

GEOTECHNICAL SYSTEMS

DYWIDAG Permanent Anchors (Single Bar Anchors) for Soil and Rock with Steel Tendons made of: B500B - GEWI® Ø 40mm and Ø 50mm and S 555/700 - GEWI® Ø 63.5mm

Approval Number Z-34.11-225

Validity 13th April 2020 - 13th April 2025

General Construction Supervisory Authority Approval
No. Z-34.11-225 from April 13, 2020

Deutsches Institut für Bautechnik DIBt
(German Institute for Building Technology)

Approval Office for Construction Products and
Building Methods

Constructional Testing Authority

A statutory body jointly sponsored by the
German national government and
the German Länder

Member of EOTA, UEAtc and WFTAO

General Construction Supervisory Authority Approval

Date:

May 25, 2020

Reference No.:

I 64-1.34.11-1/20

Approval No.:

Z-34.11-225

Period of validity:

from: April 13, 2020

to: April 13, 2025

Applicant:

DYWIDAG-Systems

International GmbH

Destouchesstrasse 68

80796 München

Subject of approval:

DYWIDAG Permanent Anchors (Single Bar Anchors) for Soil and Rock with Steel Tendons made of: B500B-GEWI 40mm dia. and 50mm dia. and S 555/700-GEWI 63.5mm dia.

The above-mentioned subject matter is hereby granted general construction supervisory authority accreditation/a general construction supervisory authority approval.

This notice contains 16 pages and four annexes comprising six pages.

The subject matter was granted a general construction supervisory authority approval on March 30, 1994 for the first time.

Important Note

This general construction supervisory authority approval/general design-type approval is the translation of a document originally prepared in the German language which has not been verified and officially authorized by "Deutsches Institut für Bautechnik" (DIBt; German Institute for Civil Engineering). In case of doubt in respect to the wording and interpretation of this notice, the original German version hereof shall prevail exclusively. Therefore, no liability is assumed for translation errors or inaccuracies.

I GENERAL PROVISIONS

- 1 This notice verifies the applicability or fitness for the intended purpose of the subject matter of approval within the meaning of the *Land* building codes [*Landesbauordnungen*].
- 2 This notice does not replace the permissions, approvals and certificates required by law for the realization of building projects.
- 3 This notice is issued without prejudice to the rights of third parties, especially private property rights.
- 4 Copies of this notice must be made available to the user or installer of the subject matter of approval without prejudice to the more detailed provisions under "Special Provisions". In addition, it must be pointed out to the user or installer of the subject matter of approval that this notice must be available at the site of use or installation. Copies hereof must also be made available to the authorities involved on request.
- 5 This notice may only be reproduced in its entirety. Any publication of excerpts is subject to the approval of DIBt. Texts and drawings included in promotional material may not contradict this notice, and translations must include the note "Translation of the German original version not verified by DIBt".
- 6 This notice is issued subject to revocation. The provisions herein can be subsequently amended or modified, especially if the latest technical findings give reason for this.
- 7 This notice refers to the information and documents provided by the applicant. Any amendment of such information and documents is not covered by this notice and must be promptly disclosed to DIBt.
- 8 The general design-type approval covered by this notice is deemed to be a general construction supervisory authority approval of the design at the same time.

II SPECIAL PROVISIONS**1 Subject matter of approval and applicability****1.1 Subject of approval and field of application**

(1) Subject matter is the "DYWIDAG permanent anchor (single bar anchor)" of company DYWIDAG-Systems International GmbH, which consists of steel tendons made of bars according to Table 1, connecting and anchoring means, and additional components. The steel tendon can be provided with a corrosion protection system consisting of a plastic corrugated sheathing injected with inner cement grout (see Annex 1).

(2) The "DYWIDAG permanent anchor (single bar anchor)" may be used for ground anchors as specified by DIN EN 1537¹ in conjunction with DIN SPEC 18537².

1.2 Subject matter of approval and scope of application

(1) Subject matter of approval is the planning, design and installation of ground anchors for which the stipulations of DIN EN 1537 in conjunction with DIN SPEC 18537 must be observed, unless stated otherwise below.

(2) The ground anchors are to be assembled according to Annexes 1 to 4, using the "DYWIDAG permanent anchor (single bar anchor)" and cement grout.

(3) The ground anchors may be installed as permanent anchors.

2 Provisions for the building product(s)**2.1 Properties and composition****2.1.1 Steel tendon**

(1) The ground anchors are to be fabricated as single bar anchors with steel tendons made of reinforcing steel bars with thread ribs.

(2) Only the following generally approved steel with rolled-on thread ribs according to Table 1 on both sides may be used as material for the steel tendon:

Table 1: Steel tendon

Type	Designation	Steel grade	Diameter
Reinforcing steel bar with thread ribs	B500B-GEWI	B500B	40 and 50mm
Steel bar with thread ribs	S 555/700-GEWI	S 555/700	63,5mm

2.1.2 Mechanical splice formation

(1) For the coupling of bars, couplers as defined by the general construction supervisory authority approvals Z-1.5-149 (B500B-GEWI) and Z-1.5-2 (S 555/700-GEWI) are to be used (see also Annex 2). The couplers can be provided with boreholes to secure them against loosening (fixing) by means of threaded pins (6 pcs. per coupler), the diameters and positions of which are indicated on the construction drawings deposited.

(2) Bars to be coupled must be prepared in the factory in accordance with Section 2.2.1. Depending on the installation position of the coupling, the coupler connection is to be protected by corrosion protection measures as set forth in Sections 2.1.2.1 and 2.1.2.2.

¹ DIN EN 1537:2014-07 Execution of special geotechnical works - ground anchors; German version EN 1537:2013

² DIN SPEC 18537:2017-11 Supplementary provisions to DIN EN 1537:2014-07, Execution of special geotechnical works - Ground anchors

2.1.2.1 Coupling in the tendon free length L_{tf}

(1) In the area of the tendon free length L_{tf} , elongation values must be complied with at the sites of coupling. These values must, for all sections in a building project, be selected equal to or greater than the maximum elongation value occurring there.

(2) Coupling in the tendon free length L_{tf} can be performed in two variants (see Annex 2).

Variant A

- A coupler sleeve consisting of PVC-U plastic ducts according to DIN EN ISO 21306-1³ is to be arranged over the coupler connection. The coupler sleeve is to be connected to the particular smooth sheathings of the bar sections to be coupled with appropriate plastic and tissue adhesive or by means of fixed heat shrink sleeves according to Section 2.1.6(3). The space between the coupling and the coupler sleeve is to be injected with anti-corrosion compound as set forth in Section 2.1.7.

Variant B

- A corrosion protection heat shrink sleeve as set forth in Section 2.1.6(2) is shrunk onto the coupler and connected on both sides to the corrosion protection of the bars (plastic corrugated sheathing with ventilation or grout cap). A coupler sleeve must be arranged over the entire coupler connection similar to Variant A and connected to the respective smooth sheathings of the bar sections to be coupled.

2.1.2.2 Coupling in the bond length L_{tb} and at the transition to the tendon free length L_{tf}

(1) In the case of a coupling in the bond length L_{tb} , two layers of heat shrink sleeves are to be arranged over the coupler connection, where the first layer must be a corrosion protection heat shrink sleeve and the second (outer) layer a fixed heat shrink sleeve according to Section 2.1.6. Only one coupling may be arranged in the area of the bond length.

(2) A coupling at the transition from the tendon free length L_{tf} to the bond length L_{tb} is to be performed like a coupling in the bond length, although it is not to be seen as a coupling in the bond length.

2.1.3 Anchor head

(1) The anchor head must be designed as shown in Annexes 1 and 3; for this purpose, the pipe socket must be connected to the anchor plate during the prefabrication in the factory (see Section 2.2.1.3).

(2) To anchor the bars, anchor nuts as stipulated by the general construction supervisory authority approvals Z-1.5-149 (B500B-GEWI) and Z-1.5-2 (S 555/700-GEWI) must be used (see also Annex 3).

(3) The bar must be anchored perpendicular to its axis in each direction.

(4) For the load transfer from the anchor nut to the concrete structure to be anchored, square anchor plates according to Annex 3 or the general construction supervisory authority approval No. Z-1.5-2 must be used. The anchor plates are provided with boreholes to fasten the anchor cap and inject the pipe socket with an anti-corrosion compound, the diameter and position of which must be indicated on the construction drawings deposited.

³ DIN EN ISO 21306-1:2019-07

Plastics - Unplasticized poly (vinyl chloride) (PVC-U) molding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 21306-1:2019) - German version EN ISO 21306-1:2019

(5) The pipe sockets (S235JR) must have the dimensions stated in Annex 3, dependent on the diameter of the bar used. At the air-side end, the pipe sockets are connected to the anchor plate, while, at the earth-side end, two rubber sealing rings are installed during the assembly of the anchor head on the construction site. The sealing rings must conform to the dimensions of the pipe sockets and of the plastic corrugated sheathings; these are, dependent on the bar diameter of the steel tendon used, deposited at the DIBt.

(6) The anchor plates are provided with boreholes to fasten the anchor cap and inject the pipe socket with an anti-corrosion compound, the diameter and position of which must be indicated on the construction drawings deposited (see also Annex 7).

2.1.4 Anchor cap

(1) The anchor cap in accordance with Annex 1 consists of steel (S235JR, minimum thickness of 3.0mm). It is screwed onto the anchor plate which has a sealing ring inserted (nitrile rubber).

(2) If the anchor cap cannot be exposed to mechanical loads as it will subsequently be cast in concrete, the cap may consist of PE-HD.

2.1.5 Plastic pipes

(1) To encase the bars in the tendon free length or bond length, only such plastic pipes may be used which consist of PVC-U pursuant to DIN EN ISO 21306-1, of polyethylene with a molding compound ISO 17855-PE-HD,,E,44-T022 in accordance with DIN EN ISO 17855-1⁴ or of polypropylene with the molding compounds ISO 19069-PP-B,,EAGC,10-16-003 or ISO 19069-PP-H,,E,06-35-012/022 pursuant to DIN EN ISO 19069-1⁵. Only pipes without trapped bubbles and with uniform pigmentation may be used.

(2) Both pipes in straight length and pipes in coils may be used. Any individual segments of PVC-U sheathings possibly required must be screwed together and carefully glued with a specific PVC adhesive or sealed by wrapping them with a specific PVC tape. Unspliced pipes must be used as the PE or PP sheathings.

(3) The basic dimensions of the plastic pipes (smooth and corrugated pipes) must comply with the specifications in Annex 1.

2.1.6 Heat shrink sleeves

(1) Corrosion protection heat shrink sleeves or fixed heat shrink sleeves must be used as the heat shrink sleeves.

(2) Corrosion protection heat shrink sleeves pursuant to DIN EN 12068⁶ with the classification "sheathing EN 12068-C30" (e.g. SATM, CPSM) made from radiated cross-linked polyethylene must be used, which, on the inside, are coated with a butyl rubber based adhesive with corrosion inhibitors; the adhesive applied should be at least 700g/m².

(3) Fixed heat shrink sleeves (e.g. MWTM, SRH2) consist of polyethylene; the sealing adhesive compound within the heat shrink sleeve must be a hot melt type adhesive.

4	DIN EN ISO 17855-1:2015-02	Plastics - Polyethylene (PE) moulding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 17855-1:2014) - German version EN ISO 17855-1:2014
5	DIN EN ISO 19069-1:2015-06	Plastics - Polypropylene (PP) molding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 19069-1:2015) - German version EN ISO 19069-1:2015
6	DIN EN 12068:1999-03	External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection - Tapes and shrinkable materials; German version EN 12068:1998

(4) The heat shrink sleeves must be shrunk on with hot air, infrared radiation, or the soft flame of a gas burner; the wall thickness in shrunk condition must be $\geq 1.5\text{mm}$.

2.1.7 Anti-corrosion compound

(1) Anti-corrosion compounds are used for the splice formation of the bars and at the anchor head. Denso-Cord, Denso-Jet, Denso-Fill, Petro-Plast or Nontribos MP-2 must be used as the anti-corrosion compound. These anti-corrosion compounds must each correspond to the formula deposited at the DIBt by the manufacturer of the particular compound.

(2) If Nontribos MP-2 is used as the anti-corrosion compound, and if direct contact to cement stone surfaces is given, then these surfaces must be sealed with SikaCor-299 beforehand.

2.1.8 Anti-corrosion coating

(1) If not fully cast in concrete (concrete cover of at least 5cm), exposed steel parts of the prefabricated anchor head construction (anchor plate with pipe sockets and anchor cap) must be provided with a corrosion protection system as required by DIN EN ISO 12944-5⁷ dependent on the determined corrosivity category of the surroundings with the period of protection "very high (VH)". The surface must be prepared as specified by DIN EN ISO 12944-4⁸. DIN EN ISO 12944-7⁹ must be observed for the execution of the coating work.

(2) Alternatively, the prefabricated anchor head construction and exposed areas of the anchor caps can, in the case of a corrosivity category of the surroundings of C1 to C4 inclusive, be provided with a corrosion protection using hot-dip zinc coating pursuant to DIN EN 14713-1¹⁰ dependent on the determined corrosivity category of the surroundings with the period of protection "very high (VH)". The surfaces must be prepared and finished in accordance with DIN EN ISO 1461¹¹. DAST Guideline 022¹² must be observed.

2.1.9 Inner cement grout

(1) Inner cement grout as prescribed by DIN EN 447¹³ must be used. In addition, DIN EN 445¹⁴ and DIN EN 446¹⁵ must be observed.

7	DIN EN ISO 12944-5:2018-06	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 5: Protective paint systems (ISO 12944-5:2018); German version EN ISO 12944-5:2018
8	DIN EN ISO 12944-4:2018-04	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 4: Types of surface and surface preparation (ISO 12944-4:2017); German version EN ISO 12944-4:2017
9	DIN EN ISO 12944-7:2018-04	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 7: Execution and supervision of paint work (ISO 12944-7:2017) - German version EN ISO 12944-7:2017
10	DIN EN ISO 14713-1:2010-05	Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures - Part 1: General principles of design and corrosion resistance (ISO 14713-1:2009); German version EN ISO 14713-1:2009
11	DIN EN ISO 1461:2009-10	Zinc coatings applied on steel by hot-dip galvanizing (galvanization of pieces) – requirements and tests (ISO 1461:2009); German version EN ISO 1461:2009
12	DAST Guideline 022:2016-06	Guideline for hot-dip-zinc-coating of prefabricated structural steel components, Deutscher Ausschuss für Stahlbau DAST, Sohnstr. 65, 40237 Düsseldorf
13	DIN EN 447:1996-07	Grout for prestressing tendons - Specification for common grout; German version EN 447:1996
14	DIN EN 445:1996-07	Grout for prestressing tendons - Test methods; German version EN 445:1996
15	DIN EN 446:1996-07	Grout for prestressing tendons - Grouting procedures; German version EN 446:1996

(2) For the injection of the plastic corrugated sheathing with inner cement grout in the factory, the prepared anchor must be positioned on an inclined plane, so that injection from the lowest point (injection cap) and ventilation at the highest point (ventilation cap) are ensured. The injection must continue until bubble-free inner cement grout exits from the ventilation cap.

2.1.10 Additional components

(1) The spacers must correspond to the specifications of Annex 1 and to the specifications deposited at the DIBt.

(2) To maintain a distance of $\geq 5\text{mm}$ between the bar and the plastic corrugated sheathing, the bar is to be provided with internal spacers every 1.0m, or a PE helix 6mm dia. (bar 40mm dia. and 50mm dia.) or 8mm dia. (bar 63.5mm dia.) with a pitch of 0.5m must be arranged. The material thickness of the internal spacers in the area of their star spikes or webs is $> 5\text{mm}$.

2.2 Manufacture, storage, transport and marking

2.2.1 Corrosion protection and manufacture of the anchor construction prefabricated for installation and grouting

2.2.1.1 Steel tendon

(1) Prior to its use, the steel tendon (bars) must be treated in accordance with the approval provisions for the steel in question. The steel tendon must be clean and free of damaging rust.

(2) Steel tendons with a slight rust film may be used. The term "slight rust film" is defined as the uniform beginning of rust formation which has not yet led to the formation of corrosion pits visible with the naked eye and which, in general, may be removed by wiping with a dry rag.

2.2.1.2 Prefabricated anchor construction

(1) The manufacture of the prefabricated anchors and the corrosion protection measures must be carried out in the factory for each tendon or each tendon section in accordance with the work instructions deposited at the DIBt.

(2) In particular, the following is to be observed for the manufacture of the DYWIDAG permanent anchor (single bar anchor) (Annex 1) in the factory:

The steel tendon must be inserted into a corrugated sheathing made of plastic according to Section 2.1.5 over approximately the entire length. The corrugated sheathing (dimensions see Annex 1) must have a uniform wall thickness of $\geq 1.0\text{mm}$ (steel tendon 40mm dia. and 50mm dia.) or $\geq 1.5\text{mm}$ (steel tendon 63.5mm dia.). To maintain the distance between the tendon and the corrugated sheathing, internal spacers as per Section 2.1.10 must be used.

The ends of the corrugated sheathing must be covered with caps (injection and ventilation caps) on both sides and glued. The annular void between the tendon and the corrugated sheathing must be injected with inner cement grout in accordance with Section 2.1.9. Following the grouting operation, the opening of the injection cap is to be closed with a corrosion protection heat shrink sleeve as required by Section 2.1.6 at the earth-side end of the bond length of the ground anchor, or, alternatively, an injection cap with a ball valve must be mounted (see Annex 1).

A smooth sheathing made of plastic according to Section 2.1.5 with a wall thickness of $> 1.5\text{mm}$ is pulled over the corrugated sheathing in the area of the tendon free length L_{tf} . The basic dimensions of the smooth plastic pipes are stated in Annex 1, and the distance between the corrugated sheathing and the smooth sheathing may only amount to a maximum of 2mm. The smooth sheathing must be fixed in its position with an adhesive tape suited for the particular plastic used.

(3) If the steel tendon is coupled and assembled from individual tendon sections at the site of installation, then Section 2.1.2 must be observed. Free steel projections required for the coupling must be taken into account for the assembly of the corrugated sheathing and injection and ventilation caps and protected from corrosion by means of temporary measures.

2.2.1.3 Design and corrosion protection of the anchor head

(1) The design of the anchor head is depicted in Annexes 1 and 3. The assembly of the anchor head on the construction site must be performed in accordance with the work instructions deposited at the DIBt. The following prefabrication measures of the anchor head construction must be conducted in the factory:

The anchor plate must be circumferentially welded to the pipe socket. The welding operations may only be carried out by companies, which have a welding certificate for the execution class EXC 1 as required by DIN EN 1090-1¹⁶. Following the welding operations, the prefabricated anchor head construction and exposed surfaces of the anchor caps must be protected from corrosion in accordance with Section 2.1.8.

(2) If considered necessary by the external monitoring body, samples must be lodged with such body. DIN EN ISO 12944-7, Section 7, applies to coating materials covered by DIN EN ISO 12944-5.

2.2.2 Packaging, transport and storage

(1) The integrity of the corrosion protection components of the DYWIDAG permanent anchor (single bar anchor) must be ensured. Special care must be taken during storage, transport and installation of the readily assembled permanent anchors so that the sheathings are not damaged as a result of improper handling.

(2) Depending on the temperatures, the anchors may not be removed from the assembly bench earlier than one day after the injection of the inner cement grout has taken place in the factory.

(3) The further transport and the installation may only be carried out three days after the inner cement grout has been injected in the plant.

(4) The anchors may not be stored on the ground; contamination and soiling of, most notably, the corrugated sheathing must be avoided. If the anchors are supported at intervals only, the support points may not be sharp-edged, but must be flat.

(5) If anchors are piled up, they must lie on top of one another in a parallel manner. If supported in intervals by square timbers or adequate spacers, then the weight of the anchors on top may only be carried via the timbers or spacers.

(6) In no case may the anchors be thrown or dropped. They must be transported in such a manner (e.g. by hand on the shoulders or by means of carrying straps) that particularly the corrugated sheathing cannot be damaged. If transported by a crane hook, the anchor must be carried at its stressing end directly on the steel or with carrying straps or must be placed in ducts.

2.2.3 Marking

(1) The delivery note for the prefabricated anchor must be marked by the manufacturer with the mark of conformity ("Ü-Zeichen") in accordance with the conformity mark regulations issued by the German *Länder*. The marking may only be performed if the requirements pursuant to Section 2.3 have been met.

(2) The delivery note must, among other things, state for which ground anchors the components are designated and in which factory they have been manufactured. Only components for one design variant to be specified may be delivered on a delivery note; it must be possible to obtain clear assignment of the components from the delivery note.

¹⁶

DIN EN 1090-1:2012-02

Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structural components; German version EN 1090-1:2009+A1:2011

2.3 Certificate of conformity**2.3.1 General**

(1) The conformity of the anchor components and of the anchor construction prefabricated for installation and grouting with the provisions of the general construction supervisory authority approval covered by this notice must be confirmed for every manufacturing plant with a declaration of conformity issued by the manufacturer based on its internal production control system and on a certificate of conformity issued by a notified product certification body, as well as regular external monitoring by a recognized external surveillance authority in accordance with the following provisions: The manufacturer of the anchor components and of the prefabricated anchor construction must commission a notified product certification body and an external surveillance authority to issue the certificate of conformity and perform the external monitoring, including the product inspection/testing to be carried out in this process.

(2) The manufacturer must issue the declaration of conformity by marking the building product with the mark of conformity (Ü-Zeichen), indicating the intended purpose of use.

(3) The certification body must forward a copy of the certificate of conformity issued to DIBt for information.

(4) In addition, DIBt must be provided with a copy of the report on the first inspection for information.

2.3.2 Factory production control

(1) Every manufacturing plant must establish and implement its own factory production control system. A factory production control system is defined as the continuous monitoring of the production to be performed by the manufacturer who thus ensures that the building products manufactured meet the requirements covered by this general construction supervisory authority approval.

(2) The factory production control system should at least include the measures listed in Annex 7 regarding the incoming goods inspection and the control during the production.

(3) The results of the internal production control must be recorded and evaluated. The records must at least contain the following information:

- The description of the construction product or of the basic material and of its components,
- the type of the control or inspection,
- the date of manufacture and the date of inspection of the construction product or of the basic material or of its components,
- the results of the controls and inspections and, if applicable, a comparison with the relevant requirements,
- the signature of the person in charge of the internal production control system.

(4) The records must be kept for a minimum of five years and submitted to the notified product certification body involved in continuous surveillance. They must be submitted to DIBt and to the competent highest construction supervisory authority on request.

(5) If the test results are unsatisfactory, the manufacturer must immediately take the measures necessary to eliminate the identified deficiency. Construction products which do not meet the requirements must be handled in such a manner that they cannot be mistaken for conforming products. Once the deficiency has been eliminated, the test in question must be immediately repeated, provided that this is technically feasible and also required to verify the elimination of the deficiency.

2.3.3 External surveillance

(1) The facilities and the internal factory production control system in all manufacturing plants must be reviewed by a notified product certification body on a regular basis, but at least twice a year.

(2) An initial inspection must be carried out as part of the external surveillance. As part of the external surveillance, samples are to be taken for sample checks, and the testing tools are to be checked. Both sampling and testing are incumbent on the notified product certification body involved in continuous surveillance.

(3) The results of the certification and of the external surveillance must be kept for a minimum of five years. They must be presented to DIBt and to the competent highest construction supervisory authority by the notified product certification body on request.

3 Provisions for planning, design and installation**3.1 Planning and design**

(1) Unless stated otherwise in the text below, DIN EN 1997-1¹⁷ in conjunction with DIN EN 1997-1/NA¹⁸ and DIN 1054¹⁹ in conjunction with DIN 1054/A1 and A2²⁰ apply to the planning and design of structures using ground anchors.

(2) The use is limited to those cases where the entire load transfer length of the anchor is located either in non-cohesive or cohesive soils or in rock (cf. DIN EN 1997-1 in conjunction with DIN EN 1997-1/NA and DIN 1054 in conjunction with DIN 1054/A1 and A2, Section 3.1). Deviating cases may only be realized subject to the consent of a geotechnical engineering expert.

(3) DIN EN 1537, Section 5, applies to soil investigation requirements. 3.1.1 Maximum values of the prestressing loads and further evidence

3.1.1 Maximum values of prestressing forces and other verifications

(1) Proof must be provided that the prestressing loads (lockoff loads) $P_{0,max}$ do not exceed the following condition:

$$P_{0,max} = 0.6 \cdot A_s \cdot f_{t0,2k}$$

A_s = cross-sectional area of the steel tendon

$f_{t0,2,k}$ = characteristic value of the tension of the steel tendon at 0.2% permanent elongation

(2) It must be verified that the change of load (characteristic value) in the steel tendon due to frequently repetitive live loads (including wind) is not greater than 20% of the characteristic load E_k .

(3) Proof must be provided that the fatigue stress range on the air-side anchorage and on possible couplers does not exceed 0.7 times the verified fatigue stress range stipulated by the relevant general construction supervisory authority approval No. Z-1.5-149 or No. Z-1.5-2. Load cycle numbers exceeding $2 \cdot 10^6$ are not proven by the general construction supervisory authority approval No. Z-1.5-149 or Z-1.5-2. Verification will only be required if the dynamic load is not covered by the prestressing operation.

17	DIN EN 1997-1:2009-09	Eurocode 7: Geotechnical design - Part 1: General rules; German version EN 1997-1:2004 + AC:2009
18	DIN EN 1997-1/NA:2010-12	National Annex - Nationally determined parameters - Eurocode 7: Geotechnical design - Part 1: General rules
19	DIN 1054:2010-12	Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1
20	DIN 1054/A1:2012-08 DIN 1054/A2:2015-11	Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1:2010; amendment A1:2012 Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1; amendment 2

3.1.2 Air-side anchorage via reinforced concrete and steel structures and rock

(1) When anchoring reinforced concrete structures, anchor plates and anchor nuts according to Annex 3 must be used (see also Section 2.1.3). In this process, the additional reinforcement and the minimum distances of the anchorage for the plate anchorage dependent on the concrete strength class according to Annex 3 or the general construction supervisory authority approval No. Z-1.5-2 must be observed.

(2) For anchorage or support on steel structures, sufficient bearing capacity and adequate corrosion protection must be proven or determined for the bearing plates and transition structures (e.g. angle compensation tube) in each individual case. Both are not the subject matter of this notice.

(3) In the case of rock anchors, the overall safety of the anchored rock mass is the subject matter of verifications of stability in terms of rock mechanics; the anchor forces required for stability must be determined by an expert²¹. For anchorage on rock, the design values of the rock pressure (resistance) must be established on a case-to-case basis by an expert, taking into consideration a possible structural breakdown in the immediate vicinity of the borehole. Any necessary adapters must be designed in accordance with the relevant standards, taking into account the design values of the rock pressure (resistance).

3.2 Installation

3.2.1 General

(1) The requirements of DIN EN 1537 in conjunction with DIN SPEC 18537 and DIN EN 1997-1 in conjunction with DIN EN 1997-1/NA and DIN 1054 must be observed for the installation (in-situ installation of the ground anchor) and verification, provided that nothing to the contrary is stated in the text below.

(2) DYWIDAG-Systems International GmbH must keep a list of structures secured with permanent anchors, indicating the structure anchored, the type of anchor (nominal diameter of the bar), and the number of anchors.

3.2.2 Contractor

(1) The assembly and installation of ground anchors by means of DYWIDAG permanent anchors (single bar anchors) may only be performed under the leading technical supervision of DYWIDAG-Systems International GmbH.

(2) The ground anchors may also be assembled and installed by companies which can present a certificate issued by DYWIDAG-Systems International GmbH that they have been trained in the assembly and installation of the ground anchors in accordance with the general design-type approval covered by this notice.

(3) The work is to be carried out in accordance with the work instructions prepared by DYWIDAG-Systems International GmbH, which have been deposited at the DIBt. The work instructions regarding the assembly of anchors on the construction site and the assembly of the anchor head must be available on the construction site. A copy of the instructions must be made available to the monitoring body (see Section 3.2.7); the same also applies to the construction drawings of the anchor head.

3.2.3 Drilling the boreholes

3.2.3.1 Borehole diameter

The minimum borehole diameter must be chosen in such a manner that the anchor with its spacers can be installed without any problems. DIN EN 1537 in conjunction with DIN SPEC 18537, Section 8.1, applies.

²¹ Experts in geotechnical engineering must be called in for the determination of static and structural requirements, as well as of characteristic loads.

3.2.3.2 Boreholes in soil

- (1) In general, boreholes must be cased.
- (2) Boreholes may be uncased or partly cased in cohesive soil if it is proven within the scope of a suitability test that there is solid ground over the total length of the uncased part of the borehole, that the drill rods used are sufficiently rigid to ensure straight drilling, and that the borehole can be thoroughly cleaned.

3.2.3.3 Boreholes in rock

- (1) The drilling method must be matched with the specific rock properties.
- (2) It must be verified that in the area of the free bond length perpendicular to the borehole axis:
 - joint displacements are not anticipated if the load transfer length has not been limited (see Section 3.2.5.4), or that
 - the joint displacements to be anticipated are less than the difference between the smooth sheathing and the borehole diameter if the load transfer length has been limited.
- (3) The free passage of the boreholes must be verified, for example, by means of a gage.

3.2.4 Installation into the borehole

(1) In the area of the bond length, elastic spacers according to Annex 1 must be positioned at least every 1.50m on a continuous basis, beginning from the first elastic spacer at the anchor base. The first spacer must be arranged a maximum of 0.75m from the anchor base-side end. When installing ground anchors using a casing, the arrangement of spacers can be abandoned if the wall thickness of the starting tube or the material thickness at the nipple passages is > 10mm.

(2) If a lost drill or ram bit is used, it must be knocked off with a steel bar prior to the installation of the anchor. If, during the installation of a tendon protected by a cased borehole, the projecting end of the drill set has an edged internal thread or a sharp-edged pipe end, the anchors prepared in accordance with Section 2.2.1 may only be inserted into the casing if an edge-free inserting trumpet or a pipe nipple fully covering the internal thread of the casing has been placed onto the projecting end of the drill set. When inserting the anchor, attention must be paid that the corrosion protection is not damaged.

3.2.4.1 Coupler splices

(1) The general requirements of Section 2.1.2 apply to the splice formation of the steel tendon.

(2) The coupler splice can be completed on the construction site prior to or directly during the anchor installation. For this production prior to the installation of the anchor, the anchor must be stored on a straight plane; Section 2.2.2 must be observed.

(3) Tendon sections prefabricated in the plant as per Section 2.2.1.2 must be used. The projecting steel at the tendon sections to be coupled must be embedded in the Denso-Jet or Petroplast anti-corrosion compound; however, temporary protection measures must be removed beforehand. The coupler is, when the tendon sections are assembled, screwed onto the tendon until the ventilation cap is tightly clamped. Thereafter, the coupler on that side is secured against unscrewing. The second tendon section is screwed into the coupler up to the grout or ventilation cap and tightened, then the locking device against unscrewing must be activated.

(4) According to the variant and installation position of the coupling, especially the following must be observed during the manufacture:

- Coupler splice in the tendon free length L_{tf} - variant A:
Prior to pushing on the coupler sleeve, the coupler is embedded in a corrosion protection compound, so that the space between the coupler connection and the coupler sleeve is filled with the corrosion protection compound. Thereafter, the coupler sleeve is pushed on and connected on both sides to the smooth sheathing, using an appropriate plastic or tissue adhesive (as a stopper) and fixed heat shrink sleeves (cf. Annex 2).
- Coupler splice in the tendon free length L_{tf} - variant B:

A corrosion protection heat shrink sleeve is shrunk onto the coupler, and the overlap length for the corrosion protection of the tendon sections (corrugated sheathing with injection or ventilation cap) corresponds at least to the diameter of the ribbed pipes. The pushed on coupler sleeve is, similar to variant A, connected on both sides to the smooth sheathing (cf. Annex 2).

- Coupler splice in the tendon bond length L_{tb} :

A splice in L_{tb} must be made as described in Annex 2. In this process, the coupling socket is covered by heat shrink sleeves in two layers (inside: corrosion protection heat shrink sleeve, outside: fixed heat shrink sleeve; cf. Section 2.1.6), where the outer layer covers the inner layer or has at least the same length. The overlap length for the corrosion protection of the tendon sections (corrugated sheathing with injection or ventilation cap) corresponds at least to the diameter of the corrugated sheathing.

- (5) When applying the adhesive tapes or heat shrink sleeves, the surfaces of the plastic pipes must be clean and dry.

3.2.5 Manufacture of the ground anchor

3.2.5.1 Cement grout

(1) The basic materials to be used for the cement grout are cements with particular properties in accordance with DIN 1164-10²² and cements in line with DIN EN 197-1²³ - taking into consideration the applicable exposure classes as defined by DIN EN 206-1²⁴ in conjunction with DIN 1045-2²⁵ (Table 1, F.3.1 and F.3.2) -, water as stipulated by DIN EN 1008²⁶ and, where required, additives in accordance with DIN EN 934-2²⁷ in conjunction with DIN EN 206-1/DIN 1045-2 or subject to a general construction supervisory authority approval, and natural aggregates for concrete with a maximum grain diameter of 4mm in compliance with DIN EN 12620²⁸, taking into consideration DIN EN 206-1/DIN 1045-2.

22	DIN 1164-10:2013-03	Special cement - Part 10: Composition, requirements and conformity evaluation for cement with low effective alkali content
23	DIN EN 197-1:2011-11	Cement - Part 1: Composition, specifications and conformity criteria of common cements; German version EN 197-1:2011
24	DIN EN 206-1:2001-07 DIN EN 206-1/A1:2004-10 DIN EN 206-1/A2:2005-09	Concrete - Part 1: Specification, performance, production and conformity Concrete - Part 1: Specification, performance, production and conformity; German version EN 206-1/A1:2004 Concrete - Part 1: Specification, performance, production and conformity; German version EN 206-1:2000/A2:2005
25	DIN 1045-2:2008-08	Concrete, reinforced and prestressed concrete structures - Part 2: Concrete - Specification, properties, production and conformity - Application rules for DIN EN 206-1
26	DIN EN 1008:2002-10	Mixing water for concrete - Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete; German version EN 1008:2002
27	DIN EN 934-2:2009-09	Admixtures for concrete, mortar and grout - Part 2: Concrete admixtures - Definitions, requirements, conformity, marking and labelling; German version EN 934-2:2009
28	DIN EN 12620:2008-07	Aggregates for concrete; German version EN 12620:2002+A1:2008

(2) The water/cement ratio must be between 0.35 and 0.70 and should be chosen as low as possible especially in cohesive soil and in rock. The cement grout must be mixed mechanically and may not segregate and lump before its injection. In the case of an alternative use of the inner cement grout, the water/cement ratio must be limited to a maximum of 0.44 pursuant to DIN EN 447.

(3) The amount of cement grout required for an anchor, its composition and the grouting pressure must be measured and recorded, e.g. by using the manufacture record according to Annex G.1 of DIN SPEC 18537.

(4) An injection for the production of the grout body must always be carried out from the lowest point of the grout body, while venting, if required, must always be performed from the highest point.

3.2.5.2 Production of the grout body in soil

(1) In the instance of a cased borehole, the pipes are pulled slowly and incrementally after the borehole has been filled with cement grout and the anchor has been installed and, where required, a grout cap has been put on, while the necessary grouting pressure is maintained. Grouting must at least be performed up to the transition point from the tendon bond length L_{tb} to the tendon free length L_{tf} .

(2) In the case of ascending anchors, a packer mounted outside on the corrugated pipe at the transition from the tendon bond length L_{tb} to the tendon free length L_{tf} must be activated prior to the beginning of the grouting operations (Annex 4). The grouting operation may only be terminated if bubble-free cement grout exits from the ventilation tube as it has been added through the filling or grouting tube.

In the case of downwardly inclined (descending) anchors, the ventilation tube may be omitted if the borehole is injected from the bottom until cement grout exits at the borehole top without any bubbles.

3.2.5.3 Production of the grout body in rock

(1) The rock must be sufficiently compact so that a faultless production of the grout body is ensured. This must be verified by special examinations (e.g. visual borehole inspection, gage measurement of the grout level, geohydraulic test) to the extent required.

(2) The mortar formula, the grouting pressure and the grouting operation must be determined on a case-by-case basis by the field engineer in consultation with an expert²¹ and the designing engineer based on the results of the rock explorations, water injection tests and the findings after the drilling of the boreholes. The designated grouting method must be explored within the scope of a suitability test.

3.2.5.4 Limitation of the load transfer length

(1) The load transfer length must be limited using one of the following methods:

a) by flushing out excess cement grout by means of a flushing tube firmly mounted on the sheathing. The flushing tube must be arranged in such a manner that the first discharge openings are 50m above the transition point between the tendon free length and the tendon bond length. The verification of this value must be confirmed in the drilling record. The flushing pressure applied must amount to approx. 4bar.

b) by flushing out excess cement grout by means of a flushing lance. The flushing lance closed at the bottom and provided with lateral openings must be inserted up to approx. 1.0m above the L_{tb}/L_{fs} transition point. The flushing pressure applied must amount to approx. 4bar.

c) by sealing off the load transfer length by means of a packer (Annex 4). The suitability of the packer must be proven within the scope of a suitability test.

In the case of downwardly inclined (descending) ground anchors, method a), b) or c) may be applied. For upwardly inclined (ascending) ground anchors, method c) must be applied.

(2) Limitation of the fixed anchor length can be neglected if the conditions for such limitation stated in DIN EN 1537, Section 8.3.4, in conjunction with DIN SPEC 18537 are fulfilled.

3.2.5.5 Post-grouting

(1) Once the cement grout of the initial grouting operation has set or fully hardened, further injections of cement grout can be made in the area of the grout body. For this purpose, valve tubes or rather tubes with valves provided with collars, or grout tubes with valves must be used. The grout body can be burst using water; grouting with grout cement must be performed in accordance with DIN EN 1537, Section 8.3.5.

(2) Subsequently, if the load transfer length must be limited, the free bond length must be flushed free again.

3.2.6 Anchor head assembly, corrosion protection measures on the construction site

(1) The individual steps of the assembly of the anchor head on the construction site including the corrosion protection measures must be carried out in accordance with the work instructions deposited at the DIBt.

(2) The free bar end must be coated with a thick layer of an anti-corrosion compound as defined by Section 2.1.7 until the time when the anchor head construction is mounted.

(3) The prefabricated anchor head construction (anchor plate with pipe socket, Section 2.2.1.3) is pushed on via the free steel end and the end of the ribbed pipe or smooth sheathing. The transition from the pipe socket to the corrugated sheathing or smooth sheathing must be sealed with two rubber sealing rings (see Annex 1), and the correct position must be ultimately checked.

(4) The space between the steel tendon and the anchor plate/pipe socket must be injected with an anti-corrosion compound in accordance with Section 2.1.7.

(5) If any anti-corrosion compound is removed during the stressing operation, it must be replaced.

(6) After the anchor has been stressed, the anchor nut and the bar projection must be protected with an anchor cap as set forth in Section 2.1.4, and the space between the nut and the cap must also be injected with an anti-corrosion compound according to Section 2.1.7.

(7) If the anchors must be restressed due to monitoring inspections, care must be taken that any anti-corrosion compound removed during the tensioning operation is replaced.

3.2.7 Suitability and acceptance tests, supervision of the installation

(1) Suitability and acceptance tests must be carried out on each construction site in accordance with DIN EN 1537 in conjunction with DIN SPEC 18537.

(2) The suitability tests must be supervised by a monitoring body for monitoring the installation of ground anchors included in the list of inspection, monitoring and certification bodies in accordance with the *Land* building codes, Part V, as amended from time to time²⁹.

(3) Within the scope of the monitoring activities related to suitability and acceptance tests, the monitoring body commissioned must monitor - at least randomly - the assembly of the permanent anchors on the construction site, especially the corrosion protection measures to be carried out on site, e.g. the complete injection of the anchor head area with an anti-corrosion compound.

(4) The beginning of the anchor operations must be reported to the competent building supervision authority. The monitoring body must report to the competent building supervision authority if facilities and personnel on site do not warrant proper installation.

²⁹

Most recent: List of inspection, monitoring and certification bodies based on the *Land* building codes [“LBO”] as of May 2017 - DIBt - Mitteilungen, Deutsches Institut für Bautechnik, 2017 edition of May 26, 2017

3.2.8 Declaration of conformity regarding the installation

(1) To confirm the agreement of the design type with the general design-type approval, the contractor must give a declaration of conformity pursuant to Section 16a(5) in conjunction with Section 21(2) MBO³⁰.

(2) The declaration of conformity of the contractor must be given in accordance with DIN EN 1537, Section 10, in conjunction with DIN SPEC 18537. In addition, the notice number must be stated.

(3) The declaration of conformity must be handed over to the client for incorporation into the construction file and presented to DIBt and to the competent highest construction supervisory authority on request.

4 Provisions for usage, support and maintenance

4.1 Verification

(1) DIN EN 1537, Section 9.10, in conjunction with DIN SPEC 18537 applies.

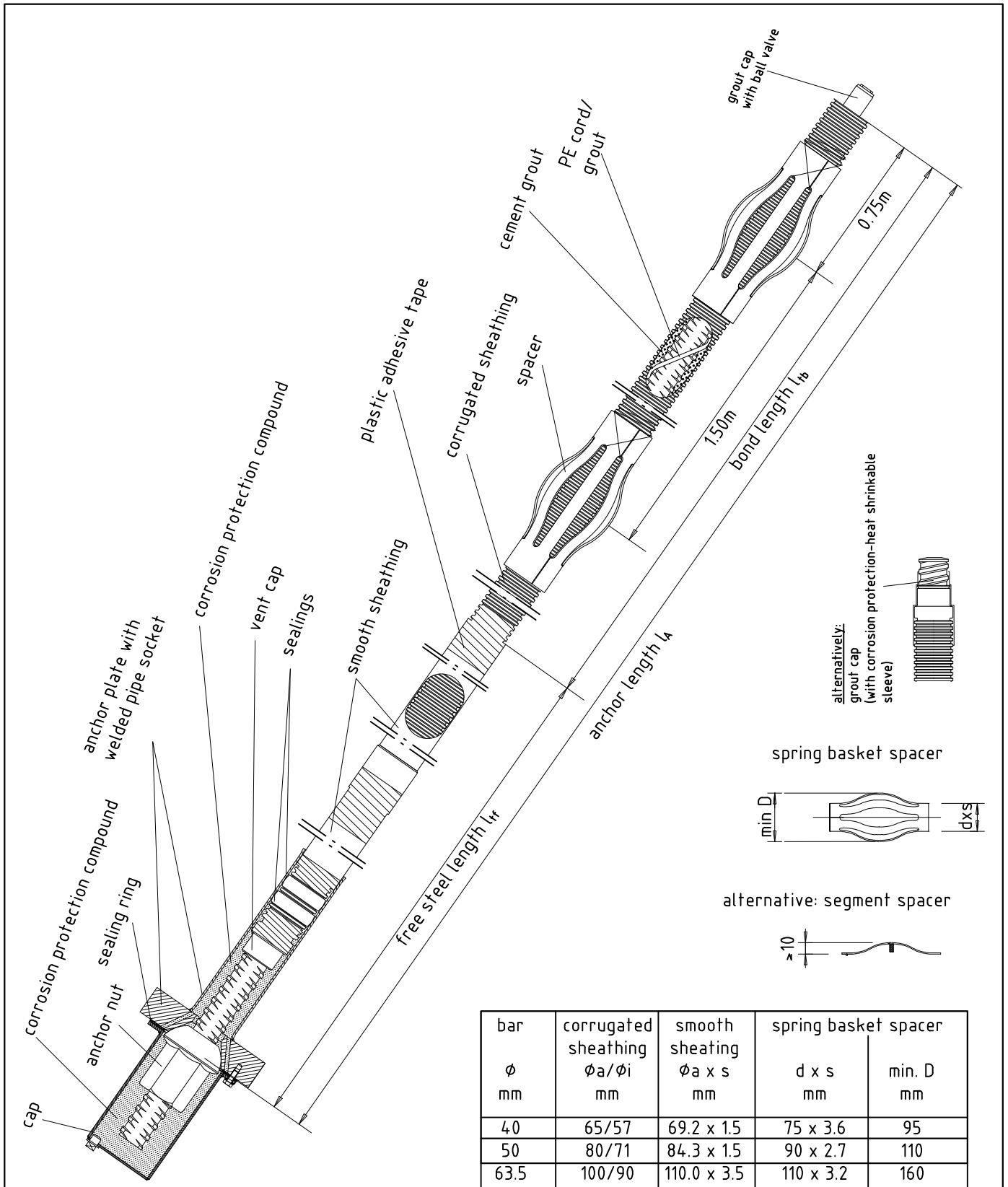
(2) If required, verification should be performed by the monitoring body which has also carried out the suitability tests.

Bettina Hemme
Section Head

Certified
Jendryschik

³⁰ Musterbauordnung (MBO, German Model Building Code)

Version of November 2002, last amended by the resolution adopted by the conference of the ministers of construction of 05/13/2016

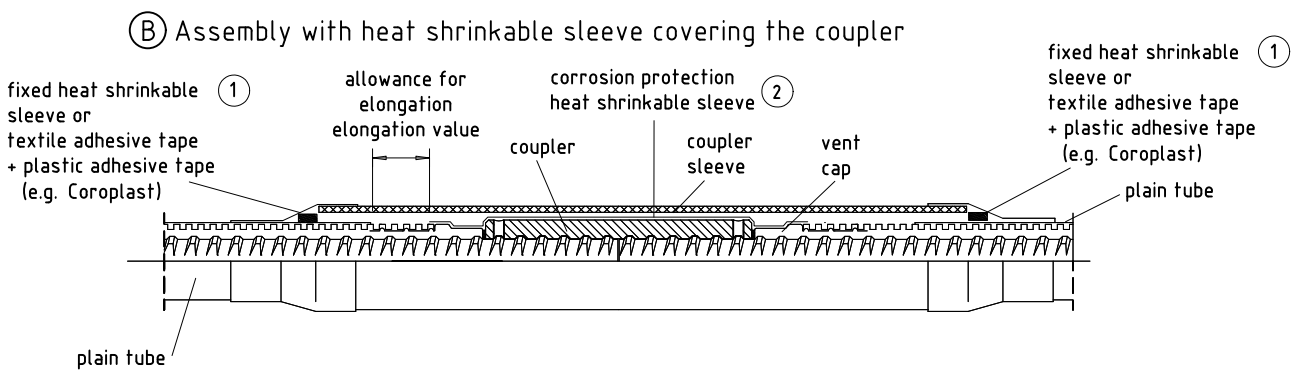
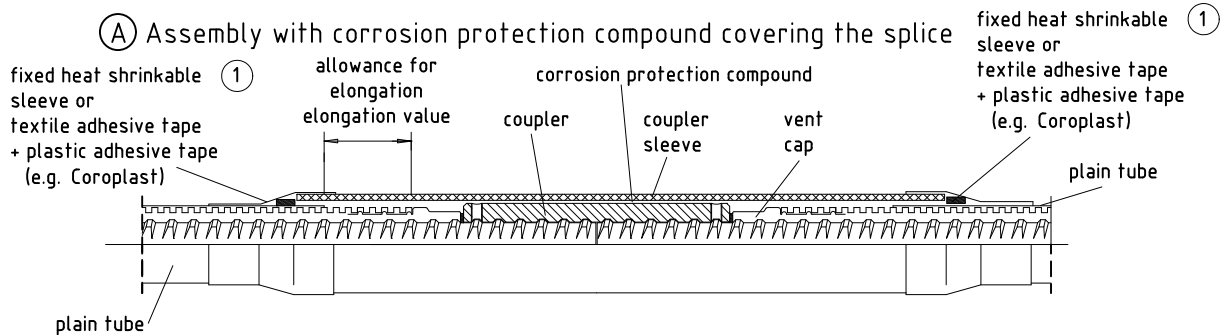


Permanent DYWIDAG Anchors (Single Bar Anchors) for Soil and Rock with steel tendons
made of: B500B-GEWI Ø 40 mm and Ø 50 mm and S 555/700-GEWI Ø 63.5 mm

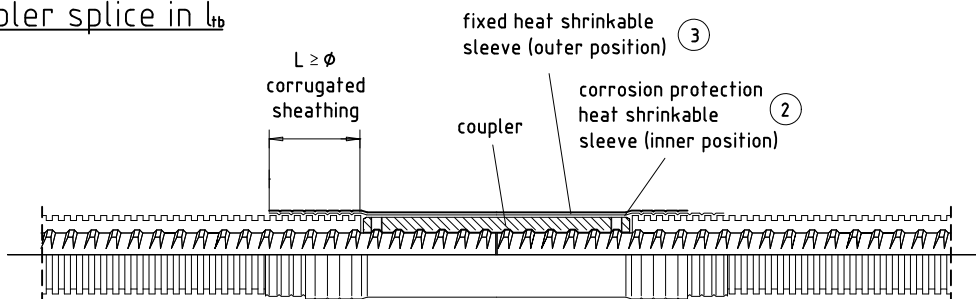
Overview DYWIDAG permanent bar anchor with GEWI steel

Annex 1

coupler splice in l_{tr}



coupler splice in l_{cb}



Rotary protection of all couplers by threaded pins.
Alternatively, glue in one bar end using resin adhesive.

bar \varnothing mm	coupler	heat shrinkable sleeve			coupler sleeve ¹⁾			
		①	②	③	Type (A)		Type (B)	
		d	s	d	s	d	s	
mm		mm	mm	mm	mm	mm	mm	
40	acc. Z-1.5-149	115/34	95/29	95/29	80	4.4	90	6.7
50		115/34	140/42	115/34	110	5.3	110	5.3
63,5	acc. Z-1.5-2	140/42	140/42	115/34	125	3.7	125	3.7

¹⁾PVC coupler sleeve, up to 15 bar of grouting pressure

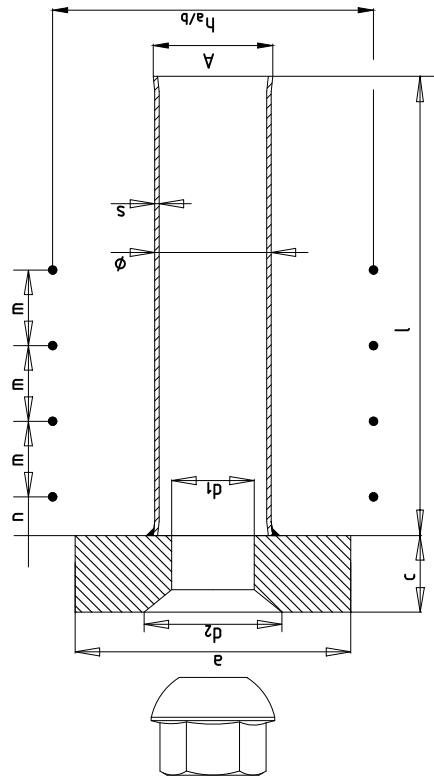
Permanent DYWIDAG Anchors (Single Bar Anchors) for Soil and Rock with steel tendons made of: B500B-GEWI \varnothing 40 mm and \varnothing 50 mm and S 555/700-GEWI \varnothing 63.5 mm

coupler splice assembly

Annex 2

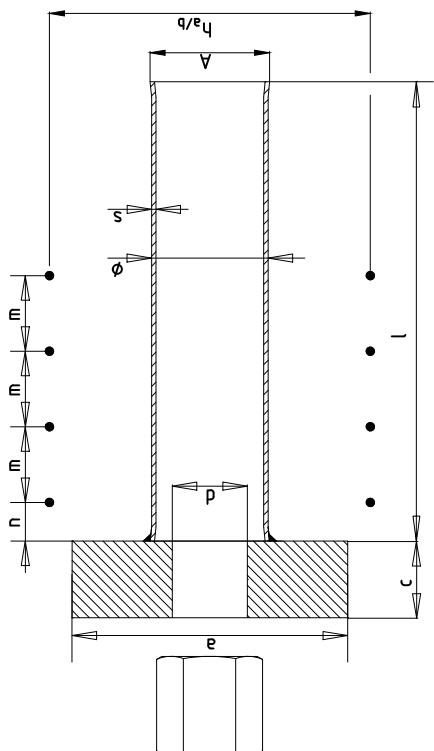
Permanent DYWIDAG bar anchor Ø63,5mm GEWI

domed anchor nut
anchor plate with cone



Permanent DYWIDAG bar anchor Ø40, Ø50
and Ø63,5mm GEWI

anchor nut
anchor plate



Minimum concrete grade: C20/25

Exposition classes according to
DIN EN 1992-1-1/NA :2013-04, table E.1DE
have to be taken into account.

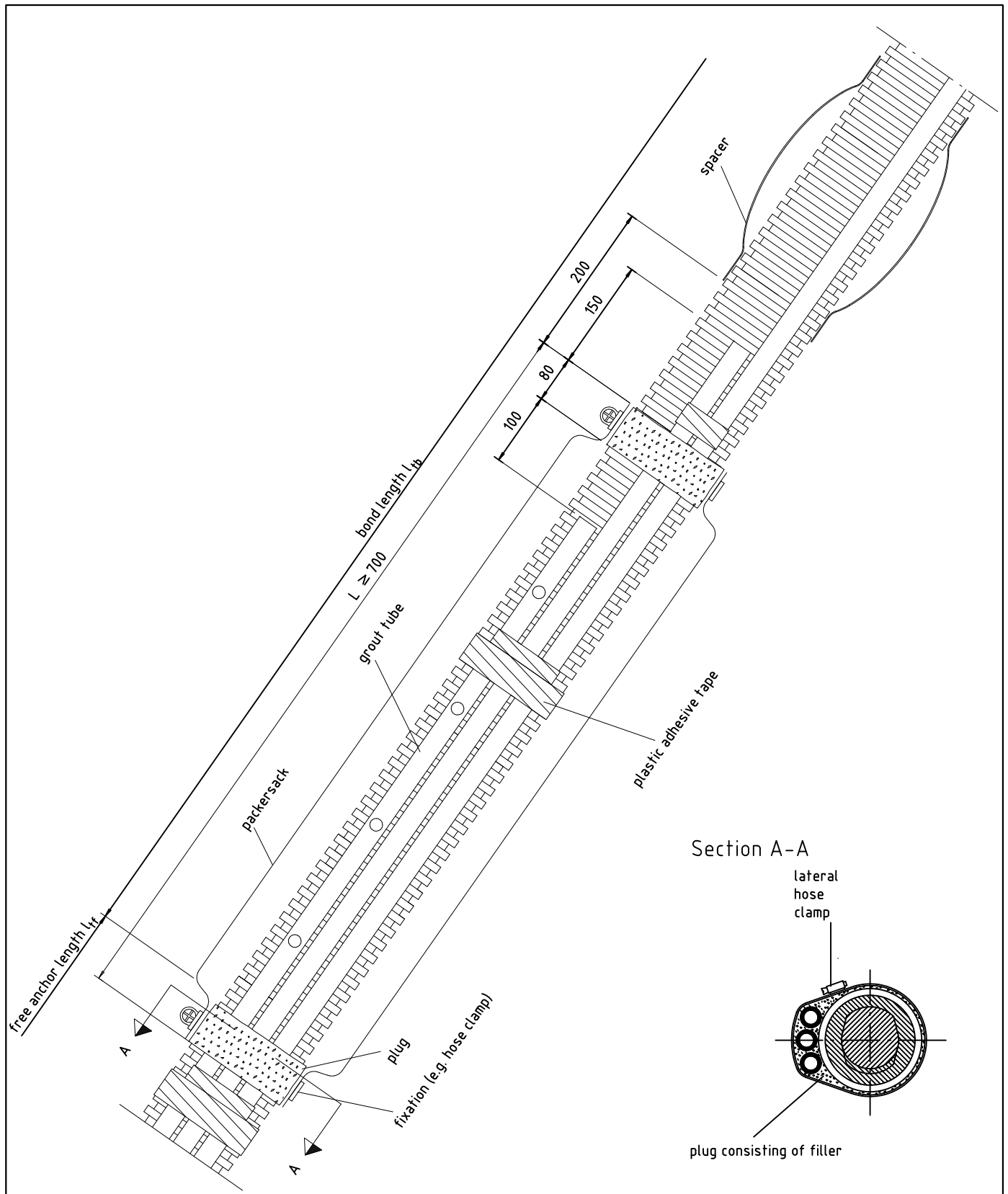
bar φ mm	square anchor plate			pipe socket tube φ x s mm	Material	domed - / anchor nut	additional reinforcement			min. axis distance mm	min. edge distance mm		
	a mm	c mm	d mm				d _r /d _z mm	h mm	a/b mm			n mm	m mm
40	160	40	46	-	76.1x2.9	S235JR (1.0038) DIN EN 10025-2	acc. Z-1.5-149	210	20	50	3	φ 12mm	140
50	200	45	58	-	101.6x3.6			300	25	60	4	φ 12mm	190
63.5	acc. Z-1.5-2			127x4	≥ 300	acc Z-1.5-2	acc. Z-1.5-2						

The valid approvals for the GEWI system (Z-1.5-149 und Z-1.5-2) must be observed.

Permanent DYWIDAG Anchors (Single Bar Anchors) for Soil and Rock with steel tendons
made of: BSt 500 S-GEWI Ø 40 mm and Ø 50 mm and S 555/700-GEWI Ø 63.5 mm

anchor assembly

Annex 3



<p>Permanent DYWIDAG Anchors (Single Bar Anchors) for Soil and Rock with steel tendons made of: B500B-GEWI Ø 40 mm and Ø 50 mm and S 555/700-GEWI Ø 63.5 mm</p>	<p>Annex 4</p>
<p>injection packer</p>	

Inspection	Inspection method	FPCS ¹	IP/EM ²	Value	
1. Incoming goods inspection					
1.1	Steel bar B500B-GEWI or S 555/700 GEWI	Delivery note	every delivery	X	Mark of conformity acc. to the GCSA approval
1.2	Anchor nuts	Delivery note	every delivery	X	Mark of conformity acc. to the Z-1.5-149 or Z-1.5-2
	Domed nut				Mark of conformity acc. to the Z-1.5-2
1.3	Coupling sleeve	Delivery note	every delivery	X	Mark of conformity acc. to the Z-1.5-149 or Z-1.5-2
	Unscrew protection: Diameter and position of the holes	Measurement	at least 5% of each delivery	X*	Shop drawings
1.4	Anchor plates/anchor plate with cone for Ø 63,5 mm	Delivery note	every delivery	X	Mark of conformity acc. to the Z-1.5-2
	Anchor plates for Ø 40 and 50 mm	DIN EN 10204 Measurement Geometry	every delivery	X X*	Inspection certificate 2.2 Annex 3 and shop drawings
	Borholes for anchor caps and backfill: Diameter and position of the holes	Measurement	at least 5% of each delivery	X*	Shop drawings
1.5	Plastic pipes (smooth pipes, corrugated pipes, socket pipes), press-in and vent caps				
	Molding compound	DIN EN 10204	every delivery	X	Inspection certificate 2.1
	Wall thickness (by corrugated pipe wall thickness at inner and outer rib and at the flank)	Measurement	1 per 100 pcs.	X*	Appendix 1 and 2 and shop drawings
	Pipe diameter inside and outside	Measurement	1 per 100 pcs.	X*	Appendix 1 and 2 and shop drawings
1.6	Sealing rings				
	Molding compound	DIN EN 10204	every delivery	X	Inspection certificate "2.1"
	Inner and outer diameter	Measurement	1% of each delivery, min. 5pcs	X*	Shop drawings

to be continued on Annex 5, Page 2

¹ Internal Production Control System

² Initial testing/external monitoring (twice a year)

DYWIDAG Permanent Anchors (Single Bar Anchors) for Soil and Rock with Steel Tendons made of: B500B-GEWI 40mm dia. and 50mm dia. and S 555/700-GEWI 63.5mm dia.

Annex 5
Page 1 of 2

Minimum Requirements for the Internal Production Control System

continuation of Annex 5, Page 1

	Inspection	Inspection method	FPCS ¹	IP/EM ²	Value
1.7	Pipe socket				
	Steel grade	DIN EN 10204	every delivery	X	Inspection certificate 2.1
	Diameter, widening A, wall thickness, length	Measurement	1 per 100 pcs.	X*	Shop drawings
1.8	Heat shrink sleeves				
	Molding compound	DIN EN 10204	every delivery	X	Inspection certificate 2.1
	Corrosion protection shrink tubing: - Classification - Glue applying	EN 12068 Measurement	1 per 100 pcs. 1 per 100 pcs.	X X*	C30 >700 g/m ²
1.9	Corrosion protection coatings, materials and corrosion protection systems				
	Material properties and layer thickness	DIN EN 10204	5% of the quantity produced	X	Inspection certificate 3.1
2. Control during manufacture					
2.1	Heat shrink sleeves- wall thickness in the shrunk condition	Specimen and measurement	1 per anchor type per delivery	X*	>1,5 mm
2.2	Cement grout	DIN EN 445	DIN EN 446	X	DIN EN 447
2.3	Assembly of the prefabricated anchors	visual	every working day	X	Section 2.2.1
2.4	Sealing rings for pipe socket / corrugated or smooth tube	Funktionalität, fit accuracy	1 per 100 pcs.	X	Yes/no- test

* Inspection plan:

If each individual measured value equals or exceeds the minimum value stipulated, the batch must be accepted. Otherwise, additional samples can be taken. The same measurements as those on the first sample must be carried out on these additional samples. The measuring results must be merged with the previous measurements. The mean value \bar{x} and the standard deviation s must be derived from all values. If the test value (numerical value)

$$z = \frac{\bar{x} - \text{min. value}}{s}$$

derived therefrom equals or exceeds the minimum value required, the batch must be accepted, otherwise rejected.

¹Internal Production Control System

²Initial testing/external monitoring (twice a year)

DYWIDAG Permanent Anchors (Single Bar Anchors) for Soil and Rock with Steel Tendons made of: B500B-GEWI 40mm dia. and 50mm dia. and S 555/700-GEWI 63.5mm dia.

Annex 5
Page 2 of 2

Minimum Requirements for the Internal Production Control System



BELGIUM AND LUXEMBOURG

DYWIDAG-Systems International N.V.
Philipssite 5, bus 15
Ubicenter, 3001 Leuven, Belgium
Phone +32-16-60 77 60
Fax +32-16-60 77 66
E-mail info.be@dywidag-systems.com

FRANCE

DSI France SAS
Rue de la Craz
Z.I. des Chartinières
01120 Dagneux, France
Phone +33-4-78 79 27 82
Fax +33-4-78 79 01 56
E-mail dsi.france@dywidag-systems.fr

GERMANY

DYWIDAG-Systems International GmbH
Germanenstrasse 8
86343 Koenigsbrunn, Germany
Phone +49-8231-96 07 0
Fax +49-8231-96 07 40
E-mail geotechnik@dywidag-systems.com

DYWIDAG-Systems International GmbH
Max-Planck-Ring 1
40764 Langenfeld, Germany
Phone +49-2173-79 02 0
Fax +49-2173-79 02 20
E-mail suspa@dywidag-systems.com

DYWIDAG-Systems International GmbH
Schuetzenstrasse 20
14641 Nauen, Germany
Phone +49-3321-44 18 0
Fax +49-3321-44 18 18
E-mail suspa@dywidag-systems.com

ITALY

DYWIDAG Systems S.r.l.
Viale Europa 72 Strada A 7/9
20090 Cusago (MI), Italy
Phone +39-02-901 65 71
Fax +39-02-901 65 73 01
E-mail info@dywit.it

NETHERLANDS

DYWIDAG-Systems International B.V.
Veilingweg 2
5301 KM Zaltbommel
Netherlands
Phone +31-418-57 89 22
Fax +31-418-51 30 12
E-mail email.nl@dywidag-systems.com

POLAND

DYWIDAG-Systems International Sp. z o.o.
ul. Bojowników o Wolność i Demokrację 38/121
41-506 Chorzów, Poland
Phone +48-32-241 09 98
Fax +48-32-241 09 28
E-mail dsi-polska@dywidag-systems.com

SPAIN

DYWIDAG Sistemas Constructivos, S.A.
Avd/de la Industria, 4
Pol. Ind. la Cantuena
28947 Fuenlabrada (Madrid), Spain
Phone +34-91-642 20 72
Fax +34-91-642 27 10
E-mail dywidag@dywidag-sistemas.com

UNITED KINGDOM

DYWIDAG-Systems International Ltd.
Northfield Road, Southam, Warwickshire
CV47 0FG, Great Britain
Phone +44-1926-81 39 80
Fax +44-1926-81 38 17
E-mail sales@dywidag.co.uk



www.dywidaggroup.com