

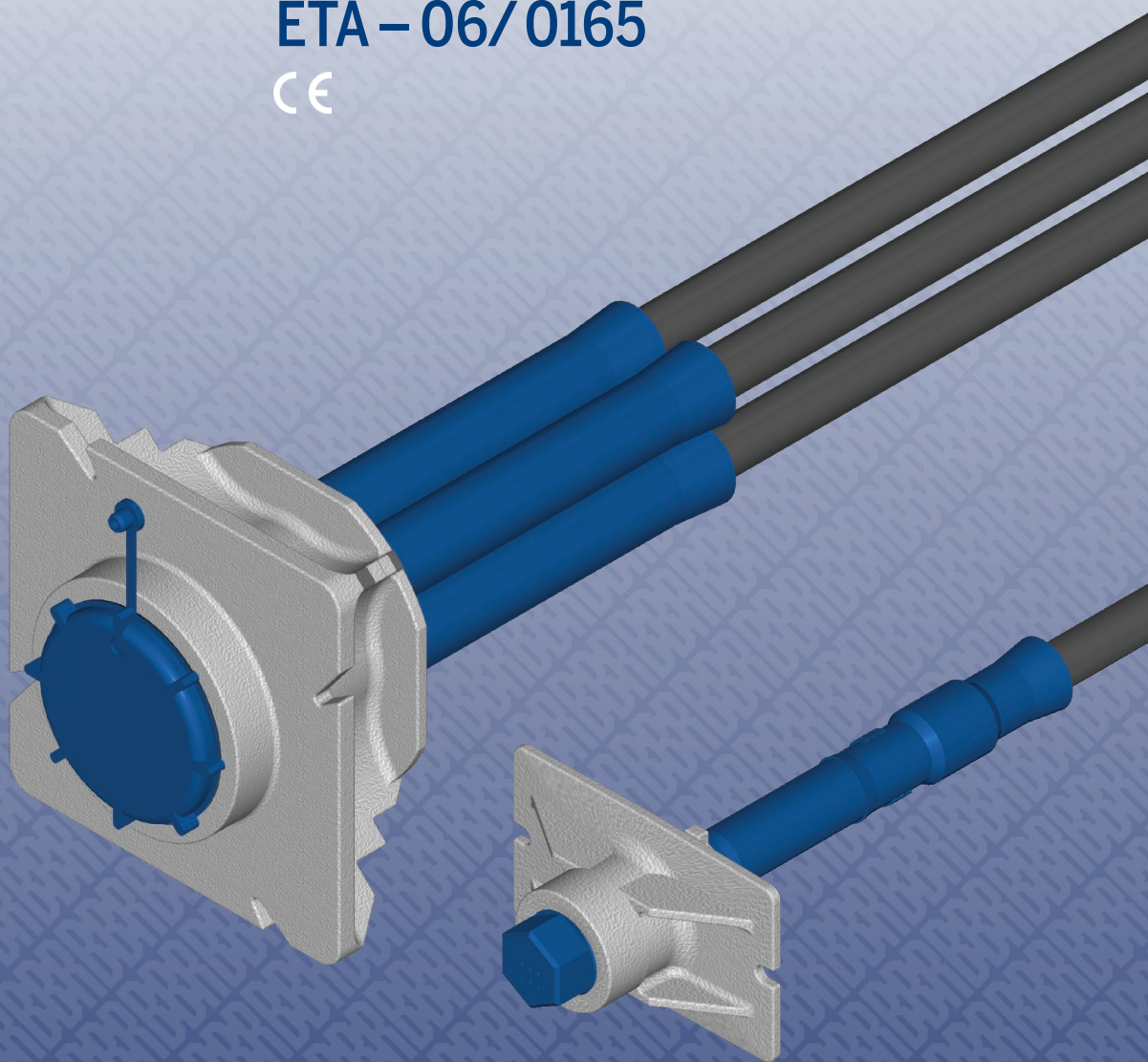
BBR VT CONA CMM

Unbonded and Bonded Post-tensioning System



European Technical Assessment
ETA – 06/ 0165

CE



A Global Network of Experts
www.bbrnetwork.com



ETA-06/0165

BBR VT CONA CMM

Unbonded Post-tensioning System
with 01, 02 and 04 Strands

BBR VT International Ltd

Ringstrasse 2, 8603 Schwerzenbach (Switzerland)
www.bbrnetwork.com

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Responsible BBR PT Specialist Company



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



Assembly and installation of BBR VT CONA CMM 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
Organisation Européenne pour l'Agrément technique

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-06/0165
of 08.06.2018

General part

Technical Assessment Body issuing the European Technical Assessment

Österreichisches Institut für Bautechnik (OIB)
Austrian Institute of Construction Engineering

Trade name of the construction product

BBR VT CONA CMM – Unbonded and bonded
Post-tensioning System with 01, 02, and
04 Strands

Product family to which the construction product belongs

Bonded and unbonded post-tensioning kits for
prestressing of structures with strands and
monostrands

Manufacturer

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This European Technical Assessment contains

56 pages including Annexes 1 to 27, which form
an integral part of this assessment.

This European Technical Assessment is issued in accordance with Regulation (EU) № 305/2011, on the basis of

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

This European Technical Assessment replaces

European Technical Assessment ETA-06/0165 of
22.07.2016 and European technical approval
ETA-12/0282 with validity from 26.06.2013 to
25.06.2018.

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Remarks

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Specific parts

1 Technical description of the product

1.1 General

The European Technical Assessment¹ – ETA – applies to a kit, the PT system

BBR VT CONA CMM – Unbonded and bonded Post-tensioning System with 01, 02, and 04 Strands,

comprising the following components, see Annex 1, Annex 2, Annex 3, Annex 4, Annex 5, and Annex 6.

- Tendon

Unbonded tendons with 01, 02, or 04 tensile elements

Bonded tendons with 01 tensile element

- Tensile element

Unbonded 7-wire prestressing steel strand with nominal diameters and maximum characteristic tensile strengths as given in Table 1, factory-provided with a corrosion protection system comprising corrosion protective filling material and HDPE-sheathing. Unbonded 7-wire prestressing steel strands are monostrands or VT CMM Bands.

7-wire prestressing steel strand with nominal diameters and maximum characteristic tensile strengths as given in Table 1 – Bare 7-wire prestressing steel strand are for unbonded and bonded tendons in ducts.

Table 1 Tensile elements

Nominal diameter	Nominal cross-sectional area	Maximum characteristic tensile strength ¹⁾
mm	mm ²	MPa
15.3	140	1 860
15.7	150	
15.2 ²⁾	165	1 820

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

²⁾ Compacted strand

NOTE 1 MPa = 1 N/mm²

¹ ETA-06/0165 was firstly issued in 2006 as European technical approval with validity from 15.11.2006, extended in 2011 with validity from 15.11.2011, converted in 2016 to European Technical Assessment ETA-06/0165 of 22.07.2016, and amended in 2018 to European Technical Assessment ETA-06/0165 of 08.06.2018. ETA-12/0282 was firstly issued in 2013 as European technical approval with validity from 26.06.2006 and included in 2018 in European Technical Assessment ETA-06/0165 of 08.06.2018.

- Anchorage and coupler

Anchorage of the prestressing steel strands with ring wedges

End anchorage

Fixed (passive) anchor or stressing (active) anchor as end anchorage for 01, 02, and 04 prestressing steel strands

Stressing intermediate anchor for 01 prestressing steel strand

Fixed or stressing coupler

Sleeve coupler for 01 and 04 prestressing steel strands

- Helix and additional reinforcement in the region of the anchorage
- Corrosion protection for tensile elements, anchorages, and couplers

PT system

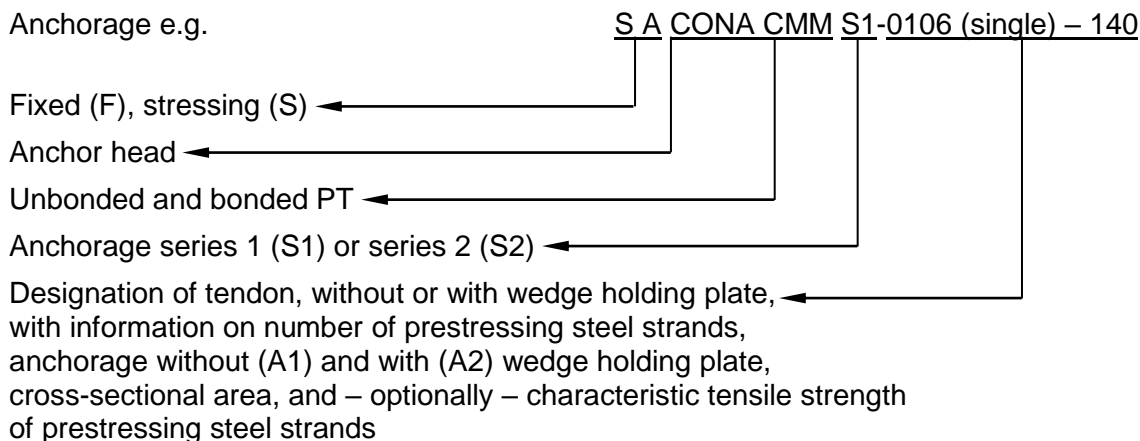
1.2 Designation and range of anchorages and couplers

1.2.1 General

End anchorages can be fixed or stressing, or intermediate stressing anchorages. Couplers are fixed couplers only. The principal dimensions of anchorages and couplers are given in Annex 4, Annex 5, and Annex 6, and Annex 14 and Annex 15.

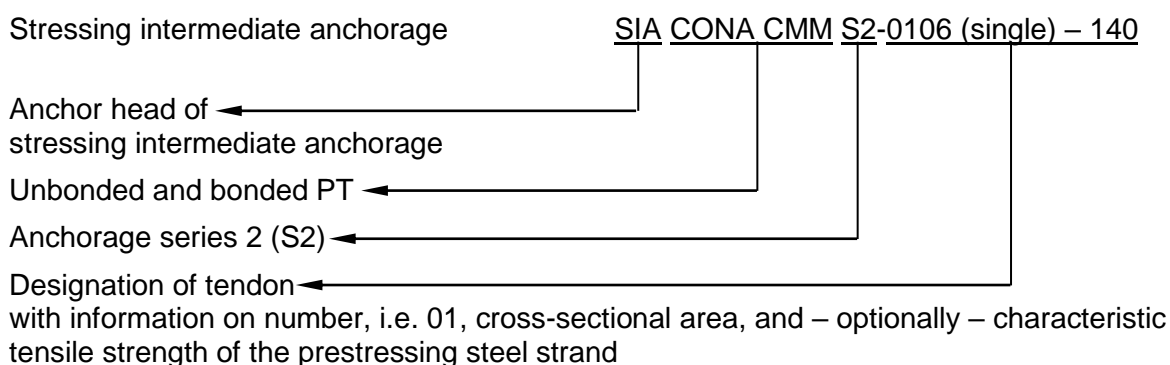
1.2.2 Designation

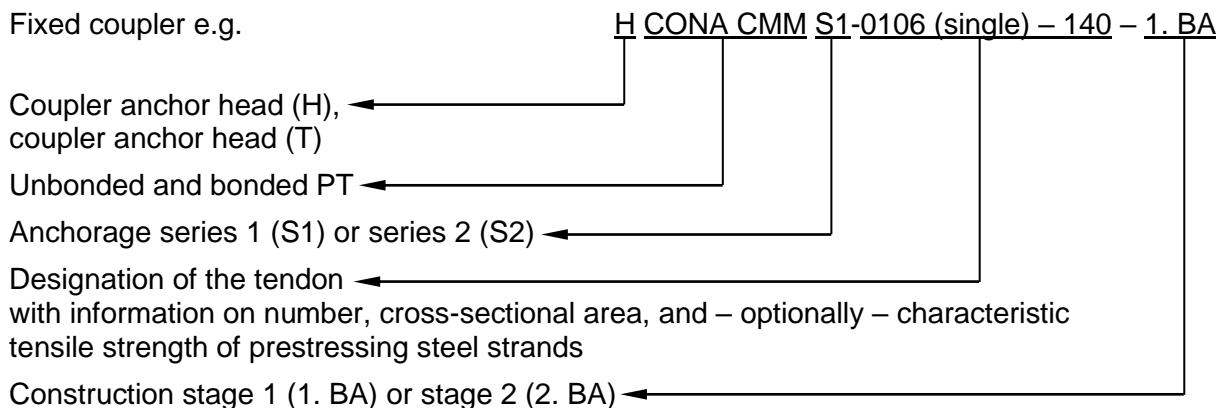
Anchorage e.g.



NOTE Wedge holding plates are available for S1-0206 (two) A2 and S1-0406 (four) A2.

Stressing intermediate anchorage





1.2.3 Anchorage

1.2.3.1 End anchorage

The anchor heads of the fixed and stressing anchorages are identical, see Annex 1, Annex 2, and Annex 3. A differentiation is needed for the construction works. The principal dimensions of the anchorages are given in Annex 4, Annex 5, and Annex 6.

Fixed anchorages that are accessible may be prelocked. Fixed anchorages that are not accessible are prelocked with prelocking force as specified in Table 5. The ring wedges are secured with rings between ring wedges and protection caps and wedge holding plates.

1.2.3.2 Stressing intermediate anchorage

The stressing intermediate anchorage is employed when structures are built in two or several steps. The principal dimensions of the stressing intermediate anchorage are given Annex 6.

The intermediate anchorage serves to stress and temporarily anchor one single prestressing steel strand in construction stage 1 – or construction stage n –, before construction stage 2 – or construction stage $n + 1$ – is built and the full length of the prestressing steel strand is stressed from the end of construction stage 2 – or construction stage $n + 1$. After stressing the prestressing steel strand from construction stage 2 – or construction stage $n + 1$ –, the stressing intermediate anchorage of construction stage 1 – or construction stage n – remains in the structure without taking any forces. Stressing intermediate anchorage is available for internal unbonded tendons with monostrands.

1.2.3.3 Restressable and exchangeable tendon

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

- Bare prestressing steel strand in a duct and
- Monostrands and VT CMM Bands.

NOTE A bonded tendon with bare prestressing steel strand, grouted in a duct is neither restressable nor exchangeable.

Significant to a restressable or exchangeable tendon is the excess length of the prestressing steel strands, see Annex 3. The extent of the excess length depends on the jack used for restressing and where applicable, the elongation for a full release of the prestressing force of the tendon. The protrusions of the prestressing steel strands require a permanent corrosive protection and an adapted protection cap.

1.2.4 Fixed and stressing coupler

Couplers are intended as fixed couplers only. The principal dimensions of the couplers are given in Annex 5, Annex 6, Annex 14, and Annex 15. Fixed couplers are for tendons with 01 and 04 prestressing steel strands, see Annex 1, Annex 2, and Annex 3.

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.

For tendons CONA CMM S1, 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). The coupler anchor head 2. BA (construction stage 2) are prelocked with a prelocking force as specified in Table 5 and the wedges are secured by the following means.

- At coupler anchor head H CONA CMM S1-0106 (single) – 2. BA (construction stage 2), with protection cap and wedge holding ring, see Annex 1
- At coupler anchor head H CONA CMM S1 -0406 (four) – 2. BA (construction stage 2), with a wedge holding plate, see Annex 1.

For tendons CONA CMM S2, the coupler anchor head 2. BA (construction stage 2) is screwed onto the coupler anchor head 1. BA (construction stage 1). The tendon of construction stage 2 is coupled by pushing the strand in the installed coupler anchor head 2. BA (construction stage 2). Coupler plug and spring force the ring wedge and establish the connection. The wedge is secured by the following means.

- At coupler anchor head T CONA CMM S2-0106 (single) – 2. BA (construction stage 2), with spring and coupler plug, see Annex 2

1.2.5 Layout of the anchorage recesses

All anchor heads are placed perpendicular to the axis of the tendon, see Annex 14 and Annex 15.

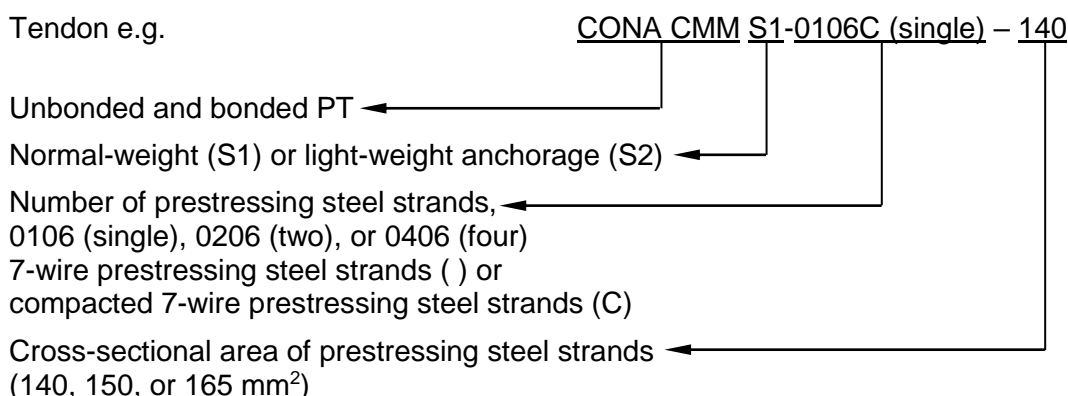
In Annex 14, Annex 15, Annex 17, and Annex 18 the minimum dimensions of the anchorage recesses are given. The dimensions of the anchorage recesses are adapted to the prestressing jacks used. The ETA holder saves for reference information on the minimum dimensions of the anchorage recesses.

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

1.3 Designation and range of the tendons

1.3.1 Designation

Tendon e.g.



The characteristic tensile strength of the prestressing steel strands (1 770, 1 820, or 1 860 MPa) may be indicated optionally.

NOTE Wedge holding plates are available for S1-0206 (two) A2 and S1-0406 (four) A2.

The available tendons with their respective anchorages and couplers are given in Table 2 and Table 3.

Table 2 Available tendons – Anchorages and couplers

Anchorage and coupler	Unbonded tendon		Bonded tendon
	Monostrand ¹⁾	Filled duct ²⁾	Grouted duct ²⁾
Stressing anchorage	+	+	+
Fixed anchorage – accessible	+	+	+
Fixed anchorage – not accessible	+	+	—
Intermediate anchorage	+ ³⁾	—	—
Fixed or stressing coupler	+ ⁴⁾	+	—

¹⁾ Tendon with 01, 02, and 04 monostrands

²⁾ Tendon with 01 prestressing steel strand in duct

³⁾ Tendon with 01 monostrand

⁴⁾ Tendon with 01 and 04 monostrands

Key

+..... Tendon available

—..... Tendon unavailable

Table 3 Available tendons – Prestressing steel strands

Anchorage and coupler	Cross-sectional area of prestressing steel strand		
	140 mm ²	150 mm ²	165 mm ²
Stressing and fixed anchorage S1	+	+	+
Stressing and fixed anchorage S2	+	+	—
Intermediate anchorage S2	—	+	—
Fixed or stressing coupler S1	+	+	+
Fixed or stressing coupler S2	+	+	—

Key

+..... Tendon available

—..... Tendon unavailable

1.3.2 Range

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 are listed in Annex 13.

1.3.2.2 Unbonded tendon

The unbonded tendon comprises 01, 02, or 04 7-wire prestressing steel strands as monostrands or VT CMM Bands.

One single prestressing steel strand within a duct, filled with grease, wax, or an equivalent soft filling material, is also available as unbonded tendon.

1.3.2.3 Bonded tendon

The bonded tendon comprises one single 7-wire prestressing steel strand, grouted within a duct, either in plastic or in steel.

1.3.2.4 CONA CMM S1-n06 – 140 and CONA CMM S2-0106 – 140

7-wire prestressing steel strand

Nominal diameter 15.3 mm

Nominal cross-sectional area 140 mm²

Maximum characteristic tensile strength 1 770 or 1 860 MPa

Annex 12 lists the available tendon range for CONA CMM S1-n06 – 140 and CONA CMM S2-0106 – 140.

1.3.2.5 CONA CMM S1-n06 – 150 and CONA CMM S2-0106 – 150

7-wire prestressing steel strand

Nominal diameter 15.7 mm

Nominal cross-sectional area 150 mm²

Maximum characteristic tensile strength 1 770 or 1 860 MPa

Annex 12 lists the available tendon range for CONA CMM S1-n06 – 150 and CONA CMM S2-0106 – 150.

1.3.2.6 CONA CMM S1-n06C – 165

Compacted 7-wire prestressing steel strand

Nominal diameter 15.2 mm

Nominal cross-sectional area 165 mm²

Maximum characteristic tensile strength 1 820 MPa

Annex 12 lists the available tendon range for CONA CMM S1-n06C – 165.

1.4 Duct

1.4.1 Use of ducts

Ducts are used for tendons with one single 7-wire prestressing steel strands in either unbonded or bonded applications.

1.4.1.1 Internal unbonded tendon with one single 7-wire prestressing steel strand

For unbonded tendons smooth steel or plastic ducts are used.

1.4.1.2 Internal bonded tendon with one single 7-wire prestressing steel strand

For bonded tendons in general corrugated ducts either in steel or in plastic are used. Smooth steel ducts may be used if permitted at the place of use.

1.4.2 Round steel strip sheath

Steel strip sheaths in conformity with EN 523² are used. The minimum radii of curvature, R_{min} , is according to Clause 1.9.

1.4.3 Pre-bent smooth round steel duct

If permitted at the place of use, smooth steel ducts according to EN 10255, EN 10216-1, EN 10217-1, EN 10219-1 or EN 10305-5 are used. The ducts are pre-bent and free of any kinks. The minimum radii of curvature, R_{min} , is according to Clause 1.9. The minimum wall thickness is according to the standards and regulations in force at the place of use.

² Reference documents are listed in Annex 26 and Annex 27.

1.4.4 Corrugated plastic duct

Corrugated plastic ducts and minimum radii of curvature, R_{\min} , according to the standards and regulations in force at the place of use are used.

1.4.5 Smooth plastic duct

Smooth plastic ducts according to EN 12201-1 and minimum radii of curvature, R_{\min} , according to the standards and regulations in force at the place of use are used.

1.5 Friction losses

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

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

Where

F_xkNPrestressing force at a distance x along the tendon

F_0kNPrestressing force at $x = 0$ m

μ rad^{-1} Friction coefficient, see Table 4

α radSum of angular displacements over distance x, irrespective of direction or sign

k rad/mWobble coefficient, see Table 4

x mDistance along the tendon from the point where the prestressing force is equal to F_0

NOTE 1 rad = 1 m/m = 1

Table 4 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 duct	0.12		0.10–0.14	
Smooth plastic duct	0.12		0.10–0.14	
Monostrand or VT CMM Band 140/150	0.06	$8.73 \cdot 10^{-3}$	0.05–0.07	0.007–0.011
Monostrand or VT CMM Band 165	0.05		0.04–0.06	

If band-shaped tendons CONA CMM S1-n06 – 150 or CONA CMM S1-n06 – 165 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 $k = 4.37 \cdot 10^{-3} \text{ rad/m}$ ($= 0.25^\circ/\text{m}$).

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

1.6 Support of tendons

The individual monostrands or VT CMM Bands are fastened in their position. Spacing of supports is.

1 Normally

Individual monostrands (01 strand) and

VT CMM Bands with 01, 02 and 04 strands..... 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 fastened in its position. Special spacers for tendons are therefore not required. For details see Annex 19.

1.7 Slip at anchorages and couplers

Table 5 specifies the slip at anchorages couplers that is taken into consideration in calculations of tendon elongation and forces in tendon.

Table 5 Slip at anchorages and couplers

Stressing anchorage Coupler S1 and S2 1. BA	SA CONA CMM S1-n06	6 mm
	H CONA CMM S1-n06 – 1. BA	
	SA CONA CMM S2-0106 (single)	8 mm
	T CONA CMM S2-0106 (single) – 1. BA	
	SIA CONA CMM S2-0106 (single)	
Not accessible fixed anchorage, prelocked ¹⁾ Coupler S1 2. BA, prelocked ¹⁾	FA CONA CMM S1-n06	3 mm
	H CONA CMM S1-n06 – 2. BA	
	FA CONA CMM S2-0106 (single)	4 mm
Accessible passive anchorage Coupler S2 2. BA	FA CONA CMM S1-0106 (single)	6 mm
	FA CONA CMM S2-0106 (single)	8 mm
	T CONA CMM S2-0106 (single) – 2. BA	
	FA CONA CMM S1-0206 (two)	8 mm ²⁾
	FA CONA CMM S1-0406 (four)	

¹⁾ Prelocked with $\sim 0.5 \cdot F_{pk}$

²⁾ If a more exact evaluation is required, slip for

Y1860S7 9 mm

Y1820S7G 7 mm

1.8 Centre spacing and edge distances for anchorages

In general, spacing and distances are not less than the values given in Table 6 and Annex 14 and Annex 15.

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 placing of additional

reinforcement still is possible, see Annex 16. In this case the spacing in the perpendicular direction is increased by the same percentage. The corresponding edge distance is calculated by

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

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

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

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

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 Table 6 and in Annex 14 and Annex 15.

Table 6 Spacing of tendon anchorages

Tendon			CONA CMM S1-0106	CONA CMM S2-0106 ¹⁾	CONA CMM S2-0106 ²⁾	CONA CMM S1-0206	CONA CMM S1-0406
Minimum centre spacing	a_c, b_c	mm	180, 140	175, 105	235, 150	200, 150	300, 220
Minimum edge distance	a_e, b_e	mm	$70 + c, 50 + c$	$78 + c, 43 + c$	$108 + c, 65 + c$	$90 + c, 65 + c$	$130 + c, 90 + c$

- ¹⁾ With helix or additional reinforcement
²⁾ Without helix and without additional reinforcement. Concrete cover refers to reinforcement, placed in the same cross section, however 10 mm as a minimum.
 c Concrete cover

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

1.9 Minimum radii of curvature of internal tendons

1.9.1 Minimum radii of curvature for tendons with 7-wire prestressing steel strands

The minimum radius of curvature, R_{min} , of internal tendons in steel strip sheath is

$$R_{min} = \begin{cases} \geq \frac{F_{pm, 0}}{p_R} \\ \text{and} \\ \geq \frac{400 \cdot d}{3\,000} \end{cases}$$

Where

- R_{min} m..... Minimum radii of curvature
 $F_{pm, 0}$ kN..... Prestressing force of the tendon
 d mm..... Nominal diameter of the prestressing steel strand
 p_R kN/m..... Design pressure under the prestressing steel strands

The above given equations on the minimum radius of curvature result in a minimum radius of 2.0 m applying the following parameters.

- a prestressing force of the tendon of $F_{pm,0} = 0.85 \cdot F_{p0.1}$
- a nominal diameter of the prestressing steel strand of $d = 15.3 \text{ mm}$, $d = 15.7 \text{ mm}$, and $d = 15.2 \text{ mm}$
- a pressure under the prestressing strands of $p_R = 140 \text{ kN/m}$ or $p_R = 200 \text{ kN/m}$ and
- a concrete compressive strength of $f_{cm,0, \text{cube}} \geq 18 \text{ MPa}$.

In case of different tendon parameters or a different pressure under the prestressing strands, p_R , the calculation of the minimum radius of curvature of the tendon is carried out using the equation given above.

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 strands in force at the place of use are observed.

1.9.2 Minimum radii of curvature for tendons with monostrands or VT CMM Bands

The minimum radius of curvature R_{\min} of internal tendons with prestressing steel strands of nominal diameter of 15.7 or 15.2 mm 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 a tendon with multistrand anchorages in the anchorage zone outside the transition pipes up to the last reinforcement steel bar is 3.5 m.

1.10 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

- S1 anchorages
 - $f_{cm,0, \text{cube } 150} \geq 24 \text{ MPa}$ or
 - $f_{cm,0, \text{cylinder}} \geq 20 \text{ MPa}$
- S2 anchorages with helix or additional reinforcement
 - $f_{cm,0, \text{cube } 150} \geq 22 \text{ MPa}$ or
 - $f_{cm,0, \text{cylinder}} \geq 18 \text{ MPa}$
- S2 anchorages with without additional reinforcement
 - $f_{cm,0, \text{cube } 150} \geq 23 \text{ MPa}$ or
 - $f_{cm,0, \text{cylinder}} \geq 19 \text{ MPa}$

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 the concrete compressive strength is at least $0.5 \cdot f_{cm,0, \text{cube}}$ or $0.5 \cdot f_{cm,0, \text{cylinder}}$. Intermediate values may be interpolated linearly according to Eurocode 2.

Helix, additional reinforcement, centre spacing and edge distance are taken from Annex 14 and Annex 15, see also the Clauses 1.12.5 and 2.2.3.4.

Where

- $f_{cm,0, \text{cube } 150}$ Mean concrete compressive strength at time of stressing, determined at cubes, 150 mm
- $f_{cm,0, \text{cylinder } \varnothing 150}$ Mean concrete compressive strength at time of stressing, determined at cylinders, diameter 150 mm

Components

1.11 Prestressing steel strands

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

Table 7 Prestressing steel strands

Maximum characteristic tensile strength ¹⁾	f_{pk}	MPa	1 860		1 820
Nominal diameter	d	mm	15.3	15.7	15.2 ²⁾
Nominal cross-sectional area	A_p	mm ²	140	150	165
Mass of prestressing steel	M	kg/m	1.093	1.172	1.289
Sheathed prestressing steel strand, filled with a corrosion protective filling material – Individual monostrands or VT CMM Bands					
Nominal mass per prestressing steel strand		kg/m	1.23	1.31	1.42
External diameter of HDPE-sheathing		mm	≥ 19.5	≥ 20	≥ 19.5

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

²⁾ Compacted strand

Sheathed prestressing steel strands provided with a corrosion protective filling material may be either individual monostrands or VT CMM Bands.

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 11 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 4, Annex 5, Annex 6, Annex 7, Annex 8, and Annex 9 and the technical file³. Therein the component dimensions, materials and material identification data with tolerances are given.

1.12.2 Anchor head

1.12.2.1 General

The anchor heads, see Annex 4 and Annex 6, are made of cast iron with spheroidal graphite. They provide regularly arranged conical holes to accommodate 01, 02, or 04 prestressing steel strands and ring wedges. The load transfer to the concrete occurs in two planes for anchorages S1 and in one plane for anchorage S2. Threaded blind bores may be provided at anchor heads A CONA CMM S1-0206 (two) A2 and A CONA CMM S1-0406 (four) A2 to attach wedge retaining plates.

The anchor heads have cylindrical extensions with an internal thread to screw-in a protection cap. The outlet end of the conical holes for anchoring the prestressing steel strands is formed in such a way as to allow the transition pipes to be inserted tension-proof.

1.12.2.2 Anchor head in unbonded tendon

For unbonded tendon a protection cap is screwed in the cylindrical extension of the anchor head, filled with corrosion protective filling material to protect ring wedges and prestressing steel strands.

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

Transition pipes fitted at the outlet end of the conical holes act as the transition from the anchor head to the sheathing of the prestressing steel strands for monostrand tendons, see Annex 1, Annex 2, Annex 7, and Annex 8. For unbonded tendons in ducts, transition pipes fitted at the outlet end of the conical holes act as the transition from the anchor head to the duct of the tendon, see Annex 3 and Annex 9. The transition pipes are provided with a port to attach a hose for filling or venting.

1.12.2.3 Anchor head in bonded tendon

During grouting of the bonded tendon, a protection cap is screwed in the cylindrical extension of the anchor head filled with grout to protect ring wedges and prestressing steel strands.

Grouting transition pipes fitted at the outlet end of the conical holes act as the transition from the anchor head to the duct of the tendon, see Annex 3 and Annex 9. The grouting transition pipes are provided with a port to attach a hose for grouting or venting.

1.12.2.4 Anchor head for stressing intermediate anchorage

The anchor head SIA CONA CMM S2-0106 (single) is made of cast iron with spheroidal graphite, see Annex 6. It provides a conical hole to accommodate 01 prestressing steel strand and ring wedge I. The load transfer to the concrete occurs in one plane.

The anchor head has a cylindrical extension with an internal thread to screw-in a protection pipe. The outlet end of the conical holes for anchoring the prestressing steel strands is formed in such a way as to allow a transition pipe to be inserted tension-proof, see Annex 2 and Annex 8.

Stressing intermediate anchorage is for unbonded tendons. At the outlet end of the conical hole a transition pipe is fitted that acts as transition from anchor head to sheathing of the prestressing steel strands. The protection pipe is screwed in the cylindrical extension of the anchor head that, together with a plastic pipe, or cut sheathing and tape acts as transition to the sheathing of the strands, see Annex 2 and Annex 8.

1.12.3 Coupler

1.12.3.1 Coupler S1

Fixed couplers are provided for tendons with 01 and 04 prestressing steel strands. They comprise a coupler anchor head 1. BA (construction stage 1) and a coupler anchor head 2. BA (construction stage 2).

The coupler anchor head 1. BA (construction stage 1) is of the same shape as the anchor heads of active and passive anchorages for 01 and 04 prestressing steel strands. Compared to the anchor heads of active and passive anchorages, the cylindrical extension is deeper, provides an external thread to accommodate the coupler sleeve and an internal thread to screw-in a protection cap, see Annex 5.

The coupler anchor head 2. BA (construction stage 2) for 01 prestressing steel strand is either a cast iron head with a conical hole or a steel body with a conical bore. The coupler anchor head 2. BA (construction stage 2) for 04 prestressing steel strands is a steel body with conical bores. All coupler anchor heads provide an external thread for the coupler sleeve, see Annex 5.

The connection between coupler anchor heads 1. BA (construction stage 1) and 2. BA (construction stage 2) is by means of a coupler sleeve, a steel tube featuring an internal thread, a threaded bore to accommodate the filling device and a bore for ventilation, see Annex 1 and Annex 5.

Transition pipes fitted at the outlet end of the conical holes act as the transition from the coupler anchor head 1. BA (construction stage 1) and 2. BA (construction stage 2) to the sheathing of the prestressing steel strands, see Annex 1 and Annex 7.

The end surface of the fixed coupler H CONA CMM 0406 (four) is provided with a BDSD-plate to permit settlement of the coupler during stressing, see Annex 14 and Annex 9.

1.12.3.2 Coupler S2

The fixed coupler comprises a coupler anchor head 1. BA (construction stage 1) and a coupler anchor head 2. BA (construction stage 2).

The coupler anchor head 1. BA (construction stage 1) is of the same shape as the anchor heads of active and passive anchorages. Compared to the anchor heads of active and passive anchorages, the cylindrical extension is deeper, provides an external thread to accommodate the coupler anchor head 2. BA (construction stage 2) and an internal thread to screw-in a protection cap, see Annex 2 and Annex 6.

The coupler anchor head 2. BA (construction stage 2) is a cast iron head with a conical hole for prestressing steel strand and wedge. The outlet end of the conical holes is formed in such a way as to allow a transition pipe to be inserted tension-proof. The opposite end of the coupler anchor head 2. BA (construction stage 2) is provided with an internal thread to be screwed onto the coupler anchor head 1. BA (construction stage 1). Thereby, coupler anchor head 1. BA (construction stage 1) and 2. BA (construction stage 2) are connected. The prestressing steel strand of the 2. BA (construction stage 2) is pushed in the installed coupler anchor head 2. BA (construction stage 2). Holding spring and coupler plug force the wedge and establish and secure the connection of both tendons, see Annex 2, Annex 3, and Annex 6.

For unbonded monostrand tendons, transition pipes fitted at the outlet end of the conical holes act as the transition from the coupler anchor head 1. BA (construction stage 1) and 2. BA (construction stage 2) to the sheathing of the prestressing steel strands, see Annex 2 and Annex 8.

For unbonded tendons in ducts, transition pipes fitted at the outlet ends of the conical holes act as the transition from the coupler anchor heads to the ducts of the tendons. The transition pipes are provided with a port to attach a hose for filling or venting, see Annex 3 and Annex 9.

1.12.4 Ring wedges

The ring wedges, see Annex 5 and Annex 6, are in either two pieces or three pieces. Three different ring wedges are used.

- Ring wedge H in three pieces, fitted with spring ring, is available in two different materials.
- Ring wedge F in three pieces, without spring ring or fitted with spring ring, is made of one material.
- Ring wedge I in two pieces, without spring ring or fitted with spring ring, is made of one material. Ring wedge I is for stressing intermediate anchorage only.

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

Devices for securing the ring wedges after prelocking are.

- At inaccessible fixed anchorage FA CONA CMM S1-0106, FA CONA CMM S1-0206 (two) A1 and FA CONA CMM S1-0406 (four) A1 wedge holding rings with protection cap are installed.
- At inaccessible fixed anchorage FA CONA CMM S1-0206 (two) A2 and FA CONA CMM S1-0406 (four) A2 a wedge holding plate is attached.
- At coupler H CONA CMM S1-0106 (single) – 2. BA wedge holding ring with protection cap are installed.
- At coupler H CONA CMM S1-0406 (four) – 2. BA a wedge holding plate is attached.
- At coupler T CONA CMM S2-0106 (single) – 2. BA coupler plug and spring are forcing the ring wedge.

1.12.5 Helix and additional reinforcement

Helix and the 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 conforms to the values specified in Annex 14 and Annex 15, see also Clause 2.2.3.4.

If required for a specific project design, the reinforcement given in Annex 14 and Annex 15 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 authorities and of the ETA holder, to provided equivalent performance.

1.12.6 Protection cap and coupler plug

Protection cap and coupler plug are made of plastic, see Annex 8 and Annex 9.

The protection cap is screwed into the anchor head and for anchorages with two or four prestressing steel strands is provided with an air vent, Annex 1 and Annex 2.

The coupler plug is screwed into coupler anchor head T CONA CMM S2-0106 (single) – 2. BA together with a spring to force the wedge, see Annex 2.

1.12.7 Pocket former set

The pocket former set is made of plastic. It comprises mandrel, nut, and pocket former, see Annex 7 and Annex 8.

Available are

- For anchorage S1 and S2 with 01 prestressing steel strand
 - Mandrel, suitable for anchorage S1 and S2
 - Nut, suitable for anchorage S1 and S2
 - One pocket former, suitable for anchorage S1 and S2
 - One pocket former for anchorage S1
 - One pocket former for anchorage S2
 - The three pocket former are of different dimensions.
- For anchorage S1 with 02 and 04 prestressing steel strands
 - One common mandrel for 02 and 04 prestressing steel strands
 - One common nut for 02 and 04 prestressing steel strands
 - One common pocket former for 02 and 04 prestressing steel strands

The pocket formers are employed to form anchorage recesses for stressing anchorages SA CONA CMM S1-0106, SA CONA CMM S2-0106, SA CONA CMM S1-0206, and SA CONA CMM S1-0406.

1.12.8 Material specifications

Annex 10 lists the material standards or 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 components and materials of the corrosion protection system referred to in the Clauses 1.13.2 and 1.13.3. In execution, all components or materials are selected according to the standards and regulations in force at the place of use.

1.13.2 Unbonded tendon

1.13.2.1 Corrosion protection of prestressing steel strand

Monostrands or VT CMM Bands are sheathed in the factory with an extruded HDPE-sheathing with a thickness of at least 1.0 mm. The actual thickness of the sheathing is in accordance with the standards and regulations in force at the place of use. Inside the HDPE-sheathing a corrosion protective filling material is applied. When assembling the anchorage, the sheathing is

removed along the required length. During construction the prestressing steel strand excess lengths protruding from the anchorage are temporarily protected with cut-off HDPE-sheaths.

Beside monostrands, one single prestressing steel strand can be installed unbonded in a duct. The duct is filled with grease, wax, or an equivalent soft material.

1.13.2.2 Corrosion protection in anchorage and coupler

All voids of anchorages and couplers are completely filled with corrosion protective filling material according to the installation instructions in Annex 20.

During tendon installation not accessible anchorage, fixed or stressing coupler – and where appropriate accessible anchorage as well – are completely filled with corrosion protective filling material. I.e. the void from protection cap or coupler plug to wedge and up to the inlet or venting port of the transition pipe is provided with corrosion protective filling material.

Anchorage that are prelocked receive their corrosion protection immediately after the prelocking operation by filling with corrosion protective filling material and screwing-on of the protection cap. Coupler sleeve of fixed and stressing coupler S1 and coupler anchor head 2. BA of fixed and stressing coupler S2 is completely filled with corrosive protective filling material during installation.

All anchorages and couplers are fully embedded in concrete. The recesses are designed as to permit a reinforced concrete cover with the required dimensions and in any case with a thickness of at least 20 mm.

1.13.3 Bonded tendon

To protect the tendons from corrosion, ducts and anchorages 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. This is ensured by grout penetrating from the protection caps at the anchorages.

All anchorages are fully embedded in concrete. The recesses are designed as to permit a reinforced concrete cover with the required dimensions and in any case with a thickness of at least 20 mm.

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

2.1 Intended uses

The PT system is intended to be used for the prestressing of structures. The specific intended uses are listed in Table 8.

Table 8 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 1.45 to 1.75 m or as specified by the manufacturer of the prestressing steel strand is observed.
- Temporary protection of prestressing steel and components in order to prevent corrosion during transport from production site to job site
- Transportation, storage and handling of the 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 on design and installation is submitted to those responsible for the design and execution of the structures executed with "BBR VT CONA CMM – Unbonded and bonded Post-tensioning System with 01, 02, and 04 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.

2.2.3.2 Anchorage Recess

The anchorage recess is designed so as to permit 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. 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.

If other prestressing jacks than those shown in Annex 17 and Annex 18 are used, the ETA holder keeps information on prestressing jacks and minimum dimensions of anchorage recesses.

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

2.2.3.3 Maximum prestressing forces

Prestressing and overstressing forces are specified in the respective standards and regulations in force at place of use. Annex 13 lists the maximum possible prestressing and overstressing forces according to Eurocode 2.

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

Centre spacing, edge distance, helix, and additional reinforcement given in Annex 14 and Annex 15 are adopted, see Clause 1.8.

Verification of transfer of prestressing forces to structural concrete is not required if centre spacing and edge distance of anchorages and couplers as well as grade and dimensions of additional reinforcement, see Annex 14 and Annex 15, are conformed to. In the case of grouped anchorages the additional reinforcement of the individual anchorages can be combined, provided appropriate anchorage is ensured. However, number, cross-sectional area, and position with respect to the 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 the additional reinforcement are verified and, if necessary, dealt with by appropriate reinforcement.

If required for a specific project design, the reinforcement given in Annex 14 and Annex 15 may be modified in accordance with the respective regulations in force at the place of use as well as with the relevant approval of the local authority and of the ETA holder to provide equivalent performance.

2.2.3.5 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 1.8, 1.10, 1.12.5 and 2.2.3.4, or according to Eurocode 3, respectively.

The concrete or steel members have dimensions as to permit a force of $1.1 \cdot F_{pk}$ being transferred into the masonry. The verification is 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 is only carried out by qualified PT specialist companies with the required resources and experience in the use of multi strand unbonded post-tensioning systems, see CWA 14646. The respective standards and regulations in force at the place of use are considered. The company's PT site manager has a certificate, stating that she or he has been trained by the ETA holder and that she or he possesses the necessary qualifications and experience with the "BBR VT CONA CMM – Unbonded and bonded Post-tensioning System with 01, 02, and 04 Strands".

The sequence of work steps for installation of anchorage and fixed coupler is described in Annex 20 and the construction stages are shown in Annex 21 and Annex 22

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.

Anchor heads, and coupler anchor heads are placed perpendicular to the tendon's axis. Couplers are situated in a straight tendon section.

In the anchorage zone, the webs of the VT CMM Bands are longitudinally cut over a length of 1.3 m from the end. The layout of the transition zone is shown in Annex 19.

Before 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 protective filling material. In the case of minor damage of the sheathing, the damaged area is cleaned and sealed with an adhesive tape.

2.2.4.2 Stressing operation

With a mean concrete compressive strength in the anchorage zone according to the values laid down in Annex 14 and Annex 15 full prestressing may be applied.

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

Elongation and prestressing forces are 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 is pulled in and reduces the elongation by the amount of slip at the anchor head of 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 shall be complied with.

2.2.4.3 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 with 7-wire prestressing steel strands that remain restressable throughout the working life of the structure are unbonded tendons. Grease, wax, or an equivalent soft material is used as filling material for tendons in ducts. Moreover, a strand protrusion at the stressing anchor remains with a length compatible with the prestressing jack used.

Restressing of tendons with monostrand or VT CMM Bands is possible.

2.2.4.4 Exchanging tendons

Exchange of unbonded tendons is permitted, subject of acceptance at the place of use. The specifications for exchangeable tendons are defined during the design phase.

Corrosion protective filling material for tendons in ducts is grease, wax, or an equivalent soft material. Exchanging the prestressing steel strand of monostrand or VT CMM Band, with the sheathing remaining in the structure is also possible.

The radii of curvature should be reasonable larger than the minimum radii given in Clause 1.9 as to not impair the plastic ducts or sheathings of monostrand or VT CMM Band by wear due to stressing of the tendons.

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

2.2.4.5 Filling operations

2.2.4.5.1 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 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, grouting inlets, and protection caps 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.

2.2.4.5.2 Filling with corrosion protective filling material

Unbonded tendons with ducts are with corrosion protective filling material. The specifications and the recommendations of the supplier are relevant for corrosion protective filling material.

Filling with corrosion protective filling material follows a similar procedure as the one specified for grouting. At anchorages and couplers, the voids from wedge to port are completely filled with corrosion protective filling material prior to filling operation, preferably during tendon installation.

2.2.4.5.3 Filling records

The results of the grouting and filling operation are recorded.

2.2.4.6 Welding

Welding is not intended and it is not permitted to weld on built-in components of post-tensioning systems.

In case of welding operations near tendons precautionary measures are required to avoid damage to the corrosion protection system.

2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of the BBR VT CONA CMM – Unbonded and bonded Post-tensioning System with 01, 02, and 04 Strands of 100 years, provided that the BBR VT CONA CMM – Unbonded and bonded Post-tensioning System with 01, 02, and 04 Strands is subject to appropriate installation, use, and maintenance, see Clause 2.2. These provisions are based upon the current state of the art and the available knowledge and experience.

In normal use conditions, the real working life may be considerably longer without major degradation affecting the basic requirements for construction works⁴.

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

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

3.1 Essential characteristics

The performances of the PT system for the essential characteristics are given in Table 9. In Annex 25 the combinations of essential characteristics and corresponding intended uses are listed.

Table 9 Essential characteristics and performances of the product

No	Essential characteristic	Product performance
Product BBR VT CONA CMM		
Intended use The PT system is intended to be used for the prestressing of structures, Clause 2.1, Table 8, lines № 1 and 2.		
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.

⁴ The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works are subject, as well as on the particular conditions of design, execution, use, and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the assumed working life.

No	Essential characteristic	Product performance
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 values of maximum force, F_{pk} , of the tendon for prestressing steel strands according to Annex 11 are listed in 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 values of maximum force, F_{pk} , of the tendon for prestressing steel strands according to Annex 11 are listed in Annex 12.

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 for prestressing steel strands according to Annex 11 are listed in Annex 12.

3.2.1.4 Friction coefficient

For friction losses including friction coefficient see Clause 1.5.

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

For minimum radii of curvature see Clause 1.9.

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 CMM – Unbonded and bonded Post-tensioning System with 01, 02, and 04 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 Annex A of EAD 160004-00-0301, Post-tensioning kits for prestressing of structures, for

- Item 1, Internal bonded tendon
- Item 2, Internal unbonded tendon

3.4 Identification

The European Technical Assessment for the BBR VT CONA CMM – Unbonded and bonded Post-tensioning System with 01, 02, and 04 Strands is issued on the basis of agreed data⁵ that identify the assessed product. Changes to materials, to composition or 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 the Commission Decision 98/456/EC the system of assessment and verification of constancy of performance to be applied to the BBR VT CONA CMM – Unbonded and bonded

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

Post-tensioning System with 01, 02, and 04 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 plan⁶.
- (b) The notified product certification body shall decide on the issuing, restriction, suspension or withdrawal of the certificate of constancy of performance of the construction product on the basis of the outcome of the following assessments and verifications carried out by that body
 - (i) an assessment of the performance of the construction product carried out on the basis of testing (including sampling), calculation, tabulated values, or descriptive documentation of the product;
 - (ii) initial inspection of the manufacturing plant and of factory production control;
 - (iii) continuing surveillance, assessment, and evaluation of factory production control;
 - (iv) audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities.

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

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

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

⁶ The prescribed test plan has been deposited with Österreichisches Institut für Bautechnik and is handed over only to the notified product certification body involved in the procedure for the assessment and verification of constancy of performance. The prescribed test plan is also referred to as control plan.

- 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 23, conform to EAD 160004-00-0301, Table 3, and are specified in the quality management plan of the BBR VT CONA CMM – Unbonded and bonded Post-tensioning System with 01, 02, and 04 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 24.

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 9. In Annex 25 the combinations of essential characteristics and corresponding intended uses are listed.

5.2 Tasks for the notified product certification body

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

The notified product certification body 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 24 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 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 24 summarises the minimum procedures. Annex 24 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.

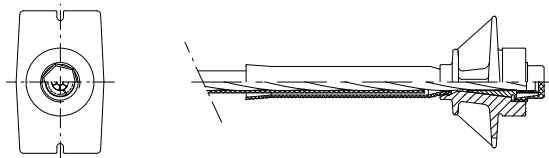
Issued in Vienna on 08 June 2018
by Österreichisches Institut für Bautechnik

The original document is signed by

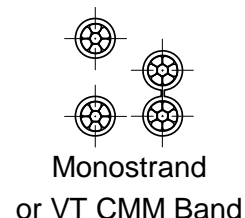
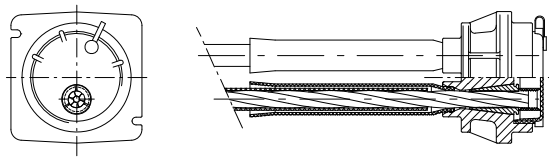
Rainer Mikulits
Managing Director

Stressing anchorages, accessible fixed anchorages SA, FA

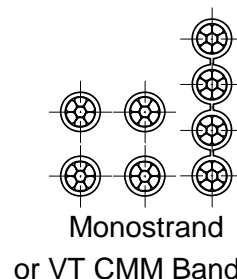
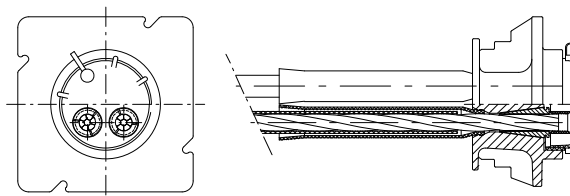
CONA CMM S1-0106
(single)



CONA CMM S1-0106
(two)¹⁾

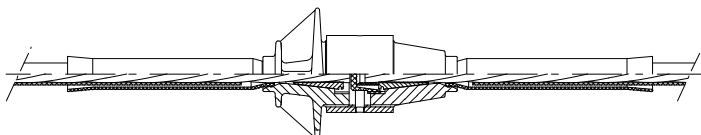


CONA CMM S1-0406
(four)¹⁾

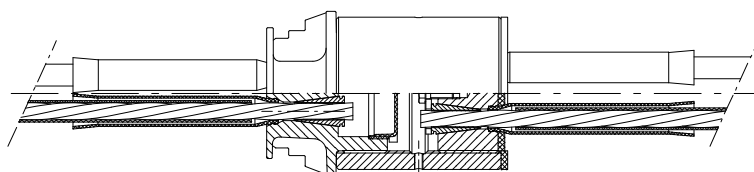


Fixed and stressing couplers FH, SH

Sleeve coupler H CONA CMM S1-0106 (single)



Sleeve coupler H CONA CMM S1-0406 (four)



VT CMM Band

VT CMM Band 01-140
VT CMM Band 01-150



VT CMM Band 02-140
VT CMM Band 02-150



VT CMM Band 04-140
VT CMM Band 04-150



VT CMM Band 01-165



VT CMM Band 02-165



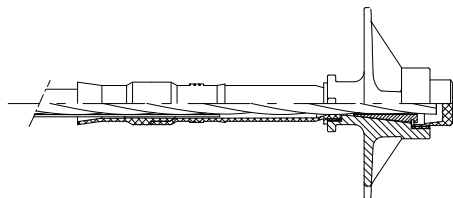
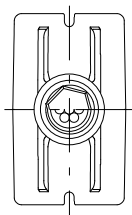
VT CMM Band 04-165



¹⁾ Wedges secured with wedge retaining plates are also available.

Stressing anchorage, accessible fixed anchorage SA, FA

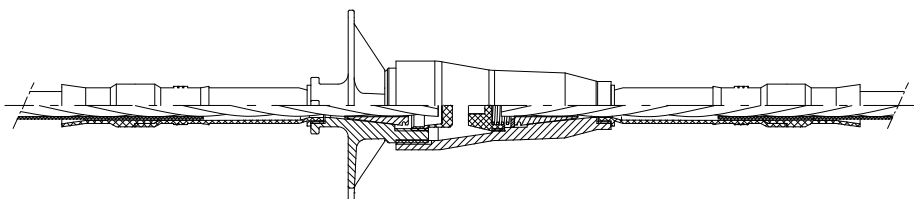
CONA CMM S2-0106
(single)




Monostrand
or VT CMM Band

Fixed and stressing coupler FT, ST

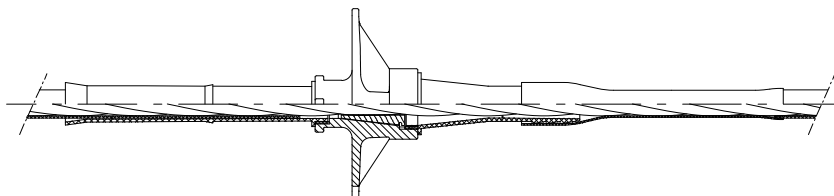
Coupler T CONA CMM S2-0106 (single)




Monostrand
or VT CMM Band

Stressing intermediate anchorage SIA

SIA CONA CMM S2-0106 (single)




Monostrand
or VT CMM Band

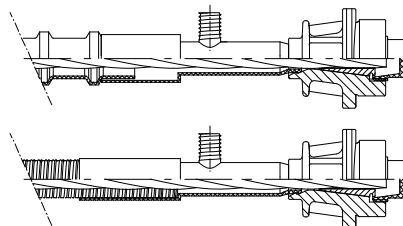
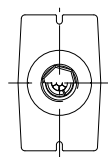
VT CMM Band

VT CMM Band 01-140
VT CMM Band 01-150



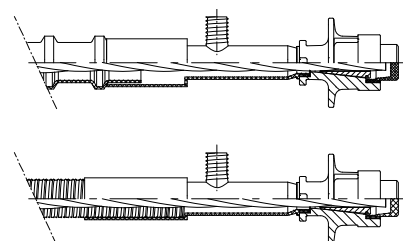
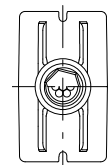
Stressing anchorages, accessible fixed anchorages SA, FA

CONA CMM S1-0106
(single)




Monostrand
or VT CMM Band

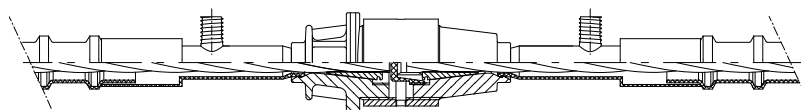
CONA CMM S2-0106
(single)



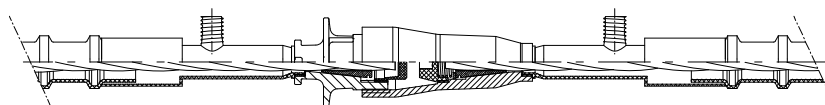

Monostrand
or VT CMM Band

Fixed and stressing couplers FH, SH

H CONA CMM S1-0106 (single)

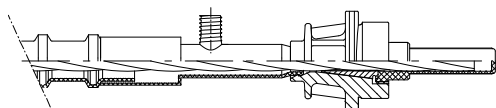


T CONA CMM S2-0106 (single)

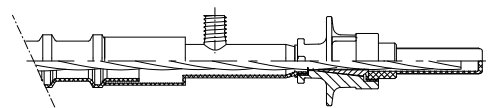


Restressable and exchangeable anchorages SA, FA

CONA CMM S1-0106 (single)

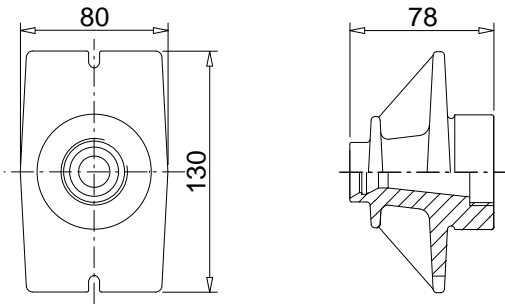


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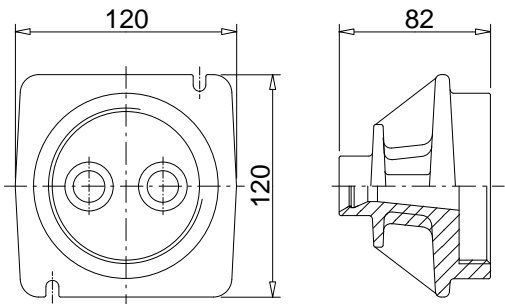


Stressing and fixed anchorages

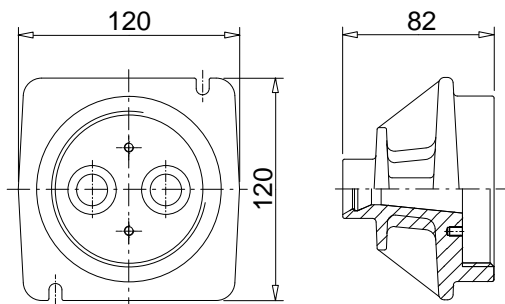
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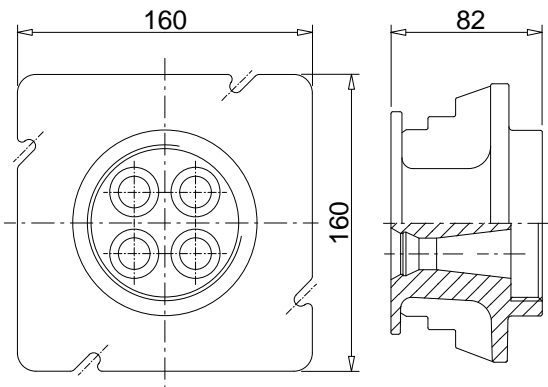
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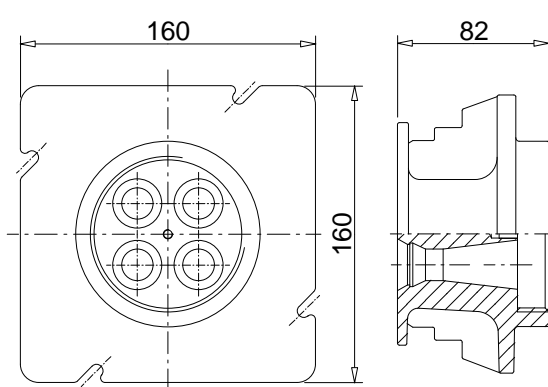
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(S/F) A CONA CMM S1-0406 (four) A1



(S/F) A CONA CMM S1-0406 (four) A2

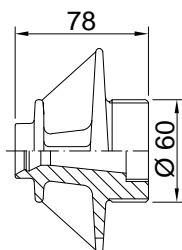


Dimensions in mm

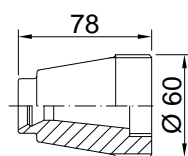
Fixed couplers

H CONA CMM S1-0106 (single)

1. BA

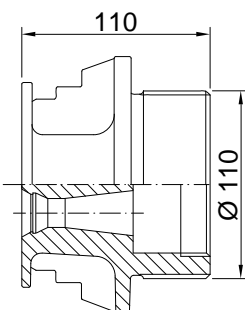


2. BA

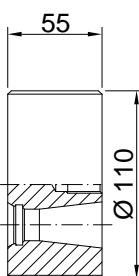


H CONA CMM S1-0406 (four)

1. BA

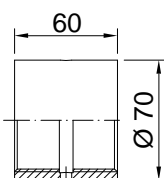


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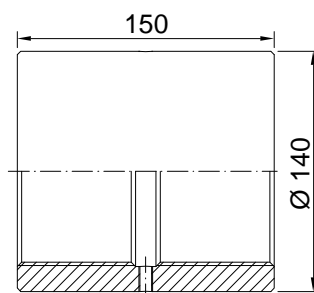


Threaded coupler sleeves

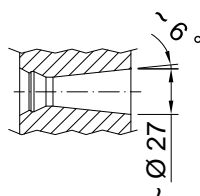
H CONA CMM S1-0106 (single)



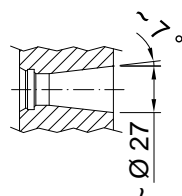
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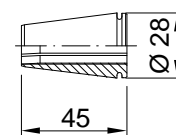
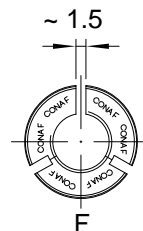
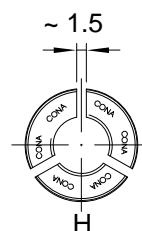
Cast iron cone S1



Machined cone



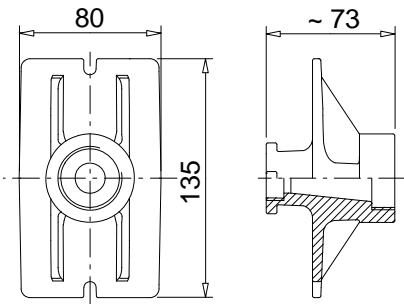
Ring wedges



Dimensions in mm

Stressing and fixed anchorage

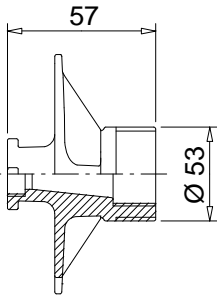
A CONA CMM S2-0106



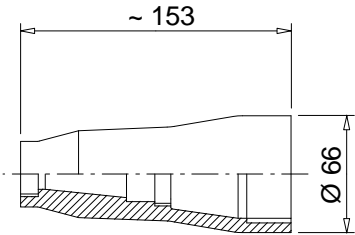
Fixed coupler

T CONA CMM S2-0106

1. BA

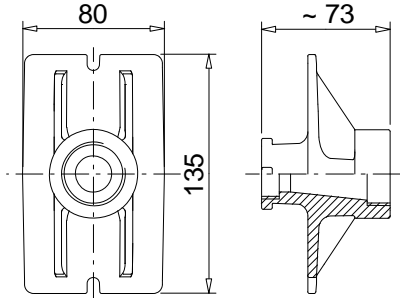


2. BA

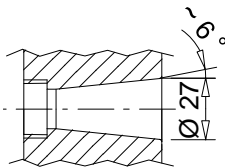


Stressing intermediate anchorage SIA

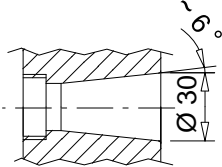
SIA CONA CMM S2-0106



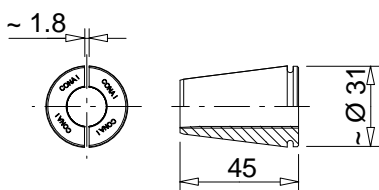
Cast iron cone S2



Intermediate cone S2



Ring wedge



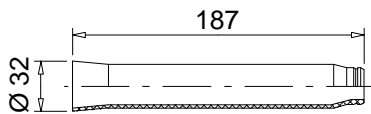
Dimensions in mm



Internal Post-tensioning System
 Components – Anchorages and fixed coupler – S2

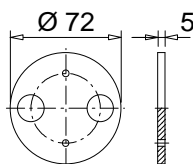
Annex 6
 of European Technical Assessment
ETA-06/0165 of 08.06.2018

Transition pipe S1

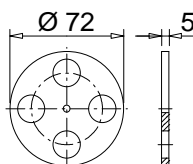


Wedge holding plate

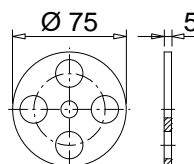
A CONA CMM S1-0206 (two)
A2



A CONA CMM S1-0406 (four)
A2

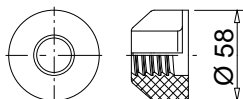


H CONA CMM S1-0406 (four),
2. BA

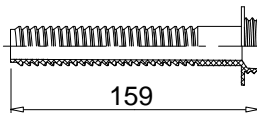


Pocket former set

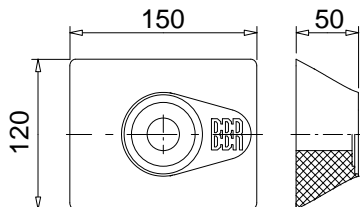
Nut S1-0106, S2-0106



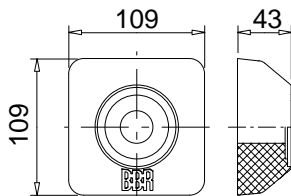
Mandrel S1-0106, S2-0106



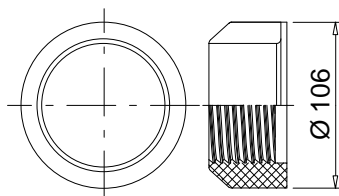
Pocket former R S1-0106, R S2-0106



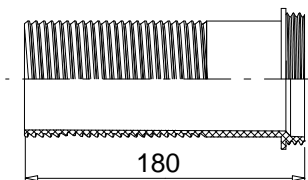
Pocket former C S1-0106



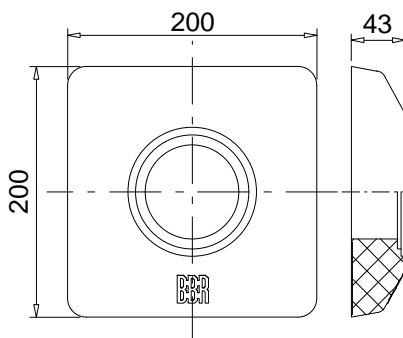
Nut S1-0206, S1-0406



Mandrel S1-0206
S1-0406

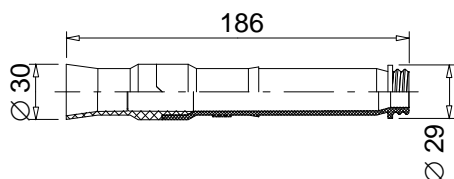


Pocket former C S1-0206
C S1-0406

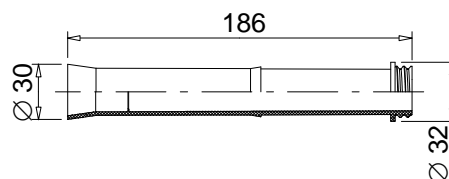


Dimensions in mm

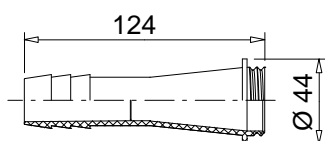
Transition pipe A-S2



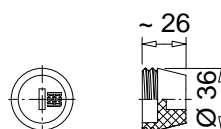
Transition pipe I-S2



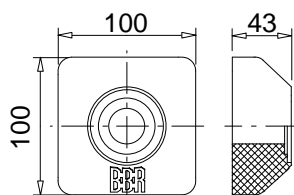
Protection pipe-S2



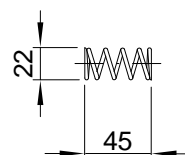
Coupler plug CONA CMM S2-0106



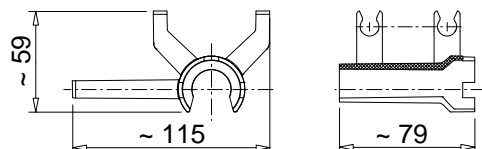
Pocket former C S2-0106



Spring A

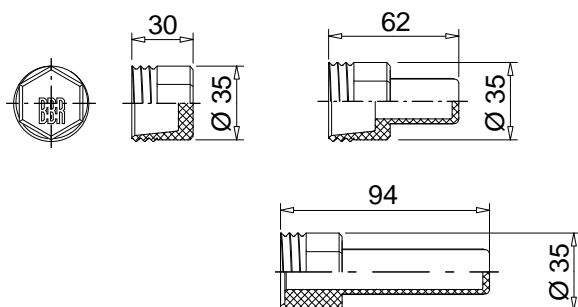


Reinforcement chair CONA CMM S2-0106

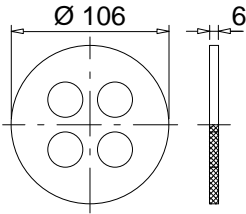
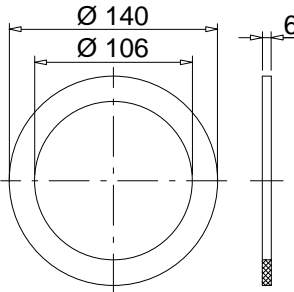
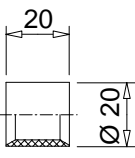
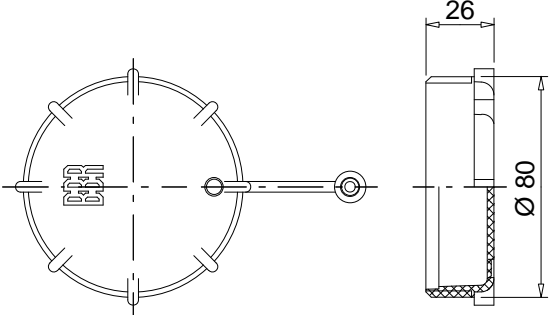
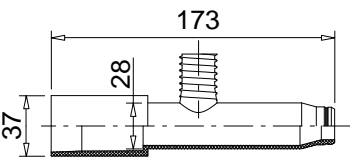
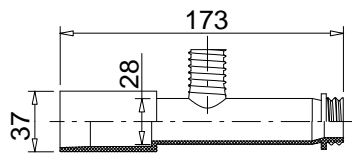
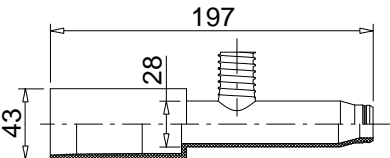
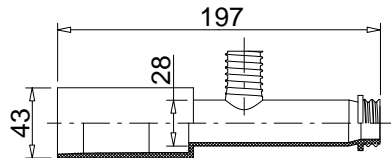



Protection caps

CONA CMM S1-0106 (single), CONA CMM S2-0106 (single)
Protection caps with holes for ventilation are also available.



Dimensions in mm

<p>BDSB-plate</p> <p>CONA CMM S1-406 (four) Version A</p> 	<p>Version DF</p> 	<p>Wedge holding ring</p> 
<p>Protection caps</p> <p>CONA CMM S1-0206 (two) CONA CMM S1-0406 (four)</p> 		
<p>(Grouting) Transition pipe steel duct A</p> <p>CONA CMM S1-0106 (single)</p> 	<p>CONA CMM S2-0106 (single)</p> 	
<p>(Grouting) Transition pipe plastic duct A</p> <p>CONA CMM S1-0106 (single)</p> 	<p>CONA CMM S2-0106 (single)</p> 	<p>Dimensions in mm</p>
	<p>Internal Post-tensioning System Components – Accessory</p>	<p>Annex 9 of European Technical Assessment ETA-06/0165 of 08.06.2018</p>

Material characteristics

Component	Standard / Specification
Anchor head S1-0106/0206/0406 Anchor head S2-0106	EN 1563
Coupler anchor head S1-0106/0406 – 1. BA Coupler anchor head S2-0106 – 1. BA	EN 1563
Coupler anchor head S1-0106 – 2. BA Coupler anchor head S2-0106 – 2. BA	EN 1563 EN 10083-1 EN 10083-2
Coupler anchor head S1-0406 – 2. BA	EN 10083-1 EN 10083-2
Coupler sleeve S1-0106/0406 Coupler sleeve S1-0106	EN 10210-1
Ring wedge H F I	EN 10277-2 EN 10084
Wedge holding plate	EN 10025-2
Helix	Ribbed reinforcing steel, $R_e \geq 500$ MPa
Additional reinforcement, stirrups	Ribbed reinforcing steel, $R_e \geq 500$ MPa ¹⁾
Transition pipes S1 Transition pipes S2 A and I Protection pipes S1 Protection pipes S2	EN ISO 16396-1 EN ISO 17855-1
Grout pipe	EN ISO 16396-1 EN ISO 17855-1
Wedge holding ring Protection caps S1 and S2 Coupler plug CONA CMM S2-0106 Pocket former sets	EN ISO 17855-1
Spring A	EN 10270-1
Steel strip sheath	EN 523
Smooth steel duct Smooth plastic duct	EN 10255, EN 10216-1, EN 10217-1, EN 10219-1, EN 10305-5 EN 12201-1
BDSD-plate	—

¹⁾ Ribbed reinforcing steel with $R_e \geq 460$ MPa may be placed according to Annex 14 and Annex 15.

7-wire prestressing steel strands according to prEN 10138-3 ¹⁾

Steel designation			Y1770S7	Y1860S7	Y1770S7	Y1860S7	Y1820S7G
Tensile strength	R _m	MPa	1 770	1 860	1 770	1 860	1 820
Diameter	D	mm	15.3	15.3	15.7	15.7	15.2 ²⁾
Nominal cross-sectional area	A _p	mm ²	140	140	150	150	165
Nominal mass per metre	M	kg/m	1.093		1.172		1.289
Permitted deviation from nominal mass		%	± 2				
Characteristic value of maximum force	F _{pk}	kN	248	260	266	279	300
Maximum value of maximum force	F _{m, max}	kN	285	299	306	321	345
Characteristic value of 0.1 % proof force ³⁾	F _{p0.1}	kN	218	229	234	246	264
Minimum elongation at maximum force, L ₀ ≥ 500 mm	A _{gt}	%	3.5				
Modulus of elasticity	E _p	MPa	195 000 ⁴⁾				

¹⁾ Suitable prestressing steel strands according to standards and regulations in force at the place of use may also be used.

²⁾ Compacted strand

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

⁴⁾ Standard value

CONA CMM S1-0106/0206/0406-140 and CONA CMM S2-0106-140

Number of strands	Nominal cross-sectional area of prestressing steel	Nominal mass of prestressing steel	Nominal mass of tendon	Characteristic value of maximum force of tendon	
				$f_{pk} = 1\,770\text{ MPa}$	$f_{pk} = 1\,860\text{ MPa}$
n	A_p	M	M	F_{pk}	F_{pk}
—	mm ²	kg/m	kg/m	kN	kN
01	140	1.09	1.23	248	260
02	280	2.19	2.46	496	520
04	560	4.37	4.92	992	1 040

CONA CMM S1-0106/0206/0406-150 and CONA CMM S2-0106-150

Number of strands	Nominal cross-sectional area of prestressing steel	Nominal mass of prestressing steel	Nominal mass of tendon	Characteristic value of maximum force of tendon	
				$f_{pk} = 1\,770\text{ MPa}$	$f_{pk} = 1\,860\text{ MPa}$
n	A_p	M	M	F_{pk}	F_{pk}
—	mm ²	kg/m	kg/m	kN	kN
01	150	1.17	1.31	266	279
02	300	2.34	2.62	532	558
04	600	4.69	5.24	1 064	1 116

CONA CMM S1-0106C/0206C/0406C-165, Compacted strand

Number of strands	Nominal cross-sectional area of prestressing steel	Nominal mass of prestressing steel	Nominal mass of tendon	Characteristic value of maximum force of tendon
				$f_{pk} = 1\,820\text{ MPa}$
n	A_p	M	M	F_{pk}
—	mm ²	kg/m	kg/m	kN
01	165	1.29	1.42	300
02	300	2.58	2.84	600
04	660	5.16	5.68	1 200

Maximum prestressing and oversteering forces

CONA CMM S1-0106 (C) (single)

Prestressing steel strands	A_P	mm ²	140		150		165 ¹⁾
Characteristic tensile strength	f_{pk}	MPa	1 770	1 860	1 770	1 860	1 820
Characteristic value of maximum force of tendon	F_{pk}	kN	248	260	266	279	300
Maximum prestressing force ²⁾	$0.90 \cdot F_{p0.1}$	kN	196	206	211	221	238
Maximum oversteering force ^{2), 3)}	$0.95 \cdot F_{p0.1}$	kN	207	218	222	234	251

CONA CMM S2-0106 (single)

Prestressing steel strands	A_P	mm ²	140		150	
Characteristic tensile strength	f_{pk}	MPa	1 770	1 860	1 770	1 860
Characteristic value of maximum force of tendon	F_{pk}	kN	248	260	266	279
Maximum prestressing force ²⁾	$0.90 \cdot F_{p0.1}$	kN	196	206	211	221
Maximum oversteering force ^{2), 3)}	$0.95 \cdot F_{p0.1}$	kN	207	218	222	234

CONA CMM S1-0206 (C) (two)

Prestressing steel strands	A_P	mm ²	140		150		165 ¹⁾
Characteristic tensile strength	f_{pk}	MPa	1 770	1 860	1 770	1 860	1 820
Characteristic value of maximum force of tendon	F_{pk}	kN	496	520	532	558	600
Maximum prestressing force ²⁾	$0.90 \cdot F_{p0.1}$	kN	392	412	421	443	475
Maximum oversteering force ^{2), 3)}	$0.95 \cdot F_{p0.1}$	kN	414	435	445	467	502

CONA CMM S1-0406 (C) (four)

Prestressing steel strands	A_P	mm ²	140		150		165 ¹⁾
Characteristic tensile strength	f_{pk}	MPa	1 770	1 860	1 770	1 860	1 820
Characteristic value of maximum force of tendon	F_{pk}	kN	992	1 040	1 064	1 116	1 200
Maximum prestressing force ²⁾	$0.90 \cdot F_{p0.1}$	kN	785	824	842	886	950
Maximum oversteering force ^{2), 3)}	$0.95 \cdot F_{p0.1}$	kN	828	870	889	935	1 003

1) Compacted strand

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

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

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

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

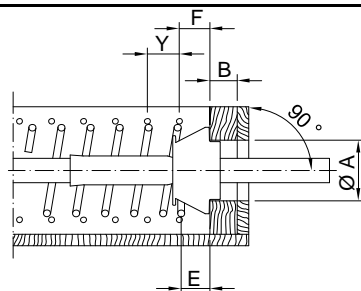
3) Oversteering is permitted if the force in the prestressing jack can be measured to an accuracy of $\pm 5\%$ of the final value of the prestressing force.



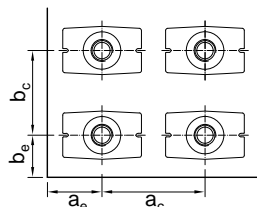
Internal Post-tensioning System
Maximum prestressing and oversteering forces

Annex 13
of European Technical Assessment
ETA-06/0165 of 08.06.2018

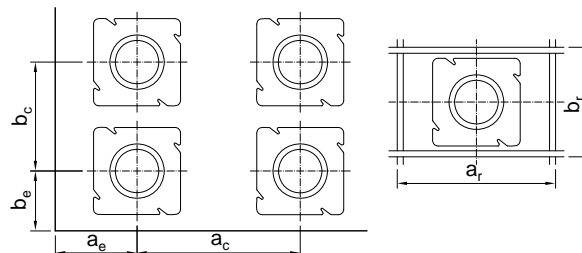
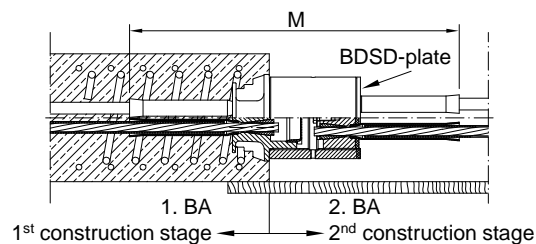
Stressing and fixed
anchorage / coupler S1



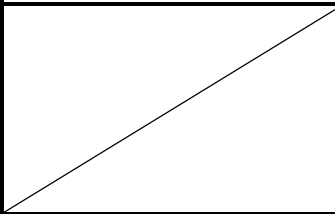
Centre and edge
distance



Additional reinforcement



Technical data of the BBR VT CONA CMM S1 anchorage and coupler anchorage system

BBR VT CONA CMM ¹⁾			S1-0106 (single)				S1-0206 (two)					S1-0406 (four)									
Strands	A _p	mm ²	140		150		165	140		150		165	140		150		165				
Char. tensile strength	f _{pk}	MPa	1770	1860	1770	1860	1820	1770	1860	1770	1860	1820	1770	1860	1770	1860	1820				
Char. value of maximum force	F _{pk}	kN	248	260	266	279	300	496	520	532	558	600	992	1040	1064	1116	1200				
0.90 · F _{p0.1k} ²⁾		kN	196	206	211	221	238	392	412	421	443	475	785	824	842	886	950				
0.95 · F _{p0.1k} ²⁾		kN	207	218	222	234	251	414	435	445	467	502	828	870	889	935	1003				
Dimensions of strands / band		mm	Ø 20					2 × Ø 20 / 44 × 20					4 × Ø 20 / 90 × 20								
Minimum concrete strength																					
Cube	f _{cm,0}	MPa	≥ 24																		
Cylinder	f _{cm,0}	MPa	≥ 20																		
Helix, anchorage sided end is welded								Ribbed reinforcing steel, R _e ≥ 500 MPa													
Outer diameter	mm							100					160								
Bar diameter	mm							10					12								
Length, approx.	mm							180					275								
Pitch	mm							40					50								
Number of pitches	—							4 + 1					5 + 1								
Distance	E	mm						50					45								
Additional reinforcement ³⁾			Ribbed reinforcing steel, R _e ≥ 500 MPa ⁴⁾																		
Number of stirrups	—		2					4					6								
Bar diameter	mm		8					10					10								
Spacing	Y	mm	50					50					55								
Distance from anchor plate	F	mm	55					25					53								
Outside dimensions	a _r	mm	140					180					260								
	b _r	mm	100					130					180								
Centre and edge spacing																					
Minimum centre	a _c	mm	180					200					300								
spacing	b _c	mm	140					150					220								
Minimum edge distance	a _e	mm	70 + c					90 + c					130 + c								
	b _e	mm	50 + c					65 + c					90 + c								
Bore in forms	ØA	mm	65					103					103								
Bore in forms for coupler 1. BA	ØA	mm	62					—					113								
Depth	B	mm	50					50					50								
Coupler	M	mm	~ 545					—					~ 565								

¹⁾ For strand pattern see Annex 4.

²⁾ For prestressing steel strands according to prEN 10138-3, 2000, the values are multiplied by 0.98.

³⁾ Additional reinforcement may be replaced by a rectangular helix of identical characteristics and number of pitches equal to number of stirrups plus one.

⁴⁾ Reinforcing steel with R_e ≥ 460 MPa requires a stirrup spacing of 40 mm and one additional stirrup.

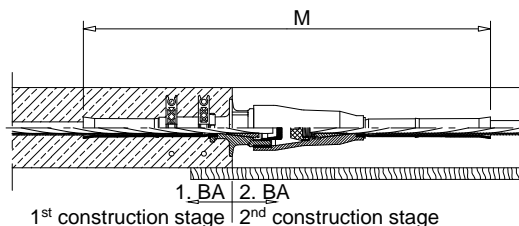
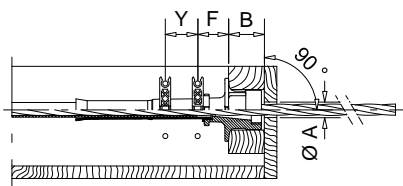
cConcrete cover



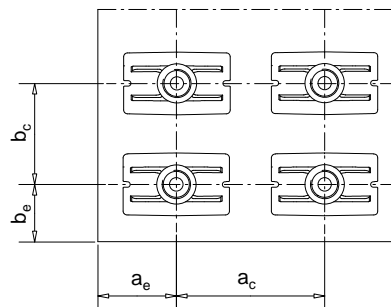
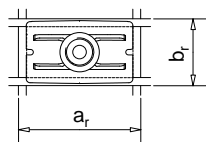
Internal Post-tensioning System
Dimensions of anchorages, helix, and additional
reinforcement, centres spacing and edge distance
Anchorages and couplers S1

Annex 14
of European Technical Assessment
ETA-06/0165 of 08.06.2018

Stressing and fixed
anchorage / coupler S2



Additional reinforcement
Centre and edge
distance



Technical data of the BBR VT CONA CMM S2 anchorage, coupler anchorage and intermediate anchorage system

BBR VT CONA CMM ¹⁾			S2-0106 (single)				S2-0106 (single)				S2-0106 (single)					
Strands	A _p	mm ²	140		150		140		150		140		150			
Char. tensile strength	f _{pk}	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		
Char. value of maximum force	F _{pk}	kN	248	260	265	279	248	260	265	279	248	260	265	279		
0.90 · F _{p0.1k} ²⁾		kN	192	206	206	216	192	206	206	216	192	206	206	216		
0.95 · F _{p0.1k} ²⁾		kN	202	218	218	228	202	218	218	228	202	218	218	228		
Dimensions of strands / band		mm	Ø 20				Ø 20				Ø 20					
Minimum concrete strength																
Cube	f _{cm,0}	MPa	≥ 22								≥ 23					
Cylinder	f _{cm,0}	MPa	≥ 18								≥ 19					
Helix ³⁾ , anchorage sided end is welded			Ribbed reinforcing steel, R _e ≥ 500 MPa ³⁾													
Outer diameter		mm	155/85													
Bar diameter		mm	10													
Length, approx.		mm	165													
Pitch		mm	45													
Number of pitches		—	3													
Distance	E	mm	40													
Additional reinforcement ⁴⁾			Ribbed reinforcing steel, R _e ≥ 500 MPa ⁴⁾													
Number of stirrups		—									2					
Bar diameter		mm									10					
Spacing	Y	mm									45					
Distance from anchor plate	F	mm									40					
Outside dimensions	a _r	mm					155									
	b _r	mm					85									
Centre and edge spacing																
Minimum centre spacing	a _c	mm					175				175		235			
	b _c	mm					105				105		150			
Minimum edge distance	a _e	mm					78 + c				78 + c		108 + c			
	b _e	mm					43 + c				43 + c		65 + c			
Bore in forms	Ø A	mm	53				53		53							
Bore in forms for coupler 1. BA	Ø A	mm	55				55		55							
Depth	B	mm	50				50		50							
Coupler	M	mm	~ 567				~ 567		~ 567							

¹⁾ For strand pattern see Annex 6.

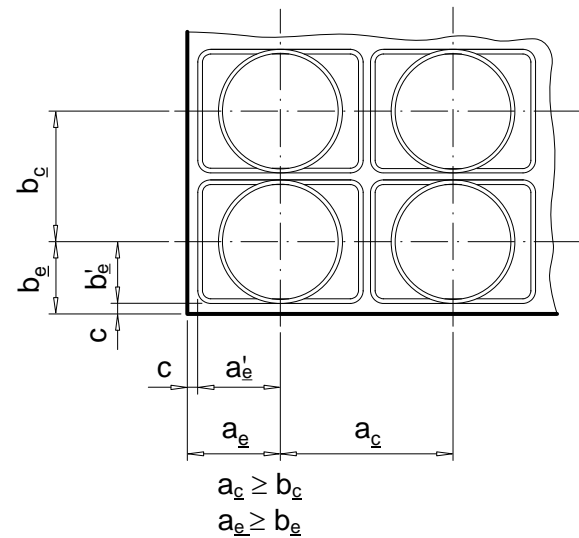
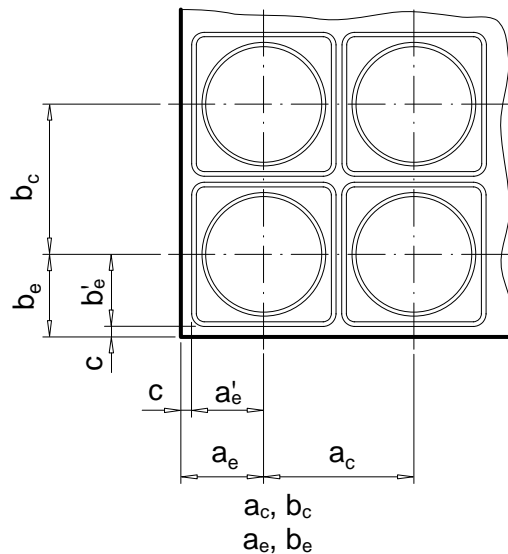
²⁾ For prestressing steel strands according to prEN 10138-3, 2000, the values are multiplied by 0.98.

³⁾ Reinforcing steel with R_e ≥ 460 MPa requires a pitch of 40 mm and one additional turn.

⁴⁾ Reinforcing steel with R_e ≥ 460 MPa requires a stirrup spacing of 40 mm and one additional stirrup.

c Concrete cover, Concrete cover refers to reinforcement, placed in the same cross section, however 10 mm as a minimum.

Centre spacing and edge distance



Modification of centre spacing and edge distance are in accordance with the Clauses 1.8 and 2.2.3.4.

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

$$a_c \geq \frac{A_c}{b_c}$$

$$A_c = a_c \cdot b_c \leq a_c \cdot b_c$$

Corresponding edge distances

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

and

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

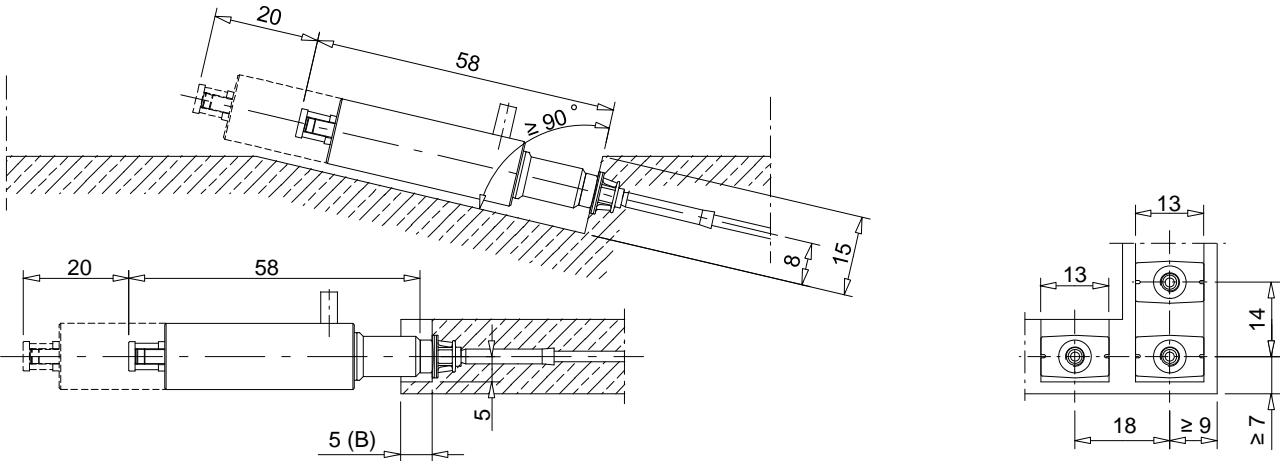
c..... Concrete cover

¹⁾ The outer dimensions of the additional reinforcement are adjusted accordingly. Further modifications of reinforcement are in accordance with the Clause 1.12.5 and 2.2.3.4.

Construction examples, minimised anchorage recess dimensions

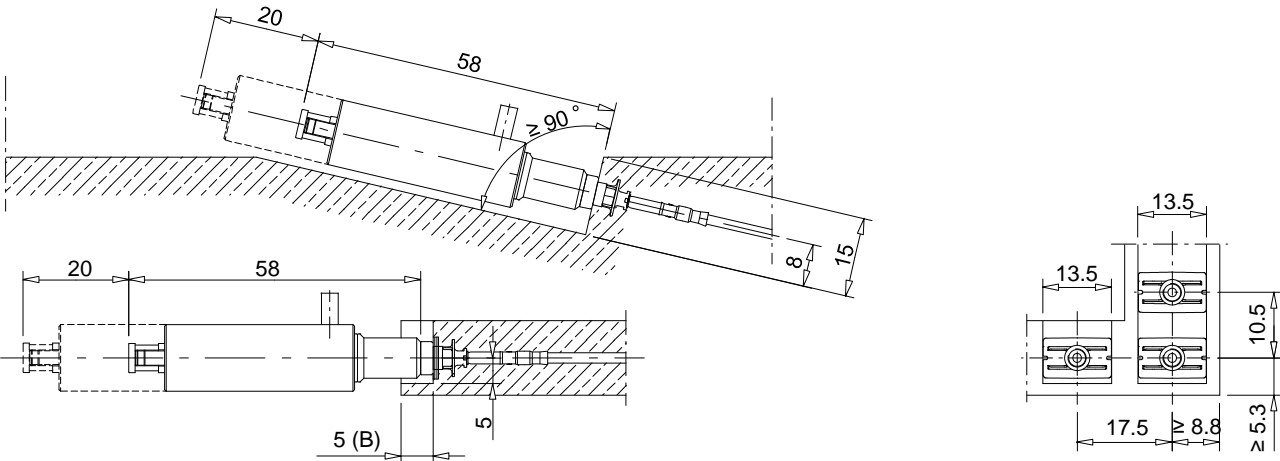
Tendon CONA CMM S1-0106 (single)
 Strand excess length: 70 cm

Supposed 2 cm concrete cover



Tendon CONA CMM S2-0106 (single)
 Strand excess length: 70 cm

Supposed 1 cm concrete cover



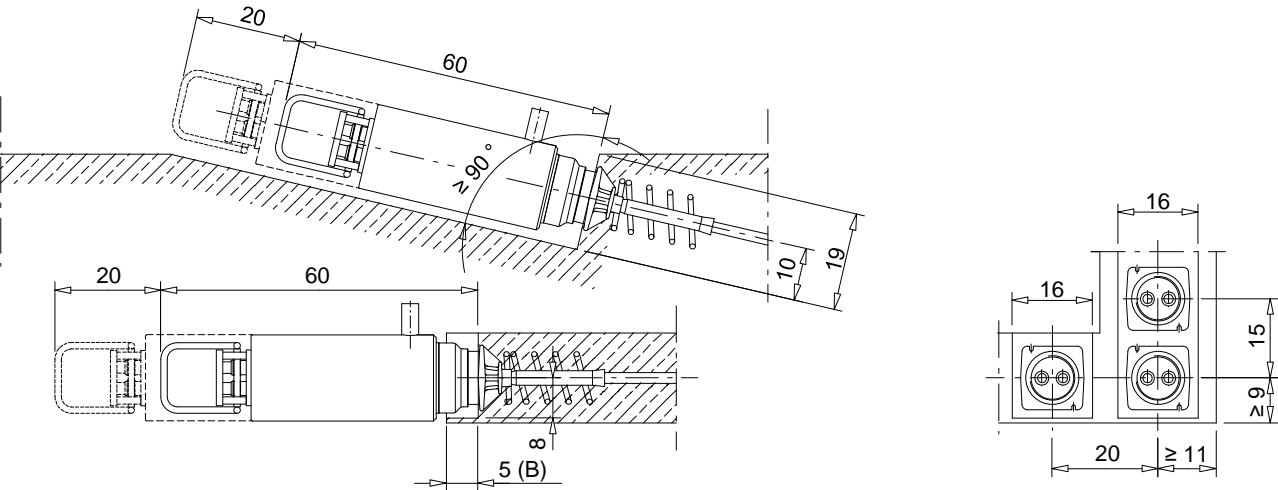
If other prestressing jacks will be used, different minimum dimensions may apply. Ask ETA holder for advice.

Dimensions in cm

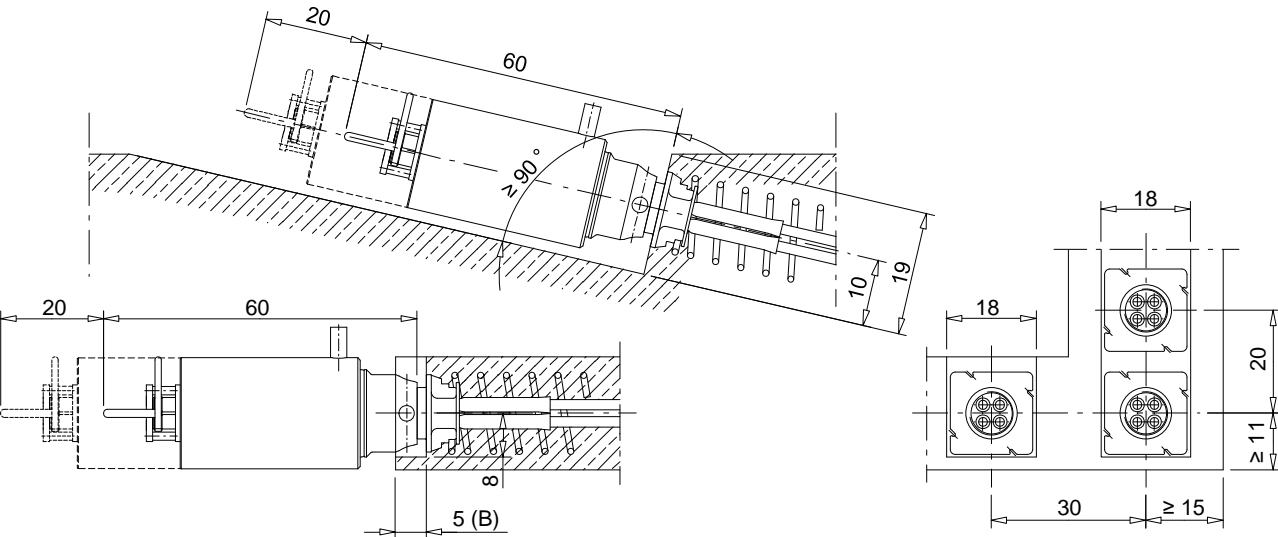
Construction examples, minimised anchorage recess dimensions

Tendon CONA CMM S1-0206 (two)
Strand excess length: 40 cm

Supposed 2 cm concrete cover



Tendon CONA CMM S1-0406 (four)
Strand excess length: 40 cm



If other prestressing jacks will be used, different minimum dimensions may apply. Ask ETA holder for advice.

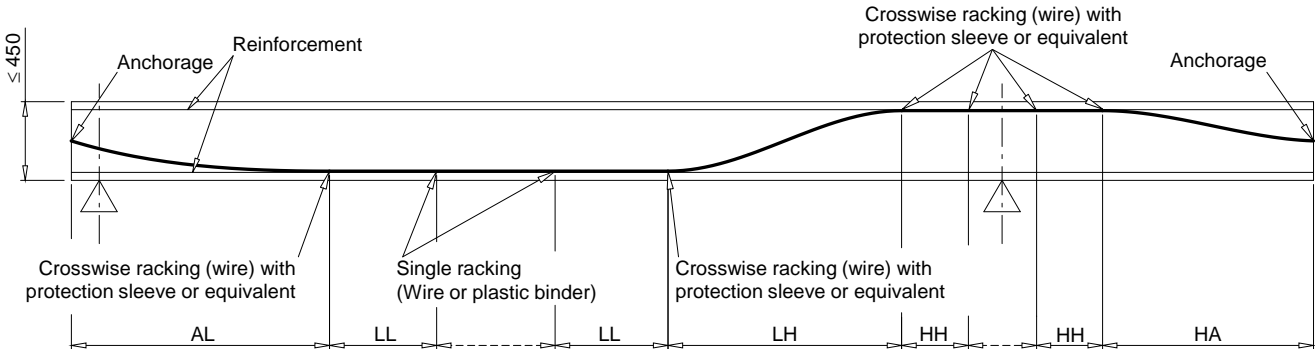
Dimensions in cm



Internal Post-tensioning System
Dimensions of anchorage recesses – S1

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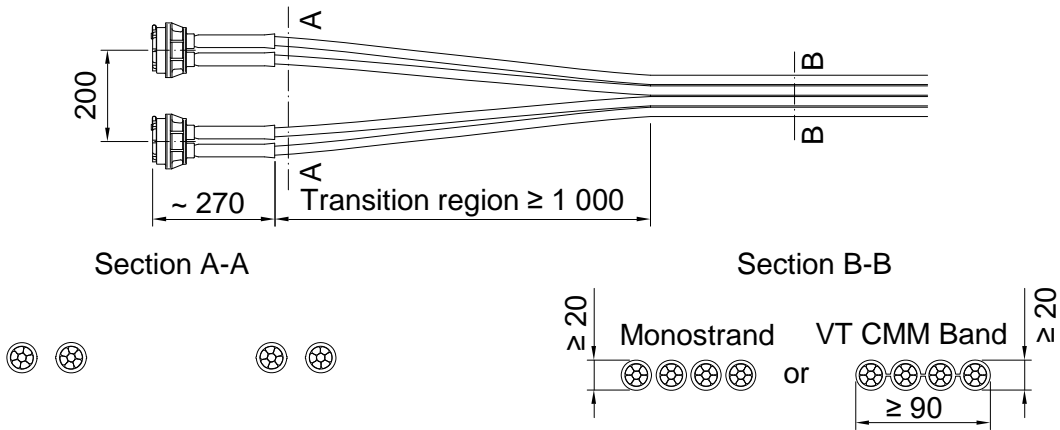
Free tendon layout



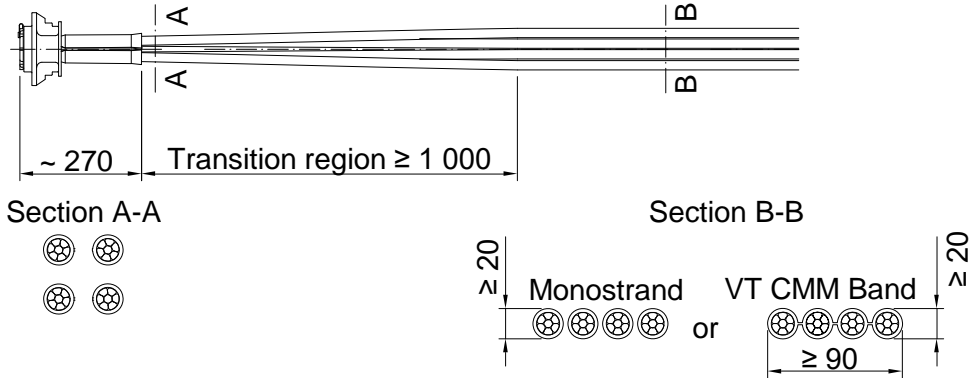
Typical zones		Max. distances	Min. number	Racking
AL	Anchor – Low point	3 m	—	crosswise
LL	Low point – Low point	(1.0–1.3) m	2	single wire
LH	Low point – High point	3 m	—	crosswise
HH	High point – High point	(0.3–1.0) m	2	crosswise
HA	High point- Anchor	1.5 m	—	crosswise

Transition regions

Tendon CONA CMM S1-0206 (two)



Tendon CONA CMM S1-0406 (four)




Dimensions in mm



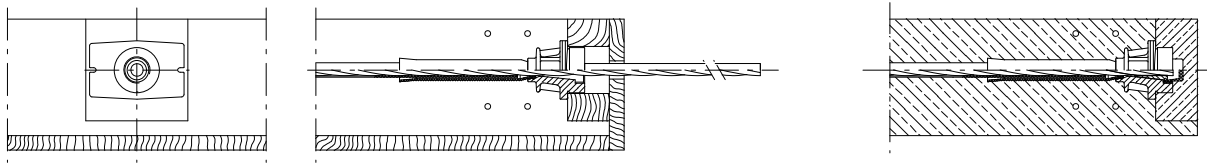
Internal Post-tensioning System
 Free tendon layout – Transition regions

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 of European Technical Assessment
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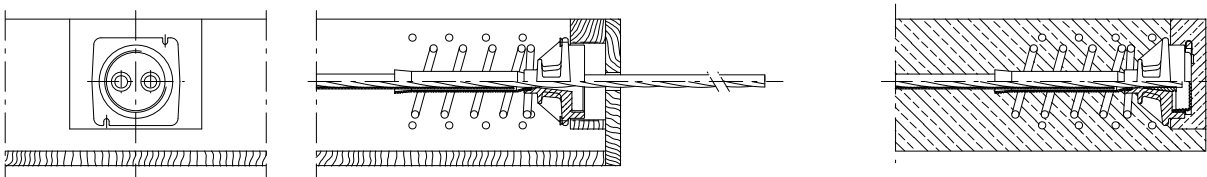
PT Works	A) Manufacturing of the tendon	Construction Works
<ol style="list-style-type: none"> Longitudinal cutting of the VT CMM Band ¹⁾ Removing the PE-sheathing at the end Wrapping the single prestressing steel strands with bandage filled with corrosion protective filling material in the region of the transition pipe Mounting the anchor block on the prestressing steel strands Prelocking the anchor block Securing wedges with wedge holding rings or holding plate ²⁾ Filling protection cap with corrosion protective filling material and screwing it onto the anchor block Coiling according to the tendon list and fixing the tendon for transport/ Transport ³⁾ 		
B) Preliminary site works		
<ol style="list-style-type: none"> Erection of the formwork 		
Fixing the active anchor block (SA, H 1. BA) on the formwork		
<ol style="list-style-type: none"> Placing reinforcement bottom layer and supporting stirrups 		
C) Tendon installation		
<ol style="list-style-type: none"> Placing the tendon Fastening the tendon with wire or plastic binder at the bottom layer and supporting stirrups 		
Coupling ⁴⁾ : The coupler anchor block 2. BA is mounted and prelocked on the prefabricated tendon		
<ol style="list-style-type: none"> Placing the coupler anchor block (2nd construction stage) Screwing-on the coupler sleeve on the coupler anchor 1. BA, meanwhile or afterwards filling of the space inside the coupler sleeve and both coupler anchor blocks with corrosion protective filling material. 		
Connecting tendon with the active anchor block (SA, H 1.BA)		
<ol style="list-style-type: none"> Longitudinal cutting of the VT CMM Band ¹⁾ Removing the PE-sheathing at the end Wrapping the single prestressing steel strands with bandage filled with corrosion protective filling material in the region of the transition pipe Inserting the prestressing steel strands into the anchor block Putting on removed PE-sheathing to protect excess strand length 		
<ol style="list-style-type: none"> Placing reinforcement top layer 		
<ol style="list-style-type: none"> Fastening tendon with wire or plastic binder on the reinforcement top layer 		
D) Concreting of the structure		
<ol style="list-style-type: none"> Concreting the structure, recommended to make testing cubes Determining concrete strength Dismantling the formwork at the active anchorage side 		
E) Stressing and finishing work		
<ol style="list-style-type: none"> Removal of protecting PE-sheaths and check whether cones are clean Inserting ring wedges Stressing the tendon according to stressing order Cutting excess strand lengths Filling protection cap with corrosion protective filling material and screwing it onto the anchor block 		
<ol style="list-style-type: none"> Filling of the anchorage recess with concrete ⁵⁾ 		
¹⁾ not applicable when assembling a tendon VT CMM 106 or monostrand ²⁾ applicable case of using an anchor body K VT CMM 406 – 2. BA ³⁾ not applicable in case of manufacturing on the site ⁴⁾ only applicable when using a coupler ⁵⁾ not applicable when assembling a coupler 1 st construction stage		
	Internal Post-tensioning System Description of worksteps – Anchorage Fixed coupler 1 st and 2 nd construction stage	
	Annex 20 of European Technical Assessment ETA-06/0165 of 08.06.2018	

Construction stages

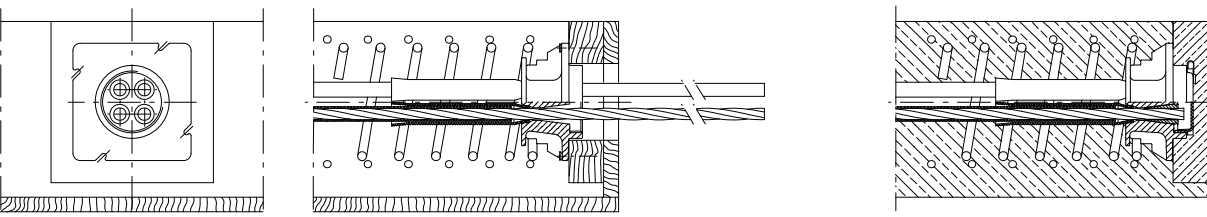
Tendon CONA CMM S1-0106 (single)



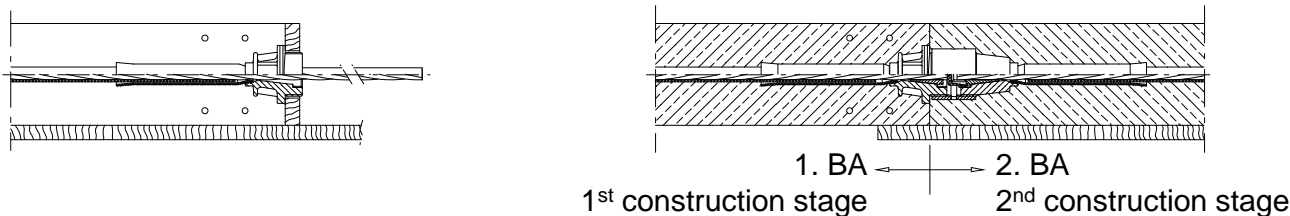
Tendon CONA CMM S1-0206 (two)



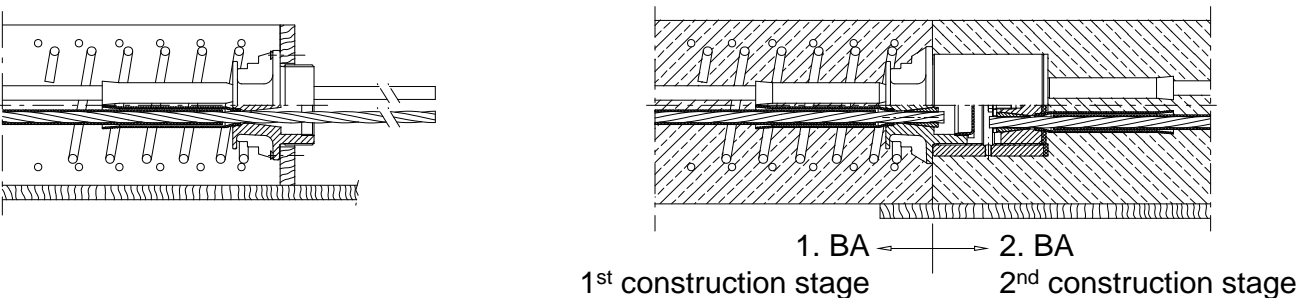
Tendon CONA CMM S1-0406 (four)



Fixed coupler CONA CMM S1-0106 (single)

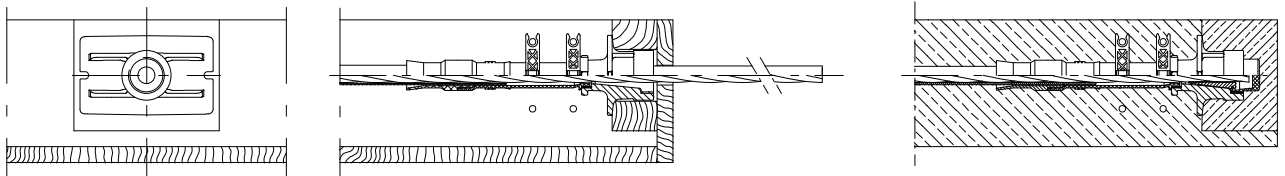


Fixed coupler CONA CMM S1-0406 (four)

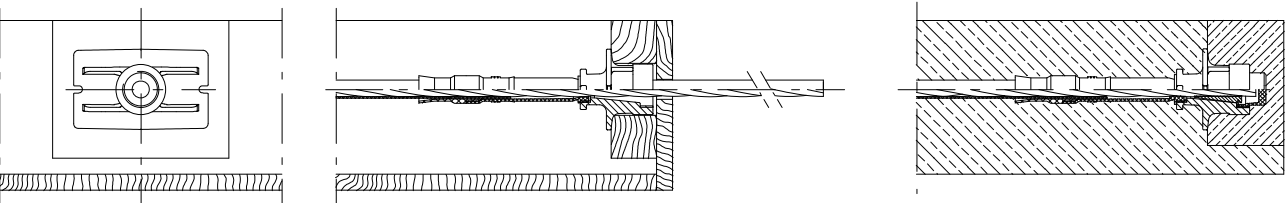


Construction stages

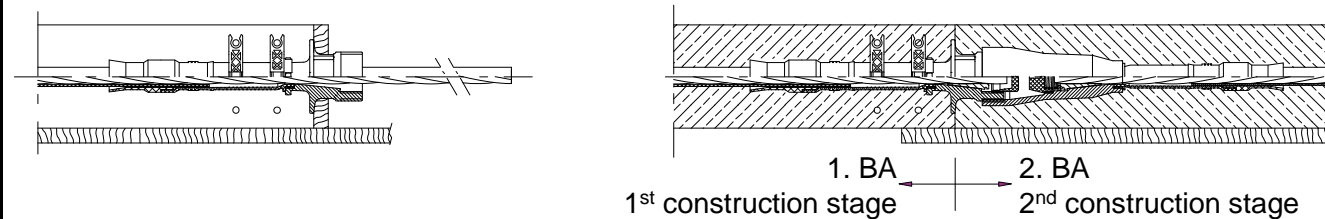
Tendon CONA CMM S2-0106 (with reinforcement)



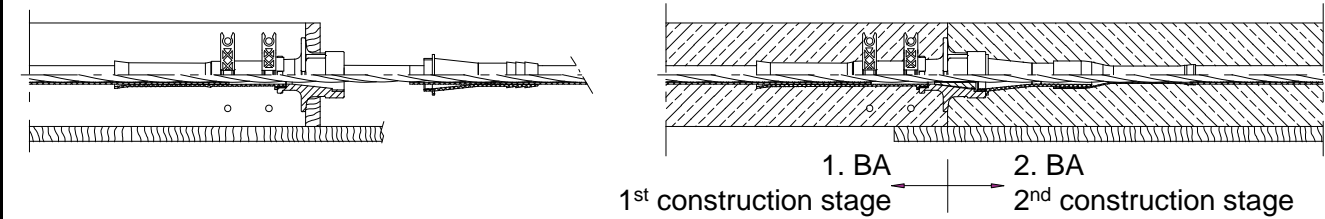
Tendon CONA CMM S2-0106 (without reinforcement)



Coupler CONA CMM S2-0106



Intermediate CONA CMM S2-0106



Contents of the prescribed test plan

Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
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			
VT CMM Band, Individual monostrand	Material	Checking	^{2), 4)}	100 %	continuous
	Diameter	Testing	^{2), 4)}	1 sample	each coil or every 7 tons ⁵⁾
	Visual inspection	Checking	^{2), 4)}	1 sample	

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.

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 of control method	Criteria, if any	Minimum number of samples ¹⁾	Minimum frequency of control
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		9	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 component

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

№	Essential Characteristic	Clause	Intended use Line № according to Clause 2.1, Table 8	
			1	2
1	Resistance to static load	3.2.1.1	+	+
2	Resistance to fatigue	3.2.1.2	+	+
3	Load transfer to the structure	3.2.1.3	+	+
4	Friction coefficient	3.2.1.4	+	+
5	Deviation, deflection (limits) for internal bonded and unbonded tendon	3.2.1.5	+	+
6	Assessment of assembly	3.2.1.6	+	+
7	Corrosion protection	3.2.1.7	+	+
8	Reaction to fire	3.2.2.1	+	+
9	Content, emission and/or release of dangerous substances	3.2.3.1	+	+

Key

+..... Essential characteristic relevant for the intended use

— Essential characteristic not relevant for the intended use

For combinations of intended uses, the essential characteristics of all intended uses composing the combination are relevant.



Internal Post-tensioning System
Essential characteristics for the intended uses

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Reference documents

European Assessment Documents

EAD 160004-00-0301	Post-Tensioning Kits for Prestressing of Structures
EAD 160027-00-0301	Special filling products for post-tensioning kits

Standards

Eurocode 2	Eurocode 2– Design of concrete structures
Eurocode 3	Eurocode 3 – Design of steel structures
Eurocode 4	Eurocode 4 – Design of composite steel and concrete structures
Eurocode 6	Eurocode 6 – Design of masonry structures
EN 206, 12.2013 + 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 1563, 12.2011	Founding – Spheroidal graphite cast irons
EN 10025-2, 11.2004	Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels
EN 10025-2/AC, 06.2005	
EN 10083-1, 08.2006	Steels for quenching and tempering – Part 1: General technical delivery conditions
EN 10083-2, 08.2006	Steels for quenching and tempering – Part 2: Technical delivery conditions for non alloy steels
EN 10084, 04.2008	Case hardening steels – Technical delivery conditions
EN 10204, 10.2004	Metallic products – Types of inspection documents
EN 10210-1, 04.2006	Hot finished structural hollow sections of non-alloy and fine grain steels – Part 1: Technical delivery conditions
EN 10216-1, 12.2013	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Non-alloy steel tubes with specified room temperature properties
EN 10217-1, 05.2002 + 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 10255:2004 + A1, 04.2007	Non-Alloy steel tubes suitable for welding and threading – Technical delivery conditions
EN 10270-1:2011 + A1, 05.2017	Steel wire for mechanical springs – Part 1: Patented cold drawn unalloyed spring steel wire

Reference documents

Standards

EN 10277-2, 03.2008	Bright steel products – Technical delivery conditions – Part 2: Steels for general engineering purposes
EN 10305-5, 03.2016	Steel tubes for precision applications – Technical delivery conditions – Part 5: Welded cold sized square and rectangular tubes
EN 12201-1, 09.2011	Plastics piping systems for water supply, and for drainage and sewerage under pressure – Polyethylene (PE) – Part 1: General
EN ISO 16396-1, 02.2015	Plastics – Polyamide (PA) moulding and extrusion materials – Part 1: Designation system, marking of products and basis for specifications
EN ISO 17855-1, 10.2014	Plastics – Polyethylene (PE) moulding and extrusion materials – Part 1: Designation system and basis for specifications
prEN 10138-3, 09.2000	Prestressing steels – Part 3: Strand
prEN 10138-3, 08.2009	Prestressing steels – Part 3: Strand
CWA 14646, 01.2003	Requirements for the installation of post-tensioning kits for prestressing of structures and qualification of the specialist company and its personnel

Other documents

98/456/EC	Commission decision 98/456/EC of 3 July 1998 on the procedure for attesting the conformity of construction products pursuant to Article 20 (2) of Council Directive 89/106/EEC as regards posttensioning kits for the prestressing of structures, Official Journal of the European Communities L 201 of 17 July 1998, p. 112
305/2011	Regulation (EU) № 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, OJ L 88 of 4 April 2011, p. 5, amended by Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, OJ L 157 of 27.05.2014, p. 76 and Commission Delegated Regulation (EU) № 574/2014 of 21 February 2014, OJ L 159 of 28.05.2014, p. 41
568/2014	Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014 amending Annex V to Regulation (EU) № 305/2011 of the European Parliament and of the Council as regards the assessment and verification of constancy of performance of construction products, OJ L 157 of 27.05.2014, p. 76

Materialprüfungsamt Nordrhein-Westfalen

Prüfen • Überwachen • Zertifizieren

Certificate of constancy of performance**0432-CPR-00299-1.2 (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 CMM - Unbonded and bonded Post-tensioning System
with 01, 02, and 04 Strands**

Bonded and unbonded post-tensioning kits for prestressing of structures with strands and monostrands

placed on the market under the name or trade mark of

BBR-VT International Ltd

Ringstr. 2

8603 Schwerzenbach (ZH) / Switzerland

and produced in the manufacturing plant(s)

BBR-VT International Ltd

Ringstr. 2

8603 Schwerzenbach (ZH) / Switzerland

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

ETA-06/0165, issued on 08.06.2018

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 07.09.2016 and will remain valid until 22.07.2023 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, 23.07.2018

by order

Dipl.-Ing. Hönig
Head of Certification Body (Dep. 21)

This Certificate consists of 1 page.

This Certificate replaces the Certificate no. 0432-CPR-00299-1.2
dated 07.09.2016, Version 02.

second copy

BBR VT International Ltd
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Technical Headquarters and Business Development Centre
Switzerland



A Global Network of Experts
www.bbrnetwork.com