

FREYSSIBAR

Prestressing system



The FREYSSIBAR prestressing system

Developed by Freyssinet, this prestressing system comprises of a wide range of fully threaded bar and complementary anchoring, coupling and extension devices. It is used for post-tension cables, prestressed ground anchors and for any application involving temporary or permanent tie rods: lifting, suspension, prestressed splices, etc.

SUMMARY :

Page 3	: TECHNOLOGY: <ul style="list-style-type: none">• The FREYSSIBAR• The anchorages• The accessories QUALITY CONTROL
Page 4	: INSTALLATION: <ul style="list-style-type: none">• Shimming of the anchorages• Tensioning• Safety factors• Tensioning jacks
Page 5	: INSTALLATION: <ul style="list-style-type: none">• Tensioning pumps• The injection compounds• Mixing, melting, and injection equipment
Pages 6 to 9	: GEOMETRICAL CHARACTERISTICS <ul style="list-style-type: none">• Types of anchorages• Sketches of the types of anchorages• Sketches of common accessories
Page 10	: PRESTRESSED GROUND ANCHORS

TECHNOLOGY

The FREYSSIBAR

The bars are hot rolled from high strength alloyed steel. They are subsequently cold worked by stretching and then threaded over their full length by cold rolling. The standard range of nominal diameters is: 26.5; 32; 36; 40 and 50 mm. Larger diameter bars can be delivered on request. The fabrication process provides a high quality thread ensuring good fatigue resistance and a low susceptibility to stress corrosion.

The geometry of the thread is specifically designed to ensure ease of use on site, providing fast, accurate and easy tightening.

Bars are available in maximum lengths of 11.7 meters. Beyond this length, extension sleeves allow bars to be connected together.



The anchorages

The anchor devices are designed to anchor the force in the tendon and transfer it to the structure. Three types of anchorages are available: standard anchorages with a nut and washer, hinge anchorages using a nut with a spherical seat, and fixed anchorages using a threaded end plate.

All nuts are hot forged. Also, couplers allow primary bars to be connected to secondary bars.

The accessories

Freyssinet offer a full range of sheathing that is easy to install. In particular:

- Steel strip corrugated sheath, threaded over its full length, which allows easy and fast connections.
- High density polyethylene tube, with elements butt welded by means of a heating mirror to achieve a leak free and non corrodible envelope.
- Sheathing accessories specific to the tensioning and coupling devices, required to fit the coupler geometry. The length of the ducting element used is defined case by case, so as to allow the coupler displacement over a sufficient length during the tensioning operations.

QUALITY CONTROL

The fabrication of the bars and the anchorages is carried out under a quality assurance system in compliance with the quality standard ISO 9000 : 2000. Bars and anchorages comply with the requirements of international standards related to prestressing tendons and anchorages.

INSTALLATION

The accuracy of the prestressing force actually introduced into the structure and the durability of the tendons depend on the quality of the installation works.

Shimming of the anchorages

When anchorages are applied onto an existing concrete element, it is recommended to shim under the bearing plate using a non-shrink mortar, free from chloride.

Tensioning

The tensioning equipment provided by Freyssinet ensures the accuracy of the load applied within +/- 2%. This is achieved through regular calibration of the pump pressure gauge and the jacks.

Safety factors

The tensioning force in the prestressing bars is given by the relevant design standards. Recommendations are given below as examples: (Note: Fpk means the guaranteed tendon tensile breaking load).

- A) In post-tensioned structures, the French rules (BPEL91 revision 99) limit the stressing force to 0.70 Fpk.
- B) In prestressed ground anchors, the norm EN 1537 prescribes a final force limited to 0.60 Fpk. The tensile force for the preliminary inspection and reception tests being less than 0.80 Fpk.
- C) In case of re-use, the tensioning force of the bar is limited to 0.60 Fpk for the first use, and to 0.50 Fpk for all subsequent uses.

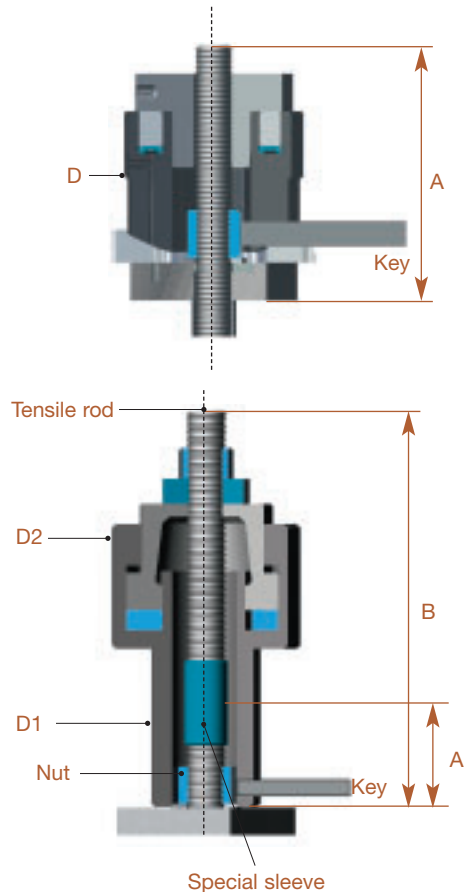
Tensioning jacks

JACKS – WITH DIRECT CONNECTION AND HINGE			
References	CF 77	CF 110	VP 230
Units (mm)	26.5-32-36	26.5-32-36-40	50
Capacity (t)	770	1 100	2 300
Stroke (mm)	12	12	20
Piston cross section (cm ²)	110	159.4	150.59
Pressure maxi (bars)	700	700	1 500
Overlength A (mm)	195	200	250
D (mm)	195	200	250
Weight (kg)	26	30	65

JACKS – WITH A TIE ROD		
References	80 VAD 90	150 VAD 90
Units (mm)	26.5-32-36-40	26.5-32-36-40-50
Capacity (t)	1 000	1 700
Stroke (mm)	100	100
Piston cross section (cm ²)	127.2	240
Pressure maxi (bars)	790	710
Overlength A (mm)	215	215
B (mm)	700	740
D1 (mm)	160	200
D2 (mm)	160	243
Weight (kg)	63	91

Notes : A/ Diameter adaptations must be indicated when ordering the jacks, in the following manner: CF 110 for Ø 26.5 and 40 mm : CF 110-ADP-26.5/40
 B/ Bars fitted with hinge anchorages shall be tensioned exclusively by means of a jack with a hinge.

Two types of jacks can be used: with a tie rod connected to the tendon or with a direct connection. Jacks should be used in conjunction with Freyssinet hydraulic pumps, with high pressure and a low flow rate to allow a progressive tensioning of the bar.



Tensioning pumps

TENSIONING PUMPS With associated hoses	
Working pressure (bars)	1 500
Tank capacity (l)	9
Flow rate (l/min)	2.45
Weight (kg)	27

Bars are stressed using hydraulic tensioning pumps, hand actionned or motorized, with low flow rate for a progressive stressing.

The injection compounds

The bars and the anchor heads should be protected against corrosion either by using a cement mortar or a wax. Freyssinet recommends the ready mix SUPERSTRESSCEM for the standard applications and the thixotropic and retarded cement mix SMARTGEL, which avoids any segregation or settlement of the grout, in case of vertical or highly inclined tendons.

To allow for subsequent re-tensioning of the bars, the injection must be achieved with a flexible anti-corrosion product. Freyssinet recommends the Freyssinet/Elf CP-HPF wax, specially designed for prestressing and stay cables.

Safety recommendation

Prestressing bars shall not be welded or submitted to any local heating or welding spray.

SPECIAL CEMENT GROUT		SUPERTSTRESSCEM	SMARTGEL
Cement	NF P 15 301	CPA-CEM I 42.5 PM ES CP2	CPA-CEM I 52.5 PM ES CP2
Mix rate	Water/cement Admixture/cement	38% 0.82%	35% 9.5%
Conditions of use	Mix temperature Injection duration	20°C +/- 15°C 4 hours	20°C +/-15°C 24 hours
Specificity		Admixture in hydro-soluble pocket Cement in bags of 50 kg	Thixotropic retarded Cement in bags of 25 kg

WAX	CP-HPF
Type	Micro-crystalline
Melting point	82° C
Salt spray resistance test (ASTM B117)	3 000 hours
Packing	170 kg barrel or 25 kg plate

The injection equipment

Freyssinet has designed specific injection equipment which ensures the proper filling of the ducts.

CEMENT GROUT MIXING AND INJECTION UNIT MMJ100	
Volume of mixing tanks (liters)	2 X 100
Flow rate (l/min)	18
Weight (kg)	350

WAX MELTING AND INJECTION UNIT	
Flow rate (l/min)	4.3
Weight (kg)	340



TYPES OF ANCHORAGE - GEOMETRICAL CHARACTERISTICS

Types	Items	Characteristics	Units	Nominal diameters of bars (mm)					Sketches references
				26.5	32	36	40	50	
Bars		Item reference		B26.5	B32	B36	B40	B50	B
		Steel grade	MPa	1030	1030	1030	1030	1030	
		Transversal cross sectional area	mm ²	552	804	1018	1257	1964	
		Linear mass	kg/m	4.56	6.66	8.45	10.41	16.02	
		Characteristics breaking load : Fpk	KN	568	828	1048	1295	2022	
		0,1% proof load	KN	461	672	850	1049	1640	
		Tensioning force at 0.70 x Fpk	KN	398	580	734	906	1416	
		Thread pitch	mm	6	6	6	8	8	
	Average secant modulus	GPa	170	170	170	170	170		
Standard anchorage	Nut	Item reference		N26.5	N32	N36	N40	N50	N
		Length	mm	38	42	47	52	72	
		Width on flat surfaces	mm	50	56	62	65	90	
	Washer	Item reference		W26.5	W32	W36	W40	W50	W
		External diameter	mm	65	70	75	80	105	
		Thickness	mm	6	6	6	6	6	
	Square plate	Item reference		FP26.5	FP32	FP36	FP40	FP50	FP
		Width**	mm	110	125	140	150	185	
Thickness		mm	30	35	40	40	45		
		Option : with injection groove : width x depth	mm ²	10x10	10x10	10x10	10x10	12x10	G
Hinge anchorage	Nut	Item reference		SN26.5	SN32	SN36	SN40	SN50	SN
		Length	mm	45	51	56	60	71	
		Width on flat surfaces	mm	50	56	62	65	90	
	Square plate	Item reference		SP26.5	SP32	SP36	SP40	B50	SP
		Width**	mm	110	125	140	150	185	
Thickness		mm	35	40	45	50	60		
Fixed anchorage	Threaded plate	Item reference		TEP26.5	TEP32	TEP36	TEP40	TEP50	TEP
		Width**	mm	110	125	140	150	185	
		Thickness	mm	40	50	50	60	70	
			Option : with welded cap/length	mm	15	20	20	25	25
Options	Formwork tube*	Length	mm	200	200	200	250	250	T
		External diameter	mm	42.9	48.5	50.8	57.2	70	
		Thickness	mm	2	2	2	2	2	
		Air vent connection	"	1/2	1/2	1/2	1/2	1/2	V
	"Cap fixing threaded holes"		Thread	-	M8	M8	M8	M8	M8

*On request the tube is welded to the plate

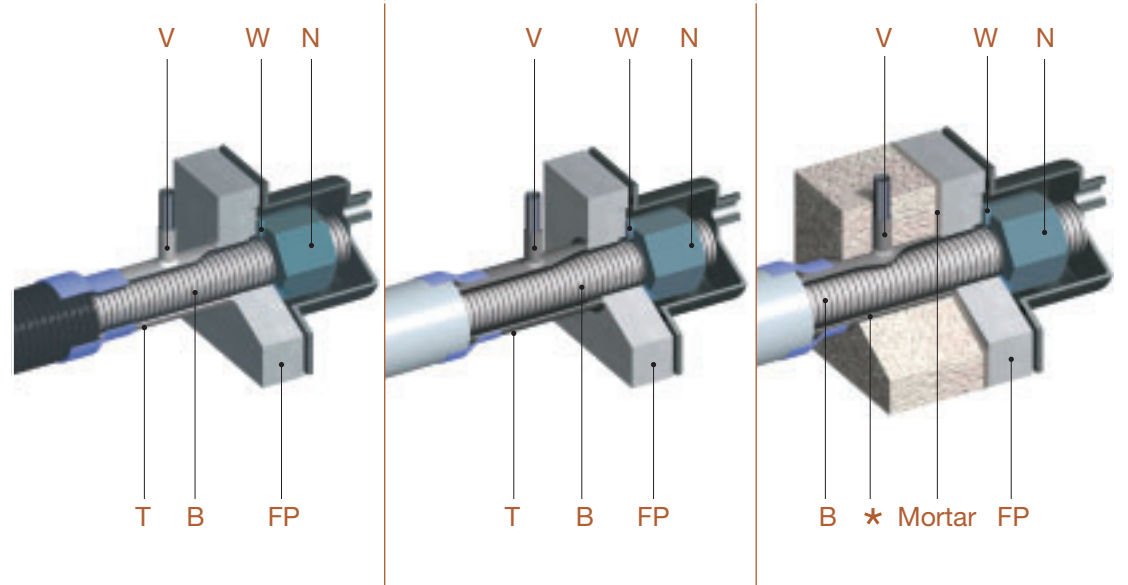
**Wider plates are available on request

STANDARD ANCHORAGE

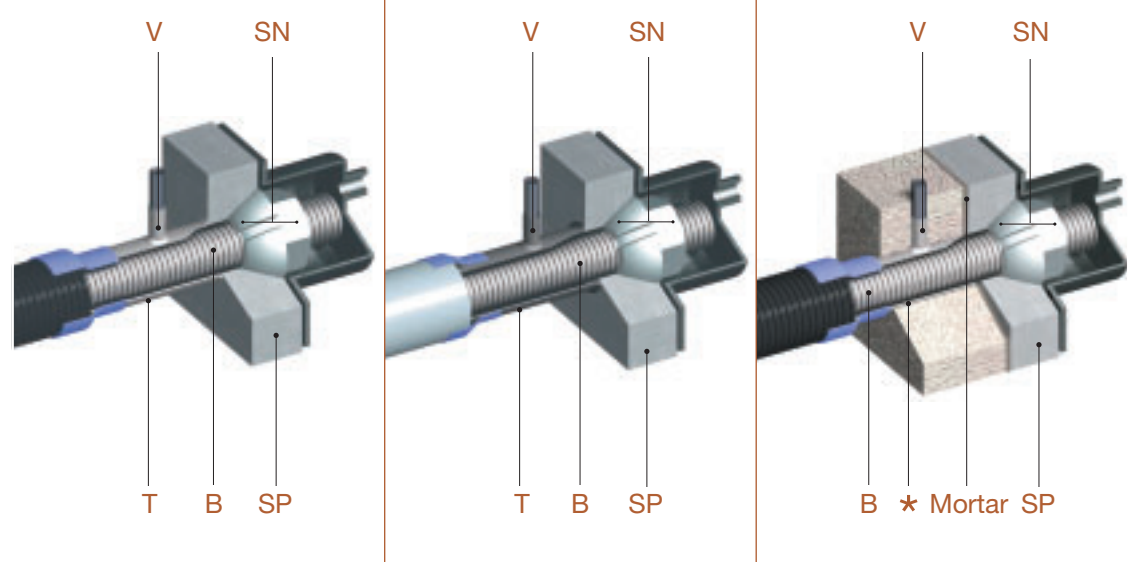
Steel corrugated sheath

HDPE tube

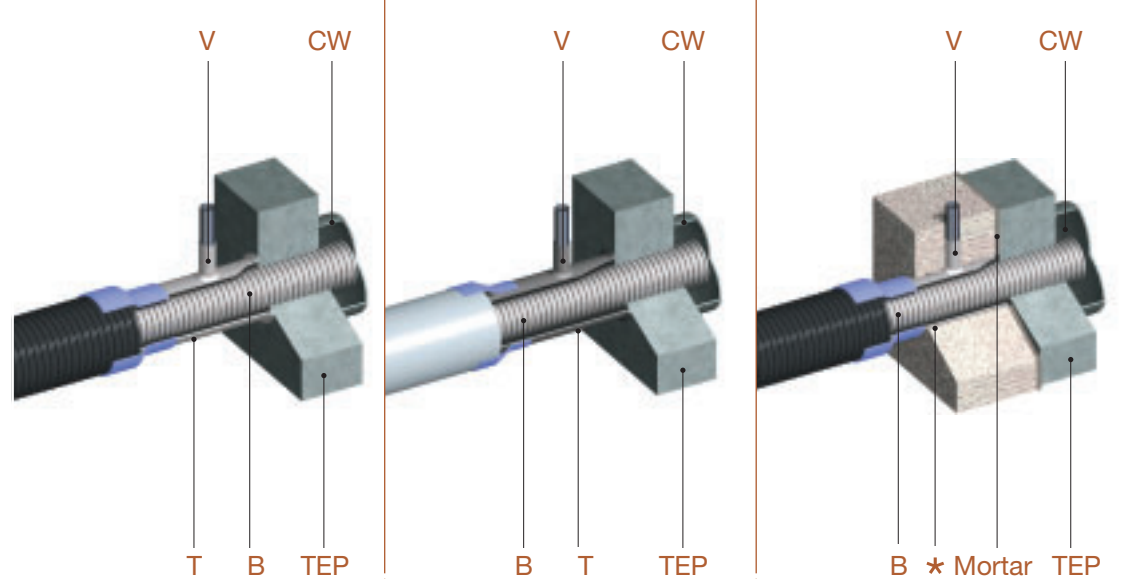
With shimming of anchorage



HINGE ANCHORAGE



FIXED ANCHORAGE



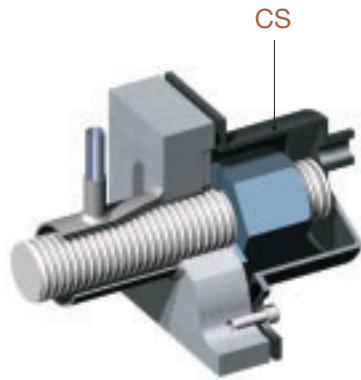
References are related to the table on page 6

*T is not welded to the plate

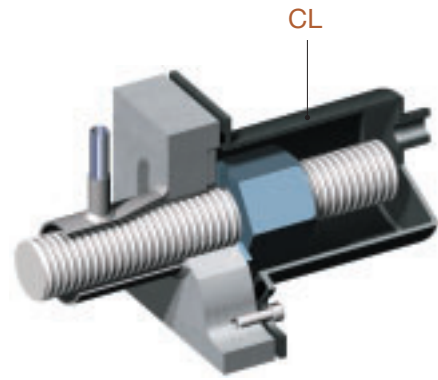
COMMON ACCESSORIES - GEOMETRICAL CHARACTERISTICS

Types	Items	Characteristics	Units	Nominal diameters of bars (mm)					Sketches references
				26.5	32	36	40	50	
Caps	Standard caps	Item reference		CS26.5	CS32	CS36	CS40	CS50	CS
		Length	mm	95	100	120	120	150	
	Long caps	Item reference		CL26.5	CL32	CL36	CL40	CL50	CL
		Length	mm	210	220	220	220	280	
Sleeves		Item reference		C26.5	C32	C36	C40	C50	C
		External diameter	mm	45	50	60	65	76	
		Length	mm	90	115	130	140	170	
Ducts	Steel corrugated sheath	Internal diameter	mm	45	50	55	60	75	G1
		Thickness	mm	0.45	0.45	0.45	0.45	0.50	
		Volume of grout	L/m	0.10	0.12	0.14	0.16	0.25	
		Duct connection element : internal diameter	mm	50	55	65	70	85	G'1
	HDPE tube	External diameter	mm	63	63	75	75	90	G2
		Thickness	mm	5.8	5.8	6.8	6.8	8.2	
Volume of grout		L/m	0.15	0.13	0.19	0.17	0.23		
Duct for the prolongation sleeve		Item reference		GR26.5	GR32	GR36	GR40	GR50	GR
		External diameter	mm	70	76.2	88.9	95	114.3	
		Thickness	mm	2	2	2	2	2	
		Minimum length (add "L " ; sleeve displacement)	mm	180 + L	205 + L	220 + L	230 + L	260 + L	
Duct for the coupling sleeve		Item reference		GC26.5	GC32	GC36	GC40	GC50	GC
		External diameter	mm	88.9	88.9	101.6	114.3	152.4	
		Thickness	mm	2	2	2	2	2	
		Minimum length	mm	210	235	255	265	320	
Air vents	Connexion	Thread	"	1/2	1/2	1/2	1/2	1/2	V
	Half shell	Air vent tube length	mm	600	600	600	600	600	F

CAPS



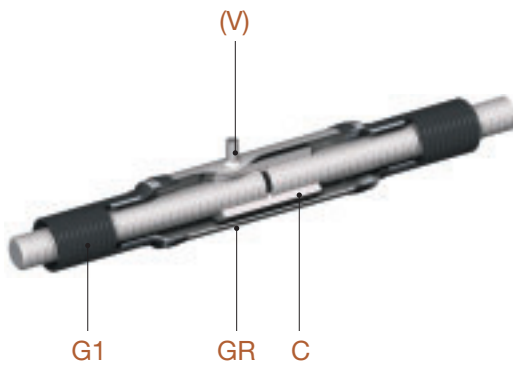
Standard cap



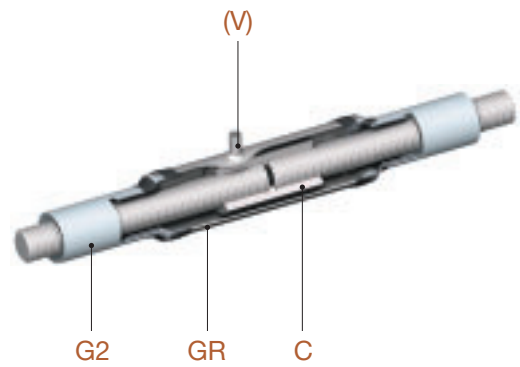
Long cap – for re-tension

EXTENSION DEVICES

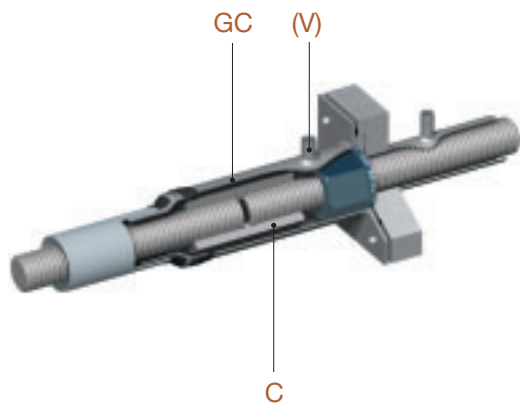
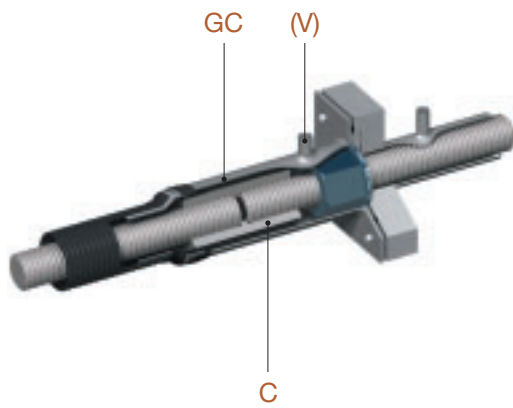
Steel corrugated sheath



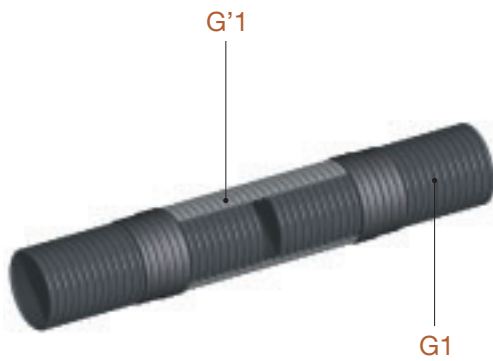
HDPE tube



COUPLERS



MISCELLANEOUS



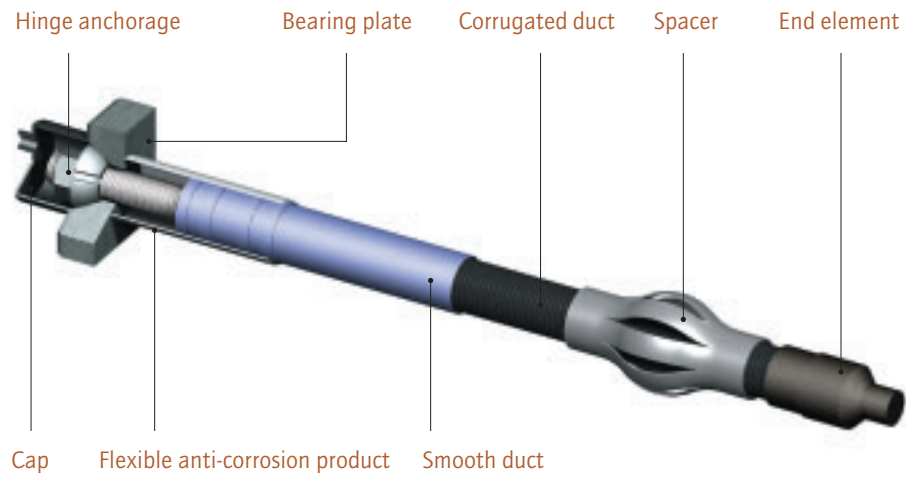
Connection of steel strip sheath



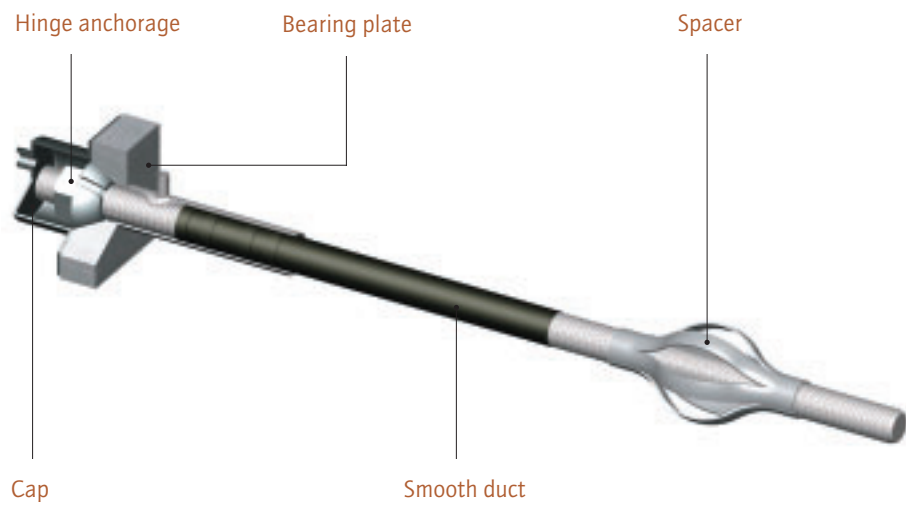
Freyssinet Vent

Prestressed Ground Anchors

PERMANENT



TEMPORARY



List of components will be provided on request

Applications



◀ PRESTRESSING OF PRECAST ELEMENTS



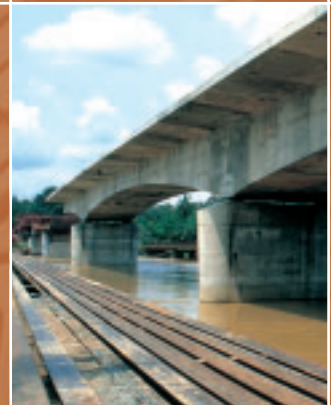
◀ LAUNCHING FRONT NOSE ASSEMBLY



▶ ROOF HANGERS



▶ SPAN PRESTRESSING



◀ MOBILE FORMWORK TRAVELLERS HANGERS



◀ PRESTRESSED GROUND ANCHORS



▶ ANCHORAGE OF SUSPENSION CABLES



Photos :
Adrian Hall
Francis Vigouroux
Freysinet & subsidiaries photographic library
July 2004



1 bis, rue du Petit-Clamart
78148 Vélizy Cedex - France
Tél. : +33 (1) 46 01 84 84
Fax : +33 (1) 46 01 85 85
www.freyssinet.com
freysibar@freyssinet.com