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European Technical Assessment

ETA 19/0733 of 10/11/2023

General part

Technical Assessment Body issuing the ETA:	Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (Cerema)
Trade name of the construction product	CCL 'XU2-15' Monostrand Anchorage CCL 'XU2-13' Monostrand Anchorage
Product family to which the construction product belongs	16. Reinforcing and prestressing steel for concrete (and ancillaries). Post tensioning kits.
Manufacturer	CCL Stressing International Ltd Unit 8 Park 2000 Millennium Drive Leeds England LS11 5BP
Manufacturing plant(s)	CCL Stressing Systems Ltd Unit 8 Park 2000 Millennium Drive Leeds England LS11 5BP
This European Technical Assessment contains	28 pages including 12 Annexes (12 pages) which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	EAD 160004-00-0301 Post tensioning kits for prestressing of structures, September 2016.
This ETA replaces	ETA 19/0733 issued on 5 March 2020

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

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Specific parts

1 Technical description of the products

1.1. Definition of the product

This European Technical Assessment applies to:

CCL ‘XU2’ Monostrand Anchorage

Consisting of the following components:

- Tendon: Unbonded monostrand tendons with single tensile elements
- Tensile elements: 7-wire prestressing steel strand with nominal tensile strengths of 1770MPa/1860MPa and nominal diameters of 12.9 mm and 15.7 mm, HDPE/grease coated monostrand
- Anchorages: Live End and Dead End anchorages with single strands
- Reinforcement: Local anchorage zone reinforcement as link layouts
- Corrosion protection: Plastic coated strand with sealing around the anchorage zone
- Electric isolation: Plastic coated anchorage

1.2. Components and design

1.2.1. Range and designation of anchorages

The XU2 post-tensioning kit system of CCL includes two types of monostrand anchorages:

- XU2-15 monostrand anchorage for the use of single strands with a nominal diameter of 15.7 mm and a nominal cross section of 150 mm².
- XU2-13 monostrand anchorage for the use of single strands with a nominal diameter of 12.9 mm and a nominal cross section of 100 mm².

The type of anchorage is designated depending on its function in the structure in the following order :

- The first letters signify the system type;
- The next numbers signify the nominal diameter of the strands in the tendon;
- The next letter shows the type of anchorage;

Example: **XU2-15-D** means Dead End monostrand anchorage having 1 strand of Ø15 mm.

1.2.1.1 XU2 Live End Anchorages

CCL XU2 Live End (LE) anchorage components are circular/rectangular in section monostrand anchorages shown in Annex B. The anchorage comprises:

- Steel Wedge
- Plastic Coated Force Transfer Unit (FTU)
- Plastic Sleeve
- Plastic Sleeve Nut
- Plastic Sealing Cap (SC)

The strands of the anchorage are singularly stressed by a jack bearing on the FTU by means of a Stressing Nose (SN).

The prestressing force is applied to the strand and locked in place by the wedge into the FTU which is cast into the concrete. This FTU ensures the transmission of the prestressing force into the concrete.

There is no deviation of the strands from the FTU.

LE anchorages can be used as active or passive anchorages.

1.2.1.2 XU2 Dead End Anchorages

CCL „XU2" Dead End (DE) anchorages are circular/rectangular in section monostrand anchorages shown in Annex B. The anchorage comprises:

- Steel Wedge
- Plastic Coated Force Transfer Unit (FTU)
- Plastic Sleeve
- Plastic Sleeve Nut
- Plastic Sealing Cap (SC) with Spring

The wedge is locked in place via pre-seating. The prestressing force for pre-seating of the wedge should be equal to the values of F_{0s} shown in Table 1.2.3.3.1. A spring is required unless the pre-seating method is pre-approved by CCL. The spring is held in place by the SC while the prestressing force is applied to the opposite (live) end of the tendon. The prestressing force in the strand is locked by the wedge into the FTU which is cast into the concrete. This FTU ensures the transmission of the prestressing force to the concrete.

There is no deviation of the strand from the FTU.

DE anchorages can be used as buried passive anchorages. It is recommended in this case the wedges are preloaded onto the strand to ensure correct and efficient seating after concreting.

1.2.2. Anchorage Components

1.2.2.1 Wedges Type ‘U’

CCL Type “U" wedges are manufactured from a suitable case-hardening steel according to EN 10084.

The wedges are machined from bar stock according to the dimensions provided in Annex D. Wedges are roll marked on their cylindrical face for identification purposes.

The wedges are then heat treated to a specific process to obtain the necessary hardness and ductility.

1.2.2.2 XU2 Force Transfer Units

CCL ’XU2’ FTUs are manufactured from a suitable cast steel or suitable hot forged steel according to EN 10293 or EN 10083, the plastic coating is then applied by injection moulding.

The FTUs are manufactured according to the dimensions provided in Annex C. The FTUs are marked with the CCL Logo, part number and traceability reference for identification purposes.

1.2.2.3 XU2 Plastic Sealing Caps

CCL ‘XU2’ SCs are manufactured from plastic to the dimensions provided in Annex E and have lugs to lock into the FTUs. When springs are used for dead ends, such springs are placed inside the sealing caps.

1.2.2.4 Bursting reinforcement

Bursting reinforcement material designation is in accordance with European Standard EN 10080 with characteristic yield strength (f_{yk}) 500 MPa. The bursting reinforcement For the XU2 Monostrand anchorage is made of links, as shown in Annex G. As the bursting reinforcement cannot compensate for a local defect of filling of the concrete behind the anchorage, the designer of the structure will have to ensure that the density and the distribution of the reinforcement in the vicinity of the anchorages allows pouring and adequate compaction of the concrete whilst maintaining containment of the bursting forces.

If stated in the ETA, the local zone reinforcement specified in the ETA and confirmed in the load transfer test, may be modified for a specific project design if required in accordance with regulations at the place of use and relevant approval of the local authority and of the ETA holder to provide equivalent performance.

The local anchorage zone bursting reinforcement design rules for the CCL 'XU2' monostrand anchorage are based on a modified version of the equation proposed by Roberts[1].

1.2.2.5 XU2 Plastic Sleeve

CCL 'XU2' sleeves are manufactured from plastic to the dimensions provided in Annex D.

1.2.3. Tendons

1.2.3.1 Standard Notation

Table 1.2.3.1.1 lists the standard notation and its intended meaning used within this ETA.

Table 1.2.3.1.1 – Standard Notation

Notation	Definition
d	Nominal Diameter of an individual strand / mm
f_{pk}	Characteristic Tensile Strength of the strand / MPa
A_p	Nominal Cross-Sectional Area of the tendon / mm^2
A_s	Nominal Cross-Sectional Area of an individual strand / mm^2 ($A_s = A_p$ for a monostrand)
F_{pk}	Characteristic Ultimate Resisting Force of the tendon / kN ($F_{pk} = A_p$ x f_{pk})
$F_{p0.1k}$	Characteristic 0.1 % Proof Force of the tendon / kN ($F_{p0.1k} = A_p$ x $f_{p0.1k}$)
F_{pks}	Characteristic Ultimate Resisting Force of an individual strand / kN ($F_{pks} = F_{pk}$ for a monostrand)
$F_{p0.1ks}$	Characteristic 0.1 % Proof Force of an individual strand / kN ($F_{p0.1ks} = F_{p0.1k}$ for a monostrand)
F_0	Min (k_1F_{pk} ; $k_2F_{p0.1k}$) / kN
F_{0s}	Min (k_1F_{pks} ; $k_2F_{p0.1ks}$) / kN ($F_{0s} = F_0$ for a monostrand)
M_p	Nominal Mass per Metre of the tendon / kg/m
M_s	Nominal Mass per Metre of an individual strand / g/m ($M_s = M_p$ for a monostrand)

The maximum allowable stressing force that can be applied to the tendon immediately prior to lock-off must be determined in accordance with EN 1992-1.1, with values given in the relevant national annex for k_1 and k_2. Values given in the tables below are indicative values respecting recommended values by EN 1992-1.1 for k_1 and k_2. Overstressing is permitted if the force in the jack can be measured to an accuracy of ± 5 % of the final value of the prestressing force. In such cases the maximum prestressing force P_{max} may be increased to $k_3F_{p0,1ks}$ with $k_3 = 0.95$.

1.2.3.2 Strand Designation

Strand designation is in accordance with European Standard White Draft prEN 10138-3:2006 "Prestressing Steels - Part 3: Strand". For example, prestressing steel strand with a nominal tensile strength of 1860 MPa, 7 wires and a nominal diameter of 15.7 mm is designated as "EN10138-3-Y1860S7-15.7". Prestressing steel strand with a nominal tensile strength of 1770 MPa, 7 wires and a nominal diameter of 12.9 mm is designated as "EN10138-3-Y1770S7-12.9". In the interest of simplicity and for the purpose of this document, the various classes of strand will be referred to as Y(nominal tensile strength)-(nominal diameter), e.g. Y1770-15.2, as the standard prEN 10138-3 and number of wires in the strand remain constant.

[1] Roberts C., Behaviour and Design of the Local Anchorage Zone in Post-Tensioned Concrete. M.S. Thesis, University of Texas at Austin, May 1990

1.2.3.3 Strand Characteristics

The tendons consist of a single 7-wire prestressing steel strand, factory-provided with a sheathing and a corrosion protection system with characteristics in accordance with prEN 10138-3. Some typical characteristics are provided in Annex A.

In the absence of European standards for prestressing steel, strands complying with national provisions and with the characteristics given in Table 1.2.3.3.1 and Annex A shall be used.

Table 1.2.3.3.1 – Strand Characteristics

Designation	d mm	A_s mm²	M_s g/m	f_{pk} MPa	F_{pks} kN	$F_{p0.1ks}$ kN	F_{0s} kN
Y1770-12.9	12.9	100	781	1770	177	156	140
Y1860-12.9	12.9	100	781	1860	186	164	148
Y1770-15.7	15.7	150	1172	1770	266	234	211
Y1860-15.7	15.7	150	1172	1860	279	246	221

1.2.3.4 Prestressing Forces

Table 1.2.3.4.1 list the maximum allowable prestressing forces F_0 for all monostrands specified in this ETA as a guide only in accordance with Eurocode 2-1-1, Clause 5.10.2.1. For certain countries where national provisions are more restrictive, lower prestressing forces than specified below shall be applied. Allowable prestressing forces must be checked against relevant local standards.

Table 1.2.3.4.1 – Maximum Allowable Stressing Forces per Tendon

			Y1770		Y1860	
Strand diameter	A_p mm²	M_p kg/m	F_{pk} kN	F_0 kN	F_{pk} kN	F_0 kN
12.9 mm	100	0.78	177	140	186	148
15.7 mm	150	1.17	266	211	279	221

1.2.4. CCL Stressing Jacks

The CCL Stressing Jacks used for the CCL 'XU2' have the following features:

- Automatic gripping of the wedges on the strands.
- Single strand stressing of strands to the tendon.
- Stressing Noses to suit the anchorage.
- Partial stressing of the tendons with later recovery up to the final values of the prestressing force.
- The stressing by successive loadings of the Jack when the final extension is greater than the full extension of the CCL Jack.

Other different Jacks may be used by the CCL Specialist PT Distribution/Licence Company, provided their suitability to the CCL 'XU2' Monostrand anchorage is approved by CCL before use.

Manuals and procedures are supplied with each CCL Stressing Jack.

Various dimensions and characteristics of CCL Stressing Jacks are given in Annex H, Annex I, and Annex J. CCL Jacks are marked on the Outer Cylinder with their Serial Numbers for identification purposes.

Table 1.2.4.1 – Jacks for Relevant Anchorages

Jacks	XU2-13	XU2-15
160kN Jack Short Stroke (Including Nose Assembly Plunger)	106420	-
160kN Jack Long Stroke (Including Nose Assembly Plunger)	106430	-
300kN Jack Short Stroke (Including Nose Assembly Plunger)	-	107420
300kN Jack Long Stroke (Including Nose Assembly Plunger)	-	107430
250kN PT Jack (Including Nose Assembly Plunger)	103120	103130
250kN HRL Jack (Including Nose Assembly Plunger)	108420	108421

1.2.5. Friction Losses

With Post-Tensioned steel the effect of friction may be the single greatest factor causing loss of prestress. There are three main causes of friction loss in the Post-Tensioned tendon:

- Friction due to the deviation of the tendon through the anchorage.
- Friction between the tendon and the concrete due to unintentional lack of alignment (or wobble).
- Friction due to the curvature of the tendon.

Friction Loss for Post-Tensioned tendons can be estimated from:

$$\Delta P_{\mu}(x) = P_{\max}\left(1 - e^{-\mu(\theta + kx)}\right)$$

Where:

$\Delta P_{\mu}(x) =$ losses due to friction
$P_{max} =$ force at the active end (x = 0)
$\theta =$ sum of the angular displacements over a distance x (irrespective of direction or sign)
$\mu =$ coefficient of friction between the tendon and its duct (per 1/radian)
$k =$ unintentional angular displacement (per radian/meter)
$x =$ distance along the tendon from the point where the prestressing force is equal to P_{max}

The values for the coefficient of friction, μ, and unintentional angular displacement, *k*, are given in Table 1.2.5.1. Values are in line with EN 1992 "Eurocode 2: Design of Concrete Structures" and previous experience from site measurements. Values for the coefficient of friction may differ in local codes and can change due to the condition of strand and installation practices. The user should check local codes for compliance.

Table 1.2.5.1 – Coefficients of Friction and Unintentional Angular Displacement

Application	Strand Sheathing Type	μ		k	
		Minimum	Maximum	Minimum	Maximum
Unbonded Prestressing	Plastic	0.07	0.10	0.01	0.025

When the tendon to be controlled has 2 Active/LE anchorages, i.e. with the tendon being able to be stressed with the jack at both ends, the measurement on site of the friction loss of the tendon is possible by comparing the load applied by one Jack to the load measured on the other jack.

1.2.6. Anchorage Wedge Set

CCL 'XU2' Range Jacks are equipped with a hydraulic lock-off system ensuring even seating of the wedges in the FTU before removal of the jack. After the transfer of load from the jack to the anchorage, the strand and wedges draw a little further into the FTU. This further movement is known as wedge set. The wedge set leads to a loss of tension in the strand, which must be taken into account in the load loss/elongation calculations.

The values for wedge set to be used in the calculations for all tendons are:

- For active anchorages with jacks with hydraulic lock-off:
- Wedge set, g = 6 mm ± 2 mm

For active anchorages with jacks without hydraulic lock-off:

- Wedge set, g = 8 mm ± 2 mm

For passive anchorages with pre-seated wedge, where pre-seat load ≥ stressing load :

- Wedge set, g = 0 mm

For passive anchorages with spring-loaded retaining plates:

- Wedge set, g = 8 mm ± 2 mm

1.2.7. Tendon Elongation

The force in the tendon during stressing is measured with a hydraulic pressure gauge. Elastic elongation of the tendon can also be used to monitor this force. The designer specifies an expected elongation (including acceptable tolerance). The following formula can be used to estimate the elongation:

$$\delta = \frac{PL_t}{\left(A_p E_s\right)}$$

Where:

δ = elongation of the tendon

P = average force in a tendon

L_t = tendon length between anchorages

A_p = nominal cross - sectional area of a tendon

E_s = modulus of elasticity of the tendon steel

Monostrand tendons usually have very little slack in the system before stressing and therefore should not require an initial stressing operation. Before being stressed, a reference point should be marked on the strand tail. This point is then taken as the reference zero point for the measurement of elongation.

1.2.8. Spacing of the Supports

For XU2-13 and XU2-15, the maximum spacing of the supports will be 1.0 m to 1.2 m and 1.2 m to 1.5 m respectively depending on construction practices and national regulations.
The supports carrying the tendons should be sufficiently strong to carry the weight of the tendons, as well as the forces occurring during and after concreting, including compaction of the concrete.

1.2.9. Radius of Curvature

Generally minimum radius of curvature must comply with national regulations.

1.2.10. Compressive Strength of Concrete

The mean compressive strength of concrete at which full prestressing is permitted, $f_{cm,0}$, specified by the designer of the structure must be greater than or equal to 25 MPa cube strength.

1.2.11. Anchorage Spacing and Concrete Cover

Taking into account the tested values of mean compressive concrete strength, $f_{cm,0}$, (25 MPa cube strength for units XU2-13 and XU2-15); the test specimen side lengths of the end block (a and b) are provided in Annex F.

The minimum concrete cover from the reinforcement to the edge of the structure, c_{min}, should be established according to EN 1992 Eurocode 2: Design of Concrete Structures and must be taken

into account when determining the minimum distances from the axis of an anchorage to the edge of the structure (e_x and e_y).

Given the test specimen side lengths ***a*** and ***b*** in Annex F, the minimum distances between two axes of anchorages (x and y) result from the following formula:

$$x \,.\, y = a \,.\, b$$

With:

$$x \geq 0.85\, a$$
$$\text{or } y \geq 0.85\, b$$

Where a, b : side lengths of test specimen (reference dimensions given in ETA)
$x,\ y$: minimum specified centre spacing of the particular tendon in the structure, whichever is smaller; $x \leq y$

Edge distances in the structure (e_x and e_y) are calculated with centre spacing in x- and y-direction by:

$$e_x = \frac{x}{2} - 10\ \text{mm} + c$$
$$e_y = \frac{y}{2} - 10\ \text{mm} + c$$

Where:

$e_x,\ e_y$: Edge distance in x- and y-direction respectively
c : Concrete cover of reinforcement in the structure as required at the place of use

1.3. Installation

The CCL 'XU2' anchorages are fit for use in suitably designed structures. The designer of the structure is assumed to respect the relevant specifications set by applicable standards and to adapt their design in accordance with these standards and the advice of the ETA holder.

1.3.1. Anchorages

The plastic coated strand is fitted into the FTU and the sheathing cut flush with the back face of the FTU (see Annex B) it is then sealed by means of a plastic concrete excluder. The pocket former and FTU are fixed to the formwork by means of a rubber sealing washer, plastic bayonet fitting and a slotted plastic nut.

The local bursting reinforcement is attached with the general reinforcement.

To facilitate the installation of the FTU and the wedge a sufficient open space must be reserved behind each anchorage. This open space must also allow for the implementation of the sealing cap and stressing.

Setting out dimensions of the anchorage and space reserved behind each anchorage are to be checked before concreting. Wedges are assembled immediately prior to stressing of the tendon in order to avoid corrosion.

1.3.1.1 Active Anchorages

Sufficient space must be reserved behind the anchorage for the installation and operation of the stressing jack. Stressing must only be carried out when the concrete has cured to the required minimum compressive strength.

The tail length of the strands, calculated from exposed face of the FTU must be sufficient to allow installation of the FTU and wedge, the threading of the stressing jack and insertion of the jack wedge. These lengths should be checked with the local agent to ensure the suitability to the particular stressing jack to be used.

1.3.1.2 Passive Anchorages

For tendons where the tension is applied at one end only, a dead end anchorage can be used. The wedge is pre seated in the anchor head by a seating jack. The prestressing force for pre seating of the wedge should be equal to the values of F_{0s} shown in Table 1.2.3.3.1. The spring is then located within the sealing cap which is filled with grease. This will hold the wedges in place with sufficient force to help prevent wedge-stepping.

The cut length of the strands, calculated from exposed face of the FTU must be sufficient to allow installation of the sealing cap and spring but not too long to interfere with the fitting of the cap.

1.3.2. Corrosion Protection

At live end anchorages, the strands are cut after stressing and grease filled caps are fitted onto the FTU to protect the open end of the strand. The cut length of the strands, calculated from exposed face of the FTU must be sufficient to allow installation of the sealing cap but not too long to interfere with the fitting of the cap.

After fitting the sealing cap the exposed void is filled with a dry mixture of sand and cement grout. See Clause 1.2.3.3 for details of strand sheath.

1.4. Working life

The provisions made in this ETA are based on an assumed intended working life of the CCL ‘XU2’ Monostrand Anchorage of 100 years (provided that the conditions laid down for packaging / transport / storage / installation / use / maintenance / repair are met). The indications given on the working life cannot be interpreted as a guarantee given by the producer or the approval body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

2 Performance of the products and methods used for its assessment

This European Technical Assessment for the post-tensioning system part of this document is issued on the basis of agreed data, deposited at Cerema, which identifies the post-tensioning system that has been assessed and judged.

Assessment of the performance of the post-tensioning system part of this document for the intended use in the sense of basic requirement for construction work 1 (mechanical resistance and stability) and for basic requirement for construction work 3 (hygiene, health and environment) has been made in accordance with the European Assessment Document (EAD) 160004-00-0301 edition September 2016 "Post-tensioning kits for prestressing of structures".

Table 2.1 – Performances

Product type: Post-Tensioning kit		**Intended use:** Prestressing of structures
N°	**Essential characteristic** (acc. to EAD 160004-00-0301)	**Product Performance**
Basic requirement for construction works 1: Mechanical resistance and stability		
1	Resistance to static load	≥ 95 % of Actual Ultimate Tensile Strength – AUTS
2	Resistance to fatigue	No fatigue failure in anchorage and not more than 5 % loss on cross section after 2 million cycles
3	Load transfer to the structure	Stabilization of crack width under cyclic load and ultimate resistance ≥ 110 % characteristic load
4	Friction coefficient	See Clause 1.2.5
5	Deviation / deflection for internal unbonded tendon	See Clause 1.2.9
6	Deviation / deflection for external tendon	See Clause 1.2.9
7	Assessment of assembly	Assessment based on judgment and data of PT system
8	Resistance to static load under cryogenic conditions for applications with anchorage/coupling outside the possible cryogenic zone	No performance assessed
9	Resistance to static load under cryogenic conditions for applications with anchorage/coupling inside the possible cryogenic zone	No performance assessed
10	Material properties, component performance, system performance of plastic duct	No performance assessed
11	System performance of plastic duct to provide an encapsulated tendon	System performance PL2
12	Material properties, component performance, system performance of plastic duct to provide an electrically isolated tendon.	No performance assessed
13	Corrosion protection	See Clause 1.3.2
Monostrand, sheathing base material[2]		No performance assessed
Monostrand, manufactured sheathing[3]		No performance assessed

[2] Essential characteristics 14 to 19 according to EAD 160004-00-0301, Table 1.
[3] Essential characteristics 20 to 26 according to EAD 160004-00-0301, Table 1.

Monostrand, manufactured monostrand[4]		No performance assessed
Basic requirement for construction works 2: Safety in case of fire		
35	Reaction to fire	No performance assessed
Basic requirement for construction works 3: Hygiene, health and the environment		
36	Content, emission and/or release of dangerous substances	No performance assessed

[4] Essential characteristics 27 to 34 according to EAD 160004-00-0301, Table 1.

3 Assessment and verification of constancy of performance system applied, with reference to its legal base

In accordance with the decision 98/456/EC[5] of the European Commission, the system 1+ of assessment and verification of constancy of performances (see Annex V to Regulation (EU) No 305/2011), given in the following table applies:

Table 3.1 – AVCP system

Product(s)	Intended use(s)	Level(s) or class(es)	System(s)
Post-tensioning Kits	For the prestressing of structures	-	1+

This AVCP system is defined as follows:

System 1+: Declaration of the performance of the essential characteristics of the construction product by the manufacturer on the basis of the following items:

(a) Tasks of the manufacturer
- (1) Factory production control;
- (2) Further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;

(b) Tasks for the notified body
- (3) Determination of the product-type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product;
- (4) Initial inspection of factory and of factory production control;
- (5) Continuous surveillance, assessment and approval of factory production control;
- (6) Audit testing of samples taken at the factory.

[5] Official Journal of the European Union L201/112 of 3 July 1998

4 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

4.1. Tasks for the Manufacturer

4.1.1. Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures including records or results performed. This production control system shall insure that the product is in conformity with this European Technical Assessment.

The manufacturer shall only use initial / raw / constituent materials (as relevant) stated in the technical documentation of this European Technical Assessment.

The factory production control shall be in accordance with the "CCL Control Plan" relating to this European Technical Assessment which is part of the technical documentation of this European Technical Assessment. The "Control Plan" is laid down in the context of the factory production control system operated by the manufacturer and deposited at Cerema.

The prescribed test plan defined in Annex K gives the type and frequency of checks and tests conducted during production and on the final product as part of the continuous internal production control.

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the "CCL Control Plan" relating to this European Technical Assessment.

The records contain at least the following information:

- designation of the product or basic materials and the components;
- type of control or testing;
- date of manufacture and of testing of product or components and of basic materials or components;
- results of controls and tests and, where relevant, comparison with the requirements;
- signature of person responsible for the factory production control.

The kit manufacturer is responsible for the manufacture and the quality of each component that is manufactured or supplied by a subcontractor.

If the test results are unsatisfactory, the manufacturer shall immediately implement measures to eliminate defects. Construction products or components which are not in compliance with the requirements shall be handled such that they cannot be mistaken for products complying with the requirements. After elimination of the defects the relevant tests shall be immediately repeated as far as is technically possible and necessary for verifying the deficiency elimination.

The records shall be kept for at least ten years and submitted to the notified body. On request they shall be presented to Cerema.

4.1.2. Other tasks

The manufacturer shall, on the basis of a contract, involve a body (bodies) which is (are) notified for the tasks referred to in Clause 4.2 in the field of CCL post-tensioning system in order to undertake the actions laid down in Clause 4.2. For this purpose, the "CCL Control Plan" referred to in sections 4.1 and 4.2 shall be handed over by the manufacturer to the notified body or bodies involved.

The manufacturer shall make a declaration of performance, stating that the construction product is in conformity with the provisions of this European Technical Assessment.

At least once a year, each components manufacturer shall be audited by the kit manufacturer.

At least once a year specimens shall be taken from at least one job site and one series of single tensile element test shall be performed according to Clause 3.3 of EAD 160004-00-0301. The results of these test series shall be made available to the notified body.

4.2. Tasks of the Notified body

4.2.1. General

The notified body (bodies) shall perform the :

- Determination of the product-type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product,
- Initial inspection of factory and of factory production control,
- Continuous surveillance, assessment and approval of factory production control,
- Audit-testing of samples taken at the factory

in accordance with the provisions laid down in the "CCL Control Plan" relating to this European Technical Assessment.

The notified body (bodies) shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The main production centre is checked at least once a year by the notified body. Each component producer is checked at least once every five years by the notified body.

The notified certification body involved by the manufacturer shall issue a certificate of constancy of performance of the product stating the conformity with the provisions of this European Technical Assessment.

In cases where the provisions of the European Technical Assessment and its “Control Plan” are no longer fulfilled the certification body shall withdraw the certificate of constancy of performances and inform Cerema without delay.

4.2.2. Determination of the product-type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product

For initial type testing the results of the tests performed as part of the assessment of the European Technical Assessment may be used unless there are changes in production procedure or factory plant. In such cases, the necessary initial type testing shall be agreed between Cerema and the notified body involved.

4.2.3. Initial inspection of factory and of factory production control

The notified body shall ascertain that, in accordance with the prescribed test plan, the manufacturing plant, in particular personnel and equipment, and the factory production control are suitable to ensure a continuous orderly manufacturing of the post-tensioning system according to the specifications given in this European Technical Assessment.

4.2.4. Surveillance, assessment and approval of factory production control

The kit manufacturer shall be inspected at least once a year. Each component manufacturer shall be inspected at least once in five years. It shall be verified that the system of factory production control and the specified manufacturing process are maintained taking into account the prescribed test plan.

4.2.5. Audit testing of samples taken from the kit manufacturer

During surveillance inspection, the notified body shall take samples at the factory of components of the PT system or of individual components for which this European Technical Assessment has been granted, for independent testing. For the most important components, Annex L complying with

Clause 3.3 of EAD 160004-00-0301, summarises the minimum procedures which have to be performed by the certification body.

Issued in Sourdun on 10 November 2023

By
Centre d’étude et d’expertise sur les risques, l’environnement, la mobilité et l’aménagement (Cerema)
Direction technique Infrastructures de transport et matériaux (DTecITM)

Eric MOULINE 2310009981me

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Date : 2023.11.10 14:12:14 +01'00'

Éric MOULINE, Deputy Director of Cerema ITM

Designation of tendon

Prestressing steel:

-	Type:		Strand according to prEN 10183-3
-	Strength:	f_{pk}	1860 MPa or 1770 MPa
-	Nominal cross section:	A_s	See Clause 1.2.3.3 Strand Characteristics
-	Relaxation at $0.70f_{pk}$ after 1000 hours:		2.5 %
-	Modulus of elasticity:	E_s	195 GPa

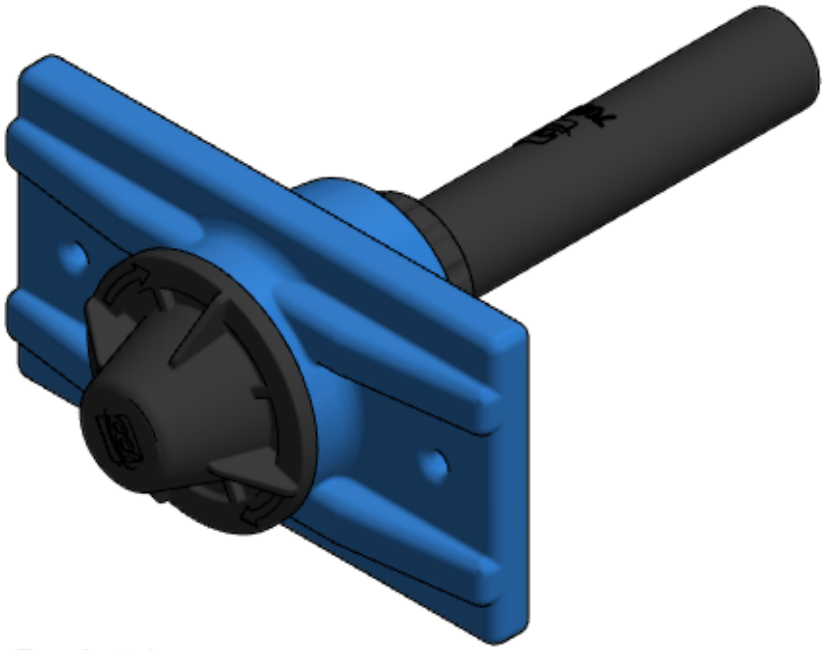
Tendon:

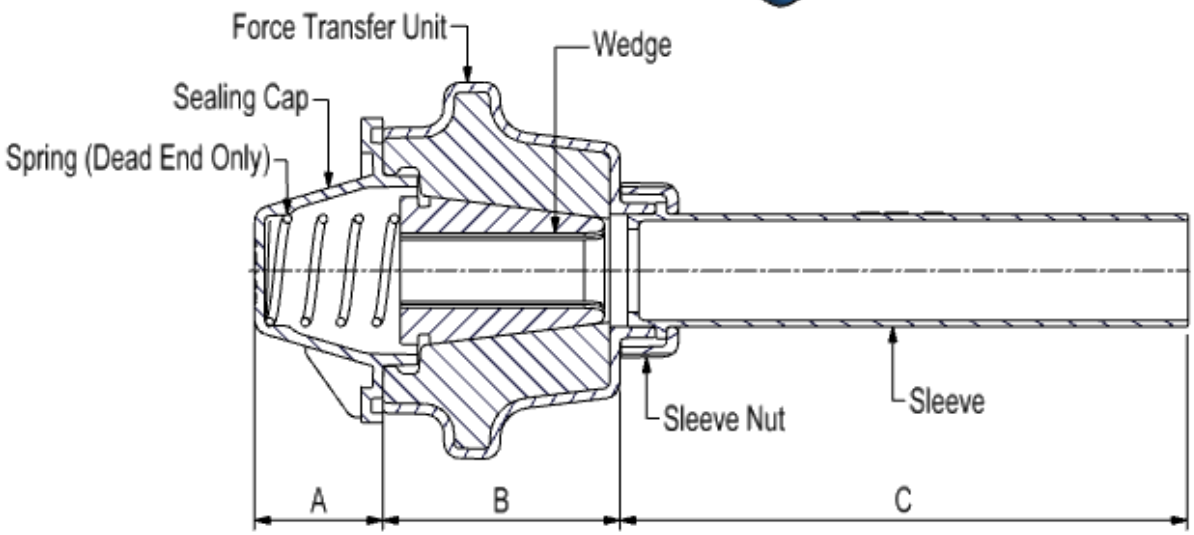
-	Type:		Internal Unbonded
-	Use category:		Concrete, Composite, Steel, Masonry, Timber
-	Corrosion protection:		Grout, Grease, Wax
-	Weight of tendon:	M_p	See Clause 1.2.3.4 Prestressing Forces
-	Force at $1.00f_{pk}$:	F_{pk}	See Clause 1.2.3.4 Prestressing Forces
-	Friction coefficient:	μ	See Clause 1.2.5 Friction Losses
-	Unintentional deviation/ Wobble coefficient:	k	See Clause 1.2.5 Friction Losses
-	Minimum radius of curvature:	$R_{\min}$	See Clause 1.2.9 Radius of Curvature
-	Maximum spacing of duct supports:	$s_{\max}$	See Clause 1.2.8 Spacing of the Supports

Anchorages:

-	Type:		See Clauses 1.2.1 to 1.2.2 & Annexes B to E
-	Minimum centre spacing:	x , y	See Annex F and Clause 1.2.11 Anchorage Spacing and Concrete Cover
-	Minimum edge distance:	e_x, e_y	See Annex F and Clause 1.2.11 Anchorage Spacing and Concrete Cover
-	Anchorage seating:	g	See Clause 1.2.6 Anchorage Wedge Set

Live and Dead end Anchorage Assembly



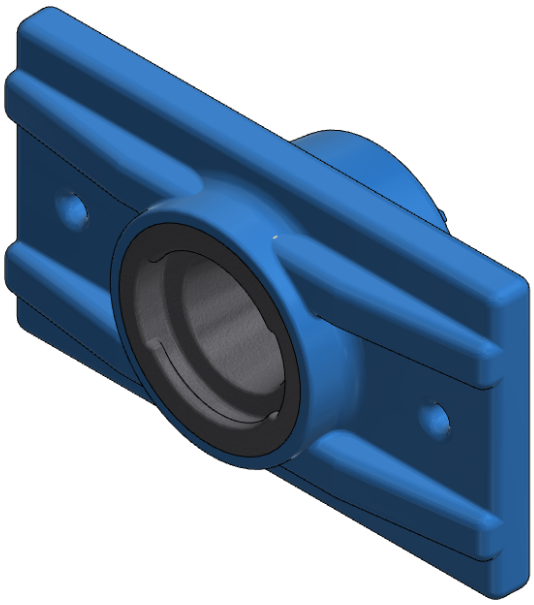


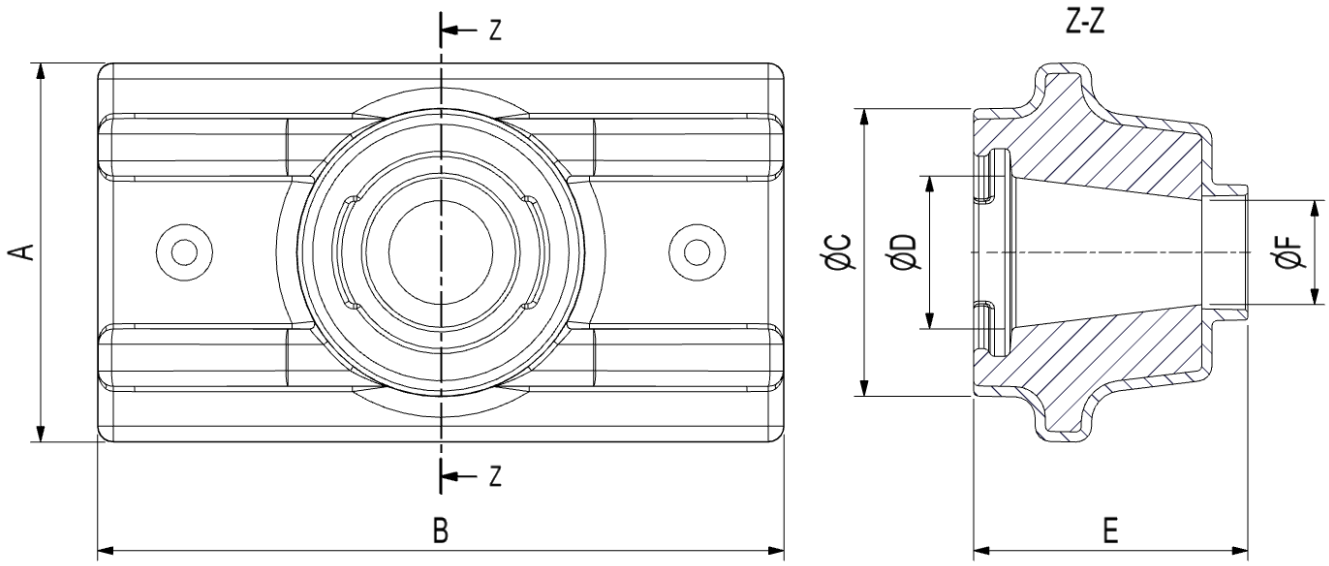
Anchorage	A (mm)	B (mm)	C (mm)
XU2-13	46	38	112
XU2-15	25	47	112

CCL ‘XU2’ System
Live and Dead end Anchorage

Annex B
of ETA-19/0733

Plastic Coated Force Transfer Unit



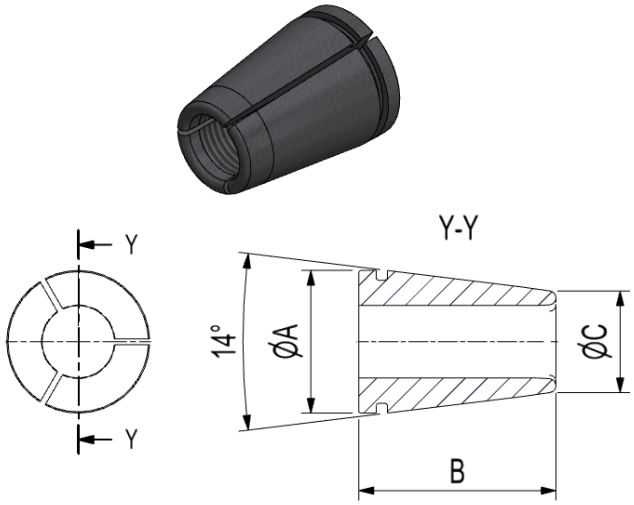


Anchorage	A (mm)	B (mm)	ØC (mm)	ØD (mm)	E (mm)	ØF (mm)
XU2-13	64	114	49	29	45	20
XU2-15	74	134	56	25	54	18

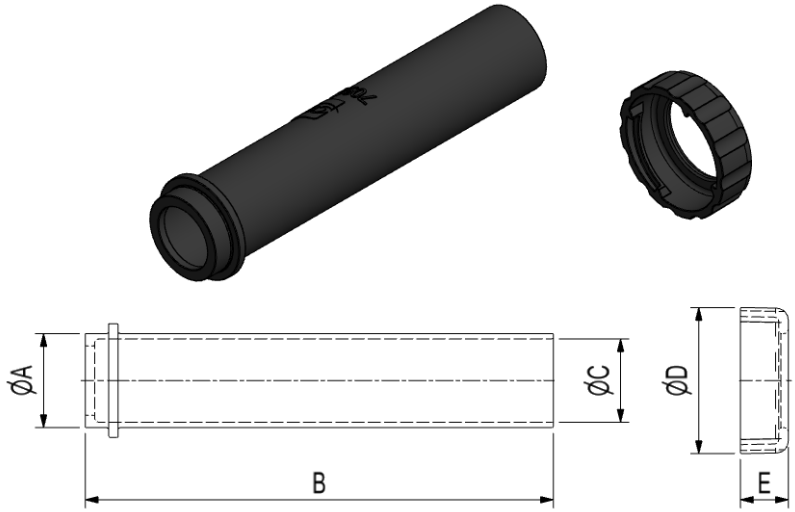
CCL ‘XU2’ System
Force Transfer Unit

Annex C
of ETA-19/0733

Wedge, Sleeve and Sleeve Nut



Anchorage	ØA (mm)	B (mm)	ØC (mm)
XU2-13	25	32	18
XU2-15	29	40	21

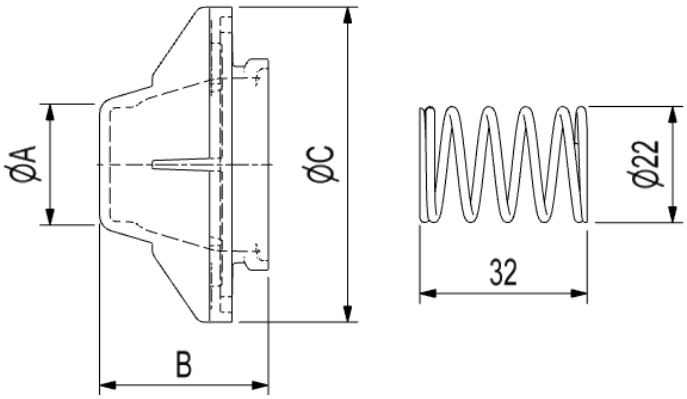


Anchorage	ØA (mm)	B (mm)	ØC (mm)	ØD (mm)	E (mm)
XU2-13	20	110	17	34	10
XU2-15	22	110	20	32	10

CCL ‘XU2’ System
Wedge and Sleeve

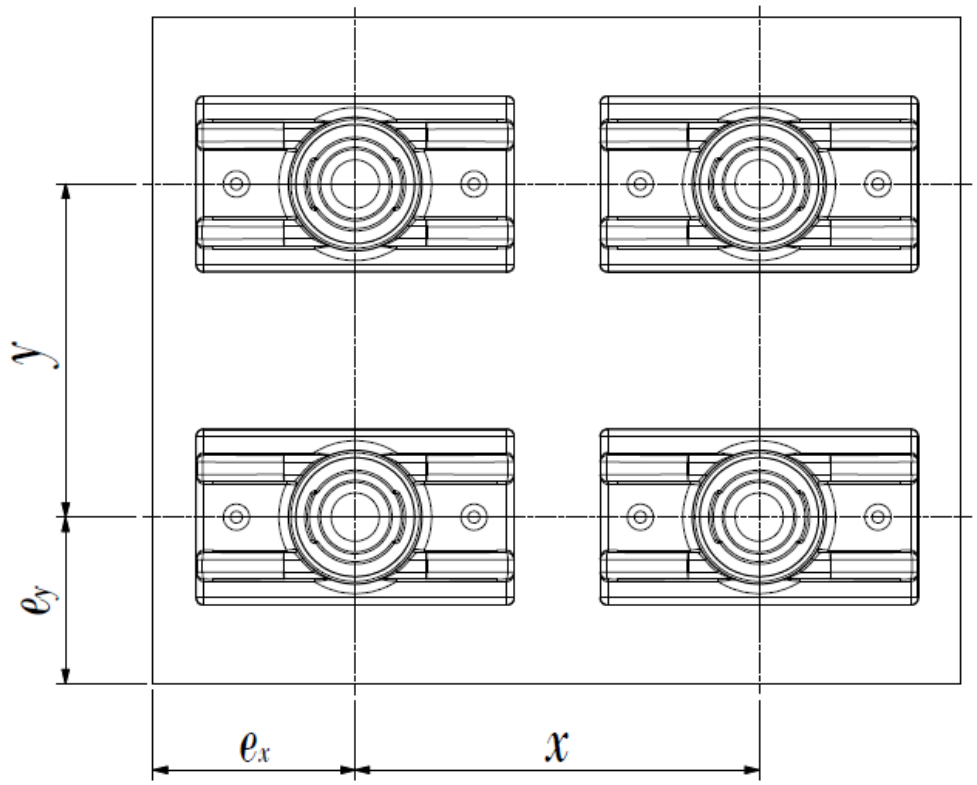
Annex D
of ETA-19/0733

Sealing Cap and Spring



Anchorage	ØA (mm)	B (mm)	ØC (mm)
XU2-13	24	53	53
XU2-15	25	32	60

Anchorage Spacing and Edge Distances for Links Type Bursting Reinforcement



$x \,.\, y \geq a \,.\, b$

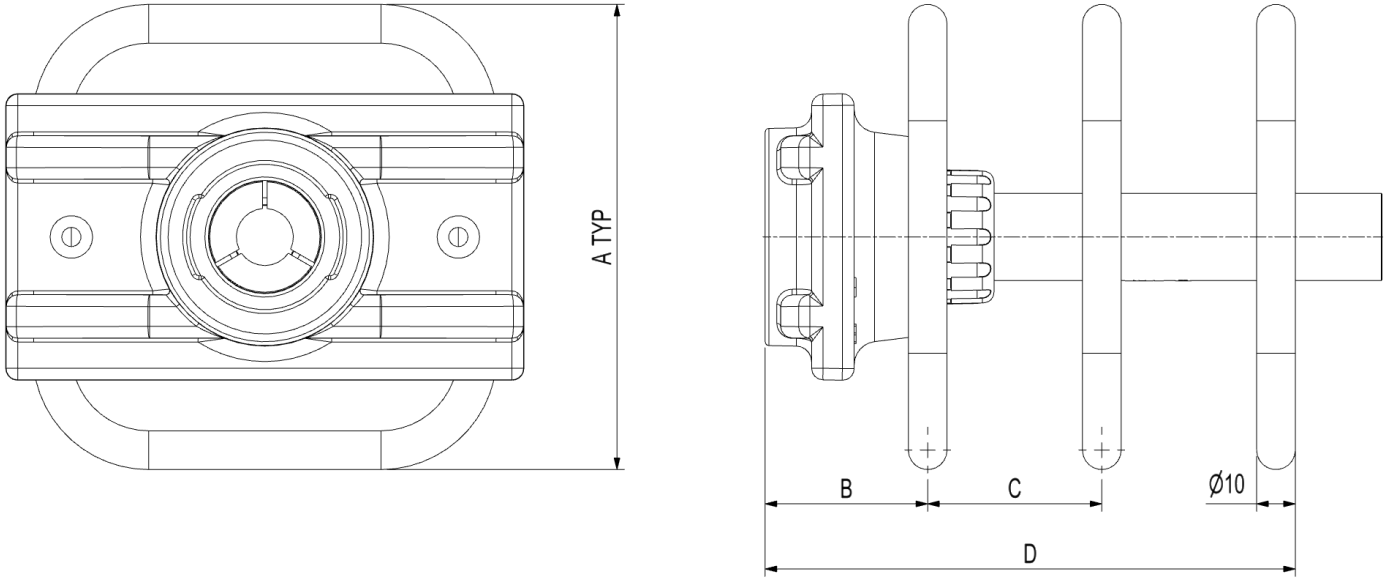
$x \geq 0.85\, a$
$y \geq 0.85\, b$

$e_x = \frac{x}{2} - 10\ \text{mm} + c$
$e_y = \frac{y}{2} - 10\ \text{mm} + c$

Where c is the minimum concrete cover

	$f_{cm,0}$ on cube	
	25 MPa	
Anchorage	**a (mm)**	**b (mm)**
XU2-13	150	120
XU2-15	170	140

Bursting Reinforcement Sizes for Links (f_{yk} = 500 MPa)

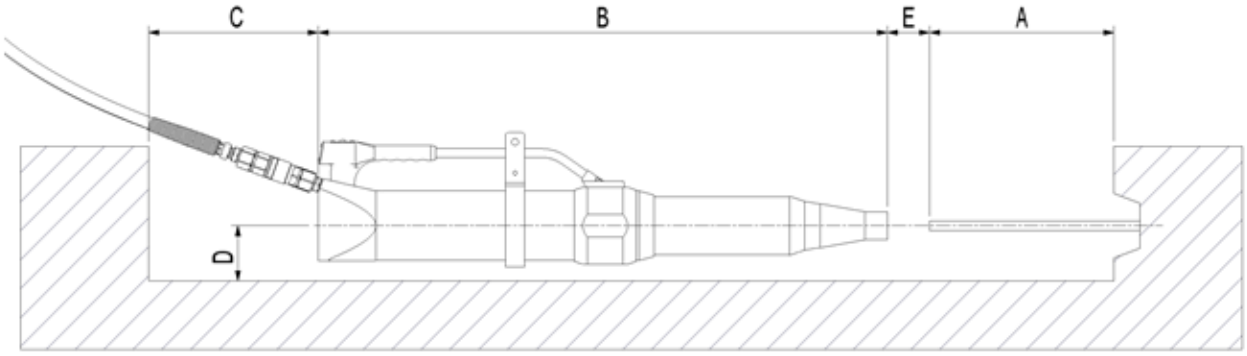


	$f_{cm,0}$ on cube				
	25 MPa				
Anchorage	**A (mm)**	**B (mm)**	**C (mm)**	**D (mm)**	**N**
XU2-13	100	41	58	104	2
XU2-15	120	42	45	137	3

N = Number of Links
Each Link Shall be Closed by Overlapping or Welding

	CCL ‘XU2’ System Bursting Reinforcement Sizes for links (f_{yk} = 500 MPa)	**Annex G** of ETA-19/0733

Stressomatic Jack

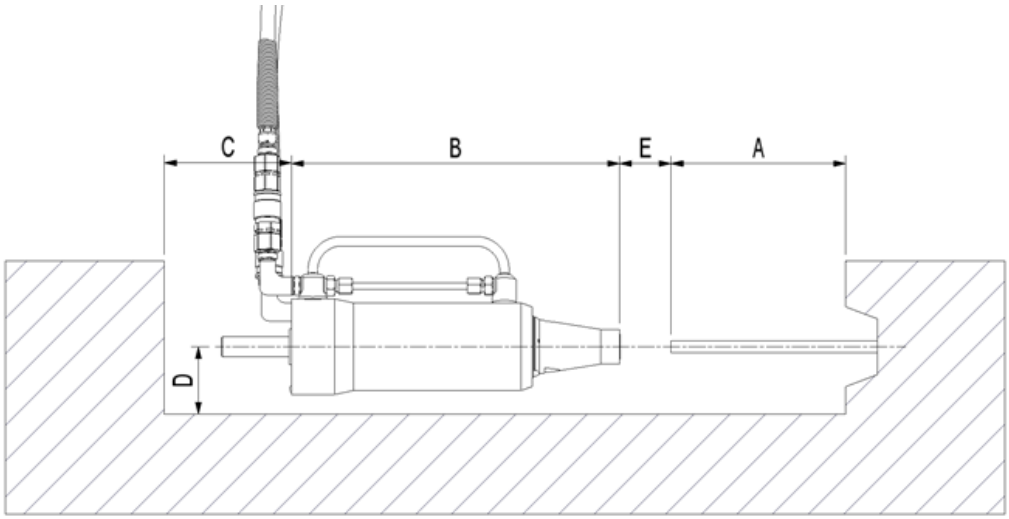


Jack	Anchorage	A (mm)	B (mm)	C (mm)	D (mm)	E (Extension) (mm)
160 kN Short stroke	XU2-13	225	755	200	60	205
160 kN Long stroke	XU2-13	225	1085	200	60	535
300 kN Short stroke	XU2-13 / XU2-15	350	860	200	70	205
300 kN Long stroke	XU2-13 / XU2-15	350	1070	200	70	410

CCL ‘XU2’ System
Stressomatic Jack

Annex H
of ETA-19/0733

250kN PT Jack

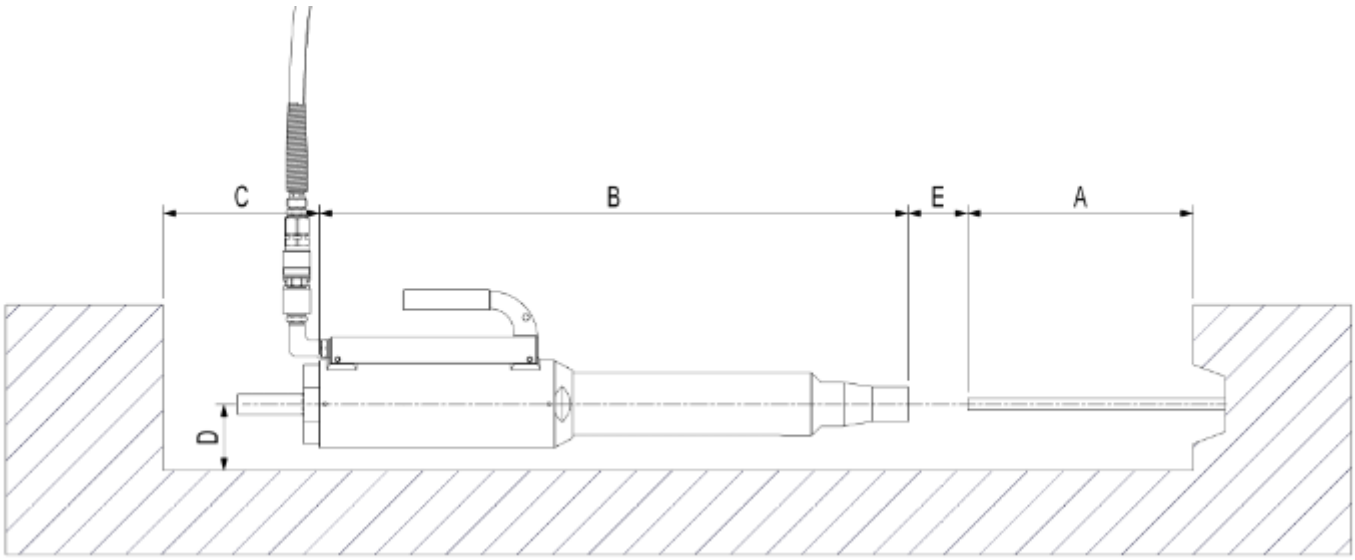


Jack	Anchorage	A (mm)	B (mm)	C (mm)	D (mm)	E (Extension) (mm)
250kN	XU2-13	175	370	100	70	190
250kN	XU2-15	175	370	100	70	190

CCL ‘XU2’ System
250kN PT Jack

Annex I
of ETA-19/0733

250kN HRL Jack



Jack	Anchorage	A (mm)	B (mm)	C (mm)	D (mm)	E (Extension) (mm)
250kN	XU2-13	225	765	100	70	195
250kN	XU2-15	350	765	100	70	195

CCL ‘XU2’ System
250kN HRL Jack

Annex J
of ETA-19/0733

Prescribed Test Plan

1	2	3	4	5	6
Component	**Item**	**Test/ Check**	**Traceability[4]**	**Minimum Frequency**	**Documentation**
Wedge	Material	Check	Full	100 %	3.1[1]
	Treatment, Hardness[5]	Test		0.5 % ≥ 2 Specimens	Yes
	Detailed Dimensions[2]	Test		5 % ≥ 2 Specimens[7]	Yes
	Visual Inspection[3,6]	Check		100 %	No
XU2 FTU	Material	Check	Full	100 %	3.1[1]
	Detailed Dimensions[2]	Test		5 % ≥ 2 Specimens	Yes
	Visual Inspection[3]	Check		100 %	No
Tensile Element Strand	Material	Check	CE	100 %	CE
	Diameter	Test		Each Coil / Bundle	No
	Visual Inspection[3]	Check		Each Coil / Bundle	No
Plastic Sealing Cap, Sleeve and Sleeve Nut	Material	Check	Bulk	100 %	3.1[1]
	Visual Inspection[3]	Check		0.1 % ≥ 2 Specimens	No
Spring (XU System)	Material	Check	"CE" [1]	100 %	3.1[1]
	Visual Inspection[3]	Check		0.1 % ≥ 2 Specimens	No
Bursting Reinforcement (Links)	Material	Check	Full	100 %	Yes
	Visual Inspection[3]	Check		100 %	No

All samples shall be randomly selected and clearly identified.

1. Inspection certificate type "3.1" according to EN 10204. If the basis of "CE"-marking is not available, the prescribed test plan has to include appropriate measures, only for the time until the harmonised technical specification is available.
2. Measurement of all dimensions and angles as stated in the Control Plan and Process Control Record Sheet.
3. Visual inspection covers main dimensions, gauge testing, correct marking or labelling, appropriate performance, surface finish, fins, kinks, smoothness, corrosion, coating etc. as detailed in the Control Plan.
4. Full: Full traceability of each component to its raw material.
   Bulk: Traceability of each delivery of components to a defined point.
5. Surface hardness.
6. Wedge teeth.
7. Test quantities are assumed as wedge segments.

Audit Testing

1	2	3	4
Component	**Item**	**Test/ Check**	**Sampling – No. of Components Per Visit**
Wedge	Material According to Specification	Check, Test	2
	Treatment	Test	2
	Detailed Dimensions	Test	1
	Main Dimensions, Surface Hardness	Test	5
	Visual Inspection	Check	5
XU2 FTU	Material According to Specification	Check, Test	1
	Detailed Dimensions	Test	
	Visual Inspection	Check	
Single Tensile Element Test	EAD 160004-00-0301, Annex C, Clause C.7	Test	1 Series