BBR PTE

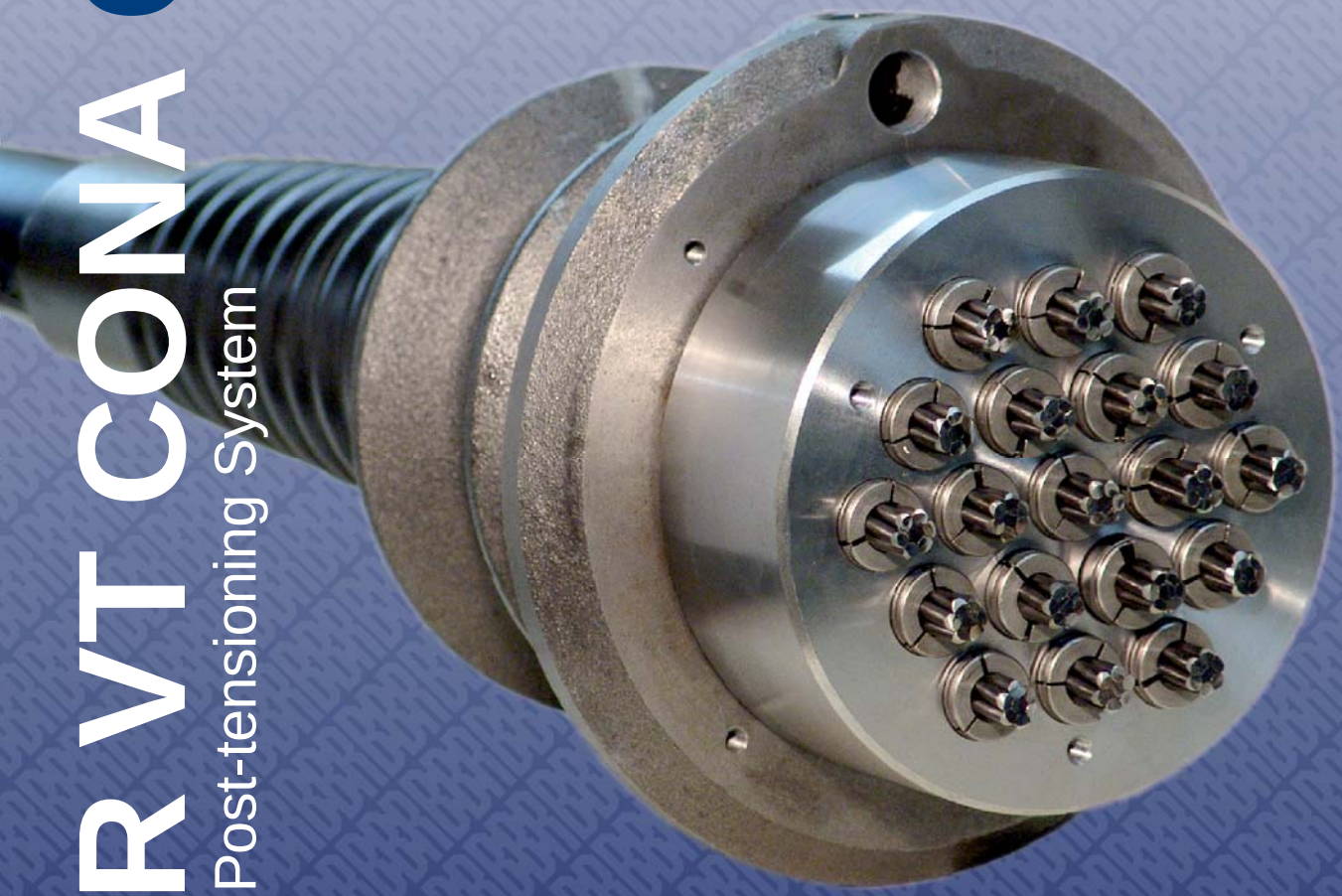
BBR Pretensados y Técnicas Especiales, S.L.

BBR VT CONA CMI

Bonded Post-tensioning System

European Technical Approval
ETA – 06/0147

CE



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EN

prEN 13391 Mechanical Tests for Post-tensioning Systems

ETAG 013 Guideline for European Technical Approval of Post-tensioning Kits for Prestressing of Structures

European Organisation for Technical Approvals
Europäische Organisation für Technische Zulassungen
Organisation Européenne pour l'Agrément Technique

With the European Technical Approval and an associated Certificate of Conformity, the BBR VT CONA CMI Post-tensioning Kit can be placed on the market with the CE marking.

PT Specialist Company

The installation of Post-tensioning Kits with CE marking has to be performed by certified Companies. For a complete list of all countries where BBR certified PT Specialist Companies can be found, please visit the BBR Website:

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Mitglied der EOTA

European Technical Approval ETA-06/0147

English translation, the original version is in German

Handelsbezeichnung *Trade name*	**BBR VT CONA CMI – Spannverfahren im Verbund mit 04 bis 31 Litzen** *BBR VT CONA CMI – Bonded Post-tensioning System with 04 to 31 Strands*
Zulassungsinhaber *Holder of Approval*	**BBR VT International Ltd** **Bahnstrasse 23** **CH-8603 Schwerzenbach (ZH)** **Switzerland**
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*	**Litzen-Spannverfahren, intern, im Verbund, für das Vorspannen von Tragwerken** *Post-tensioning kit for prestressing of structures with internal bonded strands*
Geltungsdauer vom *Validity from* bis zum *to*	**25.08.2006** **24.08.2011**
Herstellwerk *Manufacturing plant*	**BBR VT International Ltd** **Bahnstrasse 23** **CH-8603 Schwerzenbach (ZH)** **Switzerland**
Diese Europäische Technische Zulassung umfasst *This European Technical Approval contains*	**32 Seiten, einschließlich 12 Anhängen** *32 Pages including 12 Annexes*

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I LEGAL BASES AND GENERAL CONDITIONS

1 This European Technical Approval is issued by Österreichisches Institut für Bautechnik in accordance with:

1. Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1] – Construction Products Directive (CPD) –, amended by the Council Directive 93/68/EEC of 22 July 1993[2];

2. *dem Salzburger Bauproduktegesetz, LGBl. Nr. 11/1995, in der Fassung LGBl. Nr. 47/1995, LGBl. Nr. 63/1995, LGBl. Nr. 123/1995, LGBl. Nr. 46/2001, LGBl. Nr. 73/2001 und LGBl. Nr. 99/2001*; the Salzburg Construction Product Regulation LGBl. No. 11/1995, amended by LGBl. No. 47/1995, LGBl. No. 63/1995, LGBl. No. 123/1995, LGBl. No. 46/2001, LGBl. Nr. 73/2001 and LGBl. No. 99/2001;

3. Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex of Commission Decision 94/23/EC[3];

4. Guideline for European Technical Approval of Post-Tensioning Kits for Prestressing of Structures, ETAG 013, Edition June 2002.

2 Österreichisches Institut für Bautechnik is authorised to check whether the provisions of this European Technical Approval are met. Checking may take place at the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.

3 This European Technical Approval shall not be transferred to manufacturers or agents of manufacturers other than those indicated on Page 1, or manufacturing plants other than those indicated on Page 1 of this European Technical Approval.

4 This European Technical Approval may be withdrawn by Österreichisches Institut für Bautechnik, in particular after information by the Commission on the basis of Article 5 (1) of the Council Directive 89/106/EEC.

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6 The European Technical Approval is issued by the Approval Body in its official language. This version corresponds to the version circulated within EOTA. Translations into other languages have to be designated as such.

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[1] Official Journal of the European Communities N° L 40, 11.02.1989, page 12

[2] Official Journal of the European Communities N° L 220, 30.08.1993, page 1

[3] Official Journal of the European Communities N° L 17, 20.01.1994, page 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of product

This European Technical Approval (ETA) applies to a kit, the PT system

BBR VT CONA CMI –
Bonded Post-tensioning System with 04 to 31 Strands,

comprising the following components:

– Tendon

Bonded tendons with 04 to 31 tensile elements.

– Tensile element

7-wire prestressing steel strand with a nominal diameter and nominal tensile strength as given in Table 1.

Table 1: Tensile elements

Nominal diameter mm	Nominal cross section mm^2	Maximum characteristic tensile strength MPa
15.2	140	1,860
15.7	150	

Note 1 MPa = 1 N/mm^2

– Anchorage and coupler

Anchorage of the strands with ring wedges;

End anchorage

Fixed (passive) anchor or stressing (active) anchor as end anchorage for 04, 07, 09, 12, 15, 19, 22, 24, 27 and 31 strands;

Fixed coupler

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

Sleeve coupler (FH) for 04, 07, 09, 12, 15, 19, 22, 24, 27 and 31 strands;

Movable coupler

Single plane coupler (BK) for 04, 07, 09, 12, 15, 19, 22, 24, 27 and 31 strands

Sleeve coupler (BH) for 04, 07, 09, 12, 15, 19, 22, 24, 27 and 31 strands;

– Bearing trumplate for 04, 07, 09, 12, 15, 19, 22, 24, 27 and 31 strands;

– Helix and additional reinforcement in the region of the anchorage;

– Corrosion protection for tensile elements, couplers and anchorages.

1.2 Intended use

The PT system is intended to be used for the prestressing of structures.

Use categories according to type of tendon and material of structure:

– Internal bonded tendon for normal weight concrete in concrete and composite structures;

– For special structures according to Eurocode 2, Eurocode 4 and Eurocode 6.

The provisions made in this European Technical Approval are based on an assumed intended working life of the PT system of 100 years. The indications given on the working life of the PT system cannot be interpreted as a guarantee given by the manufacturer or the Approval Body, but are to be regarded only as a means for selecting the appropriate product in relation to the expected, economically reasonable working life of the construction works.

2 Characteristics of the product and methods of verification

PT system

2.1 Designation and range of the anchorages and couplers

End anchorages can be used as fixed and stressing anchors, while couplers may be fixed or movable couplers. The principal dimensions of anchorages and couplers are given in the Annexes 2 to 4 and 6 to 8.

2.1.1 Designation

End anchorage e.g. S A CONA CMI 1906-150 1860

Stressing (S) or fixed (F)

Anchor head

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

Coupler, e.g. F K CONA CMI 1906-150 1860

Fixed (F) or movable (B)

Coupler anchor head (K or H)

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

2.1.2 Anchorage

The anchor heads of the stressing and fixed anchorages are identical. A differentiation is needed for the construction works.

The wedges of inaccessible fixed anchors shall be secured with springs and/or a wedge retaining plate.

2.1.3 Fixed coupler

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.

2.1.3.1 Single plane coupler (FK)

The coupling is achieved by means of a coupler anchor head K. The strands of the first construction stage are anchored by means of wedges in machined cones, drilled in parallel. The arrangement of the cones of the first construction stage is identical to that of the anchor heads of the stressing and fixed anchorages. In a circle around the cones of the first construction stage, the strands of the second construction stage are anchored by means of wedges in machined cones, drilled at an inclination of 7 °.The wedges for the second construction stage are secured by holding springs and a cover plate.

2.1.3.2 Sleeve coupler (FH)

The coupler anchor heads H are of the same basic geometry as the anchor heads of the fixed and stressing anchors. Compared to the anchor heads of the fixed and stressing anchors, the coupler anchor heads H are higher and provide an external thread for the coupler sleeve.

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

2.1.4 Movable coupler (BK, BH)

The movable coupler is either a single plane coupler or a sleeve coupler in a coupler sheathing made of steel. Length and position of the coupler sheathing shall be for the expected strain displacement, see clause 4.3.

The coupler anchor heads and the coupler sleeves of the movable couplers are identical to the coupler anchor heads and the coupler sleeves of the fixed couplers.

A 100 mm long and at least 3,5 mm thick PE-HD insert should be installed at the deviating point at the end of the trumpet if the coupler may be subjected to significant fatigue actions. The insert is not required for plastic trumpets where the ducts are slipped over the plastic trumpets.

2.1.5 Layout of the anchorage recesses

All anchor heads have to be placed perpendicular to the axis of the tendon, see Annex 5.

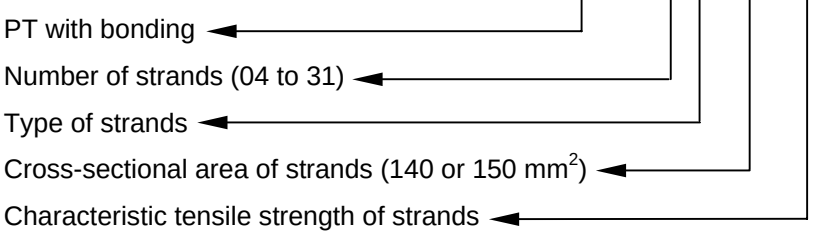
The dimensions of the anchorage recesses are to be adapted to the prestressing jacks used. The ETA holder shall keep available information on the minimum dimensions of the anchorage recesses.

The formwork for the anchorage recesses should be slightly conical for ease of removal. The anchorage recesses shall be designed so as to permit a reinforced concrete cover with the required dimensions, in any case with a thickness of at least 20 mm.

2.2 Designation and range of the tendons

2.2.1 Designation

Tendon, e.g. CONA CMI 1906-150 1860



The tendons comprise 04 to 31 tensile elements, seven wire prestressing steel strands according to Annex 11.

2.2.2 Range

Prestressing and overtensioning forces are given in the corresponding standards and regulations in force at the place of use. The maximum prestressing and overstressing forces are listed in Table 13.

The tendons consist of 04, 07, 09, 12, 15, 19, 22, 24, 27 and 31 strands. By omitting strands in the anchorages and couplers in the best possible radially symmetrically way, also tendons with numbers of strands lying between the numbers given above can be installed. Any omitted hole shall be sealed with a short piece of strand and wedges shall be pressed in.

2.2.2.1 CONA CMI n06-140

7-wire prestressing steel strand

Nominal diameter .....15.3 mm

Nominal cross-sectional area.....140 mm^2

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

Table 2: CONA CMI n06-140

Number of strands	n	---	04	07	09	12	15	19	22	24	27	31
Nominal cross-sectional area of prestressing steel	A_p	mm^2	560	980	1,260	1,680	2,100	2,660	3,080	3,360	3,780	4,340
Nominal mass of prestressing steel	m	kg/m	4.37	7.65	9.84	13.12	16.40	20.77	24.05	26.23	29.51	33.88
Characteristic tensile strength f_{pk} = 1,770 MPa												
Characteristic ultimate resistance of tendon	F_{pk}	kN	992	1,736	2,232	2,976	3,720	4,712	5,456	5,952	6,696	7,688
Characteristic tensile strength f_{pk} = 1,860 MPa												
Characteristic ultimate resistance of tendon	F_{pk}	kN	1,040	1,820	2,340	3,120	3,900	4,940	5,720	6,240	7,020	8,060

2.2.2.2 CONA CMI n06-150

7-wire prestressing steel strand

Nominal diameter .....15.7 mm

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

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

Table 3: CONA CMI n06-150

Number of strands	n	---	04	07	09	12	15	19	22	24	27	31
Nominal cross-sectional area of prestressing steel	A_p	mm^2	600	1,050	1,350	1,800	2,250	2,850	3,300	3,600	4,050	4,650
Nominal mass of prestressing steel	m	kg/m	4.69	8.20	10.55	14.06	17.58	22.27	25.78	28.13	31.64	36.33
Characteristic tensile strength f_{pk} = 1,770 MPa												
Characteristic ultimate resistance of tendon	F_{pk}	kN	1,064	1,862	2,394	3,192	3,990	5,054	5,852	6,384	7,182	8,246
Characteristic tensile strength f_{pk} = 1,860 MPa												
Characteristic ultimate resistance of tendon	F_{pk}	kN	1,116	1,953	2,511	3,348	4,185	5,301	6,138	6,696	7,533	8,649

2.3 Sheaths

2.3.1 Metal sheaths

Sheaths complying with EN 523[4] shall be used. The degree of filling, f, should not exceed 0.5 and should not be less than 0.35.

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

with

f ..... degree of filling

Table 4: Inner diameter of sheath, d_i, and minimum radii of curvature, R_{min}

Number of strands	d_i for f ≈ 0.5	R_{min} for f ≈ 0.5	d_i for f ≈ 0.35	R_{min} for f ≈ 0.35
---	mm	m	mm	m
04	40	3.00	45	2.90
07	55	4.00	60	3.80
09	60	4.50	70	4.20
12	70	5.20	80	4.90
15	80	5.80	90	5.50
19	90	6.50	100	6.20
22	95	7.00	105	6.70
24	100	7.30	110	7.00
27	105	7.70	120	7.30
31	110	8.40	130	7.80

The larger inner diameter of sheaths should be selected in the case of long tendons (> 80 m) or if the tensile elements are installed after concreting.

2.3.2 Plastic sheaths

Sheaths complying with ETAG 013, Annex C.3 shall be used. Alternatively also other corrugated plastic ducts may be used if permitted at the place of use.

2.4 Friction losses

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

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

with

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 5

k ..... rad/m ..... wobble coefficient, see Table 5

[4] The reference documents are listed in Annex 12.

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

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

Note 1 rad = 1 m/m = 1

Table 5: Friction losses

Tendon ---	μ rad^{-1}	k rad/m	ΔF_s %
CONA CMI 0406	0.22	0.006	1.2
CONA CMI 0706	0.21	0.006	1.1
CONA CMI 0906	0.21	0.006	1.0
CONA CMI 1206 to 3106	0.20	0.006	0.9

With

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

The friction coefficient μ given in Table 5 applies to steel strip sheaths according to EN 523.

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 this value can be reduced by 10 to 20 %. Compared to e.g. the use of prestressing steel or sheaths with a film of rust this value increases by more than 100 %.

2.5 Support of tendons

Spacing of supports is between 1.0 m and 1.8 m. In the region of tendon curvatures a spacing of 0.8 m shall be applied.

The tendons shall be systematically fixed in their position so that they are not displaced by placing and compacting the concrete.

2.6 Slip at anchorages and couplers

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

2.7 Centre spacing and edge distance for anchorages in mm

In general, spacing and distances shall not be less than the values given in Tables 6 and 7 and Annexes 6 to 8. However, a reduction of up to 15 % of the centre spacing of tendon anchorages in one direction is permitted, but should not be less than the outside diameter of the helix and the placing of additional reinforcement shall still be possible. In this case the spacing in the perpendicular direction shall be increased by the same percentage.

Table 6: Minimum centre spacing of tendon anchorages

Tendon		Minimum centre spacing $a_c = b_c$				
$f_{cm,\ 0,\ cube,\ 150}$	MPa	23	28	34	38	43
$f_{cm,\ 0,\ cylinder,\ \varnothing\ 150}$	MPa	19	23	28	31	35
CONA CMI 0406	mm	235	215	195	190	
CONA CMI 0706	mm	310	285	260	250	240
CONA CMI 0906	mm	350	320	295	280	
CONA CMI 1206	mm	405	370	340	325	310
CONA CMI 1506	mm	455	415	380	365	345
CONA CMI 1906	mm	510	465	425	410	390
CONA CMI 2206	mm	550	500	460	440	420
CONA CMI 2406	mm	575	525	480	460	435
CONA CMI 2706	mm	610	555	505	485	460
CONA CMI 3106	mm	650	595	545	520	495

Table 7: Minimum edge distance of tendon anchorages

Tendon		Minimum edge distance $a_e = b_e$				
$f_{cm,\ 0,\ cube,\ 150}$	MPa	23	28	34	38	43
$f_{cm,\ 0,\ cylinder,\ \varnothing\ 150}$	MPa	19	23	28	31	35
CONA CMI 0406	mm	110 + c	100 + c	90 + c	85 + c	
CONA CMI 0706	mm	145 + c	135 + c	120 + c	115 + c	110 + c
CONA CMI 0906	mm	165 + c	150 + c	140 + c	130 + c	
CONA CMI 1206	mm	195 + c	175 + c	160 + c	155 + c	145 + c
CONA CMI 1506	mm	220 + c	200 + c	180 + c	175 + c	165 + c
CONA CMI 1906	mm	245 + c	225 + c	205 + c	195 + c	185 + c
CONA CMI 2206	mm	265 + c	240 + c	220 + c	210 + c	200 + c
CONA CMI 2406	mm	280 + c	255 + c	230 + c	220 + c	210 + c
CONA CMI 2706	mm	295 + c	270 + c	245 + c	235 + c	220 + c
CONA CMI 3106	mm	315 + c	290 + c	265 + c	250 + c	240 + c

With

c ..... concrete cover in mm

Standards and regulations on concrete cover in force at the place of use shall be complied with.

2.8 Minimum radii of curvature

In Table 4 the minimum radii of curvature of the tendon, R_{min}, are given against the number of strands in the tendon and the diameter of the sheath. The given radii correspond to a concrete compressive strength of $f_{cm,\,0,\,cube}$ = 23 MPa.

2.9 Concrete strength at time of stressing

Concrete complying with EN 206-1 shall be used. At the time of stressing the mean concrete compressive strength, $f_{cm,\,0}$, shall be at least according to Table 8. The concrete test specimen shall be subjected to the same hardening conditions as the structure.

For partial prestressing with 30 % of the full prestressing force the actual mean value of the concrete compressive strength shall be 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 EN 1992-1-1.

Table 8: Compressive strength of concrete

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

The helixes, additional reinforcement, centre spacing and edge distance corresponding to the concrete compressive strengths shall be taken from Annexes 6 to 8, see also clauses 2.11.6 and 4.2.3.

Components

2.10 Strands

Only 7-wire prestressing steel strands with characteristics according to Table 9 shall be used, see also Annex 11.

Table 9: Prestressing steel strands

Max. characteristic tensile strength	f_{pk}	MPa	1,860	
Nominal diameter	d	mm	15.3	15.7
Nominal cross-sectional area	A_p	mm^2	140	150
Mass of prestressing steel	m	kg/m	1.093	1.172

In a single tendon only strands spun in the same direction shall be used. To avoid confusion at a given construction site, only strands of the same nominal diameter and the same characteristic tensile strength shall be used.

2.11 Anchorages and couplers

The components of anchorages and couplers shall be in compliance with the specifications given in Annexes 2 to 4 and the technical documentation[5]. Therein the component dimensions, materials and material identification data with tolerances are given.

2.11.1 Anchor heads

The anchor heads are made of steel and provide regularly arranged conical holes drilled in parallel to accommodate prestressing steel strands and wedges. In addition, threaded bores may be provided to fix protective caps and wedge retaining plates. At the back of the anchor head there may be a step, for ease of centring the anchor head on the bearing trumplate.

2.11.2 Bearing trumplates

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

2.11.3 Trumpets

The conical trumpets made of PE have a corrugated or a plain surface. At the sheath sided end there is a radius for the deviation of the tendons and a smooth surface, to ensure a good transition to the sheath. The opposite end is connected to the bearing trumplate by an external thread.

2.11.4 Coupler anchor heads K, H

The coupler anchor heads K for the single plane couplers are made of steel and provide in the inner part for anchorage the strands of the first construction stage the same arrangement of holes as the anchor head for the stressing or fixed anchorages. In the outer pitch circle there is an arrangement of holes with an inclination of 7 ° to accommodate the strands of the second construction stage. With additional threaded bores wedge retaining plates and cover plates are fixed.

The coupler anchor heads H for the sleeve coupler are made of steel and have the same basic geometry as the anchor heads of the stressing or fixed anchorages. Compared to the anchor heads of the fixed and stressing anchors, the coupler anchor heads H are higher and provide an external thread for the coupler sleeve.

At the back of the coupler anchor heads K and H there is a step for ease of centring the coupler anchor head on the bearing trumplate.

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

2.11.5 Ring wedges

The ring wedges are in three pieces, which are held together with spring rings. Two types of ring wedge are used. Within one anchorage or coupler only one type of ring wedge shall be used.

In the case of fixed anchors and couplers the wedges are held in place by springs and/or by a wedge retaining plate.

2.11.6 Helix and additional reinforcement

The helix and the additional reinforcement are made of ribbed reinforcing steel. The end of the helix on the anchorage side is welded to the next ring. The helix shall be placed exactly in the tendon axis. The helix dimensions shall comply with the values specified in Annexes 6 to 8.

If required for a specific project design, the reinforcement given in the Annexes 6 to 8 may be modified in accordance with the respective regulations in force at the place of use as well as with the relevant approval of the local authority and of the ETA holder to provide equivalent performance.

2.11.7 Protective caps

The protective caps are made of steel or plastic. They are provided with air-vents and fixed with screws or threaded rods.

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[5] The technical documentation of this European Technical Approval is deposited at the Österreichisches Institut für Bautechnik and, as far as relevant of the tasks for the approved body involved in the attestation of conformity procedure, is handed over to the approved body.

2.11.8 Material properties

Table 10: Material properties

Component	Standard / Specification
Anchor head A CONA CMI 0406 to 3106	EN 10083-1 EN 10083-2
Coupler anchor head K CONA CMI 0406 to 3106	EN 10083-1 EN 10083-2
Coupler anchor head H CONA CMI 0406 to 3106	EN 10083-1 EN 10083-2
Bearing trumplate CONA CMI 0406 to 3106	EN 1561 EN 1563
Coupler sleeve H CONA CMI 0406 to 3106	EN 10210-1
Wedge retaining plate, cover plate KS CONA CMI 0406 to 3106	EN 10025-2
Trumpet Type A, Type K	EN ISO 1872-1
Tension ring B	EN 10210-1
Ring wedge Type H Ring wedge Type F	EN 10277-2 EN 10084
Spring A, K	EN 10270-1
Helix	Ribbed reinforcing steel $R_e \geq 500$ MPa
Additional reinforcement (stirrups)	Ribbed reinforcing steel $R_e \geq 500$ MPa
Sheaths	EN 523 ETAG 013, Annex C.3

2.12 Permanent corrosion protection

The sheaths and the anchorage zone have to be completely filled with grout according to EN 447 to protect the tendons from corrosion and to provide bond between the tendons and the structure.

2.13 Dangerous substances

The release of dangerous substances is determined according to ETAG 013, clause 5.3.1. The PT system complies with the provisions of Guidance Paper H[6] relating to dangerous substances.

A declaration in this respect was made by the manufacturer.

In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the product falling within their scope (e.g. transposed European legislation and national laws, regulations and administrative

[6] Guidance Paper H: A harmonised approach relating to dangerous substances under the Construction Products Directive, Rev. September 2002.

provisions). In order to meet the provisions of the Construction Products Directive, these requirements also need to be complied with, when and where they apply.

2.14 Methods of verification

The assessment of the fitness of the "BBR VT CONA CMI Bonded Post-tensioning System with 04 to 31 Strands" for the intended use in relation to the requirements for mechanical resistance and stability in the sense of Essential Requirement 1 of the Council Directive 89/106/EEC has been made in compliance with the Guideline for European Technical Approvals of "Post-Tensioning Kits for Prestressing of Structures", ETAG 013, Edition June 2002, based on the provisions for bonded systems.

2.15 Identification

This European Technical Approval for the "BBR VT CONA CMI – Bonded Post-tensioning System with 04 to 31 Strands" is issued on the basis of agreed data, deposited with Österreichisches Institut für Bautechnik, which identifies the "BBR VT CONA CMI – Bonded Post-tensioning System with 04 to 31 Strands" that has been assessed and judged. Changes to the production process of the "BBR VT CONA CMI – Bonded Post-tensioning System with 04 to 31 Strands", which could result in this deposited data being incorrect, should be notified to Österreichisches Institut für Bautechnik before the changes are introduced. Österreichisches Institut für Bautechnik will decide whether or not such changes affect this European Technical Approval and consequently the validity of the CE marking on the basis of this European Technical Approval and, if so, whether further assessment or alterations to this European Technical Approval is considered necessary.

3 Evaluation of conformity and CE marking

3.1 Attestation of conformity system

The system of attestation of conformity assigned by the European Commission to this product in accordance with the Council Directive 89/106/EWG of 21 December 1988, Annex III, Section 2, Clause i), referred to as System 1+, provides for:

Certification of the conformity of the product by an approved certification body on the basis of

(a) Tasks for the manufacturer

(1) Factory production control;

(2) Further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan[7];

(b) Tasks for the approved body

(3) Initial type testing of the product;

(4) Initial inspection of factory and of factory production control;

(5) Continuous surveillance, assessment and approval of the factory production control;

(6) Audit testing of samples taken at the factory.

3.2 Responsibilities

3.2.1 Tasks for the manufacturer – factory production control

At the manufacturing plant, the manufacturer shall implement and continuously maintain a factory production control system. All the elements, requirements and provisions adopted by the manufacturer shall be documented systematically in the form of written operating and processing instructions. The factory production control system shall ensure that the product is in conformity with this European Technical Approval.

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[7] The prescribed test plan has to be deposited at the Österreichisches Institut für Bautechnik and handed over only to the approved body involved in the conformity attestation procedure.

Within the framework of factory production control, the manufacturer shall carry out tests and controls in accordance with the prescribed test plan[7], which is fixed with this European Technical Approval. Details of the extent, nature and frequency of testing and controls to be performed within the framework of the factory production control shall correspond to this prescribed test plan[7], which forms part of the technical documentation[5] of this European Technical Approval.

The results of factory production control shall be recorded and evaluated. The records shall include at a minimum the following information:

- Designation of the products and the basic materials;
- Type of check or testing;
- Date of manufacture of the products and date of testing of the products or basic materials or components;
- Results of check and testing and, if appropriate, comparison with requirements;
- Name and signature of the person responsible for the factory production control.

On request, the records shall be presented to Österreichisches Institut für Bautechnik.

If the test results are unsatisfactory, the manufacturer shall immediately implement measures to eliminate the defects. Construction products or components which are not in compliance with the requirements shall be removed. After elimination of the defects the respective test – if a verification is required for technical reasons – shall be repeated immediately.

The basic elements of the prescribed test plan[7] comply with ETAG 013, Annex E.1 and are specified in the quality management plan of the “BBR VT CONA CMI – Bonded Post-tensioning System with 04 to 31 Strands”.

Table 11: Contents of the prescribed test plan

Component	Item	Test / Check	Traceability	Minimum frequency	Documentation
Bearing trumplate	Material	Check	full	100 %	”3.1” [1)]
	Detailed dimensions	Test		3 % ≥ 2 specimen	yes
	Visual inspection [3)]	Check		100 %	no
Anchor head and coupler anchor head	Material	Check	full	100 %	“3.1” [1)]
	Detailed dimensions [2)]	Test		5 % ≥ 2 specimens	yes
	Visual inspection [3), 4)]	Check		100 %	no
Ring wedge	Material	Check	full	100 %	“3.1” [1)]
	Treatment, Hardness [5), 6)]	Test		0.5 % ≥ 2 specimens	yes
	Detailed dimensions [2)]	Test		5 % ≥ 2 specimens	yes
	Visual inspection [3), 7)]	Check		100 %	no

Component	Item	Test / Check	Traceability	Minimum frequency	Documentation
Coupler sleeve	Material	Check	full	100 %	"3.1" [1)]
	Detailed dimensions	Test		5 % ≥ 2 specimens	yes
	Visual inspection [3)]	Check		100 %	no
Steel strip duct	Material	Check	"CE"	100 %	"CE"
	Visual inspection [3)]	Check		100 %	no
Strand [8)]	Material	Check	full	100 %	"CE" [8)]
	Diameter	Test		each coil	no
	Visual inspection [3)]	Check		each coil	no
Constituents of filling material as per EN 447	cement	Check	full	100 %	"CE"
	admixtures, additions	Check	bulk	100 %	"CE"
Plastic duct, ETAG 013, Annex C.3	Material	Check	full	100 %	yes

1) "3.1": Inspection certificate type "3.1" according to EN 10204

2) Other dimensions than [4)]

3) Visual inspections includes e.g.: Main dimensions, gauge testing, correct marking or labelling, appropriate performance, surface, fins, kinks, smoothness, corrosion, coating etc., as detailed in the prescribed test plan[7]

4) Dimensions: All conical bores of the anchor heads and coupler anchor heads regarding angle, diameter and surface condition, thread dimensions of all anchor heads and coupler anchor heads.

5) Geometrical properties

6) Surface hardness

7) Teeth, cone surface

8) As long as the basis for CE marking for prestressing steel is not available, an approval or certificate according to the respective rules in force at the place of use shall accompany each delivery.

full: Full traceability of each component to its raw materials.

bulk: Traceability of each delivery of components to a defined point.

3.2.2 Tasks of the approved body

3.2.2.1 Initial type testing of the products

For initial type-testing the results of the tests performed as part of the assessment for the European Technical Approval may be used unless there are changes in the production procedure or factory plant. In such cases, the necessary initial type testing shall be agreed between Österreichisches Institut für Bautechnik and the approved body involved.

3.2.2.2 Initial inspection of factory and of factory production control

The approved body shall ascertain that, in accordance with the prescribed test plan[7], the manufacturing plant, in particular personnel and equipment, and the factory production control are suitable to ensure a continuous orderly manufacturing of the PT system according to the specifications given in Section II as well as in the Annexes of this European Technical Approval.

3.2.2.3 Continuous surveillance

The kit manufacturer shall be inspected at least once a year. Each component manufacturer of the components listed in Table 12 shall be inspected at least once in five years. It shall be verified that the system of factory production control and the specified manufacturing process are maintained taking account of the prescribed test plan[7].

The results of product certification and continuous surveillance shall be made available on demand by the approved body to Österreichisches Institut für Bautechnik. If the provisions of this European Technical Approval and the prescribed test plan[7] are no longer fulfilled, the certificate of conformity shall be withdrawn and Österreichisches Institut für Bautechnik informed immediately.

3.2.2.4 Audit testing of samples taken at the factory

During surveillance inspection, the approved body shall take samples at the factory of components of the PT system or of individual components, for which this European Technical Approval has been granted, for independent testing. For the most important components Table 12 given below summarises the minimum procedures, which shall be implemented by the approved body.

Table 12: Audit testing

Component	Item	Test / Check	Sampling[2)] – Number of components per visit
Anchor head, Coupler anchor head, Bearing trumplate	Material according to specification	Test / Check	1
	Detailed dimensions	Test	
	Visual inspection[1)]	Check	
Ring wedge	Material according to specification	Test / Check	2
	Treatment	Test	2
	Detailed dimensions	Test	1
	Main dimensions, surface hardness and surface finish	Test	5
	Visual inspection[1)]	Check	5

Component	Item	Test / Check	Sampling[2)] – Number of components per visit
Coupler sleeve	Material according to specification	Test / Check	1
	Detailed dimensions	Test	
	Visual inspection[1)]	Check	
Single tensile element test	Single tensile element test according to ETAG 013, Annex E.3	Test	1 Series

[1)] Visual inspections means e.g.: main dimensions, gauge testing, correct marking or labelling, appropriate performance, surface, fins, kinks, smoothness, corrosion protection, corrosion, coating etc., as given in the prescribed test plan[7].

[2)] All samples shall be randomly selected and clearly identified.

3.3 CE marking

The delivery note of the components of the PT system shall contain the CE marking. The symbol “CE” shall be followed by the identification number of the certification body and shall be accompanied by the following information:

- Name or identification mark and address of the manufacturer;
- The last two digits of the year in which the CE marking was affixed;
- Number of the European Technical Approval;
- Number of the certificate of conformity;
- Product identification (trade name).

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

“BBR VT CONA CMI – Bonded Post-tensioning System with 04 to 31 Strands” is manufactured in accordance with the provisions of this European Technical Approval. Composition and manufacturing process are deposited at Österreichisches Institut für Bautechnik.

4.2 Design

4.2.1 Anchorage Recess

The anchorage recess shall be designed so as to ensure a concrete cover of at least 20 mm at the protection caps in the final state. Clearance is required for the handling of prestressing jacks. The ETA holder shall keep available information on prestressing jacks and appropriate clearance behind the anchorage.

4.2.2 Maximum prestressing force

The prestressing and overstressing forces are specified in the respective standards and regulations in force at the place of use. Table 13 lists the maximum prestressing and overstressing forces.

Table 13: Maximum prestressing and overstressing forces

		Max. prestressing force[1] $0.9 \cdot F_{p0,1k}$				Max. overstressing force[1), 2)] $0.95 \cdot F_{p0,1k}$			
Designation		CONA CMI							
		n06-140		n06-150		n06-140		n06-150	
Characteristic tensile strength f_{pk}	MPa	1,770	1,860	1,770	1,860	1,770	1,860	1,770	1,860
---	---	kN	kN	kN	kN	kN	kN	kN	kN
n Number of strands	04	767	806	824	864	809	851	870	912
	07	1,342	1,411	1,443	1,512	1,416	1,490	1,523	1,596
	09	1,725	1,814	1,855	1,944	1,821	1,915	1,958	2,052
	12	2,300	2,419	2,473	2,592	2,428	2,554	2,611	2,736
	15	2,876	3,024	3,092	3,240	3,035	3,192	3,263	3,420
	19	3,642	3,830	3,916	4,104	3,845	4,043	4,133	4,332
	22	4,217	4,435	4,534	4,752	4,452	4,682	4,786	5,016
	24	4,601	4,838	4,946	5,184	4,856	5,107	5,221	5,472
	27	5,176	5,443	5,565	5,832	5,463	5,746	5,874	6,156
	31	5,943	6,250	6,389	6,696	6,273	6,597	6,744	7,068

1) The given values are maximum values according to EN 1992-1-1. The actual values are to be taken from the standards and regulations in force at the place of use. Compliance with the stabilisation and crack width criteria in the load transfer test was verified to a load level of $0.80 \cdot F_{pk}$.

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

4.2.3 Reinforcement in the anchorage zone

The helix and the additional reinforcement given in Annexes 6 to 8 shall be adopted.

Verification of the transfer of the prestressing forces to the structural concrete is not required if the centre spacing and edge distances of the tendons as well as grade and dimensions of additional reinforcement, see Annexes 6 to 8, are complied with. The forces outside the area of the additional reinforcement shall be verified and, if necessary, dealt with by appropriate reinforcement.

If required for a specific project design, the reinforcement given in the Annexes 6 to 8 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.

4.2.4 Fatigue resistance

Fatigue resistance of the tendons has been tested with a maximum force of $0.65 \cdot F_{pk}$ and a stress variation of 80 N/mm^2 up to $2 \cdot 10^6$ load cycles.

4.2.5 Tendons in masonry structures – Load transfer to the structure

Load transfer of prestressing force to masonry structures shall be via concrete or steel members designed according to this European Technical Approval, especially according to clauses 2.7, 2.9, 2.11.6 and 4.2.3 or Eurocode 3 respectively.

The concrete or steel members shall have dimensions as to permit a force of $1.1 \cdot F_{pk}$ being transferred into the masonry. The verification shall be done according to Eurocode 6 as well as to the respective standards and regulations in force at the place of use.

4.3 Installation

Assembly and installation of tendons shall only be carried out by qualified PT specialist companies with the required resources and experience in the use of multi strand bonded post-tensioning systems, see ETAG 013, Annex D.1 and CWA 14646. The respective standards and regulations in force at the place of use shall be considered. The company's PT site manager shall have a certificate, stating that he has been trained by the ETA holder and that he possesses the necessary qualifications and experience with the "BBR VT CONA CMI – Bonded Post-tensioning System with 04 to 31 Strands".

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

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

Couplers shall be situated in a straight tendon section.

At the anchorages and couplers the tendon layout shall provide a straight section over a length of at least 250 mm beyond the end of the trumpet.

Before placing the concrete a final check of the installed tendons or sheaths has to be carried out.

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

In the case of a movable coupler it shall be ensured by means of the corresponding position and length of the coupler sheath, that displacement over the length $l_{BK} + 1.15 \cdot \Delta l + 30$ mm or $l_{BH} + 1.15 \cdot \Delta l + 30$ mm is possible without any hindrance. The values of l_{BK} and l_{BH} shall be taken from Annexes 6 to 8. Δl is the expected displacement of the coupler at stressing.

4.4 Stressing operation

With a mean concrete compressive strength in the anchorage zone complying with the values laid down in the Annexes 6 to 8 full prestressing may be applied.

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

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

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

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

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

4.5 Restressing

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

4.6 Grouting

The grout shall be injected through the inlet holes until it escapes from the outlet tubes with the same consistency. Special measures shall be applied for long tendons, tendon paths with distinct high points or inclined tendons to avoid voids in the hardened grout. All vents and grouting inlets shall be sealed immediately after grouting.

The standards to be 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 shall be applied for ready mixed grout.

The results of the grouting operation shall be recorded in the grouting records.

The respective standards and regulations in force at the place of use shall be complied with.

4.7 Welding

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

After installation of the tendons further welding may not be carried out on the tendons. In case of welding operations near tendons precautionary measures are required to avoid damage.

5 Recommendations for the manufacturer

5.1 Recommendations for packing, transport and storage

During transport of prefabricated tendons a minimum radius of curvature of 1.65 m for tendons up to CONA CMI 1206 and 1.80 m for larger tendons shall be observed.

The ETA holder shall have instructions related to

- Temporary protection of prestressing steels and components in order to prevent corrosion during transportation from the production site to the job site;
- Transportation, storage and handling of the tensile elements and of other components in order to avoid any mechanical, chemical or electrochemical changes;
- Protection of tensile elements and other components from moisture;
- Keeping tensile elements separate from areas where welding operations are performed.

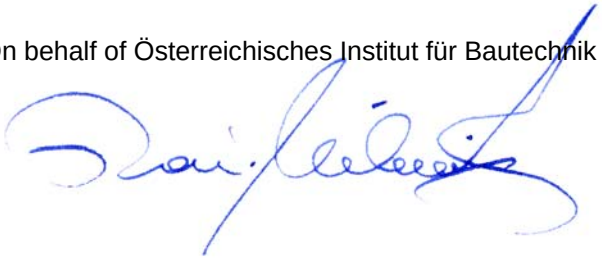
5.2 Recommendations on installation

The manufacturer's installation instructions have to be complied with, see ETAG 013, Annex D.3. The respective standards and regulations in force at the place of use should be observed. See also Annexes 9 and 10.

5.3 Accompanying information

It is the responsibility of the ETA holder to ensure that all necessary information on design and installation is submitted to those responsible for the design and execution of the structures executed with "BBR VT CONA CMI – Bonded Post-tensioning System with 04 to 31 Strands".

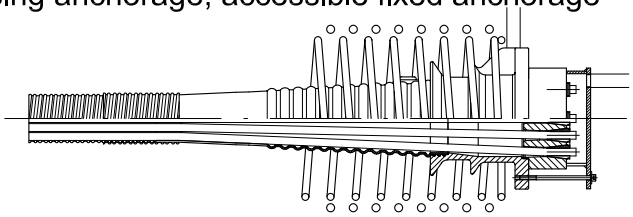
On behalf of Österreichisches Institut für Bautechnik



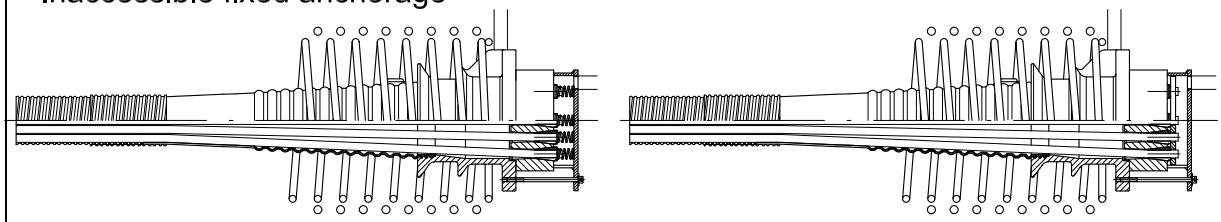
Dipl.-Ing. Dr. Rainer Mikulits

Managing Director

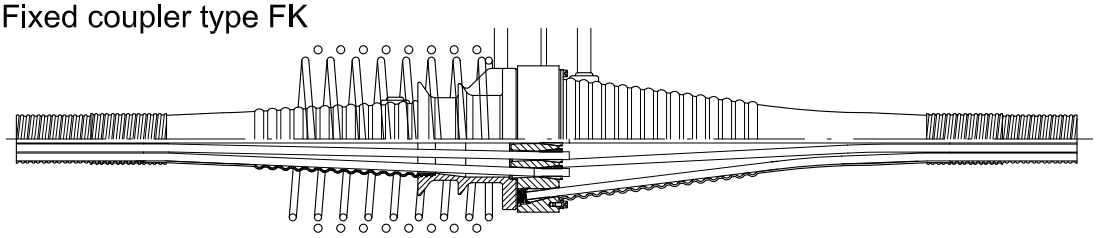
Stressing anchorage, accessible fixed anchorage



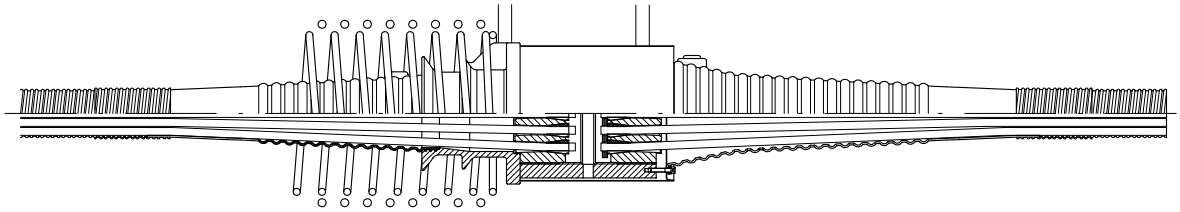
Inaccessible fixed anchorage



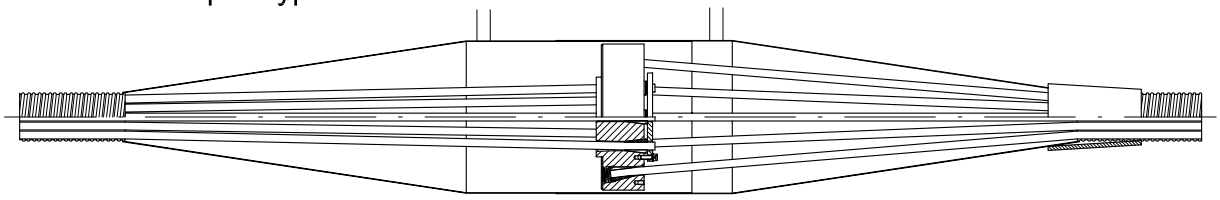
Fixed coupler type FK



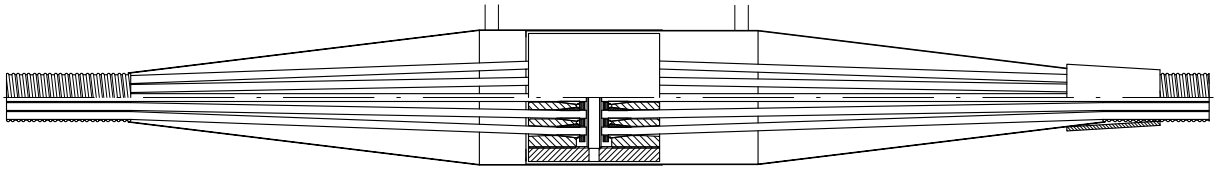
Fixed coupler type FH



Movable coupler type BK

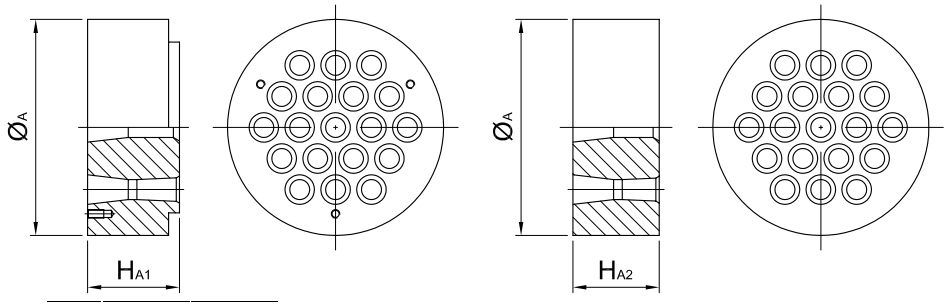


Movable coupler type BH

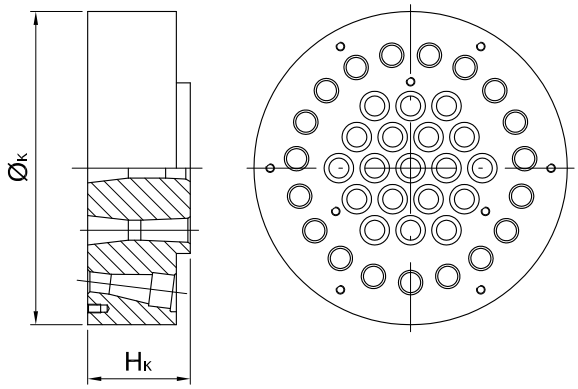


BBR CONA CMI	Bonded Post-tensioning System Overview anchorages	Annex 1 of European Technical Approval ETA-06/0147

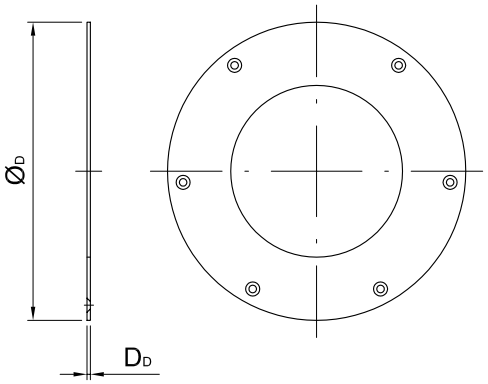
Anchor head



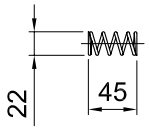
Coupler head K



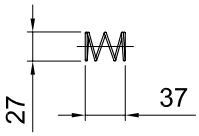
Cover plate



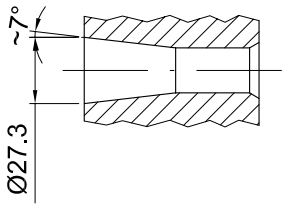
Spring A



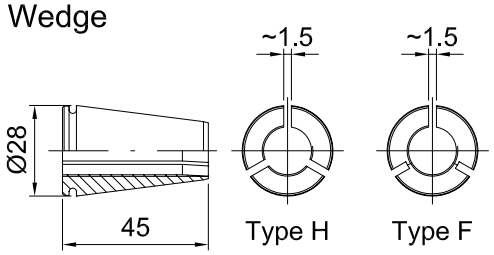
Spring K



Cone



Wedge

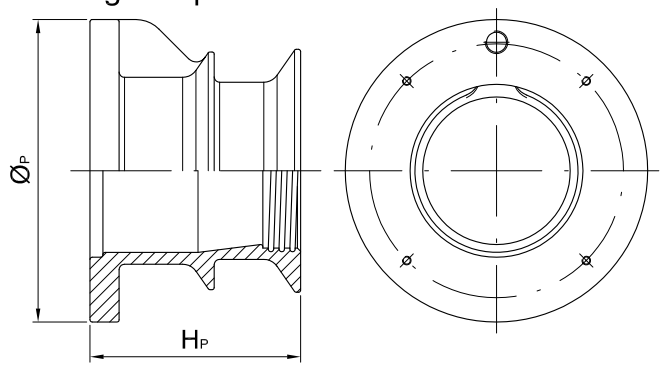


Dimensions in mm

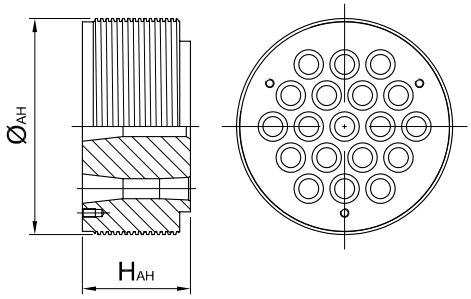
Number of strands			04	07	09	12	15	19	22	24	27	31
Anchor head												
Diameter	$Ø_A$	mm	90	115	160		200		225	240	255	
Height (with groove)	H_{A1}	mm	50	55	60	65	75	85	95	100	105	110
Height (w/o groove)	H_{A2}	mm			55	60	70	80	90	95	100	105
Coupler head K												
Diameter	$Ø_K$	mm	185	205	240		290		310	340	390	
Height	H_K	mm	85	85	90	90	90	95	105	120	125	130
Cover plate												
Diameter	$Ø_D$	mm	182	202	238		276		306	336	380	
Thickness	D_D	mm	3	3	3		3		5	5	5	

BBR CONA CMI	Bonded Post-tensioning System Anchorage parts	Annex 2 of European Technical Approval ETA-06/0147

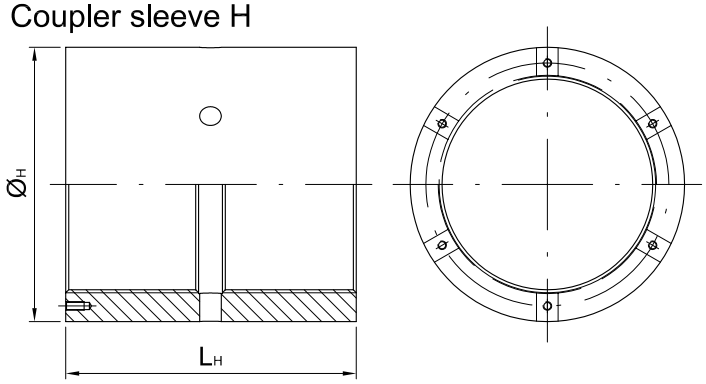
Bearing trumplate



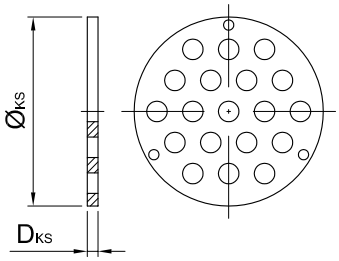
Coupler head H



Coupler sleeve H



Wedge retaining plate KS



Number of strands			04	07	09	12	15	19	22	24	27	31
Bearing trumplate												
Diameter	$Ø_P$	mm	130	170	225		280		310	325	360	
Height	H_P	mm	120	128	150		195		206	227	250	
Coupler head H												
Diameter	$Ø_{AH}$	mm	90	115	160		200		225	240	255	
Height	H_{AH}	mm	55	65	70	80	80	95	100	100	105	115
Coupler sleeve H												
Diameter	$Ø_H$	mm	121	152.4	193.7	203	244.5	254	292	298.5	318	330
Length	L_H	mm	160	180	190	210	210	240	250	250	260	280
Wedge retaining plate KS												
Diameter	$Ø_{KS}$	mm	75	120	145		175		182	210	210	
Thickness	D_{KS}	mm	5	5	10		10		10	10	10	

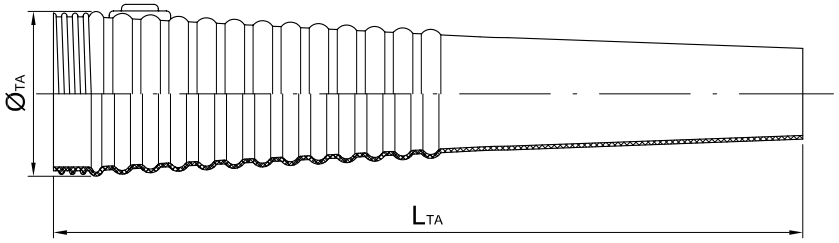
CONA CMI

Bonded Post-tensioning System
Anchorage and accessory parts

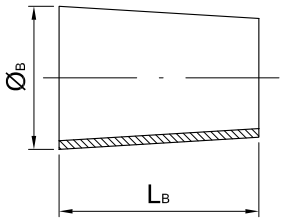
Annex 3

of European Technical Approval
ETA-06/0147

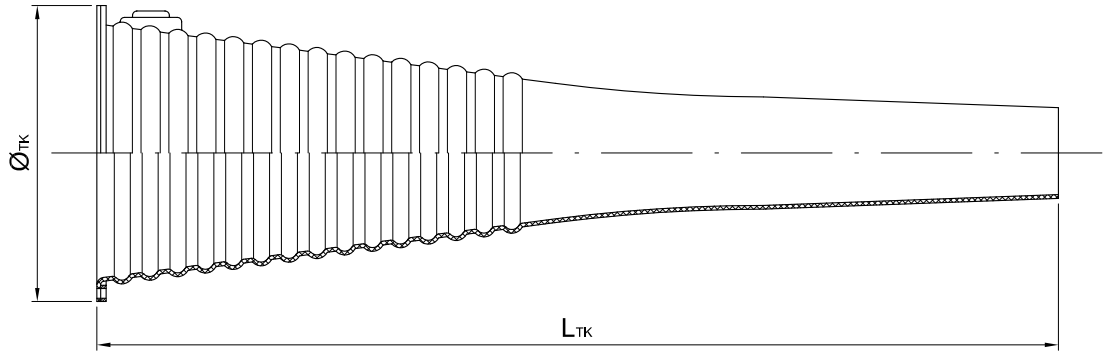
Trumpet type A



Tension ring B



Trumpet type K



Number of strands			04	07	09	12	15	19	22	24	27	31
Trumpet A												
Diameter	$Ø_{TA}$	mm	72	88	127	127	153	153	170	191	191	191
Length	L_{TA}	mm	230	328	623	509	694	580	715	871	871	757
Tension ring B												
Diameter	$Ø_B$	mm	78	93	108	108	130	130	137	144	158	158
Length	L_B	mm	185	185	185	185	185	185	185	185	185	185
Trumpet K												
Diameter	$Ø_{TK}$	mm	185	203	240	240	275	275	305	330	375	375
Length	L_{TK}	mm	539	640	845	730	890	775	840	1,090	1,265	1,150

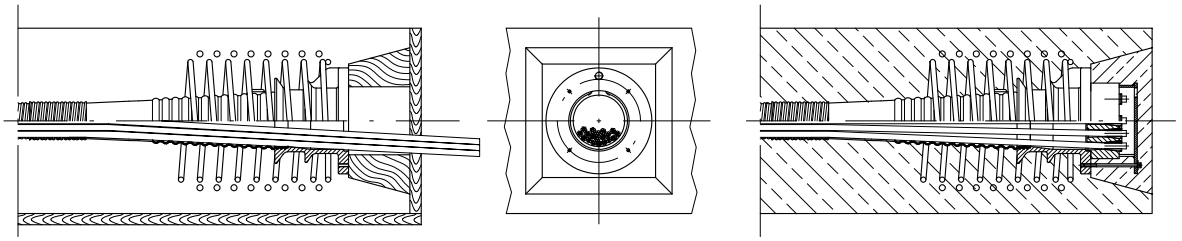
CONA CMI

Bonded Post-tensioning System
Anchorage and accessory parts

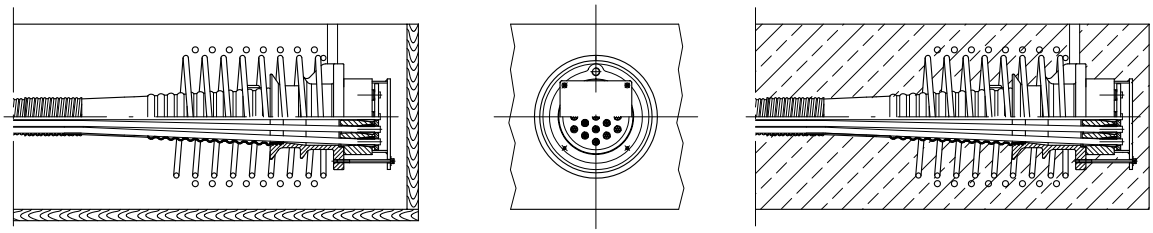
Annex 4

of European Technical Approval ETA-06/0147

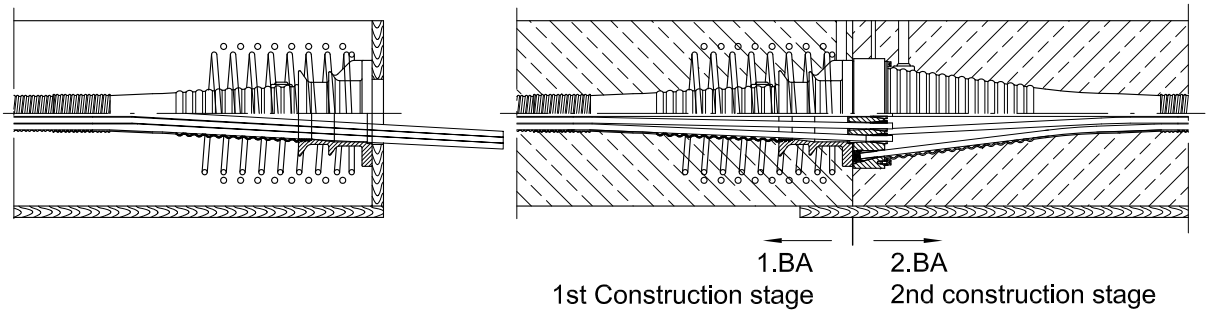
Stressing anchorage



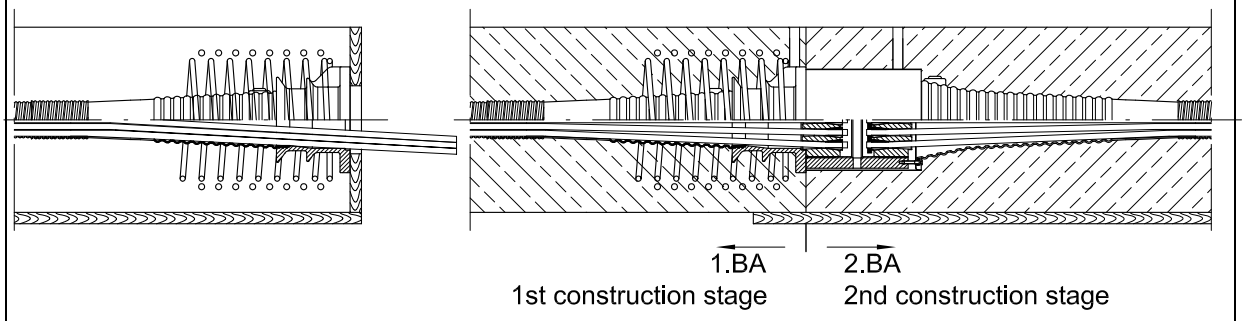
Fixed anchorage



Fixed Coupler FK

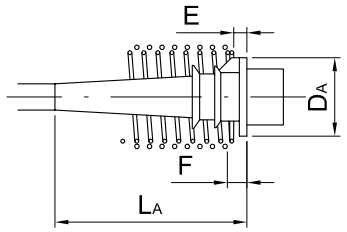


Fixed Coupler FH

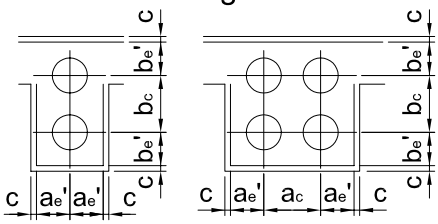


BBR CONA CMI	Bonded Post-tensioning System Construction stages	Annex 5 of European Technical Approval ETA-06/0147

Stressing and fixed anchorage



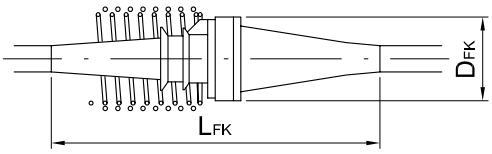
Centre- and edge distances



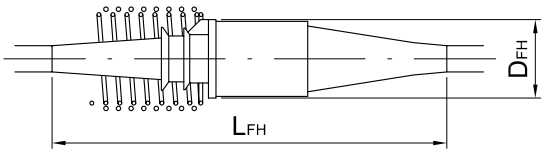
$a_e = a_e' + c$

$b_e = b_e' + c$

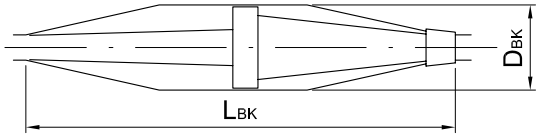
Fixed coupler FK



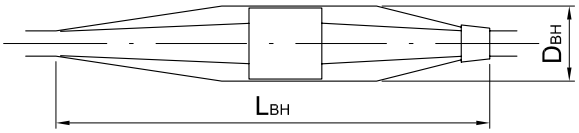
Fixed coupler FH



Movable coupler BK



Movable coupler BH



Technical data of anchorages

BBR VT CONA CMI			**04**					**07**					**09**					**12**				
Strand arrangement																						
Strand		**mm²**	**140**		**150**			**140**		**150**			**140**		**150**			**140**		**150**		
Cross sectional area		mm²	560		600			980		1,050			1,260		1,350			1,680		1,800		
Charact. tensile strength	R_m	**MPa**	**1,770**	**1,860**	**1,770**	**1,860**		**1,770**	**1,860**	**1,770**	**1,860**		**1,770**	**1,860**	**1,770**	**1,860**		**1,770**	**1,860**	**1,770**	**1,860**	
Charact. maximum force	F_m	kN	992	1,040	1,064	1,116		1,736	1,820	1,862	1,953		2,232	2,340	2,394	2,511		2,976	3,120	3,192	3,348	
0.90 $F_{p0.1k}$		kN	767	806	824	864		1,342	1,411	1,443	1,512		1,725	1,814	1,855	1,944		2,300	2,419	2,473	2,592	
0.95 $F_{p0.1k}$		kN	809	851	870	912		1,416	1,490	1,523	1,596		1,821	1,915	1,958	2,052		2,428	2,554	2,611	2,736	
Helix and additional reinforcement																						
Min. concrete strength (cube)	$f_{cm,0}$	**MPa**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**
Min. concrete strength (cyl.)	$f_{cm,0}$	**MPa**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**
Helix																						
Outer diameter		mm	180	150	150	150		230	200	200	180	180	280	230	230	230		330	280	280	260	260
Bar diameter		mm	14	12	12	12		14	14	14	14	14	14	14	14	14		14	14	14	14	14
Length, approx.		mm	182	181	216	216		232	232	277	277	277	282	282	337	337		332	332	332	382	282
Pitch		mm	50	50	60	60		50	50	60	60	60	50	50	60	60		50	50	50	50	50
Number of pitches			4	4	4	4		5	5	5	5	5	6	6	6	6		7	7	7	8	6
Distance	E	mm	15	15	15	15		18	18	18	18	18	20	20	20	20		20	20	20	20	20
Additional reinforcement																						
Number of stirrups			3	3	4	3		5	4	3	3	4	5	5	4	4		7	6	5	5	6
Bar diameter		mm	12	12	10	10		14	14	14	14	14	12	14	14	14		12	14	16	16	14
Spacing		mm	60	55	40	50		55	60	65	65	60	60	55	60	60		60	55	70	65	50
Distance from anchor plate	F	mm	30	30	30	30		33	33	33	33	33	35	35	35	35		35	35	35	35	35
Outer dimensions	BxB	mm	220	200	180	170		290	270	240	230	220	330	300	280	260		390	350	320	310	290
Centre- and edge spacing																						
min. centre spacing	a_c, b_c	mm	235	215	195	190		310	285	260	250	240	350	320	295	280		405	370	340	325	310
min. edge distance (plus c)	a_e', b_e'	mm	110	100	90	85		145	135	120	115	110	165	150	140	130		195	175	160	155	145
Dimensions of anchorages																						
Anchor diameter	D_A	mm	130					170					225									
Anchor length	L_A	mm	327					454					743					627				
Coupler FK diameter	D_{FK}	mm	185					205					240									
coupler FK length	L_{FK}	mm	945					1,152					1,664					1,435				
coupler FH diameter	D_{FH}	mm	130					170					225									
coupler FH length	L_{FH}	mm	848					1,080					1,708					1,500				
coupler BK diameter	D_{BK}	mm	199					219					254					254				
coupler BK length (plus 1.15Δ_L)	L_{BK}	mm	1,170					1,210					1,540					1,440				
coupler BH diameter	D_{BH}	mm	135					170					210					220				
coupler BH length (plus 1.15Δ_L)	L_{BH}	mm	1,270					1,340					1,670					1,590				
duct diameter min.		mm	40					55					60					70				
duct diameter max.		mm	45					60					70					80				

c...Concrete cover

Δ_L...elongation

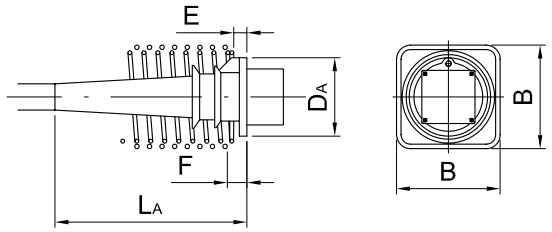
CONA CMI

Bonded Post-tensioning System
Dimensions of anchorages, helix and additional reinforcement and spacing

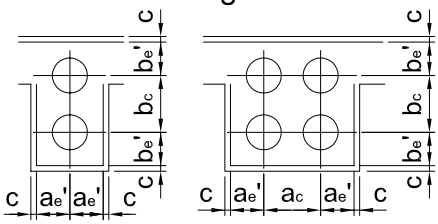
Annex 6

of European Technical Approval ETA-06/0147

Stressing and fixed anchorage



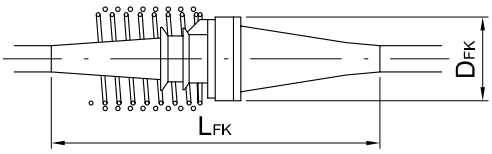
Centre- and edge distances



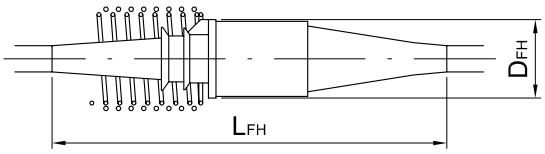
$a_e = a_e' + c$

$b_e = b_e' + c$

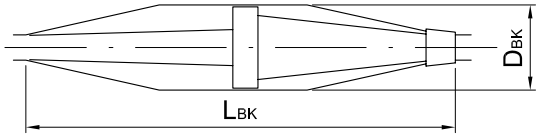
Fixed coupler FK



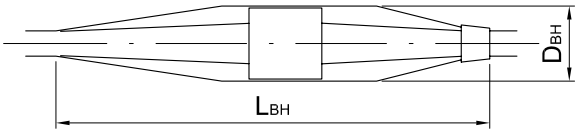
Fixed coupler FH



Movable coupler BK



Movable coupler BH



Technical data of anchorages

BBR VT CONA CMI			**15**					**19**					**22**					**24**				
Strand arrangement																						
Strand		**mm²**	**140**		**150**			**140**		**150**			**140**		**150**			**140**		**150**		
Cross sectional area		mm²	2,100		2,250			2,660		2,850			3,080		3,300			3,360		3,600		
Charact. tensile strength	R_m	**MPa**	**1,770**	**1,860**	**1,770**	**1,860**		**1,770**	**1,860**	**1,770**	**1,860**		**1,770**	**1,860**	**1,770**	**1,860**		**1,770**	**1,860**	**1,770**	**1,860**	
Charact. maximum force	F_m	kN	3,720	3,900	3,990	4,185		4,712	4,940	5,054	5,301		5,456	5,720	5,852	6,138		5,952	6,240	6,384	6,696	
0.90 $F_{p0.1k}$		kN	2,876	3,024	3,092	3,240		3,642	3,830	3,916	4,104		4,217	4,435	4,534	4,752		4,601	4,838	4,946	5,184	
0.95 $F_{p0.1k}$		kN	3,035	3,192	3,263	3,420		3,845	4,043	4,133	4,332		4,452	4,682	4,786	5,016		4,856	5,107	5,221	5,472	
Helix and additional reinforcement																						
Min. concrete strength (cube)	$f_{cm,0}$	**MPa**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**
Min. concrete strength (cyl.)	$f_{cm,0}$	**MPa**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**
Helix																						
Outer diameter		mm	375	330	330	280	280	420	360	360	330	330	475	420	360	360	330	475	430	420	360	360
Bar diameter		mm	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Length, approx.		mm	432	432	382	432	332	457	457	432	432	382	482	482	482	482	382	532	532	482	532	432
Pitch		mm	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Number of pitches			9	9	8	9	7	9.5	9.5	9	9	8	10	10	10	10	8	11	11	10	11	9
Distance	E	mm	27	27	27	27	27	27	27	27	27	27	31	31	31	31	31	32	32	32	32	32
Additional reinforcement																						
Number of stirrups			7	6	5	6	5	7	7	7	7	7	8	7	7	7	8	7	7	7	7	8
Bar diameter		mm	14	16	16	16	16	16	16	16	16	16	16	20	20	20	16	20	20	20	20	16
Spacing		mm	60	65	65	55	60	65	65	65	65	65	65	75	70	65	55	80	80	70	65	55
Distance from anchor plate	F	mm	42	42	42	42	42	42	42	42	42	42	46	46	46	46	46	47	47	47	47	47
Outer dimensions	BxB	mm	440	400	360	350	330	490	450	410	390	370	530	480	440	420	400	560	510	460	440	420
Centre- and edge spacing																						
min. centre spacing	a_c, b_c	mm	455	415	380	365	345	510	465	425	410	390	550	500	460	440	420	575	525	480	460	435
min. edge distance (plus c)	a_e', b_e'	mm	220	200	180	175	165	245	225	205	195	185	265	240	220	210	200	280	255	230	220	210
Dimensions of anchorages																						
Anchor diameter	D_A	mm	280										310					325				
Anchor length	L_A	mm	858					744					946					1,067				
Coupler FK diameter	D_{FK}	mm	290										310					340				
coupler FK length	L_{FK}	mm	1,824					1,600					1,821					2,264				
coupler FH diameter	D_{FH}	mm	280										310					325				
coupler FH length	L_{FH}	mm	1,969					1,770					2,063					2,428				
coupler BK diameter	D_{BK}	mm	304					304					324					354				
coupler BK length (plus 1.15Δ_L)	L_{BK}	mm	1,685					1,550					1,750					1,970				
coupler BH diameter	D_{BH}	mm	260					270					300					315				
coupler BH length (plus 1.15Δ_L)	L_{BH}	mm	1,840					1,730					1,920					2,140				
duct diameter min.		mm	80					90					95					100				
duct diameter max.		mm	90					100					105					110				

c...Concrete cover

Δ_L...elongation

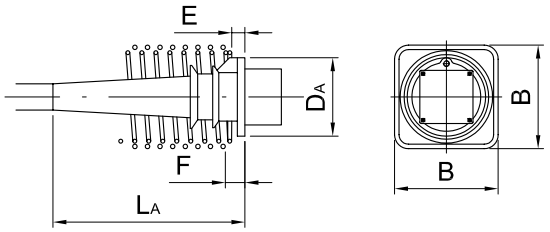
CONA CMI

Bonded Post-tensioning System
Dimensions of anchorages, helix and additional reinforcement and spacing

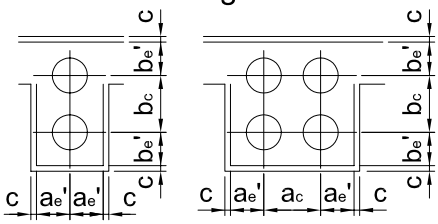
Annex 7

of European Technical Approval ETA-06/0147

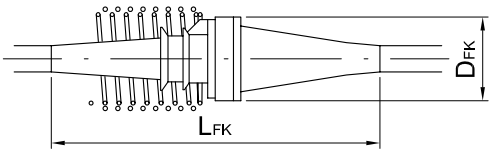
Stressing and fixed anchorage



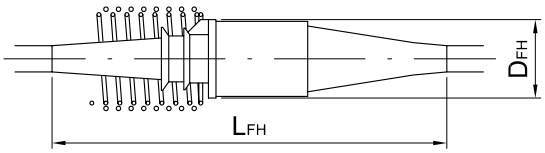
Centre- and edge distances



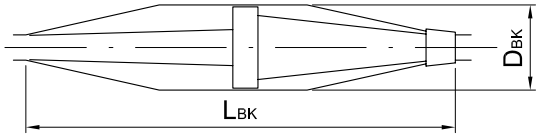
Fixed coupler FK



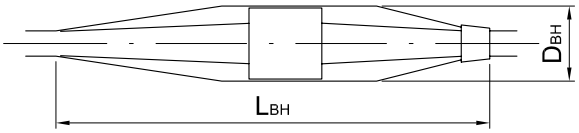
Fixed coupler FH



Movable coupler BK



Movable coupler BH



Technical data of anchorages												
BBR VT CONA CMI			**27**					**31**				
Strand arrangement												
Strand		**mm²**	**140**		**150**			**140**		**150**		
Cross sectional area		mm²	3,780		4,050			4,340		4,650		
Charact. tensile strength	**R_m**	**MPa**	**1,770**	**1,860**	**1,770**	**1,860**		**1,770**	**1,860**	**1,770**	**1,860**	
Charact. maximum force	F_m	kN	6,696	7,020	7,182	7,533		7,688	8,060	8,246	8,649	
0.90 $F_{p0.1k}$		kN	5,176	5,443	5,565	5,832		5,943	6,250	6,389	6,696	
0.95 $F_{p0.1k}$		kN	5,463	5,746	5,874	6,156		6,273	6,597	6,744	7,068	
Helix and additional reinforcement												
Min. concrete strength (cube)	**$f_{cm,0}$**	**MPa**	**23**	**28**	**34**	**38**	**43**	**23**	**28**	**34**	**38**	**43**
Min. concrete strength (cyl.)	**$f_{cm,0}$**	**MPa**	**19**	**23**	**28**	**31**	**35**	**19**	**23**	**28**	**31**	**35**
Helix												
Outer diameter		mm	520	475	430	420	360	560	520	475	430	430
Bar diameter		mm	14	14	14	14	14	14	14	14	14	14
Length, approx.		mm	532	532	532	427	432	532	532	582	467	432
Pitch		mm	50	50	50	40	50	50	50	50	40	50
Number of pitches			11	11	11	11	9	11	11	12	12	9
Distance	E	mm	35	35	35	35	35	35	35	35	35	35
Additional reinforcement												
Number of stirrups			8	7	7	7	8	8	8	8	8	8
Bar diameter		mm	20	20	20	20	20	20	20	20	20	20
Spacing		mm	80	80	75	70	60	85	75	70	65	60
Distance from anchor plate	F	mm	50	50	50	50	50	50	50	50	50	50
Outer dimensions	BxB	mm	590	540	490	470	440	630	580	530	500	480
Centre- and edge spacing												
min. centre spacing	a_c, b_c	mm	610	555	505	485	460	650	595	545	520	495
min. edge distance (plus c)	a_e', b_e'	mm	295	270	245	235	220	315	290	265	250	240
Dimensions of anchorages												
Anchor diameter	D_A	mm	360									
Anchor length	L_A	mm	1,090					975				
Coupler FK diameter	D_{FK}	mm	390									
coupler FK length	L_{FK}	mm	2,466					2,242				
coupler FH diameter	D_{FH}	mm	360									
coupler FH length	L_{FH}	mm	2,494					2,285				
coupler BK diameter	D_{BK}	mm	404					404				
coupler BK length (plus 1.15Δ_L)	L_{BK}	mm	2,475					2,280				
coupler BH diameter	D_{BH}	mm	335					345				
coupler BH length (plus 1.15Δ_L)	L_{BH}	mm	2,660					2,480				
duct diameter min.		mm	105					110				
duct diameter max.		mm	120					130				

c...Concrete cover

Δ_L...elongation

CONA CMI

Bonded Post-tensioning System
Dimensions of anchorages, helix and additional reinforcement and spacing

Annex 8

of European Technical Approval ETA-06/0147

1) Preparatory work
The components of the prestressing kit shall be stored so as to avoid any damage or corrosion.

2) Anchorage recesses
Adequate space to accommodate and to use the prestressing jack shall be ensured (see also Clause 2.1.5).

3) Fixing the bearing trumplates
Four holes are provided to fix the bearing trumplates to the formwork. The trumpet is screwed into the bearing trumplate. The helix is either welded to the bearing trumplate by means of radial bars (see also Clause 4.7) or positioned by fixing it to the existing reinforcement.

4) Placing of the sheaths
The sheaths are placed on supports with spacing according to Clause 2.5 and minimum radii of curvature according to Clause 2.8. The sheaths have to be jointed in a leak-proof way. The sheaths shall be supported such that any movement is prevented.

The same applies for prefabricated tendons.

5) Installation of tensile elements (prestressing steel)
The prestressing steel is pushed or pulled into the sheath before or after concreting of the structure.

6) Installation of the inaccessible fixed anchorages
After passing the strands through the anchor head, they are anchored individually in the cones by means of ring wedges. After assembling the wedges are secured with springs or a wedge retaining plate.

7) Installation of fixed coupler anchor block 2.BA
The function of the fixed coupler is to connect two tendons, whereas the first tendon is stressed before the second tendon is installed and stressed.

The coupling is achieved by pushing the strands into the already tensioned coupler anchor head K, side 2.BA (outer pitch circle), whereby the strands have to be marked to check the correct depth of penetration.

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.

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

The assembly of the coupler anchor heads is performed in accordance with Point 7 and Clause 2.1.4. The transverse forces at the end of the trumpet are covered by steel deflector rings.

9) Checking the tendons before concreting
Before concreting the structure the fixation and position of the entire tendon have to be checked and corrected if necessary. The sheaths shall be checked for any damage.

10) Assembly of anchor block/coupler anchor 1.BA
After passing the strands through the anchor head, they are anchored individually in the cones by means of ring wedges. The same applies for the coupler anchor head in case of fixed couplers in the first construction stage.

11) Prestressing
At the time of stressing the mean concrete compressive strength shall be at least according to Table 8 and the provisions of Clause 2.9. The stressing and possible wedging has to be carried out with a suitable prestressing jack and in accordance with Clause 4.4.

The elongation of the tendon and the prestressing forces shall be checked and recorded systematically during the stressing operation.

Restressing the tendons is allowed in accordance with Clause 4.5.

12) Grouting the tendons
The grout shall be injected through the inlet holes until it escapes from the outlet tubes with the same consistency. All vents and grouting inlets shall be sealed immediately after grouting (see also Clause 4.6).

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

Seven-wire strands according to prEN 10138-3 [d)]

Steel name			Y 1770S7	Y1860S7	Y1770S7	Y1860S7
Tensile strength	R_m	MPa	1,770	1,860	1,770	1,860

Strand

Diameter	d	mm	15.3	15.3	15.7	15.7
Nominal cross-sectional area	A_p	mm^2	140	140	150	150

Nominal mass per metre	m	kg/m	1.093		1.172	
Permitted deviation from nominal mass		%	± 2			
Characteristic value of maximum force	F_{pk}	kN	248	260	266	279
Maximum value of maximum force	$F_{m,max}$	kN	285	299	306	321
Characteristic value of 0.1 % proof force	$F_{p0.1}$	kN	213	224	229	240
Minimum elongation at max. force, $L_0 \geq 500$ mm	A_{gt}	%	3.5			

Relaxation after 1,000 h

at $0.7 \cdot f_{pk}$		%	2.5[a)]
at $0.8 \cdot f_{pk}$		%	4.5[b)]
Modulus of elasticity	E_p	MPa	195,000[c)]

[a)] For specific applications the relaxation requirement may be agreed between supplier and purchaser at time of enquiry and order.

[b)] The requirement for $0.7 \cdot f_{pk}$ is mandatory. Values for $0.8 \cdot f_{pk}$ may be agreed at time of enquiry and order.

[c)] Standard value

[d)] Suitable strands according to standards and regulations valid at the place of use may also be used.

Reference documents

Guideline for European Technical Approval

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

Standards

EN 206-1 (12.2000)	Concrete - Part 1: Specification, performance, production and conformity
EN 445 (03.1996)	Grout for prestressing tendons - Test methods
EN 446 (03.1996)	Grout for prestressing tendons - Grouting procedures
EN 447 (03.1996)	Grout for prestressing tendons - Specification for common grout
EN 523 (08.2003)	Steel strip sheaths for prestressing tendons - Terminology, requirements, quality control
EN 1561 (06.1997)	Founding - Grey cast irons
EN 1563+A1+A2 (07.2005)	Founding - Spheroidal graphite cast irons
EN 1992-1-1 (12.2004)	Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings
EN 10025-2+AC (06.2005)	Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels
EN 10083-1+A1 (08.1996)	Quenched and tempered steels – Part 1: Technical delivery conditions for special steels
EN 10083-2+A1 (08.1996)	Quenched and tempered steels - Part 2: Technical delivery conditions for unalloyed quality steels
EN 10084 (04.1998)	Case hardening steels - Technical delivery conditions
EN 10204 (10.2004)	Metallic products - Types of inspection documents
EN 10210-1 (03.1994)	Hot finished structural hollow sections of non-alloy and fine grain structural steels – Part 1: technical delivery requirements
EN 10270-1 (04.2001)	Steel wire for mechanical springs - Part 1: Patented cold drawn unalloyed steel wire
EN 10277-2+AC (12.2003)	Bright steel products - Technical delivery conditions - Part 2: Steels for general engineering purposes
EN ISO 1872-1 (05.1999)	Plastics - Polyethylene (PE) moulding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 1872-1:1993)
prEN 10138-3 (04.2005)	Prestressing steels - Part 3: Strands
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

MPA NRW.

MATERIALPRÜFUNGSAMT NORDRHEIN-WESTFALEN

EC-CERTIFICATE OF CONFORMITY
0432-CPD-11 9181-1/1

In compliance the Directive 89/106/EEC of the Council of European Communities of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to the construction products (Construction Products Directive - CPD), amended by the Directive 93/68/EEC of the Council of European Communities of 22 July 1993, it has been stated that the construction product

BBR VT CONA CMI – Bonded Post-tensioning System with 04 to 31 Strands

placed on the market by

BBR VT International Ltd
Bahnstraße 23
CH-8603 Schwerzenbach (ZH)
SWITZERLAND

and produced in the factory

BBR VT International Ltd
Bahnstraße 23
CH-8603 Schwerzenbach (ZH)
SWITZERLAND

is submitted by the manufacturer

- to a factory production control and
- to the further testing of samples taken at the factory in accordance with a prescribed test plan

and that the approved body – MPA NRW –

- has performed the initial type-testing for the relevant characteristics of the product
- the initial inspection of the factory and of the factory production control
- and performs the continuous surveillance, assessment and approval of the factory production control and
- an audit-testing of samples taken at the factory, on the market or at the construction site.

This certificate attests that all provisions concerning the attestation of conformity and the performances described in Annex ZA of the standard (resp. in)

ETA-06/0147 from 25.08.2006

were applied and that the product fulfils all the prescribed requirements.

This certificate was first issued on 07.12.2006 and remains valid as long as the conditions laid down in the harmonized technical specification in reference or the manufacturing conditions in the factory or the FPC itself are not modified significantly, and latest on 24.08.2011.

Dortmund, 07.12.2006

Materialprüfungsamt MPA NRW 10 Nordrhein-Westfalen

Dipl.-Ing. Gödecker
Head of Certification Body

English translation, the original version is in German.

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