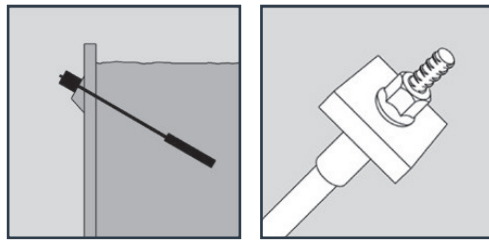


## DYWIDAG Geotechnical Systems

### DYWIDAG Permanent Anchors



**Permanent DYWIDAG Anchors  
(Single Bar Anchors) for Soil  
and Rock with Steel Tendons  
made of: Grade St 950/1050  
Ø 26.5mm, Ø 32mm, Ø 36mm  
and Ø 40mm**

**Approval Number  
Z-20.1-17**

Validity  
11 April 2015 - 29 June 2018

# General Construction Supervisory Authority Approval

**Approval Office for Construction Products and  
Construction Methods**

**Testing Office for Structural Engineering**

A statutory body commonly sponsored by the  
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**Approval No.:**  
**Z-20.1-17**

**Period of validity:**  
from: **April 11, 2015**  
to: **June 29, 2018**

**Applicant:**  
**DYWIDAG-Systems  
International GmbH**  
Destouchesstrasse 68  
80796 München

**Subject of approval:**  
**Permanent DYWIDAG Anchors (Single Bar Anchors) for Soil and Rock with Steel Tendons made of:  
Grade St 950/1050 dia. 26.5 mm, dia. 32.0 mm, dia. 36.0 mm and dia. 40.0 mm**

The above-mentioned subject of approval is hereby granted a general construction supervisory authority approval. This general construction supervisory authority approval comprises sixteen pages and six appended sheets. The subject matter was granted a general construction supervisory authority approval on April 1, 1989 for the very first time.

### **Important Notice**

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

## I. GENERAL PROVISIONS

- 1 This general construction supervisory authority approval verifies the suitability (fitness for the intended purpose) of the subject of approval in keeping with the state construction ordinances.
- 2 If requirements for particular technical knowledge and experience of persons entrusted with the manufacture of construction products and construction methods are imposed in accordance with state-specific regulations corresponding to Section 17 Sub-Section 5 of the Musterbauordnung (German Model Building Code), it must be observed that such technical knowledge and experience can also be proven by equal supporting documents issued by other member states of the European Union. Where required, this also applies for equal supporting documents submitted within the scope of the Agreement on the European Economic Area (EEA) or other bilateral agreements.
- 3 This general construction supervisory authority approval does not replace any permissions, agreements and certifications required by law for the construction projects to be carried out.
- 4 This general construction supervisory authority approval is granted without prejudice to the rights of third parties, especially private property rights.
- 5 Notwithstanding any further regulations in the "Special Provisions" section, the manufacturer and distributor of the subject of approval must provide the user with copies of the general construction supervisory authority approval; furthermore, they have to inform the user that the general construction supervisory authority approval must be available at the place of use. Copies of this general construction supervisory authority approval must be made available to the involved authorities on request.
- 6 This general construction supervisory authority approval may only be copied in its entirety. The publication of extracts is subject to the approval by the DIBt. Texts and drawings of advertising material may not contradict this general construction supervisory authority approval. Translations of the general construction supervisory authority approval must contain the note "Translation of the German original which has not been verified by the DIBt".
- 7 This general construction supervisory authority approval is granted subject to revocation. The provisions of this general construction supervisory authority approval can be subsequently amended or changed, especially if the latest technical findings give reason for this.

## II. SPECIAL PROVISIONS

### 1 Subject of approval and scope of application

#### 1.1 Subject of approval

Subject of this general construction supervisory authority approval is the permanent DYWIDAG anchor (single bar anchor) for soil and rock by DYWIDAG-Systems International GmbH with steel tendons made of grade St 950/1050, dia. 26.5 mm, dia. 32.0 mm, dia. 36.0 mm and dia. 40.0 mm.

Unless stated otherwise below, the requirements of DIN EN 1537<sup>1</sup> in conjunction with DIN SPEC 18537<sup>2</sup> and DIN EN 1997-1<sup>3</sup> in conjunction with DIN EN 1997-1/NA<sup>4</sup> and DIN 1054<sup>5</sup> must be observed with regard to the installation (production) and testing. Unless stated otherwise hereinafter, the dimensions must comply with DIN EN 1997-1<sup>3</sup> in conjunction with DIN EN 1997-1/NA<sup>4</sup> and DIN 1054<sup>5</sup>.

#### 1.2 Scope of application

Ground anchors may be used as permanent anchors.

Their application is limited to such cases where the entire load transfer length of an anchor is located either in non-cohesive or cohesive soil or in rock (cf. DIN EN 1997-1<sup>3</sup> in conjunction with DIN EN 1997-1/NA<sup>4</sup> and DIN 1054<sup>5</sup>, Section 3.1). Deviating cases may only be carried out subject to the consent of an expert in geotechnical engineering.

DIN EN 1537<sup>1</sup>, Section 5, applies for the soil investigation requirements.

### 2 Provisions covering the construction product

#### 2.1 Features and constituents

##### 2.1.1 General

Ground anchors must be designed as single bar anchors using the steel tendons listed under Section 2.1.2.

##### 2.1.2 Steel tendon

The material to be used for the steel tendon may only be corrugated prestressing steel bars with rolled-on thread ribs on both sides, grade St 950/1050, diameters 26,5 mm, 32 mm, 36 mm and 40 mm, based on the general construction supervisory authority approval No. Z-13.73-50123<sup>6</sup> for the European technical approval ETA-05/0123<sup>7</sup>.

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<sup>1</sup> DIN EN 1537:2001-01	Execution of special geotechnical works - Ground anchors
<sup>2</sup> DIN EN 1537 Ber. 1:2011-12 DIN SPEC 18537:2012-02	Correction to DIN EN 1537:2001-01 Supplementary provisions to DIN EN 1537:2001-01, Execution of special geotechnical works - Ground anchors
<sup>3</sup> DIN EN 1997-1:2009-09	Eurocode 7: Geotechnical design - Part 1: General rules; German version EN 1997-1:2004 + AC:2009
<sup>4</sup> DIN EN 1997-1/NA:2010-12	National Annex - Nationally determined parameters - Eurocode 7: Geotechnical design - Part 1: General rules
<sup>5</sup> DIN 1054:2010-12 DIN 1054/A1:2012-08	Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1 Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1:2010; amendment A1:2012
<sup>6</sup> Z-13.73-50123	DYWIDAG-System international GmbH; Destouchesstrasse 68; 80796 München, Germany; Application rules for the bar post-tensioning system according to ETA-05/0123 of June 30, 2013 for the external prestressing of load-bearing structures
<sup>7</sup> ETA-05/0123	DYWIDAG-System international GmbH; Destouchesstrasse 65; 80796 München, Germany; Bar post-tensioning system for the prestressing of load-bearing structures, internally with and without bond as well as externally, period of validity from June 30, 2013 to June 29, 2016

**2.1.3 Anchor head****2.1.3.1 General requirements**

The anchor head must be designed in accordance with Appendices 1, 2 and 5. The assembly of the anchor head on the construction site must be carried out in accordance with the description filed with the DIBt.

To anchor the grade St 950/1050 steel, diameters 26.5 mm, 32 mm, 36 mm and 40 mm, domed nuts and square bearing plates must be used in accordance with the general construction supervisory authority approval No. Z-13.73-50123<sup>6</sup> for the European technical approval ETA-05/0123<sup>7</sup>. Bearing plates must be provided with boreholes to fasten the anchor cap and inject the steel tube with anti-corrosion agent, whose diameter and position must be indicated on the construction drawings deposited (see also Section 2.3. Certificate of conformity).

If not cast in concrete completely, the bearing plate must be provided with a corrosion protection system according to DIN EN ISO 12944-5<sup>8</sup> in dependency of the determined corrosivity category of the environment and with the term of protection "high (H)". The surface must be prepared as specified by DIN EN ISO 12944-4<sup>9</sup>. DIN EN ISO 12944-7<sup>10</sup> must be observed for the execution of the coating work.

All exposed surfaces or surfaces not sufficiently covered with concrete (minimum 5 cm) of steel components, e.g. of the steel tube and of the steel protection cap, must also be provided with one of those corrosion protection systems.

Alternatively, the bearing plate and exposed surfaces or surfaces not sufficiently covered with concrete, given a corrosivity category of the environment from C1 to C4 inclusive, must be provided with corrosion protection using hot-dip zinc coating according to DIN EN ISO 14713-1<sup>11</sup> in dependency of the determined corrosivity category of the environment with the term of protection "very high (VH)".

The surfaces must be prepared and treated according to DIN EN ISO 1461<sup>12</sup>. DASSt Guideline 022<sup>13</sup> must be observed.

The tendon must in each direction be anchored perpendicular to its axis.

**2.1.3.2 Air-side anchorage via rock**

For rock anchorages the design values of the rock pressure to be absorbed must be established on a case-to-case basis by an expert<sup>14</sup> taking into consideration a possible structural fault in the immediate vicinity of the borehole. Any necessary adapters must be designed pursuant to the relevant standards, taking into account the design values of the rock pressure to be absorbed.

<sup>8</sup> DIN EN ISO 12944-5:2008-01

Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 5: Protective paint systems (ISO 12944-5:2007); German version EN ISO 12944-5:2007

<sup>9</sup> DIN EN ISO 12944-4:1998-07

Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 4: Types of surface and surface preparation (ISO 12944-4:1998); German version EN ISO 12944-4:1998

<sup>10</sup> DIN EN ISO 12944-7:1998-07

Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 7: Execution and supervision of paint work (ISO 12944-7:1998); German version EN ISO 12944-7:1998

<sup>11</sup> 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

<sup>12</sup> 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

<sup>13</sup> DASSt Guideline 022:2009-08

Guideline for hot-dip-zinc-coating of prefabricated structural steel components, Deutscher Ausschuss für Stahlbau DASSt, Sohnstr. 65, 40237 Düsseldorf

<sup>14</sup> Experts in geotechnical engineering must be consulted for the determination of static and structural requirements and characteristic loads.

- 2.1.3.3 Air-side anchorage via steel and reinforced concrete structures  
For the anchorage of reinforced concrete structures, the reinforcement requirements and the minimum distances of the anchorage for the plate anchorage (Appendix 5) in dependency of the concrete strength class according to the general construction supervisory authority approval No. Z-13.73-50123<sup>6</sup> for the European technical approval ETA-05/0123<sup>7</sup> must be observed.  
For supports on steel structures, the static behavior of wedge plates and transition structures must be demonstrated in each individual case. Both are not covered by the present general construction supervisory authority approval.
- 2.1.4 **Plastic sheathing**  
For the sheathing of the tendon free length or rather of the bond length, only such plastic sheathings may be used which consist of PVC-U as specified by DIN EN ISO 1163-1<sup>15</sup>, of polyethylene with a molding compound pursuant to DIN EN ISO –1872-1<sup>16</sup> – PE, E, 45 T 022 - or of polypropylene with a molding compound as required by DIN EN ISO 1873-1<sup>17</sup> - PP - B, EAGC, 10-16-003 or DIN EN ISO 1873-1<sup>17</sup> - PP - H, E, 06-35-012/022. The sheathings must be straight and may not show any trapped bubbles, and their pigmentation must be uniform.  
Any possibly required individual segments of the PVC-U sheathings must be screwed together and carefully glued with specific PVC adhesive or carefully sealed by wrapping them with specific PVC tape. Unspliced tubes must be used as PE or PP sheathings.
- 2.2 **Manufacture, storage, transport and marking**
- 2.2.1 **Corrosion protection and manufacture of prefabricated anchors for installation and grouting**
- 2.2.1.1 General  
The corrosion protection and manufacture must be carried out at the shop in accordance with the work instructions filed with the DIBt.  
The effectiveness of the corrosion protection applied depends on the integrity of the corrosion protection components used. Therefore, special care must be taken during transport and installation of the readily assembled permanent anchors so that sheathings will not be damaged as a result of improper handling.  
Prior to its installation, the steel tendon must be treated as required by the general construction supervisory authority approval provisions for the respective steel. For the production of the anchor the steel tendon must be clean and free of damaging rust.  
Steel 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. However, rust should not be removed in this way, except in areas which must be protected from corrosion by means of heat shrink sleeves; such areas must be free of rust and rust films.

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<sup>15</sup> DIN EN ISO 1163-1:1999-10 Plastics - Unplasticized poly(vinyl chloride) (PVC-U) moulding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 1163-1:1995); German version EN ISO 1163-1:1999

<sup>16</sup> DIN EN ISO 1872-1:1999-10 Plastics - Polyethylene (PE) moulding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 1872-1:1993); German version EN ISO 1872-1:1999

<sup>17</sup> DIN EN ISO 1873-1:1995-12 Plastics - Polypropylene (PP) moulding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 1873-1:1995); German version EN ISO 1873-1:1995

- 2.2.1.2 The following corrosion protective measures must be taken in the factory:
- 2.2.1.2.1 Anchor with corrugated sheathing in  $L_{tf}$  and  $L_{tb}$   
The steel tendon must be inserted into a corrugated tube (corrugated sheathing) made of plastic according to Section 2.1.4 for approximately the entire length (cf. Appendix 1). Care must be taken to ensure that only straight sheathings, which have also been delivered in such condition, are used. The corrugated sheathing must have a uniform wall thickness of  $\geq 1$  mm. The dimensions of the corrugated sheathings are specified in Appendix 1.  
The corrugated sheathing must be closed with caps (injection and ventilation caps) on both sides and glued. The annular space between the steel tendon and the corrugated sheathing must be grouted completely until bubble free grout emerges from the ventilation cap. The grouting must be done from the bottom (grout cap) to the top (ventilation cap) using grout as stipulated by DIN EN 447<sup>18</sup>, taking into account the amendments according to the valid List of Building Regulations A Part 1<sup>19</sup> or in accordance with the relevant general construction supervisory authority approval. In addition, DIN EN 445<sup>20</sup> and DIN EN 446<sup>21</sup> must be observed. The steel tendon must be provided with spacers every 1.0 m to maintain a distance of  $\geq 5$  mm between the tendon and the corrugated sheathing, or a PE helix 6 mm dia. with a pitch of 0.5 m must be placed between them. The material thickness of the spacers around their beam peaks or rather webs must be  $> 5$  mm. A smooth sheathing made of plastic according to Section 2.1.4 with a wall thickness of  $> 1.5$  mm is pulled over the corrugated sheathing in the area of the tendon free length. The basic dimensions of the smooth plastic sheathings are stated in Appendix 1. The inner diameter of the smooth sheathing may be maximum 2 mm larger than the outer diameter of the corrugated sheathing.  
The smooth sheathing must be fixed in its position with an adhesive tape suited for the plastic used or with a fix heat shrink sleeve (with adhesive coating inside, e.g. MWTM) (cf. Appendix 1). Section 2.2.1.3.2 must be observed regarding corrosion protection around the couplers.
- 2.2.1.2.2 Anchor with heat shrink sleeve in  $L_{tf}$   
Heat shrink sleeves instead of corrugated sheathings may be arranged throughout the tendon free length (cf. Appendix 2). The heat shrink sleeves must overlap the corrosion protection in the area of the bond length for minimum 10 cm. The heat shrink sleeves must overlap for minimum 5 cm at joints, if any, in the area of the tendon free length.  
Corrosion protection heat shrink sleeves pursuant to DIN EN 12068<sup>22</sup> with the classification sheathing EN 12068- C30 (e.g. SATM, CP5M) made of radiated cross-linked polyethylene with an initial wall thickness of  $\geq 0.7$  mm must be used, which are coated on the inside with a butyl rubber based adhesive with corrosion inhibitors; the adhesive applied must amount to minimum 700 g/m<sup>2</sup> (mean value 1,100 g/m<sup>2</sup>, nominal thickness 0.95 mm).  
The heat shrink sleeves must be hot shrunk with hot air, infrared radiation or the low flame of a gas burner. A smooth sheathing must be placed around the corrosion protection heat shrink sleeve. The smooth sheathing must be sealed on both the ground and air side with fix heat shrink sleeves (with adhesive coating inside, e.g. MWTM) (cf. Appendix 2).

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<sup>18</sup> DIN EN 447:1996-07 Grout for prestressing tendons - Specification for common grout; German version EN 447:1996  
<sup>19</sup> List of Building Regulations A, List of Building Regulations B and List C - 2014/2 edition; available online at [www.dibt.de](http://www.dibt.de)  
<sup>20</sup> DIN EN 445:1996-07 Grout for prestressing tendons - Test methods; German version EN 445:1996  
<sup>21</sup> DIN EN 446:1996-07 Grout for prestressing tendons - Grouting procedures; German version EN 446:1996  
<sup>22</sup> 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

- 2.2.1.2.3 Connecting the anchor plate with the steel tube  
A steel tube to be welded to the bearing plate must be disposed in the area between the bearing plate and the upper end of the sheathing. The welding work to seal the steel tube to the anchor plate must be carried out in the factory. Companies which carry out the welding operations on bearing plates, must have a welding certificate for the execution class EXC 1 according to DIN EN 1090-1<sup>23</sup>. After their connection, the steel tubes (on the inside and outside) and exposed bearing plates must be provided with a coating according to DIN EN ISO 12944-5<sup>8</sup> or a zinc coating according to DIN EN ISO 14713-1<sup>11</sup> in the factory which offers permanent corrosion protection taking into account the actual environmental conditions, see Section 2.1.3.1.
- 2.2.1.3 Coupler
- 2.2.1.3.1. General requirements  
For the coupling of the grade St 950/1050 steel, couplers according to the general construction supervisory authority approval No. Z-13.73-50123<sup>6</sup> for the European technical approval ETA-05/0123<sup>7</sup> must be used (see also Appendices 3 and 4). The couplers can be provided with boreholes to secure them against loosening (fixing) by means of threaded pins (6 pcs per coupler), whose diameter and position are indicated on the construction drawings deposited (see also Section 2.3.2.5 Certificate of compliance). Tendon sections to be coupled must be prepared in the factory according to Sections 2.2.1.2.1 and 2.2.1.2.2, respectively. The protruding steel at the tendons to be coupled must be embedded with Denso-Jet or Petroplast anti-corrosion agent; however, the temporary corrosion protection must be removed completely at the bar ends beforehand. Maximum one splice may be disposed in the area of the bond length  $L_{tb}$ . If a coupler splice is arranged in the transition area from the tendon free length  $L_{tf}$  to the bond length  $L_{tb}$ , no further coupler splice is admissible in the area of  $L_{tb}$ . A coupler splice in the transition area from the tendon free length  $L_{tf}$  to the bond length  $L_{tb}$  must be executed as a coupler splice in  $L_{tb}$  (see Sections 2.2.1.3.2, 2.2.1.3.3 and Appendix 3). Elongation values to be kept according to Appendices 3 and 4 must be selected equal or greater than the maximum elongation value there occurring for all sections in a building project. The below mentioned types of splices are permissible subject to the overall corrosion protection system (cf. Section 2.2.1.2.1 and 2.2.1.2.2, respectively).
- 2.2.1.3.2 Splice for anchor with corrugated sheathing (cf. Section 2.2.1.2.1).  
Two types are available for the splice in  $L_{tf}$  (cf. Appendix 3).  
Type A: The coupler splice within the coupler tube is protected by an anti-corrosion agent. Afterwards, the coupler tube is arrested on both sides either with a suited plastic and textile adhesive tape or alternatively with fix heat shrink sleeves (with adhesive coating inside).  
Type B: A corrosion protection heat shrink sleeve (CPSM or equivalent) is hot shrunk onto the coupler. The slipped on coupler tube is arrested as in Type A (cf. Appendix 3).  
The material properties and dimensions must correspond to the specifications deposited with the DIBt.  
The heat shrink sleeves must be hot shrunk with hot air, infrared radiation or the low flame of a gas burner. The heat shrink sleeves must have a minimum wall thickness of 1.5 mm in the shrunk condition.  
The coupler tube (see Appendices 3 and 4) consists of PVC-U according to DIN EN ISO 1163-1<sup>15</sup>; the dimensions can be taken from Appendices 3 and 4.

<sup>23</sup> 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



The surfaces of the plastic tube to be wrapped must be clean and dry before applying the adhesive tapes or heat shrink sleeves.

A splice in  $L_{tb}$  must be executed as described in Appendix 3. In doing so, the coupler of heat shrink sleeves must be covered in 2 (two) layers (inside: corrosion protection heat shrink sleeve, outside: fix heat shrink sleeve), with the outer layer covering the inner one or rather at least being the same length.

Only fix and corrosion protection heat shrink sleeves may be used, whose material properties and dimensions must comply with the specifications deposited with the DIBt, see also Appendix 3.

2.2.1.3.3 Splice for anchor with heat shrink sleeve in  $L_{tf}$  (cf. Section 2.2.1.2.2)

For a splice in  $L_{tf}$  see Appendix 4. A splice in  $L_{tb}$  must be executed as described in Appendix 3. Only fix and corrosion protection heat shrink sleeves may be used, whose material properties and dimensions must comply with the specifications deposited with the DIBt, see also Appendices 3 and 4.

## 2.2.2 Storage

Depending on the temperatures, the anchors may not be removed from the assembly platform at the factory for 24 hours after the grouting operation has taken place. Transportation and installation may only be carried out 3 days after grouting has taken place in the factory.

The readily assembled anchors may not be stored on the ground. If the anchors are supported at intervals only, the support points must not be sharp-edged, but flat. If anchors are piled up, they must lie on top of each other 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.

## 2.2.3 Transport

The anchors may neither be thrown nor dropped. They must be transported in such a manner (e.g. by hand on the shoulders or by means of carrying straps) that in particular corrugated sheathings will not 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.

## 2.2.4 Marking

The delivery note for the preassembled anchor structure must be marked with the conformity mark ("Ü-Zeichen") by the manufacturer in accordance with the Conformity Mark Ordinances of the German Lander. The marking may only be carried out, if the requirements according to Clause 2.3 have been met.

The delivery note must, among other things, state for which ground anchors the components are determined and in which factory they have been manufactured. The delivery note must clearly indicate to which type of ground anchor the components are assigned.

## 2.3 Certificate of conformity

### 2.3.1 General

Each manufacturing plant must confirm that the anchor components and the prefabricated anchors for installation and grouting comply with the provisions in this general construction supervisory authority approval by means of a certificate of conformity based on the plant's own quality control and regular external surveillance, including initial testing, in accordance with the following provisions.

The manufacturer of the anchor components and of the prefabricated anchors must commission a recognized certification authority and a recognized external surveillance authority to issue the certificate of conformity and carry out external surveillance, including product testing.

The declaration that a certificate of conformity has been issued must be made by the manufacturer by marking the building products with the mark of conformity, indicating the intended purpose.

The certification agency must send a copy of the issued certificate of conformity to the DIBt for information.

In addition, a copy of the original inspection report must be forwarded to the DIBt for information.

## **2.3.2 In-house manufacturing control**

### **2.3.2.1 General**

Each manufacturing plant must set up and also carry out its own quality control. In-house manufacturing control is understood to be the continuous monitoring of production by the manufacturer who thus ensures that the construction products manufactured by them meet the requirements of this general construction supervisory authority approval.

The results of the internal quality control must be recorded and evaluated. The recordings must contain at least the following information:

- Description of the building product or rather of the basic material and its components,
- type of control or inspection,
- date of manufacture and date of inspection of the building product or rather of the basic material or of the components,
- results of the controls and inspections and, if applicable, comparison with the respective requirements,
- a signature by the person responsible for in-house quality controls.

The records must be kept for minimum five years and submitted to the external agency assigned with surveillance. On request, they must be submitted to the DIBt and the competent highest construction supervisory authority.

If the inspection results are unsatisfactory, the manufacturer must immediately take the measures required to eliminate the problem. Construction products which do not meet the respective requirements must be treated in such a manner that they cannot be mixed with conforming products. Once the problem has been eliminated, the original inspection must be repeated immediately, provided that this is technically feasible and also required, to verify the elimination of the problem.

The in-house quality control should at least include the following measures.

### **2.3.2.2 Steel tendons**

Only steel tendons may be used for which an agreement certificate has been produced in compliance with the provisions of the relevant general construction supervisory authority approval.

### **2.3.2.3 Anchor nuts**

Only anchor nuts may be used for which a certificate of conformity or compliance, if any, has been furnished within the scope of the European technical approval ETA-05/0123<sup>7</sup> in conjunction with the general construction supervisory authority approval No. Z-13.73-50123<sup>6</sup>.

- 2.3.2.4 Plastic sheathings  
The composition of the molding compound must be verified by certificate of compliance "2.1" as per DIN EN 10204<sup>24</sup>.  
Regarding the corrugated plastic sheathings, one corrugated sheathing must be taken from each batch (100 sheathings) to measure the wall thickness at an internal and external rib each and on the flank as well as the diameter of the sheathings. The wall thickness of corrugated sheathings must not be less than 1.0 mm:  
The dimensions must correspond to the drawings deposited with the DIBt and the external surveillance agency. The decision whether a batch is accepted or rejected must be made in accordance with Section 2.3.2.12.
- 2.3.2.5 Couplers, coupler tubes  
Only couplers may be used for which a certificate of conformity or compliance, if any, has been furnished within the scope of the European technical approval ETA-05/0123<sup>7</sup> in conjunction with the general construction supervisory authority approval No. Z-13.73-50123<sup>6</sup>. When using couplers which are secured against loosening, minimum 5% of all couplers must be verified with regard to the diameter and position of the boreholes based on the construction drawings deposited.  
One coupler tube must be taken from each batch (100 pipes), and the wall thickness and diameter measured on that coupler tube. The dimensions must comply with the specifications deposited with the DIBt. The decision whether a batch is accepted or rejected must be made in accordance with Section 2.3.2.12.
- 2.3.2.6 Ventilation, grout caps, sealing elements and steel tubes  
The material properties and dimensions must comply with the specifications deposited with the DIBt and the external surveillance agency. The values must be verified by certificate of conformity "2.1" in accordance with DIN EN 110204<sup>24</sup>.  
Minimum 1% of the steel tubes must be inspected in the factory with regard to whether the sealing rings are tightly connected to the designated corrugated or smooth sheathing (in accordance with the construction method in L<sub>tf</sub>).  
One steel tube per batch (100 pcs. of one type) must be taken, and the outer, inner diameters and the wall thickness must be measured.  
The wall thicknesses and diameters or rather the widths and thicknesses of the sealing rings must be verified on 1%, but minimum 5 pieces, of each furnished batch.  
The decision whether a batch is accepted or rejected must be made in accordance with Section 2.3.2.12.
- 2.3.2.7 Heat shrink sleeves  
The material properties of the heat shrink sleeves and of the adhesive must be verified by the certificate of conformity "2.1" in keeping with DIN EN 10204<sup>24</sup>. For each batch (100 pieces) the wall thickness of the basic material must be measured and the application of the adhesive determined.  
The heat shrink sleeves must have a minimum wall thickness of 1.5 mm in the shrunk condition. The thicknesses of the heat shrink sleeves must be measured in shrunk condition. For this purpose, one sleeve must each be shrunk onto corresponding tube sections parallel to the manufacture of an anchor type.  
The decision whether a batch is accepted or rejected must be made in accordance with Section 2.3.2.12.
- 2.3.2.8 Steel Tendons protected by heat shrink sleeves  
By means of a yes/no check the freeness from pores in heat shrink sleeves must be verified on each steel tendon by applying a voltage of 10 kV (statistical evaluation is not required).

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<sup>24</sup> DIN EN 10204:2005-01

Metallic products - Types of inspection documents; German version EN 10204:2004

- 2.3.2.9 **Bearing plates**  
Only bearing plates may be used for which a certificate of conformity or compliance, if any, has been furnished within the scope of the European technical approval ETA-05/0123<sup>7</sup> in conjunction with the general construction supervisory authority approval No. Z-13.73-50123<sup>6</sup>.  
Minimum 5% of all bearing plates must be verified with regard to the diameter and position of the boreholes (injection boreholes and mounting of the steel protection cap) based on the construction drawings filed.
- 2.3.2.10 **Corrosion protection coatings, materials of the corrosion protection system**  
Compliance with the layer thickness requirements for the anti-corrosion coating of the bearing plate, anchor trumpet and steel protection cap must be verified on 5% of each production batch in the factory.  
Evidence for the material properties of all materials used for corrosion protection must be furnished by the manufacturing factory with inspection certificate "3.1" in accordance with DIN EN 10204<sup>24</sup>. The inspection certificate must indicate, in particular, that the requirements stated in the description and the technical delivery conditions have been complied with. If considered necessary by the external surveillance agency, samples must be deposited with such agency. DIN EN ISO 12944-7<sup>10</sup>, Section 6, applies for coating materials according to DIN EN ISO 12944-5<sup>8</sup>.
- 2.3.2.11 **Assembly and corrosion protection**  
The grout must be monitored in accordance with the general construction supervisory authority approval No. Z-13.73-50123<sup>8</sup>.  
The necessary working steps including corrosion protection measures to be carried out in the factory pursuant to Section 2.2.1 must be verified by visual inspection for each anchor (statistical evaluation not necessary).
- 2.3.2.12 **Inspection plan**  
If each individual measured value equals or exceeds the minimum value stipulated, the batch must be accepted. If not, further samples can be taken. The same measurements as those on the first sample must be carried out on such samples. The measuring results must be integrated into the previous measurements. The mean value  $\bar{x}$  and the standard deviation  $s$  must be obtained from all values. If the resulting test value (numerical value)  

$$z = \bar{x} - 1.64 s$$
equals or exceeds the minimum value stipulated, the batch must be accepted, otherwise rejected.
- 2.3.3 External surveillance**  
The in-house quality control in each manufacturing plant must be monitored by external surveillance on a regular basis, but at least twice a year.  
An initial inspection must be carried out as part of the external surveillance. Also samples for sampling tests must be taken and testing tools inspected. In each case, samplings and tests are incumbent on the respective recognized surveillance authority.  
The results of the certification and external surveillance must be kept for minimum five years. On request, they must be presented to the DIBt and to the competent highest construction supervisory authority by the certification agency or the surveillance agency.

### 3 Provisions covering design and dimensions

#### 3.1 General

Unless stated otherwise below, DIN EN 1997-1<sup>3</sup> in conjunction with DIN EN 1997-1/NA<sup>4</sup> and DIN 1054<sup>5</sup> apply to the design and calculation of structures using ground anchors.

#### 3.2 Additional proof

##### 3.2.1 Permissible prestressing loads

Proof must be provided that the permissible prestressing loads  $P_{m0,(x)}$  according to Section 3.2 of the general construction supervisory authority approval No. Z-13.73-50123<sup>6</sup> are not exceeded.

##### 3.2.2 Change of load in the steel tendon due to frequently repetitive live loads

Evidence must be provided that the change of load (characteristic value) in the steel tendon due to frequently repetitive live loads (including wind) is not larger than 20% of the characteristic load  $E_k$ .

Based on fatigue tests carried out within the scope of the European technical approval ETA-05/0123<sup>7</sup>, a fatigue stress range of 80 N/mm<sup>2</sup> for  $2 \cdot 10^6$  load cycles for an upper load of  $0.65 f_{pk}$  was proven. Proof must be supplied that the fatigue stress range on the air-side anchorage and on possible couplers does not exceed 0.7 times that value. Load cycle numbers exceeding  $2 \cdot 10^6$  are not verified by the European technical approval ETA-05/0123.

Evidence will only be required if the dynamic load is not covered by the prestressing operation.

#### 3.3 Rock anchors

The overall safety of the anchored rock body is the subject matter of rock stability verifications; the anchor loads required for stability must be determined by an expert<sup>14</sup>.

### 4 Provisions covering installation

#### 4.1 General

The assembly and installation of ground anchors may only be carried out under the technical management of DYWIDAG-Systems International GmbH. Work must be carried out in accordance with the work instructions deposited with the DIBt. The work instructions for the installation of ground anchors must be available on the construction site. A copy of those instructions must be made available to the surveillance agency (see Section 4.6); the same also applies for the construction drawings of the anchor head.

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 thoroughly trained in the production of ground anchors in accordance with this general construction supervisory authority approval. The company executing the installation must declare that the ground anchors produced by it comply with the provisions of this general construction supervisory authority approval.

DYWIDAG-Systems International GmbH must keep a list of structures secured with permanent anchors in compliance with this general construction supervisory authority approval from which the structure anchored, the number of anchors and the type of anchor can be obtained.

## 4.2 Drilling the boreholes

### 4.2.1 Borehole diameter

The minimum borehole diameter must be chosen such that the anchor with its spacers can be installed without any problems. DIN EN 1537<sup>1</sup> in conjunction with DIN SPEC 18537<sup>2</sup>, Section 8.1, applies.

### 4.2.2 Drilling boreholes in the ground

DIN EN 1537<sup>1</sup> in conjunction with DIN SPEC 18537<sup>2</sup>, Section 8.1, applies. In General, boreholes must be cased.

The borehole may be drilled uncased or partly cased in cohesive soils, if evidence is produced within the scope of the suitability test that there is solid ground on the total length of the uncased part of the borehole, that the drill rods used are sufficiently rigid to assure a straight drilling and that the borehole can be properly cleaned.

### 4.2.3 Drilling boreholes in rock

The drilling method must be selected in dependency of the specific rock properties. It must be verified that in the area of the free anchor length perpendicular to the borehole axis

- no joint movements are anticipated, if the load transfer length has not been limited (see Section 4.4.3), or rather
- joint movements to be expected are smaller than the difference between the smooth sheathing and the borehole diameter, if the load transfer length has been limited.

Checking of the free passage of the boreholes by means of a template is recommended.

## 4.3 Installation into the borehole

In the area of the bond length, elastic spacers according to the Appendices 1 and 2 must be positioned minimum every 1.5 m on a continuous basis, beginning from the first elastic spacer at the anchor base. The first elastic spacer must be arranged maximum 0.75 m from the anchor base-sided end (see Appendices 1 and 2). 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 > 10 mm.

If a lost drill or ram bit is used, it must be knocked off with a steel rod prior to the anchor installation. If in the case of a cased borehole, the projecting end of the drill outfit has an edged internal thread or rather a sharp-edged tube end, the anchors prepared in accordance with Section 2.2.1 may only be inserted into the borehole, if an edge-free inserting trumpet or a tube nipple fully covering the internal thread of the casing has been placed onto the projecting end of the drill outfit. Care must be taken that the corrosion protection is not damaged when inserting the anchor.

After injecting the borehole with grout in accordance with Section 4.4.2 and after placing the grout cap, it must be injected at least up to the transition point from the bond length  $L_{tb}$  to the tendon free length  $L_{tf}$  while pulling out the casings step-by-step.

**4.4 Producing the ground anchor****4.4.1 Composition of the grout**

The basic materials to be used for the cement grout are cements with particular properties in accordance with DIN 1164-10<sup>25</sup> and cements in line with DIN EN 197-1<sup>26</sup>, taking into consideration the valid exposure classes as defined by DIN EN 206-1<sup>27</sup> in conjunction with DIN 1045-2<sup>28</sup> (Tables 1, F.3.1 and F.3.2), water as stipulated by DIN EN 1008<sup>29</sup> and, where required, additives in accordance with DIN EN 934-2<sup>30</sup> in conjunction with DIN EN 206-1<sup>27</sup>/DIN 1045-2<sup>28</sup> or a general construction supervisory authority approval, and natural aggregates for concrete with a maximum grain diameter of 4 mm in compliance with DIN EN 12620<sup>31</sup> and the List of Building Regulations B Part 1<sup>19</sup>, Annex 1/1.3, taking into account DIN EN 206-1<sup>27</sup>/DIN 1045-2<sup>28</sup>.

The water/cement value must range between 0.35 and 0.7 and should be chosen as low as possible 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 grout, the water/cement value must be limited to maximum 0.44 pursuant to DIN EN 447<sup>18</sup>.

**4.4.2 Producing the grout body****4.4.2.1 Producing the grout body in soil**

In the instance of a cased borehole, the tubes will be drawn slowly and step by step after injecting the sheathing with grout while maintaining the necessary grouting pressure. The injection for the production of the grout body must always be carried out from the deepest point of the grout body, the venting from the highest point. The grouting operation may not be stopped until cement grout emerges through the vent tube without any bubbles. In the case of downwardly inclined anchors, the vent tube may be abandoned, if the borehole is injected from the bottom until cement grout escapes at the top.

**4.4.2.2 Producing the grout body in rock**

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

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25	DIN 1164-10:2004-08	Special cement - Part 10: Composition, requirements and conformity evaluation for special common cement
26	DIN 1164-10 Ber. 1:2005-01 DIN EN 197-1:2004-08	Corrections to DIN 1164-10:2004-08 Cement - Part 1: Composition, specifications and conformity criteria of common cements; German version EN 197-1:2000 + A1:2004
	DIN EN 197-1 Ber. 1:2004-11 DIN EN 197-1/A3:2007-09	Corrections to DIN EN 197-1:2004-08 Cement - Part 1: Composition, specifications and conformity criteria of common cements; German version EN 197-1:2000/A3:2007
27	DIN EN 206-1:2001-07 DIN EN 206-1/A1:2004-10	Concrete - Part 1: Specification, performance, production and conformity Concrete - Part 1: Specification, performance, production and conformity; German version EN 206-1/A1:2004
	DIN EN 206-1/A2:2005-09	Concrete - Part 1: Specification, performance, production and conformity; German version EN 206-1:2000/A2:2005
28	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
29	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
30	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
31	DIN EN 12620:2008-07	Aggregates for concrete; German version EN 12620:2002+A1:2008

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 expert<sup>14</sup> 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. The quantity of cement grout required for an anchor, its composition and the grouting pressure must be measured and recorded. It is recommended to use the production record according to Annex H.1 of DIN SPEC 18537<sup>2</sup>.

#### 4.4.3 **Limitation of the load transfer length**

In general, the load transfer length must be limited by the methods listed hereinafter:

- a) by flushing out excess cement grout by means of a flushing hose mounted on the sheathing. The flushing hose must be arranged such that the first discharge openings are positioned 50 cm above the transition point between the tendon free length and the bond length. The verification of this value must be confirmed in the drilling record. The flushing pressure applied must amount to about 4 bar.
- 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. 1.0 m above the transition point  $L_{tb}/L_{tf}$ . The flushing pressure applied must amount to about 4 bar.
- c) by blocking the load transfer length by means of a packer (see Appendix 6). The suitability of the packer must be verified within the scope of a suitability test.

Methods a) and b) must be applied for downwardly inclined grouted anchors in soil and may also be used for downwardly inclined ground anchors in rock. Method c) must be applied for upwardly inclined grouted anchors, but may also be used for downwardly inclined anchors.

Limitation of the fixed anchor length can be neglected, if the conditions for such limitation stated in DIN EN 1537<sup>1</sup> in conjunction with DIN SPEC 18537<sup>2</sup>, Section 8.3.6, are fulfilled.

#### 4.4.4 **Post-grouting**

Once the initial grouting has set or fully hardened, further injections of cement grout can be made in the area of the ground anchor. For this purpose, valve tubes or rather tubes with valves provided with collars, or grout tubes with valves must be used. The grout body may be burst open using water; however, grouting with grout cement must be carried out as required by DIN EN 1537<sup>1</sup> in conjunction with DIN SPEC 18537<sup>2</sup>, Section 8.3.6.

If the load transfer length  $l_{fixed}$  must be limited (see Section 4.4.3), the free anchor length must subsequently be flushed again.

#### 4.5 **Protective measures against corrosion on site**

The individual steps for the assembly of the anchor head on the construction site including corrosion protection measures must be carried out in accordance with the work instructions issued by DYWIDAG-Systems International GmbH and filed with the DIBt.

Before applying the anchor head structure, the free steel end must be protected against corrosion (embedding in viscous anti-corrosion agent as deposited with the DIBt).

The transition area between the bearing plate and the corrosion protection sheathing of the anchor must be protected with a steel tube tightly welded to the bearing plate, which must be sealed by means of two rubber gaskets towards the corrugated/smooth sheathing (in compliance with the construction method, see Appendices 1 and 2).



The cavity between the steel tendon and the bearing plate/steel tube must be grouted with anti-corrosion agent. Denso-Cord, Denso-Jet, Denso-Fill, Petro-Plast or Nontribos MP-2 must be used as the anti-corrosion agent. Those anti-corrosion agents must each correspond to the formula deposited with the DIBt by the manufacturer of the respective agents.

If the anti-corrosion agent Nontribos MP-2 is used, the cement grout surface inside the corrugated sheathing must be sealed with Icosit 277 beforehand.

If the anti-corrosion agent is removed during the tensioning operation, it must be replaced.

After the anchor has been tensioned, the domed nut and the steel protrusion must be protected with a steel protection cap, and the space between the nut and the steel protection cap must be injected with the aforementioned anti-corrosion agent. If the steel protection cap cannot be subjected to mechanical loads (e.g. is subsequently cast in concrete), then it can be made of PE-HD.

In all other cases a minimum 3 mm thick, hot-dip galvanized steel cap according to DIN EN ISO 1461<sup>12</sup> coated according to DIN EN ISO 1461-t Zn o or a steel protection cap provided with a corrosion protection system according to Section 2.1.3.1 must be used which is screwed upon the bearing plate with an inserted sealing washer made of nitrile rubber.

If anchors must be retensioned due to surveillance inspections, then care must be taken that the anti-corrosion agent removed during the tensioning operation is replaced again.

#### 4.6 **Suitability and acceptance tests, supervision of the installation**

Suitability and acceptance tests must be carried out on every construction site pursuant to DIN EN 1537<sup>1</sup> in conjunction with DIN SPEC 18537<sup>2</sup>.

The suitability tests for permanent anchors must be supervised by a surveillance agency for monitoring the installation of ground anchors, which is included in the list of inspection, surveillance and certification agencies according to the German state construction ordinances, Part V, as amended from time to time<sup>32</sup>.

In the course of their surveillance activities associated with suitability and acceptance tests, the commissioned geotechnical surveillance authority must supervise 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 grouting of the anchor head area with anti-corrosion agent.

The surveillance agency must report to the competent building supervision authority, when facilities and personnel on site do not warrant proper installation. The beginning of such work must be reported to the building supervision authority in charge.

## 5 **Provisions for usage, maintenance and service**

### 5.1 **Verification**

DIN EN 1537<sup>1</sup> in conjunction with DIN SPEC 18537<sup>2</sup>, Section 9.11, applies.

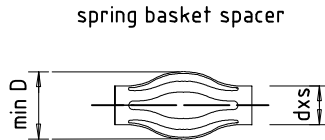
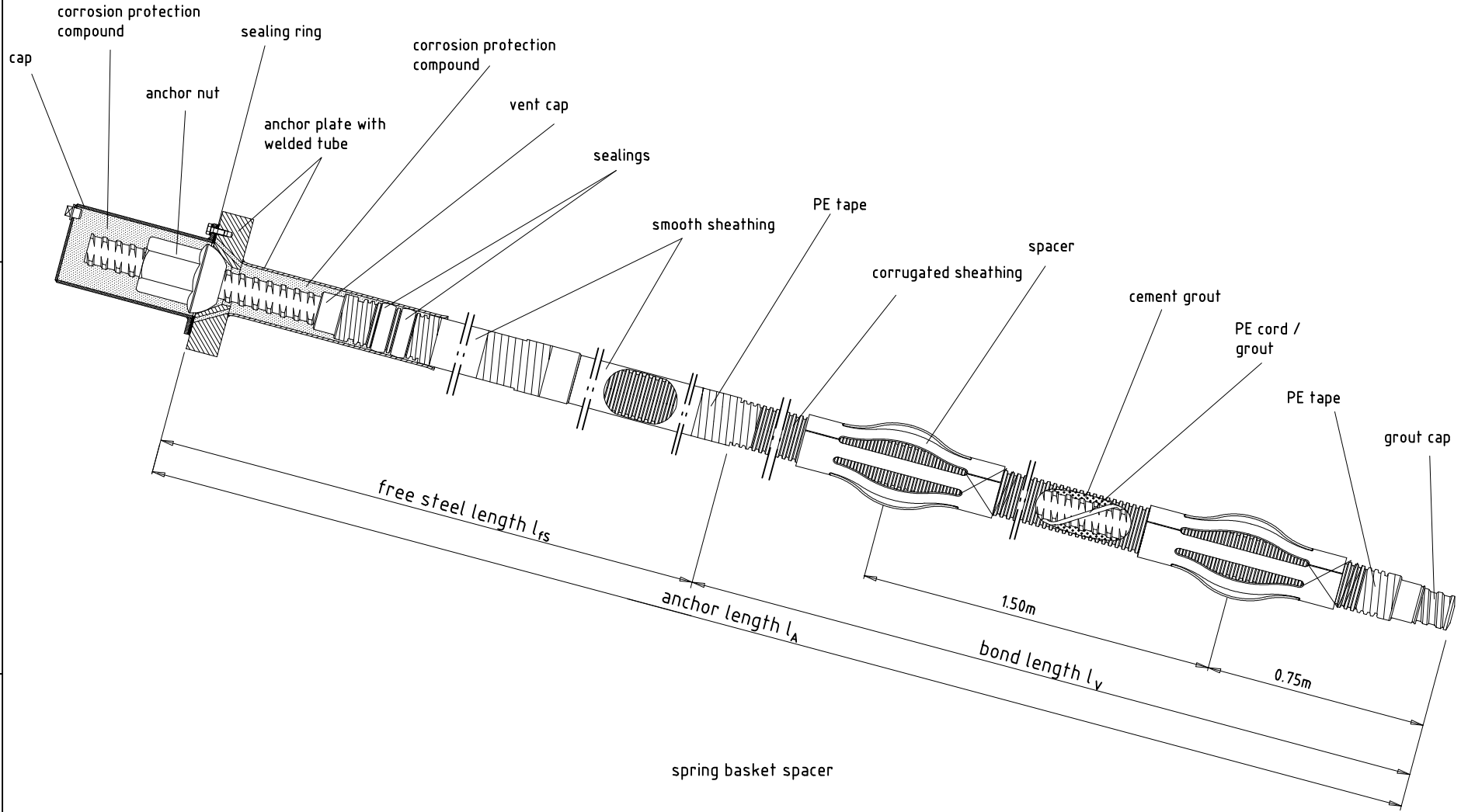
If verification is required, it should be conducted by the surveillance agency which has already carried out the suitability tests.

Anneliese Böttcher  
Section Head

Certified

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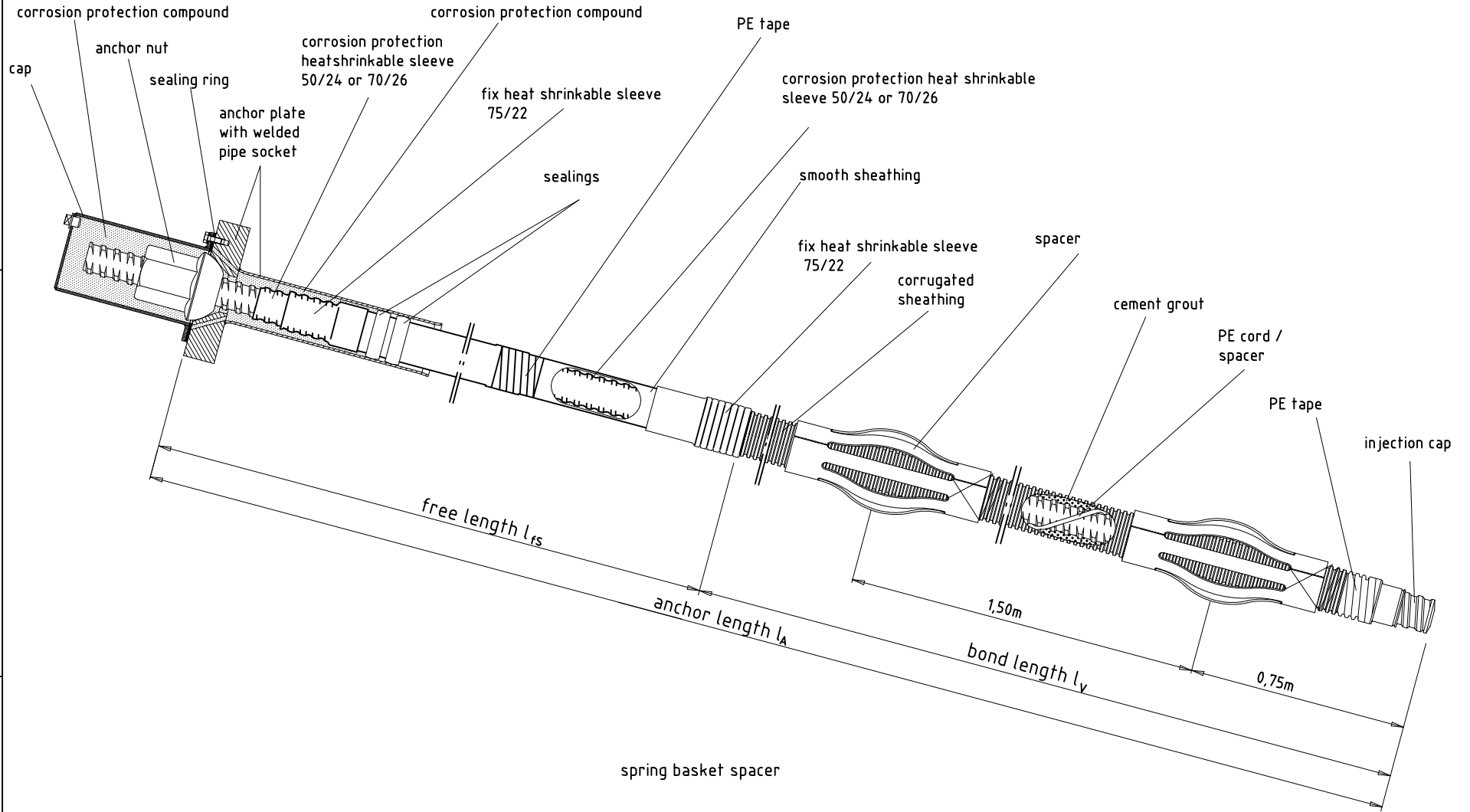
<sup>32</sup> most recent: List of inspection, surveillance and certification agencies based on the German state construction ordinances as of May 2014 - DIBt - Mitteilungen, Deutsches Institut für Bautechnik, 2014 edition of June 19, 2014



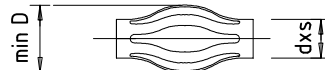
alternatively: segment spacer



bar φ mm	corrugated sheathing φ <sub>a</sub> /φ <sub>i</sub> mm	smooth sheathing φ <sub>a</sub> x s mm	spring basket spacer	
			d x s mm	min. D mm
26,5	50/43	54,2 x 1,5	55 x 3	80
32	56/49	60,2 x 1,5	63 x 3	86
36	65/57	69,2 x 1,5	75 x 3,6	95
40	65/57	69,2 x 1,5	75 x 3,6	95



spring basket spacer

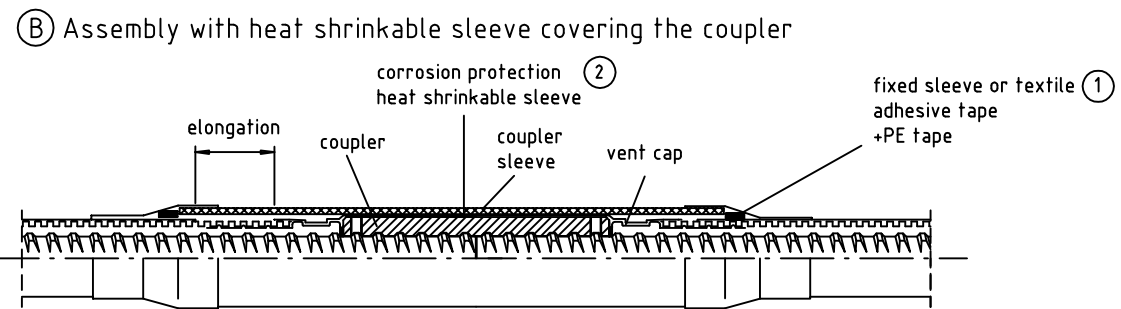
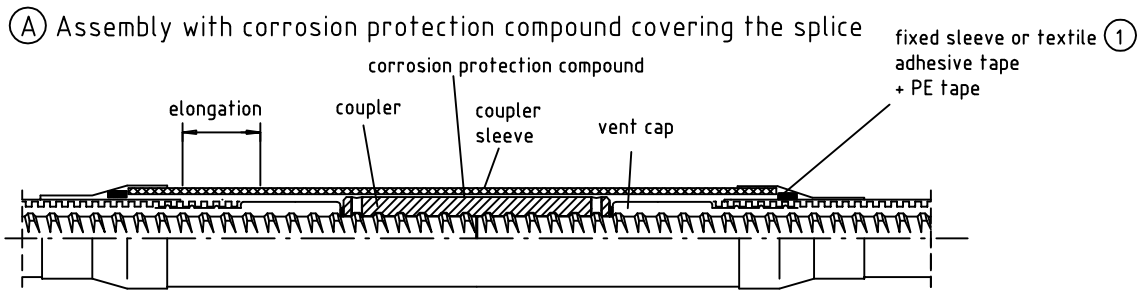


alternatively: segment spacer

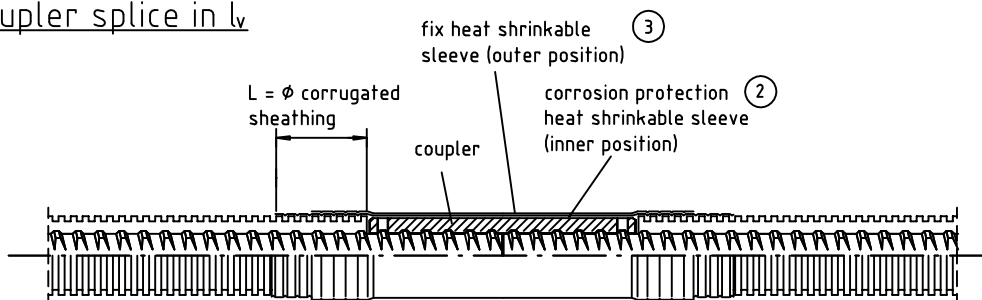


bar $\phi$ mm	corrugated sheathing $\phi_a/\phi_i$ mm	smooth sheathing $\phi_a \times s$ mm	spring basket spacer	
			d x s mm	min. D mm
26,5	50/43	41 x 1,8	55 x 3	80
32	56/49	46 x 2,0	63 x 3	86
36	65/57	50 x 2,0	75 x 3,6	95
40	65/57	60 x 1,5	75 x 3,6	95

coupler splice for anchors with corrugated sheathing in  $l_{fs}$



coupler splice in  $l_v$



bar Ø mm	coupler  in accordance with ETA 05/0123 and Z-13.73-50123	heat shrinkable sleeve			coupler sleeve <sup>1)</sup>			
		Ⓐ	Ⓑ	Ⓒ	Type Ⓐ		Type Ⓑ	
		mm	mm	mm	dia- meter mm	thick- ness mm	dia- meter mm	thick- ness mm
26,5		95/29	75/22	75/22	63	3,0	75	3,6
32		95/29	75/22	75/22	75	5,6	75	3,6
36		115/34	95/29	95/29	80	4,4	90	4,3
40		115/34	95/29	95/29	80	4,4	90	4,3

rotary protection of all couplers by threaded pins

<sup>1)</sup> PVC coupler sleeve, up to 15 bar of grouting pressure



DYWIDAG-Systems  
International GmbH  
www.dywidag-systems.com

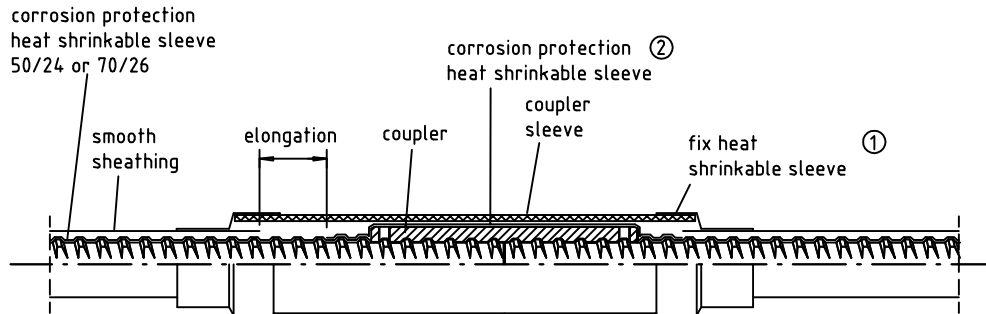
Permanent DYWIDAG Anchor  
St 950/1050 Ø26,5 up to 40 mm

Coupler splice  
Permanent single bar anchor  
with corrugated sheathing

Appendix 3

for the General Technical Approval  
No. Z-20.1-17

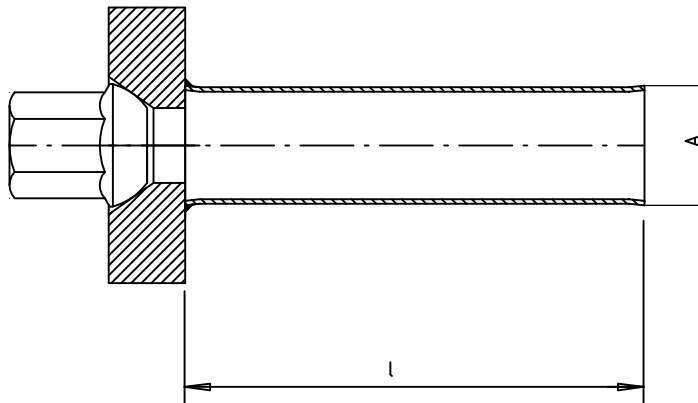
## coupler splice for anchors with shrink sleeve in $l_{fs}$



bar $\phi$ mm	coupler	heat shrinkable sleeve		coupler sleeve <sup>1)</sup>	
		① mm	② mm	dia- meter mm	thick- ness mm
26,5	in accordance to ETA 05/0123 and Z-13.73-50123	95/29	75/22	75	3,6
32		95/29	75/22	75	3,6
36		115/34	95/29	90	4,3
40		115/34	95/29	90	4,3

rotary protection of all couplers by threaded pins

<sup>1)</sup>PVC coupler sleeve, up to 15 bar of grouting pressure



Minimum concrete grade: C20/25

Exposition classes according to DIN 1045-1 (2008-08), section 6.2 (table 3) have to be taken into account

bar $\phi$ mm	solid plate	pipe socket			material	anchor nut	min. axis distance mm	min. edge distance mm
		tube $\phi \times s$ mm	A mm	l mm				
26,5	in accordance to ETA 05/0123 and Z-13.73-50123	63,5x3,2	~ 67	$\geq 300$	S235JR (1.0038) DIN EN 10025-2	in accordance to ETA 05/0123 and Z-13.73-50123	in accordance to ETA 05/0123 and Z-13.73-50123	
32		70,0x3,2	~ 74					
36		76,1x2,9	~ 80					
40		76,1x2,9	~ 80					



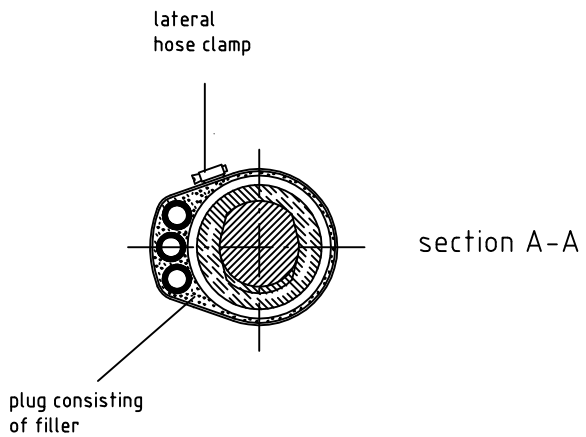
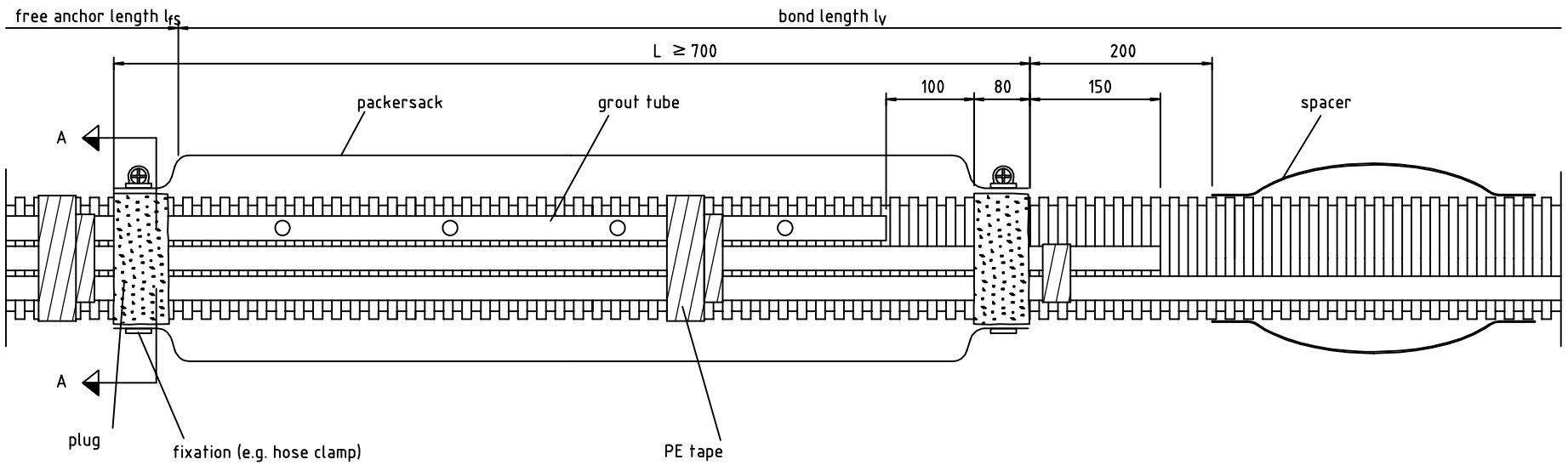
DYWIDAG-Systems  
International GmbH  
www.dywidag-systems.com

Permanent DYWIDAG Anchor  
St 950/1050  $\phi 26,5$  up to 40 mm

Anchorage with solid plate  
and anchor nut

Appendix 5

for the General Technical Approval  
No. Z-20.1-17



DYWIDAG-Systems  
International GmbH

www.dywidag-systems.com

Permanent DYWIDAG Anchor  
St 950/1050  $\varnothing 26,5$  up to 40 mm  
Injection packer  
for permanent bar anchors

Appendix 6  
for the General Technical Approval  
No. Z-20.1-17

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