European Technical Assessment
Post-Tensioning Systems

SUSPA SYSTEMS

External Prestressing System with 30 to 84 Prestressing Steel Wires

ETA-07/0186

30 May 2016
**European Technical Assessment**

**ETA-07/0186**

of 30.05.2016

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**General part**

| **Technical Assessment Body issuing the European Technical Assessment** | Österreichisches Institut für Bautechnik (OIB)  
Austrian Institute of Construction Engineering |
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<td>SUSPA – Wire EX</td>
</tr>
<tr>
<td><strong>Product family to which the construction product belongs</strong></td>
<td>External prestressing system with 30 to 84 prestressing steel wires</td>
</tr>
</tbody>
</table>
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| **This European Technical Assessment contains** | 46 pages including Annexes 1 to 23, which form an integral part of this assessment. |
| **This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of** | ETAG 013, Guideline for European technical approval of Post-Tensioning Kits for Prestressing of Structures, edition June 2002, used according to Article 66 (3) of Regulation (EU) No 305/2011 as European Assessment Document. |
| **This European Technical Assessment replaces** | European Technical Assessment ETA-07/0186 from 19.10.2015. |
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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 PT system SUSPA – Wire EX,

comprising the following components, see Annex 1 and Annex 2.

- Tendon
  External, pre-assembled tendon with 30 to 84 tensile elements, wound up on barrels for delivery on site.

- Tensile element
  Circular, plain prestressing steel wire with nominal diameter and nominal tensile strengths as defined in Table 1

<table>
<thead>
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<th>Nominal diameter</th>
<th>Designation according to prEN 10138-2(^2)</th>
<th>Nominal tensile strength</th>
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<tr>
<td>mm</td>
<td></td>
<td>N/mm(^2)</td>
</tr>
<tr>
<td>7.0</td>
<td>Y1670C</td>
<td>1 670</td>
</tr>
<tr>
<td>7.0</td>
<td>Y1770C</td>
<td>1 770</td>
</tr>
</tbody>
</table>

NOTE 1 N/mm\(^2\) = 1 MPa

- Anchor and coupler
  The prestressing steel wires are anchored via cold-upset heads (button heads).
  Stressing anchor C with bearing plate or multi plane anchor body for tendons with 30 to 84 prestressing steel wires

\(^1\) ETA-07/0186 was firstly issued in 2007 as European technical approval with validity from 12.11.2007, extended in 2012 with validity from 12.11.2012, amended in 2013 with validity from 28.06.2013, amended and converted 2015 to European Technical Assessment ETA-07/0186 of 19.10.2015, and amended 2016 to ETA-07/0186 of 30.05.2016.

\(^2\) Standards and guidelines referred to in the European Technical Assessment are listed in Annex 23.
Fixed anchor D with bearing plate or multi plane anchor body for tendons with 30 to 84 prestressing steel wires
Fixed anchor E with bearing plate for tendons with 30 to 84 prestressing steel wires
Fixed coupler C-K with bearing plate or multi plane anchor body for tendons with 30 to 66 prestressing steel wires
Movable coupler K-K for tendons with 30 to 66 prestressing steel wires

- Helix and additional reinforcement in the anchorage zone
- Permanent corrosion protection for tensile elements, anchors and couplers

PT system

1.2 Designation and range of the anchorages and couplers

1.2.1 Designation

The designation of the anchor or coupler unit is by its function in the structure and by the number of prestressing steel wires. The prefix "EX" before the number of the prestressing steel wires refers to the external arrangement of the tendons, i.e. outside the concrete cross section.

The various anchors and couplers are shown in Annex 1 and Annex 2.

1.2.2 Anchors and couplers

1.2.2.1 General

The tendon is pre-assembled at the manufacturing plant. It is wound up on a barrel for delivery on site.

The prestressing steel wires are anchored via cold-upset heads (button heads) in basic bodies or in anchor bodies E. The basic bodies or anchor bodies E provide cylindrical boreholes for 30 to 84 prestressing steel wires. An external thread is machined on the basic body. Button heads and boreholes in basic body and anchor body E are identical for all anchors and couplers, and hence the same principle of anchoring the prestressing steel wires applies from the smallest to the largest anchor.

1.2.2.2 Stressing anchor C

Stressing anchor C comprises a basic body with an external thread, a tensioning sleeve with an external and internal thread, a bearing nut C with an internal thread, and a bearing plate or a multi plane anchor body. The internal thread of the tensioning sleeve is threaded onto the basic body and the bearing nut C is threaded onto the external thread of the tensioning sleeve. Bearing nut C is supported on the bearing plate or multi plane anchor body.

Within the structure

- adjacent to the bearing plate helix and additional reinforcement are arranged centrically aligned with regard to the bearing plate or
- adjacent to the multi plane anchor body additional reinforcement is arranged centrically aligned with regard to the multi plane anchor body.

The pre-assembled tendon is passed through a recess tube and the bearing plate or multi plane anchor body. For details regarding the stressing anchor C, see Annex 5, Annex 6, Annex 8, Annex 9, Annex 10, and Annex 14.

For stressing the tensioning spindle, which transfers the force from the prestressing jack to the tendon, is screwed into the tensioning sleeve. Subsequently the bearing nut C is screwed up to
the bearing plate or multi plane anchor body. After stressing, the force is transferred to the structure by the tensile elements via the basic body, the tensioning sleeve, the bearing nut C, and the bearing plate or multi plane anchor body.

1.2.2.3 Fixed anchor D

The fixed anchor D comprises a basic body with an external thread, a bearing nut D with an internal thread, and a bearing plate or a multi plane anchor body. The bearing nut D, which is screwed on the basic body, is supported on the bearing plate or multi plane anchor body.

Same as to the stressing anchor C within the structure

- adjacent to the bearing plate helix and additional reinforcement are arranged centrically aligned with regard to the bearing plate or
- adjacent to the multi plane anchor body additional reinforcement is arranged centrically aligned with regard to the multi plane anchor body.

The pre-assembled tendon is passed through a recess tube and the bearing plate or multi plane anchor body. For details regarding the fixed anchor D, see Annex 5, Annex 6, Annex 8, Annex 9, Annex 10, and Annex 14.

After stressing, the force is transferred to the structure by the tensile elements via the basic body, the bearing nut D, and the bearing plate or multi plane anchor body.

1.2.2.4 Fixed anchor E

The fixed anchor E comprises an anchor body E and a bearing plate. The anchor body E is supported on the bearing plate. Same as to fixed anchor D within the structure, adjacent to the bearing plate helix and additional reinforcement are arranged centrically aligned with regard to the bearing plate.

The pre-assembled tendon is passed from the anchorage through bearing plate and recess tube. For details regarding the fixed anchor E, see Annex 5, Annex 7, Annex 10, and Annex 14.

After stressing, the force is transferred to the structure by the tensile elements via anchor body E and the bearing plate.

1.2.2.5 Fixed coupler C–K

For the fixed coupler C–K a coupling sleeve and a coupling spindle are employed. The fixed coupler C–K connects a second tendon, second construction stage, with a first tendon previously stressed on stressing anchor C, first construction stage.

Coupling is achieved by the coupling spindle that is screwed into the tensioning sleeve of the previously stressed tendon. The basic body of the second tendon is connected to the coupling spindle via the coupling sleeve. For details regarding the fixed coupler C–K, see Annex 5, Annex 9, Annex 10, Annex 11, and Annex 17.

1.2.2.6 Movable coupler K–K

For the movable coupler K–K two coupling sleeves and a coupling spindle are employed. The movable coupler K–K connects two tendons prior to stressing.

Coupling sleeves are screwed each on the basic bodies of both tendons to be coupled. Coupling is achieved by a coupling spindle that is screwed into the two coupling sleeves. For details regarding the movable coupler K–K, see Annex 11 and Annex 17.

1.3 Designation and range of the tendons

1.3.1 General

The tendon is designated by “SUSPA – Wire EX”, followed by a hyphen and the number of prestressing steel wires, extending up to 84 prestressing steel wires.
1.3.2 Prestressing steel wire

Only circular, plain prestressing steel wire with a nominal diameter of 7.0 mm and a nominal tensile strength of 1 670 or 1 770 N/mm² may be used. The dimensions and specifications of the prestressing steel wire are given in Annex 18.

1.3.3 Maximum stressing forces

The prestressing and overstressing forces are specified in the respective standards and regulations in force at the place of use. Annex 4 lists the maximum prestressing and overstressing forces of the tendons according to Eurocode 2. Overstressing is only permitted, if the force in the prestressing jack can be measured with an accuracy of ± 5 % of the final overstressing force.

Intermediate tendon sizes may be developed from the basic sizes by reducing the number of prestressing steel wires. Thereby the prestressing steel wires are arranged in the best possible radially symmetric way. The maximum prestressing forces are reduced proportionately to the number of prestressing steel wires.

1.4 Centre spacing and edge distances, concrete cover

Depending on the actual mean compressive strength of concrete at the time of stressing, $f_{cm, 0}$, the centre and edge distances of the anchor are given in Annex 9 and Annex 10. However, the centre and edge distances of anchors may be reduced in one direction by up to 15 %, but not smaller than the outer diameter of the helix and the bearing plate or multi plane anchor body dimensions and placing of additional reinforcement remains still possible. In case of reduction of the distances in one direction, the centre and edge distances in the perpendicular direction are increased by the same percentage.

Standards and regulations on concrete cover in force at the place of use are to be observed.

1.5 Concrete strength at time of stressing

Normal concrete according to EN 206 is used.

At the time full prestressing force is transmitted to the concrete structure, the actual mean cube compressive strength of concrete, $f_{cm, 0, \text{cube}}$, or the actual mean cylinder compressive strength of concrete, $f_{cm, 0, \text{cyl}}$, is at least as given in Annex 9 and Annex 10, i.e. $f_{cm, 0, \text{cube}} = 33 \text{ N/mm}^2$ or $40 \text{ N/mm}^2$. The actual mean compressive strength, $f_{cm, 0, \text{cube}}$ or $f_{cm, 0, \text{cyl}}$, is verified by at least three specimens, cube of size 150 mm or cylinder with diameter of 150 mm and height of 300 mm, that are cured under the same conditions as the structure.

1.6 Slip at anchorages and couplers

The impact of slip at anchor and coupler is taken into account for the calculation and determination of the elongation at stressing. The slip per tendon end does not exceed 1 mm.

1.7 Deflection

1.7.1 Deviators

The deviators are designed in accordance with Annex 12 and Annex 13. The deflection half shells are trumpet-shaped at their ends. The trumpet-shaped extension allows compensating angular tolerances. Grease is applied on the contact surface between PE duct and deflection half shells.
Deviators may be open or closed. Where a tendon is placed on a member or passing through a member of the structure, deviator or aperture have such dimensions as to avoid any unintended contact of tendon and structure. In detailing the construction tolerances are taken into account.

1.7.2 Minimum radii of curvature

Depending on the tendon size, the minimum radii of curvature are given in Annex 13. If these radii are observed, prestressing steel edge stresses in the area of curvature do not need to be verified.

1.8 Friction losses

For calculation of loss of prestressing force due to friction Coulomb’s law applies. Calculation of friction loss is by the equation

\[ F_x = F_0 \cdot e^{-\mu \cdot \alpha} \]

Where

- \( F_x \) .......... kN ............. prestressing force at a distance \( x \) along the tendon
- \( F_0 \) .......... kN ............. prestressing force at \( x = 0 \) m
- \( \mu \) ........ rad\(^{-1}\) .......... friction coefficient, see Table 2
- \( \alpha \) .......... rad ............. sum of the angular displacements over distance \( x \), irrespective of direction or sign
- \( x \) .......... m ............. distance along the tendon from the point where prestressing force is equal to \( F_0 \)

**NOTE 1** 1 rad = 1 m/m = 1

**NOTE 2** Wobble effect can be neglected for external tendons

**Table 2: Friction coefficient \( \mu \)**

<table>
<thead>
<tr>
<th>PE duct</th>
<th>( \mu ) rad(^{-1})</th>
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<tbody>
<tr>
<td></td>
<td>0.06</td>
</tr>
</tbody>
</table>

1.9 Reinforcement in the anchorage zone

Verification of transfer of prestressing forces to structural concrete is not required if centre and edge distances of the tendons as well as grade and dimensions of helix and additional reinforcement, see Annex 9, Annex 10, and Clause 1.4, are conformed to. Forces outside the area of helix and additional reinforcement are verified and, if required, covered by appropriate reinforcement. In general, reinforcement of the structure may not be taken into consideration as additional reinforcement. Reinforcement exceeding the required reinforcement of the structure may be used as additional reinforcement, if adequate placing is possible.

If required for a specific project design, the reinforcement given in Annex 9 and Annex 10 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 the ETA holder in order to provide equivalent performance.
Components

1.10 Prestressing steel wire

The prestressing steel wire is suitable for cold-upsetting of button heads. In the course of preparing the European Technical Assessment no characteristic has been assessed for the prestressing steel wires. In execution, a suitable prestressing steel wire that conforms to Annex 18 and is according to the standards and regulations in force at the place of use is applied.

1.11 Anchorages and couplers

1.11.1 General

The anchor and coupler components conform to the specifications given in the Annexes and in the technical file\(^3\) of the European Technical Assessment. The technical file specifies dimensions, materials, information regarding the material identification of the components including tolerances and the materials used in the corrosion protection system.

1.11.2 Basic body

The basic body serves for all anchors and couplers, except for fixed anchor E, to transfer the prestressing force from the prestressing steel wires to the anchor or coupler, see Annex 1, Annex 2, and Annex 3. An external thread is provided on the basic body to screw on tensioning sleeve, bearing nut D, or coupling sleeve.

1.11.3 Tensioning sleeve

The tensioning sleeve provides both an external and an internal thread. It serves to transfer the prestressing force from basic body to bearing nut C in stressing anchor C, see Annex 1, Annex 2, Annex 5, Annex 6, Annex 8. Furthermore the sleeve receives the tensioning spindle during stressing. As regards fixed couplers, see Annex 2 and Annex 11, the coupling spindle is screwed into the tensioning sleeve to couple the tendons.

1.11.4 Bearing nuts C and D

The principal layout of both bearing nuts is identical.

Bearing nut C is used for the stressing anchor and fixed coupler. The internal thread of bearing nut C is screwed on the external thread of the tensioning sleeve, see Annex 1, Annex 2, Annex 5, Annex 6, and Annex 8. During stressing bearing nut C on the tensioning sleeve is screwed up to the bearing plate or multi plane anchor body.

Bearing nut D, which is screwed on the basic body of the fixed anchor, directly transfers the prestressing force from basic body to bearing plate or multi plane anchor body, see Annex 1, Annex 5, Annex 6, and Annex 8.

1.11.5 Anchor body E

Anchor body E is for fixed anchors only. It transfers the prestressing force from the prestressing steel wires directly to the bearing plate, see Annex 1, Annex 5, and Annex 7.

\(^3\) The technical file of the European Technical Assessment is deposited at Österreichisches Institut für Bautechnik and, in so far as is relevant to the tasks of the notified product certification body involved in the assessment and verification of constancy of performance, is handed over to the notified product certification body.
1.11.6 Coupling sleeve
The coupling sleeve is used to connect the basic bodies with the coupling spindle in fixed and movable couplers, see Annex 2 and Annex 11. Compared to the tensioning sleeve, the coupling sleeve provides no external thread.

1.11.7 Coupling spindle
In case of fixed coupler C–K, the coupling spindle serves to connect the second tendon to the previously stressed first tendon and, in case of the movable coupler K–K, to connect the two tendons. The coupling spindle has external threads on both ends, which for the fixed coupler C-K are screwed into the tensioning sleeve and into the coupling sleeve and for the movable coupler K–K are screwed into both coupling sleeves, see Annex 2 and Annex 11.

1.11.8 Bearing plate
The bearing plate, which is of circular shape, has a central hole to pass through the tendon.

1.11.9 Multi plane anchor body
The multi plane anchor body is of circular shape with a central aperture for the tendon and transfers the tendon force by two load transfer planes into the concrete, see Annex 1, Annex 2, Annex 6, and Annex 9.

1.11.10 Button heads of the prestressing steel wires
From prestressing steel wire to basic body and anchor body E the force is transferred by button heads. The button heads may only be cold-upset on suitable prestressing steel wires by means of a special equipment. Diameters and heights of the button heads conforms to the technical file.

1.11.11 Head retaining disc
The head retaining disc is installed on all basic bodies and anchor bodies E of stressing and fixed anchors as well as of couplers.

1.12 Permanent corrosion protection

1.12.1 General
In the course of preparing the European Technical Assessment, no characteristic has been assessed for components and materials of the corrosion protection system referred to in the Clauses 1.12.2 to 1.12.4. In execution, all components or materials have to be selected according to the standards and regulations in force at the place of use. In the absent of such standards or regulations, components and materials in accordance with ETAG 013 are deemed as acceptable. Österreichisches Institut für Bautechnik has been notified about such materials.

1.12.2 Corrosion protecting filling materials
The prestressing steel wires are coated with corrosion protecting filling materials at the factory and subsequently the duct is filled with the same filling material.
The technical specifications of the corrosion protecting filling materials are deposited with Österreichisches Institut für Bautechnik.

1.12.3 Corrosion protection for anchors and couplers
Corrosion protection is applied in accordance with Annex 14 to Annex 17. If installed in an area protected from UV radiation also PE anchor caps according to Annex 15 may be used for stressing anchors C, and fixed anchors D or fixed anchors E. If installed in a non UV protected area, steel anchor caps are installed, see Annex 16.
Where the couplers are not installed in a closed hollow box girder or protected against UV radiation by different means, a second shrinkable sleeve is shrunk over each first shrinkable sleeve of the couplers as a protection to UV radiation.

1.12.4 Corrosion protection of exposed steel parts
Surfaces of all steel parts not protected by a sufficiently thick cover of concrete or by corrosion protecting filling material and PE duct are protected against corrosion by one of the protection systems in accordance with EN ISO 12944-5, unless they consist of stainless steel.
The surface is prepared in accordance with EN ISO 12944-4. EN ISO 12944-7 is observed for the execution of the corrosion protection. If other corrosion protection systems are used, these correspond to those stated above as far as their efficiency is concerned.

1.13 Material specifications of the components
Material specifications of the components are given in Annex 19.

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

2.1 Intended uses
The PT system is intended to be used for the prestressing of structures.

Table 3: Intended uses

<table>
<thead>
<tr>
<th>Line No</th>
<th>Use category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use category according to tendon configuration and material of structure</td>
</tr>
<tr>
<td>1</td>
<td>External tendon where the tendon path is situated outside the cross section of the structure, but inside the envelope of the cross section of the structure, for normal weight concrete in concrete and composite structures</td>
</tr>
</tbody>
</table>

Optional use categories

<table>
<thead>
<tr>
<th>Line No</th>
<th>Use category</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Restressable external tendons</td>
</tr>
<tr>
<td>3</td>
<td>Exchangeable external tendons</td>
</tr>
<tr>
<td>4</td>
<td>Tendon for use in structural steel or composite construction as external tendon</td>
</tr>
</tbody>
</table>
2.2 General assumptions

2.2.1 Packaging, transport and storage

The manufacturer undertakes the appropriate measures and prepares advice on product packaging, transport, and storage. It is the responsibility of the manufacturer of the product to ensure that this information is given to those who are concerned.

Advice on packaging, transport, and storage includes:

- During transport of the tendons a minimum radius of curvature of 0.90 m is observed.
- Temporary protection of prestressing steel and components in order to prevent corrosion during transportation from the production site to the job site.
- Transportation, storage, and handling of the prestressing steel and other components in a manner as to avoid damage by mechanical or chemical impact.
- Protection of prestressing steel and other components from moisture.
- Keeping tensile elements separate from areas where welding operations are performed.

2.2.2 Design

2.2.2.1 General

Design of the structure permits correct installation and stressing of tendons. Reinforcement in the anchorage zone permits correct placing and compacting of concrete.

The initial prestressing force applied to the stressing anchor will decrease especially as a result of friction along the tendon and of the elastic shortening of the structure and in the course of time as a result of creep and shrinkage of concrete and of relaxation of prestressing steel. Advice is provided by stressing instructions prepared by the ETA holder.

The design of the structure should consider protection of the external tendons against damage by e.g. impact of vehicles, vibrations, etc.

2.2.2.2 Helix and additional reinforcement

The centric position of the helix is secured by welding the end ring to the bearing plate or by fastening to the reinforcement.

Additional reinforcement is installed according to Annex 9 or Annex 10 adjacent to bearing plate or multi plane anchor body.

2.2.2.3 Fixed couplers

Under all possible load combinations, the prestressing force at the second construction stage is at no time greater than at the first construction stage, neither during construction nor in the final state.

2.2.3 Installation

2.2.3.1 General

Assembly and installation of tendons are only carried out by qualified PT specialist companies with the required resources and experience in the use of unbonded multi-wire post-tensioning systems, see ETAG 013, Annex D.1 and 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 external prestressing system, "SUSPA - Wire EX".

Anchor plate and anchor body are placed perpendicular to the tendon’s axis. At the anchorages the tendon layout continues with a straight length. Couplers are only placed in straight tendon sections.
The respective standards and regulations in force at the place of use are considered.

2.2.3.2 Ankers

2.2.3.2.1 Stressing anchor C

Installation on site includes the following working steps:
- Installation of the tendon through the aperture, the recess tube, and the bearing plate or multi plane anchor body.
- Screwing the tensioning sleeve on the basic body.
- Place bearing nut C accordingly, to screw it on the tensioning sleeve during stressing.
- Stressing the tendon by means of a tensioning spindle screwed into the tensioning sleeve.
- Applying the prestressing force and screwing bearing nut C to bearing plate or multi plane anchor body.
- Providing the steel parts of the anchor with corrosion protection, see Annex 14.

The minimum engagement depths of the threaded parts in accordance with Annex 5 are observed.

2.2.3.2.2 Fixed anchor D

Installation on site includes the following working steps:
- Installation of the tendon through the aperture, the recess tube, and the bearing plate or multi plane anchor body.
- Screwing the bearing nut D on the basic body.

Providing the steel parts of the anchor with corrosion protection after stressing, see Annex 14.

The minimum engagement depths of the threaded parts in accordance with Annex 5 are observed.

2.2.3.2.3 Fixed anchor E

Installation on site includes the following working steps:
- Installation of the tendon through the bearing plate, the aperture, and the recess tube.

Anchor body E is pre-assembled on the tendon. The tendon is threaded from the anchorage through bearing plate, recess tube, and aperture.
- Providing the steel parts of the anchor with corrosion protection after stressing, see Annex 14.

2.2.3.3 Couplers

2.2.3.3.1 Fixed coupler C-K

The fixed coupler connects a second tendon with a previously stressed first tendon. At the fixed coupler C-K the layout of the tendon axis of the first construction stage coincides with the tendons axis of the second construction stage.

The installation on site includes the following working steps:
- Screwing the coupling spindle into the tensioning sleeve of the previously stressed first tendon.
- Screwing the coupling sleeve on the basic body of the tendon to be attached and on the coupling spindle.
Providing the steel parts of the fixed coupler with corrosion protection in accordance with Annex 17 after stressing of the second construction stage.

The minimum engagement depths of the threaded parts in accordance with Annex 5 and Annex 11 are observed.

2.2.3.3.2 Movable coupler K-K

The movable coupler connects two tendons prior to stressing. The installation on site includes the following working steps:

- Screwing coupling sleeves on the basic bodies of the tendons to be coupled.
- Screwing the coupling spindle into the coupling sleeve screwed on the first basic body.
- Screwing the coupling sleeve of the second tendon on the coupling spindle.
- Providing the steel parts of the movable coupler with corrosion protection in accordance with Annex 17 before or after stressing.

The minimum engagement depths of the threaded parts in accordance with Annex 11 are observed.

2.2.3.4 Checking of tendons

During installation, careful handling of the tendons shall be ensured. Prior to the stressing operation, the person responsible shall perform a final check on the installed tendons.

2.2.3.5 Stressing and stressing records

2.2.3.5.1 Stressing

With a mean concrete compressive strength in the anchorage zone conforming to the specifications in Annex 9, Annex 10, and Clause 1.5 full prestressing may be applied.

The prestressing forces are applied in accordance with a specified stressing schedule. This schedule includes the required mean compressive strength of the concrete, time and sequence of the tendons to be stressed, the various prestressing levels, and the elongations calculated for the tendons, as well as time, and way of lowering and removal of the formwork. Any possible spring back forces of the formwork are taken into account.

2.2.3.5.2 Restressing

Restressing or relaxing the prestressing force is possible at any time. The minimum engagement depths of the threaded parts are observed.

2.2.3.5.3 Stressing records

In particular prestressing forces applied and elongation measured, and any important observations made during the stressing operation are documented in the stressing records.

2.2.3.5.4 Stressing equipment, space requirements, and safety-at-work

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

Clearance is considered directly behind the anchors to stress the tendons. The ETA holder keeps for reference more detailed information on the prestressing jacks used and the required clearance for handling and stressing.

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

2.2.3.6 Welding on anchor

Welding on anchors is permitted on the following parts only.

- Welding the helix end turn to a closed ring.
2.3 Assumed working life

The European Technical Assessment is based on an assumed working life of the PT system of 100 years, provided that the PT system is subject to appropriate installation, use and maintenance, see the Clauses 2.1 to 2.2.3. The indications given as to the working life of the PT system cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by the Technical Assessment Body, but are regarded only as a means for selecting the appropriate products in relation to the expected economically reasonable working life of the works.

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

3.1 Essential characteristics

The performances of the PT system for the essential characteristics are given in Table 4 and Table 5. In Annex 22 the combinations of essential characteristics and corresponding intended uses are listed.

Table 4: Essential characteristics and performances of the product

<table>
<thead>
<tr>
<th>№</th>
<th>Essential characteristic</th>
<th>Product performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>(3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Product
SUSPA – Wire EX

Intended use
The PT system is intended to be used for the prestressing of structures, Clause 2.1, Table 3, line № 1.

Basic requirement for construction works 1: Mechanical resistance and stability

<table>
<thead>
<tr>
<th>№</th>
<th>Essential characteristic</th>
<th>Product performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Resistance to static load</td>
<td>See Clause 3.1.1.1.</td>
</tr>
<tr>
<td>2</td>
<td>Resistance to fatigue</td>
<td>See Clause 3.1.1.2.</td>
</tr>
<tr>
<td>3</td>
<td>Load transfer to the structure</td>
<td>See Clause 3.1.1.3.</td>
</tr>
<tr>
<td>4</td>
<td>Friction coefficient</td>
<td>See Clause 3.1.1.4.</td>
</tr>
<tr>
<td>5</td>
<td>Deviation, deflection (limits)</td>
<td>See Clause 3.1.1.5.</td>
</tr>
</tbody>
</table>

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.
<table>
<thead>
<tr>
<th>№</th>
<th>Essential characteristic</th>
<th>Product performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Practicability, reliability of installation</td>
<td>See Clause 3.1.1.6.</td>
</tr>
</tbody>
</table>

Basic requirement for construction works 2: Safety in case of fire

- Not relevant. No characteristic assessed.

Basic requirement for construction works 3: Hygiene, health, and the environment

| 7 | Content, emission, and/or release of dangerous substances | See Clause 3.1.2.                          |

Basic requirement for construction works 4: Safety and accessibility in use

- Not relevant. No characteristic assessed.

Basic requirement for construction works 5: Protection against noise

- Not relevant. No characteristic assessed.

Basic requirement for construction works 6: Energy economy and heat retention

- Not relevant. No characteristic assessed.

Basic requirement for construction works 7: Sustainable use of natural resources

- No characteristic assessed.

Related aspects of serviceability

| 8 | Related aspects of serviceability                        | See Clause 3.1.3.                          |

**Table 5: Additional essential characteristics and performances of the product for optional use categories**

<table>
<thead>
<tr>
<th>№</th>
<th>Additional essential characteristic</th>
<th>Product performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Product
SUSPA – Wire EX

Optional use category
Clause 2.1, Table 3, line № 2, restressable external tendon

Basic requirement for construction works 1: Mechanical resistance and stability

| 9 | Practicability, reliability of installation | See Clause 3.1.4.1. |

OIB-205-053/15-059
## Optional use category

Clause 2.1, Table 3, line № 3, exchangeable external tendon

### Basic requirement for construction works 1: Mechanical resistance and stability

<table>
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<tr>
<th>№</th>
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<th>Product performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
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<td>(2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Optional use category

Clause 2.1, Table 3, line № 4, tendon for use in structural steel or composite construction as external tendon

### Basic requirement for construction works 1: Mechanical resistance and stability

<table>
<thead>
<tr>
<th>№</th>
<th>Product performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10)</td>
<td>Practicability, reliability of installation</td>
</tr>
<tr>
<td>(11)</td>
<td>Load transfer to the structure</td>
</tr>
</tbody>
</table>

### 3.1.1 Mechanical resistance and stability

#### 3.1.1.1 Resistance to static load

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.1-I. The characteristic values of maximum force, \( F_{pk} \), of the tendon with prestressing steel wires according to Annex 18 are listed in Annex 18.

#### 3.1.1.2 Resistance to fatigue

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.2-I. The characteristic values of maximum force, \( F_{pk} \), of the tendon with prestressing steel wires according to Annex 18 are listed in Annex 18.

The 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.

#### 3.1.1.3 Load transfer to the structure

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.3-I. The characteristic values of maximum force, \( F_{pk} \), of the tendon with prestressing steel wires according to Annex 18 are listed in Annex 18.

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

#### 3.1.1.4 Friction coefficient

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.4-I. For friction losses including friction coefficient see Clause 1.8.

#### 3.1.1.5 Deviation, deflection (limits)

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.5-I. For minimum radii of curvature see Clause 1.7.2.

#### 3.1.1.6 Practicability, reliability of installation

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.6-I.
3.1.2 Hygiene, health, and the environment

Content, emission, and/or release of dangerous substances is determined according to ETAG 013, Clause 5.3.1. No dangerous substances is the performance of the PT system in this respect. A manufacturer’s declaration to this effect has been submitted.

NOTE In addition to specific clauses relating to dangerous substances in the European Technical Assessment, there may be other requirements applicable to the product falling within their scope, e.g. transposed European legislation and national laws, regulations and administrative provisions. These requirements also need to be complied with, when and where they apply.

3.1.3 Related aspects of serviceability

The PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.7.

3.1.4 Mechanical resistance and stability

3.1.4.1 Restressable external tendon – Practicability, reliability of installation

For restressable external tendons the PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.6-ll(a).

3.1.4.2 Exchangeable external tendon – Practicability, reliability of installation

For exchangeable external tendons the PT system as described in the ETA meets the acceptance criteria of ETAG 013, Clause 6.1.6-ll(b).

3.1.4.3 Tendon for use in structural steel or composite construction as external tendon – Load transfer to the structure

Load transfer of prestressing force to steel structures is via steel members designed according to Eurocode 3.

The steel members have such dimensions as to permit a force of $1.1 \cdot F_{pk}$ being transferred into the steel structure. The verification is performed according to Eurocode 3 as well as to the respective standards and regulations in force at the place of use. The characteristic values of maximum force, $F_{pk}$, of the tendon with prestressing steel wires according to Annex 18 are listed in Annex 18.

3.2 Assessment methods

The assessment of the essential characteristics in Clause 3.1 of the PT system for the intended uses and in relation to the requirements for mechanical resistance and stability, and for hygiene, health, and the environment in the sense of the basic requirements for construction works № 1 and 3 of Regulation (EU) № 305/2011 has been made in accordance with the Guideline for European technical approvals of “Post-Tensioning Kits for Prestressing of Structures”, ETAG 013, Edition June 2002, used according to Article 66.3. of Regulation (EU) № 305/2011 as European Assessment Document, based on the assessment for external systems.

3.3 Identification

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

\(^5\) The technical file of the European Technical Assessment is deposited at Österreichisches Institut für Bautechnik.
4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

4.1 System of assessment and verification of constancy of performance

According to Commission Decision 98/456/EC the system of assessment and verification of constancy of performance to be applied to the PT system is System 1+. System 1+ is detailed in Commission Delegated Regulation (EU) N 568/2014 of 18 February 2014, Annex, 1.1., and provides for the following items.

(a) The manufacturer shall carry out
   (i) factory production control;
   (ii) further testing of samples taken at the manufacturing plant by the manufacturer in accordance with the prescribed test plan$^6$.

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

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

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

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

5.1 Tasks for the manufacturer

5.1.1 Factory production control

In the manufacturing plant the manufacturer establishes and continuously maintains a factory production control. All procedures and specification adopted by the manufacturer are documented in a systematic manner. Purpose of factory production control is to ensure the constancy of performances of the PT system with regard to the essential characteristics.

The manufacturer only uses raw materials supplied with the relevant inspection documents as laid down in the control plan. The incoming raw materials are subjected to controls by the

$^6$ 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.
manufacturer before acceptance. Check of incoming materials includes control of inspection documents presented by the manufacturer of the raw materials.

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

If test results are unsatisfactory, the manufacturer shall immediately implement measures to eliminate the defects. Construction products or components that are not in conformity with the requirements are removed. After elimination of the defects, the respective test – if verification is required for technical reasons – is repeated immediately.

At least once a year the manufacturer audits the manufacturers of the components given in Annex 21. The basic elements of the prescribed test plan are given in Annex 20, conform to ETAG 013, Annex E.1, and are specified in the quality management plan of “SUSPA – Wire EX”.

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 a declaration of performance. Essential characteristics to be included in the declaration of performance for the corresponding intended use are given in Table 4 and Table 5. In Annex 22 the combinations of essential characteristics and corresponding intended uses are listed.

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 verifies the ability of the manufacturer for a continuous and orderly manufacturing of the PT system according to the European Technical Assessment. In particular the following items are appropriately considered.

- Personnel and equipment
- Suitability of the factory production control established by the manufacturer
- Full implementation of the prescribed test plan

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

The notified product certification body visits the factory at least once a year for routine inspection. In particular the following items are appropriately considered.

- Manufacturing process including personnel and equipment
- Factory production control
- Implementation of the prescribed test plan

Each component manufacturer of the components listed in Annex 21 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 inspections the notified product certification body takes samples of components of the PT system for independent testing. For the most important components Annex 21 summarises the minimum procedures performed by the notified product certification body.

Issued in Vienna on 30 May 2016
by Österreichisches Institut für Bautechnik

The original document is signed by

Rainer Mikulits
Managing Director
Overview on tendons and anchorage assemblies, and maximum prestressing forces

<table>
<thead>
<tr>
<th>Tendon</th>
<th>SUSPA – Wire</th>
<th>EX-30</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
<th>EX-78</th>
<th>EX-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum prestressing force for Y1670C at 0.90 · Fp0,1</td>
<td>kN</td>
<td>1528</td>
<td>1834</td>
<td>2139</td>
<td>2445</td>
<td>2751</td>
<td>3056</td>
<td>3362</td>
<td>3668</td>
<td>3973</td>
<td>4279</td>
</tr>
<tr>
<td>Maximum prestressing force for Y1770C at 0.90 · Fp0,1</td>
<td>kN</td>
<td>1617</td>
<td>1941</td>
<td>2264</td>
<td>2588</td>
<td>2911</td>
<td>3235</td>
<td>3558</td>
<td>3882</td>
<td>4205</td>
<td>4528</td>
</tr>
<tr>
<td>Stressing anchor C</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fixed anchor D and E</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Multi plane anchorage C and D</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Key
✓ ...... Available
**Fixed coupler C–K**

*with bearing plate anchorage*

- Stressing anchor C
- Coupler K
- Tensioning sleeve
- Basic body
- Coupling sleeve
- Coupling spindle
- Bearing nut C

**Fixed coupler C–K**

*with multi plane anchor body*

- Stressing anchor C
- Coupler K
- Multi plane anchor body
- Bearing nut C
- Coupling sleeve
- Coupling spindle
- Tensioning sleeve

**Movable coupler K–K**

- Coupler K
- Coupler K
- Coupling sleeve
- Coupling spindle
- Coupling sleeve

---

### Overview on tendons and coupler assemblies, and maximum prestressing forces

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<tbody>
<tr>
<td>Maximum prestressing force</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fixed coupler C–K</td>
<td>—</td>
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</tr>
<tr>
<td>Movable coupler K–K</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

**Key**

- ✓ ..... Available
- — ..... Not available

---

**External prestressing system**

**SUSPA – Wire Ex**

**Coupler assemblies – Overview**

---

**Annex 2**

of European Technical Assessment ETA-07/0186 of 30.05.2016

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**OIB-205-053/15-059**
External Prestressing System

Tendon including sheathing scheme

Sheeting scheme

SUSPA wire EX

Tendon after prefabrication

Tendon retaining head 

PE duct end

Expander ring 

PE duct reducer

Tension straps

Basic body

Anchorage sleeve

PE duct 

PE welding fitting

Injected with corrosion protection wax

Prestressing steel wires

Expander ring

Basic body

Anchorage sleeve

Tensioning disc
<table>
<thead>
<tr>
<th>Number of wires</th>
<th>Wire mass</th>
<th>Cross-sectional area of wires</th>
<th>( f_{pk} = 1670 \text{ N/mm}^2 )</th>
<th>( f_{pk} = 1770 \text{ N/mm}^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maximum prestressing force</td>
<td>Maximum overstressing force</td>
</tr>
<tr>
<td></td>
<td>kg/m</td>
<td>mm²</td>
<td>kN</td>
<td>kN</td>
</tr>
<tr>
<td>30</td>
<td>9.0</td>
<td>1155</td>
<td>1528</td>
<td>1613</td>
</tr>
<tr>
<td>36</td>
<td>10.8</td>
<td>1388</td>
<td>1834</td>
<td>1936</td>
</tr>
<tr>
<td>42</td>
<td>12.6</td>
<td>1617</td>
<td>2139</td>
<td>2258</td>
</tr>
<tr>
<td>48</td>
<td>14.4</td>
<td>1848</td>
<td>2445</td>
<td>2581</td>
</tr>
<tr>
<td>54</td>
<td>16.2</td>
<td>2079</td>
<td>2751</td>
<td>2904</td>
</tr>
<tr>
<td>60</td>
<td>18.0</td>
<td>2310</td>
<td>3056</td>
<td>3226</td>
</tr>
<tr>
<td>66</td>
<td>19.8</td>
<td>2541</td>
<td>3362</td>
<td>3549</td>
</tr>
<tr>
<td>72</td>
<td>21.7</td>
<td>2772</td>
<td>3668</td>
<td>3871</td>
</tr>
<tr>
<td>78</td>
<td>23.5</td>
<td>3003</td>
<td>3973</td>
<td>4194</td>
</tr>
<tr>
<td>84</td>
<td>25.3</td>
<td>3234</td>
<td>4279</td>
<td>4517</td>
</tr>
</tbody>
</table>

Notes:
- \( A_p \cdot 0.90 \cdot f_{p0,1} = 0.90 \cdot f_{p0,1} \) .......... Maximum prestressing force.
- \( A_p \cdot 0.95 \cdot f_{p0,1} = 0.95 \cdot f_{p0,1} \) .......... Maximum overstressing force.

For \( f_{p0,1} = A_p \cdot f_{p0,1} \) see Annex 18.

By omitting wires in anchorages and couplers in a radially symmetrical way, also tendons with numbers of wires lying between the numbers given above can be installed. Any unnecessary hole remains undrilled.

With regard to dimensions and reinforcement, anchorages and couplers with omitted wires remain unchanged compared to anchorages and couplers with a full number of wires.

Each omitted wire reduces mass, cross-sectional area, and prestressing force of the tendon by the figures given in the following table.

<table>
<thead>
<tr>
<th>Number of wires</th>
<th>Wire mass</th>
<th>Cross-sectional area of wires</th>
<th>( f_{pk} = 1670 \text{ N/mm}^2 )</th>
<th>( f_{pk} = 1770 \text{ N/mm}^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maximum prestressing force</td>
<td>Maximum overstressing force</td>
</tr>
<tr>
<td></td>
<td>kg/m</td>
<td>mm²</td>
<td>kN</td>
<td>kN</td>
</tr>
<tr>
<td>1</td>
<td>0.300</td>
<td>38.5</td>
<td>50.9</td>
<td>53.8</td>
</tr>
</tbody>
</table>
### Technical data for tendons EX-30 to EX-84

<table>
<thead>
<tr>
<th>Tendon</th>
<th>SUSPA – Wire Ex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferred sizes X</td>
<td>EX-30 EX-36 EX-42 EX-48 EX-54 EX-60 EX-66 EX-72 EX-78 EX-84</td>
</tr>
<tr>
<td>PE pipes</td>
<td></td>
</tr>
<tr>
<td>Recess tube C and D</td>
<td>( \varnothing \text{d}_{31} \times s )</td>
</tr>
<tr>
<td>Recess tube E</td>
<td>( \varnothing \text{d}_{31} )</td>
</tr>
<tr>
<td>( \varnothing \text{min}_{31} )</td>
<td>101</td>
</tr>
<tr>
<td>Duct type 1</td>
<td>( \varnothing \text{d}_{32} \times s )</td>
</tr>
<tr>
<td>Duct type 2</td>
<td>( \varnothing \text{d}_{32} \times s )</td>
</tr>
<tr>
<td>Characteristic friction coefficient ( \mu )</td>
<td>( \mu )</td>
</tr>
</tbody>
</table>

### Anchoring components with thread C and D

<table>
<thead>
<tr>
<th>Basic body</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum engagement depth</td>
<td>( D_v )</td>
</tr>
<tr>
<td>Length of tensioning sleeve</td>
<td>( L_z )</td>
</tr>
<tr>
<td>Bearing nut C</td>
<td>( \Omega \text{M} )</td>
</tr>
<tr>
<td>Height</td>
<td>( C_h )</td>
</tr>
<tr>
<td>Minimum engagement depth</td>
<td>( C_v )</td>
</tr>
<tr>
<td>Bearing nut D</td>
<td>( \Omega \text{M} )</td>
</tr>
<tr>
<td>Height</td>
<td>( D_h )</td>
</tr>
<tr>
<td>Minimum engagement depth</td>
<td>( D_v )</td>
</tr>
</tbody>
</table>

### Anchoring components fixed anchor E

| Outer diameter | \( \Omega \text{E} \) | 138                      | 147                      | 158                      | 167                      | 177                      | 188                      | 198                      | 203                      | 213                      | 218                      |
| Height overall  | \( G_{\text{E}} \) | 70                      | 73                      | 80                      | 80                      | 95                      | 90                      | 100                      | 105                      | 110                      | 115                      |
| Height over bearing plate, thread connection | \( E_{\text{E}} \) | 52                      | 57                      | 60                      | 63                      | 76                      | 71                      | 80                      | 86                      | 90                      | 96                      |
| Thread diameter  | \( \Omega \text{G} \) | 80                      | 88                      | 95                      | 98                      | 98                      | 108                      | 117                      | 117                      | 121                      | 121                      |
| Height over bearing plate, flange connection | \( E_{\text{G}} \) | 74                      | 77                      | 84                      | 84                      | 99                      | 94                      | 104                      | 109                      | 114                      | 119                      |

Dimensions in mm

---

**Note:** The above information is a summary of technical data for tendons EX-30 to EX-84. For complete details, please refer to the original document or technical manual.
Stressing anchor C

Fixed anchor D

Above representations without corrosion protection, see Annex 14

External prestressing system
SUSPA – Wire Ex
Stressing anchor C and fixed anchor D with multi plane anchor body – Anchorage layout

Annex 6 of European Technical Assessment ETA-07/0186 of 30.05.2016
Fixed anchor E with thread connection

Fixed anchor E with flange connection

Fixed anchor E is applicable with bearing plate only.

Above representations without corrosion protection, see Annex 14

External prestressing system
SUSPA – Wire Ex
Fixed anchor E with bearing plate
Anchorage layout

Annex 7
of European Technical Assessment ETA-07/0186 of 30.05.2016
Stressing anchor C

Fixed anchor D

Above representations without corrosion protection, see Annex 14
### Multi plane anchor body

**Stressing anchor C and fixed anchor D**

![Diagram of anchor body](image)

### Tendon SUSPA – Wire

<table>
<thead>
<tr>
<th>Tendon</th>
<th>SUSPA – Wire</th>
<th>EX-30 1)</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
<th>EX78</th>
<th>EX-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete strength $f_{cm}$, 0, cube 150 N/mm² during prestressing</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Multi plane anchor body

<table>
<thead>
<tr>
<th>Dimension</th>
<th>EX-30 1)</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
<th>EX78</th>
<th>EX-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer diameter $\varnothing A$</td>
<td>276</td>
<td>276</td>
<td>322</td>
<td>322</td>
<td>322</td>
<td>367</td>
<td>367</td>
<td>367</td>
<td>387</td>
<td>387</td>
</tr>
<tr>
<td>Aperture $\varnothing T$</td>
<td>152</td>
<td>152</td>
<td>172</td>
<td>172</td>
<td>172</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>193</td>
<td>193</td>
</tr>
<tr>
<td>Inner diameter $\varnothing b_1$</td>
<td>163</td>
<td>163</td>
<td>183</td>
<td>183</td>
<td>183</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
</tr>
<tr>
<td>Inner diameter notch $\varnothing b_2$</td>
<td>171</td>
<td>171</td>
<td>197</td>
<td>197</td>
<td>197</td>
<td>207</td>
<td>207</td>
<td>207</td>
<td>207</td>
<td>207</td>
</tr>
<tr>
<td>Thickness D</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Height $J$</td>
<td>132</td>
<td>132</td>
<td>154</td>
<td>154</td>
<td>154</td>
<td>175</td>
<td>175</td>
<td>175</td>
<td>185</td>
<td>185</td>
</tr>
</tbody>
</table>

### Minimum anchor distances

<table>
<thead>
<tr>
<th>Distance</th>
<th>EX-30 1)</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
<th>EX78</th>
<th>EX-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge distance (plus c) 2)</td>
<td>r_{ex/ey}</td>
<td>155</td>
<td>170</td>
<td>185</td>
<td>195</td>
<td>205</td>
<td>215</td>
<td>225</td>
<td>235</td>
<td>245</td>
</tr>
<tr>
<td>Centre distance $a_{ex/ey}$</td>
<td>330</td>
<td>355</td>
<td>385</td>
<td>405</td>
<td>425</td>
<td>450</td>
<td>470</td>
<td>490</td>
<td>505</td>
<td>520</td>
</tr>
</tbody>
</table>

### Additional reinforcement, ribbed reinforcing steel, $R_e \geq 500$ N/mm²

<table>
<thead>
<tr>
<th>Dimension</th>
<th>EX-30 1)</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
<th>EX78</th>
<th>EX-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar diameter $d_s$</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Edge distance $z$</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Distance $i$</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Number $n$</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>External dimensions $x/y$</td>
<td>300</td>
<td>310</td>
<td>320</td>
<td>340</td>
<td>360</td>
<td>370</td>
<td>380</td>
<td>395</td>
<td>410</td>
<td>430</td>
</tr>
</tbody>
</table>

1) Anchor EX-36 equipped with 30 prestressing steel wires only

2) c ... concrete cover

Dimensions in mm
**Bearing plate anchorage**

**Stressing anchor C and fixed anchor D and E**

---

### Tendon

**SUSPA – Wire**

**Preferred sizes X**

<table>
<thead>
<tr>
<th>Tendon</th>
<th>EX-30</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
<th>EX-78</th>
<th>EX-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearing plates and helixes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete strength $f_{cm}$, cube 150 during prestressing</td>
<td>N/mm²</td>
<td>33</td>
<td>40</td>
<td>33</td>
<td>40</td>
<td>33</td>
<td>40</td>
<td>33</td>
<td>40</td>
<td>33</td>
</tr>
<tr>
<td>Bearing plate</td>
<td>Ø A</td>
<td>320</td>
<td>360</td>
<td>360</td>
<td>370</td>
<td>405</td>
<td>405</td>
<td>415</td>
<td>405</td>
<td>425</td>
</tr>
<tr>
<td>Aperture anchors C and D</td>
<td>Ø T</td>
<td>143</td>
<td>183</td>
<td>183</td>
<td>183</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
<td>203</td>
</tr>
<tr>
<td>Aperture anchor E</td>
<td>Ø T</td>
<td>101</td>
<td>118</td>
<td>121</td>
<td>122</td>
<td>133</td>
<td>141</td>
<td>141</td>
<td>141</td>
<td>141</td>
</tr>
<tr>
<td>Thickness</td>
<td>D</td>
<td>50</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>Helix outer diameter</td>
<td>Ø W</td>
<td>300</td>
<td>350</td>
<td>350</td>
<td>360</td>
<td>410</td>
<td>410</td>
<td>420</td>
<td>410</td>
<td>430</td>
</tr>
<tr>
<td>Maximum pitch</td>
<td>G</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Minimum length</td>
<td>Lw</td>
<td>262</td>
<td>314</td>
<td>316</td>
<td>366</td>
<td>416</td>
<td>416</td>
<td>416</td>
<td>416</td>
<td>416</td>
</tr>
<tr>
<td>Minimum wire diameter</td>
<td>Ø d</td>
<td>12</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>PE anchor cap</td>
<td>Ø H</td>
<td>225</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>315</td>
<td>315</td>
<td>315</td>
<td>315</td>
<td>315</td>
</tr>
<tr>
<td>Minimum length of cap C</td>
<td>Ci</td>
<td>170</td>
<td>200</td>
<td>200</td>
<td>230</td>
<td>240</td>
<td>240</td>
<td>240</td>
<td>260</td>
<td>275</td>
</tr>
<tr>
<td>Minimum length of cap D and E</td>
<td>Di</td>
<td>100</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>120</td>
<td>160</td>
<td>160</td>
<td>165</td>
<td>170</td>
</tr>
<tr>
<td>Steel anchor cap</td>
<td>Ø H</td>
<td>229</td>
<td>254</td>
<td>279</td>
<td>279</td>
<td>298.5</td>
<td>298.5</td>
<td>298.5</td>
<td>305</td>
<td>318</td>
</tr>
<tr>
<td>Minimum length of cap C</td>
<td>Ci</td>
<td>180</td>
<td>243</td>
<td>243</td>
<td>243</td>
<td>235</td>
<td>235</td>
<td>235</td>
<td>255</td>
<td>270</td>
</tr>
<tr>
<td>Minimum length of cap D and E</td>
<td>Di</td>
<td>110</td>
<td>133</td>
<td>133</td>
<td>133</td>
<td>155</td>
<td>155</td>
<td>155</td>
<td>160</td>
<td>165</td>
</tr>
</tbody>
</table>

**Minimum anchor distances**

- Edge distance (plus $c$) ¹) $r_{H} \bar{F}_{y}$
- Centre distance $a_{H} \bar{F}_{y}$

| Additional reinforcement, ribbed reinforcing steel, $R_{y} \geq 500$ N/mm² |
|-----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Bar diameter | Ø d | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Edge distance | z | 115 | 120 | 130 | 130 | 125 | 125 | 125 | 110 | 110 | 110 | 110 | 110 |
| Distance | l | 50 | 50 | 50 | 50 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Number | n | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

¹) $c$ ... Concrete cover

Dimensions in mm
Fixed coupler C–K
Bearing plate

Stressing anchor C

Movable coupler
K–K

Representations without corrosion protection, see Annex 17

<table>
<thead>
<tr>
<th>Tendon</th>
<th>SUSPA – Wire</th>
<th>EX-30</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchor cap FK (steel)</td>
<td>Ø H</td>
<td>229</td>
<td>254</td>
<td>279</td>
<td>279</td>
<td>279</td>
<td>298.5</td>
<td>298.5</td>
</tr>
<tr>
<td>min. length</td>
<td>H_l</td>
<td>100</td>
<td>100</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>PE sheath tubes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>min. length FK</td>
<td>F_l</td>
<td>400</td>
<td>430</td>
<td>510</td>
<td>510</td>
<td>620</td>
<td>640</td>
<td>700</td>
</tr>
<tr>
<td>min. length BK</td>
<td>B_l</td>
<td>500</td>
<td>530</td>
<td>630</td>
<td>630</td>
<td>670</td>
<td>700</td>
<td>750</td>
</tr>
<tr>
<td>Components with thread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coupling sleeve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>min. engagement depth</td>
<td>D_v</td>
<td>46</td>
<td>50</td>
<td>60</td>
<td>60</td>
<td>76</td>
<td>70</td>
<td>78</td>
</tr>
<tr>
<td>min. engagement depth</td>
<td>C_v</td>
<td>40</td>
<td>45</td>
<td>47</td>
<td>50</td>
<td>53</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>Outer diameter</td>
<td>Ø K</td>
<td>118</td>
<td>128</td>
<td>140</td>
<td>144</td>
<td>148</td>
<td>160</td>
<td>173</td>
</tr>
<tr>
<td>Length</td>
<td>K_l</td>
<td>180</td>
<td>200</td>
<td>240</td>
<td>240</td>
<td>300</td>
<td>305</td>
<td>335</td>
</tr>
<tr>
<td>Coupling spindle min. length</td>
<td>S_l</td>
<td>220</td>
<td>230</td>
<td>270</td>
<td>270</td>
<td>320</td>
<td>330</td>
<td>360</td>
</tr>
</tbody>
</table>

Dimensions in mm
**Tendon deflection by means of deflection half shells**

**Without recess tube**

- PE duct
- Deflection half shells
- No offset between deflection half shells in the aperture permitted.
- Minimum thickness of deflection half shell = 7 mm

Section A – A

PE duct

- Deflection half shell
- Grease on contact surface
- PE duct to deflection half shell

Deviator may be either open or closed, i.e. with deflection half shells resting on a member or deflection half shells resting inside an aperture passing through a member.

**With recess tube**

- PE duct
- Recess tube, PE pipe or steel pipe
- Minimum thickness of deflection half shell = 7 mm

Section B – B

PE duct

- Deflection half shell
- Grease on contact surface
- PE duct to deflection half shell

External prestressing system

**SUSPA – Wire Ex**

Tendon deflection by means of deflection half shells
Standard sizes of deflection half shells

For the deflection half shells there are standardised sizes.

**Deflection radius of standardised sizes is 5 000 mm.**

For details please ask ETA-holder for advice.

Special sizes of deflection half shells for minimum deflection radii

The dimensions of the half shells with special sizes depend on the deflection angle. They shall be agreed with the ETA-holder. All edges of the deflection half shells are rounded.

Minimum deflection radii for normal filling ratios of duct – optimised duct diameter

<table>
<thead>
<tr>
<th>Tendon</th>
<th>SUSPA – Wire</th>
<th>EX-30</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
<th>EX-78</th>
<th>EX-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE duct type 1</td>
<td>Ø dₘ₂</td>
<td>63</td>
<td>63</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>83</td>
<td>83</td>
<td>87</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Minimum deflection radius at wire Y1670C</td>
<td>R</td>
<td>2 700</td>
<td>2 800</td>
<td>2 700</td>
<td>2 900</td>
<td>3 200</td>
<td>2 800</td>
<td>3 100</td>
<td>3 300</td>
<td>3 500</td>
<td>3 700</td>
</tr>
<tr>
<td>Minimum deflection radius at wire Y1770C</td>
<td>R</td>
<td>2 500</td>
<td>2 900</td>
<td>2 700</td>
<td>3 000</td>
<td>3 400</td>
<td>3 000</td>
<td>3 300</td>
<td>3 500</td>
<td>3 700</td>
<td>4 000</td>
</tr>
</tbody>
</table>

Minimum deflection radii for low filling ratios of duct – optimised deflection radius

<table>
<thead>
<tr>
<th>Tendon</th>
<th>SUSPA – Wire</th>
<th>EX-30</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE duct type 2</td>
<td>Ø dₘ₂</td>
<td>75</td>
<td>75</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Minimum deflection radius at wire Y1670C</td>
<td>R</td>
<td>2 700</td>
<td>2 700</td>
<td>2 700</td>
<td>2 700</td>
<td>2 700</td>
<td>2 700</td>
<td>2 900</td>
<td>3 200</td>
</tr>
<tr>
<td>Minimum deflection radius at wire Y1770C</td>
<td>R</td>
<td>2 500</td>
<td>2 500</td>
<td>2 500</td>
<td>2 500</td>
<td>2 600</td>
<td>2 800</td>
<td>3 100</td>
<td>3 400</td>
</tr>
</tbody>
</table>

Deflection devices

For deflection of Wire EX tendons also bent pipes can be used. The bent pipes are in plastic or steel. Bent pipes shall have the bending radii as in the tables above. The pipes have trumpets or ends with an enlarged inner diameter to allow for compensation of tolerances.

The use of concrete parts for the deflection of Wire EX tendons is possible. The deflection radii are the same as in the tables above. The concrete surface is plastic coated on the rounded side.
Stressing anchor C

Fixed anchor D

Fixed anchor E

Corrosion protection of exposed surfaces of bearing plates according to Clause 1.12.4

Key for corrosion protection

\[ \text{Corrosion protection wax} \]

\[ \text{Corrosion protection wax or grease} \]
NOTE Above fixed anchor D is shown.

Above representations without corrosion protection, see Annex 14

<table>
<thead>
<tr>
<th>Tendon</th>
<th>SUSPA – Wire</th>
<th>EX-30</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
<th>EX-78</th>
<th>EX-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE anchor cap</td>
<td>Ø A</td>
<td>320</td>
<td>340</td>
<td>360</td>
<td>370</td>
<td>405</td>
<td>405</td>
<td>405</td>
<td>405</td>
<td>405</td>
<td>405</td>
</tr>
<tr>
<td></td>
<td>Ø H</td>
<td>225</td>
<td>250</td>
<td>250</td>
<td>280</td>
<td>315</td>
<td>315</td>
<td>315</td>
<td>315</td>
<td>315</td>
<td>315</td>
</tr>
<tr>
<td>Anchors length</td>
<td>C \text{i}</td>
<td>170</td>
<td>180</td>
<td>200</td>
<td>230</td>
<td>240</td>
<td>260</td>
<td>280</td>
<td>290</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anchor cap C</td>
<td>D \text{i}</td>
<td>100</td>
<td>110</td>
<td>110</td>
<td>120</td>
<td>160</td>
<td>165</td>
<td>170</td>
<td>175</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anchor cap FK</td>
<td>H \text{i}</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>110</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dimensions in mm
Fixed anchor D/E

Stressing anchor C

Anchor cap D/E

Anchor cap FK

NOTE Above fixed anchor D is shown.

Above representations without corrosion protection, see Annex 14

<table>
<thead>
<tr>
<th>Tendon</th>
<th>SUSPA – Wire</th>
<th>EX-30</th>
<th>EX-36</th>
<th>EX-42</th>
<th>EX-48</th>
<th>EX-54</th>
<th>EX-60</th>
<th>EX-66</th>
<th>EX-72</th>
<th>EX-78</th>
<th>EX-84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchor cap</td>
<td>Ø A</td>
<td>320</td>
<td>340</td>
<td>360</td>
<td>370</td>
<td>405</td>
<td>405</td>
<td>405</td>
<td>405</td>
<td>405</td>
<td>405</td>
</tr>
<tr>
<td></td>
<td>Ø H</td>
<td>229</td>
<td>254</td>
<td>279</td>
<td>279</td>
<td>298.5</td>
<td>298.5</td>
<td>305</td>
<td>318</td>
<td></td>
<td></td>
</tr>
<tr>
<td>min. length</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anchor cap C</td>
<td>C_i</td>
<td>180</td>
<td>193</td>
<td>243</td>
<td>243</td>
<td>235</td>
<td>255</td>
<td>275</td>
<td>285</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anchor cap D/E</td>
<td>D_i</td>
<td>110</td>
<td>123</td>
<td>133</td>
<td>133</td>
<td>155</td>
<td>160</td>
<td>165</td>
<td>170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anchor cap FK</td>
<td>H_i</td>
<td>100</td>
<td>100</td>
<td>110</td>
<td>110</td>
<td>120</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dimensions in mm

External prestressing system
SUSPA – Wire Ex
Dimensions of steel anchor caps

Annex 16
of European Technical Assessment
ETA-07/0186 of 30.05.2016

OIB-205-053/15-059
Fixed Coupler C–K

Stressing anchor C

Coupler K

Bearing plate C/D

Bolt M16 with DUBO gasket and PE cap

Injection opening with PE plug

Injection opening with PE plug

Heat shrinking sleeve

PE sheathing tube FK

Anchor cap FK

Sealing washer

Movable coupler K–K

Coupler K

Coupler K

Heat shrinking sleeve

Injection opening with PE plug

Heat shrinking sleeve

PE sheathing tube BK

A second heat shrinking sleeve protects the first heat shrinking sleeve if the coupler is not installed in a UV protected area.

Corrosion protection of exposed surfaces of bearing plates according to Clause 1.12.4

Corrosion protection wax or grease

Key for corrosion protection

......Corrosion protection wax

......Corrosion protection wax or grease

DYWIDAG-Systems International GmbH

External prestressing system

SUSPA – Wire Ex

Corrosion protection for couplers

Annex 17

of European Technical Assessment ETA-07/0186 of 30.05.2016

OIB-205-053/15-059
### Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designation according to prEN 10138-2</td>
<td></td>
<td>Y1670C Y1770C</td>
</tr>
<tr>
<td>Nominal tensile strength $R_{m, f_{pk}}$ N/mm²</td>
<td></td>
<td>1670 1770</td>
</tr>
<tr>
<td>Nominal diameter $d$ mm</td>
<td></td>
<td>7.0</td>
</tr>
<tr>
<td>Nominal cross-sectional area $A_p$ mm²</td>
<td></td>
<td>38.5</td>
</tr>
<tr>
<td>Nominal mass $M$ g/m</td>
<td></td>
<td>300.7</td>
</tr>
<tr>
<td>Cross-sectional shape</td>
<td></td>
<td>circular</td>
</tr>
<tr>
<td>Surface</td>
<td></td>
<td>plain</td>
</tr>
<tr>
<td>Characteristic value of maximum force $F_{pk}$ kN</td>
<td></td>
<td>64.3 68.1</td>
</tr>
<tr>
<td>Maximum value of maximum force $F_{p,max}$ kN</td>
<td></td>
<td>73.9 78.3</td>
</tr>
<tr>
<td>Characteristic value of 0.1 % proof force $F_{p,0.1}$ kN</td>
<td></td>
<td>56.6 59.9</td>
</tr>
<tr>
<td>Minimum elongation at maximum force, $L_0 \geq 100$ mm</td>
<td>$A_{glt}$ %</td>
<td>3.5</td>
</tr>
<tr>
<td>Modulus of elasticity E N/mm²</td>
<td></td>
<td>205 000 1)</td>
</tr>
</tbody>
</table>

---

1) Standard value

### Number of Wires

<table>
<thead>
<tr>
<th>Number of wires $n$</th>
<th>30</th>
<th>36</th>
<th>42</th>
<th>48</th>
<th>54</th>
<th>60</th>
<th>66</th>
<th>72</th>
<th>78</th>
<th>84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal cross-sectional area of prestressing steel $A_p$ mm²</td>
<td>1155</td>
<td>1386</td>
<td>1617</td>
<td>1848</td>
<td>2079</td>
<td>2310</td>
<td>2541</td>
<td>2772</td>
<td>3003</td>
<td>3234</td>
</tr>
<tr>
<td>Characteristic tensile strength $f_{pk} = 1670$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characteristic value of maximum force of tendon $F_{pk}$ kN</td>
<td>1929</td>
<td>2315</td>
<td>2701</td>
<td>3086</td>
<td>3472</td>
<td>3858</td>
<td>4244</td>
<td>4630</td>
<td>5015</td>
<td>5401</td>
</tr>
<tr>
<td>Characteristic tensile strength $f_{pk} = 1770$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characteristic value of maximum force of tendon $F_{pk}$ kN</td>
<td>2043</td>
<td>2452</td>
<td>2860</td>
<td>3269</td>
<td>3677</td>
<td>4086</td>
<td>4495</td>
<td>4903</td>
<td>5312</td>
<td>5720</td>
</tr>
</tbody>
</table>

---

By omitting wires in the anchorages and couplers in a radially symmetrical way, also tendons with numbers of wires lying between the numbers given above can be installed. Any unnecessary hole remains undrilled. With regard to dimensions and reinforcement, anchorages and couplers with omitted wires remain unchanged compared to anchorages and couplers with full number of wires.

Each omitted wire reduces the nominal cross-sectional area by 38.5 mm² and the characteristic value of maximum force of tendon by 64.3 kN and 68.1 kN respectively.
<table>
<thead>
<tr>
<th>Designation</th>
<th>Standard</th>
<th>Material ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic body</td>
<td>EN 10083-1+A1</td>
<td>Steel</td>
</tr>
<tr>
<td>Anchor body E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bearing nut C</td>
<td>EN 10083-1+A1</td>
<td>Steel</td>
</tr>
<tr>
<td>Bearing nut D</td>
<td>EN 10083-1+A1</td>
<td>Steel</td>
</tr>
<tr>
<td>Tensioning sleeve</td>
<td>EN 10083-1+A1</td>
<td>Steel</td>
</tr>
<tr>
<td>Coupling sleeve</td>
<td>EN 10083-1+A1</td>
<td>Steel</td>
</tr>
<tr>
<td>Coupling spindle</td>
<td>EN 10083-1+A1</td>
<td>Steel</td>
</tr>
<tr>
<td>Bearing plate</td>
<td>EN 10025-2+AC</td>
<td>Steel</td>
</tr>
<tr>
<td>Multi plane anchor body</td>
<td>EN 1563</td>
<td>Cast iron</td>
</tr>
<tr>
<td>Helix</td>
<td>EN 10025-2+AC</td>
<td>Steel</td>
</tr>
<tr>
<td>Additional reinforcement</td>
<td>—</td>
<td>Ribbed reinforcing steel, $R_e \geq 500 \text{ N/mm}^2$</td>
</tr>
<tr>
<td>PE duct</td>
<td>EN ISO 17855-1</td>
<td>PE-HD</td>
</tr>
<tr>
<td>PE recess tube</td>
<td>EN ISO 17855-1</td>
<td>PE-HD</td>
</tr>
<tr>
<td>PE anchor cap</td>
<td>EN ISO 17855-1</td>
<td>PE-HD</td>
</tr>
<tr>
<td>PE duct end</td>
<td>EN ISO 17855-1</td>
<td>PE-HD</td>
</tr>
<tr>
<td>Steel anchor cap</td>
<td>EN 10025-2+AC</td>
<td>Steel</td>
</tr>
<tr>
<td>Head retaining disc</td>
<td>EN 10025-2+AC</td>
<td>Steel</td>
</tr>
<tr>
<td>Anchor sleeve</td>
<td>EN 10025-2+AC EN 1563</td>
<td>Steel</td>
</tr>
<tr>
<td>Sealing washer</td>
<td>—</td>
<td>Perbunan</td>
</tr>
</tbody>
</table>

¹) Detailed material data is deposited with Österreichisches Institut für Bautechnik.
<table>
<thead>
<tr>
<th>Component</th>
<th>Item</th>
<th>Test / check</th>
<th>Traceability</th>
<th>Minimum frequency</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic body, Anchor body E, Bearing nut C, Bearing nut D, Tensioning sleeve, Coupling sleeve, Coupling spindle, Multi plane anchor body</td>
<td>Material</td>
<td>Check</td>
<td>Full ²)</td>
<td>100 %</td>
<td>&quot;3.1&quot; ³)</td>
</tr>
<tr>
<td></td>
<td>Detailed dimensions ⁴)</td>
<td>Test</td>
<td>Full ²)</td>
<td>5 % ≥ 2 samples</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Visual inspection ⁵), ⁶)</td>
<td>Check</td>
<td>100 %</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Button heads</td>
<td>Dimensions</td>
<td>Test</td>
<td>Full ²)</td>
<td>5 % ≥ 2 samples</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Visual inspection ⁵)</td>
<td>Check</td>
<td>100 %</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tensile capacity of button head ⁷)</td>
<td>Test</td>
<td>2 per heat</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Bearing plate</td>
<td>Material</td>
<td>Check</td>
<td>Bulk ⁸)</td>
<td>100 %</td>
<td>&quot;2.2&quot; ⁹)</td>
</tr>
<tr>
<td></td>
<td>Detailed dimensions ⁴)</td>
<td>Test</td>
<td>3 % ≥ 2 samples</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visual inspection ⁵)</td>
<td>Check</td>
<td>100 %</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Prestressing steel wire</td>
<td>Material</td>
<td>Check</td>
<td>&quot;CE&quot;</td>
<td>Every coil</td>
<td>&quot;CE&quot; ¹⁰)</td>
</tr>
<tr>
<td></td>
<td>Diameter</td>
<td>Test</td>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visual inspection ⁵)</td>
<td>Check</td>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>PE ducts</td>
<td>Material</td>
<td>Check</td>
<td>Full ²)</td>
<td>100 %</td>
<td>&quot;3.1&quot; ³)</td>
</tr>
<tr>
<td></td>
<td>Visual inspection ⁵)</td>
<td>Check</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrosion protection wax</td>
<td>Material</td>
<td>Check</td>
<td>Full ²)</td>
<td>100 %</td>
<td>&quot;3.1&quot; ³)</td>
</tr>
<tr>
<td></td>
<td>Visual inspection ⁵)</td>
<td>Check</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹) All samples shall be randomly selected and clearly identified.
²) Full: Full traceability of each component to its raw material
³) "3.1": Inspection certificate "3.1" according to EN 10204
⁴) Detailed dimensions: Measurement of all relevant geometrical characteristics, in particular thread dimensions.
⁵) Visual inspection: E.g. main dimensions, gauge testing, correct marking or labelling, check documents for appropriate performance, surfaces, kinks, smoothness, corrosion protection, notches, coating, etc., as given in the prescribed test plan.
⁶) Visual inspection: bore distance, diameter
⁷) Tensile capacity of the single button head shall be at least 98 % of the actual tensile strength of the prestressing steel wire.
⁸) Bulk: Traceability of each component back to a certain point
⁹) "2.2": Test report "2.2" according to EN 10204
¹⁰) As long as the basis for CE marking of prestressing steel is not available, an approval or certificate according to the standards and regulations in force at the place of use shall accompany each delivery.

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**External prestressing system**
SUSPA – Wire Ex
Contents of the prescribed test plan

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**Annex 20**
of European Technical Assessment ETA-07/0186 of 30.05.2016

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<table>
<thead>
<tr>
<th>Component</th>
<th>Element</th>
<th>Test / check</th>
<th>Sampling – number of components per visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic body, Anchor body E, Bearing nut C, Bearing nut D, Tensioning sleeve, Coupling sleeve, Coupling spindle, Multi plane anchor body</td>
<td>Material according to specification</td>
<td>Test / check</td>
<td>2</td>
</tr>
<tr>
<td>Geometry</td>
<td></td>
<td>Test</td>
<td>1</td>
</tr>
<tr>
<td>Visual inspection 2)</td>
<td></td>
<td>Check</td>
<td>5</td>
</tr>
<tr>
<td>Button heads</td>
<td>Visual inspection 2)</td>
<td>Check</td>
<td>2</td>
</tr>
<tr>
<td>Single tensile element test</td>
<td>According to ETAG 013, Annex E.3</td>
<td>Test</td>
<td>1 series</td>
</tr>
</tbody>
</table>

1) All samples shall be randomly selected and clearly identified.
2) Visual inspection: E.g. main dimensions, gauge testing, correct marking or labelling, checking documents for appropriate performance, surfaces, fins, kinks, smoothness, corrosion protection, corrosion, notches, coating, etc., as laid down in the prescribed test plan.
## Essential characteristics for the intended uses of the PT system

<table>
<thead>
<tr>
<th>№</th>
<th>Essential characteristic</th>
<th>Clause</th>
<th>Intended use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Line No.</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>Resistance to static load</td>
<td>3.1.1.1</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Resistance to fatigue</td>
<td>3.1.1.2</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Load transfer to the structure</td>
<td>3.1.1.3</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>Friction coefficient</td>
<td>3.1.1.4</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>Deviation, deflection (limits)</td>
<td>3.1.1.5</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>Practicability, reliability of installation</td>
<td>3.1.1.6</td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td>Content, emission, and/or release of dangerous substances</td>
<td>3.1.2</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>Related aspects of serviceability</td>
<td>3.1.3</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>Practicability, reliability of installation</td>
<td>3.1.4.1</td>
<td>—</td>
</tr>
<tr>
<td>10</td>
<td>Practicability, reliability of installation</td>
<td>3.1.4.2</td>
<td>—</td>
</tr>
<tr>
<td>11</td>
<td>Load transfer to the structure</td>
<td>3.1.4.3</td>
<td>—</td>
</tr>
</tbody>
</table>

**Key**

- + ........ Essential characteristic relevant for the intended use
- — — — — — Essential characteristic not relevant for the intended use

For combinations of intended uses the essential characteristics of all intended uses composing the combinations are relevant.
<table>
<thead>
<tr>
<th>Reference Document</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETAG 013 (06.2002)</td>
<td>Guideline for European Technical Approval of Post-Tensioning Kits for Prestressing of Structures</td>
</tr>
<tr>
<td>Eurocode 2</td>
<td>Eurocode 2 – Design of concrete structures</td>
</tr>
<tr>
<td>EN 1563 (12.2011)</td>
<td>Founding – Spheroidal graphite cast irons</td>
</tr>
<tr>
<td>EN 10025-2+AC (06.2005)</td>
<td>Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels</td>
</tr>
<tr>
<td>EN 10083-1 (08.2006)</td>
<td>Steels for quenching and tempering – Part 1: General technical delivery conditions</td>
</tr>
<tr>
<td>EN 10204 (10.2004)</td>
<td>Metallic products – Types of inspection documents</td>
</tr>
<tr>
<td>prEN 10138-2 (08.2009)</td>
<td>Prestressing steels – Part 2: Wires</td>
</tr>
<tr>
<td>EN ISO 12944-7 (05.1998)</td>
<td>Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 7: Execution and supervision of paint work</td>
</tr>
<tr>
<td>EN ISO 17855-1 (10.2014)</td>
<td>Plastics – Polyethylene (PE) moulding and extrusion materials – Part 1: Designation system and basis for specifications</td>
</tr>
</tbody>
</table>

**Reference documents**

- External prestressing system
  - SUSPA – Wire Ex
  - Reference documents

Annex 23

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