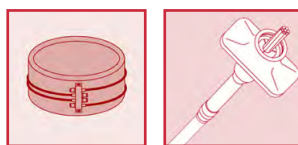


DYWIDAG 



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



POST-TENSIONING

**DYWIDAG single monostrand anchorage
for prestressing of structures with
one monostrand**

ETA-13/0814

29 January 2021



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European Technical Assessment

ETA-13/0814
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 single monostrand anchorage

Product family to which the construction product belongs

Unbonded post-tensioning kits for prestressing of structures with 1 monostrand

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This European Technical Assessment contains

28 pages including Annexes 1 to 9, which form an integral part of this assessment.

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This European Technical Assessment replaces

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Remarks

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Specific parts

1 Technical description of the product

1.1 General

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

DYWIDAG single monostrand anchorage,

comprising the following components.

– Tendon

Unbonded tendon with one single monostrand as tensile element

– Tensile element

7-wire prestressing steel strand with nominal diameters and nominal tensile strengths as given in Table 1, factory provided with a corrosion protection system, comprising corrosion protection filling material and PE-sheathing.

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/mm² = 1 MPa

– Anchorage

Monostrand anchored by 3-piece wedge

Stressing (active) and fixed (passive) anchor with wedge and anchor body 1072 for tendons with one single monostrand

¹ ETA-13/0814 was firstly issued in 2013 as European technical approval with validity from 25.06.2013, converted 2018 to European Technical Assessment ETA-13/0814 of 15.06.2018 and amended 2021 to European Technical Assessment ETA-13/0814 of 29.01.2021.

² Standards and other documents referred to in the European Technical Assessment are listed in Annex 9.

- Additional reinforcement in the anchorage zone
- Transition tube between anchor body 1072 and monostrand
- Permanent corrosion protection for tensile elements and anchorages

PT system

1.2 Designation and range of anchorages

1.2.1 Designation

The anchorage is designated by its function in the structure, the nominal diameter of the prestressing steel strand and the number of prestressing steel strands, i.e. one single prestressing steel strand. The first number indicates the nominal diameter of the prestressing steel strand, "78" = 15.3 mm (0.6 ") or 15.7 mm (0.62 "), followed by the maximum number of prestressing steel strands per unit "n", 78 n, i.e. 7801 for the DYWIDAG single monostrand anchorage.

1.2.2 Range

The PT system provides tendons with one single monostrand. The characteristic values of maximum force, F_{pk} , of the tendon are given in Annex 4.

1.2.3 Stressing anchor

The stressing anchor comprises the 1-piece anchor body 1072 with a circular disc for load transfer, one 3-piece wedge, a transition tube, and a grease cap, see Annex 1 and Annex 2. Anchor body 1072 serves for both in one piece, anchoring the prestressing steel strand and load transfer to the structural concrete. The additional reinforcement, see Annex 3, is placed and secured exactly centrally with regard to the anchor body 1072.

The transition tube is attached to the anchor body 1072. The monostrand is threaded into the anchor body 1072 through the transition tube, ensuring an overlap between monostrand sheathing and transition tube. Following stressing, the monostrand is anchored in anchor body 1072 by means of the wedge.

1.2.4 Fixed anchor

The fixed anchor comprises the same components as the stressing anchor.

The fixed anchor can either be assembled on the construction site like a stressing anchor or preassembled with the monostrand in the factory. For preassembled fixed anchor the monostrand is cut, observing the required length, and de-sheathed along a section suitable for anchor body 1072. The de-sheathed monostrand is threaded into the anchor body 1072 through the transition tube. An overlap between monostrand sheathing and transition tube is ensured. The wedge is inserted, the anchor body 1072 is filled with corrosion protection filling material, and the grease cap is attached.

In Annex 2 the stressing and fixed anchor is shown. Preassembled anchorages do not require access during stressing and can be embedded in concrete, observing a cover of concrete on the grease cap of at least 20 mm.

1.2.5 Centre and edge distances, concrete cover

The minimum centre and edge distances of tendon anchorages and the actual mean compressive strength of concrete at time of stressing $f_{cm,0}$, as given in Annex 3, are adopted. However, the centre and edge distances of anchorages may be reduced in one direction by up to 15 % but are not smaller than the outer diameter of the anchor body 1072 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 the same concrete area in the anchorage zone.

The concrete cover of the tendon is under no circumstances less than 20 mm nor less than the concrete cover of the reinforcement installed in the same cross section. The anchorage has a concrete cover of at least 20 mm on the grease cap. Standards and regulations on concrete cover in force in 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 full 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 3. 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 concrete compressive strength 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

Steel grade and dimensions of additional reinforcement specified in the Annex 3 are conformed to. The centric position of the additional reinforcement is secured by appropriate means.

If required for a specific project design, the reinforcement given in Annex 3 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 Tendon – Designation and range

The tendon is designated by the nominal diameter of the prestressing steel strand and the number of prestressing steel strands with 78n. The first number indicates the nominal diameter of the prestressing steel strand “78” = 15.3 mm (0.6 ") or 15.7 mm (0.62 "), followed by the number "n" of prestressing steel strands, i.e., 7801 for the DYWIDAG single monostrand anchorage.

The PT system provides tendons with one single monostrand. Only 7-wire prestressing steel strands with nominal diameters of 15.3 mm or 15.7 mm and nominal tensile strengths of 1 770 N/mm² or 1 860 N/mm² are used. The dimensions and specifications of the prestressing steel strands are given in Table 1 and Annex 4.

Characteristic values of maximum force, F_{pk} , of the tendon are given in Annex 4.

1.4 Maximum stressing forces

Prestressing and overstressing forces are specified in the respective standards and regulations in force at the place of use. Annex 4 lists the maximum prestressing and overstressing forces of the tendons according to Eurocode 2, i.e., the maximum prestressing force applied to a tendon does not exceed $P_{max} = 0.90 \cdot A_p \cdot f_{p0.1}$. Overstressing with $P_{max, o} = 0.95 \cdot A_p \cdot f_{p0.1}$ is only permitted if the force in the 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 mm².....Cross-sectional area of prestressing steel, i.e. $A_p = n \cdot S_n$

$f_{p0.1}$ N/mm².....Characteristic 0.1 % proof stress of prestressing steel, i.e. $F_{p0.1} = f_{p0.1} \cdot S_n$

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

S_n mm².....Nominal cross-sectional area of one single prestressing steel strand, see Annex 4

$F_{p0.1}$kNCharacteristic value of 0.1 % proof force, see Annex 4
 P_{m0}kNInitial prestressing force immediately after stressing and anchoring

1.5 Slip at anchorages

Slip at anchorages is taken into consideration in design and for determining tendon elongation. In Table 2 slip taken into account for determination of elongation during stressing and of prestressing force and the required locking measures of the wedge are specified. While the slip at the fixed anchor only is considered for calculation of elongation, the slip at the stressing anchor mainly occurs at the load transfer from jack to anchorage and is considered for calculation of the prestressing force.

Table 2 Slip values and locking of wedges

Anchorage	Slip	Locking measures
—	mm	—
Slip at stressing anchor ¹⁾	6 ²⁾	—
Slip at fixed anchor	6	Grease cap

¹⁾ Slip at transfer of prestressing force from jack to anchorage.
²⁾ Slip is 3 mm with power-seating of ~ 20 kN per prestressing steel strand. This requires a special jack, its availability requires coordination with the ETA holder.

1.6 Friction losses

The tendon layout should not feature abrupt changes of the tendon axis, since this may lead to significant additional friction losses. Due to the corrosion protection filling material within the PE-sheathing of monostrands, the friction coefficient μ is very low. 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_xkNPrestressing force at distance x from the stressing anchor along the tendon
 P_0kNPrestressing force at the distance x = 0 m
 μ rad⁻¹.....Friction coefficient, $\mu = 0.06 \text{ rad}^{-1}$
 α rad.....Sum of angular deviations over a distance x, irrespective of direction and sign
 k rad/m.....Wobble coefficient, $k = 0.9 \cdot 10^{-2} \text{ rad/m} (= 0.5 \text{ }^\circ/\text{m})$
 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

Friction losses in the anchorages are low and are not taken into consideration in design and execution.

1.7 Support of monostrands

Monostrands are installed with high accuracy and secured in their position. Spacing of tendon support is.

- 1 Normally ≤ 1.00 m

For radius of curvature in normal cases, see Clause 1.8.

- 2 Free tendon layout, see Annex 6, in maximum 45 cm thick slabs

In the transition zone between

- a) high tendon position and anchorage, e.g. cantilever 1.50 m
- b) low and high tendon position or low tendon position and anchorage 3.00 m

At high and low tendon position, the tendons are connected in an appropriate way to the rebar mesh, at least at two points with a spacing of 0.3 m to 1.0 m. The rebar mesh is fastened in its position. Special spacers for tendons are therefore not required. For details see Annex 6.

1.8 Radii of curvature

The minimum allowable radius of curvature for internal tendons with prestressing steel strands of nominal diameters of 15.3 mm and 15.7 mm is 2.5 m. If this radius is adhered to, verification of prestressing steel outer fibre stresses in curvatures is not required. The minimum radius of curvature in the anchorage zone outside the transition tube is 3.5 m.

Components

1.9 Monostrand

1.9.1 Specification of prestressing steel strand

7-wire prestressing steel strands with plain surfaces of the individual wires, nominal diameters of 15.3 mm or 15.7 mm, and tensile strengths of 1 770 N/mm² or 1 860 N/mm² are used. Dimensions and specifications of the prestressing steel strands are according to prEN 10138-3 and are given in Clause 1.1, Table 1, and Annex 4.

1.9.2 Specification of monostrand

The tendon for DYWIDAG single monostrand anchorage comprises one single monostrand with a 7-wire prestressing steel strand according to Clause 1.9.1, factory provided with a corrosion protection system comprising a corrosion protection filling material and a PE-sheathing, see Clause 1.11.

Within one structure, prestressing steel strands with one nominal diameter and one characteristic tensile strength should be used. If tendons with prestressing steel strands different in diameter and tensile strength are to be installed, appropriate measures to prevent confusion are implemented.

In the course of preparing the European Technical Assessment, no characteristic has been assessed for the monostrand. In execution, a suitable monostrand that conforms to Annex 4 and is according to the standards and regulations in force at the place of use is taken.

Table 3 Monostrand

7-wire prestressing steel strand, see Annex 4	—	Y1770S7 ¹⁾		Y1860S7 ¹⁾	
Nominal diameter	mm	15.3 ²⁾	15.7 ³⁾	15.3 ²⁾	15.7 ³⁾
Nominal cross-sectional area	mm ²	140	150	140	150
Characteristic tensile strength	N/mm ²	1 770		1 860	
0.1 % proof force ⁴⁾	kN	218	234	229	246
Nominal mass of prestressing steel	kg/m	1.09	1.17	1.09	1.17
Monostrand					
External diameter of monostrand	mm	≥ 20		≥ 19.5	
Mass of monostrand	kg/m	1.20	1.30	1.20	1.30

1) Designation according to prEN 10138-3

2) Corresponding to 0.6 inches

3) Corresponding to 0.62 inches

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

1.10 Anchorage components

1.10.1 General

Specification of anchorage components are given in the Annexes and the technical file³ 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 diameters of 15.3 mm and 15.7 mm and with nominal tensile strengths of 1 860 MPa and 1 770 MPa the same anchorages are used.

1.10.2 Anchor body 1072

The anchor body 1072 is forged of steel with a circular disc as load transfer plane and a bore for anchoring the prestressing steel strand, see Annex 1. The bore provides a conical end at one side for bearing the wedge. Anchor body 1072 is employed for stressing and fixed anchors.

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

1.10.3 Transition tube

The transition tube is a precision steel tube, which is connected to the anchor body 1072 by cold forming. It secures the transition from monostrand to anchorage, see Annex 2.

1.10.4 Wedges

Only 3-piece wedges according to Annex 1 are used. The wedges feature different lengths for the respective nominal diameters of the prestressing steel strand. Wedge dimensions and teeth geometry are specified with reference to nominal diameter of the prestressing steel strand, 15.3 mm or 15.7 mm, in Annex 1.

1.10.5 Additional reinforcement

The steel grades and dimensions of the additional reinforcement are in conformity with the specifications given in Annex 3.

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

- Protection of tensile elements and other components from moisture.
- Keeping tensile elements away from zones where welding operations are performed.

2.2.3 Design

Advice on design includes.

- Design of the structure permits correct installation and stressing of tendon and design and reinforcement of the anchorage zone permits correct placing and compacting of concrete.
- Verification of transfer of stressing forces to the structural concrete is not required if the centre and edge distances of the tendons, strength of concrete, as well as grade and dimensions of the additional reinforcement, see Clause 1.2.7 and Annex 3, are conformed to. Additional reinforcement is of closed stirrups or properly anchored orthogonal reinforcement. The forces outside the area of the 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.
- The anchorage recess is designed so as to ensure a concrete cover of at least 20 mm at the caps in the final stage.
- Bursting out of prestressing steels in case of failure is prevented. Sufficient protection is provided by e.g. a cover of reinforced concrete.
- The initial prestressing force applied to the stressing anchor will decrease especially as a result of slip, see Clause 1.5, friction along the tendon, see Clause 1.6, 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.

2.2.4 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 the unbonded prestressing system DYWIDAG single monostrand anchorage, 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 unbonded prestressing system DYWIDAG single monostrand anchorage.

2.2.4.2 De-sheathing of monostrands

The length along which the monostrand sheathing is removed is determined by the PT specialist company depending on the expected variations in temperature between installation and concreting. The monostrand sheathing overlaps the transition tube but does not press against the anchorage. This is checked by the application of markings before concreting.

2.2.4.3 Anchor body 1072

2.2.4.3.1 General

Anchor body 1072 is a 1-piece anchor body with a transition tube jointed by cold forming. The anchorage is applied as stressing anchor, as accessible fixed anchor, and as inaccessible fixed anchor. For an inaccessible fixed anchor, the grease cap secures the wedge seating. At final stage the voids in anchorage and transition tube are completely filled with corrosion protection filling material. The monostrand sheathing overlaps the transition tube by at least

80 mm and does not press against the anchorage. This is checked by application of markings before concreting.

The centric position of the additional reinforcement is secured by tying or by means of spacers braced against the tendon.

Anchor body 1072 is installed perpendicular to the tendon's axis. Adjacent to the transition tube the tendon continues with a straight section over a length of at least 125 mm.

2.2.4.3.2 Stressing anchor

The anchor body 1072 is fastened to the formwork on site and connected to the monostrand.

Site assembly comprises the following steps.

- Fastening the anchor body 1072 with assembled transition tube and with pocket element and retaining spindle pushed through the hole in the formwork.
- Placing the monostrand against the anchorage to mark the cutting point and overlapping length on the PE-sheathing.
- Cutting and pulling off the PE-sheathing of the monostrand in the anchorage zone.
- Inserting the monostrand through transition tube and anchor body 1072.
- Check of overlapping length between PE-sheathing and transition tube, filling of transition tube with corrosion protection filling material and sealing of respective transition joint.
- Placing the previously removed PE-sheathing onto the end of the prestressing steel strand in order to protect the prestressing steel strand protrusion.

For prefabricated tendons the first step is done later on site. The other steps are carried out in identical order and the prefabricated tendon is prepared, e.g. coiled, for transport.

2.2.4.3.3 Fixed anchor

The fixed anchors are also either prefabricated or assembled and installed at the construction site. In case of inaccessible fixed anchors, it additionally comprises the mounting of grease cap before or at tendon installation for securing the wedge.

The fixed anchor usually is assembled in the factory. Factory assembly comprises the following steps.

- Placing the wedge into the conical bore of the anchor body 1072.
- Filling in a measured quantity of corrosion protection filling material.
- Screwing on the grease cap filled with corrosion protection filling material.
- Removing a 5 to 6 cm long piece of the PE-sheathing from the monostrand.
- Inserting the de-sheathed monostrand through the transition tube, observing the overlapping length.
- Wiping off the corrosion protection filling material that has leaked from the transition tube and sealing the joint monostrand to transition tube.
- Cutting the monostrand from the coil, ensuring the correct length.

2.2.4.4 Examination of tendons and possible repairs of the corrosion protection system

During installation careful handling of tendons is ensured. Before concreting the PT site manager carries out a final examination of the installed tendons. Damages to PE-sheathings, which cause or may cause leaking of corrosion protection filling material, are repaired. Repair is in accordance with the respective load requirements and suitable for operating temperatures up to 30 °C.

2.2.5 Stressing and stressing records

2.2.5.1 Stressing

With a mean concrete compressive strength in the anchorage zone, $f_{cm,0}$, according to the specifications in Annex 3, full prestressing may be applied.

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.

Prestressing comprises the following steps.

- Removing the PE protective sheathing from the prestressing steel strand protrusion.
- Filling the void in the anchorage with corrosion protection filling material using a thin injection lance.
- Placing the wedge into the conical bore of the stressing anchor.
- Stressing with prestressing jack.
- Cutting off the prestressing steel strand protrusion with a cutting disk or cutting tool.
- Screwing on the grease cap filled with corrosion protection filling material.
- Filling the anchorage recess with concrete.

2.2.5.2 Restressing

Restressing of tendons before final cutting of prestressing steel strand protrusions in combination with release and reuse of the wedge is permitted. After restressing, the wedge bites into a least 15 mm of virgin prestressing steel strand surface and no wedge marks remain on the tendon between the anchorages.

2.2.5.3 Stressing records

Any important observations made during stressing operation, in particular prestressing forces applied and elongation measures, are recorded in a stressing record for each tendon.

2.2.5.4 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. Special jack with power-seating mechanism for reduced slip at the stressing anchor requires coordination with the ETA holder for timely availability.

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

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

2.2.6 Welding at anchorages

Welding is not intended, and it is not permitted to weld on built-in components of the PT systems.

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

2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of DYWIDAG single monostrand anchorage of 100 years, provided that DYWIDAG single monostrand anchorage is subject to appropriate installation, use, and maintenance, see Clause 2.2.

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

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

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

3.1 Essential characteristics

The performances of DYWIDAG single monostrand anchorage for the essential characteristics are given in Table 4.

Table 4 Essential characteristics and performances of the product

No	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 unbonded tendon	See Clause 3.2.1.5.
6	Assessment of assembly	See Clause 3.2.1.6.
7	Corrosion protection	See Clause 3.2.1.7.
Basic requirement for construction works 2: Safety in case of fire		
8	Reaction to fire	See Clause 3.2.2.1.
Basic requirement for construction works 3: Hygiene, health, and the environment		
9	Content, emission, and/or release of dangerous substances	See Clause 3.2.3.1.

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

No	Essential characteristic	Product performance
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 4 are listed in Annex 4.

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 4 are listed in Annex 4.

Fatigue resistance of anchorages 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 4 are listed in Annex 4.

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 1.6.

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

For minimum radii of curvature see Clause 1.8.

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 single monostrand anchorage, 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 2, Internal unbonded tendon.

3.4 Identification

The European Technical Assessment for DYWIDAG single monostrand anchorage is issued on the basis of agreed data that identify the assessed product⁵. 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.

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 single monostrand anchorage 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;

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

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

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

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

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

5.1 Tasks for the manufacturer

5.1.1 Factory production control

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

- Control of the incoming materials

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

- Inspection and testing

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

- Definition of the number of samples taken by the kit manufacturer
- Material properties e.g. tensile strength, hardness, surface finish, chemical composition, etc.
- Determination of the dimensions of components
- 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 7, conform to

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.

EAD 160004-00-0301, Table 3, and are specified in the quality management plan of the DYWIDAG single monostrand anchorage.

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

- Control of non-conforming products

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

- Complaints

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

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

At least once a year the manufacturer audits the manufacturers of the components given in Annex 8.

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 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 8 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 request 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

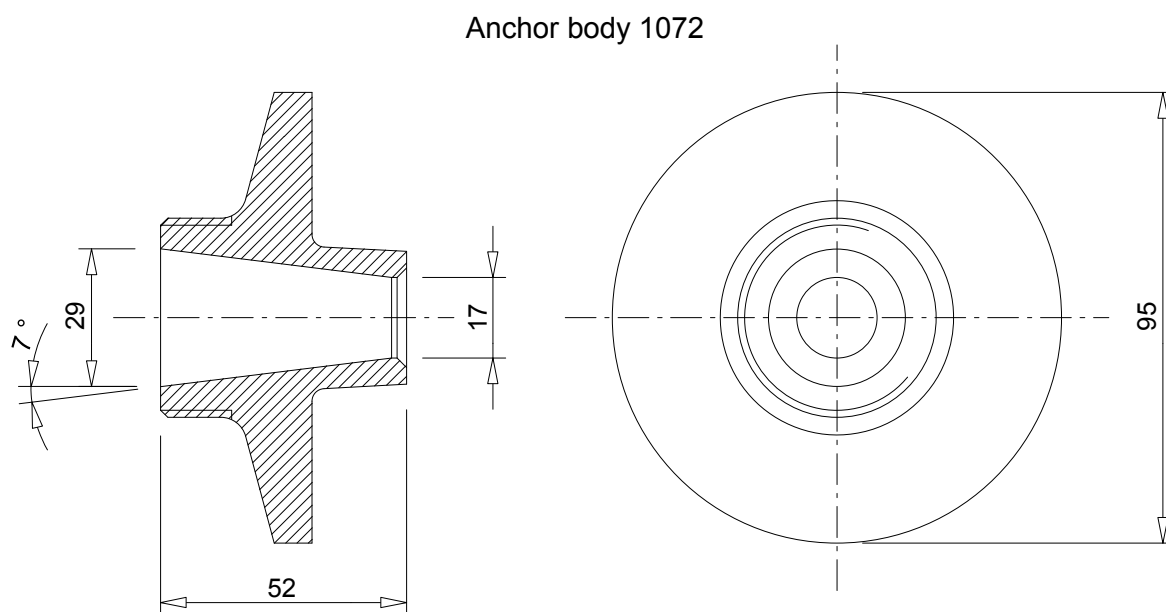
5.2.3 Audit-testing of samples taken by the notified product certification body at the manufacturing plant or at the manufacturer's storage facilities

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 8 summarises the minimum procedures. Annex 8 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.

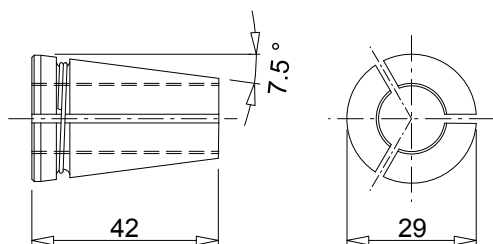
Issued in Vienna on 29 January 2021
by Österreichisches Institut für Bautechnik

The original document is signed by

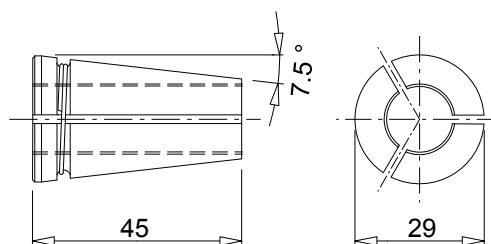
Rainer Mikulits
Managing Director



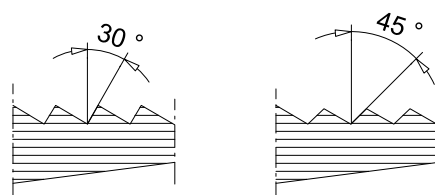
Wedge for strand \varnothing 15.3 mm



Wedge for strand \varnothing 15.7 mm



Wedge tooth geometry for both wedge sizes



Dimensions in mm

Overview of tendons and maximum prestressing forces

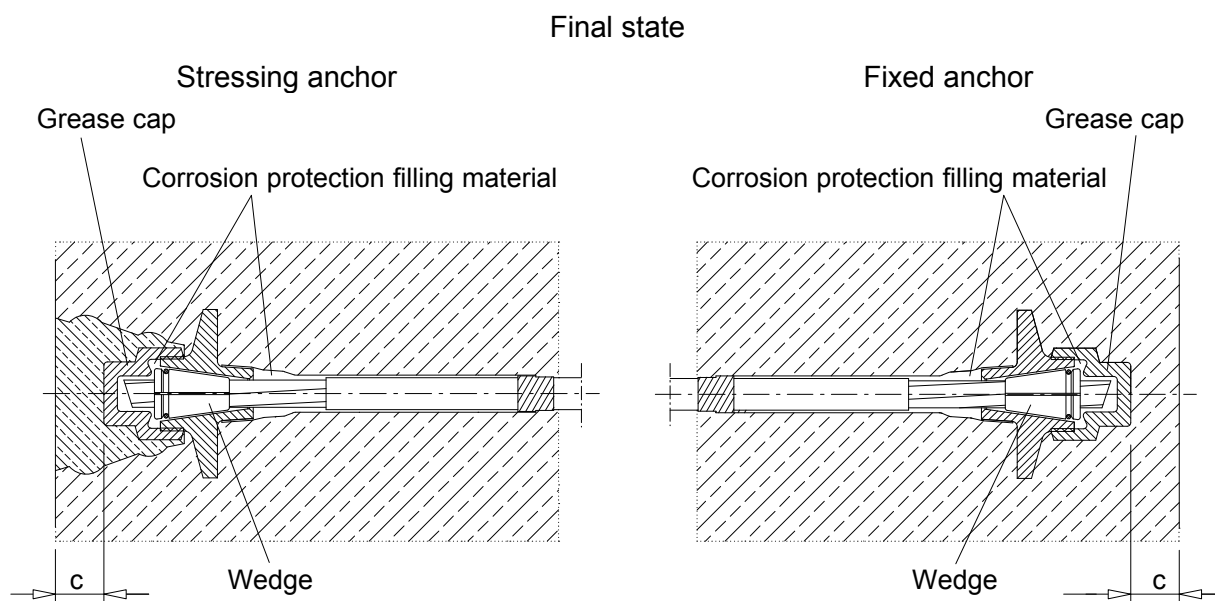
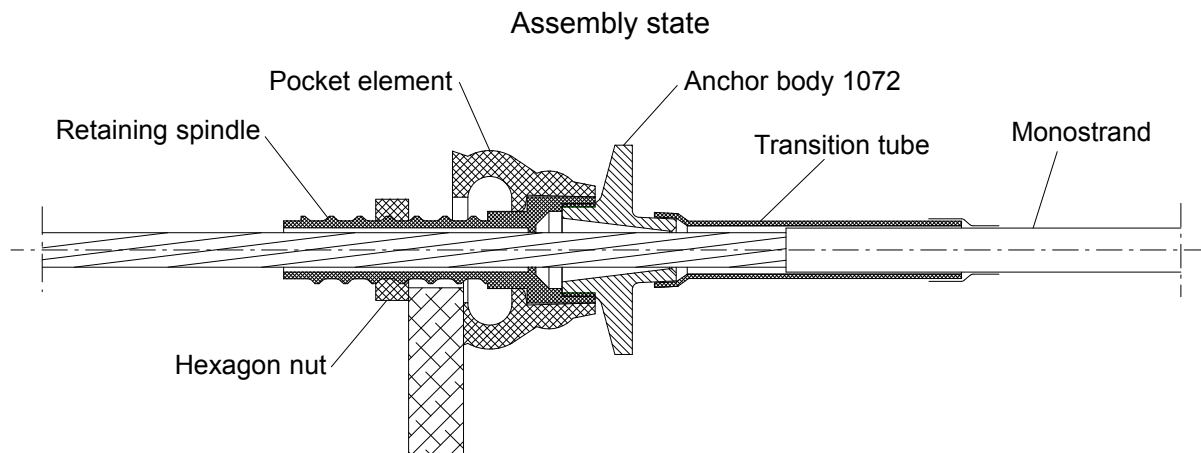
Cross-sectional area of strand		140 mm ²		150 mm ²	
		N/mm ²	1 770	1 860	1 770
Tensile strength	N/mm ²	1 770	1 860	1 770	1 860
Maximum prestressing force at $0.9 \cdot F_{p0.1}$ ¹⁾	kN	196	206	211	221

¹⁾ For prestressing steel strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.

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DYWIDAG Single Monostrand Anchorage
Basic components

Annex 1
of European Technical Assessment
ETA-13/0814 of 29.01.2021



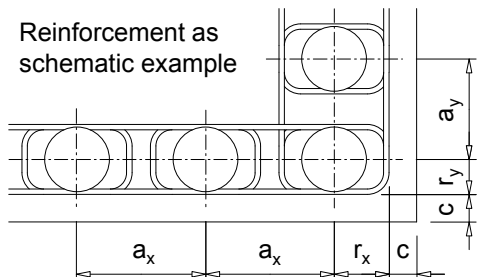
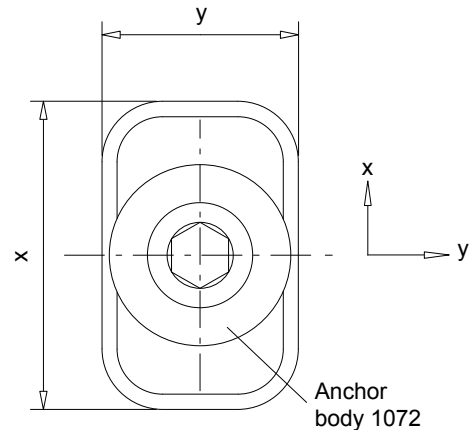
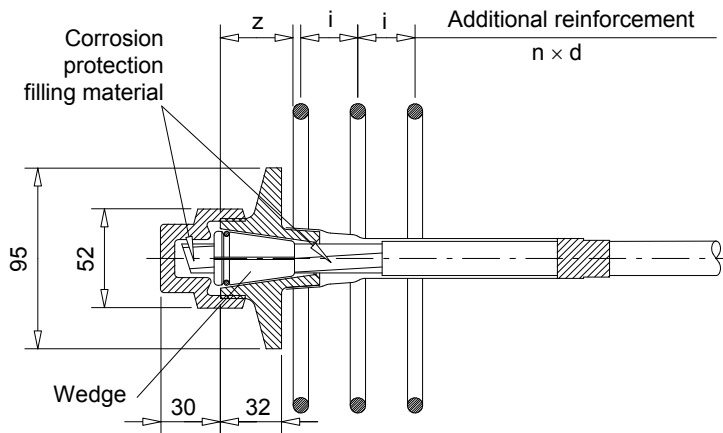
c...Concrete cover

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**DYWIDAG Single Monostrand
 Anchorage**
 Tendon 7801
 Stressing and fixed anchor

Annex 2
 of European Technical Assessment
ETA-13/0814 of 29.01.2021

Additional reinforcement



Minimum edge distance $\begin{cases} r_x + c \\ r_y + c \end{cases}$
Concrete cover c

Nominal cross-sectional area of prestressing steel strand	mm ²	140		150	
Nominal tensile strength of prestressing steel strand	N/mm ²	1770	1860	1770	1860
Minimum concrete compressive strength at time of stressing	$f_{cm, 0, cube}$ $f_{cm, 0, cylinder}$	39 31			
Centre distance	a_x	130	130	135	140
	a_y	105	110	110	110
Edge distance, plus c	r_x	55	55	60	60
	r_y	45	45	45	45
Additional reinforcement, Ribbed reinforcing steel, $R_e \geq 500$ N/mm ²	n	—	3	3	3
	d	mm	8	8	8
	z	mm	40	40	40
	i	mm	30	30	30
	x	mm	110	110	115
	y	mm	85	90	90

Dimensions in mm

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DYWIDAG Single Monostrand Anchorage
Tendon 7801
Centre and edge distances

Annex 3
of European Technical Assessment
ETA-13/0814 of 29.01.2021

Maximum prestressing and overstressing forces

Number of strands	Mass of mono-strand	Cross-sectional area of strands	$f_{pk} = 1\,770\text{ N/mm}^2$ $f_{p0.1} = 1\,560\text{ N/mm}^2$		$f_{pk} = 1\,860\text{ N/mm}^2$ $f_{p0.1} = 1\,640\text{ N/mm}^2$	
			Maximum prestressing force ¹⁾	Maximum overstressing force ¹⁾	Maximum prestressing force ¹⁾	Maximum overstressing force ¹⁾
—	kg/m	A_p mm ²	$0.90 \cdot A_p \cdot f_{p0.1}$ kN	$0.95 \cdot A_p \cdot f_{p0.1}$ kN	$0.90 \cdot A_p \cdot f_{p0.1}$ kN	$0.95 \cdot A_p \cdot f_{p0.1}$ kN
01	1.22	140	196	207	206	218
01	1.30	150	211	222	221	234

¹⁾ For strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.

$0.90 \cdot A_p \cdot f_{p0.1} = 0.90 \cdot F_{p0.1}$ Maximum prestressing force

$0.95 \cdot A_p \cdot f_{p0.1} = 0.95 \cdot F_{p0.1}$ Maximum overstressing force

For $F_{p0.1} = A_p \cdot f_{p0.1}$ see Table below.

Prestressing steel strand

Characteristic	Symbol	Unit	Y1770S7		Y1860S7	
			15.3	15.7	15.3	15.7
Tensile strength	R_m, f_{pk}	N/mm ²	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 of prestressing steel	M	g/m	1 093	1 172	1 093	1 172
Allowable deviation from nominal mass	—	%	± 2			
Nominal cross-sectional area	A_p, S_n	mm ²	140	150	140	150
Characteristic value of maximum force	F_{pk}	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, $L_0 \geq 500\text{ mm}$	A_{gt}	%	3.5			
Modulus of elasticity	E	N/mm ²	195 000 ²⁾			
Relaxation after 1 000 h, for an initial force of	$0.70 \cdot F_{ma}$	%	≤ 2.5			
	$0.80 \cdot F_{ma}$	%	≤ 4.5			

¹⁾ For prestressing steel strands according to prEN 10138-3, 09.2000, the values are multiplied by 0.98.

²⁾ Standard value



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DYWIDAG Single Monostrand Anchorage

Tendon 7801 – Maximum prestressing and overstressing forces – Specifications of 7-wire prestressing steel strands

Annex 4
of European Technical Assessment
ETA-13/0814 of 29.01.2021

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Designation	Standard	Material ¹⁾
Wedge	EN 10277	Steel
Anchor body 1072	EN ISO 683-1	Steel
Transition tube	EN 10305-1	Steel
Additional reinforcement	Ribbed reinforcing steel, $R_e \geq 500 \text{ N/mm}^2$	
Grease cap	EN ISO 17855-1	PE-HD

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

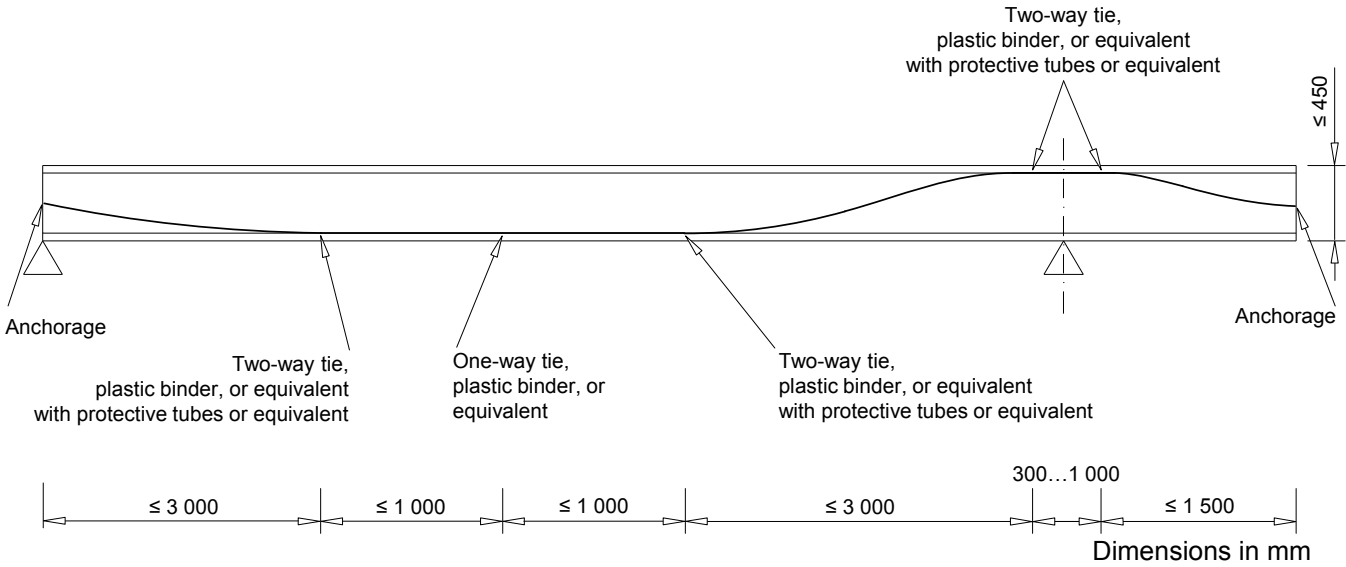


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DYWIDAG Single Monostrand Anchorage
 Material specifications

Annex 5
 of European Technical Assessment
ETA-13/0814 of 29.01.2021

Free tendon layout, plate thickness ≤ 450 mm



- 1 Installing the bottom layer of reinforcement on spacers
- 2 Installing the tendon anchorages, fastened onto the framework
- 3 Placing the tendons on the lower reinforcement and on spacers for high tendon position
- 4 Cutting the monostrand to the required length and de-sheathing the ends
- 5 Inserting the tendons through the anchorages
- 6 Installing the spacers for the top layer of reinforcement
- 7 Placing protective tubes (e.g. cut PE-sheathings) in the region of the connections with the reinforcement for protection of the tendons
- 8 Installing the upper reinforcement
- 9 Lifting up and connecting the tendons to the upper reinforcement
- 10 Connecting the tendons with the lower reinforcement
- 11 Connecting and sealing the tendons with tape at the transition tubes of the anchorages
- 12 Checking correct seat of anchorages and of transition tubes before concreting

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Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Anchor body 1072	Material	Checking ¹⁾	²⁾	100 %	continuous
	Detailed dimensions	Testing	²⁾	5 %, ≥ 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			
Monostrand	Material	Checking	^{2), 4)}	100 %	continuous
	Diameter	Testing	^{2), 4)}	1 sample	each coil or every 7 tons ⁵⁾
	Visual inspection ³⁾	Checking	^{2), 4)}	1 sample	

- 1) Checking by means of an inspection certificate 3.1 according to EN 10204.
- 2) Conformity with the specifications of the component
- 3) Successful visual inspection does not need to be documented.
- 4) Checking of relevant certificate as long as the basis of "CE"-marking is not available.
- 5) Maximum between a coil and 7 tons is taken into account

Traceability full Full traceability of each component to its raw material.
 Material Defined according to technical specification deposited by the supplier
 Detailed 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



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DYWIDAG Single Monostrand Anchorage
 Contents of the prescribed test plan

Annex 7
 of European Technical Assessment
ETA-13/0814 of 29.01.2021

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Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Anchor body 1072	Material	Checking and testing, hardness and chemical ¹⁾	2)	1	1/year
	Detailed dimensions	Testing	2)	1	1/year
	Visual inspection	Checking	2)	1	1/year
Wedge	Material	Checking and testing, hardness and chemical ¹⁾	2)	2	1/year
	Treatment, hardness	Checking and testing, hardness profile	2)	2	1/year
	Detailed dimensions	Testing	2)	1	1/year
	Main dimensions, surface hardness	Testing	2)	5	1/year
	Visual inspection	Checking	2)	5	1/year
Single tensile element test		According to EAD 160004-00-0301, Annex C.7		9	1/year

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

2) Conformity with the specifications of the component

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



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DYWIDAG Single Monostrand Anchorage
Audit testing

Annex 8
of European Technical Assessment
ETA-13/0814 of 29.01.2021

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European Assessment Document

EAD 160004-00-0301 Post-Tensioning Kits for Prestressing of Structures

Standards

Eurocode 2	Eurocode 2 – Design of concrete structures
EN 206+A1 (11.2016)	Concrete – Specification, performance, production and conformity
EN 10204 (10.2004)	Metallic products – Types of inspection documents
EN 10277 (06.2018)	Bright steel products - Technical delivery conditions
EN 10305-1 (03.2016)	Steel tubes for precision applications - Technical delivery conditions - Part 1: Seamless cold drawn tubes
prEN 10138-3 (08.2009)	Prestressing steels – Part 3: Strands
prEN 10138-3 (09.2000)	Prestressing steels – Part 3: Strands
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
CWA 14646 (01.2003)	Requirements for the installation of post-tensioning kits for prestressing of structures and qualification of the specialist company and its personnel

Other documents

98/456/EC	Commission decision 98/456/EC of 3 July 1998 on the procedure for attesting the conformity of construction products pursuant to Article 20 (2) of Council Directive 89/106/EEC as regards posttensioning kits for the prestressing of structures, 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



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DYWIDAG Single Monostrand Anchorage
Reference documents

Annex 9
of European Technical Assessment
ETA-13/0814 of 29.01.2021

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