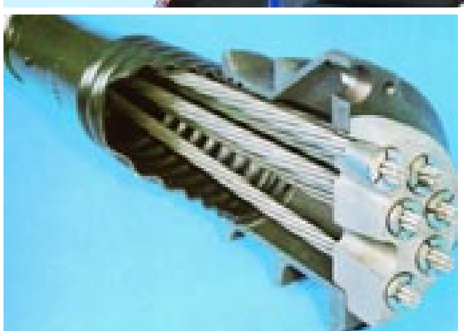
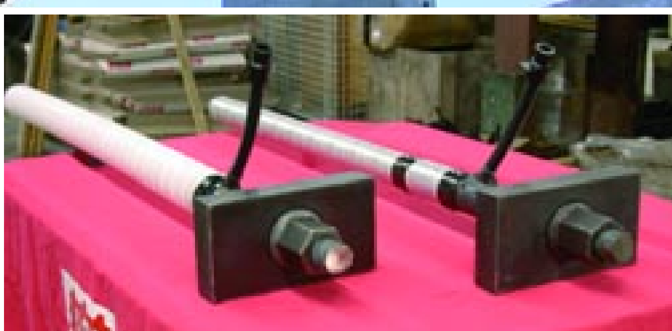
DYWIDAG-SYSTEMS INTERNATIONAL

DYWIDAG Post-Tensioning Systems
Multistrand Systems
Bar Systems
Repair and Strengthening





New Victory Bridge, Perth Amboy, NJ

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

Perth Amboy, NJ

The first ever structure built with a prototype DYWIDAG Post-Tensioning System using bars was the Alsleben (Germany) arch-bridge in 1927. From that time on DYWIDAG has continuously improved its systems to keep up with the growing demand of modern construction technology. DYWIDAG-Systems International (DSI) offers a complete product line in strand and bar post-tensioning (bonded, unbonded and external) as well as stay-cables being able to fully serve the post-tensioning construction industry. DYWIDAG Post-Tensioning Systems have always combined the highest safety and reliability standards with the most economical efficiency in their research and development. Dependable corrosion protection methods incorporated into the DYWIDAG Post-Tensioning Systems contribute to the longevity of modern construction. High fatigue resistance is achieved with optimized material selection and careful detailing of all components especially in their system assembly.

DSI looks 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 field equipment which is easy to operate in all phases of installation including assembly, installation, stressing and finally grouting.

DYWIDAG Post-Tensioning Systems are being developed and maintained by DYWIDAG-Systems International and are serviced and distributed by a worldwide network of subsidiaries, licensees and agents. Our systems comply with the different national and international specifications and recommendations (ASTM, AASHTO, BS, Eurocode, DIN, Austrian Code, SIA, FIP, fib, EOTA, etc.).

Woodrow Wilson Bridge, Virginia Approach, Alexandria, VA

DSI Scope of Services:

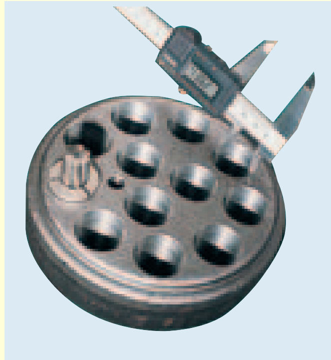
- consulting
- design and shop-drawing engineering
- manufacturing and supply
- installation or training and/or supervision of installation
- inspection and maintenance

Water Tanks, FL

Contents

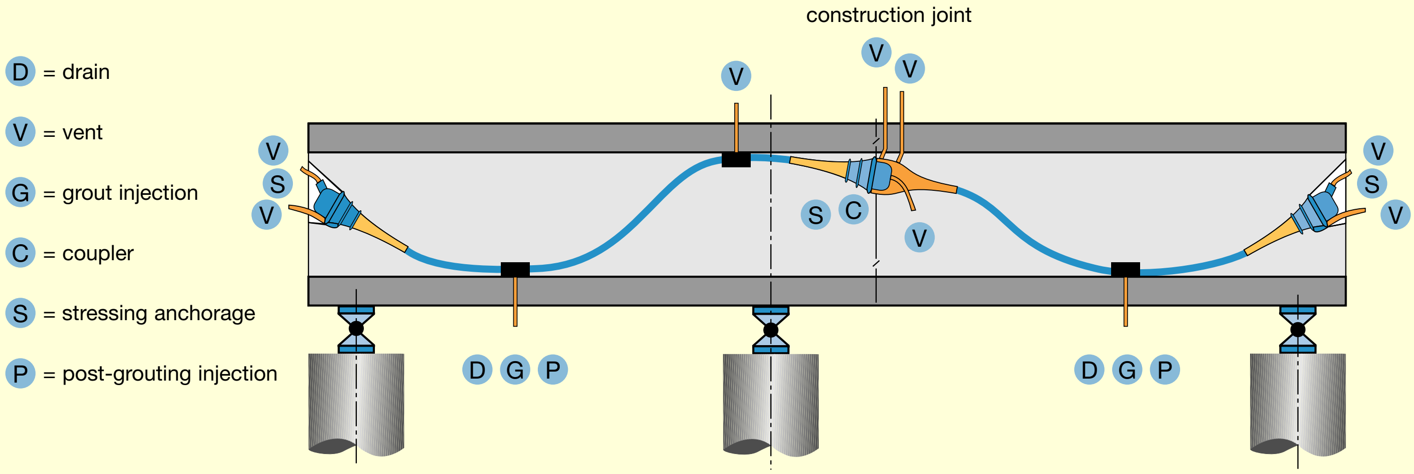
6th Street Bridge
Milwaukee, Wisconsin

Strand is manufactured from 7 individual cold-drawn wires, 6 outer wires helically wound around one center wire (king wire). The mechanical properties of the strand as well as it's corrosion protection are most important to DSI. Strand coatings do not affect the anchorage's capacity or efficiency. For improved corrosion protection we offer systems using polyethylene (PE) or polypropylene (PP) ducts.
See page 6.



Strand is normally packaged in calwrap coils that typically weigh up to 3.2 tons.

Epoxy Coated Strand



▶ Technical Data

code/specification		ASTM A 416			ASTM A 416	
type		0.5" (13 mm)	0.6" (15 mm)		0.5" (13 mm)	0.6" (15 mm)
yield strength f_y [1]	(ksi)	243	243	(N/mm²)	1,670	1,670
ultimate strength f_u	(ksi)	270	270	(N/mm²)	1,860	1,860
nom. diameter	(in)	0.5	0.6	(mm)	12.7	15.24
cross-sectional area	(in2)	0.153	0.217	(mm²)	98.71	140
weight	(lbs/ft)	0.52	0.74	(kg/m)	0.775	1.102
ultimate load	(kips)	41.3	58.6	(kN)	183.7	260.7
modulus of elasticity	(ksi)	28,000	28,000	(N/mm²)	195,000	195,000
relaxation after [2]						
1,000 h at 0.7 x 9013	(%)	2.5	2.5	(%)	2.5	2.5

[1] yield measured at 1% extension under load
[2] applicable for relaxation class 2 according to Eurocode prEN 10138/BS 5896: or low relaxation complying with ASTM A 416, respectively.

Epoxy coated strand used in the DYWIDAG Post-Tensioning Systems is Flo-Fill® where the interstices are filled with epoxy during the coating process providing exceptional corrosion protection. The epoxy coated strand conforms to ASTM A 882 with either a smooth or grit impregnated surface.

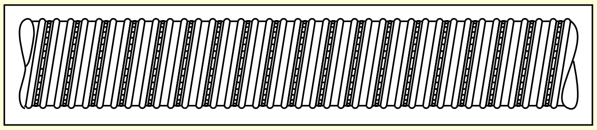
Corrugated Duct

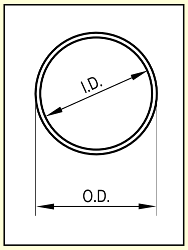
Corrugated metal ducts are the most economical means to create a void for the tensile elements. These thin-walled galvanized corrugated 28ga/0.38 mm - 24ga/0.61 mm sheet metal ducts also provide a secondary corrosion protection with excellent bond behavior between tendon grout and concrete. Primary corrosion protection is provided by the alkalinity of the grout and concrete.

Dimensions of Corrugated Metal Duct (Standard Sizes)

tendon type 0.5"	tendon type 0.6"	sheathing I.D.	sheathing O.D.
		in/mm	in/mm
5907	6805	2/50	2.15/54.6
5909	6807	2.375/60	2.6/66
5912	6809	3.12/80	3.31/84
5915	6812	3.52/90	3.7/94
5920	6815	3.63/93	3.82/97
5927	6819	4/100	4.19/106.3
5937	6827	4.6/117	4.78/121.4
	6837	5.26/134	5.45/138.4

The tendon type number (e.g. 5904, 6807) is composed as follows: the first digit (5 or 6) identifies the nominal strand diameter in tenths of an inch, i.e. 0.5" or 0.6", the last two digits (..07) reference the number of used strands (= 7 strands). The second digit is an internal code.





tendon type 0.5"	tendon type 0.6"	min. center distances	support distances up to
		in/mm	ft/m
5904	6804	3.90/99	5.91/1.8
5905	6805	4.25/108	5.91/1.8
5907	6806	4.61/117	5.91/1.8
5909	6807	4.61/117	5.91/1.8
5912	6809	4.61/117	5.91/1.8
5915	6812	5.67/144	5.91/1.8
5920	6815	6.38/162	5.91/1.8
5927	6819	6.73/171	5.91/1.8
5937	6827	7.80/198	5.91/1.8
–	6837	9.25/235	5.91/1.8

PE/PP Round Duct

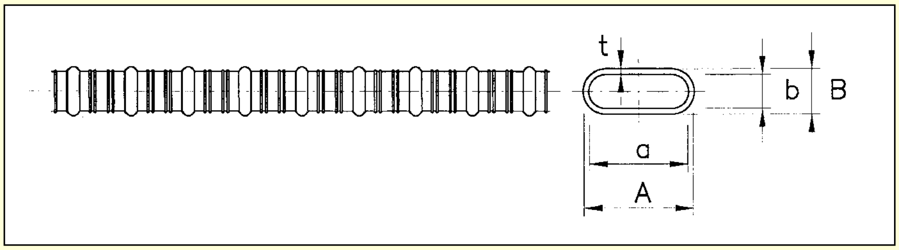
Thick-walled polyethylene / polypropylene (PPEX3) plastic ducts provide long-term secondary corrosion protection especially in aggressive environments such as waste water treatment plants, acid tanks or silos.

DYWIDAG-Systems International offers polyethylene/polypropylene (PPEX3) ducts in straight lengths up to 80 feet for all sizes. Standard shipping length is 40 feet. Longer lengths in coils are available for all sizes except 130 mm.

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

tendon type	tendon type	sheathing		wall thickness
		I.D.	O.D.	
0.5"	0.6"	in/mm	in/mm	in/mm
5907	6805	2.32/59	2.874/73	.079/2
5909	6807	2.32/59	2.874/73	.079/2
5912	6809	2.99/76	3.58/91	.1/2.54
5915	6812	3.31/84	3.95/100	.1/2.54
5920	6815	3.93/100	4.53/115	.1/2.54
5927	6819	3.93/100	4.53/115	.1/2.54
5937	6827	4.55/115	5.36/136	.14/3.56
	6837	5.12/130	5.96/151	.14/3.56

Flat PE/PP Duct



type	tendon type	A	B	a	b	wall thickness
	0.6"	(in/mm)	(in/mm)	(in/mm)	(in/mm)	(in/mm)
flat duct	6804	3.55/90.2	1.55/39.5	3.15/80	1.14/29	.079/2

subject to modification, April 2006

Multiplane Anchorage MA

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

The wedge plate and compact conical anchor body with three load transfer planes introduces the prestressing force gradually into the concrete member.

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 accurate installation as well as trouble-free stressing. The anchorage is also suitable for cryogenic application (LNG-tanks).

The six bolt hole pattern in the anchor body is designed to accept a permanent plastic cap. Multiple grout ports allow for post grout inspection.

System 100

System 100

stressing anchorage	dead end anchorage accessible	dead end anchorage not accessible	coupling	ultimate load [kips/kN] from	ultimate load [kips/kN] to
✔	✔	✔	✔	287/1,302	2,168/9,644

pocket former for each anchorage system on request

Plate Anchorage SD

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

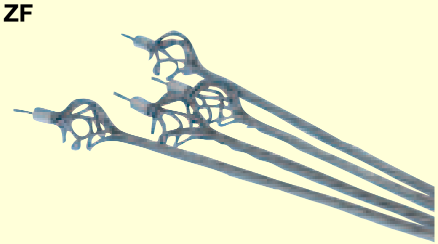
stressing anchorage	dead end anchorage accessible	dead end anchorage not accessible	coupling	ultimate load [kips/kN]
✔	✔	✔	N/A	1,040.8/234

pocket former for each anchorage system on request

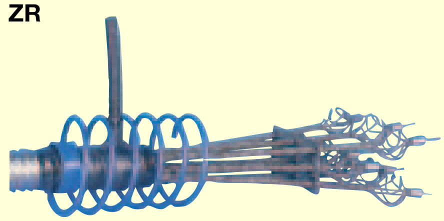
Bond Head Anchorage ZF/ZR

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

ZF



ZR



stressing anchorage	dead end anchorage accessible	dead end anchorage not accessible	coupling	ultimate load (0.5) [kips/kN] from	ultimate load (0.5) [kips/kN] to	ultimate load (0.6) [kips/kN] from	ultimate load (0.6) [kips/kN] to
–	–	✔	–	41.3/184	1,115/4,961	58.6/261	1,582/7,037

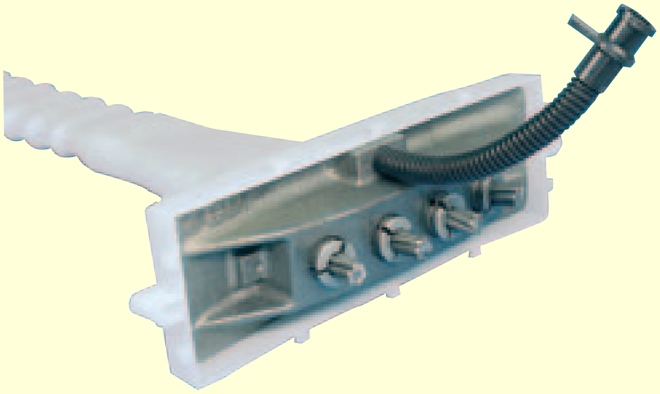
Loop Anchorage HV

Often used in large plate-shaped structures, walls, piers or LNG tanks. The 180° loop should be positioned in the center of the tendon to minimize movement of the strand within the loop during simultaneous two-end stressing.

stressing anchorage	dead end anchorage accessible	dead end anchorage not accessible	coupling	ultimate load [kips/kN] from	ultimate load [kips/kN] to
–	–	✔	–	82/372	1.169/5,301

Flat Anchorage FA

The 3-0.6" and 4-0.6" Flat Anchorage provides strands in one plane with a trumpet to deviate the strands into an oval duct. The Flat Anchorage is designed to be installed in thin members such as transverse post-tensioning of bridge decks and prestressed flat slabs.

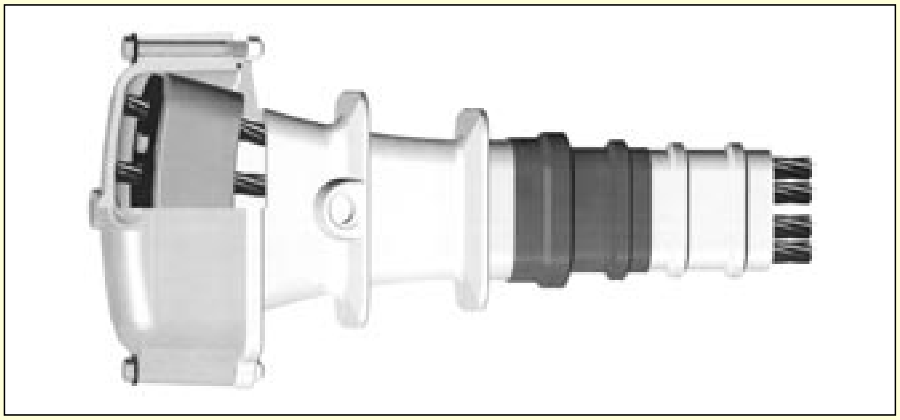


stressing anchorage	dead end anchorage accessible	dead end anchorage not accessible	coupling	ultimate load [kips/kN] from	ultimate load [kips/kN] to
✔	✔	✔	–	175/782	234/1043

pocket former for each anchorage system on request

Flat Anchorage System 100

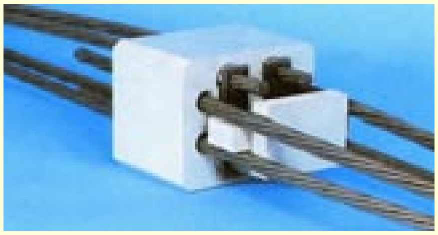
The two part multiplane anchorage is designed primarily for bridge transverse post-tensioning. The System 100 meets the Florida Department Of Transportation specifications regarding corrosion protection.



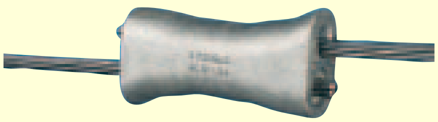
Coupler M/ME (Floating Anchorage Block)

Cylindrical 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 overlap within the block. The ring-tendon is very compact and requires a small pocket. Stressing is performed using conventional jacks and a curved jack nose.

M



ME



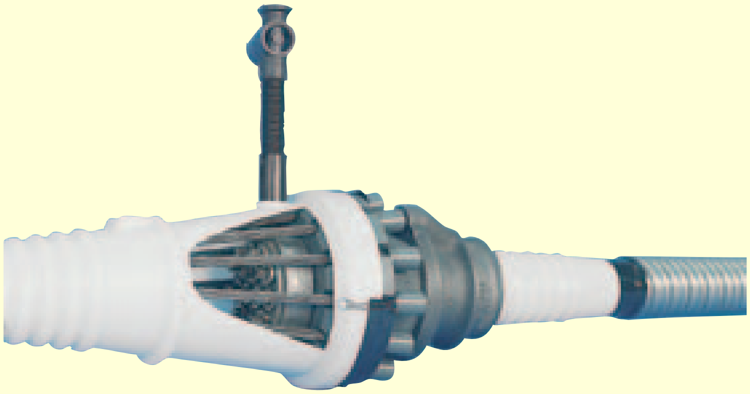
stressing anchorage	dead end anchorage accessible	dead end anchorage not accessible	coupling	ultimate load [kips/kN] from	ultimate load [kips/kN] to
✔	✔	–	–	62/279	738/3,348

pocket former for each anchorage system on request
M anchorage available in 2, 4, 6, 8 and 12-0.6 Versions

Coupler P

P Coupler consists of a multiplane anchorage body, a standard wedge plate and a coupler ring that accepts the continuing strands with swaged anchorages instead of wedges.

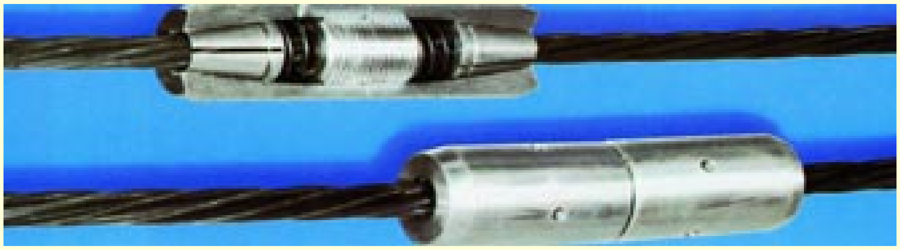
The Coupler P is available in 5, 9, 12, 15, 19 and 27-0.6 versions.



fixed coupler	floating coupler	ultimate load [kips/kN] from	ultimate load [kips/kN] to
✔	–	293/1303	1113/4953

Coupler D

The D Coupler is used to lengthen unstressed tendons in segmental bridge construction. The coupler consists of two spring-loaded wedges that connect two strands individually.



fixed coupler	floating coupler	ultimate load [kips/kN] from
–	✔	58.6/261

Available Anchorage Types

Tendon Type 59… (0.5" system)

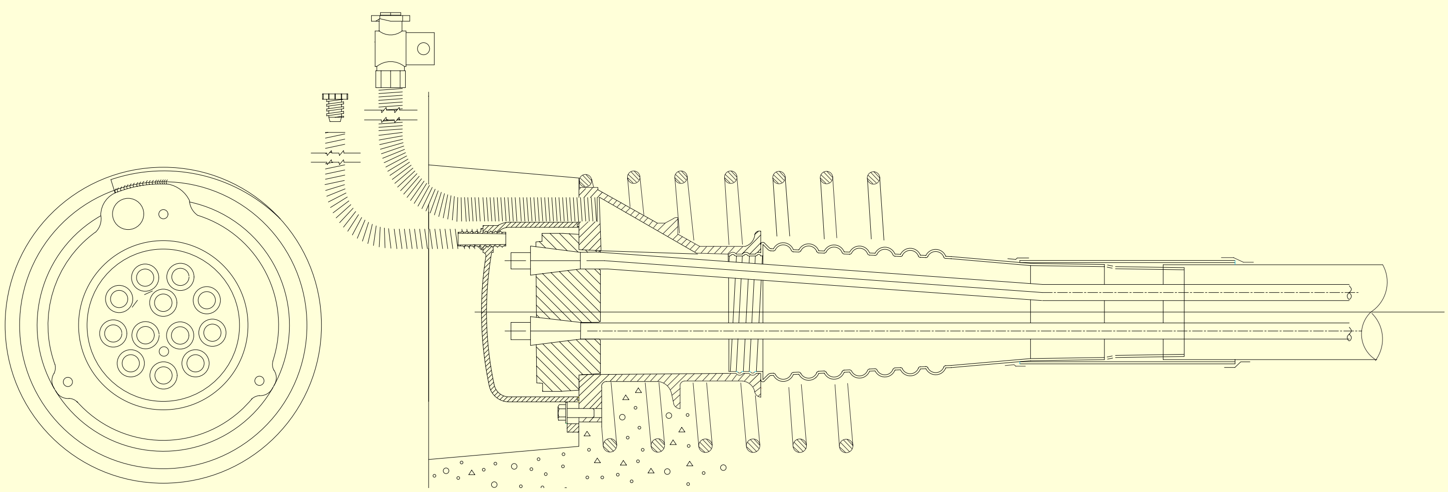
59…	01	02	03	04	05	06	07	08	09	12	15	20	27	37
Anchorage Type														
Multiplane Anchorage MA							●		●	●	●		●	●
Plate Anchorage SD				●										
Bond Head Anchorage ZF/ZR	●		●	●	●	●	●	●	●	●	●	●	●	
Loop Anchorage HV		●	●	●	●	●	●	●	●	●	●	●	●	●
Coupler D	●													

Other size tendons on request
Plate Anchor SD and Flat Anchor FA use 0.5" Jumbo Wedge

Tendon Type 68… (0.6" system)

68…	01	02	03	04	05	06	07	08	09	12	15	19	27	37
Anchorage Type														
Multiplane Anchorage MA					●		●		●	●	●	●	●	●
Plate Anchorage SD				●										
Mono Anchorage EV	●													
Bond Head Anchorage ZF/ZR	●		●	●	●	●	●		●	●	●	●	●	
Loop Anchorage HV		●	●	●	●	●	●		●	●	●	●	●	●
Flat Anchorage FA			●	●										
Coupler M and ME (Floating Anchorage)		●		●		●		●		●				
Coupler P					●				●	●	●	●	●	
Coupler D	●													

Other size tendons on request



System drawings are available on request for each type anchorage showing details and assembly instructions. System 100 castings supplied with 6 bolt holes for installation of permanent plastic cap.

Installation

DYWIDAG-Systems International utilizes two different methods to insert strands into ducts. The installation method depends on the access conditions of the structure and the job site.

Uncoiling Cages

Method 1: Pushing

Pushing 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 a flexible pipe connected to the insertion point. DSI strand pushers provide relatively high speeds of up to 25 ft/s (8 m/s) and require minimal operating personnel. These advantages make pushing the preferred method for strand installation.

Strand Pusher

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 most cases the entire bundle of strands is pulled through the duct using a winch with a steel cable.

Pre-Assembled Tendons

The prefabrication of tendons either in the shop or in the field can be very economical when the tendons are short and the location of the job site is close. Special uncoilers and hydraulic winches are usually required to properly install the tendons in the structure.

Stressing

DYWIDAG has developed a series of jacks and hydraulic pumps in order to efficiently and economically stress its tendons. Versatility is provided by changing devices that make one unit adaptable for many different tendon sizes. DYWIDAG jacks have capacities ranging from 56/250 kips/kN up to 2,191/9,750 kips/kN.

DYWIDAG jacks are highly sophisticated, but still easy to operate. They employ inner tube bundles with automatic gripping devices that guide the strand safely through the inside of the jack. This feature makes it possible to control the stressing operation with the highest degree of reliability. Minimal wedge seating losses can be achieved with the power seating option. Power seating hydraulically seats the wedges with a predetermined load, individually and simultaneously, rather than relying simply on friction seating. DYWIDAG jacks also make it possible to overstress and release a tendon to compensate for friction losses and maximize the stress level over the tendon length.

Every jack has a pressure relief valve that safely limits hydraulic pressure to prevent overload. To verify the stressing operation a gauge port is provided directly on the jack.

Stressed tendons can be safely destressed by employing special wedges and a special jack configuration. Hydraulic pumps are generally equipped with a convenient remote control device. Further information concerning the equipment is provided on page 19 to 21.

Jack HoZ 4,000

Tensa 4,800

Hydraulic pump

Some important notes concerning the safe handling of high strength strand for prestressed concrete:

1. Do not damage surface of the strand.
2. Do not weld or burn so that sparks or hot slag will touch any portion of the strand which will be under stress.
3. Do not use any part of the strand as a ground connection for welding.
4. Do not use strand that has been kinked or contains a sharp bend.

Disregard of these instructions may cause failure of material during stressing.

Grouting

Mixing and pumping equipment

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

DYWIDAG has developed grouting methods 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.

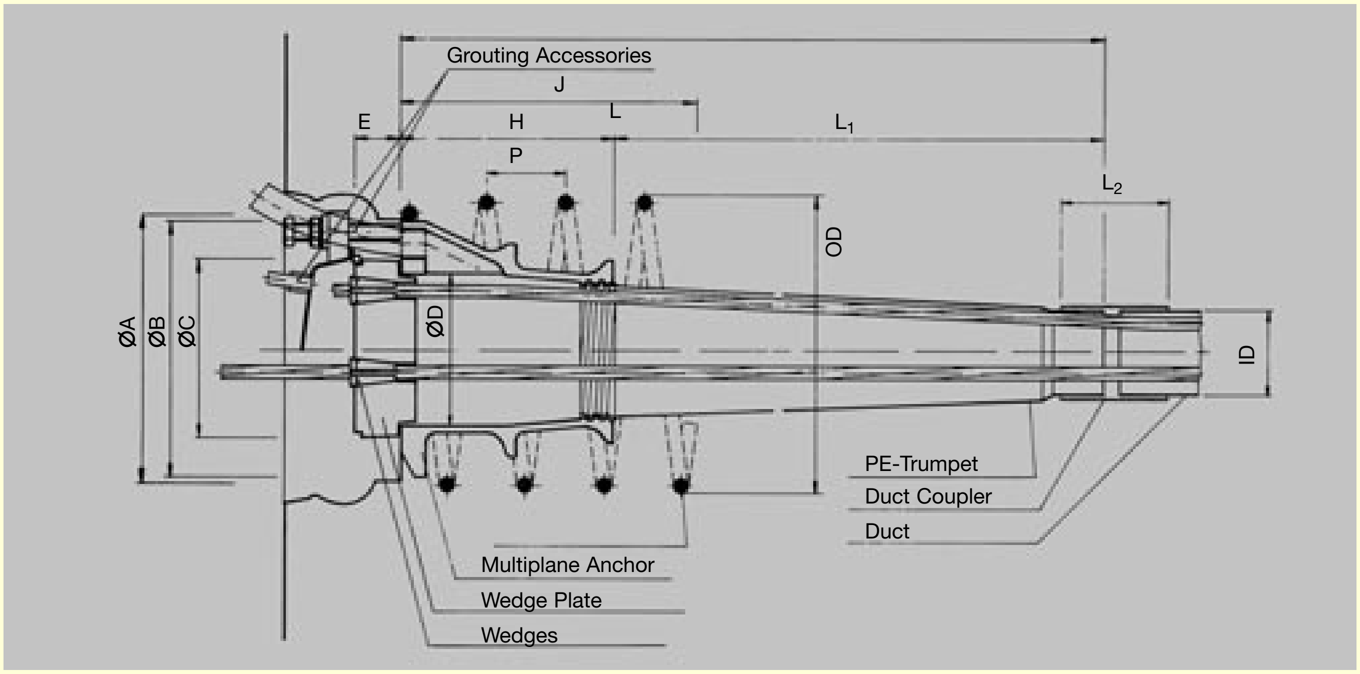
Grouting is always done from a low-point of the tendon. This can be one of the anchorages where a grout cap with grout hose is the port for the grout or along the tendon utilizing an intermediate grout saddle. All grouting components are threaded for easy, fast and positive connection.

Venting operation

Mixing and pumping

Vacuum grouting

Multiplane Anchorage MA

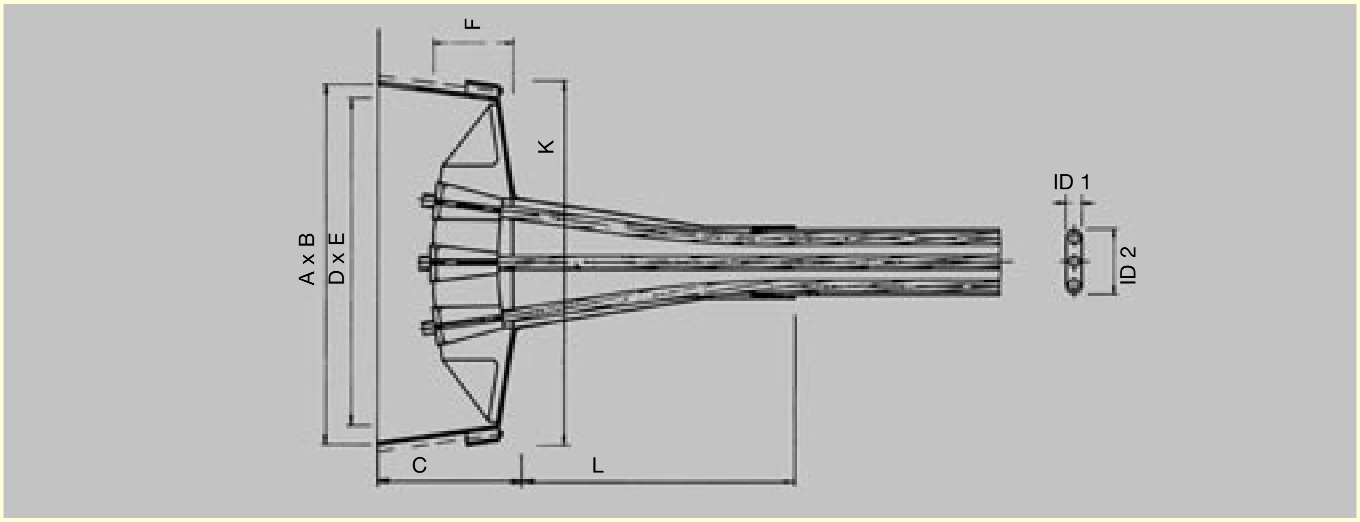


▶ Technical Data

Anchorage Size		5-0.6" or 7-0.5"	7-0.6" or 9-0.5"	9-0.6" or 12-0.5"	12-0.6" or 15-0.5"	15-0.6" or 20-0.5"	19-0.6" or 27-0.5"	27-0.6" or 37-0.5"	37-0.6"
Min. Block-out Dia.	A	7 \ 179	8 \ 203	9 \ 229	10 \ 254	11 \ 279	12 \ 305	13-1/2 \ 343	16 \ 407
Transition Length		12-3/8 \ 314	13-7/16 \ 341	15-3/4 \ 400	20 \ 508	22-5/8 \ 575	25-3/16 \ 640	27-5/8 \ 702	35 \ 890
Anchor Dia.	B	5-15/16 \ 150	6-11/16 \ 170	7-1/2 \ 190	8-5/8 \ 220	9-7/8 \ 250	11 \ 280	12-3/8 \ 315	14-1/8 \ 360
	D	3-9/16 \ 90	3-7/8 \ 98	4-7/16 \ 113	5-1/16 \ 128	5-13/16 \ 148	6-3/8 \ 162	7-1/2 \ 190	8-1/2 \ 220
	H	3-9/16 \ 90	3-15/16 \ 100	4-15/16 \ 125	7-1/16 \ 180	7-7/8 \ 200	8-5/8 \ 220	9-7/16 \ 240	12-1/2 \ 320
Wedge Plate	C	5-1/8 \ 130	5-1/8 \ 130	5 1/2 \ 140	6-5/16 \ 160	7-1/16 \ 180	7-7/8 \ 200	9-7/16 \ 240	10-2/3 \ 270
	E	2 \ 50	1-9/16 \ 40	1-11/16 \ 43	1-11/16 \ 43	2 \ 50	2-3/16 \ 55	2-15/16 \ 75	3-1/2 \ 90
Trumpet	L1	8-7/8 \ 225	9-1/2 \ 241	10-13/16 \ 275	12-7/8 \ 327	14-3/4 \ 375	16-1/2 \ 419	18-1/8 \ 460	22-1/2 \ 600
Rebar Spiral*	Size	# 4 \ 15M	# 4 \ 15M	# 4 \ 15M	# 5 \ 15M	# 5 \ 15M	# 5 \ 15M	# 6 \ 20M	# 7 \ 22M
	Grade 400 MPa	60 KSI \ 400 MPa	60 KSI \ 400 MPa	60 KSI \ 400 MPa	60 KSI \ 400 MPa	60 KSI \ 400 MPa	60 KSI \ 400 MPa	60 KSI \ 400 MPa	60 KSI \ 400 MPa
	Pitch	1-7/8 \ 50	1-7/8 \ 50	1-7/8 \ 50	2-1/4 \ 55	1-7/8 \ 50	1-7/8 \ 50	2-1/4 \ 55	2-3/8 \ 60
	J	10 \ 255	10-1/2 \ 265	10-5/8 \ 270	14 \ 355	14-3/4 \ 365	15 \ 380	16-5/8 \ 420	18 \ 460
	OD	7-3/4 \ 190	9 \ 230	9-1/2 \ 240	11-1/4 \ 285	12-1/2 \ 315	14-1/2 \ 365	17 \ 430	22 \ 560
Duct	ID	2 \ 50	2-3/8 \ 60	3 \ 75	3-3/8 \ 85	3-3/4 \ 95	4 \ 100	4-1/2 \ 115	5-1/8 \ 130
Duct Coupler	L2	8 \ 200	8 \ 200	8 \ 200	8 \ 200	8 \ 200	8 \ 200	8 \ 200	12 \ 300
Grout Requirements	gal/ft \ l/m	0.12 \ 1.5	0.17 \ 2.1	0.28 \ 3.46	0.35 \ 4.39	0.44 \ 5.48	0.47 \ 5.80	0.58 \ 7.25	0.72 \ 8.90

* Spiral required in local anchor zone
All dimensions are nominal and are expressed in inch \ mm.

Flat Anchorage FA / Plate Anchorage SD



Flat Anchorage FA

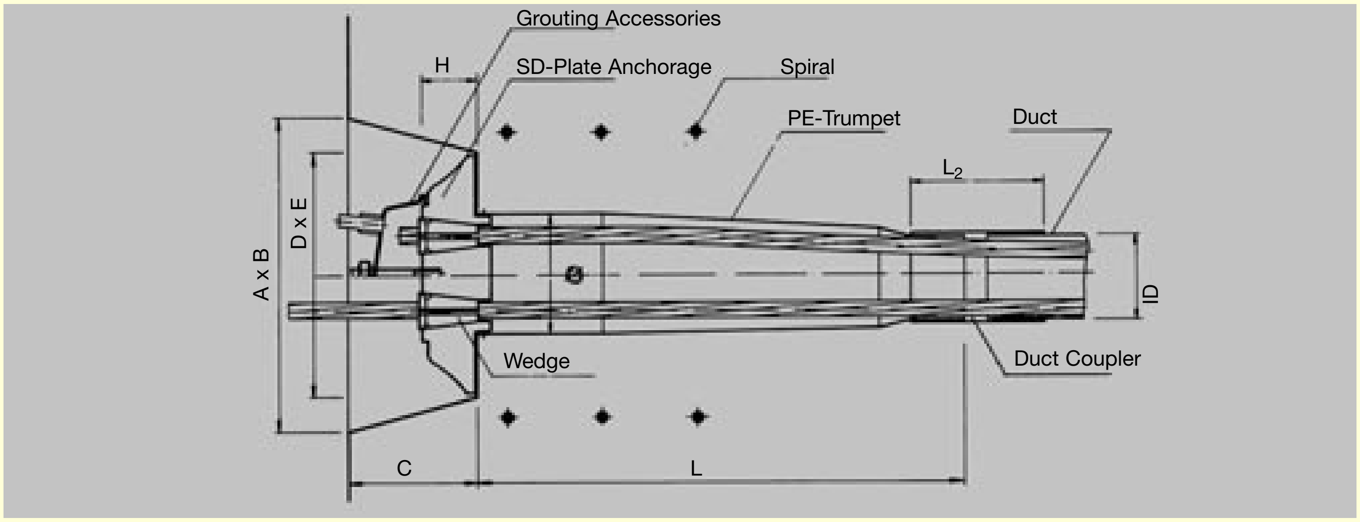


Plate Anchorage SD

▶ Technical Data

Flat Anchorage FA

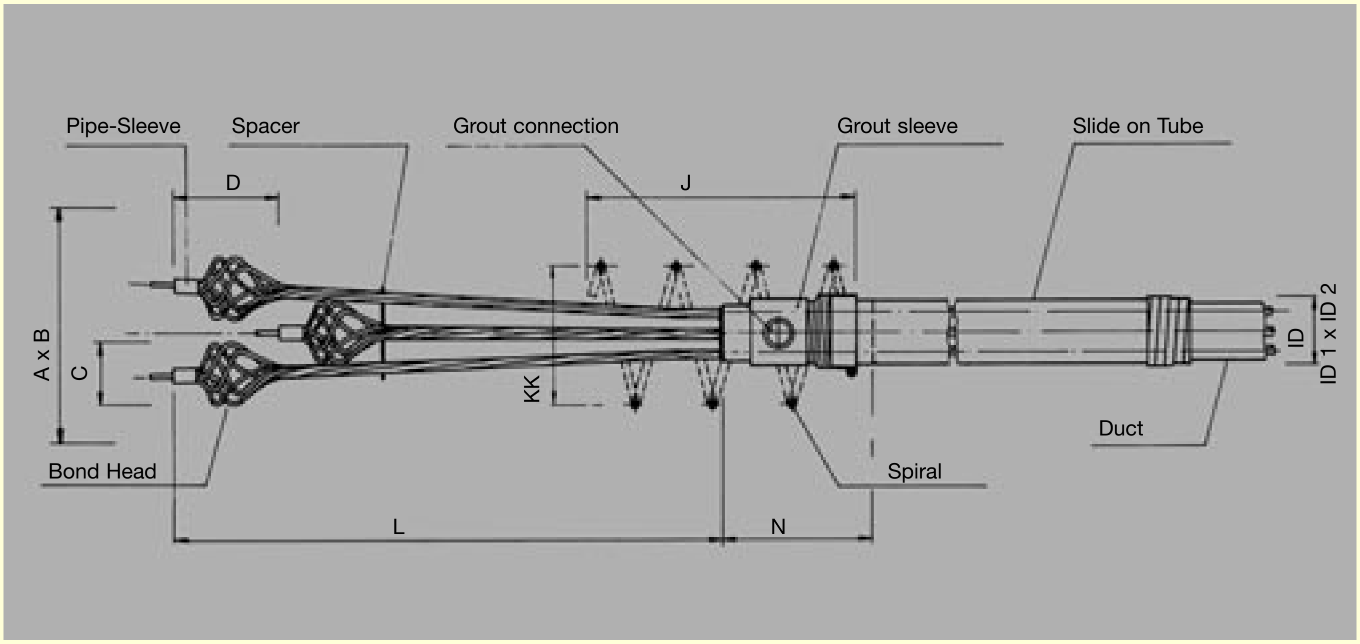
Tendon Size		3-0.6" or 4-0.5"	4-0.6" or 5-0.5"
Flat	D	10\255	13\330
Anchorage	E	4\100	4\100
	F	2-1/4\57	2-1/4\57
Transition	K	12-1/4\310	–
	L	4-1/2 \ 115	8-5/8 \ 220
Pocket	A	10-3/4\275	13-3/4\350
Former	B	4-1/2\115	4-7/8\124
	C	5-1/2\140	5-7/8\148
Duct	ID1	1\25	1\25
	ID2	3\75	3\75

Combination Plate Anchorage SD

Tendon Size		3-0.6" or 4-0.5"	4-0.6" or 5-0.5"	5-0.6" or 7-0.5"	6-0.6" or 8-0.5"	7-0.6" or 9-0.5"
Combin.	D	4-15/16\125	5-5/16\135	5-7/8\150	6-1/2\165	6-11/16\170
Plate	E	5-1/2\140	6-5/16\160	7-1/16\180	8-1/16\205	8-1/2\215
	H	1-5/8\41	1-5/8\41	1-9/16\40	1-3/4\44	1-3/4\44
Transition	∅	2-9/16\65	2-15/16\75	3-3/8\85	3-3/4\95	3-3/4\95
	L	11-3/8 \ 290	10-7/16\265	14\355	15-15/16\405	15-15/16\405
Pocket	A	6-1/2\165	6-1/2\165	7-1/16\180	7-7/8\200	7-7/8\200
Former	B	7-5/16\185	7-5/16\185	8-1/4\210	9-7/16\240	9-7/16\240
	C	3-15/16\100	3-15/16\100	3-15/16\100	4-5/16\110	4-5/16\110
Duct	ID	1-9/16\40	1-13/16\46	2-1/16\52	2-7/16\62	2-7/16\62
	L2	8\200	8\200	8\200	8\200	8\200

All dimensions are nominal and are expressed in inch \ mm.

Bond Head Anchorage Z



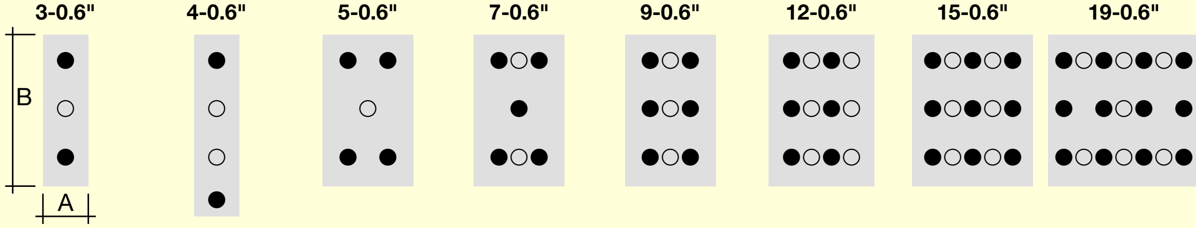
▶ Technical Data

Tendon Size **3-0.6"** **4-0.6"** **5-0.6"** **7-0.6"** **9-0.6"** **12-0.6"** **15-0.6"** **19-0.6"**

Strand Arrangement

● long

○ short

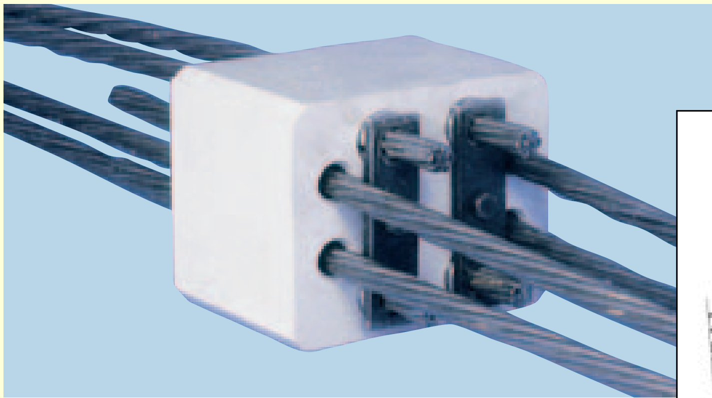


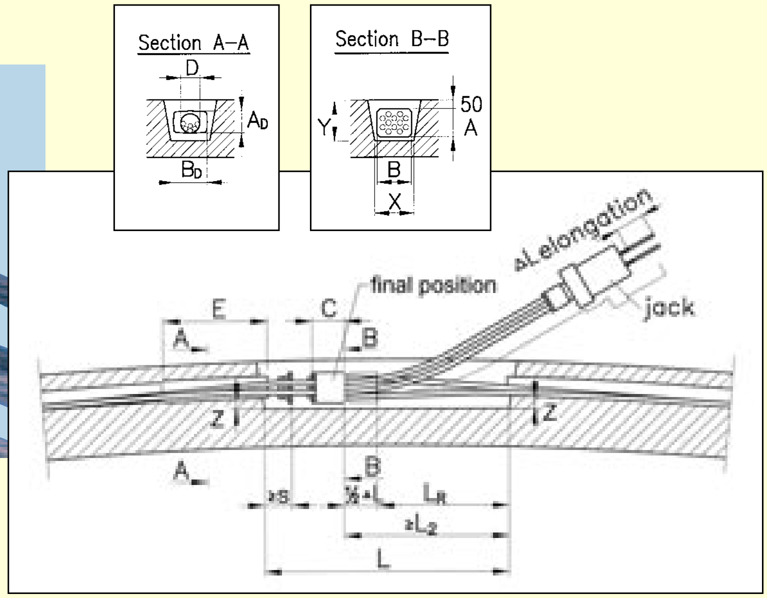
Tendon Size		3-0.6"	4-0.6"	5-0.6"	7-0.6"	9-0.6"	12-0.6"	15-0.6"	19-0.6"
Anchorage	A	7 \ 178	7 \ 178	11 \ 280	11 \ 280	15 \ 380	15 \ 380	15 \ 380	15 \ 380
	B	11 \ 280	13 \ 330	11 \ 280	11 \ 280	11 \ 280	13 \ 330	15 \ 380	19 \ 483
	C	3 \ 75	3 \ 75	3 \ 75	3 \ 75	3 \ 75	3 \ 75	3 \ 75	3 \ 75
	D	6 \ 150	6 \ 150	6 \ 150	6 \ 150	6 \ 150	6 \ 150	6 \ 150	6 \ 150
	L	40 \ 1015	40 \ 1015	40 \ 1015	40 \ 1015	40 \ 1015	40 \ 1015	40 \ 1015	40 \ 1015
Grout Sleeve	N	8-1/4 \ 210	9 \ 230	9 \ 230	9 \ 230	9 \ 230	9 \ 230	9 \ 230	9 \ 230
Duct-Round	ID	—	—	2 \ 50	2-3/8 \ 60	3 \ 75	3-1/2 \ 90	3-3/4 \ 95	4 \ 100
Duct-Eliptical	ID1	1 \ 25	1 \ 25	—	—	—	—	—	—
	ID2	2 \ 50	3 \ 75	—	—	—	—	—	—
Spiral	K	4-1/8 \ 105	7-7/8 \ 200	7-7/8 \ 200	7-7/8 \ 200	7-7/8 \ 200	7-7/8 \ 200	7-7/8 \ 200	7-7/8 \ 200
	J	10 \ 255	10 \ 255	10 \ 255	10 \ 255	10 \ 255	10 \ 255	10 \ 255	12 \ 305

Lightweight hydraulic equipment is used for fabrication of bond heads. All dimensions are nominal and are expressed in inch\mm.

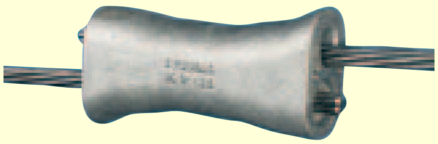
Coupler M/ME (Floating Anchorage Block)

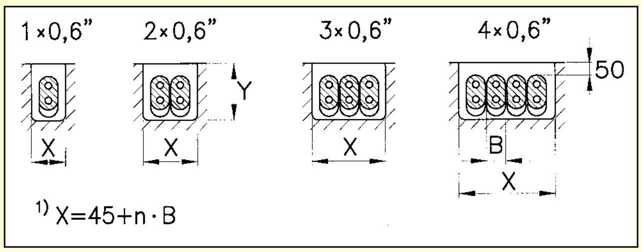
Coupler M

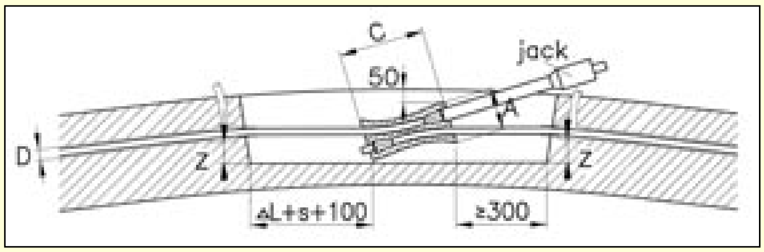




Coupler ME







▶ Technical Data

Tendon Size		**2-0.6"**	**4-0.6"**	**6-0.6"**	**8-0.6"**	**12-0.6"**
Block-Out Cross Section for 2" [50 mm] Concrete Cover	X	5-1/8 \ 130	7-1/16 \ 180	7-1/16 \ 180	9 \ 230	9 \ 230
	Y	6-1/8 \ 155	7-11/16 \ 195	7-11/16 \ 195	7-11/16 \ 195	9-1/4 \ 235
	A	3-1/2 \ 90	5-1/8 \ 130	5-1/8 \ 130	5-1/8 \ 130	6-5/8 \ 168
	B	4-1/8 \ 105	6-1/4 \ 160	6-1/4 \ 160	8-1/4 \ 210	8-1/4 \ 210
	C	4-3/4 \ 120	4-3/4 \ 120	4-3/4 \ 120	4-3/4 \ 120	4-3/4 \ 120
Duct	E	7-7/8 \ 200	25-5/8 \ 650	25-5/8 \ 650	41-3/8 \ 1050	45-1/4 \ 1150
— Rectangular	A_D	2-3/8 \ 60	2-3/8 \ 60	2-3/4 \ 70	2-3/4 \ 70	2-3/4 \ 70
— Rectangular	B_D	2-3/4 \ 70	5-1/8 \ 130	5-1/8 \ 130	6-5/8 \ 170	6-5/8 \ 170
— Round	D	1-3/4 \ 45	2-1/8 \ 55	2-5/8 \ 65	3 \ 75	3-1/8 \ 80
— Min. Distance	Z	2 \ 50	2-3/4 \ 70	2-3/4 \ 70	2-3/4 \ 70	3-1/2 \ 90
Min. Required Distance after Stressing	L_2	17-3/4 \ 450	27-1/2 \ 700	27-1/2 \ 700	53-1/8 \ 1350	59 \ 1500
Space Required for Stressing Jack Nose	L_R	21-5/8 \ 550	23-5/8 \ 600	23-5/8 \ 600	23-5/8 \ 600	27-1/2 \ 700

Block-Out Length

$L = s + 11\text{-}1/4"\ (285\ mm) + L_2$ — If $L_R \leq L_2 - 1/2\ \Delta L$

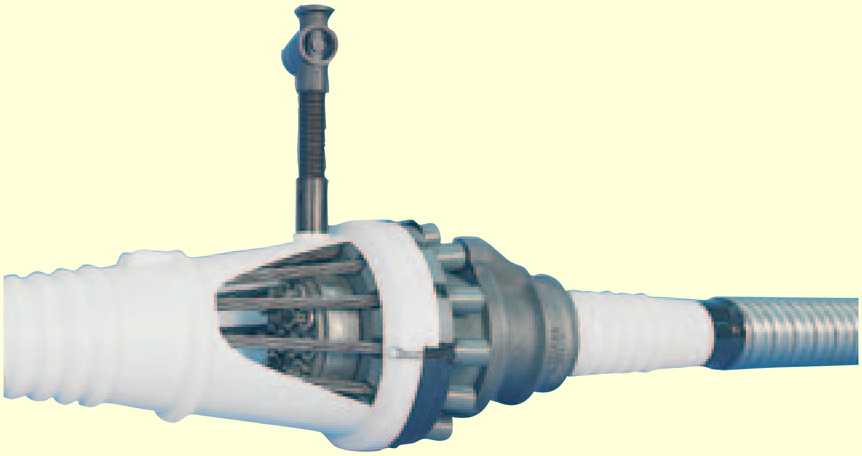
$L = s + 1/2\ \Delta L + 11\text{-}1/4"\ (285mm) + L_s$ — If $L_R \geq L_2 - 1/2\ \Delta L$

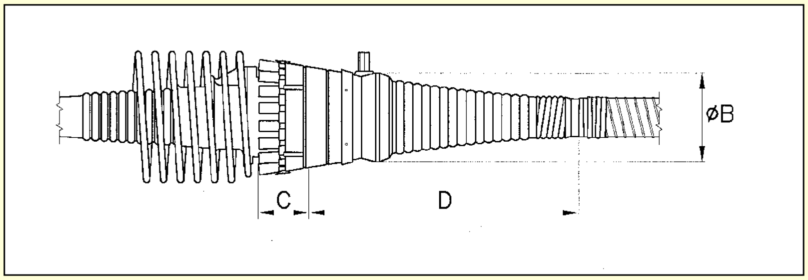
Where $s = 0.2 \times 1/2\ \Delta L$, but 5" (125 mm) min.

ΔL is Elongation

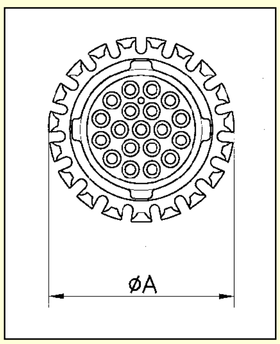
All dimensions are nominal and expressed in inch\mm.

Coupler P





DYWIDAG Coupler “P” utilizes a standard wedge plate and a slotted coupling ring bearing on the multi-plane anchorage. An extruded grip is hydraulically installed on the ends of the coupled strands and the strands are placed in the slots of the coupling ring. This system provides a simple and inexpensive solution for coupling large strand tendons.



▶ Technical Data

type 0.6"	∅ A	∅ B	C	D
	(in/mm)	(in/mm)	(in/mm)	(in/mm)
6805	6.93/176	4.53/115	5.2/132	20/510
6809	9.29/236	8.07/205	5.35/136	22.44/570
6812	10.24/260	8.86/225	5.71/145	29.72/755
6815	11.42/290	9.84/250	5.91/150	29.72/755
6819	12/305	10.43/265	6.1/155	34.65/880
6827	14.37/365	12.6/320	6.69/170	35.63/905

▶ Details of the Coupler Zone

type 0.6"	center distances of anchorages	length of space for installation
	in/mm	in/mm
6805	11.81/300	78.75/2000
6809	14.17/360	78.75/2000
6812	15.35/390	78.75/2000
6815	16.54/420	78.75/2000
6819	18.90/480	78.75/2000
6827	22.83/580	78.75/2000

Equipment Overview

Hydraulic Jacks

Monostrand Jack

Tensa 4,800 / 6,800 / 8,600

HoZ 3,000 / 4,000

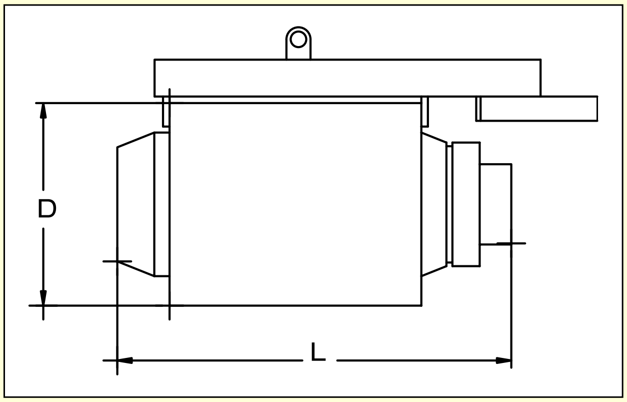
59 .. (0.5")

jack type	01	02	03	04	05	06	07	08	09	12	15	19	27	37
Mono 0.6	●													
HoZ 950		●	●	●	●									
HoZ 1,700						●	●	●	●					
HoZ 3,000										●	●			
HoZ 4,000												●	●	
Tensa 260														
Tensa 3,000														
Tensa 4,800														
Tensa 6,800														●
Tensa 8,600														

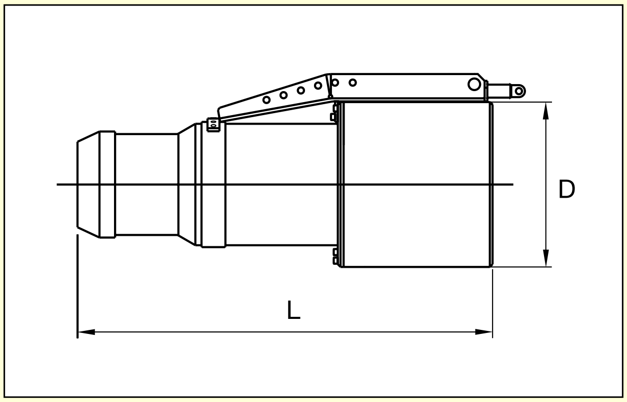
68 .. (0.6")

jack type	01	02	03	04	05	06	07	08	09	12	15	19	27	37
Mono 0.6	●													
HoZ 950		●	●	●										
HoZ 1,700					●	●	●							
HoZ 3,000								●	●	●				
HoZ 4,000											●	●		
Tensa 260								●	●	●				
Tensa 3,000								●	●	●				
Tensa 4,800											●	●		
Tensa 6,800													●	
Tensa 8,600														●

Tensa Style



HoZ Style



Technical Data

jack type[1]	length L[3] (in/mm)	diameter D (in/mm)	stroke (in/mm)	piston area (in^2/cm^2)	capacity[2] (kip/kN)	weight (lbs/kg)
Mono 0.6	21.5/546	n/a	8.5/213	7.95/51.3	60/267	52/24
HoZ 950	24.45/621	8/203	3.94/100	25.1/162	218/972	144/65
HoZ 1,700	31.6/803	11/280	5.9/150	46.26/298.45	392/1,745	354/160
HoZ 3,000	44.76/1,137	15.16/385	9.84/250	78.9/509	687/3,054	884/400
HoZ 4,000	50/1,271	18.98/482	9.84/250	138.7/894.6	945/4,204	1,326/600
Tensa 2,600	30.9[3]/785	14.57/370	9.84/250	85.2/549.8	572/2,546	729/330
Tensa 3,000	30.9[3]/785	14.57/370	9.84/250	85.2/549.8	680/3,024	782/354
Tensa 4,800	39.6[3]/1,005	18.5/470	11.81/300	135.86/876.5	1,083/4,820	1,432/648
Tensa 6,800	45.3[3]/1,150	22/560	11.81/300	191.7/1,237	1,529/6,803	2,619/1,185
Tensa 8,600	46[3]/1,170	26.8/680	11.81/300	274.7/1,772.5	2,191.4/9,748	3,912/1,770

NOTE:
Detailed operating and safety instructions are provided with all stressing and grouting units. Read and understand these instructions before operating equipment.

1) power seating included
2) without friction
3) retracted position

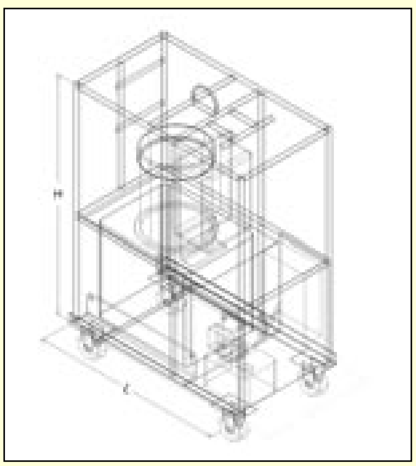
Hydraulic Pumps

PE 55

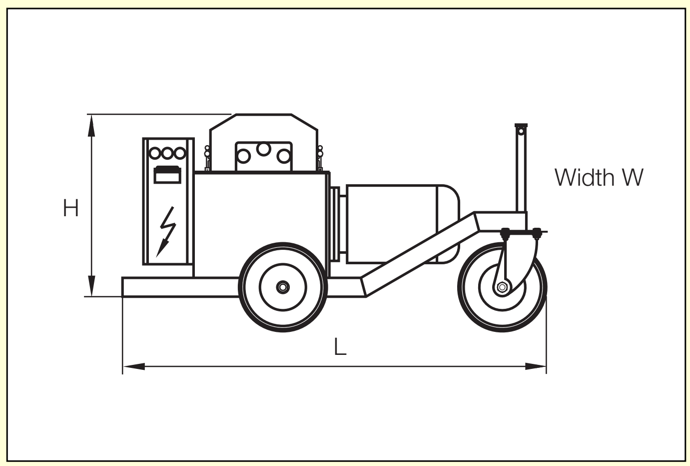
PE 4000

R 11.2 - 11.2/210

jacks	0.6 mono	HoZ 950	HoZ 1,700	HoZ 3,000 Tensa 3,000/260	HoZ 4,000 Tensa 4,800	Tensa 6,800	Tensa 8,600
Pumps							
PE55	●	●					
PE4000/PE55			●	●	●		
R11.2						●	●



PE 4000



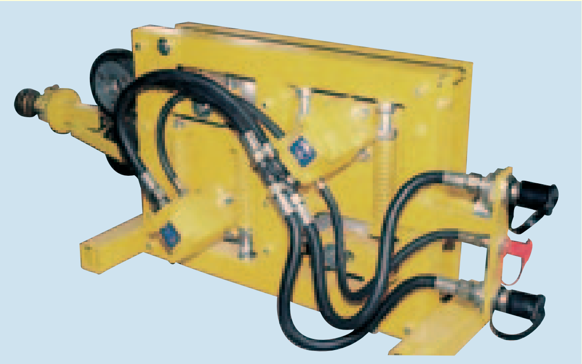
R 11.2

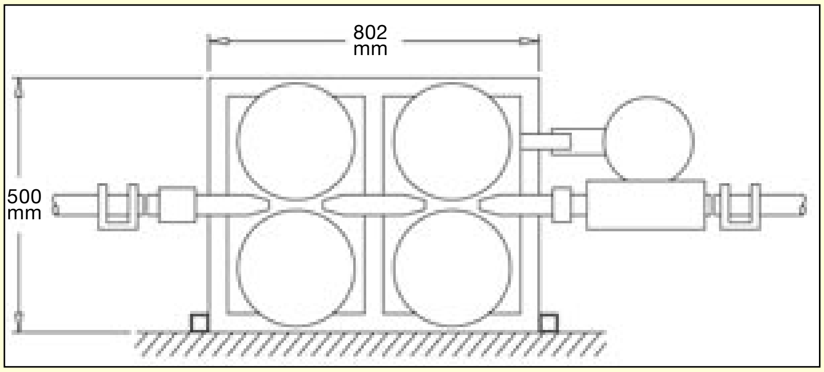
▶ Technical Data

Pumps	operating pressure psi/MPa	capacity V/min Gpm/Lpm	eff. oil amount G/L	weight lbs/kg	dimensions LxWxH in	dimensions LxWxH mm	amp draw
PE55	10,000/69	.3[1]/1.14	2/7.57	65/29.4	11.5/9.5/18.25	292/241/464	25[2]
PE4000	10,000/69	1.95[1]/7.37	20/75.7	492/223	25/24/36.5	635/610/927	17[3]
R11.2	7,970/55	5.9/22.4	44.9/170	1,590/720	78.75/31.5/51.2	2,000/800/1,300	46[3]

1) At operating pressure
2) At 10,000 psi, 115 Volt
3) At 460 Volt

Pushing Equipment





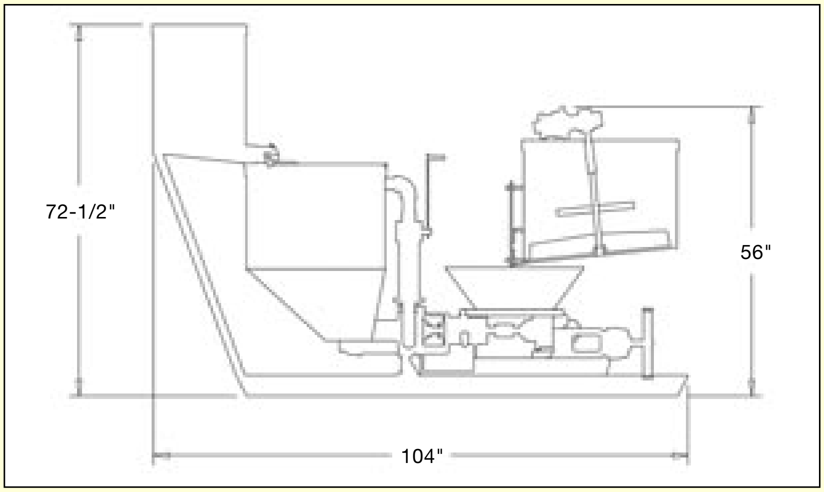
ESG 8 - 1

type	Pushing force	pushing speed	weight	dimensions L x W x H	hydraulic pumps	Amp draw
	kips	ft/s	lbs	in	-	
	kN	m/s	kg	mm		
ESG 8 - 1	0.88	20	309	55/13.8/20	ZP 57*	44
	3.9	6.1	140	1,400/350/510		

* Also can use R35 pump.

Grouting Equipment
(mixing and pumping)

CG600 Colloidal



grouting equipment	max injection pressure	capacity	weight	dimensions L x W x H
	psi	gpm	pounds	in
	MPa	l/h	kg	mm
CG600 Colloidal				
– with Moyno pumps	250	20	1,100	90 x 37 x 63
	1.7	4542	500	2286 x 940 x 1600
– with Piston Pump (1,000 psi)	1,000	20	1,725	90 x 37 x 63
	6.9	4542	784	2286 x 940 x 1600

Note: Air pressure required to operate is 280 cfm@100 psi

DYWIDAG BARS

The components of the DYWIDAG Bar System are manufactured in the United States exclusively by DYWIDAG-Systems International. Used worldwide since 1965, the system provides a simple, rugged method of efficiently applying prestress force to a wide variety of structural applications including post-tensioned concrete, as well as rock and soil anchor systems.

Available in 1" (26.5 mm), 1 1/4" (32 mm) and 1 3/8" (36 mm) THREADBARS® are hot rolled and proof stressed alloy steel conforming to ASTM A722 CAN/CSA (G279-M1982). The 1 3/4" (46 mm) and 2 1/2" (65 mm) nominal diameter bar is cold drawn quenched and tempered alloy steel which after threading also conforms to the strength properties specified in A722.

The DYWIDAG THREADBAR® pre-stressing steel has a continuous rolled-in pattern of thread-like deformations along its entire length. More durable than machined threads, the deformations allow anchorages and couplers to thread onto the THREADBAR® at any point. The 1 3/4" (46mm) and 2 1/2" (65mm) bar can be cold threaded for its entire length or if enhanced bond is not required the bars can be supplied with threaded ends only.

The strength of the DYWIDAG anchorages and couplers exceeds the requirements of ACI 318 and the PTI Acceptance Standards for Post-Tensioning Systems.

Bars may also be galvanized, but will lose about 5% of their strength. Epoxy coating is the preferred method.

Test reports are available for the principal components of the system.

Conforming to the requirements of ASTM A615, the deformations develop an effective bond with cement or resin grout. The continuous thread simplifies stressing. Lift-off readings may be taken at any time prior to grouting and the prestress force increased or decreased as required without causing any damage.

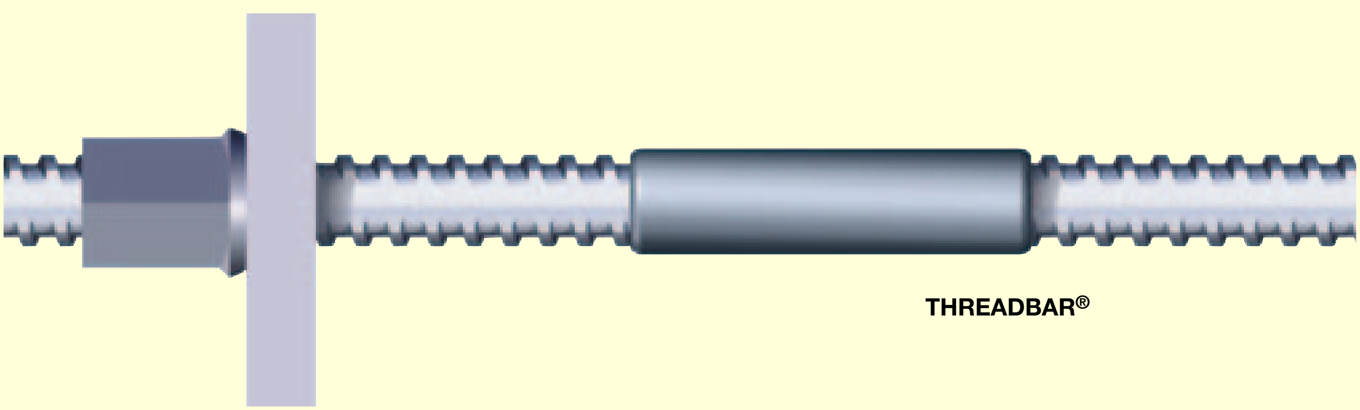
The DYWIDAG Bar System is primarily used for grouted construction. In addition they are sometimes used as external tendons with various types of corrosion protection.

All system components are designed to be fully integrated for quick and simple field assembly. Duct, duct transitions, grout sleeves and grout tubes all feature thread type connections.

Tendon duct can be metal or plastic. Galvanized or epoxy coated accessories that thread over the coated bar are available.

Placing DYWIDAG THREADBAR® anchorages is simplified by the use of reusable plastic pocket formers. Used at each stressing end, the truncated, cone-shaped pocket former can extend through, or butt up against the form bulkhead.

Threadbars are available in mill lengths to 60' (18.3 m), and may be cut to specified lengths before shipment to the job site. Where circumstances warrant, the threadbars may be shipped to the job site in mill lengths for field cutting with a portable friction saw or coupled to extend a previously stressed bar. Cold threaded 1 3/4" (46 mm) and 2 1/2" (65 mm) diameter are available in lengths up to 45 feet.



THREADBAR®

Prestressing Bar Properties

Nominal Bar Diameter (in.) (mm)	Ultimate Stress f_{pu} (ksi) (Mpa)	Cross Section Area A_{ps} (in.^{2}) (mm^2)	Ultimate Strength f_{pu} Aps (kips) (kN)	Prestressing Force (kips)(kN) 0.8 f_{pu} A_{ps}	0.7 f_{pu} A_{ps}	0.6 f_{pu} A_{ps}	Weight (lbs./ft.) (kg/m)	Minimum* Elastic Bending Radius (ft.) (m)	Maximum Bar Diameter (in) (mm)
1 in. 26 mm	150 1,030	0.85 548	127.5 567	102.0 454	89.3 397	76.5 340	3.01 4.48	52 15.9	1.20 30.5
$1^{1}/_{4}$ in. 32 mm	150 1,030	1.25 806	187.5 834	150.0 662	131.3 584	112.5 500	4.39 6.54	64 19.5	1.46 37.1
$1^{3}/_{8}$ in. 36 mm	150 1,030	1.58 1,018	237.0 1055	189.6 839	165.9 738	142.2 633	5.56 8.28	72 22.0	1.63 41.4
$1^{3}/_{4}$ in. 46 mm	150 1,030	2.62 1,690	400 1,779	320 1,423	280 1,245	240 1,068	9.23 13.74	92 28.0	2.00 51.0
$2^{1}/_{2}$ in. 65 mm	150 1,030	5.2 3,355	780 3,471	624 2,776	546 2,429	4.618 2,082	17.71 26.29	– –	2.71 68.9

* Prebent bars are required for radii less than the minimum elastic radius
** Grade 160 bar may be available on special request

Steel Stress Levels

DYWIDAG bars may be stressed to the allowable limits of ACI 318.The maximum jacking stress (temporary) shall not exceed 0.80 f_{pu}, and the transfer stress (lockoff) shall not exceed 0.70 f_{pu}.

ACI 318 does not stipulate the magnitude of prestress losses or the maximum final effective (working) prestress level.

Prestress losses due to shrinkage, elastic shortening and creep of concrete, as well as steel relaxation and friction must be considered.

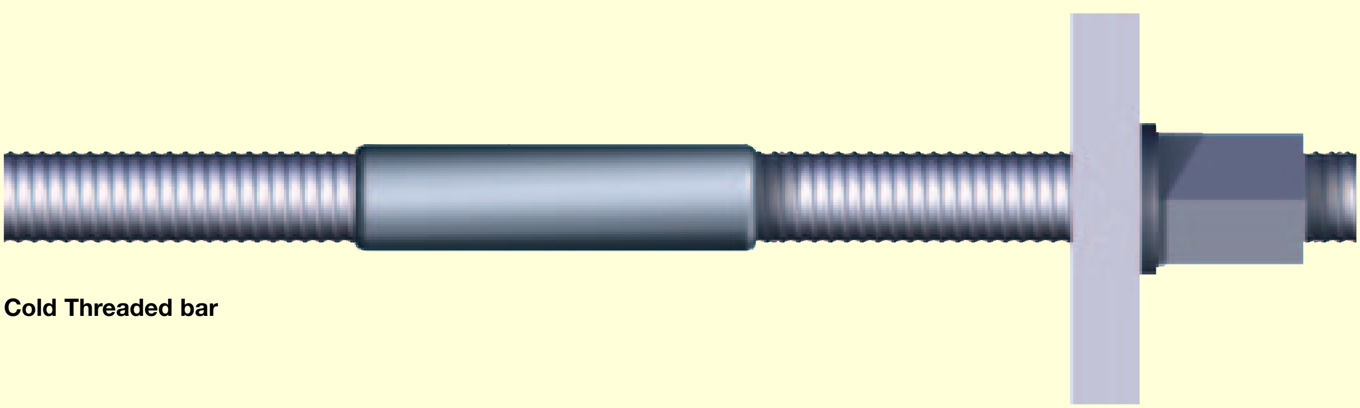
The final effective (working) prestress level depends on the specific application. In the absence of a detailed analysis of the structural system, 0.60 f_{pu} may be used as an approximation of the effective (working) prestress level.

Actual long term loss calculations require structural design information not normally present on contract documents.

Some important notes concerning the safe handling of high strength steel for prestressed concrete:

1. Do not damage surface of bar.
2. Do not weld or burn so that sparks or hot slag will touch any portion of bar which will be under stress.
3. Do not use any part of bar as a ground connection for welding.
4. Do not use bar that has been kinked or contains a sharp bend.

Disregard of these instructions may cause failure of material during stressing.

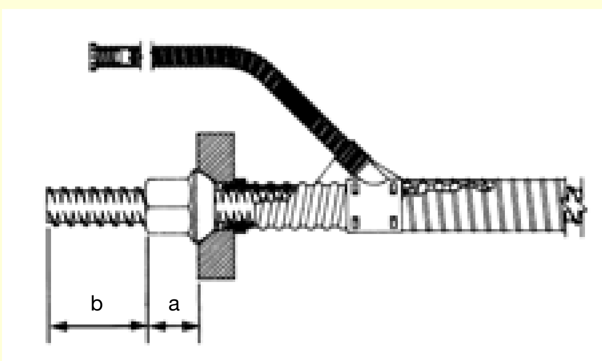


Cold Threaded bar

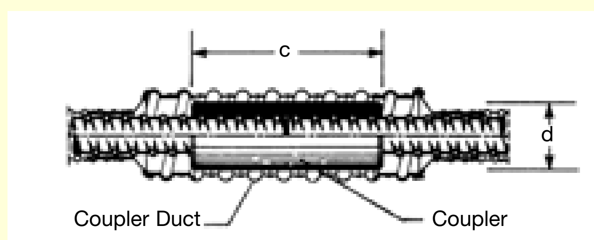
THREADBAR® Accessory Dimensions

Anchorage Details								
Bar Diameter	1"	26 mm	1-1/4"	32 mm	1-3/8"	36 mm	1-3/4"	46 mm
Anchor Plate Size*	5 x 5 x $1\frac{1}{4}$	127 x 140 x 32	6 x 7 x $1\frac{1}{2}$	152 x 178 x 38	7 x $7\frac{1}{2}$ x $1\frac{3}{4}$	178 x 191 x 44	9 x 9 x 2	230 x 230 x 57
Anchor Plate Size*	4 x $6\frac{1}{2}$ x $1\frac{1}{4}$	102 x 165 x 32	5 x 8 x $1\frac{1}{2}$	127 x 203 x 38	5 x $9\frac{1}{2}$ x $1\frac{3}{4}$	127 x 241 x 44	-	-
Nut Extension a	1-$\frac{7}{8}$	48	$2\frac{1}{2}$	64	$2\frac{3}{4}$	70	$2\frac{7}{8}$	74
Min. Bar Protrusion **B	3	76	$3\frac{1}{2}$	89	4	102	$3\frac{5}{8}$	92
*other plate sizes available on special order. **To accommodate stressing								
Coupler Details								
Length C								
For plain bars	$6\frac{1}{4}$	159	$6\frac{3}{4}$	171	$8\frac{3}{4}$	219	$6\frac{3}{4}$	171
For epoxy coated bars	$7\frac{3}{4}$	197	$8\frac{1}{4}$	210	$10\frac{1}{8}$	267	$8\frac{3}{4}$	222
Diameter d	2	51	$2\frac{3}{8}$	60	$2\frac{3}{4}$	67	$3\frac{1}{8}$	79
Duct Details (galvanized steel)								
Bar Duct O.D.	$1\frac{7}{8}$	47	2	51	$2\frac{1}{8}$	55	$2\frac{3}{4}$	70
Bar Duct I.D.	$1\frac{5}{8}$	43	$1\frac{7}{8}$	48	2	51	$2\frac{5}{8}$	67
Coupler Duct O.D.	$2\frac{3}{4}$	70	3	76	$3\frac{1}{2}$	87	4	101
Coupler Duct I.D.	$2\frac{5}{8}$	67	$2\frac{7}{8}$	72	$3\frac{1}{4}$	83	$3\frac{3}{4}$	95
Duct Details (plastic duct)								
Bar duct OD	$2\frac{7}{8}$	73	$2\frac{7}{8}$	73	$2\frac{7}{8}$	73	$2\frac{7}{8}$	73
Bar duct ID	$2\frac{9}{32}$	63	$2\frac{9}{32}$	63	$2\frac{9}{32}$	63	$2\frac{9}{32}$	63
Coupler duct OD	$2\frac{7}{8}$	73	$3\frac{9}{16}$	90.5	$3\frac{7}{8}$	98.4	$4\frac{17}{32}$	115
Coupler duct ID	$2\frac{9}{32}$	63	3	76	$3\frac{1}{4}$	82.5	$3\frac{15}{16}$	100
Pocket Former Details								
Depth	$7\frac{1}{8}$	178	8	203	$8\frac{5}{8}$	219	N/A	N/A
Maximum Diameter	$5\frac{1}{8}$	130	$6\frac{1}{2}$	165	$6\frac{1}{2}$	165	N/A	N/A

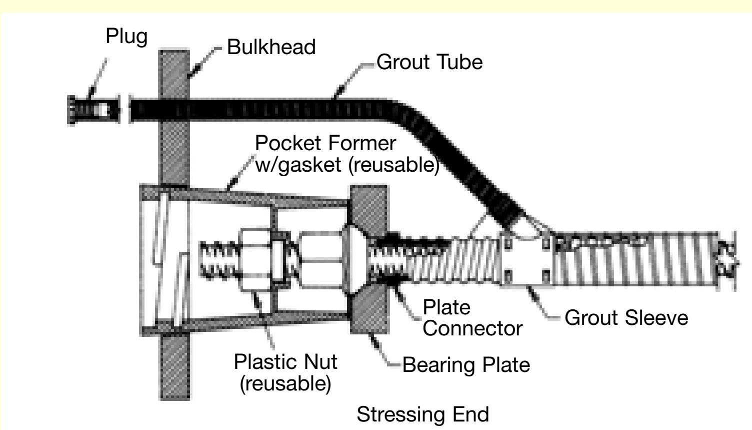
Plate Anchorage



Coupler



Pocket Former Detail



subject to modification, April 2006

2-1/2"	65 mm
12 x 14 x 2 1/2	305 x 356 x 63.5
-	-
5	127
5 3/8	136.5
10 3/4	273
13 3/8	340
4 1/2	114
3 15/32	88
3 9/32	83.7
5 7/16	138
5 1/4	134
3 7/8	98.4
3 1/4	82.5
6	152.4
5	127
N/A	N/A
N/A	N/A

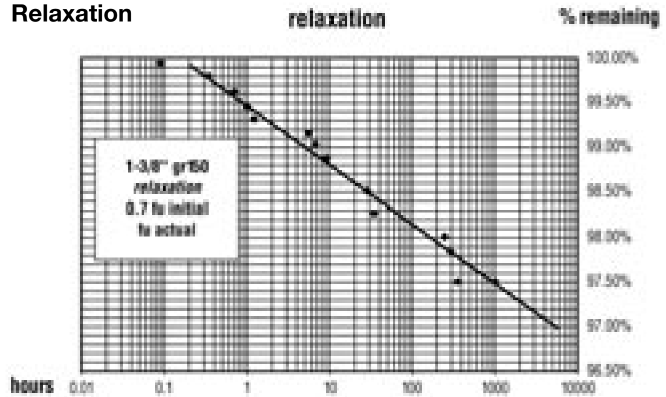
Modulus of Elasticity

The modulus of elasticity "E" is an intrinsic property of steel whose magnitude remains basically constant and is little affected by normal variations in mill processes. For Threadbars this value has been determined to be 29,700 ksi (205 MPa).

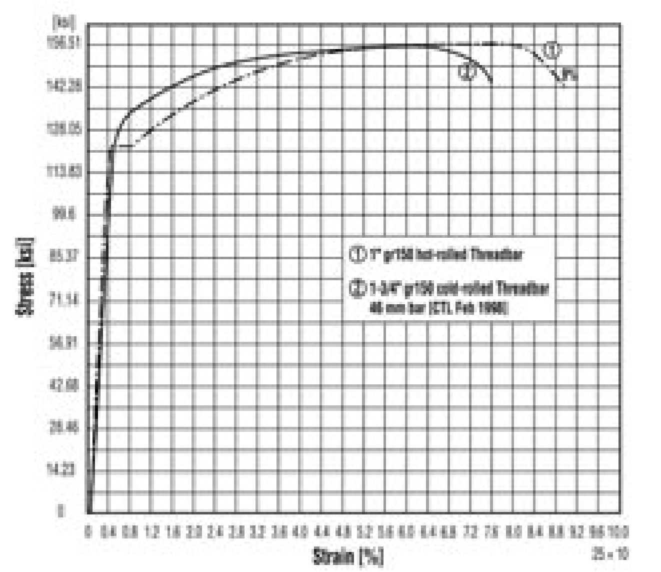
Relaxation

Relaxation is defined as the loss of prestress load in a post-tensioning steel subjected to a specified initial stress while maintaining the length and the temperature constant. Relaxation tests are usually conducted at an initial load equal to 70% of the strand's actual ultimate strength (see chart below). The tension loss after 1,000 hrs for a THREADBAR® initially stressed to 70% of guaranteed ultimate strength can be assumed between 1.5 and 2%.Tests indicate that the relaxation losses in cold drawn, cold threaded bars are significantly higher.

Relaxation



Stress-strain characteristics



Stress-strain characteristics

A typical stress-strain curve for a stretched and stress relieved bar is substantially different from a typical curve produced for a cold drawn, cold threaded bar. Samples of each are illustrated below.The most notable feature is the lack of a definite yield point characteristic of cold drawn bars.

Fatigue strength

Under normal circumstances fatigue is not a primary design consideration for prestressing steels. However, all DYWIDAG bars and accessories have been tested and proven to exceed the fatigue requirements specified by the Post-Tensioning Institute.

Temperature characteristics

Tests have demonstrated that no significant loss of strength occurs when bars are subjected to elevated temperatures up to 1,100 degrees F (593° C). Only the yield strength is reduced when temperatures exceed approximately 750 degrees F (399° C). Bar ductility is not significantly affected by temperatures down to -60 degrees F (-51° C).

Susceptibility to stress corrosion cracking and hydrogen embrittlement

All prestressing steel is susceptible to stress corrosion cracking and hydrogen embrittlement in aggressive environments and therefore must be properly protected. However, accelerated tests have demonstrated that while A 416 strand failed after 5 to 7 hours, bars still held their load when testing was discontinued at 200 hours.

Bond

The deformations on the DYWIDAG THREADBAR® exceed the deformation requirements of A 615. Consequently bond strength is at least equivalent to A 615 reinforcing bars.

Shear

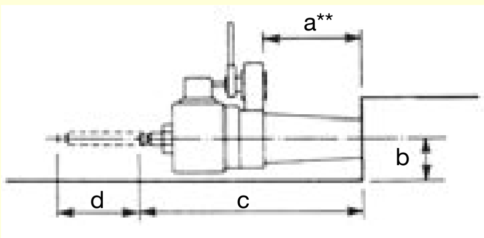
High strength bars are not usually used to resist transverse shear loads. However, their untensioned shear strength is similar to that of any other steel.

$$t = \frac{fy}{\sqrt{3}}$$

Stressing

DYWIDAG Threadbars are stressed using compact lightweight hydraulic jacks. In most cases handled by one man, the jack fits over a pull rod designed to thread over the THREADBAR® protruding from the anchor nut. The jack nose contains a socket wrench and ratchet device which allow the nut to be tightened as the THREADBAR® elongates. $1^3/_4$" and $2^1/_2$" bars utilize specially equipped center-hole stressing jacks.

The magnitude of the prestressing force applied is monitored by reading the hydraulic gauge pressure and by measuring the THREADBAR® elongation. The elongation can be measured directly by noting the change in threadbar protusion.



d = Total tendon elongation

Jack Capacity	Kips kN	67 267	160 712	220 979	330* 1,500	630* 2,800
Bar Size	in mm	$^5/_8$ 15	1, $1^1/_4$ 26, 32	$1^1/_4$, $1^3/_8$ 32, 36	$1^3/_4$ 46	$2^1/_2$ 65
a**	in mm	$7^3/_4$ 197	$8^1/_2$ 216	11 279	NA	NA
b	in mm	$3^1/_4$ 83	4 102	6 152	6 145	7 180
Min. c	in mm	24 610	26 660	30 762	36 900	43 1,070
Weight	lbs Kg	50 23	80 36	110 50	334* 152	500 227

* This system should have a mechanical means of lifting and moving.
** Special nose extensions for deep stressing pockets are available on request.

NOTE: Detailed operating and safety instructions are provided with all stressing and grouting units. Read and understand these instructions before operating equipment.

Grouting

Grouting completes the installation process for post-tensioned concrete construction.The grout is important in protecting the steel from corrosion and contributes significantly to the ultimate strength of the structure.

After mixing, the grout is injected into a low point vent until consistent material is exhausted at the terminating or anchorage vent. An admixture may be used to control expansion and pumpability.

CG 500

THREADBAR® Stressing Operation
Mopac Freeway/US 183 Interchange Austin, TX.

Temporary Threadbars for Precast Segmental Construction

Typical THREADBAR® Tendon Installation, Aeration/Equalization Basin McIntosh, AL

Bridge Repair THREADBAR® Stays Route 580 Altamont Pass, California

Inspection and Repair of Grouted Tendons

With over twenty years of experience in the field of inspection and repair of structures, DSI offers a complete service package that includes Non-Destructive Testing (NDT) for the non-invasive detection of flaws in structures, in particular, problems of voids in grouted post-tensioning tendons. DSI also offers special equipment such as metal sensitive drills and videoscopes for the limited invasive inspection at suspect locations in the structure, digital volumeters that measure the volume of any void inside the tendon and vacuum grouting equipment for subsequent filling of the void.

Non-Destructive Testing (NDT)

DSI's procedures for NDT include locating the ducts in the concrete using Ground Penetrating Radar (GPR), then using Impact Echo instrumentation to determine the location of any voids located inside the grouted tendons.

Locating tendons using GPR

Using Impact Echo to locate voids in the tendon

Vibration testing of external tendons

Vibration Testing

Vibration Testing is an economical and efficient procedure used to determine the amount of force existing in external tendons. The method consists of an external sensor located on the tendon to be tested and then generating a vibration in the tendon. The tendon response is recorded and analyzed with special software that will compute, based on the tendon characteristics, the remaining force in the tendon.

Invasive Inspections

The NDT inspection shall be followed by limited invasive inspection to verify the NDT findings. DSI offers special devices and techniques developed to minimally invade the structure in order to determine the actual conditions of the grouted tendons and protect the prestressing steel during the inspection.

Volume Measuring

DSI is able to determine the volume of the void through the use of a Digital Volumeter with leak compensating capabilities.

Digital Volumeter with leak compensating capabilities

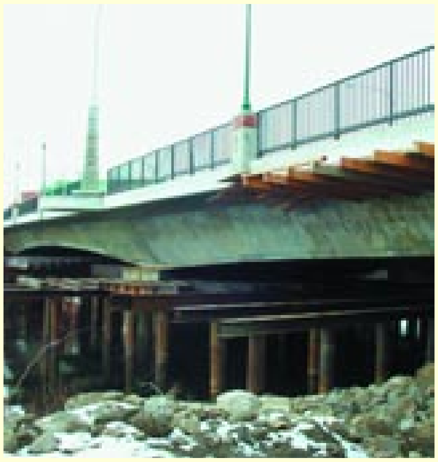
Grout Remediation of PT Tendons

DSI uses vacuum grouting techniques & experienced personnel to fill any voids. As a necessary check, the volume of material injected in the void should be compared to the volume previously measured.

DSI uses only ASBI certified grout technicians cross trained in NDT inspection. All technicians have extensive experience in both pressure and vacuum grouting techniques employing thixotropic grout.

Result of void grouted with conventional methods

Result of void grouted with Vacuum Grouting



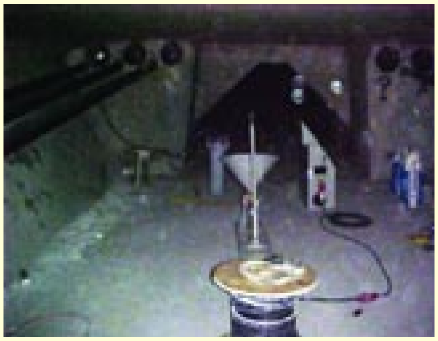
Repair of the Trent Street Bridge, Spokane, WA
Washington Department of Transportation

DSI performed an NDT inspection using Ground Penetrating Radar to detect post-tensioning ducts and steel reinforcement as well as an Impact Echo Scanner to detect voids in the grouted ducts. Videoscope inspections were carried out to assess the condition of the post-tensioning strands. The volume of voids inside the ducts was measured with state-of-the-art equipment capable of compensating for air leaks. The grouting remediation of the post-tensioned tendons in web b was performed using vacuum grouting.

i **DSI Services** Inspection: NDT (GPR and Impact Echo), Special drills with shut-off capabilities when in contact with metal, Videoscope and Void volume measurement with air leak compensation capabilities / Repair: Vacuum Grouting

Mid Bay Bridge, Destin, FL
Mid Bay Bridge Authority

Inspection at anchorage areas of external tendons of the bridge and vacuum grouting of voids.



i **DSI Services** Inspection and Measurement of the Volume of Voids / Repair: Vacuum injected more than 700 voids Engineering: Assisted in preparing procedures for detensioning and replacement of 11 external tendons

C & D Canal Bridge, SR1 over Chesapeake & Delaware Canal, St. Georges, New Castle Co., Delaware
Delaware Department of Transportation

i **DSI Services** NDT inspection, by videoscope, of 18 cable stay guide pipes at the stays and NDT, limited invasive inspection and vacuum grouting of the anchorages of the external P.T. tendons in the bridge

I-88 & I-355 Interchange, Downer Grove, IL
The Illinois State Toll Highway Authority

Overall inspection of the post-tensioning tendons of 4 segmental ramps. Inspection included both, tendons in the superstructure as well as in the substructure.

DSI planned and performed NDT and limited invasive inspection in a selected sample of the post-tensioning tendon population of these ramps and assessed the condition of those elements of the structure (i.e. condition of the prestressing steel and grout).

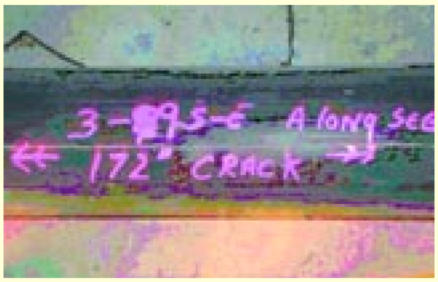
i **DSI Services** Preparation and implementation of the inspection plan. Inspection included the use of GPR, IE, vibration testing of external tendons, drillings, videoscope, volume measurement of the voids found inside the ducts and report preparation

Half Pipe

DSI's half pipe is the perfect solution for cracked or cracking HDPE external grouted ducts.

Developed to be installed in difficult access contitions, the Half Pipe snaps into place over an existing HDPE duct and has been engineered so that the annular spaces can be pressure grouted; restoring the tendon to it's original corrosion protection specifications.

The DSI Half Pipe also allows for the complete removal of the existing HDPE pipe to assess the condition of the grout and strands, if required, prior to its installation.



Cracked HDPE Duct

Simulated Repair of Cracked HDPE (White Pipe) duct using Half Pipe (Outer black Pipe). Annulus between pipes has been grouted.

USA

DYWIDAG-SYSTEMS
INTERNATIONAL USA INC.
Headquarter Americas
320 Marmon Drive
Bolingbrook, IL 60440
Phone: (630) 739-1100
Fax: (630) 972-9604
E-Mail: dsiamerica@dsiamerica.com

DYWIDAG-SYSTEMS
INTERNATIONAL USA INC.
Post-Tensioning & Reinforcement
525 Wanaque Avenue
Pompton Lakes, NJ 07442
Phone: (973) 831-6560
Fax: (973) 831-6503
E-Mail: dsiamerica@dsiamerica.com

DYWIDAG-SYSTEMS
INTERNATIONAL USA INC.
#1808 N. Peyco Drive
Arlington, TX 76001-6704
Phone: (817) 465-3333
Fax: (817) 465-3696
E-Mail: dsiamerica@dsiamerica.com

DYWIDAG-SYSTEMS
INTERNATIONAL USA INC.
5220 Clark Avenue
Suite 220
Lakewood, CA 90712
Phone: (562) 263-0256
Fax: (562) 263-0285
E-Mail: dsiamerica@dsiamerica.com

DYWIDAG-SYSTEMS
INTERNATIONAL USA INC.
4732 Stone Drive
Tucker, GA 30084
Phone: (770) 491-3790
Fax: (770) 938-1219
E-Mail: dsiamerica@dsiamerica.com

Canada

DYWIDAG-SYSTEMS
INTERNATIONAL CANADA LTD.
Eastern Division
37 Cardico Drive
Gormley, ON L0H1G0
Phone: + 1-905-888-8988
Fax: + 1-905-888-8987
E-Mail: dsiamerica@dsiamerica.com

DYWIDAG-SYSTEMS
INTERNATIONAL CANADA LTD.
Western Division
Suite 103
19433 96th Av.
Surrey, BC V4N4C4
Gormley, ON L0H1G0
Phone: + 1-604-888-8818
Fax: + 1-604-888-5008
E-Mail: dsiamerica@dsiamerica.com

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