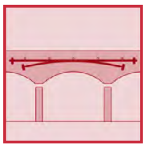


POST-TENSIONING

DYWIDAG Multistrand PT System for Bonded Application with 3 to 55 strands ETA-13/0815

29 January 2021

DYWIDAG

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

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European Technical Assessment

ETA-13/0815 of 29.01.2021

General part

Technical Assessment Body issuing the European Technical Assessment	Österreichisches Institut für Bautechnik (OIB) Austrian Institute of Construction Engineering
Trade name of the construction product	DYWIDAG Strand
Product family to which the construction product belongs	Bonded post-tensioning kits for prestressing of structures with 3 to 55 strands
Manufacturer	DYWIDAG-Systems International GmbH Neuhofweg 5 85716 Unterschleissheim Germany
Manufacturing plants	DYWIDAG-Systems International GmbH Max-Planck-Ring 1 40764 Langenfeld Germany DYWIDAG-Systems International GmbH ul. Hallera 78 41-709 Ruda Śląska Poland
This European Technical Assessment contains	58 pages including Annexes 1 to 31, which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with Regulation (EU) № 305/2011, on the basis of	European Assessment Document (EAD) 160004-00-0301 – Post-Tensioning Kits for Prestressing of Structures.
This European Technical Assessment replaces	European Technical Assessment ETA-13/0815 of 25.06.2018.

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Specific parts

1 Technical description of the product

1.1 General

The European Technical Assessment[1] – ETA – applies to a kit, the bonded PT system

DYWIDAG Strand,

comprising the following components.

– Tendon

  Bonded tendon with 3 to 55 tensile elements

– Tensile element

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

Table 1 Tensile elements

Nominal diameter		Designation according to prEN 10138-3[2]	Nominal tensile strength
mm	inch	—	N/mm^2
15.3	0.6	Y1770S7	1 770
15.3	0.6	Y1860S7	1 860
15.7	0.62	Y1770S7	1 770
15.7	0.62	Y1860S7	1 860

NOTE 1 N/mm^2 = 1 MPa

– Anchorage

  Prestressing steel strand anchored by either 3-piece wedge or bond head.

  Stressing (active) and fixed (passive) anchor with wedges, wedge plate, and multi-plane anchor body MA for tendons with 3 to 55 prestressing steel strands

[1] ETA-13/0815 was firstly issued in 2013 as European technical approval with validity from 28.06.2013, converted 2018 to European Technical Assessment ETA-13/0815 of 25.06.2018 and amended 2021 to European Technical Assessment ETA-13/0815 of 29.01.2021.

[2] Standards and other documents referred to in the European Technical Assessment are listed in Annex 30 and Annex 31.

Stressing (active) and fixed (passive) anchor with wedges and anchor plate SD for tendons with 3 to 9 prestressing steel strands

Fixed (passive) anchor with bond anchorage H for tendons with 3 to 22 prestressing steel strands

– Coupler

Prestressing steel strand anchored by 3-piece wedge.

Fixed coupler with wedges, coupler plate R, and multi-plane anchor body MA for tendons with 5 to 37 prestressing steel strands

Movable coupler with wedges and single strand couplers D for tendons with 3 to 37 prestressing steel strands

– Helix and additional reinforcement or only additional reinforcement without helix in the anchorage zone

– Ducts

– Permanent corrosion protection for tensile elements, anchors, and couplers

PT system

1.2 Designation and range of anchorages and couplers

1.2.1 Designation

Anchorages and couplers are designated by their function in the structure, the nominal diameter of the prestressing steel strands and the maximum number of the prestressing steel strands. The first number indicates the nominal diameter of the prestressing steel strand, “68” = 15.3 mm (0.6 ") or 15.7 mm (0.62 "), followed by the maximum number of prestressing steel strands per unit “n”, 68 n. The available anchorages and couplers are shown in Annex 1 and Annex 2, and are listed in Table 2.

Table 2 Anchorages and Couplers

Component	**Number of strands [1]**																
Anchorage																	
Wedge plate with anchor body MA			5		7		9	12	15	19	22	27	31	37	43	49	55
Anchor plate SD	3	4	5	6	7	8	9										
Bond anchorage H	3	4	5		7		9	12	15	19	22						
Coupler																	
Fixed coupler with coupler plate R and anchor body MA			5		7		9	12	15	19	22	27	31	37			
Movable coupler D	3	4	5		7		9	12	15	19	22	27	31	37			

[1] One or more prestressing steel strands may be omitted to install tendons with numbers of prestressing steel strands between the numbers given.

“Multi-plane anchor body MA” and “anchor body MA” are synonyms.

1.2.2 Tendon range

The available tendon sizes are listed in Table 2. The characteristic values of maximum force of tendons are given in Annex 27.

Anchorage and coupler may be provided with less prestressing steel strands than the maximum number, resulting in a continuous tendon row. Thereby the prestressing steel strands are omitted as much as possible radial symmetrically. For all omitted prestressing steel strands, the respective bores in wedge plate or coupler plate do not need to be drilled. Alternatively, at wedge plate and coupler plate R a short length of prestressing steel strand with a wedge is pressed in. For coupler plate R the bores in the projecting collar may be equally redistributed. However, overall dimensions of wedge plate and coupler plate are unchanged in any case.

Moreover, each anchorage and coupler may be installed with virtually any meaningful number of prestressing steel strands smaller or equal to the complete number of prestressing steel strands for the respective size. However, the resulting prestressing force is exactly axial with regard to anchorage and coupler. This is obtained by an appropriate arrangement of the prestressing steel strands in wedge plate and coupler plate.

Anchorages and couplers with omitted strands are in any case installed with unchanged dimensions and unchanged reinforcement compared to anchorages and couplers with complete number of prestressing steel strands.

1.2.3 Anchorage

1.2.3.1 General

The stressing anchor arranges the prestressing steel strands for the stressing operation and subsequently anchors the stressed prestressing steel strands by means of wedges. Each prestressing steel strand is individually anchored within a conical bore of the wedge plate or anchor plate SD by means of a 3-piece wedge, see Annex 9. All prestressing steel strands of the bundle tendon are stressed at the same time.

At the fixed anchor, the prestressing steel strands are anchored by means of wedges in wedge plate or in anchor plate SD, or by bond and bond heads within bond anchorage H.

The same principles of anchorage apply from the smallest to the largest tendon.

1.2.3.2 Stressing and fixed anchor with wedge plate and anchor body MA

The stressing anchor comprises wedges, wedge plate, and multi-plane anchor body MA, see Annex 10 to Annex 13. The trumpet is arranged between anchor body MA and duct. Anchorage with anchor body MA can be installed without or with helix. The helix, if present, is centrically aligned to the anchor body MA and fastened in its position. If required, the free end of the helix is fastened to the additional reinforcement. The duct is inserted into the trumpet or screwed thereon. The wedge plate is slipped over the prestressing steel strands before stressing.

Anchorage with anchor body MA can be installed with a flat duct, see Annex 4.

The stressing anchor can also be used as a fixed anchor. In that case, access is given to the fixed anchor during stressing. If the fixed anchor is not accessible and embedded in concrete, the wedges are secured by a wedge keeper plate, see Annex 10.

1.2.3.3 Stressing and fixed anchor with anchor plate SD

The stressing anchor comprises wedges and anchor plate SD, see Annex 15 and Annex 16. The trumpet is fastened at the formwork, optionally with a connection tube. Duct and trumpet are joined by inserting the duct into the trumpet or the duct is screwed on the trumpet. The helix, if present, is centrically aligned to the trumpet and fastened in its position. If required, the free end of the helix is fastened to the additional reinforcement. The anchor plate SD is slipped over the strands before stressing.

Anchorage with anchor plate SD can be installed with a flat duct, see Annex 4.

The stressing anchor can also be used as a fixed anchor. In that case, access is given to the fixed anchor during stressing. If the fixed anchor is not accessible and embedded in concrete, the complete anchorage, comprising anchor plate SD, connection tube, trumpet, and helix is mounted at once and the wedges are secured in the anchor plate SD by means of a wedge keeper plate, see Annex 15.

1.2.3.4 Fixed anchor with bond anchorages H – HL and HR

At the fixed anchor with bond anchorage H, the prestressing steel strands are anchored by bond of the prestressing steel strands and in particular with bond heads to the structural concrete, see Annex 1, Annex 17, and Annex 18. Therefore, it can only be used as a fixed anchor, embedded in concrete. Beside bond heads, it comprises ring, helix, and spacers for creating the intended strand layout, see Annex 1 and Annex 17. The prestressing steel strands used in this anchorage are free of any surface treatment, i.e., free of temporary corrosion protection, neither applied at the manufacturing plant nor on site.

1.2.4 Coupler

1.2.4.1 General

In the coupler, the prestressing steel strands are anchored by means of wedges at both construction stages.

1.2.4.2 Fixed coupler with coupler plate R

The fixed coupler comprises wedges, coupler plate R and anchor body MA, see Annex 21 and Annex 22. The fixed coupler connects a 2nd tendon with an already stressed 1st tendon. The already stressed 1st tendon is anchored in the same way as a stressing anchor with wedge plate. In addition, the coupler plate R provides a projecting ring collar with conical bores and pre-installed wedges that are secured by press-on-segments and springs. The prestressing steel strands of the 2nd tendon are pushed into the bores from bottom side and anchored with pre-installed wedges.

A 100 mm long and at least 4 mm thick PE-HD insert is installed at the deviating point at the end of the trumpet if the coupler can be subjected to significant fatigue actions. The insert is not required for a plastic trumpet, where the duct is screwed on an external thread of the plastic trumpet.

1.2.4.3 Movable coupler D with single strand coupler

The movable coupler D comprises for each prestressing steel strand a single strand coupler. The single strand coupler is assembled of 2 wedges with 2 springs inside 2 barrel chucks, connected by the fitting bolt, see Annex 23. Movable couplers connect two tendons prior to stressing. The prestressing steel strands of both tendons are pushed into the single strand couplers and anchored with the pre-installed wedges. Springs between wedges and fitting bolt secure the wedge positions in the cones.

The group of single strand couplers are arranged staggered in up to 3 levels, see Annex 23 and Annex 24.

Prior to final assembly of the tube, and according to the stressing direction, the correct position of the coupler in the coupler tube is checked.

1.2.5 Centre and edge distances, concrete cover

All centre and edge distances have been determined with regard to requirements on load-bearing capacity, depending on the actual mean compressive strength of concrete at time of stressing, $f_{cm,\,0}$. Distance of tendon anchorages conforms to the values specified in Annex 11, Annex 12, Annex 13, Annex 16, Annex 17, Annex 18, Annex 19, and Annex 20. However, these values for centre distance between anchorages may be reduced in one direction by 15 %, but not smaller than the outside diameter of the helix and the dimensions of anchor body MA or anchor plate SD and placing of additional reinforcement is still possible. In case of a reduction of the distances in one direction, the centre and edge distances in the perpendicular direction are increased by the same percentage in order to keep an equal concrete area in the anchorage zone.

The concrete cover of tendons is neither smaller than 20 mm nor smaller than the concrete cover of reinforcement installed in the same cross section. Concrete cover at the anchorage is at least 20 mm on the grout cap. Standards and regulations on concrete cover in force at the place of use are observed.

1.2.6 Strength of concrete

Concrete according to EN 206 is used.

At the time of transmission of the prestressing force to the structural concrete, the actual mean cube compressive strength of concrete, $f_{cm,\,0,\,cube}$, or the actual mean cylinder compressive strength of concrete, $f_{cm,\,0,\,cyl}$, is at least as given in Annex 11, Annex 12, Annex 13, Annex 16, Annex 17, Annex 18, Annex 19, and Annex 20. The actual mean compressive strength, $f_{cm,\,0,\,cube}$ or $f_{cm,\,0,\,cyl}$, is verified by means of at least three specimens, cube of size 150 mm or cylinder with diameter of 150 mm and height of 300 mm, which are cured under the same conditions as the structure.

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

1.2.7 Reinforcement in the anchorage zone

In any case, steel grades and dimensions of helix and additional reinforcement specified in Annex 11, Annex 12, Annex 13, Annex 16, Annex 17, Annex 18, Annex 19, Annex 20, and Annex 25 are conformed to.

The centric position of the helix, if present, is secured by welding the end ring onto the multi-plane anchor body MA or onto the anchor plate SD or by means of holding devices that are braced against the tendon.

If required for a specific project design, the reinforcement given in Annex 11, Annex 12, Annex 13, Annex 16, Annex 17, Annex 18, Annex 19, and Annex 20 may be modified in accordance with the respective regulations in force at the place of use as well as with the relevant approval of the local authority and of the ETA holder to provide equivalent performance.

1.3 Designation and range of tendons

1.3.1 Designation

The tendon is designated by the nominal diameter of the prestressing steel strand and the number of prestressing steel strands with 68n. The first two digits indicate the nominal diameter of the prestressing steel strand “68” = 15.3 mm (0.6 ") or 15.7 mm (0.62 "), followed by two digits as the number "n" of prestressing steel strands, e.g. 6804.

1.3.2 Range of tendons

The PT system includes tendons, see Table 2, with 3 to 55 prestressing steel strands. Only 7-wire prestressing steel strands with nominal diameters of 15.3 mm or 15.7 mm and tensile strengths of 1 770 N/mm^2 or 1 860 N/mm^2 are used. The dimensions and specifications of the prestressing steel strands are given in Table 1 and Annex 26.

Characteristic values of maximum force of the tendons are listed in Annex 27.

1.3.3 Maximum stressing forces

Prestressing and overstressing forces are specified in the respective standards and regulations in force at the place of use. Annex 5 and Annex 6 list the maximum prestressing and overstressing forces of the tendons according to Eurocode 2. I.e., the maximum prestressing force applied to a tendon is not exceeding $P_{0,\,max} = 0.90 \cdot A_p \cdot f_{p0.1}$. Overstressing with up to $0.95 \cdot A_p \cdot f_{p0.1}$ is only permitted if the force in the prestressing jack can be measured to an accuracy of $\pm$ 5 % of the final value of the overstressing force.

Initial prestressing force, P_{m0}, immediately after stressing and anchoring does not exceed the forces as specified in Eurocode 2.

Where

A_p .... mm^2 .... Cross-sectional area of prestressing steel of tendon, i.e. $A_p = n \cdot S_0$

$f_{p0.1}$ ..... N/mm^2 .... Characteristic 0.1 % proof stress of prestressing steel, i.e. $F_{p0.1} = f_{p0.1} \cdot S_0$

n .... — .... Number of prestressing steel strands, i.e. n = 1 to 55

S_0 .... mm^2 .... Nominal cross-sectional area of one single prestressing steel strand, see Annex 26

$F_{p0.1}$ ...... kN .... Characteristic value of 0.1 % proof force of one single prestressing steel strand, see Annex 26

$P_{0,\,max}$ .... kN .... Maximum prestressing force

P_{m0} .... kN .... Initial prestressing force immediately after stressing and anchoring

1.4 Slip at anchorage and coupler

Slip at anchorage and coupler is taken into consideration in design and for determining tendon elongation. In Annex 14 slip and the required locking measure of wedges are specified.

1.5 Friction losses

The tendon layout should not feature abrupt changes of the tendon axis, since this may lead to significant additional friction losses. For calculation of losses of prestressing forces due to friction, Coulomb's friction law applies. Calculation of friction loss is by the equation

$$P_x = P_0 \cdot e^{-\mu \cdot (\alpha + k \cdot x)}$$

Where

P_x .... kN .... Prestressing force at distance x from the stressing anchor along the tendon

P_0 .... kN .... Prestressing force at the distance x = 0 m

μ .... rad^{-1} .... Friction coefficient, see Table 3

α .... rad .... Sum of angular deviations over a distance x, irrespective of direction and sign

k .... rad/m .... Wobble coefficient, see Table 3

x .... m .... Distance along the tendon from the point where the prestressing force is equal to P_0

NOTE 1 rad = 1 m/m = 1

Table 3 Friction coefficient μ and wobble coefficient k

—		Circular steel duct		Circular plastic duct	
		Duct I	**Duct II**	**Range**	**Recommended value**
μ	rad^{-1}	0.20	0.19	0.10 to 0.14	0.14
k	rad/m	0.005	0.005	—	0.005
	°/m	(0.3) [1)]	(0.3) [1)]		(0.3) [1)]

NOTE
1) For information only
For flat steel duct see Annex 4.

Information on friction losses in anchorages and couplers is included in Annex 3.

1.6 Support of ducts

Tendons are installed with high accuracy. This is achieved by installation of duct supports exactly levelled with regard to their designated position. The supports are secured in their position and the ducts fastened thereto. Distance between duct supports for tendons with steel strip sheaths does not exceed 1.80 m. In sections with maximum tendon curvature the distance between duct supports is reduced to 0.60 to 0.75 m.

If the prestressing steel strands are installed after concreting (duct II), special attention is applied that the duct will not displace. For that, the duct is additionally fastened between the supports e.g. to the reinforcement of the structure. If tendons are installed in several layers, only the lowest layer can be firmly connected with the duct support. All other tendon layers are placed and fastened on subsequently installed supports.

1.7 Radii of curvature

The minimum radii of curvature of tendons with steel strip sheaths as specified in Annex 7 and Annex 8 are observed. They correspond to

- A maximum prestressing force of the tendon of $P_{m0} = 0.85 \cdot F_{p0.1}$
- A nominal diameter of the prestressing steel strand of d = 15.7 mm
- Prestressing steel strand with a maximum nominal tensile strength of 1 860 N/mm²
- A maximum pressure under the prestressing steel strands of $p_{R,\,max}$ = 140 kN/m or 200 kN/m
- A minimum compressive strength of concrete of $f_{cm,\,0,\,cube}$ = 25 N/mm²

In case of different tendon parameters or a different pressure under the prestressing steel strands, the calculation of the minimum radius of curvature can be carried out by the equation

$$R_{min} = \frac{2 \cdot P_{m0} \cdot d}{d_i \cdot p_{R,max}}$$

Where

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

P_{m0}........kN ....Prestressing force of the tendon

d ....mm ....Nominal diameter of the prestressing steel strand

d_i..........mm ....Inner duct diameter

$p_{R,\,max}$ ..kN/m ....Maximum pressure under the prestressing steel strands

The minimum radius of curvature should not be less than 2.0 m. For a reduction of the minimum radius of curvature, the effects of the radial deviation forces on the concrete and stresses resulting from the curvature in the prestressing steel require verification, or the stressing force is reduced accordingly. Standards and regulations on minimum radius of curvature or on the maximum pressure under the prestressing steel strands in force in the place of use are observed.

Components

1.8 Specification of prestressing steel strand

7-wire prestressing steel strand with plain surfaces of the individual wires, a nominal diameter of 15.3 or 15.7 mm and tensile strengths of 1 770 N/mm^2 or 1 860 N/mm^2 is used. Dimensions and specifications of the prestressing steel strand are according to prEN 10138-3 and are given in Clause 1.1, Table 1, and Annex 26.

In the course of preparing the European Technical Assessment, no characteristic has been assessed for the prestressing steel strand. In execution, a suitable prestressing steel strand that conforms to Annex 26 and is according to the standards and regulations in force at the place of use is taken.

1.9 Anchorage and coupler components

1.9.1 General

Specifications of anchorage and coupler components are given in the Annexes and the technical file[3] of the European Technical Assessment. Therein the components' dimensions, materials, material identification data with tolerances and the materials used in corrosion protection are specified.

For prestressing steel strands with nominal tensile strength of 1 860 N/mm^2 as well as 1 770 N/mm^2 the same anchorages and couplers are used.

1.9.2 Wedge plate and anchor plate SD

Both, wedge plate and anchor plate SD are made of steel with a pattern of regular arranged bores for anchoring the prestressing steel strands, see Annex 9, Annex 11, Annex 12, Annex 13, Annex 16, and Annex 22. The bores are cylindrical with conical ends at one side for bearing the wedges and are identical for stressing and fixed anchors. All bores are countersunk and deburred. See Annex 9 for details on the conical bores.

The wedge plate is supported by anchor body MA for load transfer to the structural concrete. Anchor plate SD serves for both in one piece, anchoring the prestressing steel strands and load transfer to the structural concrete by one load transfer plane.

For installation the bores and cones are clean and free of damage or rust and are provided with corrosion protection oil.

1.9.3 Coupler plate R

The coupler plate R for fixed couplers, see Annex 22, is made of steel with two patterns of regular arranged bores for anchoring the prestressing steel strands. In the inner part of the coupler plates, the pattern is identical with the pattern of the wedge plate, providing cylindrical bores with conical ends at one side for bearing the wedges of the 1st construction stage. On the outer ring collar of the coupler plate, the pattern of bores are concentric rings, providing cylindrical bores with conical ends at one side for bearing the wedges of the 2nd construction stage. All bores are countersunk and deburred. See Annex 9 for details on the conical bores.

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

At the 2nd construction stage, the wedges are pre-installed in the conical bores and secured with springs. A grouting box with vent is attached to coupler plate R to facilitate grouting.

For installation the bores and cones are clean and free of damage or rust and are provided with corrosion protection oil.

1.9.4 Multi-plane anchor body MA

Multi-plane anchor body MA, see Annex 11, Annex 12, and Annex 13 is made of cast iron and used together with wedge plate as stressing or fixed anchor and with coupler plates R as fixed coupler.

Anchor body MA is of circular shape and provides several load transfer planes for load transfer to concrete. A centric circular hole allows for passing through the tendon.

1.9.5 Single strand coupler

The single strand coupler, see Annex 23, is made of steel and employed for movable coupler D. Single strand coupler comprises 2 barrel chucks with conical bore and inner thread, 2 wedges, and 2 springs. The barrel chucks are connected by screwing a fitting bolt in steel in the inner threads of both barrel chucks.

For installation, the prestressing steel strands of both tendons are pushed into the single strand coupler with pre-assembled wedges, locked with springs. Cones are clean and free of damage or rust and provided with corrosion protection oil.

1.9.6 Bond head

The bulb shaped bond head at the end of the prestressing steel strand, see Annex 17, for bond anchorage H is made by means of a special jack.

1.9.7 Ring

Steel ring is used for bond anchorage H, see Annex 17, Annex 19, and Annex 20.

1.9.8 Wedges

Only 3-piece wedges according to Annex 9 are used. The wedges feature different lengths for the respective nominal diameters of the prestressing steel strand, see Annex 9.

1.9.9 Wedge keeper plate

Wedge keeper plate is used for fixed anchor that is not accessible, either with wedge plate, see Annex 10, or with anchor plate SD, see Annex 15.

1.10 Helix and additional reinforcement

Steel grades and dimensions of helix and additional reinforcement conform to the specifications given in the Annexes and the technical file of the European Technical Assessment. Helix for anchorage with anchor bodies MA can be made of plain round steel wire or ribbed reinforcing steel. Helix for bond anchorage H is made of ribbed reinforcing steel. Generally, both ends of each helix are welded to closed rings. Welding of one end, the inner end, may be omitted. Details on welding of helix are given in Annex 11, Annex 12, and Annex 16.

1.11 Duct

Usually, a corrugated duct made of steel strips is used. As a general rule, ducts with a smaller inner diameter, duct I, are used for pre-fabricated tendons. Longer tendons are transported to the job site in coils or oblong loops. The minimum transport bending diameter D for tendons up to 6812 is 1.50 m and for larger tendons up to 6827 is 1.80 m.

For on-site fabrication of tendons, the prestressing steel strands are inserted into the ducts either before or after placing the concrete. In general, ducts with a larger inner diameter, duct II, are used for that purpose. Either one or several prestressing steel strands are consecutively pushed or pulled into the respective duct or the entire tendon all at once.

In general, the ducts have circular cross section – so called “round” duct. Optionally, for tendons 6803 to 6805, ducts with oval cross sections – so called “flat” duct – are available. The ends of the ducts are connected with couplers. For length compensation, a short duct piece may be installed between duct and trumpet of an anchorage as a telescopic duct.

The circular duct conforms to EN 523. For the flat duct EN 523 applies analogously.

Alternatively, corrugated plastic ducts may be installed, if permitted at the place of use.

1.12 Permanent corrosion protection

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

Corrosion protection of tendon, anchorage, and coupler is provided by grout according to EN 447, special grout according to EAD 160027-00-0301, or ready-mixed grout with an adequate composition according to standards and regulations in force at the place of use.

1.13 Welding

Welding is only permitted for the following components.

– Welding the helix end turn to a closed ring.

– Welding the helix end ring to the anchor body MA or to the anchor plate SD or its connection tube to secure the centric position of the helix.

During welding it is ensured that there is no contact to duct and to prestressing steel strand.

After assembly of the tendons, no welding operations are carried out anymore. Welding operations close to tendons require precautionary measures to avoid damage.

1.14 Material specifications of the components

Material specifications of the components are given in Annex 25.

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

2.1 Intended use

The PT system DYWIDAG Strand is intended to be used for the prestressing of structures. The specific intended use is

– Internal bonded tendon for concrete and composite structures

2.2 Assumptions

2.2.1 General

Concerning product packaging, transport, storage, maintenance, replacement, and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on transport, storage, maintenance, replacement, and repair of the product as he considers necessary.

2.2.2 Packaging, transport and storage

Tendons and anchorages may be assembled on site or at the factory, i.e. pre-assembled tendons.

The tendons are packed, stored, and transported in transport racks, pallets, and bobbins such that they do not fall short of the following curvature diameters D.

For tendons up to 6812 .... D ≥ 1.50 m

For larger tendons up to 6827 .... D ≥ 1.80 m

Advice on packaging, transport, and storage includes.

- Temporary protection of prestressing steels and components in order to prevent corrosion during transportation from the production site to the job site
- Transportation, storage, and handling of prestressing steel and other components in a manner as to avoid damage by mechanical or chemical impact
- Protection of tensile elements and other components from moisture
- Keeping tensile elements away from zones where welding operations are performed

2.2.3 Design

2.2.3.1 General

Advice on design includes the following items.

Design of the structure permits correct installation, stressing, and grouting of tendon and design and reinforcement of the anchorage zone permits correct placing and compacting of concrete.

Tendons arranged one on top of each other are separated by an appropriate thick concrete layer, as in case of tendon curvatures there is a risk of inner ducts being crushed as a result of deviation forces from the prestressed outer tendons.

Verification of transfer of prestressing forces to the structural concrete is not required, if centre and edge distances of the tendons, strength of concrete, as well as grade and dimensions of helix and additional reinforcement, see Clause 1.2.5, Clause 1.2.6, Clause 1.2.7, Annex 11, Annex 12, Annex 13, Annex 16, Annex 17, Annex 18, Annex 19, and Annex 20, are conformed to. The forces outside the area of helix and additional reinforcement are verified and, if necessary, covered by appropriate, in general transverse reinforcement. The reinforcement of the structure is not employed as additional reinforcement. Reinforcement exceeding the required reinforcement of the structure may be used as additional reinforcement if appropriate placing is possible.

If required for a specific project design, the reinforcement given in Annex 11, Annex 12, Annex 13, Annex 16, Annex 17, Annex 18, Annex 19, and Annex 20 may be modified in accordance with the respective regulations in force at the place of use as well as with the relevant approval of the local authority and of the ETA holder to provide equivalent performance.

The anchor recess is designed as to ensure a concrete cover of at least 20 mm at the grout caps in the final state.

The initial prestressing force applied to the stressing anchor will decrease especially as a result of slip, see Clause 1.4 and Annex 14, of friction along the tendon, see Clause 1.5, and of the elastic shortening of the structure, and in the course of time because of relaxation of the prestressing steel, and creep and shrinkage of concrete. The stressing instructions prepared by the ETA holder should be consulted.

2.2.3.2 Bond anchorage

For calculation of elongations the free length of the tendon includes 50 % of the distance between ring and bond head. Full tendon force is applied after the ring only. Between ring and bond head the decrease of the tendon force can be assumed to be linear and zero at the beginning of the bond head.

2.2.3.3 Increased losses of prestressing forces at fixed coupler

For verification of the limitation of crack widths and for verification of the stress range increased losses of prestressing forces at fixed couplers due to creep and shrinkage of the concrete are taken into consideration. The determined losses of prestressing forces of tendons without the influence of couplers are multiplied by the factor 1.5 in the areas of fixed couplers.

For movable couplers, increased losses of prestressing forces do not need to be taken into consideration.

2.2.3.4 Fixed coupler

Under all possible load combinations, the prestressing force at the 2nd construction stage of the fixed coupler is at no time higher than at the 1st construction stage, neither during construction nor in the final state.

2.2.3.5 Movable coupler

The length of the coupler tube and its position relative to the coupler ensures unimpeded movement of the coupler in the coupler tube along a length of $\geq \max \begin{cases} 1.20 \cdot \Delta l \\ 120 \text{ mm} \end{cases}$, with Δl in mm as the expected displacement of the coupler during stressing.

2.2.3.6 Tendons in masonry structures

Post-tensioning kits are primarily used in structures made of concrete. They can, however, be used with other structural materials, e.g. in masonry structures. However, there is no particular assessment in EAD 160004-00-0301 for these applications. Hence, load transfer of stressing force from the anchorage to the masonry structure is via concrete or steel member, designed according to the European Technical Assessment, especially according to the Clauses 1.2.5, 1.2.6, 1.2.7, or Eurocode 3 respectively.

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

2.2.4 Installation

2.2.4.1 General

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

Assembly and installation of tendons are only carried out by qualified PT specialist companies with the required resources and experience in the use of bonded multi-strand post-tensioning systems, see CWA 14646. The company's PT site manager has a certificate, stating that she or he has been trained by the ETA holder and that she or he possesses the necessary qualification and experience with the PT system DYWIDAG Strand.

2.2.4.2 Anchorages

2.2.4.2.1 General

Stressing and fixed anchor with anchor body MA and wedge plate, fixed coupler with anchor body MA and coupler plate R, and stressing and fixed anchor with anchor plate SD are installed perpendicular to the tendon's axis. Adjacent to the trumpet, the tendon continues with a straight section over a length of at least 250 mm.

The centric position of the helix is secured by welding the end ring to anchor body MA or to the anchor plate SD or its connection tube or by means of spacers braced against the tendon. The additional reinforcement is fastened centrically to the trumpet by tying or by means of spacers.

2.2.4.2.2 Stressing anchor

Site assembly comprises the following working steps, see Annex 10 and Annex 15.

- Fastening the anchor body MA or trumpet or connection tube for anchor plate SD to the formwork.
- Installation of the trumpet between anchor body MA and duct or between connection tube for anchor plate SD and duct.
- If the helix is not already welded onto the anchor body MA or the connection tube for anchor plate SD in the manufacturing plant, the helix is placed, centred relative to the tendon axis and fastened to the reinforcement.
- Pushing the duct into the trumpet to approximately a length of d, with d as the duct diameter, or aligning trumpet and duct and connecting them by means of a duct coupler with a minimum length of $2 \cdot d$, or, in the case of appropriately shaped plastic trumpets, screwing the duct onto the trumpet.
- Sealing the joint trumpet to duct.
- Pushing the wedge plate or the anchor plate SD over the strands shortly before stressing.
- Tightening the prestressing steel strands with 3-piece wedges.

2.2.4.2.3 Fixed anchor

The anchorage with anchor body MA and wedge plate or with anchor plate SD is also used as fixed anchor. If the fixed anchor is accessible during stressing, the installation is the same as for the stressing anchor according to Clause 2.2.4.2.2 with an anchor body MA with wedge plate or an anchor plate SD.

If the fixed anchor is not accessible during stressing, site assembly comprises the following working steps, see Annex 10 and Annex 15.

- Assembly and placing of multi-plane anchor body MA, helix, trumpet, and duct or of connection tube, trumpet, and duct at the formwork. Subsequently fastening of respective components to reinforcement and sealing of joints.
- Pushing or pulling of strands.
- Pushing the wedge plate or the anchor plate SD over the strands.
- Installation of wedges and pre-wedging with $P_{0,\, max}$ according to Annex 5 and Annex 6 and subsequently securing the wedges with a wedge keeper plate.
- Mounting of grout cap together with respective sealing and vent pipes.

2.2.4.2.4 Bond anchorage H – HL or HR

Before shaping the bond heads, ring, helix, and spacers are placed on the tendon. The bond heads are shaped in the manufacturing plant or on site by cold forming and all bond heads are arranged by means of spacers according to their designated position.

2.2.4.3 Couplers

2.2.4.3.1 Fixed coupler with coupler plate R

The fixed coupler R joints a 2nd tendon with an already stressed 1st tendon. The anchorage of the prestressing steel strands in the already stressed 1st tendon in coupler plate R is equivalent to the stressing anchor with wedge plate and anchor body MA. The coupler with coupler plate R and anchor body MA are installed perpendicular to the tendon's axis with the same procedure as the stressing anchor. Adjacent to the trumpet, the tendon continues with a straight section over a length of at least 250 mm.

Site assembly of the 2nd tendon comprises the following working steps, see Annex 21 and Annex 22.

- Assembly and positioning of end trumpet, duct sleeve, and duct in the formwork, subsequently fastening of respective components to reinforcement and sealing of the joints. End trumpet and duct sleeve are mounted with distance L_t from coupler plate R, where L_t as the total length of the end trumpet.
- Pushing or pulling of strands.
- Jointing the 2nd tendon with the 1st tendon by inserting the strands into the cylindrical bores of the outer ring collar of coupler plate R. The strands are locked by the pre-installed wedges, springs and press-on-segments at the rear conical ends of the cylindrical bores. Proper seating of the strand ends with regard to sufficient insertion length is checked with colour markings. The section behind the conical ends of the outer ring collar is covered with an also pre-installed protection cap.
- Installing end trumpet and duct sleeve in final position.
- Arranging grout or vent pipes on end trumpet and on protection cap for grouting.

2.2.4.3.2 Movable coupler with single strand couplers D

The movable coupler joints two tendons prior to stressing by single strand couplers. The strands of both tendons are anchored by means of wedges. The single strand couplers consist of 2 coupler barrel chucks each with cone and thread, which are connected by a steel fitting bolt. Springs between wedges and fitting bolt secure the wedge positions in the cones.

Site assembly of the coupler D comprises the following working steps, see Annex 23 and Annex 24.

- Assembly and positioning of duct, sleeve tubes, trumpets, and coupler tube at the formwork. Subsequently, fastening of duct to reinforcement and sealing of the joints. Coupler tube, trumpets and sleeve tubes remain pushed back on duct, to provide space for installation of strand couplers.
- Pushing or pulling of strands.
- Cutting to length of strand with regard to staggered position of single strand couplers.
- Connecting the strands with strand couplers D by inserting the strand into the bores of the single strand couplers. The proper seating of the two strand ends with regard to sufficient insertion length is checked with colour markings.
- Before final assembly of coupler tube, trumpets, and sleeve tubes, checking the correct position of single strand couplers in the coupler tube with regard to the direction of stressing.
- Installing of coupler tube, trumpets and sleeve tube and sealing the joints.
- Arranging a vent pipe at both ends of the coupler tube.

2.2.4.4 Ducts and tendon placement

Tendons are installed with high accuracy on supports, see Clause 1.6. During installation careful handling of tendons is ensured.

Prior to concreting, the PT site manager carries out a final examination of the installed tendons. Damages to duct or tendons are either repaired immediately or reported to the responsible person.

2.2.4.5 Stressing and stressing records

2.2.4.5.1 Stressing

With a mean compressive strength of concrete in the anchorage zone according to Annex 11, Annex 12, Annex 13, Annex 16, Annex 19, and Annex 20 full prestressing may be performed.

The prestressing forces are applied in accordance with a prescribed stressing schedule. Said schedule includes

- Mean cube or cylinder compressive strength of the concrete at time of stressing
- Time and sequence of the various prestressing levels
- Prestressing forces and elongations calculated for the tendons
- Time and kind of shuttering lowering and removal
- Any possible spring back forces of the falsework are taken into account.

2.2.4.5.2 Restressing

Restressing of tendons in combination with release and reuse of wedges is permitted. After restressing the wedges bite into a least 15 mm of virgin strand surface and no wedge marks remain on the tendon between the anchorages.

Stressing records

For each tendon any important observation made during the stressing operation, in particular prestressing forces applied, and elongation measured, are recorded in stressing records.

2.2.4.5.3 Stressing equipment, clearance requirements, and safety-at-work

For stressing, hydraulic jacks are used. Information about the stressing equipment has been submitted to Österreichisches Institut für Bautechnik.

To stress the tendons, clearance of approximately 1 m directly behind the anchorages is ensured. The ETA holder keeps available more detailed information on prestressing jacks used and the required space for handling and stressing.

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

2.2.4.6 Grouting of tendons

2.2.4.6.1 Grout

Grout according to EN 447, special grout according to EAD 160027-00-0301, or ready-mixed grout with an adequate composition according to standards and regulations in force at the place of use is used.

2.2.4.6.2 Grouting procedure

All anchorages have inlets and vents for grouting or ventilation. The ducts have vent pipes at their top points and at additional points, if required.

After completion of the prestressing operation and acceptance of the stressing records, the tendons are grouted as soon as possible. For the grouting procedure, EN 446 applies. Standards and regulations in force at the place of use are observed. If tendons remain ungrouted for a longer time, appropriate corrosion protection measures are implemented after acceptance of the ETA holder.

The anchor recesses are concreted once stressing and grouting are completed, to establish a complete corrosion protection of the tendon.

2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of DYWIDAG Strand of 100 years, provided that DYWIDAG Strand is subject to appropriate installation, use, and maintenance, see Clause 2.2. These provisions are based upon the current state of the art and the available knowledge and experience.

In normal use conditions, the real working life may be considerably longer without major degradation affecting the basic requirements for construction works[4].

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

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

3.1 Essential characteristics

The performances of DYWIDAG Strand for the essential characteristics are given in Table 4.

Table 4 Essential characteristics and performances of the product

№	Essential characteristic	Product performance
Basic requirement for construction works 1: Mechanical resistance and stability		
1	Resistance to static load	See Clause 3.2.1.1.
2	Resistance to fatigue	See Clause 3.2.1.2.
3	Load transfer to the structure	See Clause 3.2.1.3.
4	Friction coefficient	See Clause 3.2.1.4.
5	Deviation, deflection (limits) for internal bonded and internal unbonded tendon	See Clause 3.2.1.5.
6	Assessment of assembly	See Clause 3.2.1.6.
7	Corrosion protection	See Clause 3.2.1.7.
Basic requirement for construction works 2: Safety in case of fire		
8	Reaction to fire	See Clause 3.2.2.1.

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

№	Essential characteristic	Product performance
Basic requirement for construction works 3: Hygiene, health, and the environment		
9	Content, emission, and/or release of dangerous substances	See Clause 3.2.3.1.
Basic requirement for construction works 4: Safety and accessibility in use		
—	Not relevant. No characteristic assessed.	—
Basic requirement for construction works 5: Protection against noise		
—	Not relevant. No characteristic assessed.	—
Basic requirement for construction works 6: Energy economy and heat retention		
—	Not relevant. No characteristic assessed.	—
Basic requirement for construction works 7: Sustainable use of natural resources		
—	No characteristic assessed.	—

3.2 Product performance

3.2.1 Mechanical resistance and stability

3.2.1.1 Resistance to static load

The PT system as described in the ETA meets the acceptance criteria of EAD 160004-00-0301, Clause 2.2.1. The characteristic values of maximum force, F_{pk}, of the tendon with prestressing steel strands according to Annex 26 are listed in Annex 27.

3.2.1.2 Resistance to fatigue

The PT system as described in the ETA meets the acceptance criteria of EAD 160004-00-0301, Clause 2.2.2. The characteristic values of maximum force, F_{pk}, of the tendon with prestressing steel strands according to Annex 26 are listed in Annex 27.

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

3.2.1.3 Load transfer to the structure

The PT system as described in the ETA meets the acceptance criteria of EAD 160004-00-0301, Clause 2.2.3. The characteristic values of maximum force, F_{pk}, of the tendon with prestressing steel strands according to Annex 26 are listed in Annex 27.

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

3.2.1.4 Friction coefficient

For friction losses including friction coefficient see Clause 1.5.

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

For minimum radii of curvature see Clause 1.7.

3.2.1.6 Assessment of assembly

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

3.2.1.7 Corrosion protection

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

3.2.2 Safety in case of fire

3.2.2.1 Reaction to fire

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

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

3.2.3 Hygiene, health, and the environment

3.2.3.1 Content, emission and/or release of dangerous substances

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

– SVOC and VOC

  The performance of components made of steel or cast iron that are free of coating with organic material is no emission of SVOC and VOC.

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

– Leachable substances

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

3.3 Assessment methods

The assessment of the essential characteristics in Clause 3.1 of DYWIDAG Strand, for the intended use, and in relation to the requirements for mechanical resistance and stability, safety in case of fire, and for hygiene, health and the environment, in the sense of the basic requirements for construction works № 1, 2, and 3 of Regulation (EU) № 305/2011, has been made in accordance with Annex A of EAD 160004-00-0301, Post-tensioning kits for prestressing of structures, for Item 1, Internal bonded tendon.

3.4 Identification

The European Technical Assessment for DYWIDAG Strand is issued on the basis of agreed data that identify the assessed product[5]. Changes to materials, to composition, or to characteristics of the product, or to the production process could result in these deposited data being incorrect. Österreichisches Institut für Bautechnik should be notified before the changes are introduced, as an amendment of the European Technical Assessment is possibly necessary.

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

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

4.1 System of assessment and verification of constancy of performance

According to Commission Decision 98/456/EC, the system of assessment and verification of constancy of performance to be applied to DYWIDAG Strand is System 1+. System 1+ is detailed in Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, Annex, point 1.1., and provides for the following items.

(a) The manufacturer shall carry out

(i) factory production control;

(ii) further testing of samples taken at the manufacturing plant by the manufacturer in accordance with the prescribed test plan[6].

(b) The notified product certification body shall decide on the issuing, restriction, suspension, or withdrawal of the certificate of constancy of performance of the construction product on the basis of the outcome of the following assessments and verifications carried out by that body

(i) an assessment of the performance of the construction product carried out on the basis of testing (including sampling), calculation, tabulated values, or descriptive documentation of the product;

(ii) initial inspection of the manufacturing plant and of factory production control;

(iii) continuing surveillance, assessment, and evaluation of factory production control;

(iv) audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities.

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

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

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

5.1 Tasks for the manufacturer

5.1.1 Factory production control

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

– Control of the incoming materials

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

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

- Inspection and testing

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

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

All tests are performed according to written procedures with suitable calibrated measuring devices. All results of inspections, tests, and checks are recorded in a consistent and systematic way. The basic elements of the prescribed test plan are given in Annex 28, conform to EAD 160004-00-0301, Table 3, and are specified in the quality management plan of the DYWIDAG Strand.

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

- Control of non-conforming products

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

- Complaints

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

The records are presented to the notified product certification body involved in continuous surveillance and are kept at least for ten years after the product has been placed on the market. On request, the records are presented to Österreichisches Institut für Bautechnik.

At least once a year the manufacturer audits the manufacturers of the components given in Annex 29.

5.1.2 Declaration of performance

The manufacturer is responsible for preparing the declaration of performance. When all the criteria of the assessment and verification of constancy of performance are met, including the certificate of constancy of performance issued by the notified product certification body, the manufacturer draws up the declaration of performance. Essential characteristics to be included in the declaration of performance for the corresponding intended use are given in Table 4.

5.2 Tasks for the notified product certification body

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

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

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

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

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

Each manufacturer of the components given in Annex 29 is audited at least once in five years. It is verified that the system of factory production control and the specified manufacturing process are maintained, taking account of the prescribed test plan.

The results of continuous surveillance are made available on demand by the notified product certification body to Österreichisches Institut für Bautechnik. When the provisions of the European Technical Assessment and the prescribed test plan are no longer fulfilled, the certificate of constancy of performance is withdrawn by the notified product certification body.

5.2.3 Audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities

During surveillance inspection, the notified product certification body takes samples of components of the PT system for independent testing. Audit-testing is conducted at least once a year by the notified product certification body. For the most important components, Annex 29 summarises the minimum procedures. Annex 29 conforms to EAD 160004-00-0301, Table 4. In particular, at least once a year, the notified product certification body also carries out one single tensile element test series according to EAD 160004-00-0301, Annex C.7 and Clause 3.3.4 on specimens taken from the manufacturing plant or at the manufacturer's storage facility.

Issued in Vienna on 29 January 2021
by Österreichisches Institut für Bautechnik

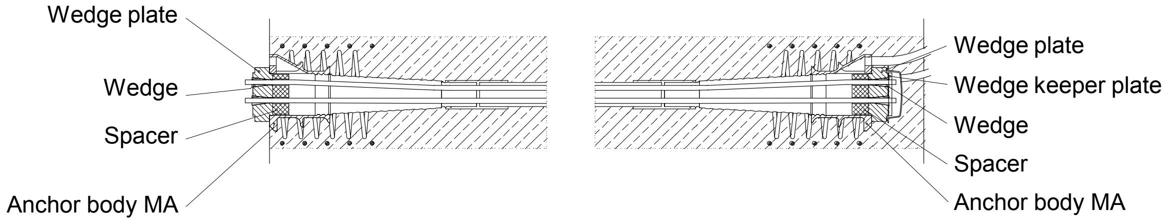
The original document is signed by

Rainer Mikulits
Managing Director

Anchorages

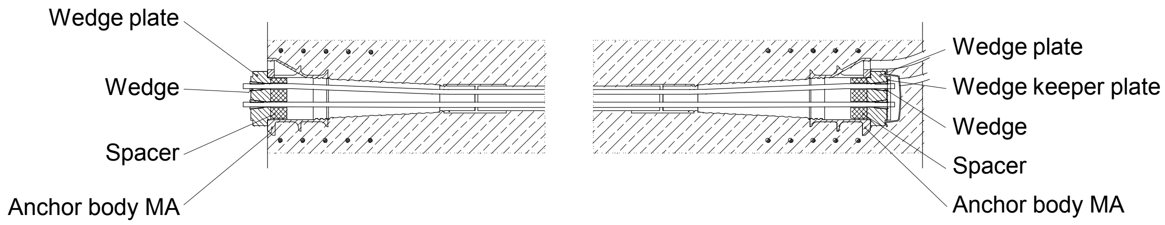
Anchor with wedge plate and multi-plane anchor body MA with helix — 5–55 strands

Stressing anchor — Fixed anchor



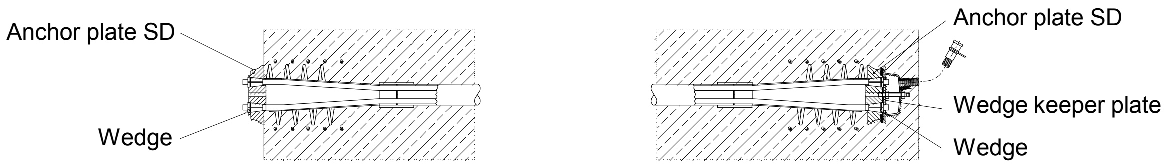
Anchor with wedge plate and multi-plane anchor body MA without helix — 5–22 strands

Stressing anchor — Fixed anchor

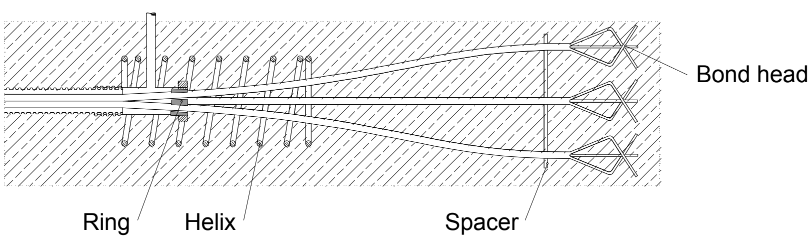


Anchor with anchor plate SD — 3–9 strands

Stressing anchor — Fixed anchor



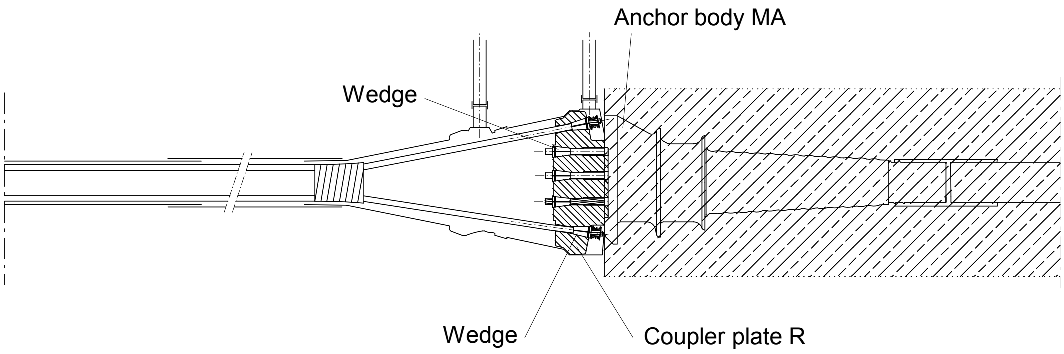
Bond anchorage H, HL and HR — 3–22 strands



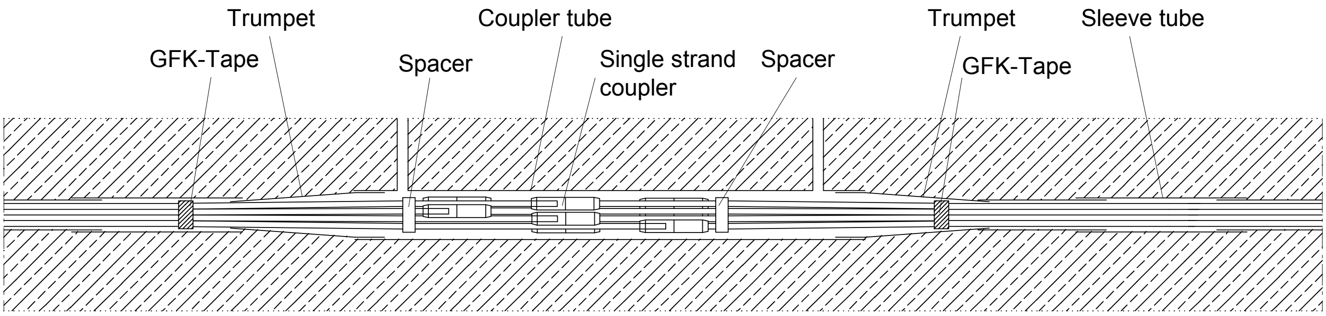
DYWIDAG DYWIDAG-Systems International GmbH Phone: +49/89/309050-100 E-Mail: dsihv@dywidag-systems.com	**Bonded prestressing system** **DYWIDAG – Strand** Overview on anchorages	**Annex 1** of European Technical Assessment **ETA-13/0815** of 29.01.2021

Couplers

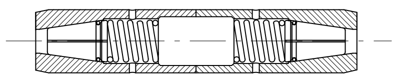
Fixed coupler R — 5–37 strands



Movable coupler D — 3–37 strands



Single strand coupler



DYWIDAG DYWIDAG-Systems International GmbH Phone: +49/89/309050-100 E-Mail: dsihv@dywidag-systems.com	**Bonded prestressing system** **DYWIDAG – Strand** Overview on couplers	**Annex 2** of European Technical Assessment **ETA-13/0815** of 29.01.2021

Technical data for tendons 6803 to 6855 with round steel duct

Tendon			**6803**	**6804**	**6805**	**6806**	**6807**	**6808**	**6809**	**6812**	**6815**
Number of strands			3	4	5	6	7	8	9	12	15
Cross-sectional area of prestressing steel	∅ 15.3 mm	mm^2	420	560	700	840	980	1 120	1 260	1 680	2 100
	∅ 15.7 mm	mm^2	450	600	750	900	1 050	1 200	1 350	1 800	2 250
Nominal mass of prestressing steel	∅ 15.3 mm	kg/m	3.28	4.37	5.47	6.56	7.65	8.74	9.84	13.12	16.40
	∅ 15.7 mm	kg/m	3.52	4.69	5.86	7.03	8.20	9.37	10.55	14.06	17.58
Modulus of elasticity		N/mm^2	195 000 (standard value)								
Round steel duct [1)]											
Duct I	∅ d_i/d_a	mm	40/47	45/52	50/57	55/62	55/62	65/72	65/72	75/82	80/87
Eccentricity		mm	3	6	7	7	6	10	9	10	10
Duct II	∅ d_i/d_a	mm	45/52	50/57	55/62	60/67	60/67	70/77	70/77	80/87	85/92
Eccentricity		mm	5	9	10	11	9	14	12	14	13
Distance of tendon support		m	0.60–1.80 m with stiffening, e.g. with strand bundle or PE tube 0.60–1.00 m with strengthened duct In tendon section with minimum radius of curvature a distance of 0.60–0.80 m applies.								
Friction coefficient	μ	rad^{-1}	0.19								
Wobble coefficient	k		0.005 rad/m ≙ 0.30 °/m								
Friction loss in stressing anchor		%	1.0	1.0	1.0	0.8	0.8	0.7	0.7	0.5	0.5

Tendon			**6819**	**6822**	**6827**	**6831**	**6837**	**6843**	**6849**	**6855**
Number of strands			19	22	27	31	37	43	49	55
Cross-sectional area of prestressing steel	∅ 15.3 mm	mm^2	2 660	3 080	3 780	4 340	5 180	6 020	6 860	7 700
	∅ 15.7 mm	mm^2	2 850	3 300	4 050	4 650	5 550	6 450	7 350	8 250
Nominal mass of prestressing steel	∅ 15.3 mm	kg/m	20.77	24.05	29.51	33.88	40.44	47.00	53.56	60.12
	∅ 15.7 mm	kg/m	22.27	25.78	31.64	36.33	43.36	50.40	57.43	64.46
Modulus of elasticity		N/mm^2	195 000 (standard value)							
Round steel duct [1)]										
Duct I	∅ d_i/d_a	mm	90/97	95/102	105/112	115/122	—	—	—	—
Eccentricity		mm	10	10	11	15	—	—	—	—
Duct II	∅ d_i/d_a	mm	95/102	105/112	115/122	120/127	130/137	140/147	150/157	160/167
Eccentricity		mm	14	18	18	17	17	19	21	23
Distance of tendon support		m	1.00–1.80 m with stiffening, e.g. with PE tube 0.80–1.50 m with strengthened duct In tendon section with minimum radius of curvature a distance of 0.80–1.20 m applies.							
Friction coefficient	μ	rad^{-1}	0.19							
Wobble coefficient	k		0.005 rad/m ≙ 0.30 °/m							
Friction loss in stressing anchor		%	0.5							

1) Friction and wobble coefficients for round plastic duct see Clause 1.5.

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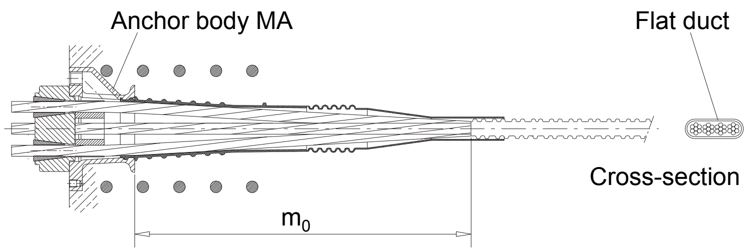
Technical data for tendons 6803 to 6805 with flat steel duct



Tendon			6803	6804	6805
Number of strands			3	4	5
Cross-sectional area of prestressing steel	∅ 15.3 mm	mm^2	420	560	700
	∅ 15.7 mm	mm^2	450	600	750
Nominal mass of prestressing steel	∅ 15.3 mm	kg/m	3.28	4.37	5.47
	∅ 15.7 mm	kg/m	3.52	4.69	5.86
Modulus of elasticity		N/mm^2	195 000 (standard value)		
Flat steel duct [1]					
Dimensions	d_i	mm	55 × 21	70 × 21	85 × 21
	d_a	mm	60 × 25	75 × 25	90 × 25
Trumpet length	m_o	mm	350	350	500
Distance of tendon support		m	0.50–1.00		
Wobble coefficient	k		0.010 rad/m ≙ 0.60 °/m		
Bending around weak axis, Minimum radius of curvature	R_{min}	m	2.5		
Friction coefficient	μ	rad^{-1}	0.15		
Bending around strong axis Minimum radius of curvature	R_{min}	m	5.0		
Friction coefficient	μ	rad^{-1}	0.23	0.26	0.32

[1] Friction and wobble coefficients for flat plastic duct see Clause 1.5.

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Bonded prestressing system
DYWIDAG – Strand
Technical data
Tendons 6803 to 6805 with flat steel duct

Annex 4
of European Technical Assessment
ETA-13/0815 of 29.01.2021

Maximum prestressing and overstressing forces for strand 140 mm²

Number of strands [1]	Mass of strands	Cross-sectional area of strands	f_{pk} = 1 770 N/mm²		f_{pk} = 1 860 N/mm²	
			Maximum prestressing force [2), 4)]	Maximum over-stressing force [2), 3), 4)]	Maximum prestressing force [2), 4)]	Maximum over-stressing force [2), 3), 4)]
		A_p	$0.90 \cdot F_{p0.1}$ [5)]	$0.95 \cdot F_{p0.1}$	$0.90 \cdot F_{p0.1}$ [5)]	$0.95 \cdot F_{p0.1}$
—	kg/m	mm²	kN	kN	kN	kN
1	1.09	140	197	208	207	218
3	3.28	420	590	622	620	654
4	4.37	560	786	830	827	872
5	5.47	700	983	1037	1 033	1 091
6	6.56	840	1 179	1 245	1 240	1 309
7	7.65	980	1 376	1 452	1 446	1 527
8	8.74	1 120	1 572	1 660	1 653	1 745
9	9.84	1 260	1 769	1 867	1 860	1 963
12	13.12	1 680	2 359	2 490	2 480	2 617
15	16.40	2 100	2 948	3 112	3 100	3 272
19	20.77	2 660	3 735	3 942	3 926	4 144
22	24.05	3 080	4 324	4 565	4 546	4 799
27	29.51	3 780	5 307	5 602	5 579	5 889
31	33.88	4 340	6 093	6 432	6 406	6 762
37	40.44	5 180	7 273	7 677	7 646	8 070
43	47.00	6 020	8 452	8 922	8 886	9 379
49	53.56	6 860	9 631	10 167	10 125	10 688
55	60.12	7 700	10 811	11 411	11 365	11 997

1) By omitting strands, tendons with number of strands between the numbers given may be installed. The respective prestressing force is reduced per omitted strand as specified for one strand.

2) The given values are maximum values according to Eurocode 2. The actual values are taken from the standards and regulations in force at the place of use.

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

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

5) Maximum prestressing force $P_{0,\,max}$

Where

f_{pk} ....Characteristic tensile strength of prestressing steel strand

$F_{p0.1}$ ....Characteristic value of 0.1 % proof force of tendon, $F_{p0.1} = A_p \cdot f_{p0.1}$

For $F_{p0.1}$ of one single prestressing steel strand see Annex 26.

Maximum prestressing and overstressing forces for strand 150 mm²

Number of strands 1)	Mass of strands	Cross-sectional area of strands	f_{pk} = 1 770 N/mm²		f_{pk} = 1 860 N/mm²	
			Maximum prestressing force 2), 4)	Maximum over-stressing force 2), 3), 4)	Maximum prestressing force 2), 4)	Maximum over-stressing force 2), 3), 4)
		A_p	$0.90 \cdot F_{p0.1}$ 5)	$0.95 \cdot F_{p0.1}$	$0.90 \cdot F_{p0.1}$ 5)	$0.95 \cdot F_{p0.1}$
—	kg/m	mm²	kN	kN	kN	kN
1	1.17	150	211	222	221	234
3	3.52	450	632	667	664	701
4	4.69	600	842	889	886	935
5	5.86	750	1 053	1 112	1 107	1 169
6	7.03	900	1 264	1 334	1 328	1 402
7	8.20	1 050	1 474	1 556	1 550	1 636
8	9.38	1 200	1 685	1 778	1 771	1 870
9	10.55	1 350	1 895	2 001	1 993	2 103
12	14.06	1 800	2 527	2 668	2 657	2 804
15	17.58	2 250	3 159	3 335	3 321	3 506
19	22.27	2 850	4 001	4 224	4 207	4 440
22	25.78	3 300	4 633	4 891	4 871	5 141
27	31.64	4 050	5 686	6 002	5 978	6 310
31	36.33	4 650	6 529	6 891	6 863	7 245
37	43.36	5 550	7 792	8 225	8 192	8 647
43	50.40	6 450	9 056	9 559	9 520	10 049
49	57.43	7 350	10 319	10 893	10 849	11 451
55	64.46	8 250	11 583	12 227	12 177	12 854

1) By omitting strands, tendons with number of strands between the numbers given may be installed. The respective prestressing force is reduced per omitted strand as specified for one strand.

2) The given values are maximum values according to Eurocode 2. The actual values are taken from the standards and regulations in force at the place of use.

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

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

5) Maximum prestressing force $P_{0,\,max}$

Where

f_{pk} ....Characteristic tensile strength of prestressing steel strand

$F_{p0.1}$ ....Characteristic value of 0.1 % proof force of tendon, $F_{p0.1} = A_p \cdot f_{p0.1}$

For $F_{p0.1}$ of one single prestressing steel strand see Annex 26.

DYWIDAG	Bonded prestressing system	Annex 6
DYWIDAG-Systems International GmbH Phone: +49/89/309050-100 E-Mail: dsihv@dywidag-systems.com	**DYWIDAG – Strand** Maximum prestressing and overstressing forces for prestressing steel strand 150 mm²	of European Technical Assessment **ETA-13/0815** of 29.01.2021

Minimum radii of curvature for **$p_{R,\,max}$ = 140 kN/m**, prestressing steel strand Y1860S7 [1)]
with use of corrugated steel ducts according to EN 523

Strand Y1860S7, A_p = 140 mm²					Strand Y1860S7, A_p = 150 mm²				
Number of strands	Duct I	Minimum radius of curvature	Duct II	Minimum radius of curvature	Number of strands	Duct I	Minimum radius of curvature	Duct II	Minimum radius of curvature
n	∅ d_i	R_{min}	∅ d_i	R_{min}	n	∅ d_i	R_{min}	∅ d_i	R_{min}
—	mm	m	mm	m	—	mm	m	mm	m
1	20	2.0	25	2.0	1	20	2.0	25	2.0
3	40	3.7	45	3.0	3	40	4.0	45	3.2
4	45	3.8	50	3.4	4	45	4.1	50	3.8
5	50	4.3	55	3.9	5	50	4.7	55	4.3
6	55	4.7	60	4.3	6	55	5.1	60	4.7
7	55	5.4	60	5.0	7	55	6.0	60	5.5
8	65	5.3	70	4.9	8	65	5.8	70	5.4
9	65	5.9	70	5.5	9	65	6.5	70	6.0
12	75	6.8	80	6.4	12	75	7.5	80	7.0
15	80	8.0	85	7.5	15	80	8.8	85	8.3
19	90	9.0	95	8.5	19	90	9.9	95	9.4
22	95	9.9	105	8.9	22	95	10.9	105	9.8
27	105	11.0	115	10.0	27	105	12.1	115	11.0
31	115	11.5	120	11.0	31	115	12.6	120	12.1
37	—	—	130	12.1	37	—	—	130	13.3
43	—	—	140	13.1	43	—	—	140	14.4
49	—	—	150	13.9	49	—	—	150	15.3
55	—	—	160	14.7	55	—	—	160	16.1

[1)] Minimum radii of curvature for prestressing steel strand Y1770S7 can be calculated with the equation in Clause 1.7.

DYWIDAG DYWIDAG-Systems International GmbH Phone: +49/89/309050-100 E-Mail: dsihv@dywidag-systems.com	**Bonded prestressing system** **DYWIDAG – Strand** Minimum radii of curvature p_R = 140 kN/m	**Annex 7** of European Technical Assessment **ETA-13/0815** of 29.01.2021

Minimum radii of curvature for $\mathbf{p_{R,\,max}}$ **= 200 kN/m**, prestressing steel strand Y1860S7 [1)]
with use of corrugated steel ducts according to EN 523

Strand Y1860S7, A_p = 140 mm^2					Strand Y1860S7, A_p = 150 mm^2				
Number of strands	Duct I	Minimum radius of curvature	Duct II	Minimum radius of curvature	Number of strands	Duct I	Minimum radius of curvature	Duct II	Minimum radius of curvature
n	∅ d_i	R_{min}	∅ d_i	R_{min}	n	∅ d_i	R_{min}	∅ d_i	R_{min}
—	mm	m	mm	M	—	mm	m	mm	m
1	20	2.0	25	2.0	1	20	2.0	25	2.0
3	40	2.6	45	2.2	3	40	2.8	45	2.3
4	45	2.7	50	2.4	4	45	2.8	50	2.6
5	50	3.0	55	2.7	5	50	3.3	55	3.0
6	55	3.3	60	3.0	6	55	3.6	60	3.3
7	55	3.8	60	3.5	7	55	4.2	60	3.8
8	65	3.7	70	3.4	8	65	4.0	70	3.8
9	65	4.1	70	3.8	9	65	4.5	70	4.2
12	75	4.8	80	4.5	12	75	5.3	80	4.9
15	80	5.6	85	5.3	15	80	6.2	85	5.8
19	90	6.3	95	6.0	19	90	6.9	95	6.6
22	95	6.9	105	6.3	22	95	7.6	105	6.9
27	105	7.7	115	7.0	27	105	8.4	115	7.7
31	115	8.0	120	7.7	31	115	8.8	120	8.5
37	—	—	130	8.5	37	—	—	130	9.3
43	—	—	140	9.2	43	—	—	140	10.1
49	—	—	150	9.8	49	—	—	150	10.7
55	—	—	160	10.3	55	—	—	160	11.3

[1)] Minimum radii of curvature for prestressing steel strand Y1860S7 can be calculated with the equation in Clause 1.7.

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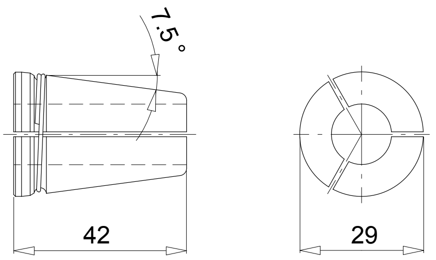
Bonded prestressing system
DYWIDAG – Strand
Minimum radii of curvature
p_R = 200 kN/m

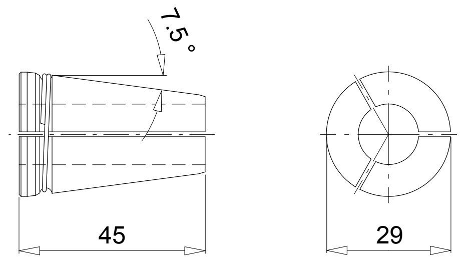
Annex 8
of European Technical Assessment
ETA-13/0815 of 29.01.2021

Wedge and cone geometry

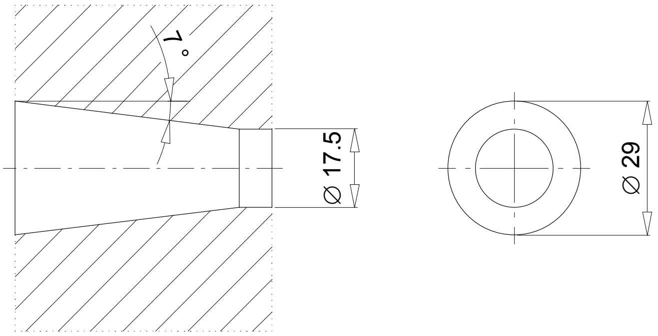
Prestressing steel strand 140 mm² (0.6")



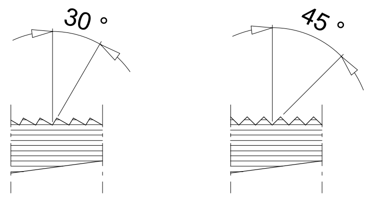
Prestressing steel strand 150 mm² (0.62")



Cone, for both wedge sizes

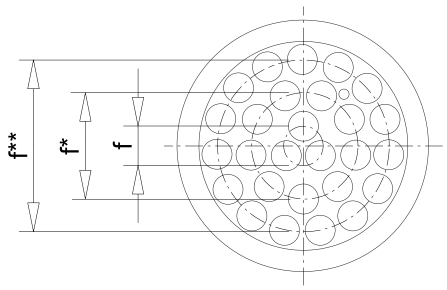


Wedge tooth geometry, for both wedge sizes

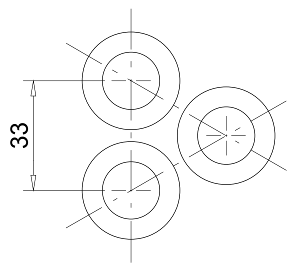


Geometry of wedge plate and anchor plate SD

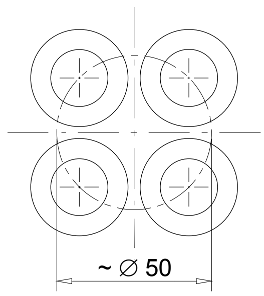
Tendon 6803 to 6837



Tendon 6843 to 6855

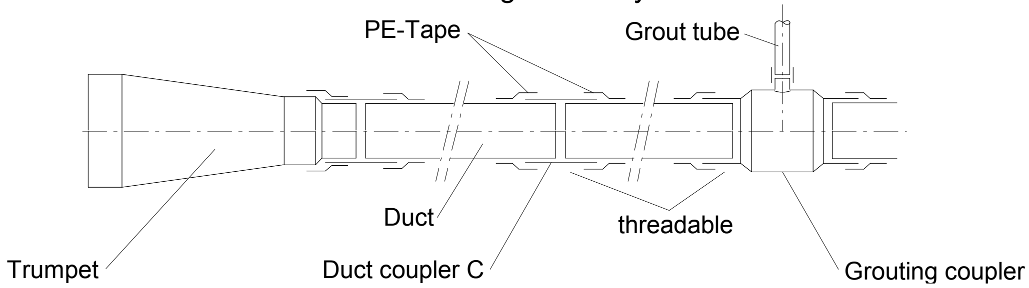


Tendon 6804



f, f*, and f** according to Annex 16 and Annex 22

Sheathing assembly



Dimensions in mm

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Bonded prestressing system

DYWIDAG – Strand

Basic components

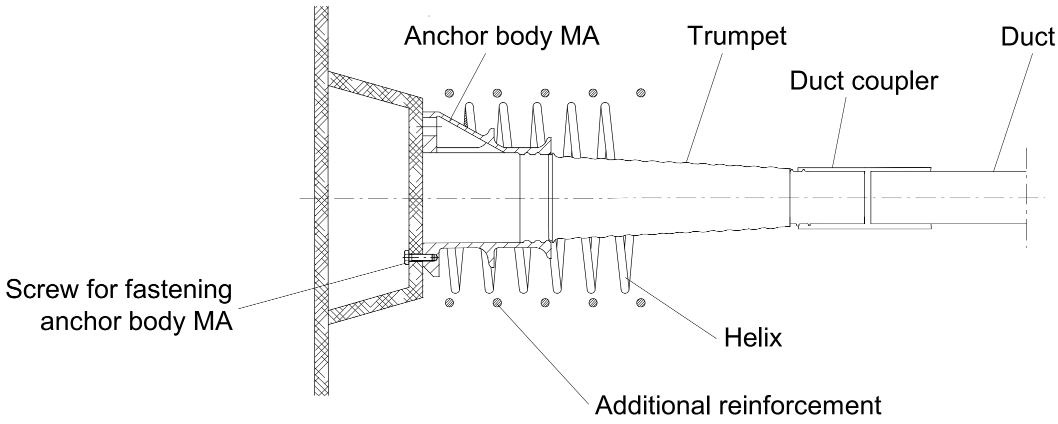
Annex 9

of European Technical Assessment

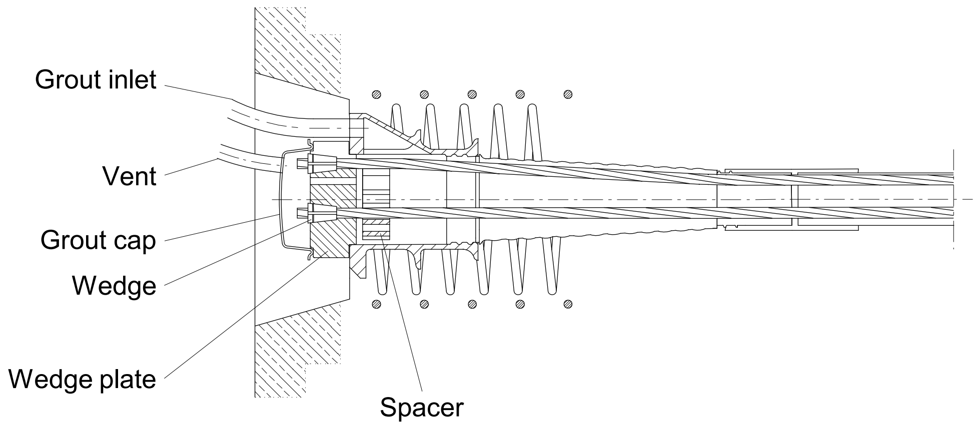
ETA-13/0815 of 29.01.2021

Stressing anchor with wedge plate and anchor body MA

Installation of anchor body, trumpet, duct, and reinforcement

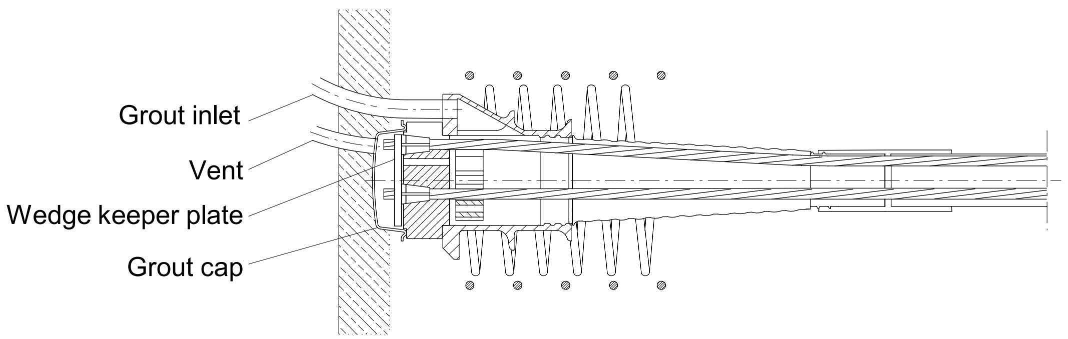


After installation and stressing of tendon



Fixed anchor with wedge plate and anchor body MA

Not accessible



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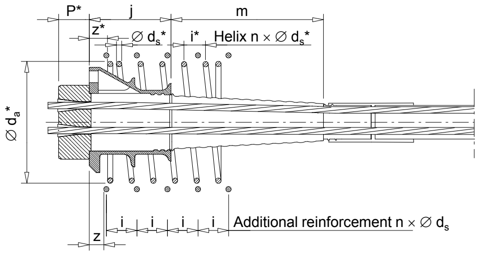
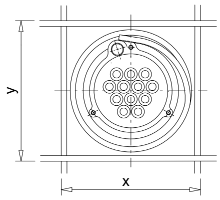
Bonded prestressing system
DYWIDAG – Strand
Assembly of anchorage with multi-plane anchor body MA

Annex 10
of European Technical Assessment
ETA-13/0815 of 29.01.2021

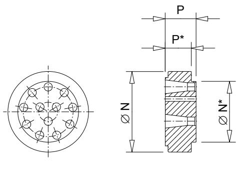
Multi-plane anchor body MA with additional reinforcement and with helix and with minimum centre distances, prestressing steel strand Y1770S7 15.3, Y1770S7 15.7, Y1860S7 15.3, and Y1860S7 15.7



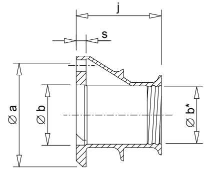


$r_x + c$, $r_y + c$ ..... Minimum edge distance
c .... Concrete cover

Wedge plate

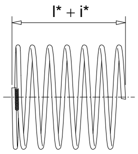


Anchor body MA

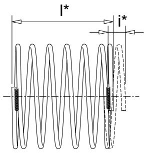


Helix

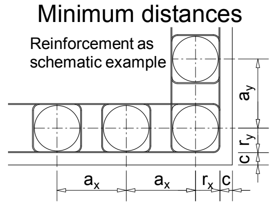
one end welded



both ends welded



Minimum distances



Tendon		**6805**	**6807**	**6809**	**6812**	**6815**	**6819**	**6822**
Number of strands		5	7	9	12	15	19	22
Strand arrangement								
Wedge plate	∅ N	117	130	145	170	190	210	220
	∅ N*	88	96	112	128	148	159	176
thickness	P	55	60	60	65	70	80	85
depth	P*	47	52	52	55	60	68	73
Anchor body MA	∅ a	150	170	190	220	250	280	305
	∅ b	90	98	114	130	150	162	179
	∅ b*	80	90	100	120	130	145	161
height	j	90	100	125	180	200	220	220
thickness	s	18	18	15	17	19	23	26.5
Trumpet length	m	240	210	280	350	390	430	550
Minimum compressive strength of concrete at time of stressing								
$f_{cm,0,cube}$	N/mm²	**25 34 45**	**25 34 45**	**25 34 45**	**25 34 45**	**25 34 45**	**25 34 45**	**25 34 45**
$f_{cm,0,cyl}$	N/mm²	**20 28 36**	**20 28 36**	**20 28 36**	**20 28 36**	**20 28 36**	**20 28 36**	**20 28 36**
Centre distance [1]	a_x, a_y	270 235 220	320 280 245	345 305 270	400 350 310	445 390 345	500 435 380	540 470 410
Edge distance [1] (plus c) [2]	r_x, r_y	125 110 100	150 130 115	165 145 125	190 165 145	215 185 165	240 210 180	260 225 195
Helix								
Minimum number of turns	n*	5.5 5 5	5 5 5	6.5 6 6	6 7 7	8 8 7	8.5 8 7.5	9 8.5 8
Minimum wire diameter	∅ ds*	12 12 12	14 14 14	14 14 14	14 14 14	16 14 14	16 16 16	16 16 16
Maximum distance	z*	40 40 40	40 40 40	40 40 40	45 45 45	50 50 50	50 50 50	55 55 55
Min. external diameter	∅ da*	205 185 180	240 220 200	270 250 220	320 265 255	345 310 285	420 375 310	465 370 340
	max. i*	45 40 50	50 50 50	50 50 50	50 50 50	50 50 50	50 50 50	50 50 50
	min. l*	235 195 235	240 240 240	315 290 290	290 340 340	395 390 340	420 395 370	445 420 395
Additional reinforcement, ribbed reinforcing steel $R_e \geq 500$ N/mm²								
Minimum number of layers	n	5 5 5	6 6 6	7 7 7	7 8 8	8 8 8	8 8 8	8 8 8
Minimum bar diameter	∅ ds	12 12 12	12 12 12	14 14 14	14 14 14	16 16 16	16 16 16	16 16 16
Maximum distance	z	40 40 40	40 40 40	40 40 40	45 45 45	50 50 50	50 50 50	55 55 55
Maximum spacing	i	50 45 50	55 50 50	55 55 55	55 50 55	65 60 60	65 65 65	60 55 55
External dimensions	x, y	250 215 200	300 260 225	325 285 250	380 330 290	425 370 325	480 415 360	520 450 390

[1] Minimum dimensions [2] c … concrete cover Dimensions in mm

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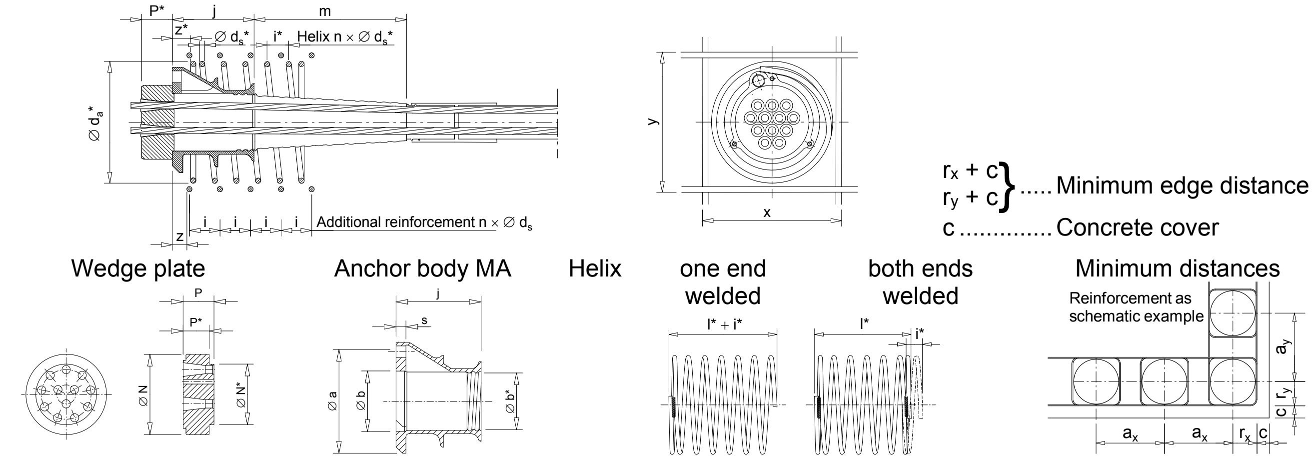
Bonded prestressing system

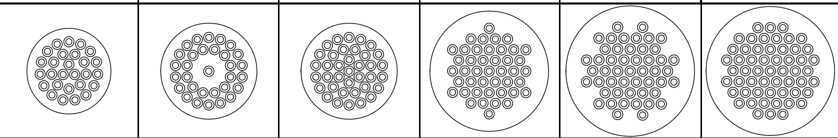
DYWIDAG – Strand

Anchorage with multi-plane anchor body MA with additional reinforcement and with helix
Data sheet for tendons 6805 to 6822

Annex 11
of European Technical Assessment
ETA-13/0815 of 29.01.2021

Multi-plane anchor body MA with additional reinforcement and with helix and with minimum centre distances, prestressing steel strand Y1770S7 15.3, Y1770S7 15.7, Y1860S7 15.3, and Y1860S7 15.7



Tendon		6827	6831	6837	6843	6849	6855
Number of strands		27	31	37	43	49	55
Strand arrangement							
Wedge plate	∅ N	240	270	270	320	340	340
	∅ N*	188	214	214	251	262	262
thickness	P	95	100	115	130	140	140
depth	P*	80	80	95	110	120	120
Anchor body MA	∅ a	330	385	420	465	510	510
	∅ b	190	217	217	254	266	266
	∅ b*	161	196	196	252	252	252
height	j	240	350	350	380	420	420
thickness	s	30	40	50	50	50	50
Trumpet length	m	550	570	570	950	780	780
Minimum compressive strength of concrete at time of stressing							
$f_{cm, 0, cube}$	N/mm²	**25 34 45**	**28 40 53**	**28 40 53**	**53**	**53**	**53**
$f_{cm, 0, cyl}$	N/mm²	**20 28 36**	**23 33 43**	**23 33 43**	**43**	**43**	**43**
Centre distance 1)	a_x, a_y	600 520 460	690 590 535	760 650 600	640	680	710
Edge distance 1) (plus c) 2)	r_x, r_y	290 250 220	335 285 260	370 315 290	310	330	345
Helix							
Minimum number of turns	n*	10 9 8.5	10 9 8	11 9 8	10	10	11
Minimum wire diameter	∅ ds*	16 16 16	20 20 20	20 20 20	20	20	20
Maximum distance	z*	55 55 55	60 60 60	70 70 70	70	70	70
Min. external diameter	∅ da*	510 430 370	620 530 480	660 570 520	530	550	580
	max. i*	50 50 50	55 60 65	50 60 65	55	60	55
	min. l*	495 445 420	555 540 515	560 540 515	555	600	610
Additional reinforcement, ribbed reinforcing steel $R_e \geq 500$ N/mm²							
Minimum number of layers	n	10 10 10	9 8 8	10 9 8	10	13	14
Minimum bar diameter	∅ ds	20 20 20	20 20 20	20 20 20	20	20	20
Maximum distance	z	55 55 55	40 40 40	40 40 40	50	50	50
Maximum spacing	i	65 60 60	75 80 80	75 75 85	70	60	55
External dimensions	x, y	580 500 440	670 570 515	740 630 580	620	660	690

1) Minimum dimensions 2) c … concrete cover Dimensions in mm

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Bonded prestressing system

DYWIDAG – Strand

Anchorage with multi-plane anchor body MA with additional reinforcement and with helix
Data sheet for tendons 6827 to 6855

Annex 12
of European Technical Assessment
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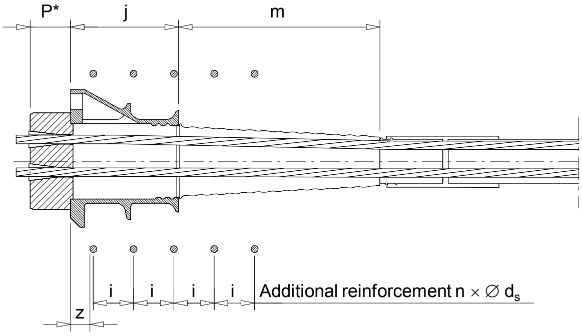
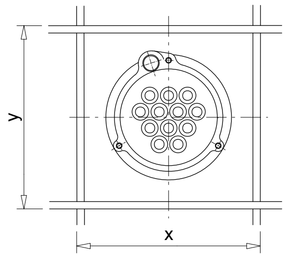
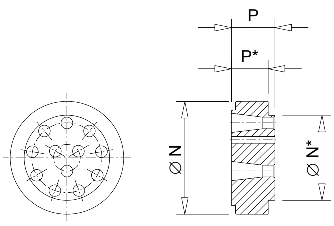
Multi-plane anchor body MA with additional reinforcement and without helix, prestressing steel strand Y1770S7 15.3, Y1770S7 15.7, Y1860S7 15.3, and Y1860S7 15.7



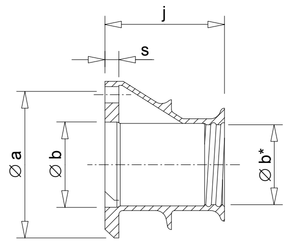


$r_x + c$ } ..... Minimum edge
$r_y + c$ } distance
c .... Concrete cover

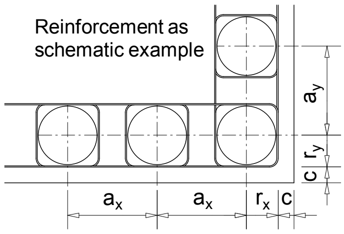
Wedge plate



Anchor body MA



Minimum distances



Tendon		6805	6807	6809	6812	6815	6819	6822
Number of strands		5	7	9	12	15	19	22
Strand arrangement								
Wedge plate	Ø N	117	130	145	170	190	210	220
	Ø N*	88	96	112	128	148	159	176
thickness	P	55	60	60	65	70	80	85
depth	P*	47	52	52	55	60	68	73
Anchor body MA	Ø a	150	170	190	220	250	280	305
	Ø b	90	98	114	130	150	162	179
	Ø b*	80	90	100	120	130	145	161
height	j	90	100	125	180	200	220	220
thickness	s	18	18	15	17	19	23	26.5
Trumpet length	m	240	210	280	350	390	430	550
Minimum compressive strength of concrete at time of stressing								
$f_{cm,\,0,\,cube}$	N/mm²	**34 44 54**	**34 44 54**	**34 44 54**	**34 44 54**	**34 44 54**	**34 44 54**	**34 44 54**
$f_{cm,\,0,\,cyl}$	N/mm²	**28 35 43**	**28 35 43**	**28 35 43**	**28 35 43**	**28 35 43**	**28 35 43**	**28 35 43**
Centre distance [1]	a_x, a_y	255 225 205	300 265 240	335 300 275	380 340 310	425 375 345	475 420 385	510 450 410
Edge distance [1] (plus c) [2]	r_x, r_y	120 105 95	140 125 110	160 140 130	180 160 145	205 180 165	230 200 185	245 215 195
Additional reinforcement, ribbed reinforcing steel $R_e \geq 500$ N/mm²								
Minimum number of layers	n	5 5 5	6 5 6	6 6 6	8 8 7	8 8 8	8 8 9	10 9 8
Minimum bar diameter	Ø d_s	16 16 16	16 16 16	16 16 16	16 16 16	20 16 16	20 20 20	20 20 20
Maximum spacing	Z	40 40 40	40 40 40	40 40 40	40 40 40	40 40 40	40 40 40	40 40 40
Maximum spacing	I	50 50 50	50 50 50	50 50 50	45 50 50	55 45 45	55 55 50	50 50 50
External dimensions [3]	x, y	240 205 175	280 235 195	305 260 225	320 295 260	380 335 300	410 370 350	430 390 360

[1] Minimum dimensions [1] c … concrete cover
[3] The external dimensions x, y have to be met exactly.

Dimensions in mm

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Bonded prestressing system
DYWIDAG – Strand
Anchorage with multi-plane anchor body MA with additional reinforcement and without helix
Data sheet for tendons 6805 to 6822

Annex 13
of European Technical Assessment
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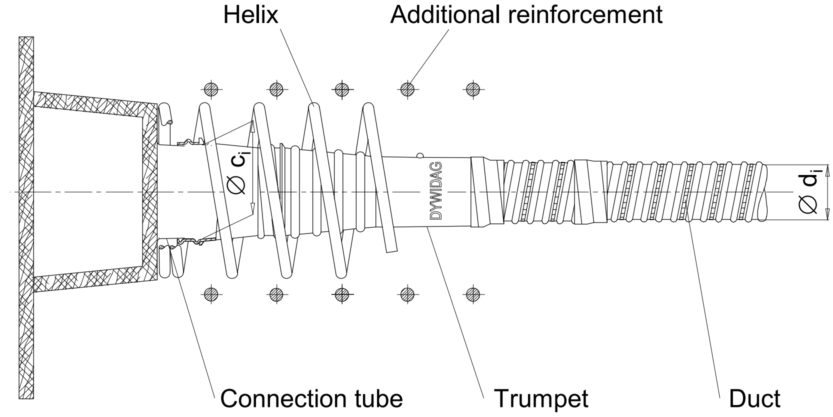
Anchorage or coupler	Slip	Locking measures
—	mm	—
Stressing anchor – Wedge plate – Anchor plate SD – Coupler plate R	3 [1]	Power-seating 20 kN per strand
	6 [1]	—
Slip at stressing anchor considered for calculation of elongation	1	—
Fixed anchor – Wedge plate – Anchor plate SD	1	Pre-wedging with $P_{0,\,max}$, wedge keeper plate
	5	Wedge keeper plate
Bond anchorage	0	—
Fixed coupler R 2nd construction stage	4	Spring
Movable coupler D	8	Spring

[1] Slip occurs by transfer of prestressing force from jack to anchorage.

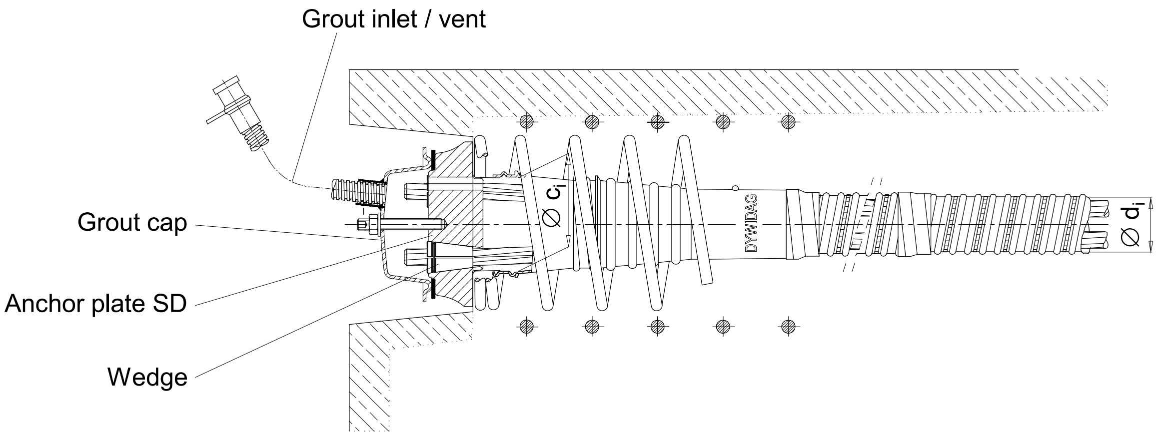
OiB Member of EOTA

Stressing anchor SD

Installation of connection tube (optionally), trumpet, duct, and reinforcement

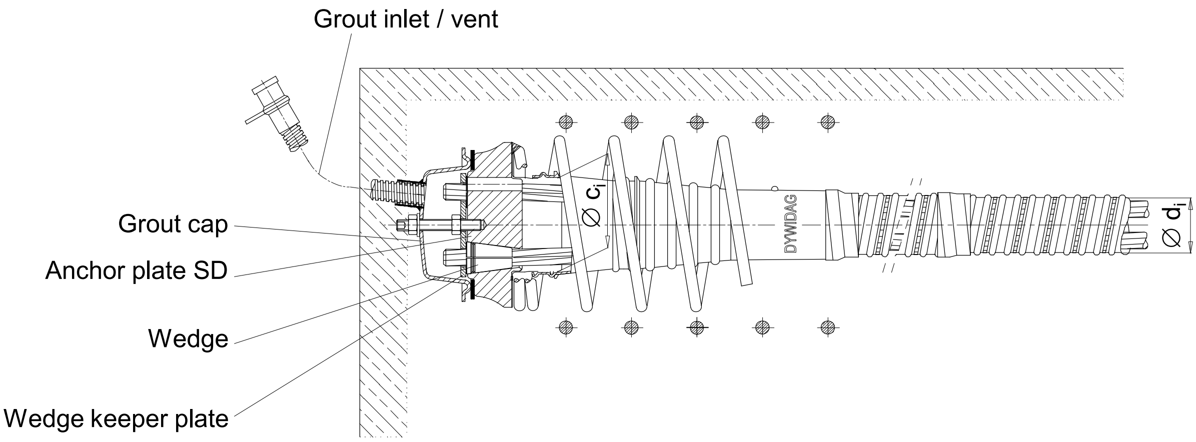


After installation and stressing of tendon



Fixed anchor SD

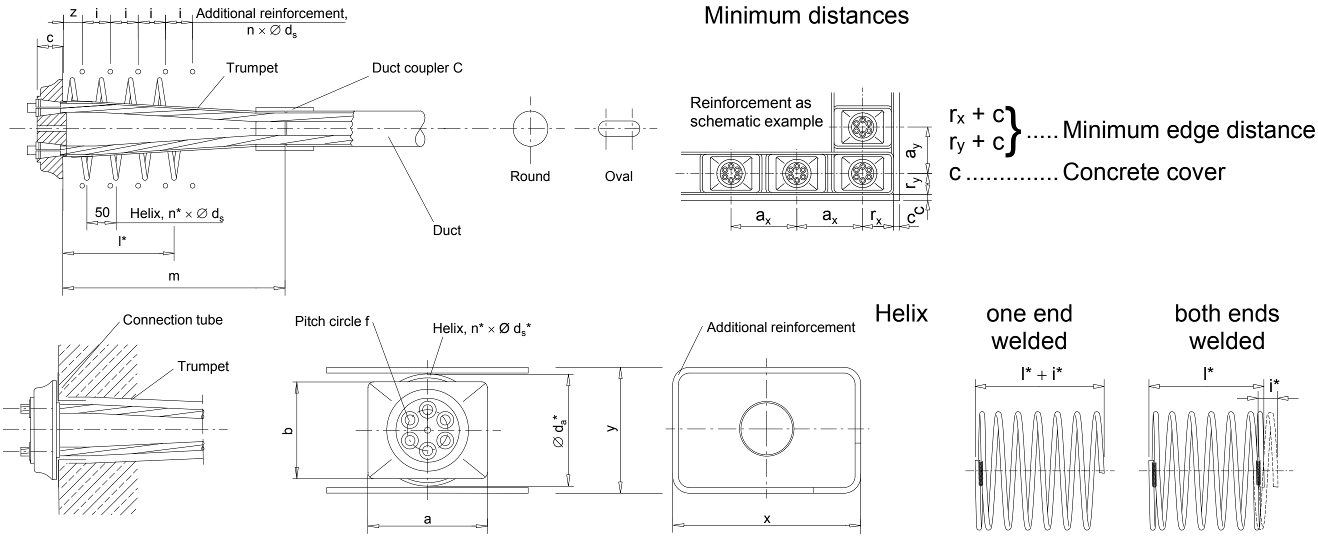
Not accessible

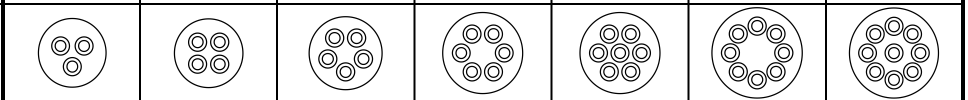


DYWIDAG DYWIDAG-Systems International GmbH Phone: +49/89/309050-100 E-Mail: dsihv@dywidag-systems.com	**Bonded prestressing system** **DYWIDAG – Strand** Assembly of anchorage with anchor plate SD	**Annex 15** of European Technical Assessment **ETA-13/0815** of 29.01.2021

Plate anchorage SD

Minimum distances



Tendon	6803	6804	6805	6806	6807	6808	6809
Number of strands	3	4	5	6	7	8	9
Strand arrangement							
Pitch circle f	44	50	60	70	70	86	86
Anchor plate SD a	140	160	180	215	215	245	245
b	125	135	150	170	170	190	190
c	50	50	50	50	50	55	55
Connection tube ∅ c_i	65	75	85	95	95	110	110
Trumpet length m	300	300	400	350	350	400	400
Minimum compressive strength of concrete at time of stressing							
$f_{cm,\,0,\,cube}$ N/mm²	**30**	**30**	**30**	**30**	**30**	**30**	**30**
$f_{cm,\,0,\,cyl}$ N/mm²	**24**	**24**	**24**	**24**	**24**	**24**	**24**
Centre distance [1] a_x/a_y	250/170	290/190	320/215	340/240	370/250	400/270	420/280
Edge distance [1] (plus c) [2] r_x/r_y	115/75	135/85	150/100	160/110	175/115	190/125	200/130
Helix							
Minimum number of turns n*	—	—	6	6	6	6	6
Minimum wire diameter ∅ d_s*			12	12	14	14	14
Min. external diameter ∅ d_a*			160	180	190	210	220
max. i*			50	50	50	50	50
min. l*			285	285	290	290	290
Additional reinforcement, ribbed reinforcing steel $R_e \geq 500$ N/mm²							
Minimum number of layers n	6	6	7	7	7	7	7
Minimum bar diameter ∅ d_s	12	12	12	12	12	12	12
Maximum distance z	35	35	40	40	40	40	40
Maximum spacing i	50	50	50	50	50	55	55
External dimensions [2] x, y	230/150	270/170	300/195	320/220	350/230	380/250	400/260

[1] Minimum dimensions [1] c … concrete cover
[2] The external dimensions x, y have to be met exactly.

Dimensions in mm

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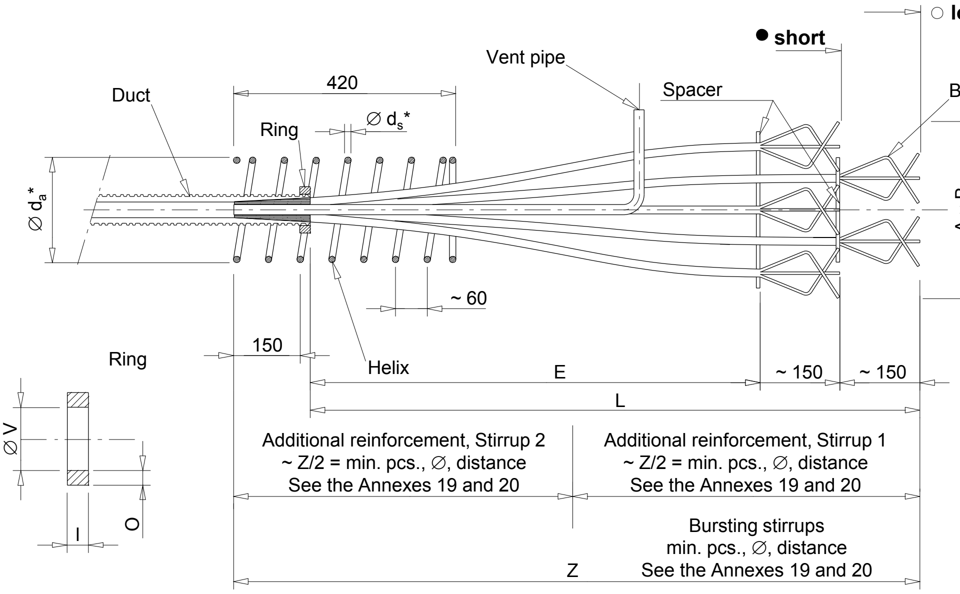
Bonded prestressing system

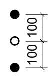
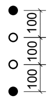
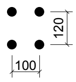
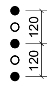
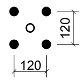
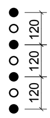
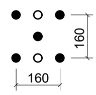
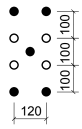
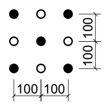
DYWIDAG – Strand

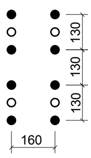
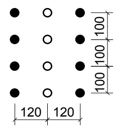
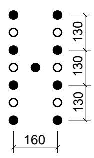
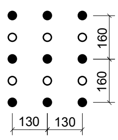
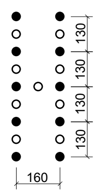
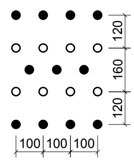
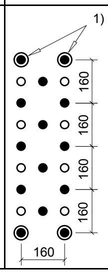
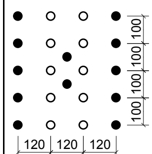
Plate anchorage SD
Data sheet for tendons 6803 to 6809

Annex 16
of European Technical Assessment
ETA-13/0815 of 29.01.2021

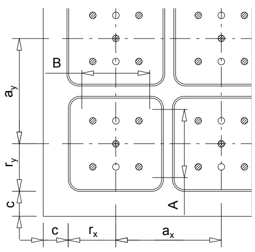
Bond anchorage H 6803 to 6822
for $f_{cm,\,0,\,cube} \geq 34$ N/mm² or $f_{cm,\,0,\,cyl} \geq 28$ N/mm²



Tendon	6803	6804		6805		6807		6809	
Format	HL	HL	HR	HL	HR	HL	HR	HL	HR
Elevation anchorage (Y A, B X)									

Tendon	6812		6815		6819		6822	
Format	HL	HL	HL	HR	HL	HR	HL	HR
Elevation anchorage (Y A, B X)								

Key
○ .... Position long
● .... Position short
◉ .... 3rd position 1)
$r_x + c$ } .... Minimum edge distance
$r_y + c$ }
c.................. Concrete cover



1) 3rd position see Annex 18

Reinforcement as schematic example

Dimensions in mm

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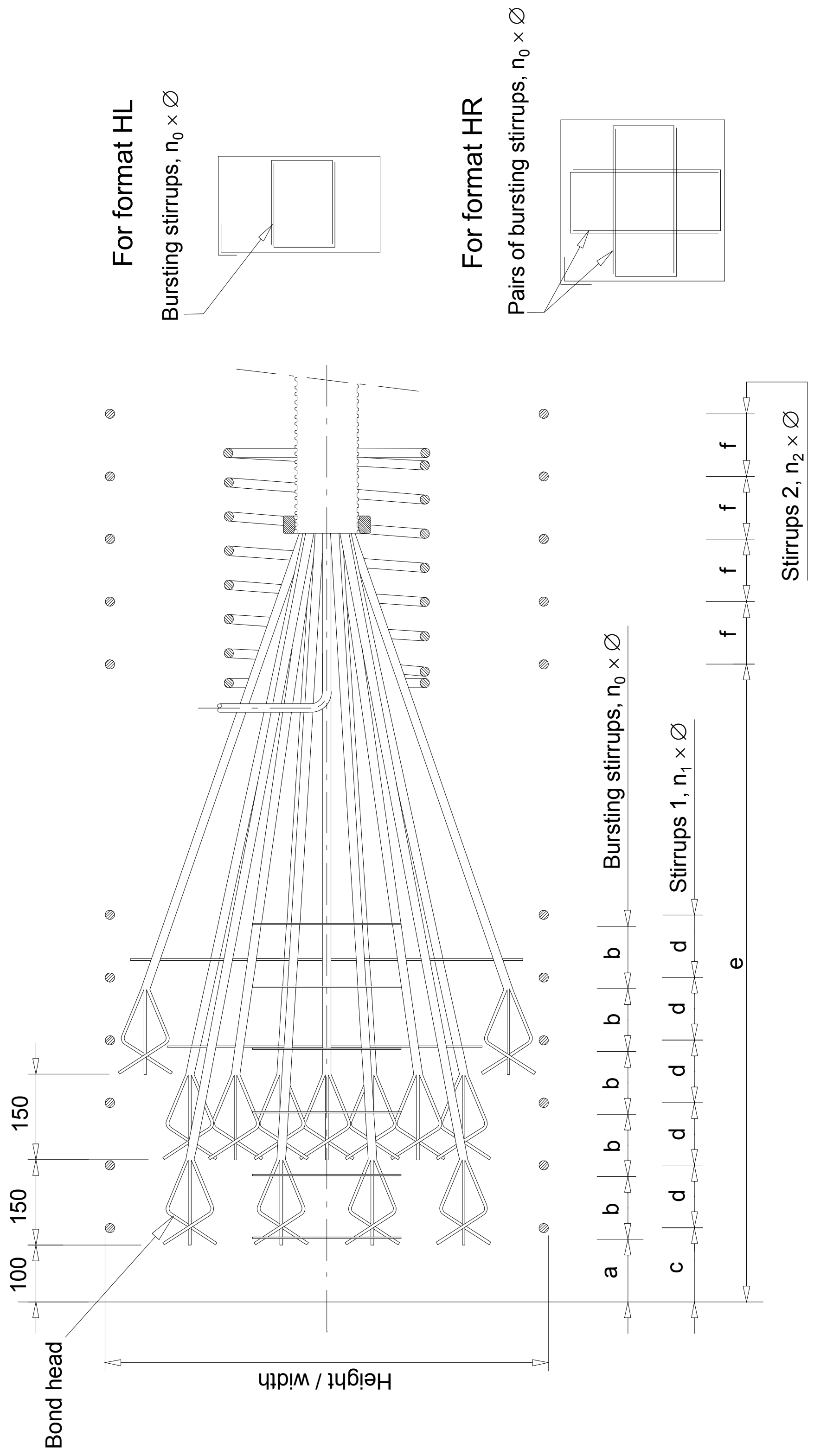
Bonded prestressing system
DYWIDAG – Strand
Bond anchorage H
Strand arrangement – Helix

Annex 17
of European Technical Assessment
ETA-13/0815 of 29.01.2021

Bond anchorage H 6803 to 6822
for $f_{cm, 0, cube} \geq$ 34 N/mm² or $f_{cm, 0, cyl} \geq$ 28 N/mm²



Dimensions in mm

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Bonded prestressing system
DYWIDAG – Strand
Bond anchorage H
Stirrup reinforcement

Annex 18
of European Technical Assessment
ETA-13/0815 of 29.01.2021

Bond anchorage H 6803 to 6809 for $f_{cm,\,0,\,cube} \geq 34$ N/mm² or $f_{cm,\,0,\,cyl} \geq 28$ N/mm²
strand Y1770S7 15.3, Y1770S7 15.7, strand Y1860S7 15.3, and strand Y1860S7 15.7

For layout see the Annexes 17 and 18.

Tendon		**6803**	**6804**		**6805**		**6807**		**6809**	
Number of strands		3	4		5		7		9	
Format		HL	HL	HR	HL	HR	HL	HR	HL	HR
Dimensions	A	290	390	210	330	210	450	250	390	290
	B	90	90	190	90	210	90	250	210	290
	Z	1 400	1 400	1 400	1 400	1 400	1 400	1 400	1 400	1 400
	E	950	950	950	950	950	950	950	950	950
	L	1 250	1 250	1 250	1 250	1 250	1 250	1 250	1 250	1 250
Helix	∅ d_a*	—	—	—	160	160	180	180	230	230
	∅ d_s*	—	—	—	12	12	12	12	14	14
Ring	∅ V	Duct outer diameter + ~ 3 mm								
	O	11	14	14	14	14	14	14	14	14
	I	20	20	20	20	20	30	30	30	30
Minimum centre and edge distance	a_x	180	190	285	210	305	230	340	280	375
	a_y	380	430	285	440	305	500	340	500	375
	r_x	80	85	135	95	145	105	160	130	180
	r_y	180	205	135	210	145	240	160	240	180
Bursting stirrups [1)]	a	100	100	—	100	—	100	—	100	100
	b	80	80	—	80	—	83	—	90	100
	n_0	6	6	—	6	—	6	—	6	5
	∅	10	10	—	10	—	10	—	12	14
	Width	160	170	—	190	—	210	—	260	355
	Height	150	180	—	180	—	180	—	200	120
Stirrup 1	c	115	115	115	115	105	115	105	120	120
	d	80	80	80	80	80	83	85	90	100
	n_1	8	8	7	8	7	8	7	8	6
	∅	12	12	12	12	12	12	12	14	14
	Width	160	170	265	190	285	210	320	260	355
	Height	360	410	265	420	285	480	320	480	355
Stirrup 2	e	850	850	785	850	785	850	785	900	810
	f	166	166	170	166	170	166	170	200	185
	n_2	5	5	5	5	5	5	5	4	5
	∅	12	12	12	12	12	12	12	14	14
	Width	160	170	265	190	285	210	320	260	355
	Height	360	410	265	420	285	480	320	480	355

[1)] Crosswise installation of bursting reinforcement for fixed anchor HR according to Annex 18

Dimensions in mm

Bond anchorage H 6812 to 6822 for $f_{cm, 0, cube} \geq 34$ N/mm² or $f_{cm, 0, cyl} \geq 28$ N/mm²
strand Y1770S7 15.3, Y1770S7 15.7, strand Y1860S7 15.3, and strand Y1860S7 15.7

For layout see the Annexes 17 and 18.

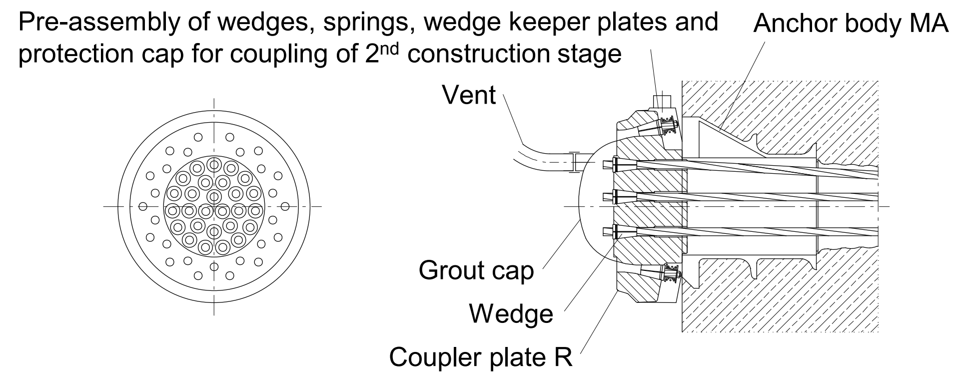
Tendon		**6812**		**6815**		**6819**		**6822**	
Number of strands		12		15		19		22	
Format		HL	HR	HL	HR	HL	HR	HL	HR
Dimensions	A	480	390	480	410	610	490	730	490
	B	250	330	250	350	250	390	250	450
	Z	1 400	1 400	1 400	1 400	1 400	1 400	1 400	1 400
	E	950	950	950	950	950	950	800 2)	950
	L	1 250	1 250	1 250	1 250	1 250	1 250	1 250	1 250
Helix	∅ d_a*	250	250	295	295	330	330	360	360
	∅ d_s*	14	14	16	16	16	16	16	16
Ring	∅ V	Duct outer diameter + ~ 3 mm							
	O	20	20	20	20	20	20	20	20
	I	30	30	30	30	30	30	30	30
Minimum centre and edge distance	a_x	300	390	350	460	390	525	410	570
	a_y	570	440	630	475	715	525	780	560
	r_x	140	185	165	220	185	255	195	275
	r_y	275	210	305	230	350	255	380	270
Bursting stirrups 1)	A	100	100	100	100	110	110	110	120
	B	100	100	100	100	110	110	110	120
	n_0	6	5	6	6	6	5	6	5
	∅	12	12	14	14	14	14	14	14
	Width	280	420	330	455	370	505	390	550
	Height	200	150	220	230	220	230	260	280
Stirrup 1	c	120	120	120	120	130	130	130	140
	d	100	100	100	100	110	110	110	120
	n_1	8	6	8	6	7	6	6	5
	∅	14	14	14	14	14	14	14	14
	Width	280	370	330	440	370	505	390	550
	Height	550	420	610	455	695	505	760	540
Stirrup 2	e	1 020	820	1 020	900	1 120	1 000	1 120	1 060
	f	200	200	150	150	110	120	110	120
	n_2	3	4	5	5	5	6	5	6
	∅	14	14	14	14	14	14	14	14
	Width	280	370	330	440	370	505	390	550
	Height	550	420	610	455	695	505	760	540

1) Crosswise installation of bursting reinforcement for fixed anchor HR according to Annex 18
2) Bond head in 3rd position

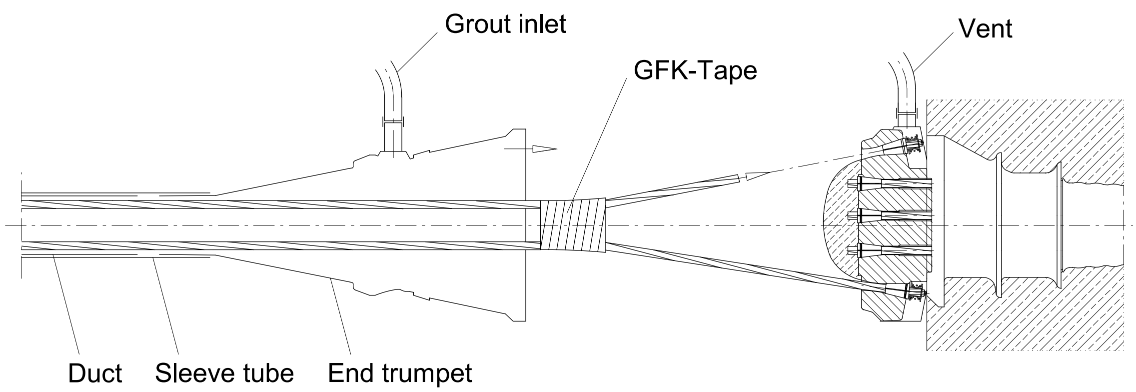
Dimensions in mm

Installation of 1st construction stage

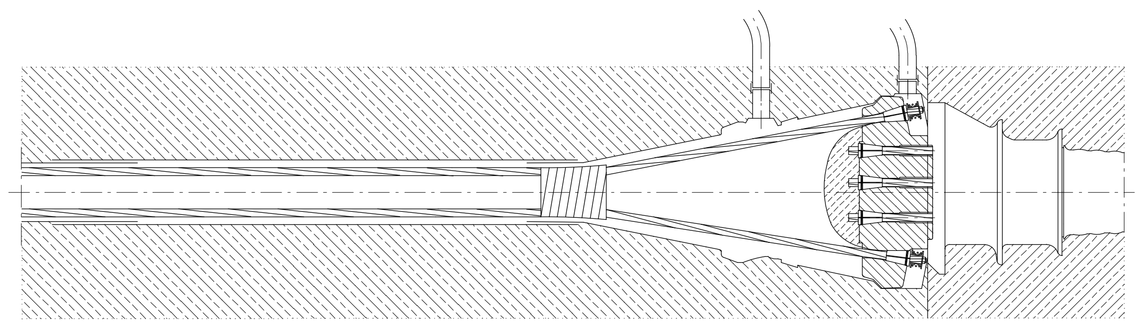
Installation of anchor body and other components identical to stressing anchor with wedge plate and anchor body MA



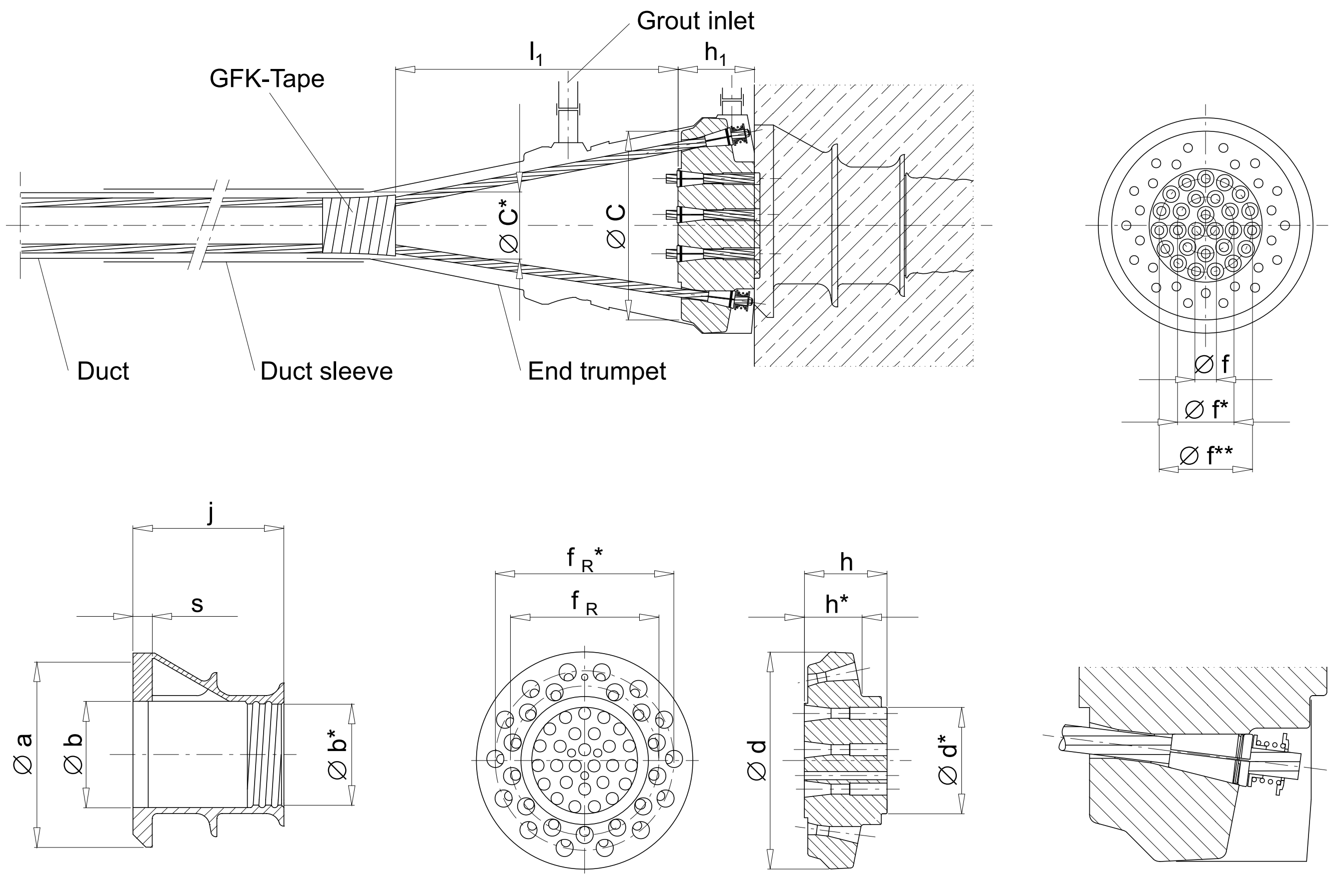
Coupler assembly



Pouring of concrete, stressing 2nd construction stage



DYWIDAG DYWIDAG-Systems International GmbH Phone: +49/89/309050-100 E-Mail: dsihv@dywidag-systems.com	**Bonded prestressing system** **DYWIDAG – Strand** Assembly of fixed coupler R	**Annex 21** of European Technical Assessment **ETA-13/0815** of 29.01.2021



Tendon			6805	6807	6809	6812	6815	6819	6822	6827	6831	6837
Number of strands			05	07	09	12	15	19	22	27	31	37
Anchor body MA	∅ a	mm	150	170	190	220	250	280	305	330	385	420
	∅ b	mm	90	98	114	130	150	162	179	190	217	217
	∅ b*	mm	80	90	100	120	130	145	161	161	196	196
	j	mm	90	100	125	180	200	220	220	240	350	350
	s	mm	18	18	15	17	19	23	26.5	30	40	50
Coupler plate R	∅ d	mm	207	207	224	246	264	289	340	380	435	435
	∅ d*	mm	88	96	112	128	148	159	176	188	214	214
	h	mm	115	115	115	115	120	130	135	145	170	170
	h*	mm	75	75	75	75	76	85	90	100	120	120
	h_1	mm	105	105	105	105	110	120	125	135	158	158
Pitch circles	central	—	—	◎	◎	—	—	◎	—	—	◎	◎
	∅ f	mm	60	70	86	40	60	70	86	38	—	65
	∅ f*	mm	—	—	—	105	125	136	152	100	126	126
	∅ f**	mm	—	—	—	—	—	—	—	165	190	190
	∅ f_R	mm	152	152	168	188	207	224	244	261	306	306
	∅ f_R*	mm	—	—	—	—	—	—	276	314	370	370
End trumpet	Length l_1	mm	460	370	350	500	450	570	640	660	870	870
	∅ c	mm	185	185	205	232	250	268	297	333	395	395
	∅ c*	mm	75	75	85	90	100	105	120	120	137	137

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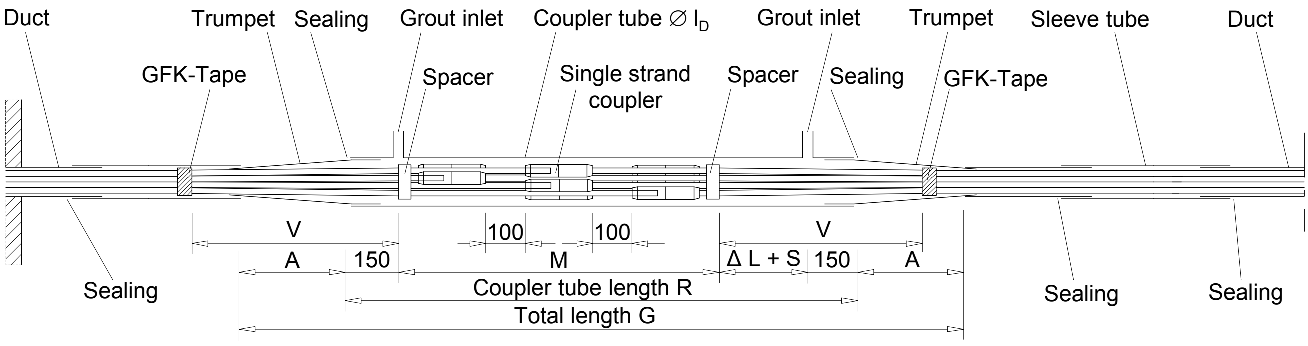
Bonded prestressing system

DYWIDAG – Strand

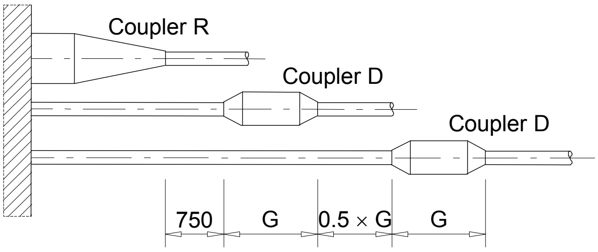
Fixed coupler R
Data sheet for tendons 6805 to 6837

Annex 22
of European Technical Assessment
ETA-13/0815 of 29.01.2021

Movable coupler D



Schematic representation of staggering



Key

ΔL....Expected displacement during stressing

S .....Maximum $\begin{cases} 0.2 \cdot \Delta L \\ 120 \text{ mm} \end{cases}$, safety clearance

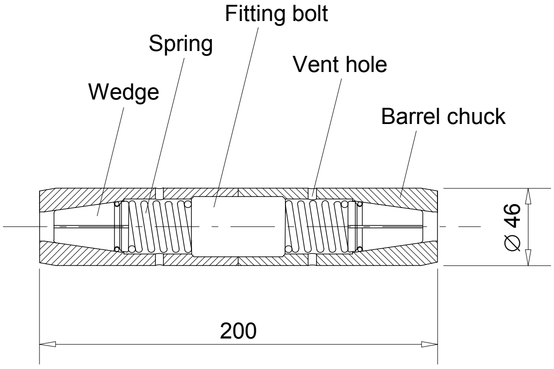
Coupler tube length

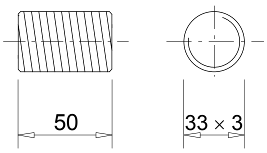
$R = \Delta L + S + M + 300$ mm

Total length

$G = R + 2 \cdot A$

Single strand coupler





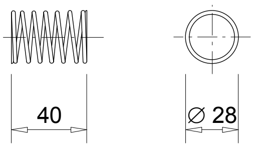
Fitting bolt with
special thread 33 × 3, l = 50 mm

NOTE

Outer dimensions are identical for both nominal diameters of the prestressing steel strand. For installation, refer to marking

- 060 for 140 mm² or
- 062 for 150 mm²

prestressing steel strand respectively.



Spring ∅ 28 mm, l = 40 mm

Dimensions in mm

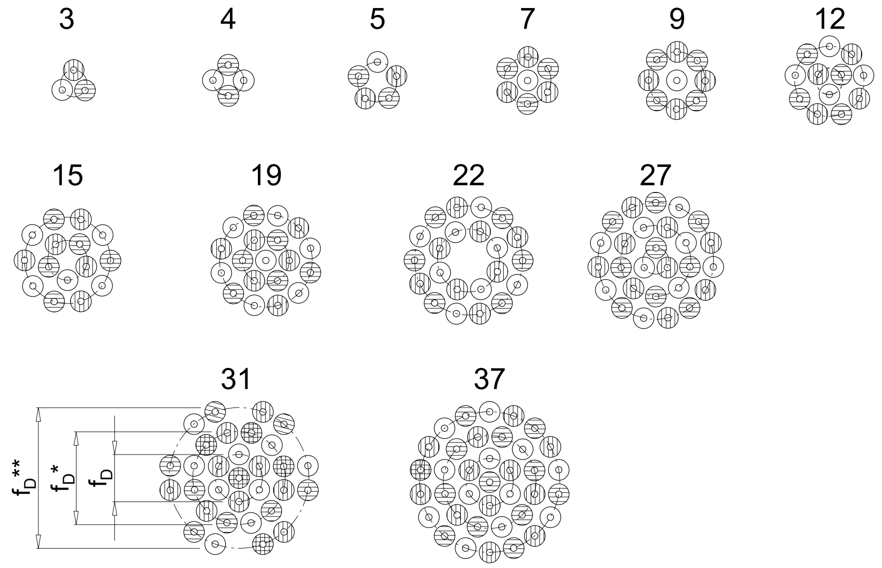
DYWIDAG DYWIDAG-Systems International GmbH Phone: +49/89/309050-100 E-Mail: dsihv@dywidag-systems.com	**Bonded prestressing system** **DYWIDAG – Strand** Assembly of movable coupler D	**Annex 23** of European Technical Assessment **ETA-13/0815** of 29.01.2021

Movable coupler D – Arrangement of single strand couplers

Number of strands

Number of strands

Number of strands



Position of single strand coupler

◎ = position 1

⊜ = position 2

⦶ = position 3

Tendon			6803	6804	6805	6807	6809	6812	6815	6819	6822	6827	6831	6837
Number of strands			03	04	05	07	09	12	15	19	22	27	31	37
Deviation length	V	mm	300	350	400	500	550	650	700	750	900	900	1 000	1 000
Transition length	A	mm	150	200	250	300	350	450	500	550	700	700	800	800
Length	M	mm	900	600	900	900	900	900	900	940	940	940	940	940
Pitch circles of spacer		—	—	—	—	◎	◎	—	—	◎	—	—	◎	◎
	f_D	mm	44	50	60	70	86	40	60	70	86	38	65	65
	f_D*	mm	—	—	—	—	—	105	125	136	152	100	126	126
	f_D**	mm	—	—	—	—	—	—	—	—	—	165	190	190
Coupler tube	I_D	mm	100	110	120	125	140	160	180	200	225	225	250	250

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Bonded prestressing system

DYWIDAG – Strand

Movable coupler D
Data sheet for tendons 6803 to 6837

Annex 24
of European Technical Assessment
ETA-13/0815 of 29.01.2021

Designation	Specification	Material 1)
Wedge	EN 10277	Steel
Wedge plate	EN ISO 683-1	Steel
Anchor plate SD	EN ISO 683-1	Steel
Coupler plate R	EN ISO 683-1	Steel
Coupler D barrel chuck	EN ISO 683-1	Steel
Coupler D fitting bolt	EN 10025-2	Steel
Anchor body MA	EN 1563	Ductile cast iron
Duct, Telescopic duct	EN 523	Steel
Coupler tube, Duct sleeve, Sleeve tube	EN 523	Steel
	EN 10130	Steel
	EN ISO 17855-1	PE-HD
Trumpet	EN 10130 EN ISO 17855-1	Steel PE-HD
Helix	—	Ribbed reinforcing steel, $R_e \geq 500$ N/mm^2
	EN 10025-2	Plain round steel
Additional reinforcement	—	Ribbed reinforcing steel, $R_e \geq 500$ N/mm^2
Ring	EN 10025-2	Steel
Wedge keeper plate	EN 10025-2	Steel
Spacer	EN ISO 17855-1	PE-HD
Grout cap	EN 10130	Steel
Sealing	—	Synthetic caoutchouc

1) Detailed material specifications are deposited at Österreichisches Institut für Bautechnik

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Bonded prestressing system
DYWIDAG – Strand
Material specifications

Annex 25
of European Technical Assessment
ETA-13/0815 of 29.01.2021

Prestressing steel strand			Y1770S7		Y1860S7	
Characteristic tensile strength	R_m	N/mm²	1 770		1 860	
Nominal diameter of strand	D	mm	15.3	15.7	15.3	15.7
Nominal diameter of outer wire	d_o	mm	5.0	5.2	5.0	5.2
Diameter of core wire	d’	mm	$\geq 1.03 \cdot d_o$			
Nominal mass per metre	M	g/m	1 093	1 172	1 093	1 172
Nominal cross-sectional area	A_p	mm²	140	150	140	150
Characteristic value of maximum force	F_m	kN	248	266	260	279
Maximum value of maximum force	$F_{m,\,max}$	kN	285	306	299	321
Characteristic value of 0.1% proof force [1)]	$F_{p0.1}$	kN	218	234	229	246
Minimum elongation at maximum force, $L_0 \geq 500$ mm	A_{gt}	%	3.5			
Modulus of elasticity	E	N/mm²	195 000 [2)]			
Relaxation after 1 000 h, for an initial force of – $0.70 \cdot F_{ma}$ – $0.80 \cdot F_{ma}$	 — —	 % %	 ≤ 2.5 ≤ 4.5			

1) For prestressing steel strand according to prEN 10138-3, 09.2000, the value is multiplied by 0.98.
2) Standard value

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Bonded prestressing system
DYWIDAG – Strand
Specifications of the
7-wire prestressing steel strands

Characteristic maximum force of tendon, F_{pk}

Number of strands	Prestressing steel strand A_p = 140 mm²				Prestressing steel strand A_p = 150 mm²			
	M [1]	A_p [2]	Y1770S7	Y1860S7	M [1]	A_p [2]	Y1770S7	Y1860S7
			F_{pk} [3]	F_{pk} [3]			F_{pk} [3]	F_{pk} [3]
—	kg/m	mm²	kN	kN	kg/m	mm²	kN	kN
1	1.09	140	248	260	1.17	150	266	279
3	3.28	420	744	780	3.52	450	798	837
4	4.37	560	992	1 040	4.69	600	1 064	1 116
5	5.47	700	1 240	1 300	5.86	750	1 330	1 395
6	6.56	840	1 488	1 560	7.03	900	1 596	1 674
7	7.65	980	1 736	1 820	8.20	1 050	1 862	1 953
8	8.74	1 120	1 984	2 080	9.38	1 200	2 128	2 232
9	9.84	1 260	2 232	2 340	10.55	1 350	2 394	2 511
12	13.12	1 680	2 976	3 120	14.06	1 800	3 192	3 348
15	16.40	2 100	3 720	3 900	17.58	2 250	3 990	4 185
19	20.77	2 660	4 712	4 940	22.27	2 850	5 054	5 301
22	24.05	3 080	5 456	5 720	25.78	3 300	5 852	6 138
27	29.51	3 780	6 696	7 020	31.64	4 050	7 182	7 533
31	33.88	4 340	7 688	8 060	36.33	4 650	8 246	8 649
37	40.44	5 180	9 176	9 620	43.36	5 550	9 842	10 323
43	47.00	6 020	10 664	11 180	50.40	6 450	11 438	11 997
49	53.56	6 860	12 152	12 740	57.43	7 350	13 034	13 671
55	60.12	7 700	13 640	14 300	64.46	8 250	14 630	15 345

[1] Nominal mass of tendon
[2] Nominal cross-sectional area of tendon
[3] Characteristic maximum force of tendon

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Subject / type of control		Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Wedge plate, Anchor plate SD, Coupler plate R, Barrel chuck, Fitting bolt	Material	Checking [1]	[2]	100 %	continuous
	Detailed dimensions	Testing	[2]	5%, ≥ 2 specimens	continuous
	Visual inspection [3]	Checking	[2]	100 %	continuous
	Traceability	full			
Anchor body MA	Material	Checking [1]	[2]	100 %	continuous
	Detailed dimensions	Testing	[2]	3%, ≥ 2 specimens	continuous
	Visual inspection [3]	Checking	[2]	100 %	continuous
	Traceability	full			
Wedge	Material	Checking [1]	[2]	100 %	continuous
	Treatment, hardness	Testing	[2]	0.5 %, ≥ 2 specimens	continuous
	Detailed dimensions	Testing	[2]	5 %, ≥ 2 specimens	continuous
	Visual inspection [3]	Checking	[2]	100 %	continuous
	Traceability	full			
Prestressing steel strand	Material	Checking	[2], [4]	100 %	continuous
	Diameter	Testing	[2]	1 sample	each coil or every 7 tons [5]
	Visual inspection	Checking	[2]	1 sample	
Helix in plain round steel, EN 10025	Material	Checking [6]	[2]	100 %	continuous
	Visual inspection [3]	Checking	[2]	100 %	continuous
	Traceability	full			
Steel strip duct	Material	Checking [7]	[2]	100 %	continuous
	Dimension	Testing	[2]	3 %, ≥ 2 specimens	continuous
	Traceability	full			
Cement, Admixtures, Additions of filling materials as per EN 447	Material	Checking [7]	[2]	100 %	continuous
	Traceability	full			

[1] Checking by means of an inspection certificate 3.1 according to EN 10204.
[2] Conformity with the specifications of the components
[3] Successful visual inspection does not need to be documented.
[4] Checking of relevant certificate, as long as the basis of "CE"-marking is not available.
[5] Maximum between a coil and 7 tons is taken into account.
[6] Checking by means of at least a test report 2.2 according to EN 10204.
[7] Checking of relevant certificate, CE marking and declaration of performance or, if basis for CE marking is not available, certificate of supplier

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

Subject / type of control		Test or control method	Criteria, if any	Minimum number of samples [1)]	Minimum frequency of control
Wedge plate, Anchor plate SD, Coupler plate R, Barrel chuck, Fitting bolt	Material	Checking and testing, hardness and chemical [2)]	[3)]	1	1/year
	Detailed dimensions	Testing	[3)]	1	1/year
	Visual inspection	Checking	[3)]	1	1/year
Anchor body MA	Material	Checking and testing, hardness and chemical [2)]	[3)]	1	1/year
	Detailed dimensions	Testing	[3)]	1	1/year
	Visual inspection	Checking	[3)]	1	1/year
Wedge	Material	Checking and testing, hardness and chemical [2)]	[3)]	2	1/year
	Treatment, hardness	Checking and testing, hardness profile	[3)]	2	1/year
	Detailed dimensions	Testing	[3)]	1	1/year
	Main dimensions, surface hardness	Testing	[3)]	5	1/year
	Visual inspection	Checking	[3)]	5	1/year
Single tensile element test		According to EAD 160004-00-0301, Annex C.7		9	1/year

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

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

[3)] Conformity with the specifications of the components

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

Reference documents

European Assessment Documents

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

Eurocodes

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

Standards

EN 206+A1, 11.2016	Concrete – Specification, performance, production and conformity
EN 446, 10.2007	Grout for prestressing tendons – Grouting procedures
EN 447, 10.2007	Grout for prestressing tendons – Basic requirements
EN 523, 08.2003	Steel strip sheaths for prestressing tendons – Terminology, requirements, quality control
EN 1563, 08.2018	Founding – Spheroidal graphite cast irons
EN 10025-2, 08.2019	Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels
EN 10130, 12.2006	Cold-rolled low carbon steel flat products for cold forming – Technical delivery conditions
EN 10204, 10.2004	Metallic products – Types of inspection documents
EN 10277, 06.2018	Bright steel products – Technical delivery conditions
EN ISO 683-1, 06.2018	Heat-treatable steels, alloy steels and free-cutting steels – Part 1: Non-alloy steels for quenching and tempering
EN ISO 17855-1, 10.2014	Plastics – Polyethylene (PE) moulding and extrusion materials – Part 1: Designation system and basis for specifications
prEN 10138-3, 09.2000	Prestressing steels – Part 3: Strand
prEN 10138-3, 08.2009	Prestressing steels – Part 3: Strand
CWA 14646, 01.2003	Requirements for the installation of post-tensioning kits for prestressing of structures and qualification of the specialist company and its personnel

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Other documents

98/456/EC	Commission decision 98/456/EC of 3 July 1998 on the procedure for attesting the conformity of construction products pursuant to Article 20 (2) of Council Directive 89/106/EEC as regards posttensioning kits for the prestressing of structures, OJ L 201 of 17.07.1998, p. 112
305/2011	Regulation (EU) № 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, OJ L 088 of 04.04.2011, p. 5, amended by Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, OJ L 157 of 27.05.2014, p. 76, Commission Delegated Regulation (EU) № 574/2014 of 21 February 2014, OJ L 159 of 28.05.2014, p. 41, and Regulation (EU) 2019/1020 of the European Parliament and of the Council of 20 June 2019, OJ L 169 of 25.06.2019, p. 1
568/2014	Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014 amending Annex V to Regulation (EU) № 305/2011 of the European Parliament and of the Council as regards the assessment and verification of constancy of performance of construction products, OJ L 157 of 27.05.2014, p. 76