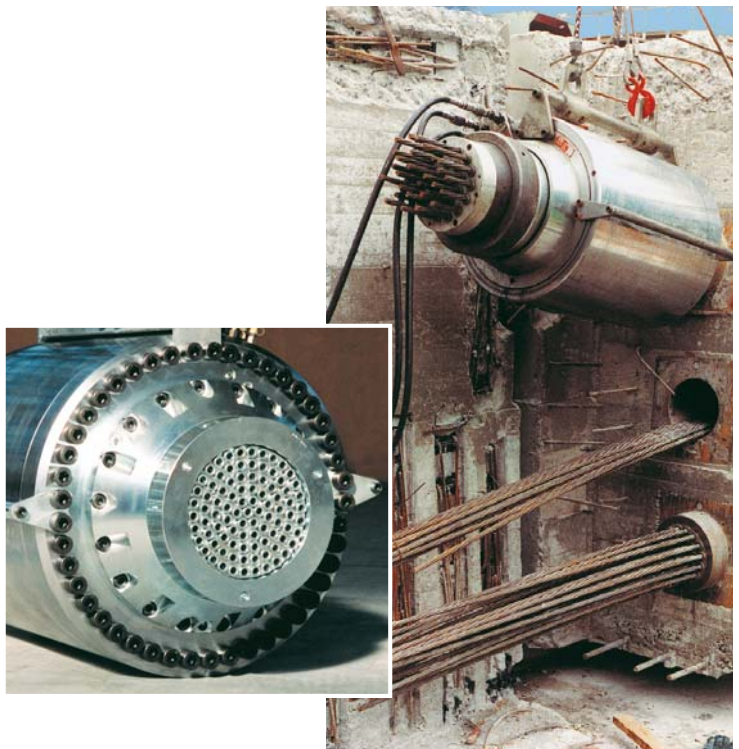


P R E S T R E S S E D
C O N C R E T E
T E C H N O L O G Y



Post-Tensioning Technology TENSA M



Post-Tensioning Technology from PAUL

PAUL has built multi-strand post-tensioning jacks for several decades. The range of models has been continuously expanded over the years and today PAUL is able to offer a suitable stressing jack for a wide variety of applications.

Thanks to the fact that all basic models can be equipped with exchangeable interior parts suiting different tendon configurations, PAUL stressing jacks are used with many renowned prestressing systems.

The stressing jacks are normally equipped with a hydraulic wedge-seating facility to provide secure power seating of the anchor wedges.

This principle of construction has proved successful for decades. Together with the high quality and robust design it established the excellent reputation of the PAUL stressing jacks throughout the world.

Stressing jacks, pump units and anchor grips from a single source ensure that all components work together in perfect tune.

TENSA M Stressing jacks with rear-gripping feature

Multi-strand stressing jacks of the TENSA M series are an important part of the equipment on construction sites and in pre-stressed concrete factories.

They are used in the construction of bridges and flyovers, in the prestressing of ground anchors as well as for the lifting and lowering of heavy loads.

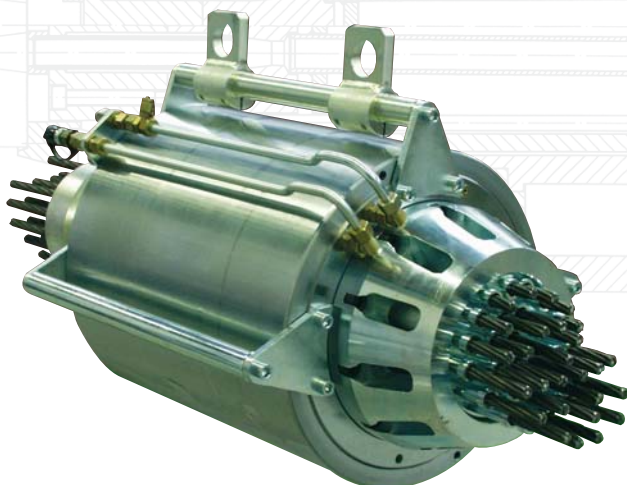


Fig. 1: TENSA M 6800 kN stressing jack for 27 x 0.7"

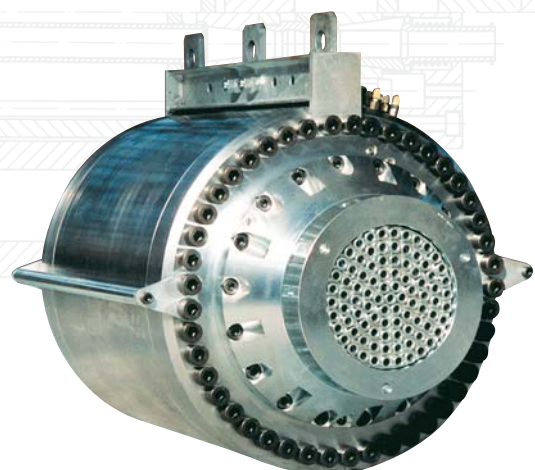


Fig. 2: TENSA M 15000 kN stressing jack

TENSA M - PV

Stressing jacks with front-gripping feature

Unlike the TENSA M series, the stressing jacks of the TENSA M - PV series grip the strands at the front.

A major benefit of the TENSA M - PV jacks is that they only require a very short projecting strand length for attachment so that they are also suitable for use in confined space conditions.



Fig. 3: TENSA M - PV 8600 kN stressing jacks

Special versions

For special applications we also develop and supply custom-designed stressing jacks to meet any specific requirements:

- e.g. with hydraulic wedge-seating device and mechanically actuated internal stressing grip, available in the following size:

5000 kN 37 x 0.6"

8500 kN 61 x 0.6"

12500 kN 91 x 0.6"

with a stressing stroke of 200 mm or for checking the stay cable force with a stroke of 90 mm

- Special stressing jacks for correcting the stay cable stress that was applied by single-strand stressing jacks, available in the following sizes:

3500 kN 27 x 0.6"

4200 kN 37 x 0.6"

6800 kN 61 x 0.6"

8400 kN 73 x 0.6" etc.



Fig. 4:
12500 kN flat stressing jack,
stroke 90 mm, for 91 x 0.6"



Fig. 5:
12500 kN stressing jack,
stroke 200 mm, for 91 x 0.6"

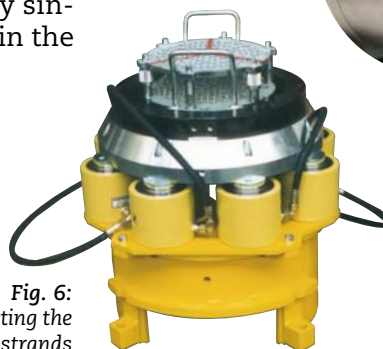


Fig. 6:
6800 kN stressing jack for correcting the
stay cable stress, for 61 x 0.6" strands

Series TENSA M

Stressing force	kN	1 000	1 000 ¹⁾	1 090 ¹⁾	1 500	1 700
at a pressure of approx.	bar	430	430	600	550	550
Stressing piston area	cm ²	235.74	235.74	182.21	278.02	309.25
Stressing stroke / Wedge-seating stroke	mm	250 / 40	100 / 40 250 / 40 250 / 60	200 / 60	250 / 0 250 / 40	150 / 40 250 / 40 250 / 160
Overall dimensions ²⁾ Diameter x length	mm	252 x 660	252 x 410 252 x 560 252 x 580	226 x 750	280 x 550 280 x 850	280 x 725 280 x 825 280 x 950
Center hole	mm	108	108	85	120	108
Max. number of strands	approx.	5 x 0.6" 7 x 0.5"	5 x 0.6" 7 x 0.5"	5 x 0.6" 7 x 0.5"	9 x 0.6" 12 x 0.5"	7 x 0.6" 12 x 0.5"
Min. projecting strand length	mm	600	450 600 620	650	700 750	650 750 880
Weight with / without interior parts	kg	120 / 95	68 / 52 ¹⁾ 95 / 76 ¹⁾ 97 / 78 ¹⁾	80 / 60 ¹⁾	180 / 150 195 / 165	170 / 140 190 / 160 208 / 175
Order No.		76-024.00	76-041.01 76-008.00 76-041.00	76-040.00	76-038.15 76-038.00	76-013.00 76-026.00 76-056.00

Series TENSA M - PV

Stressing force	kN	650	650	850	850	3 100
at a pressure of approx.	bar	550	550	500	440	600
Stressing piston area	cm ²	119.97	126.30	173.77	194.78	527.79
Stressing stroke / Wedge-seating stroke	mm	120 / 25	100 / 30 200 / 40 300 / 30 450 / 40	150 / 30	150 / 30 250 / 30	100 / 0 100 / 20 250 / 28
Overall dimensions ²⁾ Diameter x length	mm	180 x 650 180 x 470 ³⁾	197 x 375 197 x 480 197 x 580 197 x 744	215 x 600	230 x 440	400 x 500 400 x 630 400 x 940
Center hole	mm	62	74 / 65 ⁵⁾	85	85	175
Max. number of strands	approx.	3 x 0.6"	3 x 0.6"	4 x 0.6"	4 x 0.6"	15 x 0.6"
Min. projecting strand length	mm	260 / 130 ³⁾	150	160	160	250
Weight with / without interior parts	kg	70 / 57 ³⁾	60 / 53 82 / 75 104 / 97 136 / 128	95 / 92	100 / 97 125 / 121	285 / 230 390 / 320 505 / 420
Order No.		76-012.00 ³⁾ 76-012.26 ⁴⁾	76-011.00 76-030.00 75-007.00 76-045.00	76-017.00	76-031.00 76-037.00	76-047.40 76-047.00 76-048.00

2100	3000	3500	4800	6800	9750	15000
550	550	550	550	550	550	580
388.77	549.78	639.12	876.51	1237.01	1772.45	2695.29
250 / 60	250 / 0 250 / 60 250 / 160 460 / 60	100 / 0 250 / 0 250 / 60	200 / 60 300 / 60	120 / 60 300 / 60	300 / 60	500 / 60
328 x 840	375 x 600 375 x 880 375 x 980 375 x 1090	390 x 800 390 x 860	470 x 1040 470 x 1140	560 x 1020 560 x 1200	680 x 1200	980 x 1700
140	150	157	185	225	260	420
12 x 0.5" (12 x 0.6")	15 x 0.6" 19 x 0.5"	19 x 0.6"	22 x 0.6" 31 x 0.5"	31 x 0.6" 42 x 0.5"	42 x 0.6"	108 x 0.6"
800	750 800 900 1000	570 720 780	950 1050	970 1150	1150	1650
260 / 218	290 / 220 320 / 255 340 / 275 420 / 355	265 / 220 320 / 275 365 / 295	680 / 540 750 / 600	1030 / 720 1185 / 875	1770 / 1390	5800 / 4700
76-014.00	70-098.00 76-043.00 76-029.00 76-044.00	76-054.50 76-054.00 76-054.10	76-036.00 76-019.00	76-042.00 76-025.00	76-022.00	76-039.00

4800	7100	8600
600	600	550
860.01	1184.19	1566.87
100 / 20 300 / 28	120 / 20	300 / 40 ⁶⁾
520 x 660 520 x 1080	600 x 760	750 x 1350
235	254	360
22 x 0.6"	31 x 0.6"	61 x 0.6"
320	250	500
643 / 510 945 / 780	920 / 785	2150 / 1650
76-046.00 76-061.00	76-055.00	76-032.00

- 1) Mainly for stressing ground anchors, interior parts are threaded separately onto the anchor
- 2) The overall dimensions vary according to the interior parts used
- 3) Without separate wedge-seating piston
- 4) Order No. of separate wedge-seating piston
- 5) on 76-045.00
- 6) Wedge-seating stroke of 60 mm possible

All stressing jacks are made of high-tensile steels. The contact and slide faces of the pistons are super-finished and hard-chrome plated (superfinish: $R a_{\max} 0.1 - 0.2 \mu\text{m}$).

The seals used are antifriction slide rings and guide bands of (modified) PTFE.

To prevent corrosion, the basic jacks are chrome-plated and the interior parts electrogalvanized.



Fig. 7: On the PAUL stressing jack test stand it is possible to determine the friction of your stressing jack up to 3000 kN (10000 kN), e.g. of the PAUL TENSAM 3000 kN jack according to accuracy class 0.5 to DIN 7500-1.

Lightweight Stressing Jacks

For use on construction sites, e.g. for stressing ground anchors, we supply stressing jacks in lightweight design, made of light alloy and carbon fiber reinforced plastics (CFRP).



Fig. 8:
Light alloy hollow-piston cylinder from 950 kN to 1700 kN, center hole 90 mm to 130 mm



Fig. 9:
1400 kN CFRP lightweight stressing jack, stroke 250 mm, for 7 x 0.6" external wedge-seating cylinder

Pump Units

Stressing jacks, pushing machines and other accessories, such as steel cutters etc. are operated from a hydraulic pump unit.

To meet the demands for different working pressures and ease of handling, PAUL offer a range of pump units of different size and construction.

We supply an optimum pump unit for every application from the portable mini pump unit to the largest model provided with pneumatic tires for an easy transport over rough ground on construction sites.



Fig. 10:
NG 15 mini pump unit, 77-223.10, electrically controlled, for TENSA SM 240 kN



Fig. 11: Hydraulic unit 77-220.00, manually controlled, for TENSA M stressing jacks

Selection of Pump Units for TENSA M Stressing Jacks					
Type (Order No.)	77-193.00	77-227.32	77-220.00	77-207.00	77-194.00
Pump (l/min.)	3.0	3.7 / 7.4	5.8 / 11.6	5.8 / 11.6	7 / 24
Max. pressure (bar)	700	700	700	700	700
Control	manual	manual	manual	electric	electric
Motor power (kW)	3.0	5.5	9.0	15.0	15.0
Power supply (V/Hz) three phase (standard)	400 / 50	400 / 50	400 / 50	400 / 50	400 / 50
Oil tank (l) Nom./useful capacity	15 / 10	50 / 30	100 / 50	100 / 50	100 / 50
Weight (kg) without oil	57	120	230	340	380

All pump units are also available with combustion engines

TENSAcontrol

The exact measurement of the prestressing force and elongation is of vital importance to ensure the correct force transmission into the concrete element.

The TENSAcontrol unit provides for the exact measurement of the stressing force and elongation and stores the data obtained on a USB stick. These data can be evaluated on a PC to print out stressing force diagrams and stressing protocols.

This will enable you to document the quality of your products by protocols.

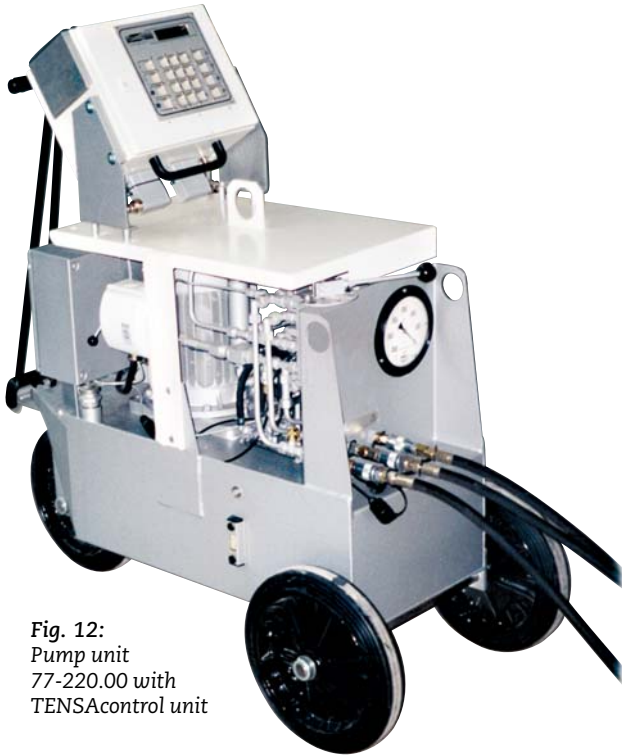


Fig. 12:
Pump unit
77-220.00 with
TENSAcontrol unit



Fig. 13: TENSA M stressing jack with TENSAcontrol unit

Strand Pushing Machines

PAUL pushing machines are used for the insertion of strands into cable ducts.

They feature an infinitely variable hydraulic pump which enables to suit the pushing speed to the course of the cable duct. Equipped with an NCS control and a length counter, the cable ducts can be filled by just one person.

PAUL has built hydraulic strand pushing machines for many years. They can be mounted on the pump unit when the strand is guided via flexible tubing and hoses to the tendon. Alternatively the lightweight pushing unit can be mounted directly on the tendon.

12 steel or plastic drive rollers push the strand at a speed of up to 9 meters/second into cable ducts of up to 300 m in length.

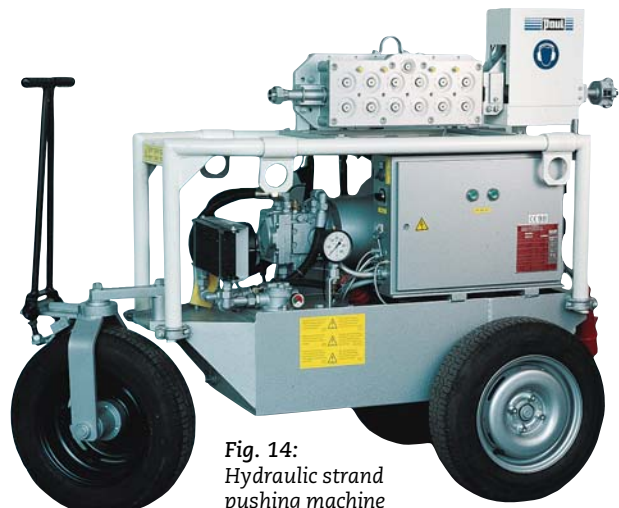


Fig. 14:
Hydraulic strand
pushing machine

TENSA M Stressing Jacks in Operation



Fig. 15:
TENSAM 3000 kN
multi-strand stressing
jack and TENSAM SM
240 kN single-strand
stressing jack



Fig. 16:
TENSAM 3000 kN
stressing jack used for
the reconstruction of a
motorway – lifting of
sections for repairing the
bearings



Fig. 17:
TENSAM 9750 kN
stressing jack (37 x 0.6")
operating in Japan



Fig. 18:
TENSAM 1700 kN
stressing jack and mini
pump unit – post-tensioned
beams on a construction
site in Malaysia

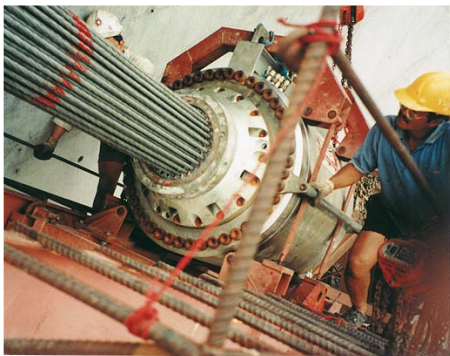


Fig. 19:
TENSAM 15000 kN
(108 x 0.6") on Kap Shui
Mun site (cable-stayed
bridge)



Fig. 20:
TENSAM 9750 kN
stressing jack stressing
37 x 0.6" anchors

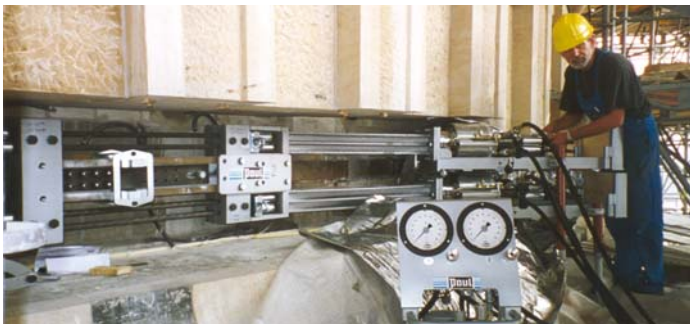


Fig. 21: TENSAM 1000 kN (4 x 2 jacks) used for stressing the circumferential anchors at the Dresden Frauenkirche cupola



Fig. 22: TENSAM 4800 kN stressing jack used for stressing 19 x 0.6" anchors