TENSA GRUPPO DE ECCHER | AMERICA

VOLUME	PRODUCTS CATALOGUE
02	**POST TENSIONING**

YOUR CHALLENGES,
OUR SOLUTIONS

High Speed Train line from Milan to Naples, Piacenza viaduct, Piacenza (Italy)

01

COMPANY PROFILE

Our mission is to constantly improve the methods
and the quality of construction processes
through research, innovation and cooperation
with designers, engineers and contractors worldwide.

TENSA

Tensacciai, now renamed TENSA, was founded in 1951 with headquarters in Milan, Italy.
It is now active in over 50 countries with a direct presence in 14 countries. TENSA is a leader in stay cables, post-tensioning, anti-seismic devices, structural bearings and expansion joints. TENSA has extensive references and numerous certifications for its products worldwide.

HISTORY

1951: Beginning of activity
1964: In the sixties Tensacciai undergoes a phase of remarkable growth in Italy. Post-tensioning is just at the beginning of its history and its application is still experimental.
1970: A programme of technological renewal begins with the adoption of the steel strand.
1980: Tensacciai develops new tensioning systems and equipment in the field of ground anchors, combining innovation with versatility and ease of use.
1990: New subsidiaries established in Brazil, India and Australia and in Europe sister companies in Portugal, Greece and the Netherlands.
2000: The internationalization process of Tensacciai continues unabated.
2010: The company becomes directly involved in projects in all five continents.
2011: Tensacciai is acquired by Deal - world leading solutions provider in the field of bridge construction - and becomes part of De Eccher Group. Tensacciai is now member of an organisation capable of designing, manufacturing and installing systems everywhere in the world, thanks to specialised technicians, engineers in the technical department and quality control. All production and delivery processes are attested by the ISO9001 certification.
2012: Tensacciai merges with Tesit, another successful concrete specialist contractor with international experience in post-tensioning, steel bars, structural bearings and expansion joints becoming a prominent player in the field of specialised subcontracting.
Tensacciai enters into a Worldwide Exclusive License Agreement with Rome-based TIS (Tecniche Idraulico-Stradali S.r.l.) - a leading company with experience in designing and producing structural bearings, expansion joints and anti-seismic devices since 1973.
2014: TIS is acquired by Tensacciai.
2015: TENSA is formed from the merging and development of the three important companies mentioned above: Tensacciai, Tesit, TIS.
After the successful completion of the Manhattan west project and the implementation of the Tensa stay cable system in the Pearl Harbor memorial bridge in New Haven, CT, Tensa America was established with main office in Miami, FL.

MISSION

Our mission is to constantly improve the methods and the quality of construction processes through research, innovation and cooperation with designers, engineers and contractors worldwide. A strong commitment to quality is the only way to ensure safe and long-lasting structures. We support the design from the initial stage, challenging standards to develop custom solutions. We value timely execution and service as keys to building long-term relationships.

Our core knowledge lies within stay-cables and post-tensioning systems, anti-seismic devices, structural bearings and expansion joints as well as all the related accessories, equipment and services.
TENSA strives to push its vast experience towards new methods and variations of applications, developing ingenious solutions for building new structures, whether they are buildings or infrastructures, as well as the rehabilitation of existing ones.

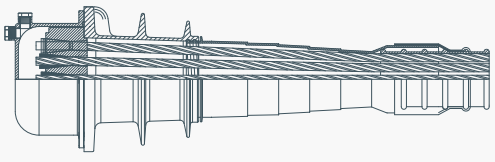
PRODUCT CATALOGUES

Highway viaduct, Loureiro (Portugal)

02

STRAND POST TENSIONING SYSTEMS

The post-tensioning system is suitable
for concrete, composite and steel structures.
A wide range of different systems is available.



GENERAL OVERVIEW

Post tensioning is a highly efficient structural reinforcement system that offers many benefits in a wide range of construction, repair and rehabilitation applications.
It can be applied in all types of construction, which include, without limitation, general buildings, special slabs, bridge decks, storage tanks, pavements and other geotechnical applications.

Compression stresses to concrete can be applied with the use of post tensioning tendons made of steel strands or steel bars.
When such tendons are fully installed in ducts within the concrete, post tensioning systems are defined as internal.
If the main tensile elements are in full adherence with the structure, the systems are defined as bonded, while they are unbonded in the other case.
In the event that the tendons are placed in ducts outside the concrete structure, such post tensioning systems are referred to as external.

Tendons are usually made of several strands (multi-strand systems), but mono-strand systems are also widely used.

High Speed Train line from Milan to Naples, Piacenza viaduct, Piacenza (Italy)

A post tensioning system employing strands is usually composed of:

PROPRIETARY COMPONENTS

Wedge: device capable of gripping the single strand and transferring the load to the anchor plate through the conical hole in it.
Wedge plate: steel disk hosting strands and wedges, resting over the cast-iron block embedded into the concrete.
Cast-iron block: piece designed to transfer the load to the surrounding concrete. In some systems it can also be designed to directly accomodate holes for wedges that grip the strand.
Deviation rear trumpet: when present, it is joined to the cast-iron block and permits the deviation of the entire bundle of strands entering the duct.
Confinement and Bursting reinforcement: spiral-shaped reinforcement and rebars properly placed around the anchorage to ensure the bearing of local high stresses and the containment of local tension-induced bursts.
Permanent protection cap: made of fiber reinforced plastic, it is used to cover the entire anchor plate and protect it from external agents.

STANDARD COMPONENTS

Seven wire steel strand: main tensile element transmitting the load through the entire tendon.
Ducts: they create void conduits where the bundle of strands is threaded.
Grout: a mix of water and cement-like materials required to fill the voids within the duct, providing protection and full bonding.
Corrosion protection injection compounds: materials used to protect the main tensile elements and the anchorages as a better performing alternative to simple grouting.
They are usually called “flexible fillers”.

QUALITY AND CERTIFICATIONS

POST-TENSIONING INSTITUTE ®

Post tensioning systems have been stringently tested under the requirements of AASHTO LRFD Specifications, PTI/ASBI M50 "Guide Specification for grouted post-tensioning" and State DOTs Specifications.
Tests have been performed in AASHTO qualified laboratories in full compliance with Technical Specifications.
TENSA AMERICA is member of Post-Tensioning Institute (PTI) and active part in Technical Committees.


Report for
TENSACCIAI srl
via Pordenone 8, 20132 Milano, Italy

251299

Report for Tensacciai 19AMTS15 AASHTO Load Efficiency Test

Date
April 29, 2013

Submitted by
Gary (Guan) Qian, Ph.D., P.E.
Principal Engineer

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Post-tensioning systems have also been tested as per European Technical Approval guideline ETAG013 and consequently granted European Technical Assessment 08/0012, 11/0007 and 15/0023.
Systems are also provided with relevant Declarations of Performance (CE marking).

As a specialized contractor with decades of experience in its specific field, TENSA does not only provide supply and installation services of the finished products, but it is also capable of providing a wide range of associated services, starting with the design, moving on to the assembly and laboratory testing, including the definition of operating manuals and installation procedures, and ending with the provision of all engineering services related to the installation and maintenance throughout the life of the post-tensioned works. All this is carried out by TENSA's own teams of specialised and highly experienced technicians under a system that promotes full accountability and is in compliance with the standards of ISO9001.

SYSTEM COMPONENTS

STEEL STRAND

Post tensioning tendons are usually made of strands 0.6'' (15.2mm) diameter. System is also available for 0.62'' (15.7mm) and 0.5'' (12.7mm).

Dimensions and properties of 7-wire strands according to ASTM A416/A416M

Grade - Tensile strength	[ksi]	270	270	270
	[MPa]	1860	1860	1860
Diameter	[in.]	0.6	0.62	0.5
	[mm]	15.2	15.7	12.7
Steel Area of Strand	[$in.^2$]	0.217	0.231	0.153
	[mm^2]	140	150	98.7
Mass of Strand	[lb/1000ft]	740	780	520
	[g/m]	1100	1200	780
Permissible variations in Diameter	[in.]	+0.026/-0.006	+0.026/-0.006	+0.026/-0.006
	[mm]	+0.65/-0.15	+0.65/-0.15	+0.65/-0.15
Minimum Breaking Strength of Strand	[kips]	58.6	62.8	41.3
	[kN]	261	279	184
Initial Load	[kips]	5.86	6.28	4.13
	[kN]	26.1	27.9	18.4
Minimum elongation	[%]	3.5	3.5	3.5
Relaxation after 1000 hours at 70% of minimum breaking strength	[%]	2.5	2.5	2.5

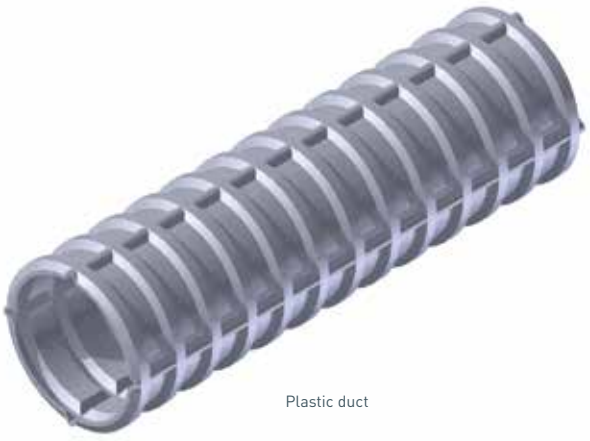
DUCTS

Depending on protection level classes required for the project, ducts for internal bonded PT, can be made of plastic material or galvanized steel sheaths.
Typically, as per PTI/ASBI M50, protection level class PL1 requires galvanized metal ducts while classes PL2 and PL3 are associated with plastic ducts.

They have a corrugated outside surface that guarantees the best possible adherence with the enveloping concrete.

In the case of the plastic ducts, the thickness varies from 0.098'' to 0.157''.

Dimensions used have to be in compliance with AASHTO requirements and in accordance with operating conditions.



Plastic duct

Galvanized metal sheath duct

Suggested technical data

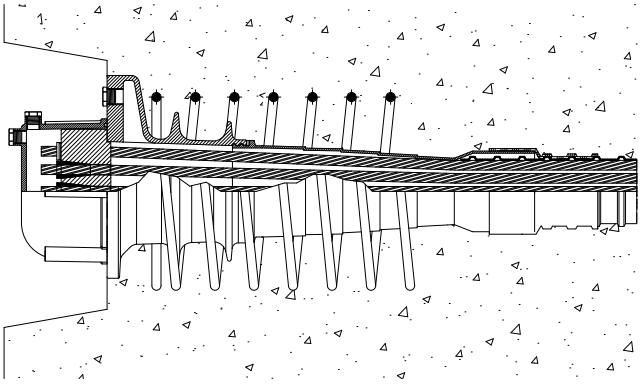
STRAND NO.		7	9	12	15	19	22	27	31	37
Internal Φ	[in.]	2.32	2.99	2.99	3.35	3.94	4.53	4.53	5.12	5.12
	[mm]	59	76	76	85	100	115	115	130	130
Grout requirement	[gal/ft]	0.14	0.26	0.23	0.29	0.42	0.59	0.53	0.72	0.65
	[l/m]	1.8	3.3	2.9	3.6	5.2	7.3	6.6	9.0	8.1

MULTI STRAND POST TENSIONING SYSTEMS

Multi-strands systems are provided with a wide range of anchorages and solutions for different construction needs.
They can be used in concrete and composite structures, both for new constructions and the rehabilitation of existing structures where an increase in resistance is required.

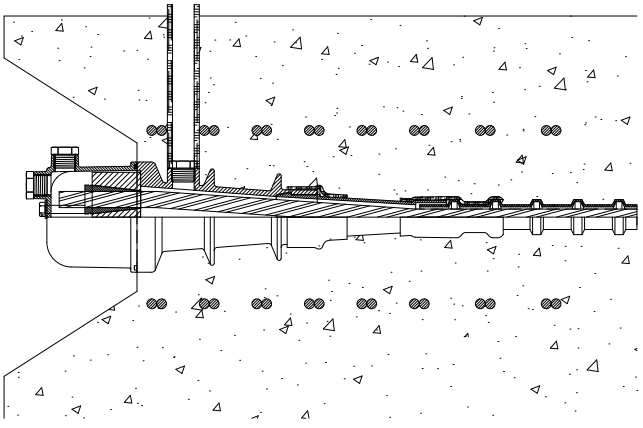
INTERNAL BONDED AMTS ANCHORAGE

The live anchorage AMTS has been designed and tested to meet the performance and corrosion protection requirements set in PTI/ASBI M50 Guide Specification for grouted post-tensioning.
It offers a wide range of sizes and a complete set of dedicated accessories to allow complete and satisfactory installation.
Standard product layout is designed in order to meet protection level class PL-2 as per PTI/ASBI M50 and FIB Bulletin 33 Recommendation.



INTERNAL FLAT BONDED APTS

The live flat anchorage APTS with its compact geometry is suitable for use in thin slabs and for decks' transversal post-tensioning.
It is in full compliance with performance and corrosion protection requirements set in PTI/ASBI M50 Guide Specification for grouted post-tensioning.
Standard product layout is designed in order to meet protection level class PL-2 as per PTI/ASBI M50 and FIB Bulletin 33 Recommendation.



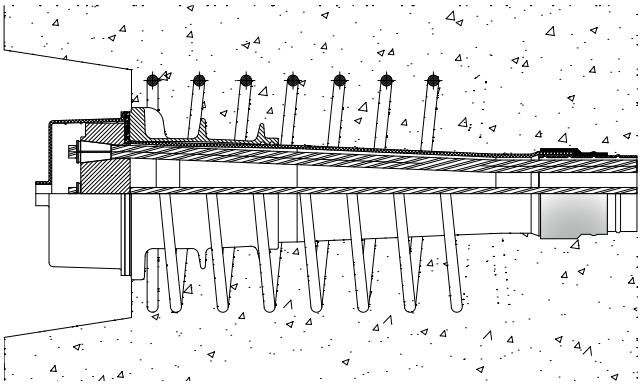
MTAID ELECTRICALLY INSULATED ANCHORAGE

MTAID anchorage for electrically insulated post tensioning is designed to meet the demand for a total and permanent protection of post tensioning tendons from corrosive agents. This protection is granted by the tendon's complete envelopment, which is made of:

•MTAID anchorage with anchor plate separated from the cast-iron block by means of rigid dielectric disks, plastic connectors positioned inside the cast-iron block and connected to the corrugated ducts by means of tight joint seals

• full covering plastic protection cap

• plastic ducts in the free length



The electrically insulated post tensioning system offers measurable advantages:

• electrical insulation of the cable from the surrounding environment and consequent protection against corrosion caused by electrochemical phenomena, oxidation and chlorides attack;

• possibility of controlling the protection's integrity through electrical resistance measures during the structures's lifetime.

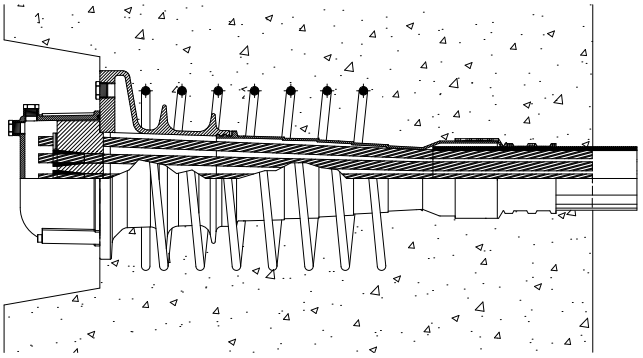
This system has been widely used and tested in the world's largest full scale application of its kind, the 4.3 km long Piacenza viaduct (Italy).

This system is in compliance with class PL-3 requirements of PTI/ASBI M50 "Guide Specification for Grouted Post-tensioning".

High Speed Train line from Milan to Naples, Piacenza viaduct, Piacenza (Italy)

EXTERNAL AMTS ANCHORAGE

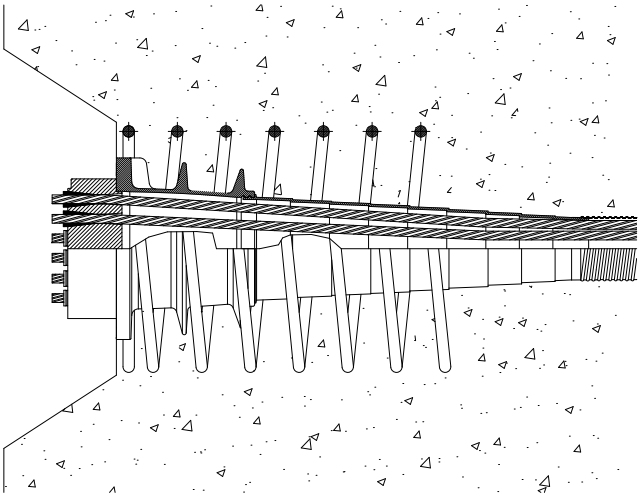
The live anchorage AMTS external allows the installation of a complete external tendon meeting requirements set in PTI/ ASBI M50 Guide Specification for grouted post-tensioning. It offers a wide range of sizes and a complete set of dedicated accessories to allow complete and satisfactory installation.



Full scale pressure tests

INTERNAL MTAI LIVE ANCHORAGE

The live anchorage MTAI is the most used and widely spread type of anchorage, whose compact geometry and reduced deviation angle provides a competitive advantage in all project applications, combined with high performance standards and ease of installation. It can be also used in the unbonded MTAIU version, where single sheathed strands are used.

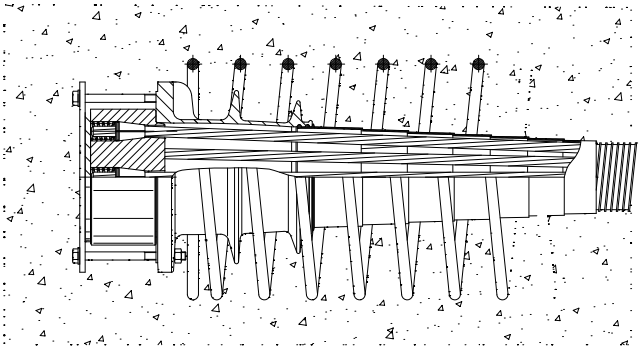


MTAI SYSTEM IN CRYOGENIC APLICATIONS

System has been successfully tested at cryogenic conditions as per ETAG013 and SR 88/2. Compliance for use in LNG tanks and special structures has been completely assessed by Third Party Laboratories.

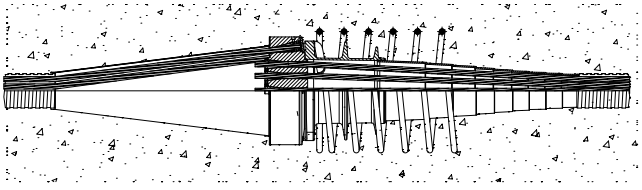
INTERNAL MTAIM DEAD ANCHORAGE

It is a non-accessible (dead) anchorage which is used in case accessibility during the stressing phases is not allowed.
In such a case strands are placed before pouring the concrete of the structure.



MTG COUPLER ANCHORAGE

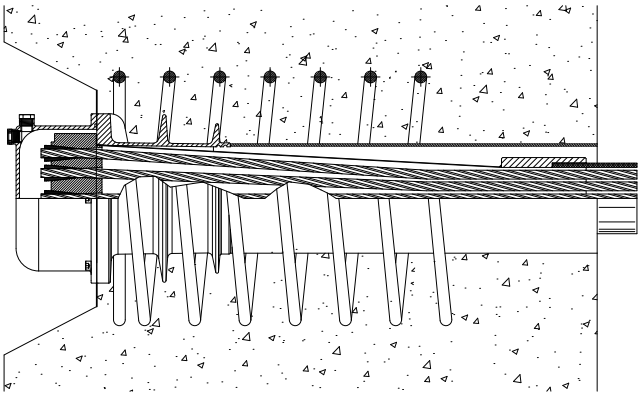
MTG system is the type of anchorage suitable for the coupling of tendons.
It is fully integrated with the MTAI system and allows installation of a secondary tendon after the primary one has been completely installed.



EXTERNAL MTAIE ANCHORAGE

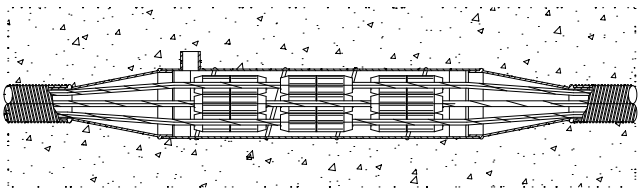
This anchorage can be used in external tendons and comes in different versions, such as:

- fully dismountable (MTAIE), through the presence of an inner steel cone that separates strands and inner protective injection from the surrounding elements in the anchorage zone;
- restressable (MTAIER) by means of a special long protection cap and the use of greased and coated strands;
- not exchangeable (MTAIEX).



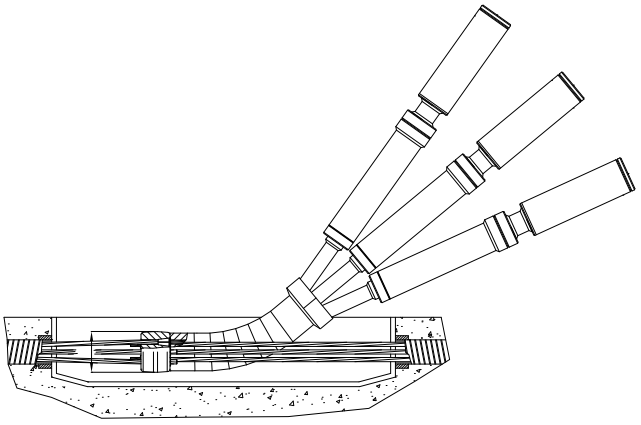
CU COUPLING SYSTEM

Single strand CU couplers are used to connect tendons built in different stages. Connection is made with single strand CU couplers, to be placed in different layers enabling a compact shape.



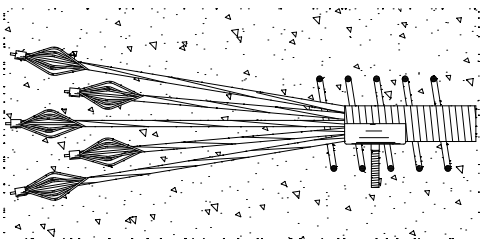
DF ANNULAR ANCHORAGE

Special rectangular anchorages are used for ring and intermediate post tensioning: these anchorages also use a special deviator for tensioning with mono-strand jacks.



ST ANCHORAGE

It is used as a dead end anchorage, done by creating a bulb end on each of the strands composing the tendon.



MONO STRAND POST TENSIONING SYSTEMS

Mono-strand systems are used for post tensioning of concrete slabs, pavements, separation walls and special concrete structures such as underground car parks, silos and tanks.
They can be used for unbonded or bonded applications.
TThe most widely-used is the unbonded application, where the use of greased and coated strands allows fast installation of mono-strand tendons without duct placing and absence of bond between plastic coating and concrete.
In such a case, the main advantages are:
• strands are covered with special corrosion inhibitor grease and with a proof PE coating;
• high performance in service conditions (SLS);
• possibility to maximize cables' eccentricity;
• rapidity of installation;
• reduction of cracking phenomena.

Isozaki Tower, Milan (Italy)

Suggested technical data

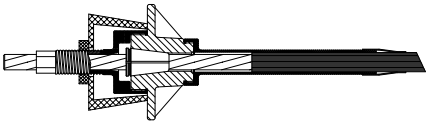
Diameter	[in.]	0.6	0.62
	[mm]	15.2	15.7
Grade - Ultimate strength	[ksi]	270	270
	[Mpa]	1860	1860
Area	[in.^{2}]	0.217	0.231
	[mm^2]	139	150
Maximum load	[kips]	58.6	62.8
	[kN]	259	279

In the case of bonded solutions, it is required to place corrugated metal sheaths or plastic ducts before concreting the structure and thread steel strands at the time of stressing.
Grout injection is then necessary to complete corrosion protection and guarantee the bond between the tensile elements and the surrounding duct and concrete.

Regione Piemonte Tower, Turin (Italy)

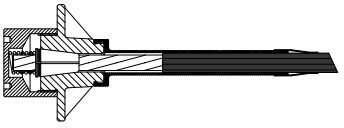
LIVE END TESIT 1C15 UL/BL

This anchorage is made of a single cast-iron piece which transfers the load from the tensile element to the concrete and hosts the wedge that grips the strand.
It is available either in the unbonded version 1C15UL or in the bonded 1C15BL, both complete with covering caps.



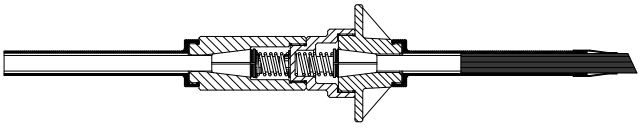
DEAD END TESIT 1C15 UD/BD

It is used where anchorage is not accessible for stressing operations.
It can be provided both in the unbonded version 1C15UD or in the bonded 1C15BD version, complete with their relevant wedge spring and fixing cap.



COUPLER TESIT 1C15 UC/BC

This system allows direct mechanical coupling of tendons that have been placed during different construction phases.

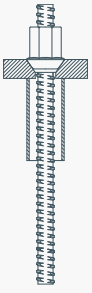


Isozaki Tower, Milan (Italy)

03

BAR POST TENSIONING SYSTEMS

Threaded steel bars can be used in different applications and structures, providing safe and reliable application of post tensioning.

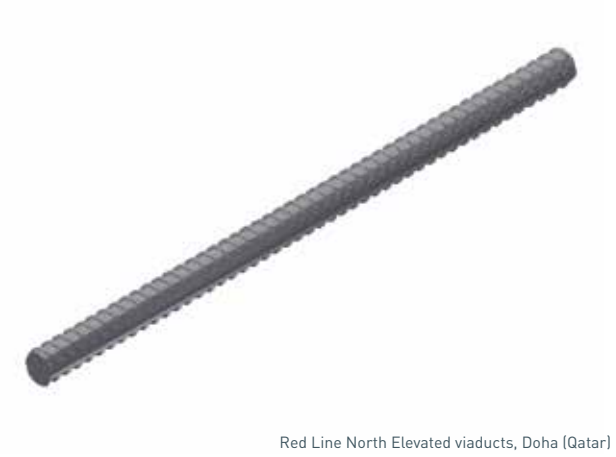


BAR POST TENSIONING SYSTEMS

TENSA AMERICA supplies bars with continuous thread for post tensioning applications in buildings, roads, bridges and viaducts, tunnels and mine shafts.
These systems can be provided in diameters varying from 26 to 75 mm, and are used worldwide in post tensioning and in pre-tensioning systems applications.
The advantages of using these post tensioning systems are several and are supported by excellent results achieved on various project sites.
Different corrosion protection systems and steel grades are available.

The main advantages are:
• Easy handling on-site;
• Continuous thread along the entire length of the bar, which ensures optimal adhesion to the cast in situ concrete;
• Cut to size and possibility of extension using couplers in any position of the bar;
• Different possibilities for protection against corrosive phenomena: galvanized, hot dip galvanized, epoxy coated, painted in accordance to different standards .

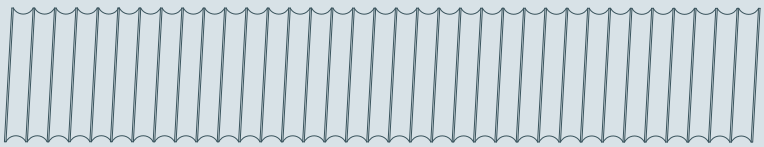
For special applications further steel grades are available.



Red Line North Elevated viaducts, Doha (Qatar)

STEEL BAR CHARACTERISTICS

CONTINUOUS LEFT OR RIGHT HAND, THREADED BAR, COLD ROLLED



R71 150 KSI ALL-THREAD-BAR

Nominal bar diameter & Pitch	[in.]	1''-4	1-1/4'' - 4	1-3/8'' - 4	1-3/4'' - 3-1/2''	2-1/4'' - 3-1/2''	2-1/2'' - 3	3'' - 3
	[mm]	26	32	36	46	57	65	75
Minimum net area	[in.^{2}]	0.85	1.25	1.58	2.6	4.08	5.19	6.46
	[mm^2]	549	807	1019	1664	2632	3350	4169
Minimum ultimate strength	[kips]	128	188	237	390	613	778	969
	[kN]	567	834	1054	1734	2727	3457	4311
Prestressing force 0,80f pu	[kips]	102	150	190	312	490	622	775
	[kN]	454	667	843	1388	2181	2766	3448
Prestressing force 0,70f pu	[kips]	89.3	131	166	273	429	545	678
	[kN]	397	584	738	1214	1909	2422	3018
Prestressing force 0,60f pu	[kips]	76.5	113	142	234	368	467	581
	[kN]	340	500	633	1041	1636	2074	2587
Nominal weight	[lbs./ft]	3.09	4.51	5.71	9.06	14.1	18.2	22.3
	[kg/m]	4.6	6.71	8.5	13.5	20.8	27.1	32.7
Approx. Thread major diameter	[in.]	1-1/8''	1-7/16''	1-9/16''	2''	2-1/2''	2-3/4''	3-3/64''
	[mm]	28.6	36.5	39.7	50.8	63.5	69.9	77.4

Several types of accessories are available to meet all design requirements. Full range of couplers, nuts and anchor plates, including special pieces can be provided on request. TENSA AMERICA is able to provide a wide range of product customization, for applications requiring new and different shapes. End caps are always placed when it is necessary to provide a protective injection in the anchorage zone.

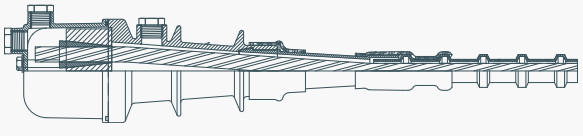
Bars can be provided with different corrosion protections such as spray galvanization, hot galvanization or epoxy coating.

Red Line North Elevated viaducts, Doha (Qatar)

04

SYSTEM PROPERTIES AND DIMENSIONS

An overlook of all the properties
and dimensions
listed in tables for each system.



MAIN FEATURES OF MULTI STRAND TENDONS

Strand diameter 0.6”

Nominal cross section area 0.217 in.^{2}

Nominal mass 740 lb/1000ft

Breaking strength 58.6 kips

STRAND NO.		4	7	9	12	15	19	22	27	31	37
Nominal cross section area of steel	[in.^{2}]	0.87	1.52	1.95	2.60	3.26	4.12	4.77	5.86	6.73	8.03
	[mm^2]	560	980	1260	1680	2100	2660	3080	3780	4340	5180
Nominal mass of steel	[lb/1000ft]	2960	5180	6660	8880	11100	14060	16280	19980	22940	27380
	[Kg/m]	4.4	7.7	9.9	13.2	16.5	20.9	24.2	29.7	34.1	40.7
Minimum resisting force of tendom	[kips]	234.4	410.2	527.4	703.2	879	1113.4	1289.2	1582.2	1816.6	2168.2
	[kN]	1044	1827	2349	3132	3915	4959	5742	7047	8091	9657

Strand diameter 0.62”

Nominal cross section area 0.231 in.^{2}

Nominal mass 780 lb/1000ft

Breaking strength 62.8 kips

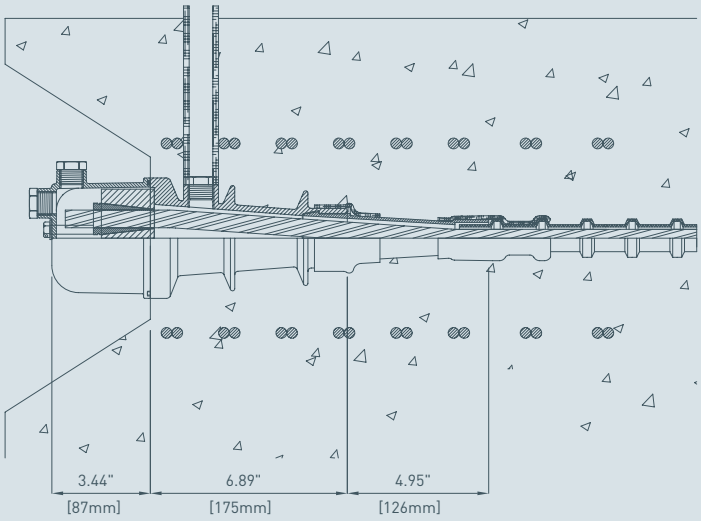
STRAND NO.		4	7	9	12	15	19	22	27	31	37
Nominal cross section area of steel	[in.^{2}]	0.92	1.62	2.08	2.77	3.47	4.39	5.08	6.24	7.16	8.55
	[mm^2]	600	1050	1350	1800	2250	2850	3300	4050	4650	5550
Nominal mass of steel	[lb/1000ft]	3120	5460	7020	9360	11700	14820	17160	21060	24180	28860
	[Kg/m]	4.8	8.4	10.8	14.4	18	22.8	26.4	32.4	37.2	44.4
Minimum resisting force of tendom	[kips]	251.2	439.6	565.2	753.6	942	1193.2	1381.6	1695.6	1946.8	2323.6
	[kN]	1116	1953	2511	3348	4185	5301	6138	7533	8649	10323

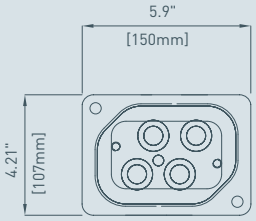
Steel strand properties according to ASTM A416.

The maximum pre-stressing force to be applied on the tendon is specified in the national standards and regulations in force in the place of use.

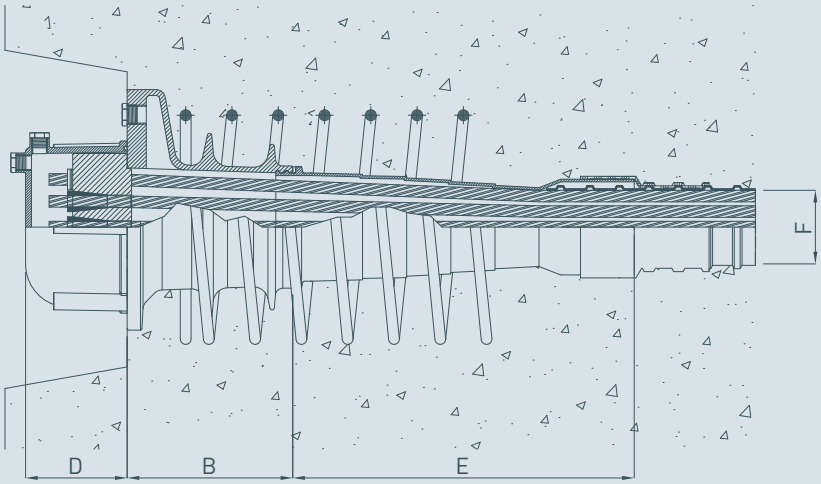
MULTI STRAND
POST TENSIONING SYSTEMS

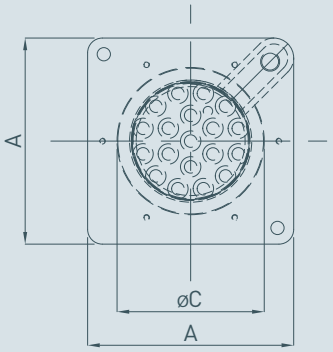
APTS SYSTEM





AMTS SYSTEM

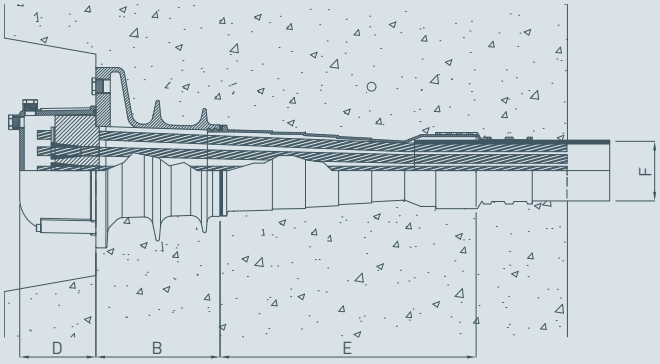


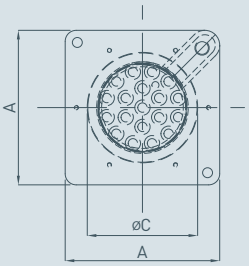


AMTS SYSTEM SIZE		7	12	15	19	27	31	37
A	[in.]	7.09	8.66	9.84	11.02	12.80	13.78	15.75
	[mm]	180	220	250	280	325	350	400
B	[in.]	4.72	7.48	8.19	8.86	9.84	11.81	14.17
	[mm]	120	190	208	225	250	300	360
C	[in.]	4.92	6.30	6.93	7.87	9.84	10.63	11.02
	[mm]	125	160	176	200	250	270	280
D	[in.]	4.02	4.76	5.24	5.43	6.57	6.81	7.01
	[mm]	102	121	133	138	167	173	178
E	[in.]	15.75	16.73	17.32	18.27	20.94	28.15	29.29
	[mm]	400	425	440	464	532	715	744
F (int) *	[in.]	2.32	2.99	3.35	3.94	4.53	5.12	5.12
	[mm]	59	76	85	100	115	130	130

* dimensions referring to corrugated plastic ducts, to be used with protection level PL-2 and PL-3, as per PTI/ ASBI M50 spec.
Dimensions given can be increased in case of need.

AMTS EXTERNAL SYSTEM

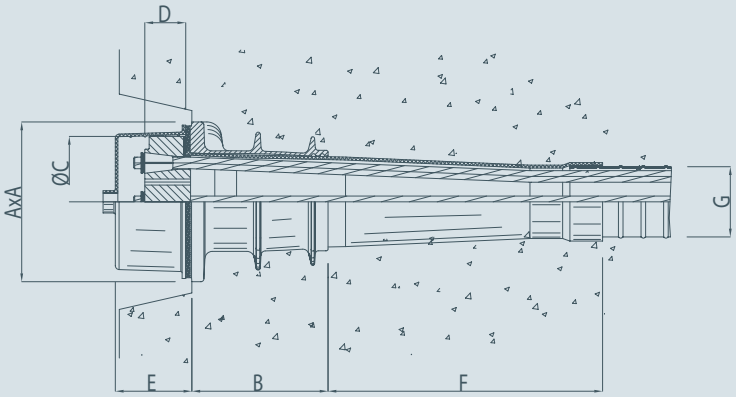




AMTS SYSTEM SIZE		7	12	15	19	27	31	37
A	[in.]	7.09	8.66	9.84	11.02	12.80	13.78	15.75
	[mm]	180	220	250	280	325	350	400
B	[in.]	4.72	7.48	8.19	8.86	9.84	11.81	14.17
	[mm]	120	190	208	225	250	300	360
C	[in.]	4.92	6.30	6.93	7.87	9.84	10.63	11.02
	[mm]	125	160	176	200	250	270	280
D	[in.]	4.02	4.76	5.24	5.43	6.57	6.81	7.01
	[mm]	102	121	133	138	167	173	178
E	[in.]	15.75	16.73	17.32	18.27	20.94	28.15	29.29
	[mm]	400	425	440	464	532	715	744
F (ext) *	[in.]	3.0	3.5	4.3	4.3	4.9	5.5	6.3
	[mm]	75	90	110	110	125	140	160

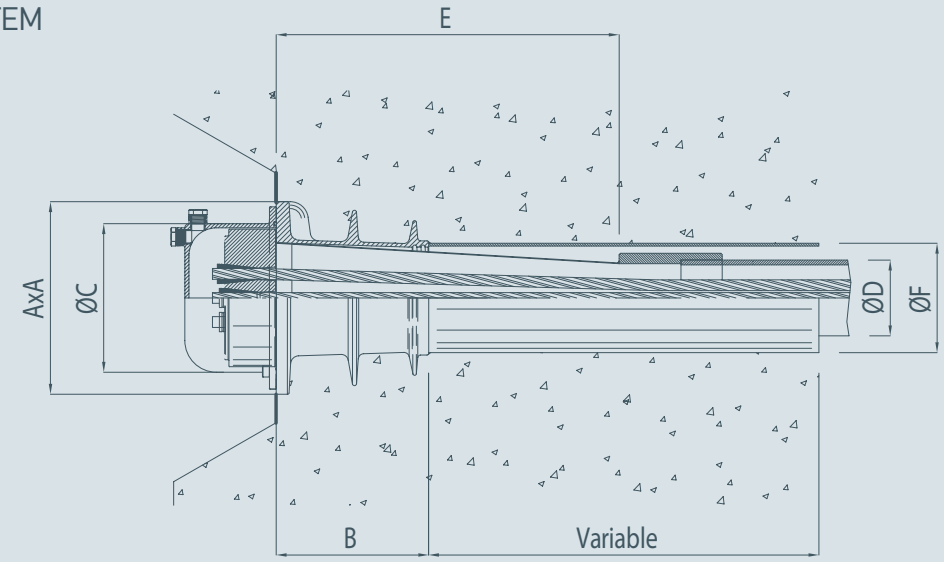
* dimensions referring to smooth plastic ducts. Dimensions given can be increased in case of need.

MTAID SYSTEM



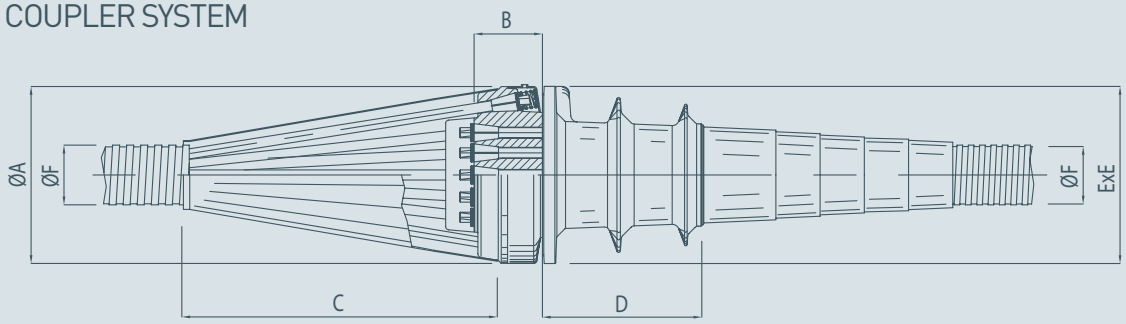
MTAID SYSTEM SIZE		4	7	9	12	15	19	22	27	31	37
A	[in.]	5.91	7.09	7.87	8.66	9.84	11.02	11.81	12.80	13.78	15.75
	[mm]	150	180	200	220	250	280	300	325	350	400
B	[in.]	3.94	4.72	7.09	7.48	8.19	8.86	9.45	9.84	11.81	14.17
	[mm]	100	120	180	190	208	225	240	250	300	360
C	[in.]	4.33	5.31	6.30	7.09	7.87	8.66	9.84	10.63	11.22	12.01
	[mm]	110	135	160	180	200	220	250	270	285	305
D	[in.]	1.77	1.93	2.05	2.44	2.72	2.91	3.15	3.43	3.58	3.78
	[mm]	45	49	52	62	69	74	80	87	91	96
E	[in.]	3.54	3.54	3.54	3.54	3.74	3,94	4.33	4.53	4.92	5.31
	[mm]	90	90	90	90	95	100	110	115	125	135
F	[in.]	15.35	22.24	19.69	19.88	15.04	22.05	19.29	24.21	24.02	31.30
	[mm]	390	565	500	505	382	560	490	615	610	795
G	[in.]	1.89	2.32	2.99	3.35	3.94	3.94	4.53	4.53	5.12	5.12
	[mm]	48	59	76	85	100	100	115	115	130	130

MTAIE SYSTEM



MTAIE SYSTEM SIZE		4	7	9	12	15	19	22	27	31	37
A	[in.]	5.91	7.09	7.87	8.66	9.84	11.02	11.81	12.80	13.78	15.75
	[mm]	150	180	200	220	250	280	300	325	350	400
B	[in.]	3.94	4.72	7.09	7.48	8.19	8.86	9.45	9.84	11.81	14.96
	[mm]	100	120	180	190	208	225	240	250	300	380
C	[in.]	5.31	6.30	6.97	7.68	8.27	9.65	10.43	11.61	12.99	12.99
	[mm]	135	160	177	195	210	245	265	295	330	330
D	[in.]	2.48	2.95	3.54	4.33	4.33	4.92	4.92	5.51	6.30	6.30
	[mm]	63	75	90	110	110	125	125	140	160	160
E	[in.]	12.20	14.17	16.93	17.72	20.47	23.62	25.98	27.56	29.53	31.50
	[mm]	310	360	430	450	520	600	660	700	750	800
F	[in.]	3.15	4.02	4.72	5.51	5.71	6.26	7.63	7.63	8.62	9.02
	[mm]	80	102	120	140	145	159	193.7	193.7	219	229

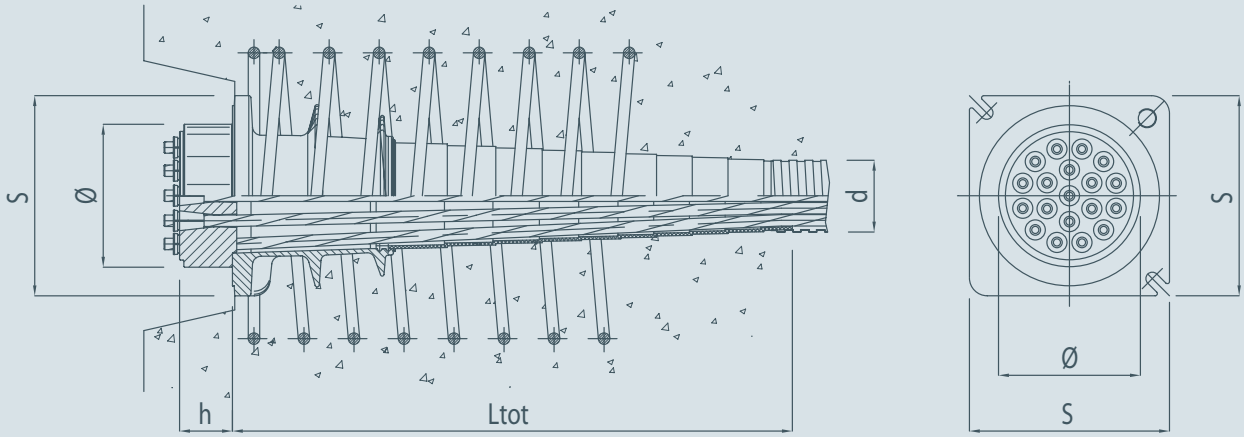
MTG COUPLER SYSTEM



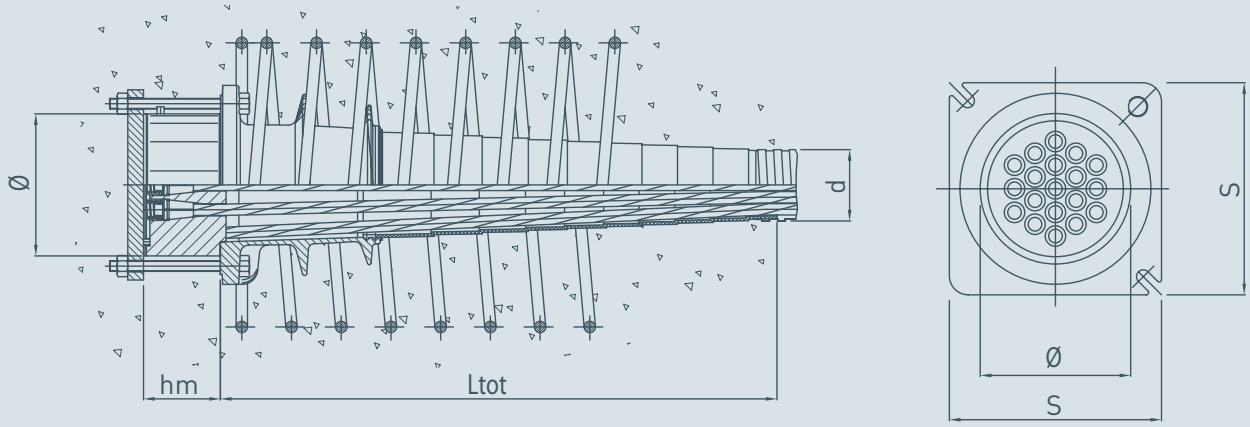
MTG SYSTEM SIZE		4	7	9	12	15	19	22	27	31	37
A	[in.]	7.28	8.46	9.06	9.76	10.43	11.02	13.39	13.39	15.35	16.93
	[mm]	185	215	230	248	265	280	340	340	390	430
B	[in.]	4.33	4.33	4.33	4.33	4.53	4.92	5.12	5.51	5.51	5.91
	[mm]	110	110	110	110	115	125	130	140	140	150
C	[in.]	12.99	14.96	15.75	16.93	18.11	18.11	23.62	23.62	28.74	32.09
	[mm]	330	380	400	430	460	460	600	600	730	815
D	[in.]	3.94	4.72	7.09	7.48	8.19	8.86	9.45	9.84	11.81	14.17
	[mm]	100	120	180	190	208	225	240	250	300	360
E	[in.]	5.91	7.09	7.87	8.66	9.84	11.02	11.81	12.80	14.57	15.75
	[mm]	150	180	200	220	250	280	300	325	370	400
F (int)*	[in.]	1.77	2.44	2.83	3.15	3.35	3.74	3.94	4.33	4.53	5.12
	[mm]	45	62	72	80	85	95	100	110	115	130

* dimensions referring to metal sheath ducts. Corrugated plastic ducts can also be used.

MTAI SYSTEM



MTAIM SYSTEM



MTAI/MTAIM SYSTEM SIZE		4	7	9	12	15	19	22	27	31	37	42	55
Ltot	[in.]	18.70	20.91	27.09	27.87	28.98	30.83	32.40	33.39	39.72	43.58	52.56	54.53
	[mm]	475	531	688	708	736	783	823	848	1009	1107	1335	1385
S	[in.]	5.91	7.09	7.87	8.66	9.84	11.02	11.81	12.80	13.78	15.75	18.70	18.70
	[mm]	150	180	200	220	250	280	300	325	350	400	475	475
Φ	[in.]	4.13	4.92	5.75	6.30	6.93	7.87	9.06	9.84	10.63	11.02	13.39	13.39
	[mm]	105	125	146	160	176	200	230	250	270	280	340	340
h	[in.]	1.77	1.93	2.05	2.44	2.72	2.91	3.15	3.43	3.58	3.78	5.12	5.35
	[mm]	45	49	52	62	69	74	80	87	91	96	130	136
hm	[in.]	3.03	3.31	3.31	3.62	3.86	4.17	4.33	4.53	4.80	5.16	6.30	6.57
	[mm]	77	84	84	92	98	106	110	115	122	131	160	167
d (int)*	[in.]	1.77	2.44	2.83	3.15	3.35	3.74	3.94	4.33	4.53	5.12	5.51	6.30
	[mm]	45	62	72	80	85	95	100	110	115	130	140	160

* dimensions referring to metal sheath ducts. Corrugated plastic ducts can also be used.

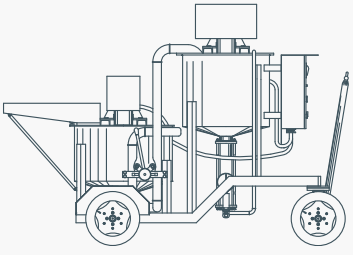
Red Line North Elevated viaducts, Doha (Qatar)

Jamal Abdul Nasser Street, Kuwait City (Kuwait)

05

INSTALLATION

Our teams take care of all installation phases, thanks to a decades-long experience in the filed and dedicated working procedures.



INSTALLATION PHASES

Installation of TENSA AMERICA's post-tensioning systems consists of the following phases:

PLACING OF THE DUCTS AND ANCHORAGE BODY

For internal post-tensioning, ducts are placed before concreting, fixed to the reinforcing steel of the structure to avoid that their position changes during the pouring phase.
For longitudinal post-tensioning they are usually placed following a parabolic layout.
Anchorage bodies are securely fastened to the formwork.

THREADING OF STRANDS

Strands are threaded one by one inside the placed duct, using special strand pushing machines.
Threading operations are carried out with care to avoid any damage to the strand or to the duct.
If required in special cases, it is also possible to have strands pulled together through ducts.

TENSIONING

Stressing in carried out using multi-strand or mono-strand jacks, depending on the system used and local jobsite conditions, all provided with automatic hydraulic lock-off system.

GROUTING

Grouting of tendon ducts is performed to protect strands from corrosion and can be performed either with cement grout or soft anti-corrosion compounds.
Tendons ducts are provided with air vent pipes at the highest points to ensure absence of vacuum pockets and must be completely tight.
In case of complex tendon layout or special applications, vacuum injection may be performed through the use of dedicated equipment.
In case of use of flexible filler, both for internal and external tendons, injection may be carried out with use of vacuum pumps.

TENSA AMERICA technicians are regularly trained and provided with PTI Level 1 and 2 Bonded Field Technician Certification and with ASBI grouting certification.

Together with its post-tensioning system TENSA AMERICA has developed a range of dedicated installation equipment, including multi and mono stressing jacks, hydraulic pumps, grouting pumps and load cells.
Nowadays TENSA AMERICA is proudly involved in design and production of new stressing jacks, applying technology and experience to achieve even more performing equipment.

Sa Carneiro Airport, Porto

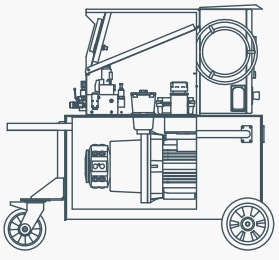
Isozaki Tower, Milan (Italy)

Manhattan West Platform, New York City (USA)

06

INSTALLATION EQUIPMENT

A wide range of equipment for tendons installation
that ensures a complete and safe work.



MULTI-STRAND AND MONO-STRAND JACKS

TENSA manufactures several types of multi-strand stressing jacks (mono-group), ranging from 1000 up to 10000 kN.
They have been designed and built considering the following stressing needs: minimum strand waste (300 mm to 500 mm), automatic lock-off, easy removal and control of the wedges, jack rotation around its own axis.

MTP SERIES

MTP series jacks are the latest evolution of TENSA's stressing equipment. This series has been designed bearing in mind all the lessons learnt from many years of experience on project sites all around the world, and is designed to guarantee top performance during installation.

MTA SERIES

MTA series jacks are the latest development of TENSA's multi-strand jacks, designed with front end master wedges gripping and short strands overlength needed.
Sizes and weights are combined to provide a good balance between performance and site needs. Jacks are completed as usual with automatic lock-off system and easy transport and movement connections.

PT SERIES (MONO-STRAND)

TENSA manufactures four types of mono-strand "PT" series jacks, which differ in terms of tensioning section, weight and dimensions. All jacks of the "PT" series are equipped with the automatic lock-off system.

STRESSING PUMP

TENSA offers a wide range of hydraulic pumps, which differ in terms of performance ratings, dimensions and weight. The "PT" series jacks require stressing pumps with power ratings ranging between 2.2 and 10 kW.
The MT, MTX and MTP series jacks require stressing pumps with power ratings ranging between 7.5 and 30 kW.
All TENSA pumps are equipped with an automatic lock-off circuit.

STRAND PUSHING MACHINE

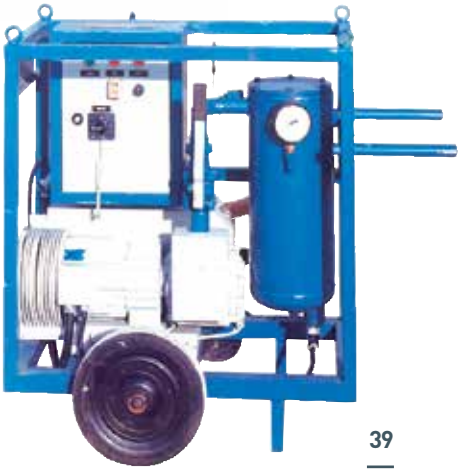
This equipment, designed to insert strands into the ducts, consists of a hydraulic pump and a unit able to push strands for long distances inside the conducts.
The two units can be installed at a remote location.
TENSA offers various models to meet all construction site requirements.

GROUTING PUMP

The "GP" pump is available in various models, which differ in terms of performance ratings. The grouting pump consists of an eccentric screw pump, a mixer and a turbomixer.
All the machines are equipped with a push-button control panel.

VACUUM PUMP

TENSA offers vacuum pumps with power ratings ranging from 4 kW to 7.5 kW. This pump is used to inject grout under a vacuum, thus guaranteeing perfect grouting without any immission of air.

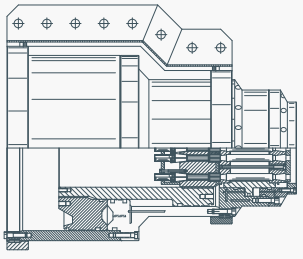


Covas Viaduct, Galicia (Spain)

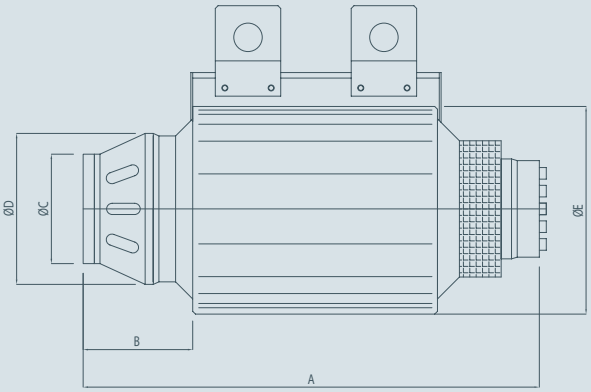
07

EQUIPMENT PROPERTIES AND DIMENSIONS

An overlook of all the properties and dimensions listed for each equipment.

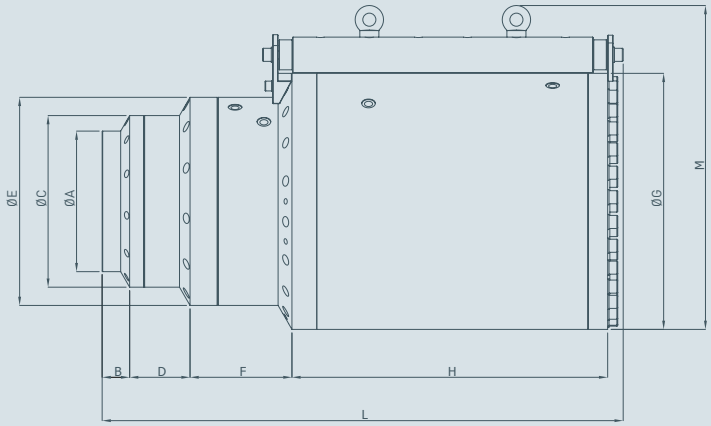


MTP SERIES



TYPE OF JACK		MTP (MS) 850kN	MTP (MS) 2600kN	MTP (MS) 4800kN	MTP (MS) 6800kN	MTP (MS) 7000kN	MTP (MS) 9750kN
Capacity	[kips]	191.09	584.51	1079.09	1528.71	1573.67	2191.90
	[kN]	850	2600	4800	6800	7000	9750
Stroke	[in.]	5.91	9.84	11.81	11.81	11.61	11.81
	[mm]	150	250	300	300	295	300
Weight	[lb]	233.69	639.33	1543.21	1929.01	2645.50	3902.12
	[kg]	106	290	700	875	1200	1770
Tensioning section	[in.²]	30.19	85.22	135.86	191.74	194.99	274.73
	[cm²]	194.78	549.78	876.51	1237.01	1258	1772.45
Max. tensioning pressure	[bar]	500	550	550	550	550	550
Tensioning over length with lock-off	[in.]	3.35	3.15	4.53	4.53	4.53	4.53
	[cm]	85	80	115	115	115	115
A	[in.]	19.41	34.65	47.24	47.24	50.20	47.24
	[mm]	493	880	1200	1200	1275	1200
B	[in.]	8.54	7.68	8.54	8.54	12.60	7.68
	[mm]	217	195	217	217	320	195
C	[in.]	5.35	8.94	10.08	10.08	12.60	14.57
	[mm]	136	227	256	256	320	370
D	[in.]	5.75	10.63	13.23	13.23	15.59	18.50
	[mm]	146	270	336	336	396	470
E	[in.]	9.06	14.76	22.05	22.05	22.05	26.77
	[mm]	230	375	560	560	560	680

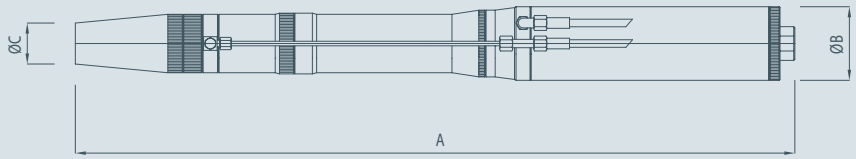
MTA SERIES



TYPE OF JACK		MTA 950kN	MTA 1700kN	MTA 2200kN	MTA 2900kN	MTA 3600kN	MTA 4600kN	MTA 5300kN	MTA 6500kN	MTA 7400kN	MTA 8800kN	MTA 10000kN
Capacity	[kips]	213.57	382.18	494.58	651.95	809.32	1034.13	1191.49	1461.27	1663.59	1978.33	2248.10
	[kN]	950	1700	2200	2900	3600	4600	5300	6500	7400	8800	10000
Stroke	[in.]	9.84	9.84	9.84	9.84	9.84	9.84	11.81	11.81	11.81	11.81	11.81
	[mm]	250	250	250	250	250	250	300	300	300	300	300
Weight	[lb]	330.69	551.15	992.06	1201.50	1344.80	1477.07	2160.49	2325.84	2755.73	3086.42	3417.11
	[kg]	150	250	450	545	610	670	980	1055	1250	1400	1550
Tensioning section	[in.²]	26.93	49.20	62.63	80.71	109.08	130.38	153.39	185.04	209.74	254.68	284.68
	[cm²]	173.72	317.42	404.06	520.72	703.72	841.16	989.6	1193.8	1353.17	1643.11	1836.62
Max. tensioning pressure	[bar]	550	550	550	550	550	550	550	550	550	550	550
Max. return pressure	[bar]	110	110	110	110	110	110	110	110	110	110	110
Max. locking pressure	[bar]	130	130	130	130	130	130	130	130	130	130	130
Tensioning over length with lock-off	[in.]	2.76	2.76	2.76	2.76	2.76	2.76	2.95	2.95	2.95	2.95	2.95
	[cm]	70	70	70	70	70	70	75	75	75	75	75
A	[in.]	5.39	6.61	7.44	7.99	8.86	10.16	10.87	11.54	13.11	14.29	15.75
	[mm]	137	168	189	203	225	258	276	293	333	363	400
B	[in.]	1.30	1.42	1.54	1.65	1.77	1.97	2.17	2.56	2.76	2.95	3.23
	[mm]	33	36	39	42	45	50	55	65	70	75	82
C	[in.]	7.68	9.06	9.84	10.63	11.22	12.40	13.58	14.17	16.14	17.72	19.29
	[mm]	195	230	250	270	285	315	345	360	410	450	490
D	[in.]	3.54	3.54	3.94	4.25	4.33	4.37	6.42	4.25	4.33	4.53	4.72
	[mm]	90	90	100	108	110	111	163	108	110	115	120
E	[in.]	10.63	11.81	12.60	13.27	13.86	15.04	16.22	16.81	18.50	19.69	21.26
	[mm]	270	300	320	337	352	382	412	427	470	500	540
F	[in.]	6.30	6.50	6.69	6.93	7.13	7.36	7.36	8.66	9.25	9.84	10.63
	[mm]	160	165	170	176	181	187	187	220	235	250	270
G	[in.]	12.60	13.39	14.17	15.16	16.54	18.50	20.47	21.46	22.24	23.43	24.80
	[mm]	320	340	360	385	420	470	520	545	565	595	630
H	[in.]	20.35	22.01	23.27	23.27	23.03	22.83	25.16	25.43	26.18	27.95	28.66
	[mm]	517	559	591	591	585	580	639	646	665	710	728
L	[in.]	31.50	33.46	35.43	37.20	37.40	37.68	42.20	42.20	42.52	45.28	47.24
	[mm]	800	850	900	945	950	957	1072	1072	1080	1150	1200
M	[in.]	17.72	18.50	19.29	20.16	21.46	23.43	25.98	26.69	27.76	28.94	30.31
	[mm]	450	470	490	512	545	595	660	678	705	735	770

MONO-STRAND STRESSING JACKS

PT SERIES



TYPE OF JACK		PT 150 kN	PT 200 kN	PT 250 kN	PT 300 kN
Capacity	[kips]	33.72	44.96	56.20	67.44
	[kN]	150	200	250	300
Stroke	[in.]	3.94	7.87	7.87	7.87
	[mm]	100	200	200	200
Weight	[lb]	35.27	50.71	50.71	61.73
	[kg]	16	23	23	28
Tensioning section	[in.²]	5.08	7.32	7.32	9.04
	[cm²]	32.8	47.2	47.2	58.32
Max. tensioning pressure	[bar]	550	450	550	550
Max. return pressure	[bar]	180	180	180	180
Max. locking pressure	[bar]	165	165	165	165
A	[in.]	26.97	37.68	36.61	34.41
	[mm]	685	957	930	874
B	[in.]	4.53	3.82	3.82	4.21
	[mm]	115	97	97	107
C	[in.]	1.50	2.09	2.13	51.00
	[mm]	38	53	54	57

TENSA GRUPPO DE ECCHER | AMERICA

Job title		Job No.
Design by	Date	Sheet No.
Item		

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