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Deutsches Institut für Bautechnik

DIBt

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European Technical Approval ETA-08/0002

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Handelsbezeichnung *Trade name*		VBT KI 4 bis 19 *VBT KI 4 to 19*
Zulassungsinhaber *Holder of approval*		Vorspann-Brückentechnologie GmbH Ruchtifeldsiedlung 51 5303 THALGAU ÖSTERREICH
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*		Litzenspannglieder für nachträglichen Verbund VBT-KI 4 bis 19 *Internal Bonded Strand Post-Tensioning System* *VBT-KI 4 to 19*
Geltungsdauer: *Validity:*	vom *from* bis *to*	22 January 2008 22 January 2013
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Herstellwerke *Manufacturing plants*		Vorspann-Brückentechnologie GmbH Am Schusterbach 18 5310 MONDSEE ÖSTERREICH VBF GmbH Rooder Straße 31 48477 Hörstel-Bevergem

Diese Zulassung umfasst *This Approval contains*	31 Seiten einschließlich 13 Anhänge *31 pages including 13 annexes*

I LEGAL BASES AND GENERAL CONDITIONS

1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998[4], as amended by Article 2 of the law of 8 November 2011[5];*
- Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC[6];
- Guideline for European technical approval of "Post-tensioning kits for prestressing of structures", ETAG 013.

2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plants. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.

3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.

4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.

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

1 Official Journal of the European Communities L 40, 11 February 1989, p. 12
2 Official Journal of the European Communities L 220, 30 August 1993, p. 1
3 Official Journal of the European Union L 284, 31 October 2003, p. 25
4 *Bundesgesetzblatt Teil I 1998*, p. 812
5 *Bundesgesetzblatt Teil I 2011*, p. 2178
6 Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product/ products and intended use

1.1 Definition of the construction product

The present European technical approval applies to a kit:

VBT-KI Internal Bonded Strand Post-Tensioning System

consisting of 4 to 19 strands with nominal tensile strength 1770 MPa or 1860 MPa (Y1770 S7 or Y1860 S7), nominal diameter 15.3 mm (0.6" - 140 mm²) or 15.7 mm (0.62" - 150 mm²) which are used in normal-weight concrete with the following anchorages (stressing and fixed anchorages and couplers; see Annex 1):

1 Stressing (active) anchorage and fixed (passive) anchorage type P with anchor block and anchor block for tendons of 4, 7, 9, 12, 15 and 19 strands,

2 Stressing (active) anchorage and fixed (passive) anchorage type M with multi-surface anchor and anchor block for tendons of 9, 12, 15 and 19 strands,

3 Fixed Couplers Type B (bolts) for tendons of 4, 7, 9, 12, 15 and 19 strands,

4 Movable Couplers Type B (bolts) for tendons of 4, 7, 9, 12, 15 and 19 strands,

5 Bursting reinforcement (helixes and additional reinforcement/stirrups)

6 Sheathing (ducts)

7 Corrosion protection

The anchorage of the strands in wedge plates and couplers is done by means of wedges.

1.2 Intended use

The Post-Tensioning System is assumed to be used for the prestressing of structures of normal-weight concrete with internal bonded tendons.

Categories of use according to type of tendon and material of structure:

- Internal bonded tendon for concrete and composite structures
- For special structures according to EN1992, EN 1994 and EN 1996.

The structural members are to be designed in accordance with national regulations.

The provisions made in this European technical approval are based on an assumed working life of the PT-System of 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer or the Approval 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.

2 Characteristics of product and methods of verification

2.1 Characteristics of product

2.1.1 General

The components correspond to the drawings and provisions given in this European technical approval 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[7] of this European technical approval. The arrangement of the tendons, the design of the anchorage zones, the anchorage components and the diameters of the ducts shall correspond to the attached description and drawings; the dimensions and materials shall comply with the values given therein.

2.1.2 Designation

End anchorages can be used as stressing and fixed anchorage, while couplers may be fixed or movable couplers.

e. g. VBT-KI 19P – 150 – 1770

The first number of the designation of components of anchorages and couplings (19) identifies the number of strands. The first letter of designation (P) defines the type of anchorage or coupler (P - plate anchorage, M - multi-surface anchorage, B - coupler with bolts). The nominal cross section area of single strand is given by the following number (e.g. "150" for 150 mm²) and the strength of strands is given by the last number (e.g. "1770" for Y1770 S7).

The components (including helix and additional reinforcement) fit for tendons with both nominal section area of strands.

2.1.3 Strands

Only 7-wire strands shall be used in accordance with national provisions with the characteristics given in Table 1.

Table 1 Characteristic of 7-wire strands in accordance with prEN 10138-3:2004-03

Designation of strand			**Y1770S7**		**Y1860S7**	
Tensile strength	R_m	MPa	1770		1860	
Diameter	d	mm	15.3	15.7	15.3	15.7
Nominal cross section area	A_p	mm²	140	150	140	150
Nominal mass per metre	M	g/m	1,093	1,172	1,093	1,172
Permitted deviation from nominal mass		%	± 2			
Characteristic value of maximum force	F_{pk}	kN	248	266	260	279
Maximum value of maximum force	$F_{m,max}$	kN	285	305	300	321
Characteristic value of 0.1% proof force	$F_{p0.1k}$	kN	213	228	224	240
Minimum elongation at maximum force with L0 ≥ 500 mm	A_{gt}	%	3,5			
Relaxation after 1000 h						
at 0.7 f_{pk}		%	2,5			
at 0.8 f_{pk}		%	4,5			
Modulus of elasticity	E_p	MPa	195,000			

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

To avoid confusion only strands with one nominal diameter shall be used on one site. If the use of strands with R_m = 1860 MPa is intended on site, these shall solely be used there.

Only strands stranded in the same direction shall be used in a tendon.

2.1.4 Ring wedges

Ring wedges (see Annex 9) consisting of three parts are used. Single parts are fixed together by a spring ring.

Wedges of one supplier only may be used at one construction site.

2.1.5 Anchor blocks and couplers

The anchor blocks of stressing and fixed anchorages are identical. Determination is only needed due to execution of construction work.

Couplers with bolts have additionally drilled holes for the bolts. The ring wedges of inaccessible fixed anchorages shall be hold in place by a retainer disc or by adequate pre-wedging.

The conical drills of the anchor blocks and couplers shall be clean, stainless and provided with corrosion protection grease.

2.1.6 Anchor plates

For 4 to 19 strands quadratic anchor plates (type P) can be used (see Annex 4).

2.1.7 Multi-surface anchor

For 9 to 19 strands multi-surface anchors (type M) can be used (see Annex 6).

2.1.8 Bolts

For couplers type B special threaded steel bolts from metal in accordance with EN 10025 shall be used.

2.1.9 Helixes and additional reinforcement / stirrups

The steel grades and dimensions of the helixes and of the additional reinforcement shall comply with the values given in the Annexes. The central position in the structural concrete member on site shall be ensured according the section 4.2.3.

Each end of the helix shall be welded to a closed ring. The welding of inner end of helix can be omitted if the length of helix is increased by 1½ additional turns.

2.1.10 Ducts, tubes and trumpets

Steel ducts shall be used in accordance to EN 523:2003.

The trumpets at stressing, fixed anchorages and couplers (see Annexes 2, 4 and 6) are manufactured from 2.5 mm thick PE material (see Annex 11). If the trumpets are made of steel it is necessary to install a PE-pipe of at least 3.5 mm thickness and a length of 100 mm at the end of trumpet to avoid the contact between strands and steel trumpet.

Also corrugated plastic ducts which meet the requirements according to ETAG 013, Annex C.3 and in accordance with regulations valid at the place of use can be used. Plastic ducts and the accompanying boundary conditions of use are not covered by ETA-08/0002.

2.1.11 Grout

Grout according to EN 447:1996 shall be used.

2.1.12 Protection cap

Protection caps are made of plastic and fitted by screws onto the wedge plates.

2.2 Methods of verification

2.2.1 General

The assessment of the fitness of the VBT-KI Internal Bonded Strand Post-Tensioning System for the intended use in the relation to the requirements for mechanical resistance and stability in the sense of Essential Requirement 1 has been made in accordance with the "Guideline for European technical approval of Post-Tensioning kits for prestressing of structures, ETAG 013".

The release of dangerous substances (Essential Requirement 3) is determined according to ETAG 013, clause 5.3.1. A declaration was made by the kit manufacturer that the product does not contain any dangerous substances.

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

The structural members (normal-weight concrete) prestressed by means of the VBT-KI Internal Bonded Strand Post-Tensioning System used to be designed in accordance with national regulations.

If VBT-KI Internal Bonded Strand Post-Tensioning system is used in masonry structures, the anchorage has to be carried out by a concrete transmitting block. At least the dimensions of the transmitting concrete block shall be in accordance with this ETA. Load transmission into the masonry has to be calculated according EN 1996 or national provisions and shall be a minimum structural strength of 1.1 F_{pk}. Additional national provisions valid in place of use, e.g. for the tendon path, corrosion protection etc. should be considered.

2.2.2 Tendons

Prestressing and over-tensioning forces are specified in the respective provisions.

The maximum force P_{max} in accordance with EN 1992-1-1:2004+AC:2010, clause 5.10.2.1 applied to a tendon shall not exceed the force $P_{max} = 0.9\ A_p\ f_{p0,1k}$ laid down in Table 2 (140 mm²) or in Table 3 (150 mm²). The value of the initial prestressing force $P_{m0}(x)$ immediately after tensioning and anchoring in accordance with EN 1992-1-1:2004+AC:2010, clause 5.10.3(2) shall not exceed the force $P_{m0}(x) = 0.85\ A_p\ f_{p0,1k}$ laid down in Table 2 (140 mm²) or in Table 3 (150 mm²). Overstressing is permitted if the force in the prestressing jack can be measured to an accuracy of ±5 % of the final value of the prestressing force. In such case the value of maximum prestressing force P_{max} in accordance with EN 1992-1-1:2004+AC:2010, clause 5.10.2.1(2) shall not exceed the force $P_{max} = 0.95\ A_p\ f_{p0,1k}$ laid down in Table 2 (140 mm²) or in Table 3 (150 mm²).

Table 2: Maximum prestressing forces[8] for tendons with A_p = 140 mm²

Tendon Designation	Number of strands	Cross section area A_p [mm²]	Prestressing force Y1770 S7 $f_{p0,1k}$ = 1520 N/mm²			Prestressing force Y1860 S7 $f_{p0,1k}$ = 1600 N/mm²		
			$P_{m0}(x)$ [kN]	P_{max} [kN]	P_{max} a) [kN]	$P_{m0}(x)$ [kN]	P_{max} [kN]	P_{max} a) [kN]
P 4	4	560	724	766	809 a)	762	806	851 a)
P 7	7	980	1266	1341	1415 a)	1333	1411	1490 a)
P/M 9	9	1260	1628	1724	1819 a)	1714	1814	1915 a)
P/M 12	12	1680	2171	2298	2426 a)	2285	2419	2554 a)
P/M 15	15	2100	2713	2873	3032 a)	2856	3024	3192 a)
P/M 19	19	2660	3437	3639 a)	3841	3618	3830	4043 a)
a) overstressing: P_{max} according to EN 1992-1-1:2004+AC:2010, clause 5.10.2.1(2)								

Table 3: Maximum prestressing forces[8] for tendons with A_p = 150 mm²

Tendon Designation	Number of strands	Cross section area A_p [mm²]	Prestressing force Y1770 S7 $f_{p0,1k}$ = 1520 N/mm²			Prestressing force Y1860 S7 $f_{p0,1k}$ = 1600 N/mm²		
			$P_{m0}(x)$ [kN]	P_{max} [kN]	P_{max} a) [kN]	$P_{m0}(x)$ [kN]	P_{max} [kN]	P_{max} a) [kN]
P 4	4	600	775	821	866 a)	816	864	912 a)
P 7	7	1050	1357	1436	1516 a)	1428	1512	1596 a)
P/M 9	9	1350	1744	1847	1949 a)	1836	1944	2052 a)
P/M 12	12	1800	2326	2462	2599 a)	2448	2592	2736 a)
P/M 15	15	2250	2907	3078	3249 a)	3060	3240	3420 a)
P/M 19	19	2850	3682	3899	4115 a)	3876	4104	4332 a)
a) overstressing: P_{max} according to EN 1992-1-1:2004+AC:2010, clause 5.10.2.1(2)								

The number of strands in a tendon may be reduced by leaving out strands lying symmetrically in the wedge plate. The provisions for tendons with completely filled wedge plates (basic types) also apply to tendons with only partly filled wedges plates. Into the cones not filled short pieces of strands with wedges have to be pressed to assure a sufficient bending stiffness of the wedge plates.

The admissible prestressing force is reduced per strand left out as shown in Table 4:

Table 4: Reduction of the prestressing force when leaving out one strand

Cross section area A_p [mm²]	Y1770 S7			Y1860 S7		
	$\Delta P_{m0}(x)$ [kN]	ΔP_{max} [kN]	ΔP_{max} a) [kN]	$\Delta P_{m0}(x)$ [kN]	ΔP_0 [kN]	ΔP_{max} a) [kN]
140	181	192	202 a)	190	202	213 a)
150	194	205	217 a)	204	216	228 a)
a) overstressing: P_{max} according to EN 1992-1-1:2004+AC:2010, clause 5.10.2.1(2)						

8 The forces stated are maximum values. The actual values are to be found in national regulations valid on place of use. Compliance with the stabilisation and crack width criteria in the load transfer test was verified to a load level of 0.80 F_{pk}.

The forces stated are maximum values. Actual values are to be found in national regulations valid on place of use.

2.2.3 Losses of the prestressing force due to friction and wobble effects

For design shall be considered EN 1992-1-1:2004+AC:2010, clause 5.10.5.2.

The losses of the prestressing force due to friction and wobble effects may normally be determined in the calculation by using the friction coefficients μ and the unintentional angular displacement k (wobble coefficient) given in Table 5. The values μ and k depend on the given duct dimensions and the maximum distances between the tendon supports.

Table 5: Friction and wobble effects for tendons with steel ducts

Tendon Designation	inner diameter of Duct (mm)	Friction coefficient μ [rad^{-1}]	Wobble coefficient k [°/m]	distances between tendon supports [m]	friction losses $\Delta P_{\mu A}$ (%)	
					Stressing anchorage	Movable Coupler
P 4	45	0.20	0.3	0.9	1.3	1.4
P 7	60	0.20	0.3	1.1	1.1	1.4
P/M 9	65	0.20	0.3	1.3	0.7	1.4
P/M 12	75	0.20	0.3	1.5	0.7	1.1
P/M 15	85	0.20	0.3	1.5	0.8	1.6
P/M 19	90	0.20	0.3	1.5	0.8	1.6

The given values of k only apply if the strands are in the ducts at time of concreting.

If the strands are arranged after concreting, the given values k shall only be used in the calculation if the ducts are adequately stiffened during concreting, e.g. by means of PE and/or PVC pipes, or if reinforced ducts are used in connection with smaller distances between tendon supports.

For the determination of strains and forces of prestressing steel friction losses $\Delta P_{\mu A}$ in the active anchorage zone shall be taken into account according to Table 5, last column.

2.2.4 Radius of curvature of the tendons in the structure

The smallest admissible radius of curvature of the tendons with circular duct depending on the strands strength, the cross section of the strands and diameter of the duct is given in Tables 6 to 9.

Table 6: Smallest radius of curvature for strands Y1770S7 with Ap = 140 mm²

Tendon Designation	Radius of curvature [m]	Inner diameter of the duct [mm]
P 4	4.20	45
P 7	4.50	60
P/M 9	5.30	65
P/M 12	6.10	75
P/M 15	6.70	85
P/M 19	7.90	90

Table 7: Smallest radius of curvature for strands Y1770S7 Y1770 S7 with Ap = 150 mm²

Tendon Designation	Radius of curvature [m]	Inner diameter of the duct [mm]
P 4	4.50	45
P 7	4.80	60
P/M 9	5.60	65
P/M 12	6.50	75
P/M 15	7.10	85
P/M 19	8.50	90

Table 8: Smallest radius of curvature for strands Y1860 S7 with Ap = 140 mm²

Tendon Designation	Radius of curvature [m]	Inner diameter of the duct [mm]
P 4	4.40	45
P 7	4.70	60
P/M 9	5.40	65
P/M 12	6.30	75
P/M 15	6.90	85
P/M 19	8.20	90

Table 9: Smallest radius of curvature for strands Y1860 S7 with Ap = 150 mm²

Tendon Designation	Radius of curvature [m]	Inner diameter of the duct [mm]
P 4	4.70	45
P 7	5.00	60
P/M 9	6.00	65
P/M 12	6.90	75
P/M 15	7.60	85
P/M 19	9.10	90

According to ETAG 013, for tendons with at least five strands and circular ducts, the following formula for calculation of the minimal radius of curvature can be used if admissible at the place of use:

$$R_{min} = \frac{2 \cdot P_{m0}(x) \cdot d_{strand}}{p_{R,max} \cdot d_{duct}}$$

with

R_{min}	minimum admissible radius of curvature in [m]
$P_{m0}(x)$	$P_{m0}(x) = 0.85\ A_p\ f_{p0,1k}$ according to section 2.2.2 in [kN]
d_{strand}	diameter of the strands in [mm]
$p_{R,max}$	maximum admissible pressure under a strand ($p_{R,max}$ = 130 to 150 kN/m)
d_{duct}	inner duct diameter in [mm]

R_{min} shall be given with an accuracy of 0.1m (shall be rounded up).

2.2.5 Concrete strength

Concrete complying with EN 206-1 shall be used.

At the time of transmission of the full prestressing force to the concrete member the mean concrete strength of the normal weight concrete in the anchorage zone shall be at least $f_{cmj,cube}$ or $f_{cmj,cyl}$ according to Table 10. The mean concrete strength ($f_{cmj,cube}$ or $f_{cmj,cyl}$) shall be verified by means of at least three specimens (cube with the edge length of 150 mm or cylinder with diameter of 150 mm and height of 300 mm), which shall be stored under the same conditions as the concrete member, with the individual values of specimens not differ no more than 5 %.

Table 10: Necessary mean concrete strength f_{cmj} of the specimens at time of prestressing for anchorages P and M

$f_{cmj,cube}$ [N/mm²]	$f_{cmj,cyl}$ [N/mm²]
30	24
37	30

For partial prestressing with 30 % of the full prestressing the minimum value of the concrete compressive strength shall be verified to be 0.5 $f_{cmj,cube}$ or 0.5 $f_{cmj,cyl}$; intermediate values may be interpolated linearly.

2.2.6 Centre and edge distances of the tendon anchorages, concrete cover

The centre and edge distances of the tendon anchorages shall not be less than the values given in the Annex 2 depending on the actual mean concrete strength.

The values of the centre or edge distances of the anchorages given in the Annex 2 may be reduced in one direction up to 15 %, however, not to a lesser value than the minimal distance between the additional reinforcing bars or the external diameter of the helix plus 2 cm. In this case the centre or edge distances of the anchorages in the other direction shall be increased for keeping the same concrete area in the anchorage zone. The dimensions of the additional reinforcement shall be adjusted accordingly.

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

The concrete cover may under no circumstance be less than 20 mm nor smaller than the concrete cover of the reinforcement installed in the same cross section. The concrete cover of the anchorage should be at least 20 mm. Standards and regulations on concrete cover valid in place of use shall be considered.

2.2.7 Reinforcement in the anchorage zone

The anchorages (including reinforcement) for the transfer of the prestressing forces to the structural concrete are verified by means of tests. The resistance to the forces occurring in the structural concrete in the anchorage zone outside the helix and the additional reinforcement shall be verified. An adequate transverse reinforcement shall be provided here in particular for the occurring transverse tension forces (not shown in the attached drawings).

The steel grades and dimensions of the additional reinforcement (stirrups) shall follow the values given in the Annexes. This reinforcement shall not be taken into account as part of the statically required reinforcement. Existing reinforcement in a corresponding in excess to the reinforcement required by design may be taken into account for the additional reinforcement. The additional reinforcement shall consist of closed stirrups (stirrups closed by means of bends or hooks or an equivalent method) or of orthogonal reinforcement properly anchored. The stirrups locks (bends or hooks) shall be placed staggered.

In the anchorage zone vertically led gaps shall be provided for proper concreting and compacting. If in exceptional cases[9] due to an increased amount of reinforcement - the helix or the concrete cannot be properly placed, the helix can be replaced by different equivalent reinforcement.

[9] This requires the approval for individual case according to the national regulations and administrative provisions.

2.2.8 Slip at the anchorages

The slip at the anchorages (see section 4.2.4) shall be taken into account in the static calculation and the determination of the tendon elongation.

2.2.9 Resistance to fatigue of the anchorages and couplers

With the fatigue tests carried out in accordance with ETAG 013, the stress range of 80 MPa of the anchorages and couplers at the maximum load of 0.65 f_{pk} at $2x10^6$ load cycles was verified.

2.2.10 Increased tension losses at couplers

For verification of crack control and stress ranges increased tension losses of prestressing forces shall be taken into account at the couplers due to creep and shrinkage of the concrete.

2.2.11 Couplers

Couplers shall be positioned in straight tendon sections with straight length of at least 1.0 m to each side. For movable couplers the position and length of the coupler duct shall ensure a movement over the length of at least 1.15 Δl + 30 mm, respectively, where Δl is the maximum elongation length at the time of prestressing at the coupler.

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the Decision 98/456/EC of the European Commission[10] system 1+ of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1+: Certification of the conformity of the product by an approved certification body on the basis of:

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

(b) Tasks for the approved body:
  (3) initial type-testing of the product;
  (4) initial inspection of factory and of factory production control;
  (5) continuous surveillance, assessment and approval of factory production control;
  (6) audit-testing of samples taken at the factory.

3.2 Responsibilities

3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

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

The kit manufacturer may only use initial materials stated in the technical documentation of this European technical approval.

[10] Official Journal of the European Communities L 201/112 of 3 July 1998

The factory production control shall be in accordance with the "control plan" of 27 March 2013 relating to the European technical approval ETA-08/0002 issued on 27 March 2013 which is part of the technical documentation of this European technical approval. The "control plan" is laid down in the context of the factory production control system operated by the manufacturer and deposited with *Deutsches Institut für Bautechnik*.[11]

The basic elements of the "control plan" comply with ETAG 013, Annex E1 (see Annex 12).

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

The records shall contain at least the following information:

- designation of the product or the initial material and the components,
- kind of control or testing,
- date of manufacture and of testing of product or components and of initial material,
- results of controls and tests and, where specified, comparison with the requirements,
- name and signature of person responsible for the factory production control.

The records shall be kept for at least ten years and on request they shall be presented to *Deutsches Institut für Bautechnik*.

If the test result is not satisfactory, the kit manufacturer shall take immediate measures to eliminate the deficiency. Construction products and components which do not comply with the requirements shall be handled such that they cannot be mistaken for products complying with the requirements. After elimination of the deficiency the relevant test shall be immediately repeated as far as is technically possible and necessary for verifying the deficiency elimination.

3.2.1.2 Other tasks for the manufacturer

The kit manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of Post-Tensioning Kits for Prestressing of Structures in order to undertake the actions laid down in section 3.2.2. For this purpose, the "control plan" referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The kit manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of the European technical approval ETA-08/0002 issued on 27 March 2013.

At least once a year specimens shall be taken from manufacturing plant and one series of single tensile element test shall be performed according ETAG 013, Annex E3 (see Annex 20). The results of these test series shall be made available to the approved body.

At least once a year, each components manufacturer shall be audited by the kit manufacturer (see ETAG 013, 8.2.1.1)

3.2.2 Tasks for the approved bodies

3.2.2.1 General

The approved body shall perform the measures according the section 3.2.2.2 to 3.2.2.5 and in accordance with the provisions laid down in the "control plan" of 27 March 2013 relating to the European technical approval ETA-08/0002 issued on 27 March 2013".

[11] The "control plan" is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

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

The approved certification body involved by the kit manufacturer (Vorspann-Brückentechnologie GmbH or VBF GmbH) shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its "control plan" are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform *Deutsches Institut für Bautechnik* without delay.

3.2.2.2 Initial type-testing of the product

For initial type-testing the results of the tests performed as part of the assessment for the European technical approval may be used unless there are changes in the production line or plant. In such cases the necessary initial type-testing has to be agreed between the *Deutsches Institut für Bautechnik* and the approved body involved.

3.2.2.3 Initial inspection of factory and of factory production control

The approved body shall ascertain that, in accordance with the "control plan", the factory, in particular the staff and equipment, and the factory production control are suitable to ensure a continuous and orderly manufacturing of the Post-tensioning system with the specifications mentioned in section 2.1 as well as in the Annexes to the European technical approval.

3.2.2.4 Continuous surveillance, assessment and approval of factory production control

The approved body shall visit the kit manufacturer at least once a year. Each factory of the components listed in annexes 12 and 13 shall be audited at least once in five years. It has to be verified that the system of factory production control and the specified manufacturing process are maintained taking account of the "control plan".

Continuous surveillance and assessment of factory production control have to be performed according to the "control plan".

The results of product certification and continuous surveillance shall be made available on demand by the approved body to the *Deutsches Institut für Bautechnik*.

3.2.2.5 Audit-testing of samples taken at the kit manufacturer

During surveillance inspections the approved body shall take samples of components of the Post-tensioning system for independent testing. For the most important components Annex 13 contains the minimum procedures which have to be performed by the approved body.

The basic elements of the Audit testing comply with ETAG 013, Annex E2 (see Annex 13)

3.3 CE marking

The CE marking shall be affixed on the delivery note. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name or identifying mark of the kit manufacturer and of the production plant (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- the number of the guideline for European technical approval,
- the identification of the product (trade name),
- nominal cross section and tensile strength of the strands.

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

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited with *Deutsches Institut für Bautechnik*, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to *Deutsches Institut für Bautechnik* before the changes are introduced. *Deutsches Institut für Bautechnik* will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

The tendon may be manufactured on the site or in the manufacturing plant (prefabricated tendons).

4.2 Installation

4.2.1 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 VBT-Post-tensioning system. 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. National standards and regulations valid on site shall be considered.

The ETA holder is responsible to inform anyone concerned about the use of this VBT-Post-tensioning system. Additional information as listed in ETAG 013, section 9.2 shall be held available at the ETA holder and shall be distributed as needed.

The tendons and the components shall be handled carefully.

4.2.2 Welding

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

a) Welding of the end of the helix to a closed ring,

b) For ensuring the central position the helix may be attached to the bearing plate or anchor body by welding,

c) Welding on additional reinforcement, e.g. to close the stirrups,

d) Welding of trumpet on bearing plate.

After placing the strands in duct nor more welding shall be performed at the anchorages.

4.2.3 Installation of the tendon

The central position of the helix or stirrups shall be ensured by tack-welding to the bearing plate or the anchor body or other appropriate mountings. The bearing plate or anchor body and the anchor head shall be in direction perpendicular to the axis of the tendon.
The tendon shall be placed straightforward the first meter at the anchorage. The connection between trumpet and duct shall be sealed carefully by tape in order to prevent the penetrating of concrete.

4.2.4 Wedging force, slip at anchorages, wedge securing and corrosion protection compound

The wedges of all anchorages (fixed anchorages and couplers) which are no longer accessible during tensioning shall be secured by means of pre-wedging with 1.1 $P_{m0}(x)$ during installation. In the case of pre-wedging no slip shall be taken into account for the determination of elongation.
Pre-wedging is not necessary if wedges of fixed anchorages or couplers are secured by retainer discs. In this case a slip within the anchorage shall be taken into account for the determination of elongation:

- fixed anchorage and coupler 6 mm
- movable coupler 12 mm

At stressing anchorage the slip of wedge is 6 mm and shall be taken into account for the determination of elongation. The slip is measured by the strand placed measuring marks behind the anchorage. The slip of the wedges is 1 mm smaller as the slip of the strand.
During installation of wedges into the cones all relevant surfaces and clearances shall be greased with corrosion protection grease. The material specification of these greases are deposited at *Deutsches Institut für Bautechnik*.

Before pouring of concrete the wedge plates of the not accessible fixed anchorages shall be sealed with a grout cap.

4.2.5 Tensioning and stressing records

4.2.5.1 Tensioning

At time of stressing the minimum mean concrete strength shall comply with the values given in section 2.2.5.
It is admissible to restress the tendons by releasing and re-using the wedges. After restressing and anchoring, wedge marks on strands resulting from first stressing shall be moved to the outside by at least 15 mm.
The minimum straight length for tensioning behind the anchorages (strand protrusion) depends on the jack which is used on site. All strands of a tendon shall be stressed simultaneously. This can be done by centrally controlled individual jacks or by a bundle jack.

4.2.5.2 Stressing record

All stressing operations shall be recorded for each tendon. In general, the required prestressing force shall be achieved. The elongation is measured and compared with the calculated value.
If during tensioning the difference between measured and calculated elongation or tensioning force is more than 5 % for the sum of all tendons at the cross or 10 % for a single tendon of the calculated value then the engineer shall be informed and the causes shall be found.

Local standards and national regulations valid in place of use shall be considered.

4.2.5.3 Prestressing jacks and space requirements, safety-at-work

For stressing hydraulic jacks are used. Information about the stressing equipment has been submitted to *Deutsches Institut für Bautechnik*.
To stress the tendons, minimal clearance according from the system holder given dimensions shall be considered directly behind the anchorages.
The safety-at-work and health protection regulations shall complied with.

4.2.6 Grouting

4.2.6.1 Grout and grouting procedures

Grout according section 2.1.11 shall be used. Grouting procedures shall be carried out in accordance with EN 446:1996.

Local standards and national regulations valid in place of use shall be considered.

4.2.6.2 Water rinse

Normally, duct shall not be rinsed with water. Local standards and national regulations valid in place of use shall be considered.

4.2.6.3 Grouting speed

The grouting speed shall be in the range between 3 m/min and 12 m/min.

4.2.6.4 Grouted section and re-grouting

The length of a grouted section shall not exceed 120 m. When exceeding this tendon length, additional grouting openings shall be provided.
Vents on the ducts shall be provided at both ends, at the points of the tendon where air or water may accumulate. In the case of ducts of considerable length, vents or inlets may be required at intermediate positions.
Local standards and national regulations valid in place of use shall be considered.

4.2.6.5 Surveillance

Surveillance according to EN 446:1996 shall be carried out.

5 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.

During transport the smallest admissible diameter of curvature of tendons with or without duct is 1.65 m.

Georg Feistel
Head of Department

beglaubigt:
Wittig

Deutsches Institut für Bautechnik DIBt

FIXED AND STRESSING ANCHORAGE

MULTI-SURFACE ANCHOR

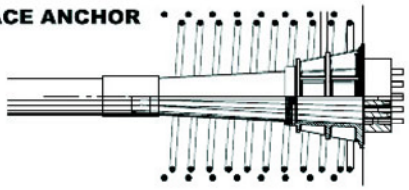
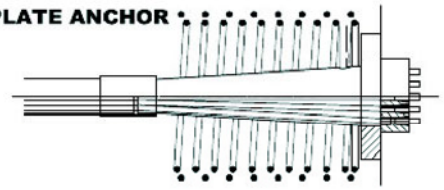
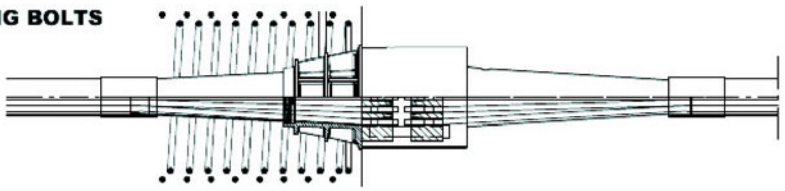


PLATE ANCHOR



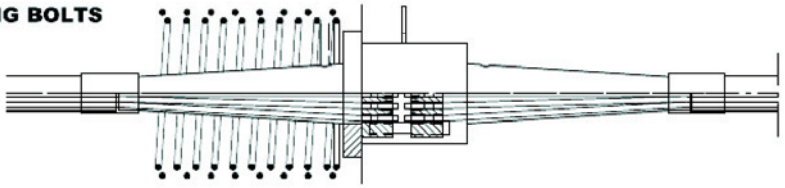
FIXED COUPLING - MULTI-SURFACE ANCHOR

LAYOUT WITH COUPLING BOLTS



FIXED COUPLING - PLATE ANCHOR

LAYOUT WITH COUPLING BOLTS



MOVABLE COUPLING

LAYOUT WITH COUPLING BOLTS

VBT KI 4 to 19	Annex 1
Overview Anchorages	

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DIMENSIONS OF ANCHORAGE [MM]

System VBT-KI		4	7	9	12	15	19
Number of strands	[-]	4	7	9	12	15	19
Weight per meter	[kg]						
A_p=140mm² per Strand		4,37	7,65	9,84	13,12	16,40	20,77
A_p=150mm² per Strand		4,69	8,20	10,55	14,06	17,58	22,27
Nominal cross section	[mm²]						
A_p=140mm² per Strand		560	980	1260	1680	2100	2660
Ap=150mm² per Strand		600	1050	1350	1800	2250	2850

Permitted prestressing force [kN]												
Steel grade Y1770S7/Y1860S7	1770	1860	1770	1860	1770	1860	1770	1860	1770	1860	1770	1860
A_p=140mm²												
Ultimate Force F_{pk}	991	1040	1735	1820	2230	2340	2974	3120	3717	3900	4708	4940
Max. Overstress Force 0.95 $F_{p0,1k}$	809	851	1415	1490	1819	1915	2426	2554	3032	3192	3841	4043
Max. Prestress Force 0.9 $F_{p0,1k}$	766	806	1341	1411	1724	1814	2298	2419	2873	3024	3639	3830
A_p=150mm²												
Ultimate Force F_{pk}	1062	1116	1859	1953	2390	2511	3186	3348	3983	4185	5045	5301
Max. Overstress Force 0.95 $F_{p0,1k}$	866	912	1516	1596	1949	2052	2599	2736	3249	3420	4115	4332
Max. Prestress Force 0.9 $F_{p0,1k}$	821	864	1436	1512	1847	1944	2462	2592	3078	3240	3899	4104

Anchor block							
Diameter	ØRK	100	120	160	160	200	200
Thickness	H	45	50	55	60	75	75

Anchor body											
Anchor plate/multi-surface anchor		P	P	P	M	P	M	P	M	P	M
Length	B x B	170	210	245	Ø220	280	Ø220	320	Ø280	340	Ø280
Thickness	D	20	30	35	180	40	180	45	210	50	210
Passage	ØL	70	88	124	124-110	124	124-110	155	152-135	155	152-135

Trumpet											
Length	Lt	250	310	650	470	600	420	665	460	615	410

Duct diameter						
Metal duct (inner/outer)	ØI/ØA	45/52	60/67	65/72	75/82	85/92	90/97
Plastic duct (inner/outer)	ØI/ØA	59/73		76/91		100/116	

Minimum distance of anchorage (**)						
for $f_{cm0,cube,150} \geq 30N/mm^2$ (*)						
Distance of axis	225	300	340	390	440	490
Distance from edge (***)	103	140	160	185	200	225
for $f_{cm0,cube,150} \geq 37N/mm^2$ (*)						
Distance of axis	210	270	310	370	410	460
Distance from edge (***)	95	125	145	175	185	210

Spiral											
Wire	Ømin	12	12	14		14		14(16)		16(14)	
Distance of windings	max.	50	50	50		50		45(50)		50(40)	
Length	min.	175	275	300	275	325	300	425	375	475	
Outer diameter	Ømin										
$f_{cm0,cube,150} \geq 30N/mm^2$ (*)		190	260	300		320		360		410	
$f_{cm0,cube,150} \geq 37N/mm^2$ (*)		160	230	270		320		350		390	

Additional reinforcement							
Diameter	Ø	5Ø12	5Ø14	6Ø14	7Ø14	8Ø14	8Ø14
Distance	e	40	50	50	50	50	50
b x b	min.						
$f_{cm0,cube,150} \geq 30N/mm^2$ (*)		205	280	320	370	400	450
$f_{cm0,cube,150} \geq 37N/mm^2$ (*)		190	250	290	350	370	420

(*) Minimum actual concrete strength at stressing [N/mm²]
(**) Distances of axis can be reduced by 85% of the given values in one direction, if increased correspondingly in the other direction
(***) Concrete cover of spiral and additional reinforcement shall be taken into account

VBT KI 4 to 19	Annex 2
Dimensions	

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COUPLING WITH COUPLING BOLTS [MM]

System	VBT-KI	B4	B7	B9	B12	B15	B19
Number of strands		4	7	9	12	15	19
Coupling block, type A							
Diameter	Øa	137	147	205	205	235	235
Height	HK	60	60	70	75	80	80
Threaded hole		M 24	M 24	M 27	M 24	M 27	M 27
Length of thread	mm	45	45	45	45	45	45
Number of threaded holes		4	6	6	9	12	12
Coupling block, type B							
Diameter	Øa	137	147	205	205	235	235
Height	HK	60	65	70	75	85	85
Passage hole for coupling bolt	Ø	25	25	28	25	28	28
Number of threaded holes		4	6	6	9	12	12
Coupling bolts (cylindrical bolts)							
Number of bolts	pcs.	4	6	6	9	12	12
Bolt dimension	Ø	M 24x160	M 24x160	M 27 x 170	M 24x180	M 27x180	M 27x180
Spacing pipe							
Number of pipes	c	4	3	3	3	3	3
Length	d	55	50	55	60	50	50
Inner Diameter	Øi	24,5	24,5	27,5	24,5	27,5	27,5
Wall thickness	mm	2	2	2	2	2	2
Cover box							
Inner Diameter	Øe	147	157	215	215	245	245
Length (fixed coupling)	f	205	205	225	240	245	245
Length (movable coupling)	g	= f + 1.15 * ΔL + 30 (with ΔL…elongation)					
Length of trumpet	Lt	250	310	650	600	665	615

VBT KI 4 to 19	Annex 3
Coupling with Coupling Bolts	

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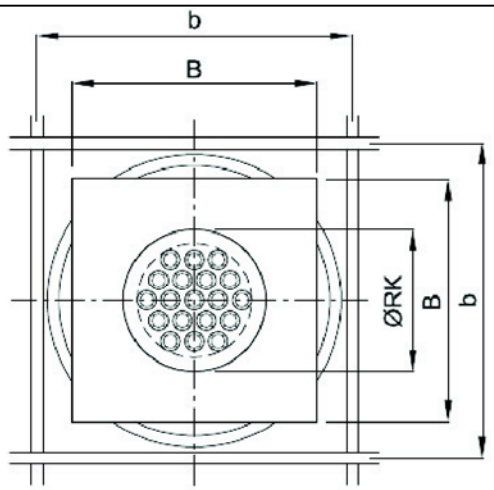
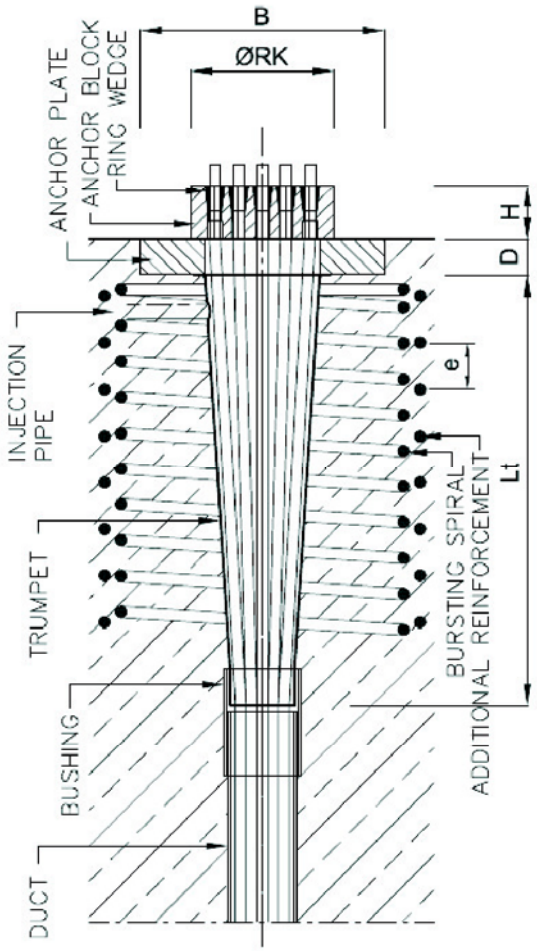
FIXED AND STRESSING ANCHORAGE





VBT KI 4 to 19	Annex 4
Plate Anchor Fixed Anchorage	

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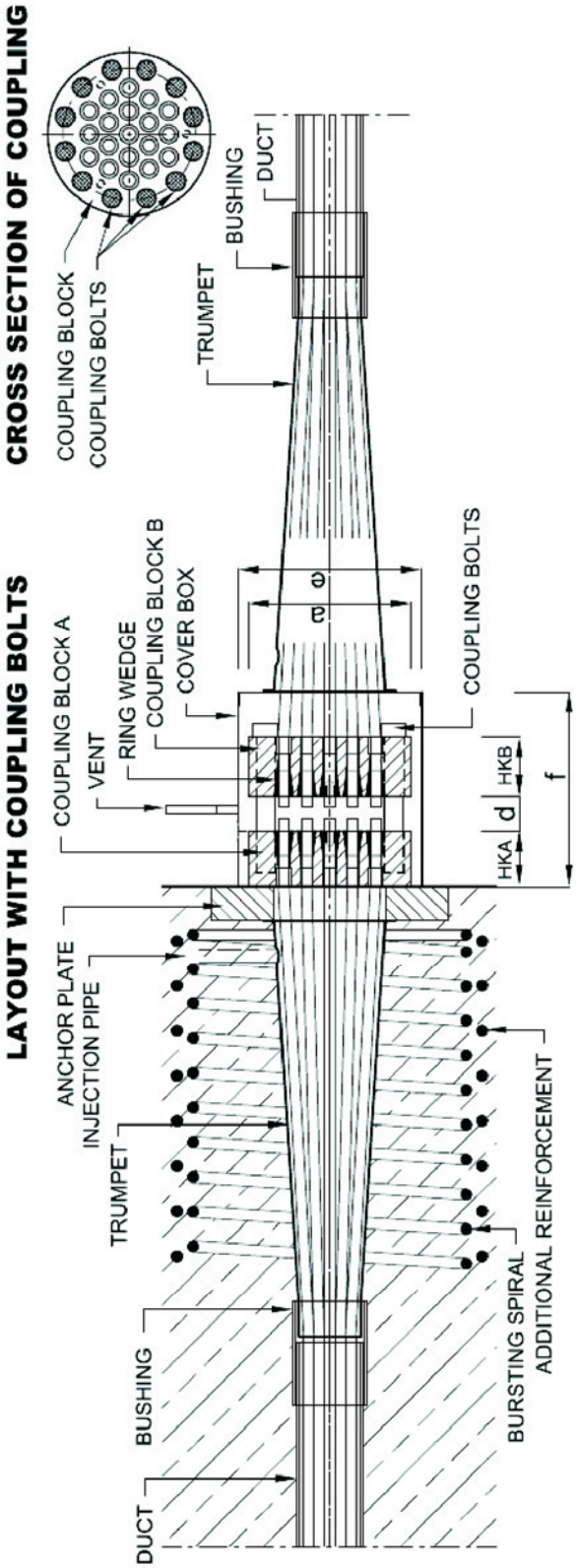
FIXED COUPLING



VBT KI 4 to 19	Annex 5
Plate Anchor Fixed Coupling	

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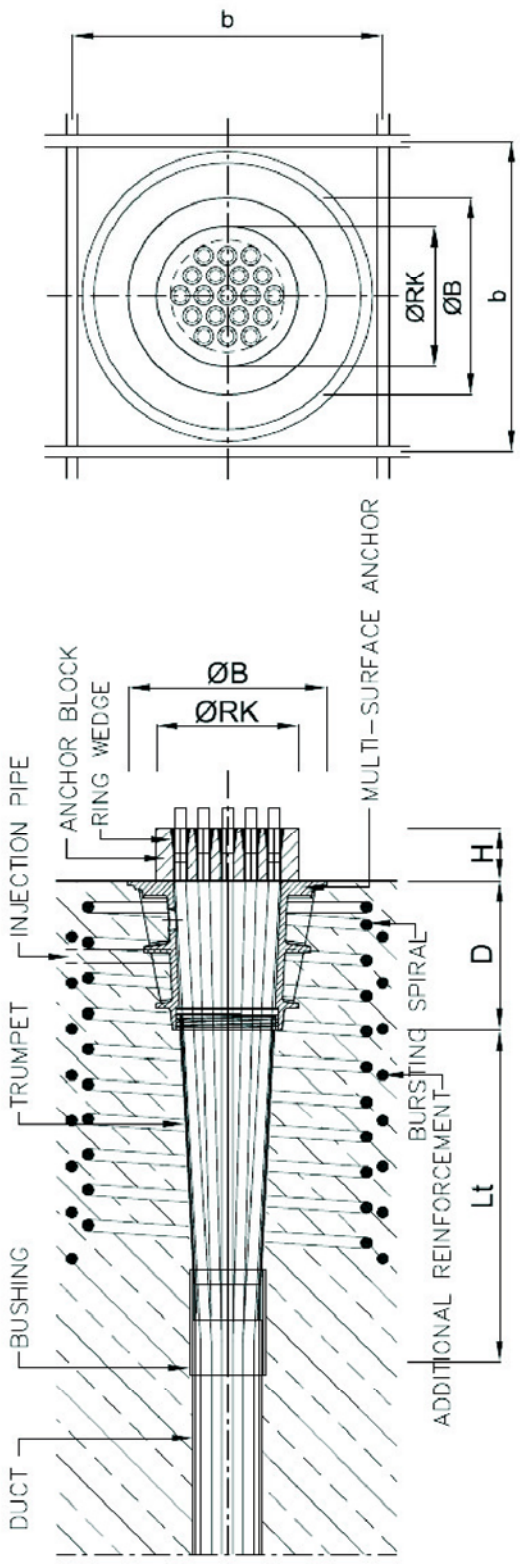
FIXED AND STRESSING ANCHORAGE



VBT KI 4 to 19	Annex 6
Multi-Surface Anchor Fixed Anchorage	

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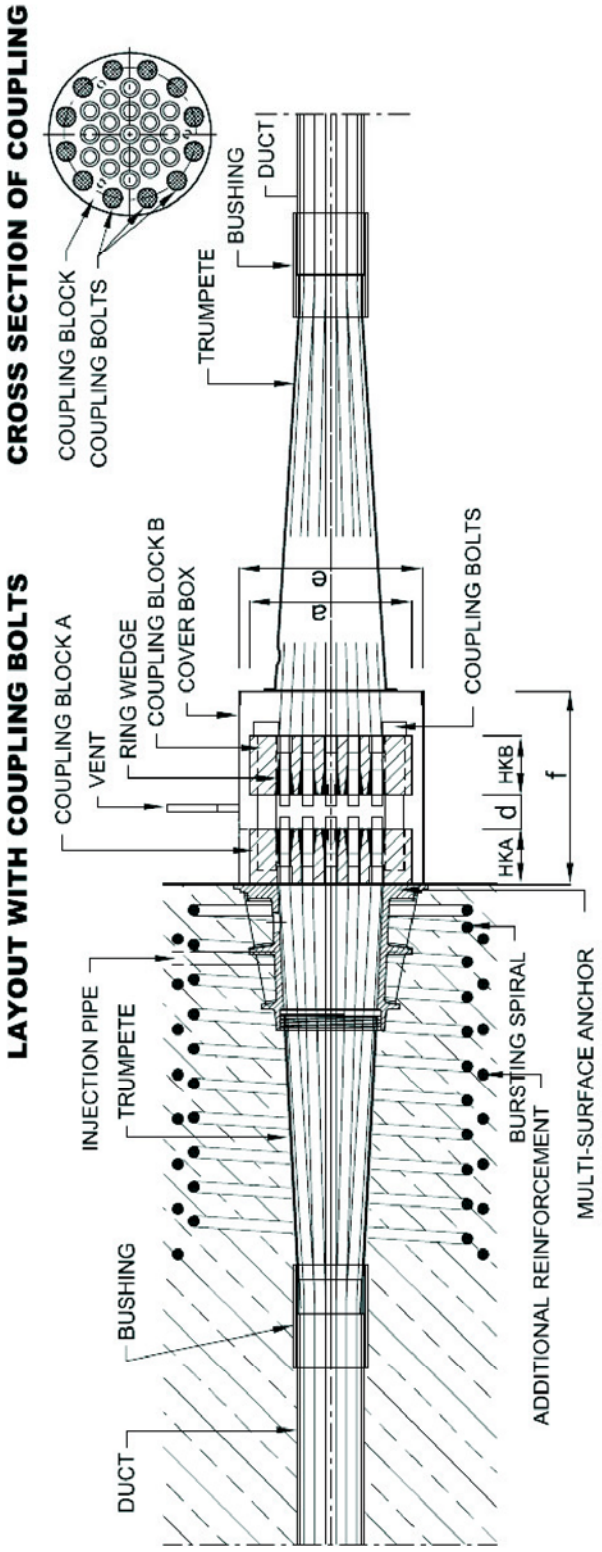
FIXED COUPLING



VBT KI 4 to 19	Annex 7
Multi-Surface Anchorage Fixed Coupling	

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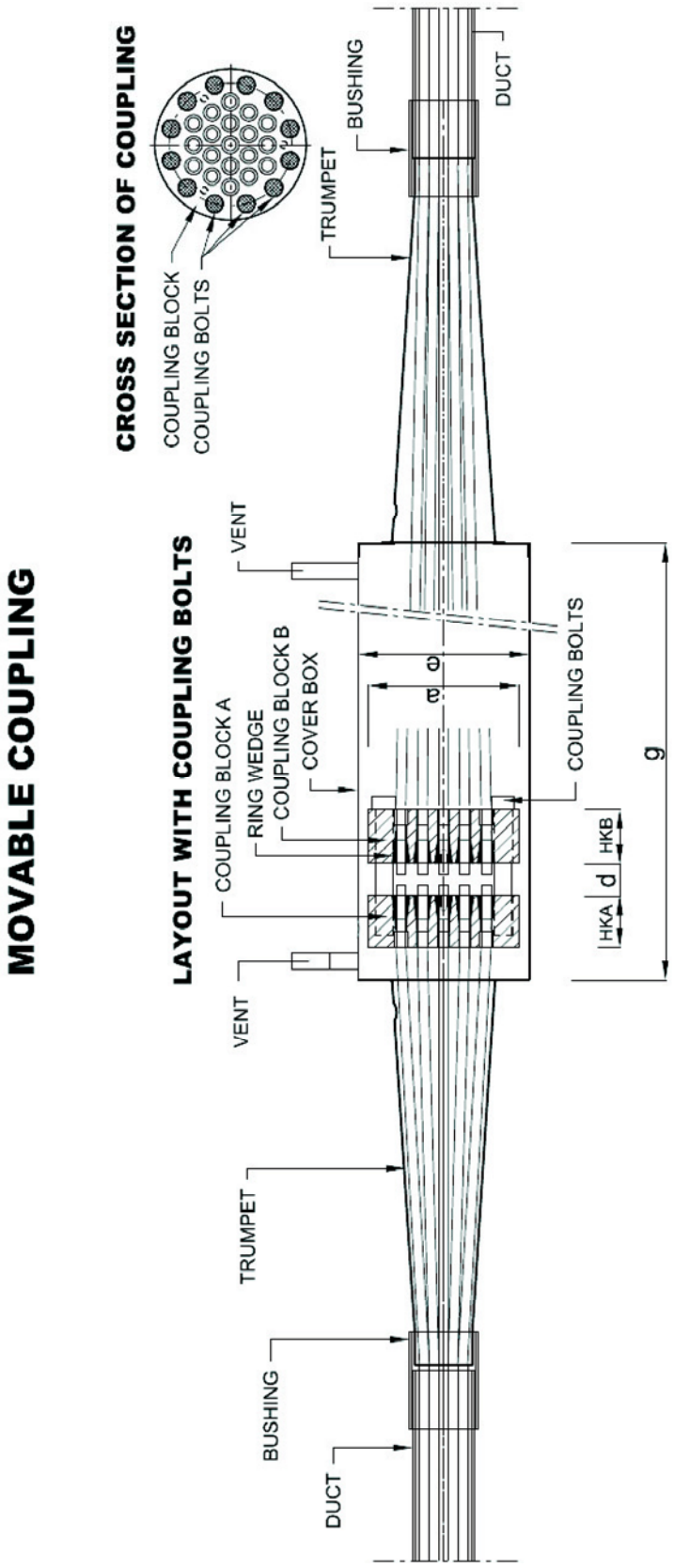

VBT KI 4 to 19	Annex 8
Movable Coupling	

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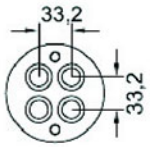
ANCHOR BLOCKS - TEMPLATE OF DRILLING

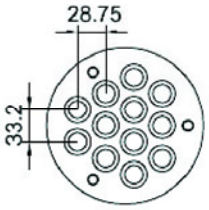
VBT–KI 4



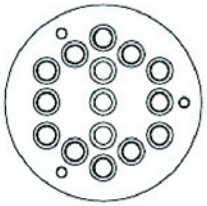
VBT–KI 7

VBT–KI 9

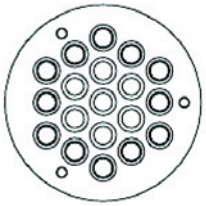
VBT–KI 12



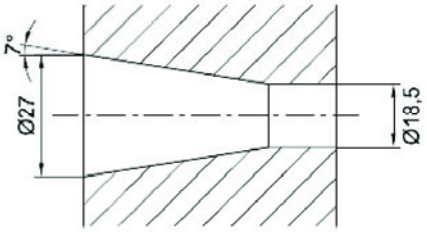
VBT–KI 15



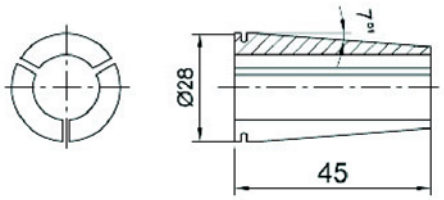
VBT–KI 19



CONICAL DRILLING



RING WEDGE



VBT KI 4 to 19	Annex 9
Detail Drawings	

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1 PRESTRESSING STEEL

As prestressing steel 7-wire strands Y1770S7 or Y1860S7 of nominal diameter 15.3mm (0.6“) respectively 15.7mm (0.62“), nominal cross section 140mm² respectively 150mm², are used.

2 DESCRIPTION OF TENDONS

The tendons are used for internal post-tensioning. They can be tensioned on a single or on both anchorages. If tensioned on a single end, the fixed anchorage will be assembled and the ring wedges fixed to the anchor block by strong hitting, a wedge retainer disc or tightened by a hydraulic jack with a pre-wedge lockup force of 1.2 to 1.6 times of the permitted prestressing force.

The coupling can either be a fixed coupling or a movable coupling. Fixed couplings are used to connect to a finished construction stage. After stressing and mostly grouting the tendon, the tendon of the second construction stage is connected to the first one. The movable coupling is needed to lengthen the total length of the non-tensioned tendon.

At fixed anchorages and coupling blocks (type B), ring wedges will be secured by a wedge retainer disc or are tightened by a hydraulic jack with a pre-wedge lockup force of 1.2 to 1.6 times of the permitted prestressing force. If the wedges will be secured by a retainer disc or will be fixed simply by strong hitting with a tube, the calculated elongation shall be increased by 6mm at fixed anchorages and fixed couplings, and by 2x6=12mm at movable couplings.

It is possible to couple tendons made of 4, 7, 9, 12, 15 and 19 strands. Couplings are realized by coupling bolts. To provide an equal force distribution along all bolts in the coupling, the bolts shall be tightened to the same torque using a torque wrench.

3 ANCHORAGE

The anchorage consists of a steel anchor block where tendons fit with ring wedges into conical drillings parallel to the axis of the tendons. The drillings are placed in a schematic pattern in the anchor block.

The anchor block is mounted on an anchor plate or an anchortrumplate to transfer the force into the surrounding concrete. The transition from tendon to anchorage is done by a trumpet-like widened pipe. To reinforce the concrete behind the anchor plate against splitting tension a combination of bursting spiral and additional reinforcement is used.

Fixed anchorages which are set in concrete shall be tightenend against intrusion of concrete through free spaces in the ring wedges. Tightening can be done either by a proctection cap or by tightening bands (Densoband). The ventilation during grouting of the prestressed system uses a ventilation pipe (plastic), which is connected to the upper side of the trumpet using a transition pipe.

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4 PRODUCTION

The stressing tendons can be produced either in factory or on site. Generally tendons are delivered in coils on site. The strands are cut on site to the final length and directly inserted into the duct. It is also possible to pre-cut the strand in factory to the final length.

5 DUCT

As ducts rebate pipes respectively corrugated pipes according EN 523:1997-07, or plastic ducts according ETAG 013 App. C.3, are used.
All connections and joints are to be tightened by sealing band.

6 STRESSING

Stressing is done by special jacks, which also preasurizes the ring wedges. While reducing the prestressing force in the jack, the tendon pulls the ring wedges into the anchor block(value of the wedge slip). A lubricant grease is applied to the conical drillings in the anchor block, which also protects against corrosion too. To compare the calculated values of the elongations with the real ones, single strands are marked before stressing and changes are measured. Wedge slip at anchorages needs to be considered with 6 mm.

Prestressing force is determined using the calibration curve of the jack. The loss in tensioning forcecaused by friction in the anchorage is included in the calibration curve.

The measured elongations shall be recorded in the stressing protocol and compared to the analytical values.

7 GROUTING

Grout material is pressed into the injection pipes until the outflow of grouting material has the same consistency as the grouting material before injection. Specific regulations for grouting of tendons using cement grout are given in EN 445, 446, 447. The results of grouting need to be recorded into the grouting protocoll.

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MATERIAL SPECIFICATIONS

Naming	Material-Code*	Standard
Ring wedge	1.0401	EN 10 277-2:1999-10
Anchor plate	1.0038	EN 10 025-2:2005-04
Wedge retaining disc	1.0038	EN 10 025-2:2005-04
Anchor block	1.1221	EN 10 083-1:1996-10
Multi surface anchor	EN-JL1040	EN 1561:1997-08
Coupling block	1.1221	EN 10 083-1:1996-10
Coupling bolts	10.9	EN 20 898-2:1994-02
Trumpet	1.0038	EN 10 025-2:2005-04
	PE	EN ISO 1872
Additional reinforcement	1.0438	DIN 488
Duct		EN 523:2003-11
		ETAG 013, C.3

* exact material definitions deposited at DIBt

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CONTENT OF CONTROL PLAN

Component	Item	Test/ Check	Traceability[4]	Minimum frequency	Documen-tation
Anchor plate	material	check	bulk	100%	„2.2“[1]
	detailed dimensions[5]	test		3% ≥2 specimen	yes
	visual inspection[3]	check		100%	no
Multi-surface anchor	material	check	full	100%	„3.1“[2]
	detailed dimensions[5]	test		3% ≥2 specimen	yes
	visual inspection[3]	check		100%	no
Anchor block, coupling block	material	check	full	100%	„3.1“[2]
	detailed dimensions[5]	test		5% ≥2 specimen	yes
	visual inspection[3]	check		100%	no
Coupling bolts	material	check	full	100%	„CE“
	visual inspection[3]	check		100%	no
Wedge	material	check	full	100%	„3.1“[2]
	treatment, hardness	test		0,5% ≥2 specimen	yes
	detailed dimensions[5]	test		5% ≥2 specimen	yes
	visual inspection[3]	check		100%	no
Duct	material	check	„CE“	100%	„CE“[9]
	visual inspection[3]	check		100%	no
Tensile element strand[8]	material[6]	check	„CE“	100%	„CE“
	diameter	test		each coil/bundle	no
	visual inspection[3]	check		each coil/bundle	no

Continuation of Control Plan and footnotes see next page

Component	Item	Test/ Check	Traceability[4]	Minimum frequency	Documen-tation
Constituents of filling material as per EN 447	cement	check	bulk	100%	yes
	admixtures, additions	check		100%	yes
Helix	material	check	full	100%	yes
	visual inspection[3]	check		100%	no
Stirrups	material	check	full	100%	yes
	visual inspection[3]	check		100%	no
Corrosion protection mass (grease)	material[7]	check	full	100%	„2.2“[1]

All samples shall be randomly selected and clearly identified.

1 „2.2“: test report type „2.2“ according to EN 10204
2 „3.1“: Inspection certificate type „3.1“ according to EN 10204
3 Visual inspection means e.g.: Main dimensions, gauge testing, correct marking or labeling, surface, fins, kinks, smoothness, corrosion, coating etc. as given in the Control Plan
4 full: full traceability of each component to its raw material bulk:: traceability of each delivery of components to a defined point
5 Detailed dimensions mean measuring of all dimensions and angles according to the specification as given in the Control Plan
6 Characteristic material properties see ETA, chapter 2.1.3
7 Corrosion protection mass (grease) according to the composition deposited by the supplier at the Deutsches Institut für Bautechnik. Characteristic material properties shall comply with ETAG 013, Annex C4.1.
8 As long as the basis for CE marking for prestressing steel is not available, an approval or certificate according to the respective rules in force at the place of use shall accompany each delivery.
9 Certificate or confirmation given by supplier

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AUDIT TESTING

Component	Item	Test/ Check	Sampling[1] – Number of components per audit
Anchor block, coupling block, anchor plate, multi surface anchor	material according to specification	check/ test	1
	detailed dimensions	test	1
	visual inspection[2]	check	1
Wedge	material according to specification	check/ test	2
	visual inspection	check	
Single tensile element test	ETAG 013, Annex E.3	test	1 series

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

[2] Visual inspection means e.g.: Main dimensions, gauge testing, correct marking or labelling, appropriate performance, surface, fins, kinks, smoothness, corrosion, etc.as given in the Control Plan.

VBT KI 4 to 19	Annex 13
Audit Testing	