

# STRAND ANCHOR PERMANENT ANCHOR A2

Fiche technique n° : FT En C IX 1 1 1

- Permanent ground anchor
- Unitary Glogal Injection (UGI)
- Anchor head according to ETE 06/0226 (CE marked)
- Safe handling
- Easy monitoring and maintenance

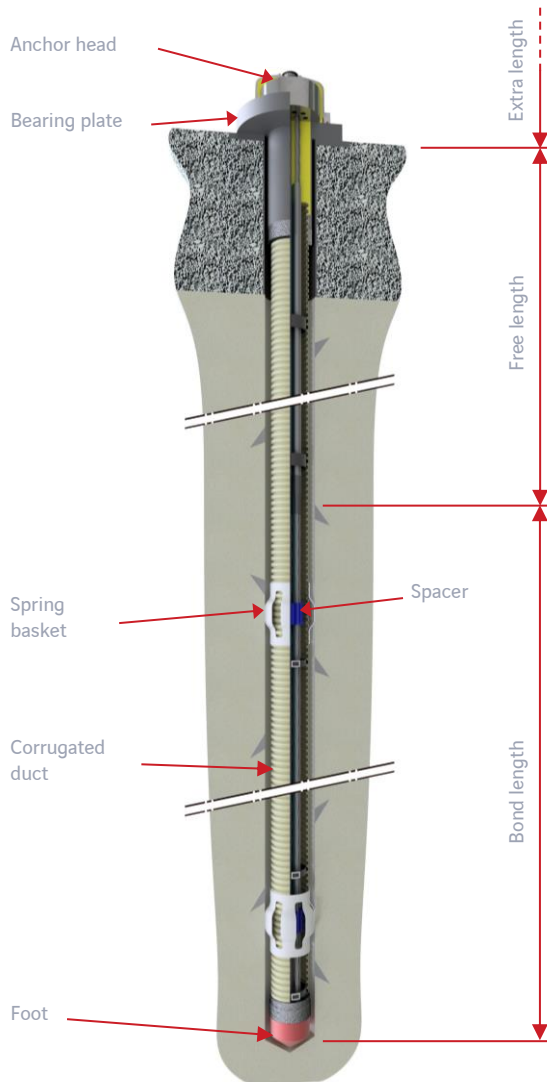
## Presentation

Freyssinet permanent ground anchors are designed for permanent ground stabilisation, structural anchoring or temporary support in particularly aggressive environments. They are used for all types of construction (buildings, roads, bridges, dams, pylons, tunnels, etc.), when a double corrosion protection (DCP) of the ground anchors is required. The A2 anchor is designed to be fitted with an UGI (Unitary Global Injection) grouting system.

## Description

The strand anchor consists of a part contained in a borehole (anchor body) and an external part (anchor head) which provides the reaction on the structure.

The anchor body is bonded in the ground over a length that depends on the anchor's capacity and the characteristics of the soil. This is achieved by injecting a cement grout using the UGI method.



General view of a strand anchor A2

## Range of strand anchors

The Freyssinet stand anchor consists of a bundle of prestressing strands. The capacity of a tendon is defined by the cross-section, steel class and number of strands making up a given cable.

| Type    |          | Nominal ultimate strength (N/mm <sup>2</sup> ) | Nominal yield strength (N/mm <sup>2</sup> ) | Cross section (N/mm <sup>2</sup> ) | Weight (kg/m) | Nominal ultimate load (kN) | Nominal yield load (kN) |
|---------|----------|--|---|------------------------------------|---------------|----------------------------|-------------------------|
| 2T15,2  | 2x0,6"   | 1 860  | 1 640                                       | 280                                | 2,20          | 521                        | 459                     |
| 3T15,2  | 3x0,6"   |  |   | 420                                | 3,30          | 781                        | 689                     |
| 4T15,2  | 4x0,6"   |  |   | 560                                | 4,40          | 1 042                      | 918                     |
| 5T15,2  | 5x0,6"   |  |   | 700                                | 5,50          | 1 302                      | 1 148                   |
| 6T15,2  | 6x0,6"   |  |   | 840                                | 6,59          | 1 562                      | 1 378                   |
| 7T15,2  | 7x0,6"   |  |   | 980                                | 7,69          | 1 823                      | 1 607                   |
| 8T15,2  | 8x0,6"   |  |   | 1 120                              | 8,79          | 2 083                      | 1 837                   |
| 9T15,2  | 9x0,6"   |  |   | 1 260                              | 9,89          | 2 344                      | 2 066                   |
| 10T15,2 | 10x0,6"  |  |   | 1 400                              | 10,99         | 2 604                      | 2 296                   |
| 11T15,2 | 11x0,6"  |  |   | 1 540                              | 12,02         | 2 864                      | 2 526                   |
| 12T15,2 | 12x0,6"  |  |   | 1 680                              | 13,19         | 3 125                      | 2 755                   |
| 13T15,2 | 13x0,6"  |  |   | 1 820                              | 14,29         | 3 385                      | 2 985                   |
| 2T15,7  | 2x0,62"  |  |   | 1 860                              | 1 640         | 300                        | 2,36                    |
| 3T15,7  | 3x0,62"  | 450  | 3,53  |                                    |               | 837                        | 738                     |
| 4T15,7  | 4x0,62"  | 600  | 4,71  |                                    |               | 1 116                      | 984                     |
| 5T15,7  | 5x0,62"  | 750  | 5,89  |                                    |               | 1 395                      | 1 230                   |
| 6T15,7  | 6x0,62"  | 900  | 7,07  |                                    |               | 1 674                      | 1 476                   |
| 7T15,7  | 7x0,62"  | 1 050  | 8,24  |                                    |               | 1 953                      | 1 722                   |
| 8T15,7  | 8x0,62"  | 1 200  | 9,42  |                                    |               | 2 232                      | 1 968                   |
| 9T15,7  | 9x0,62"  | 1 350  | 10,60                                       |                                    |               | 2 511                      | 2 214                   |
| 10T15,7 | 10x0,62" | 1 500  | 11,78                                       |                                    |               | 2 790                      | 2 460                   |
| 11T15,7 | 11x0,62" | 1 650  | 12,95                                       |                                    |               | 3 069                      | 2 706                   |
| 12T15,7 | 12x0,62" | 1 800  | 14,13                                       |                                    |               | 3 348                      | 2 952                   |
| 13T15,7 | 13x0,62" | 1 950  | 15,31                                       |                                    |               | 3 627                      | 3 198                   |

The young modulus of the strand is 195 000 MPa ± 10 000

The properties given above are those of the prEN10138 and ASTM416 standards.

Larger capacity strand anchors, with more strands, can be designed on request. The stress rate is set in relation to the nominal ultimate, or the nominal yield load, depending on the standard applicable to the project.



Ustaritz - France

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## Packing

The anchor body fitted with injection tubes that makes up the Freyssinet A2 strand anchor can be wound to a diameter of around 2 metres. It is packaged in coils for easy transport. These coils can be stored on different supports:



Lockable metal frames for truck transport



Wooden boxes for container or air transport

## Installation

Several methods of installing the strand anchors are possible. When the strand anchor is handled by crane, it can be fitted with a lifting point on request, to ensure maximum safety during the operation.



Installation with winch and guide



Installation by crane (with lifting point)

## Anchor body

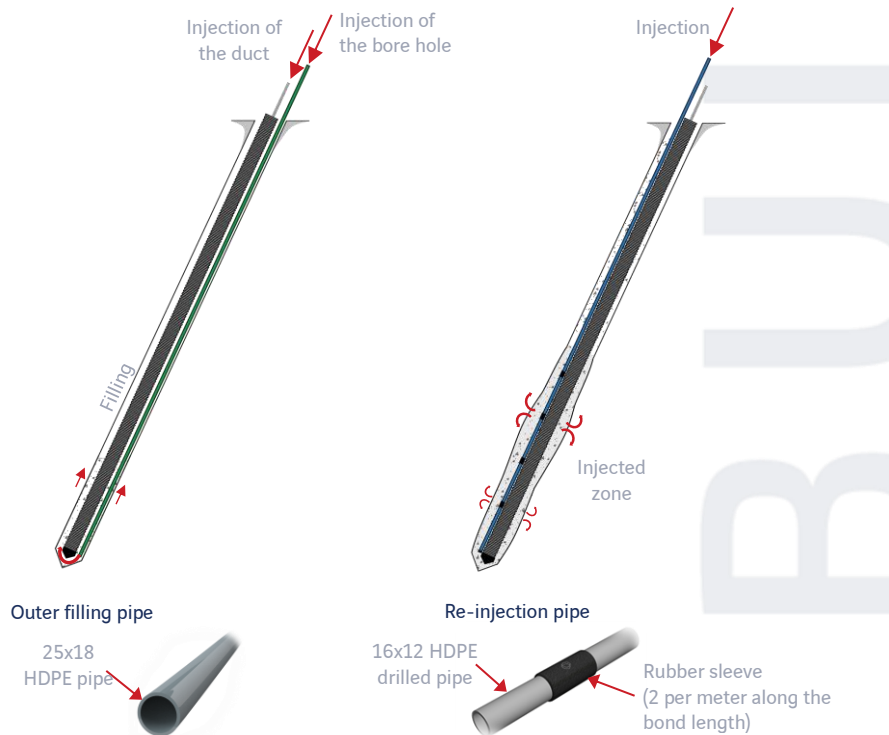
The strands are greased and individually sheathed in PE on the free length, and in bare steel on the bond length. They are arranged so that the sheath filler tube can be positioned. The bundle of strands thus formed is confined in the corrugated plastic duct. The individual injection tubes that make up the injection system are arranged on the outside of the duct. The combination of injection tubes is at the customer's discretion, depending on the method chosen:

### Phase 1 : Filling

The borehole is filled with cement grout after the strand anchor has been installed, using a pipe mounted on the outside of the duct or by some other means. The corrugated duct is filled simultaneously using the filling tube.

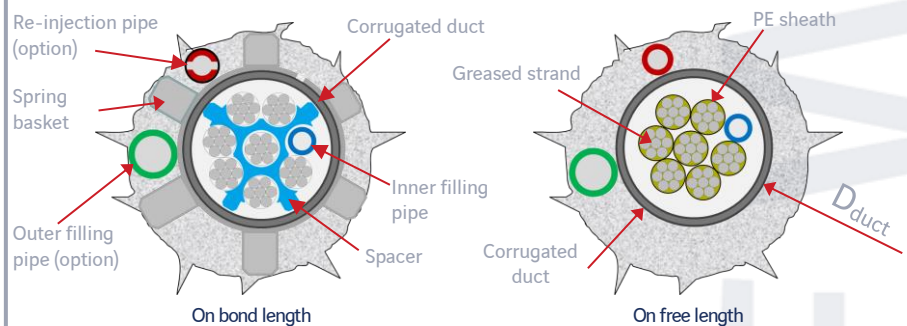
### Phase 2: UGI Injection

Injection takes place via a single reinjection sleeve tube mounted on the strand anchor. Several injection tubes can be placed in parallel to repeat the operation several times. In this case, the tubes can be of different lengths to select different injection zones.



The grouting parameters (grout properties, drilling diameter, injection pressures, lengths, etc.) are defined by the geotechnical designer and the contractor, then validated by preliminary or compliance tests.

### Example of combination with 8-slot spacer:



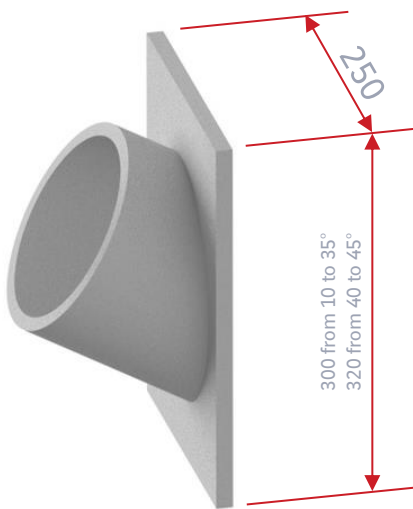
| Tendon     | D <sub>duct</sub> |
|------------|-------------------|
| 2T15       | 65 mm             |
| 3 and 4T15 | 70 mm             |
| 5 to 7T15  | 85 mm             |
| 8 to 12T15 | 100 mm            |
| 13T15      | 117 mm            |

The values in this table do not take into account the injection system located outside the duct. The diameter of the largest pipe should be added to deduce the total dimensions of the ground anchor body.

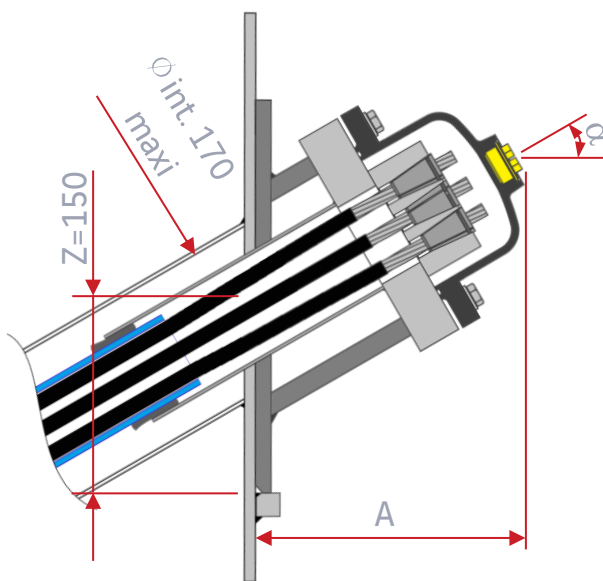
# STRAND ANCHOR PERMANENT ANCHOR A2



Anchor head equipped with an angular chair



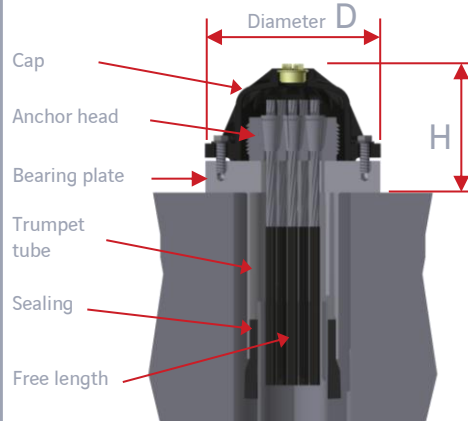
Dimensions of the standard angular chair



Position of the anchor head equipped with an angular chair

## Anchor head

The anchor head, which is installed after the bonding grout has hardened and the injection pipes have been recut, is made up of a block and jaws from Freyssinet's C range prestressing system technology, which has undergone European Technical Evaluation and is CE marked. It bears on a plate that transmits forces to the structure and ensures the continuity of the anti-corrosion protection of the stands. The cover and the area where the strands are stripped, located between the rear of the anchor block and the joint, are filled with wax or grease.



| Tendon      | Dimensions (mm) |     |
|-------------|-----------------|-----|
|             | H               | D   |
| 2 to 4T15   | 155             | 220 |
| 5 to 7T15   | 170             | 220 |
| 8 and 9 T15 | 185             | 280 |
| 10 to 13T15 | 200             | 280 |

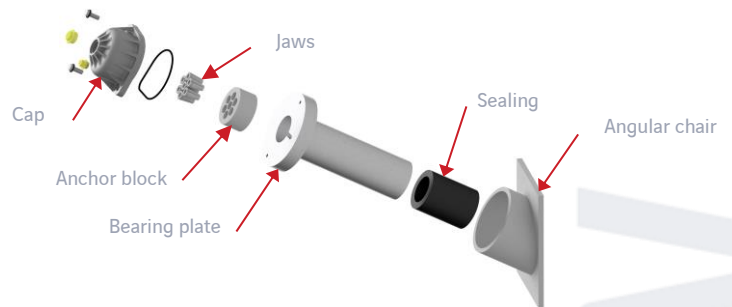
Note: the dimensions shown correspond to a maximum recess diameter of 170 mm. The strength of the concrete support surface must be checked separately. If necessary, these dimensions can be adapted on request.

The bearing plate is manufactured in accordance with EN1090-2 in execution class EXC2. Depending on the aggressiveness of the environment and the service life of the ground anchor, the bearing plate can be delivered with different anti-corrosion protective coatings:

- Without protection if the coating is applied on site
- With a simple coat of "anti-rust" paint for temporary ground anchors
- With a metal coating, according to EN 2063, equivalent to class C5-M protection
- Any other protection on request

## Angular chair

When the bearing plate is not perpendicular to the contact surface with the structure, an angular chair should be installed. The chair has the same anti-corrosion treatment as the bearing plate.



| Tendon | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|
| 4T15   | 244 | 250 | 255 | 257 | 251 | 251 | 253 | 251 |
| 7T15   | 259 | 265 | 269 | 271 | 264 | 263 | 268 | 267 |
| 9T15   | 276 | 283 | 287 | 289 | 285 | 284 | 304 | 305 |
| 13T15  | 291 | 297 | 301 | 303 | 298 | 296 | 316 | 315 |

Dimensions of the anchor head with a standard angular chair (dimension A in mm) depending on angle  $\alpha$

The support chair is manufactured in accordance with EN1090-2 in execution class EXC2. Angular chairs with different geometries can be designed on request. This is particularly the case when:

- The recess diameter is higher than 170 mm
- The angle is different from those shown above
- The dimension Z is different from 150 mm
- The ground anchors are drilled with an azimuth (lateral angle)

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## Environment

Freyssinet can issue environmental data sheets quantifying the carbon footprint of products ex-works. They consider the production of raw materials, their transport and the processing required to manufacture finished products.



## Other services and solutions

### Testing and stressing

Freyssinet offers on-site technical assistance to supervise stressing and testing operations. If these services are carried out by Freyssinet, a report complying with the applicable standard is issued for each ground anchor.



### Equipment

Freyssinet is able to provide specific equipment for stressing and testing ground anchors according to site requirements.



### Studies

For special requirements, Freyssinet's technical department is able to study tailor-made solutions, such as anchor heads adapted to an existing structure, a FreyssiCell load cell measurement acquisition system, adjustable removable monitored anchor head or handling devices adapted to the particularities of a project.

## Monitoring and surveillance

To monitor the behaviour of a wall fitted with permanent ground anchors, it is recommended to instrument a certain number of anchors (5% to 10%). This can be done by installing FreyssiCell load cells (see FreyssiCell data sheet for more details), which allow to monitor changes in tension over time. In addition, the use of threaded anchor blocks on all the ground anchors makes it possible to "weigh" each of them, through a lift off test, in order to refine the analysis if the load cells indicate abnormal behaviour in the wall. The customer is free to choose how to use these devices.



Instrumented anchor head



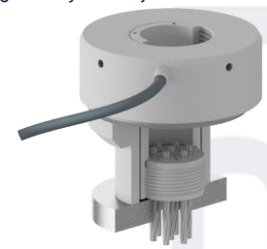
Lift-off test on a threaded block

## Threaded anchor head option

The use of a threaded anchor block offers the possibility of stressing the ground anchor once the strands have been cut. This makes it possible to carry out lift off test or tension adjustment operations by interposing washers under the anchor block, without acting directly on the jaws.



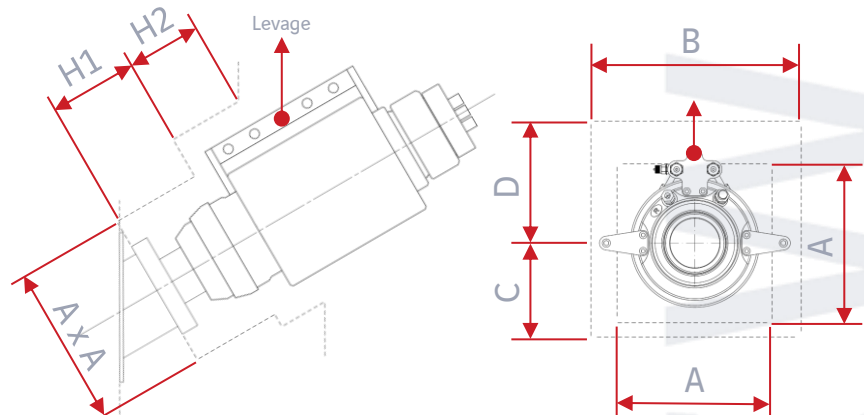
Threaded block before stressing



Lift off jack principle

## Practical arrangements

To ensure the correct installation of the tensioning and testing equipment, a minimum clearance must be maintained around the anchor heads.



| Tendon     | Jack   | H1  | H2  | A   | B   | C   | D   |
|------------|--------|-----|-----|-----|-----|-----|-----|
| 2 to 4T15  | VP 110 | 240 | 100 | 350 | 400 | 200 | 225 |
| 5 to 7T15  | VP 185 | 200 | 100 | 390 | 440 | 220 | 245 |
| 8 to 13T15 | VP 260 | 250 | 100 | 460 | 510 | 255 | 280 |

Dimensions in mm

Smaller jacks can be used if required.