

GEOTECHNICAL SYSTEMS

**Mechanical Connection and Anchorage of
Ribbed Reinforcing Steel Bar by Means of
Press Couplers**

Nominal diameter: 16 to 32mm

"FLIMU" System

Approval Number Z-1.5-150

Validity 30th September 2019 - 30th September 2024

General Construction Supervisory Authority Approval

**Approval Body for Building 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

Date:
26/09/2019

Reference No.:
I 24-1.1.5-11/19

Approval No.:
Z-1.5-150

Period of validity:
from: **September 30, 2019**
to: **September 30, 2024**

Applicant:
DYWIDAG-Systems
International GmbH
Siemensstrasse 8
85716 Unterschleißheim

Subject of approval:
Mechanical Connection and Anchorage of
Ribbed Reinforcing Steel Bar by Means of Press Couplers
Nominal diameter: 16 to 32mm
“FLIMU” System

The above-mentioned subject matter is hereby granted general construction supervisory authority accreditation/approval.
This notice comprises 8 pages and 4 annexes.
The subject matter was granted a general construction supervisory authority approval on May 1, 1988 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 more detailed provisions under “Special Provisions”. In addition, it must be pointed out to the user or installer of the subject 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. A 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 of approval, scope of application

Subject matter of this general construction supervisory authority approval is the mechanical connection and anchorage of ribbed reinforcing steel bar B500B With nominal diameter 16-32 mm - hereinafter referred to as extruded couplers.

Bars with an equal and unequal surface design may be spliced with extruded couplers, e.g. bars with transverse ribs as defined by DIN 488-1:2009-08 and bars with thread ribs in accordance with the relevant general construction supervisory authority approval.

The extruded coupler splice is produced on the construction site by continuously pressing a steel coupler onto the bar ends to be connected by means of a "reducing ring (die)". Between the ribbed surface of the reinforcing steel and the inner surface of the extruded coupler a form lock is created, by which the full bar force is transferred.

For existing structures into which reinforcing steel bar BSt420S have been built, extruded coupler splices with reinforcing steel bar B500B may be used in the connection area between the existing and the new structures. In this process, Section 3.2.1 must be taken into account.

The object of approval is the planning, dimensioning and execution of mechanical connections and anchorages according to DIN EN 1992-1-1: 2011-01, Sections 8.4 and 8.7.

2 Regulation covering the construction produkt

2.1 Properties and composition

The materials used for connecting and anchoring means, their geometrical dimensions, as well as the permissible deviations are set out in Annexes 1 and 2. The requirements for the material properties specified in the standards mentioned therein must be met.

2.2 Manufacture and marking

2.2.1 Manufacture

The couplers are cut to the required length in the manufacturing plant. A front surface of the coupler is chamfered outside, so that the material removed during the extrusion operation can be accommodated therein.

The anchoring elements receive their final form, dependent on the material used, by casting or mechanical processing.

2.2.2 Marking and packaging

Every coupler and anchoring element must be marked in the manufacturing plant with the manufacturer's mark at the locations indicated in Annexes 1 and 2, and by indicating the nominal diameters to be connected and the reinforcing steel quality.

The packaging of the extruded couplers and the delivery note 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.

2.3 Compliance certificate

2.3.1 General

The conformity of the building product with the provisions of this general construction supervisory authority approval must be confirmed for every manufacturing plant with a certificate of conformity based on the manufacturer's own internal production control system and on a regular external monitoring including initial testing of the building product by an external surveillance authority in accordance with the following provisions:

The manufacturer shall commission notified product certification body and a recognised external surveillance authority to issue the certificate of conformity and perform the external surveillance, including the inspection of products, of both the manufacturer and its suppliers.

The manufacturer shall show that a certificate of compliance has been issued by marking the construction products with the compliance mark (Ü- Zeichen) including a reference to the designated use. The notified product certification body must send a copy of the certificate of conformity issued to the DIBt.

2.3.2 Factory production control system

Every manufacturing plant must establish and implement its own internal production control system. An internal 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.

The internal production control must at least include the measures specified in the "Principles for approval and monitoring inspections of mechanical reinforcing steel connections" (edition of May 2007).

Hardness measurements to verify the strength and stability must be carried out at least once a day or per 500 couplers.

From a statistical point of view, 5% of the couplers manufactured must be sampled, and the dimensions of length, outside diameter, inside diameter and wall thickness (at locations offset by 90°) must be verified with appropriate gages.

The bearable stress range of the extruded coupler connection produced under construction site conditions must, dependent on the diameter, be verified at least once a year.

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.

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.

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

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 in accordance with the principles specified in Section 2.3.2.

Within the scope of the external monitoring, samples for sampling inspections must be taken in line with the principles specified under Section 2.3.2.

The evaluations of tensile tests to be carried out within the scope of the factory production control shall be checked as per Section 3.6.3.2.

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 Regulations for planning and design

3.1 General

DIN EN 1992-1-1 always applies in conjunction with DIN EN 1992-1-1/NA.

All bars in a cross-sectional plane may be spliced (full splice).

The position and dimensions of the couplers and anchorages must be shown in the reinforcement plans, and the requirements specified in the installation regulations must be fulfilled.

3.2 Proof of ultimate limit state

3.2.1 Predominantly dead load

Splices and anchorages as per this general construction supervisory authority approval may be loaded 100% like an unspliced bar in case of predominantly dead tensile and compressive loads.

If reinforcing steel bar BSt 420 S is spliced with B500B (see Section 1.2), the reduced load capacity of the existing steel BSt 420 S for the connection must be taken into account. Such splices may be subjected to predominantly dead loads only.

3.2.2 Fatigue load

Evidence of the fatigue behaviour shall be provided as stipulated in DIN EN 1992-1-1 and DIN EN 1992-1-1/NA Section 6.8. As the characteristic value of fatigue strength, a constant stress range of $\Delta\sigma_{Rsk} = 90\text{N/mm}^2$ must be assumed for the load cycle number range from zero to 2 million load cycles for connections and anchorages. For the load cycle number range from 2 to 10 million load cycles, an increase factor of $k_1 = 3$, and from 10 million load cycles, an increase factor of $k_2 = 5$ must be considered for the characteristic stress range.

3.3 Concrete cover, bar spacing

The same values as for unspliced bars (DIN EN 1992-1-1 and DIN EN 1992-1-1/NA, Sections 4.4.1 and 8.2) apply to the concrete cover over the outer edge of a coupler or of an anchoring element, as well as to the clear distances of the outer edges of the couplers or anchoring elements.

The distances required for the installation and, where applicable, greater distances remain unaffected thereby.

3.4 Center and edge distances of anchorages

The center and edge distances detailed in Annex 3 apply.

If the anchorages cannot be installed in a cross-sectional plane, they must be offset by at least 1.5 times the center distance in the direction of the bar (see Annex 3).

3.5 Bending

The regular bending of a bar may only start at a distance of at least 5 d from the end of the coupler (d = nominal diameter of the bent bar).

If coupler bars are bent with special equipment in the manufacturing plant, the distance to the coupler end may be decreased down to 2 d.

3.6 Regulations for work execution

3.6.1 General

Only instructed personnel may assemble coupling or anchoring components in accordance with the manufacturers written work instructions. These assembly instructions are part of the shipping documents.

Only couplers marked as per Section 2.2.2 may be used.

The dimensions and arrangement of the couplers must match the specifications in the constructional drawings (reinforcement drawings).

No special requirements are imposed for the flatness of the cutting surfaces of the reinforcement bars to be spliced; however, a joint consolidation emerging during shearing may not extend beyond the cross-sectional surface of the bar.

If the diameter measured across the ribs is greater than indicated in Annex 1, Table 1, for the inside diameter of the coupler, then the ribs may be appropriately abraded.

The specified location of the coupler (in the case of reducing couplers, the values as per Annex 1, Table 2, must be adhered to) must be verifiable through appropriate marks on the bar ends during and after the production of the coupler connection.

3.6.2 Extrusion equipment and extrusion process

The extruded coupler splices must be produced with the special equipment developed by the applicant for this type of connection.

For every extruded coupler size, the reducing ring exclusively designated therefor must be used.

One of the bars to be spliced must be movable in the axial direction.

3.6.3 Surveillance**3.6.3.1 Verification of suitability prior to the beginning of installation**

Two coupler connections per diameter to be used may be produced under construction site conditions.

The load bearing capacity of the coupler connection must be tested by qualified personnel, using the equipment required for this purpose.

Tensile tests must be carried up to failure of the bar; the test results must be recorded in test reports and evaluated with regard to the required ultimate loads stated in Annex 4.

3.6.3.2 Continuous surveillance

For every coupler connection, it must be visually inspected whether the coupler has been equally pressed on in a positive-locking manner over its entire length.

If the number of coupler connections produced on a construction site is less than 200, then a verification of suitability as per Section 3.6.3.1 is sufficient.

For every 200 coupler connections produced, at least one tensile test is to be carried out by a body recognized therefor (cf. 2.3.3), where the coupler types produced and the dimensions must be recorded representatively. The test is passed if the following evaluation criteria are met:

Type of failure 1:

Breaking of the bar outside of the connection or anchorage, with:

$$F_{\text{Actual,Bar}} \geq R_{m,\text{Nominal}} \cdot A_{S,\text{Nominal}}$$

Type of failure 2:

Breaking of the coupler or anchorage, breaking of the bar in the coupler or anchorage area, or pulling a bar from the coupler, with:

$$F_{\text{Actual,Connection}} \geq 1.3 \cdot R_{e,\text{Nominal}} \cdot A_{S,\text{Nominal}}$$

Type of failure 3:

Breaking of the bar in the coupler or anchorage area, or pulling a bar from the coupler, with:

$$F_{\text{Actual,Connection}} \geq 1.3 \cdot R_{e,\text{Nominal}} \cdot A_{S,\text{Nominal}} \text{ and } A_{gt,v} \geq 3\% \text{ and}$$

$$F_{\text{Actual,Connection}} \geq 0.95 \cdot R_{m,\text{Actual}} \cdot A_{S,\text{Actual}}$$

The actual load capacity of the bar and the uniform elongation $A_{gt,v}$ must be determined on the bar involved in the failure. If this is not possible, $A_{gt,v}$ can be measured, under the same ultimate load conditions of the connection, on a separately removed section of the reinforcement bar, which has been used for the bar involved in the failure. The elongation $A_{gt,v}$ must be measured in accordance with DIN EN ISO 15630-1.

This general construction supervisory authority approval makes reference to the following standards and cross references:

- DIN 488-1:2009-08	Reinforcing steels - Part 1: Grades, properties, marking
- DIN 488-2:2009-08	Reinforcing steels - Reinforcing steel bars
- DIN EN 1562:2019-06	Founding - Malleable cast irons; German version EN 1562:2019
- DIN EN 1563:2019-04	Founding - Spheroidal graphite cast irons (includes amendment A1:2002); German version EN 1563:2018
- DIN EN 1992-1-1:2011-01	Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings; German version EN 1992-1-1:2004+ AC:2010 and
DIN EN 1992-1-1/NA:203-04	National Annex - Nationally determined parameters - Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings
- DIN EN 10025-2:2019-10	Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels; German version EN 10025-2:2019
- DIN EN 10083-2:2006-10	Steels for quenching and tempering - Part 2: Technical delivery conditions for non alloy steels; German version EN 10083-2:2006
- DIN EN 10305-1:2016-08	Steel tubes for precision applications - Technical delivery conditions - Part 1: Seamless cold drawn tubes; German version EN 10305-1:2016

Beatrix Wittstock
Section Head

Certified

/Illegible signature/

/Stamp mark:/

/Bear emblem/

Deutsches Institut
für Bautechnik

5

Extruded coupler splice (ECP)

Material:
Precision steel pipe according to
DIN EN 10305-1: E235+N
Material No. 1.0308

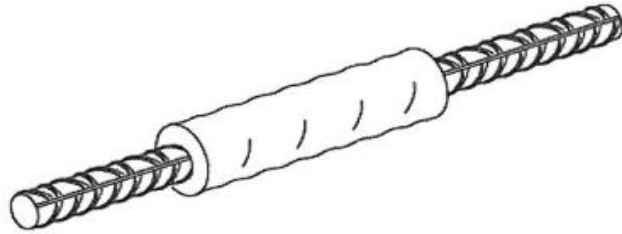
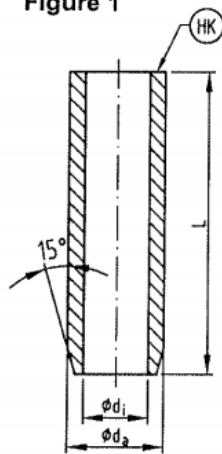


Figure 1



Extruded coupler

Table 1

Nominal diameter Reinforcing steel d [mm]	Outside diameter d _o [mm]	Inside diameter *) d _i [mm]	Coupler dimensions Length L before the extraction operation L [mm]
16	28 ±0.15	19 ±0.2	130 ±2
20	34 ±0.15	23 ±0.2	150 ±2
25	45 ±0.2	30 ±0.2	160 ±2
28	48 ±0.2	32 ±0.2	170 ±2
32	58 ±0.5	38 ±0.5	230 ±2

*) Inside diameter may be smaller for ribbed steels with an undersize
Remarks: (MM) manufacturer's mark

Extruded reducing coupler

Figure 2

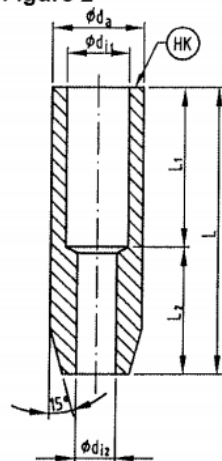


Table 2

Nominal dia. of reinforcing steel d ₁ /d ₂ [mm]	Coupler dimensions and permissible deviation					
	Outside diameter d _o [mm]	Inside diameter d _{i1} [mm]	*) d _{i2} [mm]	L [mm]	Length L ₁ [mm]	L ₂ [mm]
20/16	34 ±0.15	23 ±0.2	19 ±0.2	140 ±2	75	65
25/20	45 ±0.2	30 ±0.2	23 ±0.2	155 ±2	80	75
28/25	48 ±0.2	32 ±0.2	30 ±0.2	165 ±2	85	80
32/28	58 ±0.5	38 ±0.5	32 ±0.5	200 ±2	115	85

*) Inside diameter may be smaller for ribbed steel with an undersize
Remarks: (MM) manufacturer's mark

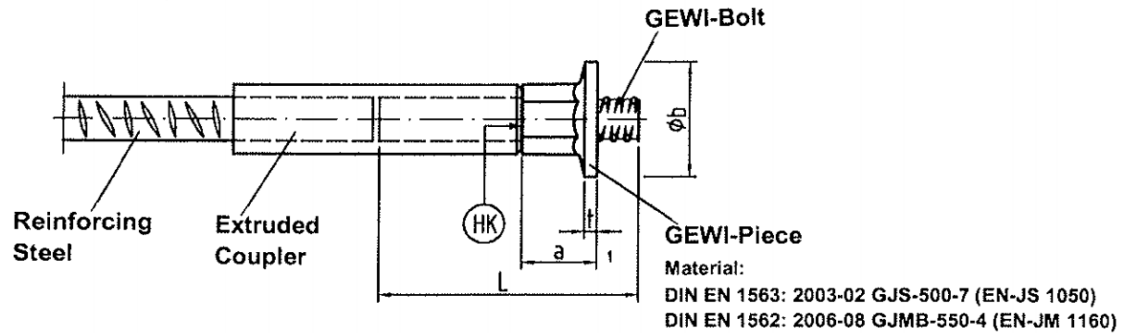
**Mechanical Connection and Anchorage of Ribbed Reinforcing Steel Bar by
Means of Press Couplers**

Overview of Extruded Coupler Splice

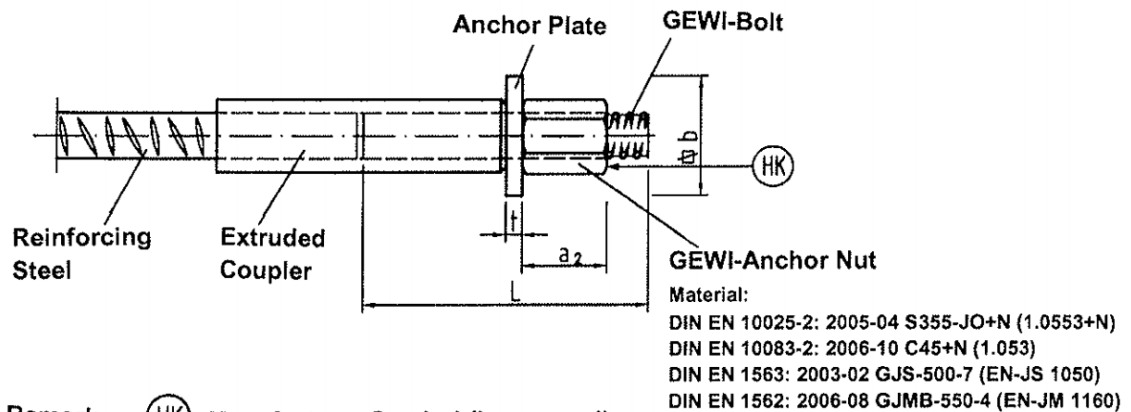
Annex 1

Figure 3 Examples for End Anchorages

At Tensile- and Compressive Load with Anchor Piece



At Tensile- and Compressive Load with Anchor Plate and Anchor Nut



Remarks: (HK) Manufacturer Symbol (impressed)

Table 3

Nominal diameter Reinforcing steel d [mm]	Torque moment M_{torque} [kNm]	GEWI d [mm]	bolt L [mm]	Extruded coupler	Anchor piece a ₁ [mm]	Anchor nut a ₂ [mm]	Anchor plate		
							Thickness t [mm]	External dimensions Ø dia. b [mm]	hole diameter [mm]
16	0.20	16	140	see Annex 1	35	50	8	50	20
20	0.35	20	165		40	65	10	60	25
25	0.70	25	180		45	75	12	70	30
28	0.95	28	200		50	85	14	85	33
32	1.60	32	240		60	90	15	100	38

**Mechanical Connection and Anchorage of Ribbed Reinforcing
Steel Bar by Means of Press Couplers**

End Anchorage

Annex 2

Figure 4

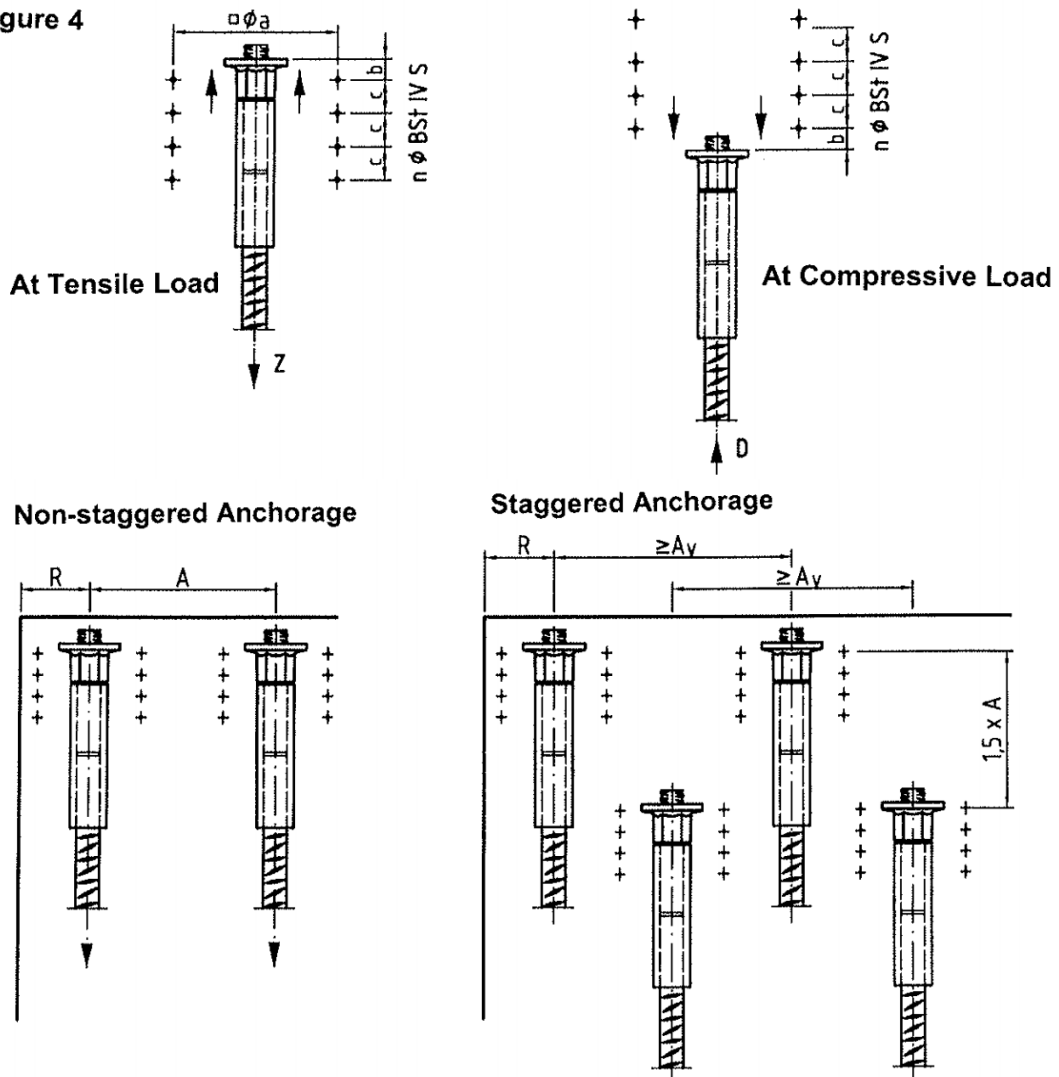


Table 4

Nominal diameter Reinforcing steel d [mm]	Center distance		Edge distance R [mm]	Additional reinforcement				
	A [mm]	A_v [mm]		n [mm]	d [mm]	a [mm]	b [mm]	c [mm]
16	100	105	70	3	6	70	20	30
20	130	140	85	3	6	100	20	30
25	145	165	90	4	6	120	15	30
28	165	190	100	4	6	140	10	40
32	180	200	110	3	8	155	20	50

Mechanical Connection and Anchorage of Ribbed Reinforcing Steel Bar by Means of Press Couplers

Center and Edge Distances for Anchorages in Concrete (Minimum Strength C 20/25)

Annex 3

Reducing ring - inside diameter (target) D_{Ri}						
Bar diameter d [mm]	16	20	25	28	32	
d_{Ri} [mm]	$25^{+0,5}_{-0,2}$	$31^{+0,5}_{-0,2}$	$40^{+0,5}_{-0,2}$	$44^{+0,5}_{-0,2}$	$51,6^{+0,5}_{-0,2}$	
Required ultimate load of the coupler connection or anchorage Reinforcing steel B500B						
Type of failure: (see Section 4.3.2)		Required ultimate load [kN] for the nominal diameter d [mm]				
		16	20	25	28	32
1)	Breaking of bar on the free length	111	173	270	339	442
2)*)	Breaking of coupler or failure by extracting the bar from the coupler	131	204	319	400	522
Reinforcing steel BSt 420 S						
Type of failure: (see Section 4.3.2)		Required ultimate load [kN] for the nominal diameter d [mm]				
		16	20	25	28	32
1)	Breaking of bar on the free length	93	145	227	284	371
2)*)	Breaking of coupler or failure by extracting the bar from the coupler	110	171	268	336	438
*) The values specified herein may be reduced in the case of failure according to type of failure 3) (see Section 4.3.2) with regard to the required load bearing capacities and requirements for uniform elongation set out therein.						
Mechanical Connection and Anchorage of Ribbed Reinforcing Steel Bar by Means of Press Couplers				Annex 4		
Reducing Ring Ultimate Loads of the Coupler Connection or Anchorage						



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