3

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

NOTE 1 rad = 1 m/m = 1

Table 3 Friction parameters

Duct	Recommended values		Range of values	
	μ	k	μ	k
	rad^{-1}	rad/m	rad^{-1}	rad/m
Steel strip sheath	0.18	0.005	0.17–0.19	0.004–0.007
Smooth steel duct	0.18		0.16–0.24	
Corrugated plastic sheath	0.12		0.10–0.14	
Smooth plastic duct	0.12		0.10–0.14	
Monostrand or band	0.06	0.009	0.05–0.07	0.008–0.011

NOTE As far as acceptable at the place of use, due to special measures like oiling or for a tendon layout with only few deviations the friction coefficient μ can be reduced by 10 to 20 %. Compared with e.g. the use of prestressing steel or sheaths with a film of rust this value increases by more than 100 %.

If tendons with bands with two or four prestressing steel strands are installed upright, with flat-wise curvature and connected at support distances of 1.15 to 1.30 m, the wobble coefficient is $k = 4.37 \cdot 10^{-3}$ rad/m.

Stressing strand by strand can cause friction losses several times larger than stressing all prestressing steel strands of the tendon at once. This is in particular important for tendons with flat ducts and deviations around the minor axis, see $R_{min, minor}$ in Annex 15 and Annex 16.

Friction losses in anchorages series 1 and series 2 are low and do not have to be taken into consideration in design and execution.

1.8 Slip at anchorages and couplers

Table 4 Slip at anchors and couplers

Anchorage series	Anchor, coupler	Slip	
—	—	mm	
Series 1	Stressing and fixed anchor	6	4 [1), 2)]
	Slip at stressing and fixed coupler, first construction stage 1. BA	6	4 [1)]
	Slip at stressing and fixed coupler, second construction stage 2. BA	6	4 [2)]
	Slip at movable coupler, first and second tendon each	6	4 [2)]
Series 2	Stressing anchor	7	4 [1)]
	Fixed anchor	7	4 [2)]

1) Stressed with prestressing jack with wedging system, wedging force ~ 25 kN per prestressing steel strand
2) Prelocking each prestressing steel strand with ~ 0.5 · F_{pk}

Where

F_{pk}...........kN.............Characteristic maximum force of one prestressing steel strand, see Annex 36

For calculation of slip at inaccessible fixed anchor by bond and bulb-ends, CMO, the tendon length continues until the bulb-ends of the fixed bond anchorage. Slip of bulb-ends may be assumed as zero.

1.9 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 as given in Table 5. The concrete test specimens are subjected to the same curing conditions as the structure.

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

Helix, additional reinforcement, and centre spacing and edge distance corresponding to the concrete compressive strength are taken from Annex 23, Annex 24, Annex 25, and Annex 26, see also the Clauses 1.12.11 and 2.2.3.3.

Table 5 Compressive strength of concrete

Mean concrete strength			**$f_{cm,\,0}$**		
Cube strength, 150 mm cube	$f_{cm,\,0,\,cube}$	MPa	21 1)	25 1)	26 2)
Cylinder strength, 150 mm cylinder diameter	$f_{cm,\,0,\,cylinder}$	MPa	17 1)	20 1)	21 2)

1) Anchorage series 1 2) Anchorage series 2

Where

$f_{cm,\,0,\,cube}$ ....MPa ......Mean concrete compressive strength at time of stressing, determined at cubes, 150 mm

$f_{cm,\,0,\,cylinder}$ .....MPa ......Mean concrete compressive strength at time of stressing, determined at cylinders, diameter 150 mm

1.10 Centre spacing and edge distance for anchorages

In general, spacing and distances are not less than the values given in Annex 23, Annex 24, Annex 25, and Annex 26.

However, a reduction of up to 15 % of centre spacing of tendon anchorages in one direction is permitted, but not less than the outside dimensions of the helix and bearing trumplate and placing of additional reinforcement still is possible. In this case the spacing in the perpendicular direction is increased by the same percentage, see Annex 27 and Annex 28. The corresponding minimum edge distance is calculated by

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

and

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

Where

a_c, $a_{\underline{c}}$ .... mm ....Centre spacing before and after modification

b_c, $b_{\underline{c}}$ .... mm ....Centre spacing in the direction perpendicular to a_c before and after modification

a_e, $a_{\underline{e}}$ .... mm ....Edge distance before and after modification

b_e, $b_{\underline{e}}$ .... mm ....Edge distance in the direction perpendicular to a_e before and after modification

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

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

The minimum values for a_c, b_c, a_e, and b_e are given in Annex 23, Annex 24, Annex 25, and Annex 26.

NOTE Replacing the additional stirrup reinforcement of series 1 by a rectangular helix according to Annex 27 does not prevent centre spacing and edge distance to be modified. The external dimensions of the rectangular helix replacing stirrups of series 1 are adapted to the modified centre spacing and edge distance. This does not apply to series 2, where external dimensions of stirrup reinforcement maintain minimum dimensions regardless any modification of centre spacing and edge distances.

Components

1.11 Prestressing steel strands

Only 7-wire prestressing steel strands, monostrands, or bands with characteristics according to Table 6 are used, see also Annex 36. The corrosion protection system of the monostrands or bands, comprising corrosion protection filling material and HDPE-sheathing, is as specified in Clause 1.13.

NOTE Monostrands are either individual monostrands or bands, see Annex 3, Annex 29, and Annex 30.

Table 6 Prestressing steel strands

Maximum characteristic tensile strength [1]	f_{pk}	MPa	1 860			
Nominal diameter	d	mm	12.5	12.9	15.3	15.7
Nominal cross-sectional area	A_p	mm^2	93	100	140	150
Mass of prestressing steel	M	kg/m	0.73	0.78	1.09	1.17
Mass of monostrand		kg/m	0.85	0.90	1.23	1.31

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 prestressing steel strands. In execution, a suitable prestressing steel strand that conforms to Annex 36 and is according to the standards and regulations in force at the place of use is taken.

1.12 Anchorages and couplers

1.12.1 General

The components of anchorages and couplers are in conformity with the specifications given in Annex 5, Annex 6, Annex 7, Annex 8, Annex 9, and Annex 10 and the technical file[4]. Therein the component dimensions, materials, and material identification data with tolerances are given.

1.12.2 Anchor head A CONA CMF BT S1

The anchor head of anchorage series 1, see Annex 5, is made of steel and contains regularly arranged conical holes drilled in parallel to accommodate prestressing steel strands and wedges. The back exits of the bore holes are provided with bell mouth openings or plastic ring cushions. In addition, threaded bores may be provided to fasten protection cap or grouting cap, and wedge retaining plate. At the back of the anchor head, there may be a step for ease of centring the anchor head on the bearing trumplate.

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

1.12.3 Anchor head CONA CMF BT S2

The anchor head of anchorage series 2, see Annex 7, is a mono barrel made of steel with one conical hole drilled in to accommodate prestressing steel strand and wedge. The prestressing steel strands of the anchorage are individually anchored with mono barrels, placed side by side on bearing trumplate CONA CMF BT S2. The mono barrels are made of two different materials.

1.12.4 Bearing trumplate CONA CMF BT S1

Bearing trumplate of anchorage series 1, see Annex 6, is made of cast iron and transmits the force via three anchorage planes to the structural concrete. Two identical bearing trumplates, with and without front air-vent situated at the interface plane to the anchor head, are available. A grout inlet or ventilation tube can be fitted to this air-vent. On the tendon-side end there is an inner thread to accommodate the trumpet.

1.12.5 Bearing trumplate CONA CMF BT S2

Bearing trumplate of anchorage series 2, see Annex 7, is made of cast iron and transmits the force via three anchorage planes to the structural concrete. The bearing trumplate is of rectangular shape and provides an oblong hole in the middle of the bearing trumplate to pass through the prestressing steel strands of the tendon, arranged side by side. A plastic insert is placed inside the bearing trumplate. The outer surface of the bearing trumplate is a curved base to support the anchor heads of the individual prestressing steel strands.

Two identical bearing trumplates, with and without front air-vent situated at the interface plane to the anchor head, are available. A grout inlet or ventilation tube can be fitted to this air-vent.

1.12.6 Trumpets CONA CMF BT S1

The conical trumpets of anchorage series 1, see Annex 8, made of HDPE, may have either a corrugated or a plain surface. At the duct-side end there are 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 with a thread to the bearing trumplate.

HDPE trumpets are equipped with a blind air-vent that might be opened and to that a grouting or ventilation tube can be connected.

1.12.7 Coupler anchor head H CONA CMF BT S1

The coupler anchor head H, see Annex 6, for the sleeve coupler is made of steel and has the same basic geometry as the anchor head of the fixed or stressing anchorage of series 1. Compared to the anchor head of the fixed and stressing anchor, the coupler anchor head H is higher and provide an external thread for the coupler sleeve. At the back of the coupler anchor head H there is a step for ease of centring the coupler anchor head on the bearing trumplate.

Ring cushions are inserted in the coupler anchor head H2.

1.12.8 Coupler sleeve H CONA CMF BT S1

The coupler sleeve H, see Annex 6, is a steel tube with an inner thread and provided with ventilation holes.

1.12.9 Ring wedge

The ring wedge, see Annex 10, is in three pieces. Five different ring wedges are used.

- Ring wedge H *05*, fitted with spring ring, is made of one material.
- Ring wedge C *05*, fitted with spring ring, is made of one material.
- Two ring wedges H 06, fitted with spring ring, are made of two different materials.
- Ring wedge F 06, 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.

1.12.10 Securing of wedges

The wedges of inaccessible fixed anchors and couplers of series 1 are secured with springs or a wedge retaining plate, see Annex 1, Annex 2, and Annex 10. An alternative is pre-locking each individual prestressing steel strand with ~ 0.5 · F_{pk} and applying a wedge retaining plate as per Clause 1.2.3.1.

For series 2, each individual prestressing steel strand is pre-locked with ~ 0.5 · F_{pk} and the wedges are secured with wedge retaining plate or wedge holding rings and an integrated protection cap, see Annex 7 and Annex 9. An alternative is applying wedge retaining plate, wedge holding rings, together with an integrated protection cap.

Where

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

1.12.11 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 following turn. The helix is placed in the tendon axis. Dimensions of helix and additional reinforcement conform to the values specified in Annex 23, Annex 24, Annex 25, and Annex 26.

If required for a specific project design, the reinforcement given in Annex 23, Annex 24, Annex 25, and Annex 26 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 provided equivalent performance.

1.12.12 Protection cap and grouting cap CONA CMF BT S1

Protection cap, see Annex 10, is made of steel or plastic. It is provided with an air-vent and fastened with screws or threaded rods.

Grouting cap, see Annex 10, is made of plastic. It is provided with a filling inlet or air-vent and fastened with screws or threaded rods.

1.12.13 Protection cap CONA CMF BT S2

Protection cap, see Annex 9, is made of plastic. It is provided with a filling inlet or an air-vent and fastened with screws or threaded rods.

1.12.14 Pocket former set CONA CMF BT S2

The pocket former set for anchorage series 2 is made of plastic, see Annex 9. It comprises for 02 to 06 prestressing steel strands

– One common mandrel
– One common nut
– Four pocket formers

The pocket formers are employed to form recesses for anchorage

SA CONA CMF BT S2-0206 SA CONA CMF BT S2-*0205* and SA CONA CMF BT S2-*0305*

SA CONA CMF BT S2-0306 SA CONA CMF BT S2-*0405*

SA CONA CMF BT S2-0406 SA CONA CMF BT S2-*0505*

SA CONA CMF BT S2-0506 SA CONA CMF BT S2-*0605*

1.12.15 Material specification

Annex 18 lists the material standards and material specifications of the components.

1.13 Permanent corrosion protection

1.13.1 General

In the course of preparing the European Technical Assessment no characteristic has been assessed for materials of the corrosion protection system. In execution, all materials are selected according to the standards and regulations in force at the place of use.

Recesses for anchorages fully embedded in concrete permit a reinforced concrete cover with the required dimensions and in any case with a thickness of at least 20 mm. The same applies for concrete cover of fixed anchorages embedded in concrete.

On exposed anchorages, not fully embedded in concrete, an adequate corrosion protection for the exposed parts is applied.

1.13.2 Bonded tendon

To protect the tendons from corrosion, ducts, anchorages, and couplers are completely filled with grout according to EN 447, special grout according to EAD 160027-00-0301, or special grout as applicable at the place of use. Complete filling is ensured by grout penetrating from the protection caps or grouting caps at the anchorages.

1.13.3 Unbonded tendon

To protect the tendons from corrosion, ducts, anchorages, and couplers are completely filled with corrosion protection filling material. Complete filling is ensured by corrosion protection filling material penetrating from the protection caps or grouting caps at the anchorages.

Corrosion protection filling material is grease or wax according EAD 160027-00-0301, or an equivalent soft material as applicable at the place of use. The corrosion protection filling material for monostrands or bands is specified in EAD 160027-00-0301 or an equivalent soft material. As an alternative, corrosion protection filling material according to the standards and regulations in force at the place of use may be applied.

For tendons of anchorage series 1 with monostrands or bands, transition pipes are attached to anchorages and couplers. Transition pipe and monostrand or band sheathing overlap to facilitate corrosion protection of de-sheathed monostrands or bands at the joints monostrand or band sheathings to anchorages.

For anchorage series 2, monostrand or band sheathings extend into the bearing trumplate, until a few cm ahead of the mono barrels. The bearing trumplate is completely filled with corrosion protection filling material.

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

2.1 Intended uses

The PT system BBR VT CONA CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands is intended to be used for the prestressing of structures. The specific intended uses are given in Table 7.

Table 7 Intended uses

Line №	Use category
Use categories according to tendon configuration and material of structure	
1	Internal bonded tendon for concrete and composite structures
2	Internal unbonded tendon for concrete and composite structures

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 1.65 m is observed.
- Temporary protection of prestressing steel and components in order to prevent corrosion during transport from production site to job site
- Transport, 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

It is the responsibility of the ETA holder to ensure that all necessary information is submitted to those responsible for the design of the structure executed with the BBR VT CONA CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands.

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.

Bursting out of prestressing steel in case of failure of an unbonded tendon is prevented. Sufficient protection is provided by e.g. a cover of reinforced concrete.

2.2.3.2 Anchorage Recess

The dimensions of the anchorage recess are adapted to the prestressing jack used. In order to allow for imperfections and to ease the cutting of the prestressing steel strand excess lengths, it is recommended to increase the dimensions of the recesses. The forms for the recesses should be slightly conical for easy removal. The ETA holder saves for reference information on the minimum dimensions of the anchorage recess.

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 on anchorages and bearing trumplates is not required. However, the exposed surfaces of bearing trumplate and cap are provided with corrosion protection.

2.2.3.3 Centre spacing and edge distance, and reinforcement of the anchorage zone

Centre spacing, edge distance, helix, and additional reinforcement given in Annex 23, Annex 24, Annex 25, and Annex 26 are adopted, see Clause 1.10.

Verification of transfer of prestressing force to structural concrete is not required if centre spacing and edge distance of anchorage and coupler, compressive strength of concrete, as well as grade and dimensions of helix and additional reinforcement, see Annex 23, Annex 24, Annex 25, and Annex 26, are conformed to. In case of grouped anchorages, the additional reinforcement of the individual anchorages can be combined, provided appropriate anchorage of additional reinforcement is ensured. However, number, cross-sectional area and position with respect to the anchor heads remain unchanged.

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 additional reinforcement are verified and, if necessary, covered with appropriate reinforcement.

Centre spacing and edge distance as well as concrete strength and reinforcement for a larger tendon in terms of number, nominal diameter, and strength of prestressing steel strands are as well applicable to a smaller tendon.

NOTE For example it is fully applicable to fit a tendon CONA CMF BT *0305*-93 into an anchorage zone, detailed and executed for a CONA CMF BT 0406-150 tendon.

If required for a specific project design, the reinforcement given in Annex 23, Annex 24, Annex 25, and Annex 26 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.

Clearance is required for the handling of prestressing jacks and stressing. The ETA holder saves for reference information on appropriate clearance behind the anchorages.

2.2.3.4 Maximum prestressing forces

The prestressing and overstressing forces are specified in the respective standards and regulations in force at place of use. Annex 19 and Annex 20 lists the maximum prestressing and overstressing forces according to Eurocode 2.

2.2.3.5 Tendons in masonry structures – Load transfer to the structure

Post-tensioning kits are primarily used in structures made of concrete. They can, however, be used with other structural materials, e.g. in masonry structures. However, there is no particular assessment in EAD 160004-00-0301 for these applications. Hence, load transfer of stressing force from the anchorage to masonry structures is via concrete or steel members, designed according to the European Technical Assessment, especially according to the Clauses 1.9, 1.10, 1.12.11, and 2.2.3.3 or according to Eurocode 3, respectively.

The concrete or steel members supporting the anchorages have dimensions that permit a force of $1.1 \cdot F_{pk}$ to be transferred to 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.

2.2.4 Installation

2.2.4.1 General

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

Assembly and installation of tendons are only carried out by qualified PT specialist companies with the required resources and experience in the use of bonded and unbonded multi-strand post-tensioning systems, see CWA 14646. 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 qualification and experience with the internal unbonded prestressing system BBR VT CONA CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands.

The tendons may be manufactured on site or in the factory, i.e. prefabricated tendons. The tendons are carefully handled during production, transport, storage, and installation. The corrosion protected HDPE sheathed prestressing steel strands are usually delivered to site in coils with an internal diameter of 1.45 to 1.75 m.

To avoid confusion, it is recommended to, in general, use on one site prestressing steel strands with one nominal diameter only.

2.2.4.2 Anchorage series 1 and coupler

In Annex 31 the description of installation of bonded and unbonded tendons, other than monostrand tendons and in Annex 32 the description of installation of monostrand tendons or tendons with bands are given.

Bearing trumplates, anchor heads, and coupler anchor heads are placed perpendicular to the tendon's axis. Couplers are situated in a straight tendon section. At the anchorages and couplers, the tendon layout provides a straight section over a length of at least 250 mm beyond the end of trumpet or transition pipes.

In case of a movable coupler it is ensured by means of appropriate position and length of coupler sheathing box and trumpet that a displacement of the movable coupler of at least $1.15 \cdot \Delta l + 30$ mm is possible without any hindrance, where Δl in mm is the expected maximum displacement of the coupler during stressing.

In the anchorage zone, the webs of bands are longitudinally cut over a length of 1.3 m from the end. The layout of the transition zone is shown in Annex 29.

Prior to placing the concrete, a final check of the installed tendons is carried out. At that time, the passive anchorages mounted at the PT works are randomly checked for proper seating of the ring wedges and complete filling of the protection caps or grouting caps with corrosion protection filling material, where applicable. In the case of minor damage of the sheathing, the damaged area is cleaned and sealed with an adhesive tape.

2.2.4.3 Anchorage series 2

In Annex 33 the description of installation of bonded and unbonded tendons, other than monostrand tendons and in Annex 34 the description of installation of monostrand tendons or tendons with bands are given.

Bearing trumplates are placed perpendicular to the tendon's axis and the tendon layout provides a straight section over a length of at least 250 mm beyond the end of the bearing trumpet.

In the anchorage zone, the webs of bands are longitudinally cut over a length of 1.3 m from the end. The layout of the transition zone is shown in Annex 30.

Prior to placing the concrete, a final check of the installed tendons is carried out. At that time, the passive anchorages mounted at the PT works are randomly checked for proper seating of the ring wedges and complete filling of the protection caps with corrosion protection filling material, where applicable. In the case of minor damage of the sheathing, the damaged area is cleaned and sealed with an adhesive tape.

2.2.4.4 Inaccessible fixed anchorage with bulb-ends, CMO

Installation is carried out according to Annex 35.

For this anchorage, the prestressing steel strands are always pushed or pulled into the duct prior to concreting the structure. The prestressing steel strands with bulb-ends are individually clipped into the bulb-strand spacer to preserve position and distance during concreting.

Prior to placing the concrete, a final check of the installed bulb-strands with bulb-strand spacers is carried out.

2.2.4.5 Stressing operation, safety-at work

With a mean concrete compressive strength in the anchorage zone according to Annex 23, Annex 24, Annex 25, and Annex 26 full prestressing may be applied.

- Tendons of anchorage series 1 are stressed strand by strand or all prestressing steel strands at once.
- Tendons of anchorage series 2 are stressed strand by strand.

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 checked continuously 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 at the stressing anchorage.

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 are complied with.

2.2.4.6 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.

Tendons remaining restressable throughout the working life of the structure are unbonded tendons. Corrosion protection filling material as grease, wax, or an equivalent soft material according to Clause 1.13 is used for corrosion protection. Moreover, a strand protrusion at the stressing anchor remains with a length compatible with the prestressing jack used.

Restressing of tendons with monostrand or bands is possible.

Tendons with fixed anchor by bond and bulb-ends, CMO, are unsuitable for restressable tendons.

2.2.4.7 Exchanging tendons

Exchange of tendons is permitted. The specifications for exchangeable tendons are defined during the design phase. The radii of curvature should be reasonable larger than the minimum radii given in Clause 1.5 as to not impair the plastic ducts or monostrand sheathings by wear due to stressing of the tendons.

Exchangeable tendons are unbonded. Corrosion protection filling material as grease, wax, or an equivalent soft material according to Clause 1.13 is used for corrosion protection. Exchanging the prestressing steel strand of monostrand or band, with the sheathing remaining in the structure is also possible.

Moreover, a strand protrusion remains at the stressing anchor with a length compatible with the prestressing jack and allowing for a safe release of the complete prestressing force. Stressing and fixed anchorages are accessible and adequate space is provided behind the anchorages.

Tendons with fixed anchor by bond and bulb-ends, CMO, are unsuitable for exchangeable tendons.

2.2.4.8 Filling operations

2.2.4.8.1 Grouting

Grout is injected through the inlet holes until it escapes from the outlet tubes with the same consistency. At fixed and stressing anchorages grout penetrates from the protection caps or grouting caps to ensure complete filling around the wedges. 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.

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 are applied for ready mixed grout.

2.2.4.8.2 Filling with corrosion protection filling material

Specifications and recommendations of the supplier are relevant for the corrosion protection filling material applied. The filling process with grease, wax, and an equivalent soft material follows a similar procedure as the one specified for grouting. However, a different filling procedure might be applied if permitted at the place of use.

2.2.4.8.3 Anchorage and coupler

Anchorages, ducts, and couplers of bonded tendons are grouted simultaneously in one operation. Vents are arranged at appropriate positions at anchorages and couplers to prevent voids in the hardened grout.

In principle, the same applies to unbonded tendons with ducts filled with corrosion protection filling material. However, when required at anchorages and couplers, the voids from wedge to port are completely filled with corrosion protection filling material prior to filling operation, preferably during tendon installation.

Tendons with monostrands or bands require corrosion protection measures to be applied during tendon installation. In particular, fixed anchorages and couplers are completely filled with corrosion protection filling material prior to placing of concrete. Stressing anchorages are completely filled with corrosion protection filling material after stressing is completed and a protection cap or grouting cap, filled with corrosion protection filling material is attached.

2.2.4.8.4 Filling records

The results of grouting and filling operation are recorded in detail in filling records.

2.2.4.9 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. However, 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 CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands of 100 years, provided that the BBR VT CONA CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 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 works[5].

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

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

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

3.1 Essential characteristics

The performances of the BBR VT CONA CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands for the essential characteristics are given in Table 8.

Table 8 Essential characteristics and performances of the product

№	Essential characteristic	Product performance
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) for internal bonded and unbonded tendon	See Clause 3.2.1.5.
6	Assessment of assembly	See Clause 3.2.1.6.
7	Corrosion protection	See Clause 3.2.1.7.
Basic requirement for construction works 2: Safety in case of fire		
8	Reaction to fire	See Clause 3.2.2.1.
Basic requirement for construction works 3: Hygiene, health, and the environment		
9	Content, emission, and/or release of dangerous substances	See Clause 3.2.3.1.
Basic requirement for construction works 4: Safety and accessibility in use		
—	Not relevant. No characteristic assessed.	—
Basic requirement for construction works 5: Protection against noise		
—	Not relevant. No characteristic assessed.	—
Basic requirement for construction works 6: Energy economy and heat retention		
—	Not relevant. No characteristic assessed.	—
Basic requirement for construction works 7: Sustainable use of natural resources		
—	No characteristic assessed.	—

3.2 Product performance

3.2.1 Mechanical resistance and stability

3.2.1.1 Resistance to static load

The PT system as described in the ETA meets the acceptance criteria of EAD 160004-00-0301, Clause 2.2.1. The characteristic value of maximum force, F_{pk}, of the tendon with prestressing steel strands according to Annex 36 is given in Annex 11 and Annex 12.

3.2.1.2 Resistance to fatigue

The PT system as described in the ETA meets the acceptance criteria of EAD 160004-00-0301, Clause 2.2.2. The characteristic value of maximum force, F_{pk}, of the tendon with prestressing steel strands according to Annex 36 is given in Annex 11 and Annex 12.

Fatigue resistance of anchorages and couplings was tested and verified with an upper force of $0.65 \cdot F_{pk}$, a fatigue stress range of 80 MPa, and $2 \cdot 10^6$ load cycles.

3.2.1.3 Load transfer to the structure

The PT system as described in the ETA meets the acceptance criteria of EAD 160004-00-0301, Clause 2.2.3. The characteristic values of maximum force, F_{pk}, of the tendon with prestressing steel strands according to Annex 36 is given in Annex 11 and Annex 12.

Conformity with the stabilisation and crack width criteria specified for the load transfer test was verified to a force level of $0.80 \cdot F_{pk}$.

3.2.1.4 Friction coefficient

For friction losses including friction coefficient see Clause 1.7.

3.2.1.5 Deviation, deflection (limits) for internal and unbonded tendon

For minimum radius of curvature of internal tendons see Clause 1.5.

3.2.1.6 Assessment of assembly

The PT system as described in the ETA meets the acceptance criteria of EAD 160004-00-0301, Clause 2.2.7.

3.2.1.7 Corrosion protection

The PT system as described in the ETA meets the acceptance criteria of EAD 160004-00-0301, Clause 2.2.13.

3.2.2 Safety in case of fire

3.2.2.1 Reaction to fire

The performance of components made of steel or cast iron is Class A1 without testing.

The performance of components of other materials has not been assessed.

3.2.3 Hygiene, health, and the environment

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

According to the manufacturer's declaration, the PT system does not contain dangerous substances.

SVOC and VOC

The performance of components made of steel or cast iron that are free of coating with organic material is no emission of SVOC and VOC. The performance of components of other materials has not been assessed.

Leachable substances

The product is not intended to be in direct contact to soil, ground water, and surface water.

3.3 Assessment methods

The assessment of the essential characteristics in Clause 3.1 of the BBR VT CONA CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands, for the intended uses, and in relation to the requirements for mechanical resistance and stability, safety in case of fire, and for hygiene, health, and the environment, in the sense of the basic requirements for construction works № 1, 2, and 3 of Regulation (EU) № 305/2011, has been made in accordance with EAD 160004-00-0301, Post-Tensioning kits for prestressing of structures, Annex A, for the following items.

– 1, Internal bonded tendon – Strands in duct, grouted
– 2, Internal unbonded tendon – Individually sheathed strands with soft corrosion protection filling material – Monostrand or band
– 4, Internal unbonded tendon – Strands in duct with soft corrosion protection filling material

3.4 Identification

The European Technical Assessment for the BBR VT CONA CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands is issued on the basis of agreed data that identify the assessed product[6]. Changes to materials, to composition, or to characteristics of the product, or to the production process could result in these deposited data being incorrect. Österreichisches Institut für Bautechnik should be notified before the changes are introduced, as an amendment of the European Technical Assessment is possibly necessary.

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

4.1 System of assessment and verification of constancy of performance

According to Commission Decision 98/456/EC the system of assessment and verification of constancy of performance to be applied to the BBR VT CONA CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands is System 1+. System 1+ is detailed in Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, Annex, point 1.1, and provides for the following items.

(a) The manufacturer shall carry out
  (i) factory production control;
  (ii) further testing of samples taken at the manufacturing plant by the manufacturer in accordance with the prescribed test plan[7].

(b) The notified product certification body shall decide on the issuing, restriction, suspension, or withdrawal of the certificate of constancy of performance of the construction product on the basis of the outcome of the following assessments and verifications carried out by that body
  (i) an assessment of the performance of the construction product carried out on the basis of testing (including sampling), calculation, tabulated values, or descriptive documentation of the product;
  (ii) initial inspection of the manufacturing plant and of factory production control;
  (iii) continuing surveillance, assessment, and evaluation of factory production control;
  (iv) audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities.

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

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

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

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

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

5.1 Tasks for the manufacturer

5.1.1 Factory production control

The kit manufacturer exercises permanent internal control of the production. All the elements, procedures, and specifications adopted by the kit manufacturer are documented in a systematic manner in the form of written policies and procedures.

– Control of the incoming materials

  The manufacturer checks the incoming materials to establish conformity with their specifications.

– Inspection and testing

  Kind and frequency of inspections, tests, and checks conducted during production and on the final product normally include.

  – Definition of the number of samples taken by the kit manufacturer
  – Material properties e.g. tensile strength, hardness, surface finish, chemical composition, etc.
  – Determination of the dimensions of components
  – Check correct assembly
  – Documentation of tests and test results

All tests are performed according to written procedures with suitable calibrated measuring devices. All results of inspections, tests, and checks are recorded in a consistent and systematic way. The basic elements of the prescribed test plan are given in Annex 37, conform to EAD 160004-00-0301, Table 3, and are specified in the quality management plan of the BBR VT CONA CMF BT – Internal Post-tensioning System with Flat Anchorages and 02 to 06 Strands.

The results of inspections, tests, and checks are evaluated for conformity. Shortcomings request the manufacturer to immediately implements measures to eliminate the defects.

– Control of non-conforming products

  Products, which are considered as not conforming to the prescribed test plan, are immediately marked and separated from such products that conform. Factory production control addresses control of non-conforming products.

– Complaints

  Factory production control includes procedures to keep records of all complaints about the PT system.

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.

At least once a year the manufacturer audits the manufacturers of the components given in Annex 38.

5.1.2 Declaration of performance

The manufacturer is responsible for preparing the declaration of performance. When all the criteria of the assessment and verification of constancy of performance are met, including the certificate of constancy of performance issued by the notified product certification body, the manufacturer draws up the declaration of performance. Essential characteristics to be included in the declaration of performance for the corresponding intended use are given in Table 8.

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 establishes that, in accordance with the prescribed test plan, the manufacturing plant, in particular personnel and equipment, and the factory production control are suitable to ensure a continuous manufacturing of the PT system according to the given technical specifications. For the most important activities, EAD 160004-00-0301, Table 4 summarises the minimum procedure.

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

The activities are conducted by the notified product certification body and include surveillance inspections. The kit manufacturer is inspected at least once a year. Factory production control is inspected and samples are taken for independent single tensile element tests.

For the most important activities, the control plan according to EAD 160004-00-0301, Table 4 summarises the minimum procedure. It is verified that the system of factory production control and the specified manufacturing process are maintained, taking account of the control plan.

Each manufacturer of the components given in Annex 38 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 inspection, the notified product certification body takes samples of components of the PT system for independent testing. Audit-testing is conducted at least once a year by the notified product certification body. For the most important components, Annex 38 summarises the minimum procedures. Annex 38 conforms to EAD 160004-00-0301, Table 4. In particular, at least once a year, the notified product certification body also carries out one single tensile element test series according to EAD 160004-00-0301, Annex C.7 and Clause 3.3.4 on specimens taken from the manufacturing plant or at the manufacturer’s storage facility.

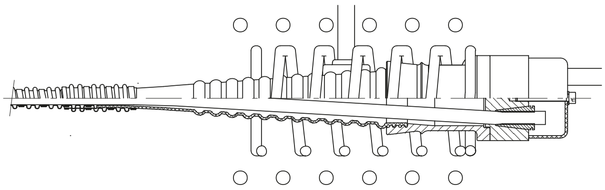
Issued in Vienna on 23 September 2019
by Österreichisches Institut für Bautechnik

The original document is signed by

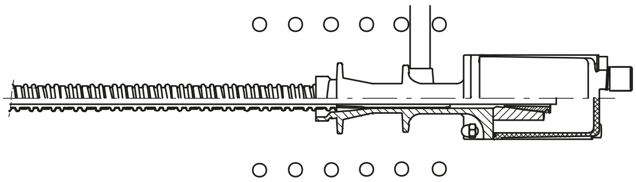
Rainer Mikulits
Managing Director

Stressing anchor SA, accessible fixed anchor FA

CONA CMF BT S1

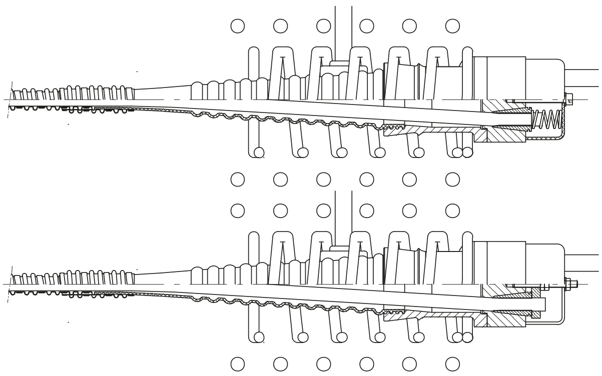


CONA CMF BT S2

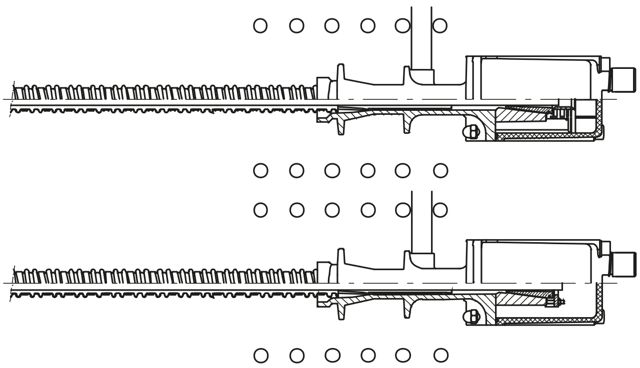


Inaccessible fixed anchor FA

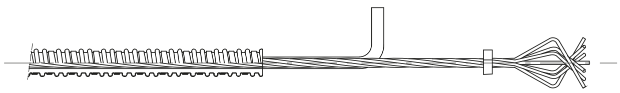
CONA CMF BT S1



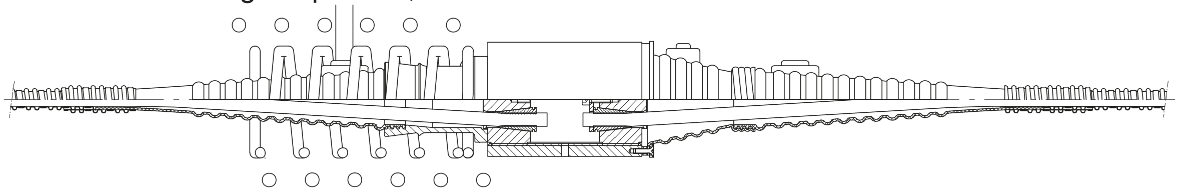
CONA CMF BT S2



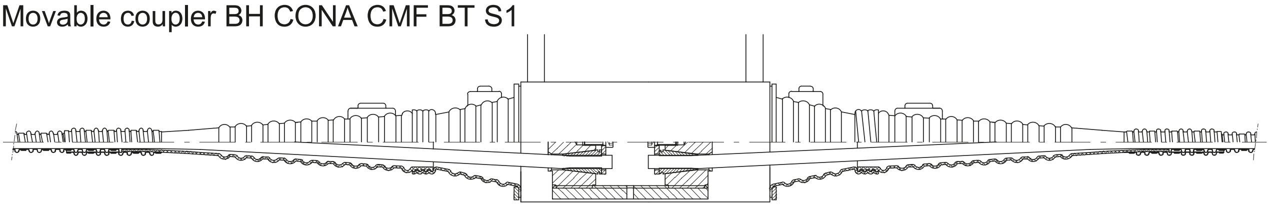
Inaccessible fixed anchor FA CONA CMO [1)]



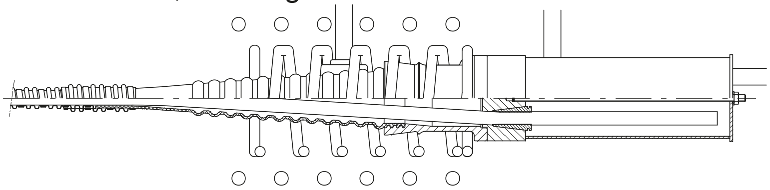
Fixed and stressing coupler FH, SH CONA CMF BT S1



Movable coupler BH CONA CMF BT S1



Restressable, exchangeable anchor CONA CMF BT S1

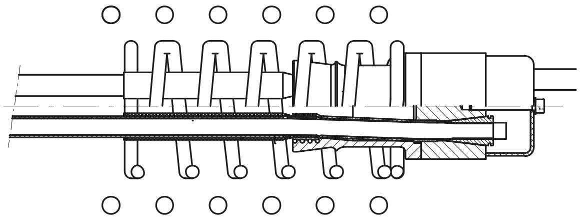


1) According to CONA CMO, ETA-15/0808

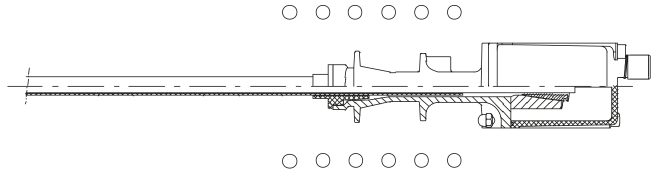
BBR CONA CMF BT	**Internal Post-tensioning System** Anchorage series 1 and series 2 Overview on anchorages and couplers for bonded and unbonded tendons, other than monostrand tendons	**Annex 1** of European Technical Assessment **ETA-12/0076** of 23.09.2019

Stressing anchor SA, accessible fixed anchor FA

CONA CMF BT S1

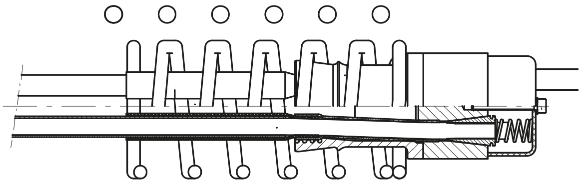


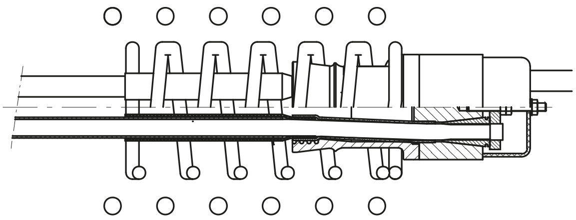
CONA CMF BT S2



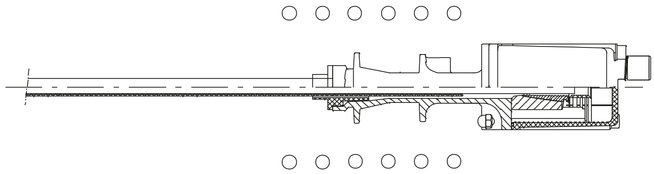
Inaccessible fixed anchor FA

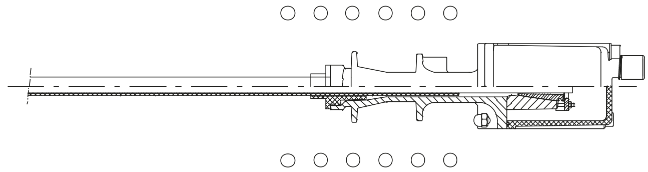
CONA CMF BT S1



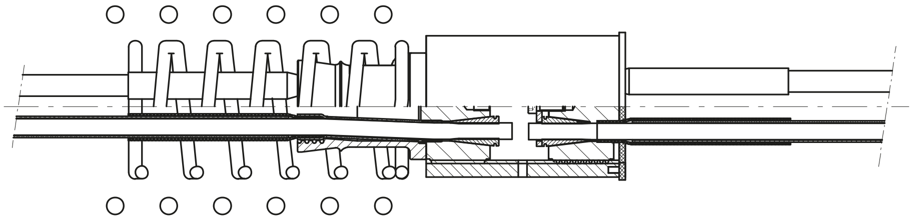


CONA CMF BT S2

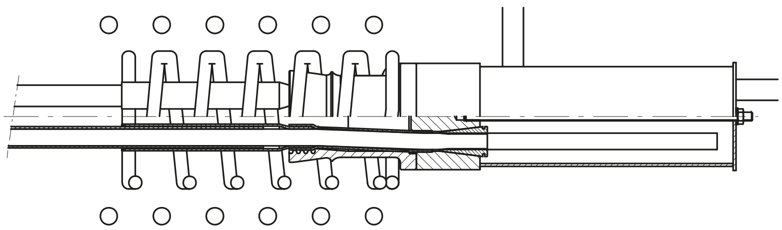




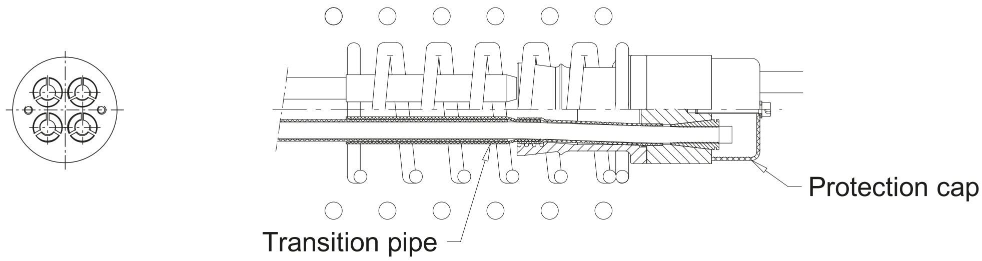
Fixed and stressing coupler FH, SH CONA CMF BT S1

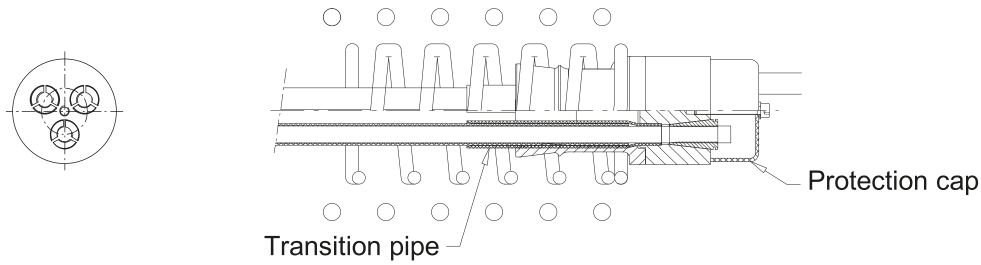


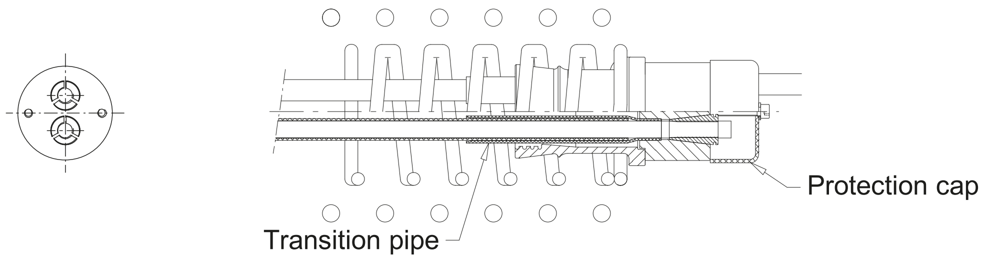
Restressable, exchangeable anchor CONA CMF BT S1



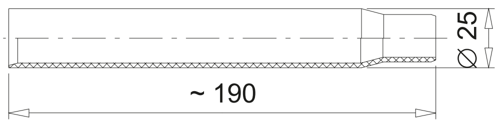
Stressing anchor SA, accessible fixed anchor FA with monostrands or bands CONA CMF BT S1



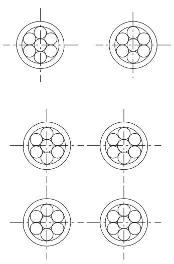




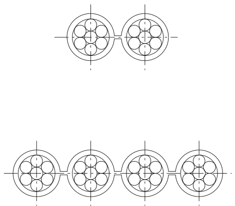
Transition pipe CONA CMF BT S1



Monostrands



Band



CONA CMF BT	**Internal Post-tensioning System** Anchorage series 1 Anchorages for unbonded tendons with monostrands or bands	**Annex 3** of European Technical Assessment **ETA-12/0076** of 23.09.2019

Anchorage and coupler	Bonded tendon	Unbonded tendon	
	Grouted duct	Filled duct	Monostrand
Anchorage series 1 – S1			
Stressing anchor	+ 1), 2)	+ 1), 2)	+
Fixed anchor	+ 1), 2)	+ 1), 2)	+
Fixed and stressing coupler	+ 1), 2)	+ 1), 2)	+
Movable coupler	+ 1)	+ 1)	—
Anchorage series 2 – S2			
Stressing anchor	+ 2)	+ 2)	+
Fixed anchor	+ 2)	+ 2)	+
Anchorage by bond in combination with bulb-ends – CMO			
Fixed anchor	+ 1), 2)	—	—

Key

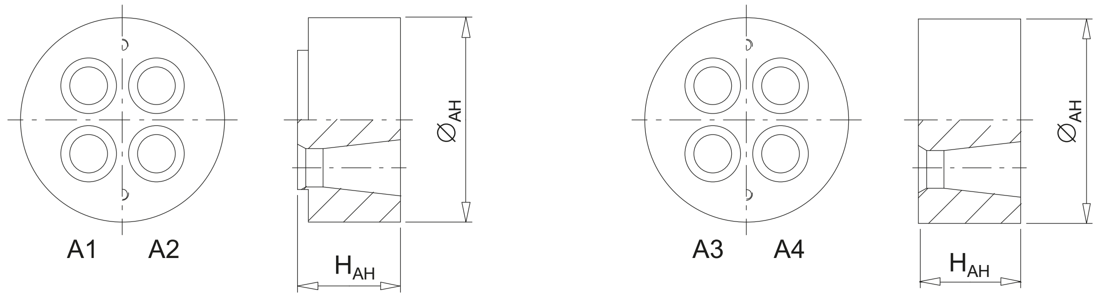
+ ...... Available
— .... Not available
1) ...... With circular duct
2) ...... With flat duct

Anchorage and coupler	Prestressing steel strand *05*		Prestressing steel strand 06	
	93 mm²	100 mm²	140 mm²	150 mm²
Anchorage series 1 – S1				
Stressing and fixed anchor	*02 03 04 — —*	*02 03 04 — —*	02 03 04 — —	02 03 04 — —
Fixed and stressing coupler	*02 03 04 — —*	*02 03 04 — —*	02 03 04 — —	02 03 04 — —
Movable coupler	*02 03 04 — —*	*02 03 04 — —*	02 03 04 — —	02 03 04 — —
Anchorage series 2 – S2				
Stressing and fixed anchor	*02 03 04 05 06*	*02 03 04 05 06*	02 03 04 05 —	02 03 04 05 —
Anchorage by bond in combination with bulb-ends – CMO				
Fixed anchor	*02 03 04 05 06*	*02 03 04 05 06*	02 03 04 05 06	02 03 04 05 06

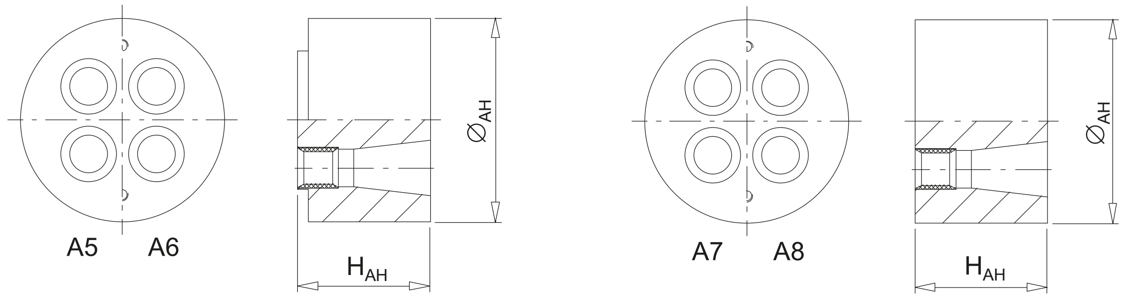
Key

02, 03, 04, 05, 06 .... Available number of prestressing steel strands of tendon
— .... Tendon not available

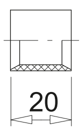
Anchor head A1–A4, CONA CMF BT S1



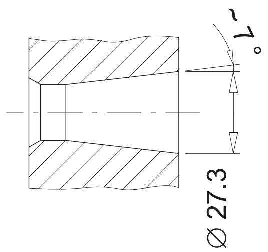
Anchor head A5–A8, CONA CMF BT S1



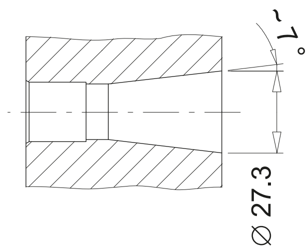
Ring cushion A5–A8
CONA CMF BT S1



Cone A1–A4
CONA CMF BT S1



Cone A5–A8
CONA CMF BT S1



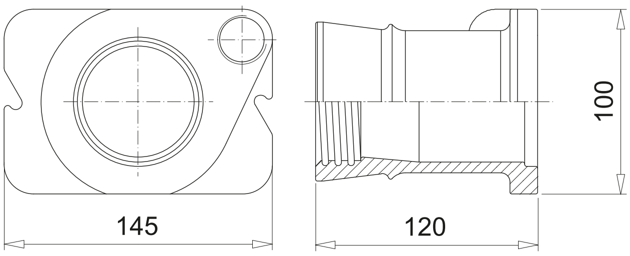
Dimensions in mm

Number of strands			*0205*	*0305*	*0405*	0206	0306	0406
Anchor head								
Diameter	$\varnothing_A$	mm	90	100	100	90	100	100
Height head anchor A1–A4	H_A	mm	50	50	50	50	50	50
Height head anchor A5–A8	H_A	mm	65	65	65	65	65	65

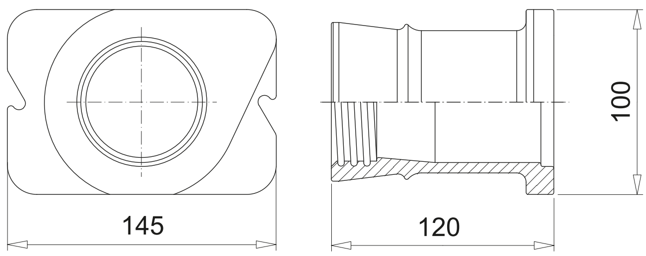
BBR CONA CMF BT	**Internal Post-tensioning System** Anchorage series 1 Anchor heads	**Annex 5** of European Technical Assessment **ETA-12/0076** of 23.09.2019

Member of EOTA

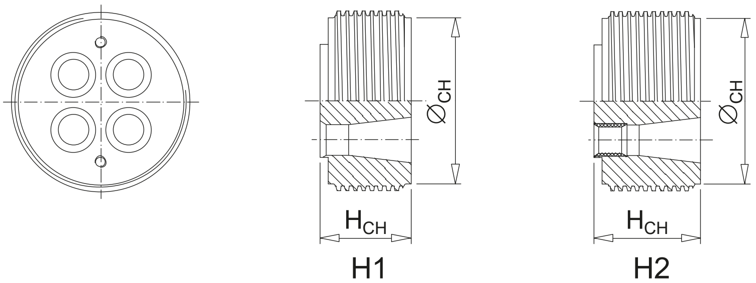
Bearing trumplate A CONA CMF BT S1



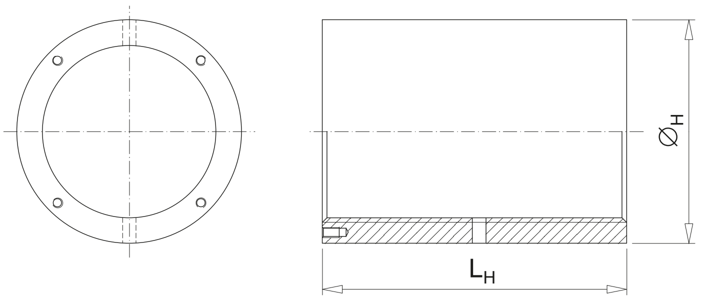
Bearing trumplate B CONA CMF BT S1



Coupler head H CONA CMF BT S1



Coupler sleeve H CONA CMF BT S1



Dimensions in mm

Number of strands			*0205*	*0305*	*0405*	0206	0306	0406
Coupler anchor head H1								
Diameter	$\varnothing_{AH}$	mm	90	100	100	90	100	100
Height	H_{AH}	mm	50	50	55	50	50	55
Coupler anchor head H2								
Diameter	$\varnothing_{AH}$	mm	90	100	100	90	100	100
Height	H_{AH}	mm	65	65	65	65	65	65
Coupler sleeve H								
Diameter	$\varnothing_{H}$	mm	114	121	130	114	121	130
Length	L_{H}	mm	180	180	180	180	180	180

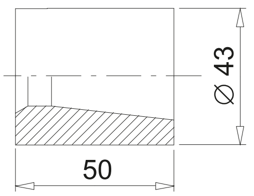
CONA CMF BT

Internal Post-tensioning System
Anchorage series 1
Bearing trumplate
Sleeve coupler

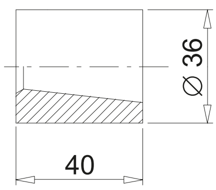
Annex 6
of European Technical Assessment
ETA-12/0076 of 23.09.2019

Mono barrels

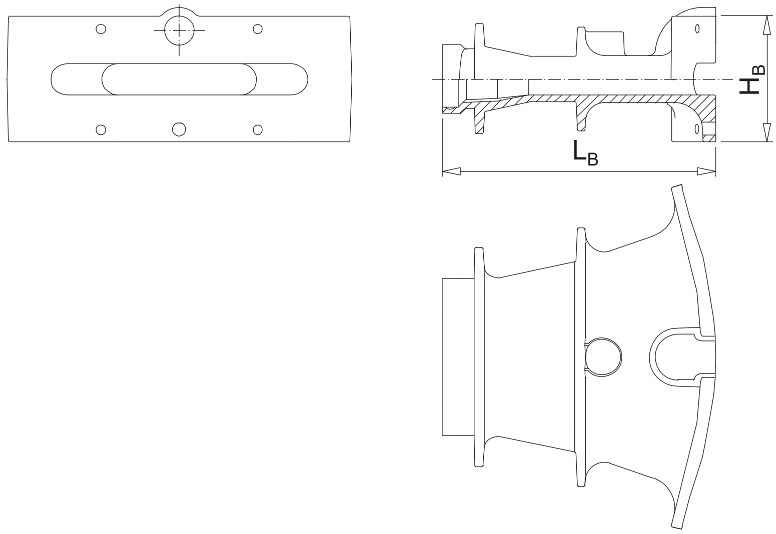
Anchor head 0106 CONA CMF BT S2



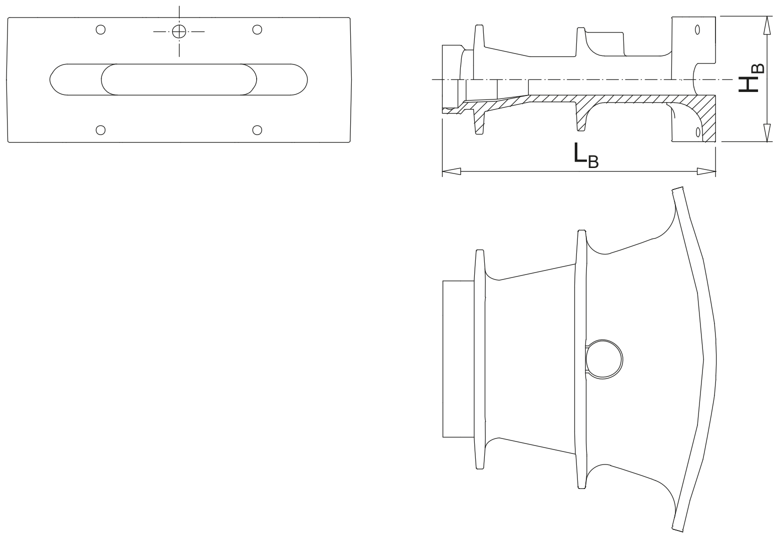
Anchor head *0105* CONA CMF BT S2



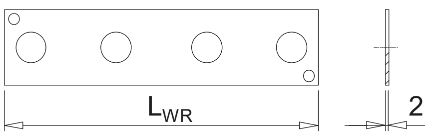
Bearing trumplate A
CONA CMF BT S2



Bearing trumplate B
CONA CMF BT S2



Wedge retaining plate
CONA CMF BT S2

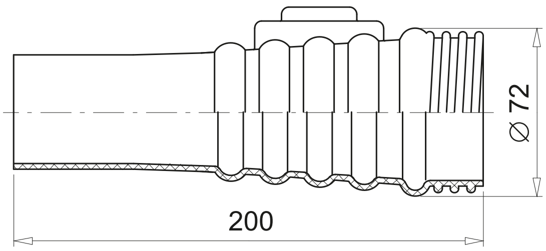


Dimensions in mm

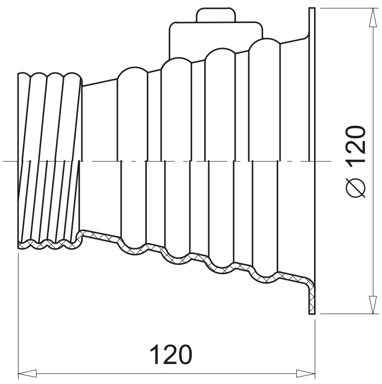
Bearing trumplate A and B CONA CMF BT S2							
Number of strands			0206 *0205, 0305*	0306 *0405*	0406 *0505*	0506 *0605*
Bearing trumplate	Height H_B	mm	70	70	80	90
	Length L_B	mm	109	164	174	243
Wedge retaining plate	Width L_{WR}	mm	145	170	200	245

Member of EOTA

Trumpet A CONA CMF BT S1

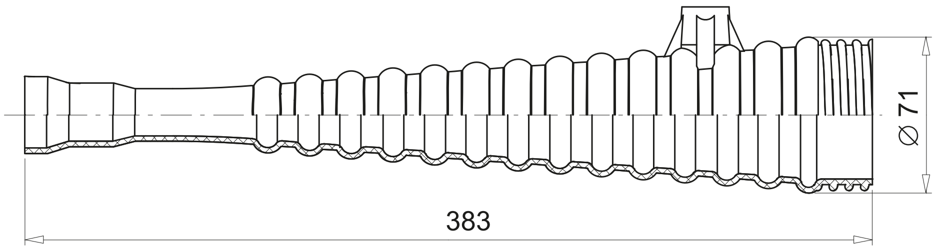


Trumpet FH CONA CMF BT S1

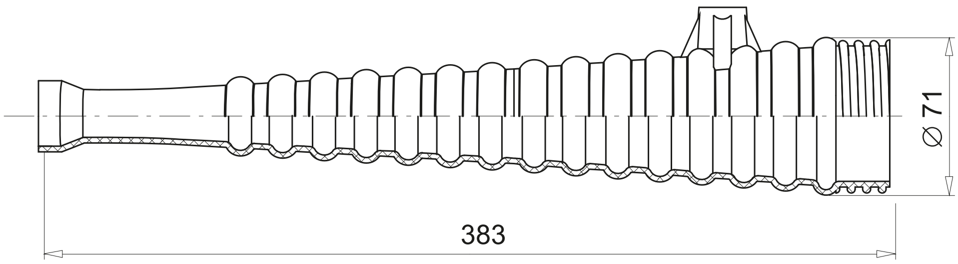


Trumpet F
CONA CMF BT S1

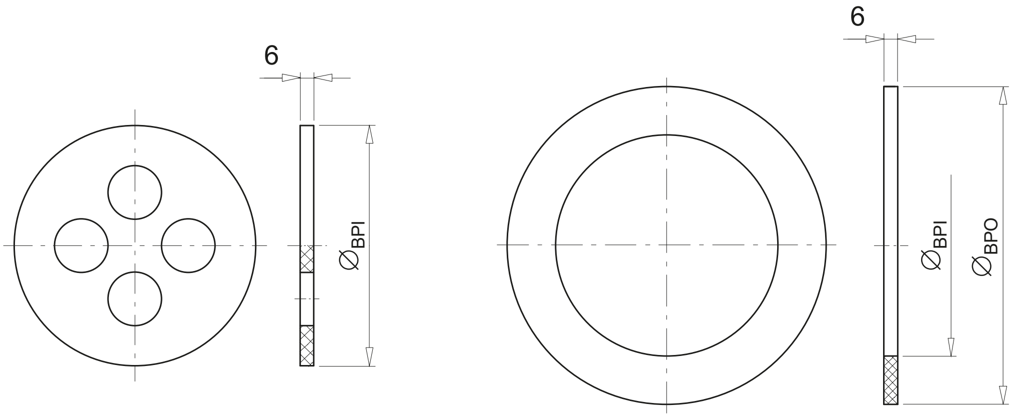
0405, 0306, 0406



0205, *0305*, 0206



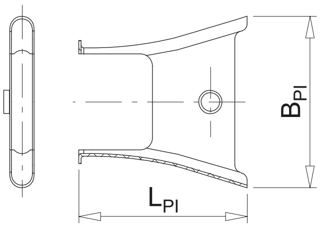
BDSD plate
CONA CMF BT S1



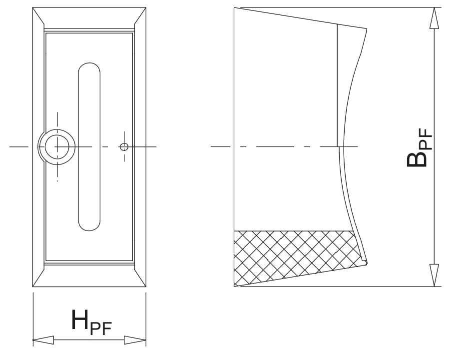
Dimensions in mm

Number of strands			*0205*	*0305*	*0405*	0206	0306	0406
BDSD plate CONA CMF BT S1								
BDSD plates	$\varnothing_{BPI}$	mm	85	90	95	85	90	95
	$\varnothing_{BPO}$	mm	125	130	140	125	130	140

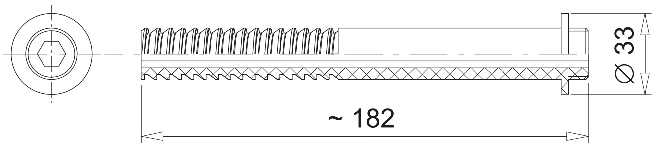
Plastic insert A CONA CMF BT S2



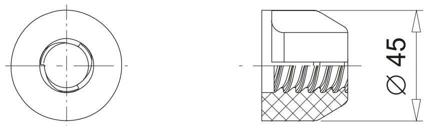
Pocket former R CONA CMF BT S2



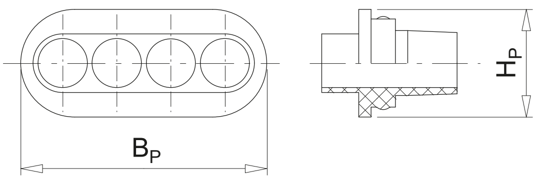
Mandrel CONA CMF BT S2



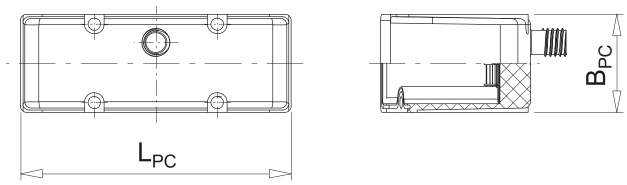
Nut CONA CMF BT S2



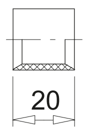
Plug CONA CMF BT S2



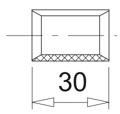
Protection cap A CONA CMF BT S2



Wedge holding ring 06 CONA CMF BT S2



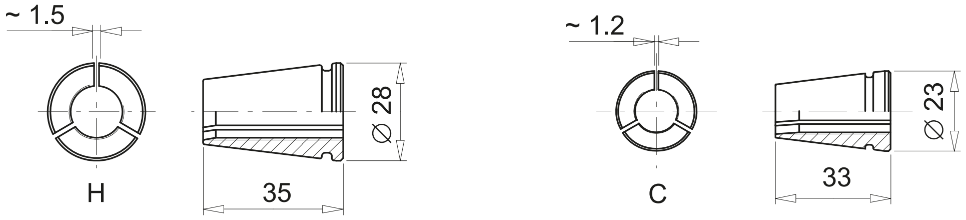
Wedge holding ring *05* CONA CMF BT S2



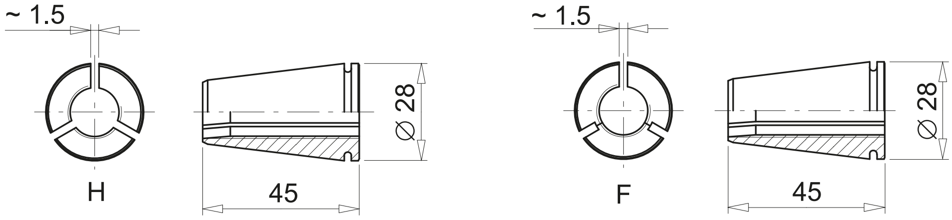
Dimensions in mm

Number of strands			**0206** *0205, 0305*	**0306** *0405*	**0406** *0505*	**0506** *0605*
Plastic insert A CONA CMF BT S2	Width	B_{PI}	83	119	139	175
	Length	L_{PI}	83	130	137	177
Pocket former R CONA CMF BT S2	Width	B_{PF}	210	240	270	310
	Height	H_{PF}	90	100	110	120
Protection Cap A CONA CMF BT S2	Width	B_{PC}	70	70	80	90
	Length	L_{PC}	165	190	220	265
Plug CONA CMF BT S2	Width	B_P	82	94	100	149
	Height	H_P	37	42	44	42

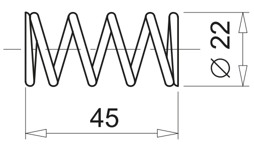
Ring wedges CONA CMF BT S1-*05* and S2-*05*



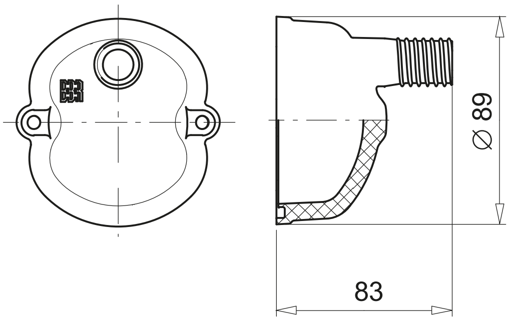
Ring wedges CONA CMF BT S1-06 and S2-06



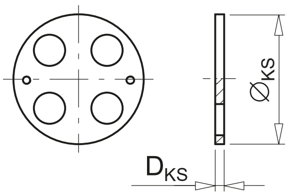
Spring A CONA CMF BT S1



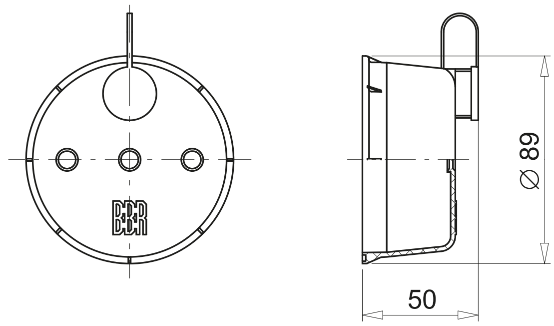
Grouting cap A CONA CMF BT S1



Wedge retaining plate KS CONA CMF BT S1



Protection cap A CONA CMF BT S1



Dimensions in mm

Number of strands			*0205*	*0305*	*0405*	0206	0306	0406
Wedge retaining plate KS								
Minimum diameter	$Ø_{KS}$	mm	65	73	75	65	73	75
Thickness	D_{KS}	mm	5	5	5	5	5	5

CONA CMF BT	**Internal Post-tensioning System** Anchorage series 1 and series 2 Wedges – Spring – Retaining plate Grouting cap – Protection cap	**Annex 10** of European Technical Assessment **ETA-12/0076** of 23.09.2019

CONA CMF BT *n05*-93

Number of strands	Nominal cross-sectional area of prestressing steel	Nominal mass of prestressing steel	Characteristic value of maximum force of tendon f_{pk} = 1 860 MPa
n	A_p	M	F_{pk}
—	mm^2	kg/m	kN
02	186	1.45	346
03	279	2.18	519
04	372	2.91	692
05	465	3.63	865
06	558	4.36	1 038

CONA CMF BT *n05*-100

Number of strands	Nominal cross-sectional area of prestressing steel	Nominal mass of prestressing steel	Characteristic value of maximum force of tendon f_{pk} = 1 860 MPa
n	A_p	M	F_{pk}
—	mm^2	kg/m	kN
02	200	1.56	372
03	300	2.34	558
04	400	3.12	744
05	500	3.91	930
06	600	4.69	1 116

CONA CMF BT 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} = 1 860 MPa
n	A_p	M	F_{pk}
—	mm²	kg/m	kN
02	280	2.19	520
03	420	3.28	780
04	560	4.37	1 040
05	700	5.47	1 300

CONA CMF BT 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} = 1 860 MPa
n	A_p	M	F_{pk}
—	mm²	kg/m	kN
02	300	2.34	558
03	450	3.52	837
04	600	4.69	1 116
05	750	5.86	1 395

Inner diameter of circular duct, d_i, and minimum radii of curvature, R_{min}, for $p_{R,\,max}$ = 130 kN/m

Number of strands	f ≈ 0.25		f ≈ 0.30		f ≈ 0.35	
n05 n06	$d_{duct,\,I}$	R_{min}	$d_{duct,\,I}$	R_{min}	$d_{duct,\,I}$	R_{min}
—	mm	m	mm	m	mm	m
0205	30	1.7	30	1.9	30	1.9
0305	40	2.0	35	2.3	35	2.8
0405	45	2.8	40	2.8	40	2.8
0206	40	2.2	35	2.8	35	2.8
0306	50	2.9	45	3.4	40	4.2
0406	55	4.2	50	4.2	45	4.2

Inner diameter of circular duct, d_i, and minimum radii of curvature, R_{min}, for $p_{R,\,max}$ = 150 kN/m

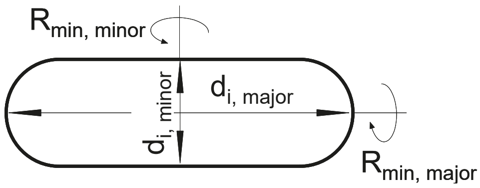
Number of strands	f ≈ 0.25		f ≈ 0.30		f ≈ 0.35	
n05 n06	$d_{duct,\,I}$	R_{min}	$d_{duct,\,I}$	R_{min}	$d_{duct,\,I}$	R_{min}
—	mm	m	mm	m	mm	m
0205	30	1.7	30	1.7	30	1.7
0305	40	1.7	35	2.0	35	2.5
0405	45	2.4	40	2.4	40	2.4
0206	40	2.0	35	2.4	35	2.4
0306	50	2.6	45	3.0	40	3.7
0406	55	3.6	50	3.6	45	3.6

Inner diameter of circular duct, d_i, and minimum radii of curvature, R_{min}, for $p_{R,\,max}$ = 200 kN/m

Number of strands	f ≈ 0.25		f ≈ 0.30		f ≈ 0.35	
n05 n06	$d_{duct,\,I}$	R_{min}	$d_{duct,\,I}$	R_{min}	$d_{duct,\,I}$	R_{min}
—	mm	m	mm	m	mm	m
0205	30	1.7	30	1.7	30	1.7
0305	40	1.7	35	1.7	35	1.8
0405	45	1.8	40	1.8	40	1.8
0206	40	2.0	35	2.0	35	2.0
0306	50	2.0	45	2.2	40	2.7
0406	55	2.7	50	2.7	45	2.7

Inner diameter of circular duct, d_i, and minimum radii of curvature, R_{min}, for $p_{R,\,max}$ = 230 kN/m

Number of strands	f ≈ 0.25		f ≈ 0.30		f ≈ 0.35	
n05 n06	$d_{duct,\,I}$	R_{min}	$d_{duct,\,I}$	R_{min}	$d_{duct,\,I}$	R_{min}
—	mm	m	mm	m	mm	m
0205	30	1.7	30	1.7	30	1.7
0305	40	1.7	35	1.7	35	1.7
0405	45	1.7	40	1.7	40	1.7
0206	40	2.0	35	2.0	35	2.0
0306	50	2.0	45	2.0	40	2.4
0406	55	2.4	50	2.4	45	2.4



Inner dimensions, d_i, of flat ducts and minimum radii of curvature, R_{min}, for $p_{R,\,max}$ = 130 kN/m

Number of strands	Inner dimensions		Radii of curvature	
n05 n06	$d_{i,\,major}$	$d_{i,\,minor}$	$R_{min,\,major}$	$R_{min,\,minor}$
—	mm	mm	m	m
0205	40	20	1.7	2.1
0305	55	20	1.7	3.2
0405	70	20	1.7	4.3
0505	70	20	1.7	5.4
0605	90	20	1.7	6.4
0206	40	20	2.0	3.2
0306	55	20	2.0	4.8
0406	70	20	2.0	6.4
0506	90	20	2.0	8.0

Inner dimensions, d_i, of flat ducts and minimum radii of curvature, R_{min}, for $p_{R,\,max}$ = 150 kN/m

Number of strands	Inner dimensions		Radii of curvature	
n05 n06	$d_{i,\,major}$	$d_{i,\,minor}$	$R_{min,\,major}$	$R_{min,\,minor}$
—	mm	mm	m	m
0205	40	20	1.7	1.9
0305	55	20	1.7	2.8
0405	70	20	1.7	3.7
0505	70	20	1.7	4.6
0605	90	20	1.7	5.6
0206	40	20	2.0	2.8
0306	55	20	2.0	4.2
0406	70	20	2.0	5.6
0506	90	20	2.0	7.0

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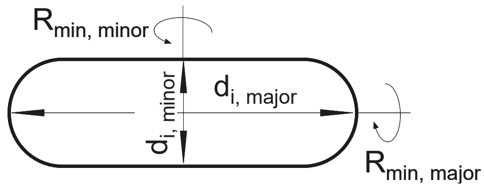


Inner dimensions, d_i, of flat ducts and minimum radii of curvature, R_{min}, for $p_{R, max}$ = 200 kN/m

Number of strands	Inner dimensions		Radii of curvature	
n05 n06	$d_{i, major}$	$d_{i, minor}$	$R_{min, major}$	$R_{min, minor}$
—	mm	mm	m	m
0205	40	20	1.7	1.7
0305	55	20	1.7	2.1
0405	70	20	1.7	2.8
0505	70	20	1.7	3.5
0605	90	20	1.7	4.2
0206	40	20	2.0	2.1
0306	55	20	2.0	3.1
0406	70	20	2.0	4.2
0506	90	20	2.0	5.2

Inner dimensions, d_i, of flat ducts and minimum radii of curvature, R_{min}, for $p_{R, max}$ = 230 kN/m

Number of strands	Inner dimensions		Radii of curvature	
n05 n06	$d_{i, major}$	$d_{i, minor}$	$R_{min, major}$	$R_{min, minor}$
—	mm	mm	m	m
0205	40	20	1.7	1.7
0305	55	20	1.7	1.8
0405	70	20	1.7	2.4
0505	70	20	1.7	3.0
0605	90	20	1.7	3.6
0206	40	20	2.0	2.0
0306	55	20	2.0	2.7
0406	70	20	2.0	3.6
0506	90	20	2.0	4.5

Diameters and wall thickness, t_{min}, of plastic duct

Number of strands *n05* n06	Corrugated plastic duct		Smooth plastic duct		
	Internal diameter d_i	Wall thickness t_{min}	Outer diameter d_o	Internal diameter d_i	Wall thickness t_{min}
—	mm	mm	mm	mm	mm
0205	30	1.5	40	36	2
0305	35	1.5	50	45	2.5
0405	40	1.5	63	57	3
0206	35	1.5	40	36	2
0306	40	2	50	45	2.5
0406	45	2	63	57	3

Wall thickness, t_{min}, of smooth steel duct

Number of strands *n05* n06	Wall thickness t_{min}
—	mm
0205	0.6
0305	0.9
0405	
0206	
0306	1.1
0406	

Inner dimensions and wall thickness, t_{min}, of flat plastic duct

Number of strands	Corrugated flat plastic duct		
	Inner dimensions		Wall thickness
n05 n06	$d_{i\ major}$	$d_{i\ minor}$	t_{min}
—	mm	mm	mm
0205	40	20	2
0305	70	21	2
0405	70	21	2
0505	75	21	2
0605	90	21	2
0206	40	20	2
0306	70	21	2
0406	70	21	2
0506	90	21	2

Wall thickness for circular and flat steel strip sheath is according to EN 523.

Material properties

Component	Standard / Specification
Anchor head A CONA CMF BT *0205* to 0406	EN ISO 683-1
Coupler anchor head H CONA CMF BT *0205* to 0406	EN ISO 683-1
Bearing trumplate CONA CMF BT *0205* to 0406	EN 1561 EN 1563
Coupler sleeve H CONA CMF BT *0205* to 0406	EN 10210-1
Wedge retaining plate KS CONA CMF BT *0205* to 0406	EN 10025-2
Trumpet A Trumpet F Trumpet FH Transition pipe	EN ISO 17855-1
Ring wedge H *05* Ring wedge H 06 Ring wedge F 06	EN 10025-2 EN ISO 683-3 EN 10277
Spring A	EN 10270-1
Helix	Ribbed reinforcing steel $R_e \geq 500$ MPa [1)]
Additional reinforcement, stirrup	Ribbed reinforcing steel $R_e \geq 500$ MPa [1)]
Duct	EN 523

[1)] Ribbed reinforcing steel with $R_e \geq 460$ MPa may be placed according to Annex 23, Annex 24, Annex 25, and Annex 26.

Maximum prestressing and overstressing forces, *05* prestressing steel strand

Force		Maximum prestressing force [1), 3)]				Maximum overstressing force [1), 2), 3)]			
		$0.9 \cdot F_{p0.1}$				$0.95 \cdot F_{p0.1}$			
Tendon designation		CONA CMF BT							
		n05-93		*n05*-100		*n05*-93		*n05*-100	
Characteristic tensile strength	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	*02*	261	274	281	295	276	289	296	312
	03	392	410	421	443	413	433	445	467
	04	522	547	562	590	551	578	593	623
	05	653	684	702	738	689	722	741	779
	06	783	821	842	886	827	866	889	935

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 tests has been 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 prestressing force.

3) For prestressing steel strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.

Where

F_{pk} .... Characteristic value of maximum force of tendon

$F_{p0.1}$ .... Characteristic value of 0.1 % proof force of the tendon

Maximum prestressing and overstressing forces, 06 prestressing steel strand

Force		Maximum prestressing force 1), 3)				Maximum overstressing force 1), 2), 3)			
		$0.9 \cdot F_{p0.1}$				$0.95 \cdot F_{p0.1}$			
Tendon designation		CONA CMF BT							
		n06-140		n06-150		n06-140		n06-150	
Characteristic tensile strength	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	02	392	412	421	443	414	435	445	467
	03	589	618	632	664	621	653	667	701
	04	785	824	842	886	828	870	889	935
	05	981	1 031	1 053	1 107	1 036	1 088	1 112	1 169

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 tests has been 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 prestressing force.

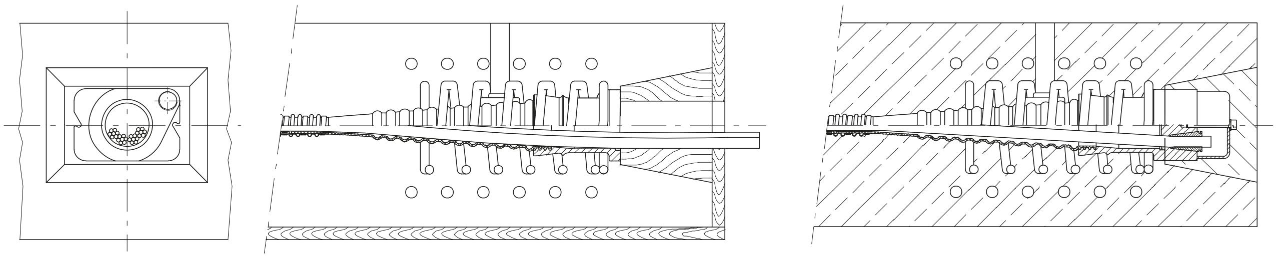
3) For prestressing steel strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.

Where

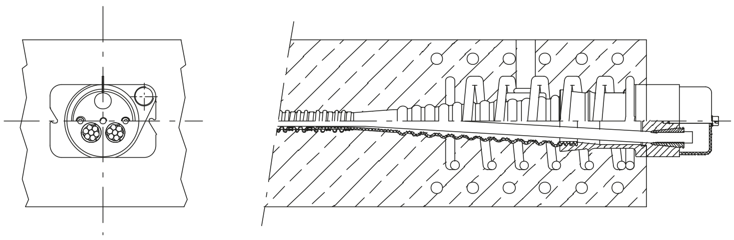
F_{pk} .... Characteristic value of maximum force of tendon

$F_{p0.1}$ .... Characteristic value of 0.1 % proof force of the tendon

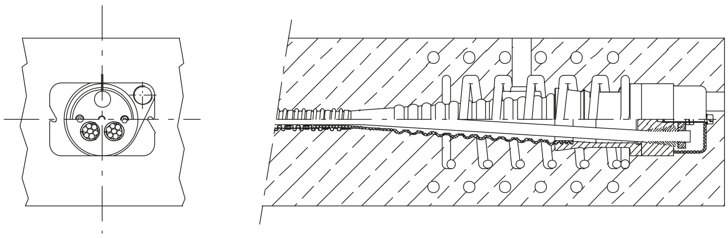
Recessed stressing anchor SA CONA CMF BT S1



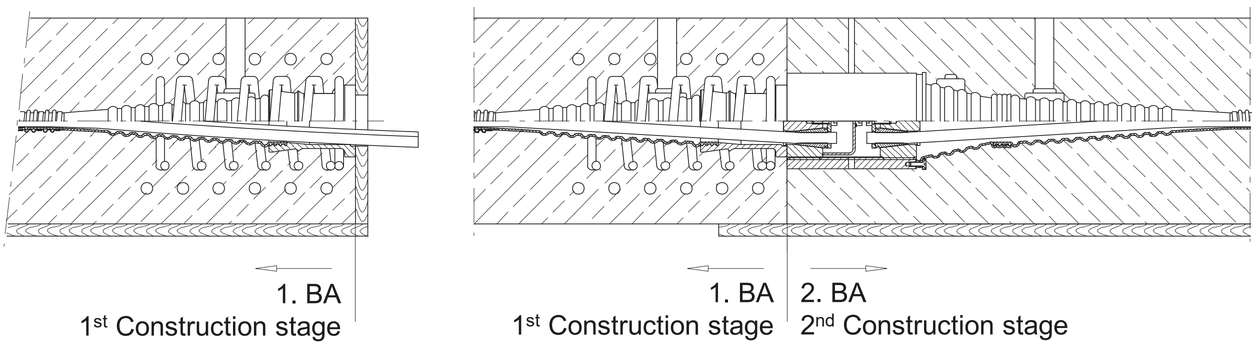
Exposed stressing anchor SA CONA CMF BT S1



Fixed anchor FA CONA CMF BT S1

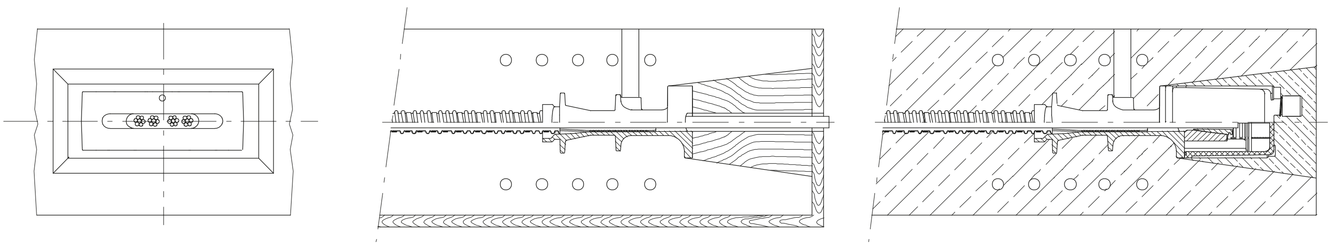


Fixed and stressing coupler FH, SH CONA CMF BT S1

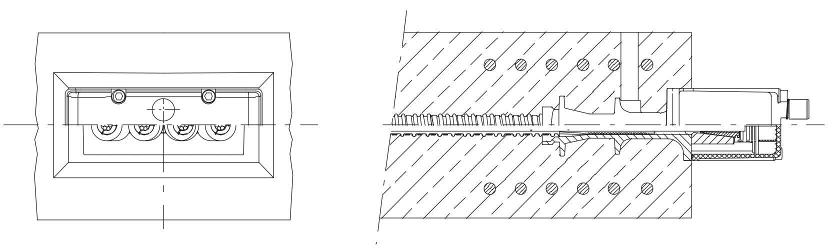


CONA CMF BT	**Internal Post-tensioning System** Anchorage series 1 Construction stages	**Annex 21** of European Technical Assessment **ETA-12/0076** of 23.09.2019

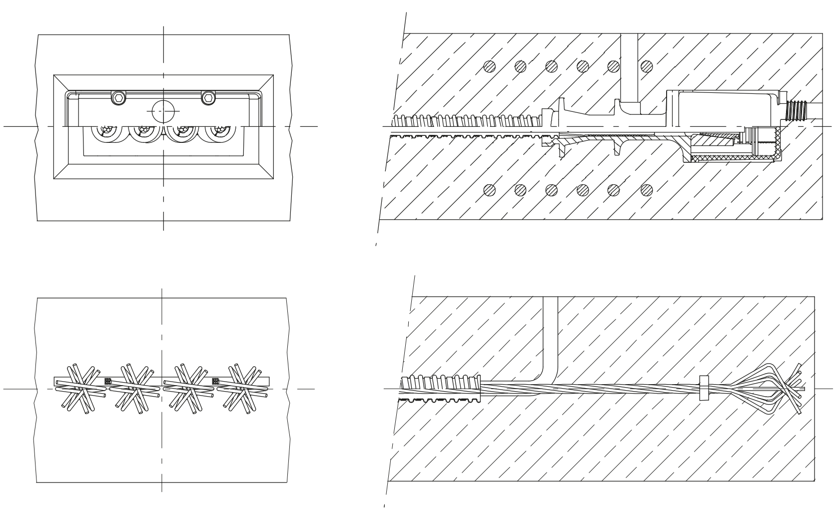
Recessed stressing anchor SA CONA CMF BT S2



Exposed stressing anchor SA CONA CMF BT S2

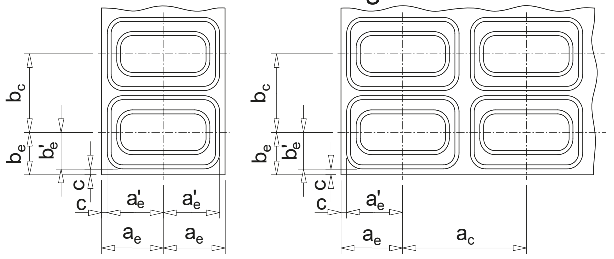


Fixed anchor FA CONA CMF BT S2



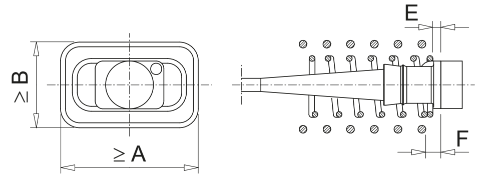
OiB
Member of EOTA

Centre and edge distances



$a_e = a'_e + c$
$b_e = b'_e + c$

Stressing and fixed anchor or coupler



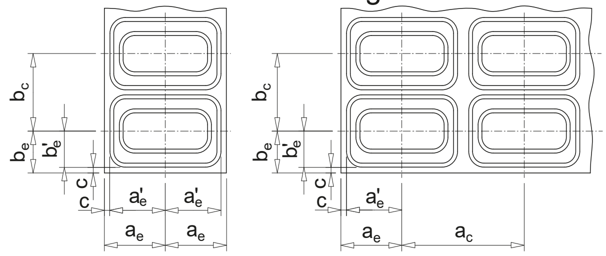
c…concrete cover

BBR VT CONA CMF BT S1		*0205*		*0305*		*0405*	
Strand arrangement							
7-wire prestressing steel strand							
Maximum characteristic tensile strength **1 860**[1)]							
Nominal diameter	in	0.49	0.51	0.49	0.51	0.49	0.51
	mm	12.5	12.9	12.5	12.9	12.5	12.9
Cross-sectional area	**mm²**	**93**	**100**	**93**	**100**	**93**	**100**
Tendon							
Cross-sectional area A_p	mm²	186	200	279	300	372	400
Charact. value of maximum force F_{pk}	kN	346	372	519	558	692	744
Charact. value of 0.1 % proof force [2)] $F_{p0.1}$	kN	304	328	456	492	608	656
Max. prestressing force [2)] $0.90 \cdot F_{p0.1}$	kN	274	295	410	443	547	590
Max. overstressing force [2)] $0.95 \cdot F_{p0.1}$	kN	289	312	433	467	578	623
Minimum concrete strength – Helix – Additional reinforcement – Centre spacing and edge distance							
Minimum concrete strength							
Cube $f_{cm,0}$	**MPa**	**21**[3)]	**25**[3)]	**21**[3)]	**25**[3)]	**21**[3)]	**25**[3)]
Cylinder $f_{cm,0}$	**MPa**	**17**[3)]	**20**[3)]	**17**[3)]	**20**[3)]	**17**[3)]	**20**[3)]
Helix – Ribbed reinforcing steel $R_e \geq 500$ MPa							
Outer dimensions	mm						
Bar diameter	mm						
Length, approximately	mm						
Pitch	mm						
Number of pitches	—						
Distance E	mm						
Additional reinforcement [4)] – Ribbed reinforcing steel $R_e \geq 500$ MPa [5)]							
Number of stirrups	—	4	4	4	4	7	7
Bar diameter	mm	8	8	10	10	10	10
Spacing	mm	50	50	50	50	50	50
Distance from bearing trumplate F	mm	35	35	35	35	35	35
Minimum outer dimensions A / B	mm	160 / 120	160 / 120	190 / 130	160 / 120	320 / 155	320 / 155
Centre spacing and edge distance							
Min. centre spacing a_c / b_c	mm	180 / 140	180 / 140	210 / 150	180 / 140	340 / 175	340 / 175
Min. edge distance a'_e / b'_e	mm	80 / 60	80 / 60	95 / 65	80 / 60	160 / 80	160 / 80

1) Prestressing steel strand with characteristic tensile strength below 1 860 MPa may also be used.
2) For prestressing steel strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.
3) Both concrete strengths are applicable to tendons with prestressing steel strands of both nominal diameters 12.5 and 12.9 mm.
4) Additional reinforcement may be replaced by a rectangular helix of identical bar diameter and external dimensions, and number of turns equal to number of stirrups plus one.
5) Reinforcing steel with $R_e \geq 460$ MPa requires a stirrup spacing of 40 mm and one additional stirrup.

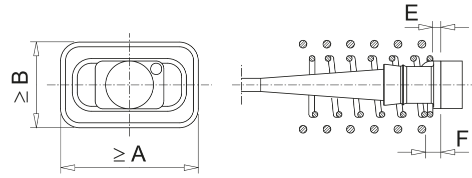
OiB
Member of EOTA

Centre and edge distances



$a_e = a'_e + c$
$b_e = b'_e + c$

Stressing and fixed anchor or coupler

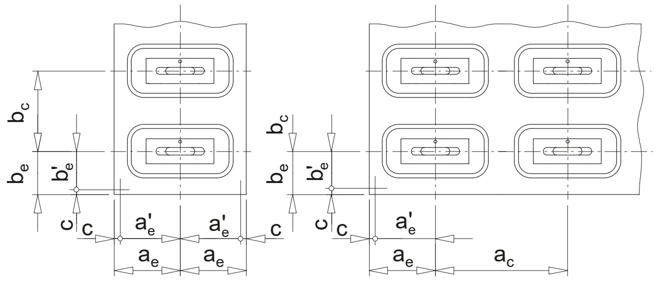


c…concrete cover

BBR VT CONA CMF BT S1			0206		0306		0406	
Strand arrangement								
7-wire prestressing steel strand								
Maximum characteristic tensile strength **1 860**[1)]								
Nominal diameter		in	0.6	0.62	0.6	0.62	0.6	0.62
		mm	15.3	15.7	15.3	15.7	15.3	15.7
Cross-sectional area		**mm²**	**140**	**150**	**140**	**150**	**140**	**150**
Tendon								
Cross-sectional area	A_p	mm²	280	300	420	450	560	600
Charact. value of maximum force	F_{pk}	kN	520	558	780	837	1 040	1 116
Charact. value of 0.1 % proof force[2)]	$F_{p0.1}$	kN	458	492	687	738	916	984
Max. prestressing force[2)]	$0.90 \cdot F_{p0.1}$	kN	412	443	618	664	824	886
Max. overstressing force[2)]	$0.95 \cdot F_{p0.1}$	kN	435	467	653	701	870	935
Minimum concrete strength – Helix – Additional reinforcement – Centre spacing and edge distance								
Minimum concrete strength								
Cube	$f_{cm,0}$	**MPa**	**21**[3)]	**25**[3)]	**25**		**25**	
Cylinder	$f_{cm,0}$	**MPa**	**17**[3)]	**20**[3)]	**20**		**20**	
Helix – Ribbed reinforcing steel $R_e \geq 500$ MPa								
Outer dimensions		mm	/	/	240 / 110		240 / 130	
Bar diameter		mm	/	/	10		10	
Length, approximately		mm	/	/	240		285	
Pitch		mm	/	/	45		45	
Number of pitches		—	/	/	6		7	
Distance	E	mm	/	/	15		15	
Additional reinforcement[4)] – Ribbed reinforcing steel $R_e \geq 500$ MPa[5)]								
Number of stirrups		—	4	4	6		7	
Bar diameter		mm	10	10	10		10	
Spacing		mm	50	50	50		50	
Distance from bearing trumplate	F	mm	35	35	35		35	
Minimum outer dimensions	A / B	mm	190 / 130	160 / 120	290 / 155		290 / 180	
Centre spacing and edge distance								
Min. centre spacing	a_c / b_c	mm	210 / 150	180 / 140	310 / 175		310 / 200	
Min. edge distance	a'_e / b'_e	mm	95 / 65	80 / 60	145 / 80		145 / 90	

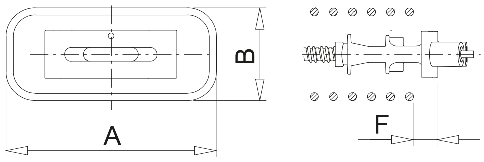
1) Prestressing steel strand with characteristic tensile strength below 1 860 MPa may also be used.
2) For prestressing steel strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.
3) Both concrete strengths are applicable to tendons with prestressing steel strands of both nominal diameters 15.3 and 15.7 mm.
4) Additional reinforcement may be replaced by a rectangular helix of identical bar diameter and external dimensions, and number of turns equal to number of stirrups plus one.
5) Reinforcing steel with $R_e \geq 460$ MPa requires a stirrup spacing of 40 mm and one additional stirrup.

Centre and edge distances



$a_e = a'_e + c$
$b_e = b'_e + c$

Stressing and fixed anchor

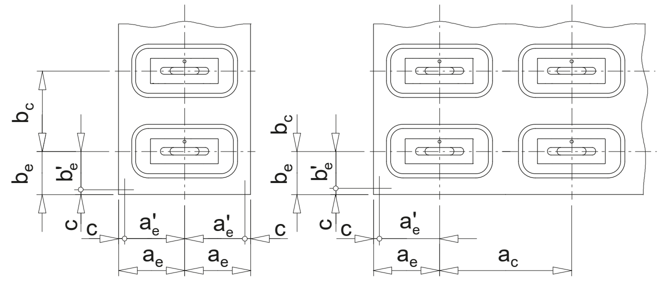


c…concrete cover

BBR VT CONA CMF BT S2		0206, *0205*[1]		*0305*		0306		*0405*	
Strand arrangement									
7-wire prestressing steel strand									
Maximum characteristic tensile strength **1 860**[2]									
Nominal diameter	in	0.60	0.62	0.49	0.51	0.60	0.62	0.49	0.51
	mm	15.3	15.7	12.5	12.9	15.3	15.7	12.5	12.9
Cross-sectional area	**mm²**	**140**	**150**	**93**	**100**	**140**	**150**	**93**	**100**
Tendon									
Cross-sectional area A_p	mm²	280	300	279	300	420	450	372	400
Charact. value of maximum force F_{pk}	kN	520	558	519	558	780	837	692	744
Charact. value of 0.1 % proof force[3] $F_{p0.1}$	kN	458	492	456	492	687	738	608	656
Max. prestressing force[3] $0.90 \cdot F_{p0.1}$	kN	412	443	410	443	618	664	547	590
Max. overstressing force[3] $0.95 \cdot F_{p0.1}$	kN	435	467	433	467	653	701	578	623
Minimum concrete strength – Helix – Additional reinforcement – Centre spacing and edge distance									
Minimum concrete strength									
Cube $f_{cm,0}$	**MPa**	**26**[4]		**26**[4]		**26**[4]		**26**[4]	
Cylinder $f_{cm,0}$	**MPa**	**21**[4]		**21**[4]		**21**[4]		**21**[4]	
Additional reinforcement[5] **– Ribbed reinforcing steel $R_e \geq 500$ MPa**[6]									
Number of stirrups	—	3		3		4		4	
Bar diameter	mm	10		10		12		12	
Spacing	mm	40		40		40		40	
Distance from bearing trumplate F	mm	35		35		45		45	
Minimum outer dimensions A / B	mm	200 / 90		200 / 90		230 / 100		230 / 100	
Centre spacing and edge distance									
Min. centre spacing a_c / b_c	mm	220 / 150		220 / 150		300 / 165		300 / 165	
Min. edge distance a'_e / b'_e	mm	100 / 65		100 / 65		140 / 75		140 / 75	

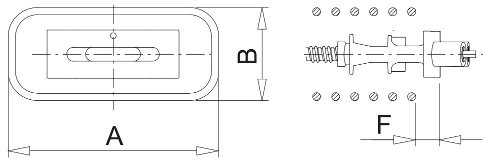
1) Strand specification and forces different for 0205. See Annex 11, Annex 19, and Annex 36.
2) Prestressing steel strand with characteristic tensile strength below 1 860 MPa may also be used.
3) For prestressing steel strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.
4) Concrete strength is applicable to tendons with prestressing steel strands of both nominal diameters 15.3 mm and 15.7 mm or 12.5 mm and 12.9 mm.
5) Additional reinforcement may be replaced by a rectangular helix of identical bar diameter and external dimensions, and number of turns equal to number of stirrups plus one.
6) Reinforcing steel with $R_e \geq 460$ MPa requires a stirrup spacing of 35 mm and one additional stirrup.

Centre and edge distances



$a_e = a'_e + c$
$b_e = b'_e + c$

Stressing and fixed anchor



c…concrete cover

BBR VT CONA CMF BT S2		0406		*0505*		0506		*0605*	
Strand arrangement									
7-wire prestressing steel strand									
Maximum characteristic tensile strength **1 860** [1]									
Nominal diameter	in	0.60	0.62	0.49	0.51	0.60	0.62	0.49	0.51
	mm	15.3	15.7	12.5	12.9	15.3	15.7	12.5	12.9
Cross-sectional area	**mm²**	**140**	**150**	**93**	**100**	**140**	**150**	**93**	**100**
Tendon									
Cross-sectional area A_p	mm²	560	600	465	500	700	750	558	600
Charact. value of maximum force F_{pk}	kN	1 040	1 116	865	930	1 300	1 395	1 038	1 116
Charact. value of 0.1 % proof force [2] $F_{p0.1}$	kN	916	984	760	820	1 145	1 230	912	984
Max. prestressing force [2] $0.90 \cdot F_{p0.1}$	kN	824	886	684	738	1 031	1 107	821	886
Max. overstressing force [2] $0.95 \cdot F_{p0.1}$	kN	870	935	722	779	1 088	1 169	866	935
Minimum concrete strength – Helix – Additional reinforcement – Centre spacing and edge distance									
Minimum concrete strength									
Cube $f_{cm,0}$	**MPa**	**26** [3]		**26** [3]		**26** [3]		**26** [3]	
Cylinder $f_{cm,0}$	**MPa**	**21** [3]		**21** [3]		**21** [3]		**21** [3]	
Additional reinforcement [4] **– Ribbed reinforcing steel $R_e \geq$ 500 MPa** [5]									
Number of stirrups	—	6		6		6		6	
Bar diameter	mm	12		12		12		12	
Spacing	mm	35		35		40		40	
Distance from bearing trumplate F	mm	45		45		45		45	
Minimum outer dimensions A / B	mm	270 / 100		270 / 100		310 / 120		310 / 120	
Centre spacing and edge distance									
Min. centre spacing a_c / b_c	mm	370 / 175		370 / 175		450 / 200		450 / 200	
Min. edge distance a'_e / b'_e	mm	175 / 80		175 / 80		215 / 90		215 / 90	

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

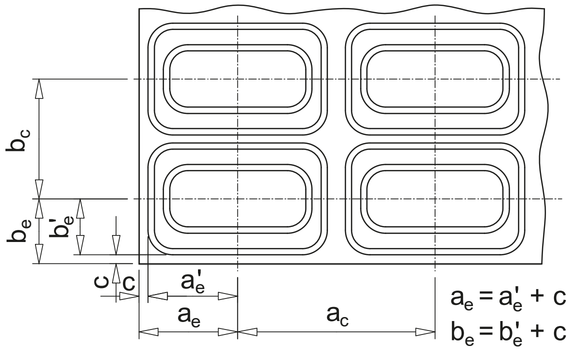
[2] For prestressing steel strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.

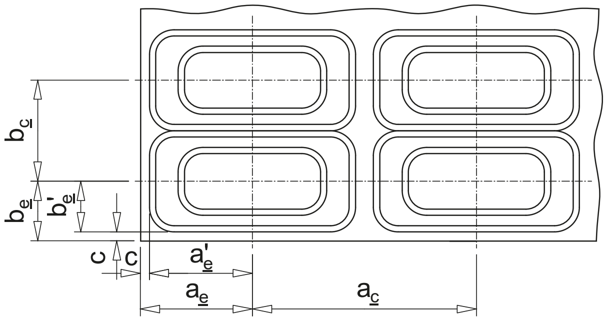
[3] Concrete strength is applicable to tendons with prestressing steel strands of both nominal diameters 15.3 mm and 15.7 mm or 12.5 mm and 12.9 mm.

[4] Additional reinforcement may be replaced by a rectangular helix of identical bar diameter and external dimensions, and number of turns equal to number of stirrups plus one.

[5] Reinforcing steel with $R_e \geq$ 460 MPa requires a stirrup spacing of 35 mm and one additional stirrup. $R_e \geq$ 460 MPa is not applicable to tendons 0406 and *0505*.

Centre spacing and edge distance





a_c, b_c	$a_{\underline{c}} > b_{\underline{c}}$
a_e, b_e	$a_{\underline{e}} > b_{\underline{e}}$

Modification of centre spacing and edge distance are in accordance with the Clauses 1.10 and 2.2.3.3.

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

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

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

Corresponding edge distances

$$a_{\underline{e}} = \frac{a_{\underline{c}}}{2} - 10 + c \quad \text{and} \quad b_{\underline{e}} = \frac{b_{\underline{c}}}{2} - 10 + c$$

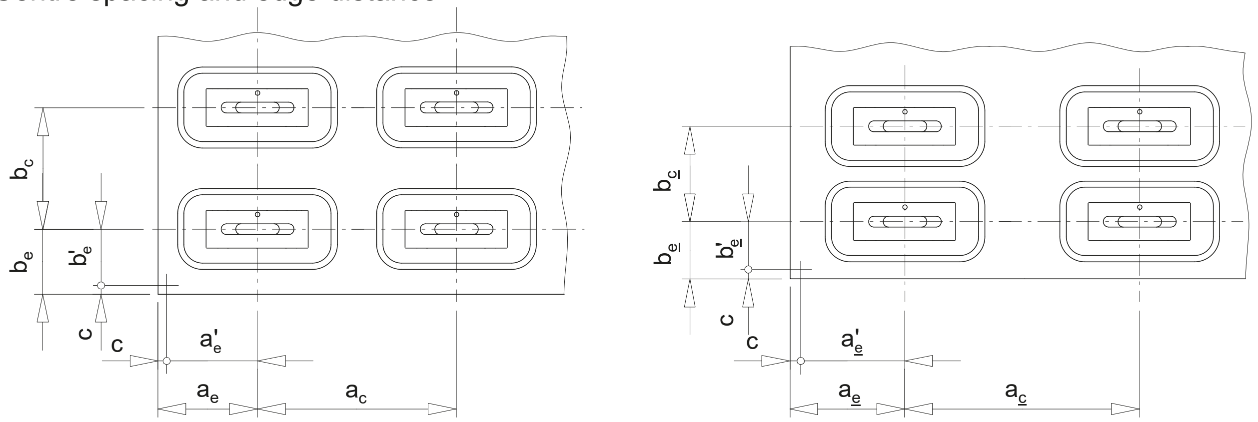
c Concrete cover

1) The outer dimensions of the additional stirrup reinforcement are adjusted accordingly. Further modifications of reinforcement in accordance with Clause 2.2.3.3.

NOTE The replacement of the additional stirrup reinforcement by a rectangular helix according to the Annex 23 and Annex 24 does not prevent the modification of centre spacing and edge distance. The external dimensions of the rectangular helix replacing stirrups are adapted to the modified centre spacing and edge distance.

Dimensions in mm

Centre spacing and edge distance



a_c, b_c
a_e, b_e

$\underline{a_c} > \underline{b_c}$
$\underline{a_e} > \underline{b_e}$

Modification of centre spacing and edge distance are in accordance with the Clauses 1.10 and 2.2.3.3.

$$\underline{b_c} \begin{cases} \geq 0.85 \cdot b_c \\ \text{and} \\ \geq \text{Stirrup, outside dimensions}^{1)} \end{cases}$$

$$\underline{a_c} \geq \frac{A_c}{\underline{b_c}} \qquad A_c = a_c \cdot b_c \leq \underline{a_c} \cdot \underline{b_c}$$

Corresponding edge distances

$$\underline{a_e} = \frac{\underline{a_c}}{2} - 10 + c \quad \text{and} \quad \underline{b_e} = \frac{\underline{b_c}}{2} - 10 + c$$

c Concrete cover
1) Further modifications of reinforcement in accordance with Clause 2.2.3.3.

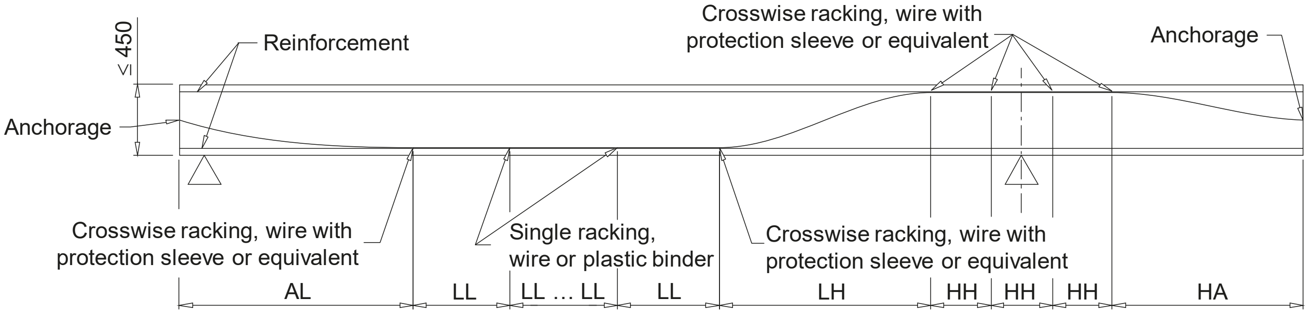
Example for modified centre spacing and edge distance, see Annex 25 and Annex 26

BBR VT CONA CMF BT S2			**0206,** *0205*	*0305*	**0306**	*0405*	**0406**	*0505*	**0506**	*0605*
Minimum concrete strength										
Cube	$f_{cm,0}$	**MPa**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**
Cylinder	$f_{cm,0}$	**MPa**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
Additional reinforcement 1) – Ribbed reinforcing steel $R_e \geq 500$ MPa 2)										
Number of stirrups		—	3	3	4	4	6	6	6	6
Bar diameter		mm	10	10	12	12	12	12	12	12
Spacing		mm	40	40	40	40	35	35	40	40
Distance from bearing trumplate	F	mm	35	35	45	45	45	45	45	45
Minimum outer dimensions	A	mm	200	200	230	230	270	270	310	310
	B	mm	90	90	100	100	100	100	120	120
Modified centre spacing and edge distance 3)										
Modified minimum centre spacing	$\underline{a_c}$	mm	255	255	355	355	435	435	530	530
	$\underline{b_c}$	mm	130	130	140	140	150	150	170	170
Modified minimum edge distance	$\underline{a'_e}$	mm	120	120	170	170	210	210	260	260
	$\underline{b'_e}$	mm	55	55	60	60	65	65	75	75

1) and 2) See footnotes 4) and 5) in Annex 25 and Annex 26.
3) Dimensions are not subject of further modifications as regards reduction.

Free tendon layout with monostrands or bands

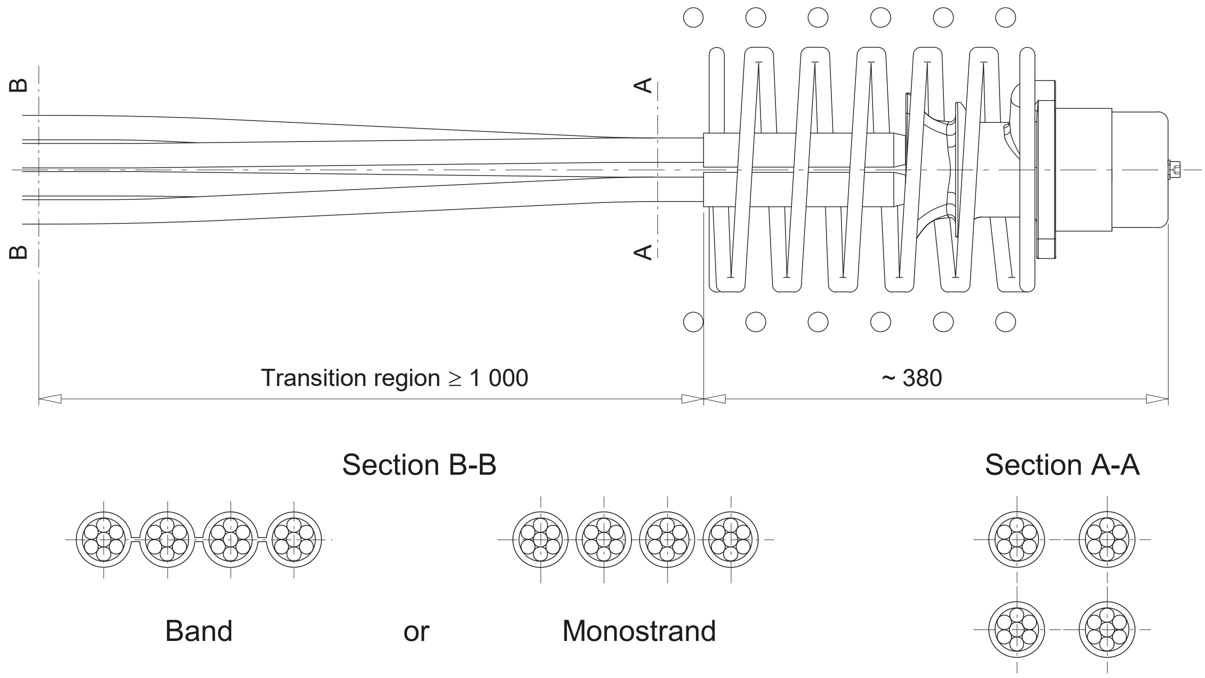
For slab thickness ≤ 450 mm



Typical zones		max. distances	min. number	Tying to reinforcement
AL	Anchor – Low point	3.0 m	—	crosswise racking
LL	Low point – Low point	1.0–1.3 m	2	single wire racking
LH	Low point – High point	3.0 m	—	crosswise racking
HH	High point – High point	0.3–1.0 m	2	crosswise racking
HA	High point – Anchor	1.5 m	—	crosswise racking

Transition region

Tendon CONA CMF BT S1-*0405* and 0406

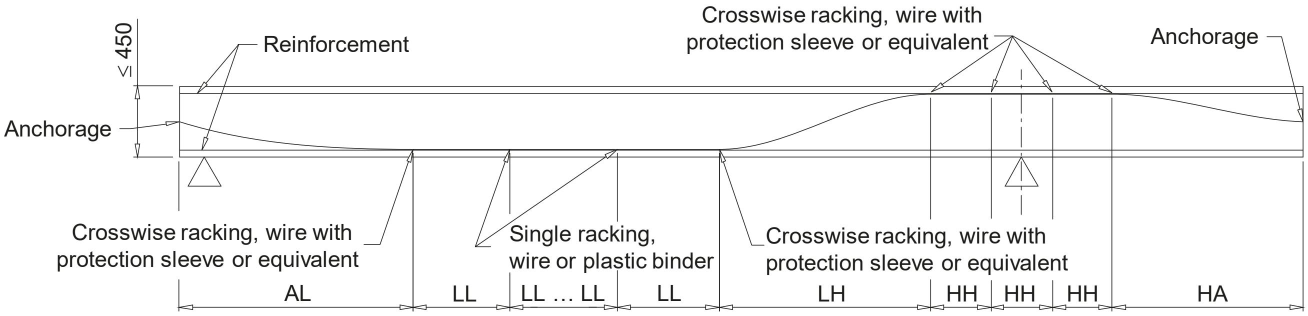


Dimensions in mm

CONA CMF BT	**Internal Post-tensioning System** Anchorage series 1 Free tendon layout with monostrands or band Tendon CONA CMF BT S1-*0405* and 0406	**Annex 29** of European Technical Assessment **ETA-12/0076** of 23.09.2019

Free tendon layout with monostrands or bands

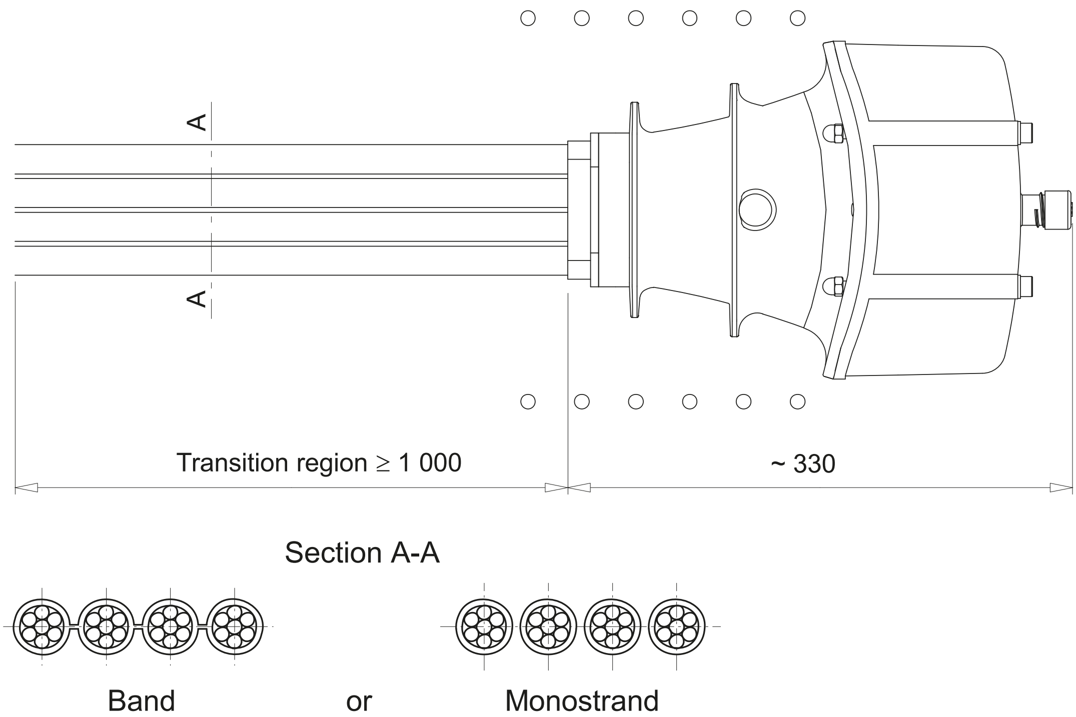
For slab thickness ≤ 450 mm



Typical zones		max. distances	min. number	Tying to reinforcement
AL	Anchor – Low point	3.0 m	—	crosswise racking
LL	Low point – Low point	1.0–1.3 m	2	single wire racking
LH	Low point – High point	3.0 m	—	crosswise racking
HH	High point – High point	0.3–1.0 m	2	crosswise racking
HA	High point – Anchor	1.5 m	—	crosswise racking

Transition region

Tendon CONA CMF BT S2-*0405* and 0406



BBR CONA CMF BT	**Internal Post-tensioning System** Anchorage series 2 Free tendon layout with monostrands or band Tendon CONA CMF BT S2-*0405* and 0406	**Annex 30** of European Technical Assessment **ETA-12/0076** of 23.09.2019

Installation of tendons with prestressing steel strands other than monostrands – Series 1

1 General

For tendon installation see EN 13670, in particular Clause 7 and Annex E.

2 Preparatory work

The components of the prestressing kit are stored in such a way as to avoid any damage or corrosion.

3 Anchorage recesses

Adequate clearance to accommodate and to use the prestressing jack is ensured, see also the Clauses 1.2.6, 2.2.3.2, and 2.2.4.5.

4 Fasten the bearing trumplates

Two slots 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, see also Clause 2.2.4.9, or placed by tying it to the existing reinforcement.

5 Placing of ducts

The ducts are placed on supports with spacing according to Clause 1.6 and minimum radii of curvature according to Clause 1.5. The ducts are connected in a water-proof way and supported such that any movement is prevented. Steel strip sheaths are slipped over the plastic trumpet at anchorages and couplers.

The same applies to prefabricated tendons.

6 Installation of tensile elements – prestressing steel strands

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

7 Installation of inaccessible fixed anchors

After passing the strands through the anchor head, they are anchored individually in the cones by means of ring wedges. After assembly, the wedges are secured with springs or a wedge retaining plate. An alternative is pre-locking each individual strand with ~ 0.5 · F_{pk} and applying a wedge retaining plate.

8 Checking the tendons before concreting

Before concreting the structure, fastening and position of the entire tendon are checked and corrected if necessary. The sheaths are checked for any damage.

9 Assembly of anchor head or 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 1. BA of a fixed coupler in the first construction stage.

10 Stressing

At the time of stressing, the mean concrete compressive strength is at least according to Table 5 and Clause 1.9. Stressing and possible wedging are carried out with a suitable prestressing jack and in accordance with Clause 2.2.4.5.

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

Restressing of the tendons is allowed in accordance with Clause 2.2.4.6.

11 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 coupler anchor head H, 2. BA is assembled with ring wedges and a wedge retaining plate. It is connected to the already tensioned coupler anchor head H, 1. BA by means of a threaded coupler sleeve.

12 Movable coupler

The movable coupler serves to lengthen tendons prior to stressing. The axial movement during stressing is ensured by a coupler sheathing box, suitable to the expected elongation at the position of the coupler.

Assembly of coupler anchor heads is performed in accordance with the Point 7 and the Clauses 1.2.5 and 2.2.4.2.

13 Filling of tendons

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 2.2.4.8.1.

Corrosion protection filling material is injected similar to grouting and the recommendations of the supplier are considered, see also Clause 2.2.4.8.2.

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

Installation of tendons with monostrands or bands – Series 1

1 General

For tendon installation see EN 13670, in particular Clause 7 and Annex E.

2 Preparatory work

The components of the prestressing kit are stored in such a way as to avoid any damage or corrosion.

3 Anchorage recesses

Adequate clearance to accommodate and to use the prestressing jack is ensured, see also the Clauses 1.2.6, 2.2.3.2, and 2.2.4.5.

4 Fastening the bearing trumplates

Two slots are provided to fasten the bearing trumplates to the formwork. The transition pipes are pushed into the anchor head and the helix is either welded to the bearing trumplate, see also Clause 2.2.4.9, or placed by tying it to the existing reinforcement.

5 Placing of monostrands or bands

Monostrands or bands are placed on supports with spacing according to Clause 1.6 and minimum radii of curvature according to Clause 1.5. Monostrands or bands are supported such as any movement is prevented. The same applies for prefabricated tendons.

Installation in free tendon layout is according to Clause 1.6.2 and Annex 29.

6 Installation of inaccessible fixed anchors

Band are cut longitudinally to separate the individual strands. This is not applicable to monostrands. PE-sheathings at the ends are removed and felt sealings are inserted on each single strand in the region of the transition pipe. The same applies to accessible fixed anchors and stressing anchors. After pushing the strands through the anchor head at the stressing anchor, the removed PE-sheathings are placed back to protect the excess strand lengths.

The strands passing through the anchor head of the inaccessible fixed anchor are anchored individually in the cones by means of ring wedges. After assembly the wedges are secured with springs or a wedge retaining plate. An alternative is pre-locking each individual strand with ~ $0.5 \cdot F_{pk}$ and applying a wedge retaining plate.

The bearing trumplate is completely filled with corrosion protection filling material.

The protection cap is filled with corrosion protection filling material and attached to the head.

7 Similar procedures

In accordance with the installation of tendons with prestressing steel strand other than monostrands, see Annex 31, the following procedures are applied:

– Checking of the tendons before concreting
– Assembly of anchor head or coupler anchor head 1. BA
– Stressing
– Installation of fixed coupler anchor head 2. BA

8 Fixed and stressing coupler FH, SH [1)]

The couplers FH and SH can be executed with monostrand and band tendons.

9 Filling of anchorages

Stressing anchors, accessible fixed anchors, couplers 1. BA, and finally installed fixed couplers are filled with corrosion protection filling material and covered with a cap in accordance with Point 6. The latter does not apply to couplers.

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

[1)] The movable coupler BH cannot be executed with monostrands or bands

Installation of tendons with prestressing steel strands other than monostrands – Series 2

1 General

For tendon installation see EN 13670, in particular Clause 7 and Annex E.

2 Preparatory work

The components of the prestressing kit are stored in such a way as to avoid any damage or corrosion.

3 Anchorage recesses

Adequate clearance to accommodate and to use the prestressing jack is ensured, see also the Clauses 1.2.6, 2.2.3.2, and 2.2.4.5.

4 Fasten the bearing trumplates

The bearing trumplate is fastened to the formwork. The additional reinforcement is placed by tying to the existing reinforcement.

5 Placing of ducts

The ducts are placed on supports with spacing according to Clause 1.6 and minimum radii of curvature according to Clause 1.5. The ducts are connected in a water-proof way and supported such that any movement is prevented. The same applies to prefabricated tendons.

6 Installation of tensile elements – prestressing steel strands

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

7 Installation of inaccessible fixed anchor

After passing the strands through the bearing trumplate, they are anchored individually in mono barrels by means of ring wedges. Each individual strand is pre-locked with ~ 0.5 · F_{pk}. After assembly, the wedges are secured with wedge retaining plate, wedge holding rings and attaching a protection cap with vent. An alternative is applying wedge retaining plate, wedge holding rings, together with an integrated protection cap.

The joint duct to bearing trumplate is completed tension proof and sealed with adhesive tape.

8 Assembly of stressing anchor

After passing the strands through the bearing trumplate, they are tightened and anchored individually in mono barrels by means of ring wedges.

The joint duct to bearing trumplate is completed tension proof and sealed with adhesive tape.

9 Checking the tendons before concreting

Before concreting the structure, fastening and position of the entire tendon are checked and corrected if necessary. The sheaths are checked for any damage.

10 Stressing

At the time of stressing the mean concrete compressive strength is at least according to Table 5 and Clause 1.9. Stressing and possible wedging are carried out with a suitable prestressing jack and in accordance with Clause 2.2.4.5.

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

Restressing of the tendons is allowed in accordance with Clause 2.2.4.6.

11 Filling of tendons

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 2.2.4.8.1.

Corrosion protection filling material is injected similar to grouting and the recommendations of the supplier are considered, see also Clause 2.2.4.8.2.

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

Installation of tendons with monostrands or bands – Series 2

1 General

For tendon installation see EN 13670, in particular Clause 7 and Annex E.

2 Preparatory work

The components of the prestressing kit are stored in such a way as to avoid any damage or corrosion.

3 Anchorage recesses

Adequate clearance to accommodate and to use the prestressing jack is ensured, see also the Clauses 1.2.6, 2.2.3.2, and 2.2.4.5.

4 Fastening the bearing trumplates

The plug is placed in the bearing trumplate and the bearing trumplate is fasten to the formwork. The additional reinforcement is placed by tying to the existing reinforcement.

5 Placing of monostrands or bands

Monostrands or bands are placed on supports with spacing according to Clause 1.6 and minimum radii of curvature according to Clause 1.5. Monostrands or bands are supported such as any movement is prevented. The same applies for prefabricated tendons.

Installation in free tendon layout is according to Clause 1.6.2 and Annex 30.

6 Installation of inaccessible fixed anchors

Band are cut longitudinally to separate the individual strands. This is not applicable to monostrands. PE-sheathings at the ends are removed. However, sheathings extend within the bearing trumplate until a few cm ahead of the mono barrels.

The strands passing through the bearing trumplate of the inaccessible fixed anchor are anchored individually in mono barrels by means of ring wedges. Each individual strand is pre-locking with ~ 0.5 · F_{pk}. An alternative is applying wedge retaining plate, wedge holding rings, together with an integrated protection cap.

The joint sheathing to bearing trumplate is completed tension proof and sealed with adhesive tape.

Bearing trumplate and protection cap are completely filled with corrosion protection filling material.

7 Assembly of stressing anchor

Band are cut longitudinally to separate the individual strands. This is not applicable to monostrands. PE-sheathings at the ends are removed. However, sheathings extend within the bearing trumplate until a few cm ahead of the mono barrels.

After passing the strands through the bearing trumplate, they are tightened and anchored individually in mono barrels by means of ring wedges.

After anchoring the strands, the removed PE-sheathings are placed back to protect the excess strand lengths. The joint sheathing to bearing trumplate is completed tension proof and sealed with adhesive tape.

8 Similar procedures

In accordance with the installation of tendons with prestressing steel strand other than monostrands, see Annex 33, the following procedures are applied:

- Checking of the tendons before concreting
- Stressing

9 Filling of anchorages

Stressing anchors and accessible fixed anchors are filled with corrosion protection filling material and covered with a cap in accordance with Point 6.

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

Installation of the PT system – Series 1 and series 2

Installation of inaccessible fixed anchor by bond and bulb-ends – CMO

1 General

For tendon installation see EN 13670, in particular Clause 7 and Annex E.

Inaccessible fixed anchors by bond and bulb ends are for bonded tendons only.

2 Preparatory work

The components of the prestressing kit are stored in such a way as to avoid any damage or corrosion.

3 Placing of ducts

The ducts are placed on supports with spacing according to Clause 1.6 and minimum radii of curvature according to Clause 1.5. The ducts are connected in a water-proof way and supported such that any movement is prevented.

The same applies to prefabricated tendons.

4 Installation of tensile elements – prestressing steel strand

The prestressing steel is pushed or pulled into the sheath before concreting the structure.

5 Assembly of inaccessible fixed bond anchor

After passing the strands through the duct, the ends of all strands are individually formed into the bulb-strand shape using a bulb-strand jack. Then the bulb-strand are individually clipped into the bulb-strand spacer. Forming of bulb-ends may as well be performed prior of threading the strands.

Ventilation is provided at the duct end of each fixed bond anchor and the duct end is sealed.

6 Fastening the bulb-strand spacer

The bulb-strand spacer is fastened to the already placed reinforcement.

7 Similar procedures

In accordance with the installation of tendons with prestressing steel strand other than monostrands, see Annex 31 and Annex 33, the following procedures are applied:

- Checking of the tendons before concreting
- Stressing
- Grouting

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

Seven-wire prestressing steel strands according to prEN 10138-3[1)]

Steel name			**Y1860S7**			
Tensile strength	f_{pk}	MPa	1 860			
Diameter	d	mm	12.5	12.9	15.3	15.7
Nominal cross-sectional area	A_p	mm^2	93	100	140	150
Nominal mass per metre	m	kg/m	0.726 3	0.781	1.093	1.172
Permitted deviation from nominal mass		%	± 2			
Characteristic value of maximum force	F_{pk}	kN	173	186	260	279
Maximum value of maximum force	$F_{m,\,max}$	kN	199	214	299	321
Characteristic value of 0.1 % proof force [2)]	$F_{p0.1}$	kN	152	164	229	246
Minimum elongation at max. force, $L_0 \geq 500$ mm	A_{gt}	%	3.5			
Modulus of elasticity	E_p	MPa	195 000 [3)]			

Steel name			**Y1770S7**			
Tensile strength	f_{pk}	MPa	1 770			
Diameter	d	mm	12.5	12.9	15.3	15.7
Nominal cross-sectional area	A_p	mm^2	93	100	140	150
Nominal mass per metre	m	kg/m	0.726 3	0.781	1.093	1.172
Permitted deviation from nominal mass		%	± 2			
Characteristic value of maximum force	F_{pk}	kN	165	177	248	266
Maximum value of maximum force	$F_{m,\,max}$	kN	190	204	285	306
Characteristic value of 0.1 % proof force [2)]	$F_{p0.1}$	kN	145	156	218	234
Minimum elongation at max. force, $L_0 \geq 500$ mm	A_{gt}	%	3.5			
Modulus of elasticity	E_p	MPa	195 000 [3)]			

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

Contents of the prescribed test plan

Subject / type of control		Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Bearing trumplate	Material	Checking [1]	[2]	100 %	continuous
	Detailed dimensions	Testing	[2]	3 %, ≥ 2 specimens	continuous
	Visual inspection [3]	Checking	[2]	100 %	continuous
	Traceability	bulk			
Anchor head, Coupler anchor head, Coupler sleeve	Material	Checking [1]	[2]	100 %	continuous
	Detailed dimensions	Testing	[2]	5 %, ≥ 2 specimens	continuous
	Visual inspection [3]	Checking	[2]	100 %	continuous
	Traceability	full			
Ring wedge	Material	Checking [1]	[2]	100 %	continuous
	Treatment, hardness	Testing	[2]	0.5 %, ≥ 2 specimens	continuous
	Detailed dimensions	Testing	[2]	5 %, ≥ 2 specimens	continuous
	Visual inspection [3]	Checking	[2]	100 %	continuous
	Traceability	full			
Prestressing steel strand, Monostrand	Material	Checking	[2], [4]	100 %	continuous
	Dimension	Testing	[2]	1 sample	each coil or every 7 tons [5]
	Visual inspection	Checking	[2]	1 sample	
Steel strip duct	Material	Checking [6]	[2]	100 %	continuous
	Dimension	Testing	[2]	3 %, ≥ 2 specimens	continuous
	Traceability	full			
Cement, admixtures, additions of filling materials as per EN 447	Material	Checking [6]	[2]	100 %	continuous
	Traceability	full			

[1] Checking by means of an inspection report 3.1 according to EN 10204.
[2] Conformity with the specifications of the component
[3] Successful visual inspection does not need to be documented.
[4] Checking of relevant certificate as long as the basis of "CE"-marking is not available.
[5] Maximum between a coil and 7 tons is taken into account.
[6] Checking of relevant certificate, CE marking and declaration of performance or, if basis for CE marking is not available, certificate of supplier

Traceability full	Full traceability of each component to its raw material.
Material	Defined according to technical specification deposited by the supplier
Detailed dimension	Measuring of all the dimensions and angles according to the specification given in the test plan
Visual inspection	Main dimensions, correct marking and labelling, surface, corrosion, coating, etc.
Treatment, hardness	Surface hardness, core hardness and treatment depth

Audit testing

Subject / type of control		Test or control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
Bearing trumplate	Material	Checking and testing, hardness and chemical [2]	[3]	1	1/year
	Detailed dimensions	Testing	[3]	1	1/year
	Visual inspection	Checking	[3]	1	1/year
Anchor head, Coupler anchor head, Coupler sleeve	Material	Checking and testing, hardness and chemical [2]	[3]	1	1/year
	Detailed dimensions	Testing	[3]	1	1/year
	Visual inspection	Checking	[3]	1	1/year
Ring wedge	Material	Checking and testing, hardness and chemical [2]	[3]	2	1/year
	Treatment, hardness	Checking and testing, hardness profile	[3]	2	1/year
	Detailed dimensions	Testing	[3]	1	1/year
	Main dimensions, surface hardness	Testing	[3]	5	1/year
	Visual inspection	Checking	[3]	5	1/year
Single tensile element test		According to EAD 160004-00-0301, Annex C.7		1 series	1/year

[1] If the kits comprise different kinds of anchor heads e.g. with different materials, different shape, different wedges, etc., then the number of samples are understood as per kind.

[2] Testing of hardness and checking of chemical composition by means of an inspection report 3.1 according to EN 10204.

[3] Conformity with the specifications of the components

Material	Defined according to technical specification deposited by the ETA holder at the Notified body
Detailed dimension	Measuring of all the dimensions and angles according to the specification given in the test plan
Visual inspection	Main dimensions, correct marking and labelling, surface, corrosion, coating, etc.
Treatment, hardness	Surface hardness, core hardness and treatment depth

Reference documents

European Assessment Document

EAD 160004-00-0301	European Assessment Document for Post-Tensioning Kits for Prestressing of Structures

Eurocodes

Eurocode 2	Eurocode 2 – Design of concrete structures
Eurocode 3	Eurocode 3 – Design of steel structures
Eurocode 6	Eurocode 6 – Design of masonry structures

Standards

EN 206+A1, 11.2016	Concrete – Specification, performance, production and conformity
EN 445, 10.2007	Grout for prestressing tendons – Test methods
EN 446, 10.2007	Grout for prestressing tendons – Grouting procedures
EN 447, 10.2007	Grout for prestressing tendons – Basic requirements
EN 523, 08.2003	Steel strip sheaths for prestressing tendons – Terminology, requirements, quality control
EN 1561, 10.2011	Founding – Grey cast irons
EN 1563, 08.2018	Founding – Spheroidal graphite cast irons
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 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+A1, 05.2017	Steel wire for mechanical springs – Part 1: Patented cold drawn unalloyed spring steel wire
EN 10277, 06.2018	Bright steel products – Technical delivery conditions
EN 10305-5, 03.2016	Steel tubes for precision applications – Technical delivery conditions – Part 5: Welded cold sized square and rectangular tubes
EN 12201, 09.2011	Plastics piping systems for water supply, and for drainage and sewerage under pressure – Polyethylene (PE)
EN 13670, 12.2009 EN 13670, Correction Notice, 02.2010	Execution of concrete structures

EN ISO 683-1, 06.2018	Heat-treatable steels, alloy steels and free-cutting steels – Part 1: Non-alloy steels for quenching and tempering
EN ISO 683-3, 02.2019	Heat-treatable steels, alloy steels and free-cutting steels – Part 3: Case-hardening steels
EN ISO 17855-1, 11.2014	Plastics – Polyethylene (PE) moulding and extrusion materials – Part 1: Designation system and basis for specifications
prEN 10138-3, 08.2009	Prestressing steels – Part 3: Strand
prEN 10138-3, 09.2000	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 post-tensioning 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, Commission Delegated Regulation (EU) № 574/2014 of 21 February 2014, OJ L 159 of 28.05.2014, p. 41, and Regulation (EU) 2019/1020 of the European Parliament and of the Council of 20 June 2019, OJ L 169 of 15.06.2019, p. 1
568/2014	Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014 amending Annex V to Regulation (EU) № 305/2011 of the European Parliament and of the Council as regards the assessment and verification of constancy of performance of construction products, OJ L 157 of 27.05.2014, p. 76

MPA NRW.

Materialprüfungsamt Nordrhein-Westfalen

Prüfen · Überwachen · Zertifizieren

Certificate of constancy of performance
0432-CPR-00299-1.7 (EN)

Version 03

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 CMF BT - Internal Posttensioning System with Flat Anchorages and 02 to 06 Strands

Post-tensioning kit for prestressing of structures with internal bonded of unbonded strands

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-12/0076, issued on 23.09.2019

and

EAD 160004-00-0301

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 17.09.2012 and will remain valid until 14.10.2024 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, 15.10.2019

by order

Dipl.-Ing. Becker
deputy 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-00299-1.7 dated 25.04.2018, Version 02.

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-11142-01-01

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