DYWIDAG

DYWIDAG Bonded Post-Tensioning Systems Using Strands


DSI

Contents

DYWIDAG Post-Tensioning Systems

DYWIDAG Post-Tensioning Systems are world renowned for reliability and performance, most suitable for all applications in post-tensioned construction. They embrace the whole spectrum from bridge construction, buildings, to civil applications.

The first ever structure built with a prototype DYWIDAG Post-Tensioning System using Bars was the arch-bridge Alsleben (Germany) in 1927. From that time on DYWIDAG has continuously improved its systems to keep up with the growing demand of modern construction technology. In addition to the traditional post-tensioning system using bars, that is mainly geared towards geotechnical applications, building rehabilitation and strengthening, DYWIDAG offers a complete product line in strand post-tensioning (bonded, unbonded and external) as well as stay-cables being able to fully serve the post-tensioning construction.

DYWIDAG Post-Tensioning Systems have always combined highest safety and reliability standards with most economical efficiency in their research and development.

Dependable corrosion protection methods of the DYWIDAG Post-Tensioning Systems contribute to the longevity of modern construction. High fatigue resistance is achieved with optimized material selection and cautious detailing of all the components especially in their system assembly.

We look back on many years of valuable experience in the field of post-tensioning which leads to our extremely versatile product range that offers economical solutions for practically any problem. This includes our highly developed, most sophisticated equipment which is easy to operate in all phases beginning with assembly, installation, stressing and finally grouting.

DYWIDAG Post-Tensioning Systems are being developed and maintained by DYWIDAG is serviced and distributed by a worldwide network of subsidiaries. Our systems comply with the international specifications and recommendations (ASTM, AASHTO, BS, Eurocode, DIN, Austrian Code, SIA, FIP, fib, EOTA, etc.).
The American construction market demands a product range that is described in separate brochures.
The quality of the DYWIDAG products and services is in full compliance with ISO 9001.

DYWIDAG Scope:

- consulting
- design and shop-drawing engineering
- manufacturing and supply
- installation or training and/or supervision of installation
- inspection and maintenance

Standard Strands

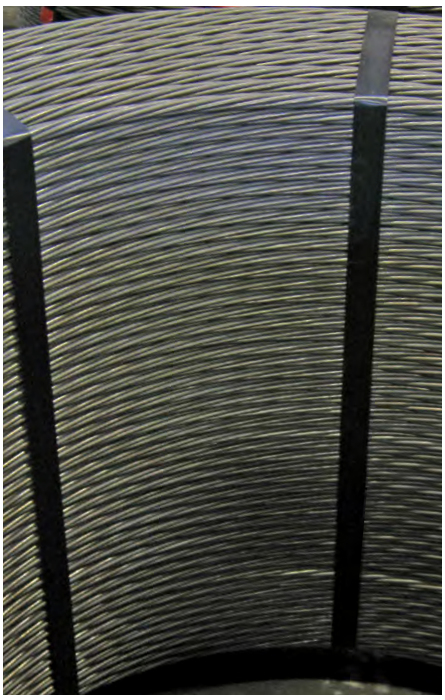
Strands are made from 7 individual cold-drawn wires, 6 helically wound outer wires and one center wire (king wire). The mechanical properties of the strand as well as corrosion protection properties are most important to DYWIDAG. For a maximum in corrosion protection we offer electrically isolated systems using polyethylene (PE) or polypropylene (PP) ducts. See also page 8.

Strands are usually packaged in so-called coils that can weigh up to 3.5 tons.

Technical Data

Type		12.9 mm (0.5")		15.3 mm (0.6")		15.7 mm (0.62")	
Code		ASTM A 416	prEN 10138	ASTM A 416	prEN 10138	prEN 10138	prEN 10138
Specification		Grade 270	BS 5896	Grade 270		BS 5896	
Yield Strength $f_{p0.1k}$	[N/mm^2]	1,670[1]	1,640[2]	1,670[1]	1,636[2]	1,560[2]	1,640[2]
Ultimate Strength f_{pk}	[N/mm^2]	1,860	1,860	1,860	1,860	1,770	1,860
Nominal Diameter	[mm]	12.70	12.90	15.24	15.3	15.70	15.70
Cross-Sectional Area	[mm^2]	98.71	100.00	140.00	140.00	150.00	150.00
Weight	[kg/m]	0.775	0.785	1.102	1.093	1.180	1.172
Ultimate Load	[kN]	183.7	186.0	260.7	260.0	265.5	279.0
Modulus of Elasticity	[N/mm^2]	~195,000					
Relaxation[3] after 1,000 h at 0.7 x Ultimate Strength f_{pk}	[%]	max. 2.5					

1) yield measured at 1% effective elongation
2) yield measured at 0.1% residual elongation
3) applicable for relaxation class 2 according to Eurocode prEN 10138/BS 5896: or low relaxation complying with ASTM A 416, respectively.



Corrugated Duct

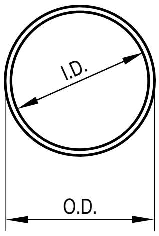
Metal ducts represent the most economical means to create a void for tensile elements. These thin-walled (0.25 - 0.60mm), ribbed sheet metal ducts provide a fair secondary corrosion protection with excellent bond behavior between tendon and concrete.
Primary corrosion protection is provided by the alkalinity of grout and concrete.

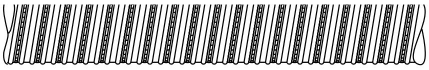
Dimensions of Corrugated Duct (Standard Sizes)

Tendon Type		Sheating	
0.5"	0.6"/0.62"	I.D. [mm]	O.D. [mm]
5901	6801	25	30
5902	6802	40	45
5904	6803	45	50
5905	6804	50	55
5907	6805	55	60
5909	6807	60	65
5912	6809	70	75
5915	6812	80	85
5920	6815	85	90
5927	6819	95	100
5932	6822	100	105
5937	6827	110	117
–	6831	120	127
–	6837	130	137
–	6843	140	147
–	6849	150	157
–	6855	160	167

The tendon type number (e.g. 5901, 6801) is composed as follows: the first digit (5 or 6) identifies the nominal strand diameter in tenth of inches, i.e. 0.5" or 0.6"/ 0.62", the last two digits (...01) reference the number of used strands (= 1 strand).
The second digit is an internal code. As regards the 0.6" tendon types, the accessories fit both Grade 250 (GUTS 1770 N/mm^2) and Grade 270 (GUTS 1860 N/mm^2) strands.

Tendon Type		Support Distances up to 1)	Wobble Coefficent 2)	Friction Coefficent 2)
0.5"	0.6"/0.62"	[mm]	[rad/m]	[rad^{-1}]
5901	6801	1.0	5 x 10^{-3}	0.19
5902	6802	1.0	5 x 10^{-3}	0.19
5904	6803	1.0	5 x 10^{-3}	0.19
5905	6804	1.0	5 x 10^{-3}	0.19
5907	6805	1.0	5 x 10^{-3}	0.19
5909	6807	1.5	5 x 10^{-3}	0.19
5912	6809	1.5	5 x 10^{-3}	0.19
5915	6812	1.5	5 x 10^{-3}	0.19
5920	6815	1.8	5 x 10^{-3}	0.19
5927	6819	1.8	5 x 10^{-3}	0.19
5932	6822	1.8	5 x 10^{-3}	0.19
5937	6827	1.8	5 x 10^{-3}	0.19
–	6831	1.8	5 x 10^{-3}	0.19
–	6837	1.8	5 x 10^{-3}	0.19
–	6843	1.8	5 x 10^{-3}	0.19
–	6849	1.8	5 x 10^{-3}	0.19
–	6855	1.8	5 x 10^{-3}	0.19





1) 1.0-1.8m with stiffening, e.g. with PE tube; 0.8-1.5 m with strengthened duct
In tendon section with minimum radius of curvature a distance of 0.6-1.2m shall apply.
2) values for calculation of friction losses with equation according to DIN EN 1992-1-1 (Eurocode 2). If friction losses are calculated according to BS or AASHTO different wobble coefficients shall be used.

PE/PP Round Duct

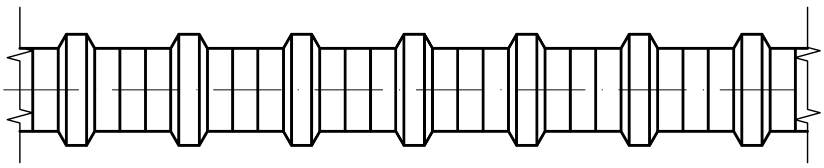
Thick-walled polyethylene/polypropylene plastic ducts provide long-term secondary corrosion protection especially in aggressive environments such as in case of waste water treatment plants, acid tanks, silos or structures exposed to de-icing salts.

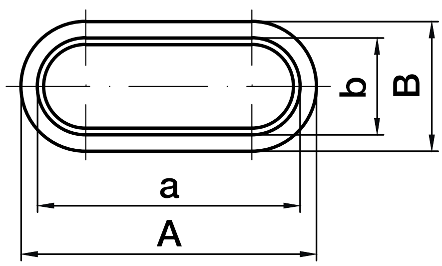
DYWIDAG-Systems International offers polyethylene/polypropylene ducts in straight lengths up to ≈24m for all sizes. Standard shipping length is ≈12m. Longer lengths in coils are available for all sizes except 130mm.

Dimensions of Round Corrugated PE/PP Duct (Standard Size)

Tendon Type		Sheating		Wall Thickness
0.5"	0.6"/0.62"	I.D.	O.D.	
		[mm]	[mm]	[mm]
5907	6805	48	59	2.0
5909	6807	59	73	2.0
5912	6809	76	91	2.5
5915	6812	76	91	2.5
5920	6815	85	100	2.5
5927	6819	100	116	3.0
5932	6822	100	116	3.0
5937	6827	115	135	3.5
–	6837	130	151	4.0

Flat PE/PP Duct





Tendon Type		A	B	a	b	Wall Thickness
0.5"	0.6"	[mm]	[mm]	[mm]	[mm]	[mm]
5902	6802	52.5	36.5	37.5	21.5	2.0
5904	6803	85.5	36.0	71.0	21.0	2.0
5905	6804	90.0	40.0	75.5	25.0	2.0
5907	6805	105.0	40.0	91.0	22.0	2.0

Wobble and friction coefficiants for plastic ducts (round and flat) see ETA-13/0815, Annex 25 and 26

ETA Approvals

Construction products with an European Technical Approval (ETA) meet all essential demands given in the Construction Products Regulation (CPR).

The ETA holder is authorized to apply the CE-marking (Conformité Européenne) on his product.
The CE-marking certifies the conformity with the technical specification and is the basis for the free movement of goods within the EU member states.

DYWIDAG is proud to have European Technical Approvals for its PT-systems with bars, bonded strands and unbonded strands.

Authorised and notified according to Article 10 of the Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products

Österreichisches Institut für Bautechnik
Schenkenstrasse 4 | 1010 Vienna | Austria
T +43 1 533 65 50 | F +43 1 533 64 23
mail@oib.or.at | www.oib.or.at

OiB Member of EOTA

European technical approval ETA-03/0036

English translation, the original version is in German

Handelsbezeichnung *Trade name*	**SUSPA/DSI – Monolitzenspannverfahren ohne Verbund mit 1 bis 5 Monolitzen** *SUSPA/DSI – Unbonded Monostrand System with 1 to 5 Monostrands*
Zulassungsinhaber *Holder of approval*	**DYWIDAG-Systems International GmbH Destouchesstraße 68 80796 München Deutschland**
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*	**Spannsystem für das Vorspannen von Tragwerken mit Monolitzen ohne Verbund für Beton** *Post-tensioning kit for prestressing of structures with unbonded monostrands for concrete*
Geltungsdauer vom *Validity from*	**30.06.2013**
bis zum *to*	**29.06.2018**
Herstellwerk *Manufacturing plant*	**DYWIDAG-Systems International GmbH Max-Planck-Ring 1 40764 Langenfeld Deutschland**
Diese Europäische technische Zulassung umfasst *This European technical approval contains*	**38 Seiten einschließlich 15 Anhängen** *38 Pages including 15 Annexes*
Diese Europäische technische Zulassung ersetzt *This European technical approval replaces*	**ETA-03/0036 mit Geltungsdauer vom 01.04.2009 bis zum 31.03.2014** *ETA-03/0036 with validity from 01.04.2009 to 31.03.2014*

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Österreichisches Institut für Bautechnik
Schenkenstrasse 4 | 1010 Vienna | Austria
T +43 1 533 65 50 | F +43 1 533 64 23
mail@oib.or.at | www.oib.or.at

OiB Member of EOTA

European technical approval ETA-13/0815

English translation, the original version is in German

Handelsbezeichnung *Trade name*	**DYWIDAG-Litze** *DYWIDAG Strand*
Zulassungsinhaber *Holder of approval*	**DYWIDAG-Systems International GmbH Destouchesstraße 68 80796 München Deutschland**
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*	**Litzenspannverfahren mit 3 bis 55 Litzen für das Vorspannen von Tragwerken im Verbund** *Bonded post-tensioning kit for prestressing of structures with 3 to 55 strands*
Geltungsdauer vom *Validity from*	**28.06.2013**
bis zum *to*	**27.06.2018**
Herstellwerk *Manufacturing plant*	**DYWIDAG-Systems International GmbH Max-Planck-Ring 1 40764 Langenfeld Deutschland**
Diese Europäische technische Zulassung umfasst *This European technical approval contains*	**58 Seiten einschließlich 35 Anhängen** *58 Pages including 35 Annexes*

EOTA European Organisation for Technical Approvals
Europäische Organisation für Technische Zulassungen
Organisation Européenne pour l'Agrément Technique

Service d'études sur les transports, les routes et leurs aménagements
110 rue de Paris
77171 Sourdun

Tel : + 33 (0)1 60 52 31 31
Fax : + 33 (0)1 60 52 31 69

Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

Sétra Service d'études sur les transports, les routes et leurs aménagements

MEMBRE DE L'EOTA
MEMBER OF EOTA

European Technical Approval ETA-13/0979
(English language translation, the original version is in French language)

Nom commercial : Trade name :	**Procédé de précontrainte extérieur DYWIDAG** DYWIDAG External and Internal unbonded Strand Post-Tensioning System
Détenteur de l'ATE : Holder of approval :	DYWIDAG-Systems International GmbH Destouchesstrasse 68 80796 München DEUTSCHTLAND
Type générique et utilisation prévue du produit de construction :	**Procédé de précontrainte par post-tension DYWIDAG avec câble extérieur et intérieur non adhérent de 3 à 37 torons (140 et 150 m²).**
Generic type and use of construction product :	DYWIDAG External and Internal unbonded Strand Post-Tensioning System for 3 to 37 Strands (140 and 150 m²).
Valid from: to:	27.06.2013 27.06.2018
Producteur du procédé : Kit manufacturer :	DYWIDAG-Systems International GmbH Max-Planck-Ring 1 40764 Langenfeld DEUTSCHLAND
Le présent agrément technique européen contient :	50 pages comprenant 27 pages de dessins faisant partie intégrante du document.
This European Technical Approval contains :	50 pages including 27 pages of drawings which form an integral part of the document.

EOTA Organisation pour l'Agrément Technique Européen
European Organisation for Technical Approvals

Anchorages

Multiplane Anchorage MA

The two-part multiplane anchorage is primarily used for longitudinal tendons in beams and bridges.

The wedge plate and the multiplane anchor body with usually three load transfer planes introduce the pre-stressing force continuously into the member with minimal front area.
The MA anchorage can be installed with and without helix reinforcement.

The separation of anchor body and wedge plate makes it possible to insert the strand after casting the concrete.
The wedge plate self-centers on the anchor body providing consistent assembly and installation as well as trouble-free stressing.

Stressing Anchorage	Dead End Anchorage Accessible	Dead End Anchorage not Accessible	Ultimate Load [kN] from	Ultimate Load [kN] to
✓	✓	✓	1,201	15,345

Plate Anchorage SD

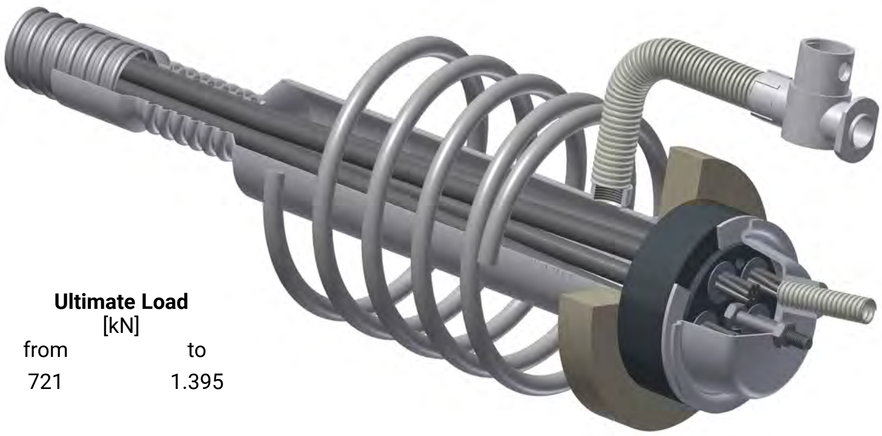
The single unit plate anchorage is designed for plate structures as well as transverse tendons in bridges. Small edge and center distances allow for an economical anchorage layout in condensed situations.

Stressing Anchorage	Dead End Anchorage Accessible	Dead End Anchorage not Accessible	Ultimate Load [kN] from	Ultimate Load [kN] to
✓	✓	✓	721	2,511

Plate Anchorage Type ED

The two-part plate anchorage can be used in slabs and similar structures, e.g. transversal prestressing in bridge decks. The wedge plate self-centers on the anchor plate providing consistent assembly and installation as well as trouble-free stressing.

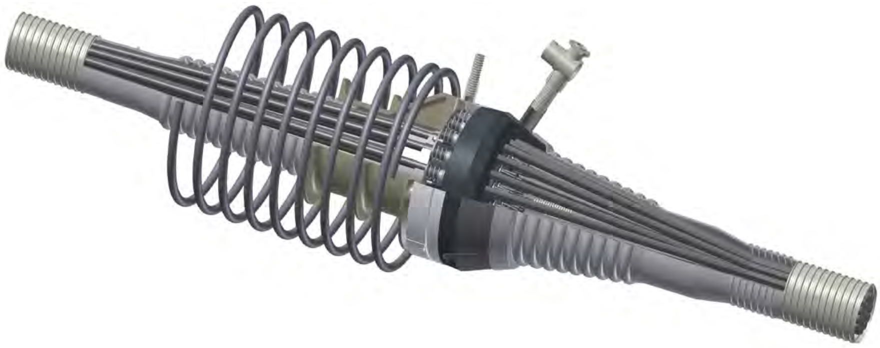
Stressing Anchorage	Dead End Anchorage Accessible	Dead End Anchorage not Accessible	Ultimate Load [kN] from	Ultimate Load [kN] to
✓	✓	✓	721	1.395



Anchorages

Coupler R (Fixed Coupler)

Coupler R is designed to couple on to already installed and stressed tendons. The coupler consists of a multiplane anchor body and a coupler wedge plate where the strands are overlapped.
The continuing strands can be installed easily and independently.



Fixed Coupler	Floating Coupler	Ultimate Load [kN] from	to
✓	–	1,201	10,323

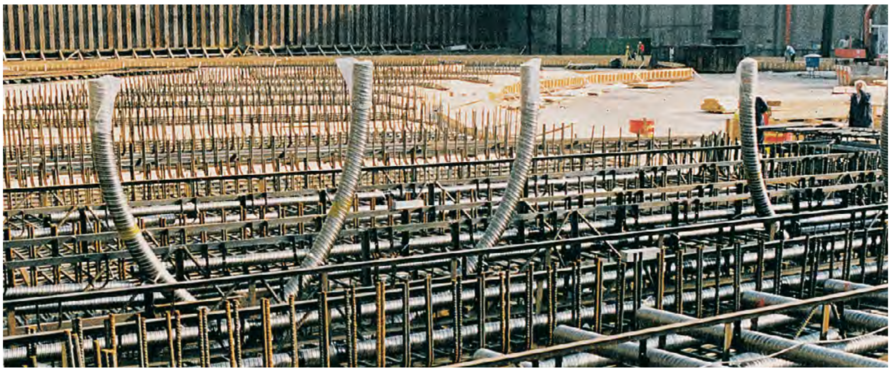
Coupler D (Floating Coupler)

To lengthen unstressed tendons, e.g. in segmental bridge construction, coupler D is put to use. The splice chuck consists of two spring-loaded wedges that connect two strands individually.

Fixed Coupler	Floating Coupler	Ultimate Load [kN] from	to
–	✓	721	10,323

Loop Anchorage HV

Often used in large plate-shaped structures, walls in off-shore structures or LNG tanks with generally static loadings. The 180° loop should be positioned in the center of the tendon to allow for non-slippage during simultaneous two-end stressing.



Stressing Anchorage	Dead End Anchorage Accessible	Dead End Anchorage not Accessible	Ultimate Load [kN] from	to
–	–	✓	721	6,138

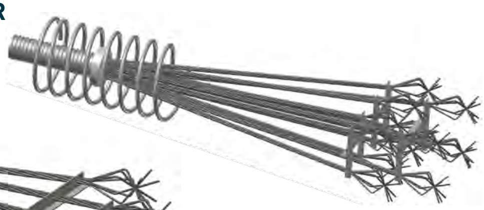
Anchorages

Bond Head Anchorage HL/HR

Primarily used with prefabricated tendons, it is also possible to fabricate this anchorage on site. The strand wires are plastically deformed to ensure a safe load transfer up to ultimate capacity in the area of the bond head proven in static as well as in dynamic applications. Depending on the boundary conditions either a rather flat or a bulky bond head anchorage pattern is available.

HL

HR



Stressing Anchorage	Dead End Anchorage Accessible	Dead End Anchorage not Accessible	Ultimate Load [kN] from	Ultimate Load [kN] to
–	–	✓	721	6,138

Coupler M/ME (Floating Anchorage Block)

Rotation symmetric structures (water tanks, digestor tanks, large pipes or dome shells) that require circumferential post-tensioning are the principal applications for the floating coupler M/ME. The tendon anchorage consists of an anchorage block with wedge holes on both sides to accept bare or greased and sheathed strands. The strands actually overlap in the block and use the belt-buckle principle. The ring-tendon is very compact and requires a very small pocket only.

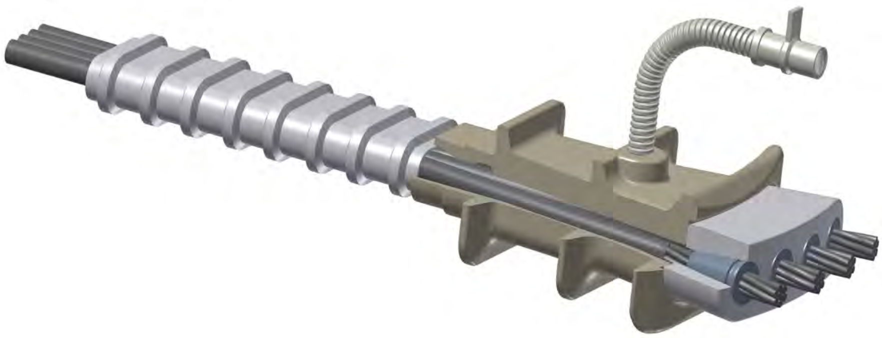
M

ME

Stressing Anchorage	Dead End Anchorage Accessible	Dead End Anchorage not Accessible	Ultimate Load [kN] from	Ultimate Load [kN] to
✓	✓	–	240	3,348

Flat Multiplane Anchorage FMA

The Flat Multiplane Anchorage of max. 5-0.62" strands in one plane to deviate into one oval duct is designed to be installed in thin members such as transverse post-tensioning of the top slab of box-girder bridges and prestressed flat slabs.



Stressing Anchorage	Dead End Anchorage Accessible	Dead End Anchorage not Accessible	Ultimate Load [kN] from	Ultimate Load [kN] to
✓	✓	✓	551	1,395

Overview

Tendon Type 59…

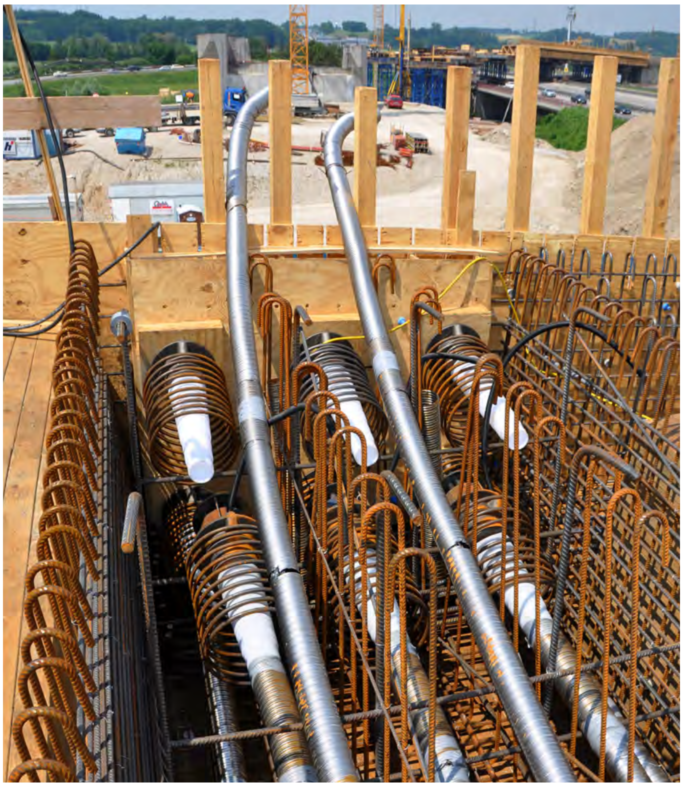
Anchorage Type 59…	01	02	03	04	05	06	07	08	09	12	15	20	27	32	37
Multiplane Anchorage MA							x		x	x	x	x	x	x	x
Plate Anchorage SD			x	x	x	x	x	x	x	x					
Plate Anchorage Type ED				x	x	x	x								
Coupler R									x	x	x	x	x	x	x
Coupler D			x	x	x		x		x	x	x	x	x	x	x
Loop Anchorage HV			x	x	x	x	x		x	x	x	x	x		
Bond Head Anchorage HL/HR			x	x	x		x		x	x	x	x			
Flat Multiplane Anchorage FMA			x	x	x										

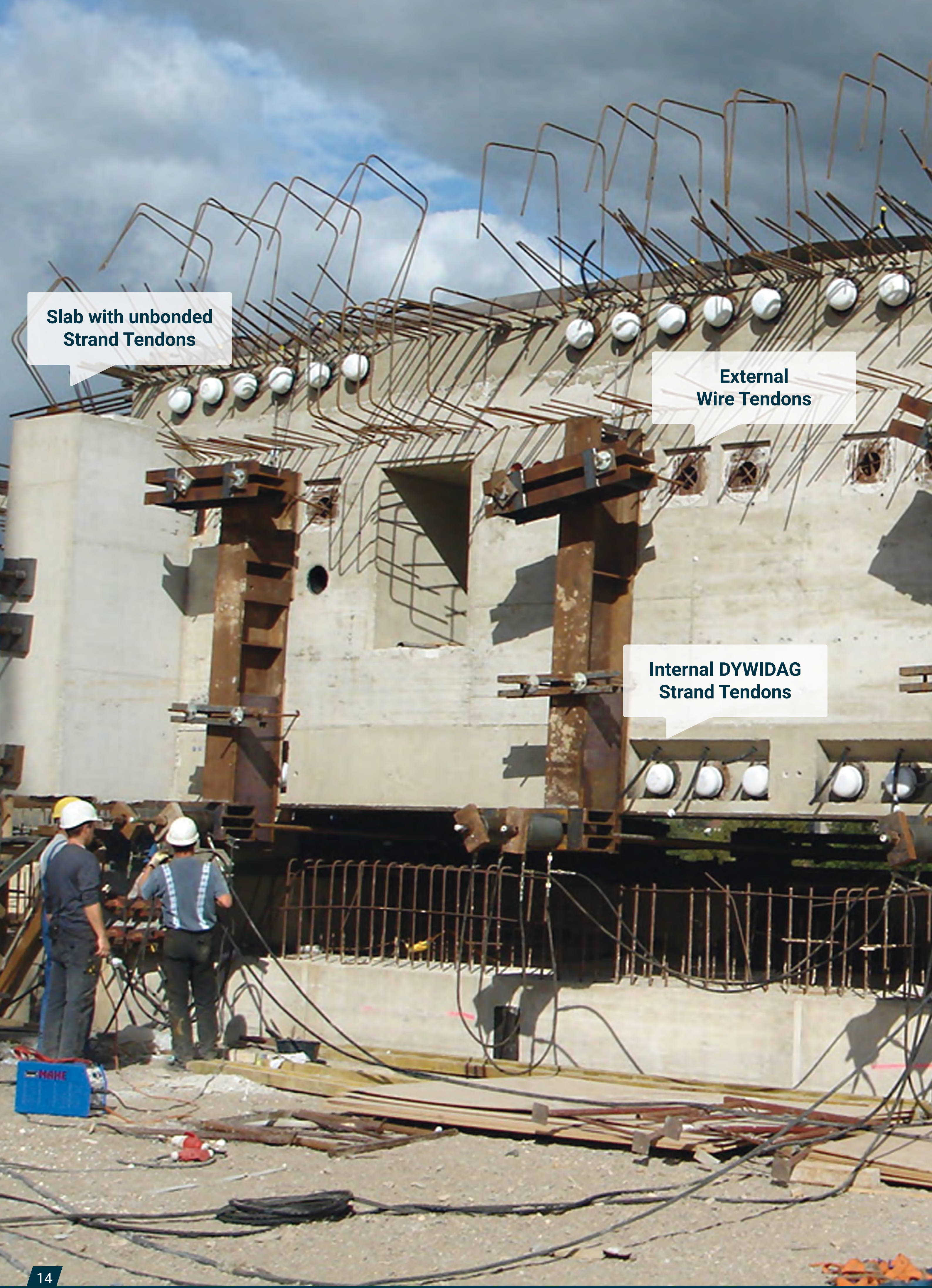
Other sized tendons on request

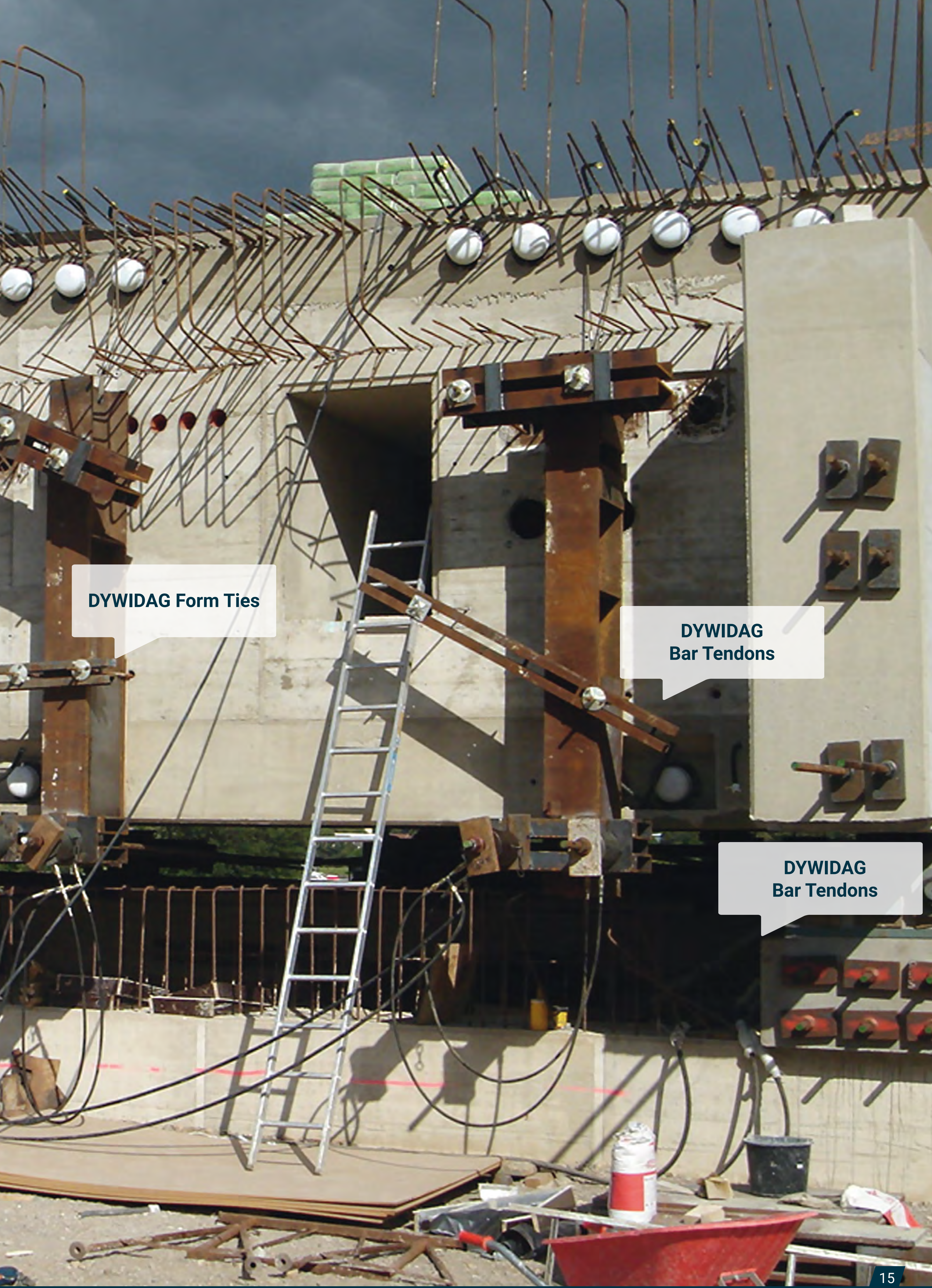
Tendon Type 68…

Anchorage Type 68…	01	02	03	04	05	06	07	08	09	10	12	15	19	22	27	31	37	43	49	55
Multiplane Anchorage MA					x		x		x		x	x	x	x	x	x	x	x	x	x
Plate Anchorage SD			x	x	x	x	x	x	x											
Plate Anchorage Type ED			x	x	x															
Coupler R					x		x		x		x	x	x	x	x	x	x			
Coupler D			x	x	x		x		x		x	x	x	x	x	x	x			
Loop Anchorage HV			x	x	x	x	x		x		x	x	x	x						
Bond Head Anchorage HL/HR			x	x	x		x		x		x	x	x	x						
Coupler M and ME	x	x		x		x		x		x	x									
Flat Multiplane Anchorage FMA		x		x	x															

Other sized tendons on request




Slab with unbonded Strand Tendons
External Wire Tendons
Internal DYWIDAG Strand Tendons

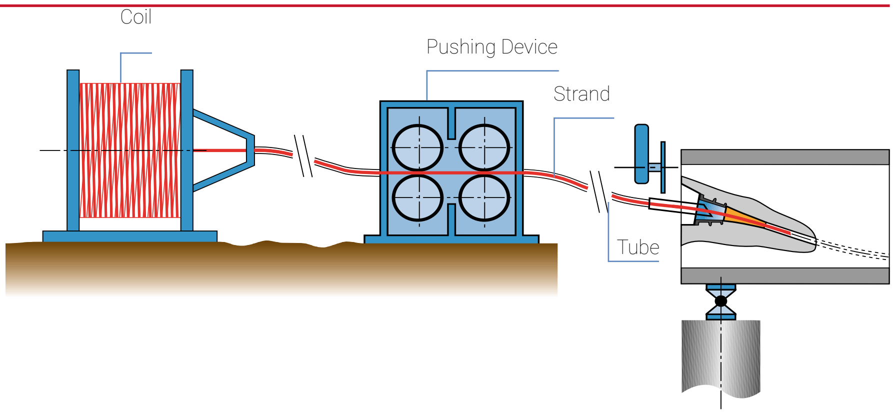

DYWIDAG Form Ties
DYWIDAG Bar Tendons
DYWIDAG Bar Tendons

Installation

DYWIDAG-Systems International has developed three different methods to insert strands into ducts. The selection of the insertion method depends on the boundary conditions of the structure and the job site.

Method 1: Pushing

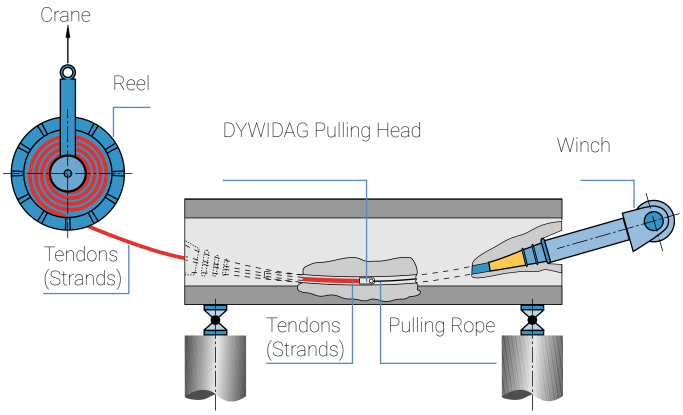
To push strands into the duct on the job site is very economical and can be done either before or after casting the concrete. The pushing equipment can be installed remotely and connected flexibly to the insertion point. DYWIDAG strand pushers provide relatively high speed of up to 8 m/s and require minimal operating personnel of only two men. These advantages make this method the preferred standard for strand installation.

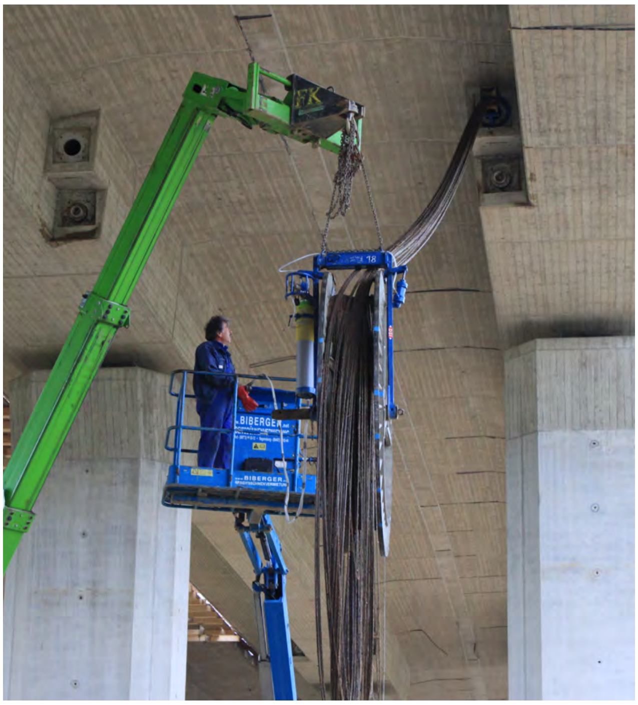


Installation

Method 2: Pulling

To install strands while pulling them into the duct can be very efficient in special structures, for example where the loop anchorage is used. In normal cases the whole bundle of strands is pulled through winching with a steel cable.





Method 3: Pre-Assembled Tendons

The prefabrication of tendons either in the shop or in the field can also be very economical, especially with shorter tendons and short shipping distances. Special uncoilers or hydraulic winches are necessary to properly install the tendons in the structure.

Stressing

DYWIDAG has developed a series of jacks, rams and hydraulic pumps in order to reach the target stressing load. The necessary versatility is provided by changing devices that make one unit adaptable for many different tendon sizes. DYWIDAG Equipment is designed to cover a wide spectrum of applications with jack capacities ranging from 250kN up to 15,000kN.

DYWIDAG rams are highly sophisticated, but still convenient to operate. They employ inner tube bundles with automatic gripping devices that guide the strand safely through the inside of the ram. This feature allows the stressing operation to be controlled with the highest degree of reliability as well as minimal wedge seating losses by benefiting from the power seating option. Power seating is a way of hydraulically pressing in the wedges with a predefined load individually and simultaneously rather than relying simply on friction seating. DYWIDAG rams also make it possible to overstress and release the tendon to compensate for friction losses and maximize the stress level over the tendon length.

Every ram has a pressure relief valve for safety reasons that activates to limit hydraulic pressure should the hydraulic pump malfunction. To further verify the stressing operation an additional gauge port is provided directly on the ram.

Stressed tendons can be destressed with special wedges and a special ram configuration. Hydraulic pumps can be equipped with a convenient remote control device. Further information concerning the equipment is provided on page 30 and following.


Hydraulic Pump with a Remote Control

Grouting

The durability of post-tensioned construction depends mainly on the success of the grouting operation. The hardened cement grout provides bond between concrete and tendon as well as primary long-term corrosion protection for the prestressing steel.

DYWIDAG has developed a grouting operation that is based on thixotropic and highly plasticized grout, and utilizes durable grouting equipment. Advanced methods such as pressure grouting, post-grouting and vacuum grouting are all results of many years of development.

Grouting is always done from a low- point of the tendon. This can be one of the anchorages where a grout cap with grout hose is the port for the grout or along the tendon utilizing an intermediate grout saddle. All grouting components are threaded for easy, fast and positive connection.

Mixing and Grouting Unit

Vacuum Grouting

Tendon Layout with Grouting System

D = draining

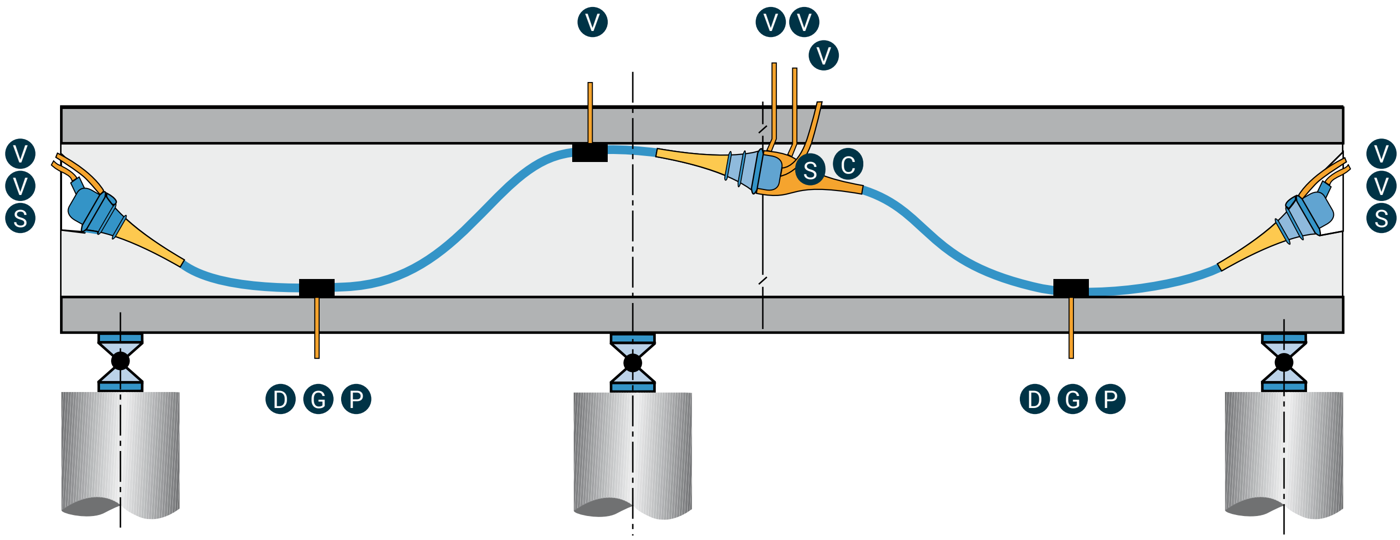
S = stressing

G = grouting

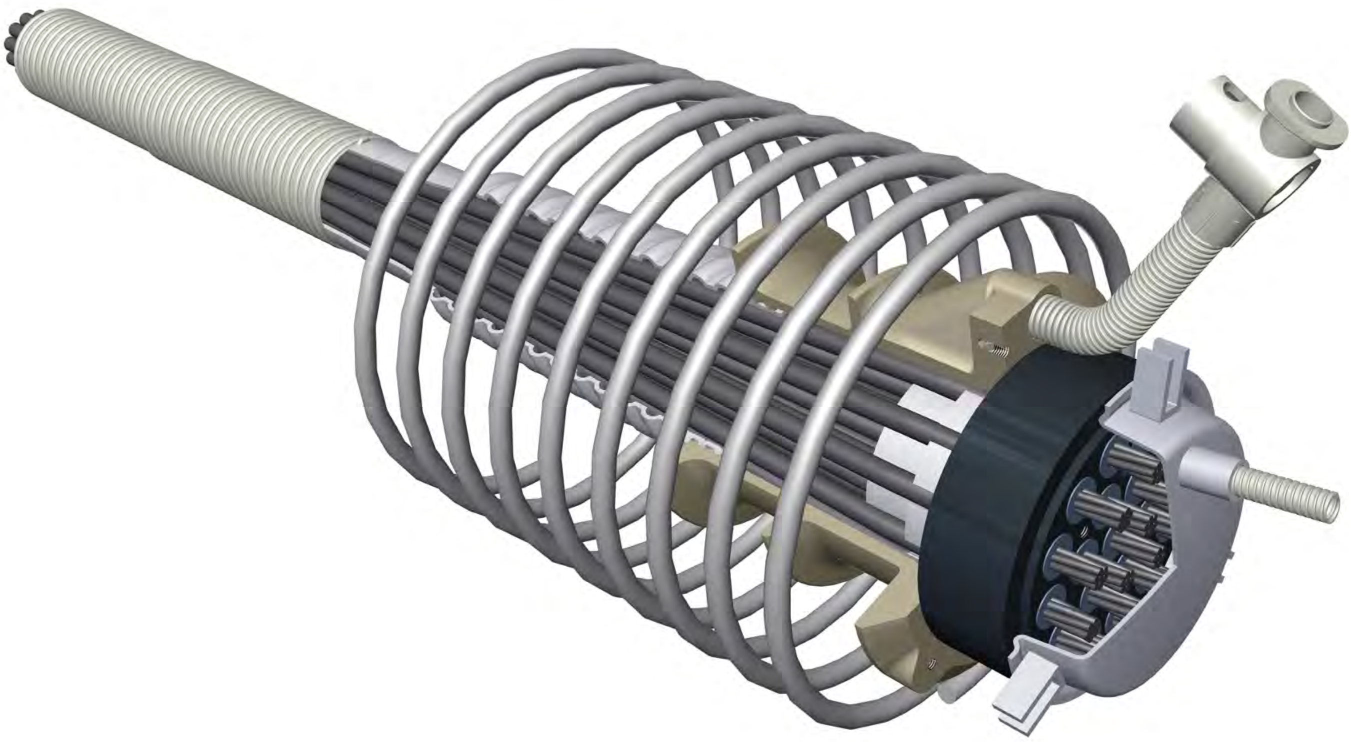
V = vent

C = coupling

P = post-grouting



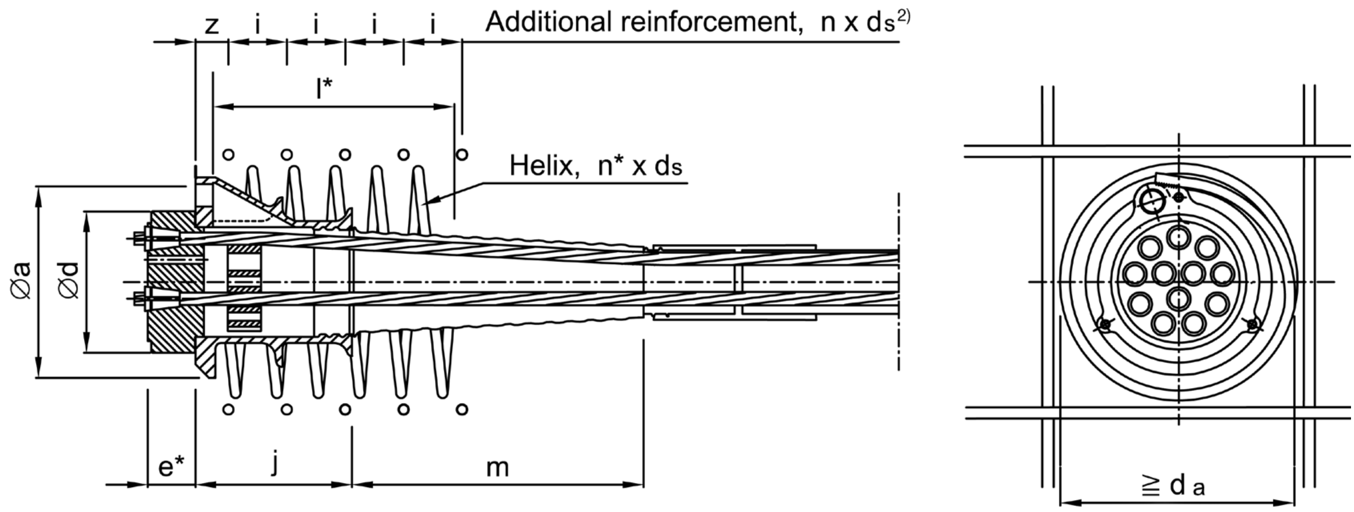
Multiplane Anchorage MA with Helix Reinforcement (Minimum Anchor Body Dimensions)



Technical Data

Type	Ultimate Load	Type	Ultimate Load					
0.5"	**Ø 12.9mm**	**0.6"/0.62"**	**Ø 15.7mm**	Ø d	e*	Ø a	j	m
f_{pk} 1860	(186kN per strand)	f_{pk} 1860	(279kN per strand)	59.. / 68..	59.. / 68..			
[N/mm²]	[kN]	[N/mm²]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]
5907	1,302	6805	1,395	117 / 117	42 / 47	150	90	240
5909	1,674	6807	1,953	130 / 130	47 / 52	170	100	210
5912	2,232	6809	2,511	140 / 145	47 / 52	190	125	280
5915	2,790	6812	3,348	160 / 170	43 / 55	220	180	350
5920	3,720	6815	4,185	180 / 190	51 / 60	250	200	390
5927	5,022	6819	5,301	200 / 210	64 / 68	280	220	430
5932	5,952	6822	6,138	220 / 220	73 / 73	305	220	550
5937	6,882	6827	7,533	240 / 240	80 / 80	330	240	550
–	–	6831	8,649	270	80	385	350	570
–	–	6837	10,323	270	95	420	350	570
–	–	6843	11,997	320	110	465	380	950
–	–	6849	13,671	340	120	510	420	780
–	–	6855	15,345	340	120	510	420	780

Multiplane Anchorage MA with Helix Reinforcement (Minimum Anchor Body Dimensions)



Details of the Anchorage Zone for 34N/mm² (cube) / 28N/mm² (cylinder) Actual Concrete Strength at Stressing

Ø12.9mm, Ultimate Load 186kN						
Type 0.5"	**Distances of the anchorages**		**Additional Reinforcement Helix[2]**			
f_{pk}1860 [N/mm^2]	Center Distance [mm]	Edge Distance[1] [mm]	Ø d_a [mm]	min l* [mm]	n*	d_s [mm]
5907	230	135	170	225	4	12
5909	260	150	190	260	4	12
5912	290	165	220	310	5	12
5915	320	180	240	410	7	12
5920	370	205	280	465	8	12
5927	425	235	350	470	8	16
5932	460	250	360	500	8.5	16
5937	500	270	390	525	9	16

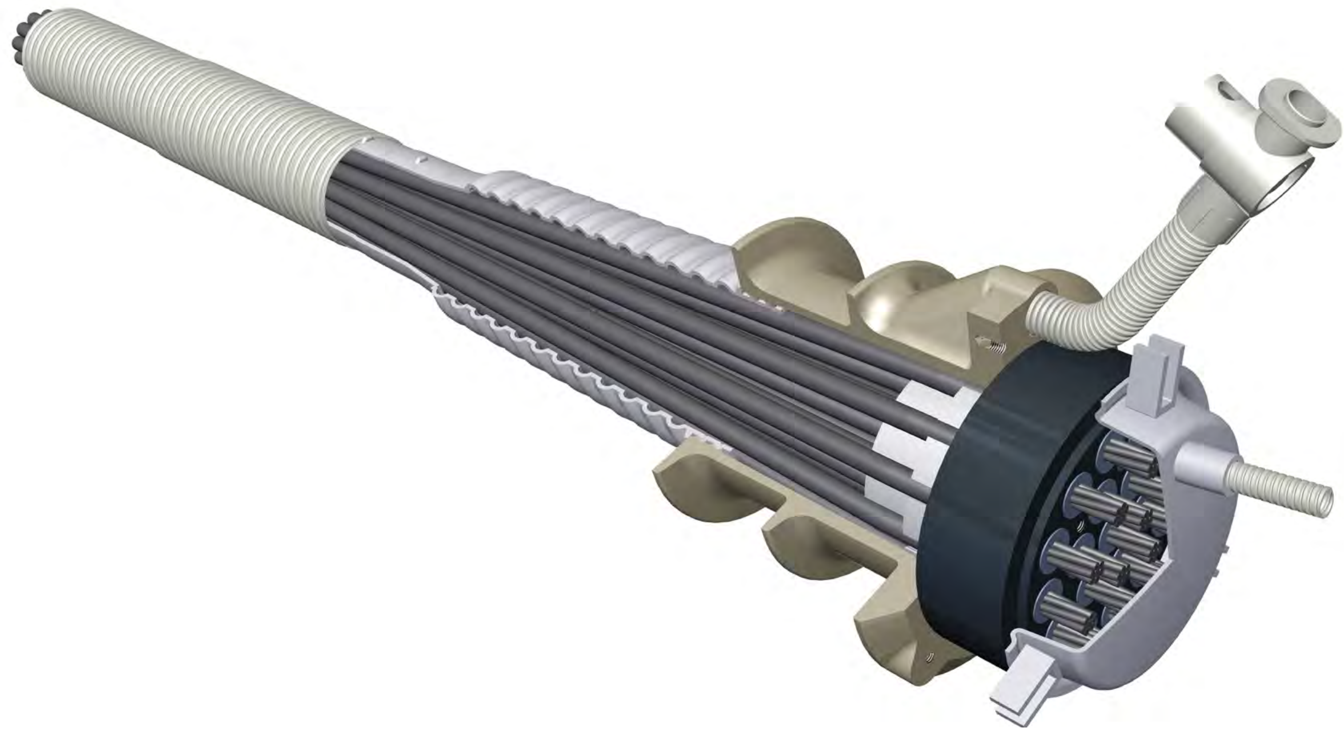
1) in case of 30mm concrete cover
2) additional surface reinforcement acc. to ETA-13/0815 is required.

The values for the anchorage zones are based on European Technical Approval ETA-13/0815.
Center/edge distances and data for additional reinforcement for other actual concrete strengths can be found on www.dywidag-systems.com
Max. prestressing load 75% of ultimate load (short-term overstressing to 80 % is permissible)
The respective standards and regulations valid at the place of use shall be complied with.

Ø15.3/15.7mm, Ultimate Load 261/279kN						
Type 0.62"	**Distances of the anchorages**		**Additional Reinforcement Helix[2]**			
f_{pk}1860 [N/mm^2]	Center Distance [mm]	Edge Distance[1] [mm]	Ø d_a [mm]	min l* [mm]	n*	d_s [mm]
6805	235	140	185	225	4	12
6807	280	160	220	260	4	14
6809	305	175	250	310	5	14
6812	350	195	265	410	7	14
6815	390	215	310	465	8	14
6819	435	240	375	470	8	16
6822	470	255	370	500	8.5	16
6827	520	280	430	525	9	16
6831	640	340	560	615	9	20
6837	700	370	620	615	9	20
6843[3]	640	340	530	675	10	20
6849[3]	680	360	550	675	10	20
6855[3]	710	375	580	700	11	20

1) in case of 30mm concrete cover
2) additional surface reinforcement acc. to ETA-13/0815 is required.
3) for that size only concrete strength 43/53N/mm².

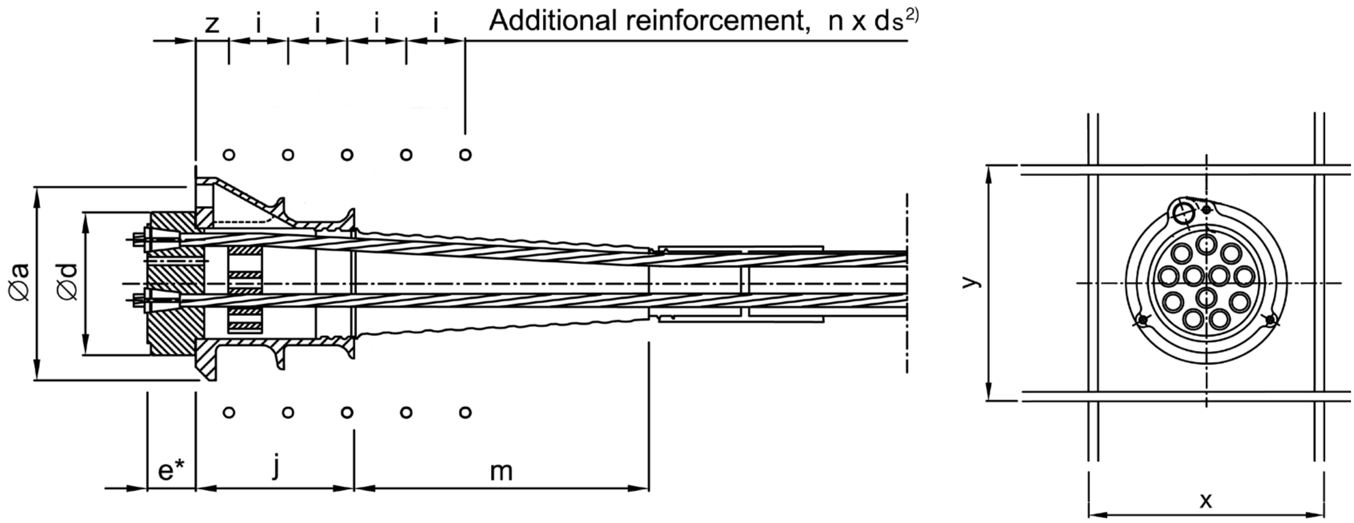
Multiplane Anchorage MA without Helix Reinforcement



Technical Data

Type	Ultimate Load	Type	Ultimate Load					
0.5"	Ø 12.9mm	0.6"/0.62"	Ø 15.7mm	Ø d	e*	Ø a	j	m
f_{pk}1860	(186kN per strand)	f_{pk} 1860	(279kN per strand)	59.. / 68..	59.. / 68..			
[N/mm²]	[kN]	[N/mm²]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]
5907	1,302	6805	1,395	117 / 117	42 / 47	150	90	240
5909	1,674	6807	1,953	130 / 130	47 / 52	170	100	210
5912	2,232	6809	2,511	140 / 145	47 / 52	190	125	280
5915	2,790	6812	3,348	160 / 170	43 / 55	220	180	350
5920	3,720	6815	4,185	180 / 190	51 / 60	250	200	390
5927	5,022	6819	5,301	200 / 210	64 / 68	280	220	430
5932	5,952	6822	6,138	220 / 220	73 / 73	305	220	550

Multiplane Anchorage MA without Helix Reinforcement



Details of the Anchorage Zone for 34N/mm² (cube) / 28N/mm² (cylinder) Actual Concrete Strength at Stressing

Ø12.9mm, Ultimate Load 186kN						
Type 0.5"	**Distances of the anchorages**		**Additional Reinforcement Stirrups2)**			
f_{pk}1860 [N/mm²]	Center Distance [mm]	Edge Distance1) [mm]	x/y [mm]	i [mm]	n*	d_s [mm]
5907	250	145	230	50	5	16
5909	280	160	260	50	6	16
5912	320	180	290	50	6	16
5915	350	195	300	45	8	16
5920	400	220	360	50	8	16
5927	465	255	400	55	8	20
5932	500	270	425	50	10	20

1) in case of 30mm concrete cover
2) stirrup dimensions must be adhered to exactly

Ø15.3/15.7mm, Ultimate Load 261/279kN						
Type 0.6"/0.62"	**Distances of the anchorages**		**Additional Reinforcement Stirrups2)**			
f_{pk}1860 [N/mm²]	Center Distance [mm]	Edge Distance1) [mm]	x/y [mm]	i [mm]	n*	d_s [mm]
6805	255	150	240	50	5	16
6807	300	170	280	50	6	16
6809	335	190	305	50	6	16
6812	380	210	320	45	8	16
6815	425	235	380	55	8	20
6819	475	260	410	55	8	20
6822	510	275	430	50	10	20

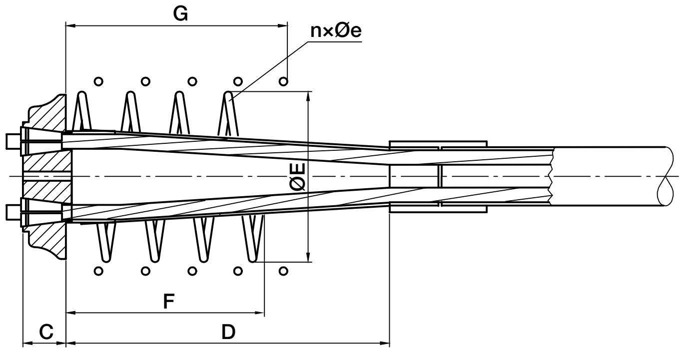
1) in case of 30mm concrete cover
2) stirrup dimensions must be adhered to exactly

The values for the anchorage zones are based on European Technical Approval ETA-13/0815.

Center/edge distances and data for additional reinforcement for other actual concrete strengths can be found on www.dywidag-systems.com

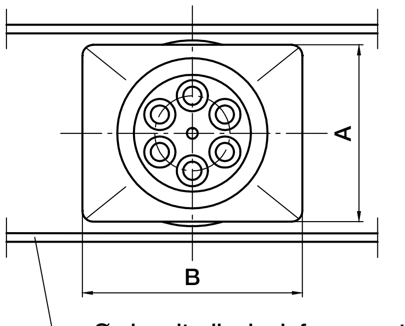
Max. prestressing load 75% of ultimate load (short-term overstressing to 80% is permissible).
The respective standards and regulations valid at the place of use shall be complied with.

Plate Anchorage SD



Technical Data

Type 0.5"	Ultimate Load Ø 12.9mm	Type 0.6"/0.62"	Ultimate Load Ø 15.7mm	A	B	C	D
f_{pk} 1860 [N/mm²]	(186kN per strand) [kN]	f_{pk} 1860 [N/mm²]	(279kN per strand) [kN]	[mm]	[mm]	[mm]	[mm]
5904	744	6803	837	125	140	41	200
5905	930	6804	1,116	135	160	41	200
5907	1,302	6805	1,395	150	180	40	300
5909	1,674	6807	1,953	170	215	44	270
5912	2,232	6809	2,511	190	245	48	325



Details of the Anchorage Zone for 30N/mm² (cube) / 24N/mm² (cylinder) Actual Concrete Strength at Stressing

Type 0.5"	Type 0.6"/0.62"	Ø12.9/15.3/15.7mm, Ultimate Load 186/261/279kN – Distances of the anchorages		Additional Reinforcement – Helix			Additional Reinforcement – longitudinal bars or stirrups			
f_{pk} 1860 [N/mm²]	f_{pk} 1860 [N/mm²]	Center Distance [mm]	Edge Distance[1)] [mm]	E [mm]	F [mm]	n	e [mm]	G [mm]	n	g [mm]
5904	6803	170/250	105/145	–	–	–	–	285	6	12
5905	6804	190/290	115/165	–	–	–	–	285	6	12
5907	6805	215/320	130/180	160	275	5	12	340	7	12
5909	6807	250/370	145/205	190	275	5	14	340	7	12
5912	6809	280/420	160/230	220	330	6	14	370	7	12

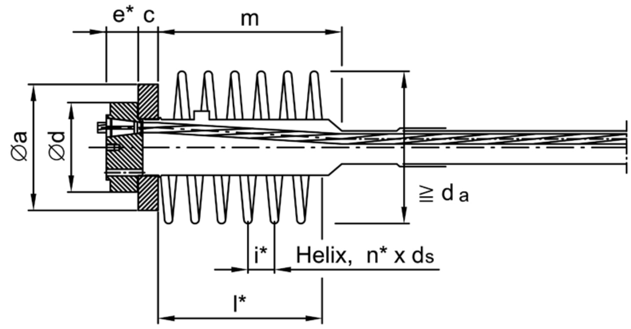
1) in case of 30mm concrete cover

The values for the anchorage zones are based on European Technical Approval ETA-13/0815.

Max. prestressing load 75% of ultimate load (short-term overstressing to 80% is permissible).

The respective standards and regulations valid at the place of use shall be complied with.

Plate Anchorage ED



Technical Data

Type	Ultimate Load	Type	Ultimate Load					
0.5"	Ø 12.9mm	0.6"/0.62"	Ø 15.7mm	Ø d	Ø a	e*	c	m
f_{pk} 1860	(186kN per strand)	f_{pk} 1860	(279kN per strand)					
[N/mm²]	[kN]	[N/mm²]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]
5904	744	6803	837	110	165	47	30	170
5905	930	6804	1,116	110	165	47	30	170
5907	1,302	6805	1,395	135	190	47	30	280

Details of the Anchorage Zone for 35N/mm² (cube) / 28N/mm² (cylinder) Actual Concrete Strength at Stressing

Ø12.9/15.3mm, Ultimate Load 186/261kN							
Type 0.5"	Type 0.6"	Distances of the anchorages		Additional Reinforcement Helix			
f_{pk}1860	f_{pk}1860	Center Distance	Edge Distance 1)	Ø d_a	min l*	n*	d
[N/mm²]	[N/mm²]	[mm]	[mm]	[mm]	[mm]		[mm]
5904	6803	190	115	150	175	5	14
5905	6804	215	130	180	195	5	14
5907	6805	240	140	205	195	5	14

1) in case of 30mm concrete cover

Ø15.7mm, Ultimate Load 279kN						
Type 0.62"	Distances of the anchorages		Additional Reinforcement Helix			
f_{pk}1860	Center Distance	Edge Distance 1)	Ø d_a	min l*	n*	d_s
[N/mm²]	[mm]	[mm]	[mm]	[mm]		[mm]
6803	200	120	150	175	5	14
6804	225	135	180	195	5	14
6805	250	145	205	195	5	14

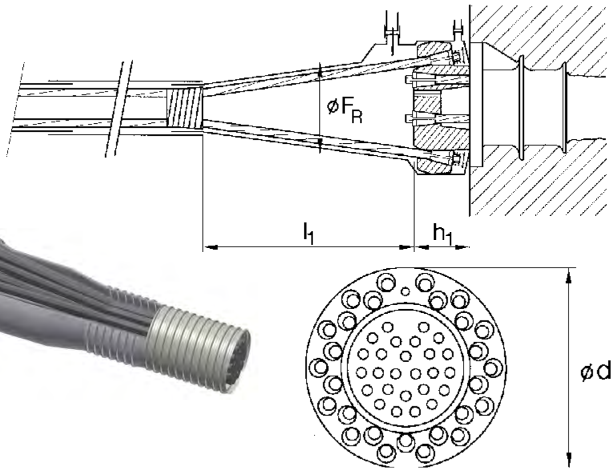
1) in case of 30mm concrete cover

The values for the anchorage zones are based on European Technical Approval ETA-06/0022.

Center/edge distances and data for additional reinforcement for other actual concrete strengths and further assistance can be found on www.dywidag-systems.com.

Max. prestressing load 75% of ultimate load (short-term overstressing to 80% is permissible).
The respective standards and regulations valid at the place of use shall be complied with.

Coupler R (Fixed Coupler)



Technical Data

Type 0.5"	Ultimate Load Ø 12.9mm	Ø d	Ø F_R	h_1	l_1
f_{pk} 1860	(186kN per strand)				
[N/mm²]	[kN]	[mm]	[mm]	[mm]	[mm]
5909	1,674	224	168	105	350
5912	2,232	224	172	105	350
5915	2,790	246	191	105	500
5920	3,720	264	215	110	450
5927	5,022	320	262	120	570
5932	5,952	340	279	125	640
5937	6,882	380	318	135	660

Type 0.6"/0.62"	Ultimate Load Ø 15.3/15.7mm	Ø d	Ø F_R	h_1	l_1
f_{pk} 1860	(261/279kN per strand)				
[N/mm²]	[kN]	[mm]	[mm]	[mm]	[mm]
6805	1,395	207	152	105	460
6807	1,953	207	152	105	370
6809	2,511	224	168	105	350
6812	3,348	246	188	105	500
6815	4,185	264	207	110	450
6819	5,301	289	224	120	570
6822	6,138	340	276	125	640
6827	7,533	380	314	135	660
6831	8,649	435	370	158	870
6837	10,323	435	370	158	870

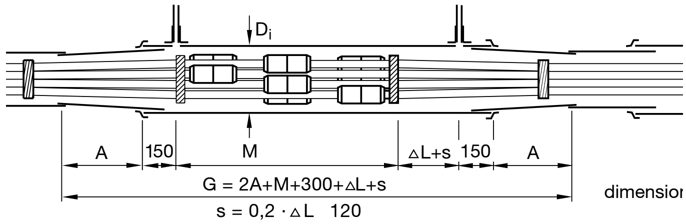
Details of the Coupler Zone

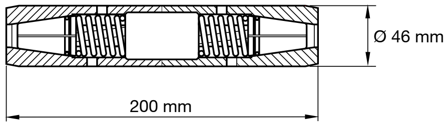
Type 0.5"	Ø 12.9mm, Ultimate Load 186kN Minimum Center Distance of Coupler R	Minimum Edge Distance of Coupler R	Length of Space for Installation
f_{pk} 1860			
[N/mm²]	[kN]	[mm]	[mm]
5909	330	190	1,500
5912	330	190	1,500
5915	350	200	1,500
5920	370	210	1,500
5927	430	240	1,700
5932	450	250	1,700
5937	490	270	1,700

Type 0.6"/0.62"	Ø 15.3/15.7mm, Ultimate Load 261/279kN Minimum Center Distance of Coupler R	Minimum Edge Distance of Coupler R	Length of Space for Installation
f_{pk} 1860			
[N/mm²]	[kN]	[mm]	[mm]
6805	310	180	1,500
6807	310	180	1,500
6809	330	190	1,500
6812	350	200	1,500
6815	370	210	1,500
6819	400	225	1,700
6822	450	250	1,700
6827	490	270	1,700
6831	550	300	2,000
6837	550	300	2,000

The center/edge distances and additional reinforcement for Coupler R are identical with those of the corresponding MA-anchorage.
Due to geometrical constraints the center/edge distances must not fall below the minimum values given in the tables.

Coupler D (Floating Coupler)





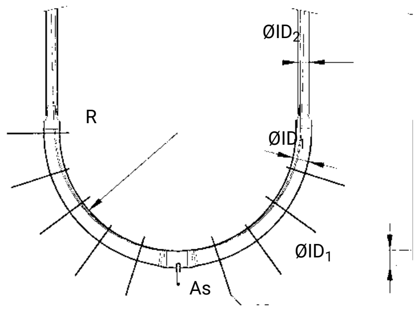
Technical Data

Type 0.5"	Ultimate Load Ø 12.9mm	Type 0.6"/0.62"	Ultimate Load Ø 15.3/15.7mm	A	M	Ø D_i
f_{pk} 1860	(186kN per strand)	f_{pk} 1860	(261/279kN per strand)			
[N/mm²]	[kN]	[N/mm²]	[kN]	[mm]	[mm]	[mm]
–	–	6803	837	150	900	100
5904	744	6804	1,116	200	600	110
5905	930	6805	1,395	250	900	120
5907	1,302	6807	1,953	300	900	125
5909	1,674	6809	2,511	350	900	140
5912	2,232	6812	3,348	450	900	160
5915	2,790	6815	4,185	500	900	180
–	–	6819	5,301	550	940	200
5920	3,720	6822	6,138	700	940	225
5927	5,022	6827	7,533	700	940	225
5932	5,952	6831	8,649	800	940	250
5937	6,882	6837	10,323	800	940	250

Details of the Coupler Zone

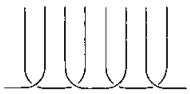
Type 0.5" f_{pk} 1860	Type 0.6"/0.62" f_{pk} 1860	Ø 12.9/15.3/15.7mm, Ultimate Load 186/261/279kN Center Distances Coupler to Coupler	Center Distances Duct to Coupler
[N/mm²]	[N/mm²]	[mm]	[mm]
–	6803	180	135
5904	6804	195	150
5905	6805	210	160
5907	6807	220	170
5909	6809	245	195
5912	6812	270	210
5915	6815	300	235
–	6819	325	255
5920	6822	365	280
5927	6827	375	295
5932	6831	420	325
5937	6837	420	335

Loop Anchorage HV



Technical Data

Type 0.5"	Ultimate Load Ø 12.9mm	Type 0.6"/0.62"	Ultimate Load Ø 15.7mm	ID1	ID2
f_{pk} 1860 [N/mm²]	(186kN per strand) [kN]	f_{pk} 1860 [N/mm²]	(279kN per strand) [kN]	[mm]	[mm]
5904	744	6803	837	50	40
5905	930	6804	1,116	55	45
5907	1,302	6805	1,395	60	50
5909	1,674	6807	1,953	75	60
5912	2,232	6809	2,511	85	75
5915	2,790	6812	3,348	95	80
5920	3,720	6815	4,185	110	90
5927	5,022	6819	5,301	120	95
5932	5,952	6822	6,138	130	100



Details of the Anchorage Zone for 28N/mm² (cube) / 23N/mm² (cylinder) Actual Concrete Strength at Stressing

Ø 12.9/15.3 mm, Ultimate Load 186/261kN			
Type 0.5"	Type 0.6"	R	As
f_{pk} 1860 [N/mm²]	f_{pk} 1860 [N/mm²]	[mm]	[mm]
5904	6803	750	12.5
5905	6804	750	16.5
5907	6805	750	21.0
5909	6807	750	29.0
5912	6809	900	37.5
5915	6812	1,100	50.0
5920	6815	1,250	62.5
5927	6819	1,500	79.0
5932	6822	1,700	91.5

Ø 15.7 mm, Ultimate Load 279kN		
Type 0.62"	R	A_S
f_{pk} 1860 [N/mm²]	[mm]	[mm]
6803	800	13.5
6804	800	18.0
6805	800	22.0
6807	800	31.0
6809	950	40.0
6812	1,150	53.5
6815	1,350	67.0
6819	1,600	85.0
6822	1,800	98.0

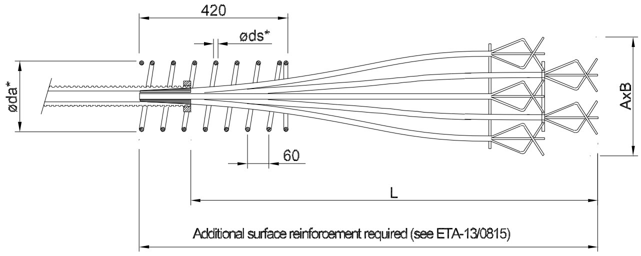
The radii given in the above tables apply for smooth metal duct. For corrugated metal duct the radius values must be doubled Ducts need to be pre-bent.

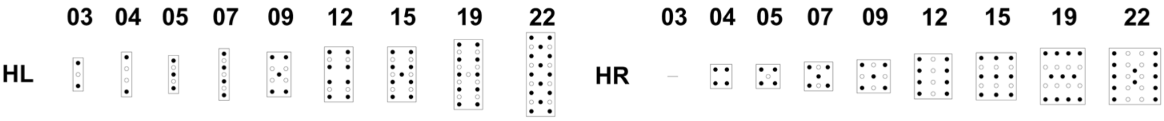
The values for the loop anchorage dimensions are based on European Technical Approval ETA-06/0022.

Application only in concrete members subject to static action. Tendons need to be stressed simultaneously at both ends.

Bond Head Anchorage HL/HR

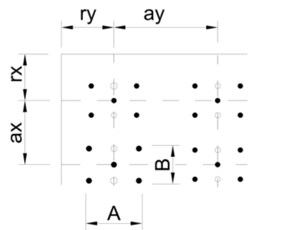
HR





Technical Data

Type 0.5"	Ultimate Load Ø 12.9mm	Type 0.6"/0.62"	Ultimate Load Ø 15.7mm	HL		HR		HL/HR
f_{pk} 1860	(186 kN per strand)	f_{pk} 1860	(279kN per strand)	A	B	A	B	L
[N/mm²]	[kN]	[N/mm²]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]
–	–	6803	837	290	90	–	–	1,250
5904	744	6804	1,116	390	90	210	190	1,250
5905	930	6805	1,395	330	90	210	210	1,250
5907	1,302	6807	1,953	450	90	250	250	1,250
5909	1,674	6809	2,511	390	210	290	290	1,250
5912	2,232	6812	3,348	480	250	390	330	1,250
5915	2,790	6815	4,185	480	250	410	350	1,250
5920	3,720	6819	5,301	610	250	490	390	1,250
–	–	6822	6,138	730	250	490	450	1,250



ax, ay = minimum centre distance
rx, ry = minimum edge distance

Details of the Anchorage Zone for 34N/mm² (cube) / 28N/mm² (cylinder) Actual Concrete Strength at Stressing

HL Ø12.9/15.3/15.7mm, Ultimate Load 186/261/279kN					
Type 0.5"	Type 0.6"/0.62"	Distances of the Anchorages		Additional Reinforcement Helix	
f_{pk} 1860	f_{pk} 1860	Center Distances	Edge Distances 1)	Ø d_a*	Ø d_s*
[N/mm²]	[N/mm²]	[mm]	[mm]	[mm]	[mm]
5903	6803	180/380	110/210	–	–
5904	6804	190/430	115/235	–	–
5905	6805	210/440	125/240	160	12
5907	6807	230/500	135/270	180	12
5909	6809	280/500	160/270	230	14
5912	6812	300/570	170/305	250	14
5915	6815	350/630	195/335	295	16
5919	6819	390/715	215/380	330	16
5920	6822	410/780	225/410	360	16

1) in case of 30mm concrete cover

HR Ø12.9/15.3/15.7mm, Ultimate Load 186/261/279kN					
Type 0.5"	Type 0.6"/0.62"	Distances of the Anchorages		Additional Reinforcement Helix	
f_{pk} 1860	f_{pk} 1860	Center Distances	Edge Distances 1)	Ø d_a*	Ø d_s*
[N/mm²]	[N/mm²]	[mm]	[mm]	[mm]	[mm]
5903	6803	–	–	–	–
5904	6804	285/285	165/165	–	–
5905	6805	305/305	175/175	160	12
5907	6807	340/340	190/190	180	12
5909	6809	375/375	210/210	230	14
5912	6812	390/440	215/240	250	14
5915	6815	460/475	250/260	295	16
5919	6819	525/525	285/285	330	16
5920	6822	570/560	305/300	360	16

1) in case of 30mm concrete cover

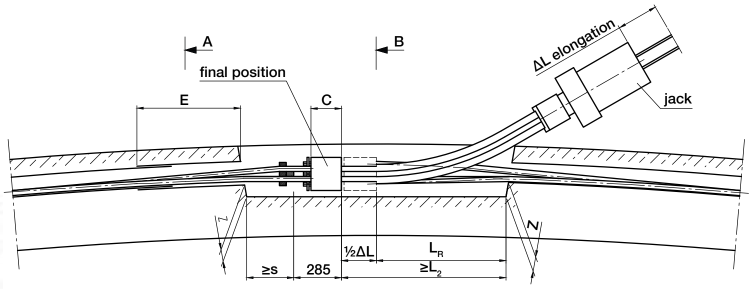
The values for the anchorage zones are based on European Technical Approval ETA-13/0815.

Max. prestressing load 75% of ultimate load (short-term overstressing to 80% is permissible).

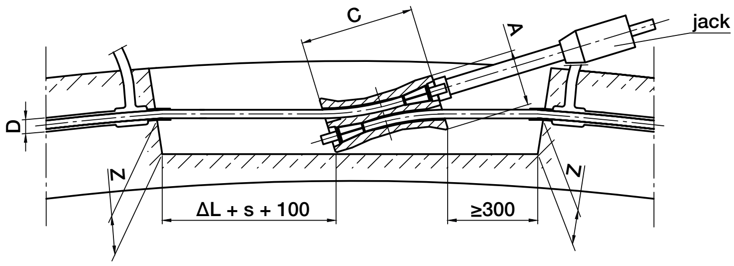
The respective standards and regulations valid at the place of use shall be complied with.

Coupler M/ME (Floating Anchorage Block)

Coupler M

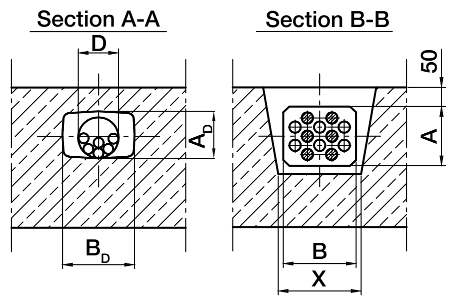


Coupler ME



Technical Data

Type 0.6"/0.62"	Ultimate Load Ø 15.3mm	Ultimate Load Ø 15.7mm	A	B	C	D	A_D	B_D	E
f_{pk} 1860	(261kN per strand)	(279kN per strand)							
[N/mm²]	[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
6801	261	279	98	55	200	20	–	–	–
6802	522	558	90	105	120	40	60	70	200
6804	1,043	1,116	130	160	120	55	70	130	650
6806	1,564	1,674	130	160	120	65	70	130	650
6808	2,086	2,232	130	210	120	75	70	170	1,050
6810	2,607	2,790	168	210	120	80	100	170	1,150
6812	3,129	3,348	168	210	120	80	100	170	1,150



Case 1: If $L_R \leq L_2 - {}^1/_2\, \Delta L$
then $L = s + 285mm + L_2$

Case 2: If $L_R > L_2 - {}^1/_2\, \Delta L$
then $L = s + 285mm + L_2 + {}^1/_2\, \Delta L$

$s = 0.2 \times {}^1/_2\, \Delta L \geq 120mm$

Max. prestressing load 70% of ultimate load (short-term overstressing to 75% is permissible). The respective standards and regulations valid at the place of use shall be complied with.

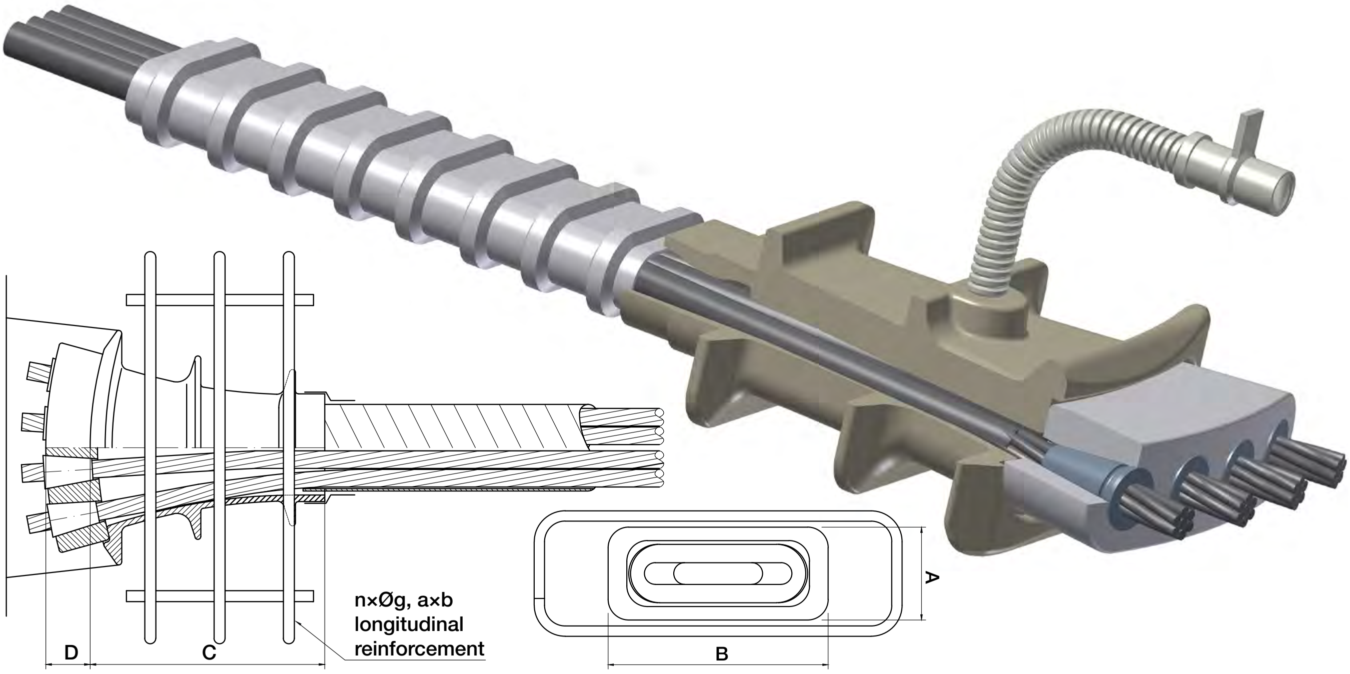
Details of Anchorage Zone

Ø 15.3/15.7mm, Ultimate Load 261/279 kN			
Type 0.6"/0.62"	X	Y	Z
f_{pk} 1860			
[N/mm²]	[mm]	[mm]	[mm]
6801	100	180	60
6802	130	155	50
6804	180	195	70
6806	180	195	70
6808	230	195	70
6810	230	235	90
6812	230	235	90

Block-Out Dimensions

Type 0.6"/0.62"	L_2	L_R
f_{pk} 1860		
[N/mm²]	[mm]	[mm]
6801	–	–
6802	550	550
6804	700	600
6806	700	600
6808	1,350	600
6810	1,500	800
6812	1,500	800

Flat Multiplane Anchorage FMA



Technical Data

Type 0.5"	Ultimate Load Ø 12.9mm	Type 0.6"/0.62"	Ultimate Load Ø 15.3/15.7mm	A	B	C	D
f_{pk} 1860 [N/mm²]	(186kN per strand) [kN]	f_{pk} 1860 [N/mm²]	(261/279kN per strand) [kN]	[mm]	[mm]	[mm]	[mm]
5903	558	6802	521	86	160	160	46
5905	930	6804	1,116	86	203	228	46
–	–	6805	1,395	86	268	231	46

Details of the Anchorage Zone for 25N/mm² (cube) / 20N/mm² (cylinder) Actual Concrete Strength at Stressing

Ø12.9/15.7mm, Ultimate Load 186/265kN					
Type 0.5"	Distances of the anchorages		Additional Reinforcement Stirrups		
f_{pk} 1860 [N/mm²]	Center Distance [mm]	min. slab thickness 1) [mm]	a x b [mm]	n	g [mm]
5903	200	200	180/140	3	12
5905	320	200	230/140	3	12

1) in case of 30mm concrete cover

Ø15.3/15.7mm, Ultimate Load 279kN					
Type 0.6"	Distances of the anchorages		Additional Reinforcement Stirrups		
f_{pk} 1860 [N/mm²]	Center Distance [mm]	min. slab thickness 1) [mm]	a x b [mm]	n	g [mm]
6802	200	200	160/140	3	12
6804	320	220	230/160	4	12
6805	400	220	310/160	4	12

1) in case of 30mm concrete cover

Max. prestressing load 75% of ultimate load (short-term overstressing to 80% is permissible). The values for the anchorage zones are based on requirements of FIP.

The respective standards and regulations valid at the place of use shall be complied with.

Equipment Overview

Jacks

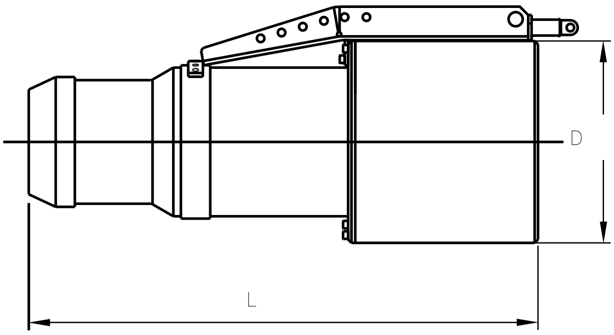
SM 240

HoZ 5,400

HoZ 6,800

	59 ..															68 ..																
Jack Type	01	02	03	04	05	06	07	08	09	12	15	20	27	32	37	01	02	03	04	05	06	07	08	09	10	12	15	19	22	27	31	37
SM 240	x															x																
HoZ 950/100		x	x	x	x												x	x	x													
HoZ 1,700/150						x	x	x	x											x	x	x										
HoZ 3,000/250										x	x												x	x	x	x						
HoZ 5,400/250												x	x													x	x	x	x			
6,800														x	x														x	x	x	
9,750																														x	x	x

Jacks for larger size tendons on request



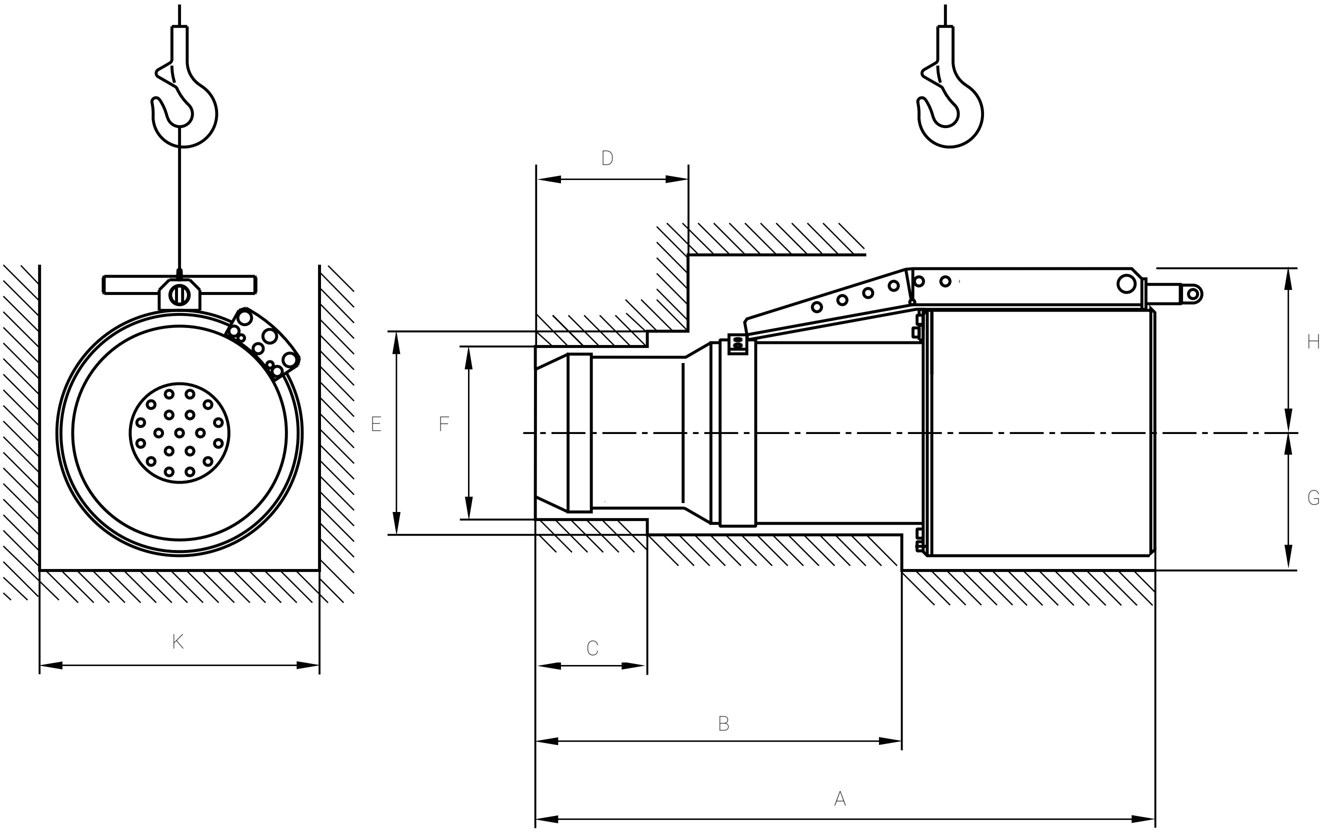
Technical Data

Jack Type1)	Length L	Diameter D	Stroke	Piston Area	Capacity2)	Weight
	[mm]	[mm]	[mm]	[cm²]	[kN]	kg
SM 240	950	98	200	47.13	240	19
HoZ 950/100	622	203	100	161.98	972	65
HoZ 1,700/150	858	280	150	298.45	1,745	160
HoZ 3,000/250	1,130	385	250	508.94	3,054	400
HoZ 5,400/250	1,215	482	250	894.57	5,367	600
6,800	1,150	560	300	1237.01	6,803	1,185
9,750	1,170	680	300	1772.45	9,748	1,770

1) power seating incl.
2) without friction

Jacks for larger size tendons (>6837) on request

Block-Out-Dimensions



Jack Type	A	B	C	D	E	F	G	H	K	L2)
SM 240	1,150 1)	350	–	80	100	–	70	150	140	500
HoZ 950/100	622	350	–	150	220	–	130	190	260	400
HoZ 1,700/150	858	490	180	–	270	230	170	220	340	600
HoZ 3,000/250	1,130	625	215	–	360	320	220	300	440	600
HoZ 5,400/250	1,215	700	200	300	420	360	270	350	540	800
6,800	1,450 1)	–	80	–	–	440	310	490	620	1,200
9,750	1,470 1)	–	90	–	–	480	370	550	740	1,200

1) stroke incl.
2) required strand protrusion

Block-Out-Dimensions and strand protrusion apply to jacks with power seating device.
Please contact DYWIDAG for dimensions for jacks without power seating device.

Equipment Overview

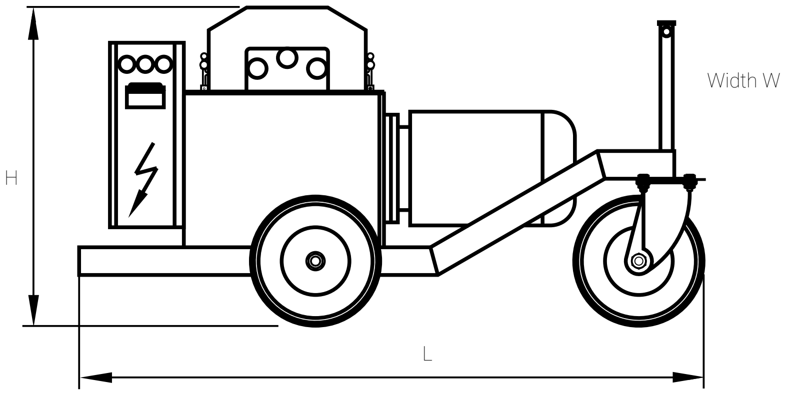
Hydraulic Pumps


77 - 193


R 6.4


R 11.2 - 11.2/210

Jacks	SM	HoZ	HoZ	HoZ	HoZ	6,800	9,750
Pumps	240	950	1,700	3,000	5,400		
77 - 193	x	x	x				
R 6.4	x	x	x	x			
R 11.2-11.2				x	x	x	x
R 11.2-11.2/210					x	x	x
ZP 57/28	for all pushing devices						



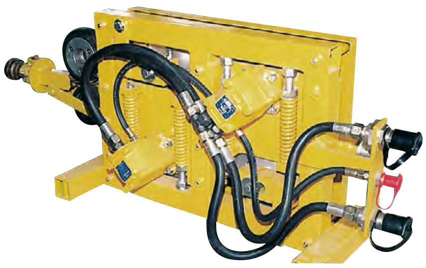
Technical Data

Pumps1)	Operation Pressure	Capacity V min	eff. Oil Amount	Weight	Dimensions L x W x H
	[MPa]	[l/min]	[l]	[kg]	[mm]
77-193	60	3.0	10.0	63	420/380/480
R 6.4	60	6.4	70.0	310	1,400/700/1,100
R 11.2-11.2	55 (60)	11.2/22.4	85.0	615	2,000/800/1,000
R 11.2-11.2/210	55 (60)	11.2/22.4	170.0	720	2,000/800/1,300
ZP 57/28	16	53/80	175.0	610	1,260/620/1,330

1) hydraulic pumps will be delivered without oil

Equipment Overview

Pushing Equipment



ESG 8 - 1

Type	Tensile or Compressive Force	Pushing Speed	Weight	Dimensions L x W x H	Hydraulic Pumps
	[kN]	[m/s]	[kg]	[mm]	–
ESG 8 - 1	3.9	6.1	140	1,400/350/510	ZP 57/28

Grouting Equipment (Mixing and Pumping)

MP 2,000 - 5

MP 4,000 - 2

ZMP 712 V

Grouting Equipment	max Injection Pressure	Capacity	Weight	Dimensions L x W x H
	[MPa]	[l/h]	[kg]	[mm]
MP 2,000 - 5	1.5	420	300	2,000/950/1,600
MP 4,000 - 2	1.5	1,500	580	2,040/1,040/1,750
ZMP 712 V	4.5	1,500	240	1,220/600/1,475

Calculation of Elongation

The stressing records are part of the structural design and serve as a basis for the stressing operation. Besides the prestressing data, they contain the sequence of stressing and directives for procedures directly connected with the stressing operation, such as lowering of the formwork and releasing of bearings.

Calculation of Strand Tendon Elongation according to DIN EN 1992-1-1 (Eurocode 2)

The total elongation ΔL_{tot} which the tendon has to achieve during stressing should be calculated as:

$$\Delta L_{tot} = \Delta L_p + \Delta L_c + \Delta L_{sl} + \Delta L_e$$

ΔL_p = elongation of the strand tendon [mm]

$$\Delta L_p = \frac{1}{A_p \cdot E_p} \cdot \int_0^{L_p} P_{x,0} \cdot d_x$$

L_p = length of tendon [m]

$P_{x,0}$ = prestressing force in the tendon at any point at distance x [kN]

$P_{x,0}$ = $P_0 \cdot e^{-\mu(\gamma_x + k \cdot L_p)}$

P_0 = prestressing force at the stressing anchorage [kN]

γ_x = $\sum$ angle of planned deflections between the stressing anchorage and any point at distance x [rad]

γ_x = $\frac{\pi}{180} \sum_i \sqrt{\alpha_{Vi}^2 + \alpha_{Hi}^2}$

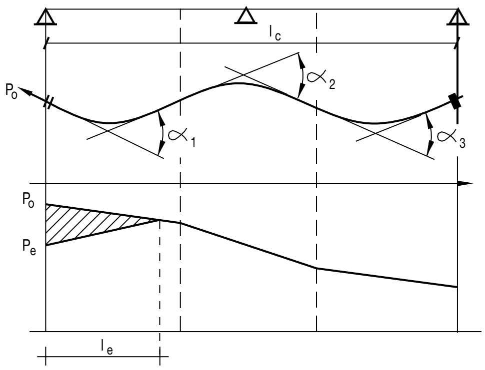
α_{Vi}, α_{Hi} = vertical and horizontal projections of the angle of i-th deflection [°]

μ = friction coefficient [rad^{-1}]

k = wobble coefficient [rad/m]

P_e = prestressing force at the stressing anchorage after wedge draw-in [kN]

A_p = cross sectional area of prestressing strands



ΔL_c = elastic deformation of the concrete (shortening must be treated as a positive value) [mm]

$$\Delta L_c = \frac{\sigma_{cm}}{E_c} \cdot L_c$$

σ_{cm} = average stress in the concrete cross section at the center of gravity of all tendons due to prestressing force [MN/m^2]

L_c = length of the concrete member [m]

ΔL_{sl} = sum of anchor plate impressions and wedge draw-in according to the anchorage/ coupling type applied [mm]

slip ΔL_{sl} [mm] anchorage	stressing anchorage	dead end anchorage	bond head anchorage	coupler R	coupler D	coupler M
accessible	1	4	–	–	–	4
not accessible	–	4	–	4	8	–

Values are based on prestressing force acc. to European Technical Approval

ΔL_e = elongation of the prestressing steel in the jack and seating device (if applicable) [mm]

Calculation of Elongation

Calculation of Prestressing Force P_e [kN] at Stressing Anchorage and Influence Length L_e [m]

due to wedge draw-in ΔL_n [mm] at stressing anchorage during lock-off of tensioning jack

$$L_e = \sqrt{\frac{\Delta L_n \cdot E_p \cdot A_p}{P_0 \cdot \mu \cdot \hat{\gamma}_1}}$$

$\hat{\gamma}_1$ = average angle of deflection along the influence length L_e of tendon behind the stressing anchorage [rad/m]

$$P_e = P_0 \cdot (1 - 2 \cdot L_e \cdot \mu \cdot \mathbf{g}_1)$$

draw-in slip ΔL_n [mm]	tendon type	jack type	
		standard case	special case
at the stressing anchorage	6803 - 6837	3*	6**
at the coupler M	6802 - 6812	8	–

values are based on prestressing force acc. to European Technical Approval
*) with wedge seating **) without wedge seating

modulus of elasticity [N/mm²]

concrete class	C 20/25	C 30/37	C 40/50	C 50/60
E_{cm}	29	32	35	37

strand E_p = 195,000 [N/mm²]

Bridges

Westrand Motorway, Amsterdam, Netherlands

DYWIDAG Services:

- Production
- Supply
- Installation

DYWIDAG Systems:

Ø15.7mm St 1860
DYWIDAG Multistrand Tendons

Rudavoi Bridge, Federal Road No. 48, Cortina d'Ampezzo, Italy

DYWIDAG Services:

- Production
- Supply

DYWIDAG Systems:

103t of 19-0.6" and 12-0.6", St 1860
DYWIDAG Multistrand Tendons

Talbruecke Bergen, A8 Motorway, Bergen, Germany

DYWIDAG Services:

- Production
- Supply
- Installation

DYWIDAG Systems:

500t of Type 19-0.62" Strand Tendons, 83t of 4-0.62" Monostrand Tendons and 117t of Wire-EX 66 Tendons

References

The Marina Bayfront Bridge, Singapore

DYWIDAG Services:
- Production
- Supply
- Installation

DYWIDAG Systems:

Type 12-0.6" internal, 19-0.6" and 27-0.6" external DYWIDAG Multistrand Tendons

Jurong East Modification Project, Singapore

DYWIDAG Services:
- Production
- Supply
- Installation

DYWIDAG Systems:

Type 7-0.6", 12-0.6", 19-0.6" and 22-0.6" DYWIDAG Multistrand Tendons with MA Anchorages as well as Ø47mm DYWIDAG Bars

Kyogbu High Speed Railway, Kimcheon, South Korea

DYWIDAG Services:
- Production
- Supply
- Technical Support

DYWIDAG Systems:

3,168 internal and 1,464 external MA Anchorages Type 22-0.6"; rental of equipment

St. Anthony Falls Bridge, Minneapolis, Maine, USA

DYWIDAG Services:
- Production
- Supply
- Installation
- Engineering Services

DYWIDAG Systems:

Supply of 1,300km 0.6" 270k strand tendons; 4,100 Anchorages; 9,000m *GEWI*® Bars and hardware for formwork 57,000m 63mm *GEWI*® Bars with hardware for reinforcement Post-Tensioning installation, stressing, and grouting equipment

Victory Bridge replacement, Perth Amboy, New Jersey, USA

DYWIDAG Services:
- Production
- Supply

DYWIDAG Systems:

Supply of 9,168 Anchorages for epoxy-coated strand, 1,126t 0.6" bare and 196t 0.6"epoxy coated strands for strand tendons, 110t DYWIDAG THREADBAR®; rental of technical equipment, stressing and grouting of PT tendons

The Canada Lin, Vancouver/Richmond, British Columbia, Canada

DYWIDAG Services:
- Production
- Supply

DYWIDAG Systems:

Supply of 374 type 27-0,6", 2.294 type 19-0,6" and 421 type 12-0,6" anchorages and duct; rental of equipment

References

Lake Champlain Bridge, Crown Point, New York, USA

DYWIDAG Services:
- Production
- Supply
- Installation

DYWIDAG Systems:

Supply of DYWIDAG Multistrand Tendons for the bridge deck and 64 DYNA Grip® Stay Cables 7-0.6"

Veterans Memorial Bridge, Portland, Maine, USA

DYWIDAG Services:
- Production
- Supply

DYWIDAG Systems:

Supply of 318 DYWIDAG Strand Tendons, 19-0.6",196 DYWIDAG Strand Tendons, 27-0.6", with MA Anchorages, 3,000 4-0.6" DYWIDAG Strand Anchors and of 70t of Ø36mm DYWIDAG Post-Tensioning Bars incl. accessories and ducts; rental of equipment

Highlands-Sea Bright Bridge, Monmouth County, New Jersey, USA

DYWIDAG Services:
- Production
- Supply
- Technical Support

DYWIDAG Systems:

Supply of 615t of types 4-0.6", 12-0.6", 15-0.6", 19-0.6" and 27-0.6" Ø15mm DYWIDAG Multistrand Tendons (120 t of which were epoxy coated); 81.5t of Ø36mm (1-3/8") Post-Tensioning Tendons; technical assistance on site

Commercial Buildings

Las Vegas CityCenter, Las Vegas, Nevada, USA

DYWIDAG Services:
- Production
- Supply
- Installation

DYWIDAG Systems:

Supply and installation of 33 Type 27-0.6" DYWIDAG Multistrand Tendons, approx. 2,723km (8,883,892ft) of Type 0.6" Strand and approx. 640m (2,100ft) of galvanized 110mm ducts; approx. 610m (2,000ft) of Galvanized Barrier Cable

Water Tanks, Al Jahra, Kuwait City, Kuwait

DYWIDAG Services:
- Production
- Supply

DYWIDAG Systems:

Supply of 396 6-0.5" DYWIDAG Ring Tendons with anchorages; sale of equipment

References

Gardens by the Bay, Singapore

DYWIDAG Services:
- Design
- Production
- Supply
- Installation

DYWIDAG Systems:

Supply of Type 0.6" DYWIDAG Multistrand Systems with 12, 15 and 19 strands

Al Ahwar Complex, Amman, Jordan

DYWIDAG Services:
- Production
- Supply
- Technical Support

DYWIDAG Systems:

Type 3-0.5" and 5-0.5" MA Anchorages; supply of Type SM 240 kN Monostrand Jack and hydraulic pump Type 77-193

Building Material City (BMC), Abu Dhabi, U. A. E.

DYWIDAG Services:
- Design
- Production
- Supply
- Installation

DYWIDAG Systems:

Supply of 4,700 Type FMA 3-0.5" and 5-0.5" DYWIDAG Flat Multiplane Anchorages

References

Tanks

LNG Tanks, Snøhvit project, Melkøya Island, Norway

DYWIDAG Services:
- Production
- Supply
- Installation

DYWIDAG Systems:
Supply of 1,650t vertical and horizontal DYWIDAG Multistrand Tendons Type 12-0.6" and 22-0.6" MA, St 1860 with accessories

LNG Tanks, Sagunto, Valencia, Spain

DYWIDAG Services:
- Production
- Supply
- Technical Support

DYWIDAG Systems:
Supply and installation of 1,300t of 9- and 19-0.62" DYWIDAG Multistrand Tendons; Supply of 9,312m *GEWI*® Threadbars 28mm with accessories; Rental of technical equipment

Sewage Plant, Dueren, Germany

DYWIDAG Services:
- Production
- Supply
- Installation
- Technical Support

DYWIDAG Systems:
Supply and installation of 108t of prefabricated Strand Tendons with 2- to 9-0.6" strands as well as anchorages and anchor plates

LNG Tanks, Incheon, South Korea

DYWIDAG Services:
- Production
- Supply
- Technical Support

DYWIDAG Systems:

Supply of DYWIDAG Multistrand Tendons with anchorages and accessories, cryogenic *GEWI*® bars; rental of technical equipment

LNG Export Terminal, Bal Haf, Yemen

DYWIDAG Services:
- Production
- Supply

DYWIDAG Systems:

Supply of 49,000m DYWIDAG Multistrand Tendons including anchorages and accessories, 48t cryogenic *GEWI*® Threadbars 28mm grade 500/550, 118t *GEWI*® Threadbars 32mm grade 500/550

Qatar Gas II Plant, Ras Laffan , Qatar

DYWIDAG Services:
- Production
- Supply
- Technical Support

DYWIDAG Systems:

Supply of 3,360t DYWIDAG Multistrand Tendons, type MA 12-0.62" and 9-0.62"ring tendons; rental of technical equipment

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www.dywidag-group.com