Cerema

Direction technique
infrastructures de transport et matériaux

Designated according to Article 29 of Regulation (EU) No 305/2011

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European Technical Assessment

ETA 12/0150
of 20/06/2018

Technical Assessment Body issuing the ETA:	Cerema Direction technique infrastructures de transport et matériaux
Trade name of the construction product	BBV Post-tensioning System type L 7 EW to L 31 EW
Product family to which the construction product belongs	16. Reinforcing and prestressing steel for concrete (and ancillaries). Post tensioning kits.
Manufacturer	BBV Systems GmbH Industriestraße 98 67240 Bobenheim Roxheim GERMANY
Manufacturing plant(s)	BBV Systems GmbH Industriestraße 98 67240 Bobenheim Roxheim GERMANY
This European Technical Assessment contains	36 pages including 18 Annexes (18 pages) which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	EAD 160004-00-0301 edition September 2016
This ETA replaces	ETA 12/0150 version 1, issued on 22/07/2015

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1. Technical description of the products

1.1. Definition of the product

The present European Technical Assessment applies to a kit :

BBV external or internal unbonded post-tensioning kit BBV L7 EW – L31 EW

consisting of 7 to 31 strands with a nominal tensile strength of 1860 N/mm² (Y1860 S7) and a nominal diameter of 15,7 mm (0.62" – 150 mm²).

Each monostrand is individually greased and plastic sheathed with a 2,0 mm PE coat which shall be in accordance with prEN 10138-3. Mass of sheathing per metre of PE- sheathing is around 111 g/m (mean value). Mass of filling material per metre is around 50 g/m (mean value).

The strands are used with the following anchors :

- Stressing (active) anchor and fixed (passive) anchor with bearing plate and anchor head for tendons of 7 to 15 strands.
- Stressing (active) anchor and fixed (passive) anchor with cast iron anchor body and anchor head for tendons of 12 to 31 strands.
- Stressing (active) anchor and fixed (passive) anchor with concrete anchor body and anchor head for tendons of 7 to 27 strands.
- Bursting reinforcement (helixes and stirrups)
- Corrosion protection

A detailed definition of the product is available in Annexes 17 and 18.

The components comply with the drawings and provisions given in this European Technical Assessment including the Annexes. The characteristic material values, dimensions and tolerances of the components not indicated in the Annexes shall correspond to the respective values laid down in the technical documentation of this European Technical Assessment. The technical documentation of this ETA is deposited with the Cerema and, as far as relevant for the tasks of the notified bodies involved in the assessment and verification of constancy of performance procedure, is handed over to the notified bodies. The arrangement of the tendons, the design of the anchorage zones and the anchorage components shall correspond to the attached descriptions and drawings; the dimensions and materials shall comply with the values given therein.

1.2. Components

1.2.1. Strands

Only 7-wire monostrands which are individually greased and sheathed shall be used in accordance to prEN 10138-3 or national provisions with the characteristics given in Table 1:

Table 1 Dimensions and properties of 7-wire strands

Designation	Symbol	Unit	Value
Tensile strength	R_m	MPa	1860
Nominal diameter	D	mm	15.7
Nominal cross section	A_P	mm²	150
Nominal mass	M	g/m	1172

Only strands stranded in the same direction shall be used in a tendon. Further characteristic values of the strands see Annex 13 and 14.

1.2.2. Wedges

Smooth wedges type 30, (see Annex 4) are approved. The segments of the wedges for the strand ⌀ 15.7 mm shall be marked with “0.62”.

1.2.3. Anchor heads

The conical boreholes of the anchor heads shall be clean and stainless and provided with corrosion protection mass.

Sizes of the anchor heads and geometrical arrangement correspond to the drawings in Annex 4.

1.2.4. Bearing plate

For 7 to 9 strands, circular bearing plates shall be used (see Annex 4).

For 12 to 15 strands, circular bearing plates can be used depending on the requirements of the designer.

1.2.5. Cast iron anchor body

For 12 to 31 strands, multi-surfaced cast-iron anchor bodies can be used (see Annex 4) depending on the requirements of the designer.

1.2.6. Concrete anchor body (HA-CAB)

For 7 to 27 strands, fiber reinforced ultra-high strength concrete bodies can be used (see Annex 7) depending on the requirements of the designer.

1.2.7. Helixes and stirrups

The steel grades and dimensions of the helixes and of the stirrups shall comply with the values given in the Annexes 5, 6 and 7. The central position of the tendon in the structural concrete member on site shall be ensured according to section 1.4.3.

1.2.8. Corrosion protection of the free tendon length in the anchorage zone

Each monostrand is individually greased and encapsulated in a PE-coat over its whole free length. Indeed, in the anchor head, each individual strand is uncoated for the stressing.

Tendons which are not protected by a PE coat in the anchorage zone shall be protected with an appropriate material such as grease, wax or Unigel 128 F-1 as described in Annex 13. To ensure a proper filling, the whole anchor head is closed with a protective cap and the recess tube is closed by a sealing body. After the stressing, the protective cap and the recess tube of the anchorage will be filled on site with corrosion protection mass. The corrosion protection mass shall comply with EAD 160027-00-.

In case of the use of Unigel 128 F-1, the installation of the sealing body can be avoided if the tendon is positioned vertically and the active anchorage at the lowest point of the pre-stressing system. The injection of Unigel 128 F-1 is realized from the bottom of the protective cap to the top of the recess tube of the anchorage zone.

The recess tube should be sufficiently extended beyond the level of concrete to prevent unintended penetrations of media

1.2.9. Corrosion protection of exposed steel components

Exposed steel components which are not covered sufficiently by concrete (at least 5 cm) or which are not protected by corrosion protection material shall be protected against corrosion by one of the following protective paint systems according to EN ISO 12944-5:2007:

a) Without metallic coating: A5M.02, A5M.4, A5M.06, A5M.07
b) With zinc coating (galvanized): A7.10, A7.11, A7.12, A7.13

The surface preparation of the steel components shall be carried out according to EN ISO 12944-4:1998. For execution of the paint work EN ISO 12944-7:1998 shall be observed. Local approved and recognized corrosion protection principles can be used instead, if admissible at the place of use.

1.3. Design and methods of verification

1.3.1. Clearances at anchorages, minimum width of crossbeams

The anchorages are schematically shown in Annexes 8 to 11. At the entrances of the crossbeams, trumpet-like widening shall be provided, with a minimum of $\Delta\alpha$ = 2°. The widening shall allow for unscheduled deviations from the planned position of the tendon axis (tendon path) without kink up to the angle $\Delta\alpha$.

1.3.2. Deviators

In the area of deviation, the minimum radius of curvature shall always be above 5 m. The formation of the area of deviation is shown in the Annex 12. The arrangement of the mono-strands at the deviation point is shown in the drawings of Annex 12. The maximum draw distance of the mono-strand over the deviation form part is limited to 830 mm. The deviation form part is made of PUR-material. The maximum deviation accepted is 7°at each side.

The minimum distance between the deviators and the sealing body shall be more than 1 meter.

1.3.3. Prestressing force

Prestressing and over-tensioning forces are specified in the respective national provisions. The maximum force P_0 applied to a tendon shall not exceed the force $P_{0,max} = 0.9\ A_p\ f_{p0,1k}$ laid down in Table 2 (150mm²). The value of the initial prestressing force P_{m0} applied to the concrete after tensioning and anchoring shall not exceed the force $P_{m0,max} = 0.85\ A_p\ f_{p0,1k}$ laid down in Table 2 (150 mm²).

Table 2 Maximum prestressing forces for tendons with Ap = 150 mm²

Tendon designation	**Number of strands**	**Cross section A_p**	**Prestressing force Y 1860 S7 $f_{p0,1k}$ = 1640 N/mm²**	
			$P_{m0,max}$	$P_{0,max}$
		[mm²]	[kN]	[kN]
BBV L7 EW	7	1050	1464	1550
BBV L9 EW	9	1350	1882	1993
BBV L12 EW	12	1800	2509	2657
BBV L15 EW	15	2250	3137	3321
BBV L19 EW	19	2850	3974	4207
BBV L22 EW	22	3300	4601	4871
BBV L27 EW	27	4050	5646	5978
BBV L31 EW	31	4650	6483	6864

The forces stated in Table 2 are the maximum values referring on $f_{p0,1k}$ = 1640 N/mm². The actual values are to be found in national regulations, valid in the place of use.

Compliance with the stabilization and crack width criteria in the load transfer test was verified to a load level of $0{,}80*F_{pk}$.

The number of strands in a tendon may be reduced by leaving out strands lying radial symmetrically in the anchor head. The provisions for tendons with completely filled anchors (basic types) also apply to tendons with only partly filled anchor heads. Into the free boreholes in the anchor head the short pieces of strands with wedges have to be pressed in to prevent slipping out. The admissible prestressing force is reduced per left out strand as shown in Table 3.

Table 3 Reduction of the prestressing force when leaving out a strand

A_p	Y 1860 S7	
	ΔP_{m0}	ΔP_0
	[kN]	[kN]
150 mm²	209	221

For further characteristic values of the tendons (mass per meter, ultimate stressing force F_{pk}) see Annexes 2 and 3.

1.3.4. Losses due to friction and wobble effects

The losses due to friction may normally be determined in the calculation by using the friction coefficient μ = 0.1 given in Annexes 2 and 3 and the unintentional angular displacement k = 0 (wobble coefficient).

The design of the tendon path shall not allow radius of curvature lower than 5 m. Minimum radius of curvature of tendons for internal and external post tensioning depends on duct type and must comply with national regulations.

1.3.5. Concrete strength

At the time of transmission of the full prestressing force the mean concrete strength of the normal weight concrete in the anchor zone shall be at least $f_{cmj,cube}$ or $f_{cmj,cyl}$ according the Annexes 5, 6 and 7. The mean concrete strength shall be verified by means of at least three specimens (cylinder or cube with the edge length of 150 mm), which shall to be stored under the same conditions as the concrete member, with the individual values of specimen not differing more than 5%.

For partial prestressing with 30% of the full prestressing the minimum value of the concrete compressive strength to be provide is 0.5 $f_{cmj,cube}$ or 0.5 $f_{cmj,cyl}$ intermediate values can be interpolated lineally.

1.3.6. Centre spacing and edge distances of the tendon anchorages

The centre spacings and edge distances of the tendon anchorages shall not be smaller than values given in the Annexes 2, 3 and 7, depending on the minimum concrete strength.

The values of the centre or edge distances of the anchors given in the Annexes may be reduced in one direction up to 15%, however, not to a smaller value the external dimensions of the stirrup reinforcement or the outer diameter of the helix. In this case the centre and the edge distances in the other direction shall be increased for keeping the same concrete area in the anchor zone.

All centre and edge distances have only been specified with the view to load transfer to the structure; therefore, the concrete cover given in national standards and provisions shall be taken into account additionally.

1.3.7. Reinforcement in the anchorage zone

The anchorages (including reinforcement) are verified by means of tests for the transfer of the prestressing forces to the structural concrete.

The designer shall ensure that outside the reinforced anchorage zone transfer of the forces is done correctly.

The steel grades and dimensions of the additional reinforcement (stirrups) shall follow the values given in the Annexes 5, 6 and 7. This reinforcement must not be taken into account as part of the statically required reinforcement. However, existing reinforcement in a corresponding position exceeding the given reinforcement may be taken into account for the additional reinforcement. The given reinforcement consists of closed stirrups (stirrups closed by means of bends or hooks or an equivalent method). The stirrup locks (bends or hooks) shall be placed mutually offset.

In the anchorage zone vertically led gaps for concreting shall be provided for concreting properly.

If in exceptional case (this requires the approval for individual case according to the national regulations and administrative provisions) – due to an increased amount of reinforcement – the helix of the concrete cannot be properly placed, the helix can be replaced by different equivalent reinforcement.

1.3.8. Slip at anchorages

The slip at the anchorages (see section 1.4.5) shall be taken into account in the static calculation and the determination of the tendon elongation.

1.3.9. Resistance to fatigue at the anchorage and the areas of deviation of the tendons

With the fatigue tests carried out in accordance with Annex C.3 of EAD 160004-00-0301, the stress range of 80 N/mm² of the strands at the maximum stress of 0.65 f_{pk} at $2x10^6$ load cycles was demonstrated.

In the area of deviation of tendons a stress range of 35 N/mm² at $2x10^6$ load cycles can be assumed as verified. Due to national provisions at the place of use, higher stress ranges up to 80 N/mm² might be assumed as verified in the areas of deviation.

1.3.10. Protection of the tendons

The external tendons shall be protected against malfunction resulting from extraneous cause (e.g. vehicle impact, elevated temperatures in case of fire, vandalism). The requirements shall be investigated on a case by case basis and rated according to the specific project conditions.

Tendons endorsed by a box girder are supposed to be sufficiently protected against corrosion. For tendons placed outside a box girder, especially in corrosion enhancing conditions, the applicability of the tendons shall be verified.

1.3.11. Prohibition of transversal oscillation of tendons

Critical transversal oscillations of the tendons caused by traffic, wind or other excitations shall be avoided by constructive measures. Transversal oscillations which occur nevertheless usually do not have any harmful effects. The fixings shall be performed in such a way that the mono-

strands will not be damaged and the movement in any direction of the tendon is not obstructed. The distance of the fixations shall be determined by the designer. Tape wrapping or cable connectors each 10m shall be installed before stressing as an additional protection in case of failure. The tape wrapping or the cable connectors shall be installed in such a way that any damaging of the mono-strand is avoided.

1.3.12. Maintenance

In the case of external tendons, a visual inspection of the anchorages and mono-strands shall be realized at least once a year. In addition, the assessment body shall be informed if a major disorder is reported when using the kit.

1.4. Installation

1.4.1. General

Assembly and installation of the tendons shall only be performed by qualified post-tensioning specialist companies which have the required technical skills and experiences with this BBV Post-Tensioning System Type EW. The company's site manager shall have a certificate of the ETA holder certifying that he is instructed by the ETA holder and has the required knowledge and experience with this post- tensioning system. Standards and regulations valid on site shall be considered.

The tendons shall be installed in such a way that any damaging on the mono-strand is avoided.

The ETA holder is responsible to inform anyone concerned about this use of this BBV Post-Tensioning System type EW.

1.4.2. Welding

Welding at the anchorages is only permitted at the following parts :

- Welding of the end of the helix to a closed ring.
- For ensuring the central positioning, the helix may be attached to the bearing plate or anchor body by tack-welding.

After the monostrands have been placed no further welding is allowed.

1.4.3. Installation of the anchorages

The conical boreholes of the anchor heads shall be clean and stainless. The cast iron anchor body or concrete anchor body or bearing plate and the anchor head shall be positioned perpendicularly to the axis of the tendon.

1.4.4. Installation of the strands

The mono-strands are individually greased and sheathed. No duct is necessary in the free length of the post-tensioning kit.
At all locations where the tendons exit from the construction member trumpet-like extensions $\Delta\alpha$ shall be provided, which allow for unscheduled deviation from the planned position of the tendon axis without kink up to a minimum of 2°.

At the stressing and the fixed anchors, the connection between the individually sheathed monostrands and the anchor body entrance shall ensure the impermeability of the anchor head.

1.4.5. Wedging force, slip, wedge securing and corrosion protection mass in the wedge-seating area

The slip to be taken into account for the determination of the elongations/movements of the strands is 4 mm at fixed anchorages. In the case of hydraulic pre-wedging with 1,1 $P_{m0,max}$ no slip shall be taken into account for the determination of the elongations/movements of the strands.

The wedges of stressing anchors shall be pre-wedged after tensioning with the minimum force of 0,1 $P_{m0,max}$. In this case the slip is 3 mm.

1.4.6. Stressing and re-stressing

All strands of a tendon shall be stressed simultaneously. In the case of straight tendons it is permitted to stress strand by strand. The order of the strands to be stressed shall be determined in such a way that the anchor carries only the eccentricity of the prestressing force of one strand at a time, in order to keep the eccentric load of the anchor head at a minimum.

It is admissible to restress the tendons by releasing and re-using the wedges. After restressing and anchoring, wedge marks on the strands resulting from first stressing shall be moved to the outside by at least 15 mm. Restressing paths < 15 mm are not admissible.

1.4.7. Corrosion protection measures of the anchorage zone

After stressing the tendons, the recess tube of the anchor zone shall be injected with corrosion protection mass. In case of grease or wax in use, the material is heated up to with a maximum temperature of 100°C. The recess tube shall be closed by a sealing body and be filled completely with corrosion protection material. Complete filling with corrosion protection material shall be checked by a vent hole at the highest point of the anchorage zone. The sealing is realized by a sealing body and it is supposed to close tightly the anchor zone in any position. The injection has to be realized according to national standards.

The use of the sealing body will be avoided if the pre-stressing system type EW is installed in a wind energy plant, where the tendon is positioned vertically along the tower wall and the active anchor in the foundation. In combination with the use of Unigel 128 F-1 and an injection of the corrosion protection material from the lowest point of the anchorage (protective cap) to the top (recess tube), the sealing body can be replaced by an appropriate device to protect the corrosion protection mass from excessive pollution.

1.4.8. Exchange of tendons

The dismounting of tendons and the following installation of new tendons is possible (see Annex 18). The conditions for future replacements of tendons, the number of tendons that can be dismounted at the same time and the on-site provisions, which already shall be planned during the design of the building, shall be determined for each single case.

For every cutting of tendons the relevant working instructions and the safety provisions for workers shall be determined by the operating company and agreed upon by the client.

1.4.9. Packaging, transport and storage

The components and the tendons shall be protected against moisture and staining. The tendons shall be kept away from areas where welding procedures are performed.

For transport and handling of the strands the provisions of the strand manufacturer shall be observed.

The monostrands which are individually greased and sheathed shall be transported in such a way that any damaging on the plastic sheath is avoided.

2. Specifications of the intended use in accordance with the applicable European Assessment Document

The Post-Tensioning System is assumed to be used for external or internal unbonded prestressing for concrete structures or elements. The external tendon path can be placed outside the cross section of the concrete element but inside its envelope or inside the cross section. The structural members used to be designed in accordance with national regulations.

Optional use categories :

- Restressable tendon
- Exchangeable tendon

The provisions made in this European Technical Assessment are based on an assumed working life of the PT-System of 100 years. The working life for the kits is assumed provided the kits are subjected to appropriate installation, use and maintenance. The indications given on the working life cannot be interpreted as a guarantee given by the producer (or the Assessment Body), but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3. Performance of the products and methods used for its assessment

This European Technical Assessment for the post-tensioning system part of this document is issued on the basis of agreed data, deposited at Cerema, which identifies the post-tensioning system that has been assessed and judged.

Assessment of the performance of the post-tensioning system part of this document for the intended use in the sense of basic requirement for construction work 1 (mechanical resistance and stability) has been made in accordance with the EAD 160004-00-0301 of post-tensioning kits for the prestressing of structures based on the provisions for all systems.

Product type: Post–Tensioning Kit		**Intended use:** Prestressing of structures
Basic requirement for construction work	**Essential characteristic**	**Performance**
1 Mechanical resistance and stability	Resistance to static load	≥95% of Actual Ultimate Tensile Strength – AUTS (acceptance criteria given in clause 2.2.1 of EAD 160004-00-0301)
	Resistance to fatigue	No fatigue failure in anchorage and not more than 5% loss on cross section after 2 million cycles (acceptance criteria given in clause 2.2.2 of EAD 160004-00-0301)
	Load transfer to the structure	Stabilization of crack width under cyclic load and ultimate resistance ≥110% characteristic load (acceptance criteria given in clause 2.2.3 of EAD 160004-00-0301)
	Friction coefficient	See clause 1.3.4 of ETA, (acceptance criteria given in clause 2.2.4 of EAD 160004-00-0301)
	Deviation/deflection (limits) for external and internal unbonded tendon	See clause 1.3.2 of ETA (acceptance criteria given in clause 2.2.5 of EAD 160004-00-0301)
	Practicability / reliability of installation	Installation of strands, duct filling (acceptance criteria given in clause 2.2.7 of EAD 160004-00-0301)

4. Assessment and verification of constancy of performance system applied, with reference to its legal base

In accordance with the decision 98/456/EC[1] of the European Commission, the system 1+ of assessment and verification of constancy of performances (see Annex V to Regulation (EU) No 305/2011), given in the following table applies:

Product(s)	Intended use(s)	Level(s) or class(es)	System(s)
Post-tensioning Kits	For the prestressing of structures	-	1+

This AVCP system is defined as follows:

System 1+: Declaration of the performance of the essential characteristics of the construction product by the manufacturer on the basis of the following items:

(a) Tasks of the manufacturer
- (1) Factory production control;
- (2) Further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;

(b) Tasks for the notified body
- (3) Determination of the product-type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product;
- (4) Initial inspection of factory and of factory production control;
- (5) Continuous surveillance, assessment and approval of factory production control;
- (6) Audit testing of samples taken at the factory.

[1] Official Journal of the European communities L201/112 of 3 July 1998

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 manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures including records or results performed. This production control system shall insure that the product is in conformity with this European Technical Assessment.

The manufacturer shall only use materials stated in the technical documentation of this European Technical Assessment.

The factory production control shall be in accordance with the "BBV Control Plan" relating to this European Technical Assessment which is part of the technical documentation of this European Technical Assessment. The "Control Plan" is laid down in the context of the factory production control system operated by the manufacturer and deposited at Cerema.

The prescribed test plan defined in Annex 15 gives the type and frequency of checks and tests conducted during production and on the final product as part of the continuous internal production control.

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the "Control Plan".

The records contain at least the following information:

- designation of the product or basic materials and the components;
- type of control or testing;
- date of manufacture and of testing of product or components and of basic materials or components;
- results of controls and tests and, where relevant, comparison with the requirements;
- signature of person responsible for the factory production control.

If the test results are unsatisfactory, the manufacturer shall immediately implement measures to eliminate defects. Construction products or components which are not in compliance with the requirements shall be handled such that they cannot be mistaken for products complying with the requirements. After elimination of the defects the relevant tests shall be immediately repeated as far as is technically possible and necessary for verifying the deficiency elimination.

The records shall be kept for at least ten years and submitted to the notified body. On request they shall be presented to Cerema.

5.1.2. Other tasks

The manufacturer shall, on the basis of a contract, involve a body which is notified for the tasks referred to in section 5.2 in the field of BBV post-tensioning system in order to undertake the actions laid down in section 5.2. For this purpose, the "control plan" referred to in sections 5.1 and 2.2 shall be handed over by the manufacturer to the approved body or bodies involved.

The manufacturer shall make a declaration of performance, stating that the construction product is in conformity with the provisions of this European Technical Assessment.

At least once a year, each components manufacturer shall be audited by the kit manufacturer.

At least once a year specimens shall be taken from at least one job site and one series of single tensile element test shall be performed according to Annex C.7 of EAD 160004-00-0301 (see annex 16 of this ETA). The results of these test series shall be made available to the notified body.

5.2. Tasks of the Notified body

5.2.1. General

The notified body (bodies) shall perform the :

- Determination of the product-type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product,
- Initial inspection of factory and of factory production control,
- Continuous surveillance, assessment and approval of factory production control,
- Audit-testing of samples taken at the factory

in accordance with the provisions laid down in the "BBV Control Plan" relating to this European Technical Assessment.

The notified body (bodies) shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The main production centre is checked at least once a year by the notified body. Each component producer is checked at least once every five years by the notified body.

The notified certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European Technical Assessment.

In cases where the provisions of the European Technical Assessment and its “Control Plan” are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Cerema without delay.

5.2.2. Determination of the product-type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product

For initial type testing the results of the tests performed as part of the assessment of the European Technical Assessment may be used unless there are changes in production procedure or factory plant. In such cases, the necessary initial type testing shall be agreed between Cerema and the notified body involved.

5.2.3. Initial inspection of factory and of factory production control

The notified body shall ascertain 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 orderly manufacturing of the post-tensioning system according to the specifications given in the Annexes of this European Technical Assessment.

5.2.4. Surveillance, assessment and approval of factory production control

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

5.2.5. Audit testing of samples taken at the kit manufacturer

During surveillance inspection, the notified body shall take samples at the factory of components of the PT system or of individual components for which this European Technical Assessment has been granted, for independent testing.
For the most important components Annex 16 of this ETA summarises the minimum procedures. These tasks shall comply with the “Audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer’s storage facilities” part in Table 4 of EAD 160004-00-0301

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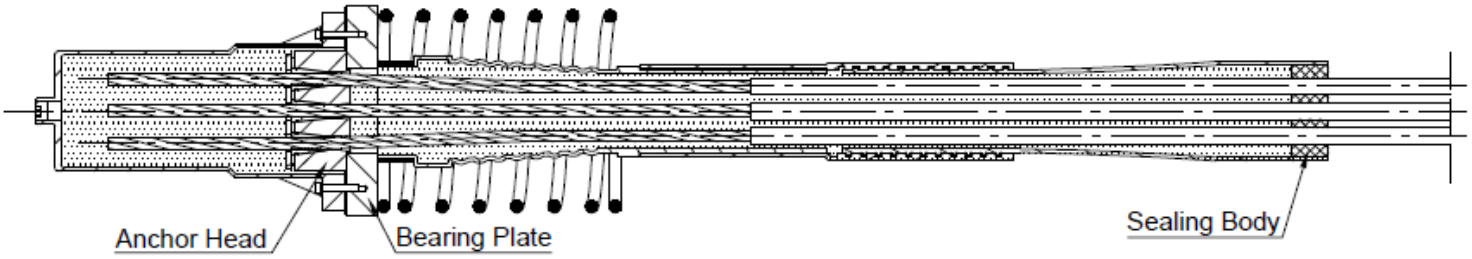
By
Centre d’étude et d’expertise sur les risques, l’environnement, la mobilité et l’aménagement
Direction technique Infrastructures de transport et matériaux

Barthélémy PETIT, ETA manager

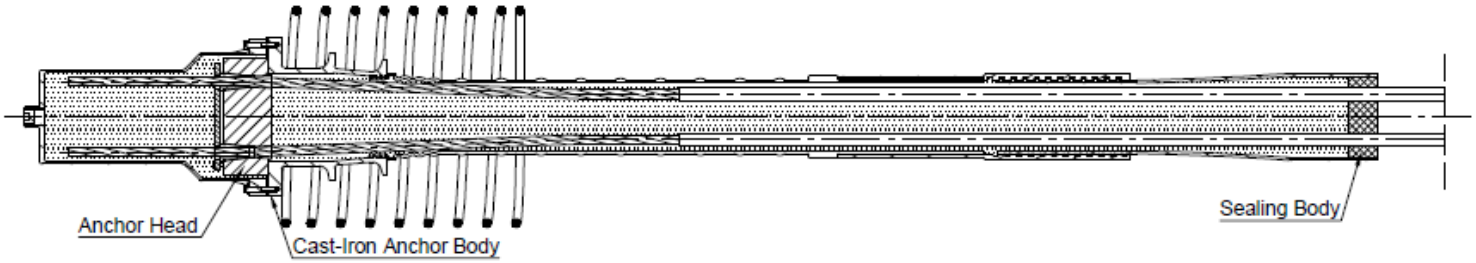
BBV External Post- Tensioning System

Overview Anchorages

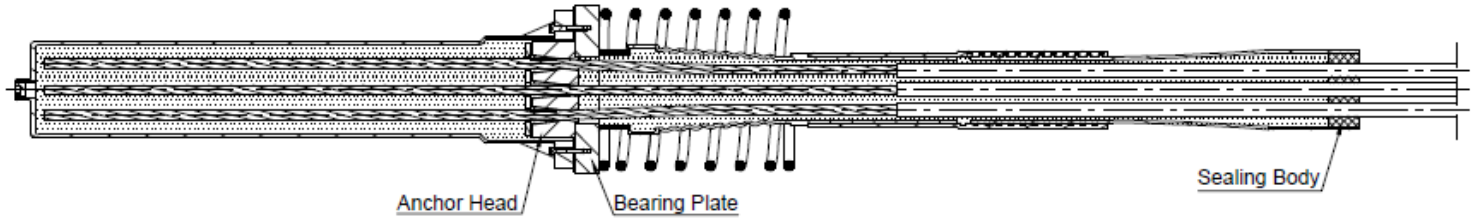
1. Active Anchor and Passive Anchor BBV L7 EW – BBV L15 EW - non re-stressable tendons



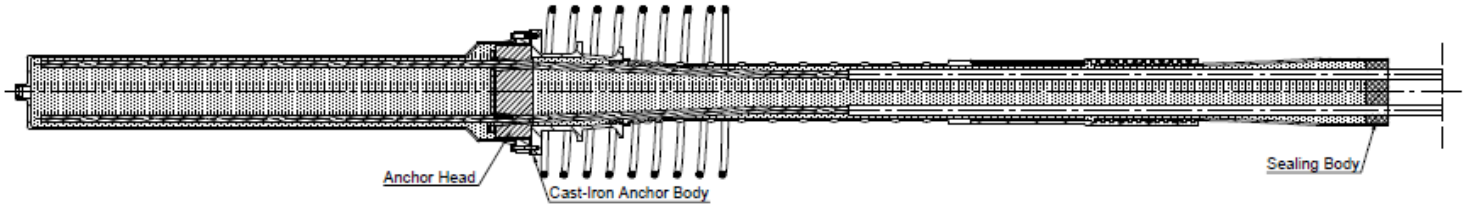
2. Active Anchor and Passive Anchor BBV L12 EW – BBV L31 EW - non re-stressable tendons



3. Active Anchor BBV L7 EW – BBV L15 EW – re-stressable tendons



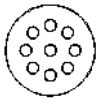
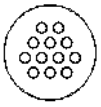
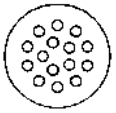
4. Active Anchor BBV L12 EW – BBV L31 EW – re-stressable tendons



BBV SYSTEMS WIR SORGEN FÜR SPANNUNG | WE STRESS FOR STRENGTH	Overview Anchorages Technical Details BBV L7 EW – BBV L31 EW	**Annex 1** of ETA-12/0150

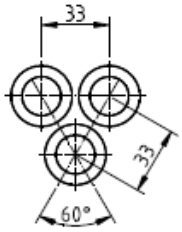
Active Anchor and Passive Anchor with bearing plate (BBV L7 EW to L15 EW)

Technical Details BBV L 7 EW – BBV L15 EW: Active Anchor and Passive Anchor with bearing plate

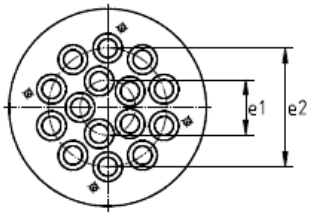
Tendon Type	Dim.	BBV L7 EW	BBV L9 EW	BBV L12 EW	BBV L15 EW
Strand Pattern					
Number of Strands, Y 1860	n	7	9	12	15
150 mm²: Nominal Cross Section A_p	mm²	1050	1350	1800	2250
150mm²: Nominal Mass without PE-Coat and Grease	kg/m	8,20	10,55	14,06	17,58
150 mm²: $P_{0,max} = 0,90 \cdot f_{p0,1k} \cdot A_p$ ***	kN	1550	1993	2657	3321
150 mm²: $P_{m0} = 0,85 \cdot f_{p0,1k} \cdot A_p$ ***	kN	1464	1882	2509	3137
150 mm²: $F_{pk} = n \cdot 150 \cdot 1860 / 1000$	kN	1953	2511	3348	4185
Friction Losses					
Mean friction coefficient μ	-	0,08	0,08	0,08	0,08
Wobble Coefficient k	-	0	0	0	0
Strand Protrusion**	mm	710	820	800	800
Minimum bending radius	m	5,00	5,00	5,00	5,00
Active and Passive Anchorages - Bearing Plate					
Minimum centre distance * $f_{cmj,cube} \geq 30$ N/mm²	mm	305	345	395	440
Minimum edge distance *, **** $f_{cmj,cube} \geq 30$ N/mm²	mm	175	195	220	240

* Concrete cover shall be taken into account additionally. Distances can be reduced to 85% of the given values in one direction, if increased correspondingly in the other direction (see section 2.2.5 of specific conditions).
** Distance from anchor head front face for placing of jack.
*** Based on $f_{p0,1k}$ = 1640N/mm² (Grade Y 1860, according to prEN 10138-3 :2000).
**** Minimum edge distance: min. centre distance / 2 + 20mm (rounding up at 5mm intervals).

Strand Patter of Anchor Head:
BBV L12 EW, L19 EW,
L22 EW, L27 EW, L31 EW
Conical borings are in line, lines result in a grid.



Strand Patter of Anchor Head:
BBV 7 EW, 9 EW and 15 EW
All conical borings are aligned on one or two circles
(e1 and e2, see table above).

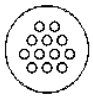
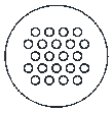
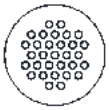


Example: BBV L15 EW

BBV SYSTEMS WIR SORGEN FÜR SPANNUNG | WE STRESS FOR STRENGTH	Steel Grade: Y 1860 Technical Details BBV L7 EW – BBV L31 EW	**Annex 2** of ETA-12/0150

Active Anchor and Passive Anchor with cast-iron anchor body (BBV L12 EW to L31 EW)

Technical Details BBV L12 EW – BBV L31 EW: Active Anchor and Passive Anchor with cast-iron anchor body

Tendon Type	Dim.	BBV L12 EW	BBV L15 EW	BBV L19 EW	BBV L22 EW	BBV L27 EW	BBV L31 EW
Strand Pattern							
Number of Strands, Y 1860	n	12	15	19	22	27	31
150 mm²: Nominal Cross Section A_p	mm²	1800	2250	2850	3300	4050	4650
150 mm²: Nominal Mass without PE-Coat and Grease	kg/m	14,06	17,58	22,27	25,78	31,64	36,33
150 mm²: $P_{0,max} = 0,90 \cdot f_{p0,1k} \cdot A_p$ ***	kN	2657	3321	4207	4871	5978	6863
150 mm²: $P_{m0} = 0,85 \cdot f_{p0,1k} \cdot A_p$ ***	kN	2509	3137	3973	4600	5646	6482
150 mm²: $F_{pk} = n \cdot 150 \cdot 1860 / 1000$	kN	3348	4185	5301	6138	7533	8649
Friction Losses							
Mean friction coefficient μ	-	0,08	0,08	0,08	0,08	0,08	0,08
Wobble Coefficient k	-	0	0	0	0	0	0
Strand Protrusion**	mm	800	800	1100	1100	1200	1200
Minimum bending radius	m	5,00	5,00	5,00	5,00	5,00	5,00
Active and Passive Anchorages – Cast-Iron Anchor Body							
Minimum centre distance *							
$f_{cmj,cube} \geq 28$ N/mm²	mm	405	450	505	545	605	645
$f_{cmj,cube} \geq 34$ N/mm²	mm	370	415	465	500	550	595
$f_{cmj,cube} \geq 40$ N/mm²	mm	340	380	430	460	510	545
$f_{cmj,cube} \geq 45$ N/mm²	mm	325	360	405	435	485	520
Minimum edge distance *, ****							
$f_{cmj,cube} \geq 28$ N/mm²	mm	225	245	275	295	325	345
$f_{cmj,cube} \geq 34$ N/mm²	mm	205	230	255	270	295	320
$f_{cmj,cube} \geq 40$ N/mm²	mm	190	210	235	250	275	295
$f_{cmj,cube} \geq 45$ N/mm²	mm	180	200	225	240	265	280

* Concrete cover shall be taken into account additionally. Distances can be reduced to 85% of the given values in one direction, if increased correspondingly in the other direction (see section 2.2.5 of specific conditions).

** Distance from anchor head front face for placing of jack.

*** Based on $f_{p0,1k}$ = 1640N/mm² (Grade Y 1860, according to prEN 10138-3 :2000).

**** Minimum edge distance: min. centre distance / 2 + 20mm (rounding up at 5mm intervals).

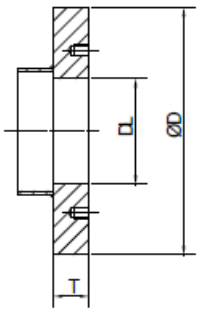
Geometry of the Anchor Components BBV L7 EW to BBV L31 EW

The number of strands in a tendon may be reduced
by leaving out strands lying radial- symmetrically in the anchor head.

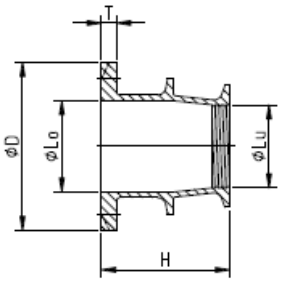
Tendon Type		Dim.	L7 EW	L9 EW	L12 EW	L15 EW	L19 EW	L22 EW	L27 EW	L31 EW
Bearing Plate										
Diameter	ØD		240	280	310	350				
Thickness	T	mm	40	40	45	50				
Hole Diameter	DL	mm	93	113	130	150				
Cast-iron Anchor Body										
Diameter	ØD	mm			240	270	300	327	360	382
Height	H	mm			182	203	227	248	272	294
Thickness	T	mm			22	23	27	28	32	34
Hole - Ø, top	Lo	mm			131	150	163	183	199	208
Hole - Ø, bottom	Lu	mm			123	139	148	165	176	182
Anchor Head										
Diameter	ØD	mm	133	160	180	194	220	245	265	280
Thickness	T	mm	50	50	61	60	77	77	91	87
Diameter	A	mm	89	109	127	146	159	179	195	204
Diameter circle	e1	mm	66	86	Grid*	120	Grid*	Grid*	Grid*	Grid*
Diameter circle	e2	mm				56				
Recess Tube										
Inner diameter , min		mm	80	90	100	110	115	130	150	150
Wall Thickness		mm	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5

* Grid according to Annex 2 and 3

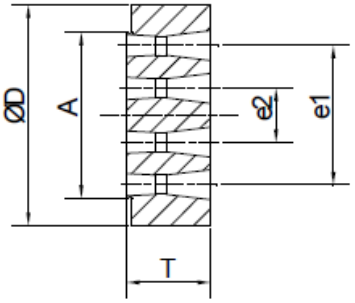
Bearing Plate



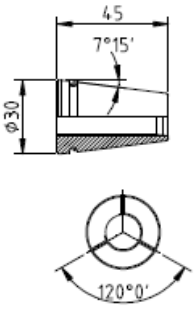
Cast-Iron Anchor Body



Anchor Head



Wedges



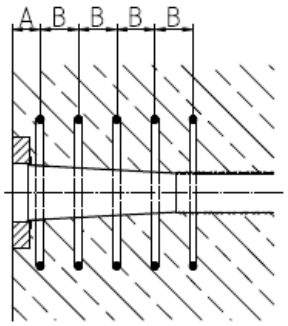
BBV SYSTEMS WIR SORGEN FÜR SPANNUNG | WE STRESS FOR STRENGTH	Geometry of Components Technical Details BBV L7 EW – BBV L31 EW	**Annex 4** of ETA-12/0150

Helix and Additional Reinforcement – Bearing Plate

The dimensions and the arrangement of the helix and additional reinforcement are also valid by reducing the number of strands in a tendon by leaving out strands lying radial-symmetrically in the anchor head.

Tendon type	Dim.	**L7 EW**	**L9 EW**	**L12 EW**	**L15 EW**
		Bearing Plate			
Helix					
Bar Diameter					
$f_{cmj,cube}$ ≥ 30 N/mm²	mm	16	16	14	14
Outer Diameter					
$f_{cmj,cube}$ ≥ 30 N/mm²	mm	220	270	330	375
Minimum length					
$f_{cmj,cube}$ ≥ 30 N/mm²	mm	275	310	350	400
Pitch					
$f_{cmj,cube}$ ≥ 30 N/mm²	mm	50	50	50	50
Helix turns					
$f_{cmj,cube}$ ≥ 30 N/mm²	n	5	6	7	8
Stirrup reinforcements					
(Number of stirrups x Ø or equivalent)					
$f_{cmj,cube}$ ≥ 30 N/mm²	mm	5 Ø 10	5 Ø 14	7 Ø 10	7 Ø 12
Stirrup Length	mm	285	320	375	420
Position behind bearing plate / cast-iron anchor body		A / B	A / B	A / B	A / B
$f_{cmj,cube}$ ≥ 30 N/mm²	mm	80 / 55	80 / 65	65 / 61	70 / 68

L7 EW – L15 EW
Bearing Plate



Helix and Additional Reinforcement – Cast-Iron Anchor Body

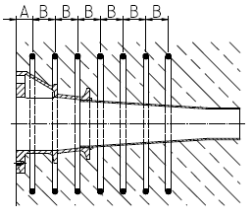
The dimensions and the arrangement of the helix and additional reinforcement are also valid by reducing the number of strands in a tendon by leaving out strands lying radial-symmetrically in the anchor head.

Tendon Type	Dim.	**L12 E**	**L15 E**	**L19 E**	**L22 E**	**L27 E**	**L31 E**
Helix							
Bar Diameter							
$f_{cmi,cube}$ = 28 N/mm²	mm	14	14	16	16	16	16
$f_{cmi,cube}$ = 34 N/mm²	mm	14	16	16	16	16	16
$f_{cmi,cube}$ = 40 N/mm²	mm	14	14	16	16	16	16
$f_{cmi,cube}$ = 45 N/mm²	mm	14	14	16	16	16	16
Outer Diameter							
$f_{cmi,cube}$ = 28 N/mm²	mm	300	345	390	430	490	520
$f_{cmi,cube}$ = 34 N/mm²	mm	300	340	380	410	450	480
$f_{cmi,cube}$ = 40 N/mm²	mm	285	320	360	380	430	460
$f_{cmi,cube}$ = 45 N/mm²	mm	270	315	340	365	410	430
Min. Length							
$f_{cmi,cube}$ = 28 N/mm²	mm	350	400	450	450	550	550
$f_{cmi,cube}$ = 34 N/mm²	mm	300	350	400	450	470	470
$f_{cmi,cube}$ = 40 N/mm²	mm	300	300	350	350	450	450
$f_{cmi,cube}$ = 45 N/mm²	mm	250	250	300	300	350	350
Min. Pitch							
$f_{cmi,cube}$ = 28 N/mm²	mm	50	50	50	50	50	50
$f_{cmi,cube}$ = 34 N/mm²	mm	50	50	50	50	50	50
$f_{cmi,cube}$ = 40 N/mm²	mm	50	50	50	50	50	50
$f_{cmi,cube}$ = 45 N/mm²	mm	50	50	50	50	50	50
Helix Turns							
$f_{cmi,cube}$ = 28 N/mm²	n	8	9	10	10	12	12
$f_{cmi,cube}$ = 34 N/mm²	n	7	8	9	10	10.5	10.5
$f_{cmi,cube}$ = 40 N/mm²	n	7	7	8	8	10	10
$f_{cmi,cube}$ = 45 N/mm²	n	6	6	7	7	8	8
Stirrup Reinforcement *		Qty. x ∅	Qty. x ∅	Qty. x ∅	Qty. x ∅	Qty. x ∅	Qty. x ∅
$f_{cmi,cube}$ = 28 N/mm²	mm	6x ∅12	5x ∅14	6x ∅16	7x ∅16	11x∅16	12x∅16
$f_{cmi,cube}$ = 34 N/mm²	mm	6x ∅14	8x ∅14	7x ∅16	8x ∅16	9x ∅20	10x∅20
$f_{cmi,cube}$ = 40 N/mm²	mm	5x ∅16	6x ∅16	7x ∅16	6x ∅20	8x ∅20	10x∅20
$f_{cmi,cube}$ = 45 N/mm²	mm	5x ∅16	6x ∅16	8x ∅16	8x ∅16	8x ∅20	9x ∅20
Position behind cast-Iron Anchor body		A/B	A/B	A/B	A/B	A/B	A/B
$f_{cmi,cube}$ = 28 N/mm²	mm	50 / 70	50 / 95	50 / 90	50 / 80	60 / 60	60 / 55
$f_{cmi,cube}$ = 34 N/mm²	mm	50 / 65	50 / 55	50 / 70	50 / 65	60 / 65	60 / 55
$f_{cmj,cube}$ = 40 N/mm²	mm	50 / 70	50 / 65	50 / 60	50 / 75	60 / 65	60 / 55
$f_{cmi,cube}$ = 45 N/mm²	mm	50 / 65	50 / 60	50 / 55	50 / 50	60 / 60	60 / 55

* Side Length Stirrup = min. Centre Distance – 20 mm

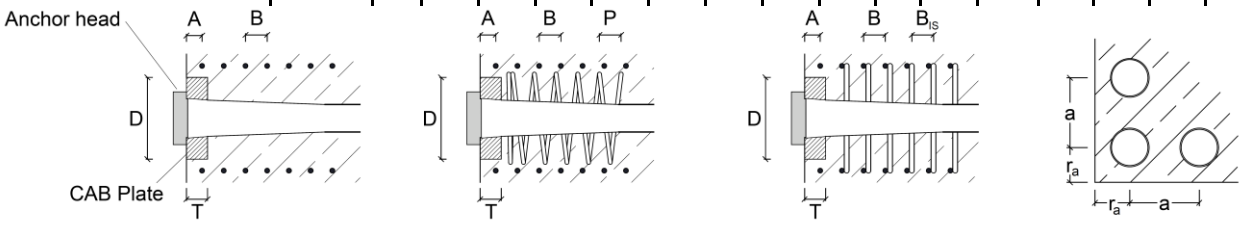
L12 EW – L31 EW

Cast-Iron Anchor Body

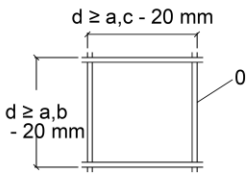


Concrete Anchor Body (HA-CAB), center distances, additional reinforcement (BBV L7 EW to L27 EW)

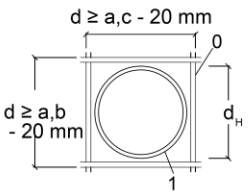
Tendon type	Dim.	L7 EW	L9 EW			L12 EW			L15 EW			L19EW			L22EW			L27EW		
		Concrete Anchor Body (HA-CAB)																		
HA-CAB Dimensions																				
Diameter D	mm	215	245			280			310			340			365			405		
Thickness T	mm	55	55			65			80			85			85			100		
Hole diameter	mm	93	113			131			150			163			183			199		
Minimum center distances																				
$f_{cmj,cube}$		≥ 34 N/mm²																		
Minimum center distance a x a	mm	290	330			375			415			465			510			575		
Additional reinforcement		0	0	0/1	0/2	0	0/1	0/2	0	0/1	0/2	0	0/1	0/2	0	0/1	0/2	0	0/1	0/2
0: Stirrup reinforcement	-	4	5	5	5	6	6	6	8	8	8	10	8	7	12	10	8	10	8	8
Bar diameter	mm	20	20	16	14	20	16	14	20	16	14	20	16	16	20	16	16	25	20	20
A	mm	45	45	50	50	45	50	50	50	55	55	70	80	60	65	80	60	70	70	70
B	mm	80	70	70	70	70	70	70	60	60	60	55	70	85	50	60	80	70	90	90
1: Helix Turns	-	-	-	4	-	-	5	-	-	7	-	-	7	-	-	9	-	-	7	-
Outer diameter d_H	mm	-	-	220	-	-	265	-	-	270	-	-	360	-	-	390	-	-	450	-
Bar diameter	mm	-	-	12	-	-	14	-	-	12	-	-	16	-	-	16	-	-	20	-
Pitch P	mm	-	-	70	-	-	70	-	-	55	-	-	70	-	-	60	-	-	85	-
2 : Inner stirrups	-	-	-	-	4	-	-	5	-	-	7	-	-	6	-	-	7	-	-	7
Bar diameter	mm	-	-	-	16	-	-	16	-	-	16	-	-	20	-	-	20	-	-	20
d_{IS}	mm	-	-	-	220	-	-	250	-	-	280	-	-	315	-	-	345	-	-	395
B_{IS}	mm	-	-	-	70	-	-	70	-	-	60	-	-	85	-	-	80	-	-	90



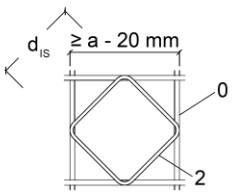
0: Stirrups

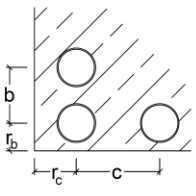


0/1: Helix



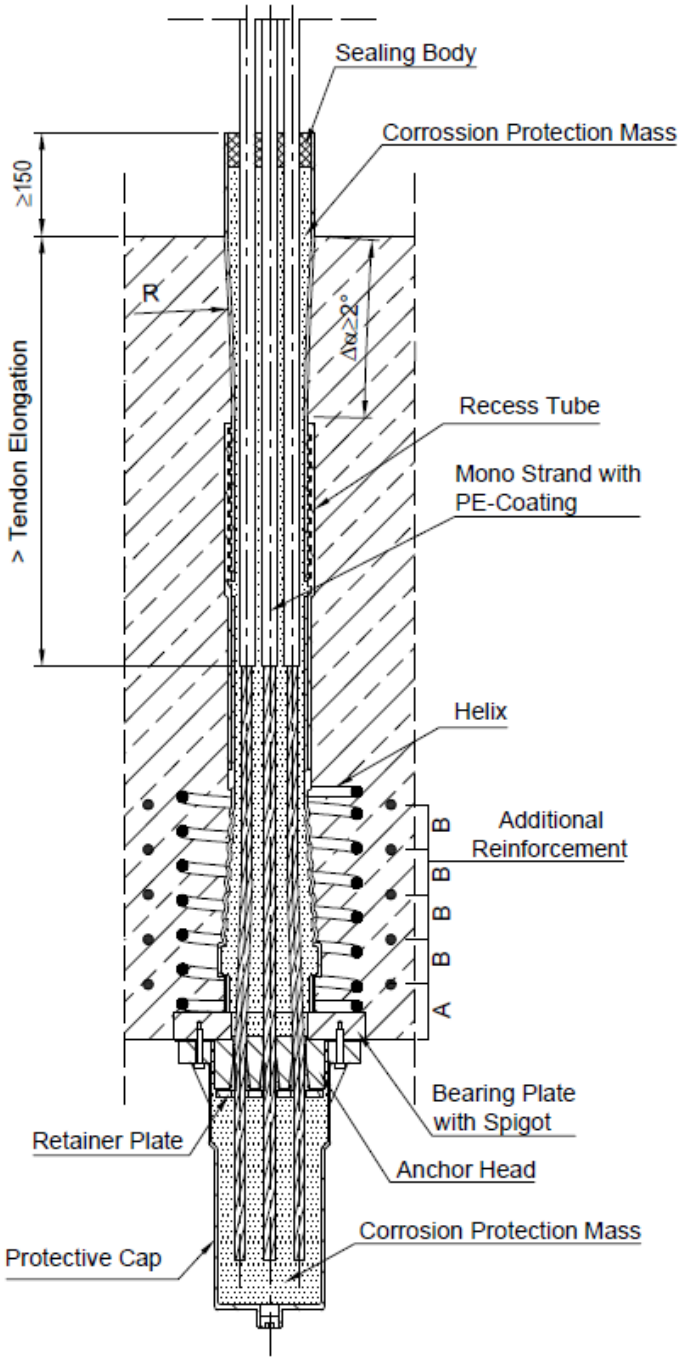
0/2: Inner stirrups





BBV SYSTEMS WIR SORGEN FÜR SPANNUNG | WE STRESS FOR STRENGTH	Concrete Anchor Body (HA-CAB), center distances, additional reinforcement Technical Details BBV L7 EW – BBV L31 EW	**Annex 7** of ETA-12/0150

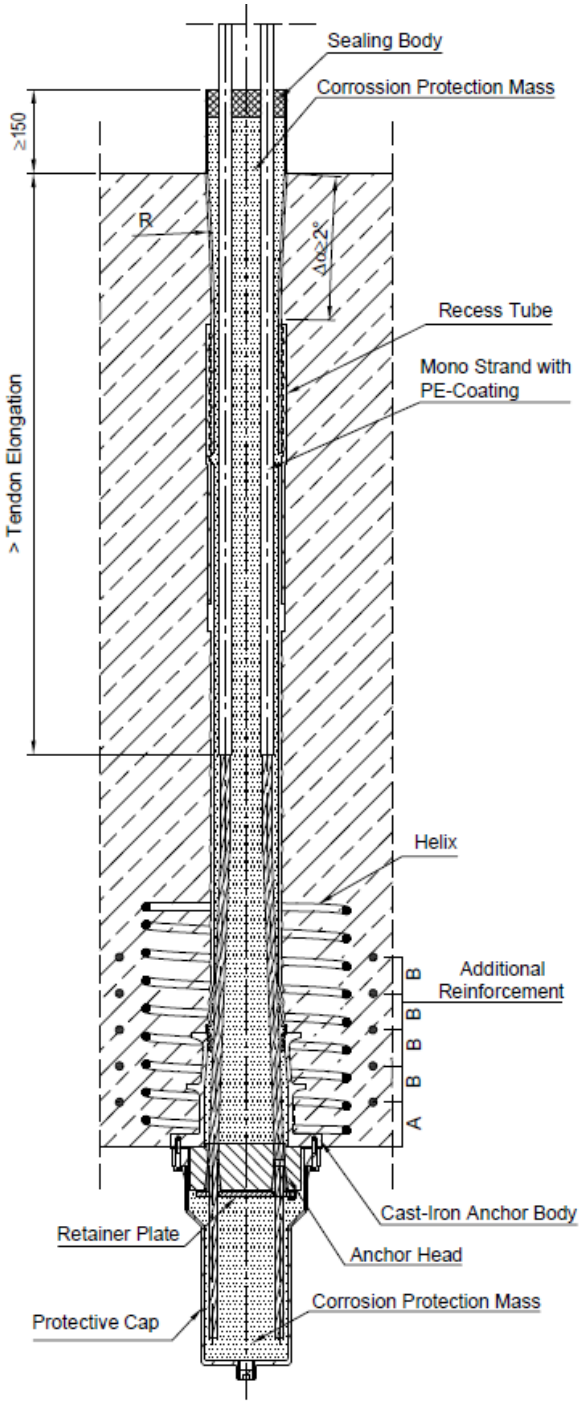
Active and Passive Anchorages with Bearing Plate BBV L7 EW to L15 EW for non re-stressable tendons:



For sealing body, see 1.2.8

BBV SYSTEMS WIR SORGEN FÜR SPANNUNG | WE STRESS FOR STRENGTH	Detail of the Active and the Passive Anchor (Bearing Plate) – non re-stressable Technical Details BBV L7 EW – BBV L31 EW	**Annex 8** of ETA-12/0150

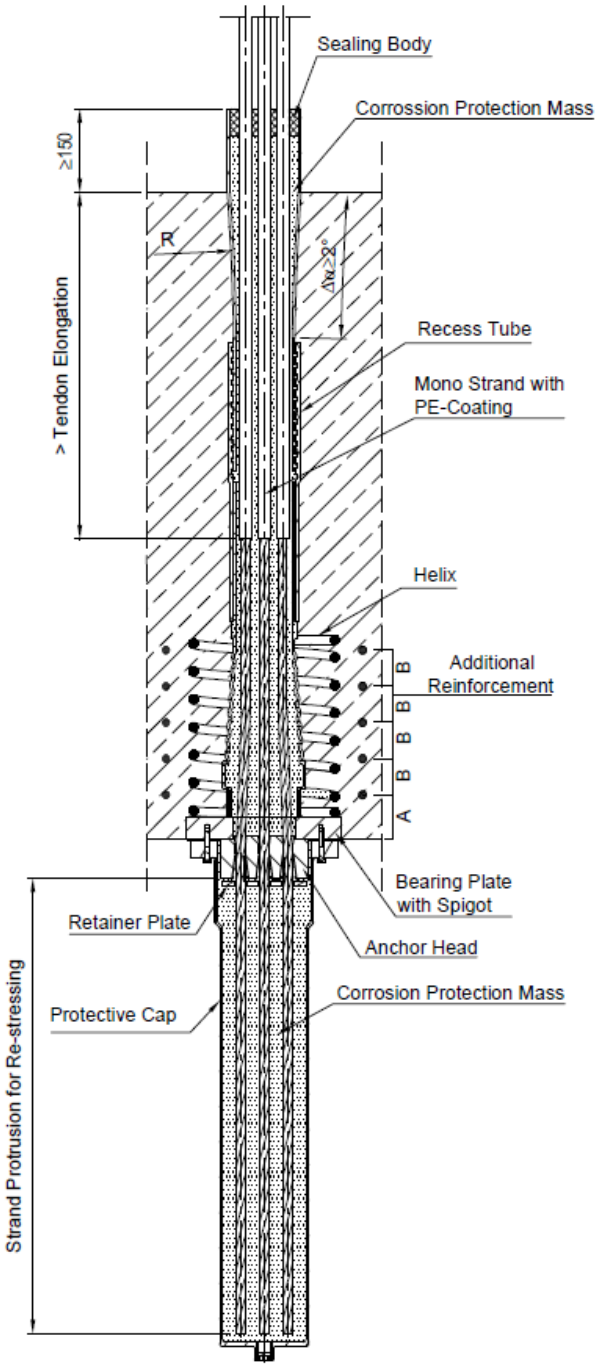
Active and Passive Anchorages with Cast-iron Anchor Body BBV L12 EW and BBV L31 EW for non re-stressable tendons:



For sealing body, see 1.2.8

BBV SYSTEMS	Detail of the Active and the Passive Anchor (Cast-iron Anchor Body) – non re-stressable Technical Details BBV L7 EW – BBV L31 EW	**Annex 9** of ETA-12/0150

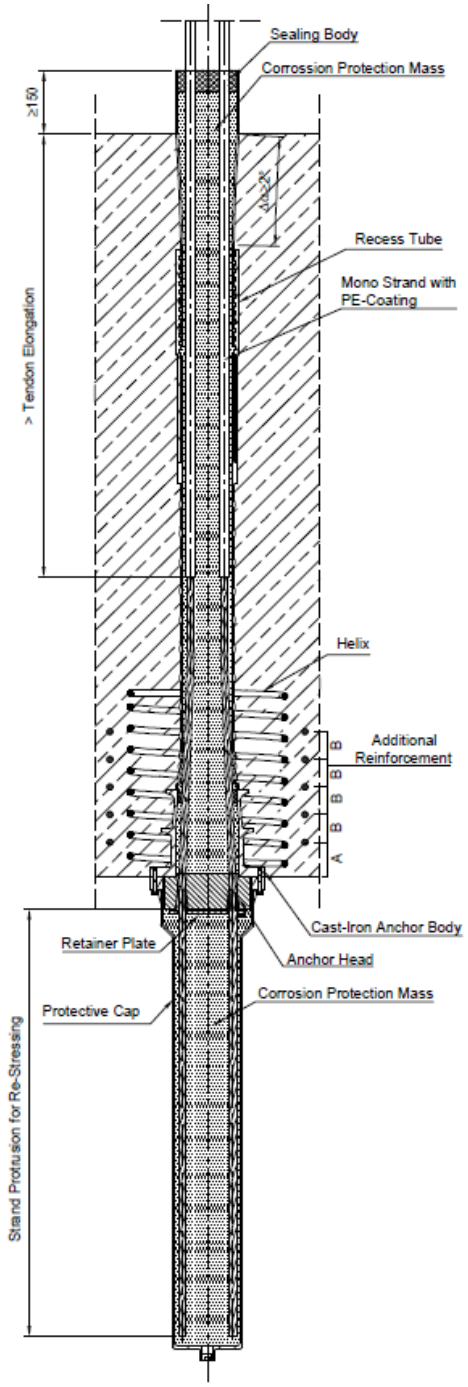
Active and Passive Anchorages with Bearing Plate BBV L7 EW to L15 EW for re-stressable tendons:



For sealing body, see 1.2.8

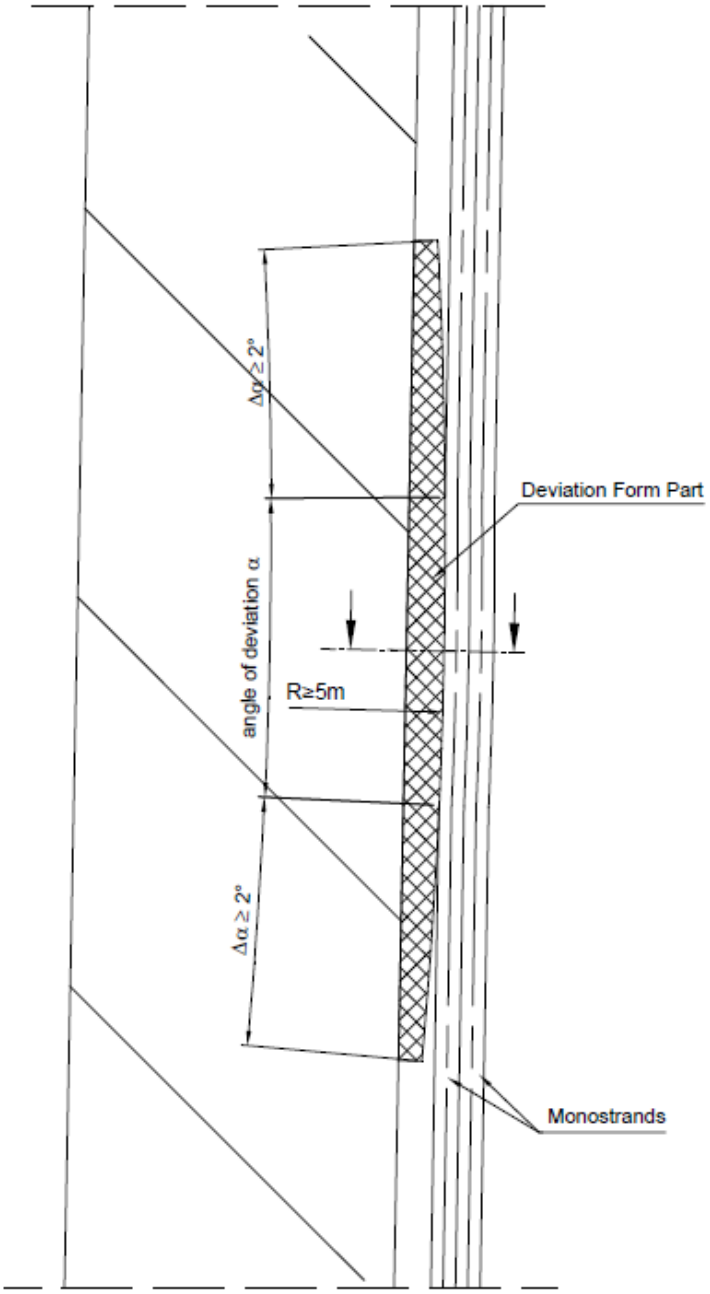
BBV SYSTEMS	Detail of the Active Anchor (Bearing Plate) – re-stressable Technical Details BBV L7 EW – BBV L31 EW	**Annex 10** of ETA-12/0150

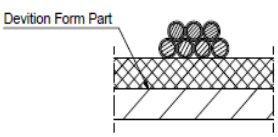
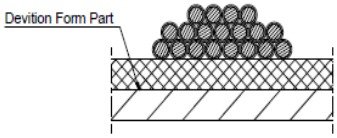
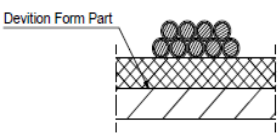
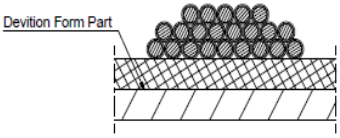
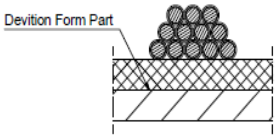
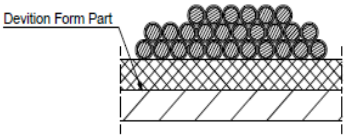
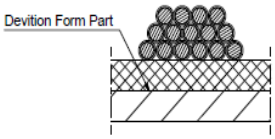
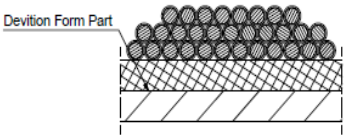
Active and Passive Anchorages with Cast-iron Anchor Body BBV L12 EW and BBV L31 EW for re-stressable tendons:



For sealing body, see 1.2.8

BBV SYSTEMS	Detail of the Active Anchor (Cast-iron Anchor Body) – re-stressable Technical Details BBV L7 EW – BBV L31 EW	**Annex 11** of ETA-12/0150



BBV L7 EW - BBV L15 EW	BBV L19 EW - BBV L31 EW
	
	
	
	

Note:
for tendon sizes L12 EW to L31 EW two layers are also permitted at the deviation form part

BBV SYSTEMS	Sectional view Arrangement of the external monostrands at deviation points BBV L7 EW – BBV L31 EW	**Annex 12** of ETA-12/0150

Material Components and related Standards

Designation	Material	Standard
Anchorage		
Bearing Plate	Deposited at Cerema	DIN EN 10025-2:2011
Cast-iron Anchor Body	Deposited at Cerema	
Concrete Anchor Body (CAB)	Deposited at Cerema	
Wedge	Deposited at Cerema	
Anchor Head	Deposited at Cerema	DIN EN 10083-2 :2006
Helix	B 500 B (ripped reinforcement steel)	EN 10080:2005-08
Additional Reinforcement	B 500 B (ripped reinforcement steel)	EN 10080:2005-08
Recess tube	PE	
Protective Cap	PE, deposited at Cerema	
Deviator	PUR, deposited at Cerema	
Sealing Body***	PE et NBR, deposited at Cerema	
Corrosion Protection Mass		
Wax or Grease*	According to EAD 160027-00-0301, or according to the regulations valid at the place of use	
Unigel 128 F-1**	According to ETAG 013, Annex C4.1 or C4.2 and according to the regulations valid at the place of use	
Monostrand		
PE Coat	According to EAD 160004-00-0301 clause 2.2.4 to 2.2.26	

* Not covered by the ETA-12/0150
** Not covered by the ETA-12/0150
*** In case of the use of Unigel 128 F-1, the installation of the sealing body can be avoided if the tendon is positioned vertically and the active anchorage at the lowest point of the pre-stressing system. The injection of Unigel 128 F-1 is realized from the bottom of the protective cap to the top of the recess tube of the anchorage zone.

The technical documentation of the components of this European Technical Assessment is deposited at Cerema.

Dimensions and Properties of 7-wires Strands

Designation	Symbol	Unit	Value
Tensile strength	R_m / F_{pk}	MPa	1860

Toron

Nominal diameter	D	mm	15,7
Nominal cross section	A_p	mm²	150
Nominal mass	M	g/m	1172
Surface configuration	-	-	plain
Strength at 0,1 %	$f_{p0,1k}$	MPa	1640
Strength at 0,2 %	$f_{p0,2k}$	MPa	1660
Modulus of elasticity	E	MPa	≈ 195 000

Content of Control Plan

Component	Item [1]	Test / Check	Traceability [2]	Minimum frequency	Documentation
Bearing plate for 7 to 15 strands	material	check	bulk	100%	"2.2" [5]
	detailed dimensions	test		3% ≥ 2 specimen	yes
	visual inspection	check		100%	n
Cast-iron body for 12 to 31 strands	material	check	full	100%	"3.1" [3]
	detailed dimensions	test		5% ≥ 2 specimen	yes
	visual inspection	check		100%	no
Concrete anchor body (CAB) for 7 to 27 strands	compressive strength of high strength mortar	test	full	≥ 3 specimens per batch	yes
Anchor head	material	check	full	100%	"3.1" [3]
	detailed dimensions	test		5% ≥ 2 specimen	yes
	visual inspection	check		100%	no
Wedge	material	check	full	100%	"3.1" [3]
	treatment, hardness	test		0,5% ≥ 2 specimen	yes
	detailed dimensions	test		0,5% ≥ 2 specimen	yes
	visual inspection	check		100%	no
Strand	material	check	full	100%	yes
	diameter	test		each coil	no
	visual inspection	check		each coil	no
Helix	material	check	full	100%	yes
	visual inspection	check		100%	no
Stirrups	material	check	full	100%	yes
	visual inspection	check		100%	no
Grease	material	check	full	100%	yes
Wax	material	check	full	100%	yes

Footnotes:
(1) Item:
material: defined according to technical specification deposited by the supplier at Cerema
detailed dimensions: measuring of all dimensions and angles according to the specification given in the Control Plan
visual inspection: means main dimensions, correct marking and labeling, surface, corrosion, coating, etc.
(2) Traceability:
Full: full traceability of each component to its raw material.
Bulk: traceability of each delivery of components to a defined point
(3) Inspection certificate type "3.1" according to EN 10204 : 2005-01.
(4) As long as the basis for CE marking for prestressing steel is not available, an approval certificate according to the respective rules in force at the place of use shall accompany each deliver.
(5) Test report type "2.2" according to EN 10204 : 2005-01.

Audit Testing

Component	Item	Test / Check	Sampling – number of components per audit
Anchor head	Material according to specifications	check, test	1
	Detailed dimensions	test	
	Visual inspection	check	
Bearing plate	Material according to specifications	check, test	1
	Detailed dimensions	test	
	Visual inspection	check	
Cast-iron anchor body	Material according to specifications	check, test	1
	Detailed dimensions	test	
	Visual inspection	check	
Concrete anchor body (CAB)	Detailed dimensions	test	1
	Compressive strength of high strength mortar	test	3
Wedge	Material according to specifications	check, test	2
	Treatment, hardness	test	2
	Detailed dimensions	test	1
	Main dimensions, surface hardness	test	5
	Visual inspection	check	5
Single tensile element test	EAD 160004-00-0301 Annex C.7	test	1 series

Description of the BBV Post-Tensioning System Type EW – 1

The BBV post-tensioning System type EW is a prestressing system for internal or external use for unbonded tendons.

Tendons
The tendons consist of 7-wire strands with a nominal diameter of 0.62” (15.7 mm) and a nominal cross section of 150 mm². The steel grade Y1860 S7 is allowed. The prestressing system covers tendons from 7 to 31 strands. Each monostrand is individually greased and plastic sheathed with a 2,0 mm PE- coat. If the coating gets damaged, remedial measures according to DIN 30672 shall be performed.
The monostrands are bundled to tendons of 7, 9, 12, 15, 19, 22, 27 or 31 individual strands. All strands of a tendon shall be stressed simultaneously and are anchored individually in the anchor head by means of three parts, round wedges. The number of strands in the tendons may be reduced by omitting strands in such a way that the pattern maintains radially symmetric in the anchorage. The tendons may be re- stressed and replaced since the ducts are filled with non-setting corrosion protection mass. The length of the tendon is unlimited. No duct is necessary in the free length of the post-tensioning kit.

Anchorages
The anchorage with anchor plate or cast-iron anchor body or concrete anchor body and anchor head is used as active anchor or passive anchor.
For anchorage of dia. 0.62” strands wedges with marking “0.62” on the front face shall be installed. The wedges have to be sealed and secured by a retainer plate.
The bursting forces caused by the load transfer to the concrete member shall be carried by a helix made of ribbed steel. Additional reinforcement such as straight bars or stirrups is required. Within the structural design resistance to the forces behind the helix as the result of stressing force transfer shall be verified.
At the fixed anchors without pre-wedging the slip is 4 mm. At the stressing anchor the slip is 3 mm.

Strand protrusion for stressing and re-stressing
The protrusion of the strands beyond the anchor head serves the purpose of fitting the prestressing jack for initial stressing and re-stressing. Annexes 2 and 3 specifies the strand protrusion generally required for initial stressing. The required strand protrusion and the required space for the prestressing jack might be adapted to specific project requirements after consulting BBV Systems.

Corrosion protection of the anchor
The active and the passive anchor of the post tensioning kit shall be protected against corrosion with a protective cap and corrosion protection mass. The recess tube of the anchor zone shall be injected with corrosion protection mass, such as grease, wax or Unigel 128 F-1. The recess tube should be sufficiently extended beyond the level of concrete to prevent unintended penetration of media. The recess tube shall be closed by a sealing body and be filled completely with corrosion protection material. Complete filling with corrosion protection material shall be checked by a vent hole at the highest point of the anchorage zone. The sealing is realized by a sealing body and it is supposed to close tightly the anchor zone in any position. Anchors in concrete are supposed to be sufficiently protected against corrosion. The injection has to be realized according to national standards.

The use of the sealing body can be avoided if the pre-stressing system type EW is installed in a wind energy plant, where the tendon is positioned vertically along the tower wall and the active anchor in the foundation. In combination with the use of Unigel 128 F-1 and an injection of the corrosion protection material from the lowest point of the anchorage (protective cap) to the top (recess tube), the sealing body can be replaced by an appropriate device to protect the corrosion protection mass from excessive pollution.

Description of the BBV Post-Tensioning System Type EW – 2

Corrosion protection of the exposed steel components

Exposed and cast-in steel components with insufficient concrete coverage (e.g. bearing plates, cast - iron anchor bodies) are coated/galvanized with one of the following protective paint systems.

Protective paint systems according to EN ISO 12944-5:2007:

a) Without metallic coating: A5M.02, A5M.4, A5M.06, A5M.07
b) With zinc coating (galvanized): A7.10, A7.11, A7.12, A7.13

The surface shall be prepared according to EN ISO 12944-4:1998.
EN ISO 12944-7:1998 shall be complied when carrying out the paint work.

Stressing

A hydraulic pump unit and a special jack are used for the stressing of the tendons. All strands of a tendon are gripped and stressed simultaneously. Stressing in load steps and resetting of the jack is easily done. In case of straight tendons, optionally a single-strand stressing jack can be used.

After stressing, the wedges will be pressed into the wedge seat using a wedge seating device.
A wedge slip of approximately 3 mm occurs when the stressing force is released.

Re-stressing

A strand protrusion can be planned at the active anchor or passive anchor for future re-stressing of the tendon after removal of the protective cap.

Check of stressing force

The stressing force may be checked, for instance, by lifting the anchor head approximately 1-2 mm off the bearing plate or the cast-iron anchor body by means of a stressing jack. The stressing force required for this is considered to be the current stressing force. The stressing jack is positioned on a stressing chair which transfers the force to the bearing plate or the cast-iron anchor body. The wedges are not released during this operation.

Replacing a tendon

If it becomes necessary to replace a tendon; the tendon must be cut close to an anchor (safety aspect). Subsequently, all movable anchorage components are removed. The bearing plate or the cast-iron anchor body remains in the building structure. The new tendon can then be installed in the same way as the original tendon.