TOP-QUALITY

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APPROVAL

ANP-strand anchor

BMVIT-327.120/0008-IV/IVVS2/2018

ANP - Systems GmbH

anchor | nail | pile | post-tensioning | formwork ties | reinforcement systems | equipment

International reference projects and more information: **www.anp-systems.at**

Data sheet for approval

Object of approval:	**ANP strand anchor with 2 to 15 prestressing steel strands Y 1770 S7 and Y 1860 S7 - 15.3/15.7 (140 and 150 mm²) as anchor for temporary use, as temporary anchor for extended short-term use, as controllable permanent anchor and as anchor with staggered bond length optionally**
Approval holder and manufacturer of anchor:	ANP – SYSTEMS GmbH Christophorusstraße 12 5061 Elsbethen / Austria
Owner of ETA Post-tensioning system:	DEAL S.r.l. Via Buttrio, Fraz. Cargnacco 33050 Pozzuolo del Friuli Udine / Italy
Manufacturer of post-tensioning components/system:	TENSACCIAI S.r.l. Via pordenone 8 20132 Mailand / Italy
Manufacturer of anchor-specific components and corrosion protection:	ANP - SYSTEMS GmbH Christophorusstraße 12 5061 Elsbethen / Austria
External quality control:	TÜF AUSTRIA TVFA Prüf- und Forschungs GmbH (tests and research)
Area of validity:	Republic of Austria Federal roads
Reference norm/standard:	ÖNORM EN 1537: 2015 Execution of special geotechnical works - ground anchors ÖNORM B 1997-1-1: 2013 Eurocode 7: Geotechnical design-Part 1: General rules - National specifications concerning ÖNORM EN 1997-1 and national supplements ETA – 08/0012 date 23.01.2017 Cerema TENSACCIAI post-tensioning method/system Assessment and verification of constancy and performance No. 1683-CPR-0037 ASQPE date 14.06.2017 Declaration of performance of TENSA test center No. 00/000-CE date 30.06.2018 according to ETA -08/0012 date 23.01.2017 about the TENSACCIAI (strand) post-tensioning system

The approval comprises 15 pages and 20 annexes.

I General regulations

1. The proof of the usability of the object of approval is established by the BMVIT (Federal Ministry of Transport, Innovation and Technology). The approval is granted on the basis of non-harmonized technical specifications and without prejudice to third-party.
2. The usability of the object of approval is assessed by the submission of respective test results and reports in accordance with the respective/corresponding Eurocodes, norms/standards and guidelines as to the applicable properties and the application range/area of application.
3. If technical specifications or norms/standards and guidelines without issue date in the specification sheet/data sheet, the current version is decisive.
4. The approval holder is responsible for the building product's conformity with the approval and guarantees all the assured properties.
5. The approval refers only to the building product of the named approval holder and manufacturer.
6. The BMVIT is authorized to check at the approval holder´s expense whether the regulations of this approval and the data sheet are complied with.
7. The approval is not granted irrevocably. It may be amended due to new technical findings and norms/standards.
8. The approval document and data sheet may only be copied in its entirety. Texts and drawings in advertising brochures must not contradict the approval certificate.

II Special regulations

Contents

Annexes

1. General

The planning, dimensioning, installation, testing and control of grouted anchors must be carried out by companies and skilled staff with adequate expert knowledge and experience without exception.

The responsibilities for the planning, dimensioning, execution, tests and control must be agreed by contract for the implementation of a building project. Appropriate records and minutes shall be kept about the anchor system, the anchor production and the installation.

With reference to ÖNORM B 1997-1-1 regular inspections for preventive maintenance of strand anchors are scheduled during the period of use. The must be determined in the planning process. The scope/extent (minimum requirements) is specified in the norm.

The manufacturer of the anchor components and the corrosion protection system is responsible for the product's conformity with the approval.

2. References

ÖNORM EN 1537: 2015	Execution of special geotechnical works – Ground anchors
ÖNORM EN ISO 22477-5: 2016	Draft: Geotechnical investigation and testing - Testing of geotechnical structures - Part 5: Testing of grouted anchors
ÖNORM EN 1990: 2013	Eurocode - Basis of structural design
ÖNORM EN 1997-1: 2014	Eurocode 7 – Geotechnical design – Part 1: General rules
ÖNORM B 1997-1-1: 2013	Eurocode 7 – Geotechnical design – Part 1: General rules – National specifications concerning ÖNORM EN 1997-1 and national supplements
ÖNORM EN 1992-1-1: 2015	Eurocode 2 – Design of concrete structures - Part 1-1: General rules and rules for building
ÖNORM B 4707: 2017	Steel for the reinforcement of concrete - Requirements, classification and conformity assessment
ÖNORM B 4758: 2014	Prestressing steel - Requirements, classification and conformity assessment
ETAG 013: 2002	Guideline for European technical approval of post-tensioning kits for prestressing structures
ÖNORM EN 445: 2008	Grout for prestressing tendons - Test methods
ÖNORM EN 446: 2008	Grout for prestressing tendons - Grouting procedures
ÖNORM EN 447: 2017	Grout for prestressing tendons - Basic requirements
ÖNORM EN 206: 2017	Concrete - Part 1: Specification performance, production and conformity (consolidated version)
ÖNORM EN ISO 9001: 2015	Quality management systems - Requirements
ÖNORM EN 10083-1: 2006	Steels for quenching and tempering - Part 1: General technical delivery conditions
ÖNORM EN 10084: 2008	Case hardening steels – Technical delivery conditions

ÖNORM EN 10277-2: 2008	Bright steel products – Technical delivery conditions - Part 2: Steels for general engineering purposes
ÖNORM EN ISO 3126: 2005	Plastic piping systems – Plastics components – Determination of dimensions
ÖNORM EN 10210-1: 2006	Hot finished structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions
ÖNORM EN 10217-1: 2007	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties (consolidated version)
ÖNORM EN 10025-2: 2005	Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels
ÖNORM EN 10220: 2003	Seamless and welded steel tubes- General tables, dimensions and masses per unit length
DIN EN 16776: 2016	Resilient floor coverings – Heterogeneous polyurethane floor coverings – Specifications
DIN 8061: 2016	Unplasticized polyvinyl chloride (PVC-U) pipes - General quality requirements, testing
DIN 8062: 2009	Unplasticized polyvinyl chloride (PVC-U) pipes - Dimensions
DIN EN 1563: 2012	Founding – Spheroidal graphite cast irons
RVS 08.22.01: 2013	Grouted anchors, tensioned grouted piles and nails/pressure-grouted anchors, piles and nails

3. Description of the prestressed ground anchor

The ANP strand anchor is built with tendons out of 2 to 15 seven-wire prestressing steel strands according ÖNORM B 4758. There are following types:

- **Y 1770 S7** – cross section 140 mm² and 150 mm² (Ø 15.3 and 15.7mm)
- **Y 1860 S7** – cross section 140 mm² and 150 mm² (Ø 15.3 and 15.7mm)

The usability and properties of the prestressing steel strand have to be proved by an approval according to ÖNORM B 4758.

Anchors are produced according to the requirements of ÖNORM EN 1537:

- **Temporary anchor** with individual sheathing of strands in the unbonded/free length and PE transition tubes in the area of the anchor head.
- **Temporary anchors for extended short-term use** or for aggressive soil conditions and higher corrosion protection requirements with mono/single strands in the unbonded/free length and PE transition tubes in the area of the anchor head.

- **Controllable permanent anchor** with mono strands in the unbonded/free length and a PE corrugated sheath over the complete anchor length and sealing against the steel tube that is welded on the base plate.

Following anchor/wedge plates of the TENSACCIAI system MTAI together with three piece anchorage wedges are used for the anchor head according to ETA-08/0012:

Wedges	Number of strands
MTAI 4	2 - 4
MTAI 7	5 - 7
MTAI 9	8, 9
MTAI 12	10 - 12
MTAI 15	13 - 15

ÖNORM EN 1992-1-1 specifies the requirements for tendons and anchorages.

According to ÖNORM EN 1537 the anchor head design of the prestressed anchor must fulfill the standards of the European technical approval for tensioning systems according to ETAG 013.

The reference system at hand is a tensioning system with subsequent bond and it uses a cast-load transmission unit that is set in concrete. The static load test according to ETAG 013 considered the requirements for an external tendon.

To use the tensioning system as anchor with a base anchor plate that is put on the concrete body, the anchor plate, concrete anchor body and tensile stress reinforcement are dimensioned for the anchorage line and the preset cut-out pipes. For the use as anchor brackets/clamps are intended as additional reinforcement. The values were verified and optimized by means of a load transmission test with a medium-sized anchorage according to ETAG 013.

The anchor head consists of a wedge plate which is placed onto a square or round anchor plate (centered). The wedge plate and the anchor plate are designed for the maximum load capacity of the prestressing steel strand Y 1860 S7 – cross section 150 mm² and a concrete quality C 25/30 of the support. For the strand cross sections 140 mm² and 150 mm² the same anchor wedges are used.

For the special use in geotechnics there are also wedge plates with a trapezoidal external thread and the system marking MTAIR for the controllable permanent anchor. These wedge plates are bigger in terms of diameter and height than those of the MTAIR system in order to comply with ETAG 013. The spigot is the same for both.

Wedges	Number of strands
MTAIR 4	2 - 4
MTAIR 7	5 - 7
MTAIR 9	8 - 9
MTAIR 12	10 - 12
MTAIR 15	13 - 15

The wedge plate can be lifted with a special lift-off device.

The steel strands of temporary anchor are cased individually in the unbonded/free length. The other anchor types use strands with a PE sheathing and a complete filling with corrosion protection compound-void free (mono strands).

The minimum thickness of the PE sheathing is set at ≥ 1.0 mm. The requirements for individual strands that are stated in ETAG 013 and ÖNORM EN 1537 are the basis. The PE sheathing serves as mechanical protection of the strands during manipulation, installation and anchor tensioning.

The friction between the PE sheath and the strand is ≤ 60 N/m. The requirements for individual strands that are stated in ETAG 013 are the basis. These requirements are fulfilled when the quantity of corrosion protection compound is ≥ 40 g/m.

The mono strands are produced in the factory in Elsbethen according to the ANP corrosion protection procedure. The corrosion protection compounds that are used comply with the requirements of ÖNORM EN 1537. ***Annex 14*** includes the specifications of the utilized corrosion protection compounds. Optionally the use of customary mono strands is possible if the conformity of the corrosion protection system is certified with ETAG 013.

Temporary anchor: The tensioning end of the unbonded length of the individual sheathing of the prestressing steel strands and mono strands respectively is sealed with PE transition tubes that are screwed on the wedge plate. Permanent anchor: A steel pipe is welded closely on the anchor plate. A sealing ring is used to seal the corrugated sheath in the free length that covers the mono strand. In both cases, the transition between anchor head and free steel length is executed according to ÖNORM EN 1537.

The permanent anchor is cased in a PE corrugated sheath on its entire length. The thickness of the corrugated sheath is dependent on its inside/inner diameter and specified in ÖNORM EN 1537.

The strand anchor is inserted into a predrilled borehole. The bond length is centered in the borehole with spacers. Grouting mortar is used to connect it with the building ground. The unbonded length of a permanent anchor is filled with cement mortar both inside and outside of the PE corrugated sheathing.

The anchor with staggered bond length is used in soft soils and grounds with different layers. The anchorage lengths of the mono strands are staggered along the complete bond length. The load transmission is not limited to one point but is distributed with several individual anchors over the anchorage length. So the existing shear stress in the ground can be utilized more efficiently.

The ANP strand anchor's corrosion protection systems are designed according to ÖNORM EN 1537 and are intended for the following fields of application:

- **Temporary anchor** with a service life up to 2 years
- **Temporary anchor for extended short-term use** and a planned service life of more than 2 years and up to 7 years
- **Permanent anchor** with a service life of more than 2 years

Following annexes (ANP-strand anchor approval, 2-15 strands, Ø 15.3 and 15.7mm) include detailed information about the anchor system:

Annex 1:	Strand anchor for temporary use and for extended short-term use
Annex 2:	Strand anchor for permanent use
Annex 3:	Strand anchor with staggered bond length
Annex 4:	Anchor head, center distances and edge distances
Annex 5:	Prestressing steel strands Y 1770 S7, cross section 140mm², tensile force/traction, internal and external load capacity, maximum test load (material resistance?)
Annex 6:	Prestressing steel strands Y 1770 S7, cross section 150mm², tensile force/traction, internal and external load capacity, maximum test load
Annex 7:	Prestressing steel strands Y 1860 S7, cross section 140mm², tensile force, internal and external load capacity, maximum test load
Annex 8:	Prestressing steel strands Y 1860 S7, cross section 150mm², tensile force, internal and external load capacity, maximum test load
Annex 9:	Components: Wedge plates
Annex 10:	Components: Wedges, transition tube, distance ring and steel ring
Annex 11:	Components: Anchor plates, anchor plates with steel tube/pipe
Annex 12:	Components: PE corrugated sheath, seal ring, and spacer
Annex 13:	Components: Cap/covering cap, sheath for mono strand and centering spacer
Annex 14:	Components: Corrosion protection procedure and corrosion protection compound
Annex 15:	Manufacturing instruction: Temporary anchor and anchor for extended short-term use
Annex 16:	Manufacturing instruction: Permanent anchor and anchor with staggered bond length
Annex 17:	Installation instruction: Temporary anchor and anchor for extended short-term use
Annex 18:	Installation instruction: Permanent anchor
Annex 19:	Transport and storage

Annex 20: Tensioning of ANP strand anchor

4. Application range

Strand anchors are ground support elements that transfer an applied tensile force on a bearing layer in the ground in accordance with the principles for the execution of geotechnical works. Ground can be soil as well as rock.

The anchor standard ÖNORM EN 1537 is an application standard and includes details about the execution of anchor works, geotechnical tests, building materials, building products, design, testing and control of anchors. In annex B of ÖNORM EN 1537 informative details about material properties of corrosion protection compounds are provided, annex C informs about anchor design and corrosion protection for temporary and permanent anchors.

The principles for the dimensioning concept of structures referring to the ultimate limit state of external load capacity are specified in ÖNORM EN 1990. The soil conditions have to be determined according to ÖNORM EN 1997-1.

The anchor's dimensioning values for the ultimate limit state of the internal load capacity are defined in ÖNORM B 1997-1-1 and the anchor load capacity is specified with partial safety factors depending on consequences categories/damage categories. ÖNORM B 1997-1-1 determines national parameters for ÖNORM EN 1997-1. Both standards have to be applied together.

5. Building materials and building products

5.1 Tendon

5.1.1 Features and classification of the steel tendon

As tendon the following types of 2 to 15 7-wire prestressing steel strands according to ÖNORM B4758 are used:

- **Y 1770 S7** – cross section 140 mm² and 150 mm² (Ø 15.3 and 15.7 mm)
- **Y 1860 S7** – cross section 140 mm² and 150 mm² (Ø 15.3 and 15.7 mm)

The Usability of the prestressing steel strand has to be proved with an approval.

Annexes 1 to 4 include system drawings that show the elements of the ANP stand anchor.

5.1.2 Load capacity requirements for the anchor

The strand anchor's tensile capacity shows an efficiency of 95% in relation to the characteristic tensile strength of the steel tendon according to ETAG 013 guidelines

The strand anchor's fatigue limit, proven under the terms of ETAG 013, is 80 N/mm².

In **annexes 5 and 6** the rated values of the tendon as well as the material resistance for the anchor's internal load capacity with reference to consequences categories/ damage categories CC 1, CC 2 and CC 3 are compiled in accordance with ÖNORM B 1997-1-1. The maximum test loads for the anchor system are also specified in the norm. The maximum test loads must not be exceeded.

The maximum rated values for/of the external load capacity are given as well. The values were backcalculated for all dimensioning situations from the maximum test loads and partial safety factors against the pulling out of anchors. (The required test loads against a pulling out of the anchor have to be calculated with reference to the external load capacity with a partial safety factor for all dimensioning situations.) Geological proof for/of the external load capacity has to be provided.

For the rated values of the anchor/tendon a wedge slip between 3.5 and 4.5mm can be specified.

5.2 Anchor head

5.2.1 Anchor head design

The anchor head is composed of the elements of the TENSACCIAI post-tensioning system in accordance with ETA 08/0012. The wedge plate and the wedges are ETA components. The square or round anchor plate has been dimensioned in accordance with the load capacity of the system.

The anchor head is designed in accordance with ÖNORM EN 1537.

Temporary anchor: The prestressing steel strands with individual casing, individual/mono strands respectively, are connected with PE transition tubes to the anchor plate.

The force can be regulated by re-tensioning or releasing via the strand excess length or a lift-off device at wedge plates with external thread (MTR system) by using 2-piece washers between wedge plate and anchor plate. An application is provided with permanent anchors mainly.

Permanent anchor: A cylindrical steel pipe is closely welded on the anchor plate. A sealing ring is used to seal the PE corrugated sheath that covers the mono strands in the unbonded steel length against the steel pipe.

The anchor plate has to be placed perpendicular to the anchor axis. Any angular misalignment has to be compensated with an appropriate angle construction.

Annexes 9 to 14 include details about anchor head components and the corrosion protection system as well as dimensions and building material.

5.2.2 Load transfer to structure

Load transfer from anchor head to bearing structure happens via a concrete body with joint fissure additional reinforcement (stirrup). The requirements for a system's maximum load capacity with prestressing steel strands Y 1860 S7 - cross section 150 mm² according to ETAG 013 are relevant for the dimensioning. With following parameters an efficiency of 110% is observed with respect to the characteristic breaking force of the steel tendon:

- Concrete compressive strength at time of stressing $f_{cm,0,\ cube\ 150} \geq 30$ N/mm²
- Minimum concrete class ≥ C 25/30 according to ÖNORM EN 206
- Additional reinforcement (stirrup) with reinforcing steel B550B based on ÖNORM B4707
- Center distance and edge distance with additional reinforcement (stirrup) according to annex 4.

If no additional reinforcement (stirrup) is used then the center distances and edge distances have to be increased by approximately factor 1.4 to 1.5 and the concrete class has to be upgraded to ≥ C 30/37. So a calculated efficiency of 130% is maintained according to ETAG requirements for a non-reinforced system. **Annex 4** defines center distances and edge distances with or without the use of additional reinforcement. A constructional reinforcement with 50kg/ m³ concrete has to be provided for.

5.3 Grouting mortar

All installed strand tendons with and without corrosion protection cover in the anchorage/bond length have a minimum external cement mortar cover of 10mm towards the borehole wall. Spacers are used for centering. The cement mortar to form the grout body has to comply with ÖNORM EN 1537.

When the cement for the grout body that is exposed to the soil/ground is chosen the impact of soil conditions, according to the ÖNORM EN 206-1 exposure classes, have to be considered.

The permanent anchor is built with a PE corrugated sheath over its entire length. The bonded length has an internal cement mortar cover between PE corrugated sheath and strand of minimum 5mm. The bundled strand tendon is centered with spacers. The cement mortar that is used has to meet the standards of ÖNORM EN 445, ÖNORM EN 446 and ÖNORM EN 447.

5.4 Corrosion protection

ÖNORM EN 1537 gives examples for the execution of corrosion protection systems with temporary and permanent anchors. Furthermore the terms for a temporary anchor for extended short-term use or aggressive soil conditions are specified.

The anchor systems at hand conform to the specified standards. The application of the corrosion protection system, except for the production of the grout body, is carried out in the factory.

The assembling of the corrosion protection is outlined subsequently. The components of the anchor head and the corrosion protection with dimensions and material details are compiled in **annexes 9 to 14**.

5.4.1 Anchor for temporary use

Annex 1 includes a schematic drawing of the temporary anchor with details about corrosion protection. The corrosion protection is guaranteed in the different anchor areas as follows:

Bond length:	Cement mortar cover of strand bundle ≥ 10 mm towards the borehole wall. The strands are distanced with internal spacers, are bundled and centered in the borehole with external spacers.
Unbonded length:	Individual casing of strands with a smooth PE tube ≥ 1.0 mm thickness and final sealing with tape or heat shrink sleeve to prevent water ingress.
Anchor head:	PE transition tubes are screwed into the holes of the wedge plate; they overlap the strand's PE casing. The corrosion protection of the anchor head is executed according to ÖNORM EN 1537.

5.4.2 Anchor for extended short-term use

Annex 1 includes a schematic drawing of the temporary anchor for extended short-term use and detailed information about corrosion protection. The corrosion protection is guaranteed in the different parts of the anchor as follows:

Bond length:	Cement mortar cover of strand bundle ≥ 10 mm towards borehole wall. The strands are distanced with internal spacers, bundled and centered in the borehole with external spacers.
Unbonded length:	Mono strands with PE tube ≥ 1.0 mm thickness and final sealing with tape or heat shrink sleeve to prevent water ingress.
Anchor head:	The PE transition tubes are screwed into the holes of the wedge plate; they overlap the mono strand's PE casing. The transition tubes are filled with corrosion protection compound. The corrosion protection of the anchor head is executed according to ÖNORM EN 1537.

5.4.3 Anchor for permanent use

Annex 2 includes a schematic drawing of the permanent anchor with details for corrosion protection. Corrosion protection is guaranteed in the different anchor areas as follows:

Bond length: PE corrugated sheath ≥ 1,0 mm thickness, respectively ≥ 1,5 mm depending on internal diameter. Internal cement mortar cover ≥ 5 mm towards strand bundle with distance elements. External cement mortar cover ≥ 10 mm towards borehole wall with spacers. The anchor end facing earth is closed with an end cap.

Unbonded length: Mono strands with PE corrugated sheath ≥ 1.0 mm thickness and final sealing of transition to bond length with tape or heat shrink sleeve. The PE corrugated sheath in the bond length is continued with an internal cement mortar layer.

Anchor head: A steel pipe is welded on the wedge plate and the transition to the PE corrugated sheath is sealed with a sealing ring. After tensioning the pipe is filled with corrosion protection compound (with adjustable anchors) or cement mortar (with controllable/lift-off anchors). A steel ring is put on the PE corrugated sheath in that area to absorb transverse tension.

The anchor plate with the welded on steel pipe is coated with corrosion protection appropriate for structural steel works or hot-dipped.

After the tensioning of the strand anchor a coated or hot-dip galvanized steel cover cap/cast steel or plastic cap is put closely on the anchor plate and filled with corrosion protection compound. When controllable anchors are used, the wedge plate, strand excess length and wedges have to be thickly coated with corrosion protection compound and wrapped with multiple layers of corrosion protection tape.

Neither a cover cap nor corrosion protection coating is needed when the head is set in concrete. Care must be taken that the anchorage wedges are not blocked.

5.4.4 Anchor with staggered bond length

Annex 3 includes a schematic drawing of a permanent anchor with staggered bond length. Temporary anchors can be executed as staggered anchors as well.

The PE sheath of the mono strands is continued into the bond length and so staggered anchorage lengths of individual strands or strand bundles are established. The anchorage lengths of the mono strands are staggered along the complete bond length.

6. Anchor production and installation

For the installation of the ANP strand anchor the guidelines of RVS 08.22.01 must be observed. RVS 08.22.01 points out that it is a prerequisite for the execution of anchorages to proof the anchorage system's aptitude in time. The executions of works, record keeping and tests have to be done according the respective designs/embodiments and test standards.

With reference to ÖNORM B 1997-1-1 the anchor system's aptitude is proven for federal roads by a BMVIT approval.

Annexes 15 to 18 include instructions for the factory-made corrosion protection of the strand anchor, the handling, installation and tensioning.

It has to be noted that after the installation of the strand anchor and a sufficient hardening of the grouting mortar in the bond length a prestressing force of at least 35% of the strand breaking force has to be applied. So a strong/firm wedge bite between wedge and strand shall be achieved to avoid strand slipping.

The assembly and installation of the ANP strand anchor has to comply with the manufacturer's installation guide and must be executed by skilled staff and local technical supervision only. The installation company's staff must be trained by the approval holder. A personal confirmation is required (proof of qualification).

According to ÖNORM B 1997-1-1 the maintenance of grouted anchors includes:

- Visual inspection of all anchor heads every 2 to 3 years
- Annual reading of designated anchor head measuring devices
- Lift-off test every 5 to 10 years

7. Tests

7.1 Material tests and conformity proof

7.1.1 Anchor components

The production control of the „TENSACCIAI – strand post-tensioning method" happens with a defined inspection plan according to ETAG 013, the approval holder of ETA 08/0012 is responsible. The product has an accredited certification body's certificate of conformity.

The wedge plates of the system MTAIR are tested by TENSACCIAI with the same test plan like those of type MTAI. The test plan is specified in ETA – 08/0012.

A documentation of the executed tests and control of the utilized anchor components has to be left at the manufacturer of the anchor.

7.1.2 Anchor-specific components and corrosion protection system

The manufacturer of the ANP strand anchor has to carry out an own/internal company production control according to ÖNORM EN ISO 9001. This control refers to those components that are not covered in ETA - 08/0012 and the production of the corrosion production system.

The inspection which is based on a supervision contract has to be carried out by an accredited inspection and supervision authority. In this supervision contract also the scope of the company's internal/own production control is defined.

A surveillance contract has to be closed between the approval holder and the external control body. The inspection has to be carried out at least once a year and comprises a check of the company's own production control and sampling tests. The results have to be documented in a report.

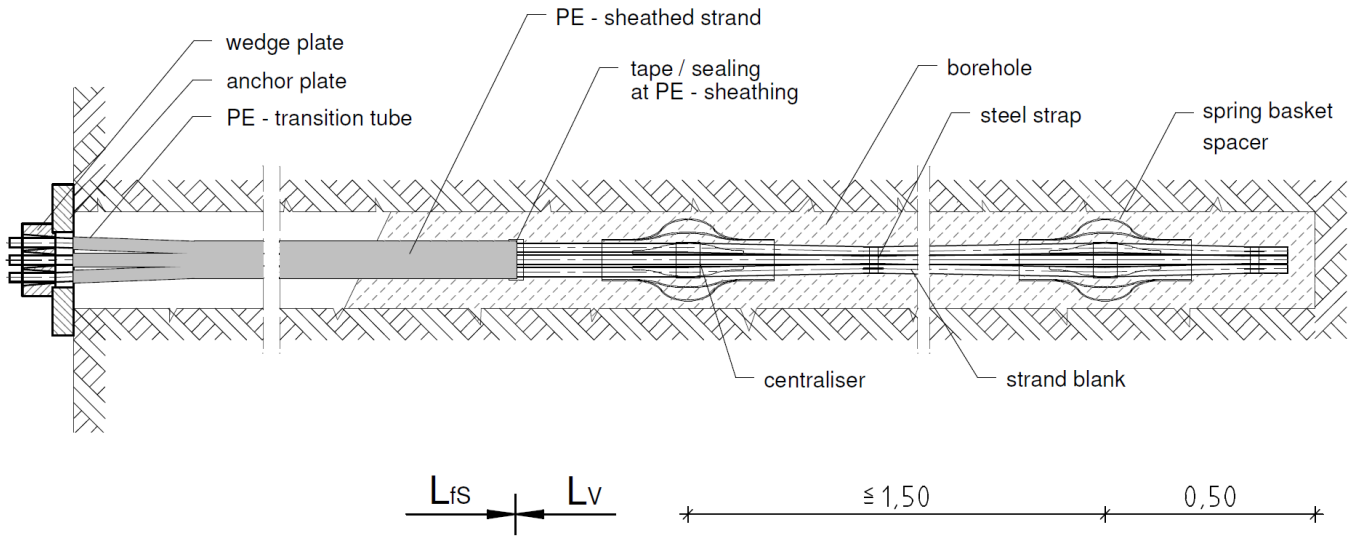
7.2 Anchor tests

At the building site load tests have to be carried out and documented according to ÖNORM B 1997-1-1. Then aptitude tests have to be carried out with at least three building/construction anchors to test the planning measures and as confirmation of each dimensioning case.

The tests have to be executed according to ÖNORM EN ISO 22477-5 (draft). The applicable test procedures are specified in ÖNORM EN ISO 22477-5.

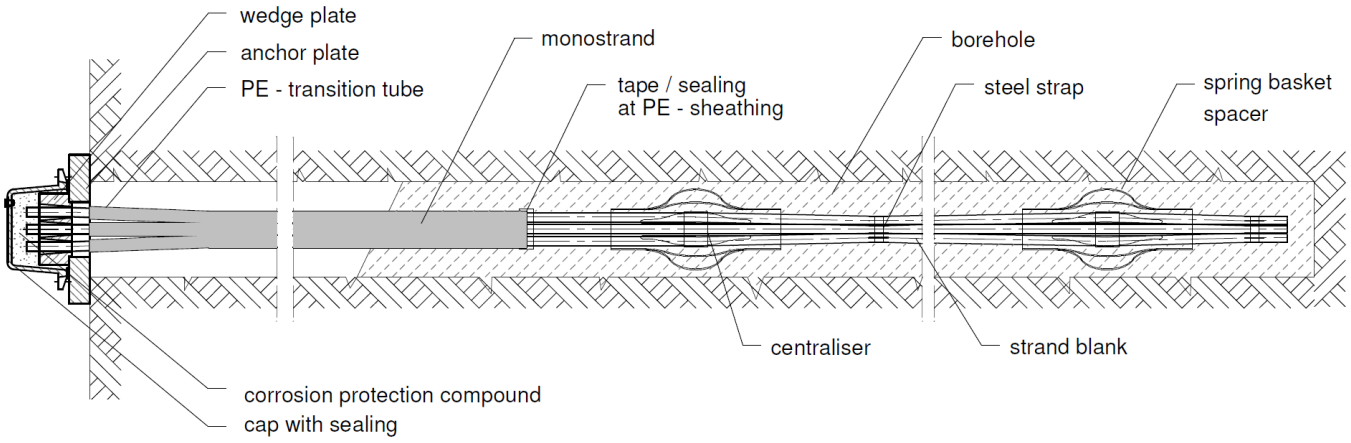
ANP – SYSTEMS GmbH	ANP – strand anchor 2 – 15 strands, Ø 15,3mm and 15,7mm Temporary strand anchor and Temporary strand anchor for extended short-term use	Annex 1

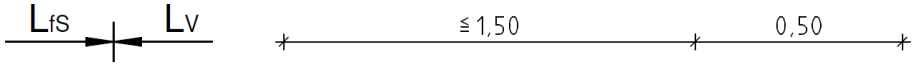
Temporary strand anchor



L_{fS} … unbonded length
L_V … bond length

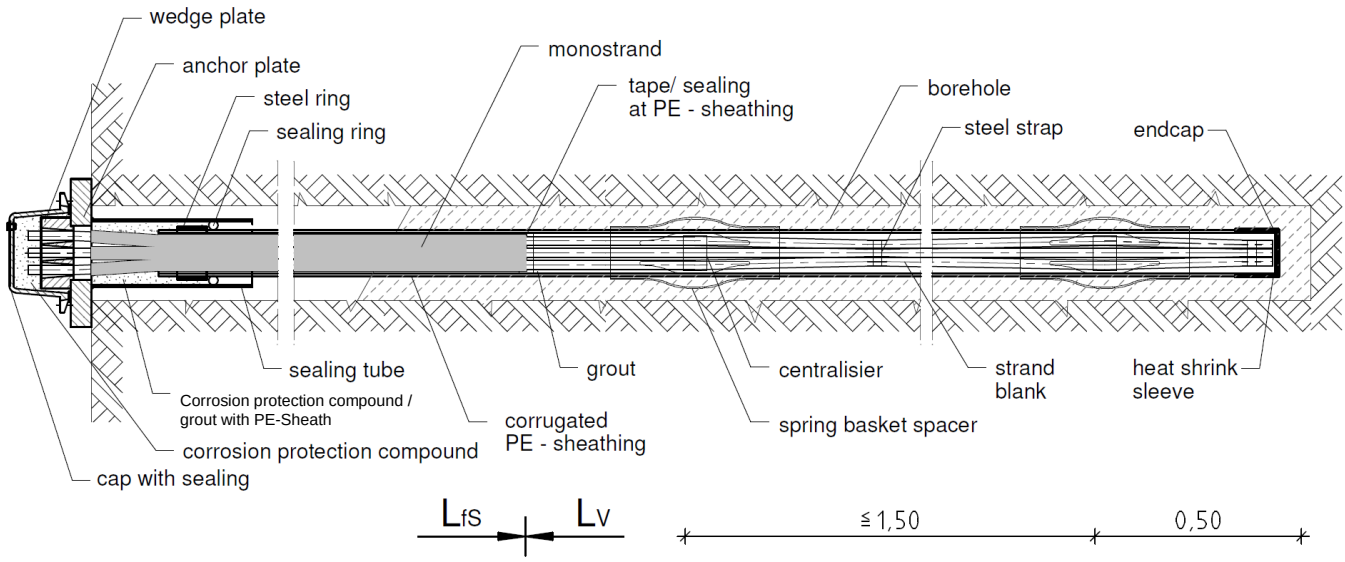
Temporary strand anchor for extended short-term use





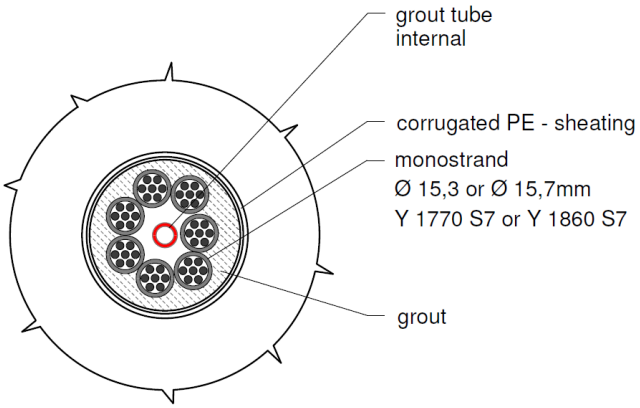
L_{fS} … unbonded length
L_V … bond length

Permanent strand anchor

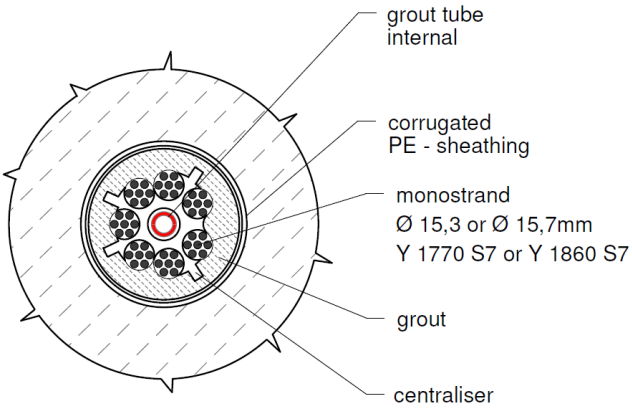


L_{fS} … unbonded length
L_v … bond length

section L_{fS}



section L_v

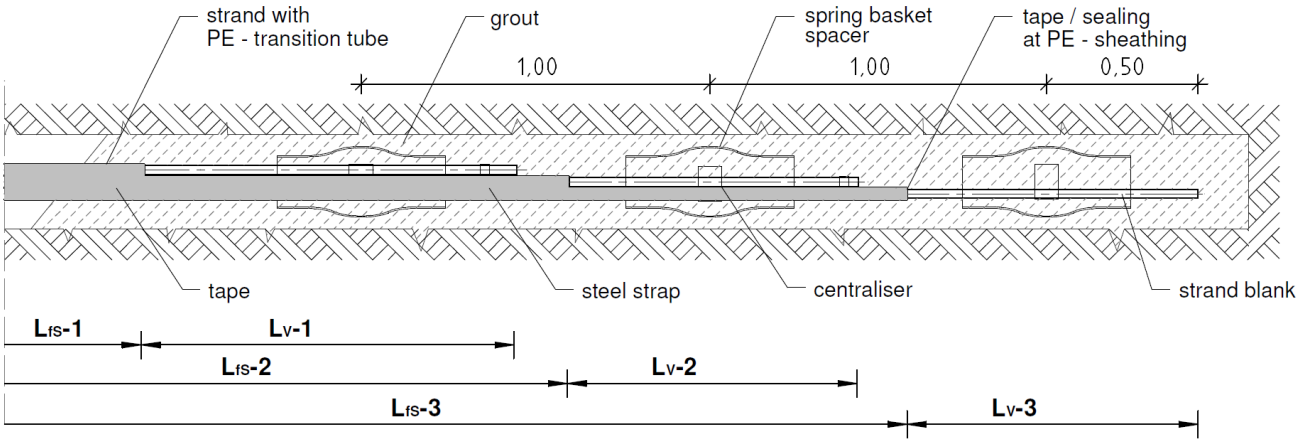


L_{fS} … unbonded length
L_v … bond length

ANP – SYSTEMS GmbH	ANP – strand anchor 2 – 15 strands, Ø 15,3mm and 15,7mm Strand anchor with staggered bond length	Annex 3

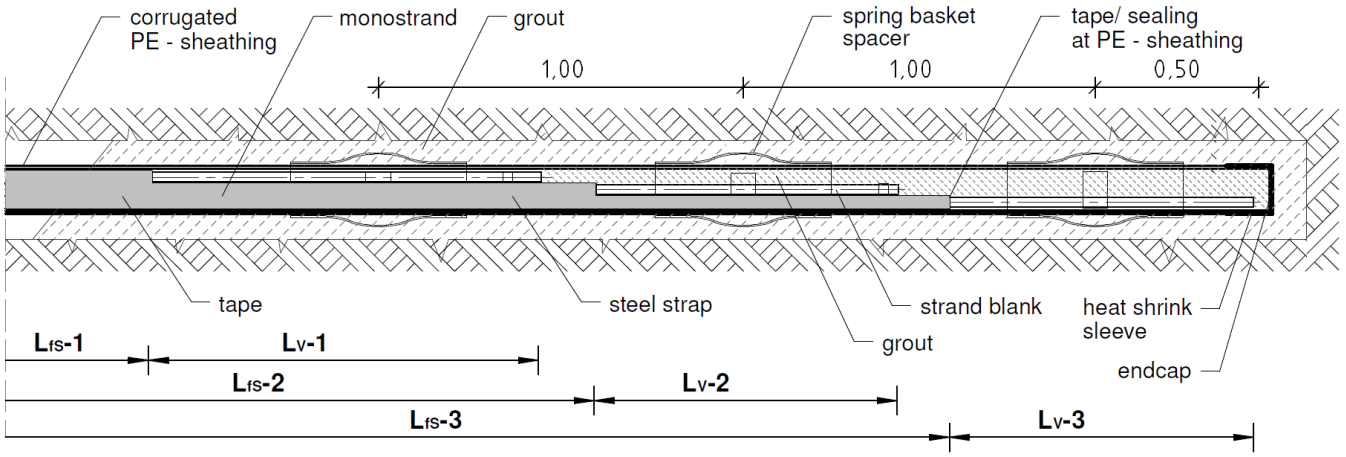
Temporary strand anchor with staggered bond length

(anchor head details see temporary strand anchor)



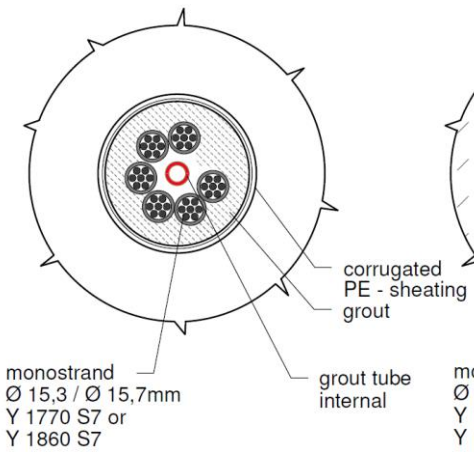
Permanent strand anchor with staggered bond length

(anchor head details see permanent strand anchor)

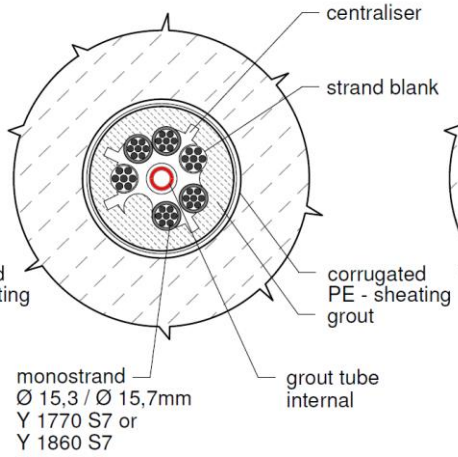


L_{fS} … unbonded length L_v … bond length

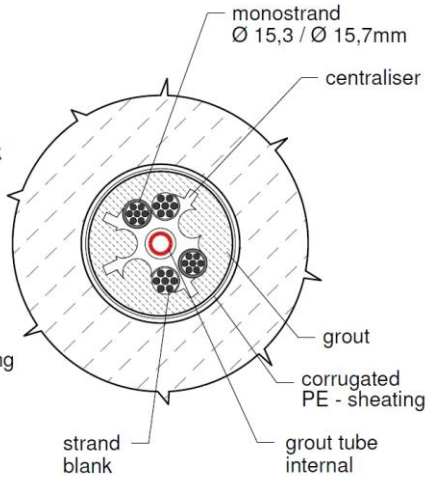
section L_{fS}-1



section L_v-1



section L_v-2



ANP – SYSTEMS GmbH	ANP – strand anchor 2 – 15 strands, Ø 15,3mm and 15,7mm Anchor head, center- and edge distance	Annex 4

Anchor head

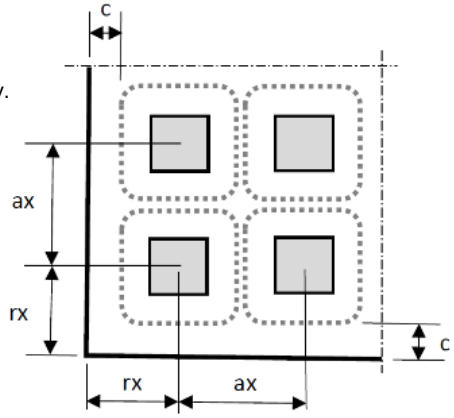
No. of strands				2 - 4	5 - 7	8 - 9	10 - 12	13 - 15
min. borehole diameter				88	105	125	125	150
Sheathing	type	steel max $Ø_A$/d		118,6x4,5	159x4,5	200x4,5	200x4,5	200x4,5
		PE-HD max $Ø_A$/d		125,0x3,2	160x4,0	200x4,0	200x4,0	200x4,0
Bursting reinforcement (stirrup)	rod diameter			10	12	12	14	14
	lateral length			230	330	400	430	460
	distance of the stirrups			50	60	60	60	60
	number of the stirrups			7	8	10	10	12
Center- and edge distance [2]	with bursting reinforcement		ax	260	365	440	470	505
	concrete ≥ C 25/30		rx	130 + c	185 + c	210 + c	235 + c	255 + c
	without bursting reinforcement [1]		ax	350	550	650	700	750
	concrete ≥ C 30/37		rx	175 + c	275 + c	325 + c	350 + c	375 + c

All values in mm

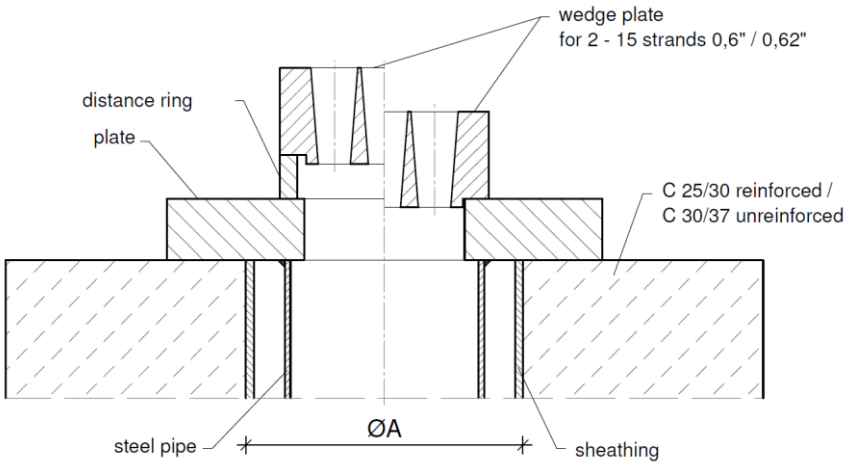
c concrete cover of constructive reinforcement acc. to national requirements and exposure class acc. to ÖNORM EN 206 if necessary.

1) with constructive reinforcement min. 50 kg/m³ concrete (acc. to ETAG 013)

2) Center- and edge distance and stirrups are designed for both types of anchor plates (round / square)



Anchor head detail



No. of strands	Y1770 S7 - 15,3mm F_{pk}=248kN, $F_{p0,1k}$=218kN, S_0=140mm²								
	char. force at permanent strain of 0,1%	Char. breaking force	Char. anchor design resistance	Rated Value of inner anchor design resistance acc. to damage category $R_{t,d} = R_{p0,1k} / (\gamma_S * \eta)$ [2]		Max. test force $P_{P,max}$ [3]		Max. rated value of outer anchor design resistance $P_d = \min P_{p,max} / \gamma_a$ [4]	
	$R_{p0,1k}$ [kN]	$R_{p,k}$ [kN]	$R_k = R_{p0,1k} / \gamma_S$ [1] [kN]	CC 1 und CC 2, η=1,0 [kN]	CC3, η=1,15 [kN]	0,8 R_{pk} [kN]	0,9 $R_{p0,1k}$ [kN]	CC 1 und CC2, γ_a=1,1 [kN]	CC 3, γ_a=1,25 [kN]
2	436	496	379	379	330	397	392	357	314
3	654	744	569	569	495	595	589	535	471
4	872	992	758	758	659	794	785	713	628
5	1090	1240	948	948	824	992	981	892	785
6	1308	1488	1137	1137	989	1190	1177	1070	942
7	1526	1736	1327	1327	1154	1389	1373	1249	1099
8	1744	1984	1517	1517	1319	1587	1570	1427	1256
9	1962	2232	1706	1706	1484	1786	1766	1605	1413
10	2180	2480	1896	1896	1648	1984	1962	1784	1570
11	2398	2728	2085	2085	1813	2182	2158	1962	1727
12	2616	2976	2275	2275	1978	2381	2354	2140	1884
13	2834	3224	2464	2464	2143	2579	2551	2319	2040
14	3052	3472	2654	2654	2308	2778	2747	2497	2197
15	3270	3720	2843	2843	2473	2976	2943	2675	2354

[1] Lock-off force P_0 must not exceed $P_0 \leq R_k$, partial safety factor γ_s = 1.15 of prestressing steel according to ÖNORM EN 1992-1-1
[2] Factor η depending on consequences categories/damage categories according to ÖNORM B 1997-1-1
[3] Design of the tendon so that the given test load in examinations, suitability tests and acceptance tests is not exceeded. The smaller value/test load is decisive
[4] Partial safety factor γ_a against pulling out of the anchor.
Please note:: The maximum rated value of the external load capacity has to be adjusted to on-site soil conditions.
The value is backcalculated from the theoretical maximum test load value.

ANP – SYSTEMS GmbH

ANP – strand anchor
2 – 15 strands, Ø 15,3mm
Prestressing strand Y 1770 S7, cross section 140mm²
Anchor forces, inner and outer anchor resistance, max. test load

Annex 5

No. of strands	Y1770 S7 - 15,7mm F_{pk}=266kN, $F_{p0,1k}$=234kN, S_0=150mm²								
	char. force at permanent strain of 0,1% $R_{p0,1k}$ [kN]	Char. breaking force $R_{p,k}$ [kN]	Char. anchor design resistance $R_k = R_{p0,1k} / \gamma_S$ [1] [kN]	Rated Value of inner anchor design resistance acc. to damage category $R_{t,d} = R_{p0,1k} / (\gamma_S * \eta)$ [2] CC 1 und CC 2, η=1,0 [kN]	 CC3, η=1,15 [kN]	Max. test force $P_{P,max}$ [3] 0,8 R_{pk} [kN]	 0,9 $R_{p0,1k}$ [kN]	Max. rated value of outer anchor design resistance P_d = min $P_{p,max} / \gamma_a$ [4] CC 1 und CC2, γ_a=1,1 [kN]	 CC 3, γ_a=1,25 [kN]
2	468	532	407	407	354	426	421	383	337
3	702	798	610	610	531	638	632	574	505
4	936	1064	814	814	708	851	842	766	674
5	1170	1330	1017	1017	885	1064	1053	957	842
6	1404	1596	1221	1221	1062	1277	1264	1149	1011
7	1638	1862	1424	1424	1239	1490	1474	1340	1179
8	1872	2128	1628	1628	1416	1702	1685	1532	1348
9	2106	2394	1831	1831	1592	1915	1895	1723	1516
10	2340	2660	2035	2035	1769	2128	2106	1915	1685
11	2574	2926	2238	2238	1946	2341	2317	2106	1853
12	2808	3192	2442	2442	2123	2554	2527	2297	2022
13	3042	3458	2645	2645	2300	2766	2738	2489	2190
14	3276	3724	2849	2849	2477	2979	2948	2680	2359
15	3510	3990	3052	3052	2654	3192	3159	2872	2527

[1] Lock-off force P_0 must not exceed $P_0 \leq R_k$, partial safety factor γ_s = 1.15 of prestressing steel according to ÖNORM EN 1992-1-1
[2] Factor η depending on consequences categories/damage categories according to ÖNORM B 1997-1-1
[3] Design of the tendon so that the given test load in examinations, suitability tests and acceptance tests is not exceeded. The smaller value/test load is decisive
[4] Partial safety factor γ_a against pulling out of the anchor.
Please note:: The maximum rated value of the external load capacity has to be adjusted to on-site soil conditions.
The value is backcalculated from the theoretical maximum test load value.

ANP – SYSTEMS GmbH

ANP – strand anchor
2 – 15 strands, Ø 15,7mm
Prestressing strand Y 1770 S7, cross section 150mm²
Anchor forces, inner and outer anchor resistance, max. test load

Annex 6

No. of strands	Y1860 S7 - 15,3mm F_{pk}=260kN, $F_{p0,1k}$=229kN, S_0=140mm²								
	char. force at permanent strain of 0,1%	Char. breaking force	Char. anchor design resistance	Rated Value of inner anchor design resistance acc. to damage category $R_{t,d} = R_{p0,1k} / (\gamma_S * \eta)$ [2]		Max. test force $P_{P,max}$ [3]		Max. rated value of outer anchor design resistance $P_d = \min P_{p,max} / \gamma_a$ [4]	
	$R_{p0,1k}$ [kN]	$R_{p,k}$ [kN]	$R_k = R_{p0,1k} / \gamma_S$ [1] [kN]	CC 1 und CC 2, η=1,0 [kN]	CC3, η=1,15 [kN]	0,8 R_{pk} [kN]	0,9 $R_{p0,1k}$ [kN]	CC 1 und CC2, γ_a=1,1 [kN]	CC 3, γ_a=1,25 [kN]
2	458	520	398	398	346	416	412	375	330
3	687	780	597	597	519	624	618	562	495
4	916	1040	797	797	693	832	824	749	660
5	1145	1300	996	996	866	1040	1031	937	824
6	1374	1560	1195	1195	1039	1248	1237	1124	989
7	1603	1820	1394	1394	1212	1456	1443	1312	1154
8	1832	2080	1593	1593	1385	1664	1649	1499	1319
9	2061	2340	1792	1792	1558	1872	1855	1686	1484
10	2290	2600	1991	1991	1732	2080	2061	1874	1649
11	2519	2860	2190	2190	1905	2288	2267	2061	1814
12	2748	3120	2390	2390	2078	2496	2473	2248	1979
13	2977	3380	2589	2589	2251	2704	2679	2436	2143
14	3206	3640	2788	2788	2424	2912	2885	2623	2308
15	3435	3900	2987	2987	2597	3120	3092	2810	2473

[1] Lock-off force P_0 must not exceed $P_0 \leq R_k$, partial safety factor γ_s = 1.15 of prestressing steel according to ÖNORM EN 1992-1-1
[2] Factor η depending on consequences categories/damage categories according to ÖNORM B 1997-1-1
[3] Design of the tendon so that the given test load in examinations, suitability tests and acceptance tests is not exceeded. The smaller value/test load is decisive
[4] Partial safety factor γ_a against pulling out of the anchor.
Please note:: The maximum rated value of the external load capacity has to be adjusted to on-site soil conditions.
The value is backcalculated from the theoretical maximum test load value.

ANP – SYSTEMS GmbH

ANP – strand anchor
2 – 15 strands, Ø 15,3mm
Prestressing strand Y 1860 S7, cross section 140mm²
Anchor forces, inner and outer anchor resistance, max. test load

Annex 7

No. of strands	Y1860 S7 - 15,7mm F_{pk}=279kN, $F_{p0,1k}$=246kN, S_0=150mm²								
	char. force at permanent strain of 0,1%	Char. breaking force	Char. anchor design resistance	Rated Value of inner anchor design resistance acc. to damage category $R_{t,d} = R_{p0,1k} / (\gamma_S * \eta)$ [2]		Max. test force $P_{P,max}$ [3]		Max. rated value of outer anchor design resistance $P_d = \min P_{p,max} / \gamma_a$ [4]	
	$R_{p0,1k}$ [kN]	$R_{p,k}$ [kN]	$R_k = R_{p0,1k} / \gamma_S$ [1] [kN]	CC 1 und CC 2, η=1,0 [kN]	CC3, η=1,15 [kN]	0,8 R_{pk} [kN]	0,9 $R_{p0,1k}$ [kN]	CC 1 und CC2, γ_a=1,1 [kN]	CC 3, γ_a=1,25 [kN]
2	492	558	428	428	372	446	443	403	354
3	738	837	642	642	558	670	664	604	531
4	984	1116	856	856	744	893	886	805	708
5	1230	1395	1070	1070	930	1116	1107	1006	886
6	1476	1674	1283	1283	1116	1339	1328	1208	1063
7	1722	1953	1497	1497	1302	1562	1550	1409	1240
8	1968	2232	1711	1711	1488	1786	1771	1610	1417
9	2214	2511	1925	1925	1674	2009	1993	1811	1594
10	2460	2790	2139	2139	1860	2232	2214	2013	1771
11	2706	3069	2353	2353	2046	2455	2435	2214	1948
12	2952	3348	2567	2567	2232	2678	2657	2415	2125
13	3198	3627	2781	2781	2418	2902	2878	2617	2303
14	3444	3906	2995	2995	2604	3125	3100	2818	2480
15	3690	4185	3209	3209	2790	3348	3321	3019	2657

[1] Lock-off force P_0 must not exceed $P_0 \leq R_k$, partial safety factor γ_s = 1.15 of prestressing steel according to ÖNORM EN 1992-1-1
[2] Factor η depending on consequences categories/damage categories according to ÖNORM B 1997-1-1
[3] Design of the tendon so that the given test load in examinations, suitability tests and acceptance tests is not exceeded. The smaller value/test load is decisive
[4] Partial safety factor γ_a against pulling out of the anchor.
Please note:: The maximum rated value of the external load capacity has to be adjusted to on-site soil conditions.
The value is backcalculated from the theoretical maximum test load value.

ANP – SYSTEMS GmbH

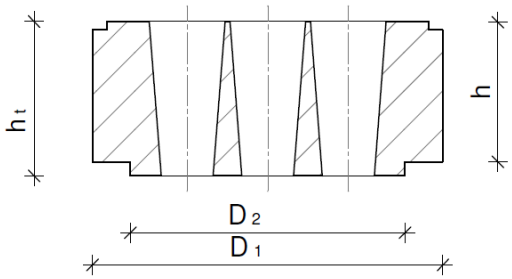
ANP – strand anchor
2 – 15 strands, Ø 15,7mm
Prestressing strand Y 1860 S7, cross section 150mm²
Anchor forces, inner and outer anchor resistance, max. test load

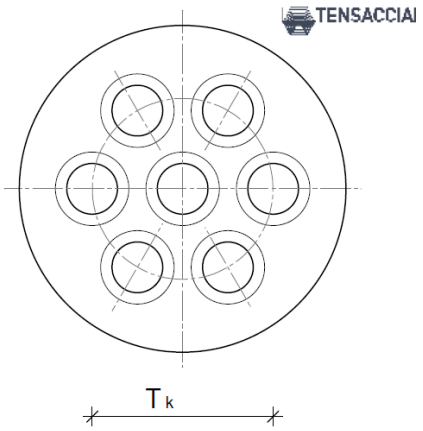
Annex 8

ANP – SYSTEMS GmbH	ANP – strand anchor 2 – 15 strands, Ø 15,3mm and 15,7mm Components: wedge plates	Annex 9

Wedge plate type MT

Material: C45, ÖNORM EN 10083-1

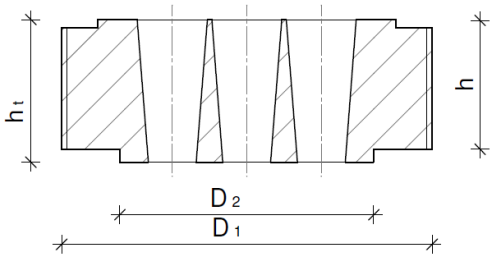


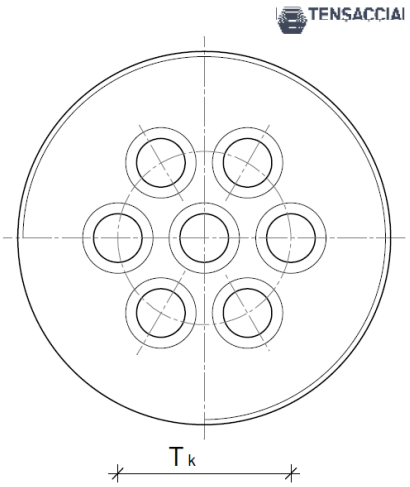


No. of strands	h_t [mm]	h [mm]	D_1 [mm]	D_2 [mm]	T_k [mm]
2 - 4	53	45	105	79	55
5 - 7	55	49	125	98	70
8 - 9	58	52	146	118	90
10 - 12	68	62	160	132	107 / 42,5
13 - 15	75	69	176	146	120 / 57

Wedge plate type MTR

Material: C45, ÖNORM EN 10083-1



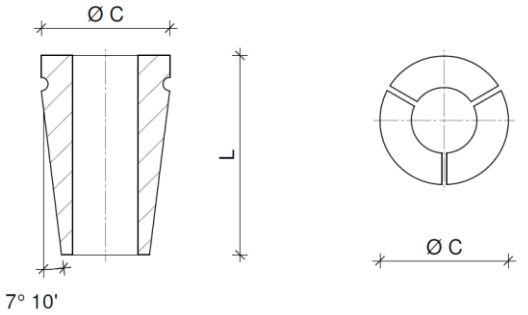


No. of strands	h_t [mm]	h [mm]	D_1 [mm]	D_2 [mm]	T_k [mm]	External thread T x Y
2 - 4	50	45	120	79	55	TR 120 × 6
5 - 7	60	55	143	98	70	TR 143 × 6
8 - 9	60	55	165	118	90	TR 165 × 6
10 - 12	67	62	175	132	107 / 42,5	TR 175 × 6
13 - 15	75	69	193	146	120 / 57	TR 193 × 6

ANP – SYSTEMS GmbH	ANP – strand anchor 2 – 15 strands, Ø 15,3mm and 15,7mm Components: wedge, transistion tube, distance ring and steel ring	Annex 10

Wedge

Material: 16NiCr, EN 10084 respectively C15 EN 10277-2

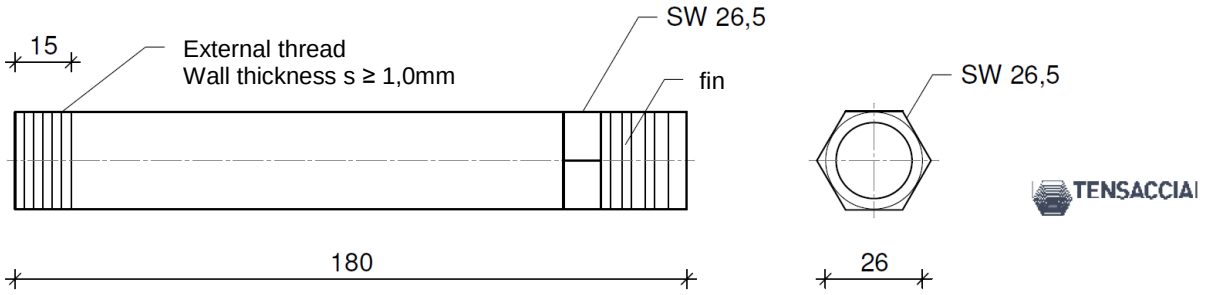


TENSACCIAI

Ø C [mm]	L [mm]
28	43

Transition tube

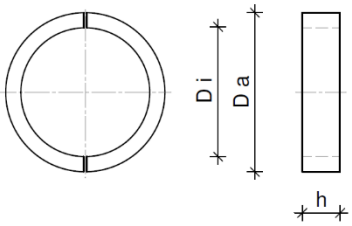
Material: HDPE 80, ÖNORM EN ISO 3126



TENSACCIAI

Distance ring (2-parts)

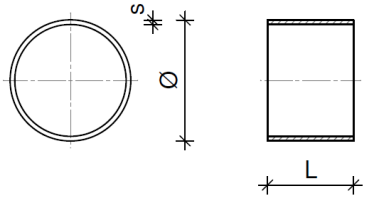
Material: S355J2H, ÖNORM EN 10210



No. of strands	h [mm]	D_a [mm]	D_i [mm]
2 - 4	20 / 30 / 40	114,3	82,3
5 - 7		139,7	99,7
8 - 9		159,0	119,0
10 - 12		177,8	133,4
13 - 15		193,7	149,3

Steel ring (absorption of lateral tensile forces at anchor head area)

Material: P235TR1, ÖNORM EN 10217-1

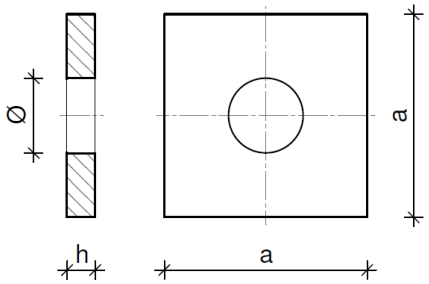


No. of strands	L [mm]	Ø [mm]	s [mm]
2 - 4	50	70,0	2,6
5 - 7		88,9	2,9
8 - 12		108,0	2,9
13 - 15		139,7	3,6

ANP – SYSTEMS GmbH	ANP – strand anchor 2 – 15 strands, Ø 15,3mm and 15,7mm Components: anchor plates, anchor plate with steel pipe	Annex 11

Anchor plate square

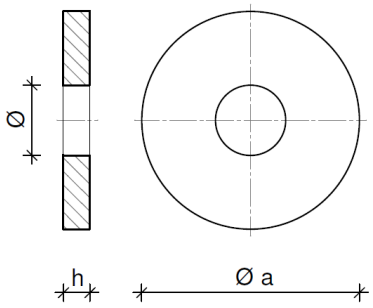
Material: S355, ÖNORM EN 10025-2



No. of strands	a [mm]	h [mm]	Ø [mm]
2 - 4	225	35	81
5 - 7	260	40	100
8 - 9	310	45	120
10 - 12	340	50	134
13 - 15	400	50	148

Ancho plate round

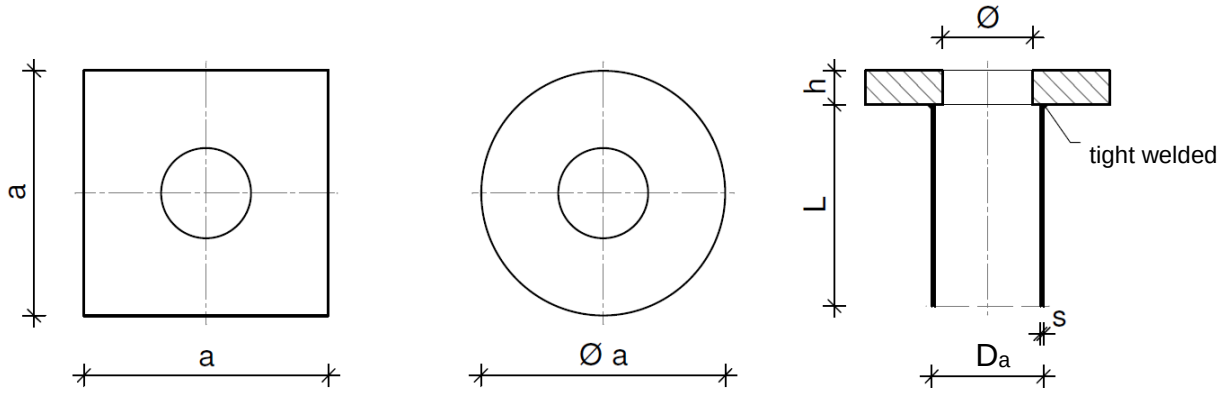
Material: S355, ÖNORM EN 10025-2



No. of strands	Ø a [mm]	h [mm]	Ø [mm]
2 - 4	250	35	81
5 - 7	290	40	100
8 - 9	350	45	120
10 - 12	380	50	134
13 - 15	450	50	148

Anchor plate with steel pipe

Material steel pipe: P 235 TR1/2, ÖNORM EN 10217-1/ÖNORM EN 10220



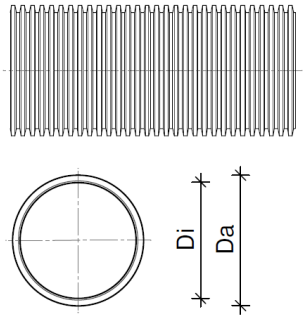
No. of strands	a [mm]	h [mm]	Ø a [mm]	Ø [mm]	L [mm]	s [mm]	D_a [mm]
2 - 4	225	35	250	81	400	2,9	88,9
5 - 7	260	40	290	100	400	3,2	114,3
8 - 9	310	45	350	120	500	3,2	127,0
10 - 12	340	50	380	134	500	3,6	139,7
13 - 15	400	50	450	148	500	4,0	152,4

ANP – SYSTEMS GmbH	ANP – strand anchor 2 – 15 strands, Ø 15,3mm and 15,7mm Components: corrugated PE-sheathing, spring basket spacer, sealing ring	Annex 12

Corrugated PE-sheathing

Material: PE-HD, DIN 16776

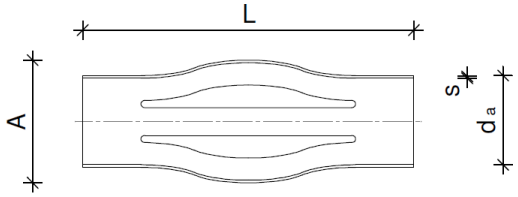
No. of strands	min Di [mm]	Da [mm]	min s [mm]
2 - 4	52	64	1,0
5 - 7	66	78	1,0
8 - 12	86	98	1,5
13 - 15	97	125	2,0



Spring basket spacer

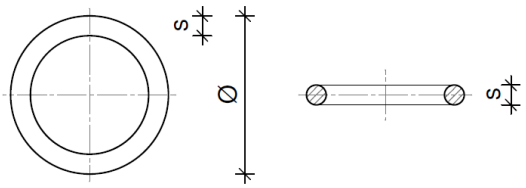
Material: PVC-U, DIN 8061 / 8062

No. of strands	L [mm]	Temporary strand anchor			Permanent strand anchor		
		A [mm]	d_a [mm]	s [mm]	A [mm]	d_a [mm]	s [mm]
2 - 4	270 - 300	100	50	3	125	63	3,6
5 - 7		125	63	3,6	125	90	2,7
8 - 12		135	90	2,7	140	110	3,2
13 - 15		190	110	3,2	190	125	3,7



Sealing ring

Material: Silicon – foam / cellular rubber

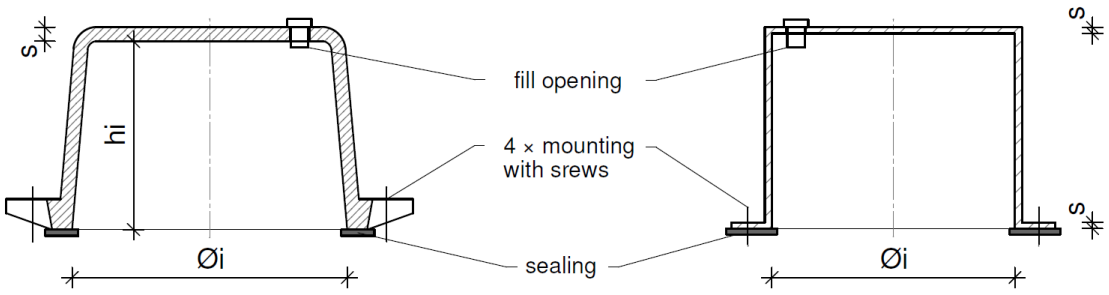


No. of strands	Ø [mm]	s [mm]
2 - 4	88	20
5 - 7	114	25
8 - 9	127	20
10 - 12	139	25
13 - 15	154	20

ANP – SYSTEMS GmbH	ANP – strand anchor 2 – 15 strands, Ø 15,3mm and 15,7mm Components: caps, centraliser, PE-sheath for monostrands	Annex 13

Caps

Material: PE-HD, DIN 16776 resp. EN-GJS-400-15, ÖNORM EN 1563 resp. S235, ÖNORM EN 10025-2

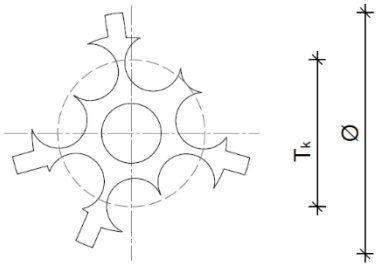


No. of strands	Wedge plate type MT		Wedge plate type MTR		min wall thickness s	
	min hi [mm]	min Øi [mm]	min hi [mm]	min Øi [mm]	steel [mm]	plastic [mm]
2 - 4	80	115	80	130	3,0	5,0
5 - 7		135	95	155		
8 - 9	95	155		175		
10 - 12		170		185		
13 - 15		185	100	205		

Centraliser

Material: PE-HD, DIN 16776

No. of strands	T_k [mm]	Ø [mm]
2 - 4	26	52
5 - 7	41	67
8 - 12	60	86
13 - 15	71	99



PE-sheath for monostrands

Material: HDPE80, ÖNORM ISO 3126

Strand Ø [mm]	Outside diameter [mm]	Wall thickness [mm]
15,3	19,0 +0,3/-0	1,25 +0,2/-0
15,7	19,6 +0,3/-0	1,25 +0,2/-0

ANP – corrosion protection procedure

Material: corrosion protection wax Petroplast acc. ÖNORM EN 1537, appendix B

Features	Standard	Criteria for acceptability
flash point	DIN 51 376	> 160° C
density (23° C)	ISO 2811	~ 0,90 g/cm³
dropping point	DIN 51 801	≥ 60° C
electrical volume resistivity	DIN 53 482	10^9 Ohm.cm
neutralization value	DIN 51 558	< 1 mgKOH/g
soapification value	DIN 53 401	< 1 mgKOH/g
testing of corrosive sulfur	DIN 51 759	not corrosive
permanent temperature stability		40° C
recommended grouting temperature		90 - 120° C
colour		braun
cleaning supplies		fuel, petroleum, xylene
amount / running meter single strand		> 40 g/m
friction: cladding and wax filled strand		< 60 N/m

Material: corrosion protection compound Unigel 128-F1, AS01, acc. ETAG 013

Features	Standard	Criteria for acceptability
flash point	ISO 2592	> 220° C
density	ASTM D1475	~ 0,90 g/cm³
dropping point	ISO 2176	≥ 190° C
cone penetration (1/10mm)	ISO 2137	270 - 300
oil separation at 40° C	DIN 51 817	after 72 h: 0 after 7 d: 0
oxidation resistance	DIN 51 808	100 h at 100° C: < 0,06 Mpa 1000 h at 100° C: < 0,2 Mpa
corrosion protection 168 h at 35° C - salt spray 168 h at 35° C - destillated water spray	 NFX 41-002 NFX 41-002	 passed, no corrosion passed, no corrosion
corrosion test	DIN 51 802	grade: 0-0
content of aggressive substances Cl^-, S^{2-}, $NO3^-$: $SO4^{2-}$:	 NFM 07-023 NFM 07-023	 ≤ 50 ppm (0,005%) ≤ 100 ppm (0,010%)

Corrosion protection compound for anchor head area

A filling material with petrolatum products is used acc. to ÖNORM EN 1537, appendix B.
Material: corrosion protection wax Petroplast or Denso-Jet
corrosion protection compound Unigel 128F-1

Corrosion protection tape for wedge plate

Tape with corrosion protection compound is used (impregnated) acc. to ÖNORM EN 1537, appendix B.
Material: Denso-Plast or KEBU

Manufacturing instruction for the ANP temporary anchor

- The strands of this anchor type are cased individually in the unbonded length and blank/uncased in the bonded length.
- The pushing of the blank strand into the sheath takes place in the ANP-Systems Gmbh production plant.
- At the transition from the unbonded length to bonded length the sealing from the polyethylene sheath to the strand is achieved with a tape or heat shrink tube.
- In the bonded length the strands are provided with spacers and bundled according to annex 1 of the approval.
- Filling pipes and post grouting pipes can be fixed on the strand bundle.
- The ready-made anchors are labeled, curled and delivered to the installation site on wooden reels.

Manufacturing instruction for the ANP temporary anchor with extended corrosion protection

- The strands of this anchor type are cased individually in the unbounded length and provided with corrosion protection compound. They are blank/uncased in the bond length.
- The blank strand is fanned out over the area of the unbonded length in the ANP-Systems GmbH production plant, provided with corrosion protection material/compound (thin layer), closed again and inserted into a sheath.
- At the transition of the unbonded length to bonded length the sealing from the sheath and strand is achieved with a tape or heat shrink tube.
- In the bonded length the strands are equipped with centering spacers and bundled according to annex 1 of the approval.
- Filling and post grouting pipes can be fixed on the strand bundle.
- The assembled/ready-made anchors are labeled, curled and delivered to the installation site on wooden reels.

Manufacturing instruction for the ANP – permanent strand anchor

- The complete anchor is cased in a polyethylene/PE corrugated sheath.
- The strands of this anchor type are cased individually in the unbonded length and equipped with corrosion protection compound. They are blank in the bonded length.
- The blank strand is fanned over the area of the unbonded length/over the complete unbonded length in the ANP-Systems GmbH manufacturing plant, filled with corrosion protection compound, closed again and inserted into a sheath.
- At the transition of the unbonded length the sealing from sheath to strand is achieved with a tape or heat shrink sleeve.
- In the bond length/area the strands are equipped with star/centering spacers and bundled in between in a way that a cement cover > 5mm is ensured in the PE corrugated sheath.
- The filling pipe for the interior anchor space is fixed on the strand bundle.
- The ready-made strand bundle with the filling pipes is inserted into the polyethylene/PE corrugated sheath.
- The end cap is assembled on the PE corrugated sheath and sealed.
- The filling pipes for the exterior anchor space and the optional post grouting pipes can be assembled outside on the PE corrugated sheath. The ready-made anchors are labeled, curled and delivered to the building site on wooden reels.

Manufacturing instruction for the ANP anchor with staggered bond lengths

- All the anchor types that have been mentioned so far can also be designed as anchors with staggered bonded length and different unbonded length.
- The manufacturing methods remain unchanged.
- The strands have to be labeled at the downstream end in a way so that the unbonded length can be clearly identified.

Installation instruction for ANP temporary anchor and ANP temporary anchor for extended short-term use

- After drilling the borehole has to be cleaned. Then the drill rods are removed and the anchor is installed.
- Anchors, depending on their size and length, can be installed either manually, automatically (with a crane) or with an anchor cylinder/an anchor drum. Before installation dirt has to be removed if necessary along the bond length (load application into ground). Filling and post grouting pipes and the external spacers have to be installed.
- The borehole is filled with cement mortar according the requirements of ÖNORM EN 1537 either before or after anchor installation from the borehole ground.
- When the casing is removed cement mortar is refilled to ensure a complete filling of the anchorage length.
- The top 50 cm of the borehole (minimum) should not be filled. It may be necessary to rinse this area.
- If necessary, a post grouting of the anchorage length can take place after some hours
- The head is installed shortly before the tensioning of the anchor. First the individual strand casing is cut off and removed at the tendon. After the anchor plate has been positioned the wedge plate with the screwed-in transition tube and the wedges are installed. The temporary anchor for extended short-term use uses transition tubes that are filled with corrosion protection compound. After tensioning the anchor head is coated with corrosion protection material and, if necessary, a cover cap is installed/mounted.

Installation instruction for the ANP strand anchor for permanent use

- After drilling the borehole has to be cleaned. Then the drill rods are removed and the anchor is installed.
- Anchors, depending on their size and length, can be installed either manually, automatically (with a crane) or with an anchor drum. Before installation dirt has to be removed from the corrugated sheath in the area of the bond length if necessary. Filling and post grouting pipes and the external spacers have to be installed. The corrugated sheath has to be checked for damage. Any damage has to be sealed with appropriate heat shrink sleeves.
- After installation first the interior anchor space is filled with cement mortar according to the requirements of ÖNORM EN 445, ÖNORM EN 446 and ÖNORM EN 447 via the built-in injection hose/tube and then the anchor exterior space is filled with grout injection mortar according to the requirements of ÖNORM EN 1537.
- When the casing is removed, the annulus/space between the corrugated sheath and the borehole wall is constantly refilled to ensure a complete filling of the bond length.
- The top 50 cm of the borehole (minimum) should not be filled. It may be necessary to flush/rinse this area. Furthermore the top 30 cm of the corrugated sheath have to be blowed dry and cleaned before the cement mortar has hardened.
- Some hours later the bond length can be post-grouted if necessary.
- The head is installed shortly before the anchor is tensioned. First, the seal ring and a steel ring (it is needed for the absorption of transverse tension) are pushed about 25cm behind the tendon on the corrugated sheath and the corrugated sheath is cut off (use special tools!) about 15cm behind the tendon.
  Then the individual strand casing is cut off at the bearing and removed. After the installation of the wedge plate with the welded-on tube (please pay attention to correct fit of the seal ring between tube and corrugated sheath), the anchor plate with the screwed-in transition tubes and the wedges are installed.
  After the anchor has been tensioned the seal tube is filled with cement mortar (with removable anchors) or with liquid corrosion protection compound (with anchors that can be released or restressed/readjusted) via a directional borehole in the base plate, the cover cap is installed and filled with liquid corrosion protection compound.

Transport and storage of ANP – strand anchors

- ANP-strand anchors shall be handled with care.
- ANP-strand anchors are either delivered in a flat position or coiled. When anchors with double corrosion protection are required, only the free/unbonded length can be delivered coiled up.
- The curvature radius shall not fall below the value that is specified by the manufacturer/plant.
- Strands and sheaths may only be lifted with the designated transport hooks or suitable interlayers to avoid damage.
- The cargo has to be secured against shifting and tilting.
- Correct and careful transport is required to protect the strand anchors from mechanical damage and corrosion.
- Long-term storage: The components of the ANP – strand anchor must stored in a sheltered area to avoid possible corrosion of the blank steel parts. Water condensation shall be prevented.
- Tension members and anchorage parts of strand anchors must not be kept near places where welding work is carried out.
- Chemical, mechanical or electrochemical impacts/impairment of ANP - strand anchor parts shall be avoided.

Tensioning of ANP strand anchors

- A precondition for tensioning is the sufficient strength of the grout body in the bond length and the concrete bearing.
- Hydraulic bundle prestressing jacks (one press stroke to tension all tendons -> identical press condition in all tendons) that have to comply with the test load requirements shall be used for anchor tensioning. The bundle presses have to be checked annually.
- The test setup and the test method comply with the requirements of ÖNORM EN ISO 22477-5.
- A wedge detention/reset plate is placed in the area of the stressing chair so that a regular wedge slip is ensured when the anchor is locked.

Tensioning of anchors with staggered bond lengths

- Unlike conventional strand anchors, the anchors with staggered bond lengths have different unbonded lengths and (hence) different elongation values.
- Either individual jacks with a single hydraulic power unit and a distribution device or bundle jacks with staggered press wedges can be used to guarantee a regular force distribution. The press wedges' distribution has to be calculated depending on the respective unbonded length.