DYWIDAG

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POST-TENSIONING

Multistrand PT System for Bonded Application with 1 to 22 strands

ETA-13/0839

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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	SUSPA Strand DW
Product family to which the construction product belongs	Bonded post-tensioning kit for prestressing of structures with 1 to 22 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 Sp. z o.o. ul. Hallera 78 41-709 Ruda Śląska Poland
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Remarks

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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

SUSPA Strand DW,

comprising the following components.

– Tendon

Bonded tendon with 1 to 22 tensile elements

– Tensile element

7-wire prestressing steel strand with nominal diameter 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/mm²
15.7	0.62	Y1770S7	1 770
15.7	0.62	Y1860S7	1 860

NOTE 1 N/mm² = 1 MPa

– Anchorage

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

Stressing (active) and fixed (passive) anchor with wedges, anchor head E, and multi-plane anchor body MA for tendons with 5 to 22 prestressing steel strands

Stressing (active) and fixed (passive) anchor with wedges, anchor head E, and anchor plate E for tendons with 3 to 22 prestressing steel strands

Fixed (passive) anchor with compression fittings, anchor head EP, and multi-plane anchor body MA for tendons with 5 to 22 prestressing steel strands

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1 ETA-13/0839 was firstly issued in 2013 as European technical approval with validity from 25.06.2013, converted 2017 to European Technical Assessment ETA-13/0839 of 11.12.2017, and amended 2021 to European Technical Assessment ETA-13/0839 of 30.03.2021.

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

Fixed (passive) anchor with compression fittings, anchor head EP, and anchor plate E for tendons with 3 to 22 prestressing steel strands

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

Stressing (active) and fixed (passive) anchor with wedges, and anchor SK6 for tendons with one single prestressing steel strand

- Coupler

  Prestressing steel strand anchored by either 3-piece wedge or compression fitting

  Fixed coupler with wedges, compression fittings, coupler head K, and multi-plane anchor body MA for tendons with 7 to 22 prestressing steel strands

  Fixed coupler with wedges, compression fittings, coupler head K, and anchor plate E for tendons with 3 to 22 prestressing steel strands

  Movable coupler with compression fittings and coupler head V for tendons with 3 to 22 prestressing steel strands

  Movable coupler with wedges and 2 coupler barrels K6 for tendons with one single prestressing steel strand

- Floating block anchorage Z with wedges and anchor head Z for tendons with 2 to 8 prestressing steel strands
- Helix and additional reinforcement or only additional reinforcement without helix in the anchorage zone.
- Ducts.
- Permanent corrosion protection for tensile elements, anchorages, 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 prestressing steel strands. The first number indicates the nominal diameter of the prestressing steel strand, “6” = 15.7 mm (0.62 "), followed by the maximum number of prestressing steel strands per unit “n”, 6-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 – Combinations of components for different use categories

Components	**Number of strands** [1)]
Anchorage	
Anchor head E with anchor body MA	5 7 9 12 15 19 22
Anchor head EP with anchor body MA	5 7 9 12 15 19 22
Anchor head E with anchor plate E	3 4 5 7 9 12 15 19 22
Anchor head EP with anchor plate E	3 4 5 7 9 12 15 19 22
Bond anchorage H	3 4 5 7 9 12 15 19 22
Anchor head SK 6	1

Components	Number of strands [1)]
Coupler	
Fixed coupler with coupler head K and anchor body MA	7 9 12 15 19 22
Fixed coupler with coupler head K and anchor plate E	3 4 7 9 12 15 19 22
Movable coupler with coupler head V	3 4 7 9 12 15 19 22
Movable coupler K6-K6	1
Floating block anchorage with anchor head Z	2 4 6 8

NOTES

[1)] Except for floating block anchorage, one or more prestressing steel strands may be omitting 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 tendons sizes are listed in Table 2. The characteristic values of maximum force of tendons are given in Annex 5 and Annex 6.

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 anchor head or coupler head do not need to be drilled. Alternatively, at anchor head E and coupler head K a short length of prestressing steel strand with a wedge is pressed in. The respective bores in anchor head EP and coupler head V may be left void. For coupler heads K and V, the slots of the projecting ring collar may be equally redistributed. However, overall dimensions of anchor head and coupler head are unchanged in any case.

Moreover, each anchor 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 anchor und coupler. This is obtained by an appropriate arrangement of the prestressing steel stands in anchor head and coupler head.

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 strands.

Omitting of prestressing steel strands in a tendon with floating block anchorage Z is impossible.

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 anchor head E or anchor SK6 by means of a 3-piece wedge. All prestressing steel strands of the bundle tendon are stressed at the same time.

In the fixed anchor, the prestressing steel strands are anchored by means of wedges in anchor head E and anchor SK6, or by means of compression fittings in anchor head EP, 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 anchor head E

The stressing anchor comprises wedges, an anchor head E, and an anchor body MA or an anchor plate E, see Annex 1, Annex 9, Annex 10, Annex 11, Annex 21, Annex 23, and Annex 24. The trumpet is arranged between anchor body MA or anchor plate E and the duct, and in general is surrounded by a helix. The helix, if present, is centrically aligned to anchor body MA or anchor plate E and fastened in its position. If required, the free end of the helix is fastened to the additional reinforcement. Anchor with anchor body MA can be installed without or with helix, while anchor with anchor plate E is always with helix. The duct is inserted into the trumpet or screwed thereon. The anchor head E is slipped over the prestressing steel strands before stressing.

Both anchors, anchor with anchor body MA and anchor with anchor plate E can be installed with 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.

1.2.3.3 Fixed anchor with anchor head EP

The fixed anchor comprises compression fittings, a retainer plate, an anchor head EP and an anchor body MA or an anchor plate E, see Annex 1, Annex 9, and Annex 21. The assembly corresponds to the stressing anchor with anchor head E but instead of wedges, the prestressing steel strands are anchored by compression fittings. The compression fittings are locked by means of a retainer plate. For this anchorage, access does not need to be provided during stressing, therefore, it can be embedded in concrete.

Same as for the stressing anchor, the fixed anchor with anchor body MA can be installed without or with helix and fixed anchor with anchor plate E is always with helix.

1.2.3.4 Anchorage with anchor body MA

Anchor body MA transfers the tendon force by several load transfer planes – multi-plane anchor body MA – into the structural concrete, see Annex 9, Annex 10, and Annex 11.

The anchor heads E and EP and the coupler head K, see Annex 2 and Annex 12, with corresponding wedges and compression fittings can be used with anchor body MA. The anchor body MA is used within a stressing anchor as well as a fixed anchor. Anchorage with multi-plane anchor body MA can be installed even without helix, see Annex 10.

1.2.3.5 Anchorage with anchor plate E

Different to anchor body MA there is only one single load transfer plane with anchor plate E. Anchor plate E always is accompanied by a helix, see Annex 1, Annex 21, Annex 23, and Annex 24. Applications with anchor plate E require preceding consultations of the ETA holder to confirm availability.

Anchor heads E and EP and coupler head K, see Annex 12, with corresponding wedges and compression fittings can be used with anchor plate E. Anchor plate E is used within a stressing anchor as well as a fixed anchor.

1.2.3.6 Bond anchorages H – HL and HR

The bond anchorage H anchors the prestressing steel strands by bond of the prestressing steel strands and in particular with bond heads to the structural concrete. Therefore, it can only be used as a fixed anchor, embedded in concrete. Beside bond heads it comprises a ring, a helix, and spacers for creating the intended strand layout, see Annex 1 and Annex 13. The prestressing steel strands used in this anchorage do not receive any surface treatment, including no temporary corrosion protection, neither from the manufacturing plant nor on site.

1.2.3.7 Stressing and fixed single prestressing steel strand anchor SK6

The single prestressing steel strand anchor SK6 comprises a wedge and anchor SK6, see Annex 1, Annex 17, Annex 18, and Annex 19. With this anchorage only one single prestressing steel strand is anchored. The stressing anchor is fastened to the formwork on site and connected to the prestressing steel strand. The fixed anchor does not need access during stressing, therefore it can be embedded in concrete. In this case it is installed with a spring and locked by a venting cap to secure the wedge seating. A PE-sleeve connects the anchor to the duct. The additional reinforcement is aligned and fastened centrically to anchor SK6, PE-sleeve and duct.

Anchor SK6 serves for both in one piece, anchoring the prestressing steel strand and load transfer to the structural concrete.

1.2.4 Coupler

1.2.4.1 General

The fixed coupler connects a 2nd tendon with an already stressed 1st tendon and the movable coupler connects two unstressed tendons prior to stressing both tendons at once. A 100 mm long and at least 4 mm thick PE-HD insert should be installed at the deviating point at the end of the trumpet, if the coupler may be subjected to significant fatigue actions. The insert is not required for plastic trumpet, where the duct is screwed on an external thread of the plastic trumpet.

1.2.4.2 Fixed coupler with coupler head K

The fixed coupler comprises wedges, compression fittings, coupler head K, anchor body MA or anchor plate E, and a ring, see Annex 2 and Annex 12. 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 with an anchor head E of a stressing anchor. In addition, the coupler head K provides a projecting ring collar with slots. The prestressing steel strands of the 2nd tendon to be joined, provided with compression fittings, are placed in the slots, and secured with a tensioning belt.

1.2.4.3 Movable coupler with coupler head V

The movable coupler comprises compression fittings, retainer plates, coupler head V, and a ring, see Annex 2 and Annex 12. Movable coupler connects two tendons prior to stressing. The prestressing steel strands of both tendons are anchored by means of compression fittings. The compression fittings of tendon 1 are secured by a retainer plate and the compression fittings of tendon 2 are locked by a retainer ring plate and a tensioning belt. The coupling principle is identical to the one of the fixed coupler with coupler head K.

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

1.2.4.4 Movable coupler K6-K6

The movable coupler comprises wedges and 2 coupler barrels K6, connected by the coupler bushing, see Annex 2 and Annex 20. With this coupler only one single prestressing steel strand is coupled. The prestressing steel strands of both tendons are anchored by means of wedges. A locking pin inside the coupler bushing prevents the prestressing steel strands from being pushed too far into the coupler bushing. Springs between wedges and coupler bushing secure the wedge positions in the cones.

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

1.2.5 Floating block anchorage Z

The floating block anchorage Z comprises wedges, an anchor head Z, retainer plates, and two rings, see Annex 2 and Annex 25. Floating block anchorage Z is normally used to stress a ring tendon e.g., in storage facilities or tanks. Both tendon ends, end 1 and end 2, of the ring tendon overlap in the floating block anchorage Z.

For stressing, the strand protrusion of tendon end 1 is guided out of the stressing recess by means of a deviation chair. To compensate the strand friction within the deviation chair, a higher force is applied by the prestressing jack for stressing.

The floating block anchorage Z can also be applied as intermediate stressing anchor between two fixed anchors, e.g., if these anchors are not accessible for prestressing jacks.

During stressing, the anchor head Z is displaced by the value E, where E is the sum of elongation and a slip of 6 mm of tendon end 2. When the prestressing force is transferred from prestressing jack to anchorage, the prestressing steel strands of tendon end 1 slip by approximately 6 mm. As a result of the slip, the force within the tendon at the end of stressing is lower than during stressing.

After stressing, the stressing recess is concreted and subsequently the tendon injected with cement grout.

1.2.6 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 10, Annex 11, Annex 15, Annex 16, Annex 19, Annex 23, and Annex 24. However, these values for centre distance between anchorages may be reduced in one direction by 15 %, but are not smaller than the outside diameter of the helix and the dimensions of anchor body MA or anchor plate E. 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 protection caps and venting caps. Standards and regulations on concrete cover in force at the place of use are observed.

1.2.7 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 10, Annex 11, Annex 15, Annex 16, Annex 19, Annex 23, and Annex 24. 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.

1.2.8 Reinforcement in the anchorage zone

In any case, steel grades and dimensions of helix and additional reinforcement specified in the Annex 10, Annex 11, Annex 15, Annex 16, Annex 19, Annex 23, and Annex 24 are conformed to.

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

If required for a specific project design, the reinforcement given in Annex 10, Annex 11, Annex 15, Annex 16, Annex 19, Annex 23, and Annex 24 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 6-n. The first number indicates the nominal diameter of the prestressing steel strand 6 = 15.7 mm (0.62 "), followed by the number "n" of prestressing steel strands.

1.3.2 Range of tendons

The PT system includes tendons, see Table 2, with 1 to 22 prestressing steel strands. Only 7-wire prestressing steel strands with a nominal diameter of 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 27.

Characteristic values of maximum force of the tendons are listed in Annex 5 and Annex 6.

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 lists 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 $0.90 \cdot A_p \cdot f_{p0.1}$. 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 22
S_0	mm^2	Nominal cross-sectional area of one single prestressing steel strand, see Annex 27
$F_{p0.1}$	kN	Characteristic value of 0.1 % proof force of one single prestressing steel strand, see Annex 27
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 Table 3 slip and the required locking measure of wedges and compression fittings are specified.

Table 3 Slip values and locking of wedges and compression fittings

Anchorage or coupler		Slip	Locking measures
—		mm	—
Stressing anchor	E6-n	6 [1), 2)]	—
	SK6	5 [1)]	—
Fixed coupler – 1st construction stage	K6-n	6 [1), 2)]	—
Fixed anchor	E6-n	6	— [3)]
	EP6-n	0	Retainer plate
	SK6	5	Spring, Venting cap
Bond anchorage	H6-n	0	—
Fixed coupler – 2nd construction stage	K6-n	0	Tensioning belt
Movable coupler	V6-n	0	Retainer plate, Retainer ring plate, Tensioning belt
Movable coupler	K6-K6	10	Spring
Floating block anchorage Z	Z6-n	6 [4)]	Retainer plate

NOTES
1) Slip occurs by transfer of prestressing force from jack to anchorage.
2) Slip is 3 mm with power-seating of ~ 20 kN per strand. This requires a special prestressing jack, its availability is coordinated with the ETA holder.
3) Anchor is accessible during stressing.
4) See Clause 1.2.5.

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 4

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

k ..... rad/m ..... Wobble coefficient, see Table 4

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 4 Friction coefficient μ and wobble coefficient k

—		Circular metal 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 metal duct see Annex 4.

Information on friction losses in anchorages and couplers is included in Annex 4, Annex 19, Annex 20, and Annex 25.

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 1.8 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/mm^2
- A maximum pressure under the prestressing steel strands of $p_{R,\,max}$ = 140 kN/m or 200 kN/m
- A minimum concrete compressive strength of $f_{cm,\,0,\,cube}$ = 25 N/mm^2

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

$$R_{min} = \frac{2 \cdot P_{m0} \cdot d}{d_i \cdot p_{R,\,max}} \geq 2.0\ m$$

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 15.7 mm and tensile strengths of 1 770 N/mm^2 or 1 860 N/mm^2 are 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 27.

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 27 and is according to the standards and regulations in force at the place of use is taken.

1.9 Anchorage and coupling 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 Anchor head

The anchor heads E and EP are made of steel with a pattern of regular arranged bores for anchoring the prestressing steel strands, see Annex 10, Annex 11, Annex 23, and Annex 24. Anchor head E for the stressing anchor provides cylindrical bores with conical ends at one side for bearing wedges. Anchor head EP for the fixed anchor provides only cylindrical bores for bearing compression fittings. All bores are countersunk and deburred. See Annex 3 for details on the conical and cylindrical bores.

The single prestressing steel strand anchor SK6, see Annex 17, is made of cast iron, and contains a conical hole to bear one wedge. It is used with a wedge as stressing anchor as well as fixed anchor.

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 head

Coupler heads K, V, and K6 are made of steel with patterns of regular arranged bores and slots for anchoring the prestressing steel strands. In the inner part of coupler heads K and V, the bore patterns are identical to the anchor head E and EP. In addition, the projecting ring collar of the coupler heads provide slots for anchoring prestressing steel strands by means of compression fittings.

Coupler head K, see Annex 12, for fixed coupler provides in the inner part cylindrical bores with conical ends for stressing and bearing the wedges of the 1st construction stage like anchor

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

head E. On the projecting ring collar, the prestressing steel strands of 2nd construction stage are anchored in slots by means of compression fittings.

The coupler head V, see Annex 12, for movable coupler provides in the inner part cylindrical bores for bearing the compression fittings of the 1st tendon like anchor head EP. On the projecting ring collar the prestressing steel strands of the 2nd tendon are anchored in slots by means of compression fittings.

The coupler K6-K6, see Annex 20, for movable single prestressing steel strand coupler comprises 2 coupler barrels K6 with cones and threads that are connected by a steel bushing.

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

1.9.4 Anchor body MA and anchor plate E

Anchor body MA, see Annex 10 and Annex 11, and anchor plate E, see Annex 23 and Annex 24, are used together with anchor heads E and EP of the stressing and fixed anchor and with coupler head K of the fixed coupler.

Applications with anchor plate E require preceding consultations of the ETA holder to confirm availability.

Cast iron anchor body MA is of circular shape and provide several load transfer planes for load transfer to the structural concrete. Steel anchor plate E is of circular shape as well, but with only one load transfer plane. Anchor body MA and anchor plate E feature a centric circular hole for passing through the tendon.

1.9.5 Bond head

The bulb shaped bond head at the end of the prestressing steel strand, see Annex 13, for bond anchorage H is made by means of a special jack.

1.9.6 Anchor head Z

The anchor head Z, see Annex 25, is made of steel, of rectangular shape, and with two patterns of regular arranged bore for anchoring the prestressing steel strands. Anchor head Z is stressing and fixed anchor in one piece. All prestressing steel strands are anchored by means of wedges. The bores and cones for the stressing end are located in the centre of the anchor head Z. The bores for the fixed end are split. One half each is located adjacent to the centre holes on the outside ends of the anchor head Z, with cones arranged on the opposite side to the ones of the stressing end.

All cylindrical bores are countersunk and deburred. For installation, the bores and cones are clean and free of damage or rust and are provided with corrosion protection oil.

1.9.7 Ring

Steel rings are used for bond anchorage H, see Annex 1, Annex 13, Annex 15, and Annex 16, fixed coupler with coupler head K, see Annex 2 and Annex 12, movable coupler with coupler head V, see Annex 2 and Annex 12, and as well as for floating block anchorage Z, see Annex 2 and Annex 25.

1.9.8 Wedge and compression fitting

Only 3-piece wedge and compression fitting according to Annex 3 are used.

Three wedges that are similar in geometry and are made of different material are used.

- Two wedges with 30 ° tooth geometry according to Annex 3 are made of two different materials
- One wedges with 45 ° tooth geometry according to Annex 3 is made of one material

Within one anchorage and one coupler, only one of these three wedges is installed.

1.9.9 Retainer plate

Retainer plate and retainer ring plate are used for fixed anchor with anchor head EP, see Annex 9, Annex 21, and Annex 22, for movable coupler with coupler head V, see Annex 12, as well as for floating block anchorage Z, see Annex 25.

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 body MA or anchor plate E 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 23, and Annex 24.

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 prefabricated tendons. Longer tendons are transported to the job site in coils or oblong loops. The minimum transport bending diameter D for tendons up to 6-12 is 1.50 m and for larger tendons 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.

The ducts have circular cross section – so called “round” duct – and for tendons 6-3 to 6-5 ducts with oval cross sections – so called “flat” duct – are available. The ends of the ducts are connected with sockets. 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 anchor body MA or to anchor plate E 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 26.

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

2.1 Intended use

The PT system SUSPA Strand DW is intended to be used for the prestressing of structures. Use category according to tendon configuration and material of structure 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., prefabricated 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 6-12 $D \geq 1.50$ m

For larger tendons $D \geq 1.80$ 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 1.2.6, Clause 1.2.7, and Clause 1.2.8, Annex 9, Annex 10, Annex 11, Annex 13, Annex 14, Annex 15, Annex 16, Annex 19, Annex 21, Annex 23, Annex 24, and Annex 25 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 10, Annex 11, Annex 15, Annex 16, Annex 19, Annex 23, and Annex 24 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 protection caps and venting 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, 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 need not to be taken into consideration.

2.2.3.4 Fixed and movable 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.

The length of the protective tube and its position relative to the coupler ensures unimpeded movement of the coupler in the protective tube along a length of minimum $1.15 \cdot \Delta l + 30$ mm, where Δl in mm is the expected displacement of the coupler during stressing.

2.2.3.5 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 anchorage to masonry structure is via concrete or steel member, designed according to the European Technical Assessment, especially according to Clause 1.2.6, Clause 1.2.7, and Clause 1.2.8, 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 SUSPA Strand DW.

2.2.4.2 Anchorage

2.2.4.2.1 General

Stressing and fixed anchor and fixed coupler with anchor head E, EP, and coupler head K can be installed with either an anchor body MA or an anchor plate E. In all that cases, the same installation procedure applies, see Annex 22. Stressing and fixed anchor and fixed coupler with anchor body MA or anchor plate E and anchor head or coupler head 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.

Centric position of helix is secured by welding the end ring to anchor body MA or anchor plate E 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 17 and Annex 22.

- Fastening anchor body MA or anchor plate E or anchor SK6 to the formwork.
- Installation of trumpet between anchor body MA or anchor plate E and duct or installation of the PE-sleeve between anchor SK6 and duct.
- If the helix is not already welded onto anchor body MA or anchor plate E in the manufacturing plant, the helix is placed, centred to the tendon axis, and fastened to the reinforcement.
- Pushing the duct into trumpet or PE-sleeve to approximately a length of d, where d is the duct diameter, or, in the case of appropriately shaped polyethylene trumpets, screwing the duct onto the trumpet.
- Sealing the joint between trumpet or PE-sleeve and duct.
- Pushing the anchor head E over the prestressing steel strands just before stressing.
- Tightening the prestressing steel strands with 3-piece wedges.

The anchor head E can be provided with an external thread, on which a protection cap can be screwed on for grouting, see Annex 22.

2.2.4.2.3 Fixed anchor

Anchor head E can also be used in a fixed anchor. In that case, the fixed anchor remains accessible during stressing of the tendon. Installation is the same as for stressing anchor according to Clause 2.2.4.2.2 using anchor body MA or anchor plate E.

Anchor head EP can be either prefabricated or assembled at the construction site. Due to the geometrically equivalence, this anchor is installed similarly to the stressing anchor. Instead of wedges, compression fittings are used for anchoring the prestressing steel strands. The compression fittings are secured by a retaining plate.

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.

2.2.4.2.5 Floating block anchorage Z

Floating block anchorage Z is in general used for ring tendons, e.g., in storage facilities or tanks. Both ends, end 1 and end 2, of the ring tendon overlap in the floating block anchor head Z.

Site assembly comprises the following steps.

- Pushing the anchor head Z over the prestressing steel strands just before stressing, whereas end 1 of the tendon is inserted into the inner bores and end 2 of the tendon into the outer bores of anchor head Z.
- Alignment of anchor head Z by anticipating its displacement during stressing
- Anchoring the prestressing steel strands of end 2 with 3-piece wedges and securing the wedges with retainer plates.
- Stressing is carried out at end 1 of the tendon by means of a special deviation chair.

Floating block anchorage Z may also be applied as intermediate stressing anchor between two fixed anchors. In this case the two tendon ends overlap in the anchor head Z. Installation steps are the same as for ring tendons.

2.2.4.3 Coupler

2.2.4.3.1 Fixed coupler with coupler head K

The fixed coupler 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 head K is equivalent to the stressing anchor with anchor head E. The coupler with coupler head K and anchor body MA or anchor plate E is installed perpendicular to the tendon's axis with the same procedure as the stressing anchor E. 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.

- Jointing the 2nd tendon with the 1st tendon by inserting the prestressing steel strands, provided with compression fittings, into the slots of the projecting ring collar of coupler head K. The compression fittings are held in place by a tensioning belt.
- Installing the trumpet.
- Arranging a vent pipe for grouting.

2.2.4.3.2 Movable coupler with coupler head V and movable coupler K6-K6

The movable coupler joints two tendons prior to stressing.

With the movable coupler with coupler head V, the prestressing steel strands of both tendons are anchored by means of compression fittings. The anchorage of the prestressing steel strands of the 1st tendon in coupler head V is equivalent to the fixed anchor with anchor head EP.

Site assembly of movable coupler with coupler head V comprises the following steps.

- Connecting tendon 2 by inserting the prestressing steel strands, provided with compression fittings, into the slots of the projecting ring collar of coupler head V. The compression fittings of tendon 1, already installed prior to tendon 1, are held in place by a retainer plate and those of tendon 2 by a retainer ring plate and a tensioning belt.
- Placing the coupler head V into the protective tube.
- The correct position of coupler head V in the protective tube with regard to direction and displacement during stressing is checked prior to final assembly of the protective tube.
- Arranging a vent pipe behind coupler head V facing the grouting direction. If the coupler, in grouting direction, is placed in a downwards position, a vent pipe is also arranged in front of coupler head V.

Movable coupler K6-K6 is installed analogously.

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 concrete compressive strength in the anchorage zone according to Annex 10, Annex 11, Annex 13, Annex 15, Annex 16, Annex 19, Annex 23, Annex 24, and Annex 25 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

Except for the floating block anchorage Z, 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.

2.2.4.5.3 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.

2.2.4.5.4 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 co-ordinated with the ETA holder for timely availability.

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 stressing 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 un-

grouted for a longer time, appropriate corrosion protection measures are implemented after acceptance of the ETA holder.

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

2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of the SUSPA Strand DW of 100 years, provided that the SUSPA Strand DW 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 SUSPA Strand DW for the essential characteristics are given in Table 5.

Table 5 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.
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.	—

[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 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 tendon with prestressing steel strands according to Annex 27 are listed in Annex 5 and Annex 6.

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 tendon with prestressing steel strands according to Annex 27 are listed in Annex 5 and Annex 6.

Fatigue resistance of anchors 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 tendons with prestressing steel strands according to Annex 27 are listed in Annex 5 and Annex 6.

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 the PT system, 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 the SUSPA Strand DW is issued on the basis of agreed data[5] that identify the assessed product. 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 the SUSPA Strand DW 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].

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

[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.

(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 28, conform to EAD 160004-00-0301, Table 3, and are specified in the quality management plan of the SUSPA Strand DW.

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 5.

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.

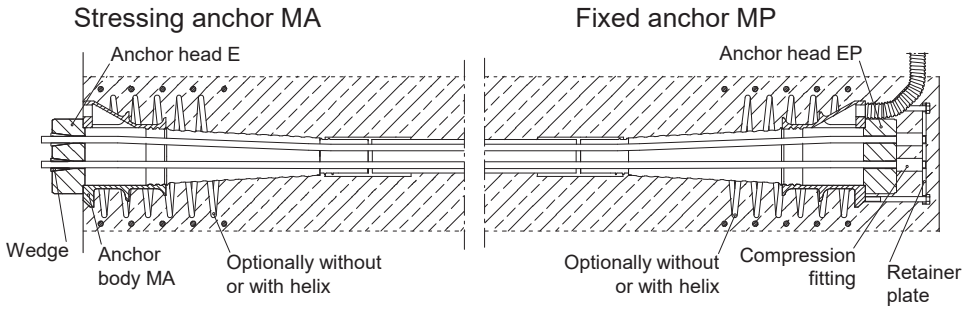
Issued in Vienna on 30 March 2021
by Österreichisches Institut für Bautechnik

The original document is signed by

Rainer Mikulits
Managing Director

Anchorages

Multi-plane anchorage MA



Bond anchorage H, HL, and HR

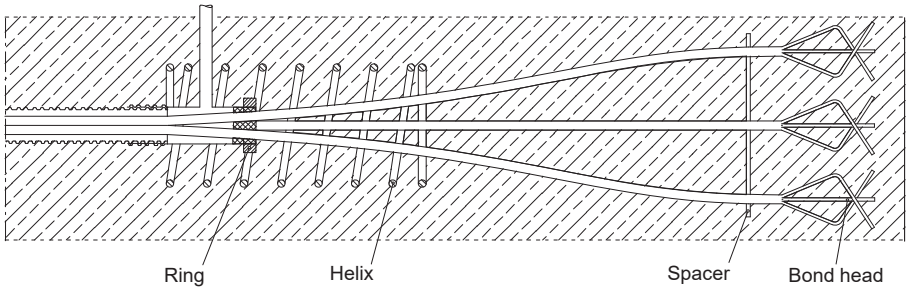
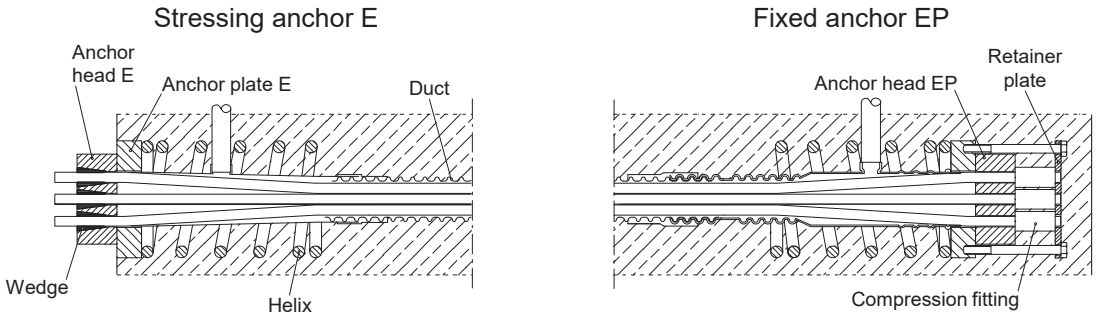
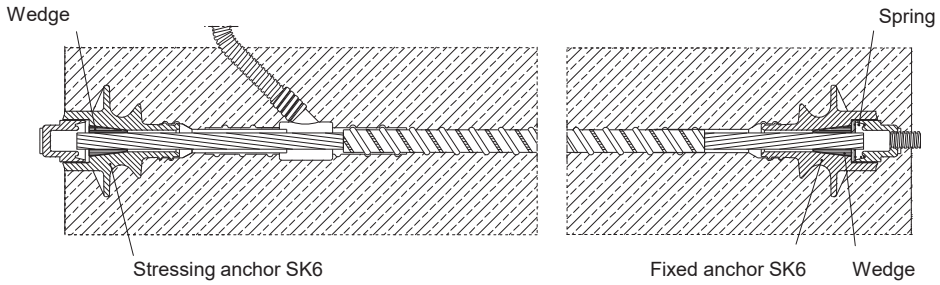


Plate anchorage E



Single strand anchorage SK6



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Bonded prestressing system SUSPA Strand DW

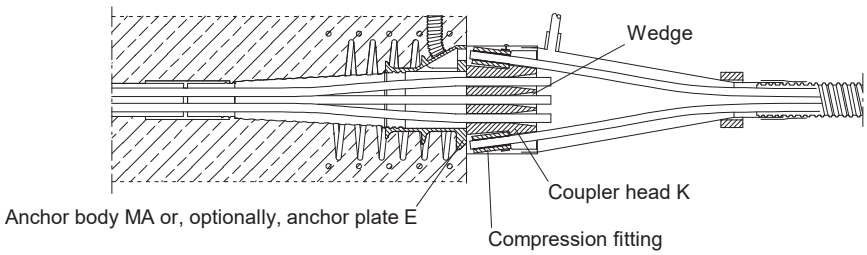
Overview on anchorages

Annex 1

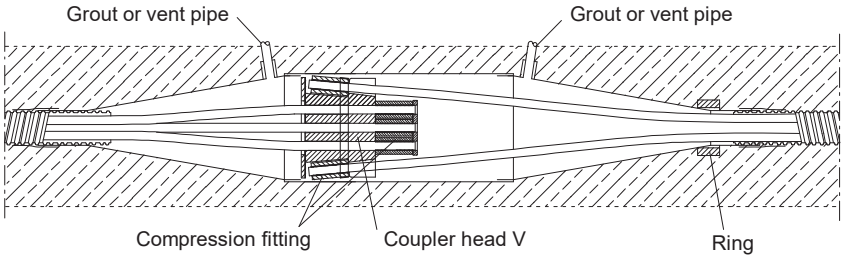
of European Technical Assessment **ETA-13/0839** of 30.03.2021

Couplers

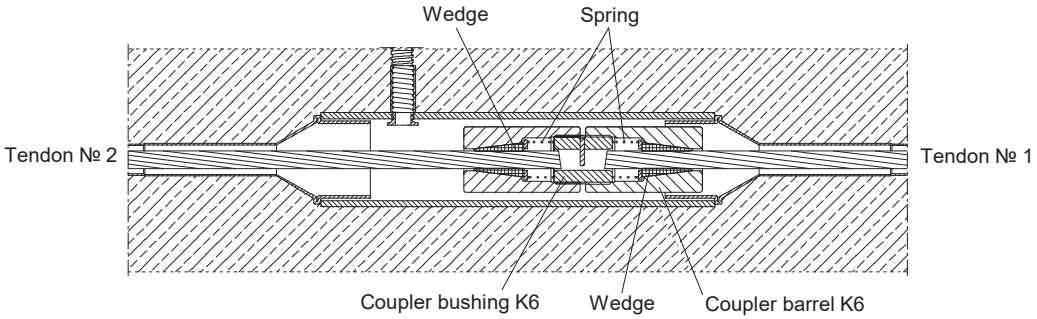
Fixed coupler K



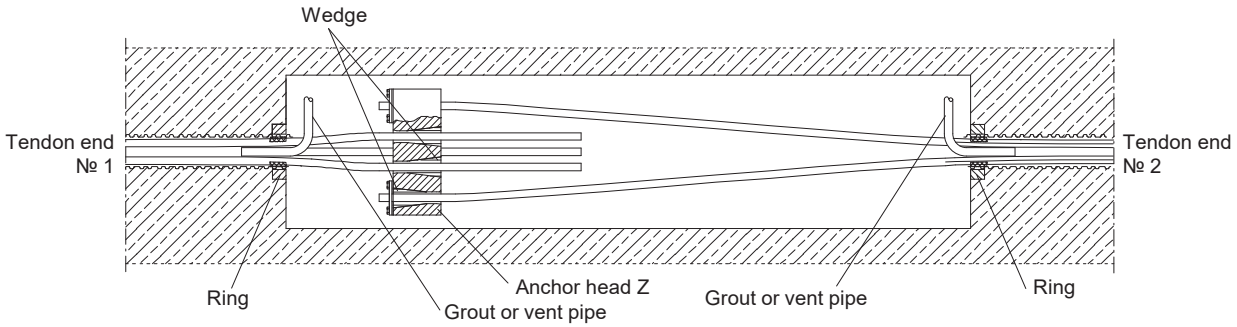
Movable coupler V



Movable coupler K6-K6



Floating block anchorage Z



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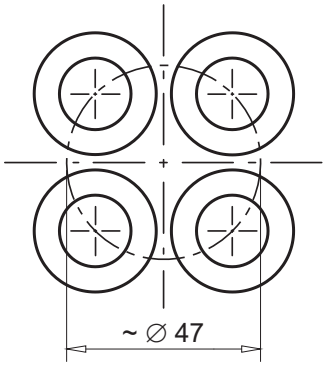
Bonded prestressing system
SUSPA Strand DW

Overview on couplers
Floating block anchorage Z

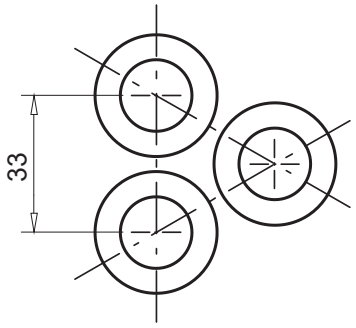
Annex 2
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Geometry of anchor heads
for strands Y1770S7 15.7 and Y1860S7 15.7

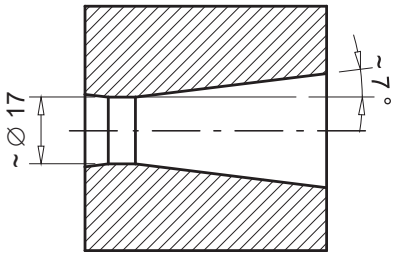
Special case 6-4

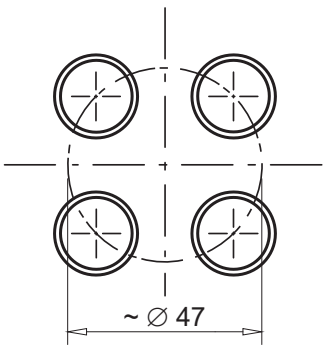


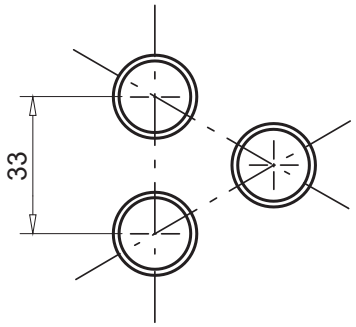
Standard case



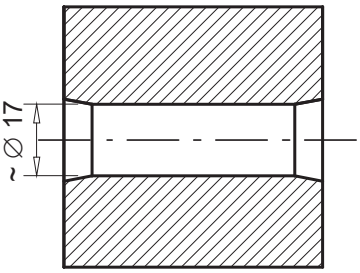
Bore E



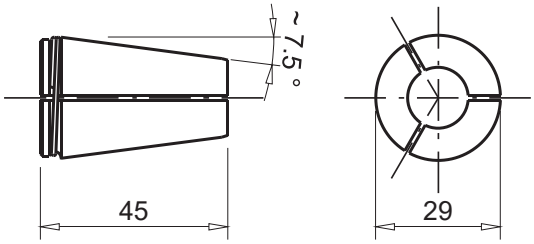




Bore EP



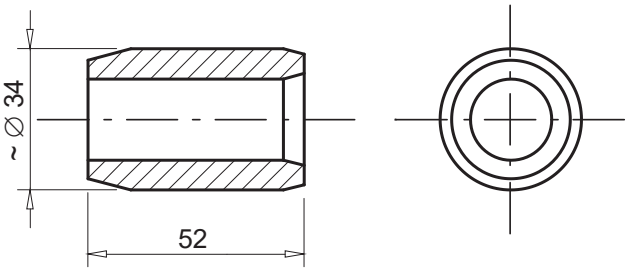
3-piece wedge



Wedge tooth geometry

Compression fitting

Sleeve



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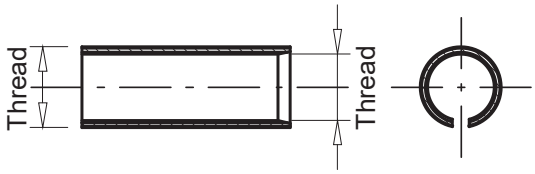

Dimensions in mm

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Bonded prestressing system SUSPA Strand DW

Basic components for anchoring the prestressing steel strand

Annex 3
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Technical data for tendons 6-1 to 6-22 with circular steel strip duct strand Y1770S7 15.7 and strand Y1860S7 15.7

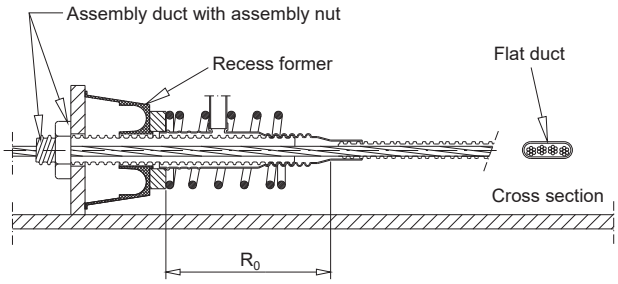
Tendon			**6-1**	**6-3**	**6-4**	**6-5**	**6-7**	**6-9**	**6-12**	**6-15**	**6-19**	**6-22**
Number of strands ∅ 15.7 mm			1	3	4	5	7	9	12	15	19	22
Nominal cross-sectional area of prestressing steel		mm^2	150	450	600	750	1 050	1 350	1 800	2 250	2 850	3 300
Nominal mass of prestressing steel		kg/m	1.17	3.52	4.69	5.86	8.20	10.55	14.06	17.58	22.27	25.78
Modulus of elasticity		N/mm^2	195 000 (standard value)									
Circular steel strip duct												
Wobble coefficient	k		0.005 rad/m ≙ 0.30 °/m									
Duct I	∅ d_i / d_a	mm	20/27	40/47	45/52	50/57	55/62	65/72	75/82	80/87	90/97	95/102
Eccentricity		mm	3	6	7	7	6	9	10	10	10	10
Friction coefficient	μ	rad^{-1}	0.20									
Distance of tendon support		m	0.60–1.80									
Duct II	∅ d_i / d_a	mm	25/32	45/52	50/57	55/62	60/67	70/77	80/87	85/92	95/102	105/112
Eccentricity		mm	5	9	10	11	9	12	14	13	14	18
Friction coefficient	μ	rad^{-1}	0.19									
Distance of tendon support		m	0.50–1.80 m with stiffening, e.g., with PE tube 0.60–1.00 m with strengthened duct In a tendon section with minimum radius of curvature 0.60–0.75 m applies.									
Friction loss in stressing anchorage E		%	—[1]	1.0	1.3	1.2	1.0	0.7	0.8	0.8	0.7	0.6
Friction loss in movable couplers K6-K6 and V		%	—[1]	1.8	2.0	—	1.8	1.7	1.7	1.7	1.7	1.6

[1] Friction losses are low and do not have to be considered in design and execution.

Technical data for tendons 6-3 to 6-5 with flat steel strip duct strand Y1770S7 15.7 and strand Y1860S7 15.7

Tendon			**6-3**	**6-4**	**6-5**
Number of strands ∅ 15.7 mm			3	4	5
Trumpet length	R_o	m	370	325	535
Flat steel strip duct					
Dimensions	d_i	mm	55 × 21	70 × 21	85 × 21
	d_a	mm	60 × 25	75 × 25	90 × 25
Distance of tendon support		M	0.50–1.00		
Wobble coefficient	k		0.014 rad/m ≙ 0.80 °/m		
Bending around weak axis, Minimum radius of curvature	R	M	2.5		
Friction coefficient	μ	rad^{-1}	0.15		
Bending around strong axis Minimum radius of curvature	R	m	5.0		
Friction coefficient	μ	rad^{-1}	0.23	0.26	0.32

Stressing anchor E
Assembly condition



NOTE Flat ducts can be installed with anchor body MA and with anchor plate E.

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Bonded prestressing system SUSPA Strand DW

Technical data
Tendons 6-1 to 6-22 with circular steel strip duct
Tendons 6-3 to 6-5 with flat steel strip duct

Annex 4

of European Technical Assessment
ETA-13/0839 of 30.03.2021

Tendon range – Strand Y1770S7 15.7 – f_{pk} = 1 770 N/mm²

Number of strands	Mass of strands	Nominal cross-sectional area	Maximum prestressing force [1), 3)]	Maximum overstressing force [1), 2), 3)]	Characteristic value of maximum force
		A_p	0.90 · $F_{p0.1}$	0.95 · $F_{p0.1}$	F_{pk}
—	kg/m	mm²	kN	kN	kN
1	1.17	150	211	222	266
2	2.34	300	421	445	532
3	3.52	450	632	667	798
4	4.69	600	842	889	1 064
5	5.86	750	1 053	1 112	1 330
6	7.03	900	1 264	1 334	1 596
7	8.20	1 050	1 474	1 556	1 862
8	9.38	1 200	1 685	1 778	2 128
9	10.55	1 350	1 895	2 001	2 394
10	11.72	1 500	2 106	2 223	2 660
11	12.89	1 650	2 317	2 445	2 926
12	14.06	1 800	2 527	2 668	3 192
13	15.24	1 950	2 738	2 890	3 458
14	16.41	2 100	2 948	3 112	3 724
15	17.58	2 250	3 159	3 335	3 990
16	18.75	2 400	3 370	3 557	4 256
17	19.92	2 550	3 580	3 779	4 522
18	21.10	2 700	3 791	4 001	4 788
19	22.27	2 850	4 001	4 224	5 054
20	23.44	3 000	4 212	4 446	5 320
21	24.61	3 150	4 423	4 668	5 586
22	25.78	3 300	4 633	4 891	5 852

1) 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.

2) 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.

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

Where

f_{pk} .....Characteristic tensile strength of prestressing steel strand
F_{pk} .....Characteristic value of maximum force of tendon
$F_{p0.1}$ .....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 strand see Annex 27.
A_p .....Nominal cross-sectional area of tendon

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Bonded prestressing system SUSPA Strand DW

Tendon range – Strand Y1770S7 15.7
Maximum prestressing and overstressing force
Characteristic values of maximum force of tendon

Annex 5
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Tendon range – Strand Y1860S7 15.7 – f_{pk} = 1 860 N/mm²

Number of strands	Mass of strands	Nominal cross-sectional area	Maximum prestressing force [1), 3)]	Maximum overstressing force [1), 2), 3)]	Characteristic value of maximum force
		A_p	0.90 · $F_{p0.1}$	0.95 · $F_{p0.1}$	F_{pk}
—	kg/m	mm²	kN	kN	kN
1	1.17	150	221	234	279
2	2.34	300	443	467	558
3	3.52	450	664	701	837
4	4.69	600	886	935	1 116
5	5.86	750	1 107	1 169	1 395
6	7.03	900	1 328	1 402	1 674
7	8.20	1 050	1 550	1 636	1 953
8	9.38	1 200	1 771	1 870	2 232
9	10.55	1 350	1 993	2 103	2 511
10	11.72	1 500	2 214	2 337	2 790
11	12.89	1 650	2 435	2 571	3 069
12	14.06	1 800	2 657	2 804	3 348
13	15.24	1 950	2 878	3 038	3 627
14	16.41	2 100	3 100	3 272	3 906
15	17.58	2 250	3 321	3 506	4 185
16	18.75	2 400	3 542	3 739	4 464
17	19.92	2 550	3 764	3 973	4 743
18	21.10	2 700	3 985	4 207	5 022
19	22.27	2 850	4 207	4 440	5 301
20	23.44	3 000	4 428	4 674	5 580
21	24.61	3 150	4 649	4 908	5 859
22	25.78	3 300	4 871	5 141	6 138

1) 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.

2) 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.

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

Where

f_{pk} .....Characteristic tensile strength of prestressing steel strand
F_{pk} .....Characteristic value of maximum force of tendon
$F_{p0.1}$ .....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 strand see Annex 27.
A_p .....Nominal cross-sectional area of tendon

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Bonded prestressing system
SUSPA Strand DW

Tendon range – Strand Y1860S7 15.7
Maximum prestressing and overstressing force
Characteristic values of maximum force of tendon

Annex 6
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Minimum radii of curvature for steel strip duct – $p_{R, max}$ = **140 kN/m**

Strand Y1770S7, f_{pk} = 1 770 N/mm²					Strand Y1860S7, f_{pk} = 1 860 N/mm²				
Number of strands	Duct I	Min. radius of curvature	Duct II	Min. radius of curvature	Number of strands	Duct I	Min. radius of curvature	Duct II	Min. 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
2	40	2.0	45	2.0	2	40	2.0	45	2.0
3	40	3.8	45	3.2	3	40	4.0	45	3.2
4	45	3.9	50	3.8	4	45	4.1	50	3.8
5	50	4.5	55	4.1	5	50	4.7	55	4.3
6	55	4.9	60	4.5	6	55	5.1	60	4.7
7	55	5.7	60	5.2	7	55	6.0	60	5.5
8	65	5.5	70	5.1	8	65	5.8	70	5.4
9	65	6.2	70	5.7	9	65	6.5	70	6.0
10	75	5.9	80	5.6	10	75	6.3	80	5.9
11	75	6.5	80	6.1	11	75	6.9	80	6.4
12	75	7.1	80	6.7	12	75	7.5	80	7.0
13	80	7.2	85	6.8	13	80	7.6	85	7.2
14	80	7.8	85	7.3	14	80	8.2	85	7.7
15	80	8.4	85	7.9	15	80	8.8	85	8.3
16	90	7.9	95	7.5	16	90	8.3	95	7.9
17	90	8.4	95	8.0	17	90	8.9	95	8.4
18	90	8.9	95	8.5	18	90	9.4	95	8.9
19	90	9.4	95	8.9	19	90	9.9	95	9.4
20	95	9.4	105	8.5	20	95	9.9	105	8.9
21	95	9.9	105	8.9	21	95	10.4	105	9.4
22	95	10.3	105	9.3	22	95	10.9	105	9.8

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Bonded prestressing system
SUSPA Strand DW

Minimum radii of curvature for steel strip duct
p_R = 140 kN/m

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Minimum radii of curvature for steel strip duct – $p_{R, max}$ = **200 kN/m**

Strand Y1770S7, f_{pk} = 1 770 N/mm²					Strand Y1860S7, f_{pk} = 1 860 N/mm²				
Number of strands	Duct I	Min. radius of curvature	Duct II	Min. radius of curvature	Number of strands	Duct I	Min. radius of curvature	Duct II	Min. 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
2	40	2.0	45	2.0	2	40	2.0	45	2.0
3	40	2.7	45	2.3	3	40	2.8	45	2.3
4	45	2.7	50	2.5	4	45	2.8	50	2.7
5	50	3.1	55	2.8	5	50	3.3	55	3.0
6	55	3.4	60	3.1	6	55	3.6	60	3.3
7	55	4.0	60	3.6	7	55	4.2	60	3.8
8	65	3.8	70	3.6	8	65	4.0	70	3.8
9	65	4.3	70	4.0	9	65	4.5	70	4.2
10	75	4.2	80	3.9	10	75	4.4	80	4.1
11	75	4.6	80	4.3	11	75	4.8	80	4.5
12	75	5.0	80	4.7	12	75	5.3	80	4.9
13	80	5.1	85	4.8	13	80	5.3	85	5.0
14	80	5.5	85	5.1	14	80	5.7	85	5.4
15	80	5.9	85	5.5	15	80	6.2	85	5.8
16	90	5.6	95	5.3	16	90	5.8	95	5.5
17	90	5.9	95	5.6	17	90	6.2	95	5.9
18	90	6.2	95	5.9	18	90	6.6	95	6.2
19	90	6.6	95	6.2	19	90	6.9	95	6.6
20	95	6.6	105	5.9	20	95	6.9	105	6.3
21	95	6.9	105	6.2	21	95	7.3	105	6.6
22	95	7.2	105	6.5	22	95	7.6	105	6.9

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Bonded prestressing system SUSPA Strand DW

Minimum radii of curvature for steel strip duct
p_R = 200 kN/m

Annex 8
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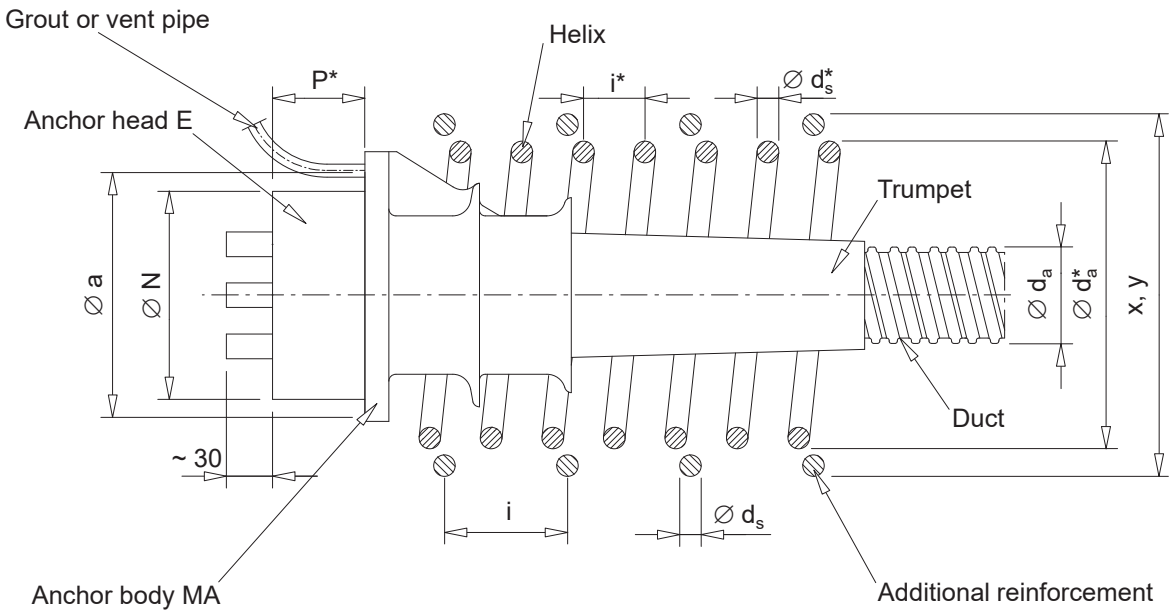
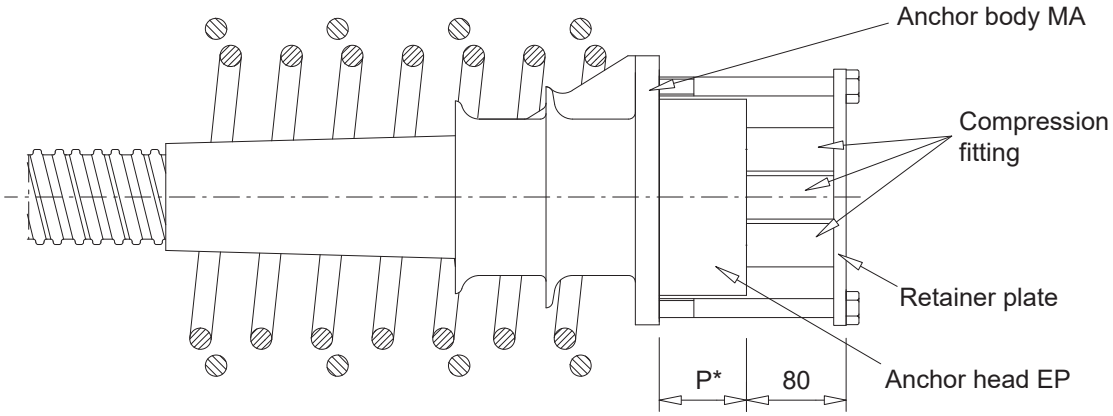
Stressing anchor with anchor body MA and anchor head E



Fixed anchor with anchor body MA and anchor head EP



Further dimensions as per stressing anchor MA

Dimensions in mm

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Bonded prestressing system SUSPA Strand DW

Stressing and fixed anchor with anchor body MA

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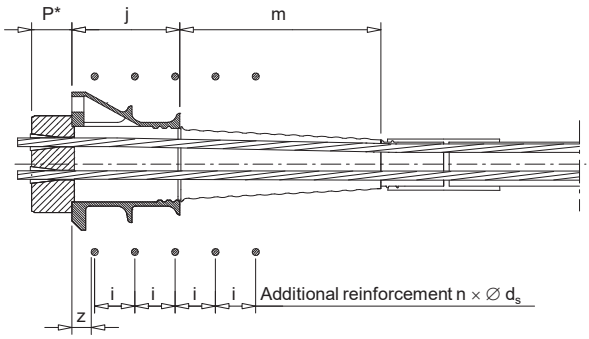
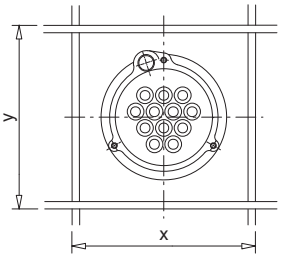
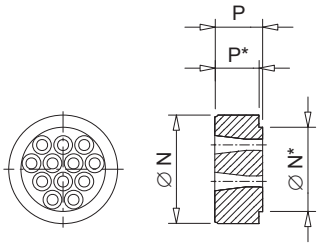
Anchorage with multi-plane anchor body MA with additional reinforcement and without helix, tendons 6-5 to 6-22, strand Y1770S7 15.7 and strand Y1860S7 15.7



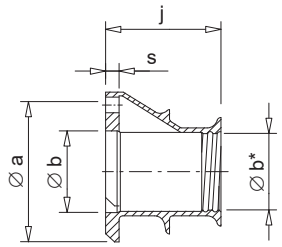


$r_x + c$ }
$r_y + c$ } ..... Minimum edge distance
c ..... Concrete cover

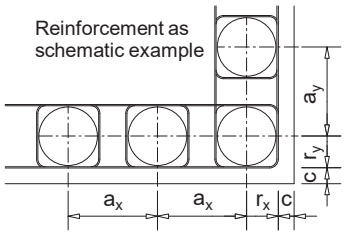
Anchor head - E or EP



Anchor body MA



Minimum distances



Tendon		6-5	6-7	6-9	6-12	6-15	6-19	6-22
Number of strands		5	7	9	12	15	19	22
Strand arrangement								
Anchor head	∅ N	135	135	155	170	190	200	220
	∅ N*	88	96	112	128	148	159	176
thickness	P	60	60	65	75	85	95	100
depth	P*	56.5	56.5	61.5	71.5	81.5	91.5	96.5
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 concrete compressive strength 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 (plus c) [1), 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 numbers 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	∅ 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 [2)] c … concrete cover
[3)] The external dimensions x, y have to be met exactly.

Dimensions in mm

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Bonded prestressing system SUSPA Strand DW

Anchorage with multi-plane anchor body MA with additional reinforcement and without helix
Data sheet for tendons 6-5 to 6-22

Annex 10

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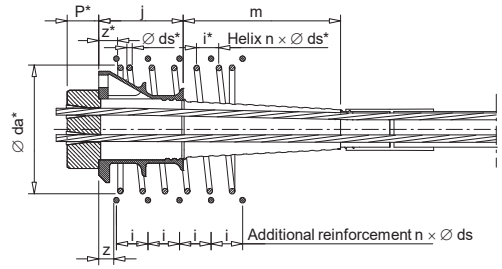
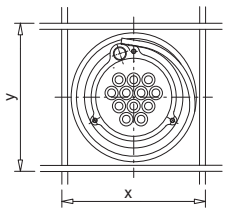
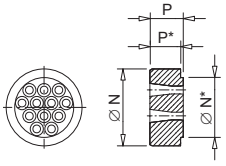
Anchorage with multi-plane anchor body MA with additional reinforcement and with helix and with minimum centre distances, tendons 6-5 to 6-22, strand Y1770S7 15.7 and strand Y1860S7 15.7



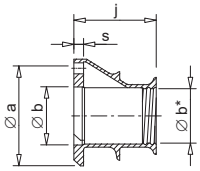


$r_x + c$ } ..... Minimum edge distance
$r_y + c$ }
c ..... Concrete cover

Anchor head – E or EP

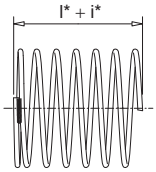


Anchor body MA

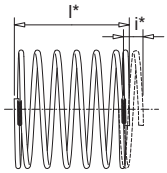


Helix

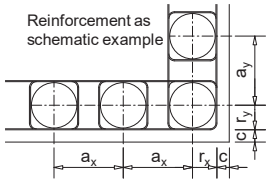
one end welded



both ends welded



Minimum distances



Tendon		6-5	6-7	6-9	6-12	6-15	6-19	6-22
Number of strands		5	7	9	12	15	19	22
Strand arrangement								
Anchor head	∅ N	135	135	155	170	190	200	220
	∅ N*	88	96	112	128	148	159	176
thickness	P	60	60	65	75	85	95	100
depth	P*	56.5	56.5	61.5	71.5	81.5	91.5	96.5
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 concrete compressive strength 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 (plus c) [1), 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	∅ d_s*	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	∅ d_a*	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 numbers 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	∅ d_s	12 12 12	12 12 12	14 14 14	14 14 14	16 16 16	16 16 16	16 16 16
Maximum distance	z	35 35 35	35 35 35	35 35 35	40 40 40	40 40 40	40 40 40	45 45 45
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 SUSPA Strand DW

Anchorage with multi-plane anchor body MA with additional reinforcement and with helix
Data sheet for tendons 6-5 to 6-22

Annex 11

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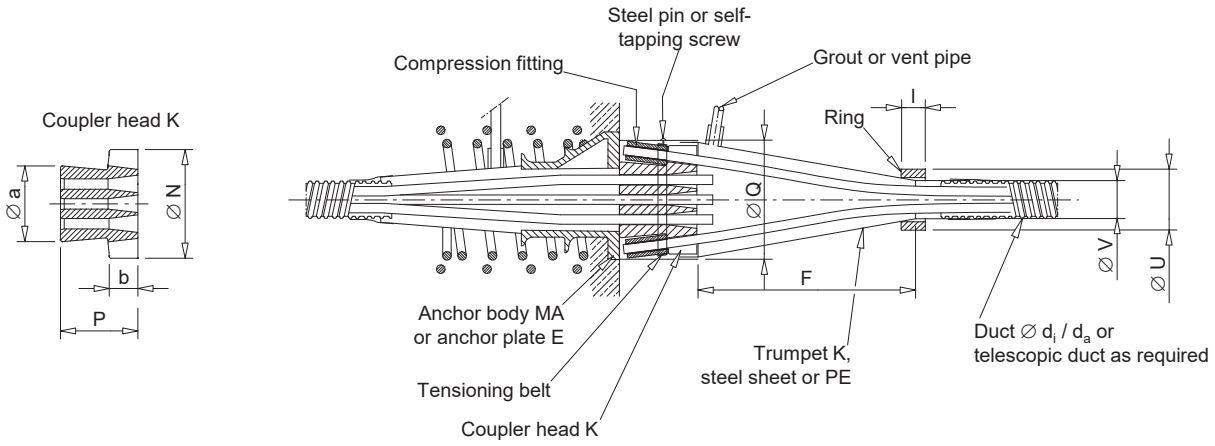
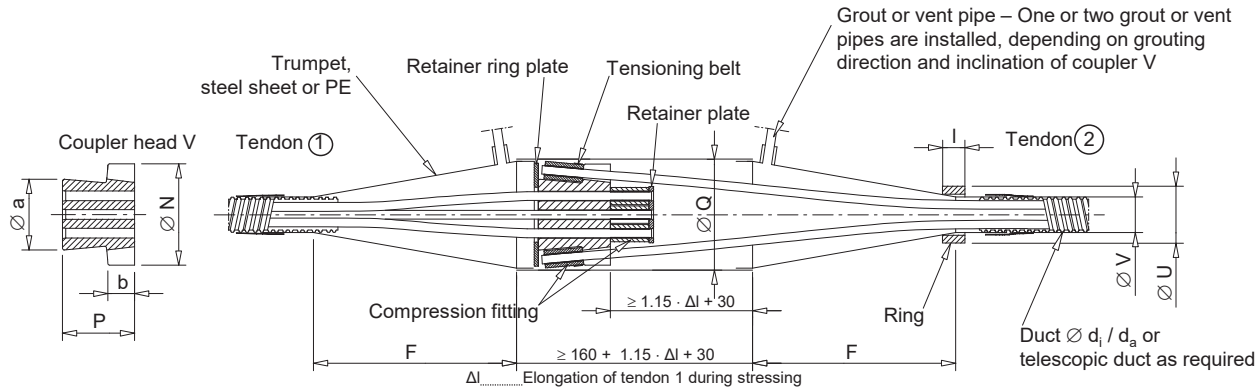
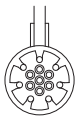
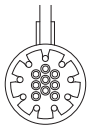
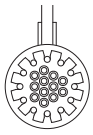
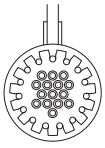
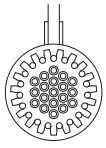
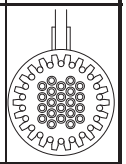
Coupler K and V 6-3 to 6-22 – Strand Y1770S7 15.7 and strand Y1860S7 15.7

Fixed coupler K – Tendons 6-7 to 6-22 with anchor body MA and 6-3 to 6-22 with anchor plate



Movable coupler V – Tendons 6-3 to 6-22 – Position of coupler head V prior to stressing



Tendon		6-3	6-4	6-7	6-9	6-12	6-15	6-19	6-22
Number of strands		3	4	7	9	12	15	19	22
Strand arrangement									
Coupler head	∅ N	140	150	180	210	220	260	260	290
	∅ a	86	96	126	156	166	206	206	236
	P	128	128	128	128	128	128	128	128
	b	50	50	50	50	50	50	50	50
Friction loss in movable coupler V		1.8 %	2.0 %	1.8 %	1.7 %	1.7 %	1.7 %	1.7 %	1.6 %
Trumpet	F	250	280	370	410	460	570	570	640
	∅ Q	150	160	190	230	240	280	280	310
Ring	∅ V	55	60	73	82	92	97	109	122
	l	30	30	40	40	40	50	50	50
	∅ U	70	80	101	110	127	140	159	171
Duct	Duct I ∅ d_i / d_a	40/47	45/52	55/62	65/72	75/82	80/87	90/97	95/102
	Duct II ∅ d_i / d_a	45/52	50/57	60/67	70/77	80/87	85/92	95/102	105/112

Dimensions in mm

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Bonded prestressing system SUSPA Strand DW

Coupler K and V
Data sheet for tendons 6-3 to 6-22

Annex 12

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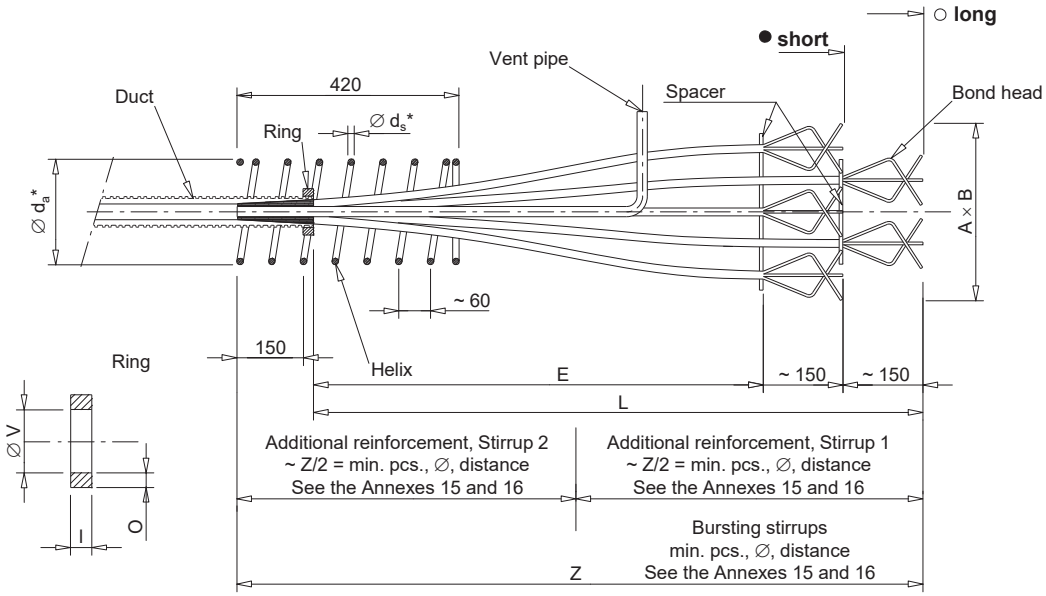
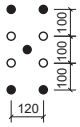
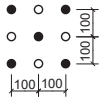
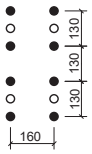
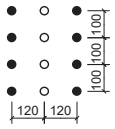
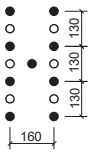
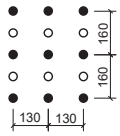
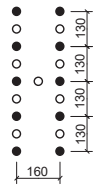
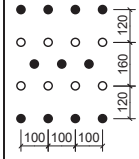
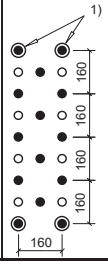
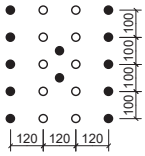
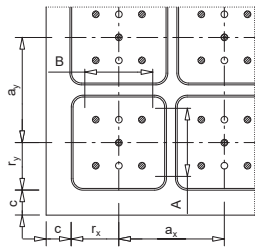
Bond anchorage H 6-3 to 6-22
for $f_{cm,\,0,\,cube} \geq 34$ N/mm² or $f_{cm,\,0,\,cyl} \geq 28$ N/mm²



Tendon	6-3	6-4		6-5		6-7		6-9	
Format	HL	HL	HR	HL	HR	HL	HR	HL	HR
Elevation anchorage									

Tendon	6-12		6-15		6-19		6-22	
Format	HL	HL	HL	HR	HL	HR	HL	HR
Elevation anchorage								

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



Reinforcement as schematic example

[1)] 3rd position see Annex 14

Dimensions in mm

DYWIDAG

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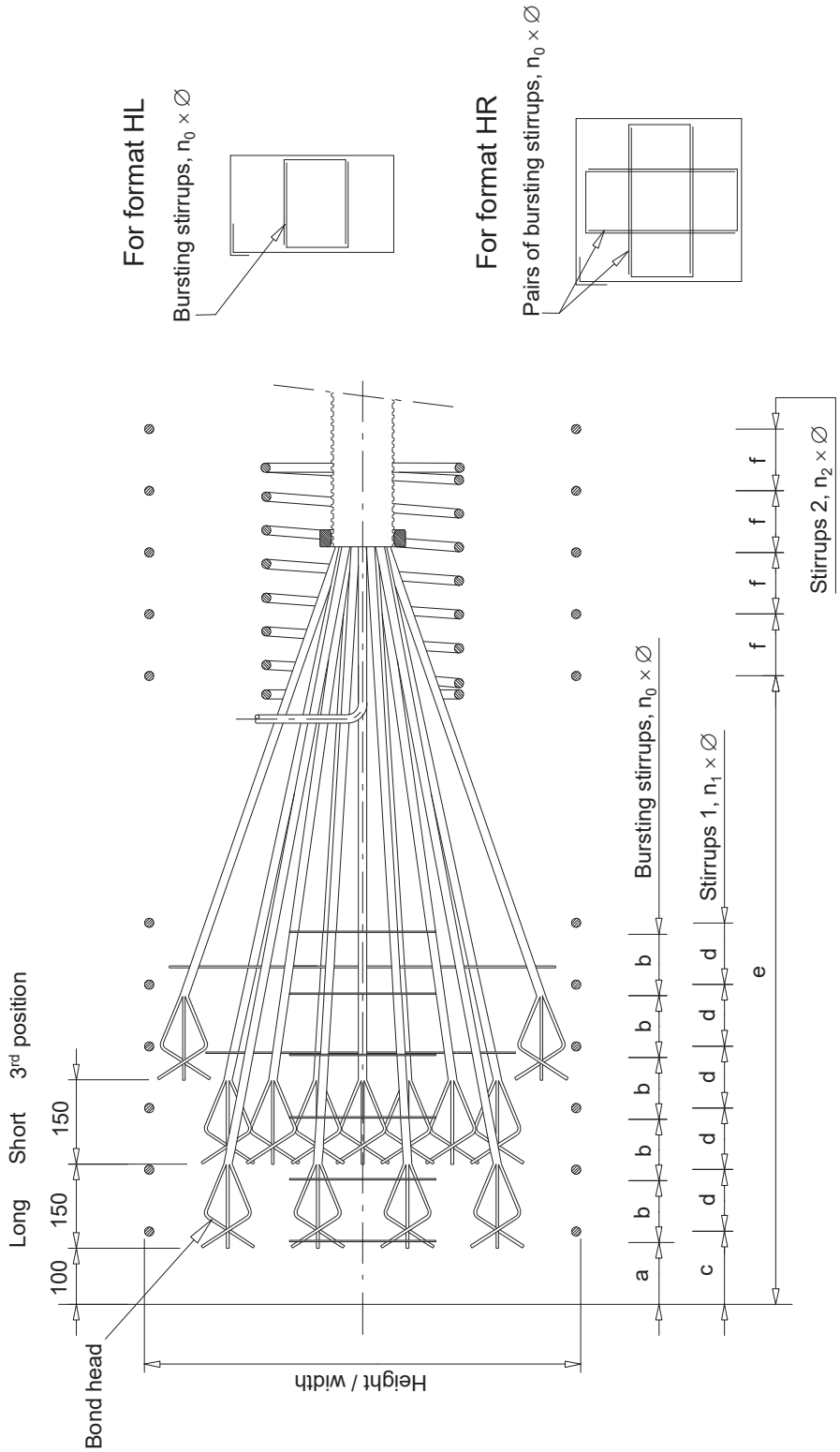
Bonded prestressing system
SUSPA Strand DW

Bond anchorage H
Strand arrangement – Helix

Annex 13
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Bond anchorage H 6-3 to 6-22
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
SUSPA Strand DW

Bond anchorage H
Stirrup reinforcement

Annex 14
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Bond anchorage H 6-3 to 6-9 for $f_{cm,\,0,\,cube} \geq 34$ N/mm² or $f_{cm,\,0,\,cyl} \geq 28$ N/mm²
strand Y1770S7 15.7 and strand Y1860S7 15.7

For layout see the Annexes 13 and 14.

Tendon		**6-3**	**6-4**		**6-5**		**6-7**		**6-9**	
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
Centre distance [1]	a_x	180	190	285	210	305	230	340	280	375
	a_y	380	430	285	440	305	500	340	500	375
Edge distance (plus c) [1), 2)]	r_x	80	85	135	95	145	105	160	130	180
	r_y	180	205	135	210	145	240	160	240	180
Bursting stirrups [3)]	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] Minimum dimension
[2] c … concrete cover
[3] Crosswise installation of bursting reinforcement for fixed anchor HR according to Annex 14

Dimensions in mm

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Bonded prestressing system
SUSPA Strand DW
Bond anchorage H
Data sheet for tendons 6-3 to 6-9

Annex 15
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Bond anchorage H 6-12 to 6-22 for $f_{cm,\,0,\,cube} \geq 34$ N/mm² or $f_{cm,\,0,\,cyl} \geq 28$ N/mm²
strand Y1770S7 15.7 and strand Y1860S7 15.7

For layout see the Annexes 13 and 14.

Tendon		**6-12**		**6-15**		**6-19**		**6-22**	
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 [1]	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
Centre distance [2]	a_x	300	390	350	460	390	525	410	570
	a_y	570	440	630	475	715	525	780	560
Edge distance (plus c) [2), 3)]	r_x	140	185	165	220	185	255	195	275
	r_y	275	210	305	230	350	255	380	270
Bursting stirrups [4]	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] Bond head in 3rd position, see Annex 14
[2] Minimum dimension
[3] c … concrete cover
[4] Crosswise installation of bursting reinforcement for fixed anchor HR according to Annex 14

Dimensions in mm

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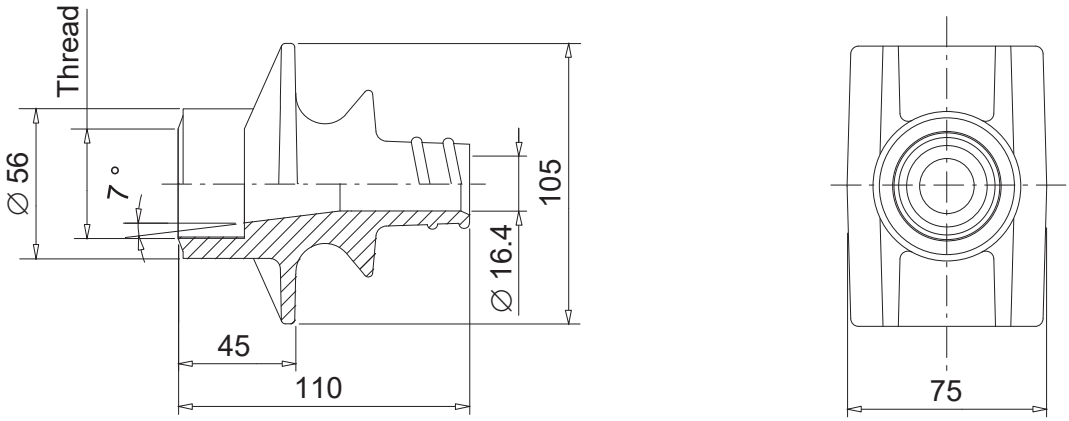
Bonded prestressing system
SUSPA Strand DW
Bond anchorage H
Data sheet for tendons 6-12 to 6-22

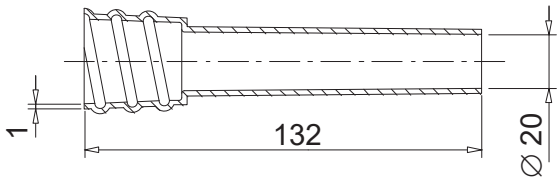
Annex 16
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Single strand anchorage SK6

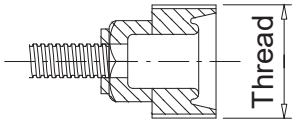
Anchor SK6



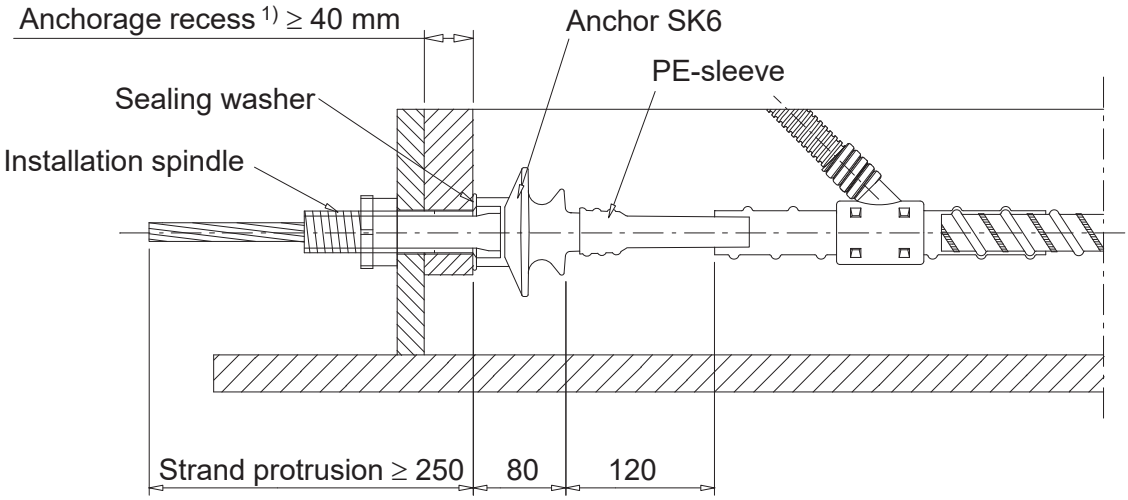
PE-sleeve



Venting cap



Stressing anchor SK6 – Assembly state



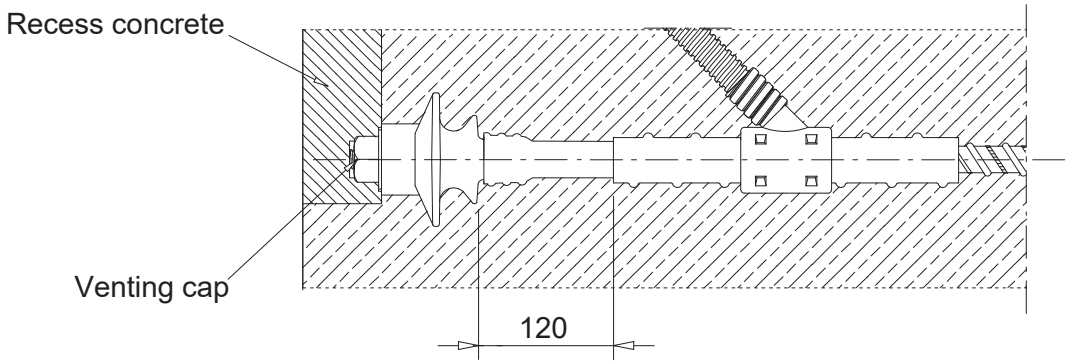
1) Concrete cover on venting cap ≥ 25 mm

Dimensions in mm

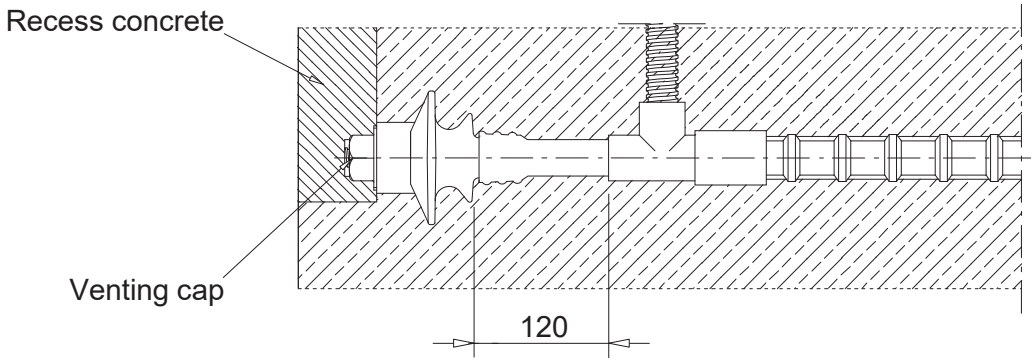
DYWIDAG DYWIDAG-Systems International GmbH Phone: +49/89/309050-100 E-Mail: dsihv@dywidag-systems.com	**Bonded prestressing system SUSPA Strand DW** Single strand anchorage SK6 Basic components and assembly	**Annex 17** of European Technical Assessment **ETA-13/0839** of 30.03.2021

Single strand anchorage SK6

Stressing anchor SK6 after prestressing – Steel strip duct

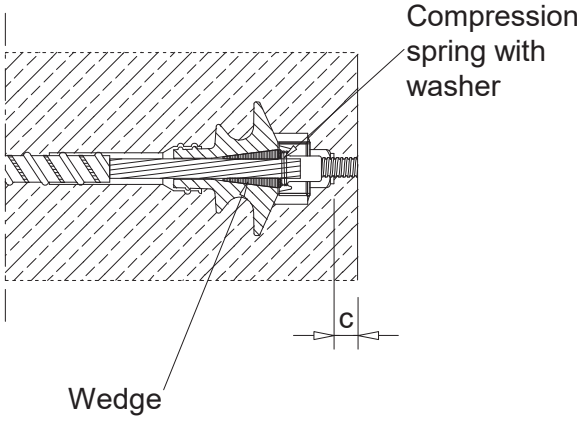


Stressing anchor SK6 after prestressing – Plastic duct
Sealing of joints to duct with heat shrinking sleeves

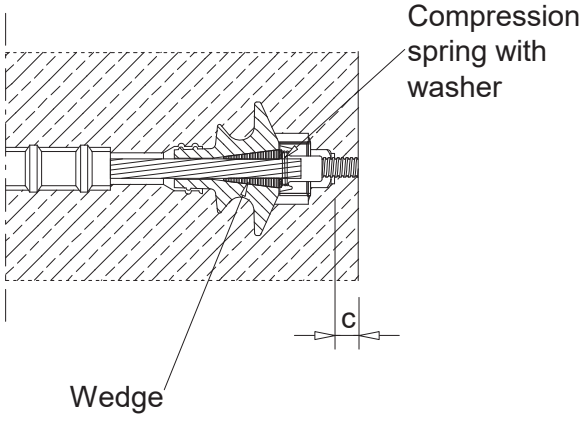


Fixed anchor SK6 grouted

Steel strip duct



Plastic duct



c..... Concrete cover on venting cap ≥ 25 mm

Dimensions in mm

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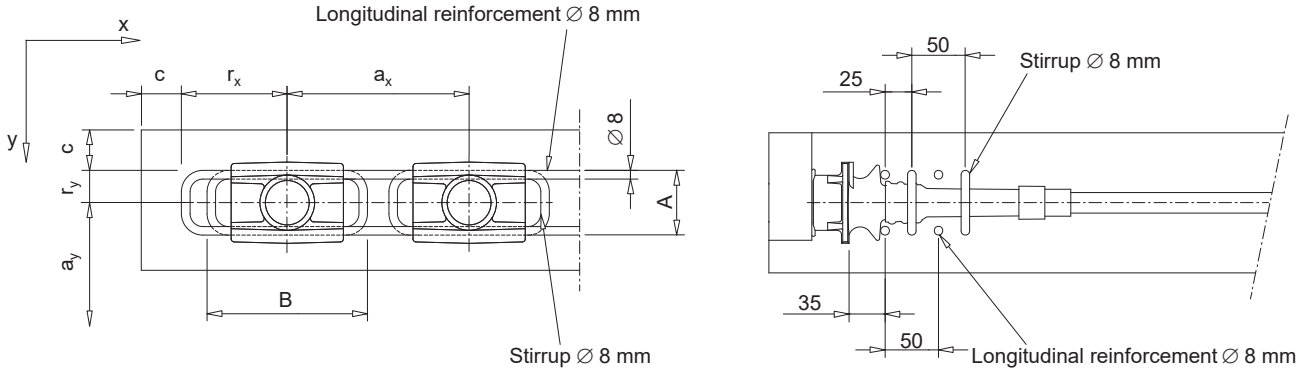
Bonded prestressing system SUSPA Strand DW

Single strand anchorage SK6
Stressing and fixed anchor

Annex 18
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Single strand anchorage SK6
strand Y1770S7 15.7 and strand Y1860S7 15.7
minimum centre and edge distances



a_x, a_y ..... Minimum centre distance

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

c ..... Concrete cover

Minimum concrete strength at time of stressing	$f_{cm,\,0,\,cube}$	N/mm²	20	28	36
	$f_{cm,\,0,\,cyl}$	N/mm²	16	23	29
Minimum centre distance		a_x	210	190	170
		a_y	120	105	90
Minimum edge distance (plus c)		r_x	120	110	100
		r_y	50	45	35
Additional reinforcement, ribbed reinforcing steel, $R_e \geq 500$ N/mm²					
Minimum number of longitudinal reinforcement, ∅ 8 mm, per side			2	2	2
Minimum number of stirrups ∅ 8 mm			2	2	2
Minimum height		A	100	85	70
Minimum width		B	190	170	150
Friction loss in stressing anchor is low and does not have to be considered in design and execution.					

Dimensions in mm

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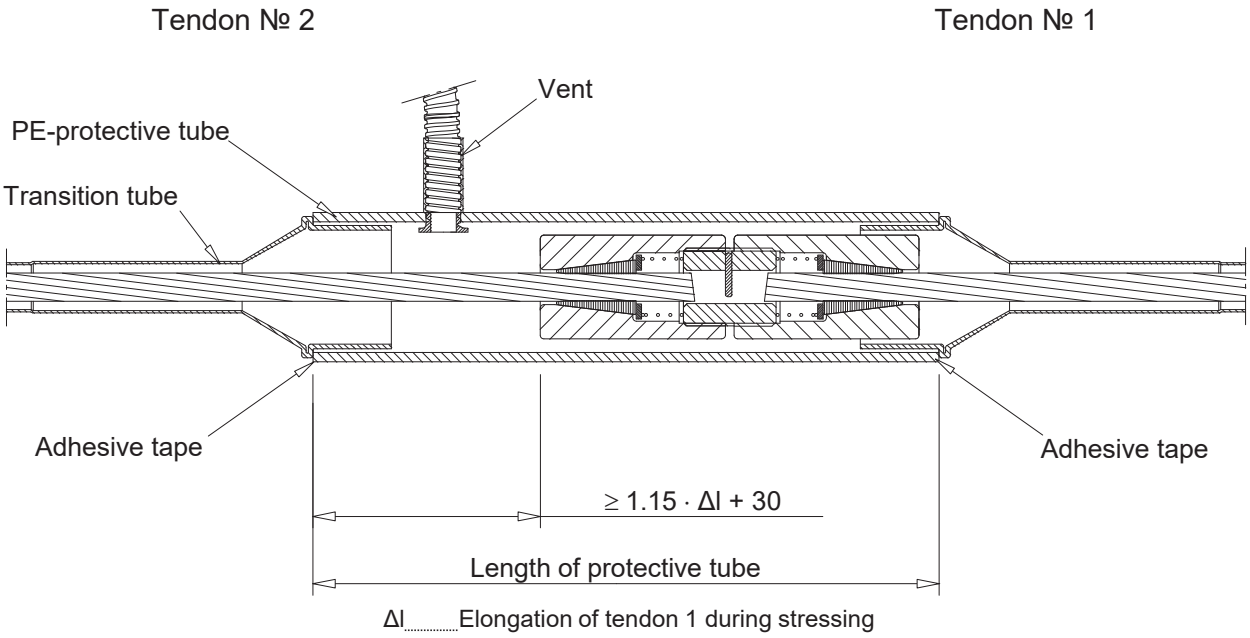
Bonded prestressing system
SUSPA Strand DW

Single strand anchorage SK6
Data sheet

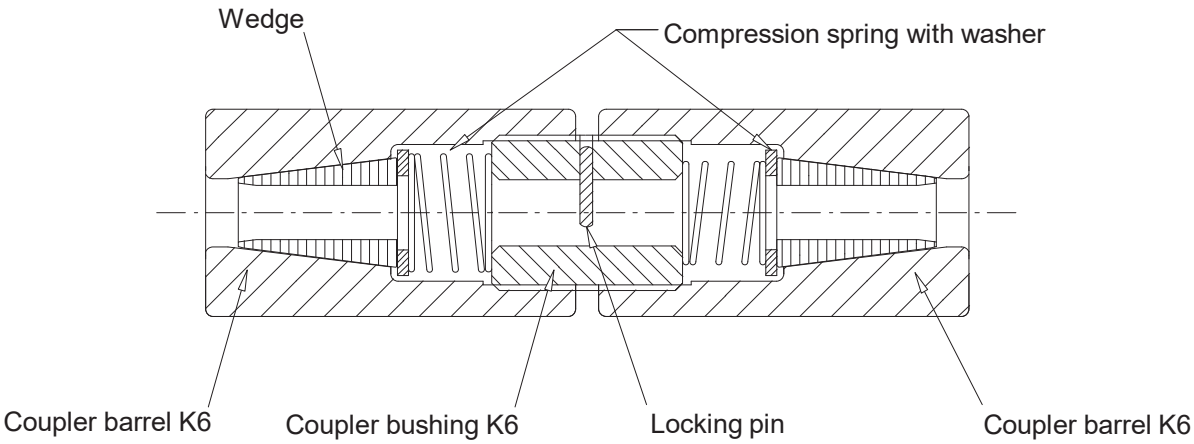
Annex 19
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Movable coupler K6-K6
strand Y1770S7 15.7 and strand Y1860S7 15.7



Minimum engagement length of coupler bushing: 20 mm on both sides

Coupler K6-K6 – Condition as delivered



Friction losses in movable coupler K6-K6 during stressing are low and do not have to be considered in design and execution.

Dimensions in mm

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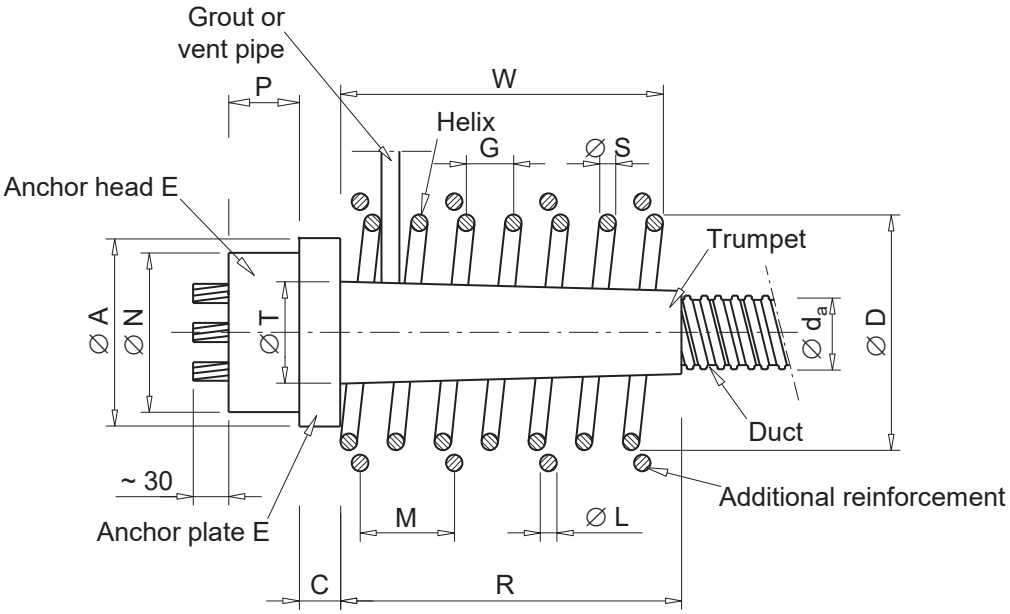
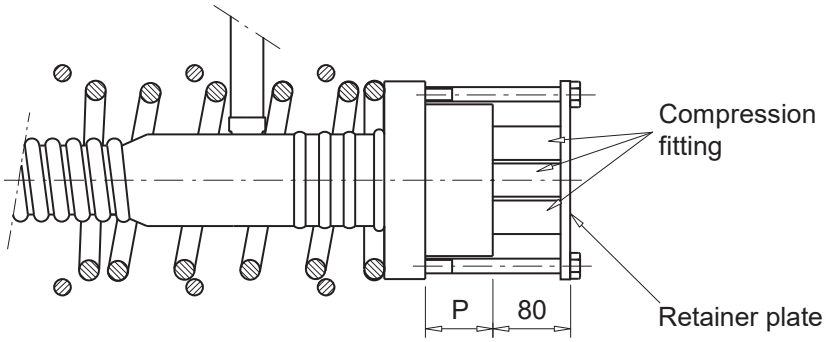
Bonded prestressing system
SUSPA Strand DW
Single strand coupler K6-K6

Annex 20
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Stressing anchor E



Fixed anchor EP



Further dimensions as per stressing anchor E

Dimensions in mm

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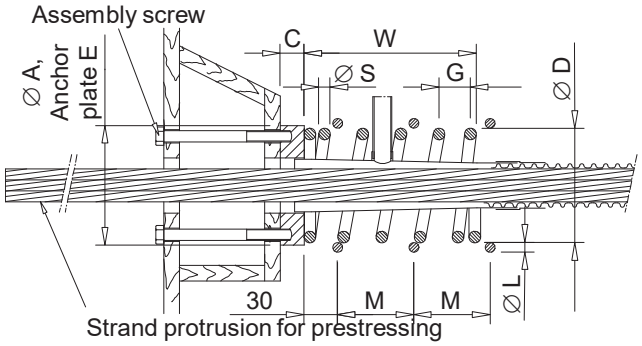
Bonded prestressing system
SUSPA Strand DW
Anchor E and EP

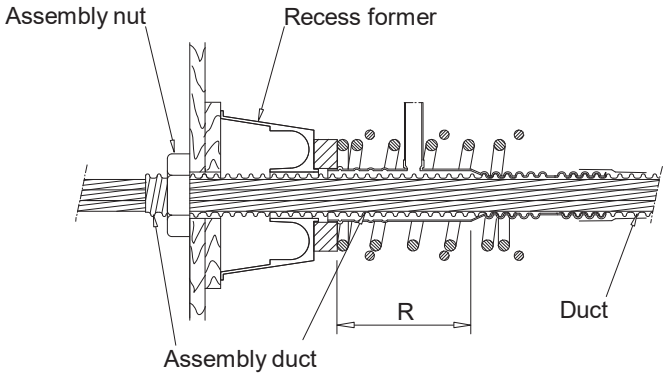
Annex 21
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Assembly overview
Stressing anchor E

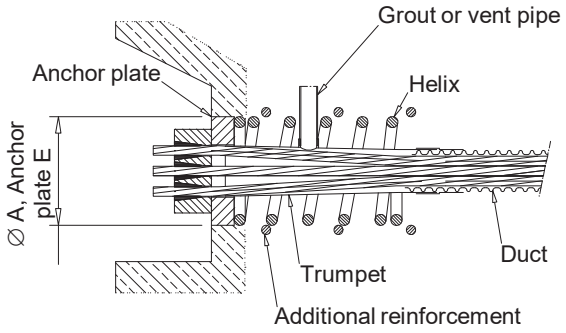
(a) Fastening the anchor plate with assembly screws
Assembly condition

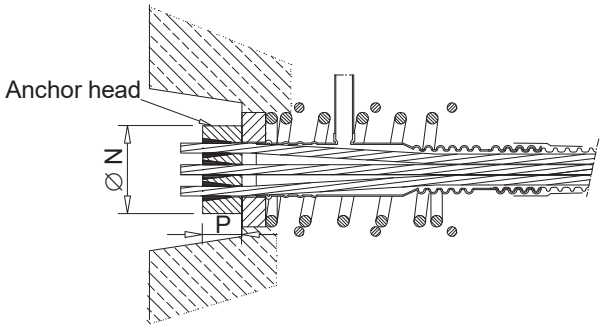


(b) Fastening the anchor plate with assembly duct and recess former
Assembly condition 6-3 to 6-5

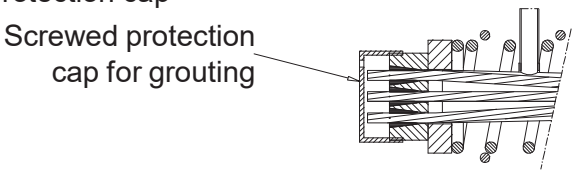


(a) and (b) after stressing



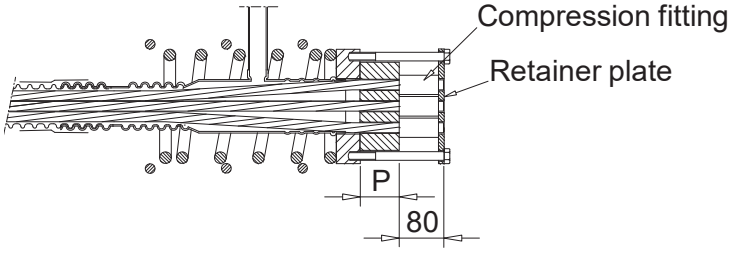


(a) and (b) with screwed on protection cap



Fixed anchor EP

With compression fittings
Assembly and after stressing



Further dimensions as per stressing anchor E

Dimensions in mm

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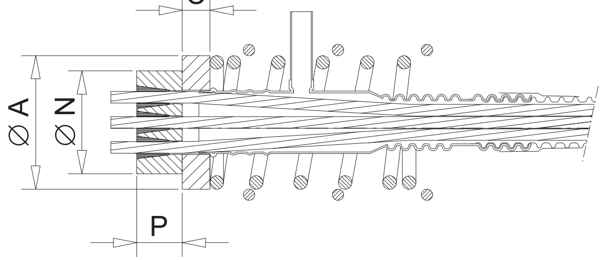
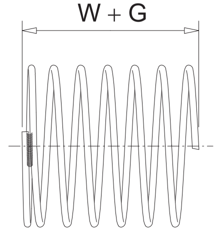
Bonded prestressing system SUSPA Strand DW

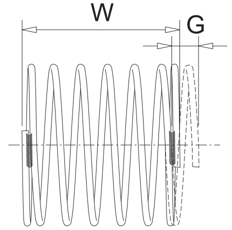
Assembly – Overview

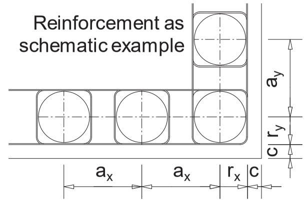
Annex 22
of European Technical Assessment
ETA-13/0839 of 30.03.2021

Stressing anchor E 6-3 to E 6-22 and fixed anchor EP 6-3 to 6-22
Strand Y1770S7 15.7









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

Tendon		6-3	6-4	6-5	6-7	6-9	6-12	6-15	6-19	6-22
Number of strands		3	4	5	7	9	12	15	19	22
Strand arrangement										
Anchor head diameter	Ø N	95	110	135	135	155	170	190	200	220
Thickness	P	50	55	60	60	65	75	85	95	100
Trumpet length	R	160	170	290	290	460	460	650	650	750
Duct I	Ø d_i / d_a	40/47	45/52	50/57	55/62	65/72	75/82	80/87	90/97	95/102
Duct II	Ø d_i / d_a	45/52	50/57	55/62	60/67	70/77	80/87	85/92	95/102	105/112

For strand Y1770S7, nominal diameter 15.7 mm

Tendon		6-3			6-4			6-5			6-7			6-9			6-12			6-15			6-19			6-22		
Minimum concrete compressive strength at time of stressing																												
$f_{cm, 0, cube}$	N/mm²	25	35	45	25	35	45	25	35	45	25	35	45	25	35	45	25	35	45	25	35	45	25	35	45	25	35	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	20	28	36	20	28	36
Minimum centre distance	a_x, a_y	215	195	—	245	220	205	270	245	225	315	280	260	360	325	300	410	370	345	455	410	380	515	460	425	560	500	465
Min. edge distance (plus c)	r_x, r_y	100	90	—	115	100	95	125	115	105	150	130	120	170	155	140	195	175	165	220	195	180	250	220	205	270	240	225
Anchor plate																												
Diameter	Ø A	150	130	—	170	150	150	190	170	170	230	200	200	260	230	230	290	280	280	330	290	290	380	330	330	420	360	360
Thickness	C	25	20	—	30	25	25	30	25	25	35	30	30	45	40	35	50	45	40	60	55	50	65	60	55	70	65	60
Hole diameter	Ø T	58	58	—	72	72	72	86	86	86	86	86	86	112	112	112	120	120	120	150	150	150	152	152	152	174	174	174
Helix																												
Minimum external diameter	Ø D	150	150	—	180	160	160	185	160	160	240	200	180	270	240	240	315	285	270	350	315	300	390	340	330	470	390	360
Minimum wire diameter	Ø S	12	12	—	12	12	14	14	12	14	14	14	14	14	14	14	16	16	14	16	16	14	16	16	16	16	16	16
Maximum pitch	G	50	50	—	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	55	50	50	50	50	50	50
Minimum length	W	235	235	—	285	235	240	290	285	240	340	290	290	390	340	340	395	345	340	445	395	370	445	445	395	495	495	345
Minimum number of turns	H	5	5	—	6	5	5	6	6	5	7	6	6	8	7	7	8	7	7	9	8	7	9	9	8	10	10	7
Additional reinforcement, ribbed reinforcement steel, $R_e \geq$ 500 N/mm²																												
Minimum number of layers	K	4	4	—	5	4	4	5	5	4	4	4	4	5	5	5	6	5	5	6	6	6	7	7	6	8	7	7
Minimum bar diameter	Ø L	10	10	—	10	12	12	10	12	12	12	14	14	12	14	14	14	14	14	14	14	16	14	14	16	14	16	16
Maximum spacing	M	70	60	—	60	60	60	60	60	60	80	70	70	80	80	70	80	80	70	80	70	70	80	70	75	75	75	75

Dimensions in mm

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Bonded prestressing system
SUSPA Strand DW

Stressing anchor E and fixed anchor EP
Prestressing steel strand Y1770S7, 15.7 mm
Data sheet for tendons 6-3 to 6-22

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Bonded prestressing system
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Stressing anchor E and fixed anchor EP
Prestressing steel strand Y1860S7, 15.7 mm
Data sheet for tendons 6-3 to 6-22

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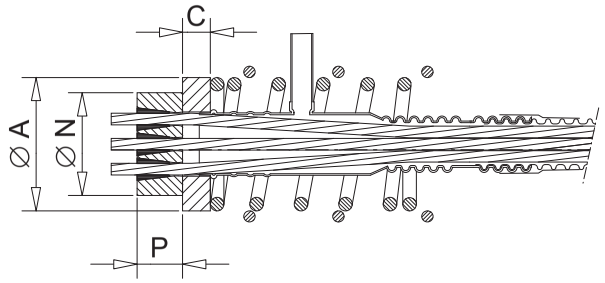
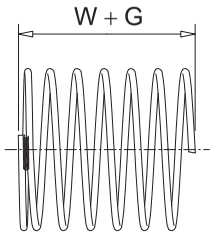
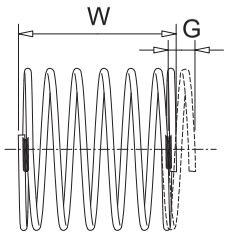
Stressing anchor E 6-3 to E 6-22 and fixed anchor EP 6-3 to 6-22
Strand Y1860S7 15.7



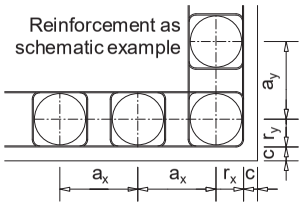
Helix
One end welded



Helix
Both ends welded



Reinforcement as
schematic example



$r_x + c$
$r_y + c$ .... Minimum edge distance

c..... Concrete cover

Tendon		6-3	6-4	6-5	6-7	6-9	6-12	6-15	6-19	6-22
Number of strands		3	4	5	7	9	12	15	19	22
Strand arrangement										
Anchor head diameter	∅ N	95	110	135	135	155	170	190	200	220
Thickness	P	50	55	60	60	65	75	85	95	100
Trumpet length	R	160	170	290	290	460	460	650	650	750
Duct Duct I	∅ d_i / d_a	40/47	45/52	50/57	55/62	65/72	75/82	80/87	90/97	95/102
Duct II	∅ d_i / d_a	45/52	50/57	55/62	60/67	70/77	80/87	85/92	95/102	105/112

For strand Y1860S7, nominal diameter 15.7 mm

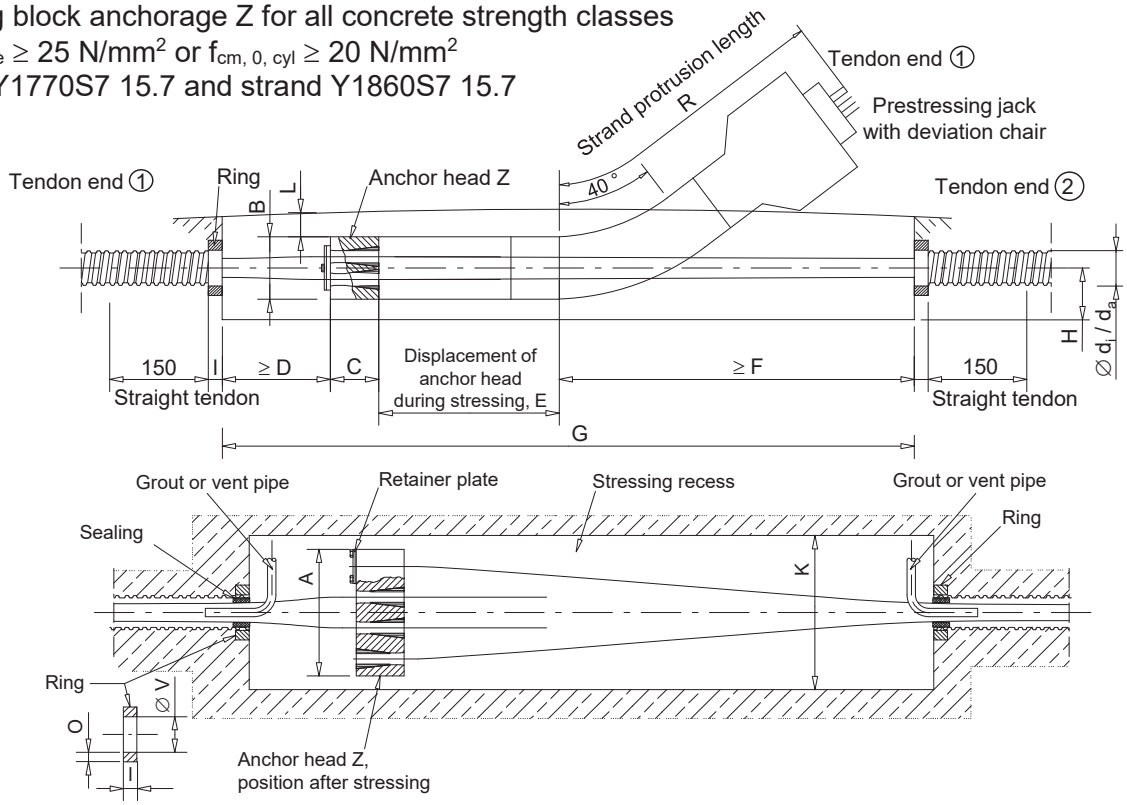
Minimum concrete compressive strength at time of stressing																												
$f_{cm,0,cube}$	N/mm²	25	35	45	25	35	45	25	35	45	25	35	45	25	35	45	25	35	45	25	35	45	25	35	45	25	35	45
$f_{cm,0,cyl}$	N/mm²	20	28	36	20	28	36	20	28	36	20	28	36	20	28	36	20	28	36	20	28	36	20	28	36	20	28	36
Minimum centre distance	a_x, a_y	225	205	185	250	230	210	275	255	235	320	295	270	365	335	305	415	385	350	465	425	390	520	480	440	555	515	475
Min. edge distance (plus c)	r_x, r_y	105	95	85	115	105	95	130	120	110	150	140	125	175	160	145	200	185	165	225	205	185	250	230	210	270	250	230
Anchor plate																												
Diameter	∅ A	155	155	155	175	165	165	200	185	185	235	205	205	260	230	230	295	265	265	330	300	300	380	330	330	420	360	360
Thickness	C	25	25	25	30	30	30	30	30	30	40	40	40	45	40	40	50	50	50	60	55	50	65	60	55	70	65	60
Hole diameter	∅ T	58	58	58	72	72	72	86	86	86	86	86	86	112	112	112	120	120	120	150	150	150	152	152	152	174	174	174
Helix																												
Minimum external diameter	∅ D	160	150	140	180	170	160	200	190	180	245	230	220	280	255	240	330	305	270	375	345	300	430	400	330	470	435	360
Minimum wire diameter	∅ S	12	12	12	12	12	14	12	12	14	14	14	14	14	14	14	16	16	14	16	16	16	16	16	16	16	16	16
Maximum pitch	G	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Minimum length	W	235	235	235	285	235	240	285	285	240	390	290	340	390	340	340	395	345	340	445	395	345	445	445	395	495	495	345
Minimum number of turns	H	5	5	5	6	5	5	6	6	5	8	6	7	8	7	7	8	7	7	9	8	7	9	9	8	10	10	7
Additional reinforcement, ribbed reinforcement steel, $R_e \geq$ 500 N/mm²																												
Minimum number of layers	K	4	4	4	5	4	4	5	4	4	4	4	4	5	5	5	6	5	5	6	6	6	7	7	6	8	7	7
Minimum bar diameter	∅ L	10	10	12	10	12	12	10	12	12	12	14	14	12	14	14	14	16	16	14	16	16	14	16	16	14	16	16
Maximum spacing	M	70	60	60	60	60	60	60	60	60	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70

Dimensions in mm

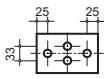
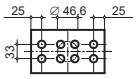
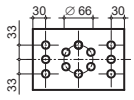
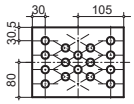
Floating block anchorage Z for all concrete strength classes

$f_{cm,\,0,\,cube} \geq 25$ N/mm² or $f_{cm,\,0,\,cyl} \geq 20$ N/mm²

strand Y1770S7 15.7 and strand Y1860S7 15.7



Over stressing with subsequent release of stressing force is impossible.

Tendon			**Z 6-2**	**Z 6-4**	**Z 6-6**	**Z 6-8**
Number of strands			2	4	6	8
Strand arrangement						
Anchor head	Length	A	140	170	210	210
	Width	B	90	100	140	160
	Thickness	C	70	80	100	100
Strand protrusion	Length	R	850	1 000	1 000	1 200
Duct	Duct I	∅ d_i / d_a	40/47	45/52	55/62	65/72
	Duct II	∅ d_i / d_a	45/52	50/57	60/67	70/77
Ring		∅ V	Duct outer diameter + ~ 3 mm			
		min. O	11	14	14	14
		I	20	20	30	30
Stressing recess		D	100	200	300	400
		E	Elongation of tendon end 2			
		F	550	800	1 000	1 100
		G	720 + E	1 080 + E	1 400 + E	1 600 + E
		H	65	70	90	100
		K	180	210	250	250
		L	Concrete cover required			
Friction loss in floating block anchorage Z, including loss in deviation chair			13 %	13 %	13 %	16 %

Dimensions in mm

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Bonded prestressing system
SUSPA Strand DW

Floating block anchorage Z
Data sheet for tendons Z 6-2 to Z 6-8

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Designation	Specification	Material [1)]
Anchor head E, Anchor head EP	EN ISO 683-1 EN ISO 683-2	Steel
Single strand anchor SK6	EN 1562	Ductile cast iron
	EN 1563	
Anchor head Z, Coupler head K, Coupler head V, Coupler barrel K6, Coupler bushing K6	EN ISO 683-1 EN ISO 683-2	Steel
Anchor plate	EN 10025-2	Steel
Anchor body MA	EN 1563	Ductile cast iron
Wedge	EN 10277	Steel
Compression fitting	EN 10277	Steel
Duct, Telescopic duct	EN 523	Steel
Protective tube	EN 10130	Steel
	EN ISO 17855-1	PE-HD
PE sleeve	EN ISO 17855-1	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
Retainer plate, Retainer ring plate, Venting cap	EN 10025-2	Steel
Trumpet	EN 10130 EN ISO 17855-1	Steel PE-HD
Protection cap	EN ISO 17855-1	PE-HD
Sealing	—	Synthetic caoutchouc

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

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Bonded prestressing system
SUSPA Strand DW
Material specifications

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Strand			Y1770S7	Y1860S7
Characteristic tensile strength	R_m	N/mm²	1 770	1 860
Nominal diameter of strand	D	mm	15.7	
Nominal diameter of outer wire	d_o	mm	5.2	
Diameter of core wire d	d'	mm	$\geq 1.03 \cdot d_o$	
Nominal mass per metre	M	g/m	1 172	
Nominal cross-sectional area	A_p	mm²	150	
Characteristic value of maximum force	F_m	kN	266	279
Maximum value of maximum force	$F_{m,\,max}$	kN	306	321
Characteristic value of 0.1 % proof force [1)]	$F_{p0.1}$	kN	234	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 strands according to prEN 10138-3, 09.2000, the value is multiplied by 0.98
2) Standard value

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Bonded prestressing system
SUSPA Strand DW

Specification of the
7-wire prestressing steel strand

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Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Anchor head E, EP, Anchor head Z, Single strand anchor SK6, Coupler head K, Coupler head V, Coupler barrel K6, Coupler bushing K6, Anchor body MA	Material	Checking [1]	[2]	100 %	continuous
	Detailed dimensions	Testing	[2]	5 %, ≥ 2 specimens	continuous
	Visual inspection [3]	Checking	[2]	100 %	continuous
	Traceability	full			
Anchor plate, Retainer plate, Retainer ring plate	Material	Checking [3]	[2]	100 %	continuous
	Detailed dimensions	Testing	[2]	3 %, ≥ 2 specimens	continuous
	Visual inspection [3]	Checking	[2]	100 %	continuous
	Traceability	bulk			
Wedge, Compression fitting	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 [4]	Checking	[2]	100 %	continuous
	Traceability	full			
Prestressing steel strand	Material	Checking [5]	[2]	100 %	continuous
	Diameter	Testing	[2]	1 sample	each coil or every 7 tons [6]
	Visual inspection [4]	Checking	[2]	1 sample	
Helix in plain round steel, EN 10025	Material	Checking [3]	[2]	100 %	continuous
	Visual inspection [4]	Checking	[2]	100 %	continuous
	Traceability	full			
Steel strip duct	Material	Checking [7]	[2]	100 %	continuous
	Dimension	Testing	[2]	3 %, ≥ 2 specimens	continuous
	Traceability	full			
Protective tube	Material	Checking [7]	[2]	100 %	continuous
	Visual inspection [5]	Checking	[2]	100 %	continuous
	Traceability	full			
Cement, Admixtures, Additions of filling materials as per EN 447	Material	Checking [7]	[2]	100 %	continuous
	Traceability	full			

[1] Checking of relevant certificate, the certificate is an inspection certificate 3.1 according to EN 10204.
[2] Conformity with the specifications of the components
[3] Checking by means of at least a test report 2.2 according to EN 10204.
[4] Successful visual inspection does not need to be documented.
[5] Checking of relevant certificate as long as the basis of "CE"-marking is not available.
[6] Maximum between a coil and 7 tons has to be taken into account.
[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
Traceability	bulk	Traceability of each delivery of components to a defined point
Material		Defined according to the 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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Bonded prestressing system SUSPA Strand DW

Contents of the prescribed test plan

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Subject / type of control		Test of control method	Criteria, if any	Minimum number of samples [1]	Minimum frequency of control
Anchor head E, Anchor head EP, Anchor head Z, Single strand anchorage SK6, Coupler head K, Coupler head V, Coupler barrel K6, Coupler bushing K6, Anchor body MA Anchor plate	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, Compression fitting	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 kit comprises different kinds of anchor bodies and heads e.g. with different materials, different shape, different wedges, etc., then the number of samples are understood as per kind of anchor bodies and heads.

[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 the 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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Bonded prestressing system SUSPA Strand DW

Audit testing

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Reference documents

European Assessment Documents

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

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 1562, 03.2019	Founding – Malleable cast irons
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 683-2, 06.2018	Heat-treatable steels, alloy steels and free-cutting steels – Part 2: 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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Bonded prestressing system SUSPA Strand DW

Reference documents

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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

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