

GEOTECHNICAL SYSTEMS

DYWI® Drill Hollow Bars with Couplers and Anchorages as a Load-bearing Element in Geotechnics - Types R32-210, R32-250, R32-280, R32-320, R32-360, R32-400, R38-420, R38-500, R38-550, R51-550, R51-660, R51-800, T76-1300, T76-1650 and T76-1900

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General Construction Supervisory Authority Approval/
General Design-Type Approval
No. Z-14.4-674 from June 19, 2018

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

General Construction Supervisory Authority Approval/General Design-Type 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

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Period of validity:

from: **June 11, 2018**

to: **June 11, 2023**

Applicant:

DYWIDAG-Systems International GmbH

Neuhofweg 5

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Subject matter of this notice:

**DYWI® Drill Hollow Bars with Couplers and Anchorages as a Load-bearing Element in Geotechnics -
Types R32-210, R32-250, R32-280, R32-320, R32-360, R32-400, R38-420, R38-500, R38-550, R51-
550, R51-660, R51-800, T76-1300, T76-1650 and T76-1900**

The above-mentioned subject matter is hereby granted general construction supervisory authority accreditation/approval.
This notice comprises 7 pages and 8 annexes.

The subject matter was granted a general construction supervisory authority approval on June 10, 2013 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" (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 matter of approval and applicability

Subject matter of this approval are hollow bars of the "DYWI® Drill" system and their mechanical connections and anchorages.

The hollow bars are longitudinally welded and seamless steel pipes made from quenched and tempered steel with a rolled-on thread.

Tension and compression splices of the hollow bars are manufactured with couplers as the connection elements. The couplers have an internal thread into which the hollow bars are screwed. The screw connection can be produced either during the drill operation or by a defined torque, whereby a slip-reducing prestressing of the threads is generated in each case, and the hollow bars are screwed together to form a load-bearing element in a form-locking and force-locking manner.

The anchorage or load transfer at the upper end of the hollow bars is effected with steel or spherical collar nuts, as well as domed or flat plates.

The "DYWI® Drill" system may be used as a steel load-bearing element for soil nails or injection piles (micropiles).

2 Regulations covering the construction product

2.1 Properties and composition

2.1.1 Hollow bars

The hollow bars have a maximum length of 6.0m and are continuously provided with a rolled-on round or trapezoidal thread.

The hollow bars of the R32, R38 and R51 series are longitudinally welded pipes made from quenched and tempered steel with a continuously rolled-on round thread of the following types:

R32-210, R32-250, R32-280, R32-320, R32-360, R32-400,
R38-420, R38-500, R38-550,
R51-550, R51-660, R51-800.

The hollow bars of the T76 series are seamless pipes made from quenched and tempered steel with a continuously rolled-on trapezoidal thread of the following types:

T76-1300, T76-1650 and T76-1900.

In this context, R means rolled round thread, T means rolled trapezoidal thread, the figures 32, 38, 51 and 76 mean the nominal diameter of the hollow bar in [mm], and the figures 210 to 1900 mean the nominal value of the tensile strength in [kN].

The geometry, the nominal weight, as well as the mechanical properties and the chemical composition of the hollow bars must comply with the details provided in Annexes 1 to 4 and with the documents deposited at DIBt. The material properties must be verified by certificate of conformity "3.1" in accordance with DIN EN 10204:2005-01.

2.1.2 Couplers, nuts, spacers and bearing plates

The basic material as well as the main dimensions of the couplers, nuts, spacers and bearing plates must comply with the details in Annexes 6 to 8 and with the documents deposited at DIBt. The material properties of the couplers and nuts must be verified by certificate of conformity "3.1" in accordance with DIN EN 10204:2005-01, while the material properties of the spacers and bearing plates must be confirmed by test report "2.2" pursuant to DIN EN 10204:2005-01.

2.2 Manufacture, packaging, transport, storage and marking

2.2.1 Manufacture

2.2.1.1 Hollow bars

The hollow bars of the R32, R38 and R51 series consist of HF longitudinally welded steel pipes formed from steel strip with removed burr inside made from quenched and tempered steel 28Mn6 in accordance with DIN EN 10083-1:2006-10.

The hollow bars of the T26 series consist of seamless pipes made from quenched and tempered steel 28Mn6 in accordance with DIN EN 10083-1:2006-10.

Additional information on the manufacture of the hollow bars and of the threads is deposited at DIBt.

The standard lengths of the hollow bars are 1, 2, 3, 4 or 6m.

2.2.1.2 Couplers, nuts, spacers and bearing plates

Dependent on the material used (see Annexes 5, 6 and 7), the couplers, nuts and spacers are either cast into their final form or cut to length as blanks from the bar stock, drilled and provided with a cut interior thread analogue to the hollow bar in the manufacturing plant. The bearing plates are cut from the metal sheet precursor material, drilled and punched or annealed.

Additional information on the manufacture of the couplers, nuts and bearing plates is deposited at DIBt.

2.2.2 Packaging, transport and storage

The components of the "DYWI® Drill" system (hollow bars, couplers, nuts and bearing plates) must be packed, transported and stored in such a manner that they are protected from corrosion, mechanical damage and soiling on the construction site prior to their installation.

2.2.3 Marking

The packaging of the components of the "DYWI® Drill" system, as well as the delivery note must be marked by the manufacturer with the compliance mark (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. If the manufacturing plant is indicated in an encrypted manner, then a list with complete details and the encryptions assigned thereto must be deposited at DIBt and the external surveillance body.

Couplers and nuts must be additionally marked at the positions indicated in Annexes 5 and 6, so that the manufacturing plant can be derived therefrom.

2.3 Certificate of conformity

2.3.1 General

The conformity of the components of the "DYWI® Drill" system with the provisions of the general construction supervisory authority approval/general design-type approval covered by this notice must be confirmed for every manufacturing plant with a declaration of conformity issued by the manufacturer based on its factory production control system and on a certificate of conformity issued by a notified product certification body, as well as regular external monitoring by an external surveillance agency in accordance with the following provisions:

The manufacturer of the "DYWI® Drill" system must commission a notified product certification body and a recognised external surveillance authority from the DIBt register of testing, monitoring and certification bodies, part IIa, serial No. 7/1, to issue the certificate of conformity and perform the external monitoring, including the product inspection/testing to be carried out in this process.

The manufacturer must issue the declaration of conformity by marking the building product with the mark of conformity, indicating the intended purpose of use.

The notified product certification body must forward a copy of the certificate of conformity issued to DIBt for information.

In addition, DIBt must be provided with a copy of the report on the initial testing for information.

2.3.2 Factory production control

Each manufacturer and each supplier must set up and also carry out their own factory production control. Factory production control is understood to be the continual monitoring of production by the manufacturer or supplier who thus ensures that the construction products manufactured meet the requirements of this general construction supervisory authority approval.

The factory production control system should at least include the following measures:

The documents deposited at DIBt must be observed.

It must be checked whether the inspection documents as defined by Section 2.1 are available and whether the certified inspection results meet the requirements.

Hollow bars:

After the thread has been rolled on, the manufacturer must carry out the following tests per diameter and rolling batch:

At least one randomly selected sample is to be taken and tested in a tensile test. The examination of the tensile specimen must include: The weight related to the length, the thread geometry according to ISO 10208, the 0.2% yield strength, the tensile strength, and the elongation at maximum load (A_{gt}).

In addition, the thread dimensions must be continuously checked during the thread rolling process, e.g. with thread gauges.

Couplers, nuts, bearing plates and spacers:

Couplers and nuts are delivered in a batch-specific manner. The factory production control must be carried out in the particular manufacturing plant.

At least the following inspections must be carried out:

- All components must be visually inspected with regard to externally visible faults.

- The main dimensions according to Annexes 5 to 8 must be verified on 0.5% of the individual components. The dimensions including the thread dimensions must be checked on couplers and nuts. If the dimensions of a component are outside the permissible range of tolerance, then all components of the particular heat must be verified with regard to their dimensions.
- The static load capacity must be verified on 0.1% of the anchorages and coupler connections by means of a tensile test.
The results of the factory 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.

An initial test must be carried out as part of the external surveillance. In the course 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 particular external surveillance authority.

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 General

The provisions set forth in the general construction supervisory authority approvals/general design-type approvals for soil nails or injection piles (micropiles), as well as the following provisions apply to the planning, design and installation.

3.2 Planning

In addition to the design specifications of the general construction supervisory authority approvals/general design-type approvals for soil nails or injection piles (micropiles), the

specifications regarding the installation as per Section 3.4 must be taken into consideration for the design.

3.3 Regulations for planing and design

3.3.1 Predominantly dead load

Splices and anchorages covered by this general construction supervisory authority approval may, in the case of predominantly dead tensile and compressive loads, be loaded 100% similar to an unspliced bar.

3.3.2 Fatigue load

In the case of a not predominantly dead load for the proof against fatigue in accordance with DIN EN 1992-1-1:2011-01; Section 6.8 in conjunction with DIN EN 1992-1-1/NA:2011-01, an absorbable load range of $\Delta\sigma_{Rsk} = 210\text{N/mm}^2$ for $N = 10^6$ load cycles is to be used as the characteristic value of the fatigue strength for the hollow bars without any additional components. In this process, the tension exponents of the Wöhler (S/N) curve are to be assumed with $k_1 = 4$ and $k_2 = 9$ for $N^* = 10^7$.

A stress variation range of $\Delta\sigma_{Rsk} = 60\text{N/mm}^2$ is to be applied to hollow bars including connecting and anchoring elements within the load cycle range of $0 < N \leq 2 \cdot 10^6$.

3.4 Provisions for the installation

Coupler connections and anchorages may only be assembled by trained personnel. For this purpose, the manufacturer must make available written work instructions that must be part of the delivery papers.

Only individual components marked as per Section 2.2.3 may be used.

The threads of the bars, connecting and anchoring means must be clean and free of rust.

The distance between the joints must be $\geq 1\text{m}$. To achieve sufficient self-locking between the steel tendon and the coupler, the ends of the steel tendon must be tensioned against one another when coupled at a torque of at least 500Nm. For this purpose, a calibrated torque wrench is to be used. The torque may also be applied by the slewing gear of the drilling equipment.

The contractor must issue a declaration of conformity with the general design-type approval in accordance with Section 16a(5) MBO [German Model Building Regulation].

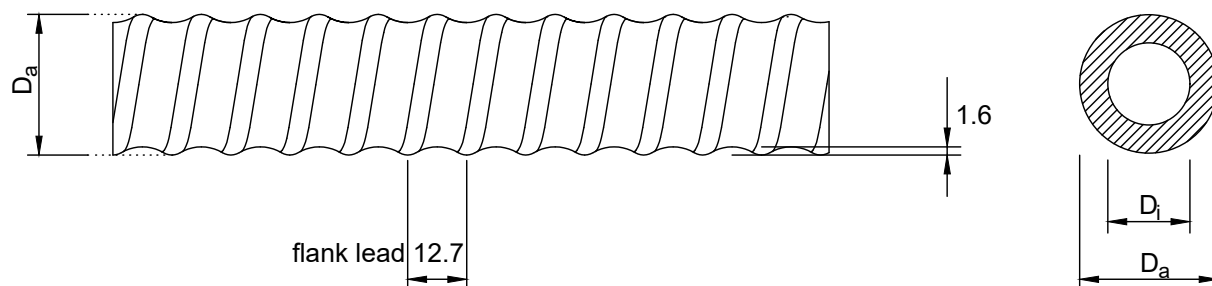
Andreas Schult
Section Head

Certified

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Deutsches Institut
für Bautechnik
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Geometry of the DYWI® Drill - Hollow bar R32



Hollow bar type	R32-210	R32-250	R32-280	R32-320	R32-360	R32-400
Nominal diameter D_{nom} [mm]	32					
Actual diameter D_a [mm]	31.1					
Inner diameter ¹⁾ D_i [mm]	21	20	19	17	15	13
Nominal cross-section area A_s [mm ²]	340	370	410	470	510	560
Nominal weight ²⁾ m [kg/m]	2.7	2.9	3.2	3.7	4.0	4.4
Thread by standard	In according to ISO 10208					
material / material standard	28Mn6 / DIN EN 10083-1					

¹⁾ Value only for reference; tolerance: ± 2.0 mm²⁾ admissible tolerance: -3% to +9%

The bars have a constant left-hand thread in according to ISO 10208
Thread parameters and tolerances are in according to ISO 10208

Mechanical properties

Hollow bar type	R32-210	R32-250	R32-280	R32-320	R32-360	R32-400
load on 0,2%-of elastic limit ³⁾ $F_{0.2,k}$ [kN]	160	190	220	250	280	330
Breaking load ³⁾ $F_{t,k}$ [kN]	210	250	280	320	360	400
Expansion under limit load ³⁾ A_{gt} [%]	≥ 4.0					

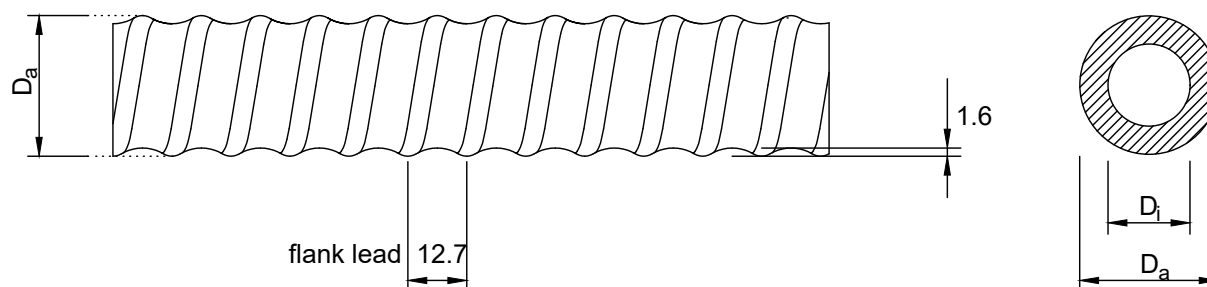
³⁾ Value equates 5%-quantileFor the elasticity modulus a calculated value of 200,000 N/mm² is to be adopted.

DYWI® Drill hollow bars with connections and
anchorage as a supporting element in geotechnical
engineering

Geometry and mechanical properties
DYWI® Drill hollow bars **R32**

Annex 1

Geometry of the DYWI® Drill - hollow bar R38



Hollow bar type		R38-420	R38-500	R38-550
Nominal diameter	D_{nom} [mm]	38		
Actual diameter	D_a [mm]	37.8		
Inner diameter ¹⁾	D_i [mm]	22	19	17
Nominal cross-section area	A_s [mm ²]	660	750	800
Nominal weight ²⁾	m [kg/m]	5,2	5,9	6,3

¹⁾ Value only for reference; tolerance: ± 2.0 mm

²⁾ admissible tolerance: -3% to +9%

The bars have a constant left-hand thread in according to ISO 10208

Thread form and material deposited with DIBt

Mechanical properties

Hollow bar type		R38-420	R38-500	R38-550
Load on 2%-of elastic limit ³⁾	$F_{0.2,k}$ [kN]	350	400	450
Breaking load ³⁾	$F_{t,k}$ [kN]	420	500	550
Expansion under limit load ³⁾	A_{gt} [%]	≥ 4.0		

³⁾ Value equates 5%-quantile

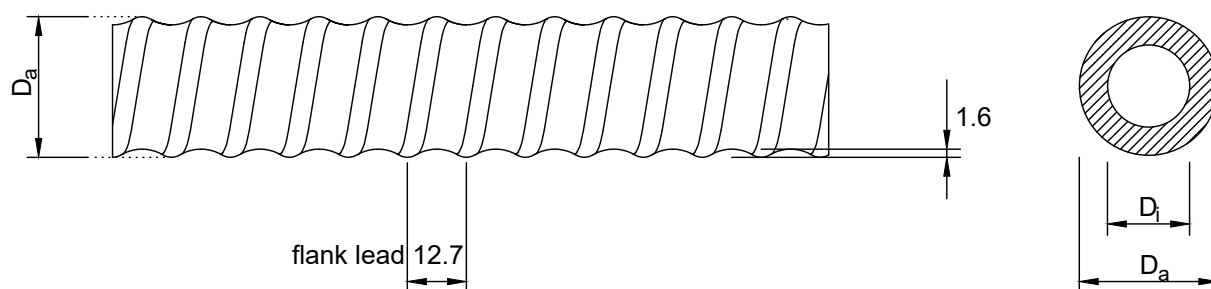
For the elasticity modulus a calculated value of 200,000 N/mm² is to be adopted.

DYWI® Drill Hollow Bars with connecting
Elements and Anchorages as
Load-Bearing Tendons for Geotechnics

Geometry and Material
properties of the hollow bar **R38**

Annex 2

Geomerty of DYWI® Drill - Hollow bar R51



Hollow bar type		R51-550	R51-660	R51-800
Nominal diameter	D_{nom} [mm]	51		
Actual diameter	D_a [mm]	49.8		
Inner diameter ¹⁾	D_i [mm]	35	33	29
Nominal cross-section area	A_s [mm ²]	890	970	1150
Nominal weight ²⁾	m [kg/m]	7.0	7.7	9.0
Thread by standard		In according to ISO 10208		
material / material standard		28Mn6 (DIN EN 10083-1)		

¹⁾ Value only for reference; tolerance: ± 2.0 mm²⁾ admissible tolerance: -3% to +9%

The bars have a constant left-hand thread in according to ISO 10208

Thread form and material deposited with DIBt

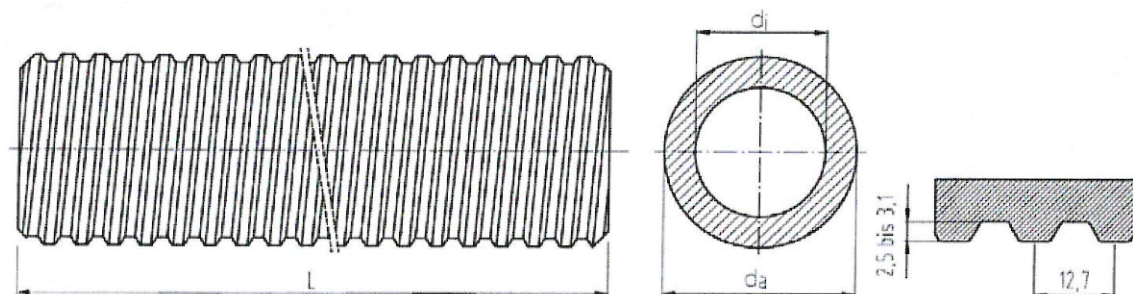
Mechanical properties

Hollow bar type		R51-550	R51-660	R51-800
Load on 2%-of elastic limit ³⁾	$F_{0.2,k}$ [kN]	450	540	640
Breaking load ³⁾	$F_{t,k}$ [kN]	550	660	800
Expansion under limit load ³⁾	A_{gt} [%]	$\geq 4,0$		

³⁾ Value equates 5%-quantileFor the elasticity modulus a calculated value of 200,000 N/mm² is to be adopt.DYWI® Drill Hollow Bars with connecting
Elements and Anchorages as
Load-Bearing Tendons for GeotechnicsGeometry and Material
properties of the hollow bar **R51**

Annex 3

Geometry of DYWI® Drill - Hollow bar T76



Hollow bar type		T76-1300	R76-1650	R76-1900
Nominal diameter	D_{nom} [mm]	76		
Actual diameter	D_a [mm]	74,6	75,6	75,6
Inner diameter ¹⁾	D_i [mm]	56	52	47
Nominal cross-section area	A_s [mm ²]	1590	1975	2360
Nominal weight ²⁾	m [kg/m]	12,5	15,5	18,5

¹⁾ Value only for reference; tolerance: ± 2.0 mm

²⁾ admissible tolerance: -3% to +9%

The bars have a constant left-hand thread in according to the factory standard DSI AT

Thread form and material deposited with DIBt

Mechanical properties

Hollow bar type		T76-1300	R76-1650	R76-1900
Load on 2%-of elastic limit ³⁾	$F_{0.2,k}$ [kN]	1000	1200	1500
Breaking load ³⁾	$F_{t,k}$ [kN]	1300	1650	1900
Expansion under limit load ³⁾	A_{gt} [%]	$\geq 4,0$		

³⁾ Value equates 5%-quantile

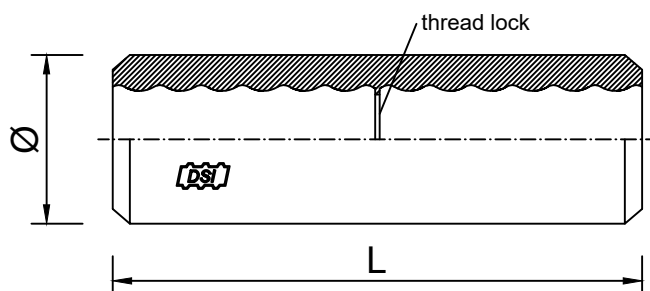
For the elasticity modulus a calculated value of 200,000 N/mm² is to be adopt.

DYWI® Drill Hollow Bars with connecting
Elements and Anchorages as
Load-Bearing Tendons for Geotechnics

Geometry and Material
properties of the hollow bar T 76

Appendix 4

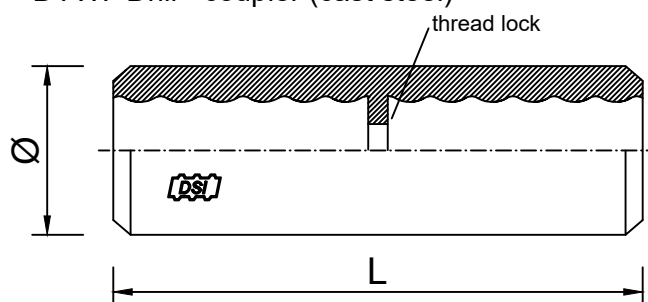
DYWI® Drill - coupler (mechanically treated)



Hollow bar type	Length L [mm]	diameter Ø [mm]	weight m [kg]
R32	150	42	0,8
R38	170	51	1,4
R51	200	63	2,0
T76	210	95	4,2

Thread form and material deposited with DIBt

DYWI® Drill - coupler (cast steel)



Hollow bar type	length L [mm]	diameter Ø [mm]	weight m [kg]
R32	160	42	0,9
R38	180	51	1,4
R51	200	63	2,0
T76	220	98	5,6

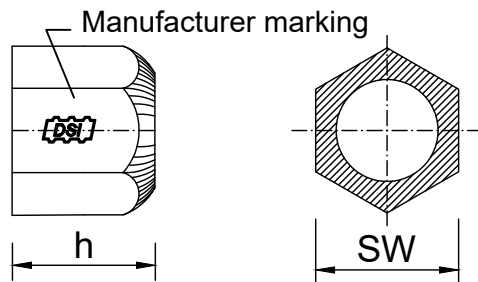
Thread form and material deposited with DIBt

DYWI® Drill Hollow Bars with connecting
Elements and Anchorages as
Load-Bearing Tendons for Geotechnics

DYWI® Drill couplers

Annex 5

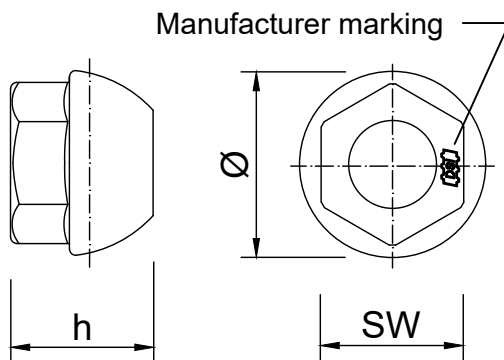
DYWI® Drill - Nut



Hollow bar	Wrench size SW [mm]	height H [mm]
R32	46	55
R38	55	70
R51	75	80
T76	100	80

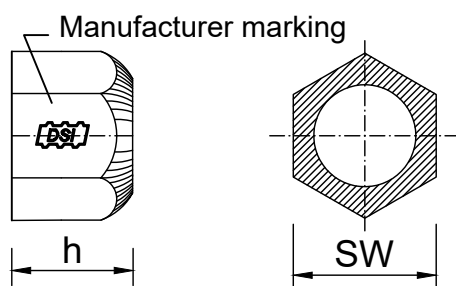
Thread form and material deposited with DIBt

DYWI® Drill - Domed Nut



Hollow bar	Wrench size SW [mm]	height H [mm]	diameter Ø [mm]
R32	46	46	60
R38	55	65	70
R51	75	70	90
T76	100	85	148

Thread form and material deposited with DIBt



Hollow bar	Wrench size SW [mm]	height H [mm]
R32	46	30
R38	55	35
R51	75	40
T76	100	40

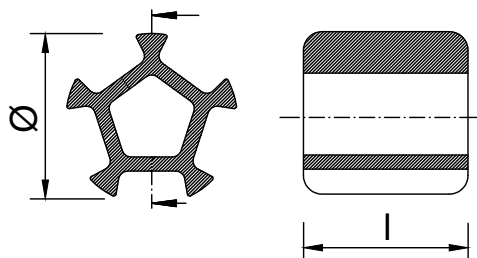
Thread form and material deposited with DIBt

DYWI® Drill Hollow Bars with connecting
Elements and Anchorages as
Load-Bearing Tendons for Geotechnics

DYWI® Drill nuts

Annex 6

DYWI® Drill - Spacer



Hollow bar	diameter Ø [mm]	length L [mm]
R32	73	40
R38	84	45
R51	95	60
T76	136	60

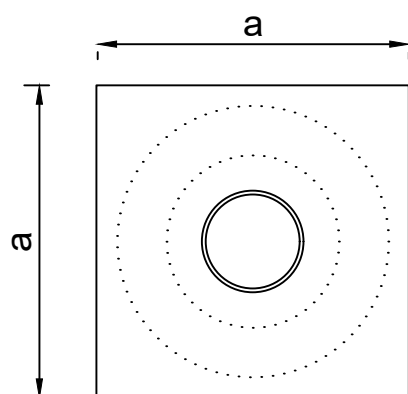
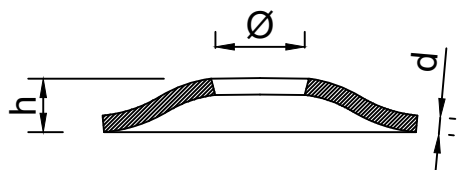
Thread form and material deposited with DIBt

DYWI® Drill Hollow Bars with connecting
Elements and Anchorages as
Load-Bearing Tendons for Geotechnics

DYWI® Drill spacer

Annex 7

DYWI® Drill - Calotte Plate



Calotte plate for cast nut

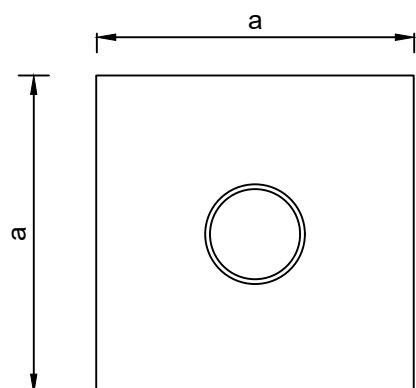
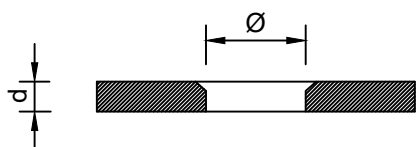
Hollow bar type	width a [mm]	thickness d [mm]	diameter Ø [mm]	height h [mm]
R32	150	10	43	31
R38	200	12	53	31
R51	200	15	75	31

Calotte plate for steel nut

Hollow bar type	width a [mm]	thickness d [mm]	diameter Ø [mm]	height h [mm]
R32-210	150	8	34	31
R32-250	150	8	34	31
R32-280	200	10	34	31
R32-320	200	12	34	31
R32-360	200	12	34	31
R32-400	200	12	34	31
R38-420	200	12	41	31
R38-500	200	15	41	31
R38-550	200	15	41	31
R51-550	200	15	55	31
R51-660	200	15	55	31
R51-800	200	20	55	31

Thread form and material deposited with DIBt

DYWI® Drill - Anchor Plate



Anchor plate for cast and steel nuts

Hollow bar type	width a [mm]	thickness d [mm]	hole Ø [mm]
R32	140	30	40
R38	160	40	48
R51	200	40	64
T76-1300	200	35	80
T76-1650	220	40	80
T76-1900	240	40	80

Thread form and material deposited with DIBt

DYWI® Drill Hollow Bars with connecting
Elements and Anchorages as
Load-Bearing Tendons for Geotechnics
DYWI® Drill bearing plates

Annex 8



BELGIUM AND LUXEMBOURG

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