ELEBOR®

ΕΛΕΒΟΡ Α.Ε.Β.Ε.

ΕΛΛΗΝΙΚΟΣ ΓΕΩΤΕΧΝΙΚΟΣ ΕΞΟΠΛΙΣΜΟΣ

Συστήματα προεντάσεως TTM

TTM post-tensioning systems

Post-Tensioning

Boring – Drilling – Tunnelling – Mining – Construction – Geotechnical

Company profile

1968 > > > > > > > > 2013 >

Η **ΕΛΕΒΟΡ ΑΕΒΕ** είναι ενδεχομένως ο αρχαιότερος και πρωτοπόρος προμηθευτής ειδικού γεωτεχνικού εξοπλισμού στην Ελληνική αγορά, με δραστηριότητα που ξεκινά από το 1968. Η εταιρεία διαθέτει πολύ μεγάλη εμπειρία στην προμήθεια εξοπλισμού για γεωτρήσεις, έργα σηραγγοποιίας, μεταλλείων και γενικά υπογείων και γεωτεχνικών έργων.

Η **ΕΛΕΒΟΡ ΑΕΒΕ** παρακολουθεί διαρκώς τις εξελίξεις της τεχνολογίας του γεωτεχνικού εξοπλισμού και διαθέτει στην αγορά πρωτοποριακά προϊόντα σύγχρονης τεχνολογίας. Οι επιλογές στηρίζονται σε μεγάλο βαθμό στη μεγάλη εμπειρία καθώς και στην εξειδικευμένη επιστημονική κατάρτιση των στελεχών της εταιρείας που κατέχουν ανώτερους και ανώτατους επιστημονικούς τίτλους. Έτσι η εταιρεία σήμερα απολαμβάνει τη φήμη των «εξειδικευμένων – τεχνοκρατών» και με ικανοποίηση διαπιστώνει ότι οι πελάτες της απευθύνονται στην εταιρεία, όχι μόνο για την αγορά εξοπλισμού, αλλά και στην αναζήτηση προτάσεων και πιθανών λύσεων σε τεχνικά θέματα καθώς και συμβουλών για εξοικονόμηση του κόστους κατασκευής των έργων.

Η **ΕΛΕΒΟΡ ΑΕΒΕ** διαθέτει την ευρεία γκάμα προϊόντων και υπηρεσιών προεντάσεως του οίκου TTM Tension Technology Srl. που αντιπροσωπεύει αποκλειστικά.

Το 2010 η **ΕΛΕΒΟΡ ΑΕΒΕ** εντάχθηκε στην κοινότητα των ισχυρότερων Ελληνικών επιχειρήσεων που αξιολογούνται από την ICAP.

ELEBOR S.A. is possibly the oldest and pioneer supplier of specialized geotechnical equipment in the Greek market, with activity being traced back to 1968. Company's expertise is the supply of equipment for drilling, tunnelling, mining and generally for underground and geotechnical works.

ELEBOR S.A. is constantly monitoring the developments of the geotechnical equipment technology and offers to the market advanced products of the latest know-how. Product selections as well as related choices are primarily based on the long experience as well as on the specialized scientific skills of key members of the company. Thus, the company today has a reputation in the market as “specialized – technocrats” and with great satisfaction realizes that customers are contacting the company not only for purchasing products but also to receive support and suggestions to technical problems as well as to proposals for project cost-cutting solutions.

ELEBOR S.A. as exclusive distributor of TTM Tension Techology Srl. offers the complete range of TTM designed post-tensioning systems.

In 2010, **ELEBOR S.A.** was assessed by ICAP and awarded with the ICAP Strongest Companies in Greece Certificate.

CRFP1309Z7

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A company of the Group:

- ***ORI Martin s.p.a****.* ***(www.orimartin.it),*** *special steel production,*
- ***SLM s.p.a. (www.slmspa.com),*** *transformation of steel and strand production for post-tensioning systems,*
- ***Strand-Tech Martin Inc. (www.strandtech.com),*** *strand production for post-tensioning applications,*

TTM **tension technology** **s.r.l.** *was founded in 2001. Our company is specialized in the study, design and production of anchor systems and equipment for their implementation. The company is part of the Group* ***ORI MARTIN s.p.a*** *located in Brescia, which, since the beginning of '900 has worked in the steel industry sector, producing special and high quality steel. Since 1960 the company has differentiated its activities entering the world of major works with its experience in the steel industry and its deriving products.*
The company has grown its know-how working in this sector for many years. It is active both at national and global level with its equipment and specialized staff.

TTM **tension technology** **s.r.l.** *has strong skills in development and research; therefore, in just ten years since its establishment, the company has become a solid support for design and a trustworthy pole for the world of constructions requirements.*

The main aim of **TTM** **tension technology** **s.r.l.** *is to provide a wide range of products and services, from the production of steel and strand as its first product to offer engineering solutions for major works.*

TTM **tension technology** **s.r.l.** *offers to the world of design and constructions the following solutions:*

- ***Post-tensioning system for bridges and viaducts,*** *supplying post-tensioning systems for structures such as: bridges, viaducts, major systems, both bonded and unbonded,*
- ***Post-tensioning systems for slabs,*** *supplying both single strand and multi-strand bonded and unbonded post-tensioning systems for plates or slabs,*
- ***Consolidating systems for geotechnical applications,*** *supplying several types of permanent and temporary rock anchorages complying with* ***EURO NORM EN 1537 – 2002****, as follows: permanent/temporary repeated grout (I.R.) rock anchorages, permanent/temporary repeated*

selective grout (I.R.S.), removable permanent/temporary rock anchorages, partially removable permanent/temporary rock anchorages, increased adherence permanent/temporary rock anchorages, dielectric permanent rock anchorages and totally encapsulated permanent rock anchorages. Rock anchorages are available as strands and bars,

- ***Passive and active guying "MS" systems,*** *supplying guying systems,*
- ***Equipment for the implementation,*** *supplying equipment for the implementation of the systems provided, such as: hydraulic jacks, strand forcing machines, hydraulic pumps, grout pumps, special jacks, special equipment, production lines and cutting of strands,*
- ***Accessorial systems for several systems,*** *aimed at reducing the implementation time on site,*
- ***Road joints,*** *in rubber and steel,*

- ***Design and production of bridges support systems*** *(in steel and elastomer),*
- ***Expansion joints, for bridges and industrial applications,***
- ***Antiseismic isolation systems****, elastomeric restraints for bridges and buildings****,***

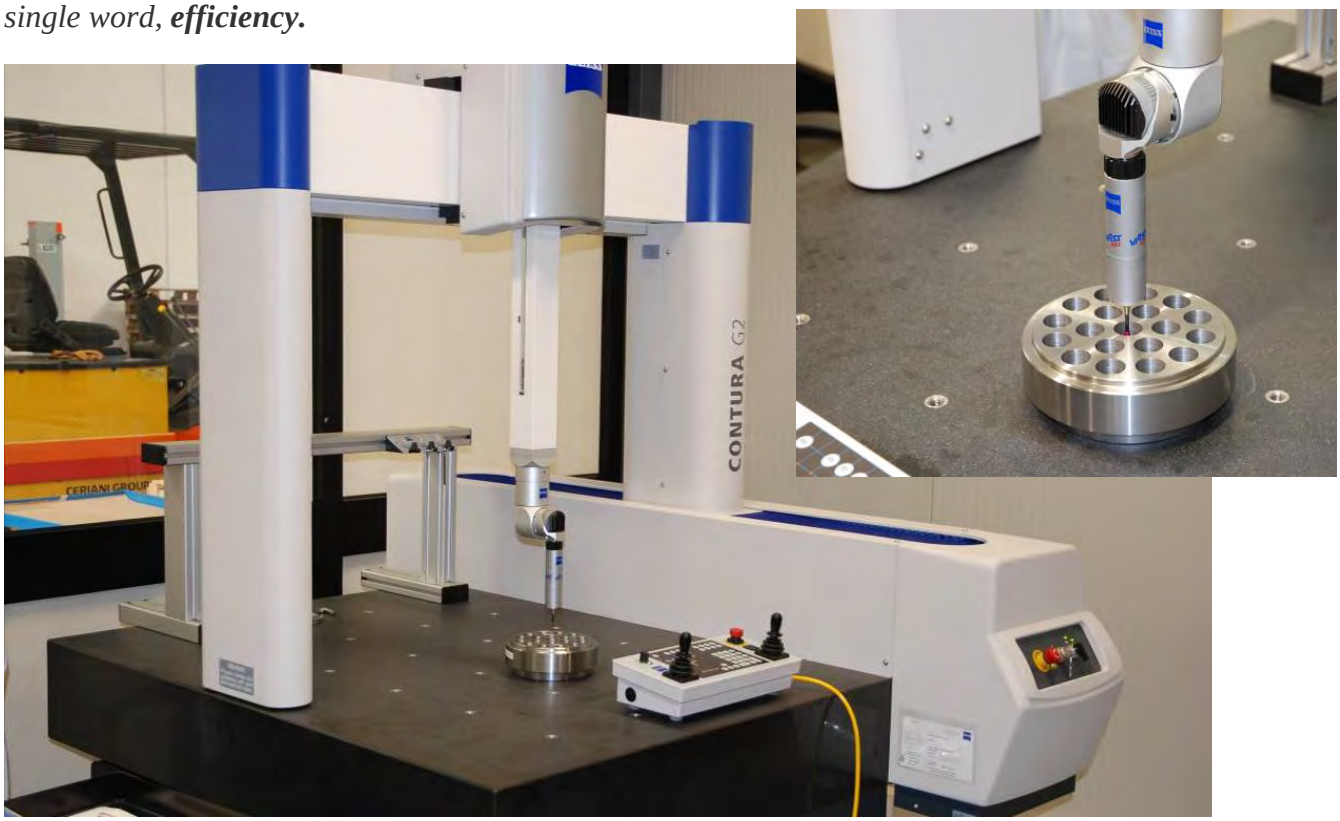
Post-tensioning systems for bridges and viaducts, **TTM tension technology s.r.l.** *in 2002 deposited with the Ministry as per* ***"Circular of 15th October 1996 no. 252 AA.GG./S.T.C."*** *for three types of strands: T15, T15S and T15C.* **TTM tension technology s.r.l.** *was the first company in Europe to offer other companies with the chance to apply post-tensioning systems with strands having a T15C section (with a section of 165 mm^2), therefore changing from strands with a section of 140 mm^2 to a section of 165 mm^2.*

The T15C strand allows to reduce the number of strands in cables, thus decreasing the class of anchorage. The systems provided are available both bonded and unbonded.

The post-tensioning systems for anchorages: M and D were awarded with the ***CE marking, according to the ETAG 013 guidelines*** *obtaining the European Technical Approval for its* ***multiple strand systems*** ***ETA-09-0013*** *and its relating marking* ***CE 0969-CPD-002/09-PT.***

Post-tensioning systems for slabs and plates, **TTM tension technology s.r.l.** *designed highly innovative encapsulated systems, which guarantee a total antioxidant effect, to offer its customers products with a higher durability and quality. The post-tensioning systems for anchorages: E, ED and EX were awarded with the* ***CE marking, according to the ETAG 013 guidelines*** *obtaining the European Technical Approval for its* ***single strand systems*** ***ETA-09-0012*** *and its relating marking* ***CE 0969-CPD-001/09-PT***

The concept of quality is highly variable. It is therefore rather difficult to give it a univocal definition. In general terms however, within companies all uses and functions of quality may be summed up in a single word, ***efficiency.***



Quality*, within business, means* ***improving*** *the production or supply of products or services while at the same time* ***reducing*** *costs.*

This is due to the fact that a great number of companies, whose organization or processes do not show adequate levels of quality, are characterized by many internal ***mistakes****, downtime, poor coordination so that a lot of activities are overlapping and disjoined,* ***waste*** *of resources and lack of instruments and procedures to* ***collect*** *feedback in order to start a process of* ***continuous improvement****. All these elements cause on the one hand the* ***dissatisfaction*** *on the part of the customer, and on the other hand an increase in* ***costs****.*

Every ***product*** *is the result of several elements such as resources, knowledge, procedures that are* ***organized*** *and* ***coordinated*** *in a precise structure. It is therefore clear that the* ***quality of a product*** *directly depends on the level of quality of the* ***organizational structure*** *itself.*
The ***improvement*** *of the company structure in terms of quality is quite* ***complex****.*
Not only economic resources are needed, but above all organizational capacities and knowledge on the factors that actually contribute to quality. **TTM** **tension technology s.r.l.** *gives a proper answer to this need thanks to its " team " of* ***experts*** *(engineers, land surveyors, technicians, operators, assistants, employees and workers) who, within the organization, harmoniously cooperate to provide companies with the* ***know-how*** *required to guarantee the total satisfaction of their needs in terms of results and development.*

TTM **tension technology s.r.l.** *developed very strict process and product control procedures. Its laboratory is equipped with the most sophisticated measuring and control devices to allow a complete assessment of the characteristics required by the drawings produced.*

TTM **tension technology s.r.l.** *is provided with:*

Microdurometer to assess the cementation thickness, the hardness at the core and on the surface on the locking wedges, optical instrument to survey the measures of profiles, roughness meter to check the finishing of the works bought and their correspondence to drawings, durometer to carry out hardness at the core and on the surface on mechanical pieces. Furthermore, our company is provided with all the devices to cut, to englobe test pieces into resin and polish them. Test pieces are then used to carry out analyses with the microdurometer on the seam and microhardness. For the current metrology, we are provided of a tridimensional control to eliminate any manual measurement of dimensions. This system allows to easily assess all the several dimensions reported on the drawings issued by the Engineering Department.

1.0 - MULTI-STRAND POST TENSIONING ANCHORAGES

The production of post-tensioning anchorages with corrosion protection is one of the main products offered by today's structural engineering. These solutions allow to consider encapsulated anchorages. ***EX*** *types for single strands and* ***MX®*** *for multi strands are designed to offer a high protection to anchorages over time against infiltration or against a corrosive environment.*

1E15 anchorage in uncovered steel

1EX15 anchorage in polyethylene covered steel

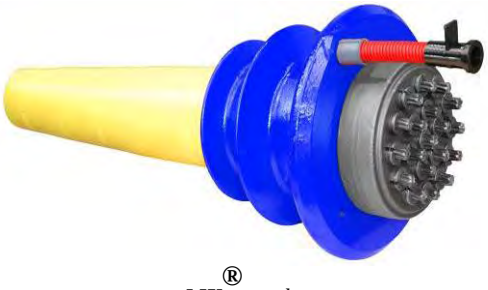
The durability of anchorages and their components reduces any maintenance on structures over time and allows to use permanent systems, which extend the life of the device by increasing their resistance against corrosion.

M *anchorage*

*"**M**" series active anchorages are designed for traditional post-tensioning applications. They are used with galvanized or non-galvanized metallic sheaths or polyethylene sheaths. The whole device is then grouted with cement mix. They are provided with front grouting hole and threaded holes to connect with the formwork. They are provided with a rear polyethylene cone for connection to several-diameter sheaths.*

M_{EP}® *anchorage*

*"**M_{EP}®**" series active anchorages are designed for post-tensioning applications in an aggressive environment. They offer casting covered in epoxy-polyester coating as corrosion protection and polyethylene cap to protect the anchor block, all grouted with grease.*



MX® *anchorage*

*"**MX®**" series active anchorages are designed for post-tensioning applications in a highly aggressive environment. The anchorage is* ***completely encapsulated in polyethylene*** *on both casting and polyethylene cap to protect the anchor block, all grouted with grease.*

D_{EP}® *anchorage*

*"**D**" series passive anchorages are designed for traditional post-tensioning applications where passive anchorages are to be applied. The anchor plate is supplied preassembled with fixing screws.*
All anchorages are provided with front grouting hole and sealed, grease-filled plate. Anchorages are provided with a rear polyethylene cone for connection to several-diameter sheaths. M castings are available in three different versions with several levels of corrosion protection: ***M***, M_{EP}® *and* ***MX*** ®.

M *casting in cast iron with no corrosion protection*

M *type natural casting with no corrosion protection in sandblasted cast iron.*

M_{EP}® *casting in cast iron protected with an epoxy coating*

M_{EP}® *type coated casting with epoxy-polyester coating. This coating guarantees protection against corrosion.*

MX ® *casting in cast iron protected with polyethylene*

MX ®*type casting coated with polyethylene/polypropylene. The anchorage offer the best protection against corrosion, thus allowing to obtain a perfectly encapsulated anchorage.*
The connection is common for all applications on M and D anchorages, and thus allows a proper connection to sheaths of several dimensions and is not exposed to corrosion.

The several dimensions of all possible connections are embossed on the connection.
The production of anchorages with corrosion protection is designed to offer a protection (encapsulation) of anchorages with polyethylene or polypropylene.
The polyethylene restrained inside cement guarantees protection for the whole anchorage, remaining stable over time against contact with any external agent that may cause oxidation on the anchorage.

1.1 - Post tensioning anchorages and protection classes

M^A anchorage in A protection

(Internal bonded post-tensioning, bare strand with cement grouting)

M *anchorage for* ***normal internal bonded post-tensioning****, made of: casting, anchor plate with wedges, polyethylene connection, wedges and metallic corrugated sheath. The anchorage is protected against corrosion with A level.*

$M_{EP}^{B®}$ anchorage in B protection

(Internal bonded post-tensioning, bare strand with cement grouting)

$M_{EP}^{B®}$ *anchorage in* ***B*** *protection for* ***internal bonded post-tensioning,*** *made of: casting protected with epoxy coating, anchor plate with wedges, polyethylene connection, wedges and galvanized metallic corrugated sheath. The anchorage is protected against corrosion with F level.*

$M_{EP}{}^{C®}$ anchorage in C protection

(Internal bonded post-tensioning, bare strand with cement grouting)

$M_{EP}{}^{C®}$ *anchorage in **C** protection for **internal bonded post-tensioning,** made of: casting protected with epoxy coating, anchor plate with wedges, polyethylene connection, protection cap, wedges and galvanized metallic corrugated sheath. The permanent protection cap allows to protect the anchorage by restraining the grouting and by preventing infiltration into the protection cement over time. The anchorage is protected against corrosion with C level.*

$M_{EP}{}^{D®}$ anchorage in D protection

(Internal bonded post-tensioning, bare strand with cement grouting)

$M_{EP}{}^{D®}$ *anchorage in **D** protection for **internal bonded post-tensioning,** made of: casting protected with epoxy coating, anchor plate with wedges, polyethylene connection, protection cap, wedges and polyethylene corrugated sheath. The permanent protection cap allows to protect the anchorage by restraining the grouting and by preventing infiltration into the protection cement over time. The anchorage is protected against corrosion with D level.*

$MX^{E®}$ anchorage in E protection

(Internal bonded post-tensioning, bare strand with cement grouting)

$MX^{E®}$ *anchorage in **E** protection for **internal bonded post-tensioning, completely encapsulated in polyethylene,** made of casting externally protected with polyethylene, anchor plate with wedges, polyethylene connection, grease-grouted protection cap, wedges and polyethylene corrugated sheath. The permanent protection cap allows to protect the anchorage by filling it with grease, which is a further protective barrier. The anchorage is protected against corrosion with E level.*

MX $^{F®}$ anchorage in F protection

(Internal unbonded post-tensioning, cement grouting covered and greased strand)



MX$^{F®}$ *anchorage in* ***F*** *protection for* ***internal bonded post-tensioning, completely encapsulated in polyethylene,*** *made of casting externally protected with polyethylene, anchor plate with wedges, polyethylene connection, grease-grouted protection cap, wedges and use of coated strands. The permanent protection cap allows to protect the anchorage by filling it with grease, which is a further protective barrier. The sheath grouting is restrained and filled with grease inside the anchorage. The anchorage is protected against corrosion with F level.*

MX $^{G®}$ anchorage in G protection

(Internal unbonded post-tensioning, bare strand with cement grouting)

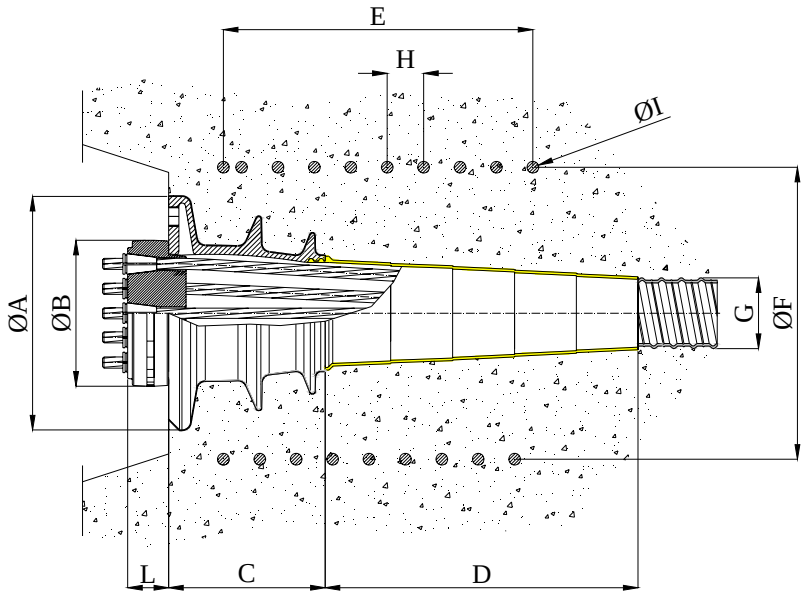


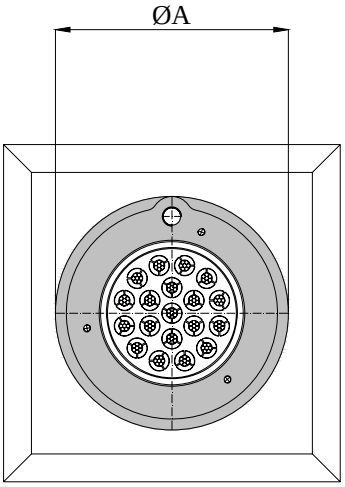
MX$^{G®}$ *anchorage in* ***G*** *protection for* ***internal bonded post-tensioning, completely encapsulated in polyethylene,*** *made of: casting externally protected with polyethylene, anchor plate with wedges, polyethylene connection, grease-grouted protection cap, wedges and use of bare strands with grease grouting on the whole length of the cable. The permanent protection cap allows to protect the anchorage with grease filling, which is a further protective barrier besides the polyethylene used as first protection element. The sheath grouting is restrained and filled with grease inside the anchorage. The anchorage is protected against corrosion with G level.*

19M15 anchorage

*The "**M**" system is designed to comply with the guidelines **ETAG 013** and it is awarded with the European Technical Approval **ETA-09-0012** and the marking **CE 0969-CPD-001/09-PT**.*
The anchorage is made of: an anchor plate, wedges, connection and anchor casting.
*Simulations made with finite element codes and laboratory tests allowed to design a compact anchorage to comply with the guidelines **ETAG 013.***

*The "**M**" series active anchorage is made of the following parts: casting, anchor plate, wedges and connection in H.D.P.E. to connect the casting to the metallic or polyethylene sheath. Castings have a turned plane for the plate, holes for connection to cap and formwork and a threaded grouting hole. Castings are in spheroidal cast iron EN-GJS 500-7 EN-JS-1050, which offers a high resistance to stress. Being weldable, it guarantees the maximum safety during installation.*
Strands are blocked on a distribution plate with truncated cone holes in steel C40-45 UNI EN 10083/1 and by means of wedges in steel 16NiCr4Pb UNI EN 10277-4.
The anchorage and the sheaths are connected by means of a truncated cone connection that guarantees a correct deviation of strands, minimizing the values of losses. The connection is made of H.D.P.E. and suitable for the connection to several-diameter sheaths.
All castings have threaded holes on the plane to allow an easy fixing to the formwork by means of bolts.
All castings have a gas threaded hole for grouting to allow the connection to the several solutions available for grouting. Castings may be supplied with an epoxy coating protection on request.

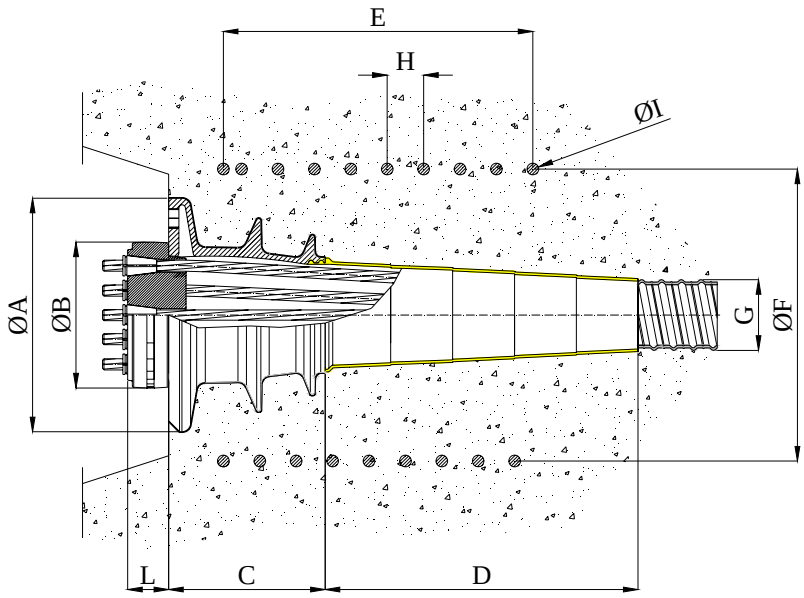


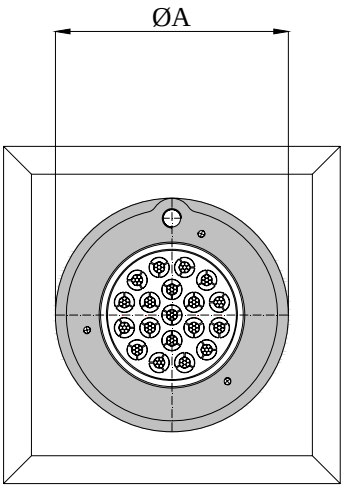


Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***L***
	T15	***T15S***	***T15C***										
	259	*279*	*307*										
	per cable	***per cable***	***per cable***										
	(KN)	*(KN)*	*(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4M15	*1036*	*1116*	*1228*	*160*	*105*	*103*	*300*	*180*	*170*	*45/50*	*45*	*12*	*45*
7M15	*1813*	*1953*	*2149*	*200*	*125*	*133*	*340*	*250*	*220*	*62/67*	*45*	*12*	*45*
9M15	*2331*	*2511*	*2763*	*235*	*146*	*163*	*380*	*250*	*250*	*72/77*	*45*	*14*	*45*
12M15	*3108*	*3348*	*3684*	*265*	*160*	*180*	*385*	*300*	*300*	*80/85*	*50*	*16*	*45*
15M15	*3885*	*4185*	*4605*	*290*	*176*	*197*	*405*	*350*	*355*	*85/90*	*50*	*16*	*45*
19M15	*4921*	*5301*	*5833*	*320*	*200*	*215*	*430*	*425*	*400*	*95/100*	*50*	*16*	*56*
22M15	*5698*	*6138*	*6754*	*355*	*230*	*260*	*430*	*425*	*420*	*100/105*	*50*	*18*	*61*
27M15	*6993*	*7533*	*8289*	*380*	*250*	*277*	*470*	*400*	*460*	*110/115*	*50*	*18*	*70*

Our company reserves the right to change our products and specifications without any previous notice. *(Measures in mm.)*

12M15 and 19M15 anchorages





Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***L***
	T15	***T15S***	***T15C***										
	259	*279*	*307*										
	per cable	***per cable***	***per cable***										
	(KN)	*(KN)*	*(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4M15	*1036*	*1116*	*1228*	*160*	*105*	*103*	*300*	*205*	*180*	*45/50*	*45*	*12*	*45*
7M15	*1813*	*1953*	*2149*	*200*	*125*	*133*	*340*	*270*	*240*	*62/67*	*45*	*12*	*45*
9M15	*2331*	*2511*	*2763*	*235*	*146*	*163*	*380*	*270*	*300*	*72/77*	*45*	*14*	*45*
12M15	*3108*	*3348*	*3684*	*265*	*160*	*180*	*385*	*350*	*350*	*80/85*	*50*	*16*	*45*
15M15	*3885*	*4185*	*4605*	*290*	*176*	*197*	*405*	*450*	*410*	*85/90*	*50*	*16*	*45*
19M15	*4921*	*5301*	*5833*	*320*	*200*	*215*	*430*	*450*	*400*	*95/100*	*50*	*16*	*56*
22M15	*5698*	*6138*	*6754*	*355*	*230*	*260*	*430*	*425*	*420*	*100/105*	*50*	*18*	*61*
27M15	*6993*	*7533*	*8289*	*380*	*250*	*277*	*470*	*480*	*460*	*110/115*	*50*	*18*	*70*

Our company reserves the right to change our products and specifications without any previous notice. *(Measures in mm.)*

3.0 - "M_{EP}® " SERIES ACTIVE ANCHORAGES

19M15 anchorage

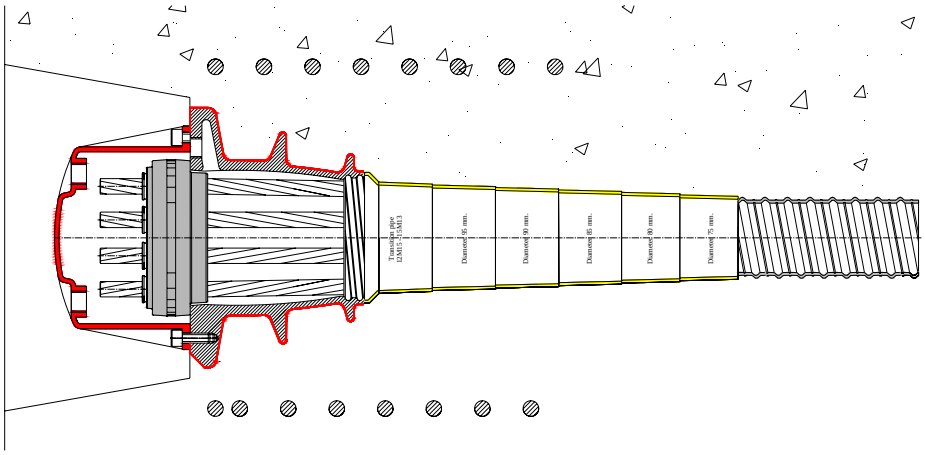
*The anchorage is made of: an anchor plate, wedges, connection and anchor casting. The anchor casting is protected with an epoxy-polyester coating to guarantee the anchorage with a proper protection against corrosion. The "**M_{EP}®**" anchorage is also provided with a closing cap to protect the anchor plate. The protection with coating can be provided with several protection levels: **"M_{EP}® I", "M_E® II"** and **"M_{EP}® III"***

*The **M_{EP}® I** anchorage in I protection is provided with a coating that has a salt spray test resistance of 250 hours*

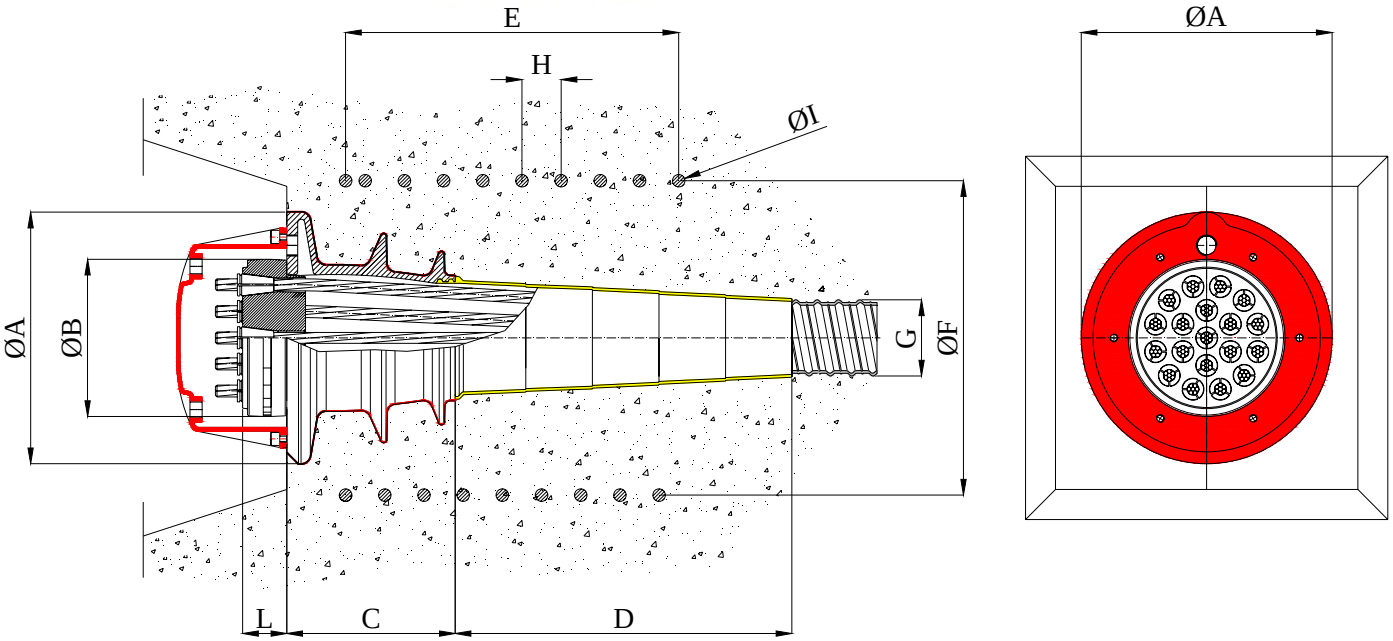
*The **M_{EP}® II** anchorage in II protection is provided with a coating that has a salt spray test resistance of 350 hours*

*The **M_{EP}® III** anchorage in III protection is provided with a coating that has a salt spray test resistance of 700 hours*

Galvanized steel has a salt spray corrosion resistance of 90 hours.



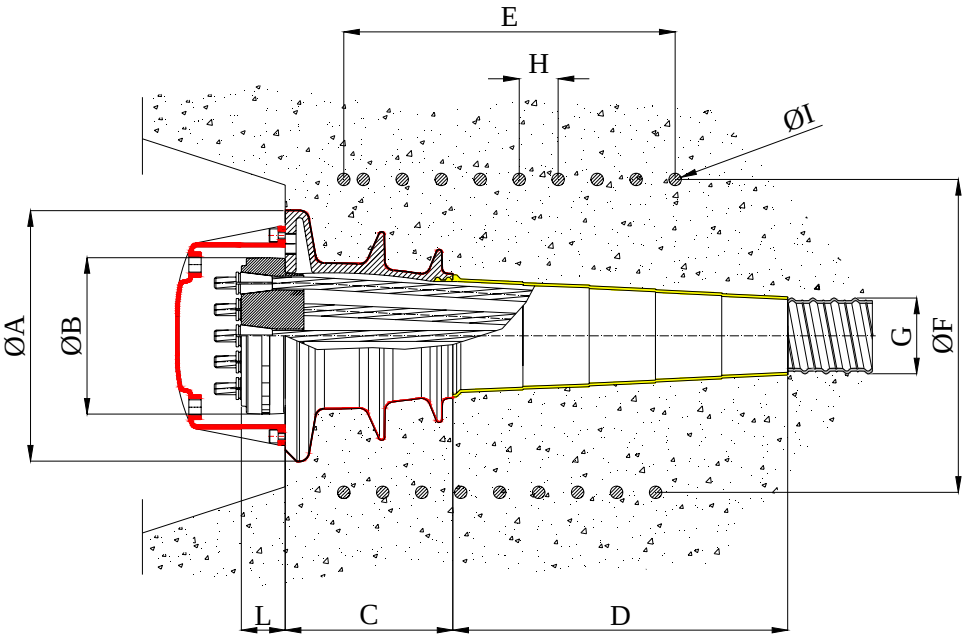
*The "**M**" series active anchorage is made of the following parts: casting, anchor plate, wedges and connection in H.D.P.E. to connect the casting to the metallic or polyethylene sheath. Castings have a turned plane for the plate, holes for connection to cap and formwork and a threaded grouting hole. Castings are in spheroidal cast iron EN-GJS 500-7 EN-JS-1050, which offers a high resistance to stress. Being weldable, it guarantees the maximum safety during installation.*
Strands are blocked on a distribution plate with truncated cone holes in steel C40-45 UNI EN 10083/1 and by means of wedges in steel 16NiCr4Pb UNI EN 10277-4.
The anchorage and the sheaths are connected by means of a truncated cone connection that guarantees a correct deviation of strands, minimizing the values of losses. The connection is made of H.D.P.E. and suitable for the connection to several-diameter sheaths.
All castings have threaded holes on the plane to allow an easy fixing to the formwork by means of bolts.
All castings have a gas threaded hole for grouting to allow the connection to the several solutions available for grouting. Castings may be supplied with an epoxy coating protection on request.

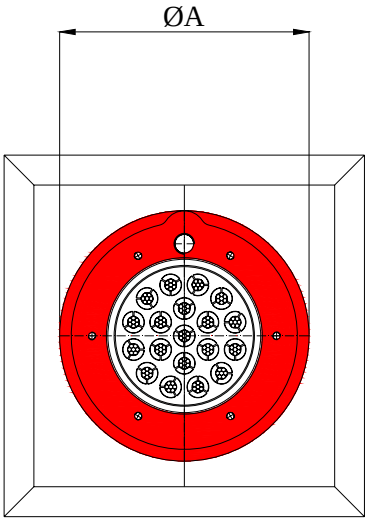


Type	Ultimate load			A	B	C	D	E	F	G	H	I	L
	T15	T15S	T15C										
	259	279	307										
	per cable	per cable	per cable										
	(KN)	(KN)	(KN)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)
4M15	1036	1116	1228	160	105	103	300	180	170	45/50	45	12	45
7M15	1813	1953	2149	200	125	133	340	250	220	62/67	45	12	45
9M15	2331	2511	2763	235	146	163	380	250	250	72/77	45	14	45
12M15	3108	3348	3684	265	160	180	385	300	300	80/85	50	16	45
15M15	3885	4185	4605	290	176	197	405	350	355	85/90	50	16	45
19M15	4921	5301	5833	320	200	215	430	425	400	95/100	50	16	56
22M15	5698	6138	6754	355	230	260	430	425	420	100/105	50	18	61
27M15	6993	7533	8289	380	250	277	470	400	460	110/115	50	18	70

Our company reserves the right to change our products and specifications without any previous notice. *(Measures in mm.)*

12M15 and 19M15 anchorages





Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***L***
	T15 *259* ***per cable*** *(KN)*	***T15S*** *279* ***per cable*** *(KN)*	***T15C*** *307* ***per cable*** *(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4M15	*1036*	*1116*	*1228*	*160*	*105*	*103*	*300*	*180*	*170*	*45/50*	*45*	*12*	*45*
7M15	*1813*	*1953*	*2149*	*200*	*125*	*133*	*340*	*250*	*220*	*62/67*	*45*	*12*	*45*
9M15	*2331*	*2511*	*2763*	*235*	*146*	*163*	*380*	*250*	*250*	*72/77*	*45*	*14*	*45*
12M15	*3108*	*3348*	*3684*	*265*	*160*	*180*	*385*	*300*	*300*	*80/85*	*50*	*16*	*45*
15M15	*3885*	*4185*	*4605*	*290*	*176*	*197*	*405*	*350*	*355*	*85/90*	*50*	*16*	*45*
19M15	*4921*	*5301*	*5833*	*320*	*200*	*215*	*430*	*425*	*400*	*95/100*	*50*	*16*	*56*
22M15	*5698*	*6138*	*6754*	*355*	*230*	*260*	*430*	*425*	*420*	*100/105*	*50*	*18*	*61*
27M15	*6993*	*7533*	*8289*	*380*	*250*	*277*	*470*	*400*	*460*	*110/115*	*50*	*18*	*70*

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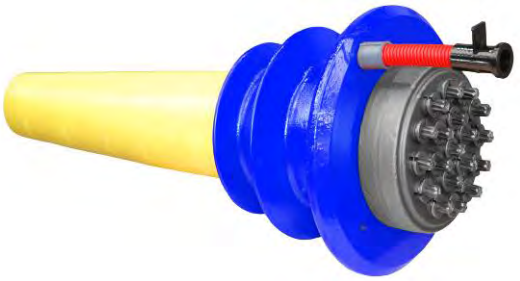
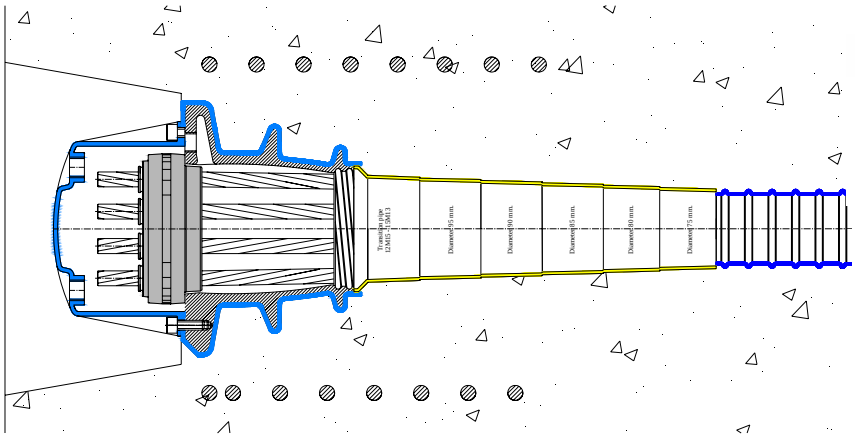
4.0 - "MX ® " SERIES ACTIVE ANCHORAGES



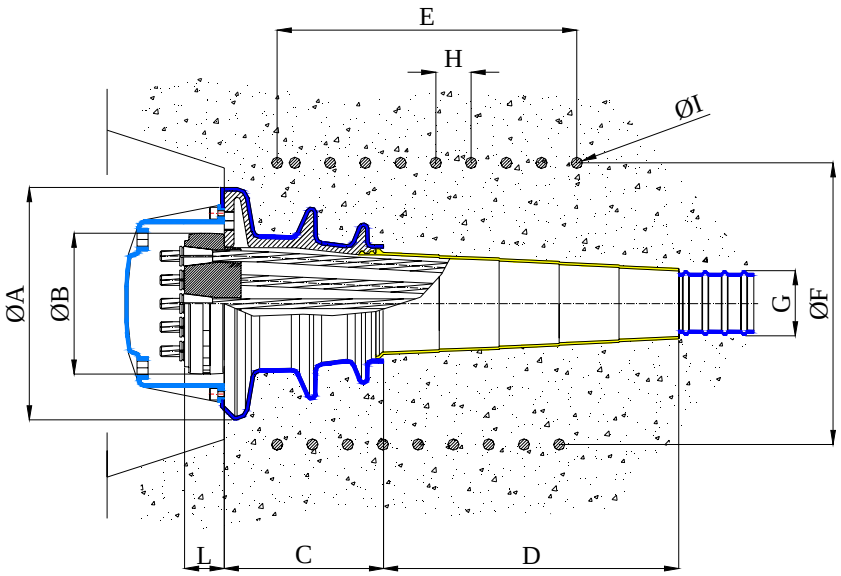
19M15 anchorage

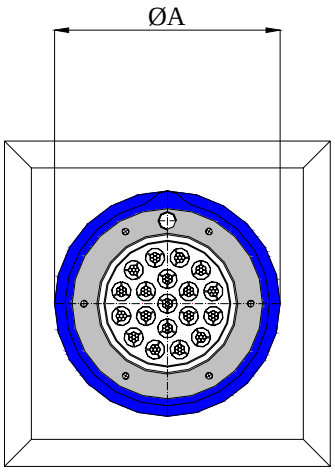
*The "MX ®" system is designed to comply with the guidelines **ETAG013**. This anchorage is made of: an anchorage awarded with the European Technical Approval **ETA-09-0012** and the marking **CE 0969-CPD-001/09-PT** completely encapsulated in polyethylene.*
*Simulations made with finite element codes and laboratory tests allowed to design a compact anchorage to comply with the guidelines **ETAG 013.***



*The "**MX®**" series active anchorage is made of the following parts: casting coated with polyethylene, anchor plate, wedges, polyethylene cap to contain grease and connection in H.D.P.E. to connect the casting to the metallic sheath, more usually in polyethylene. Castings have a turned plane for the plate, holes for connection to cap and formwork and a threaded grouting hole. Castings are in spheroidal cast iron EN-GJS 500-7 EN-JS-1050, which offers a high resistance to stress and is weldable. However, due to the polyethylene protection it is provided with, it cannot be welded without compromising the coating. This coating also requires a particular care during the installation.*
Strands are blocked on a distribution plate with truncated cone holes in steel C40-45 UNI EN 10083/1 and by means of wedges in steel 16NiCr4Pb UNI EN 10277-4.
The anchorage and the sheaths are connected by means of a truncated cone connection that guarantees a correct deviation of strands, minimizing the values of losses. The connection is made of H.D.P.E. and suitable for the connection to several-diameter sheaths.
All castings have threaded holes on the plane to allow an easy fixing to the formwork by means of bolts.
All castings have a gas threaded hole for grouting to allow the connection to the several solutions available for grouting.

45 MPa concrete class





Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***L***
	T15	***T15S***	***T15C***										
	259	*279*	*307*										
	per cable	***per cable***	***per cable***										
	(KN)	*(KN)*	*(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4M15	*1036*	*1116*	*1228*	*160*	*105*	*103*	*300*	*205*	*180*	*45/50*	*45*	*12*	*45*
7M15	*1813*	*1953*	*2149*	*200*	*125*	*133*	*340*	*270*	*240*	*62/67*	*45*	*12*	*45*
9M15	*2331*	*2511*	*2763*	*235*	*146*	*163*	*380*	*270*	*300*	*72/77*	*45*	*14*	*45*
12M15	*3108*	*3348*	*3684*	*265*	*160*	*180*	*385*	*350*	*350*	*80/85*	*50*	*16*	*45*
15M15	*3885*	*4185*	*4605*	*290*	*176*	*197*	*405*	*450*	*410*	*85/90*	*50*	*16*	*45*
19M15	*4921*	*5301*	*5833*	*320*	*200*	*215*	*430*	*450*	*400*	*95/100*	*50*	*16*	*56*
22M15	*5698*	*6138*	*6754*	*355*	*230*	*260*	*430*	*425*	*420*	*100/105*	*50*	*18*	*61*
27M15	*6993*	*7533*	*8289*	*380*	*250*	*277*	*470*	*480*	*460*	*110/115*	*50*	*18*	*70*

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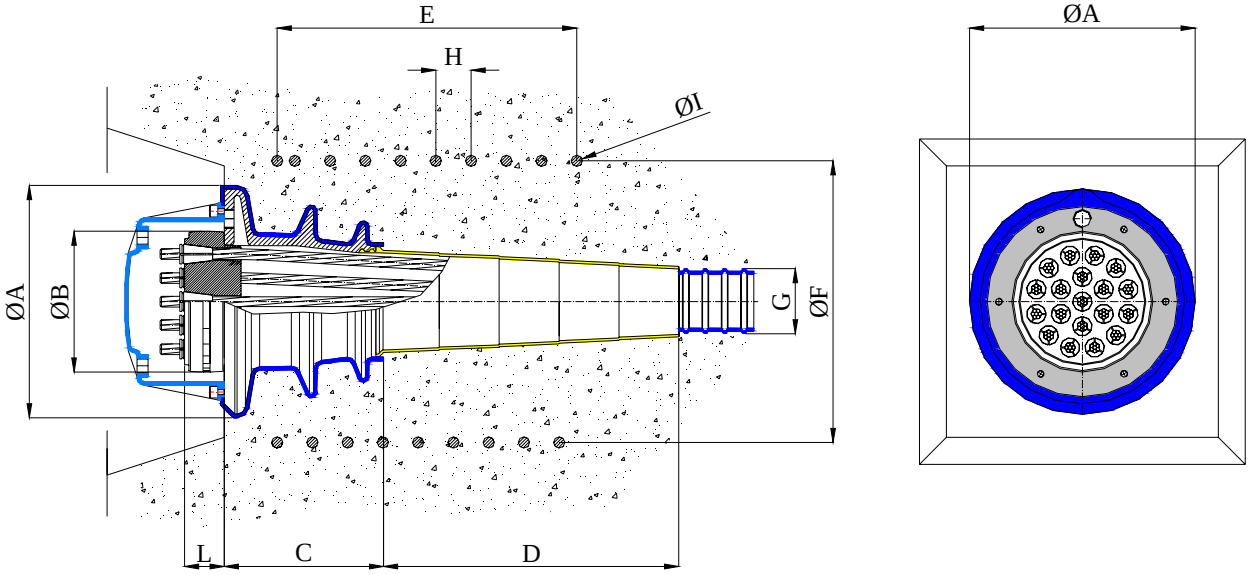
12M15 and 19M15 anchorages

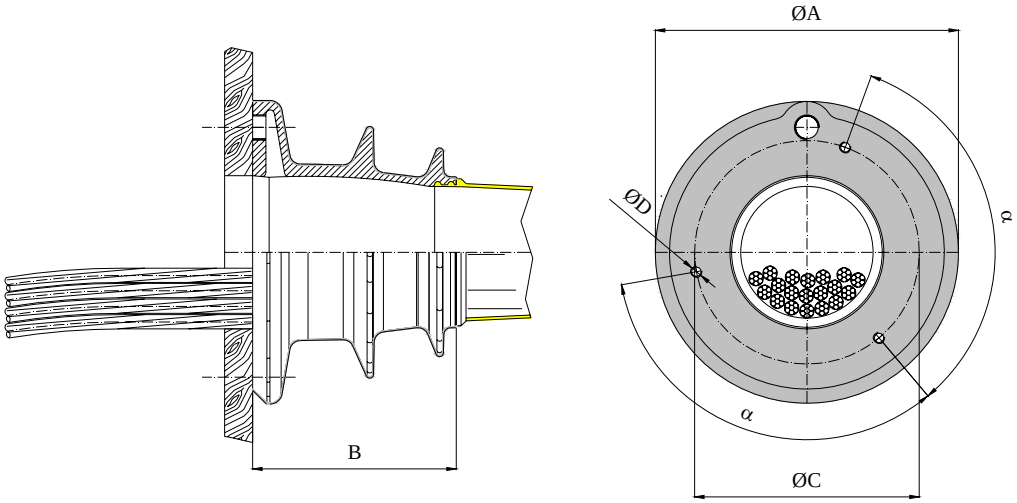


Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***L***
	T15	***T15S***	***T15C***										
	259	*279*	*307*										
	per cable	***per cable***	***per cable***										
	(KN)	*(KN)*	*(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4M15	*1036*	*1116*	*1228*	*160*	*105*	*103*	*300*	*205*	*180*	*45/50*	*45*	*12*	*45*
7M15	*1813*	*1953*	*2149*	*200*	*125*	*133*	*340*	*270*	*240*	*62/67*	*45*	*12*	*45*
9M15	*2331*	*2511*	*2763*	*235*	*146*	*163*	*380*	*270*	*300*	*72/77*	*45*	*14*	*45*
12M15	*3108*	*3348*	*3684*	*265*	*160*	*180*	*385*	*350*	*350*	*80/85*	*50*	*16*	*45*
15M15	*3885*	*4185*	*4605*	*290*	*176*	*197*	*405*	*450*	*410*	*85/90*	*50*	*16*	*45*
19M15	*4921*	*5301*	*5833*	*320*	*200*	*215*	*430*	*450*	*400*	*95/100*	*50*	*16*	*56*
22M15	*5698*	*6138*	*6754*	*355*	*230*	*260*	*430*	*425*	*420*	*100/105*	*50*	*18*	*61*
27M15	*6993*	*7533*	*8289*	*380*	*250*	*277*	*470*	*480*	*460*	*110/115*	*50*	*18*	*70*

(Measures in mm.)

5.0 - CONNECTION TO THE FORMWORK FOR M ANCHORAGES

"M" anchorage with holes for connection to the formwork



Type	***4M15***	***7M15***	***9M15***	***12M15***	***15M15***	***19M15***	***22M15***	***27M15***
A	*160*	*200*	*235*	*265*	*290*	*320*	*355*	*380*
B	*103*	*133*	*163*	*180*	*197*	*215*	*260*	*277*
C	*124*	*145*	*190*	*203*	*235*	*237*	*290*	*325*
D	*M10*	*M10*	*M10*	*M12*	*M12*	*M12*	*M16*	*M16*
α	*180°*	*120°*	*120°*	*120°*	*120°*	*120°*	*120°*	*120°*
Quantity	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*

(Measures in mm.)

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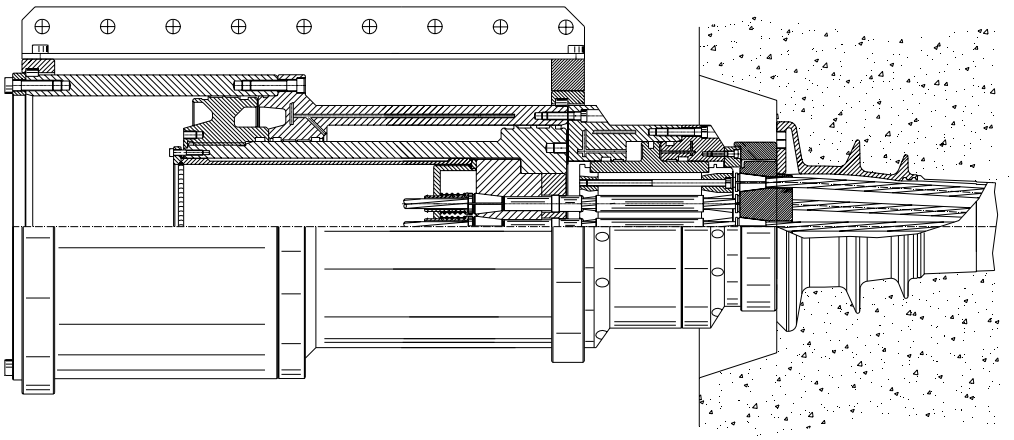
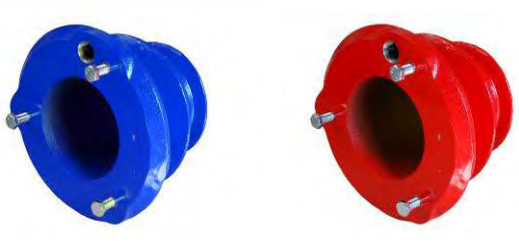
*European Technical approval **ETA-09-0013** and its relating marking **CE 0969-CPD-002/09-PT***

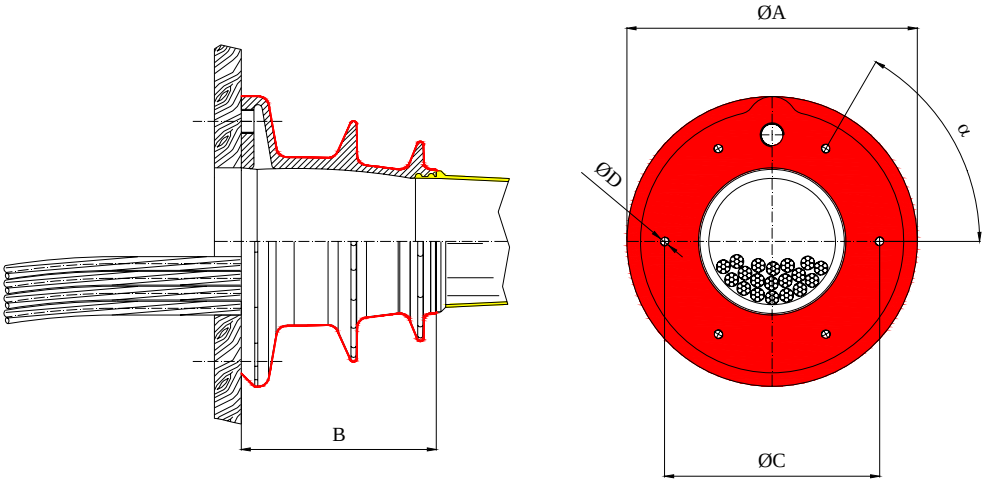


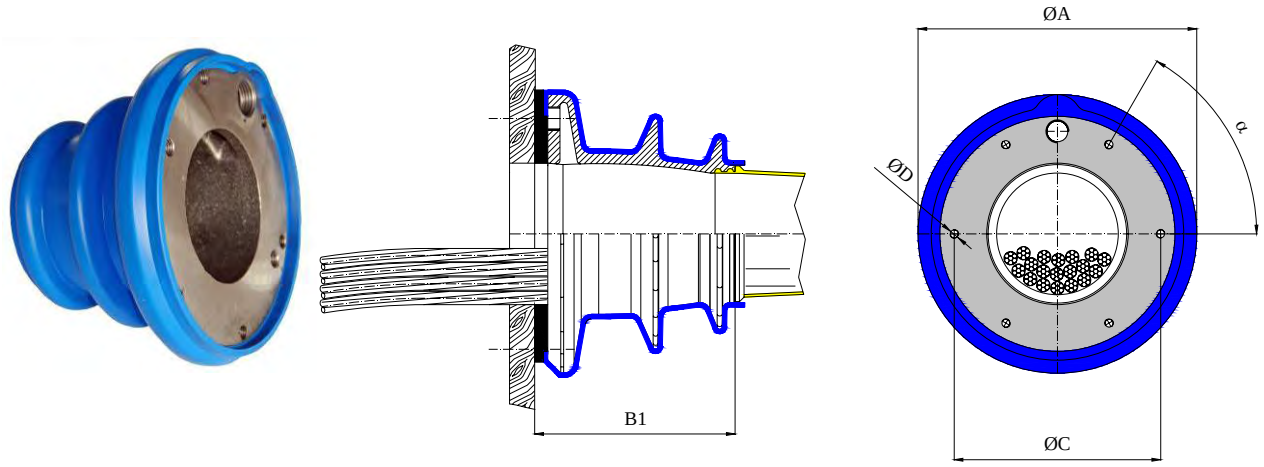
5.1 - Connection to the formwork for MX and MEP anchorages



"M" anchorages

The hole for grouting connection must be installed on the upper part of the anchorage to guarantee a correct discharge of all the air inside the cable.

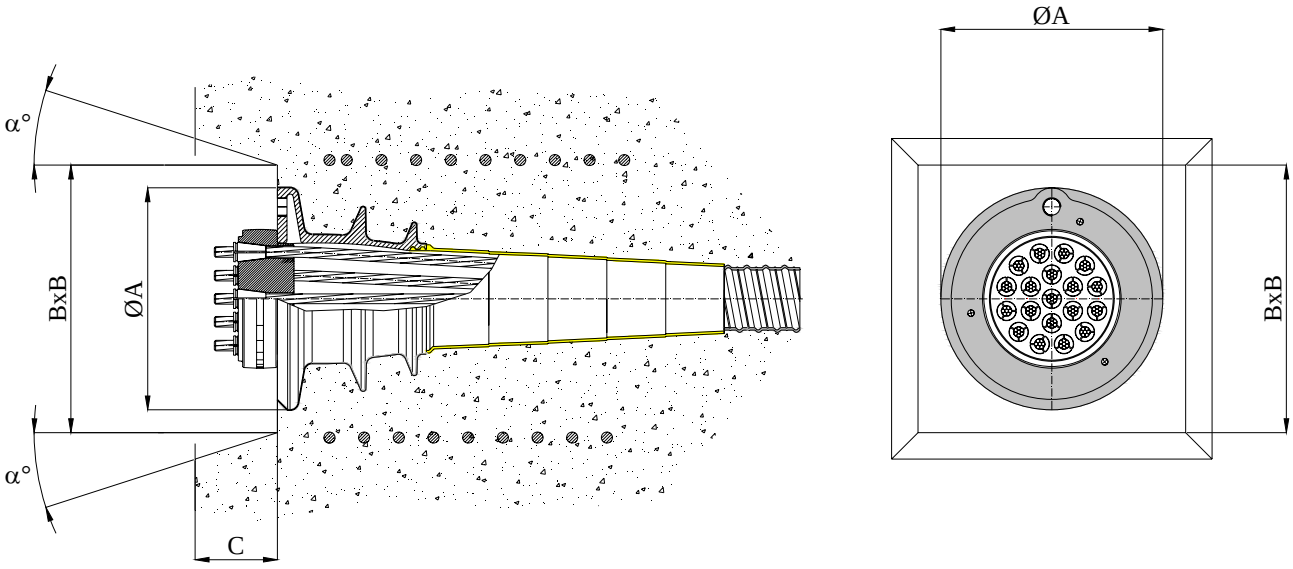




Type	*4M15*	*7M15*	*9M15*	*12M15*	*15M15*	*19M15*	*22M15*	*27M15*
A	*160*	*200*	*235*	*265*	*290*	*320*	*355*	*380*
B	*103*	*133*	*163*	*180*	*197*	*215*	*260*	*277*
B_1	*123*	*153*	*183*	*200*	*219*	*237*	*284*	*300*
C	*124*	*145*	*190*	*203*	*235*	*237*	*290*	*325*
D	*M6*	*M10*	*M10*	*M10*	*M12*	*M12*	*M16*	*M16*
α	*60°*	*60°*	*60°*	*60°*	*60°*	*60°*	*60°*	*60°*
Quantity	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*6*

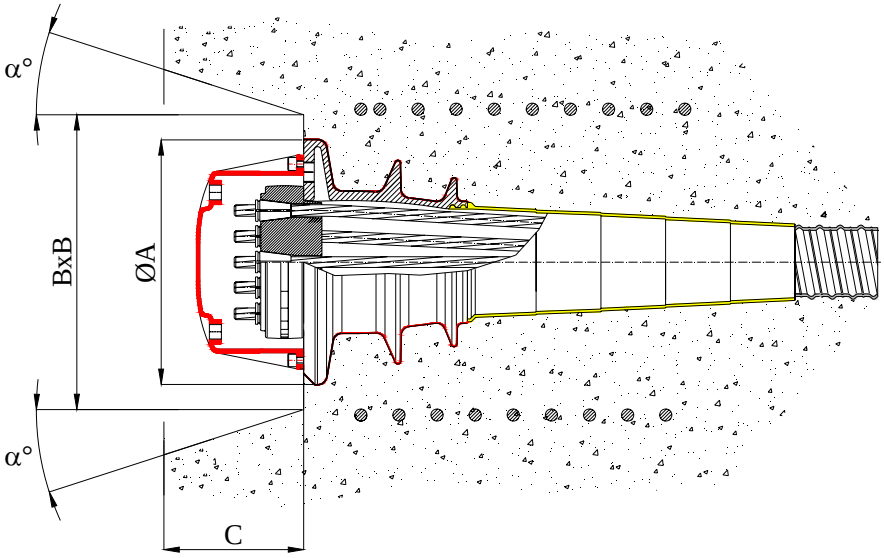
Our company reserves the right to change our products and specifications without any previous notice *(Measures in mm.)*

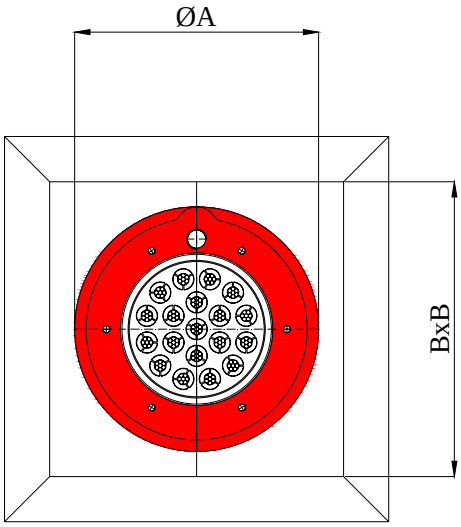
6.0 – RECESSES FOR M ANCHORAGES



Type	*4M15*	*7M15*	*9M15*	*12M15*	*15M15*	*19M15*	*22M15*	*27M15*
A	*160*	*200*	*235*	*265*	*290*	*320*	*355*	*380*
B x B	*200x200*	*240x240*	*275x275*	*305x305*	*330x330*	*360x360*	*395x395*	*420x420*
C	*110*	*110*	*110*	*110*	*110*	*125*	*130*	*140*
a	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*

Our company reserves the right to change our products and specifications without any previous notice. *(Measures in mm.)*





Type	***4M15***	***7M15***	***9M15***	***12M15***	***15M15***	***19M15***	***22M15***	***27M15***
A	*160*	*200*	*235*	*265*	*290*	*320*	*355*	*380*
B x B	*200x200*	*240x240*	*275x275*	*305x305*	*330x330*	*360x360*	*395x395*	*420x420*
C	*160*	*160*	*160*	*160*	*160*	*180*	*180*	*190*
a	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*

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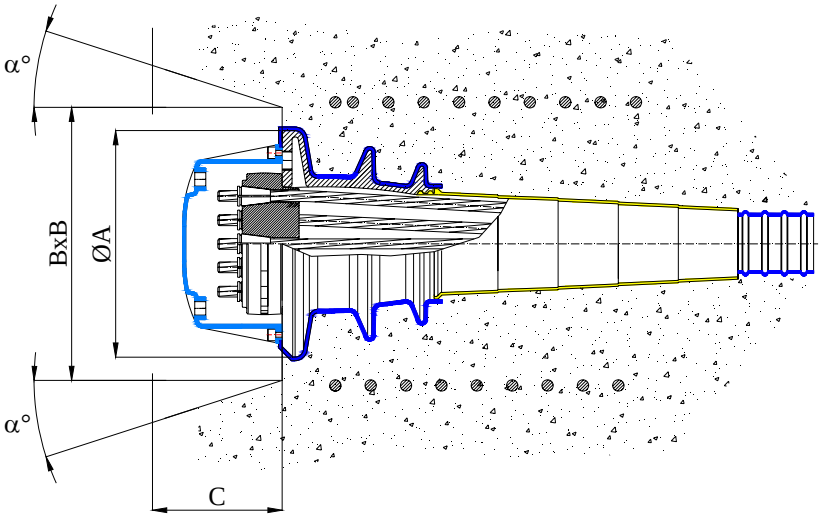
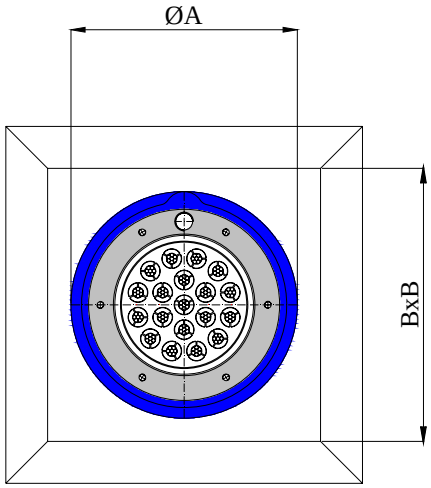




Type	***4M15***	***7M15***	***9M15***	***12M15***	***15M15***	***19M15***	***22M15***	***27M15***
A	*160*	*200*	*235*	*265*	*290*	*320*	*355*	*380*
B x B	*200x200*	*240x240*	*275x275*	*305x305*	*330x330*	*360x360*	*395x395*	*420x420*
C	*160*	*160*	*160*	*160*	*160*	*180*	*180*	*190*
a	*15*	*15*	*15*	*15*	*15*	*15*	*15*	*15*

Our company reserves the right to change our products and specifications without any previous notice. *(Measures in mm.)*

7.0 - GROUTING OF "M" ANCHORAGES

*"**M**" anchorages can be grouted in two ways whose procedures must be defined with the company before any activity on site is started.*

The two grouting methods available are:

- grouting with temporary or permanent cap,
- grouting with infilling,

7.1 -Grouting with temporary cap

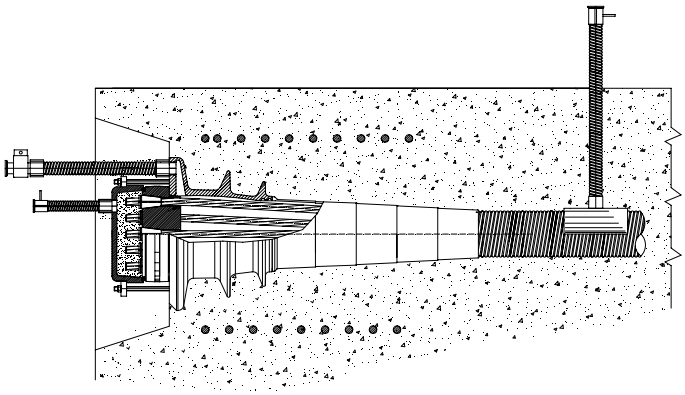
The cap is made up of a cover equipped with a sealing gasket fixed to the casting by means of suitable anchorages which vary in length and size depending on the several applications. A special closing disc tightens the sealing gasket and the cap to the grouting. The disc allows to turn the cap into the most suitable position to allow all the air to come out of the vent tube.

*The most used system for grouting consists in re-usable caps. This system allows a homogenous infilling without air bubbles when using both "**M**" and "**G**" anchorages.*

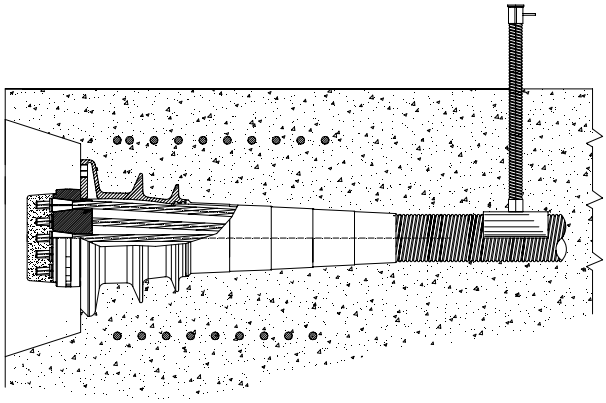
Gasket for caps

The metal cap, complete with a sealing gasket, restrains the grouting to the anchor plate side. Grouting is carried out from the gas ¾" or ½" hole on the casting. The mix enters this hole, the vent is always on the cap and provided with gate valve.

The properly mounted cap allows grouting under pressure and the total coverage of both wedges and strand protrusions from the anchorage. Qualified operators shall always be employed to carry out the installation of devices and accessories.



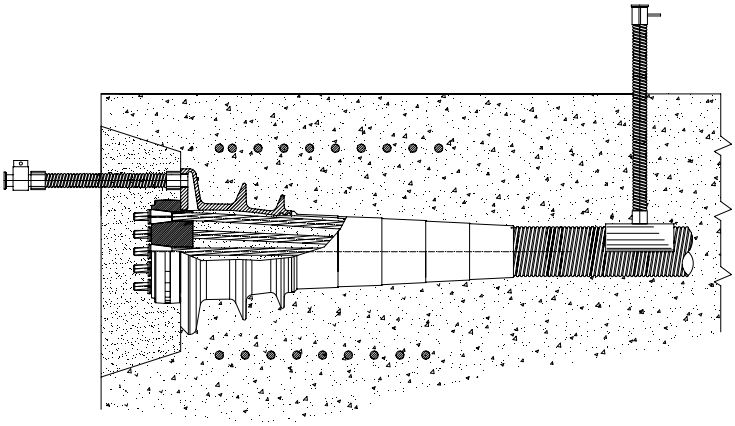
Grouting with temporary cap



The removed and properly treated cap can be reused on several anchorages

7.2 - Grouting by infilling

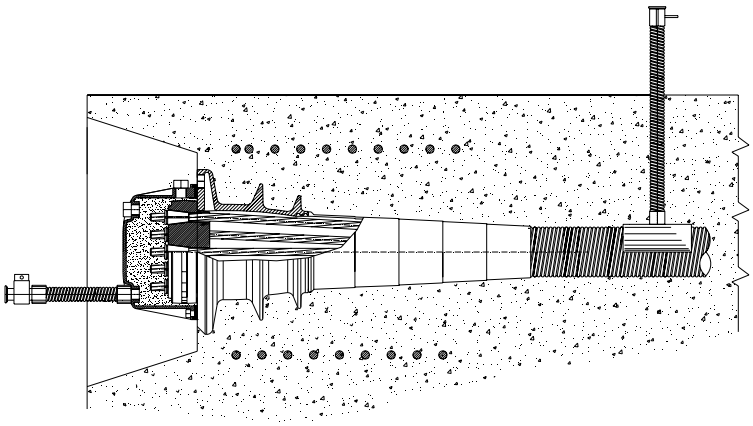
Grouting can be carried out by means of a simple padding using expanding mortar, which must respect the proper covering of the metallic parts of the anchorage.



Grouting by infilling

7.3 - Grouting with DD-KP permanent cap (double protection)

The DD-KP cap is made of polyethylene and together with a MEP or MX anchorage guarantees a double protection to corrosion. The DD-KP cap is provided with plugs to guarantee a correct grouting and vent when filling it.

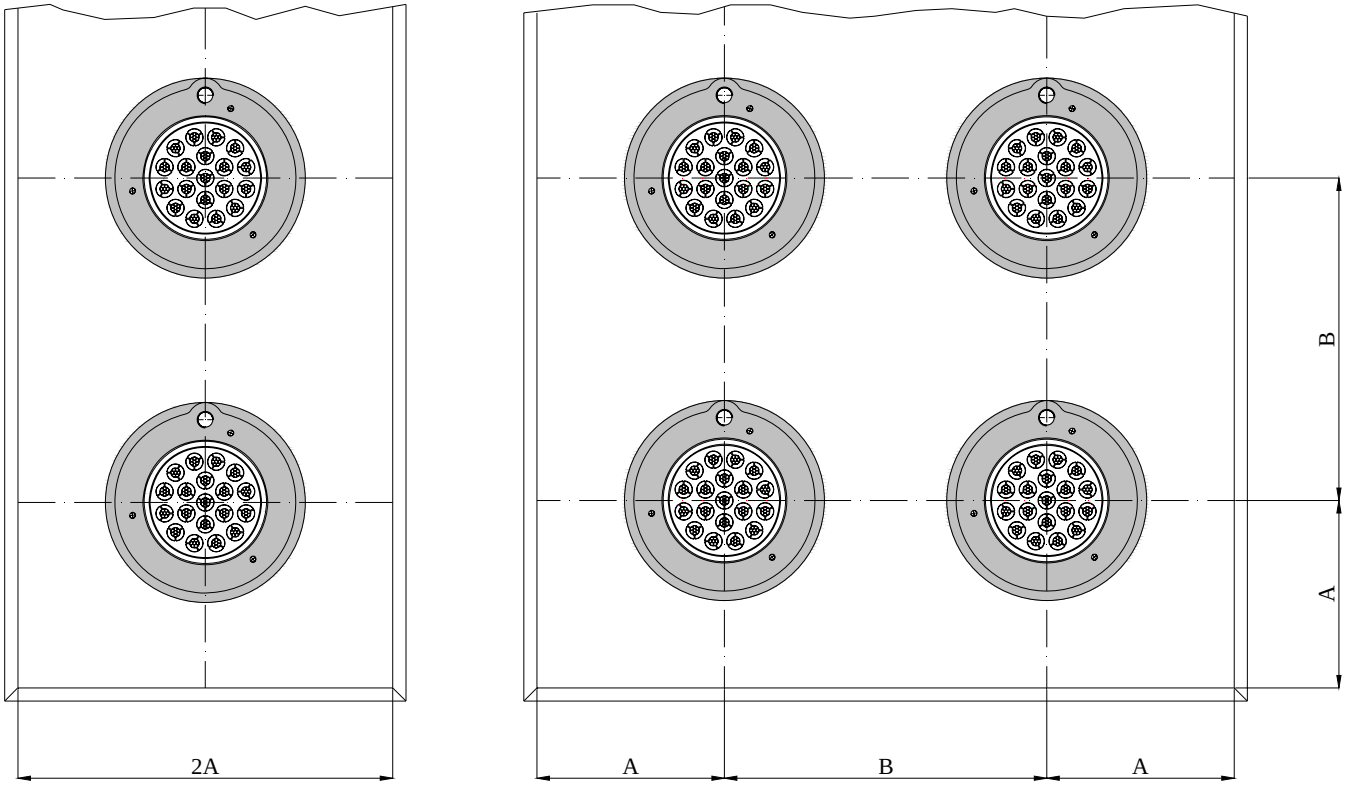


Cap grouting.

8.0 - DISTANCES FROM EDGES FOR M ANCHORAGES

"M" anchorage

The distances from edges and between anchorages are the same for the three types of anchorage ***M_{EP}®, MX®*** *and* ***M***

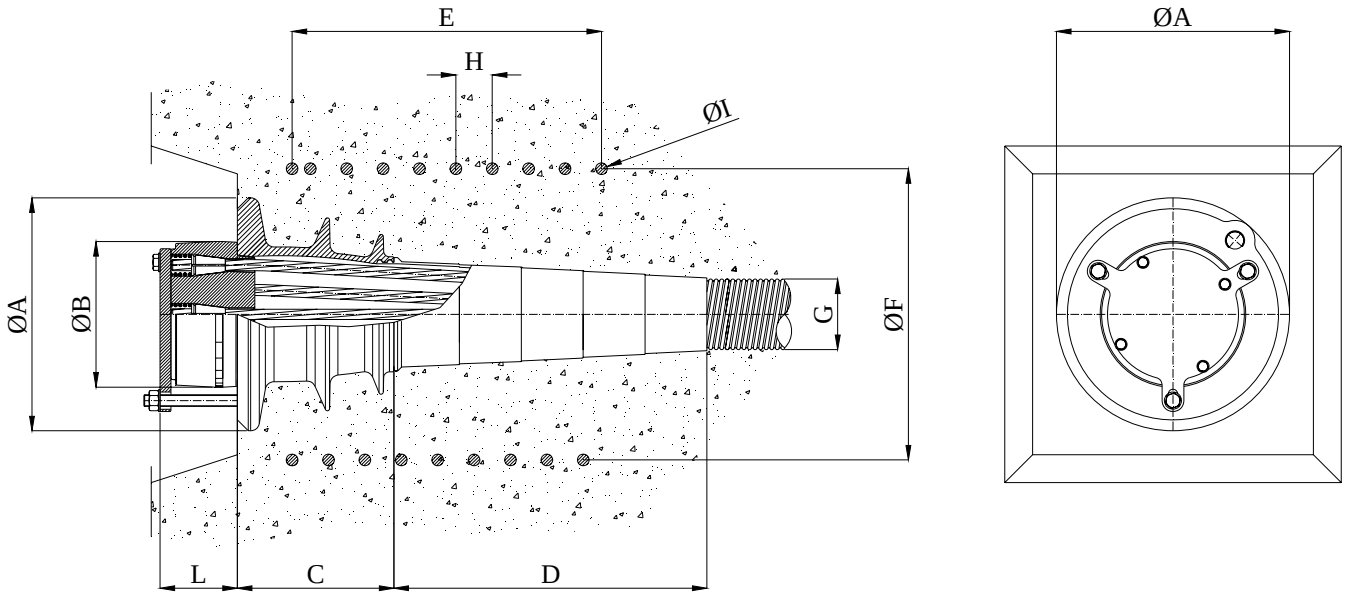


Minimum centres spacing B (mm.)			***Minimum edges distance A (mm.)***		
Type	$f_{cmj,\ cube}$		***Type***	$f_{cmj,\ cube}$	
	35 MPa	***45 MPa***		***35 MPa***	***45 MPa***
4M15	*250*	*230*	*4M15*	*130*	*120*
7M15	*335*	*295*	*7M15*	*175*	*155*
9M15	*370*	*320*	*9M15*	*190*	*165*
12M15	*430*	*380*	*12M15*	*220*	*195*
15M15	*480*	*430*	*15M15*	*245*	*220*
19M15	*545*	*485*	*19M15*	*280*	*250*
22M15	*585*	*520*	*22M15*	*300*	*265*
27M15	*650*	*580*	*27M15*	*330*	*295*

Our company reserves the right to change our products and specifications without any previous notice. *(Measures in mm.)*

*The **"D"** system is designed to comply with the guidelines **ETAG 013** and it is awarded with the European Technical Approval **ETA-09-0012** and the marking **CE 0969-CPD-001/09-PT**.*
The anchorage is made of: an anchor plate, wedges, connection and anchor casting.
*Simulations made with finite element codes and laboratory tests allowed to design a compact anchorage to comply with the guidelines **ETAG 013.** The D anchorage is designed for all the applications where the use of a passive anchorage, which is usually submerged into the grouting, is required. The steel plate that contains the wedges is preassembled and filled with grease from the factory.*

*The **"D"** series active anchorage is made of the following parts: casting, preassembled D anchor plate, wedges and connection in H.D.P.E. to connect the casting to the metallic sheath. Castings have a turned plane for the plate, holes for connection to cap and formwork and a threaded grouting hole. Castings are in spheroidal cast iron EN-GJS 500-7 EN-JS-1050, which offers a high resistance to stress. Being weldable, it guarantees the maximum safety during installation.*
Strands are blocked on a distribution plate with truncated cone holes in steel C40-45 UNI EN 10083/1 and by means of wedges in steel 16NiCr4Pb UNI EN 10277-4. The plate is provided with holes, inside which the wedge and the spring thruster are placed. Everything is sealed with a steel closing cover to guarantee sealing against infiltrations to which the anchorage is exposed while grouting.
The anchorage and the sheaths are connected by means of a truncated cone connection that guarantees a correct deviation of strands, minimizing the values of losses. The connection is made of H.D.P.E.
All castings have threaded holes on the plane to allow an easy fixing of the D plate to the casting.
All castings have a gas threaded hole for grouting to allow the connection to the several solutions available for grouting.



Type	*Ultimate load*			*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*L*
	T15 259 *per cable* (KN)	*T15S* 279 *per cable* (KN)	*T15C* 307 *per cable* (KN)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)	(mm.)
4D15	*1036*	*1116*	*1228*	*160*	*105*	*103*	*300*	*180*	*170*	*45/50*	*45*	*12*	*90*
7D15	*1813*	*1953*	*2149*	*200*	*125*	*133*	*340*	*250*	*220*	*62/67*	*45*	*12*	*90*
9D15	*2331*	*2511*	*2763*	*235*	*146*	*163*	*380*	*250*	*250*	*72/77*	*45*	*14*	*90*
12D15	*3108*	*3348*	*3684*	*265*	*160*	*180*	*385*	*300*	*300*	*80/85*	*50*	*16*	*90*
15D15	*3885*	*4185*	*4605*	*290*	*176*	*197*	*405*	*350*	*355*	*85/90*	*50*	*16*	*90*
19D15	*4921*	*5301*	*5833*	*320*	*200*	*215*	*430*	*425*	*400*	*95/100*	*50*	*16*	*106*
22D15	*5698*	*6138*	*6754*	*355*	*230*	*260*	*430*	*425*	*420*	*100/105*	*50*	*18*	*111*
27D15	*6993*	*7533*	*8289*	*380*	*250*	*277*	*470*	*400*	*460*	*110/115*	*50*	*18*	*120*

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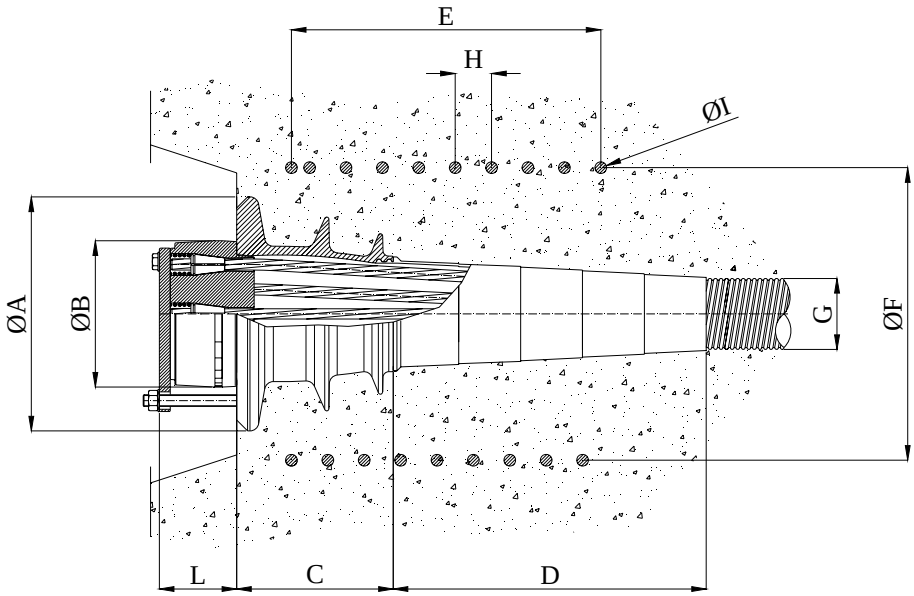

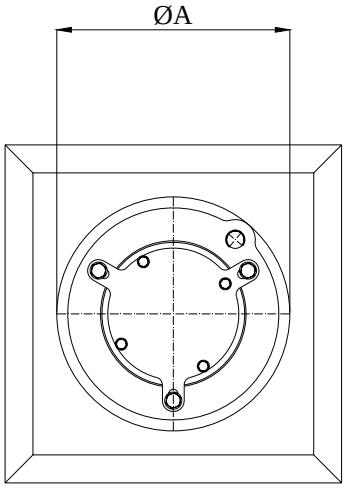

Type	*Ultimate load*			*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*L*
	T15 *259* ***per cable*** *(KN)*	***T15S*** *279* ***per cable*** *(KN)*	***T15C*** *307* ***per cable*** *(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4D15	*1036*	*1116*	*1228*	*160*	*105*	*103*	*300*	*205*	*180*	*45/50*	*45*	*12*	*90*
7D15	*1813*	*1953*	*2149*	*200*	*125*	*133*	*340*	*270*	*240*	*62/67*	*45*	*12*	*90*
9D15	*2331*	*2511*	*2763*	*235*	*146*	*163*	*380*	*270*	*300*	*72/77*	*45*	*14*	*90*
12D15	*3108*	*3348*	*3684*	*265*	*160*	*180*	*385*	*350*	*350*	*80/85*	*50*	*16*	*90*
15D15	*3885*	*4185*	*4605*	*290*	*176*	*197*	*405*	*400*	*410*	*85/90*	*50*	*16*	*90*
19D15	*4921*	*5301*	*5833*	*320*	*200*	*215*	*430*	*450*	*440*	*95/100*	*50*	*16*	*106*
22D15	*5698*	*6138*	*6754*	*355*	*230*	*260*	*430*	*450*	*480*	*100/105*	*50*	*18*	*111*
27D15	*6993*	*7533*	*8289*	*380*	*250*	*277*	*470*	*480*	*530*	*110/115*	*60*	*18*	*120*

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10.0 – "ME, ME_{EP} and MEX" ACTIVE ANCHORAGES

27 ME_{EP} 15 anchorage

*"**ME**, **ME_{EP}** and **MEX** " active anchorages are designed for external post-tensioning and may be supplied with several applications. They are made of a "M, M_{EP} or MX®" casting and properly connected to a sheath in H.D.P.E. with a special transition cone. The cone allows to contain the grouting inside it, so preventing it from bonding to the internal wall of the casting and guaranteeing the cable disassembling over time as well as a perfect tightness. The heads grouting by external precompression may be carried out with cement mix, grease or wax.*
The strands may be bare or protected with grease and H.D.P.E. and guarantee the possibility to replace the cable over time. The use of bare strands must also include in some cases the localized protection of wedges with grease according to the type of application.

Internal connection and connection to the polyethylene tube

The internal connection is made of steel and provided with a deviator. By threading, the polyethylene tube is connected to it to contain the strands.

Insertion of the internal connection into the ME anchorage

The connection entered into the anchorage is provided with a stop, which will be blocked between the plate and the casting, thus allowing to restrain the grouting.

Positioning of the internal connection into the ME anchorage

The insertion of the connection will allow the polyethylene tube to stick out from the transition tube. The sheath of the whole cable will be welded on this protrusion.

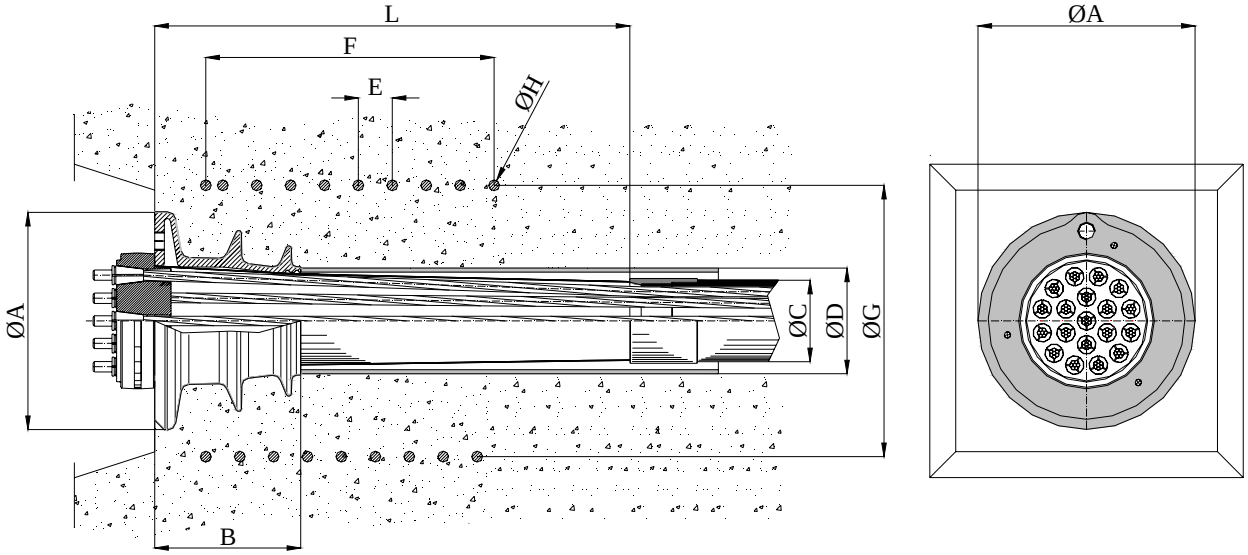
10.1 - ME anchorage

27 ME_{EP} 15 anchorage

*The **ME** version may be installed bonded or unbonded based on the project requirements and guarantees the possibility to replace the cable over time. A proper tube allows to cross the concrete diaphragm and guarantees the continuity of the polyethylene tube that contains the cable.*

Application of the anchorage with 35MPa concrete

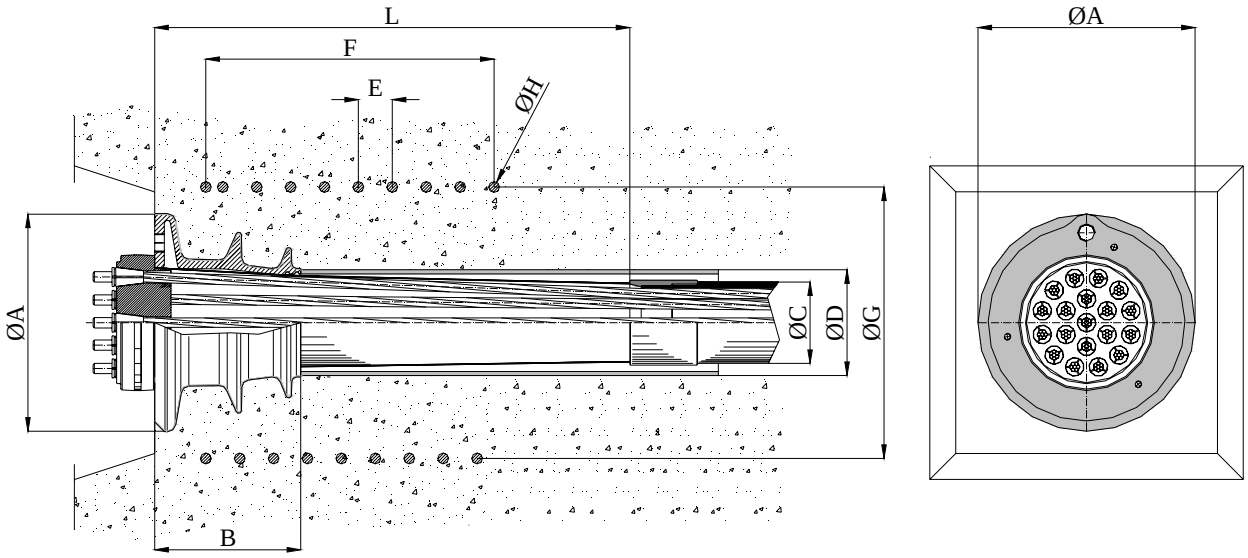
27 ME_{EP} 15 anchorage



Type	*Ultimate load*			*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*L*
	T15 *259* ***per cable*** *(KN)*	***T15S*** *279* ***per cable*** *(KN)*	***T15C*** *307* ***per cable*** *(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4ME15	*1036*	*1116*	*1228*	*160*	*103*	*63/3.6*	*135*	*45*	*205*	*180*	*12*	*310*
7ME15	*1813*	*1953*	*2149*	*200*	*133*	*75/4.3*	*160*	*45*	*270*	*240*	*12*	*360*
9ME15	*2331*	*2511*	*2763*	*235*	*163*	*90/5.1*	*177*	*45*	*270*	*300*	*14*	*430*
12ME15	*3108*	*3348*	*3684*	*265*	*180*	*110/6.3*	*195*	*50*	*350*	*350*	*16*	*450*
15ME15	*3885*	*4185*	*4605*	*290*	*197*	*110/6.3*	*210*	*50*	*400*	*410*	*16*	*520*
19ME15	*4921*	*5301*	*5833*	*320*	*215*	*110/6.3*	*245*	*50*	*450*	*440*	*16*	*600*
22ME15	*5698*	*6138*	*6754*	*355*	*260*	*125/7.1*	*265*	*50*	*450*	*480*	*18*	*660*
27ME15	*6993*	*7533*	*8289*	*380*	*277*	*140/8.0*	*295*	*60*	*480*	*530*	*18*	*700*

Our company reserves the right to change our products and specifications without any previous notice *(Measures in mm.)*

27 ME_{EP} 15 anchorage



Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***L***
	T15 *259* ***per cable*** *(KN)*	***T15S*** *279* ***per cable*** *(KN)*	***T15C*** *307* ***per cable*** *(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4ME15	*1036*	*1116*	*1228*	*160*	*103*	*63/3.6*	*135*	*45*	*180*	*170*	*12*	*310*
7ME15	*1813*	*1953*	*2149*	*200*	*133*	*75/4.3*	*160*	*45*	*250*	*220*	*12*	*360*
9ME15	*2331*	*2511*	*2763*	*235*	*163*	*90/5.1*	*177*	*45*	*250*	*250*	*14*	*430*
12ME15	*3108*	*3348*	*3684*	*265*	*180*	*110/6.3*	*195*	*50*	*300*	*300*	*16*	*450*
15ME15	*3885*	*4185*	*4605*	*290*	*197*	*110/6.3*	*210*	*50*	*350*	*355*	*16*	*520*
19ME15	*4921*	*5301*	*5833*	*320*	*215*	*110/6.3*	*245*	*50*	*425*	*400*	*16*	*600*
22ME15	*5698*	*6138*	*6754*	*355*	*260*	*125/7.1*	*265*	*50*	*425*	*420*	*18*	*660*
27ME15	*6993*	*7533*	*8289*	*380*	*277*	*140/8.0*	*295*	*50*	*400*	*460*	*18*	*700*

Our company reserves the right to change our products and specifications without any previous notice *(Measures in mm.)*

10.2 - Application of "ME" anchorages

27 ME15 anchorage

ME ^{L} anchorage in L protection

(External bonded post-tensioning, bare strands with cement grouting)

ME ^{L} *anchorage in* ***L*** *protection from* ***external bonded post-tensioning****, made of casting submerged into concrete, anchorage with wedges, painted steel connection, cement-grouted protection cap, wedges and use of bare strands. The protection cap allows to protect the anchorage with a cement filling. This application is the simplest among those which can be replaced over time.*

ME ^{M} anchorage in M protection

(External unbonded post-tensioning, cement grouting covered and greased strand)

ME ^{M} *anchorage in* ***M*** *protection from* ***external unbonded post-tensioning,*** *made of casting submerged into concrete, anchor plate with wedges, painted steel connection, cement-grouted protection cap, wedges and use of bare strands. The protection cap allows to protect the anchorage with a cement filling. The anchorage can be replaced over time if required.*

10.3 - Application of "ME_{EP}®" anchorages

27 ME_{EP} 15 anchorage

$ME_{EP}{}^{N®}$ anchorage in N protection

(External bonded post-tensioning, bare strands with cement grouting)

***$ME_{EP}{}^{N®}$** anchorage in **N** protection from **external bonded post-tensioning**, made of casting protected with epoxy coating submerged into concrete, anchor plate with wedges, steel connection protected with epoxy coating, cement grouted protection cap, wedges and the use of bare strands. The protection cap allows to protect the anchorage with a cement filling. The anchorage can be replaced over time if required.*

$ME_{EP}{}^{O®}$ anchorage in O protection

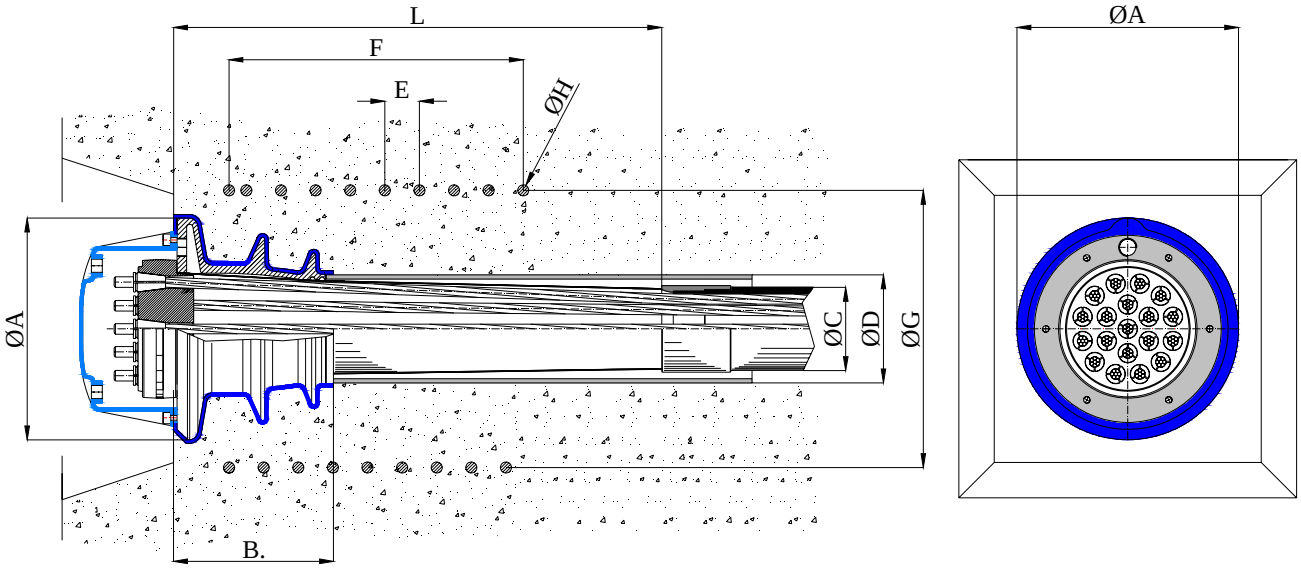
(External unbonded post-tensioning, cement grouting covered and greased strand)

***$ME_{EP}{}^{O®}$** anchorage in **O** protection from **external unbonded post-tensioning**, made of casting protected with epoxy coating submerged into concrete, anchor plate with wedges, steel connection protected with epoxy coating, grease grouted protection cap, wedges and use of a coated strand. The protection cap allows to protect the anchorage by filling it with grease as a further protective barrier. The grouting of the sheath is limited. The recess on the anchorage is therefore also full of grease, the cap protects the external part and the wedges. The anchorage is protected against corrosion with O level. It may be replaced over time if required.*

27 MEX 15 anchorage

MEX® *anchorage designed for applications of* ***external bonded and unbonded post-tensioning,*** ***completely encapsulated in polyethylene,*** *the anchorage is made of: casting externally protected with polyethylene, anchor plate with wedges, connection, grease-grouted protection cap, wedges and use of bare strands with grease grouting on the whole length of the cable. The protection cap allows to protect the anchorage with grease or cement filling, which is a further protective barrier besides the polyethylene used as first protection element. The anchorage can be replaced over time if required.*

Application of the MEX anchorage with 35MPa concrete



Type	*Ultimate load*			*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*L*
	T15 *259* ***per cable*** *(KN)*	***T15S*** *279* ***per cable*** *(KN)*	***T15C*** *307* ***per cable*** *(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4ME15	*1036*	*1116*	*1228*	*160*	*113*	*63/3.6*	*135*	*45*	*205*	*180*	*12*	*310*
7ME15	*1813*	*1953*	*2149*	*200*	*143*	*75/4.3*	*160*	*45*	*270*	*240*	*12*	*360*
9ME15	*2331*	*2511*	*2763*	*235*	*173*	*90/5.1*	*177*	*45*	*270*	*300*	*14*	*430*
12ME15	*3108*	*3348*	*3684*	*265*	*191*	*110/6.3*	*195*	*50*	*350*	*350*	*16*	*450*
15ME15	*3885*	*4185*	*4605*	*290*	*209*	*110/6.3*	*210*	*50*	*400*	*410*	*16*	*520*
19ME15	*4921*	*5301*	*5833*	*320*	*227*	*110/6.3*	*245*	*50*	*450*	*440*	*16*	*600*
22ME15	*5698*	*6138*	*6754*	*355*	*274*	*125/7.1*	*265*	*50*	*450*	*480*	*18*	*660*
27ME15	*6993*	*7533*	*8289*	*380*	*291*	*140/8.0*	*295*	*60*	*480*	*530*	*18*	*700*

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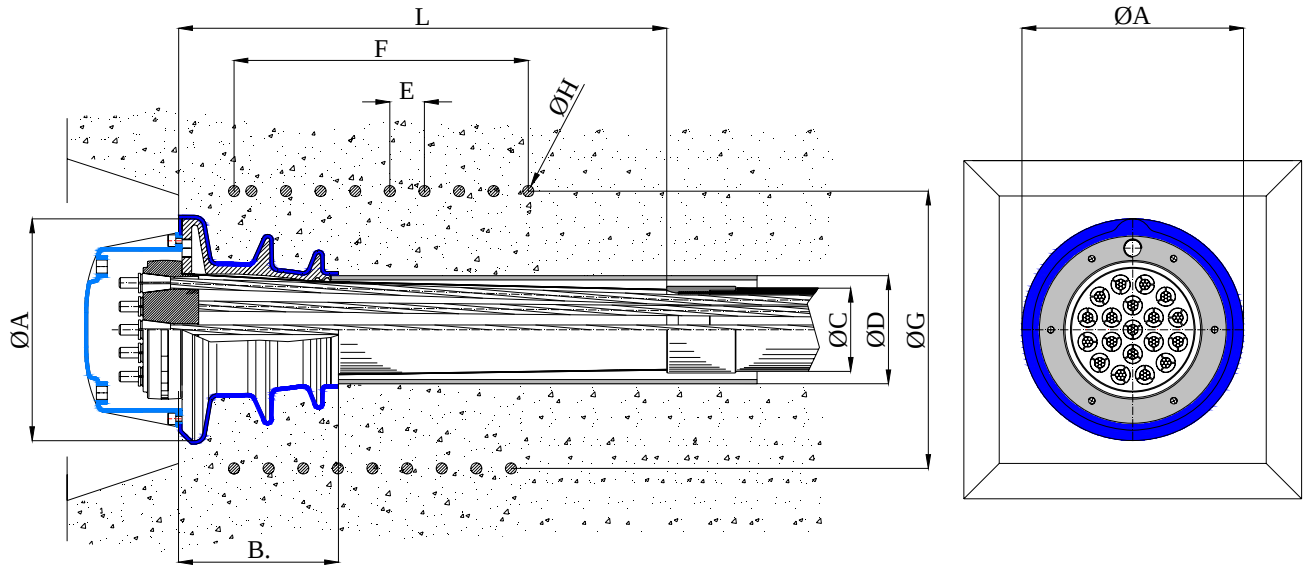
27 MEX 15 anchorage



Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***L***
	T15 *259* ***per cable*** *(KN)*	***T15S*** *279* ***per cable*** *(KN)*	***T15C*** *307* ***per cable*** *(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4ME15	*1036*	*1116*	*1228*	*160*	*113*	*63/3.6*	*135*	*45*	*180*	*170*	*12*	*310*
7ME15	*1813*	*1953*	*2149*	*200*	*143*	*75/4.3*	*160*	*45*	*250*	*220*	*12*	*360*
9ME15	*2331*	*2511*	*2763*	*235*	*173*	*90/5.1*	*177*	*45*	*250*	*250*	*14*	*430*
12ME15	*3108*	*3348*	*3684*	*265*	*191*	*110/6.3*	*195*	*50*	*300*	*300*	*16*	*450*
15ME15	*3885*	*4185*	*4605*	*290*	*209*	*110/6.3*	*210*	*50*	*350*	*355*	*16*	*520*
19ME15	*4921*	*5301*	*5833*	*320*	*227*	*110/6.3*	*245*	*50*	*425*	*400*	*16*	*600*
22ME15	*5698*	*6138*	*6754*	*355*	*274*	*125/7.1*	*265*	*50*	*425*	*420*	*18*	*660*
27ME15	*6993*	*7533*	*8289*	*380*	*291*	*140/8.0*	*295*	*50*	*400*	*460*	*18*	*700*

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27 MEX 15 anchorage

MEX H® anchorage in H protection

(External unbonded post-tensioning, bare strands with grease grouting)

MEX H® *anchorage in* ***H*** *protection from* ***external unbonded post-tensioning, completely encapsulated in polyethylene,*** *made of: casting externally protected with polyethylene, anchor plate with wedges, polyethylene connection, grease-grouted protection cap, wedges and use of bare strands with grease grouting on the whole length of the cable. The protection cap allows to protect the anchorage with grease filling, which is a further protective barrier besides the polyethylene used as first protection element. The grouting of the sheath is limited. The recess on the anchorage is therefore also full of grease and the anchorage is protected against corrosion with H level. The anchorage can be replaced over time if required.*

MEX I® anchorage in I protection

(External unbonded post-tensioning, cement grouting covered and greased strand)

MEX I® *anchorage in* ***I*** *protection from* ***external unbonded post-tensioning, completely encapsulated in polyethylene,*** *made of casting externally protected with polyethylene, anchor plate with wedges, polyethylene connection, grease-grouted protection cap, wedges and use of coated strands. The protection cap allows to protect the anchorage by filling it with grease as a further protective barrier. The grouting of the sheath is limited. The recess on the anchorage is therefore also full of grease, the cap protects the external part and the wedges. The anchorage is protected against corrosion with I level. It may be replaced over time if required.*

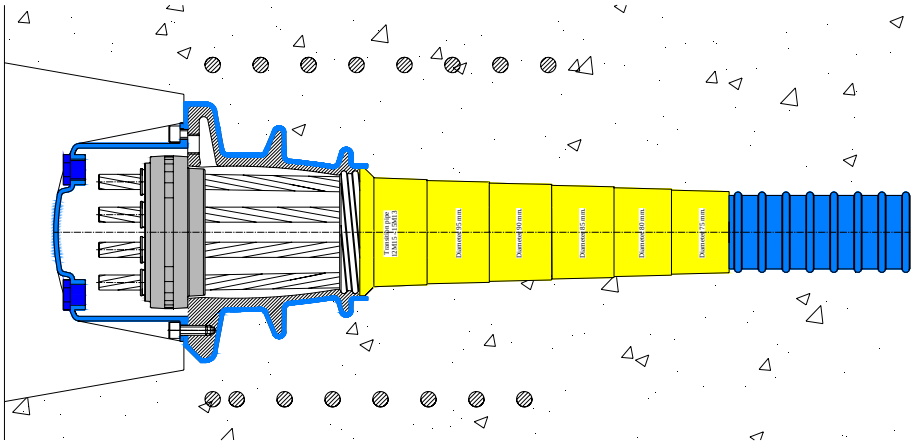
11.0 - UNBONDED POST-TENSIONING ON "M" and "ME" ANCHORAGES

(Unbonded post-tensioning)

12 ME_{EP} 15 anchorage

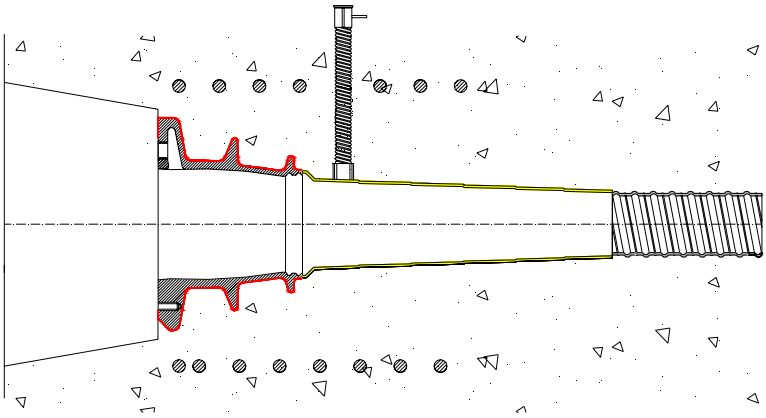
*The **unbonded** post-tensioning with **M, M_{EP}**® and **MX**® anchorages is carried out by using unbonded, greased and plastic-coated strands, which are restrained in a mortar grouting with a rubber buffer and allow their following tensioning and the covering with grease of all the parts of the anchorage that are subject to corrosion, such as: anchorage block, wedges and strand are restrained in grease.*

The rubber buffer allows to restrain grouting at half anchorage as well as the strand tightness on the polyethylene coating. Once the cable grouting is over, the buffer can be removed. The void obtained inside the anchorage allows to protect the under plate strands and shall be filled with grease. The strand by strand coating of the free whips must be removed following the procedures, the anchor plate must be removed, tensioning must be carried out and the protection cap, which is filled with grease, must be installed.



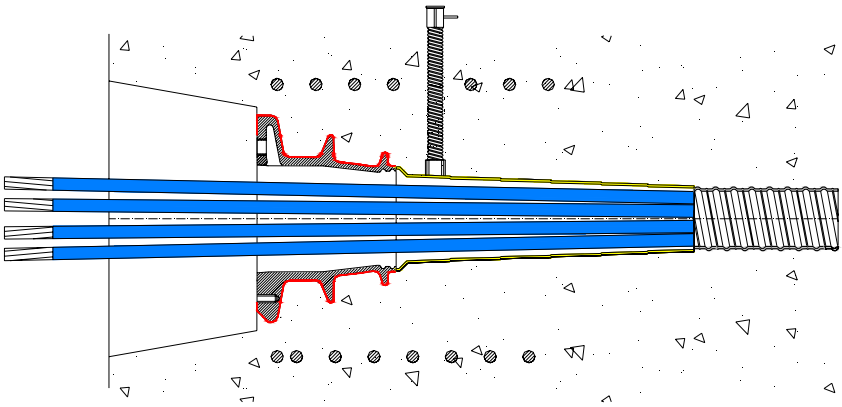
*The resulting anchorage is used together with the casting versions **M_{EP}**® and **MX**® encapsulated and protected, in particular in the most complete version **MX**® completely encapsulated in polyethylene.*

*Unbonded post-tensioning application phases with the devices **M, M_{EP}®** and **MX®***



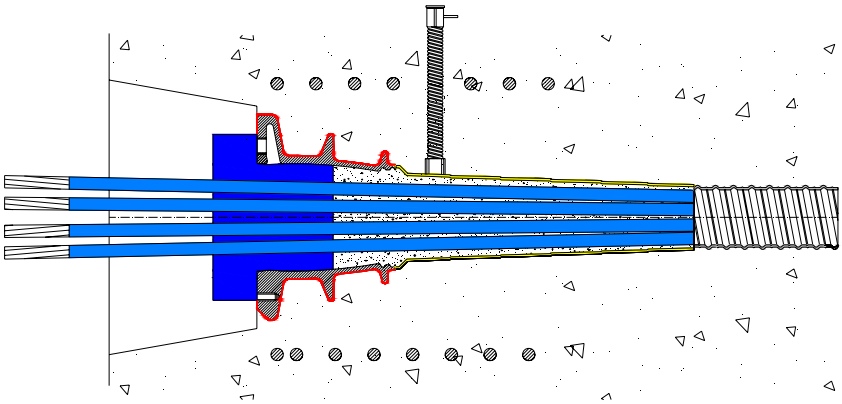
M_{EP}® anchorage

*Grouting with vent placed on the truncated cone reduction in polyethylene of the **M_{EP}®** anchorage*



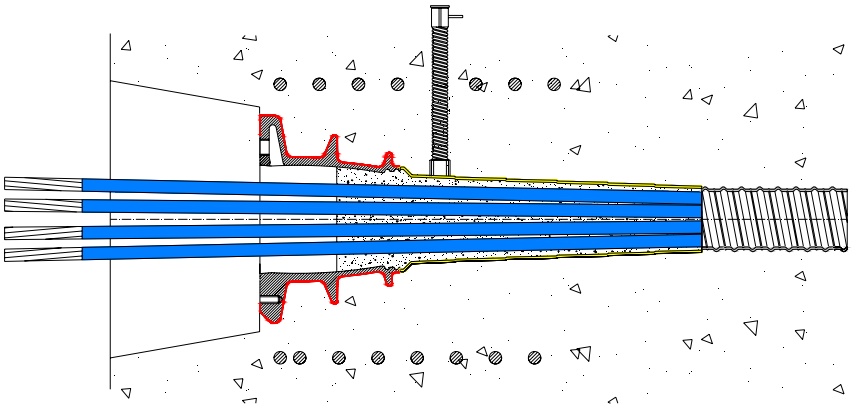
Restraining buffer for M_{EP}® anchorage

Insertion of greased and polyethylene-covered strands into the M_{EP}® anchorage. The restraining buffer allows to carry out the cable grouting before installing the anchor plate to block the strands.



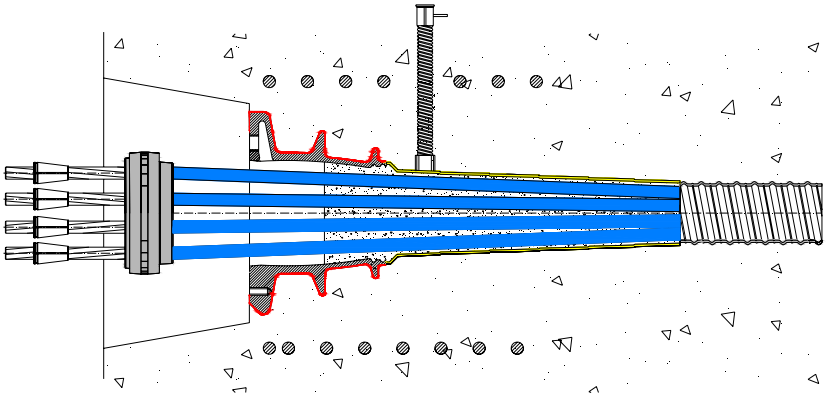
M_{EP}® anchorage with restraining buffer in position

The buffer allows to restrain the grouting at half anchorage, allowing the insertion into the thus obtained recess of the greased anchorage to protect the uncovered strands.

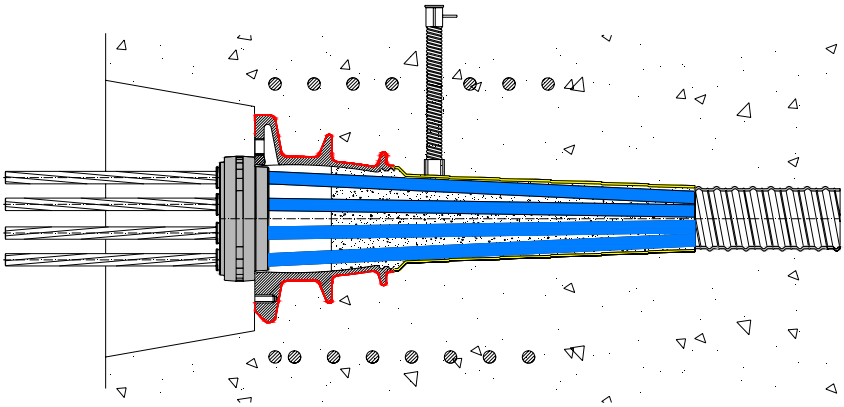


Removal of the restraining buffer after grouting

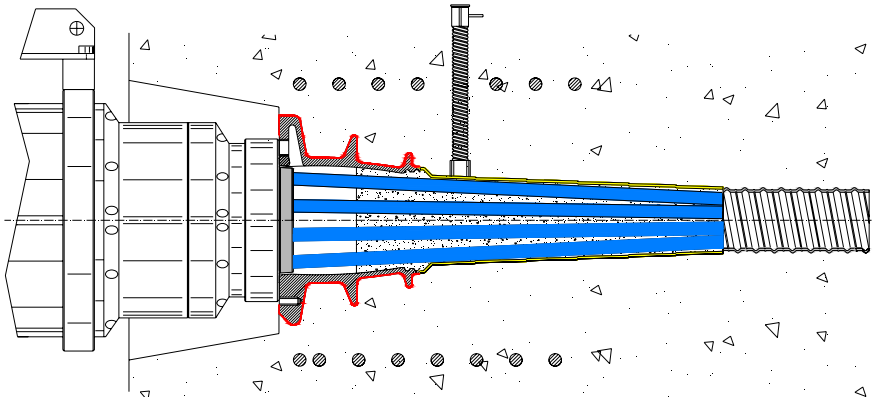
After grouting the buffer must be removed, thus obtaining a recess for the grease to protect the under plate strands.



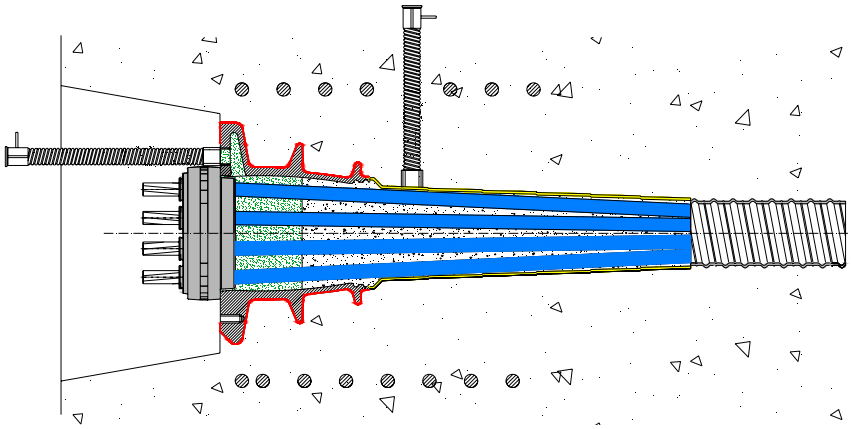
Approaching of the anchor plate and insertion of locking wedges.



Prearrangement for tensioning with M jack

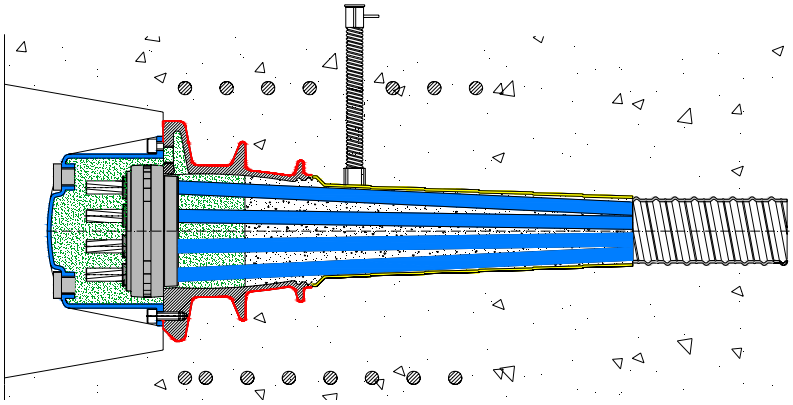


Grease grouting into the void behind the anchor plate.



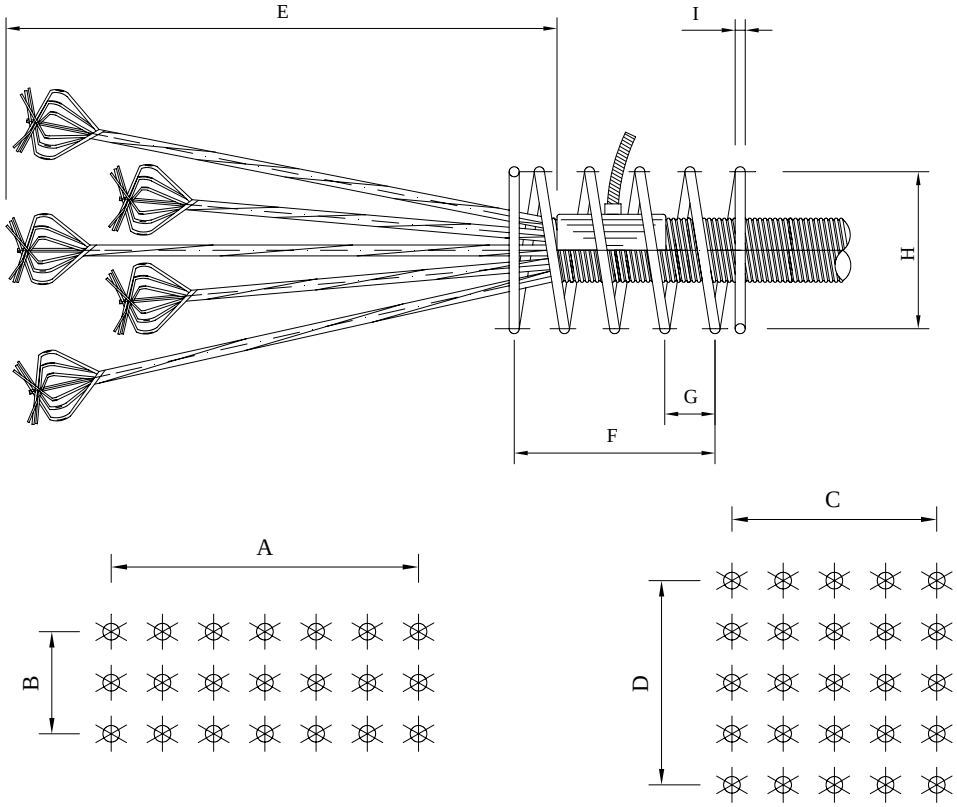
M_{EP}® anchorage

Insertion of the protection cap to guarantee the complete coverage of the anchorage area and its protection against corrosion.



1S15 single strand

"S" series passive anchorages are produced in full accordance with the regulations in force. In this type of anchorage strands are open at the end to increase their adherence to concrete.



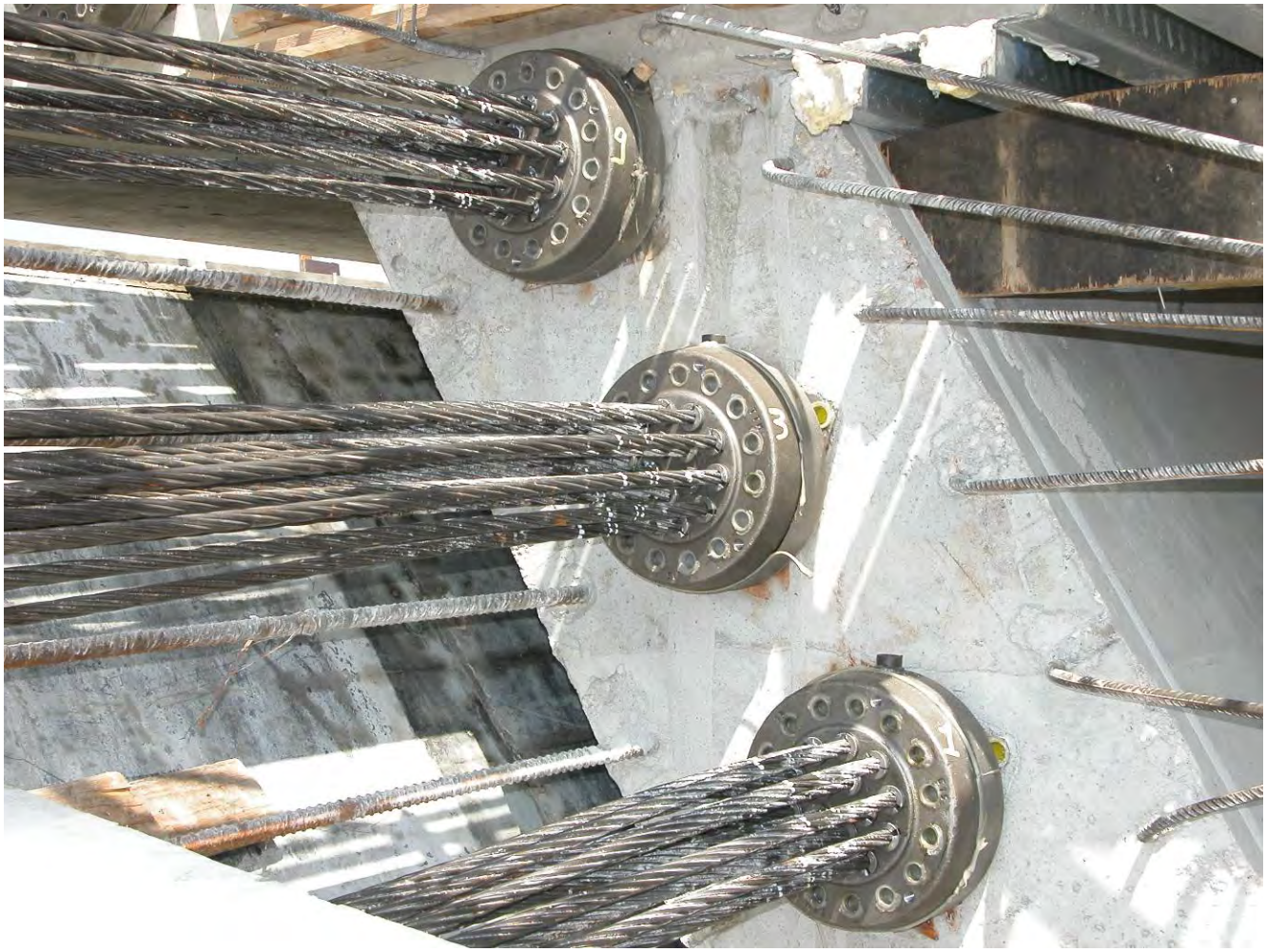
Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***
	T15 *259* ***per cable*** *(KN)*	***T15S*** *279* ***per cable*** *(KN)*	***T15C*** *307* ***per cable*** *(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4S15	*1036*	*1116*	*****	*210*	*-*	*80*	*80*	*800*	*250*	*50*	*100*	*10*
7S15	*1813*	*1953*	*****	*240*	*80*	*-*	*-*	*800*	*350*	*50*	*100*	*10*
9S15	*2331*	*2511*	*****	*-*	*-*	*160*	*160*	*800*	*400*	*60*	*150*	*12*
12S15	*3108*	*3348*	*****	*400*	*80*	*240*	*160*	*800*	*400*	*60*	*150*	*14*
15S15	*3885*	*4185*	*****	*-*	*-*	*320*	*160*	*800*	*400*	*60*	*150*	*14*
19S15	*4921*	*5301*	*****	*-*	*-*	*320*	*240*	*900*	*400*	*70*	*220*	*14*

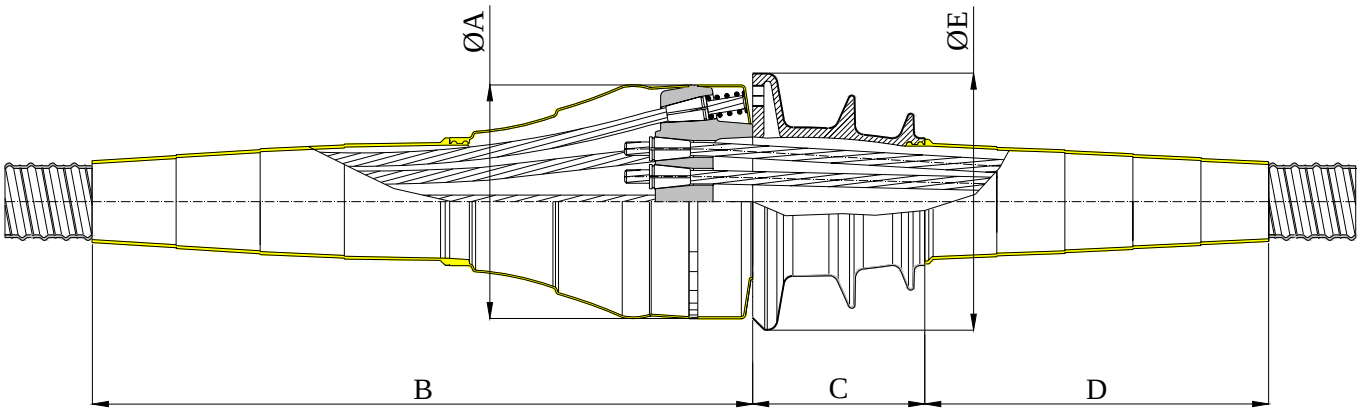
Our company reserves the right to change our products and specifications without any previous notice.
The T15C strand cannot be turned into a S passive anchorage.

14.0 - "G" CONNECTIONS

19G15 coupling plate

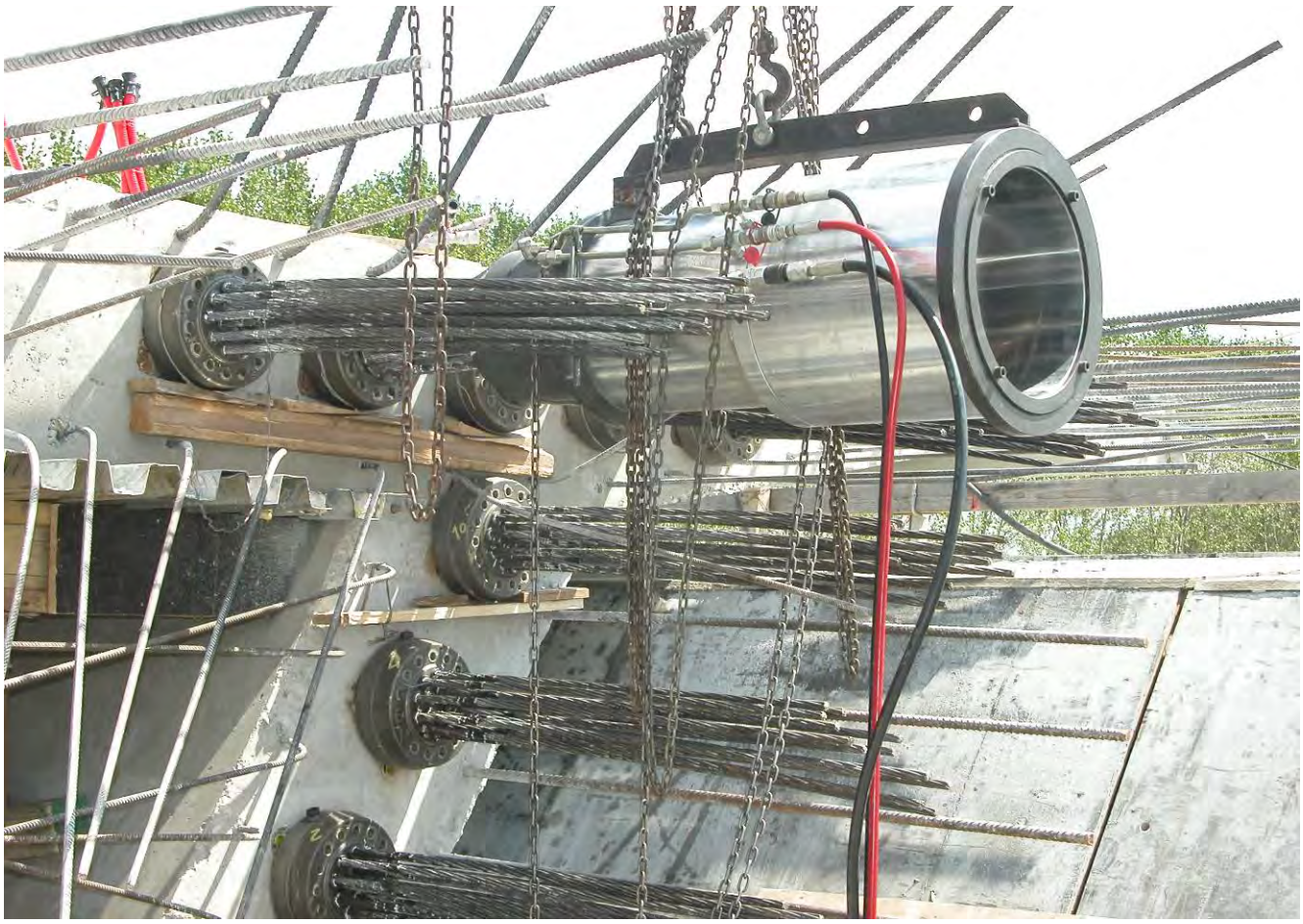
The "G" connection is made of the following parts: casting, anchor plate and connection, wedges, restressing metallic connection and H.D.P.E. or steel connection.
Castings have a turned plane for the plate, holes for connection to cap and formwork and a threaded grouting hole. Castings are in spheroid cast iron EN-GJS 500-7 EN-JS-1050, which offers a high resistance to stress. Being weldable, it guarantees the maximum safety during installation.
Strands are blocked on a distribution plate with truncated cone holes in steel C40-45 UNI EN 10083/1 and by means of wedges in steel 16NiCr4Pb UNI EN 10277-4.
The anchorage and the sheaths are connected by means of a truncated cone connection that guarantees a correct deviation of the strands, minimizing the values of losses. The connection is made of H.D.P.E.
All castings have threaded holes on the plane to allow an easy fixing to the formwork by means of bolts.
All castings have a gas threaded hole for grouting to allow the connection to the several solutions available for grouting.





Type	*A*	*B*	*C*	*D*	*E*	*Sheath diam.*
	(mm.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4G15	*155*	*400*	*103*	*300*	*160*	*45-50*
7G15	*215*	*450*	*133*	*340*	*200*	*62/67*
9G15	*235*	*550*	*175*	*350*	*235*	*72/77*
12G15	*248*	*650*	*185*	*385*	*265*	*80/85*
15G15	*265*	*750*	*197*	*430*	*290*	*85/90*
19G15	*280*	*880*	*215*	*430*	*320*	*95/100*
22G15	*315*	*1000*	*240*	*490*	*355*	*100/105*
27G15	*340*	*1150*	*277*	*500*	*380*	*110/115*

Our company reserves the right to change our products and specifications without any previous notice. *(Measures in mm.)*
All the heads comply with the Circular of 15th October 1996 no. 252 AA.GG./S.T.C.



Assembled coupler

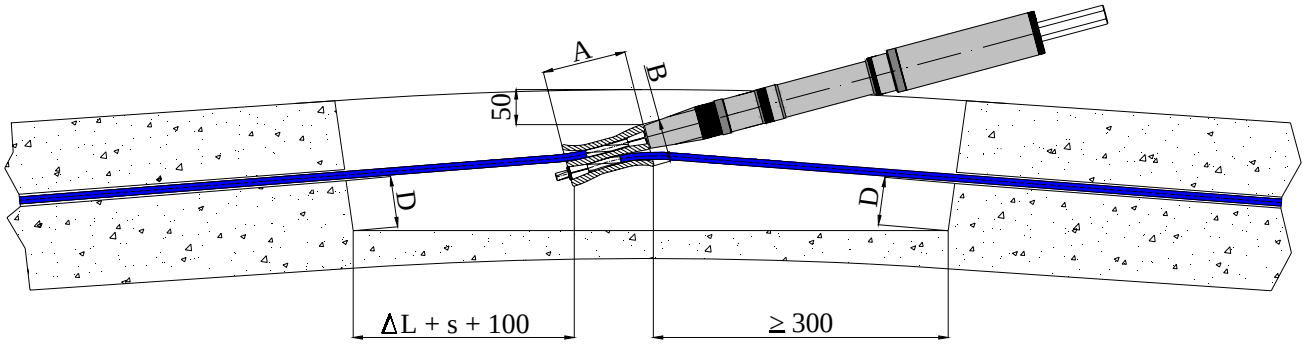
19G15 coupler

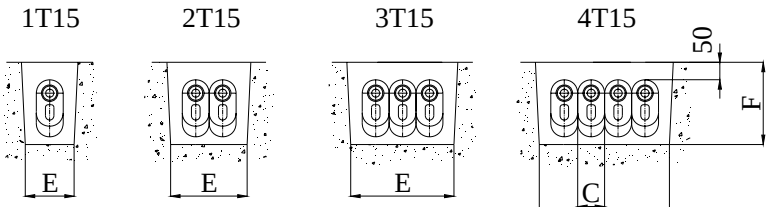
The coupler is made of a forged plate where tensioning and restressing holes are made. Strands are restressed by means of a spring mechanisms which restrains the strand when it is inserted into the external holes. Restressing wedges with springs are protected by a steel casing which makes them tight.

19G15 coupler under tensioning

F connection

The F connection is used for the encircling of tanks or for the positioning into forming moulds as a tensionable connection of two strands. The anchorage is generally used as an unbonded active anchorage and it is used with greased and coated strands.

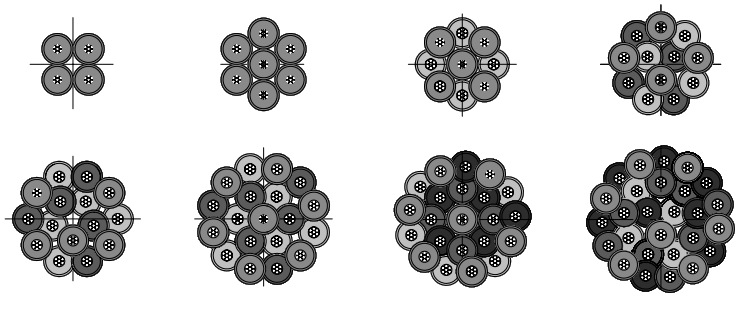




(*) E = 45 + n x B

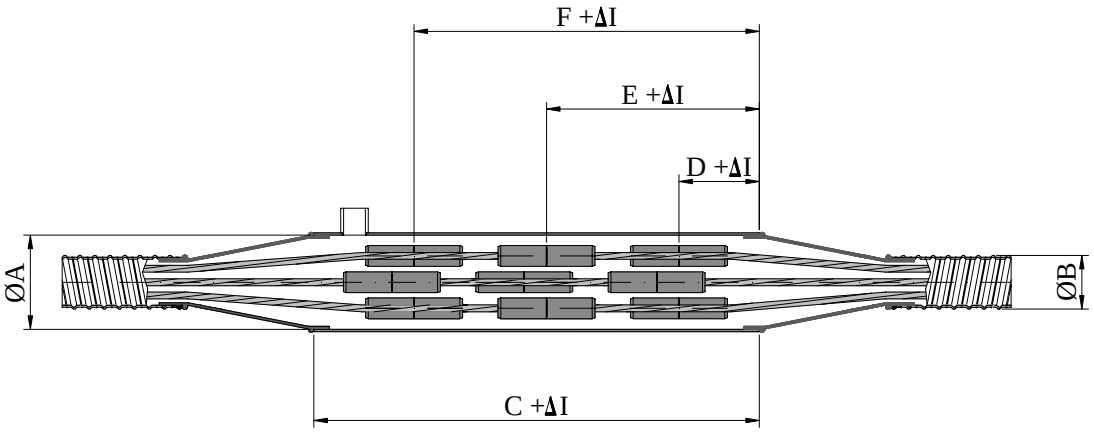
Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***
	T15 *259 per cable (KN)*	***T15S*** *279 per cable (KN)*	***T15C*** *300 per cable (KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
1F15	*259*	*279*	*300*	*200*	*98*	*55*	*60*	*(*)*	*180*	*20*

Our company reserves the right to change our products and specifications without any previous notice. *(Measures in mm.)*



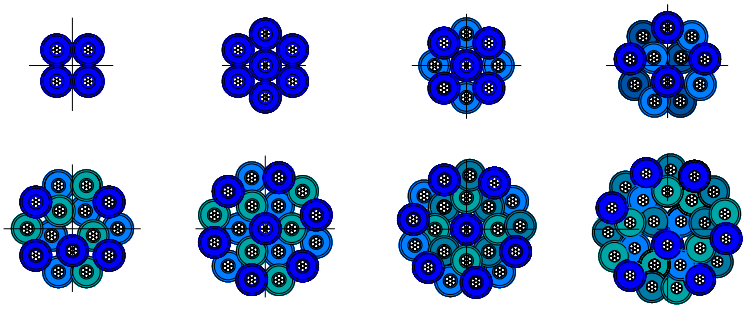
1 2 3 4

Joints "C" series are designed to allow members of splicing cables during the construction of bridges in progress, casting and shooting joints of cables. The pair made their sleeves monotrefolo with internal pre-loaded terminals with spring-loaded device.
The device is made of multiple layers of offsetting the sleeves to contain the same cable size containable in a tube in a spiral metal sheath with injection /vent.



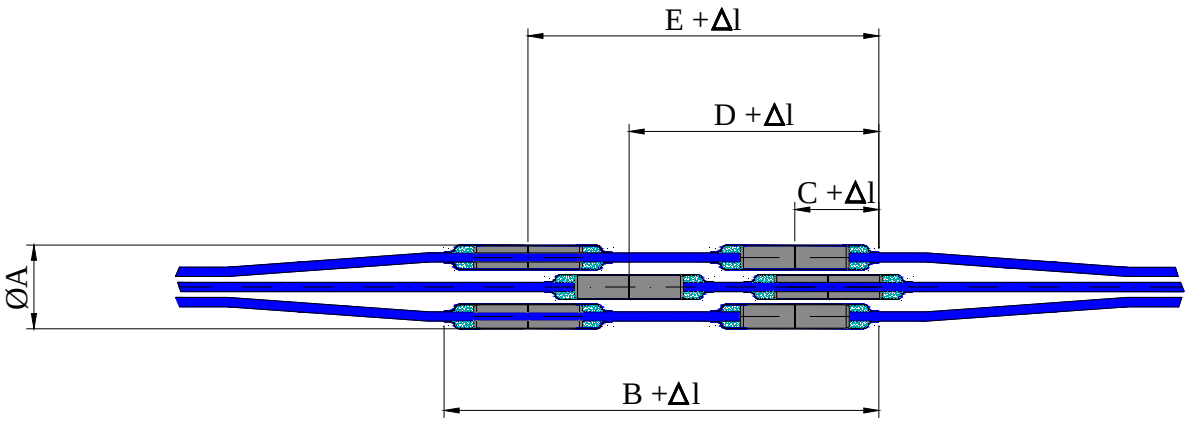
Type	***A***	***B***	***C***	***D***	***E***	***F***
	(mm.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
4C15	*140*	*45/50*	*675*	*300*	*800*	
7C15	*159*	*62/67*	*800*	*340*	*800*	
9C15	*177*	*72/77*	*950*	*400*	*800*	*1.200*
12C15	*193*	*80/85*	*1250*	*400*	*800*	*1.200*
15C15	*193*	*85/90*	*1250*	*400*	*800*	*1.800*
19C15	*193*	*95/100*	*1300*	*400*	*800*	*1.800*
22C15	*219*	*100/105*	*1385*	*400*		
27C15	*244*	*110/115*	*1700*	*400*		

(Measures in mm.)



1 2 3 4

Joints "C" series were created encapsulated in the "CX" solution designed to allow single or multi stranded cables spliced in the non-adherent, while building bridges in progress, casting and shooting joints of cables. The coupling is achieved with linear monotrefolo encapsulated, with their internal pre-loaded terminals with spring-loaded device, the whole is encapsulated in polyethylene is fat. The device is made of multiple layers of offsetting the sleeves so as to contain the same information contained in a cable size and compatible with the application. The fuel injection system does not require the application being non-adherent, he is cast in the cast assembled.



Type	***A***	***B***	***C***	***D***	***E***	***F***
	(mm)	*(mm)*	*(mm)*	*(mm)*	*(mm)*	*(mm)*
4CX15	*140*	*45/50*	*675*	*300*	*800*	
7CX15	*159*	*62/67*	*800*	*340*	*800*	
9CX15	*177*	*72/77*	*950*	*400*	*800*	*1.200*
12CX15	*193*	*80/85*	*1250*	*400*	*800*	*1.200*
15CX15	*193*	*85/90*	*1250*	*400*	*800*	*1.800*
19CX15	*193*	*95/100*	*1300*	*400*	*800*	*1.800*
22CX15	*219*	*100/105*	*1385*	*400*		
27CX15	*244*	*110/115*	*1700*	*400*		

The company reserves the right to change products and specifications without notice. *(Measures in mm.)*

18.0 - "K" CONNECTIONS

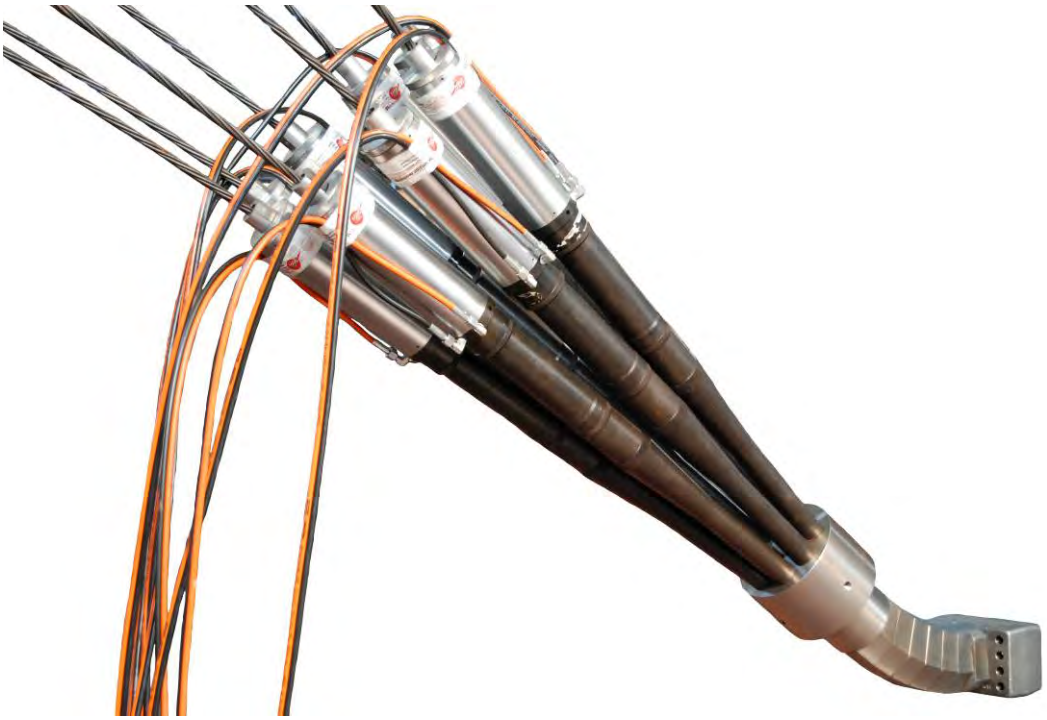
(8K15 connection)

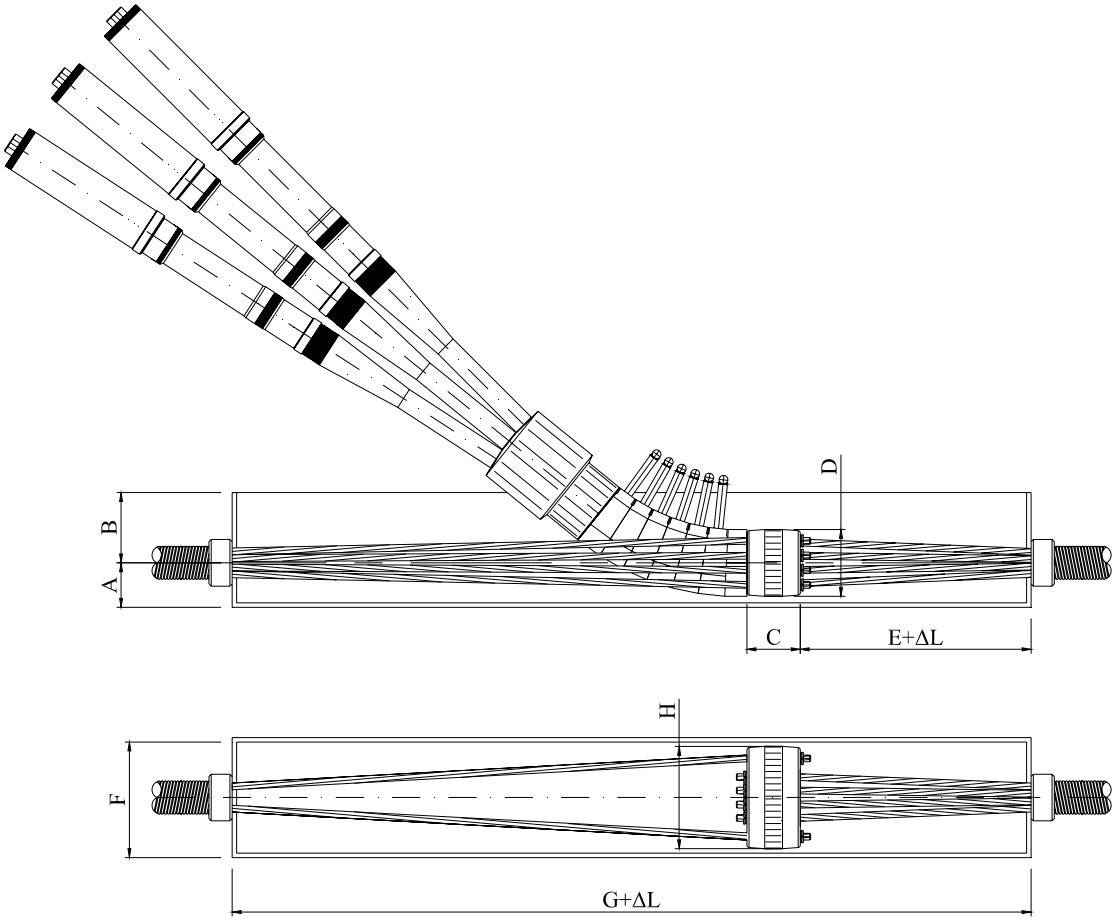
The "K" connection is carried out as a connection for the application on circular cables on: silos, forced pipelines, tunnels and applications which require a connection between cables with the use of a floating anchorage with no support, for example as a coupler for cables that can be tensioned inside a slab.
"K" connections can be tensioned with "M" and "TTM" jacks in both cases by using a special device to allow tensioning.

The "K" connection can be installed both with bonded and unbonded cables, where they can be inserted into a sheet or polythylene sheath for further protection.

"K" connection tensioning

The device is made of steel sectors whose number changes based on the deviation angle required by the application. As the angle changes, the loss of tension will also change, which shall be evaluated by means of experiments for each case.





Type	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
	(mm.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
2K15	*55*	*85*	*70*	*90*	*100*	*170*	*560*	*140*
4K15	*60*	*90*	*80*	*100*	*160*	*200*	*710*	*170*
6K15	*80*	*110*	*100*	*140*	*230*	*240*	*860*	*210*
8K15	*85*	*115*	*130*	*150*	*320*	*300*	*950*	*270*
12K15	*90*	*120*	*160*	*160*	*400*	*330*	*1,200*	*300*

19.0 SLABS

19.1 - Use of post-tensioning technologies in slabs

The new architectural and structural needs require technological solutions with devices that are able to guarantee a high performance to comply with: ***ETAG013*** *guidelines, traceability, easy assembly, durability and resistance against corrosion.*

Post-tensioning allows to build structures with greater spans and reduced structural beam depths, resulting in larger column-free areas. As a result, internal layouts are not limited by tight columns grids.

The deformation and crack control are some of the aspects that are effectively controlled by the application of cables, in spite of the conventional reinforced concrete structures.

Slab post-tensioning can include bonded as well as unbonded post-tensioning systems.

Bonded systems *are carried out with wire strands wrapped in metallic or polyethylene sheaths, provided with grout and vent to allow a correct filling of the cables with cement.*

Unbonded systems *are carried out with wire strands greased and covered in polyethylene (coated) which do not require any cement grouting.*

For both systems, bonded and unbonded, tensioning is carried out strand by strand. Wire strands are then blocked on the active anchorage with a hydraulic locking of wedges on the anchorage.

19.2 – Development of post-tensioning systems

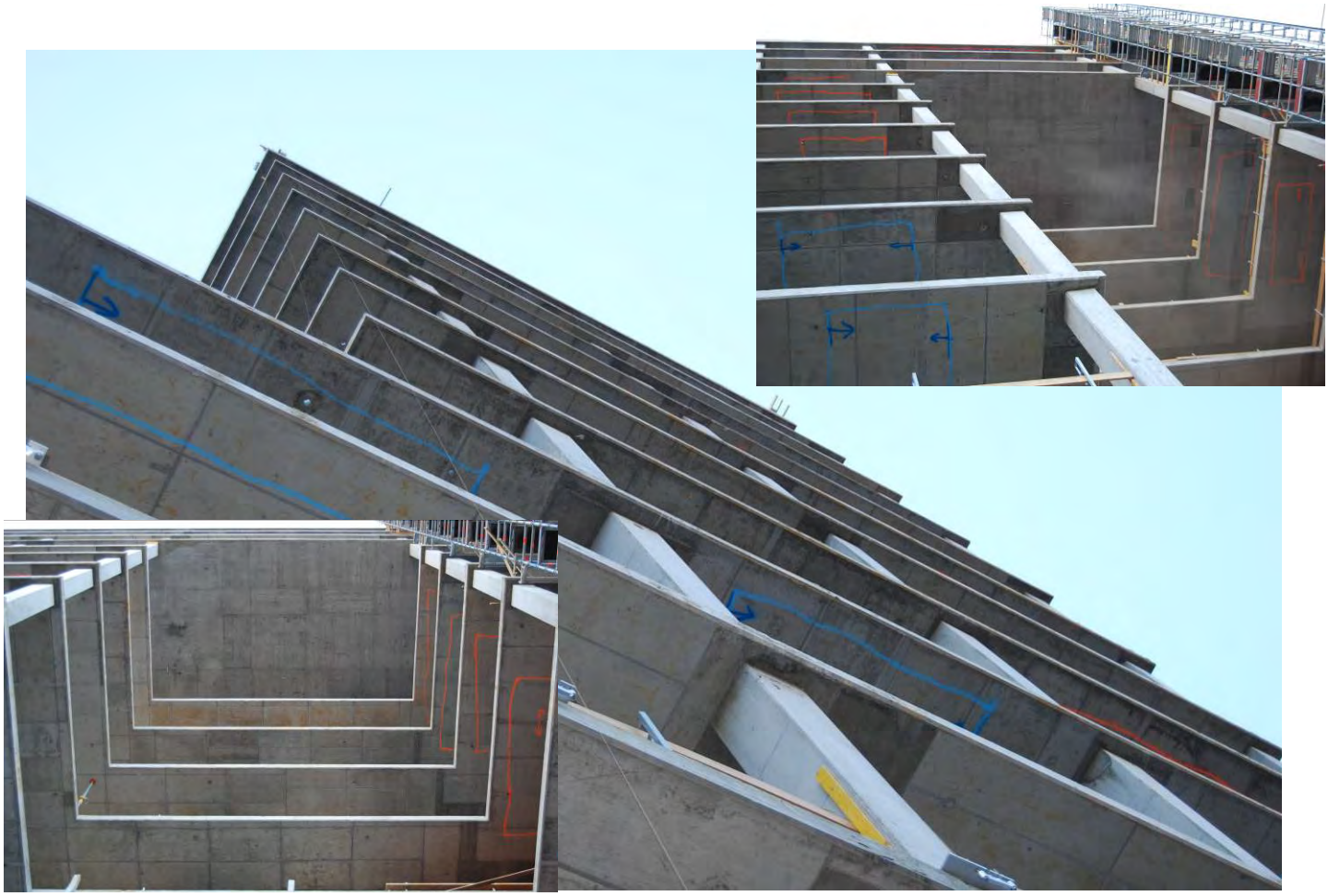
Post-tensioning technology has been used for many years mainly to build big structures such as: bridges, beams, tanks, etc. Taking advantage of the application of concentrated loads, their capacity to react to loads without cracking the concrete was improved. Smaller structures were carried out using traditional systems, without taking into consideration the possibility to use post-tensioning applications, therefore: industrial floors, diaphragms slabs, foundation piles, which were normally produced with steel reinforcement only, now take great structural advantages of the application of post-tensioning.

The same technology used for many years for bridges can be applied to slabs where the reacting thickness is much more limited, with the following structural advantages:

- *Compared with traditional concrete, this technology allows a considerable saving in the quantity of cement and steel, due to the reduction of cross sections which have a more slender design,* ***(saving of steel reinforcement and concrete)****,*
- *Smaller deflections than with the traditional reinforced concrete,* ***(greater rigidity of structures where deflection can be reduced)****,*
- *Good crack behaviour and therefore good protection of steel against corrosion,* ***(reduction of microcracking of concrete and subsequent protection of steel reinforcement against corrosion)****,*
- *Almost unchanged serviceability limit state, even after a considerable live overload, since cracks close again after the load has been removed,*
- *High fatigue strength, since the amplitude of the stress changes in the post-tensioning steel under alternating loads.*

In addition to the already mentioned general features of post-tensioning technology in construction, slabs applications are more typically characterized as follows:

- *More economical structures resulting from the use of high-performance post-tensioned steel instead of the traditional steel reinforcements,*
- *Larger spans and greater flexibility. The latter results from the reduction of the weight of the structures, which also has a beneficial effect upon foundation and elevation structures, reducing the overall height of buildings,*
- *In structures subject to dead loads, good behaviour in terms of deflection and cracking,*
- *Higher shear strength thanks to a proper layout of the strands.*



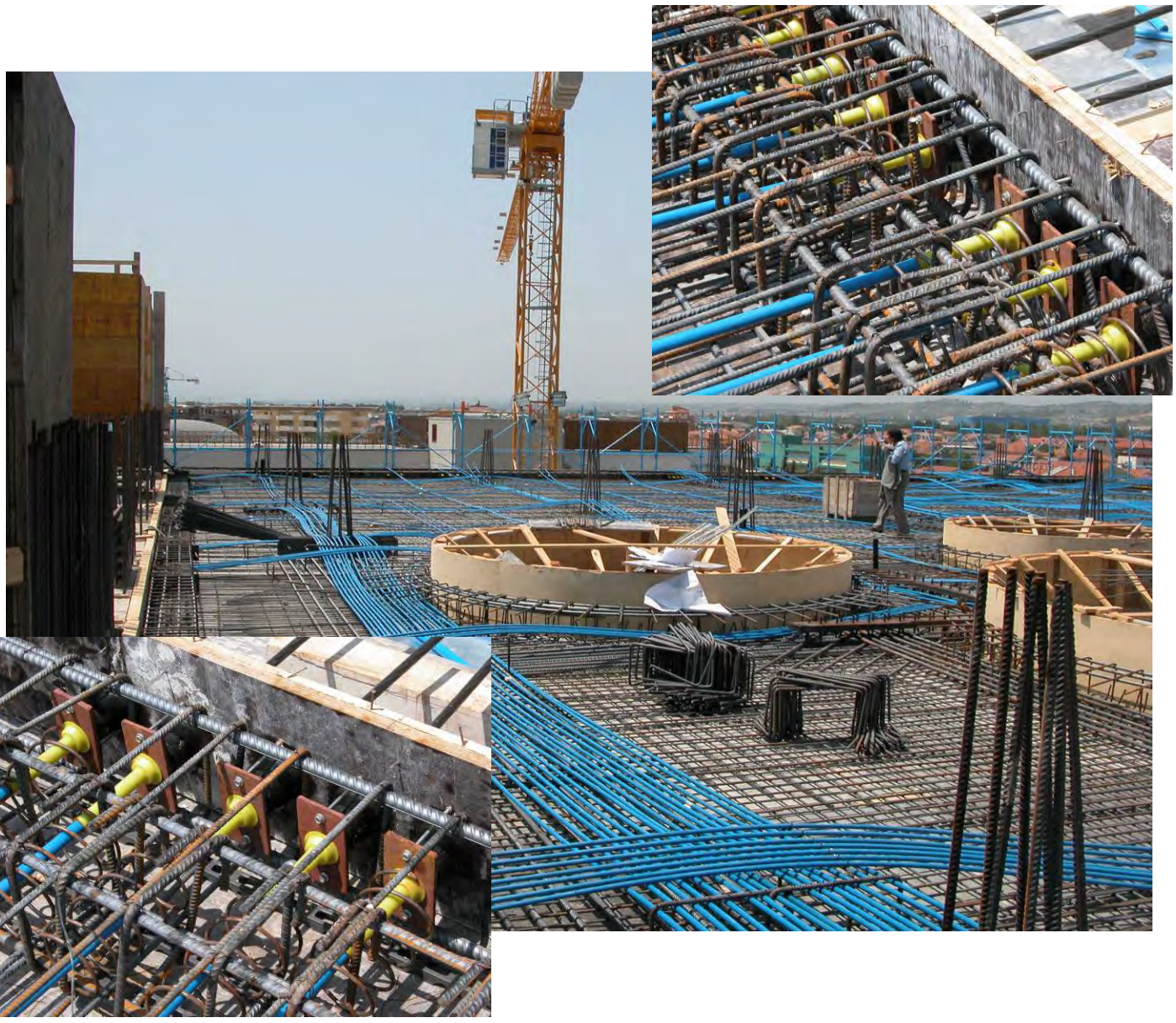
Post-tensioning is very favourable in the construction of rectangular slabs with 8-12 m long sides.
The design of these slabs requires the use of mesh of single strand cables from unitary strands, having steel reinforcement sections of: 139 mm^2, 150 mm^2 and 165 mm^2.
The shape of cables, which exploits the slab thickness at its most, follows the space funicular mesh of the semi-dead load, and the anchorages are placed at the border and fixed in central position where the strand is blocked.
The semi-dead load is obtained by adding half of the live load to the weight of the structure itself and to the entity of the dead loads. Under these conditions the slab is subjected to the axial force only with no bending moment and shear force.
If the live load is lower than 30% of the total load, the calculation is statically defined since the bending moment is only produced by +/- the half of the live load. The compression stress in slabs varies between 1.5 and 2.5 N/mm^2.

The advantages obtained with this type of technology are:

1. *the calculation is extremely precise even for complicated structures, so an automatic calculation is not necessary (mechanics of rigid body),*

2. *vertical structures (pillars and walls) receive no bending moment from the semi-dead vertical loads, therefore the bending reserve of these elements is available to withstand the horizontal loads,*
3. *slabs are perfectly flat with beams depth contained in their thickness and they maintain a flat shape because of the absence of bending creep,*
4. *slabs have no cracks and are therefore totally waterproof,*
5. *the structure may be tensioned and then propped up 2-3 days after concreting (first tensioning at 50% R_{ck}>150 Kg/cm^2),*
6. *the slab above can be shuttered and propped up on the propped up slab without any problem, thus obtaining the autotesting of all slabs,*
7. *the intrados surface can have a finishing that does not require any further processing;*
8. *making holes is very easy in the design phase, but also afterwards taking care not to cut the cables,*
9. *with some precautions, the easy hole-making can also be extended to the spaces put in axis and near the pillars,*

This kind of structure is usually safer than the traditional ones. The structure is less sensitive to the imprecision of construction: therefore, qualified personnel is only required in cable tensioning.



The post-tensioned system that is usually used for slabs can also be applied to carry out industrial floors, thus allowing the floor industry to also take advantage of this technology.
The loads applied to floors cause concentrated stress that is transmitted to the whole structure through cables. In order to avoid any possible warping of the plate, the traditional concrete reinforcement is usually replaced with greased and sheathed single strand cables (unbonded) or bare single strand cables inserted into corrugated sheaths (bonded), which are grouted with cement grout once tensioning operations are concluded.

(Bonded) post-tensioning *which after tensioning requires the grouting of the single strand, and may over time allow the cutting of the floor and cables without any loss of the applied load.*

(Unbonded) post-tensioning *which after tensioning does not require any grouting of the single strand, and does not allow any cutting of the floor and cables. If cables are cut, any post-tensioning will be lost.*

19.4 Bonded post-tensioning

This application is used when following modifications shall be needed by cutting the plate on the post-tensioned structured.

19.5 Unbonded post-tensioning

It is the easiest system to apply to floors. The supplied cables are directly covered by grouting with no need for any further grouting after tensioning. The greased and polyethylene-covered cable guarantees a proper cable protection. This unbonded structure does not allow any following structural modification or the post-tensioning is lost due to strand cutting.

Strands are inserted into the grouting delimitation formwork. According to the project indications, strands are positioned in parallel at a distance between 0.8 and 1.2 m. The project shall define:

- cable spacing,
- cable type,
- tensioning value of each single cable,
- cable trend (lifting distance from the base)

Plate sliding during the tensioning of the vertical structures within grouting, such as walls, pillars and pits, is guaranteed by isolated layers made of compressible material.
The only steel reinforcement to consider is the one to position on elevation grade planes, corners and in edgings where strand anchorages are present in order to avoid any concentrated cracks.

After seasoning is properly protected, tensioning is carried out. For through tensioning, a jack with a particular mouthpiece is used to guarantee the strand grip at the exact point of grouting. The final tensioning is usually carried out 72 hours after the resistance against compression of cubes is laboratory tested with higher stroke and capacity jacks. The actual elongation of the strand is then measured and compared to the theoretical values to check whether the applied load has caused a steel elongation as calculated.

19.6 Project characteristics for post-tensioned floors

19.6.1 Slab thickness

The post-tensioned floor allows a reduction of the plate height and therefore of costs.

19.6.2 Positioning of wire strands

Wire strands are positioned in the middle of the plate thickness by means of spacers in order to make the applied stress more compact and even.

19.7 Tensioning

Tensioning parameters are an integral part of the project. The first tensioning is usually carried out 24 hours after grouting with a value under 50% of the total tension, while the second at 100% based on the implementation and the project.

Type and quantity of wire strands

The quantity and type of strands are project data and they are supplied by the designer with the following variables: mesh spacing, cable pattern, applied loads, grouting dimension, post-tensioning type, strand type, etc. The post-tensioning type is chosen according to the plate height and its use intended, which are basic elements for the structure design.

19.8 Advantages of a post-tensioned floor

The application of the post-tensioning technology to industrial floors offers the following advantages:

- *No joints,*
- *No cracks,*
- *Greater comfort,*
- *No warping,*
- *Less concrete and steel reinforcement,*
- *Reduction of the costs of maintenance,*
- *Better aesthetics,*
- *Reduction of thickness,*
- *Quick implementation,*

19.9 Unbonded applications

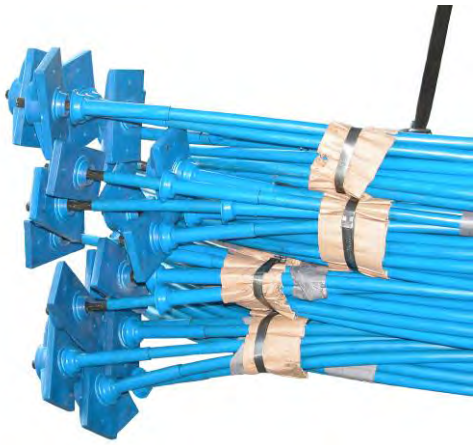
Unbonded applications are implemented for projects where the plan of openings in slabs is defined during the design phase. The application does not guarantee the feasibility of holes that may interfere with cables under tension.

The unbonded application is surely the most performing one, since it is protected against corrosion by both a grease and a polyethylene barrier. It requires no grouting after tensioning but a very accurate infilling (sealing) of the heads. In this application the load will always remain totally concentrated on the anchorage, therefore the sealing completes the protection of the anchorage over time and its importance increases together with the anchorage exposure to corrosion.

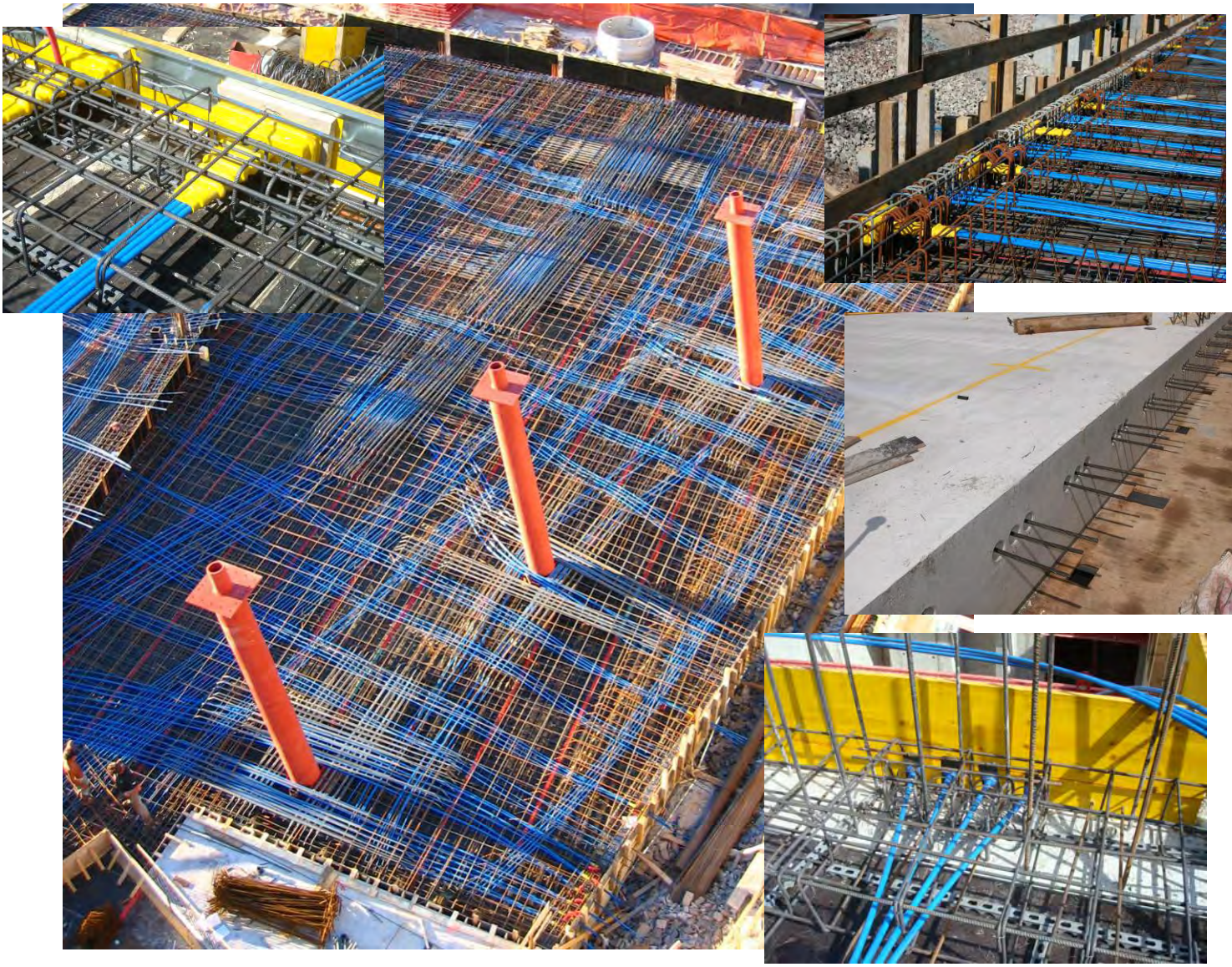
Cables for unbonded slabs may be supplied directly from the factory rolled up with a diameter of 2.2 m, with the passive anchorage preblocked at one end.

This kind of supply allows the following advantages for the site:

- *net reduction of swarfs and cutting installation,*
- *reduction of handling of post-tensioning material on site,*
- *reduction of material stocking areas on site,*
- *reduction of the use of lifting means on site,*



Cables cut to size with 1EX15 anchorage cut at one end



19.10– Bonded applications

Bonded applications are implemented for projects where the plan of openings in slabs must be modifiable over time but cannot be finally defined during the design phase. The application guarantees the feasibility of holes that may interfere with cables under tension without changing statics. The possibility to carry out cuts on the structure and on bonded cables is essential for structures where the use intended is not defined and interventions may be carried out to install stairs or lifts, on industrial floors where the plan of openings may be changed together with the use intended of the building.

The bonded application is surely the easiest one, since it is protected against corrosion by the cement grouting that is a barrier against the strand oxidation by guaranteeing the discharge of air. The quality of grouting is the best warranty to the system durability, therefore the sealing completes the protection of the anchorage over time and its importance increases together with the anchorage exposure to corrosion.

Cables for bonded slabs may be supplied directly from factory rolled up with a diameter of 2.2 m, with the passive anchorage preblocked at one end and with sheaths.

This kind of supply allows the following advantages for the site:

- *net reduction of swarfs and cutting installation,*
- *reduction of handling of post-tensioning material on site,*
- *reduction of material stocking areas on site,*
- *reduction of the use of lifting means on site,*

19.11– X series encapsulated anchorages (bonded and unbonded)

X series anchorages, both single and multi-strand, are encapsulated with polyethylene in order to guarantee unlimited durability and resistance against corrosion provided the devices are properly installed. A layer of polyethylene covers the whole anchorage, allowing a grouting of cement or grease inside it.

The application of X anchorages may be unbonded or bonded with grouting of cement or grease. The encapsulation of the whole anchorage with minimum 3mm polyethylene thickness allows a strong encapsulation of the device, which prevents corrosive agents from affecting its durability and effectiveness. The effectiveness of the system is completed by the use of polyethylene corrugated sheaths which guarantee the encapsulation of the whole cable.

20.0 - E AND EX SINGLE STRAND ANCHORAGES

Single strand anchorages are produced for both bonded and unbonded applications, they are supplied to the site with all the accessories necessary for their installation. They are produced in compliance with the guideline ***ETAG 013****. The "E" series single strand anchorage is made of the following parts: steel plate in C40-45 UNI EN 10083/1, in the EX version encapsulated in H.D.P.E., wedges in steel 16NiCr4Pb UNI EN 10277-4 and connection in H.D.P.E. to connect the plate to the wire strand. The anchorage is tested for use with the T15, T15S and T15C wire strand. Anchorages have been awarded with the* ***European Technical approval for single strand systems E.T.A. ETA-09-0012 and its relating marking CE 0969-CPD-001/09-PT****.*

20.1 - Application of unbonded anchorages

1E15 single strand anchorages are supplied with two holes to connect with the formwork. The anchorage of the steel plate to the formwork wood panel is guaranteed by two self-tapping screws.

20.2 - Application of bonded anchorages

The rear connection guarantees a proper protection of the wire strand without polyvinyl chloride in the area of connection to the anchorage. The unbonded application can be carried out with a metallic sheath and a polyethylene sheath. Sheaths are provided with proper connections for grouting and vent to guarantee a correct grouting after tensioning.

20.3 – Cables supply

Cables can be supplied cut to size directly on site, rolled up with a diameter of 2.2 m and labelled for identification and a quick allocation.

Applications of bonded and unbonded single strand anchorages

Single strand anchorages are divided into the following bonded and unbonded types and applications.
Anchorages are available in the following versions: 1E15, 1ED15, 1EX15, 1EXD15 and 1GX15 and applications:

- *A active anchorages,*
- *B through anchorages,*
- *C connections*
- *D passive anchorages.*

20.4 - "A" SERIES ACTIVE ANCHORAGES

"E" series 1E15-A1 single strand anchorages

(Unbonded post-tensioning)

Active 1E15-A1 assembled anchorage

*The anchorage: **active and unbonded, "1E15-A1" type.** It is supplied with a connection with the greased strand covered in polyethylene, the corrosion protection is provided by means of passivation while grouting. This application is typical for floors, diaphragms and slabs. The **"1E15-A1"** anchorage is unbonded, it may be supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork.*

"EX" series 1EX15-A2 single strand anchorages

(Unbonded encapsulated post-tensioning)

1EX15-A2 active assembled anchorage

*The anchorage: **active, unbonded and encapsulated, "1EX15-A2" type.** It is made with the total encapsulation of the polyethylene covered anchorage, with the greased strand covered in polyethylene. The **"1EX15-A2"** anchorage is unbonded, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. It is provided with a pressure cap that may be installed after the strand, which is filled with grease, is cut. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system.*

"EXD" series 1EXD15-A3 single strand anchorages

(Unbonded encapsulated post-tensioning)

1EXD15-A3 active assembled anchorage

*The anchorage: **active, unbonded and encapsulated, "1EX15-A3" type.** It is made with the total encapsulation of the polyethylene covered anchorage, with the greased strand covered in polyethylene. The **"1EX15-A3"** anchorage is unbonded, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system. . The anchorage is provided with a threaded closing tip in order to guarantee a stronger closure to contain grease, it can be installed on site by qualified technicians.*

"ED" series 1ED15-A4 single strand anchorages

(Unbonded post-tensioning)

1ED15 active assembled anchorage

*The anchorage: **active and unbonded, "1ED15-A4" type.** It is supplied with the greased strand covered in polyethylene. This application is typical for floors, diaphragms and slabs, where a simple anchorage protection is required by means of passivation while grouting. The **"1E15-A1"** anchorage is unbonded, it may be supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. . The anchorage is provided with a threaded closing tip in order to guarantee a stronger closure to contain grease, it can be installed on site by qualified technicians.*

" E" series 1E15-A5 single strand anchorages

(Bonded post-tensioning)

Active 1E15 assembled anchorage

*The anchorage: **active and bonded "1E15-A5"**. Its application allows to install bonded single strand anchorages with the strand entered into a metallic sheath, for an environment which requires a simple protection for the anchorage and the whole cable by means of passivation while grouting. The application is typical of industrial floors, diaphragms or slabs in a normal environment. This solution requires special tensioning jacks that can operate on a continuous cable. The cable is provided with a steel protection sheath, which must be provided with proper grouting and vent points.*

"EX" series 1EX15-A6 single strand anchorages

(Bonded post-tensioning)

1EX15-A6 active bonded anchorage

*The **active, bonded and encapsulated "1EX15-A6"** anchorage is made with the total encapsulation of the anchorage and of the cable, protected with a polyethylene corrugated sheath. The **"1EX15-A6"** anchorage is bonded and grouted, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system. The anchorage is provided with a pressure cap that may be installed after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"E" series 1E15-A7 single strand anchorages

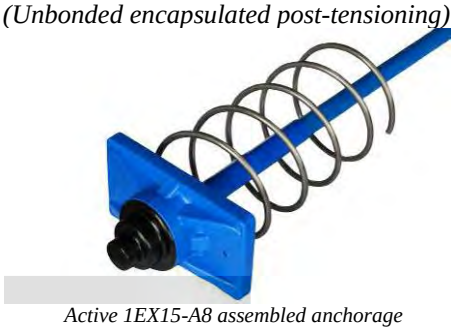
(Bonded post-tensioning)

1E15-A7 active bonded assembled anchorage

*The anchorage: **active and bonded "1E15-A7"**. The application allows to install bonded single strand anchorages with the strand entered into a polyethylene sheath. This application is used in an environment that requires a simple protection of the **"1E15-A7"**anchorage by means of passivation while grouting and of the whole cable with a polyethylene sheath. The application is typical of industrial floors, diaphragms or slabs in a normal environment. This solution requires special tensioning jacks that can operate on a continuous cable. The cable is provided with a polyethylene protection sheath, which must be provided with proper grouting and vent points.*

"EX" series 1EX15-A8 single strand anchorages

(Unbonded encapsulated post-tensioning)



Active 1EX15-A8 assembled anchorage

*The anchorage: **active, unbonded and encapsulated, "1EX15-A8" type,** it is made with the total encapsulation of the polyethylene covered anchorage, with the greased strand covered in polyethylene. The **"1EX15-A8"** anchorage is unbonded, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. It is provided with a medium cap that may be installed after the strand, which is filled with grease, is cut. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system.*

"EX" series 1EX15-A9 single strand anchorages

(Unbonded encapsulated post-tensioning)

1EX15-A9 active assembled anchorage

*The anchorage: **active, unbonded and encapsulated, "1EX15-A9" type.** It is made with the total encapsulation of the polyethylene covered anchorage, with the greased strand covered in polyethylene. The **"1EX15-A9"** anchorage is unbonded, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. It is provided with a short cap that may be installed after the strand, which is filled with grease, is cut. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system.*

"EX" series 1EX15-A10 single strand anchorages

(Encapsulated bonded post-tensioning)

1EX15-A10 active assembled anchorage

*The **active, unbonded and encapsulated "1EX15-A10"** anchorage is made with the total encapsulation of the anchorage and of the cable, protected with a polyethylene corrugated sheath. The **"1EX15-A10"** anchorage is bonded and grouted, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system. The anchorage is provided with a medium cap that may be installed under pressure after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"EX" series 1EX15-A11 single strand anchorages

(Encapsulated bonded post-tensioning)

1EX15-A11 active assembled anchorage

*The **active, unbonded and encapsulated "1EX15-A11"** anchorage is made with the total encapsulation of the anchorage and of the cable, protected with a polyethylene corrugated sheath. The **"1EX15-A11"** anchorage is bonded and grouted, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system. The anchorage is provided with a short cap that may be installed under pressure after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"EX" series 1EXD15-A12 single strand anchorages

(Encapsulated bonded post-tensioning)

1EXD15 active assembled anchorage

*The anchorage: **active and bonded, "1EXD15-A12" type.** It is made with the anchorage covered in polyethylene and entered into a metallic sheath. It is applied in an environment where a high anchorage protection is required, and where the cable protection is obtained by means of passivation while grouting. The **"1EX15-A12"** anchorage is bonded, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. The application is typical of the carried-out industrial floors, diaphragms or slabs. . The anchorage is provided with a threaded closing tip in order to guarantee a stronger closure to contain grease, it can be installed on site by qualified technicians.*

"EX" series 1EX15-A13 single strand anchorages

(Bonded post-tensioning with encapsulated anchorage)

1EX15-A13 active assembled anchorage

*The anchorage: **active and bonded, "1EXD15-A13" type.** It is made with the anchorage covered in polyethylene and the strand entered into a metallic sheath. It is applied in an environment where a high anchorage protection is required, and where the cable protection is obtained by means of passivation while grouting. The **"1EX15-A13"** anchorage is bonded, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. The application is typical of the carried-out industrial floors, diaphragms or slabs. The anchorage is provided with a pressure closing tip in order to guarantee a stronger closure to contain grease, it can be installed on site by qualified technicians.*

"ED" series 1ED15-A14 single strand anchorages

(Bonded post-tensioning)

1ED15-A14 active assembled anchorage

***The anchorage: active and bonded, "1ED15-A14" type,** it is supplied with the anchorage and the strand entered into a metallic sheath. It is applied in an environment where a unit protection is required by means of passivation while grouting. The **"1EX15-A14"** anchorage is bonded, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. The application is typical of the carried-out industrial floors, diaphragms or slabs. The anchorage is provided with a threaded closing tip in order to guarantee a stronger closure to contain grease, it can be installed on site by qualified technicians.*

"EX" series 1EX15-A15 single strand anchorages

(Bonded post-tensioning)

1EX15-A15 active assembled anchorage

*The anchorage: **active and bonded, "1EX15-A15" type.** It is made with the anchorage covered in polyethylene and entered into a metallic sheath. It is applied in an environment where a high anchorage protection is required, and where the cable protection is obtained by means of passivation while grouting. This application is typical of industrial floors, diaphragms and slabs. The "**1EX15-A15**" anchorage is bonded, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. The anchorage is provided with a medium cap that may be installed under pressure after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"EX" series 1EX15-A16 single strand anchorages

(Bonded post-tensioning)

1EX15-A16 active assembled anchorage

*The anchorage: **active and bonded, "1EX15-A16" type,** is made with the anchorage covered in polyethylene and entered into a metallic sheath. It is applied in an environment where a high anchorage protection is required, and where the cable protection is obtained by means of passivation while grouting. This application is typical of industrial floors, diaphragms and slabs. The "**1EX15-A16**" anchorage is bonded, it is supplied active (tensioning side) with truncated cone or rectangular pocket former to connect to the formwork. The anchorage is provided with a short cap that may be installed under pressure after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"EXD" series 1EXD15-A17 single strand anchorages

(Post tensione aderente incapsulata)

Ancoraggio attivo 1EXD15 assemblato

*Anchoring: active member, such as "**1EXD15-A17**", the anchor is made of polyethylene covered and placed in a polyethylene conduit, application environments where high protection is required, the anchor and cable protection passivation obtained by the jet. The anchor "**1EXD15-A17**" is adherent, is provided on (stretching the side) for attachment to the mast step with conical or rectangular mold. The application is typical of industrial flooring, partitions or floors made. . The anchorage is provided with a threaded closing tip in order to guarantee a stronger closure to contain grease, it can be installed on site by qualified technicians.*

"ED" series 1ED15-A18 single strand anchorages

(Post tensione aderente)

Ancoraggio attivo 1ED15-A18 assemblato

*Anchoring: active member, such as "**1ED15-A18**", is made with the anchor strand and inserted in a polyethylene conduit, application environments where protection is required in the casting complex obtained by passivation. The anchor "**1ED15-A18**" is adherent, is provided on (stretching the side) for attachment to the mast step with conical or rectangular mold. The application is typical of industrial flooring, partitions or floors made. The anchor has a threaded cap closure, which ensures a more energetic close to the containment of the fat, can be installed on site by qualified technicians.*

Corrosion protection levels on "A" series anchorages:

Protection level	*Anchorage type*	*Anchorage 1E15*	*Anchorage 1ED15*	*Anchorage 1EX15*	*Anchorage 1EXD15*	*Metallic sheath*	*Polyethylene sheath*	*Bonded strand*	*Unbonded strand*
1	*1E15-A5*	*X*				*X*		*X*	
1	*1ED15-A4*		*X*						*X*
2	*1ED15-A14*		*X*			*X*		*X*	
2	*1ED15-A18*		*X*				*X*	*X*	
3	*1E15-A1*	*X*							*X*
4	*1E15-A7*	*X*					*X*	*X*	
5	*1EXD15-A12*				*X*	*X*		*X*	
5	*1EXD15-A17*				*X*		*X*	*X*	
5	*1EX15-A13*			*X*		*X*		*X*	
5	*1EX15-A15*			*X*		*X*		*X*	
5	*1EX15-A16*			*X*		*X*		*X*	
5	*1EX16-A6*			*X*			*X*	*X*	
5	*1EX15-A10*			*X*			*X*	*X*	
5	*1EX15-A11*			*X*			*X*	*X*	
6	*1EXD15-A3*				*X*				*X*
6	*1EX15-A2*			*X*					*X*
6	*1EX15-A8*			*X*					*X*
6	*1EX15-A9*			*X*					*X*

***Level 5 and 6**: totally encapsulated cables, anchorage 1EX15 or 1EXD15 and greased cable covered in polyethylene represent the maximum protection level*

20.5 - "B" SERIES THROUGH ANCHORAGES

Application of "E" series anchorages for 1E15-B1 through strands

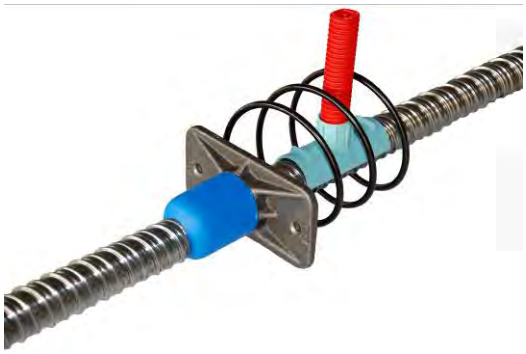
(Through unbonded post-tensioning)

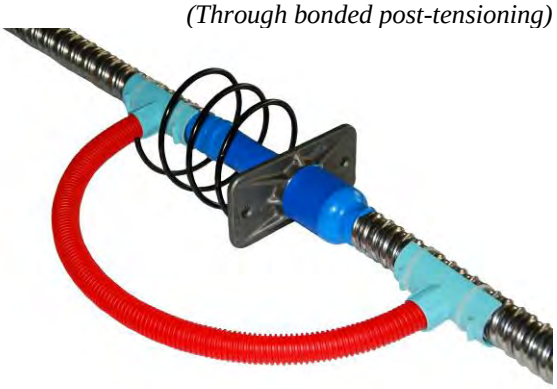
1E15-B1 assembled through anchorage

*The anchorage: **active, unbonded and through, "1E15-B1" type.** It is provided with a wedge protection cap. The application allows to install unbonded single strand anchorages with through strand. The application is typical of industrial floors, diaphragms or continuous grouting slabs, where on a continuous cable several **"1E15-B1"** anchorages are installed in series. This solution requires special TTM 280KN tensioning jacks that can operate on a continuous cable. A double cable protection is guaranteed. The cable is greased and covered in polyethylene.*

Application of "E" series anchorages for 1E15-B2 through strands

(Through bonded post-tensioning)





1E15-B2 assembled through anchorage

The anchorage: ***active, bonded and through, "1E15-B2" type.*** *It is provided with a wedge protection cap. The application allows to install bonded single strand anchorages with through strand in an environment where a cable and anchorage corrosion protection is required, which only relies on the cement coverage of the components. The application is typical of industrial floors, diaphragms or continuous grouting slabs in an environment where water is present, and where on a continuous cable several* ***"1E15-B2"*** *anchorages are installed in series. This solution requires special tensioning jacks that can operate on a continuous cable. The cable is provided with a steel protection sheath, provided with proper grouting and vent points.*

Application of "E" series anchorages for 1E15-B3 through strands

(Through bonded post-tensioning)

1E15-B3 assembled through anchorage

The anchorage: ***active, bonded and through, "1E15-B3" type.*** *It is provided with a wedge protection cap., The application allows to install bonded single strand anchorages with through strand in an environment where a cable only corrosion protection is required by means of a polyethylene corrugated sheath. The application is typical of industrial floors, diaphragms or continuous grouting slabs in an environment where water is present, and where on a continuous cable several* ***"1E15-B3"*** *anchorages are installed in series. This solution requires special tensioning jacks that can operate on a continuous cable. The cable is provided with a polyethylene protection sheath on the whole length, which must be provided with proper grouting and vent points.*

Application of "EX" series anchorages for 1EX15-B4 through strands

(Through bonded post-tensioning)

1XE15-B4 assembled through anchorage

The anchorage: ***active, bonded and through, "1XE15-B4" type.*** *It is provided with a wedge protection cap and the anchorage totally encapsulated with polyethylene. The application allows to install bonded single strand anchorages with through strand in an environment where a double anchorage only corrosion protection is required. The application is typical of industrial floors, diaphragms or continuous grouting slabs in an environment where water is present, and where on a continuous cable several* ***"1EX15-B4"*** *anchorages are installed in series. This solution requires special tensioning jacks that can operate on a continuous cable. The cable is provided with a steel protection sheath, provided with proper grouting and vent points.*

Application of "EX" series anchorages for 1EX15-B5 through strands

(Encapsulated through bonded post-tensioning)

1XE15-B5 assembled through anchorage

The anchorage: ***active, bonded and through, "1XE15-B5" type.*** *It is provided with a wedge protection cap and the anchorage totally encapsulated with polyethylene. The application allows to install bonded single strand anchorages with through strand in an environment where a double anchorage and cable corrosion protection is required (polyethylene encapsulation). The application is typical of industrial floors, diaphragms or continuous grouting slabs in a corrosive environment where water is present, and where on a continuous cable several* ***"1EX15-B5"*** *anchorages are installed in series. This solution requires special tensioning jacks that can operate on a continuous cable. The cable is provided with a polyethylene protection sheath, provided with proper grouting and vent points.*

Application of "EX" series anchorages for 1EX15-B6 through strands

(Encapsulated through unbonded post-tensioning)

1XE15-B6 assembled through anchorage

The anchorage: ***active, encapsulated, unbonded and through, "1XE15-B6" type.*** *It is provided with a wedge protection cap and the anchorage totally encapsulated with polyethylene. The application allows to install unbonded single strand anchorages with through strand in an environment where a double anchorage and cable corrosion protection is required (polyethylene encapsulation). The application is typical of industrial floors, diaphragms or continuous grouting slabs in a highly corrosive environment, where on a continuous cable several* ***"1EX15-B2"*** *anchorages are installed in series. This solution requires special tensioning jacks that can operate on a continuous cable. The system is provided with an encapsulation on its while length.*

Corrosion protection levels on "B" series anchorages:

Protection level	***Type of protection***	***Anchorage type***	***Anchorage 1E15***	***Anchorage 1EX15***	***Metallic sheath***	***Polyethylene sheath***	***Bonded strand***	***Unbonded strand***
1		***1E15-B2***	*X*		*X*		*X*	
2		***1E15-B1***	*X*					*X*
3		***1EX15-B4***		*X*	*X*		*X*	
4		***1E15-B3***	*X*			*X*	*X*	
5	*Encapsulated*	***1EX15-B5***		*X*		*X*	*X*	
6	*Encapsulated*	***1EX15-B6***		*X*				*X*

Level 6 and 5*: Level 6 totally encapsulated cable, 1EX15 anchorage and greased cable covered in polyethylene, level 5 totally encapsulated cable, 1EX15 anchorage and cable covered in a polyethylene sheath, they represent the maximum unbonded and bonded protection level.*

“ E" series 1E15-D1 single strand anchorages

(Unbonded post-tensioning)

Passive 1E15-D1 assembled anchorage

*The anchorage: **passive, unbonded, "1E15-D1" type.** It is supplied with a connection with the greased strand covered in polyethylene. This application is typical of industrial floors, diaphragms and slabs. The "**1E15-D1**" anchorage is unbonded, it is supplied passive, factory prelocked or to lock on site by using a **B300KN** jack. It is directly covered while grouting and its corrosion protection is obtained by means of passivation while grouting.*

"EX" series 1EX15-D2 single strand anchorages

(Unbonded encapsulated post-tensioning)

1EX15-D2 passive assembled anchorage

*The anchorage: **passive, unbonded and encapsulated, "1EX15-D2" type.** It is made with the total encapsulation of the polyethylene covered anchorage, with the greased strand covered in polyethylene. The "**1EX15-D2**" anchorage is unbonded, it is supplied passive, factory prelocked or to lock on site by using a **B300KN jack.** This application is typical of industrial floors, foundation piles, diaphragms and slabs in a highly corrosive environment for the whole system.*

"EXD" series 1EXD15-D3 single strand anchorages

(Unbonded encapsulated post-tensioning)

1EXD15-A3 passive assembled anchorage

*The anchorage: **passive, unbonded and encapsulated, "1EX15-D3" type.** It is made with the total encapsulation of the polyethylene covered anchorage, with the greased strand covered in polyethylene. The "**1EXD15-D3**" anchorage is passive unbonded. This application is typical of industrial floors, foundation piles, diaphragms and slabs in a highly corrosive environment for the whole system. The anchorage is provided with a threaded closing tip in order to guarantee a stronger closure, it is provided pre-assembled and- greased, it is provided with spring locking and can be installed on site by qualified technicians directly on the cut-to-measure strands. This solution allows to dramatically reduce the installation time of passive anchorages.*

"ED" series 1ED15-D4 single strand anchorages

(Unbonded post-tensioning)

1ED15 passive assembled anchorage

*Anchoring: **passive, non-adherent**, such as "**1ED15-A4**" is provided with the connecting strand greased and covered with polyethylene. The typical application is for flooring, partitions and floors, where the anchor is required simply protecting passivation obtained by the jet. The anchor has a threaded cap that ensures a more forceful closure. It comes pre-assembled and pre-lubricated and has a locking spring. It 'can be installed on site by qualified technicians directly on the strands cut to size. This solution drastically reduces the installation time of passive anchors.*

“ E" series 1E15-D5 single strand anchorages

(Bonded post-tensioning)

Passive 1E15-D6 assembled anchorage

*The anchorage: **passive and bonded "1E15-A5"**. Its application allows to install bonded single strand anchorages with the strand entered into a metallic sheath, for an environment which requires a simple protection for the anchorage and the whole cable by means of passivation while grouting. The **"1E15-D5"** anchorage is bonded, it is supplied factory prelocked or to lock on site by using a **B300KN** jack. The application is typical of industrial floors, diaphragms or slabs in a normal environment. The cable is provided with a steel protection sheath, which must be provided with proper grouting and vent points.*

"EX" series 1EX15-D6 single strand anchorages

(Bonded post-tensioning)

1EX15-D6 passive bonded anchorage

*The **passive, bonded and encapsulated "1EX15-D6"** anchorage is made with the total encapsulation of the anchorage and of the cable, protected with a polyethylene corrugated sheath. The **"1EX15-D6"** anchorage is bonded and grouted, it is supplied factory prelocked or to lock on site by using a **B300KN** jack. This application is typical of industrial floors, diaphragms, foundation piles or slabs in a highly aggressive environment for the whole system. The anchorage is provided with a pressure cap that may be installed after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"E" series 1E15-D7 single strand anchorages
(Bonded post-tensioning)

1E15-D7 bonded assembled passive anchorage

*The anchorage: **passive and bonded "1E15-D7"**. Its application allows to install single strand bonded anchorages with the strand entered into a polyethylene sheath. It is supplied factory prelocked or to lock on site by using a **B300KN** jack. This application is used in an environment that requires a simple protection of the **"1E15-D7"**anchorage by means of passivation while grouting and of the whole cable with a polyethylene sheath. The application is typical of industrial floors, diaphragms or slabs in a normal environment. The cable is provided with a polyethylene protection sheath, which must be provided with proper grouting and vent points.*

"EX" series 1EX15-D8 single strand anchorages
(Unbonded encapsulated post-tensioning)

1EX15-D8 passive unbonded assembled anchorage

*The anchorage: **passive, unbonded and encapsulated, "1EX15-D8" type.** It is made with the total encapsulation of the polyethylene covered anchorage, with the greased strand covered in polyethylene. The **"1EX15-D8"** anchorage is unbonded, it is supplied factory prelocked or to lock on site by using a **B300KN** jack. It is provided with a medium cap that may be installed after the strand, which is filled with grease, is cut. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system.*

"EX" series 1EX15-D9 single strand anchorages
(Unbonded encapsulated post-tensioning)

1EX15-D9 passive unbonded anchorage

*The anchorage: **passive, unbonded and encapsulated, "1EX15-D9" type.** It is made with the total encapsulation of the polyethylene covered anchorage, with the greased strand covered in polyethylene. The **"1EX15-D9"** anchorage is unbonded, it is supplied factory prelocked or to lock on site by using a **B300KN** jack. It is provided with a short cap that may be installed after the strand, which is filled with grease, is cut. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system.*

"EX" series 1EX15-D10 single strand anchorages

(Encapsulated bonded post-tensioning)

1EX15-D10 passive bonded assembled anchorage

*The **passive, unbonded and encapsulated "1EX15-A10"** anchorage is made with the total encapsulation of the anchorage and of the cable, protected with a polyethylene corrugated sheath. The **"1EX15-D10"** anchorage is bonded and grouted, it is supplied factory prelocked or to lock on site by using a **B300KN** jack. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system. The anchorage is provided with a medium cap that may be installed under pressure after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"EX" series 1EX15-D11 single strand anchorages

(Encapsulated bonded post-tensioning)

1EX15-D11 passive bonded anchorage

*The **passive, unbonded and encapsulated "1EX15-D11"** anchorage is made with the total encapsulation of the anchorage and of the cable, protected with a polyethylene corrugated sheath. The **"1EX15-D11"** anchorage is bonded and grouted, it is supplied factory prelocked or to lock on site by using a **B300KN** jack. This application is typical of industrial floors, diaphragms or slabs in a highly aggressive environment for the whole system. The anchorage is provided with a short cap that may be installed under pressure after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"EX" series 1EX15-D12 single strand anchorages

(Encapsulated bonded post-tensioning)

1EX15-D12 passive bonded assembled anchorage

*Anchoring: passive and compliant, like "**1EXD15-D12**", is made of polyethylene coated with the anchor strand and inserted into a metal sheath, application environments where high protection is required, the anchor and cable protection the passivation obtained by the casting anchor has a threaded cap that ensures a more forceful closure. It comes pre-assembled and pre-lubricated and has a locking spring. It 'can be installed on site by qualified technicians directly on the strands cut to size. This solution drastically reduces the installation time of passive anchors.*

"EX" series 1EX15-D13 single strand anchorages
(Bonded post-tensioning with encapsulated anchorage)

1EX15-D13 passive bonded assembled anchorage

*The anchorage: **passive and bonded, "1EXD15-D13" type.** It is made with the anchorage covered in polyethylene and the strand entered into a metallic sheath. It is applied in an environment where a high anchorage protection is required, and where the cable protection is obtained by means of passivation while grouting. The "**1EX15-D13**" anchorage is bonded, it is supplied factory prelocked or to lock on site by using a **B300KN** jack. The application is typical of industrial floors, diaphragms or slabs. The anchorage is provided with a pressure closing tip in order to guarantee a stronger closure to contain grease, it can be installed on site by qualified technicians.*

"ED" series 1ED15-D14 single strand anchorages
(Bonded post-tensioning)

1EX15-D14 assembled bonded passive anchorage

*Anchoring: passive and compliant, like "**1ED15-D14**", is made of strands inserted into a metal sheath, the application is required for environments where protection of the complex obtained by passivation in the cast. The anchor "**1ED15-D14**" is adherent, is supplied pre-assembled, is manually applied on the cables pre-cut to size on site. The anchor has a threaded cap that ensures a more forceful closure. It comes pre-assembled and pre-lubricated and has a locking spring. It 'can be installed on site by qualified technicians directly on the strands cut to size. This solution drastically reduces the installation time of passive anchors.*

"EX" series 1EX15-D15 single strand anchorages
(Bonded post-tensioning)

1EX15-D15 passive assembled anchorage

*The anchorage: **passive and bonded, "1EX15-D15" type.** It is made with the anchorage covered in polyethylene and the strand entered into a metallic sheath. It is applied in an environment where a high anchorage protection is required, and where the cable protection is obtained by means of passivation while grouting. The "**1EX15-D15**" anchorage is bonded, it is supplied factory prelocked or to lock on site by using a **B300KN** jack. The application is typical of industrial floors, diaphragms or slabs. The anchorage is provided with a medium cap that may be installed under pressure after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"EX" series 1EX15-D16 single strand anchorages

(Bonded post-tensioning)

1EX15-A16 passive assembled anchorage

*The anchorage: **passive and bonded, "1EX15-D16" type.** It is made with the anchorage covered in polyethylene and the strand entered into a metallic sheath. It is applied in an environment where a high anchorage protection is required, and where the cable protection is obtained by means of passivation while grouting. The **"1EX15-D16"** anchorage is bonded, it is supplied factory prelocked or to lock on site by using a **B300KN** jack. The application is typical of industrial floors, diaphragms or slabs. The anchorage is provided with a short cap that may be installed under pressure after the strand, which is filled with grease, is cut. The cable must be provided with proper grouting and vent points.*

"EXD" series 1EXD15-D17 single strand anchorages

(Post tensione aderente incapsulata)

Ancoraggio attivo 1EXD15 assemblato

*Anchoring: passive and compliant, like "**1EXD15-D17**", is made of polyethylene coated with the anchor strand and inserted in a polyethylene conduit, application environments where high security is required of the anchorage and protection passivation of the cable obtained by the jet. The anchor "**1EXD15-D17**" is adherent is applicable on the cables manually pre-cut to size on site. The application is typical of industrial flooring, partitions or floors. The anchor has a threaded cap that ensures a more forceful closure. It comes pre-assembled and pre-lubricated and has a locking spring. It 'can be installed on site by qualified technicians directly on the strands cut to size. This solution drastically reduces the installation time of passive anchors.*

"ED" series 1ED15-D18 single strand anchorages

(Post tensione aderente)

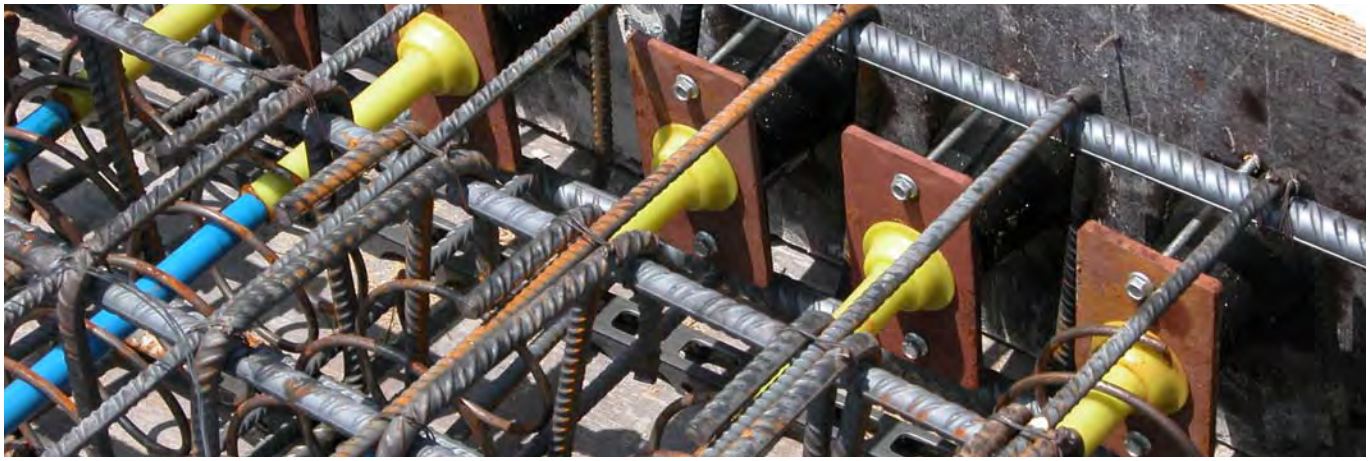
Ancoraggio attivo 1ED15-A18 assemblato

*Anchoring: passive and compliant, like "**1ED15-D18**", is made of strands inserted in a polyethylene conduit, the application is required for environments where protection of the complex obtained by passivation in the cast. The anchor "**1ED15-D18**" is adherent, is manually applied on the cables pre-cut to size on site. The application is typical of industrial flooring, partitions or floors. The anchor has a threaded cap that ensures a more forceful closure. It comes pre-assembled and pre-lubricated and has a locking spring. It 'can be installed on site by qualified technicians directly on the strands cut to size. This solution drastically reduces the installation time of passive anchors.*

Corrosion protection levels on "D" series anchorages:

Protection level	*Anchorage type*	*Anchorage 1E15*	*Anchorage 1ED15*	*Anchorage 1EX15*	*Anchorage 1EXD15*	*Metallic sheath*	*Polyethylene sheath*	*Bonded strand*	*Unbonded strand*
1	*1E15-D5*	*X*				*X*		*X*	
1	*1ED15-D4*		*X*						*X*
2	*1ED15-D14*		*X*			*X*		*X*	
2	*1ED15-D18*		*X*				*X*	*X*	
3	*1E15-D1*	*X*							*X*
4	*1E15-D7*	*X*					*X*	*X*	
5	*1EXD15-D12*				*X*	*X*		*X*	
5	*1EXD15-D17*				*X*		*X*	*X*	
5	*1EX15-D13*			*X*		*X*		*X*	
5	*1EX15-D15*			*X*		*X*		*X*	
5	*1EX15-D16*			*X*		*X*		*X*	
5	*1EX16-D6*			*X*			*X*	*X*	
5	*1EX15-D10*			*X*			*X*	*X*	
5	*1EX15-D11*			*X*			*X*	*X*	
6	*1EXD15-D3*				*X*				*X*
6	*1EX15-D2*			*X*					*X*
6	*1EX15-D8*			*X*					*X*
6	*1EX15-D9*			*X*					*X*

Level 5 and 6*: totally encapsulated cables, anchorage 1EX15 or 1EXD15 and greased cable covered in polyethylene represent the maximum protection level*



20.7 - "G" CONNECTIONS

The connection on single strand cables is carried out by using a sleeve that allows to guarantee their connection. It can be bonded "G" and unbonded "GX". Both applications can be used with all the versions of an active anchorage.

"G" series single strand connection
(Bonded unbonded encapsulated post-tensioning)

Mobile "G" coupler for single strand

Mobile "GX" coupler for single strand

The "G" connection anchorage is carried out with the total encapsulation of the device. The polyethylene covering is guaranteed on its whole length allowing the connection to slide due to the elongation.

1GX15-C1 unbonded connection with 1E15 anchorage

(Unbonded post-tensioning)

1GX15-C1 connection with 1E15 anchorage

***Unbonded 1GX15-C1** connection provided with a special protection outside the sleeve which allows it to slide while tensioning, thus guaranteeing a bonded/unbonded application. The sleeve protection must take into consideration the displacement of the sleeve during tensioning operations. The system protection relies on the two levels: grease and polyethylene, while the anchorage protection is obtained by means of passivation while grouting.*

1GX15-C2 unbonded connection with 1EX15 anchorage

(Unbonded post-tensioning)

1GX15-C2 connection with 1EX15 anchorage

***Unbonded 1GX15-C2** connection provided with a special protection outside the sleeve which allows it to slide while tensioning, thus guaranteeing a bonded/unbonded application. The sleeve protection must take into consideration the displacement of the sleeve during tensioning operations. The system protection relies on the two levels: grease and polyethylene, while the anchorage protection is obtained by means of a polyethylene encapsulation.*

1GX15-C3 bonded connection with 1EX15 anchorage

(Bonded post-tensioning)

1GX15-C3 connection with 1EX15 anchorage

***Bonded 1GX15-C3** connection provided with a special protection outside the sleeve which allows it to slide while tensioning, thus guaranteeing a bonded/unbonded application. The sleeve protection must take into consideration the displacement of the sleeve during tensioning operations. The system protection relies on the two levels: grease and polyethylene for the cable, while the anchorage protection is obtained by means of a polyethylene encapsulation.*

1GX15-C4 bonded connection with 1EX15 anchorage

(Bonded post-tensioning)

1GX15-C4 connection with 1EX15 anchorage

***Bonded 1GX15-C4** connection provided with a special protection outside the sleeve which allows it to slide while tensioning, thus guaranteeing a bonded/unbonded application. The sleeve protection must take into consideration the displacement of the sleeve during tensioning operations. The system protection relies on the two levels: steel sheath where the protection is obtained by means of passivation while grouting, while the anchorage protection is obtained by means of a polyethylene encapsulation.*

1GX15-C5 bonded connection with 1E15 anchorage

(Bonded post-tensioning)

1GX15-C5 connection with 1E15 anchorage

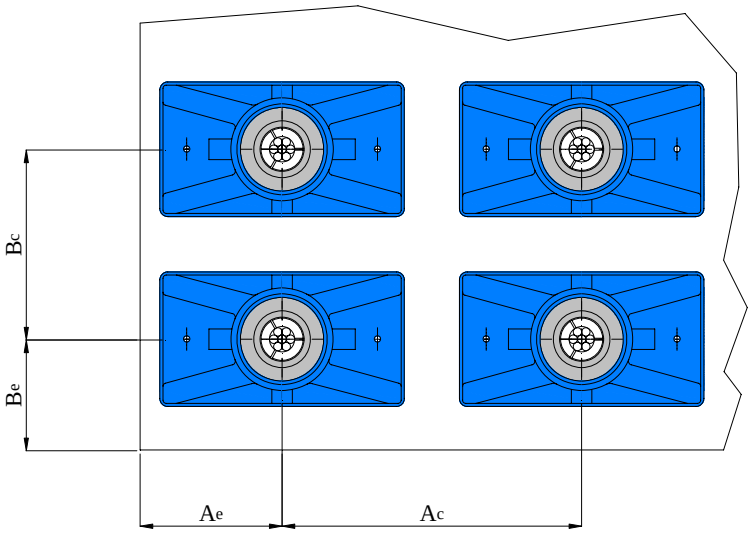
***Bonded 1GX15-C5** connection provided with a special protection outside the sleeve which allows it to slide while tensioning, thus guaranteeing a bonded/unbonded application. The sleeve protection must take into consideration the displacement of the sleeve during tensioning operations. The system protection relies on the two levels: steel sheath and anchorage, where the protections are obtained by means of passivation while grouting.*

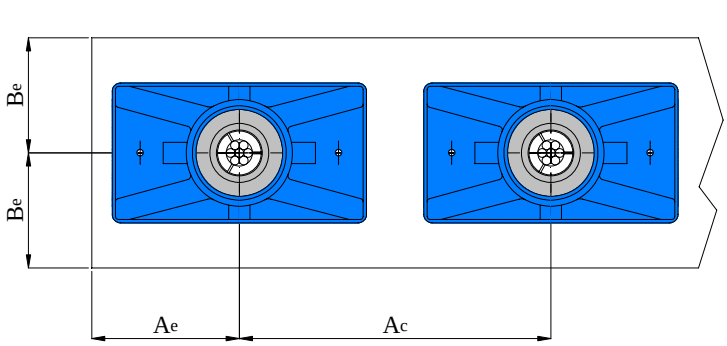
1GX15-C6 bonded connection with 1E15 anchorage

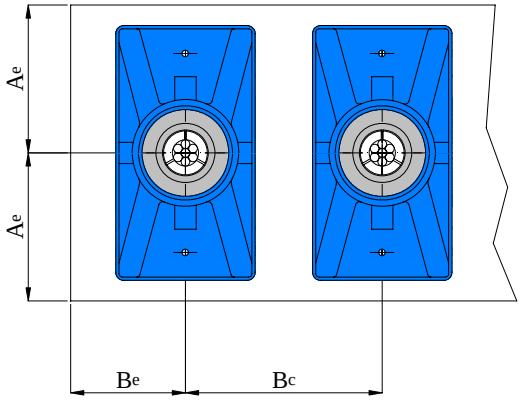
(Bonded post-tensioning)

1GX15-C6 connection with 1E15 anchorage

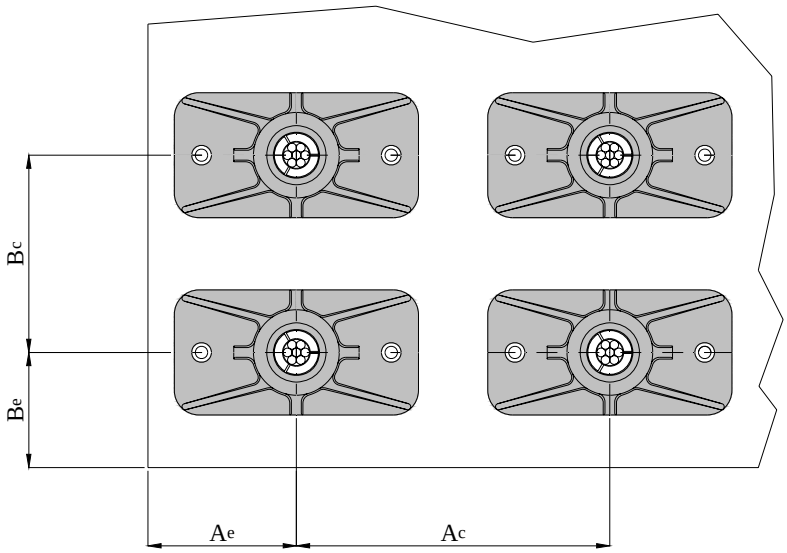
***Bonded 1GX15-C6** connection provided with a special protection outside the sleeve which allows it to slide while tensioning, thus guaranteeing a bonded/unbonded application. The sleeve protection must take into consideration the displacement of the sleeve during tensioning operations. The system protection relies on the two levels: polyethylene sheath for the cable, while the anchorage protection is obtained by means of passivation while grouting.*

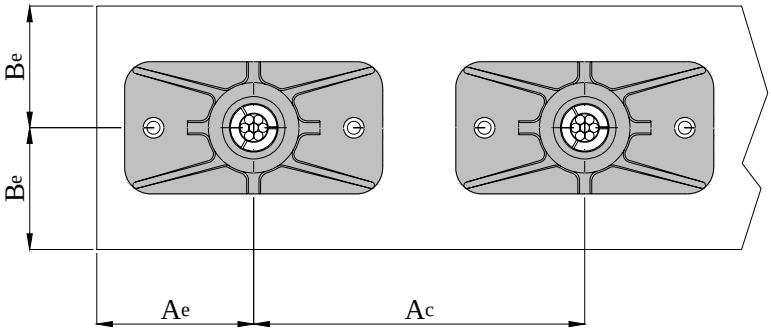


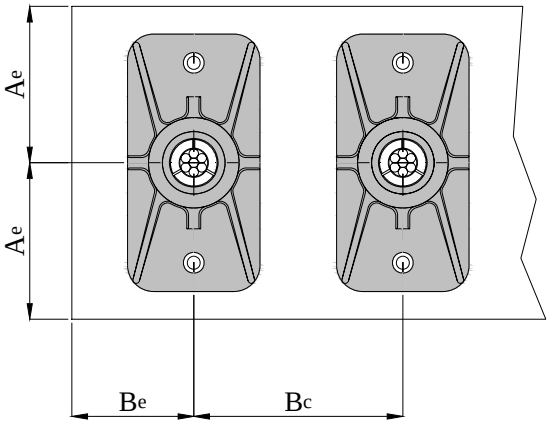




Distances from edges			
Minimum distance from anchorage to anchorage	a_c *[mm]*	*180*	*180*
	b_c *[mm]*	*140*	*140*
Minimum distance of anchorages from edges	a_e *[mm]*	*95*	*95*
	b_e *[mm]*	*70*	*70*







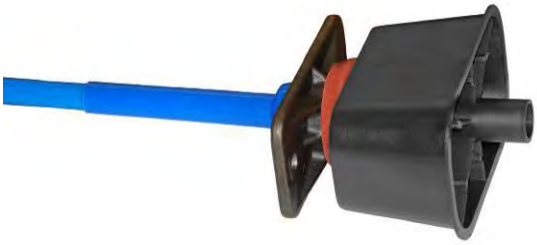
Distances from edges			
Minimum distance from anchorage to anchorage	a_c *[mm]*	*180*	*180*
	b_c *[mm]*	*140*	*140*
Minimum distance of anchorages from edges	a_e *[mm]*	*95*	*95*
	b_e *[mm]*	*70*	*70*

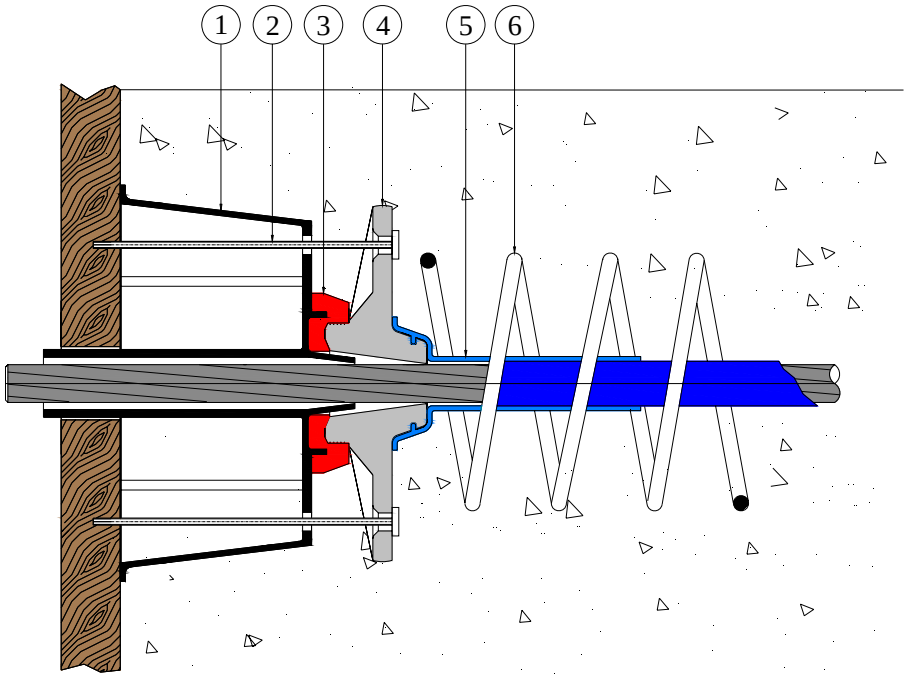
DD 7099B truncated cone pocket former
pocket former

DD-1097A rectangular

Pocket formers are produced for single strand applications in order to create, by means of special reusable plastic moulds, recesses that allow sealing after anchorage tensioning. All pocket formers are mounted only on active anchorages applications.

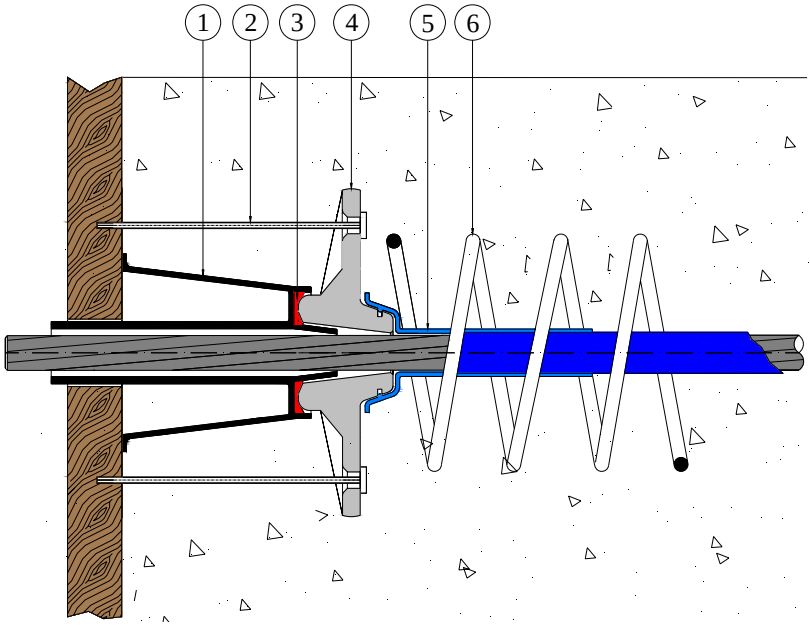
***1E15-C and 1ED15-A unbonded anchorage** with **DD-1097A** rectangular pocket former*





*The 1E15 unbonded active anchorage with DD-1097A rectangular pocket former and DD 1095GK sealing gasket is made of the following parts: **Ref. 1** DD-1097A rectangular pocket former, **Ref. 2** fixing screws, **Ref. 3** DD 1095GK sealing gasket **Ref. 4** 1E15 steel anchor plate, **Ref. 5** rear connection and **Ref. 6** spring steel reinforcement,*

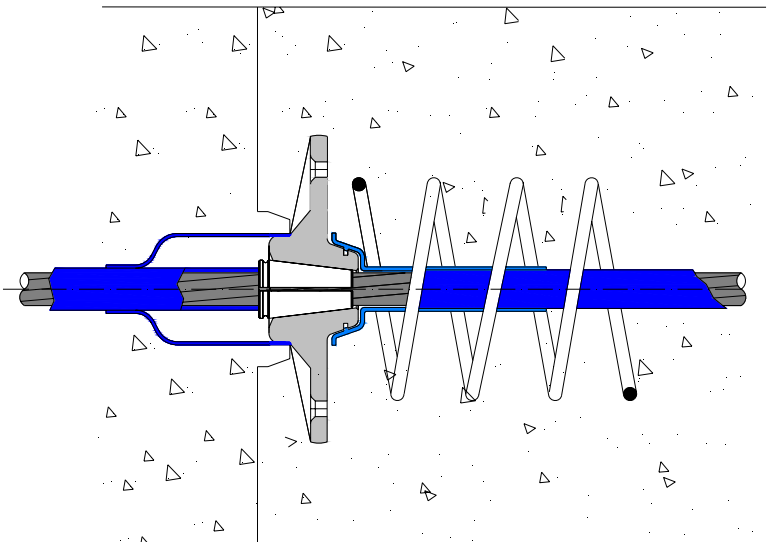
***1E15-B unbonded anchorage** with **DD 7099B** truncated cone pocket former*



The 1E15 unbonded active anchorage with DD 7099B truncated cone pocket former and DD 7025 sealing gasket is made of the following parts: ***Ref. 1*** *DD-7099B truncated cone pocket former* ***Ref. 2*** *fixing screws,* ***Ref. 3*** *DD 7025 sealing gasket,* ***Ref. 4*** *1E15 steel anchor plate,* ***Ref. 5*** *rear connection and* ***Ref. 6*** *spring steel reinforcement,*

1E15-C unbonded *through* ***anchorage*** *with* ***DD0015-CV*** *cap*

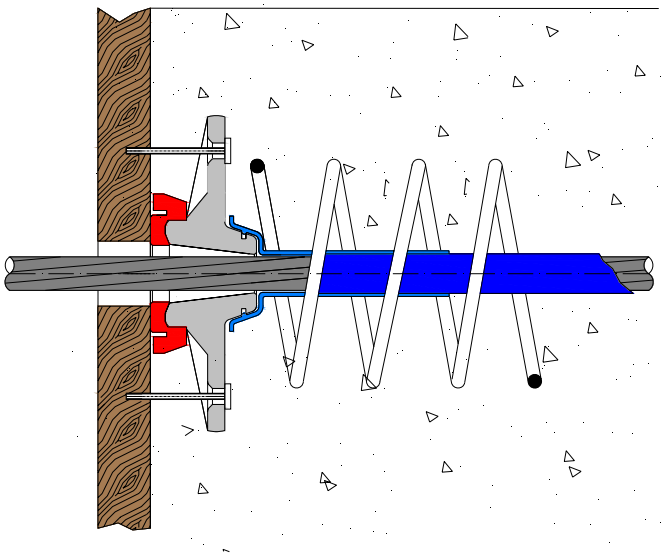
1E15 assembled through anchorage



1E15 unbonded *through* ***anchorage*** *with* ***DD 1095GK*** *gasket*

Active 1E15 assembled anchorage

The use of the DD 1095GK gasket allows to fix the 1E15 anchorage directly onto the formwork.



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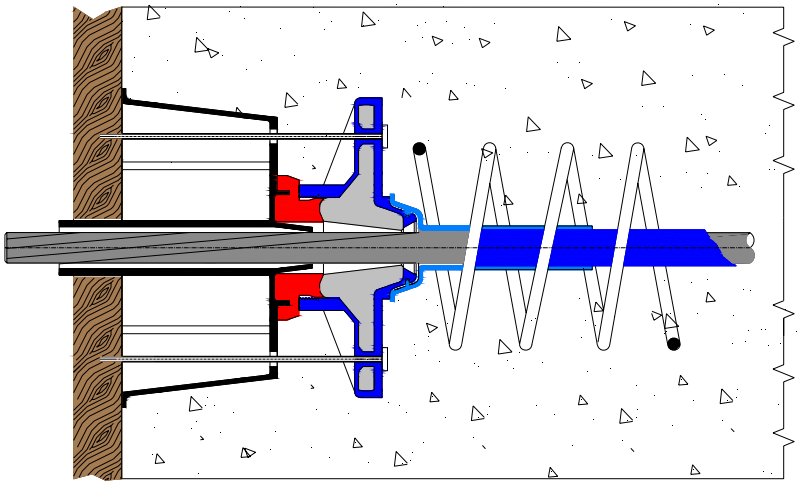
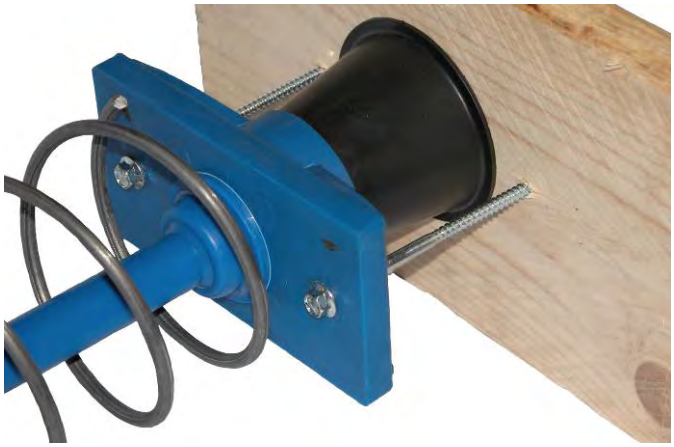
1EX15 unbonded anchorage** with **DD 1096GK gasket

The DD 1096GK gasket allows to connect 1EXD15 and 1EX15 anchorages.



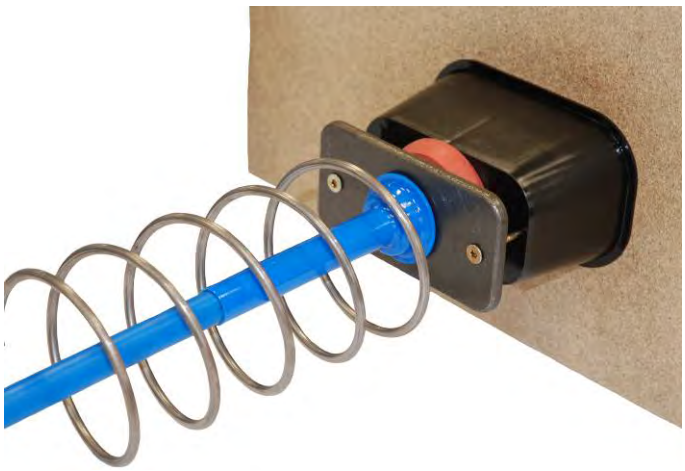
1EX15 anchorage with rectangular DD-1097A pocket former and DD 1096GK sealing gasket directly applied onto the formwork.

Two standard types of pocket formers are available, a circular and a rectangular one. The rectangular pocket former is used to ease the strand cutting with emery as near the anchorage as possible.



DD 7099B truncated cone pocket former

Truncated cone pocket former on 1E15 anchorage. It can also be mounted on the 1EX15 anchorage and all its related applications.



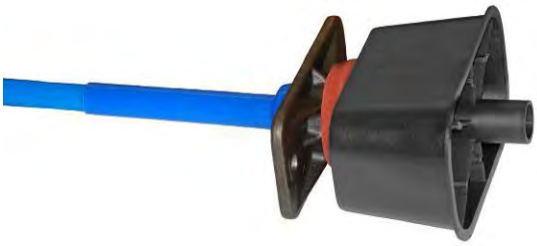
Rectangular pocket former on 1E15 anchorage. It can also be mounted on the 1EX15 anchorage and all its related applications.

DD-1097A rectangular pocket former on 1EXD15 anchorage and DD 7025 sealing gasket

Rectangular pocket former mounted on 1EX15 and 1EXD15 anchorage. They can be reused several times, and their correct application requires a proper gasket to guarantee sealing against any infiltration.

DD-1097A rectangular pocket former on 1EXD15 anchorage and DD 1096GK sealing gasket

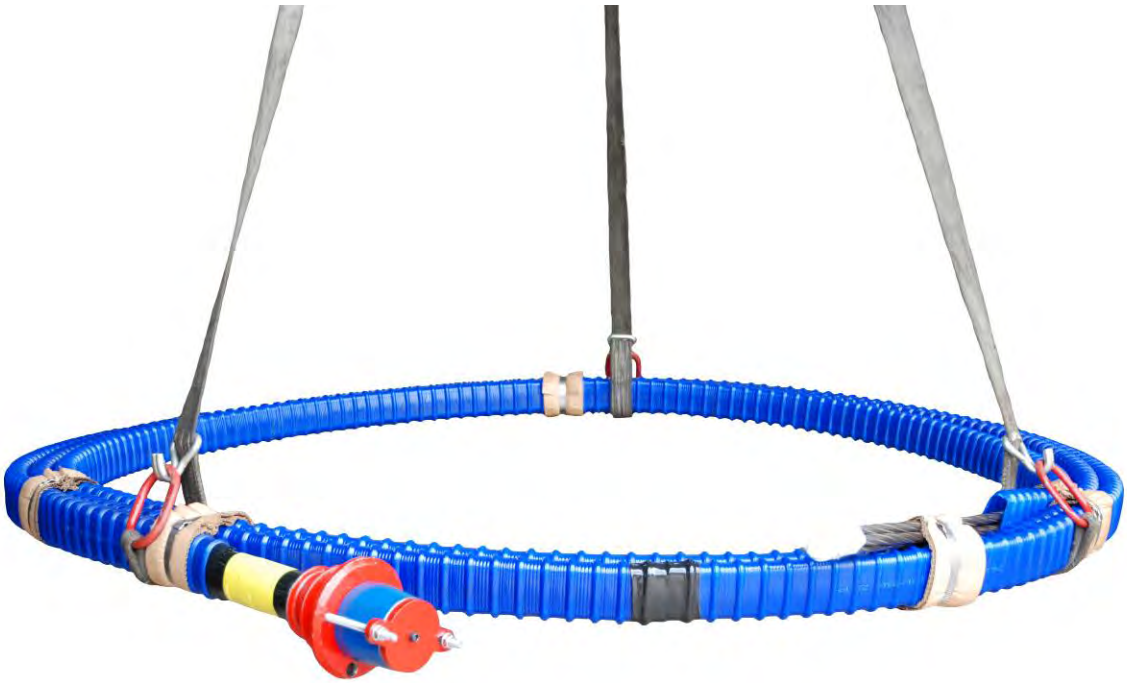
Rectangular pocket former mounted on 1E15 and 1ED15 anchorage. They can be reused several times, and their correct application requires a proper gasket to guarantee sealing against any infiltration.



DD-1097A rectangular pocket former on 1E15 anchorage and DD 1095GK sealing gasket

4D15 anchorage

For use on slabs, preassembled cables can be supplied with the passive anchorage preblocked at one end, which are ready for the installation on site and assembled from factory.



Cables are cut to size and are provided with a polyethylene corrugated sheath, all sealed and ready for the installation.

Cables area provided with proper fastenings that allow to lift and handle them without damaging the sheath, which is made of polyethylene to allow rolling up.

Sheaths are seamed by means of heat-shrinking elements in order to guarantee continuity and seal.

4/5L15 anchorage

For use on slabs, preassembled cables can be supplied with the passive/active anchorage preinstalled at one end, which are ready for the installation on site and assembled from factory.

Cables are cut to size and are provided with a polyethylene corrugated sheath, all sealed and ready for the installation.

Cables area provided with proper fastenings that allow to lift and handle them without damaging the sheath, which is made of polyethylene to allow rolling up.

Sheaths are seamed by means of heat-shrinking elements in order to guarantee continuity and seal.

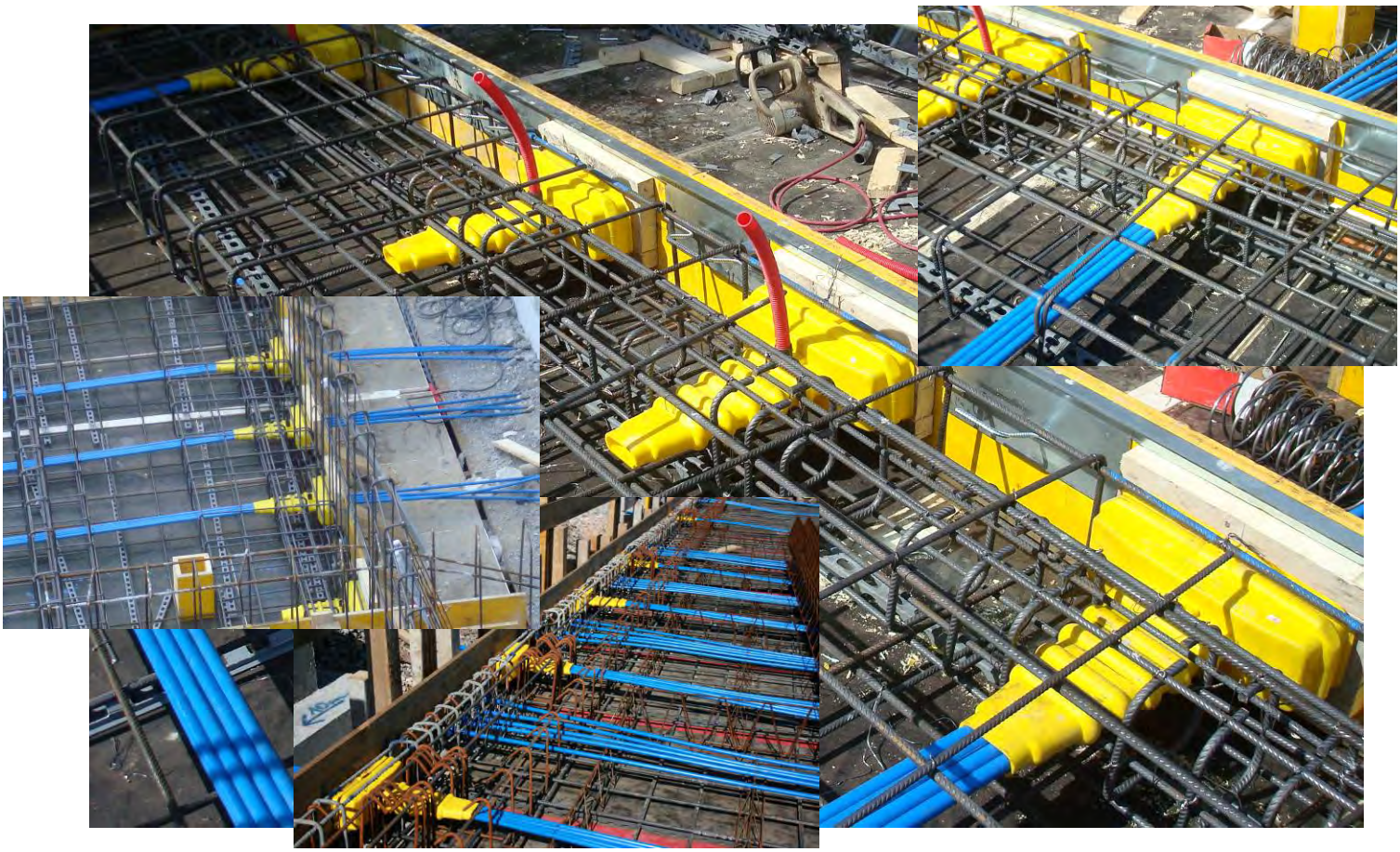
24.0 - "L" SERIES ANCHORAGES

(Post-tensioning for plates)

"L" series plates are designed for the application to plates or slabs. The main characteristic of this anchorage is its dimensions AxB, where the shorter side is suitable for limited thickness plates. They are made of polyethylene and can be used with strands having several types of protection:

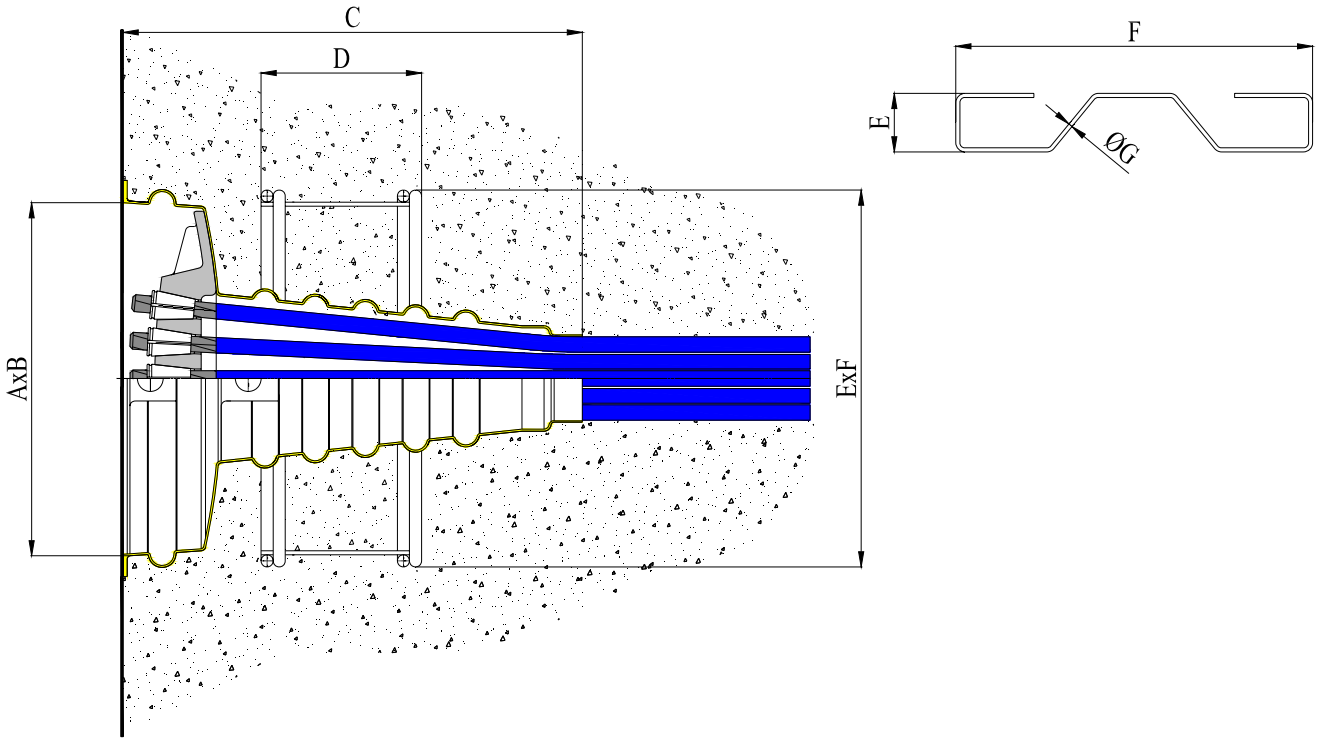
- *metallic corrugated sheaths,*
- *galvanized metallic corrugated sheaths,*
- *polyethylene sheaths,*
- *greased and polyethylene covered strands,*

The anchorage is made of a polyethylene protection that offers support to the steel anchor plate in steel ***C40-45 UNI EN 10083/1*** *which has a proper transfer surface to transfer load directly to concrete by means of the recess provided by the polyethylene protection.*
It can be applied with grouted bonded post-tensioning and unbonded post-tensioning with greased and polyethylene covered strands. The anchorage is suitable for the connection to the formwork by means of special locks and it is provided with grouting devices that allow both grouting and vent on the slab



4-5L15 anchorage

The 4-5L15 anchorage allows to install 4 and 5 strand anchorages that are encapsulated in polyethylene by installing a single anchorage that can be connected to the polyethylene-covered strands. It can be easily connected to the formwork and it is easy to install, grout and tension with a jack, strand by strand.

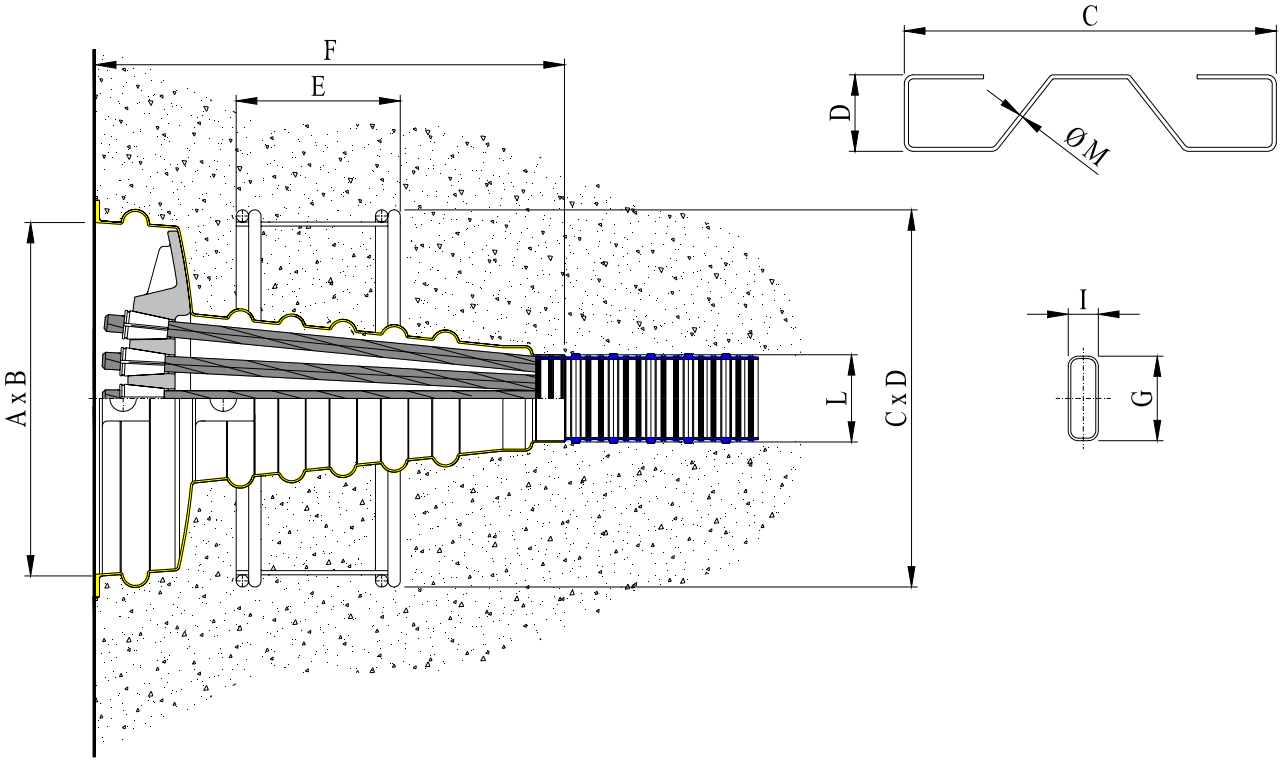


Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***L***	***M***
	T15 *259 per cable*	***T15S*** *279 per cable*	***T15C*** *300 per cable*											
	(KN)	*(KN)*	*(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*pc.*	*(mm.)*	*(mm.)*	*(mm.)*
3L15	*777*	*837*	*900*	*350*	*120*	*360*	*180*	*200*	*455*	*78x30*	*4*	*30*	*78*	*10*
4L15	*1036*	*1116*	*1200*	*350*	*120*	*360*	*180*	*200*	*455*	*78x30*	*4*	*30*	*78*	*12*
5L15	*1295*	*1395*	*1500*	*350*	*120*	*360*	*180*	*200*	*455*	*96x30*	*4*	*30*	*90*	*12*

Our company reserves the right to change our products and specifications without any previous notice *(Measures in mm.)*

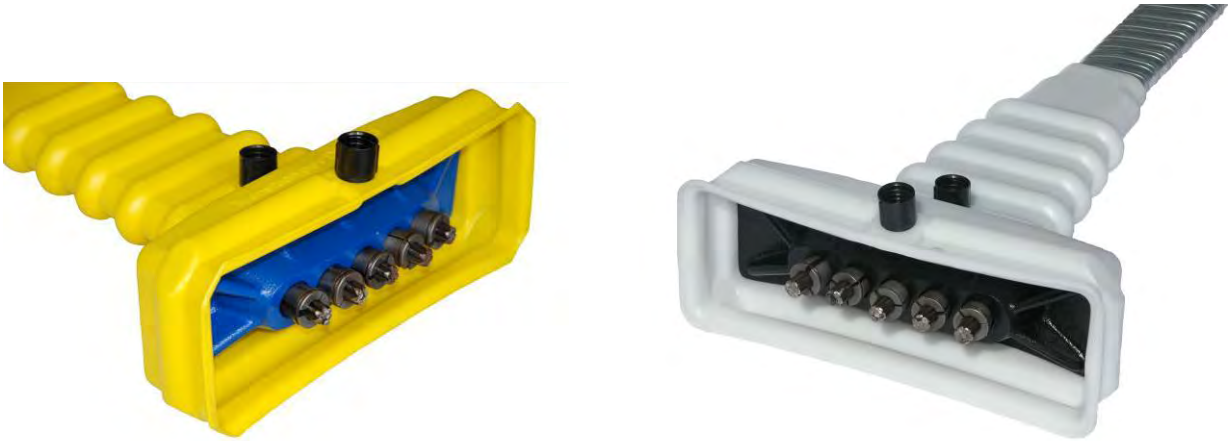
4-5L15 anchorage

The 4-5L15 anchorage is produced for the application to slabs or where the cable covering thickness requires the use of flat SL steel sheaths or SP polyethylene sheaths. It allows to install 4 or 5 strand anchorages encapsulated in polyethylene by installing a single anchorage. It can be easily connected to the formwork and it is easy to install, grout and tension with a jack, strand by strand.

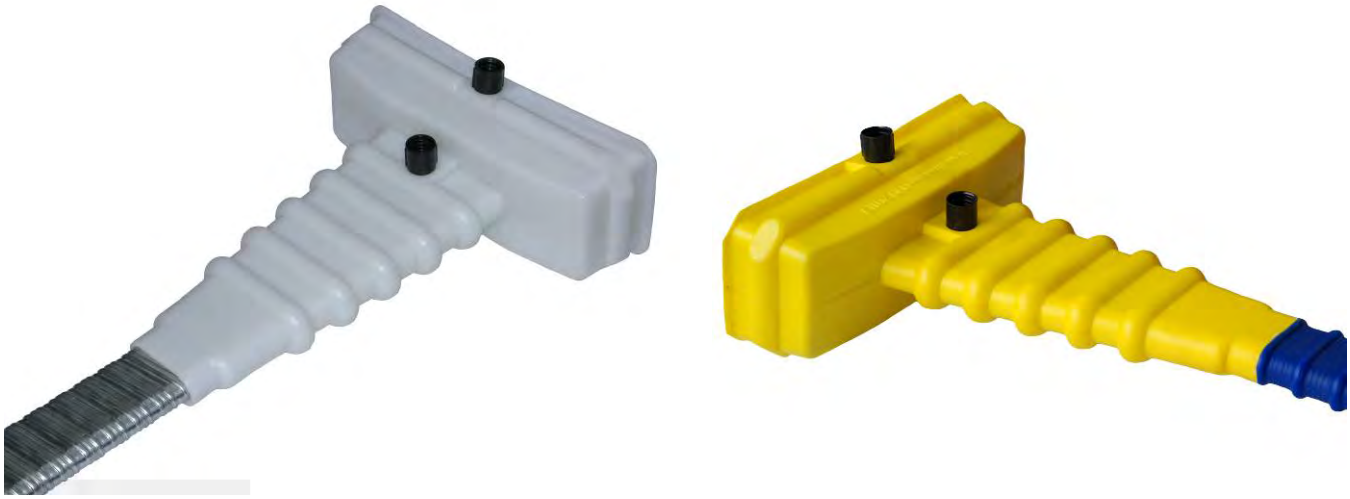


Type	***Ultimate load***			***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***L***	***M***
	T15	***T15S***	***T15C***											
	259	*279*	*307*											
	per cable	***per cable***	***per cable***											
	(KN)	*(KN)*	*(KN)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*pc.*	*(mm.)*	*(mm.)*	*(mm.)*
3L15	*777*	*837*	*900*	*350*	*120*	*360*	*180*	*200*	*455*	*78x30*	*4*	*30*	*78*	*10*
4L15	*1036*	*1116*	*1200*	*350*	*120*	*360*	*180*	*200*	*455*	*78x30*	*4*	*30*	*78*	*12*
5L15	*1295*	*1395*	*1500*	*350*	*120*	*360*	*180*	*200*	*455*	*96x30*	*4*	*30*	*90*	*12*

 (Measures in mm.)



5L15 anchorage, front view



5L15 anchorage, rear view

This wedge is designed for anchoring single or multiple strands on anchor plates. It is for disposable use and it is available for different applications.

Bushes

T15 bushes

Conical bushes with marking for post-tensioning applications for the tensioning of wire strands from 15.2 mm. to 15.7 mm. ***C40-45 UNI EN 10083/1*** *bushes for special applications on TTR anchorages.*

Spherical bushes

T15 spherical bushes

Conical spherical bushes with marking for post-tensioning applications for the tensioning of wire strands from 15.2 mm. to 15.7 mm. ***C40-45 UNI EN 10083/1*** *bushes for special applications on TTS anchorages.*

T15 wedges *(three sectors)*

T15 wedges in three sectors

Wedges for post-tensioning on anchorages for disposable use. ***16NiCr4Pb UNI EN 10277-4 steel wedges***

T15 wedges *(two sectors)*

T15 wedges in two sectors

Wedges for post-tensioning on anchorages for disposable use. ***16NiCr4Pb UNI EN 10277-4*** *steel wedges are produced in two sectors for special uses, tensioning on through cables or preblocked anchorages.*

Sleeves for T15 strand connection

T15 sleeves for strand connection

Sleeves for post-tensioning used on strand connections. Sleeve with wedges in steel ***16NiCr4Pb UNI EN 10277-4.***

T15 extruded grips

T15 extruded grips

Extruded grips are made of: T15 bushes ***C40-45 UNI EN 10083/1,*** *T15 shell in steel* ***9SMnP28 UNI 483****, they are used where a compact passive anchorage is required*

1EXD15 anchorage

1EXD15 polyethylene covered anchorage

Steel plate in C40-45 UNI EN 10083/1, covered in polyethylene made for applications with T15, T15S and T15C strands. It is produced with thread on the edge to connect to the closing tip.

1EX15 anchorage

1EX15 polyethylene covered anchorage

Steel plate in C40-45 UNI EN 10083/1, covered in polyethylene made for applications with T15, T15S and T15C strands. It is used for connecting to the pressure-closing cap.

1E15 anchorage

1E15 steel anchorage

Steel plate in C40-45 UNI EN 10083/1, made for applications with T15, T15S and T15C strands.

1E15-C anchorage

1E15 steel anchorage
with cap adapting turning

Steel plate in C40-45 UNI EN 10083/1 made for applications with T15, T15S and T15C strands, provided with turning for coupling with the protections fixed to it.

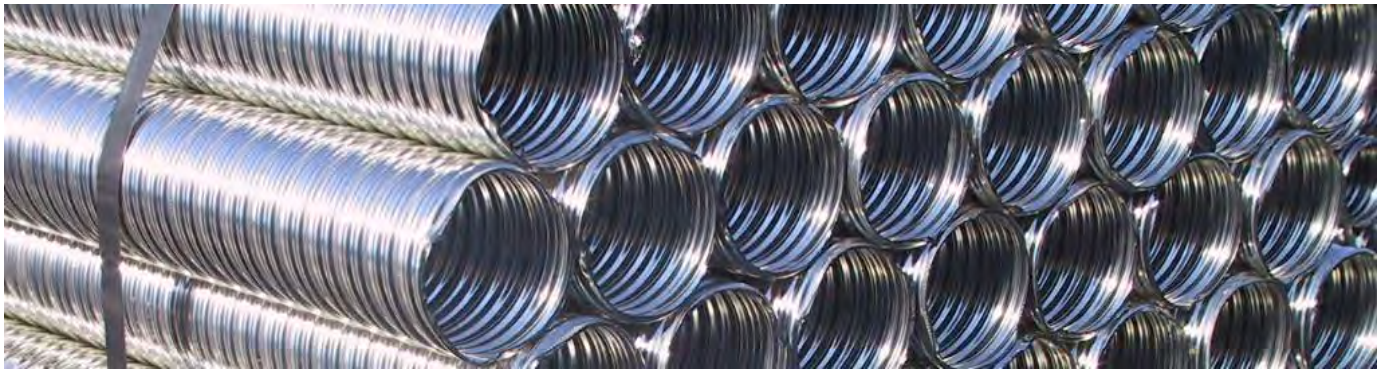
1ED15-A anchorage

1E15 steel anchorage
with thread for cap connection

Steel plate in C40-45 UNI EN 10083/1 made for applications with T15, T15S and T15C strands, provided

26.0 - SHEATHS

Metallic or polyethylene sheaths represent the most economical means to create voids in post-tensioned elements. They provide a good secondary protection against corrosion and a good connection between cables and concrete. The primary protection against corrosion is provided by the grouting alkalinity and by concrete itself, the secondary one by the sheath and its protective barrier to the cable.



26.1 - "ST" metallic sheaths

***ST** metallic sheaths are available in different versions. They are made of crimped sheet EN 10139 - 1999. They can be galvanized. Sheaths are available in bars having a length of 5.8 m. They are all provided with a sleeve screwed onto each bar.*

***ST** metallic sheaths are available in the following types:*

- ***STB-CE** according to the CE marking to comply with EN 523-524,*
- ***STA** corrugated with a thickness of 0.3 mm.*
- ***STC** corrugated with a thickness of 0.4 mm.*
- ***STD** corrugated with a thickness of 0.5 mm.*
- ***STE** corrugated with a thickness of 0.6 mm.*

26.2 - "SL" metallic sheaths

***SL** metallic sheaths are available in different versions. They are made of crimped sheet EN 10139 - 1999. They can be galvanized. Sheaths are available in bars having a length of 5.8 m. They are not all provided with a sleeve screwed onto each bar obtaining their connection by overlapping.*

***SL** metallic sheaths are available in the following types:*

- ***SL-CE** corrugated with a thickness of 0.3 mm.*

26.3 - "SP" polyethylene sheaths

***SP** polyethylene sheaths are available in several versions. They are made of extruded H.D.P.E. according to the FIB Specification, in bars with a length from 5.8 m. to 11.8 m. They are blue with a heat-shrinking sleeve on each connection.*

***SP** metallic sheaths are available in the following types:*

- ***SPA** corrugated with a thickness of 2.00 mm.*
- ***SPB** corrugated with a thickness of 2,50 mm.*
- ***SPB** corrugated with a thickness of 3.00 mm.*
- ***SPD** corrugated with a thickness of 3.50 mm.*

26.4 - "SPE" polyethylene flat sheaths

***SPE-78x25x2 mm.** polyethylene sheaths are made of extruded H.D.P.E. according to the FIB Specification, in bars with a length from 5.8 m. to 11.8 m. They are blue with a heat-shrinking sleeve on each connection.*

***SPE** metallic sheaths are available in the following types:*

- ***SPE** corrugated with a thickness of 2.00 mm.*

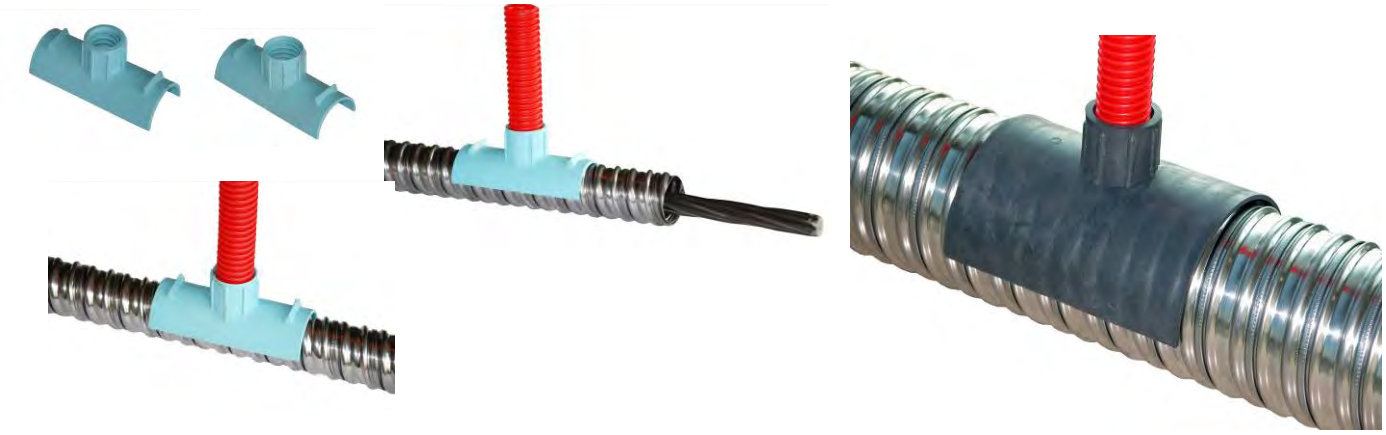
Heat-shrinking joint

The connection between polyethylene sheaths consists in heat-shrinking joints for the installation by specialized operators according to operating instructions.

26.5 - Vents on corrugated sheaths

DD-1001 vent cover

The positioning of vents on corrugated on polyethylene sheaths allows to guarantee the correct discharge of air from tubes while grouting. They must be installed on every part of the cable where an air pocket may form while grouting.
The ***DD-1001*** *cover is made of soft material to allow use with sheaths of every measure. It must be positioned with soft PVC.*



Vent cover on metallic sheath

26.6 - T 50x25 soft PVC tapes

(Adhesive tape for sealing)

The ***T 50x25*** *adhesive tape made of soft PVC allows a high-level sealing of the interested parts and allows to cover surfaces by respecting their characteristics. The tape also offers a high resistance to temperature variations and to abrasion.*

26.7 - Diameter of corrugated sheaths suggested for use with T15 and T15S wire strands

Number of strands	***Inside diameter***	***Grouting***	***Cement***	***Straight part after bending***	***Minimum radius***
	(mm.)	*Litres/meter*	*Cement Kg./meter*	*Minimum (mm.)*	*Minimum (mm.)*
4	*45*	*1.2*	*1.9*	*500*	*3,000*
7	*62*	*2.3*	*3.6*	*700*	*3,500*
9	*72*	*2.8*	*4.5*	*800*	*4,000*
12	*80*	*3.6*	*5.8*	*1,000*	*4,000*
15	*85*	*3.8*	*6.1*	*1,100*	*4,500*
19	*95*	*4.7*	*7.5*	*1,200*	*5,000*
22	*100*	*5.2*	*8.4*	*1,300*	*5,000*
27	*110*	*6.2*	*9.9*	*1,300*	*5,000*
37	*130*	*8.6*	*13.8*	*1,500*	*6,000*

All anchorage systems produced by **TTM tension technology s.r.l.** *: post-tensioning, slabs and geotechnical applications (rock anchorages) are tested with the three types of wire strands which are present on today's market:* ***T15, T15S*** *and* ***T15C****. The use of the* ***T15C*** *wire strands, having a diameter of 15.2 mm. and a section of 165 mm^2, allows to reduce dimensions by applying smaller anchorages, and also to reduce the dimensions of tensioning jacks.*
Strand, *which is supplied thanks to the iron and steel capacity of the group, which has at its disposal two factories for a production of about 150,000 ton per year.*

27.1 – Bonded wire strand in coils

Wire strand in coils

Characteristics of the wire strand

Diameter	*Standard*	*Type of strand*	*Nominal diameter*	*Nominal area*	f_{ptk}	$f_{p(1)k}$	*Mass*	*Tension 1% of elong.*	*Yield point (Ptk)*	*Elastic limit at 0.1% (Pt0.1k)*	*Relaxation after 1000 h.0.7 - 0.8 f_{pt}*	
			mm.	*mm^2*	*N/mm^2*	*N/mm^2*	*gr./m*	*KN*	*KN*	*KN*	*%*	*%*
T15 *T15S*	*EN 10138*	*normal* *super*	*15.2* *15.7*	*140* *150*	*1860* *1860*	*1670* *1670*	*1093* *1172*	*234* *251*	*260* *279*	*230* *248*	*2.5* *2.5*	*4.5* *4.5*
T15C	*EN 10138*	*Compact*	*15.2*	*165*	*1860*	*1670*	*1289*	*270*	*307*	*264*	*2.5*	*4.5*

Elastic modulus = 196 +/- 10 KN / mm^2

27.2 – Unbonded wire strand in coils

Wire strand in coils, greased and covered in H.D.P.E.

Characteristics of the greased and polyethylene covered strand:

Diameter	*Standard*	*Type of strand*	*Nominal diameter of strand*	*Covered nominal diameter*	*Grease mass*	*H.D.P.E. mass*	*Mass*	*Nom. area*
			mm.	*mm.*	*gr./m.*	*gr./m.*	*gr./m.*	*mm^2*
T15 *T15S*	*EN 10138*	*normal* *super*	*15.2* *15.7*	*18.00* *18.50*	*40* *40*	*75* *78*	*1,210* *1,290*	*139* *150*
T15C	*EN 10138*	*compact*	*15.2*	*18.00*	*35*	*70*	*1,400*	*165*

Elastic modulus = 196 +/- 10 KN / mm^2

28.0 - ELEMENTS FOR THE CALCULATION OF LOSSES AND EVALUATION OF ELONGATIONS

Tensioning protocols are an integral part of the project and the base of tensioning operations.

28.1 - Evaluation of elongations during the tensioning of cables

During the tensioning of cables it is necessary to compare the actual elongations with the theoretical elongations envisaged in the calculations to which the corrective terms must be added in order to obtain the true elongations. The elongations registered on site are the sum of the following elements:

$$^{\Delta}L_o = {}^{\Delta}L_a + {}^{\Delta}L_b + {}^{\Delta}L_c + {}^{\Delta}L_d + {}^{\Delta}L_e$$

where:

ΔL_a *is the elongation of the strand calculated considering the extra length necessary for the jack to grip it;*

ΔL_b *is the elastic deformation of concrete. Usually, the elongation measured on the jack includes the elastic shortening of concrete;*

ΔL_c *is the sum of the deformations of the anchoring devices;*

ΔL_d *is the re-entry of engagement wedges;*

ΔL_e *is the internal deformation of the jack.*

28.2 - The cable elongation

The cable elongation under the tensioning stress is calculated with the following formula:

$$\Delta L_a = 1(A_p E_p)^{-1} \int_0^{Lp} P_{x,0}\, d_x$$

where:

L_p *cable length [m.];*
$P_{x,0}$ *tensioning stress at the point at a distance x [kN];*

$$P_{x,0} = P_0\, e^{-\mu(\theta + k Lp)}$$

P_0 *tensioning stress at the anchorage to tension [kN];*
θ *is the sum of angular deviations calculated on a length x (independently of direction or sign);*

$$\theta = \pi (180)^{-1} \Sigma_i \left(\alpha_{Vi}^2 + \alpha_{Hi}^2\right)^{1/2}$$

α_{Vi}, α_{Hi} *horizontal and vertical projections of the deviation angle [in degrees]*

μ *is the friction coefficient between the strand and its sheath [rad^{-1}];*

k *is a non intentional angular deviation for internal cables (for length units, rad m^{-1});*

A_p *cable cross section [mm].*

*As recommended by **TTM**, the values of μ and K to apply are:*

Single strand:

Coated and greased single strand (HDPE sheath):

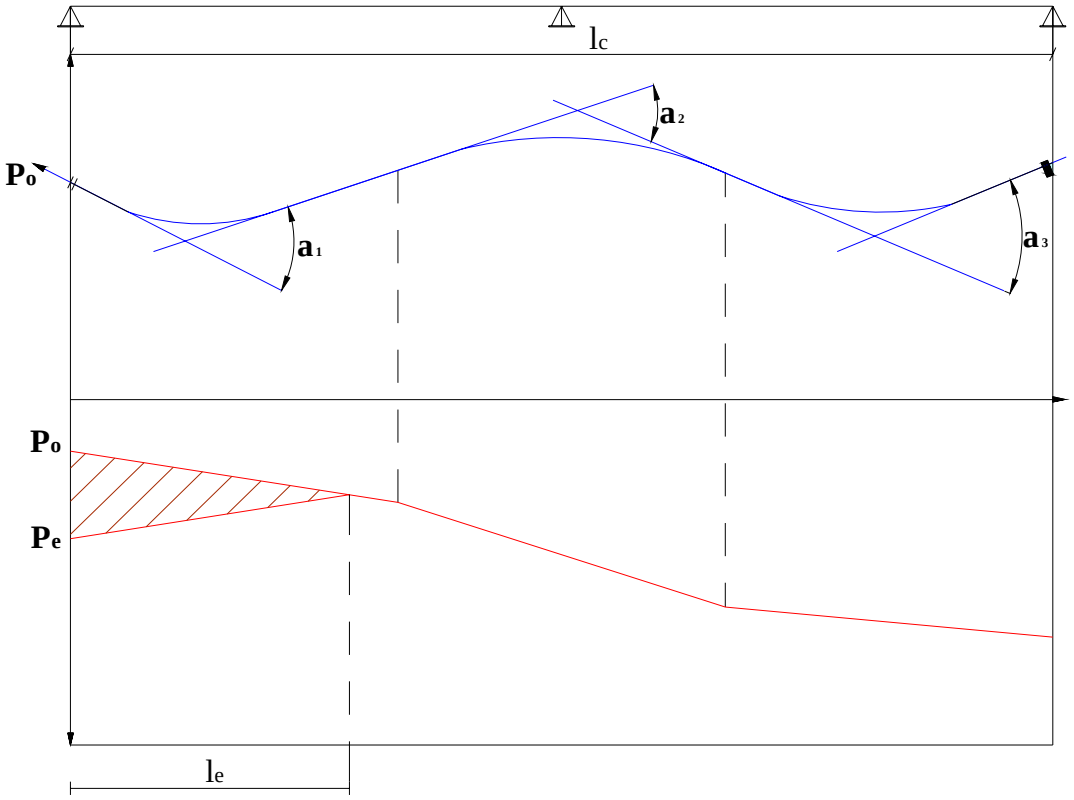
$0.05 < \mu < 0.07$ rad^{-1} and $0.004 < k < 0.008$ rad m^{-1}

Bonded single strand in a metallic sheath:

$\mu = 0.19$ rad^{-1} and $k = 0.005$ rad m^{-1}

Multi-strand:

$0.18 < \mu < 0.07\ 0.22$ rad^{-1} and $0.005 < k < 0.010$ rad m^{-1}



In case of external post-tensioning:

For seatings with bending radius between 2.5 and 4 m we may assume that:

k = 0

0.25 < μ < 0.30 strand on metallic seating

0.20 < μ < 0.25 greased strand on metallic seating

0.05 < μ < 0.07 bundle of strands coated one by one on metallic seating

0.12 < μ < 0.15 bare strand in H.D.P.E. sheath on metallic seating

28.3 - Elastic deformation of the concrete (shortening = positive addend) [mm]

The elastic deformation results from:

$$\Delta L_c = \sigma_{cm} (Ec)^{-1} L_c$$

where:

L_c *length of the concrete structural element [m];*

σ_{cm} *average precompression stress at the section corresponding to the centre of gravity of the resulting cable [MN(m)$^{-2}$];*

However, in a section with n post-tensioning cables, the deformation of the concrete during the tensioning of a general i cable causes the deformation of the element in tension and a subsequent shortening of the cables that are already tensioned.

		Effect of post-tensioning on cables					
	Cable	1	2	3	4	5	Total
Post-tensioning installed	1	P_1	$-\Delta P_2$	$-\Delta P_3$	$-\Delta P_4$	$-\Delta P_5$	$P_i - (n-1)\Delta P_i$
	2		P_2	$-\Delta P_3$	$-\Delta P_4$	$-\Delta P_5$	$P_i - (n-2)\Delta P_i$
	3			P_3	$-\Delta P_4$	$-\Delta P_5$	$P_i - (n-3)\Delta P_i$
	4				P_4	$-\Delta P_5$	$P_i - (n-4)\Delta P_i$
	5					P_5	P_i
							$n P_i - [\frac{1}{2}(n-1) n \Delta P_i]$

This shortening corresponds to a post-tensioning drop that can be evaluated using the following formula:

$$\Delta\sigma_{el} = n - 1(2n)^{-1} E_p [E_{cm}(t)]^{-1} \Delta\sigma_{cP}(t) A_p$$

where:

n *is the number of post-tensioning cables;*

E_P *is the calculated value of the elastic modulus of the strand;*

E_{cm} *is the secant elastic modulus of the concrete;*

$\Delta\sigma_{cP}(t)$ *is the stress variation at the centre of gravity of the post-tensioning reinforcements at the instant (t).*

	Concrete class	C20/25	C30/37	C40/50	C50/60
Elastic modulus [N mm^{-2}]	E_{cm}	29.00	32.00	35.00	37.00
Strand E_{tr} = 196 +/- 10 KN mm^{-2}					

28.4 Anchorage deformation

*In compliance with the reports of "**Static Load Tests, EMPA**", the deformation of anchorages under load is always limited to and does not exceed 1 mm.*

28.5 - Re-entry of wedges on the anchorage

The loss of elongation due to the re-entry of the wedges occurs during their locking phase following tensioning.

*In compliance with the reports of "**Static Load Tests, EMPA**"* ΔL_d *it is evaluated as follows:*
ΔL_d *= 5 mm. for tensioning with jacks equipped with a locking system*
ΔL_d *= 10 mm. for tensioning with jacks that are not equipped with a locking system*

The re-entry of wedges on passive anchorages causes a translation of the cable towards the tensioning jack. The values remain at about 4-5 mm.

28.6 - Deformation of jacks

These deformations must be assumed from the measure of the elongation of the strand when the readings are taken on the piston of the jack.
Jacks internal losses are considered:

TTM jacks = 8 mm = ΔL_e

When the elongations are measured directly on the strands, these values must not be taken into consideration.

28.7 - Tensioning values on strand post-tensioned anchorages
Eurocode 2, 5.10.3

In compliance with the paragraph ***5.10.3 (2) of EC2,*** *the value of the initial precompression force* $P_{m0}(x)$ *(at the instant* $t = t_0$*) applied to concrete shall not exceed the following value:*

$$P_{m0}(x) = A_p * \Delta\sigma_{P,max}$$
$$\Delta\sigma_{P,max} = \min\{0.75\, f_{pk};\ 0.85\, f_{p0.1k}\}$$

where:

P_{m0} *is the value of the initial precompression force (at the instant* $t = t_0$*);*

$\Delta\sigma_{P,max}$ *is the stress in the reinforcement just after tensioning;*

f_{pk} *is the characteristic breaking tension;*

$f_{p0,1k}$ *is tension at a 0.1% residual deformation*

28.8 - Stress limitation in concrete
EC2, 5.10.2.2

The compression stress in the structure concrete, which is applied by the precompression force and by the other loads applied at the instant of tensioning, should be limited to:

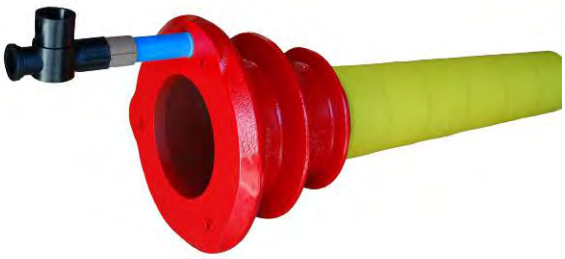
$$\sigma_c \leq 0.6\, f_{ck}(t)$$

where:

$f_{ck}(t)$ *is the characteristic resistance against compression of the concrete at the instant t when it is subjected to the precompression force.*

If the compression stress permanently exceeds $0.45\, f_{ck}(t)$*, the non-linearity of viscosity should be taken into consideration.*
If the tensioning of the single reinforcements is gradual, the resistance required for the concrete may be limited. The minimum resistance $f_{cm}(t)$ *at the instant t must be 50% of the resistance of the concrete required for the complete precompression. Between the minimum resistance of the concrete and the one required for the complete precompression, it is possible to interpolate between 30% and 100% of the complete precompression.*

29.0 - ACCESSORIES FOR GROUTING AND VENT APPLICATIONS ON " M, M_{EP}® AND MX ®" ANCHORAGES



12M_{EP}® 15 anchorage

*"**M, M_{EP}®** and **MX ®**" anchorages are provided with a front grouting/vent hole which is placed on the highest point to guarantee a correct grouting by discharging any air. All castings are provided with protective covers for threaded holes to connect to the cap or to the formwork.*

12M_{EP}® 15 anchorage

The grouting and vent of grouted cables is carried out by means of several systems designed to make activities on site as easy as possible. We offer front grouting by rigid PVC tube and flexible solutions by corrugated polyethylene tubes. There are no particular specifications to determine the choice of one system, which is defined based on the installation.

DD-1017-B connector

*The front hole for **grouting/vent** can be connected by means of a connector with grouting corrugated tubes having a diameter of 25 mm. and 20 mm. for grouting or vent with a limited flow rate. DD-1017-B connector for gas 3/4" threaded hole and DD20x25 tube. DD-1033-B connector for gas 1/2"threaded hole and DD15x20 corrugated tube. DD-1034-B connector for 1/2" threaded hole and DD20x25 corrugated tube.*

DD-1003-A valve and DD20x25 corrugated tube

***Grouting/vent** by means of DD-1003-A reusable valves and DD20x25 corrugated tube is the most common solution used both with anchorage infilling and with grouting cap. This solution is usually also adopted as vent.*

DD-3050-A valve and DD20x25 corrugated tube

***Grouting/vent** by means of a DD-3050-A reusable valve and DD20x25 corrugated tube is the most technical solution used both with infilling and with grouting cap. The DD-3050-A valve is designed to be reused several times.*

DD-1003-A valve and DD-6009 PVC tube

***Grouting/vent** by means of reusable DD-1003-A valves and DD-6009 rigid PVC tube is the most common solution used for front grouting on anchorages that allows the operator to have a rigid connection. This solution is usually also adopted as vent.*

DD-3050-A valve and DD-6009 PVC tube

***Grouting** by means of a reusable DD-3050-A valve and DD-6009 rigid PVC tube is the most common solution used for front grouting on anchorages that allows the operator to have a rigid connection. The DD-3050-A valve is designed to be reused several times.*

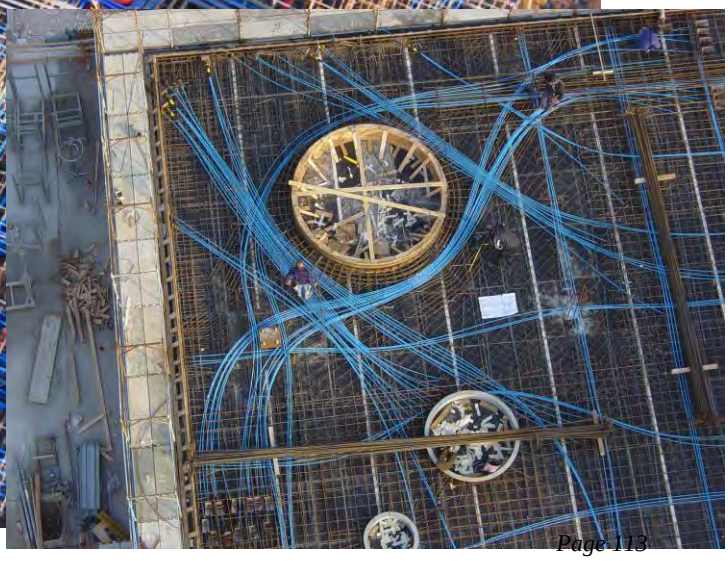
DD-1016-A valve and DD20x25 corrugated tube

***Vent** by means of DD-1016-A reusable valves and DD15x20 corrugated tube is the most economical solution used both with anchorage infilling and with grouting cap. This solution is used as vent on anchorages and caps where the connection to the grouting syringe is not required.*

These accessories can be used for grouting both with mortar and with grease. Their reuse is subject to a proper use according to operating instructions by TTM.

DD 1020-B connection to connect two DD20x25 tubes

***Connection for** corrugated **DD20x25 tube** to connect two tubes that are not correctly interrupted and allow their restoring, by giving continuity. This device is generally used to recover tubes that are broken inside a slab and guarantees the grouting pressure.*



DD-3050-A valve

Reusable valve type DD-3050-A diam. 25 mm.

This valve enables interception of the mixture, it can be connected directly to the DD20x25 diam. 25 mm corrugated tube and is reusable if the conical shut-off part is greased.

Gate valve type DD-1003-A diam. 25 mm.

This valve enables interception of the mixture, it can be connected directly to the DD20x25 diam. corrugated tube and is usually used to close the vent tubes.

DD-1003-A valve

Gate valve type DD-1016-A diam. 20 mm.

This gate valve can be connected to the 20 mm diam. type DD15x20. corrugated tube.

DD-1016-A valve

Corrugated tube for grout and vents

- *DD 20x25 diam. 25 mm corrugated tube for primary grouts and vents.*
- *DD 15x20 diam. 20 mm corrugated tube for secondary vents.*

DD 20x25 or DD15x20 corrugated tube

Threaded rigid PVC tube sections

- *Threaded tube sections L=200 mm ¾" type DD-6010.*
- *Threaded tube sections L=100 mm ¾" type DD-6009.*
- *Threaded tube sections L=200 mm 1/2" type DD-6008.*
- *Threaded tube sections L=100 mm 1/2" type DD-6007.*

DD-6010 and DD-6009 rigid PVC tube

DD-6010 rigid PVC tube and DD-6009 with DD-1017-A connection.

DD-6010 rigid PVC tube and DD-6009 with DD-1017-A connection.

DD-3050-A valves connected with ¾" DD-6009 tubes

***DD-3050-A** valves connected with ¾" **DD-6009** tubes L=100 mm and **DD-6008** L=200 mm.*

Coupling:

- ***DD-3050-A** reusable valve,*
- ***DD-1017-A** connector,*
- *Threaded tube sections L=100 mm ¾" type DD-6009.*

DD-1003-A valves connected with ¾" DD-6009 tubes

***DD-1003-A** valves connected with ¾" **DD-6009** tubes L=100 mm and **DD-6008** L=200 mm.*

Coupling:

- ***DD-1003-A** reusable valve,*
- ***DD-1017-A** connector,*
- *Threaded tube sections L=100 mm ¾" type **DD-6009***

DD-1017-A connector

***DD-1017-A** connector for coupling between:*

- *Threaded tube sections ¾" type **DD-6009** and **DD-6010,***
- ***DD-3050-A** and **DD-1003-A** valves,*

DD-1017-B connector

***DD-1017-B** connector for coupling between:*

- *corrugated tube DD20x25 mm,*
- *female ¾" joint*

***DD-1033-B 1/2"** connector corrugated tube DD15x20*

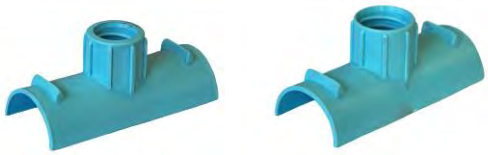
***DD-1034-B 1/2"** connector corrugated tube DD20x25*

DD-1033-B and DD-1034-B connector

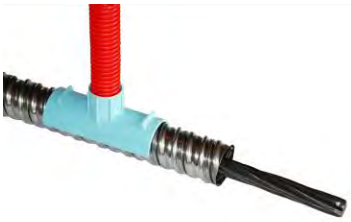
DD-1033-B connector 1/2" corrugated tube DD15x20 mm.

DD-1033-B connector 1/2" corrugated tube DD15x20 mm. and DD-8000 check nut

DD 1020-B connector for corrugated tube connection



DD 1011HF and DD 1010HF vent covers



- ***DD-1017-B*** *connector and corrugated tube* ***DD20x25*** *mm.*
- ***DD-1033-B 1/2"*** *connector corrugated tube* ***DD15x20*** *mm.*
- ***DD-1034-B 1/2"*** *connector corrugated tube* ***DD20x25****mm.*

DD-1034-B connector 1/2" corrugated tube DD20x25 mm.

Check nuts for threaded connectors:

DD-9000 *nut for coupling with thread3/4"*
DD-8000 *nut for coupling with thread1/2"*

DD 1020-B *connection for corrugated DD20x25 tube to connect two tubes that are not correctly interrupted and allow their restoring, by giving continuity. This device is generally used to recover tubes that are broken inside a slab and guarantees the grouting pressure.*

Vent covers for sheaths applied to single strands:

DD 1010HF *for* ***DD20x25*** *mm corrugated tube.*
DD 1011HF *for* ***DD15x20*** *mm corrugated tube.*

Vent cover for multi-strand cables type ***DD 1001.***

DD-1001 vent cover

DD-1001 vent cover on a metallic sheath

SPE-78x25x2 mm. *vent covers for flat sheaths:*

DD 1060HF *for* ***DD20x25*** *mm corrugated tube.*
DD 1050HF *for* ***DD15x20*** *mm corrugated tube.*

DD 1050HF vent cover for flat sheaths

DD 1060HF vent cover for flat sheaths

29.2 - DD-2015-PU reusable tips

DD-2015-PU tip

DD-2015-PU *tips are designed to prevent the corrugated sheaths from getting cut due to contact with the strand during threading and to facilitate the insertion of the strands into the sheaths..*
They can be used with T15, T15S and T15C strands and are reusable.

29.3 - DD-2115-PF reusable polypropylene tips

DD-2115-PF tip

DD-2115-PF *tips are designed to process cut to size strands on cutting benches. They can be used with T15, T15S and T15C strands and are reusable.*

29.4 - TT-5077 steel tips

TT-5077 tip

TT-5077 *tips are designed for very difficult threading. They are made of steel and provided with blocking with T15 wedges. In those cases where threading is very difficult and where the plastic tips break because of the roughness of the positioning of the sheaths,* ***TT-5077*** *steel tips are recommended because they offer a greater resistance to impacts.*
Their use offers great advantages with a powerful strand forcing machine, but they can also prove extremely harmful in case they are lost inside the sheath during their insertion as they obstruct the passing of new strands.

Adjustable anchorage

The "MS" guying system is the result of years of experience in the ironmaking sector. The research for the best materials, combined with production cycles to guarantee the highest degree of purity of the material, allowed to achieve a high performance in anchorages to resist the highest fatigue standards required by the international regulations.
The ironmaking experience of the companies of the Group allowed to concentrate in the "MS" anchorage the best materials, the best thermal treatments, the best sheathings offered by today's market. All these elements provide the anchorage with very good mechanical-structural characteristics to guarantee a very high resistance and preservation over time.

Adjustable anchorage

In order to make anchorages, vacuum cast steel of the highest quality are used. Inclusions are tested with the best control systems offered by today's market. All the heads are made of forged steel and tested with non-destructive systems to guarantee the purity of the material, which is an essential issue for important elements such as anchorages for guying systems.
All the materials used to make anchorages are normalized and stabilized with special treatments to guarantee the highest performance of the material used over time.
The protection of the surfaces of the anchor head may be further improved with a special protective treatment against corrosion to guarantee resistance against oxidation. It is a surface treatment that allows to improve the characteristics of the pieces, to increase the characteristics of energization and to improve the friction coefficient, providing the piece with a metallic grey that is typical of this treatment. The surfaces do not change their dimensions and there is no input of material, which is an important issue for the elements that are subjected to fatigue.

*There are two types of **"MS"** anchorages:*
- ***"MSA"** active anchorage*
- ***"MSD"** passive anchorage*

The anchorage system for MS guying systems is a mechanical anchorage protected by wax grouting in the area of anchorage of the strands.
The strands used are T15S 15,7 mm. galvanized, waxed/greased and protected with a high density polyethylene layer.
Anchorages are tested for a variable load from 150 N/mm^2 to 200 N/mm^2.

Active anchorages are suitable for an adjustment by means of a toroidal jack. A lock ring allows to obtain an accurate adjustment of the elongation of the whole cable.

Shock absorber/deviator

The sheaths used to protect the guying system on the outside may be:

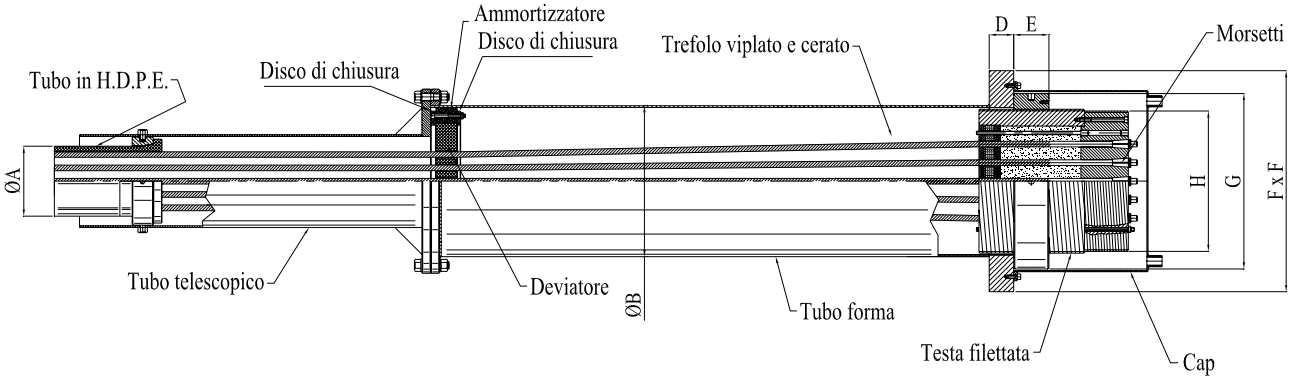
- *H.D.P.E. (polyethylene),*
- *Stainless steel,*
- *Aluminium.*

Sheaths remain the external protection of the cable and the choice must be made according to the architectural requirements of the project.
The sheaths are coupled with anti-vandalism tubes that protect the anchorage-sheath connection at the end of the cable.

30.1 - "MSA" adjustable anchorage

Adjustable anchorage

"MSA" adjustable anchorages are made of an anchor plate positioned on a threaded pin, which if used with a lock ring allows to adjust the anchorage over time. Adjustments are obtained by screwing or unscrew the lock ring with a special toroidal jack having an adequate capacity. The length of the threaded pin varies based on the adjustment required by the project.
Inside the adjustment pin there is a gap that allows to contain wax or grease to protect the parts of the strands that are not covered by the protection in H.D.P.E.
The head is completed by a deviator with shock absorber, made to deviate the strands inside the sheath and to absorb the vibrations the cable is subjected to.
A protection cap covers all the head protecting it against corrosion.

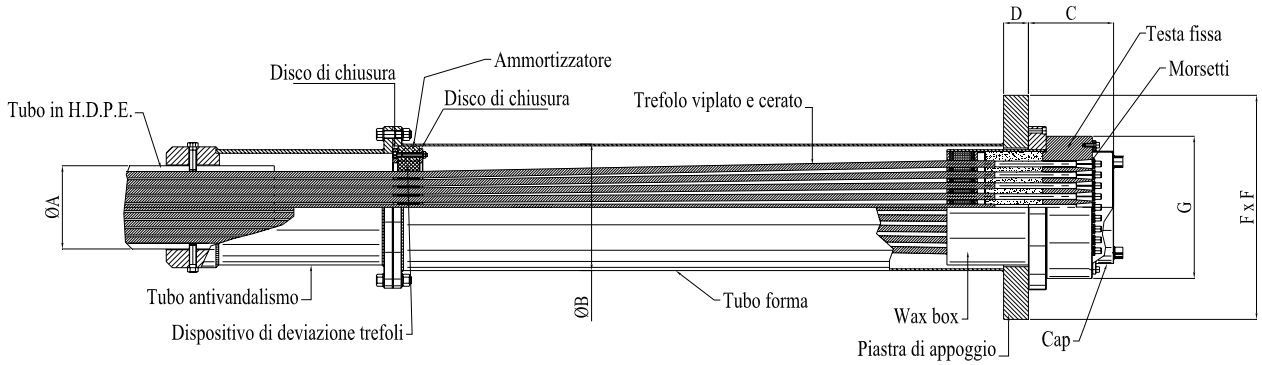


Type	***A***	***B***	***D***	***E***	***F***	***G***	***H***
	(mm.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
19MSA15	*140/8.0*	*254.0/5*	*30*	*70*	*360x360*	*292*	*232*
31MSA15	*180/10.2*	*273.0/5*	*45*	*85*	*420x420*	*310*	*249*
37MSA15	*200/11.4*	*298.5/5*	*50*	*90*	*470x470*	*345*	*270*
55MSA15	*225/12.8*	*323.9/5*	*50*	*105*	*560x560*	*400*	*300*
61MSA15	*250/14.2*	*381.0/5*	*60*	*110*	*600x600*	*450*	*350*
73MSA15	*280/15.9*	*406.4/5*	*70*	*115*	*630x630*	*470*	*370*
91MSA15	*315/17.9*	*457.2/5*	*70*	*120*	*700x700*	*505*	*405*
109MSA15	*315/17.9*	*457.2/5*	*80*	*125*	*750x750*	*526*	*426*
127MSA15	*355/20.1*	*508.0/5*	*90*	*130*	*800x800*	*570*	*470*

30.2 - "MSD" fixed anchorage

Passive anchorage

"MSD" fixed anchorages are made with an anchor plate positioned on a retaining box that allows to contain wax or grease to protect the parts of the strands that are not covered by the protection in H.D.P.E.
The head is completed by a deviator with shock absorber, made to deviate the strands inside the sheath and to absorb the vibrations the cable is subjected to.
The protection cap is smaller to contain only the area of anchorage of the strand.



Type	***A***	***B***	***C***	***D***	***F***	***G***
	(mm.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*
19MSD15	*140/8.0*	*254.0/5*	*200*	*30*	*360x360*	*292*
31MSD15	*180/10.2*	*273.0/5*	*200*	*45*	*420x420*	*310*
37MSD15	*200/11.4*	*298.5/5*	*200*	*50*	*470x470*	*345*
55MSD15	*225/12.8*	*323.9/5*	*200*	*50*	*560x560*	*400*
61MSD15	*250/14.2*	*381.0/5*	*200*	*60*	*600x600*	*450*
73MSD15	*280/15.9*	*406.4/5*	*200*	*70*	*630x630*	*470*
91MSD15	*315/17.9*	*457.2/5*	*200*	*70*	*700x700*	*505*
109MSD15	*315/17.9*	*457.2/5*	*200*	*80*	*750x750*	*526*
127MSD15	*355/20.1*	*508.0/5*	*200*	*90*	*800x800*	*570*

Medium-resistance bars are used for post-tensioning and geotechnical applications. They are provided with a continuous thread and have a variable diameter from 26.5 to 47 mm and working loads between 568 KN and 1820 KN.

The main applications are:

- *Continuous structures or prefabricated elements made of reinforced prefabricated concrete*
- *Additional reinforcement for reinforced concrete works*
- *Permanent and temporary anchors,*
- *Temporary or permanent single ground anchors with corrosion protection*

High resistance bar technical characteristics:

Diameter	***18***	***26,5***	***32***	***36***	***40***	***47***
Area (cm^2)	*2.41*	*5.55*	*8.04*	*10.20*	*12.57*	*17.35*
Mass (Kg/m)	*1.96*	*4.48*	*6.53*	*8.27*	*10.21*	*14.10*
Fpyk (KN)	*230*	*525*	*760*	*970*	*1190*	*1650*
Fptk (KN)	*255*	*580*	*850*	*1070*	*1320*	*1820*
f_{pyt} / f_{ptk}	*950/1050*	*950/1050*	*950/1050*	*950/1050*	*950/1050*	*950/1050*
Type	***Y 1050***	***Y 1050***	***Y 1050***	***Y 1050***	***Y 1050***	***Y 1050***

32.0 - EQUIPMENT

All the equipment is manufactured in full respect of the "Machinery regulations" , it is provided with CE marking and button strip for drive operation at 24 Volt. 50Hz. to allow use even in difficult conditions.
All the machines are provided with onboard electrical protections and are supplied as follows: 3 poles plus earth 3P+T with supply at 380 Volt. 50Hz. and 16, 32 and 63 Amp supply base on the machine absorption.
Where a direction of rotation must be observed, machines are provided with a change-over switch to allow the phase inversion automatically without any manual intervention on the circuit.
All the hydraulic circuits are provided with safety valves to limit overpressure or mistakes in the operation of regulation valves. A metallic label identifies the machine and its part number.
All the machines are provided with operating and maintenance manuals, and with the CE marking upon request.

32.1 - Anchor loading

*(**EURO NORM EN 1537-2002** paragraph 8.4)*

"Stressing and recording shall be carried out by experienced personnel under the control of a suitably qualified supervisor, provided preferably by a specialist anchor contractor or stressing equipment supplier".
The use of the equipment for site activities must be carried out by qualified and trained personnel.

32.2 - Maintenance

The maintenance of the equipment is defined as:

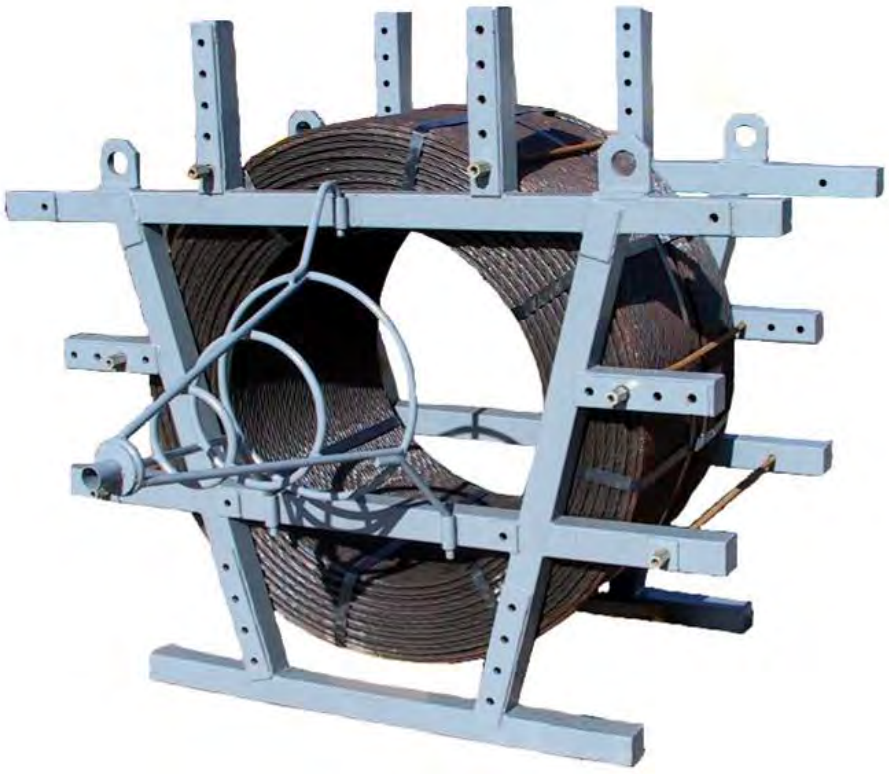
- *planned maintenance, (maintenance caused by wear due to the use of the machine)*
- *upkeep, (maintenance caused by a permanent damage of the machine)*

All maintenance operations aim at restoring the efficiency of the equipment. Any modification carried out on site or by operators make void the CE marking of the equipment void. Restoring it by removing such modifications is considered as upkeep.

32.3 – "B1500" uncoiler

(Uncoiler from 3 to 5 ton.)

*The **B1500** uncoiler was designed to ease threading operations of the strand into the sheaths on building sites. It is usually used in combination with a strand forcing machine and guarantees the unwinding of the strand without tangling even at a high speed.*
It is set up to host coils of different dimensions and diameters.



B1500 uncoiler

The B1500 uncoiler does not require any special anchorage to the ground, its own weight is sufficient to guarantee its stability when used. The coil of strand is inserted between the two shoulders, before cutting the metal band straps, the correct tightening of the closing anchors, which guarantee the correct blocking and the safety of the operations, must be checked.
While cutting the metal band straps, the unwinding direction shown inside the coil must be complied with to guarantee the strand will unwind smoothly.

Type	***Weight***	***Max. capacity***	***Loaded weight***	***Dimensions***	
	(Kg.)	*(Kg.)*	*(Kg.)*	*mm.*	
B1500	*180*	*1,000*	*5,220*	*2500x2500*	

Subject to modification *Further data is available on request*

32.4 – "F2300-Eturntable"

(single strand winding turntable)

The turntable for cable winding allows to handle precut single strands, which are cut to measure and preincised on the polyethylene protection. The ***F2300-E*** *turntable winds them up on a 2.2 m diameter to ease handling on site.*

Type	***Weight***	***Diam. max.***	***Height***	***AxB dimensions***	***Max. capacity***
	(Kg.)	*(mm.)*	*(mm.)*	*(mm.)*	*(Kg.)*
F2300-E	*250*	*2200*	*1250*	*1500x1500*	*160*

Subject to modification *Further data is available on request*

32. 5 – "F3000-E turntable"

(single strand winding turntable)

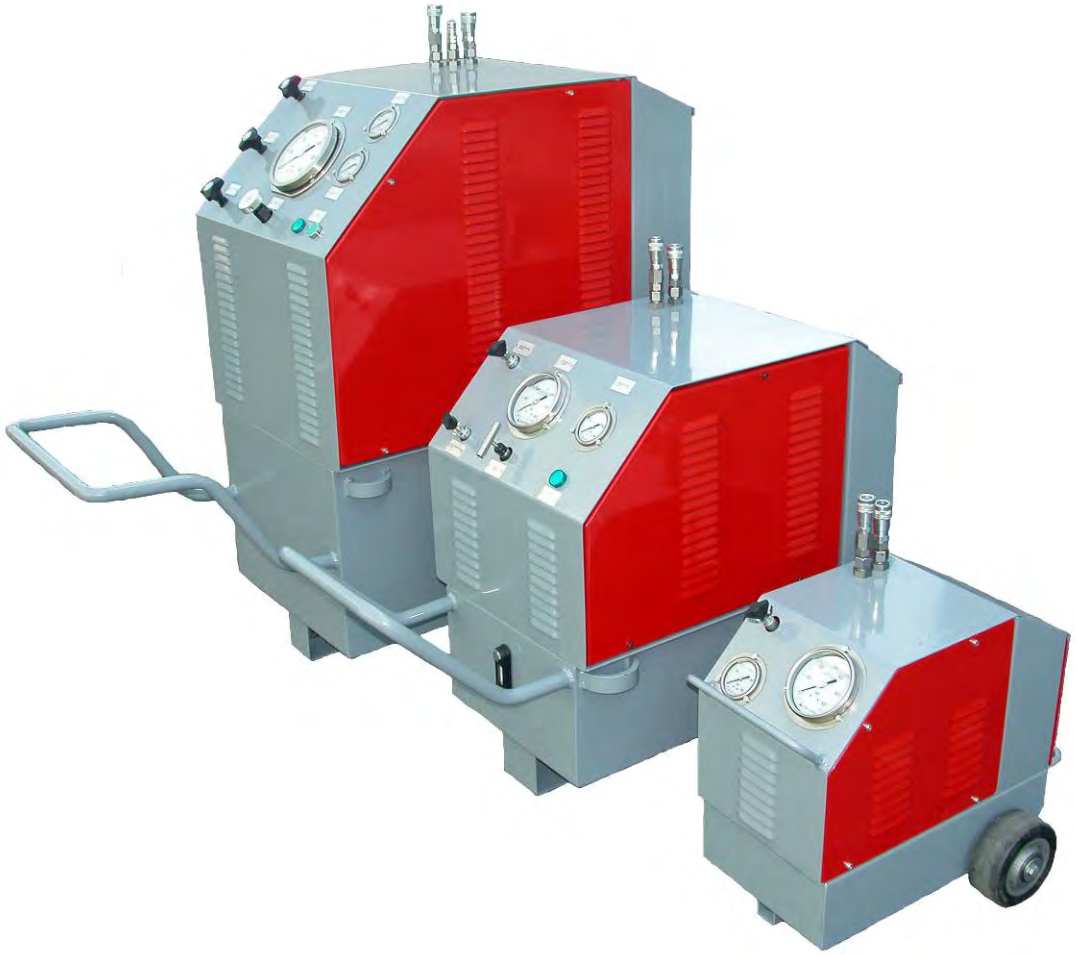
This turntable is designed for anchor winding. It allows to wind up ground anchors that are assembled with several strands by sliding them on a roller table. Strands are cut and assembled and then wound up on rolls. The ***F3000-E*** *turntable then winds them up on a 2.2 diameter to ease handling them when loading on trucks.*

Type	***Weight***	***Diam. max.***	***Height***	***AxB dimensions***	***Max. capacity***
	(Kg.)	*(mm.)*	*(mm.)*	*(mm.)*	*(Kg.)*
F3000-E	*350*	*2.500*	*2.000*	*2.500x2.500*	*400*

Subject to modification *Further data is available on request*

32.6 - TTM-A hydraulic pumps

All the machines are equipped with a button strip L=10 m which allows all the operating phases of the machine to be controlled. Special calibration valves enable the operator to manually adjust pressure very easily and precisely in the two machine circuits.
The equipment supplied is manufactured in compliance with the EC Directive and has CE markings according to the machinery regulations, as well as a calibration with a six month validity.



Hydraulic pumps: TTM1000-E, TTM 450-A and TTM 250-A

Type	***Weight***	***Max. pressure***	***Capacity***	***Voltage/ Amperes***	***Use***
	(Kg.)	*bar.*	*KW*		
TTM 250-A	*85*	*450-500*	*2.5*	*380/16*	*TTM*
TTM 450-A	*200*	*450-500*	*4,5*	*380/16*	*TTM*
TTM 550-A	*175*	*550-700*	*7,5*	*380/32*	*TTM*

Subject to modification *Further data is available on request*

All the circuits are supplied with calibration valves and safety valves to avoid overpressure.
The control gauges installed are analogue, but can be coupled to a digital gauge with 1 bar precision.

TTM 250-A, TTM 450-A and TTM 550-A are made for use with TTM250KN jacks.
650, 700 and 750 hydraulic pumps are made for use with DD jacks, for tensioning bars or simple jacks and are not equipped for the locking circuit.

TTM 450-A pump

***TTM 450-A** pump, designed for small operations with max. 8 TTM250KN jacks or DD series bar tensioning for all types of jacks.*
The limited size makes it an excellent machine for tensioning ground anchors.
The machine is made for intermittent operations and can reach max pressures of 600 bar and 550 bar for continuous services.

***TTM250-A** pump, designed for small operations with single TTM250KN jack or DD series bar tensioning jacks.*
The limited sizes and weight together with an operating pressure of 550 bar make it a simple and practical means for small operations.

TTM 250-A pump

TTM 550-A pump

***TTM550-A** pump, designed for heavy duty with TTM250KN jack where continuous operating is required.*
Its characteristics make it flexible and robust and usable for draw out tests and tensioning of post-tensioned structures, it can work with a maximum of 19 TTM250KN or 12 TTM250KN-400 jacks.
The machine is made for heavy duty and can reach max. pressures of 700 bar and pressures for continuous operating services of 550 bar.

32.7 - TTM450-A hydraulic pump

(Tensioning of TTR anchors)

TTM450-A pump

***TTM 450-A** pumps are designed for tensioning with TTM jacks. They are the most used type, they are compact and suitable for tensioning anchors up to 8 strands.*

The pump is provided with all the protections to guarantee a safe tensioning. The button strip allows the operator to control drive, stressing, locking and return at a distance of 10 m from the machine.

T-R-I button strip L=10 m for: stressing, locking and return

T-R button strip L=10 m for stressing and return only

The button strip, by precalibrating the stressing and return valves allows to change functions and the carry out the tensioning cycle by controlling the anchor. The button strip characterises all the machines produced by TTM, it is easy to replace, independent of the equipment, easy to use, it can be removed after use and it is maintenance friendly.

TR-15 *release cone for single strand T15 anchorages, to be used on TTM250-KN jacks.*

TR-15 release cone

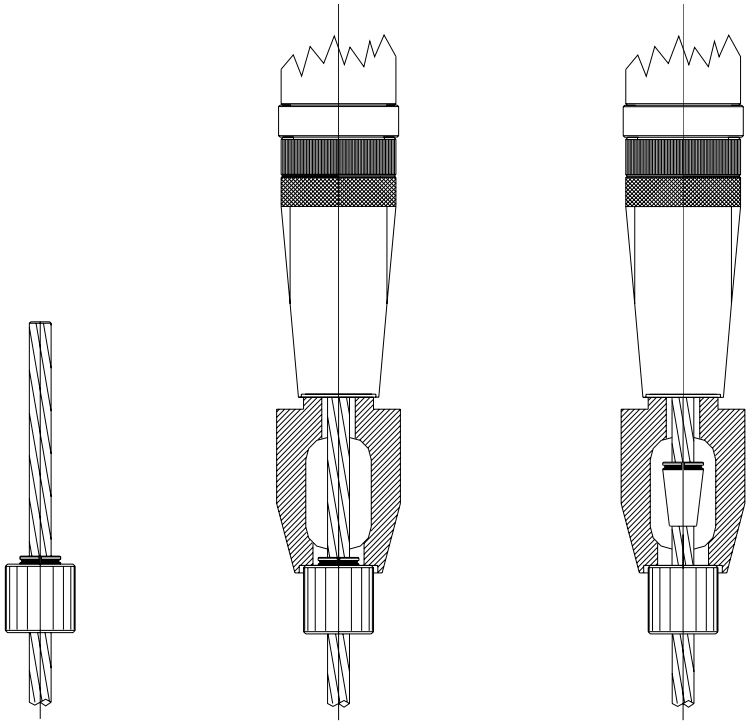
TM-15 *release cone for single strand T15 anchorages, to be used on TTM250-KN-M jacks.*
It can operate only on anchorages of the series:

- *TTM,*
- *M*
- *G*

On all multiple strand anchorages.

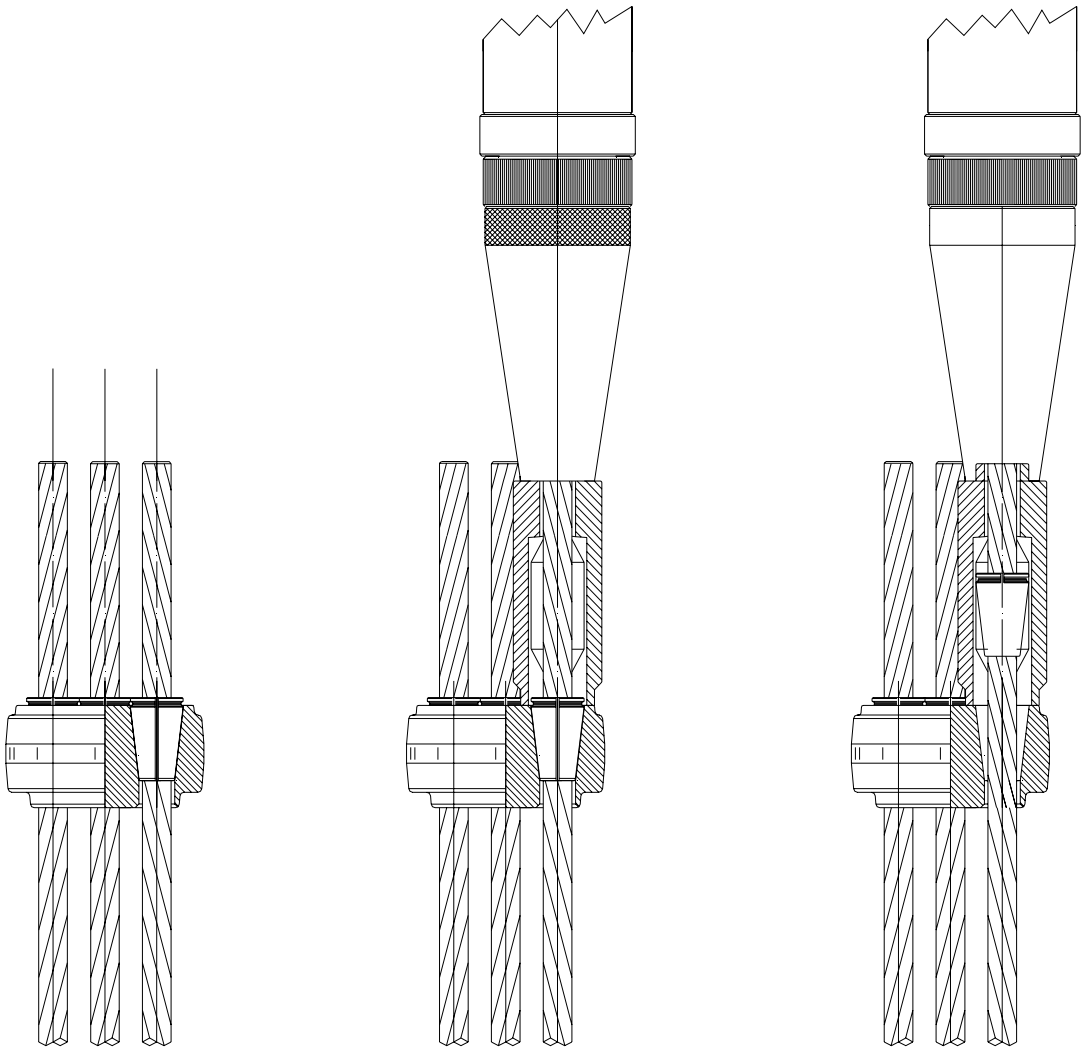
TM-15 release cone

The releasing of wedges on TTM anchorages is carried out by means of TTM 2500KN-200-M jacks and of a TR 15 release cone.



A B C

The releasing of wedges on M anchorages is carried out by means of TTM 2500KN-200-M jacks and of a TM 15 release cone.
The TTM 2500KN-200 jack must be provided with a suitable special end part for tensioning on M anchorages.



During the phase B the TTM 250KN-200 jack with the TM 15 release cone is inserted onto the strand in the return position. The stressing function is carried out thus releasing the wedge (phase B). Releasing usually occurs at a higher value than the stressing one, the wedge requires a greater stressing to overcome the friction of the wedge self-locking. The wedge must be released with the TTM jack at half stroke (mechanical detensioning). Once released, the wedge must be moved into the release cone by lifting it with a screwdriver in the slit of the release cone as high as possible (phase C).

With the TTM 250KN-200 jack, by means of the release valve, decrease pressure in the oil hydraulic circuit and tension the cable. The cycle must be repeated until the tension of the strand is zero in order to remove the wedge.

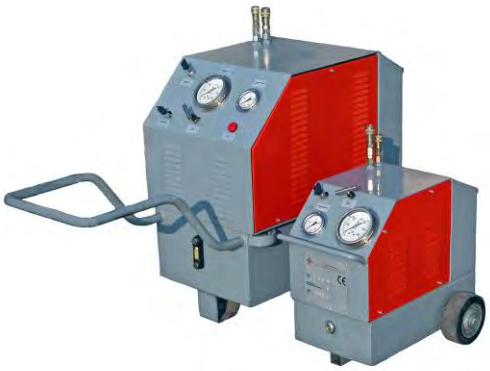
Pay attention not to break the metallic ring that joins the three sectors of the wedge, as breaking it means losing control over the three sectors of the wedge which therefore cannot be moved simultaneously any longer.

Moving the wedge with a screwdriver must be done with a particular attention, wearing proper gloves and using a screwdriver with the handle sufficiently external to the release cone. In order to make releasing easier, do not strew the anchorage with oil as, while releasing, it could prevent the wedge from self-locking.

All activities must be carried out dry with no lubricants.

32.9 – "TTM 450-A" hydraulic pump

(Tensioning of TTR anchors)



TTM450-A and TTM250-A pumps

TTM 450-A pump

Button strip for T-R stressing and return only

T-R-I button strip for: stressing, locking and return

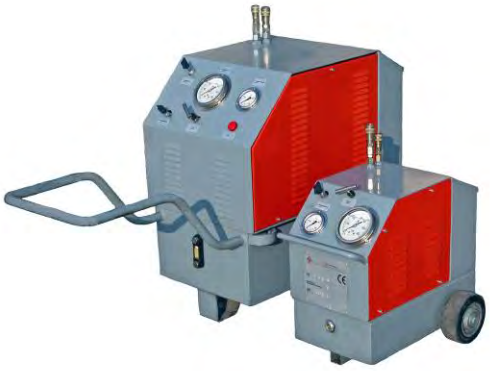
*The **"TTM-A"** series of pumps is available in two models which differ according to use required and characteristics. They are set up with a two-tube exit for driving the **TTM** and **DD** series of tensioning jacks. All the machines are equipped with three control circuits: stressing, locking and return.*
All the circuits are supplied with calibration valves and safety valves to avoid overpressure.
All the pumps are provided with a button strip to electrically control these functions: stressing, locking and return. The control gauges installed are analogue, but can be coupled to a digital gauge with 1 bar precision.

Type	***Weight***	***Max. pressure***	***Capacity***	***Voltage/ Amperes***	***Use***
	(Kg.)	*bar.*	*KW*		
TTM450-A	*170*	*450-500*	*4.5*	*380/16*	*TTR*

Subject to modification *Further data is available on request*

32.10 – "TTM 250-A" hydraulic pump

(Tensioning of TTR anchors)



TTM450-A and TTM250-A pumps

TTM 250-A pump

Button strip for T-R stressing and return only

T-R-I button strip for: stressing, locking and return

*The **"TTM-A"** series of pumps is available in several models which differ according to use required and characteristics. They are set up with a two-tube exit for driving the **TTM** and **DD** series of tensioning jacks. All the machines are equipped with three control circuits: stressing, locking and return.*
All the circuits are supplied with calibration valves and safety valves to avoid overpressure.
All the pumps are provided with a button strip to electrically control these functions: stressing, locking and return.
The control gauges installed are analogue, but can be coupled to a digital gauge with 1 bar precision.

Type	***Weight***	***Max. pressure***	***Capacity***	***Voltage/ Amp***	***Dimensions***	***Use***
	(Kg)	*bar.*	*KW*		*(mm)*	
TTM 250-A	*60*	*450-550*	*1.5*	*380/16*	*600x500x300*	*TTR-DD*

Subject to modification *Further data is available on request*

32.11 – "TTM 550-A" hydraulic pump

(Tensioning of TTR anchors)

TTM550 hydraulic pump

*This type of pump is set up with a two-tube exit for driving the **TTM and DD** series of tensioning jacks.*
All the machines are equipped with three control circuits: stressing, locking and return.
All the circuits are supplied with calibration valves and safety valves to avoid overpressure.

TTM550-A pump

TTM 550-A pumps are designed to use up to 12 single strand jacks at the same time. They are made for use with DD jacks or simple jacks.

Type	***Weight***	***Max. pressure***	***Capacity***	***Voltage/ Amp***	***Dimensions***	***Use***
	(Kg)	*bar.*	*KW*		*(mm)*	
TTM 550-A	*290*	*550-600*	*7,5*	*380/16*	*1200x650x1200*	*TTR-DD*

Subject to modification *Further data is available on request*

32.12 – "TTM 650-E" hydraulic pump

(Tensioning of TTM and M multi-strand anchorages)

TTM 650-E pump

*The **"TTM-E"** series of pumps is available in six models which differ according to use required and characteristics.*
They are set up with a three-tube exit for driving the M series of jacks. All the machines are equipped with three control circuits: stressing, locking and return.
All the circuits are supplied with calibration valves and safety valves to avoid overpressure.
The control gauges installed are analogue, but can be coupled to a portable digital gauge.

Type	***Weight***	***Max. pressure***	***Capacity***	***Voltage/ Amperes***	***Use***
	(Kg.)	*bar.*	*KW*		
TTM 650-E	*290*	*600*	*7.5*	*380/16-32*	*TTM - M*

Subject to modification *Further data is available on request*

32.13 – "TTM-E" hydraulic pump

(Tensioning of TTM and M multi-strand anchorages)

*The **"TTM-E"** series of pumps is available in two models which differ according to use required and characteristics. They are set up with a three-tube exit for driving the M series of jacks. The pumps are equipped with three control circuits: stressing, locking and return. All the services are supplied with calibration valve.*
The control gauges installed are analogue, but can be coupled to a digital gauge with 1 bar precision. All the machines are equipped with a button strip (cable L=10 m) which allows all the operating phases of the machine to be controlled. Special calibration valves enable the operator to manually adjust pressure very easily and precisely in the three machine circuits.

TTM 2000-E pump

All the machines are equipped with three control gauges to check pressure in the single circuits. They are supplied with release valve and safety valves to avoid overpressure.
All the equipment supplied is manufactured in compliance with the machinery regulations and has CE markings.

Type	***Weight***	***Max. pressure***	***Capacity***	***Voltage/ Amperes***	***Use***
	(Kg.)	*bar.*	*KW*		
TTM 1000-E	*380*	*700*	*10*	*380/32*	*TTM - M*
TTM 2000-E	*470*	*700*	*22*	*380/32*	*TTM - M*

Subject to modification *Further data is available on request*

32.14 - "DD-MF" manifold

(Tensioning of single strand anchorages with several TTM jacks)

*By means of a manifold, all the hydraulic pumps can be connected to several tensioning jacks. The **DD-MF** manifold is designed with 4, 6 or 10 hydraulic outputs under isopressure, it is made of galvanized steel and can be completely disassembled. The upper connections are for jacks, the side connections are for **TTM pumps***

*The **DD-MF** manifold is arranged for connecting a sample gauge for pressure checks during the tensioning activities and is created for maximum working pressures of 700 bar.*
The manifolds are available in the following types where the number indicates the pressure outputs available for jack connection:

- *DD04-MF,*
- *DD06-MF,*
- *DD10-MF,*

Different arrangements can be obtained by series connecting several manifolds.

Type	***Weight***	***Max. pressure***	***Height from ground***	***Dim. AxB***	***No. outputs***
	(Kg.)	*(bar.)*	*(mm.)*	*(mm.)*	*number*
DD 04-MF	*20*	*450-500*	*40*	*500x500*	*4*
DD 06-MF	*28*	*450-500*	*40*	*900x500*	*6*
DD 10-MF	*35*	*450-500*	*40*	*1200x500*	*10*

Subject to modification *Further data is available on request*

32.15 - "S 1000/S3000" dynamometer

(Dynamometer for jack calibration)

*The digital-reading **S1000/S3000** dynamometer, if used with a hydraulic pump allows to check the stress applied by the tensioning jack to a passive anchorage used to calibrate TTM 250KN and TTM300KN tensioning jacks. It is supplied calibrated by a S.I.T. centre or an authorized laboratory.*

The dynamometer is provided with a calibration certificate issued by a S.I.T. centre or an authorized laboratory with a six month validity.
*The gauge box requires a single phase supply 220 Volt. 16 Amp 2P+T 50 Hz., for calibration on site where power is supplied by generator sets. Always check the tension (voltage) and frequency calibration. If they are not within the tolerated range, they may damage the instrument. The **S1000** gauge box allows to calibrate jacks and check pressure at the same time.*
*The instrument can be supplied with different certifications on request, sample gauges are set up for use at max. 300KN. They are provided with **CE** marking.*

Type	***Weight***	***Capacity***	***Power supply***	***Dimensions***	***Use***
	(Kg.)	*KN*	*Volt.*	*mm.*	
S1000/S3000	*24*	*300*	*220*	*320x430x250*	*TTM*

TTM 250KN-200 jack

TTM 250KN-200 *jack for tensioning on anchorages: E, EX and TTR provided with 200 mm actual stroke, hydraulic locking and tubes with 4 m quick joints.*

TTM 250KN-100 jack

TTM 250KN-100 *jack for tensioning on anchorages: E, EX and TTR provided with 100 mm actual stroke, hydraulic locking and tubes with 4 m quick joints.*

TTM 250KN-60 jack

TTM 250KN-60 *jack for tensioning on anchorages: E, EX and TTR provided with 60 mm actual stroke, hydraulic locking and tubes with 4 m quick joints.*

TTM 250KN-M-100 jack

TTM 250KN-M-100 *jack for tensioning on anchorages: M and TTM provided with 100 mm actual stroke, hydraulic locking and tubes with 4 m quick joints.*

TTM 250KN-400 jack

TTM 250KN-400 *jack for tensioning on anchorages: E, EX and TTR provided with 400 mm actual stroke, hydraulic locking and tubes with 4 m quick joints.*

TTM 250KN-C-100 jack

TTM 250KN-C-100 *jack for tensioning on anchorages: E, EX and TTR with 100 mm. stroke.*
The jack without locking for tensioning of short strands is provided with tubes with 4 m quick joints.

TTM 300KN-M-100 jack

TTM300KN-M-100 *jack for tensioning on anchorages: M and TTM provided with 100 mm actual stroke, hydraulic locking and tubes with 4 m quick joints.*

TTM 300KN-100 jack

TTM300KN-200 *jack for tensioning on TTM anchorages provided with 200 mm actual stroke, hydraulic locking and tubes with 4 m quick joints.*

Head for tensioning on anchorages: E, EX and TTR

Head for tensioning on anchorages: E, EX and TTR, all the heads of this series are provided with internal hydraulic locking.

Head for tensioning on M and TTM anchorages

Head for tensioning on anchorages: M and TTM, all the heads of this series are provided with internal hydraulic locking.

32.17 - "TTM 250KN-200" tensioning jack

(Tensioning of TTR and TTS anchors)

TTM jacks are available in three models which differ according to use characteristics. They are provided with an automatic locking circuit and 4 meter long flexible tubes. The main use of ***TTM250KN*** *jacks is for tensioning on single strand heads on TTM anchorages. They are available with strokes: 400 mm., 200 mm., 100 mm. and 60 mm., the stroke reduction allows smaller dimensions of the jack.*

Type	***Weight***	***Stroke***	***Max. diameter***	***Length***	***Grip***	***Section***	***Capacity***
	(Kg.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(cm^2)*	*(KN)*
TTM 250KN-200 jack	*26*	*200*	*100*	*930*	*350*	*47.2*	*250*

Subject to modification *Further data is available on request*

32.18 - "TTM 250KN-100" tensioning jack

(Tensioning of TTR and TTS anchors)

TTM 250KN-100 jack

TTM jacks are available in three models which differ according to use characteristics. They are provided with an automatic locking circuit and 4 meter long flexible tubes. The main use of ***TTM250KN*** *jacks is for tensioning on single strand heads on TTM anchorages. They are available with strokes: 400 mm., 200 mm., 100 mm. and 60 mm., the stroke reduction allows smaller dimensions of the jack.*

Type	***Weight***	***Stroke***	***Max. diameter***	***Length***	***Grip***	***Section***	***Capacity***
	(Kg.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(cm^2)*	*(KN)*
TTM 250KN-100 jack	*24*	*100*	*100*	*720*	*350*	*47.2*	*250*

Subject to modification *Further data is available on request*

32.19 - "TTM 250KN-60" tensioning jack

(Tensioning of TTR and TTS anchors)

TTM 250KN-60 jack

TTM jacks are available in three models which differ according to use characteristics. All the jacks are provided with an automatic locking circuit and 4 meter long flexible tubes. The main use of ***TTM250KN*** *jacks is for tensioning on single strand heads on TTM anchorages. They are available with strokes: 400 mm., 200 mm., 100 mm. and 60 mm., the stroke reduction allows smaller dimensions of the jack.*

Type	***Weight***	***Stroke***	***Max. diameter***	***Length***	***Grip***	***Section***	***Capacity***
	(Kg.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(cm^2)*	*(KN)*
TTM 250KN-60 jack	*22*	*60*	*100*	*640*	*350*	*47.2*	*250*

Subject to modification *Further data is available on request*

32.20 - "TTM 250KN-400" tensioning jack

(Tensioning of TTR and TTS anchors)

TTM 250KN-400 jack

TTM jacks are available in three models which differ according to use characteristics. All the jacks are provided with an automatic locking circuit and 4 meter long flexible tubes. The main use of ***TTM250KN*** *jacks is for tensioning on single strand heads on TTM anchorages. They are available with strokes: 400 mm., 200 mm., 100 mm. and 60 mm., the stroke reduction allows smaller dimensions of the jack.*

Type	***Weight***	***Stroke***	***Max. diameter***	***Length***	***Grip***	***Section***	***Capacity***
	(Kg.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(cm^2)*	*(KN)*
TTM 250KN-400 jack	*32*	*400*	*100*	*1,035*	*300*	*47.2*	*250*

32.21 - "TTM 300KN-200" tensioning jack

(For tensioning of T15C strands on TTR and TTS anchorages)

TTM 300KN-200 jack

TTM jacks are available in two models which differ according to use characteristics. They are provided with an automatic locking circuit and 4 meter long flexible thermoplastic tubes with quick joints.

*The main use of **TTM300KN-200** jacks is for tensioning on single strand or TTR heads where the T15C compact strand is used.*

Type	***Weight***	***Stroke***	***Max. diameter***	***Length***	***Grip***	***Section***	***Capacity***
	(Kg.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(cm^2)*	*(KN)*
TTM300KN-200	*30*	*200*	*110*	*930*	*350*	*68.80*	*300*

Subject to modification *Further data is available on request*

32.22 - "TTM 300KN-100" tensioning jack

(For tensioning of T15C strands on TTR and TTS anchorages)

TTM 300KN-100 jack

TTM jacks are available in two models which differ according to use characteristics. They are provided with an automatic locking circuit and 4 meter long flexible thermoplastic tubes with quick joints.

The main use of ***TTM300KN-100*** *jacks is for tensioning on single strand or TTR heads where the T15C compact strand is used.*

Type	***Weight***	***Stroke***	***Max. diameter***	***Length***	***Grip***	***Section***	***Capacity***
	(Kg.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(cm^2)*	*(KN)*
TTM300KN-100	*25*	*100*	*110*	*730*	*350*	*68.80*	*300*

Subject to modification *Further data is available on request*

32.23 - "TTM 250KN-C-60" tensioning jack

(Tensioning on short strands)

TTM 250KN-C-60 jack

TTM 250KN-C-100 jack

***TTM250KN-C** jacks are designed for tensioning on short strands. Their main characteristic is the short strand grip to guarantee the grip of the jack on strand protrusions between 80 – 100 mm. They are without locking and are only used on single strand interventions on anchorages: TTR, E, EX, TTS with minimum support for the jacks of 48 mm. Two different strokes are available to guarantee their use in small spaces, they are provided with L=4 m hydraulic tubes as well as quick joints.*

Type	***Weight***	***Stroke***	***Max. diameter***	***Length***	***Grip***	***Section***	***Capacity***
	(Kg.)	*(mm.)*	*(mm.)*	*(mm.)*	*(mm.)*	*(cm^2)*	*(KN)*
TTM 250KN-C-60	*15,5*	*60*	*100*	*470*	*80-100*	*47,2*	*250*
TTM 250KN-C-100	*18*	*100*	*100*	*560*	*80-100*	*47,2*	*250*

Subject to modification *Further data is available on request*

32.24 - "S 1000" sample gauge

(Digital gauge to check pressure)

*The **S 1000** dynamometer (with digital reading) if used with a hydraulic pump or manifold allows to check the pressure in the circuit it is connected to. It is used to monitor the testing and operating pressure applied to jacks via manifolds. It can be supplied calibrated with factory or certified laboratory calibration.*

S1000 sample gauge

The dynamometer is provided with a calibration certificate issued by a University of Polytechnic which certifies its validity. It is valid for six months since the date of issue.
*The dynamometer requires a single phase supply 220 Volt. 2P+T 50 Hz., for calibration on site where power is supplied by generator sets. Always check the tension (voltage) and frequency calibration. If they are not within the tolerated range, they may damage the instrument. The **S1000** sample gauge allows calibration by comparison with the hydraulic system in use, via coupling before and after the circuit. It is supplied in a suitable insulated aluminium box containing a digital gauge with four digit reading, precise to 1 bar. The instrument can be supplied with different certifications on request: The sample gauges are set up for use at max. 1.000 bar. They are provided with **CE** marking, completely protected and bear identification serial numbers for the controls performed periodically by our technical service.*

Type	***Weight***	***Max. pressure***	***Power supply***	***Dimensions***	***Use***
	(Kg.)	*bar.*	*Volt.*	*mm.*	
S1000	*15*	*1,000*	*220*	*320x430x250*	*TTM*

Subject to modification *Further data is available on request*

32.25 - "S 900" analogue sample gauge

(Analogue gauge to check pressure)

The S 900 sample gauge (analogue reading), if installed on a circuit allows to check pressure at the connection point.

It is used to monitor the testing and operating pressure applied to jacks via manifolds and flexible tubes. It can be supplied calibrated with factory or certified laboratory calibration.

S 900 analogue sample gauge

It is valid for six months since the date of issue. The S 900 sample gauge allows calibration by comparison with the hydraulic system in use, via couplings before and after the circuit. It is supplied in a suitable insulated aluminium box, complete with coupling devices on both fixed and flexible circuits.

Type	***Weight***	***Max. pressure***	***Accuracy class***	***Dimensions***	***Overpressure***
	(Kg.)	*bar.*		*mm.*	
S 900	*2.4*	*1,000*	*+/- 0.25% VFS*	*320x160x50*	*30% of VFS*

Subject to modification *Further data is available on request*

The gauge is provided with part number and can operate with process fluid from -40 to +150 C° . It is provided with PI 65 protection class according to IEC 529 8896. It has an aluminium dial on white background, with rating and numbers in black with anti-parallax band.
The instrument can be installed on hydraulic circuits on site to check pressure falls or the actual pressure on a required point.

The sample gauge cannot be considered as an equipment calibration instrument, but only a system to check pressure by means of a measurement obtained via calibrated instrument.
The sample gauge can also be used to check in load tests, according to EURO NORM EN 1537-2002, annex E the decrease in pressure on the circuit after the hydraulic pump at its closure.

32.26 - " T " grouting pump

(Pump for cable grouting)

The "T" grouting pump is designed to guarantee maximum versatility with regard to site requirements and use in severe conditions. It is supplied on wheels with robust tyres, it can be towed on-site and is equipped with all the safety devices necessary for use. The machine has two tanks: one for mixing the colloidal mix and one as a tank for the mix. The turbo mixer has a turbine capable of mixing material at 1500 rpm/min.
All the injection pumps are fitted as standard with a gauge, gauge protector and button strip L=10 m. Quick joints, litre-counters, plastic accessories, grouting tubes of various lengths, syringe and the Saunders flow closing valve are considered to be accessories.

T 500 grouting pump

Characteristics	***T500 model***	***T400 model***
Weight (Kg.)	*900*	*900*
Dimensions (mm.)	*1900x1500x1900 mm*	*1900x1500x1900 mm*
Mixer capacity (litres)	*190 litres*	*190 litres*
Mixing time (sec.)	*40"*	*40"*
Agitator capacity (litres)	*200 litres*	*200 litres*
Max. grouting pressure (bar.)	*10-20 bar.*	*10-20 bar.*
Max. grouting capacity	*25-40 litres/minute*	*15-25 litres/minute*
Agitator power (KW)	*10 KW*	*10 KW*
Pump power (KW)	*7.5 KW*	*7.5 KW*

Subject to modification *Further data is available on request*

Saunders valves are membrane closing valves recommended for intercepting mud and cement mixes. They are self-cleaning and, if cleaned frequently they do not become encrusted. The litre counter, considered as an accessory is a simple mechanical, turbine fluid measuring device; it is made of plastic and is applied on client's request. All the pumps have button strip control, they are equipped with a 10 metre long cable, but extensions up to 50 m. can be requested. The extension for the button strip is necessary in all those cases where the operator has to control the machine from a distance, supervising the injection zone.

DD5001 gauge protector with gauge

***DD5001** gauge protector for T500 pumps. The device allows a proper protection of the gauge against the grouting mix. This device is made of two parts separated by a membrane that ensures pressure transmission to the valve via oil. When the mix depresses the membrane transmits pressure to the oil that in its turn transmits it to the gauge.*

The gauge protector can be supplied with a bronze quick joint that facilitates its insertion into pressurised hoses, its removal and washing.

It is essential to wash the device correctly for it to operate properly.

I is provided with a lateral hole for washing the device where it comes into contact with the cement mix; a water pipe can be attached to this joint.

*The **DD7169-B** rubber gasket allows to divide the two mix-oil parts of the gauge protector.*

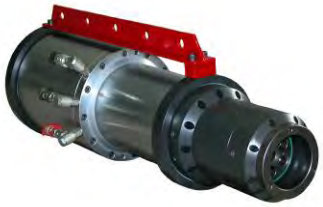
DD5001 gauge protector

Saunders valve

The 1” Saunders valves are the only element that guarantees a safe fluid interception. Closing takes place via a rubber gasket that guarantees a self-cleaning effect of the seat.

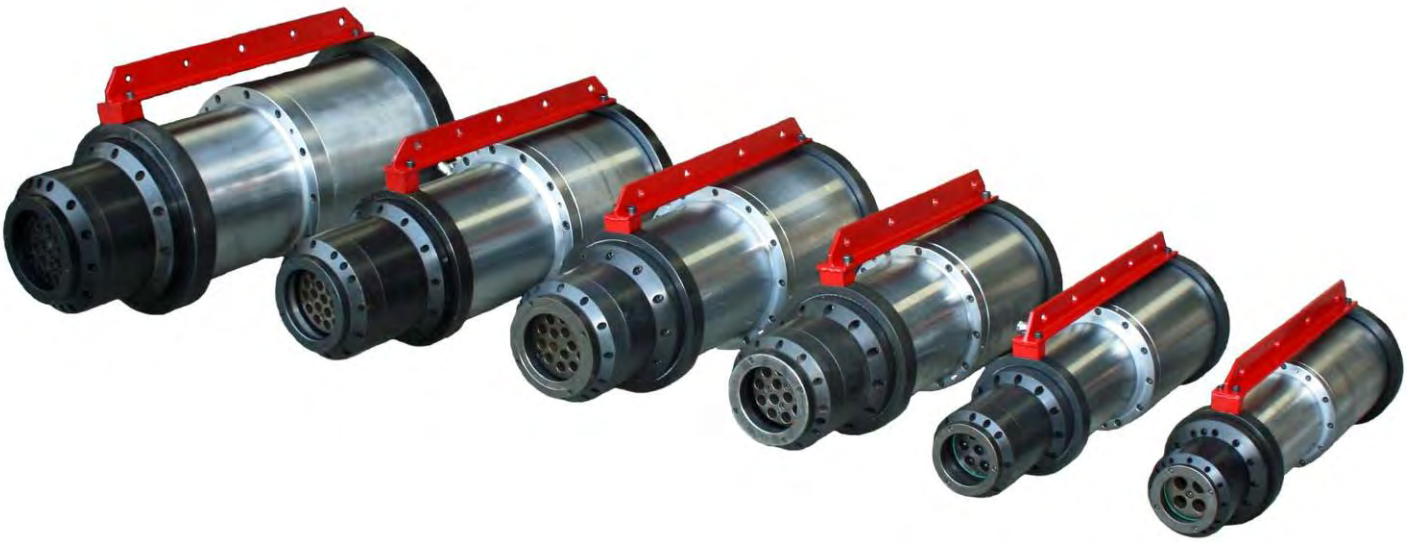
DD7169-B rubber gasket

32.27 - "M" tensioning jack



(Tensioning of TTM multi-strand anchorages)

The "M" series of jacks is available in nine models which differ according to use characteristics. They are provided with an automatic locking circuit and 10 metre long flexible tubes; they are also equipped with a device rotating on an axis, restricted tensioning extension, low operating pressure.
The jacks are equipped with a metal support, designed in particular to achieve the required inclinations during tensioning operations.
The support is integral with two bearings which enable the jack to turn on its axis, facilitating insertion of the strands protruding from the head. The restricted tensioning extension, the rotation of the jack on its axis and the support allow quick operations and a limited effort during handling.



M series jacks

Characteristics	***U.M.***	***M 1600 KN***	***M 1800 KN***	***M 3000 KN***	***M 3600 KN***	***M 4800 KN***
Capacity	*KN*	*1600*	*1800*	*3000*	*3600*	*4800*
Strand max. capacity	*No.*	*1-4*	*4-7*	*7-12*	*12-15*	*15-19*
Stroke	*mm*	*250*	*250*	*250*	*250*	*250*
Weight	*Kg*	*180*	*210*	*280*	*390*	*490*
Stressing section	*cm^2*	*155,51*	*302,20*	*424,49*	*564,21*	*725,71*
Max. stressing pressure	*bar*	*700*	*700*	*700*	*700*	*700*
Max. return pressure	*bar*	*250*	*250*	*250*	*250*	*250*
Max. locking pressure	*bar*	*250*	*250*	*250*	*250*	*250*
Tensioning extension	*mm*	*400*	*400*	*400*	*450*	*500*
Max. diameter	*Mm*	*290*	*330*	*400*	*470*	*520*
Length	*mm*	*950*	*1,050*	*1,000*	*1,150*	*1,150*

Subject to modification *Further data is available on request*

All the jacks in the M series are supplied complete with internal parts and accessories

M1600KN-4 jack

M1800KN-7 jack

M4800KN-19 jack

for tensioning.
The jacks in the M series are classified according to types, ex. ***M6800KN*** *and the inside, if different from standard, indicates* ***M6800KN-22*** *(22 strands)*
The jacks are powered by three tubes which guarantee the following functions:

- stressing,
- return,
- locking,

All the jacks require a comb for correct use to ease the insertion of the jack on the cable.

27 strand comb

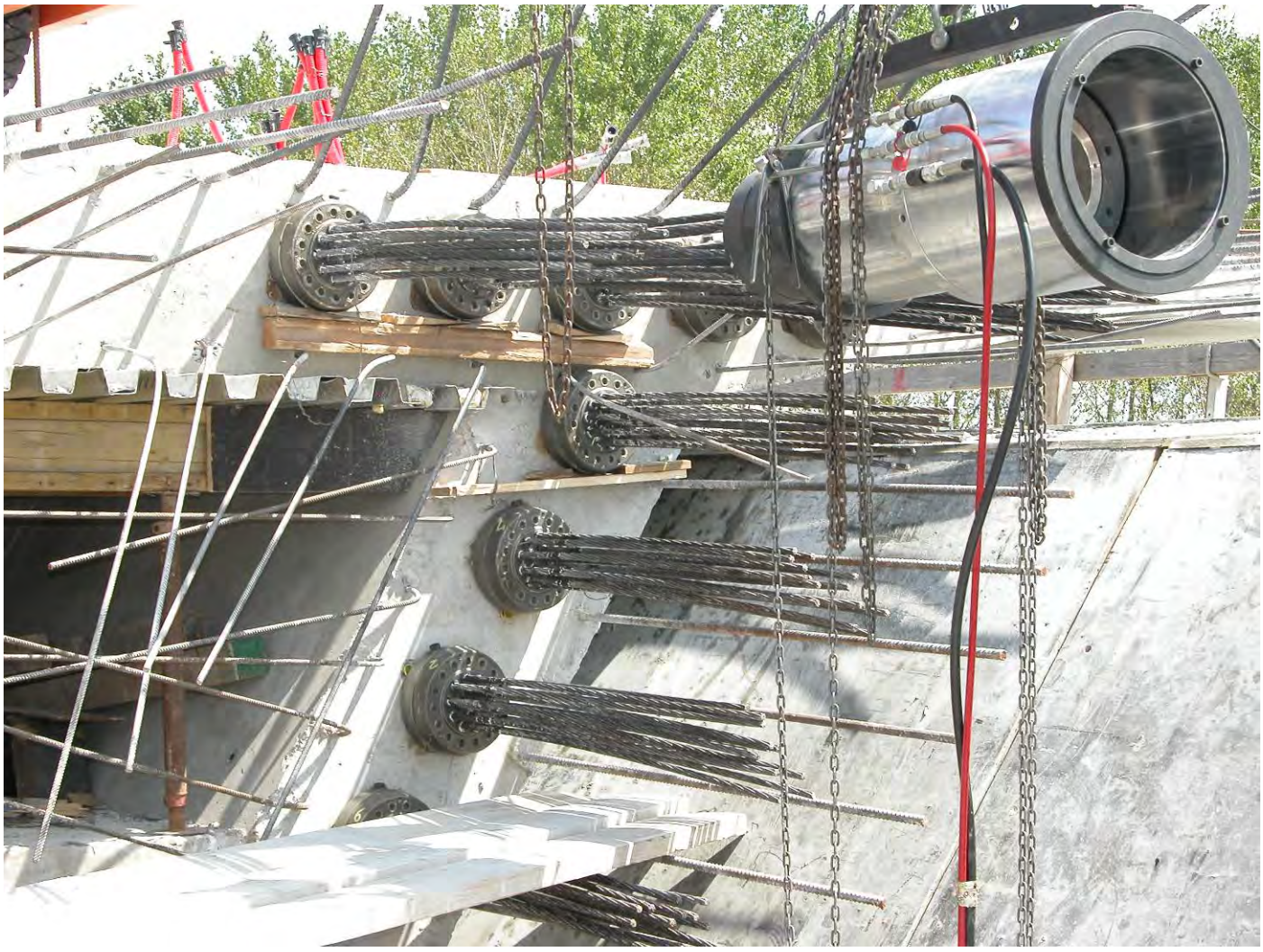
For tensioning of active anchorages, all the jacks require a belt that allows the jack to rest correctly against the anchorage.
Only on G joints does the jack rest directly on the steel plate.
The main characteristics of the M series jacks are:

- *350° rotation on an axis,*
- *reduced grip extension,*
- *automatic locking by means of a hydraulic circuit,*
- *small dimensions,*
- *front grip,*
- *easy to manoeuvre,*
- *maintenance friendly,*
- *easy inspection/cleaning of the engagement wedges,*

The jacks are identified by a serial number and equipped with certificate of calibration upon user's request.

M6800KN-27 jack

M3000KN-12 jack



*The **"DD"** series of jacks is available in four models which differ according to use characteristics. They are equipped with 10 m long flexible tubes and spanners of different sizes for all the types of bars from 26.5mm to 50mm. They are set up for automatic tightening. When the special spanner is inserted in the jack, the nut can be tightened keeping the bar under tension. This avoids the use of seatings and manual tightening operations.*
***"DD"** jacks have two robust handles for easy handling. The jacks operate with all the pumps with the following characteristics:*

- *Working pressure of 550 bar,*
- *Switch-over oil hydraulic circuit, flow and return (with return discharge).*

DD2000KN jack

The equipment is supplied with operating instructions and CE marking, it is identified by a part number and a type of construction for each component.
DD jacks are supplied with the following components:

- *Tensioning cylinder,*
- *10 m hydraulic extensions,*
- *Additional spanners for nuts associated with the bar capacity,*
- *Nut for nut pretightening,*
- *Connection sleeve.*

Tightening is by way of chain transmission (inside the jack) driven by a special lever.
The lever is supplied with a special device that permits both nut unscrewing and screwing. the chain connects the gears that allow the tightening of the nut; the assembly is protected by a robust casing.

32.29 - Characteristics of the "DD" jacks

(Jacks for tensioning bars with tightening)

DD1200KN jack

Characteristics	***U.M.***	***DD700KN***	***DD1200KN***	***DD2000KN***	***DD2600KN***
Capacity	*KN*	*700*	*1,200*	*2,000*	*2,600*
Stroke	*mm*	*50*	*50*	*50*	*50*
Weight	*Kg*	*42*	*54*	*95*	*135*
Stressing section	*cm^2*	*132.47*	*235.5*	*439.60*	*521.5*
Max. stressing pressure	*bar*	*550*	*550*	*550*	*550*
Max. return pressure	*bar*	*100*	*100*	*100*	*100*
Tensioning extension	*mm.*				
Max. diameter	*mm.*				
Length	*mm.*				

Subject to modification *Further data is available on request*

32.30 - "DX" series tensioning jacks

(Jacks for tensioning bars without tightening)

DX700KN jack

Characteristics	***U.M.***	***DX700KN***	***DX1200KN***	***DX2000KN***	***DX2600KN***
Capacity	*KN*	*700*	*1,200*	*2,000*	*2,600*
Stroke	*mm*	*50*	*50*	*50*	*50*
Weight	*Kg*	*35*	*43*	*68*	*95*
Stressing section	*cm^2*	*132.47*	*235.5*	*439.60*	*521.5*
Max. stressing pressure	*bar*	*550*	*550*	*550*	*550*
Max. return pressure	*bar*	*100*	*100*	*100*	*100*
Tensioning extension	*mm.*	*150*	*150*	*150*	*150*
Max. diameter	*mm.*	*200*	*270*	*360*	*430*
Length	*mm.*	*230*	*300*	*370*	*490*

Subject to modification *Further data is available on request*

DX jacks are supplied with the following components:

- *Tensioning cylinder,*
- *10 m hydraulic extensions,*

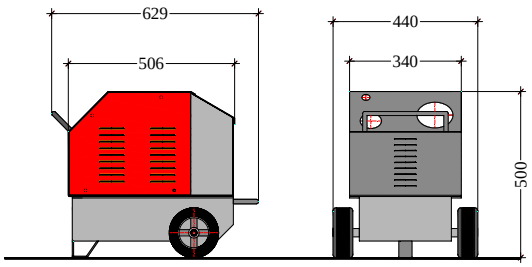
DX jacks are supplied without mechanical tightening and are used for tensioning on dressed stones where the nut is manually screwed through its entire minimum length.

Bar tensioning with DD2000KN jack

Bar tensioning of diam. 40 mm with DD2000KN jack and TTM250-A pump

33.1 - TTM-A hydraulic pumps

33.1.1 - TTM 250-A hydraulic pump

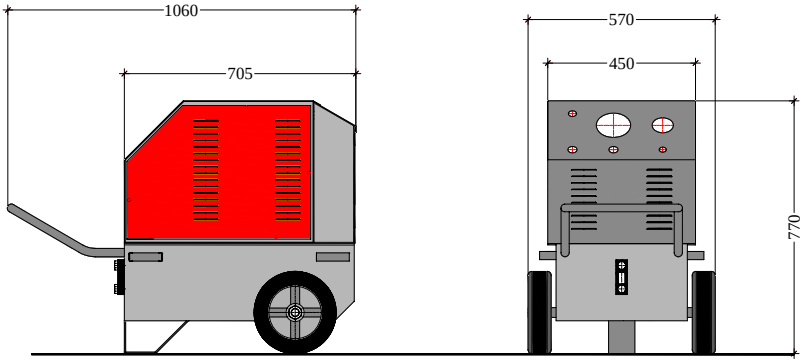


TTM250-A pump

Measures in mm.

Weight: 85 Kg./piece

33.1.2 - TTM 450-A hydraulic pump

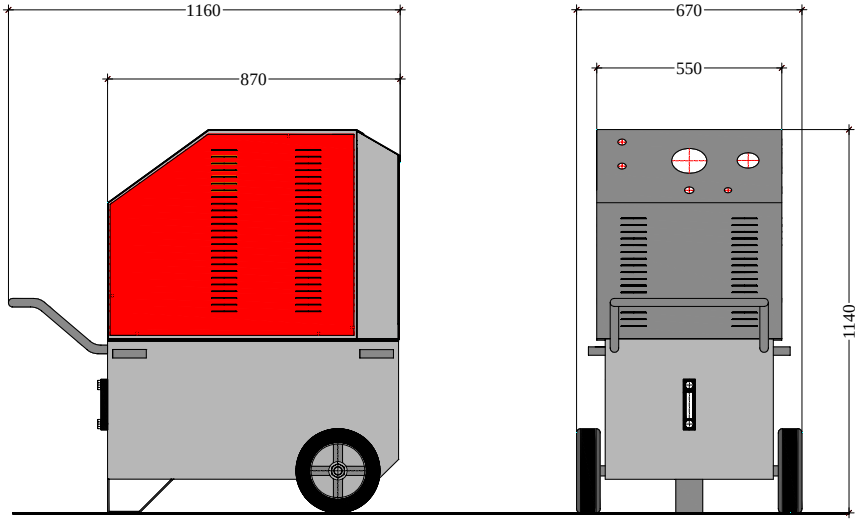


TTM450-A pump

Measures in mm.

Weight: 200 Kg./piece

33.1.3 - TTM 550-A hydraulic pump



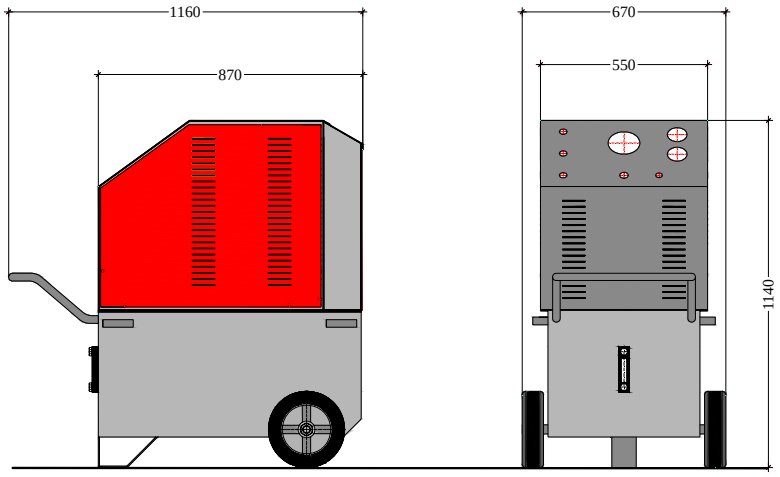
TTM550-A pump

Measures in mm.

Weight: 290 Kg./piece

33.2 - TTM-E hydraulic pumps

33.2.1 - TTM 1000-E pump

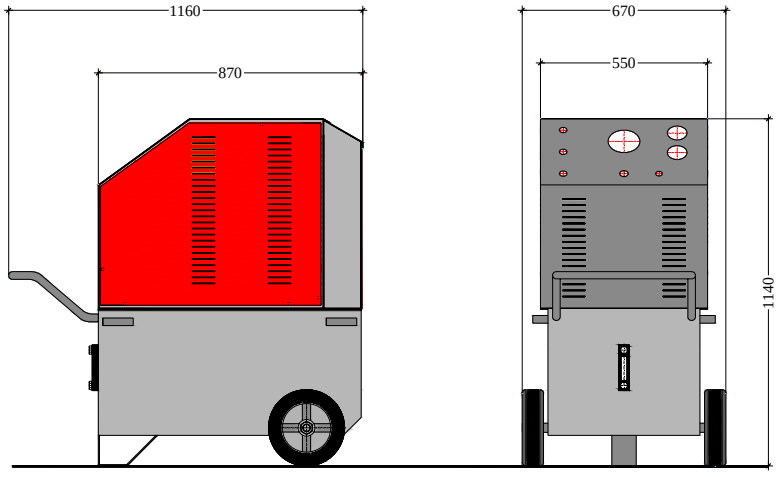


Measures in mm.

TTM1000-E hydraulic pump

Weight: 380 Kg./piece

33.2.1 - TTM 2000-E pump



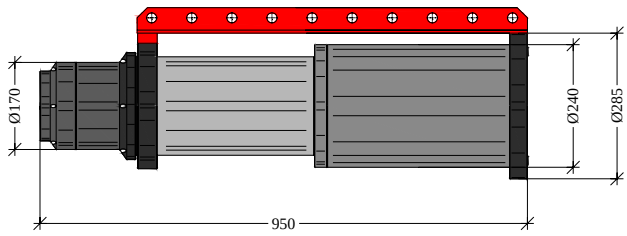
Measures in mm.

TTM2000-E hydraulic pump

Weight: 470 Kg./piece

33.3 - M series jacks

33.3.1 – M1600KN jack

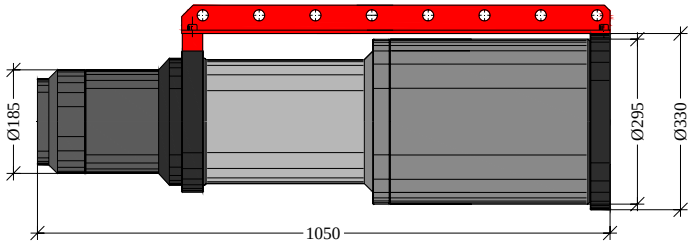


Measures in mm.

M1600KN jack

Weight: 180Kg./piece
Stressing section: 155.51 cm^2

33.3.2– M1800KN jack

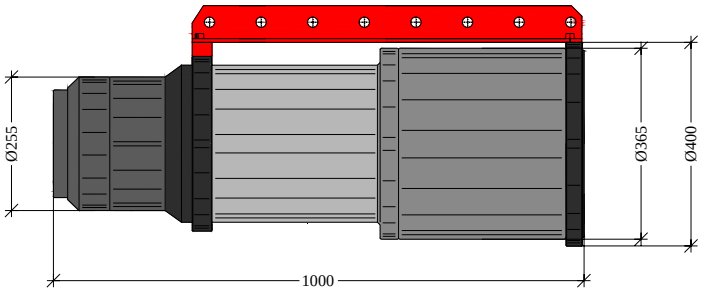


Measures in mm.

M1800KN jack

Weight: 210 Kg./piece
Stressing section: 302.20 cm^2

33.3.3 – M3000KN jack

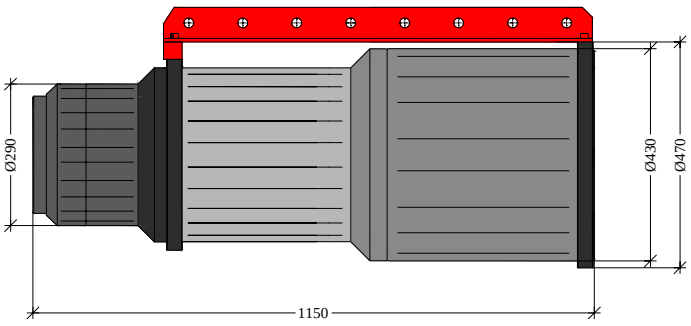


Measures in mm.

M3000KN jack

Weight: 280 Kg./piece
Stressing section: 424.49 cm^2

33.3.4 – M3600KN jack

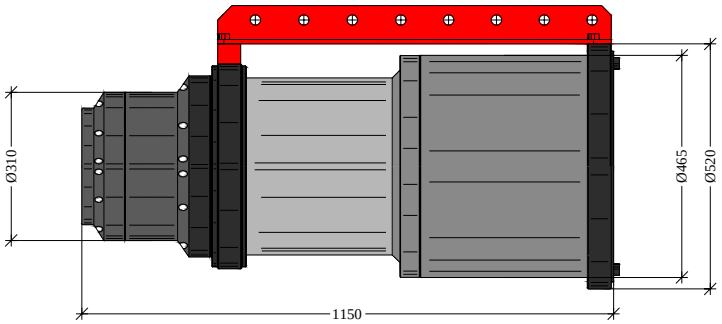


Measures in mm.

M3600KN jack

Weight: 390 Kg./piece
Stressing section: 564.21 cm^2

33.3.5 – M4800KN jack

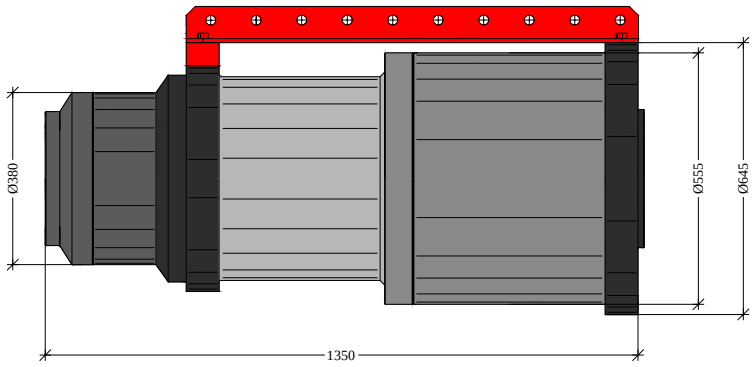


Measures in mm.

M4800KN jack

Weight: 490 Kg./piece
Stressing section: 725.71 cm^2

33.3.6 – M6800KN jack

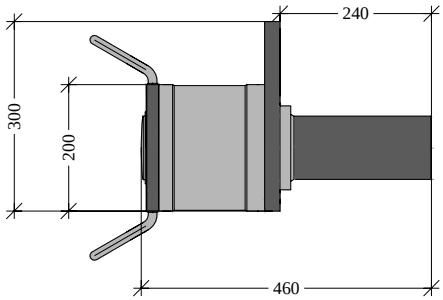


Measures in mm.

M6800KN jack

Weight: 650 Kg./piece
Stressing section: 879.20 cm^2

33.4.1 – DD700KN jack

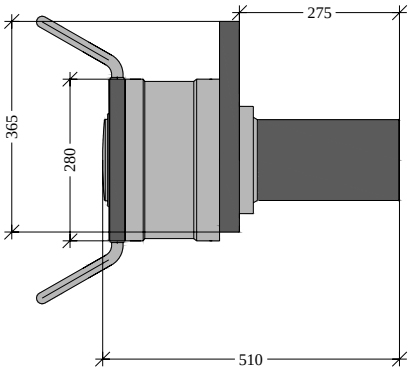


DD700KN jack

Measures in mm.

Weight: 42 Kg./piece
Stressing section: 132.47 cm^2

33.4.2 – DD1200KN jack

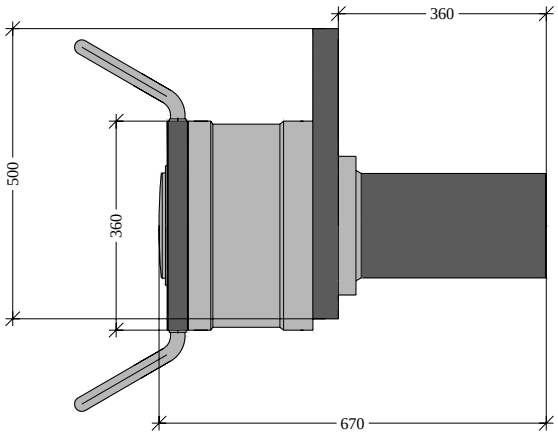


DD1200KN jack

Measures in mm.

Weight: 54 Kg./piece
Stressing section: 235.50 cm^2

33.4.3 – DD2000KN jack

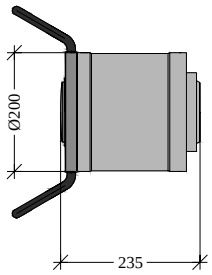


DD2000KN jack

Measures in mm.

Weight: 95 Kg./piece
Stressing section: 439.60 cm^2

33.5.1 – DX700KN jack

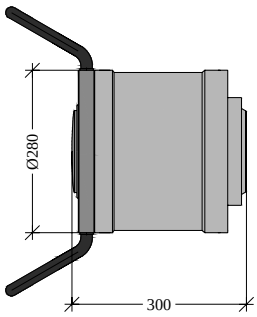


DX700KN jack

Measures in mm.

Weight: 35 Kg./piece
Stressing section: 132.47 cm^2

33.5.2 – DX1200KN jack

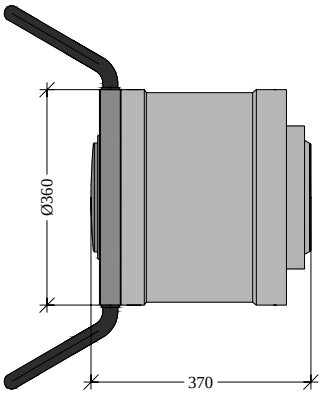


DX1200KN jack

Measures in mm.

Weight: 43 Kg./piece
Stressing section: 235.50 cm^2

33.5.3 – DX2000KN jack

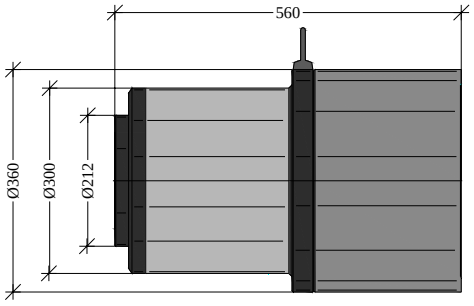


DX2000KN jack

Measures in mm.

Weight: 68 Kg./piece
Stressing section: 439.60 cm^2

33.6.1 – MX3600KN jack

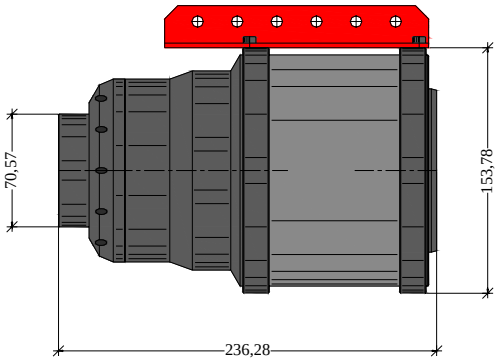


MX3600KN jack

Measures in mm.

Weight: 250 Kg./piece
Stressing section: 424,49 *cm*^{2}

33.6.2 – MC3000KN jack

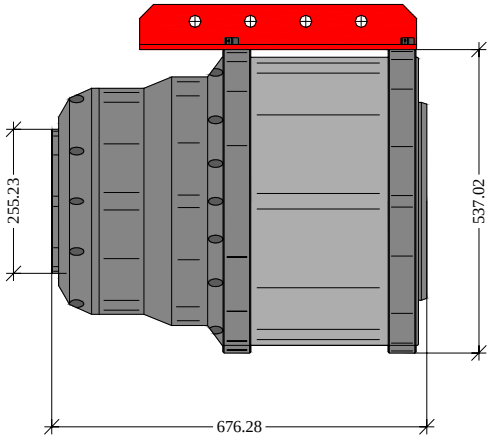


MC3000KN jack

Measures in mm.

Weight: 350Kg./piece
Stressing section: 564,50 *cm*^{2}

33.6.3 – MC4800KN jack

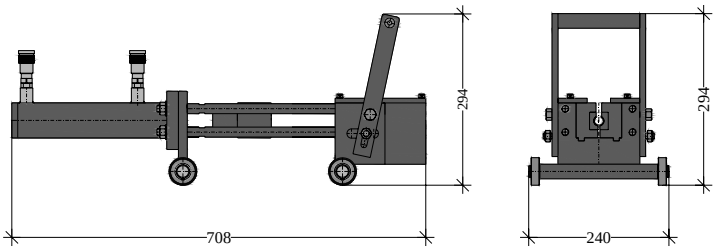


MC4800KN jack

Measures in mm.

Weight: 490Kg./piece
Stressing section: 636.76 *cm*^{2}

33.7.1– S4000 strand breaking jack

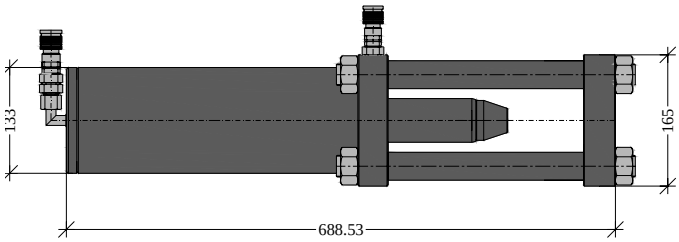


S4000 strand breaking jack

Measures in mm.

Weight: 30 Kg./piece

33.7.2 – B300 locking jack

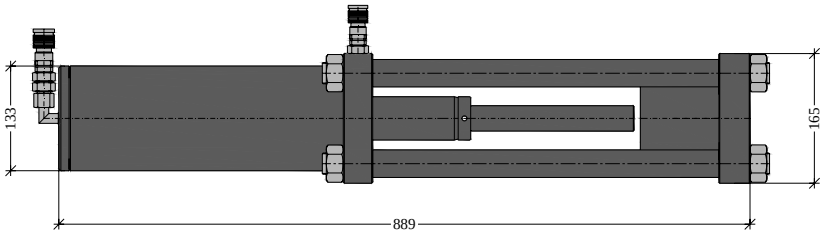


B300 locking jack

Measures in mm.

Weight: 60 Kg./piece

33.7.3 – M300 jack for extruded anchorages

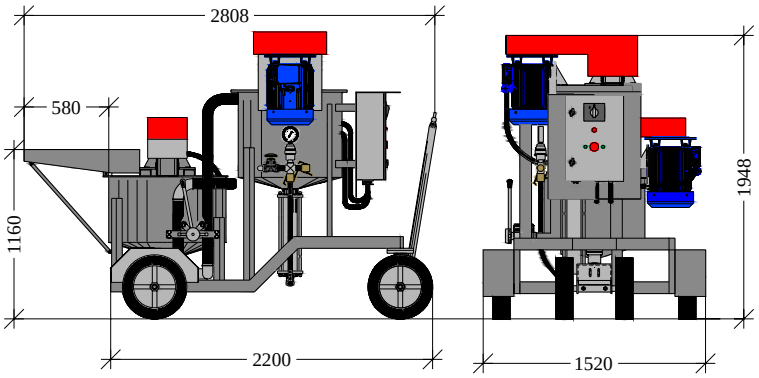


M300 jack for extruded anchorages

Measures in mm.

Weight: 60 Kg./piece

33.8.1 – T500 pump

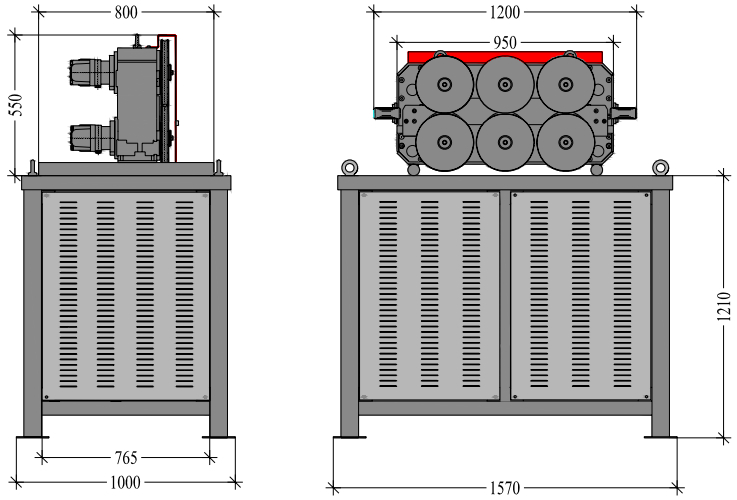


Measures in mm.

T 500 pump

Weight: 930 Kg./piece

33.9.1 – T61 strand forcing machine

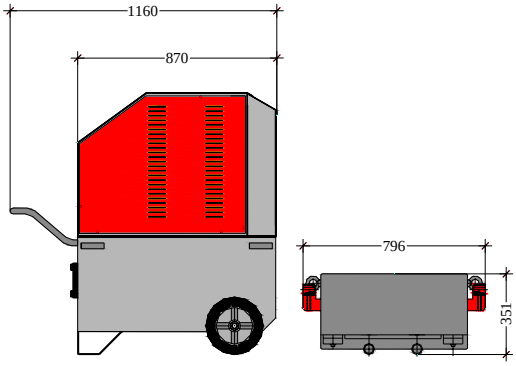


Measures in mm.

T61 strand forcing machine

Pump weight: 490 Kg./piece
Strand forcing machine weight: 160 Kg./piece

33.9.2 – TM S4 strand forcing machine

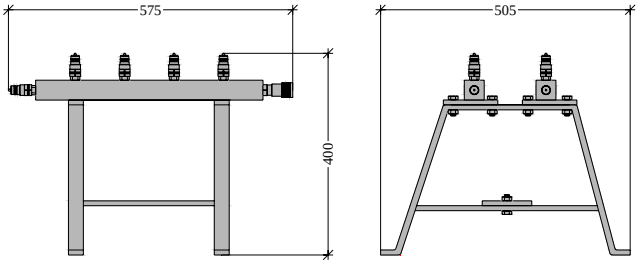


Measures in mm.

TM S4 strand forcing machine

Pump weight: 380 Kg./piece
Strand forcing machine weight: 80 Kg./piece

33.10.1 – DD 04-MF manifold

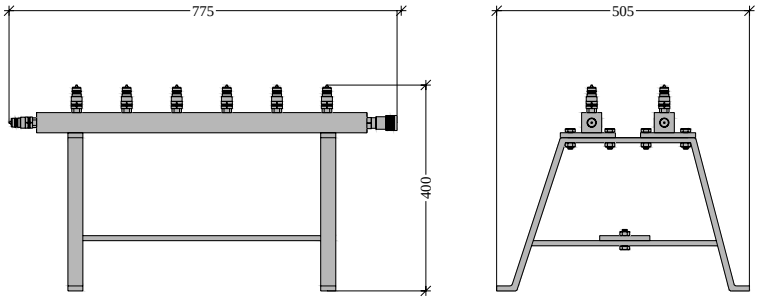


DD 04-MF manifold

Measures in mm.

Weight: 20 Kg./piece

33.10.2 – DD 06-MF manifold

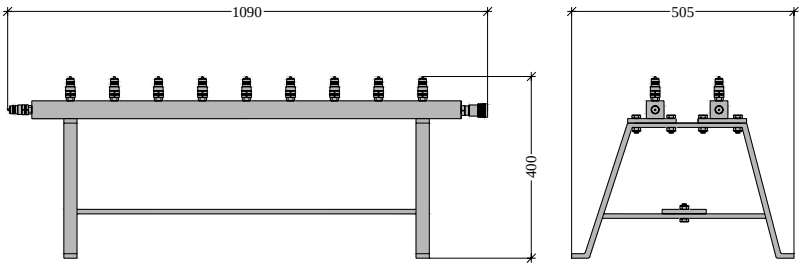


DD 06-MF manifold

Weight: 25 Kg./piece

Measures in mm.

33.10.3 – DD 10-MF manifold

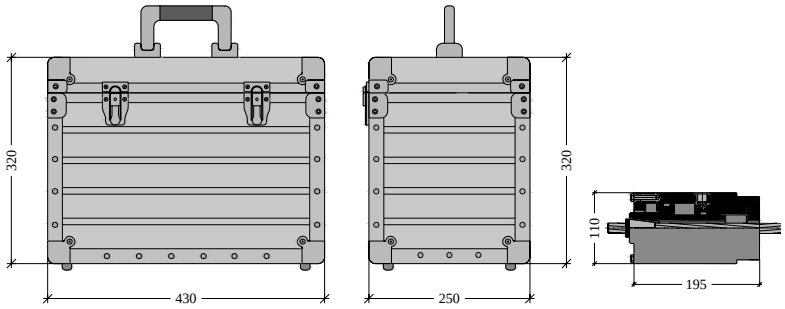


DD 10-MF manifold

Measures in mm.

Weight: 34 Kg./piece

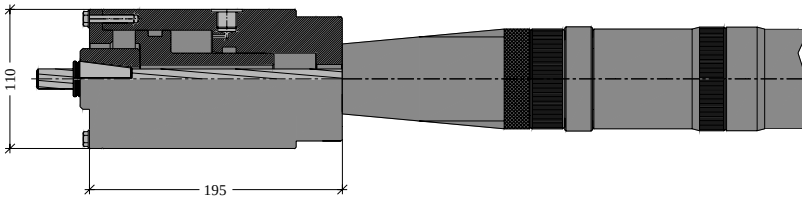
33.11.1 – Complete dynamometer box



Complete dynamometer box

Measures in mm.

33.11.2 – S3000 dynamometer

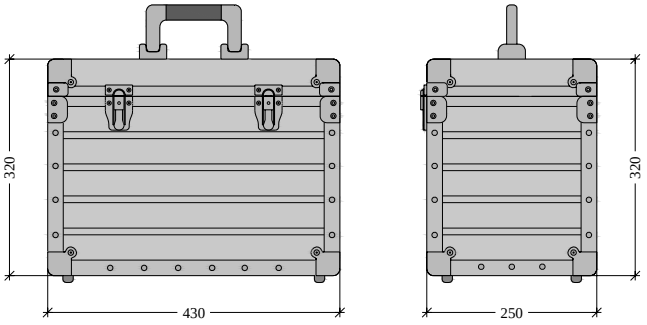


Dynamometer

Measures in mm.

Weight: 8 Kg./piece

33.11.3 – S1000 gauge box

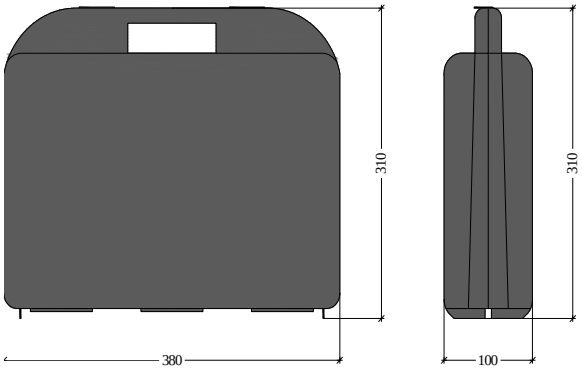


Gauge box

Measures in mm.

Weight: 9.40 Kg./piece

33.11.4 – S900 analogue sample gauge



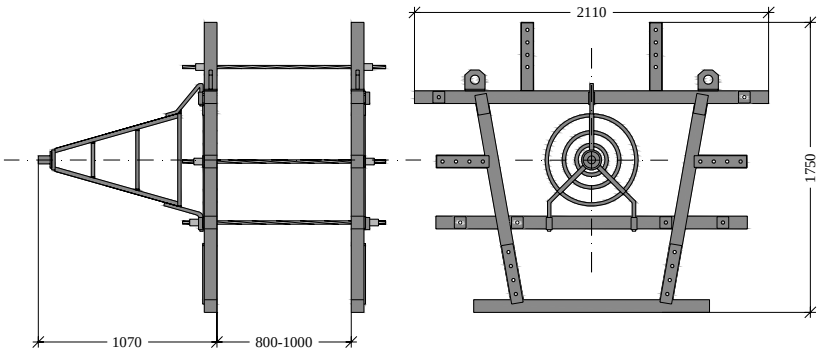
Measures in mm.

Analogue gauge box

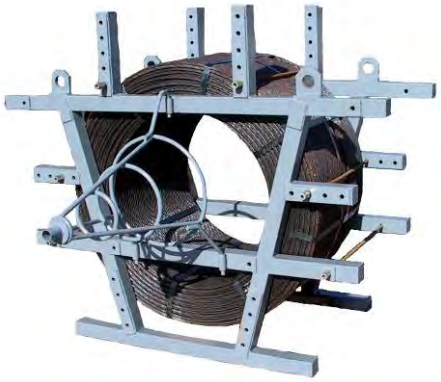
Weight: 2.40 Kg./piece

33.12 – Uncoilers

33.12.1 – B1500 uncoiler



Measures in mm.



B1500 uncoiler

Weight: 180 Kg./piece

34.1.1 – TTM 250KN-40 jack

TTM 250KN-40 jack

Weight: 16.40 Kg./piece
Stressing section: 47.2 cm^2
Length: 350 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 80-100 mm.
Stroke: 40 mm.
Without locking
Type: ***TTM 250KN-40****
**(jack for tensioning short strands)*

34.1.2 – TTM 250KN-60 jack

TTM 250KN-60 jack

Weight: 19.2 Kg./piece
Stressing section: 47.2 cm^2
Length: 640 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 350 mm.
Stroke: 60 mm.
Provided with locking
Type: ***TTM 250KN-60 jack***

34.1.3 – TTM 250KN-100 jack

TTM 250KN-100 jack

Weight: 21.5 Kg./piece
Stressing section: 47.2 cm^2
Length: 740 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 350 mm.
Stroke: 100 mm.
Provided with locking
Type: ***TTM 250KN-100***

34.1.4 – TTM 250KN-200 jack

TTM 250KN-200 jack

Weight: 26 Kg./piece
Stressing section: 47.2 cm^2
Length: 950 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 350 mm.
Stroke: 200 mm.
Provided with locking
Type: ***TTM 250KN-200***

34.1.5 – TTM 250KN-400 jack

TTM 250KN-400 jack

Weight: 35.00 Kg./piece
Stressing section: 47.2 cm^2
Length: 1,350 mm.
Max. diameter: 110 mm.
Max. capacity: 250 KN
Tensioning extension: 300 mm.
Stroke: 400 mm.
Provided with locking
Type: ***TTM 250KN-400****

**(jack for extraction tests to failure)*

34.1.6 – TTM 250KN-M-100 jack

TTM 250KN-M-100 jack

Weight: 21.5 Kg./piece
Stressing section: 47.2 cm^2
Length: 740 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 270 mm.
Stroke: 100 mm.
Provided with locking
Type: ***TTM 250KN-M-100***

34.1.7 – TTM 250KN-M-60 jack

TTM 250KN-M-60 jack

Weight: 19.2 Kg./piece
Stressing section: 47.2 cm^2
Length: 640 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 270 mm.
Stroke: 60 mm.
Provided with locking
Type: ***TTM 250KN-M-60***

34.1.8 – TTM 250KN-C-100 jack

TTM 250KN-C-100 jack

Weight: 18 Kg./piece
Stressing section: 47.2 cm^2
Length: 560 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 90-100 mm.
Stroke: 100 mm.
Without locking
Type: ***TTM 250KN-C-100****

**(jack for tensioning short strands)*

34.1.9 – TTM 250KN-C-60 jack

TTM 250KN-C-60 jack

Weight: 16.40 Kg./piece
Stressing section: 47.2 cm^2
Length: 510 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 90-100 mm.
Stroke: 60 mm.
Without locking
*Type: **TTM 250KN-C-60****
**(jack for tensioning short strands)*

34.1.10 – TTM 250KN-K-100 jack

TTM 250KN-K-100 jack

Weight: 21 Kg./piece
Stressing section: 47.2 cm^2
Length: 1,000 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 650 mm.
Stroke: 100 mm.
Without locking
*Type: **TTM 250KN-K-100***

34.1.11 – TTM 250KN-K-60 jack

TTM 250KN-K-60 jack

Weight: 19 Kg./piece
Stressing section: 47.2 cm^2
Length: 900 mm.
Max. diameter: 100 mm.
Max. capacity: 250 KN
Tensioning extension: 650 mm.
Stroke: 60 mm.
Without locking
*Type: **TTM 250KN-K-60***

33.2 – TTM 300KN jack

34.2.1 – TTM 300KN-M-100 jack

TTM 300KN-M-100 jack

Weight: 24 Kg./piece
Stressing section: 68.80 cm^2
Length: 740 mm.
Max. diameter: 110 mm.
Max. capacity: 300 KN
Tensioning extension: 270 mm.
Stroke: 100 mm.
Provided with locking
*Type: **TTM 300KN-M-100****

(jack for tensioning **T15C compact strands with sect. 165 mm^2)*

34.2.2 – TTM 300KN-100 jack

TTM 300KN-100 jack

Weight: 24 Kg./piece
Stressing section: 68.80 cm^2
Length: 740 mm.
Max. diameter: 110 mm.
Max. capacity: 300 KN
Tensioning extension: 350 mm.
Stroke: 100 mm.
Provided with locking
*Type: **TTM 300KN-100****
(jack for tensioning **T15C compact strands with sect. 165 mm^2)*

34.2.3 – TTM 300KN-200 jack

TTM 300KN-200 jack

Weight: 27.70 Kg./piece
Stressing section: 68.80 cm^2
Length: 950 mm.
Max. diameter: 110 mm.
Max. capacity: 300 KN
Tensioning extension: 350 mm.
Stroke: 350 mm.
Provided with locking
*Type: **TTM 300KN-200****

(jack for tensioning **T15C compact strands with sect. 165 mm^2)*

34.2.4 – TTM 300KN-K-100 jack

TTM 300KN-K-100 jack

Weight: 26 Kg./piece
Stressing section: 68.80 cm^2
Length: 1,000 mm.
Max. diameter: 100 mm.
Max. capacity: 300 KN
Tensioning extension: 650 mm.
Stroke: 100 mm.
Without locking
*Type: **TTM 300KN-K-60***

34.3 – TTM 280KN jack

34.3.1 – TTM 280KN-200 jack

TTM 280KN-200 jack

Weight: 28 Kg./piece
Stressing section: 51.30 cm^2
Length: 270x500x220 mm.
*Max. diameter: ******
Max. capacity: 280 KN
Tensioning extension: 300 mm.
Stroke: 200 mm.
Provided with locking
*Type: **TTM 280KN-200***
**(jack for tensioning through strands)*

34.4.1 – M1600 KN jack

M1600KN jack

Capacity: 1600 KN
Strand max. capacity: 1 - 4
Stroke: 250 mm.
Weight: 180 Kg./piece
Stressing section: 155.51 cm^2
Max. stressing pressure: 700 bar
Max. return pressure: 250 bar
Max. locking pressure: 250 bar
Tensioning extension: 400 mm.
Max. diameter: 285 mm.
Length: 950 mm.

34.4.2 – M1800 KN jack

M1800KN jack

Capacity: 1800 KN
Strand max. capacity: 7
Stroke: 250 mm.
Weight: 210 Kg./piece
Stressing section: 302,20 cm^2
Max. stressing pressure: 700 bar
Max. return pressure: 250 bar
Max. locking pressure: 250 bar
Tensioning extension: 400 mm.
Max. diameter: 330 mm.
Length: 1,050 mm.

34.4.3 – M3000 KN jack

M3000KN jack

Capacity: 3000 KN
Strand max. capacity: 9 - 12
Stroke: 250 mm.
Weight: 280 Kg./piece
Stressing section: 424.49 cm^2
Max. stressing pressure: 700 bar
Max. return pressure: 250 bar
Max. locking pressure: 250 bar
Tensioning extension: 400 mm.
Max. diameter: 400 mm.
Length: 1,000 mm.

34.4.4 – M3600 KN jack

M3600KN jack

Capacity: 3600 KN
Strand max. capacity: 12-15
Stroke: 250 mm.
Weight: 390 Kg./piece
Stressing section: 564.21 cm^2
Max. stressing pressure: 700 bar
Max. return pressure: 250 bar
Max. locking pressure: 250 bar
Tensioning extension: 450 mm.
Max. diameter: 470 mm.
Length: 1,150 mm.

34.4.5 – M4800 KN jack

M4800KN jack

Capacity: 4800 KN
Strand max. capacity: 19
Stroke: 250 mm.
Weight: 490 Kg./piece
Stressing section: 725.71 cm^2
Max. stressing pressure: 700 bar
Max. return pressure: 250 bar
Max. locking pressure: 250 bar
Tensioning extension: 500 mm.
Max. diameter: 520 mm.
Length: 1,150 mm.

34.4.6 – M6800 KN jack

M6800KN jack

Capacity: 6800 KN
Strand max. capacity: 22 - 27
Stroke: 250 mm.
Weight: 650 Kg./piece
Stressing section: 879.20 cm^2
Max. stressing pressure: 700 bar
Max. return pressure: 250 bar
Max. locking pressure: 250 bar
Tensioning extension: 600 mm.
Max. diameter: 650 mm.
Length: 1,350 mm.

34.5.1 – DD700 KN jack

DD700KN jack

Capacity: 700 KN
Stroke: 50 mm.
Weight: 42 Kg./piece
Stressing section: 132.47 cm^2
Max. stressing pressure: 550 bar
Max. return pressure: 100 bar
Tensioning extension: 100 mm.
Max. diameter: 200 mm.
Length: 460 mm.

34.5.2 – DD1200 KN jack

DD1200KN jack

Capacity: 1200 KN
Stroke: 50 mm.
Weight: 54 Kg./piece
Stressing section: 235.50 cm^2
Max. stressing pressure: 550 bar
Max. return pressure: 100 bar
Tensioning extension: 120 mm.
Max. diameter: 280 mm.
Length: 510 mm.

34.5.3 – DD2000 KN jack

DD2000KN jack

Capacity: 2000 KN
Stroke: 50 mm.
Weight: 95 Kg./piece
Stressing section: 439.60 cm^2
Max. stressing pressure: 550 bar
Max. return pressure: 100 bar
Tensioning extension: 150 mm.
Max. diameter: 360 mm.
Length: 670 mm.

34.6.1 – DX700 KN jack

DX700KN jack

Capacity: 700 KN
Stroke: 50 mm.
Weight: 35 Kg./piece
Stressing section: 132.47 cm^2
Max. stressing pressure: 550 bar
Max. return pressure: 100 bar
Tensioning extension: 150 mm.
Max. diameter: 200 mm.
Length: 235 mm.

34.6.2 – DX1200 KN jack

DX1200KN jack

Capacity: 1200 KN
Stroke: 50 mm.
Weight: 43 Kg./piece
Stressing section: 236.50 cm^2
Max. stressing pressure: 550 bar
Max. return pressure: 100 bar
Tensioning extension: 150 mm.
Max. diameter: 280 mm.
Length: 300 mm.

34.6.3 – DX2000 KN jack

DX2000KN jack

Capacity: 2000 KN
Stroke: 50 mm.
Weight: 68 Kg./piece
Stressing section: 439.60 cm^2
Max. stressing pressure: 550 bar
Max. return pressure: 100 bar
Tensioning extension: 150 mm.
Max. diameter: 360 mm.
Length: 360 mm.

34.7 - Tensioning jacks for special M anchorages

34.7.1 – MX 3600 KN jack

MX3600KN jack

Capacity: 3600 KN
Stroke: 100 mm.
Weight: 250 Kg./piece
Stressing section: 424.49 cm^2
Max. stressing pressure: 700 bar
Max. return pressure: 250 bar
Tensioning extension: 500 mm.
Max. diameter: 360 mm.
Length: 560 mm.

34.7.2 – MC 3000 KN jack

MC3000KN jack

Capacity: 3000 KN
Stroke: 100 mm.
Weight: 350 Kg./piece
Stressing section: 564.50 cm^2
Max. stressing pressure: 700 bar
Max. return pressure: 250 bar
Max. locking pressure: 250 bar
Tensioning extension: 450 mm.
Max. diameter: 153.78 mm.
Length: 236.28 mm.

34.7.3 – MC4800 KN jack

MC4800KN jack

Capacity: 4800 KN
Stroke:100 mm.
Weight: 490 Kg./piece
Stressing section: 636.76 cm2
Max. stressing pressure: 700 bar
Max. return pressure: 250 bar
Max. locking pressure: 250 bar
Tensioning extension: 400 mm.
Max. diameter: 536.02 mm.
Length: 676.28 mm.

34.8.1 – S4000 strand breaking jack

S4000 strand breaking jack

Capacity: 300 KN
Stroke: 125 mm.
Weight: 30 Kg./piece
Pushing section: 19.63 cm^2
Max. pushing pressure: 450 bar
Max. return pressure: 100 bar
Max. height: 293 mm.
Max. length: 240 mm.
Length: 708 mm.

34.8.2 – B300 locking jack

B300 locking jack

Capacity: 300 KN
Stroke: 200 mm.
Weight: 60 Kg./piece
Pushing section: 78.53 cm^2
Max. pushing pressure: 100 bar
Max. return pressure: 100 bar
Max. height: 165 mm.
Max. length: 210 mm.
Length: 688.33 mm.

34.8.3 – M300 jack for extruded anchorages

M300 jack for extruded anchorages

Capacity: 300 KN
Stroke: 200 mm.
Weight: 60 Kg./piece
Pushing section: 78.53 cm^2
Max. pushing pressure: 100 bar
Max. return pressure: 100 bar
Max. height: 165 mm.
Max. length: 210 mm.
Length: 889 mm.

34.9.1 – TTM 250-A hydraulic pump

TTM250-A pump

Installed power capacity: 1.5 KW
Power supply: 3P+T 380 Volt. 16 Amp
Weight: 85 Kg./piece
Control: with button strip
Functions: stressing-locking-return
Max. stressing pressure: 550 bar.
Max. locking pressure: 150 bar.
Max. return pressure: 150 bar.
Dimensions: 600x440x630 mm
Hydraulic tubes: two

34.9.2 – TTM 450-A hydraulic pump

TTM450-A pump

Installed power capacity: 4.5 KW
Power supply: 3P+T 380 Volt. 16 Amp
Weight: 200 Kg./piece
Control: with button strip
Functions: stressing-locking-return
Max. stressing pressure: 550 bar.
Max. locking pressure: 150 bar.
Max. return pressure: 150 bar.
Dimensions: 1050x560x910 mm
Hydraulic tubes: two

34.9.3 – TTM 550-A hydraulic pump

TTM550-A pump

Installed power capacity: 4.5 KW
Power supply: 3P+T 380 Volt. 32 Amp
Weight: 500-600 Kg./piece
Control: with button strip
Functions: stressing-locking-return
Max. stressing pressure: 550 bar.
Max. locking pressure: 150 bar.
Max. return pressure: 150 bar.
Dimensions: 1400x730x1400 mm.
Hydraulic tubes: two

34.10.1 – TTM 1000-E pump

TTM1000-E hydraulic pump

Installed power capacity: 10 KW
Power supply: 3P+T 380 Volt. 32 Amp
Weight: 380 Kg./piece
Control: with button strip
Functions: stressing-locking-return
Max. stressing pressure: 550 bar.
Max. locking pressure: 150 bar.
Max. return pressure: 150 bar.
Dimensions: 1400x730x1400 mm
Hydraulic tubes: three

34.10.2 – TTM 2000-E pump

TTM2000-E hydraulic pump

Installed power capacity: 22 KW
Power supply: 3P+T 380 Volt. 32 Amp
Weight: 470 Kg./piece
Control: with button strip
Functions: stressing-locking-return
Max. stressing pressure: 550 bar.
Max. locking pressure: 150 bar.
Max. return pressure: 150 bar.
Dimensions: 1400x730x1400 mm
Hydraulic tubes: three

34.10.3 – TTM 650-E pump

TTM650-E hydraulic pump

Installed power capacity: 7.5 KW
Power supply: 3P+T 380 Volt. 32 Amp
Weight: 290 Kg./piece
Control: with button strip
Functions: stressing-locking-return
Max. stressing pressure: 550 bar.
Max. locking pressure: 150 bar.
Max. return pressure: 150 bar.
Dimensions: 1500x900x700 mm
Hydraulic tubes: three

34.11.1 – T500 pump

T 500 pump

Installed power capacity: 20 KW
Power supply: 3P+T 380 Volt. 63 Amp
Weight: 930 Kg./piece
Control: with button strip
Functions: pump-turbo mixer
Max. grouting pressure: 20 bar.
Max. locking pressure: 150 bar.
Max. return pressure: 150 bar.
Width: 1,930 mm.
Length: 1,930 mm.
Height: 1,450 mm.
Mixer capacity: 190 litres
Agitator/turbo capacity: 200 litres

34.12 – Strand forcing machines

34.12.1 – T61 strand forcing machine

T61 strand forcing machine

Installed power: 22 KW
Pump weight: 490 Kg./piece
Strand forcing machine weight: 160 Kg./piece
Control: with button strips
Drive: proportional control
Max. speed: 10 m/sec.
Max. pushing pressure: 120 bar
Starting torque: 280 Nm
Average insertion: 350 m.
*Max. insertion: 500 mm.**
Hydraulic pump dimensions: 1600x1000x1300 mm.
Head dimensions: 800x1200x550 mm.
Hydraulic pump type: T61
Strand forcing machine type: T61

** depending on the trend of the strand seating cable*

34.12.2 – TM S4 strand forcing machine

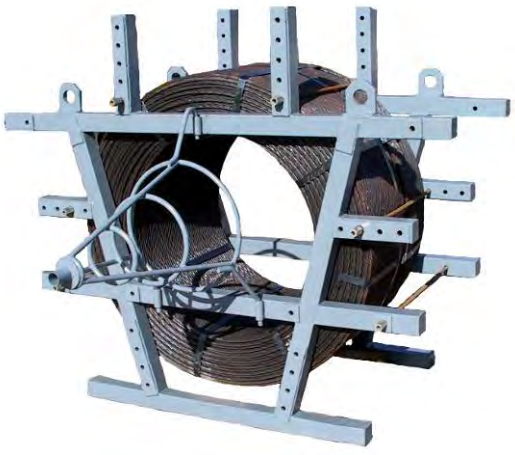
TM S4 strand forcing machine

Installed power: 7.5 KW
Pump weight: 380 Kg./piece
Strand forcing machine weight: 80 Kg./piece
Control: with button strips
Drive: on/off control
Max. speed: 3 m/sec.
Max. pushing pressure: 230 bar
Starting torque: 175 Nm
Average insertion: 80 m.
*Max. insertion: 120 mm.**
Hydraulic pump dimensions:1400x730x1400 mm.
Head dimensions: 950x410x530 mm.
Hydraulic pump type: TM
Strand forcing machine type: S4

** depending on the trend of the strand seating cable*

34.13 – Uncoilers

34.13.1 – B1500 uncoiler



B1500 uncoiler

Capacity: 1,000 Kg.
Loaded weight: 220 Kg
Equipment weight: 180 Kg./piece
Dimensions: 2500x2500 mm

34.14.1 – DD 04-MF manifold

DD 04-MF manifold

Useful positions: 4 outputs + gauge fix.
Weight: 20 Kg./piece
Dimensions: 600x500x410 mm
Max. operating pressure: 450-500 bar.

34.14.2 – DD 06-MF manifold

DD 06-MF manifold

Useful positions: 6 outputs + gauge fix.
Weight: 25 Kg./piece
Dimensions: 800x500x410 mm
Max. operating pressure: 450-500 bar.

34.14.3 – DD 10-MF manifold

DD 10-MF manifold

Useful positions: 10 outputs + gauge fix.
Weight: 34 Kg./piece
Dimensions: 600x500x410 mm
Max. operating pressure: 450-500 bar.

34.15.1 – S 1000 gauge box

Gauge box

Capacity: 999 bar.
Weight: 9.40 Kg./piece
Power supply: 3P+T 220 Volt 16 Amp
Max. pressure: 900 bar
Dimensions: 320x430x250 mm.

34.15.2 – S900 analogue sample gauge

S900 analogue sample gauge

Weight: 2.4 Kg./piece
Max pressure: 1.000 bar
Accuracy class: +/- 0.25 VFS
Dimensions: 320x160x50 mm.

34.15.3 – Complete dynamometer box

Complete dynamometer box

Dynamometer hydraulic transducer

Capacity: 350 KN
Weight: 8 Kg./piece
Useful section: 34.36 cm^2
Max. pressure: 900 bar
Reading with transducer: 4-20 mA
Reading: 1 bar
Length: 210 mm.
Diameter: 110 mm.

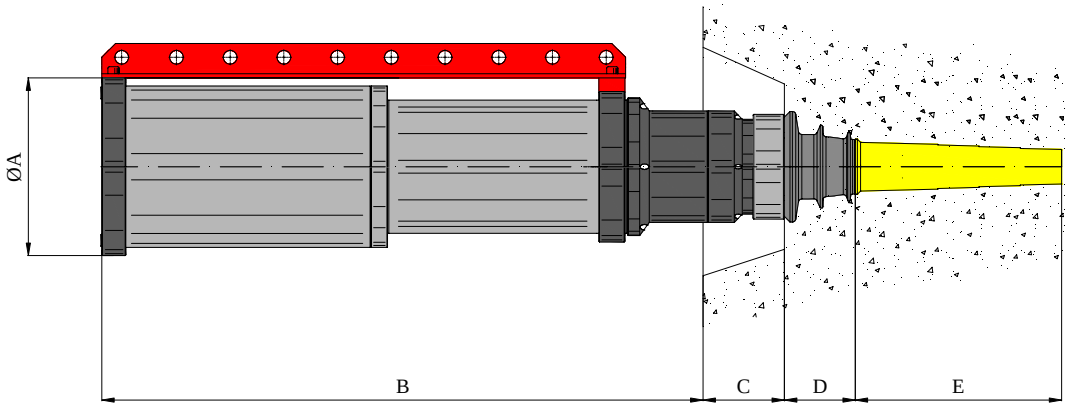
Dynamometer box

Capacity: 999 bar.
Weight: 9.40 Kg./piece
Power supply: 3P+T 220 Volt 16 Amp
Max. pressure: 900 bar
Dimensions: 320x430x250 mm.

35.0 - M JACKS DIMENSIONS

M1600KN jack

M1600KN jack

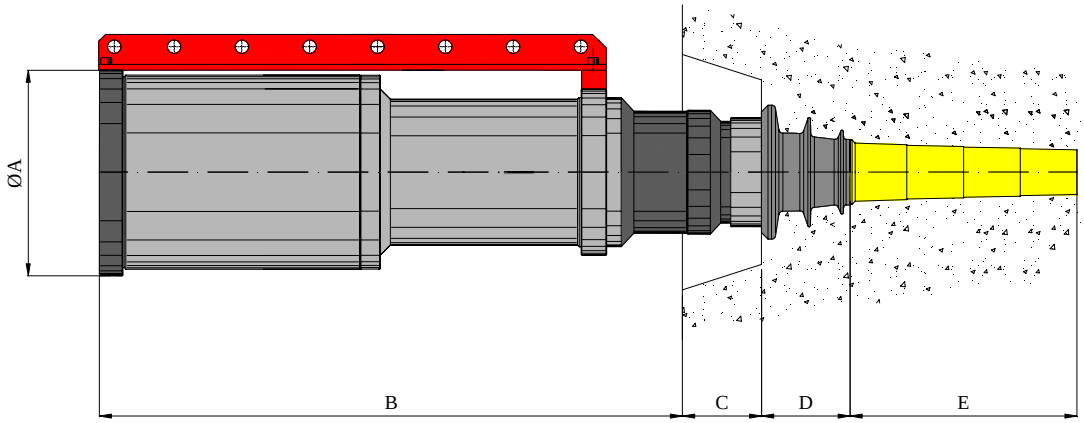


Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
M1600KN	*4*	*285*	*880*	*110*	*103*	*300*

Measures subject to modification *measures in mm.*

M1800KN jack

M1800KN jack

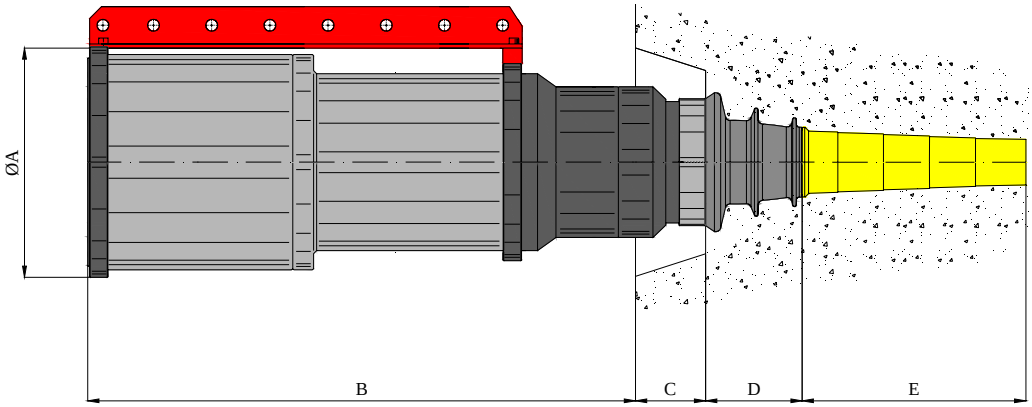


Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
M1800KN	*7*	*330*	*980*	*110*	*133*	*340*

Measures subject to modification *measures in mm.*

M3000KN jack

M3000KN-9 jack

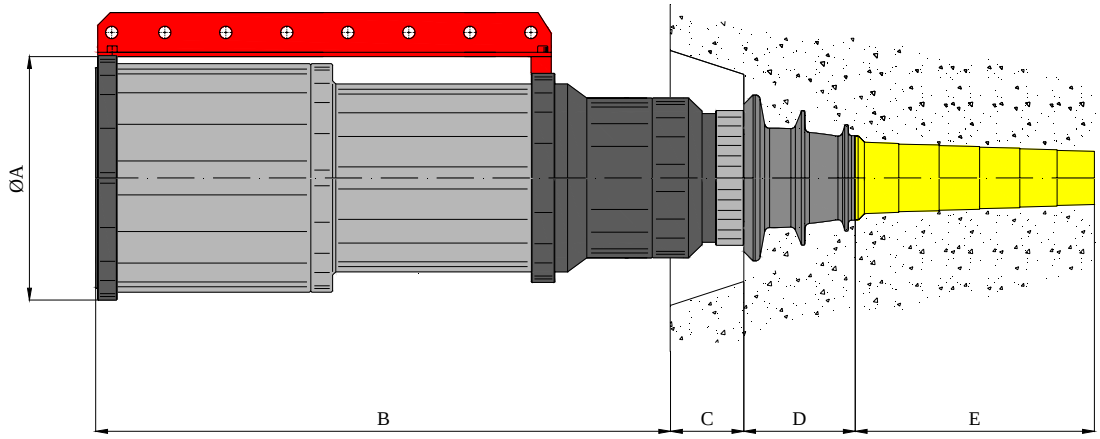


Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
M3000KN-9	*9*	*400*	*930*	*110*	*163*	*380*

Measures subject to modification *measures in mm.*

M3000KN jack

M3600KN-12 jack

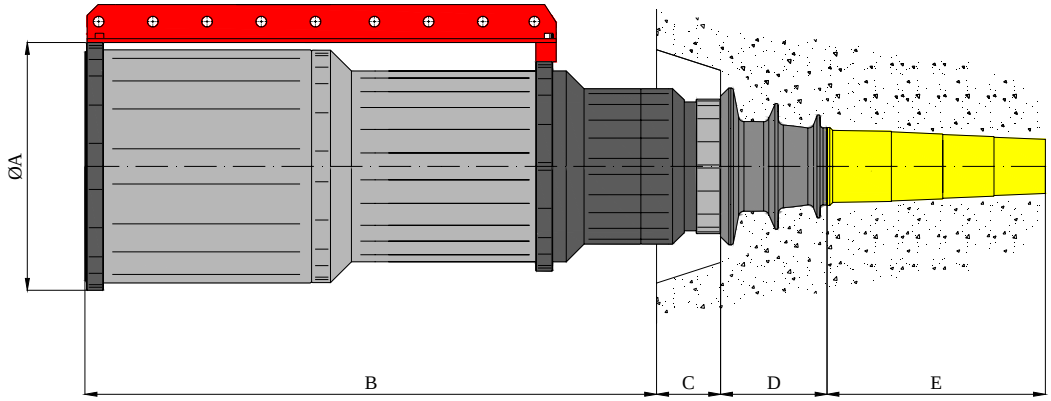


Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
M3000KN-12	*12*	*400*	*930*	*110*	*180*	*385*

Measures subject to modification *measures in mm.*

M3600KN jack

M3600KN jack

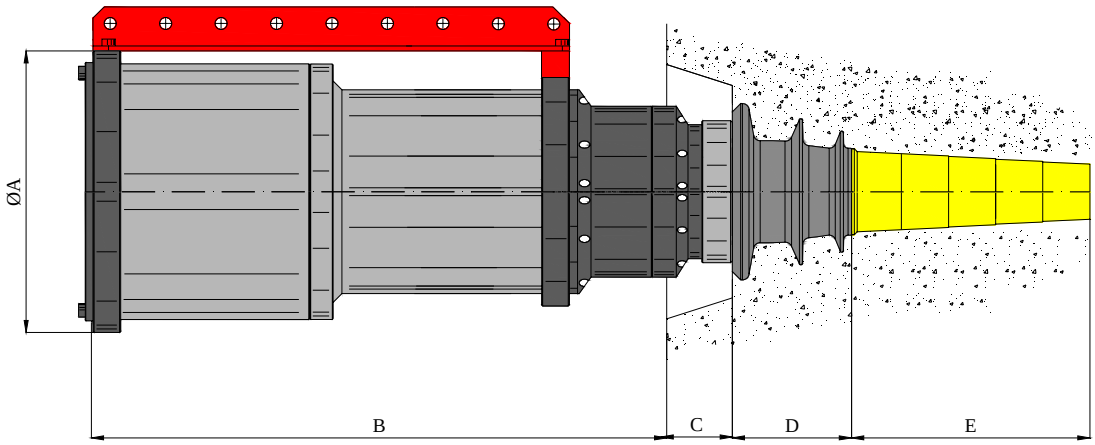


Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
M3600KN-12	*12-15*	*470*	*1090*	*110*	*197*	*405*

Measures subject to modification *measures in mm.*

M4800KN jack

M4800KN jack

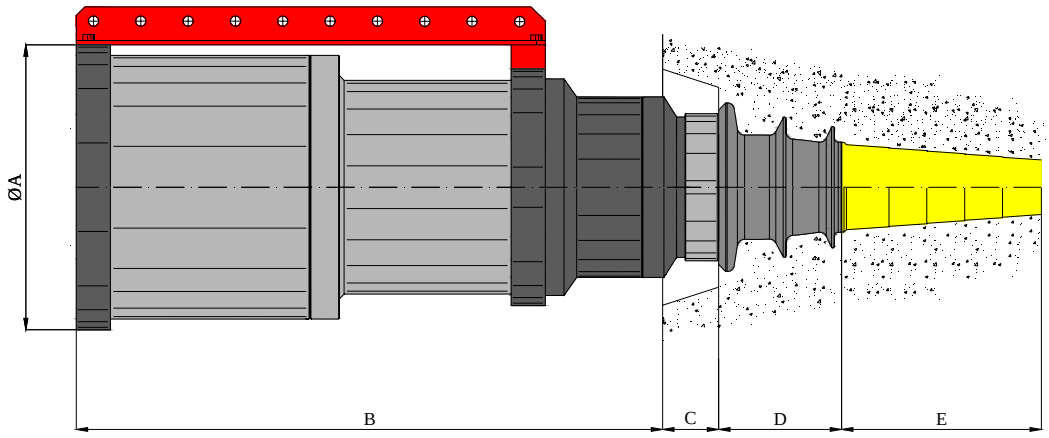


Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
M4800KN	*19*	*520*	*1075*	*125*	*215*	*430*

Measures subject to modification *measures in mm.*

M6800KN jack

M6800KN-22 jack

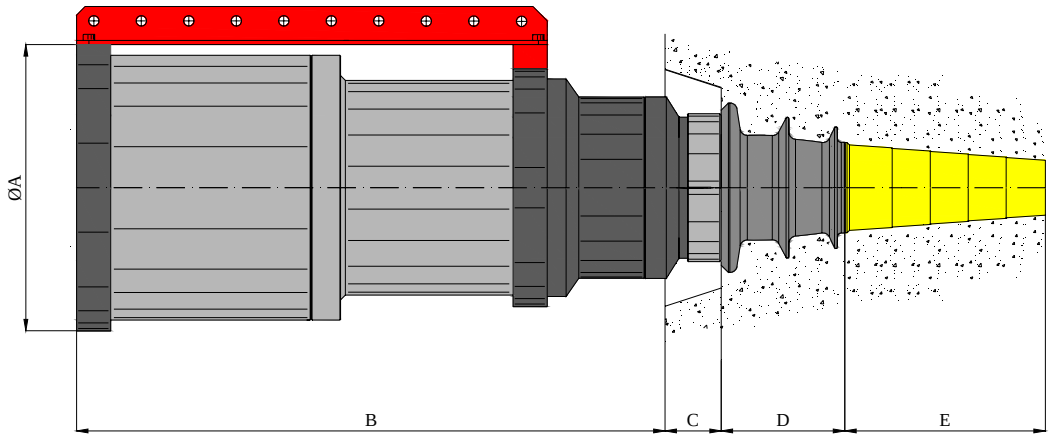


Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
M6800KN-22	*22*	*650*	*1270*	*130*	*260*	*430*

Measures subject to modification *measures in mm.*

M6800KN jack

M6800KN-27 jack

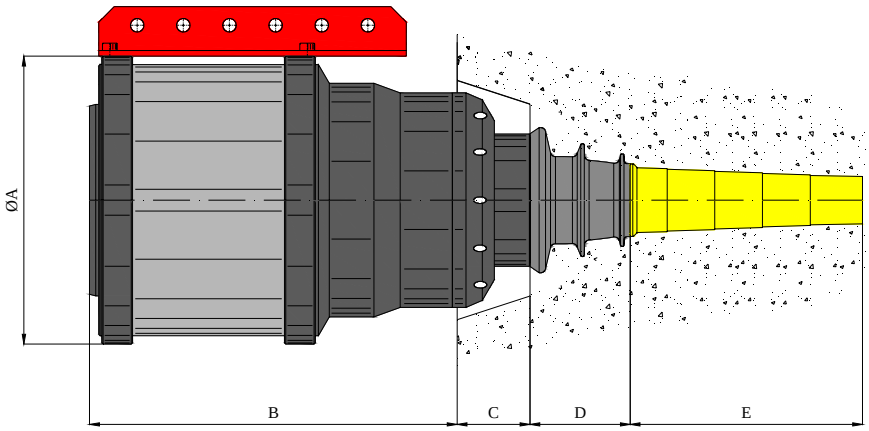


Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
M6800KN	*22*	*650*	*1270*	*130*	*260*	*430*

Measures subject to modification *measures in mm.*

MC3600KN jack

MC3000KN jack

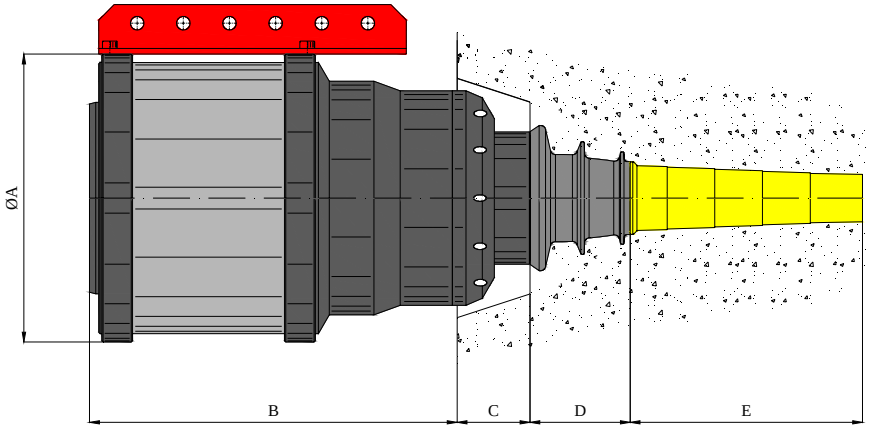


Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
MC3600KN	*12-15*	*470*	*600*	*110*	*163*	*380*

Measures subject to modification *measures in mm.*

MC4800KN jack

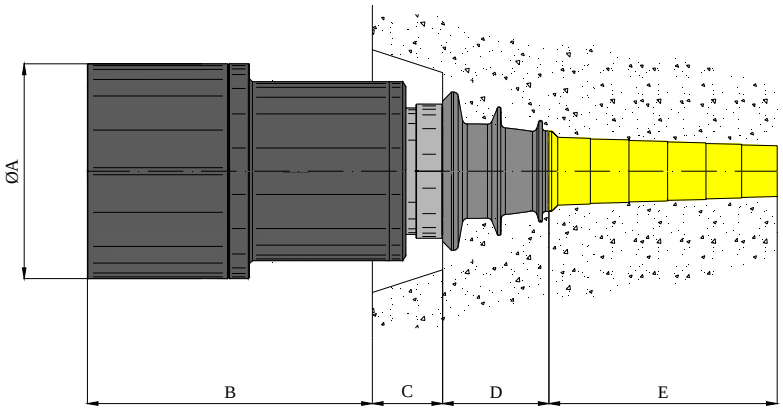
MC4800KN jack



Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
MC4800KN	*19*	*540*	*650*	*125*	*215*	*430*

Measures subject to modification *measures in mm.*

MX3600KN jack



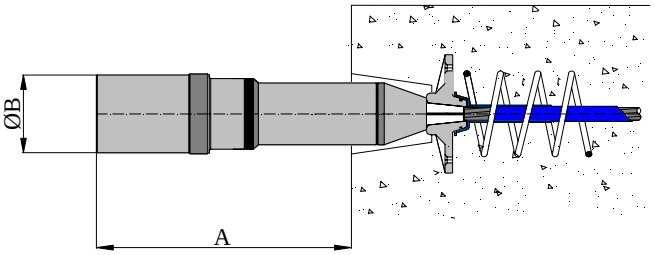
Jack type	*No. of strands*	*A*	*B*	*C*	*D*	*E*
MX3600KN	*12*	*360*	*500*	*110*	*180*	*385*

Measures subject to modification *measures in mm.*

37.0 - TTM JACKS DIMENSIONS

TTM250KN-40 jack

TTM250KN-40 jack

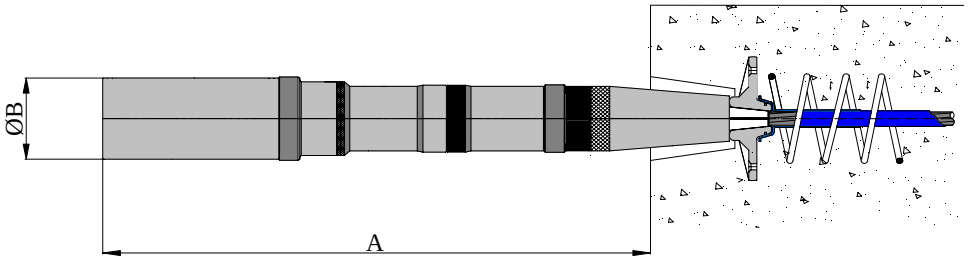


Jack type	*Tensioning extension*	*Stroke*	*Stressing section*	*Weight*	*A*	*B*
TTM250KN-40	*80-100*	*40*	*47.2cm^2*	*16.5 Kg.*	*280*	*100*

Measures subject to modification *measures in mm.*

TTM250KN-60 jack

TTM250KN-60 jack

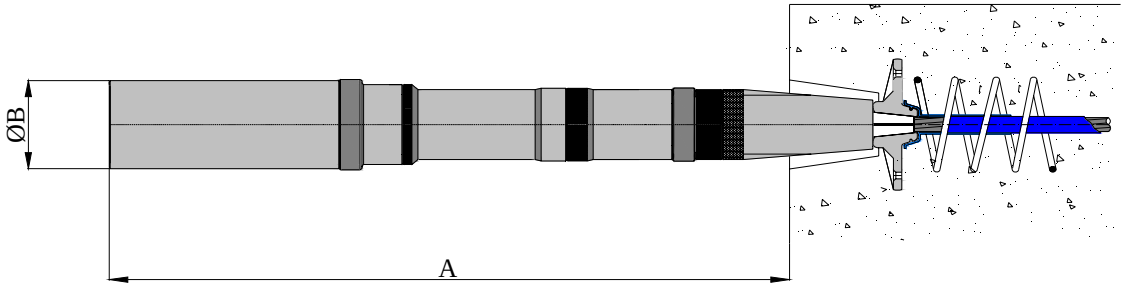


Jack type	*Tensioning extension*	*Stroke*	*Stressing section*	*Weight*	*A*	*B*
TTM250KN-60	*270*	*60*	*47.2cm^2*	*19.2 Kg.*	*570*	*100*

Measures subject to modification *measures in mm.*

TTM250KN-100 jack

TTM250KN-100 jack

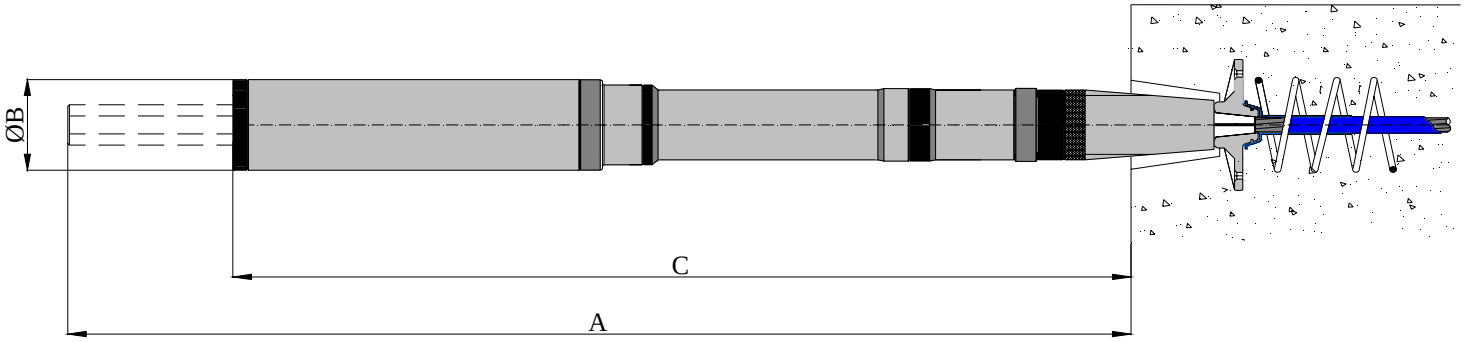


Jack type	*Tensioning extension*	*Stroke*	*Stressing section*	*Weight*	*A*	*B*
TTM250KN-100	*270*	*100*	*47.2cm²*	*21.5 Kg.*	*670*	*100*

Measures subject to modification *measures in mm.*

TTM250KN-200 jack

TTM250KN-200 jack

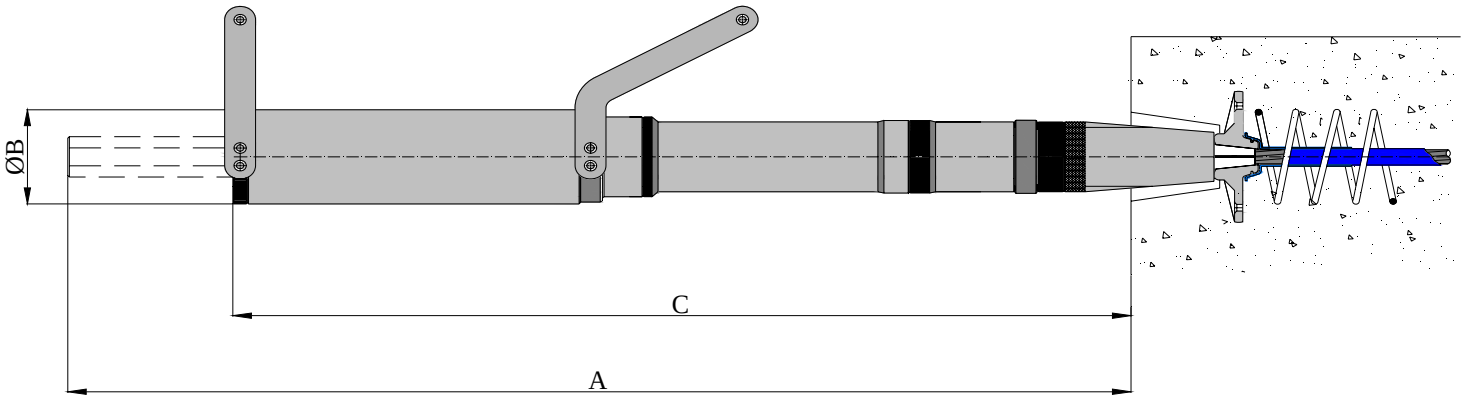


Jack type	*Tensioning extension*	*Stroke*	*Stressing section*	*Weight*	*A*	*B*	*C*
TTM250KN-200	*270*	*200*	*47.2 cm²*	*26Kg.*	*1080*	*100*	*880*

Measures subject to modification *measures in mm.*

TTM300KN-200 jack

TTM300KN-200 jack

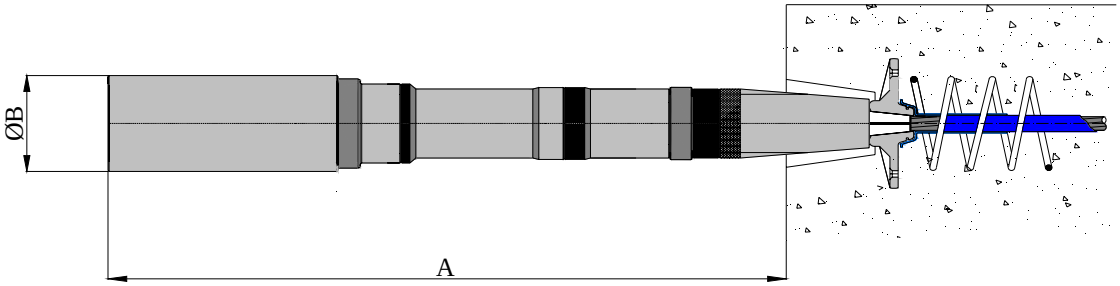


Jack type	*Tensioning extension*	*Stroke*	*Stressing section*	*Weight*	*A*	*B*	*C*
TTM300KN-200	*270*	*200*	*68.8 cm^2*	*28 Kg.*	*1080*	*110*	*880*

Measures subject to modification *measures in mm.*

TTM300KN-100 jack

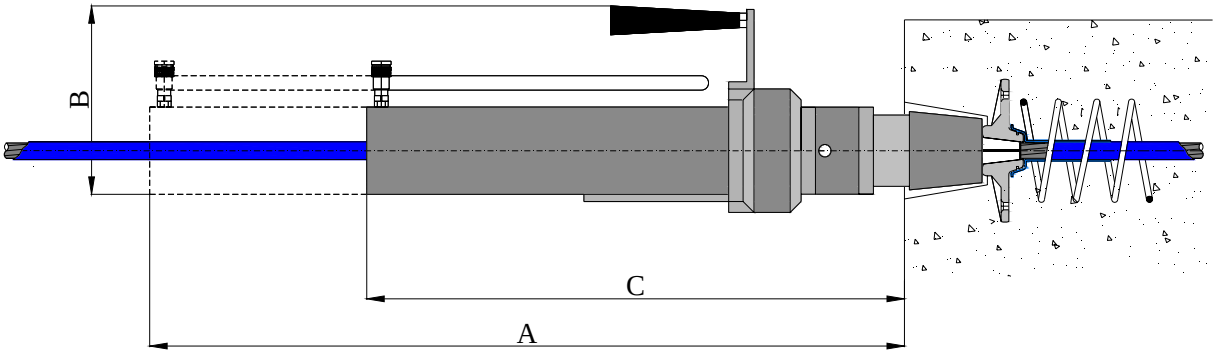
TTM300KN-100 jack



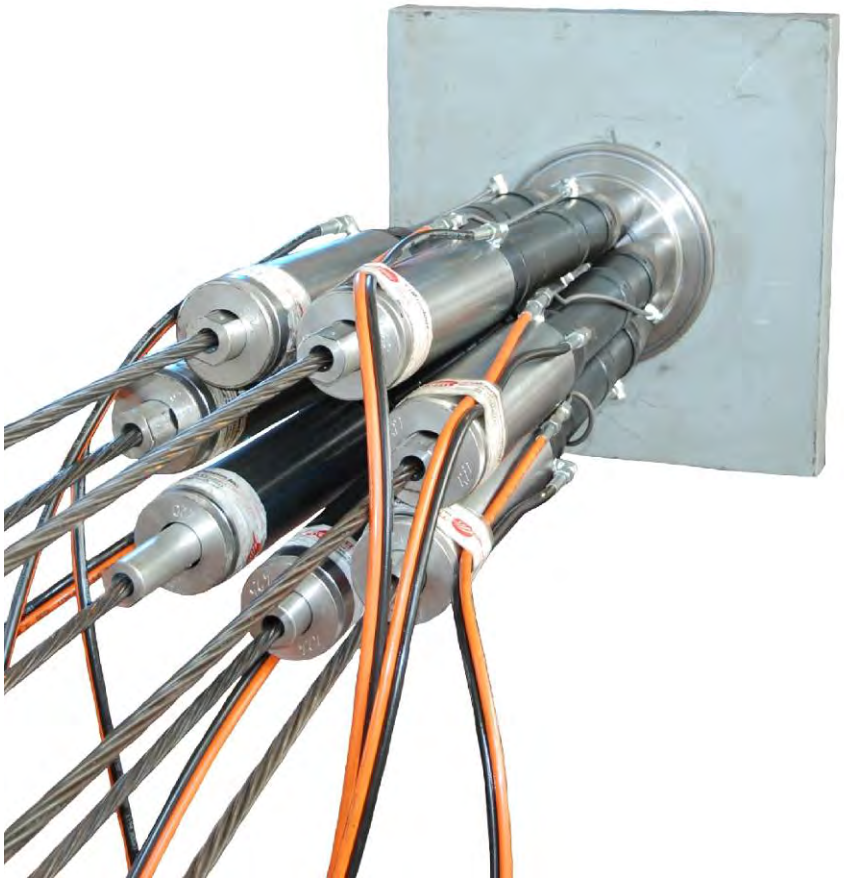
Jack type	*Tensioning extension*	*Stroke*	*Stressing section*	*Weight*	*A*	*B*
TTM300KN-100	*270*	*100*	*68.8 cm^2*	*24 Kg.*	*670*	*110*

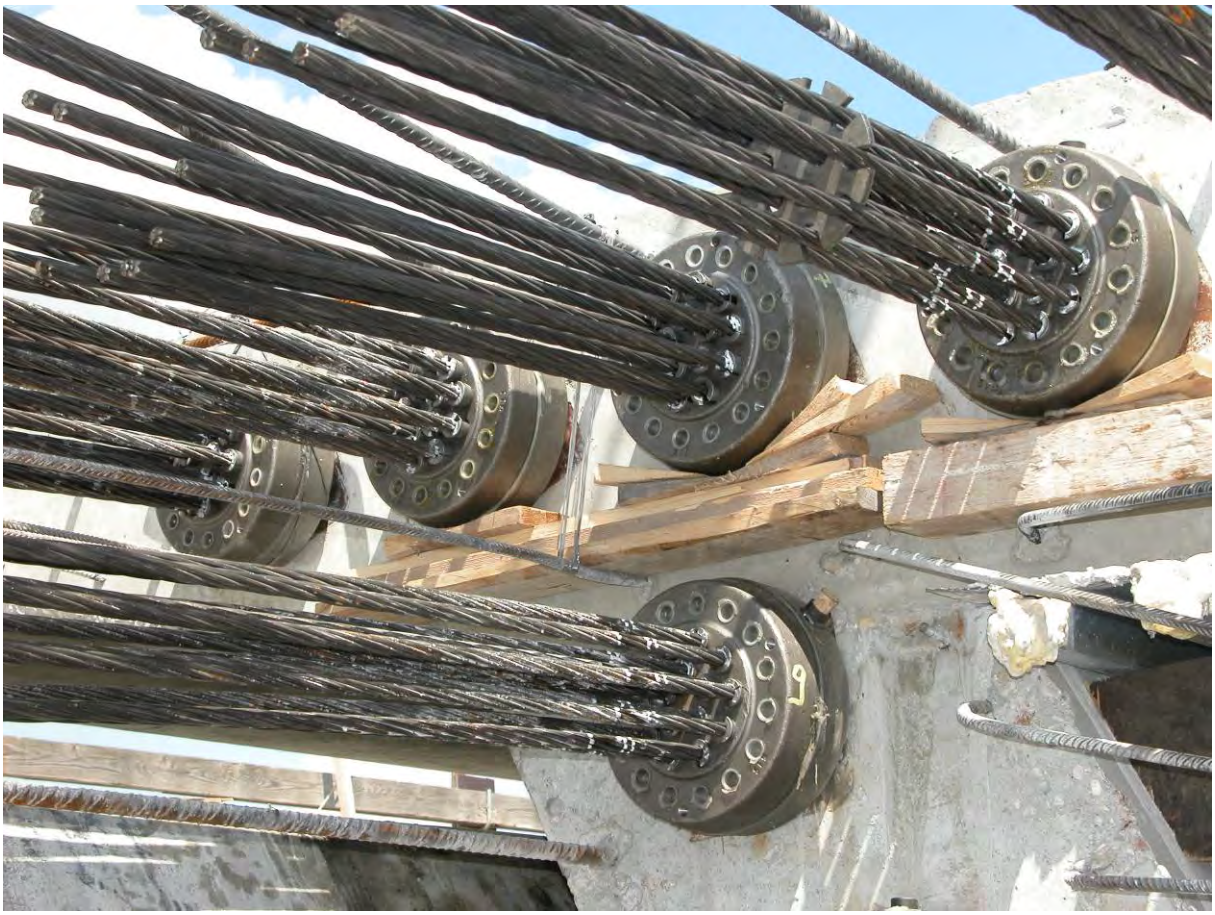
Measures subject to modification *measures in mm.*

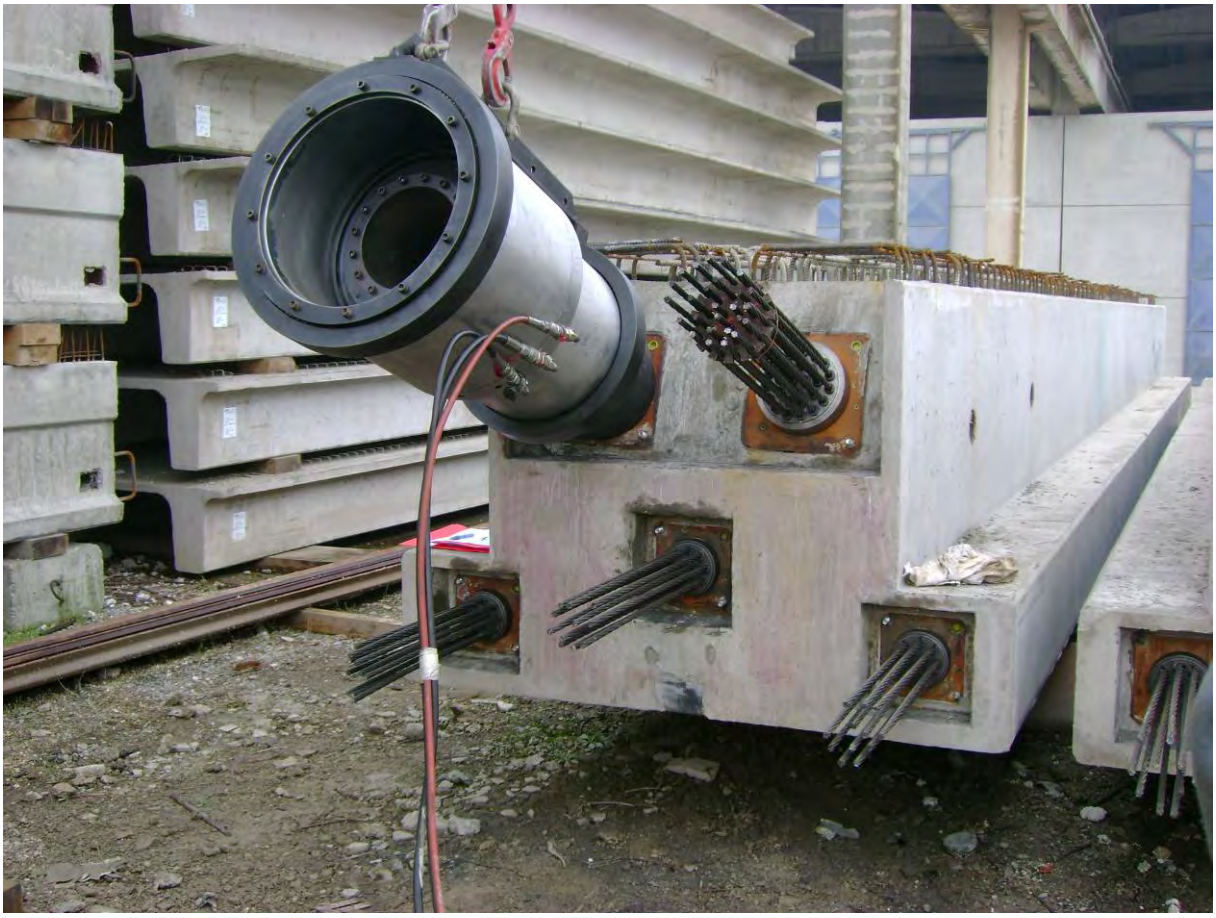
TTM280KN-200 JACK

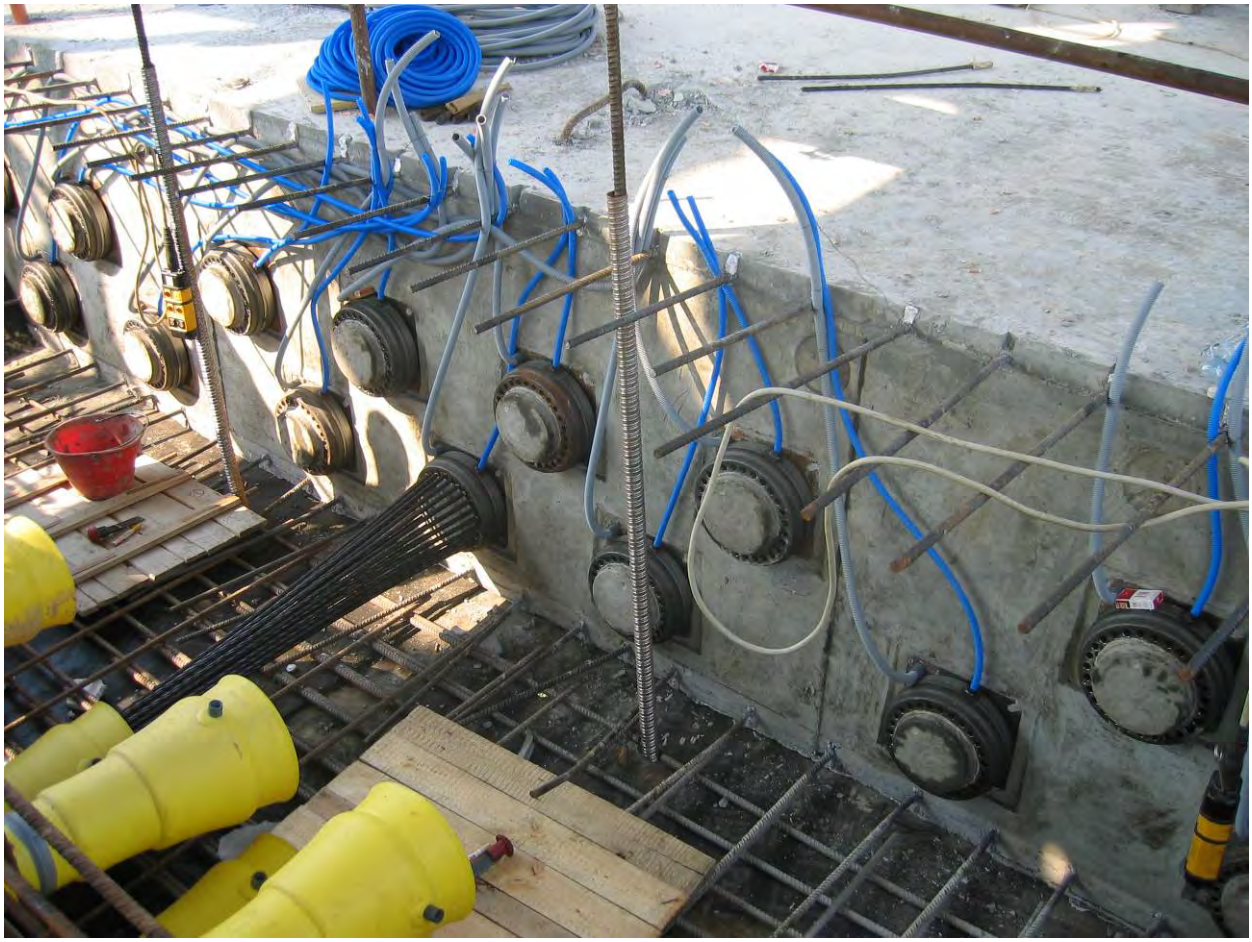


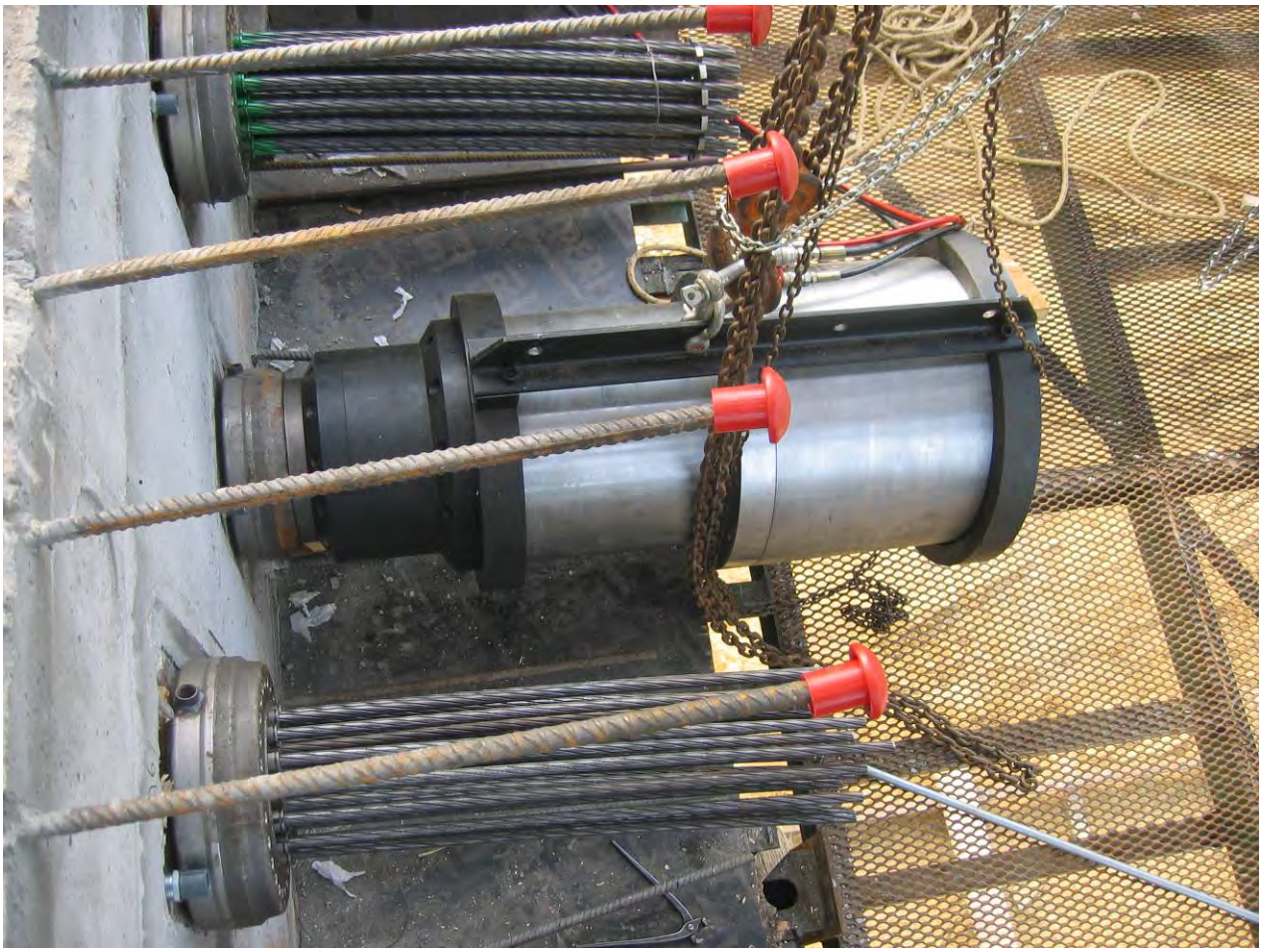
Jack type	***Tensioning extension***	***Stroke***	***Stressing section***	***Weight***	***Width***	***A***	***B***	***C***
TTM280KN-200	*300*	*200*	*51.3 cm^2*	*28 Kg.*	*260*	*690*	*180*	*490*



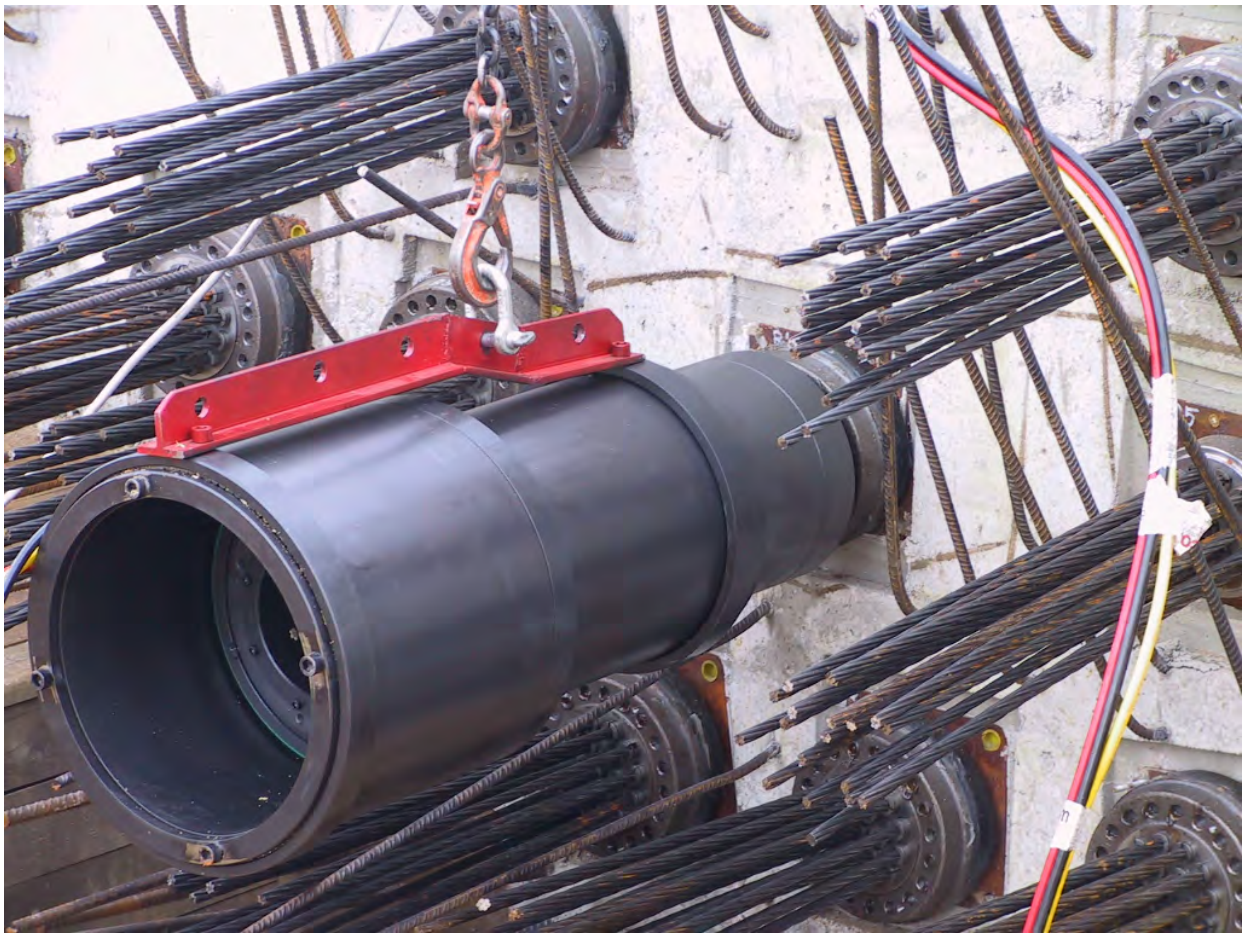


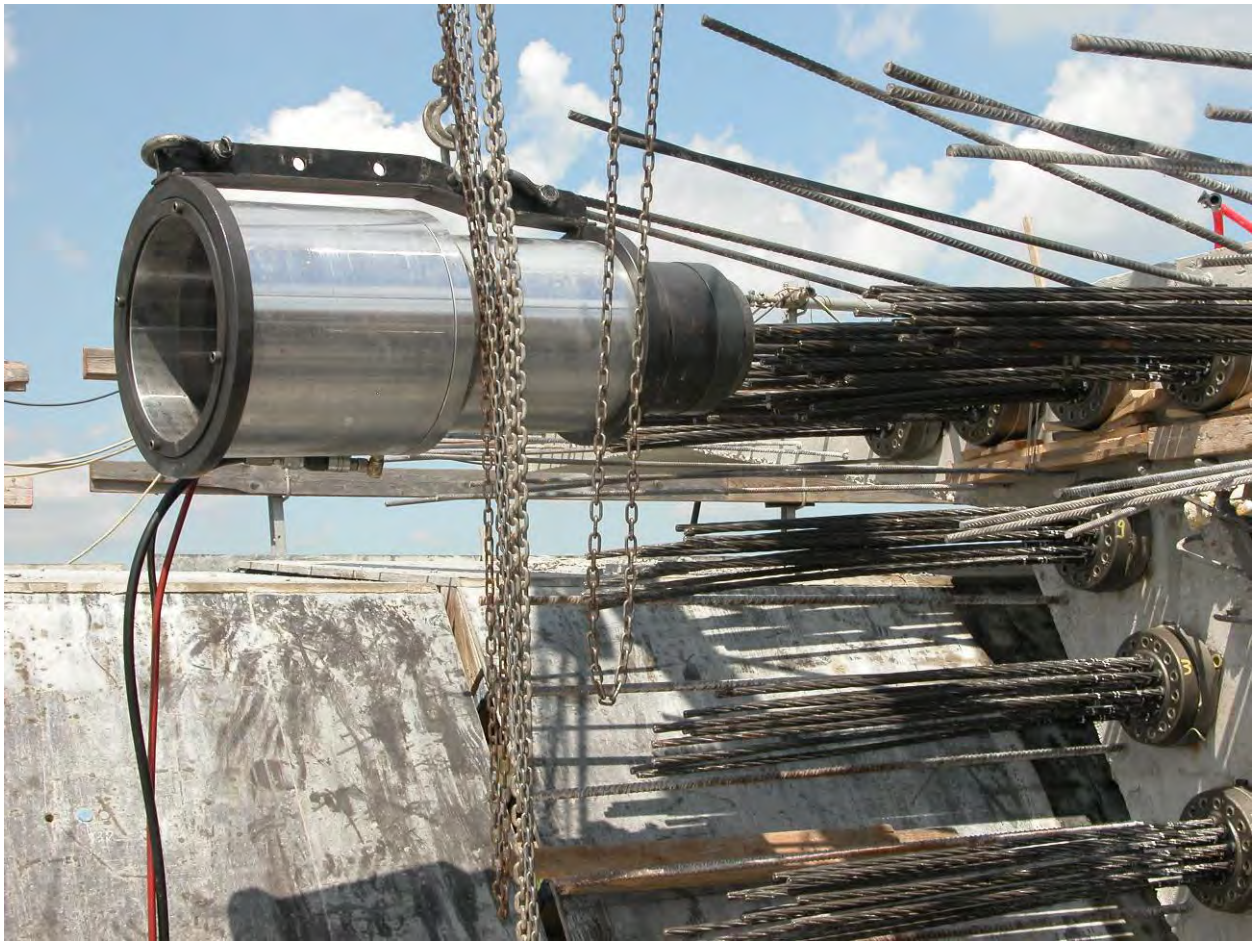







PALFINGER





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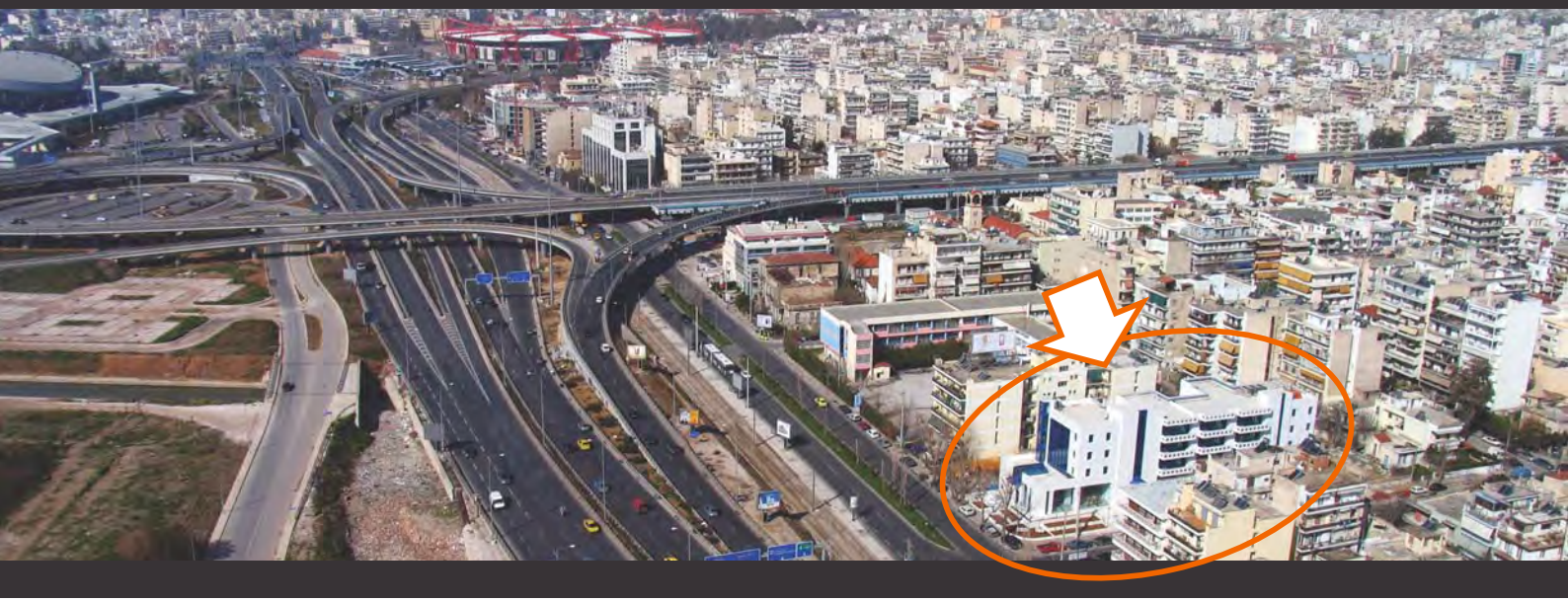

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