

# TECHNICAL DATA SHEETS

## FLAT JACKS

Data sheet n°: FT En C V 8 – 01/25

- Easy to use
- Cost-effective
- High compactness: high load and long stroke with low space requirement
- Range of products suitable for many configurations

### Product

Flat jacks, initially invented by Freyssinet to achieve the post-tensioning of structures, are thin hydraulic devices that make it possible to impose significant displacements and/or forces while requiring a particularly small space for their implementation. It is therefore a very efficient tool for example to lift existing structures.

### Description

The flat jack is in the form of a deformable capsule consisting of two half-pieces of cold-drawn steel including an o-ring chamber on its entire periphery. Two hydraulic connections (a vent and an injection point) allow the cylinder to be filled with pressurized liquid to deploy the cylinder over its entire available stroke.



Shape, stroke and colours *NEW!*

Considering the wide range of application cases likely to be encountered, the range of flat jack is developed to include 4 types of shapes: circular, oblong, rectangular or square.

In addition, depending on the load to be applied and the stroke required, the thickness and stroke of jacks are to be chosen on case-by-case basis within an off-the-shelf design, even if a specific design can be efficiently developed to fit any project needs. Refer to Figure 2, Figure 3 and Figure 5 for jacks geometry readily available. As described in , the jack stroke is equal to  $H_a - H_b = \varnothing_b - 2 \cdot e - 2$ . Should the maximum stroke available for one jack be insufficient, specific measures enable to pill up several jacks.

Considering the technical compromise between the stroke, the service load and the maximum possible steel capacity, each jack has its own maximum service pressure. The colour code described in is applied in all documentation as well as on the jack painting.

| Maximum service pressure | Colours |
|--------------------------|---------|
| 200 bar                  | Blue    |
| 160 bar                  | Green   |
| 125 bar                  | Yellow  |
| 100 bar                  | Red     |

Figure 1: Maximum service pressure colour code

| Circular jacks<br>Vérins Circulaires |         |                      |         |                           |                         |                           |
|--------------------------------------|---------|----------------------|---------|---------------------------|-------------------------|---------------------------|
| Jacks<br>Vérins                      |         |                      |         |                           |                         |                           |
| N°                                   | D<br>mm | Ø <sub>b</sub><br>mm | e<br>mm | S <sub>utile</sub><br>mm² | P <sub>max</sub><br>bar | F <sub>max</sub> **<br>kN |
| 1                                    | 70      | 15                   | 1,5     | 1256,6                    | 200                     | 25                        |
| 2                                    | 220     | 15                   | 1,5     | 28352,9                   | 200                     | 567                       |
| 3                                    | 650     | 15                   | 1,5     | 301907,1                  | 200                     | 6 038                     |
| 4                                    | 220     | 18                   | 1,5     | 26590,4                   | 200                     | 532                       |
| 5                                    | 300     | 18                   | 1,5     | 54739,1                   | 200                     | 1 095                     |
| 6                                    | 70      | 25                   | 2       | 314,2                     | 200                     | 6                         |
| 7                                    | 120     | 25                   | 2       | 3848,5                    | 200                     | 77                        |
| 8                                    | 150     | 25                   | 2       | 7854,0                    | 200                     | 157                       |
| 9                                    | 180     | 25                   | 2       | 13273,2                   | 200                     | 265                       |
| 10                                   | 190     | 25                   | 2       | 15393,8                   | 200                     | 308                       |
| 11                                   | 220     | 25                   | 2       | 22698,0                   | 200                     | 454                       |
| 12                                   | 250     | 25                   | 2       | 31415,9                   | 200                     | 628                       |
| 13                                   | 270     | 25                   | 2       | 38013,3                   | 200                     | 760                       |
| 14                                   | 300     | 25                   | 2       | 49087,4                   | 200                     | 982                       |
| 15                                   | 350     | 25                   | 2       | 70685,8                   | 200                     | 1 414                     |
| 16                                   | 420     | 25                   | 2       | 107521,0                  | 200                     | 2 150                     |
| 17                                   | 480     | 25                   | 2       | 145220,1                  | 200                     | 2 904                     |
| 18                                   | 675     | 25                   | 2       | 306796,2                  | 200                     | 6 136                     |
| 19                                   | 700     | 25                   | 2       | 331830,7                  | 200                     | 6 637                     |
| 20                                   | 920     | 25                   | 2       | 594467,9                  | 200                     | 11 889                    |
| 21                                   | 150     | 28                   | 2       | 6939,8                    | 200                     | 139                       |
| 22                                   | 270     | 30                   | 2       | 34636,1                   | 160                     | 554                       |
| 23                                   | 500     | 32                   | 2       | 149301,0                  | 160                     | 2 643                     |
| 24                                   | 250     | 35                   | 2       | 25446,9                   | 160                     | 407                       |
| 25                                   | 300     | 35                   | 2       | 41547,6                   | 160                     | 665                       |
| 26                                   | 350     | 35                   | 2       | 61575,2                   | 160                     | 985                       |
| 27                                   | 600     | 35                   | 2       | 220618,3                  | 160                     | 3 530                     |
| 28                                   | 750     | 35                   | 2       | 363168,1                  | 160                     | 5 811                     |
| 29                                   | 870     | 35                   | 2       | 502654,8                  | 160                     | 8 042                     |
| 30                                   | 920     | 35                   | 2       | 567450,2                  | 160                     | 9 079                     |
| 31                                   | 1000    | 35                   | 2       | 679290,9                  | 160                     | 10 869                    |
| 32                                   | 1016    | 35                   | 2       | 702865,4                  | 160                     | 11 246                    |
| 33                                   | 1050    | 35                   | 2       | 754296,4                  | 160                     | 12 069                    |
| 34                                   | 1250    | 35                   | 2       | 1093588,4                 | 160                     | 17 497                    |
| 35                                   | 1150    | 35                   | 2       | 916088,4                  | 160                     | 14 657                    |
| 36                                   | 350     | 40                   | 2       | 57255,5                   | 125                     | 716                       |
| 37                                   | 420     | 45                   | 2       | 85529,9                   | 125                     | 1 069                     |
| 38                                   | 500     | 45                   | 2       | 132025,4                  | 125                     | 1 650                     |
| 39                                   | 750     | 50                   | 2       | 331830,7                  | 100                     | 3 318                     |
| 40                                   | 1016    | 55                   | 2       | 644683,1                  | 100                     | 6 447                     |

Specific designs can be developed on request

\*\* F<sub>max</sub> : Maximum service load of the jack - A safety coefficient of 1,0 to 1,50 shall be applied on the required load capacity by the project

Figure 2 : Circular flat jacks available off-the-shelf

#### Fittings

The standard jacks are equipped with 6 x 8 mm steel tubes and 60 mm length (in accordance with the European standard EN 1057). These tubes are to be equipped with hydraulic connections (maximum service pressure at least equal to 250 bar). The complete range of accessories and connections can be supplied simultaneously with the jacks on request. The orientation of the nozzles, vents and supply are oriented by default at 90°, and a specific layout can be requested at the time of ordering.

# TECHNICAL DATA SHEETS

## FLAT JACKS

| Rectangular jacks<br>Vérins Rectangulaires |                |                |                |     |                  |                    |                  |                     |
|--------------------------------------------|----------------|----------------|----------------|-----|------------------|--------------------|------------------|---------------------|
| Jacks<br>Vérins                            |                |                |                |     |                  |                    |                  |                     |
| N°                                         | L <sub>1</sub> | ℓ <sub>2</sub> | Ø <sub>b</sub> | e   | R <sub>min</sub> | S <sub>utile</sub> | P <sub>max</sub> | F <sub>max</sub> ** |
|                                            | mm             | mm             | mm             | mm  | mm               | mm <sup>2</sup>    | bar              | kN                  |
| 1                                          | 420            | 360            | 15             | 1.5 | 100              | 122498             | 200              | 2 450               |
| 2                                          | 460            | 360            | 15             | 1.5 | 100              | 135698             | 200              | 2 714               |
| 3                                          | 500            | 200            | 15             | 1.5 | 100              | 73698              | 200              | 1 474               |
| 4                                          | 500            | 400            | 15             | 1.5 | 100              | 167698             | 200              | 3 354               |
| 5                                          | 610            | 410            | 15             | 1.5 | 100              | 214198             | 200              | 4 284               |
| 6                                          | 650            | 450            | 15             | 1.5 | 100              | 254198             | 200              | 5 084               |
| 7                                          | 740            | 350            | 15             | 1.5 | 100              | 220998             | 200              | 4 420               |
| 8                                          | 1550           | 280            | 15             | 1.5 | 100              | 373798             | 200              | 7 476               |
| 9                                          | 550            | 370            | 20             | 2   | 100              | 162806             | 200              | 3 256               |
| 10                                         | 850            | 650            | 20             | 2   | 100              | 488606             | 200              | 9 772               |
| 11                                         | 290            | 240            | 25             | 2   | 100              | 40771              | 200              | 815                 |
| 12                                         | 340            | 200            | 25             | 2   | 100              | 38671              | 200              | 773                 |
| 13                                         | 350            | 250            | 25             | 2   | 100              | 55171              | 200              | 1 103               |
| 14                                         | 410            | 220            | 25             | 2   | 100              | 56371              | 200              | 1 127               |
| 15                                         | 490            | 400            | 25             | 2   | 100              | 149171             | 200              | 2 983               |
| 16                                         | 500            | 300            | 25             | 2   | 100              | 107671             | 200              | 2 153               |
| 17                                         | 550            | 450            | 25             | 2   | 100              | 195171             | 200              | 3 903               |
| 18                                         | 573            | 457            | 25             | 2   | 100              | 208032             | 200              | 4 161               |
| 19                                         | 600            | 240            | 25             | 2   | 100              | 99671              | 200              | 1 993               |
| 20                                         | 700            | 250            | 25             | 2   | 100              | 125171             | 200              | 2 503               |
| 21                                         | 750            | 500            | 25             | 2   | 100              | 310171             | 200              | 6 203               |
| 22                                         | 737            | 457            | 25             | 2   | 100              | 274780             | 200              | 5 496               |
| 23                                         | 737            | 483            | 25             | 2   | 100              | 292642             | 200              | 5 853               |
| 24                                         | 850            | 750            | 25             | 2   | 100              | 555171             | 200              | 11 103              |
| 25                                         | 1550           | 280            | 25             | 2   | 100              | 340171             | 200              | 6 803               |
| 26                                         | 420            | 270            | 28             | 2   | 100              | 73446              | 200              | 1 469               |
| 27                                         | 420            | 320            | 28             | 2   | 100              | 91646              | 200              | 1 833               |
| 28                                         | 660            | 360            | 28             | 2   | 100              | 179166             | 200              | 3 583               |
| 29                                         | 700            | 450            | 28             | 2   | 100              | 249286             | 200              | 4 986               |
| 30                                         | 540            | 430            | 28             | 2   | 100              | 176566             | 200              | 3 531               |
| 31                                         | 720            | 540            | 28             | 2   | 100              | 316926             | 200              | 6 339               |
| 32                                         | 920            | 770            | 28             | 2   | 100              | 612446             | 200              | 12 249              |
| 33                                         | 650            | 500            | 30             | 2   | 100              | 255394             | 160              | 4 852               |
| 34                                         | 350            | 320            | 35             | 2   | 100              | 66373              | 160              | 1 062               |
| 35                                         | 470            | 400            | 35             | 2   | 100              | 128373             | 160              | 2 054               |
| 36                                         | 500            | 400            | 35             | 2   | 100              | 138273             | 160              | 2 212               |
| 37                                         | 770            | 370            | 35             | 2   | 100              | 206373             | 160              | 3 302               |
| 38                                         | 800            | 350            | 35             | 2   | 100              | 200773             | 160              | 3 212               |
| 39                                         | 890            | 810            | 35             | 2   | 100              | 603173             | 160              | 9 651               |
| 40                                         | 900            | 500            | 35             | 2   | 100              | 353273             | 160              | 5 652               |
| 41                                         | 900            | 700            | 35             | 2   | 100              | 519273             | 160              | 8 308               |
| 42                                         | 920            | 420            | 35             | 2   | 100              | 293873             | 160              | 4 702               |
| 43                                         | 1100           | 700            | 35             | 2   | 100              | 645273             | 160              | 10 324              |
| 44                                         | 1070           | 420            | 35             | 2   | 100              | 346373             | 160              | 5 542               |
| 45                                         | 1270           | 370            | 35             | 2   | 100              | 356373             | 160              | 5 702               |
| 46                                         | 1500           | 600            | 35             | 2   | 100              | 754273             | 160              | 12 068              |
| 47                                         | 670            | 650            | 37             | 2   | 100              | 339889             | 125              | 4 249               |
| 48                                         | 350            | 350            | 15             | 1.5 | 100              | 96198              | 200              | 1 924               |
| 49                                         | 360            | 360            | 15             | 1.5 | 100              | 102698             | 200              | 2 054               |
| 50                                         | 890            | 890            | 15             | 1.5 | 100              | 733398             | 200              | 14 668              |
| 51                                         | 750            | 750            | 25             | 2   | 100              | 485171             | 200              | 9 703               |
| 52                                         | 540            | 540            | 28             | 2   | 100              | 229806             | 200              | 4 596               |
| 53                                         | 250            | 250            | 30             | 2   | 100              | 31894              | 160              | 510                 |
| 54                                         | 370            | 370            | 35             | 2   | 100              | 86373              | 160              | 1 382               |
| 55                                         | 500            | 500            | 35             | 2   | 100              | 181273             | 160              | 2 900               |
| 56                                         | 550            | 550            | 35             | 2   | 100              | 226773             | 160              | 3 628               |
| 57                                         | 500            | 500            | 50             | 2   | 100              | 157854             | 100              | 1 579               |
| 58                                         | 650            | 650            | 50             | 2   | 100              | 300354             | 100              | 3 004               |

Specific designs can be developed on request

\*\* F<sub>max</sub> : Maximum service load of the jack - A safety coefficient of 1.0 to 1.50 shall be applied on the required load capacity by the project

Figure 3: Rectangular flat jacks available off-the-shelf



Figure 4: Filling the central volume using a resin mortar

| Vérins oblongs<br>Jacks<br>Vérins |                |                |                |     |                  |                    |                  |                     |
|-----------------------------------|----------------|----------------|----------------|-----|------------------|--------------------|------------------|---------------------|
| N°                                | L <sub>1</sub> | ℓ <sub>2</sub> | Ø <sub>b</sub> | e   | R <sub>min</sub> | S <sub>utile</sub> | P <sub>max</sub> | F <sub>max</sub> ** |
|                                   | mm             | mm             | mm             | mm  | mm               | mm <sup>2</sup>    | bar              | kN                  |
| 1                                 | 470            | 150            | 10             | 1.5 | 75               | 54873.2            | 200              | 1 097               |
| 2                                 | 470            | 200            | 10             | 1.5 | 100              | 74046.9            | 200              | 1 481               |
| 3                                 | 575            | 200            | 15             | 1.5 | 100              | 86448.0            | 200              | 1 729               |
| 4                                 | 350            | 250            | 15             | 1.5 | 125              | 60013.3            | 200              | 1 200               |
| 5                                 | 300            | 150            | 25             | 2   | 75               | 22854.0            | 200              | 457                 |
| 6                                 | 500            | 150            | 25             | 2   | 75               | 42854.0            | 200              | 857                 |
| 7                                 | 320            | 170            | 25             | 2   | 85               | 29309.7            | 200              | 586                 |
| 8                                 | 290            | 190            | 25             | 2   | 95               | 29393.8            | 200              | 588                 |
| 9                                 | 400            | 200            | 25             | 2   | 100              | 47671.5            | 200              | 953                 |
| 10                                | 400            | 270            | 25             | 2   | 135              | 66613.3            | 200              | 1 332               |
| 11                                | 615            | 200            | 25             | 2   | 100              | 79921.5            | 200              | 1 598               |
| 12                                | 750            | 150            | 25             | 2   | 75               | 67854.0            | 200              | 1 357               |
| 13                                | 870            | 270            | 25             | 2   | 135              | 170013.3           | 200              | 3 400               |
| 14                                | 1250           | 170            | 25             | 2   | 85               | 140909.7           | 200              | 2 818               |
| 15                                | 700            | 230            | 28             | 2   | 115              | 105558.7           | 200              | 2 111               |
| 16                                | 800            | 375            | 30             | 2   | 187.5            | 211806.1           | 160              | 3 389               |

Specific designs can be developed on request

\*\* F<sub>max</sub> : Maximum service load of the jack - A safety coefficient of 1.0 to 1.50 shall be applied on the required load capacity by the project

Figure 5: Oblong-shaped jacks

## Performances

The force exerted by the flat cylinder varies according to: the maximum stroke, the service pressure, as well as the useful section of the jack (which decreases when the jack opens). The maximum force values mentioned in the dimensional tables above are specific to each jack design. Jacks are to be selected while considering a safety factors applied on the expected load during the project (value between 1.2 and 1.5, as per NF EN 1993-4-2 – Eurocode 3 table 2.1).

The conversion pressure to load in the data above are to be considered with an uncertainty of around +/- 5%. If a lower uncertainty is required, a calibration (sacrificial operation to be performed on a jack dedicated to this purpose) on a cylinder in the batch) can be carried out in the laboratory.

Although these jacks can be used on a permanent or long-term basis when injected with a curable product (such as resin or cement grout), no transverse force can be taken up by the flat jack before complete setting of the filler.



Figure 6: building lifting & displacement monitoring



Figure 7: Nuclear reactor - Cadarache



## Application cases

### Areas of use

Flat cylinders can be used for many applications:

- Lifting,
- Weighing,
- Pushing,
- Formwork unloading,
- Bearings load transfer.

For the jacks to be operational after delivery to the site, they must be equipped with the required hydraulic connections that are compatible with the supply circuit (following the recommendation of the product use procedure) and the gap between the bulges must be filled. To flatten the support surface of the cylinders, several options are available:

- A wedge using a steel plate specific to the flat jack (dimensions provided on request),
- Filling the volume between the bulges with a resin mortar (see Figure 4),
- Pouring of the flat cylinder into a specifically designed concrete block (to be sized for each project).

Whether the jack is injected using a curable product (resin or cement grout) or a hydraulic fluid, the use of a high-pressure cylinder is necessary to precisely control the opening speed of the flat jack. This device is inserted in the supply circuit between the hydraulic pump and the flat jack.

Should the jack be injected with a curable product and is foreseen to be removed from the structure at a later stage, the unloading of the jack is possible using sand bearing box.

To ensure safety of the jacking operation shimming is required all along the operation to mitigate the risk of hydraulic failure during or after the jacking operation.



Abou Simbel / Egypt



Heron Tower - UK

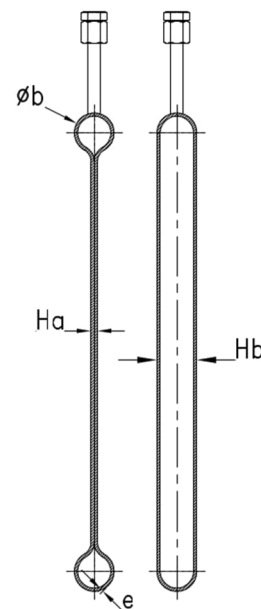
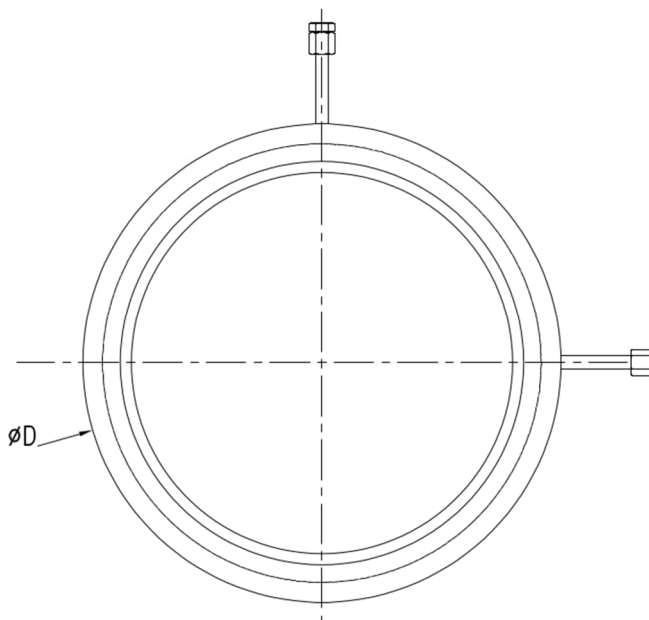


Figure 8: Jack stroke and fittings orientation