

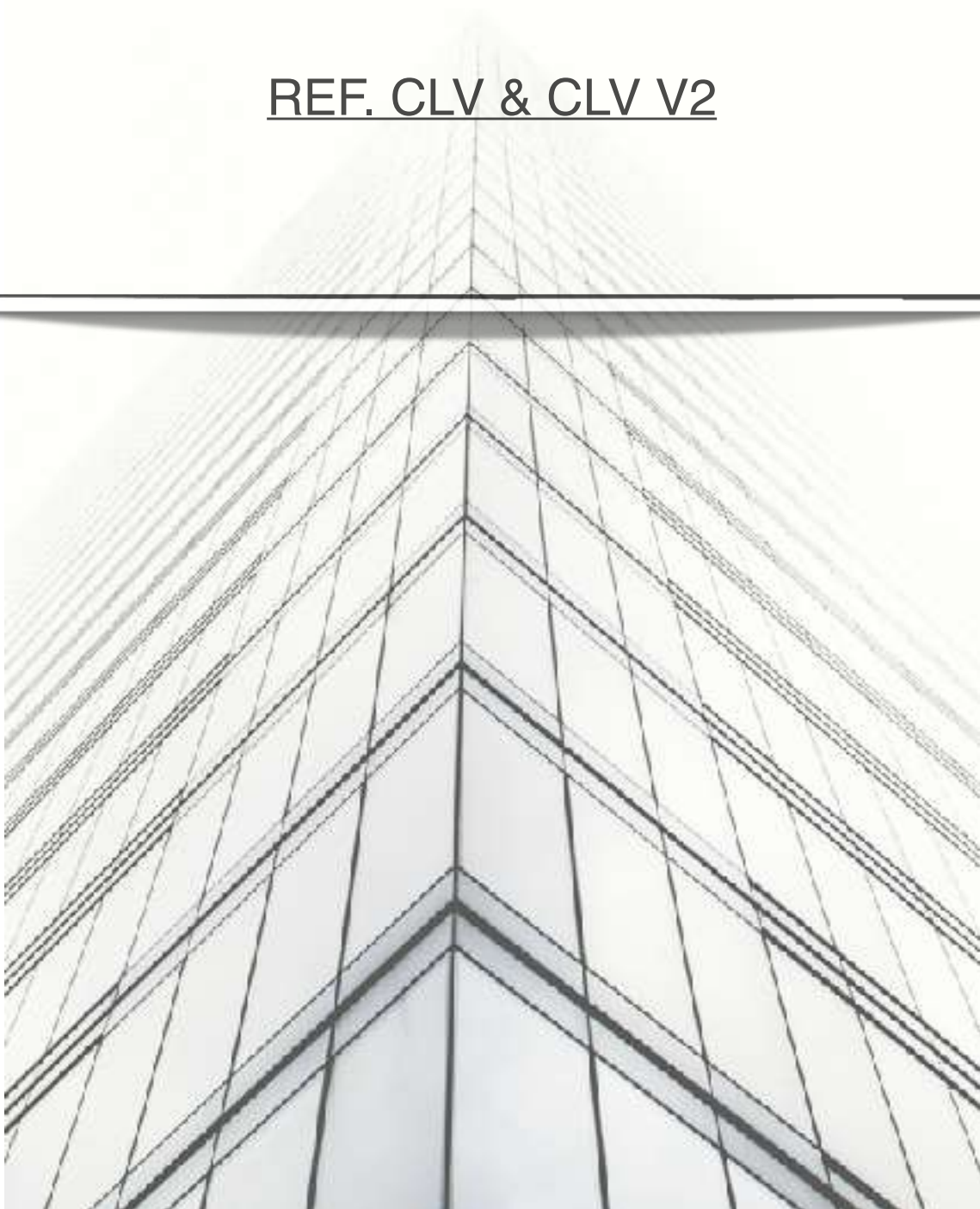


LE CLOU S.V.A

FABRIQUÉ EN FRANCE

TECHNICAL NOTICE
ANCHOR NAIL
FOR SAFETY LINE

REF. CLV & CLV V2



Revision Index	Date	Detail
A	February 2020	Creation
B	May 2020	Clauses 2 & 3 modification.
C	November 2020	Clauses 1.2.4, 2.1 & 4 added. Clauses 1.1 to 1.4, 2.2, 2.3 & 2.4 modified.
D	December 2020	Clauses 2.2.
E	January 2021	Comments on pictures of clause 3 (checking)
F	January 2022	Clauses 1, 2.1 & 2.3 added. Clauses 2.1, 2.2, 2.4, 2.5, 3.2, 3.4 & 5.1 modified.
G	Septembre 2022	Clauses 1.1, 2.6.1, 2.6.2, 2.6.3, 3.3.1, 3.3.2 & 3.4 added. Clauses 2.1, 2.3 & 3.1 modified.
F	April 2023	Change of the Reference nDocument layout. Inversion of the images of §1.2 and §1.3. §2.3 note 2 added. Last page added. Changing the name of Referenceame

46, Rue Joseph Sylvestre
05 100 Briançon (France)

Phone. : +33 (4) 65 03 08 61

Mail : commercial@leclou-sva.fr

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SUMMARY

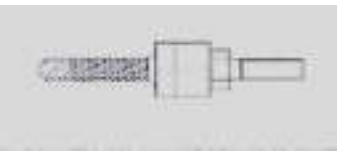
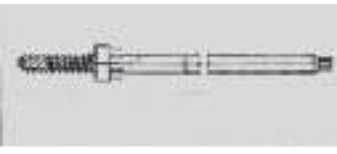
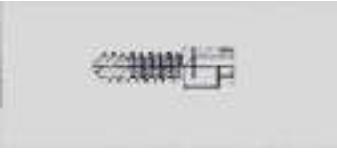

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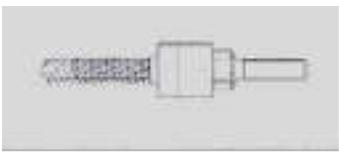
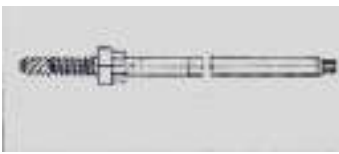

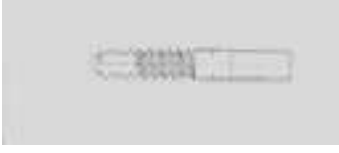
THE DIFFERENT TYPES OF ANCHOR NAILS AND THEIR USES

1



1.1 Nomenclature

	Anchor Nail	Denomination	Ref.	Shoulder	Ø Shoulder	Ø Metric Thread	Total Length
1		SAFETY LINE	CLV CLV V2	Yes	60 mm	M22	29,7 cm
2		PLATFORM AND ELEMENTS	CPTFA V1	Yes	40 mm	M20	38,3 cm
3		PLATFORMS AND ELEMENTS (INSERT)	CPTFA V2/ C.I.PL.F.A. M22	Yes	40 mm	M22	14,0 cm
4		SPACER	CECT	No	/	M22	20,5 cm

	Anchor Nail	Denomination	Ref.	Use
1		SAFETY LINE	CLV CLV V2	Connections of safety lines and other critical applications (eg : heavy elements, stay lines, tree houses, ...). Reference Notice : NT-CLV.
2		PLATFORMS AND ELEMENTS	CPTFA V1	Connections of platforms structures and support wire ropes. Reference Notice : NT-CPTFA.
3		PLATFORMS AND ELEMENTS (INSERT)	CPTFA V2/ C.I.PLF.A. M22	Connections of platforms structures (including tree houses) and support wire ropes. Reference Notice : NT-CPTFA.
4		SPACER	CECT	<ul style="list-style-type: none"> - Avoid contact between a wire rope and support tree. - Keep the height of a safety line buckle. - Connections of support wire ropes. Reference Notice : NT-CECT.

1.2 Nail Safety Line Version 1



1.3 Nail Safety Line Version 2



1.4. Comparaison between the different nails versions

Note: Dimensions between nail versions 1 & 2 are the same

Version	Main characteristics
Version 1 (Réf. CLV V1)	Surface treatment: Zinc-Nickel Black
Version 2 (Réf. CLV V2)	Surface treatment: Hot-dip Galvanized

MOUNTING THE NAILS

2



2.1 Foreword

Make sure that the anchor nail installed is related to this document.

The Anchor Nail SAFETY LINE shall be installed in a healthy tree inspected annually by a tree expert.

The Nail SAFETY LINE shall not be installed in a tree whose diameter is below 25 cm.

2.2 Tooling

The Tools required to install the anchor nail Safety Line are the following:

- 1x spray with disinfectant solution (eg: DAKIN, MILTON,...)
- 1x Screwdriver.
- 1x Drill bit with integrated lamellage device (You must use the one provided by LE CLOU SVA, Ref MCLV on the catalogue)



- 1x Graduated steel rule or measuring tape.
- 1x Pencil
- 1x Vaseline jar to apply with
- 1x Paintbrush
- 1x long open-end wrench of 41 (or socket for powered wrench) (It is mandatory to use the MAGIC KEY provided by LE CLOU SVA)

Note: The MAGIC KEY shall rather be used than a 41 wrench in order to prevent the nail from being misaligned and the drill holes from becoming oval during the screwing process.



The MAGIC KEY can be installed on a bolting machine (wrench available with 3/4" or 1" tip) and lever arms can be screwed in for easier manual tightening.



2.3 Mounting steps

Both versions of the Anchor Nail Safety Line (References CLV et CLV V2) are concerned by Step 1 to 9.

1. **Anchor Nail position:** Using a pencil, note the final position of the anchor nail.
2. **Drill Bit disinfection:** Using the spray bottle containing the disinfectant solution, spray the drill bit as well as the lamellage device integrated into the drilling bit.
3. **Drilling:** At the place defined for the position of the anchor nail, drill the support tree.

It is recommended that the nail be installed to work in the main axis of the applied load. A small inclination may be required.

NOTE 1: Drilling shall always be done in the direction of the tree's center, in the direction where the tree's diameter is the largest.

NOTE 2: Be careful, if there are black shavings, do not continue the operation. It is a good indicator to show that the tree is sick and/or dying.

4. **Lamellage:** When the drill bit is inserted until the lamellage device (largest part of the drill bit) start making a chapel (*) into the tree in order to insert the shoulder of the Anchor Nail Safety Line. Regardless of the load applied to the nail (shear or axial loading), **the depths of this chapel shall always be 65mm** in order to drive the entire nail should (this way, the maximum stresses when loading the nail are located in the external part of the nail).

(*) : This chapel is the part of the hole where the shoulder of the anchor is housed.

NOTE 1: Lamellage depth shall be measured from the sapwood (do not consider bark thickness)

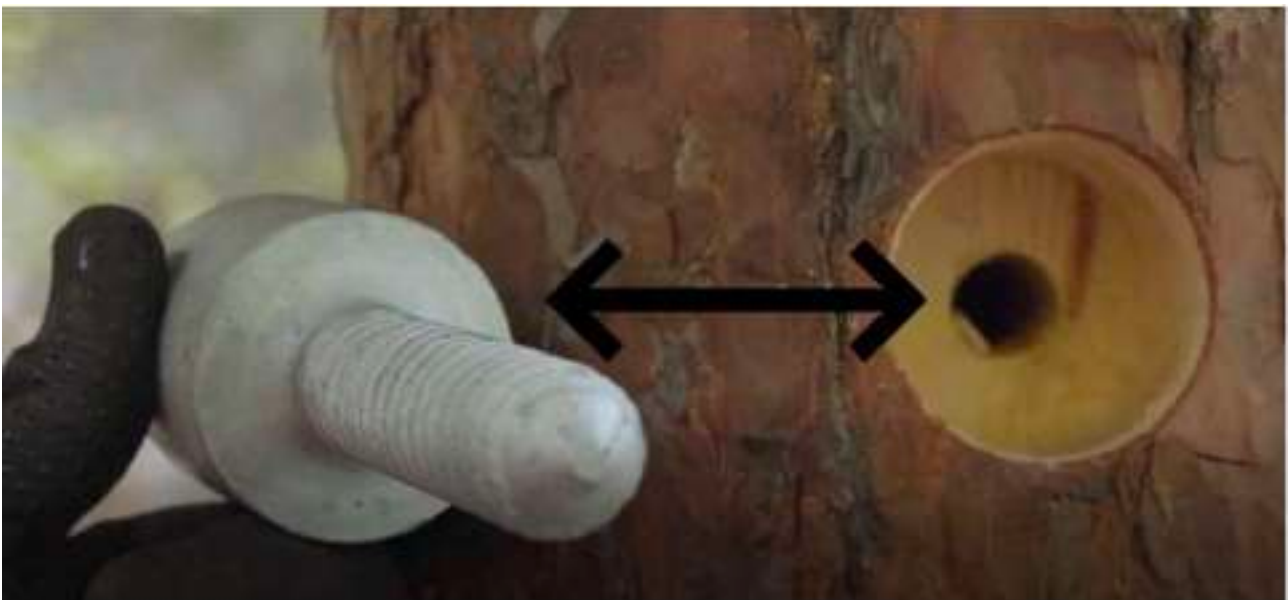
NOTE 2: A drill depth of 65 mm, which is slightly bigger than the length of the shoulder (62mm) will allow the tree to heal faster.

5. **Chapel depth checking:** Thanks to a graduated steel rule or measuring tape, check the depth of the chapel made with the drill bit. Repeat step 4, if needed, until the necessary depth is reached.

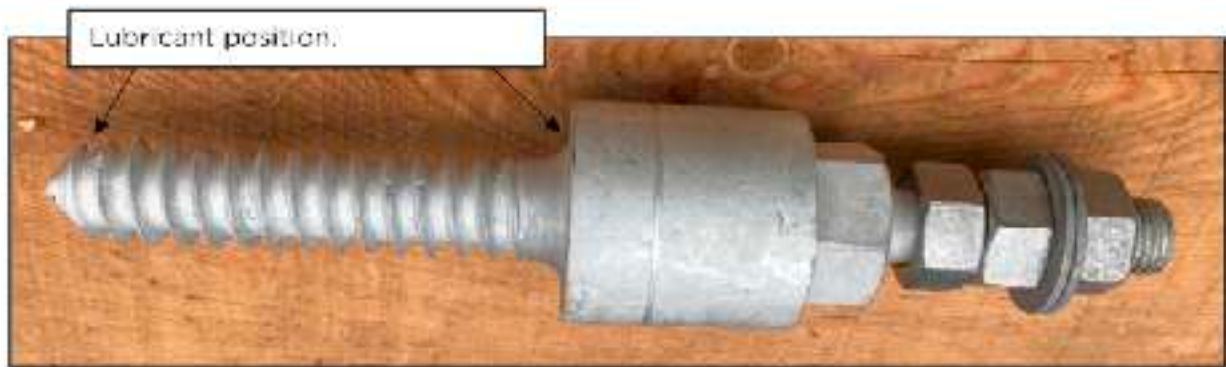


Reminder: Do not consider bark thickness for depth measurement.

6. **Wood chips evacuation:** Evacuate the remaining wood chips in the hole. Check that the surface at the bottom of the wider part is flawless and identical to that of the nail.



7. **Anchor nail disinfection:** Using the spray bottle containing the disinfectant solution, spray the anchor nail part which is going to be inserted into the support tree.
8. **Anchor Nail Lubrication:** Using a paintbrush, apply a sufficient quantity of lubricant (see NOTE 2) on the wood thread of the anchor nail as well as on the inside surface of the shoulder (see picture below).



NOTE 1: The Lubricant facilitates the Anchor Nail installation but also provides an additional protection to the tree.

NOTE 2: Placement of the lubricant on the inside surface of the shoulder should make it possible to check that the anchor nail is fully inserted into the wider hole. Indeed, if applied in a sufficient quantity, part of the lubricant will appear out the hole when screwing, demonstrating that the shoulder is correctly in contact with the bottom of the wider hole (The lubricant stops coming out as soon as sufficiently screwed).



9. **Anchor Nail screwing:** Start to screw the Anchor Nail into the tree by hand tightening (check orientation for the last time). Once correctly positioned, screw the Anchor Nail thanks to the open-end wrench 41 (nut next to the nail's shoulder).

NOTE 1: The surfaces (the bottom of the chapel with the inside part of the anchor nail shoulder) must be perfectly in contact. This can be easily checked if the lubricant is placed in the right place (see previous point).

NOTE 2: The hardware that was supplied by LE CLOU-SVA with the equipment purchased shall be used because they have mechanical properties suited to their use. If you want to use your own hardware (in case of loss of the supplied hardware or other reasons), please contact LE CLOU-SVA in order to install hardware with equivalent properties.

2.4. Number and position of nails

2.4.1 The angle between the two safety lines is more than 30°

When two successive safety lines make an angle between them higher than 30° and the safety line makes a turn to the outside, two nails should be positioned on the tree. (See Figure 1)

- A nail placed at 90° to the axis of the safety line arriving on the tree.
- A nail placed at 90° to the axis of the safety line departing the tree.

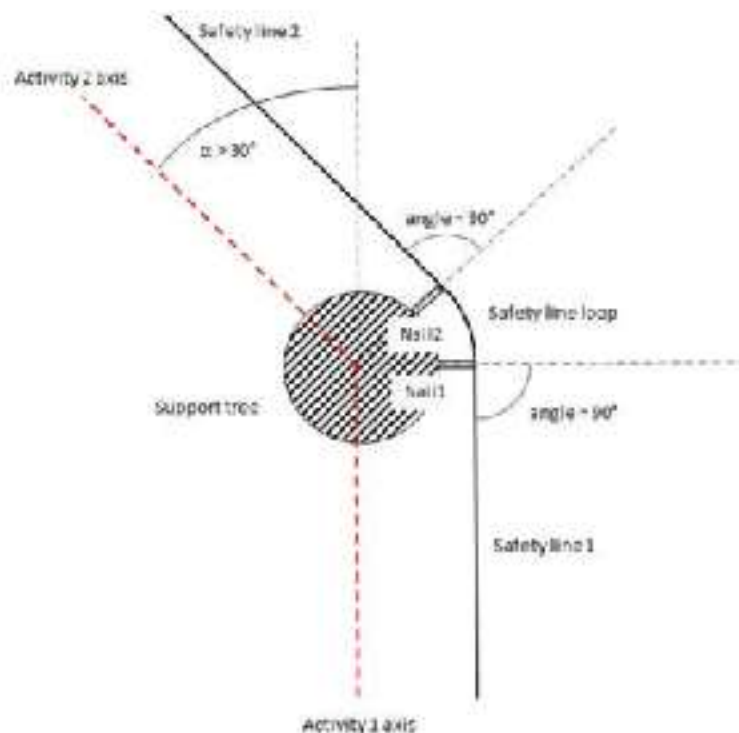


Figure 1 : Two successive safety lines with angle higher than 30° - Turn to the outside.

NOTE : If the diameter of the tree is large enough to allow a comfortable passage of the participants, Anchor Nails 1 & 2 can be placed at an angle $> 90^\circ$ from the axis of the safety line in order to make the nails work as close as possible of the main axis of the applied load.

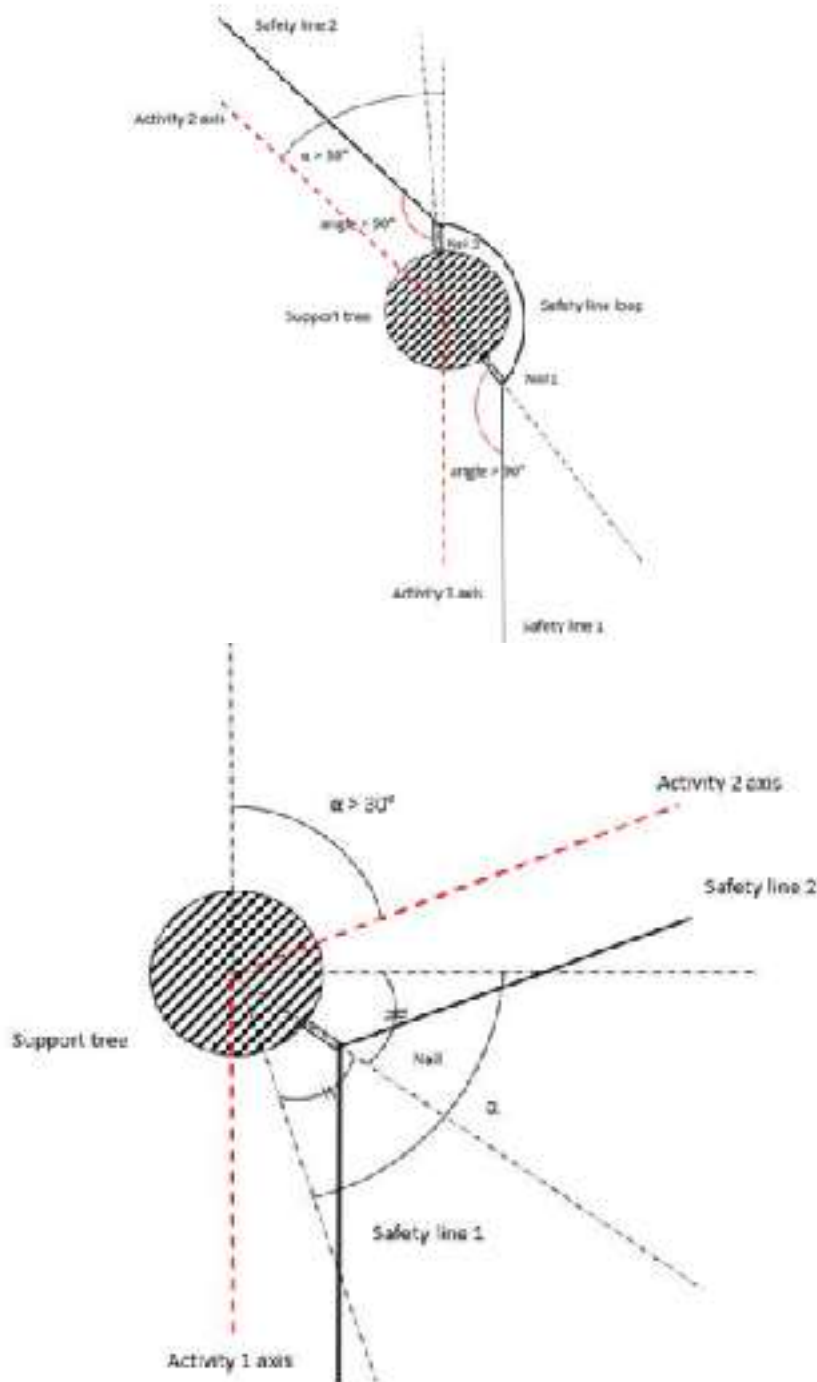


Figure 2 : Two successive safety lines with angle higher than 30° - Turn to the inside.

When two successive safety lines make an angle between them higher than 30° and safety line makes a turn to the inside, one nail should be positioned on the tree support on the bisector of this angle (see figure 2)

2.4.2 The angle between the two safety lines is less than 30°

When two successive safety lines make an angle between them lower than 30°, one anchor nail should be positioned on the tree support of the bisector of this angle (see figure 3)

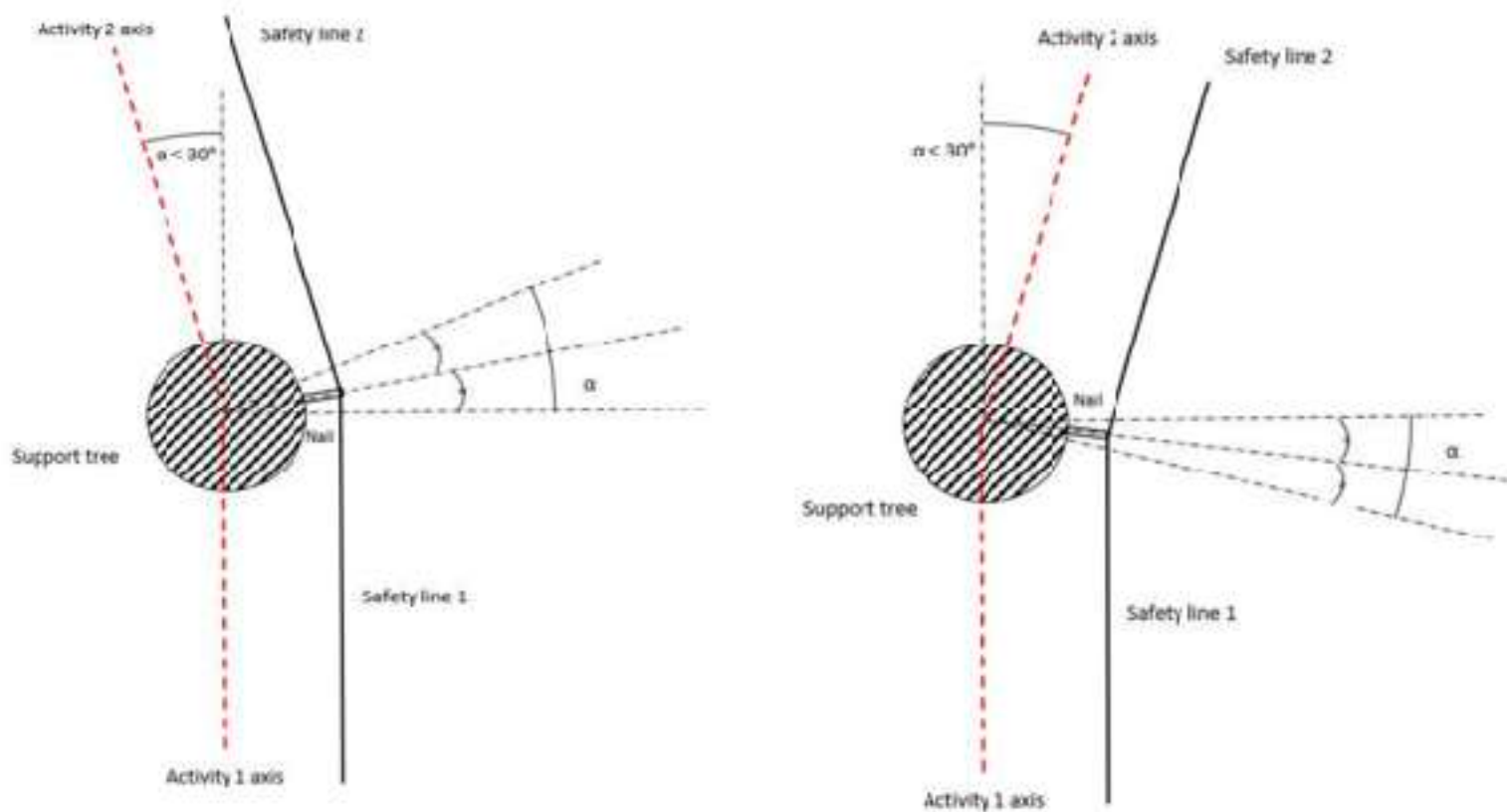


Figure 3: Two successive safety lines with angle lower than 30°

2.5. Connecteurs

Depending on the safety device in place, the connectors to be installed on the nail should be adapted.

Those connectors can be (non-exhaustive list):

- Eyebolts (male or female)
- Junction Link
- Continuous lifeline plate
- Chains.
- ...



Example for connectors

The connector working load Limit (WLL) shall be adapted to wire rope tension (or load) to which the device is connected to (operating load)

This WLL Shall not be less than 1 ton.

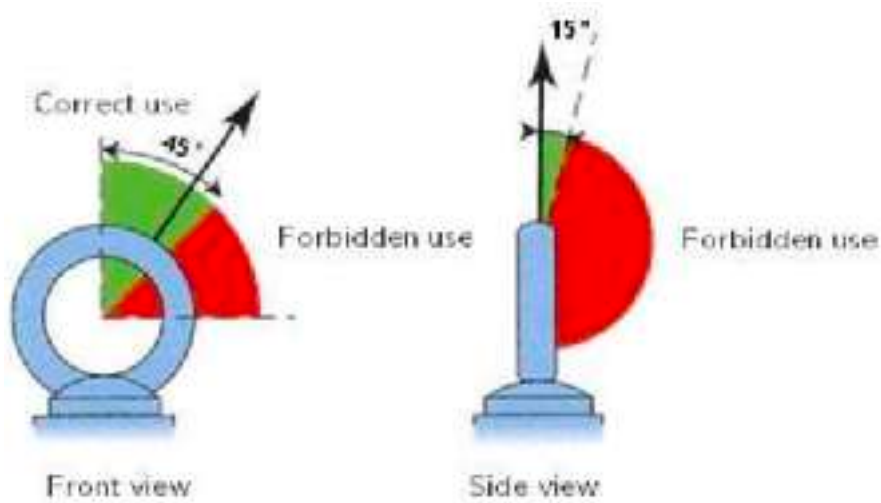
It is possible to have several different connectors connected to the same anchor nail. In such a case, all connectors shall comply to the same requirement regarding minimum WLL.

Note 1: For anchor nails with shear loading, it is recommended to install the connector as close as possible to the tree in order to reduce the forces transmitted to the tree and to improve the nail's pull-out resistance.

Note 2: For connectors screwed on an anchor nail's extremity (eg: safety nut,...) it is recommended to apply thread lock, locknuts (outside) or a second nut (inside/acting as locknut). Nuts must be placed in contact with the connector.



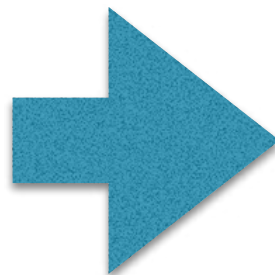
Note 3: When using an eyebolt, good practices as described in the figure below shall be considered:



Please refer anyway to the connector's technical notice which defines the limits of use.

It is recommended to use Eyebolt only when the anchor nail is mainly working with axial loads. For anchor nails working with shear load, then prefer the wire ropes connection with another more suitable connector (such as a junction link or other), places directly on the anchor nail, as close as possible to the supporting tree.

To prevent the junction link from damaging the thread, it is possible to use a protective spacer ring.



Note 4: When the supporting tree has a large diameter and the safety line loop is positioned opposite to the lifeline, it may be necessary to instal a "chain of connectors" in order to facilitate the change-over on the safety line and improve the ergonomics of the installation (see picture + figure 4 below)

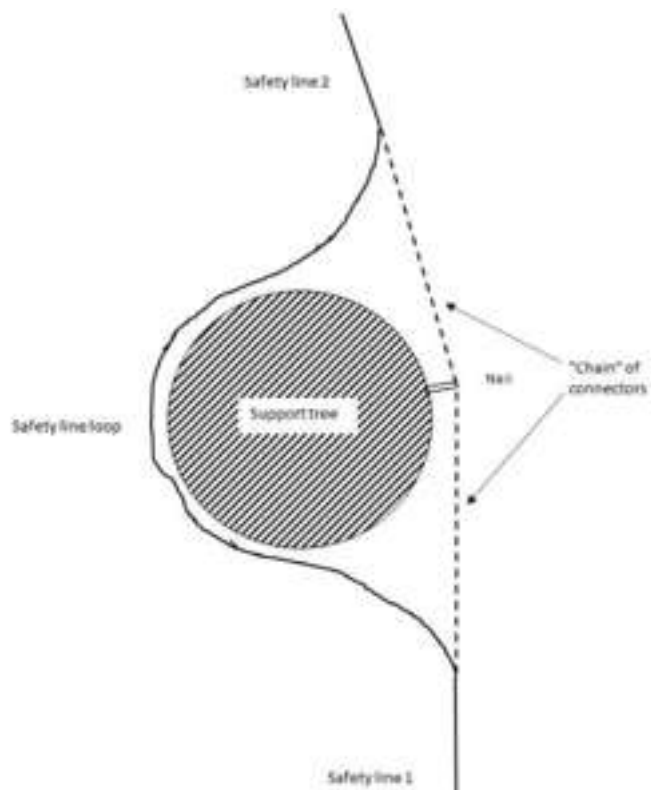


Figure 4: Exemple de montage sur un arbre de gros diamètre

2.6. Back-up

2.6.1. General informations

The pull-out resistance capacity has been tested in different configurations (unfavorable). The result of these tests is given in appendix 1.

Nevertheless, there is no sufficient existing data today in order to assess a possible loss of pull-out resistance capacity linked to the tree species used. Indeed, the tree being a living organism, we cannot guarantee the nail fixation durability because many parameters can have an impact.

For this reason, a back-up is mandatory for all anchors nails used in critical applications such as safety lines.

Note 1: A critical application is defined in standard EN 15 567-1 as an application where the consequences of a failure are likely to lead to a serious injury or death.



Back up example

This back-up can be made with a wire-rope loop, chain or equivalent, around the support tree and **linked to the connector** Installed on the anchor nail.

The Back-up device shall be considered itself as a critical application and shall be dimensioned as such.

Note 2: A continuous lifeline shall be considered as a critical application.



Anchor Spacer Nail (Ref. C.E.M22)

Note 3: LE CLOU-S.V.A provides specific anchor nails in order to avoid contact between back-up and the supporting tree (see picture below).

In the picture below, a Specific Spacer plate can be used with the anchor nail in order to hold the back-up wire rope.

Note 4: This anchor Nail and plate can also be used to maintain a safety line buckle's height.



2.6.2 Specific Requirement

The Back-up (or the set safety line + back-up) must include the entire circumference of the tree.

If the supporting tree has several SAFETY LINE anchor nails, back-up can be continuous (connected to all the connectors installed on the different nails) or discontinuous (connectors on each anchor nail are connected to each other with several back-up sections)

If the Anchor nail doesn't have one connector but several ones (see note 4 in clause 2.5), back-up shall be connected to the last element of the "connector chain".



Example: On the picture above, back-up should go through the shackle and **NOT THROUGH THE EYEBOLT.**

The consequences of a failure for the anchor nail connection on the supporting tree must allow to define the back-up tension (tight or slack).

Particularly, according to activity length and platform heights, a tight back-up shall be installed if the risk of a participant falling to the ground in case of nail fixation failure on the supporting tree is significant.

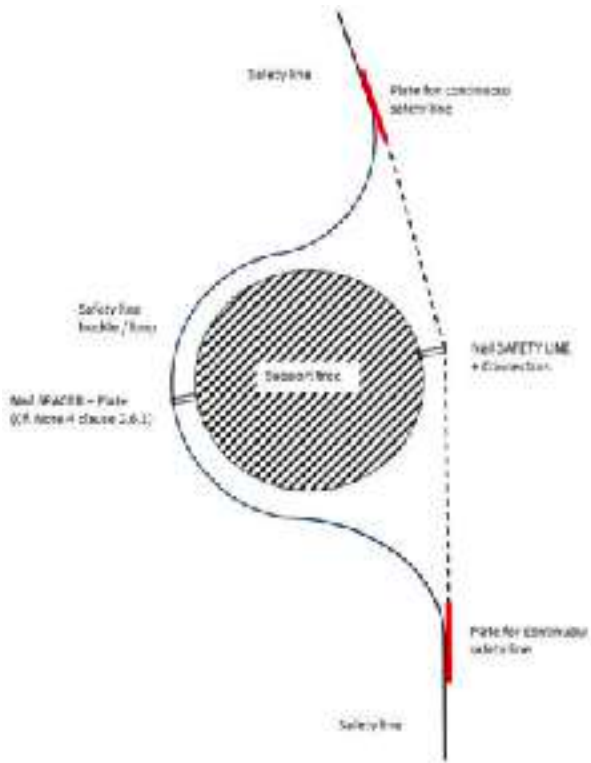
If an Anchor nail for SAFETY LINE is used for a zip line connection, back-up shall be tight.

On anchor nails submitted to vibrations and/or repeated dynamic loads, it is recommended to install tight backup.

For a tight back-up, one or more SPACER nails shall be used all around the tree.

2.6.3 Specific mounting for continuous safety lines

The following mounting is authorized for continuous safety lines



LIMITS OF USE

3



3.1 Generalities

Anchor nails installation shall comply with this notice's requirements.
LE CLOU S.V.A. cannot be considered responsible for the consequences of an installation deviating from the guidelines of this notice and/or not validated by an inaugural inspection before opening.

Batch number is located at the anchor nail's end (see picture below).



3.2 Conception and construction

Note: If for any reasons, the metric thread had to be cut, the batch number would no longer be visible and should be reported on the site maintenance logbook.

The installations for which the anchor nails are used must comply with the requirements of standards EN 15 567-1.

The use for the nail in different applications must take into account the pull-out resistance values provided in appendix 1 of this notice and must take into account the influence of loads in the design (see § 4.3.2 on standard EN 15 567-1)

It has to be noted (FOR INFORMATION ONLY) that some tests with axial loading and shear loading realized in high density tree (Beech tree) have showed no breakage nor deformation on anchor nails tested with a load higher than 6000 daN. However, these results indicate a "high" pull-out strength value which cannot be taken as a reference

3.3 Safety Line Tension

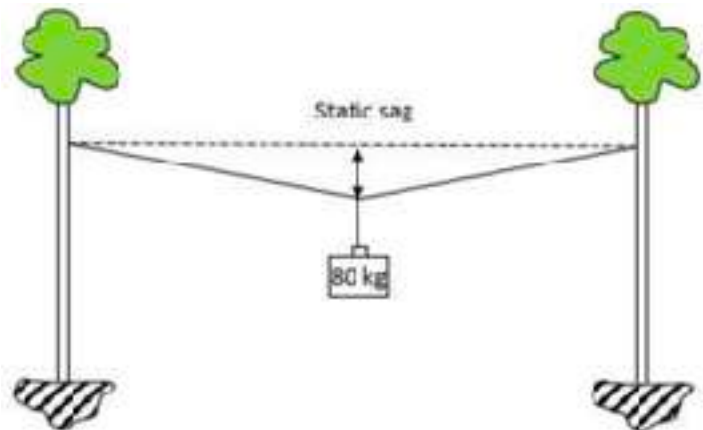
Specific attention must be paid to the safety lines tensions connected to the anchor nail.

When installing safety lines, the wire rope tension shall not lead in any case to the anchor nail deformation nor to hole deformation (into the tree) in which the shoulder of the anchor nail is inserted. In any case, it is recommended that the maximum no-load tension of the wire ropes connected to the anchor nail does not exceed 1 000 daN.

Moreover, in order to limit the peak tension value in the event of a dynamic load applied on the safety line (fall), it is recommended to set the safety line with a tension in order to obtain a static sag (measured with a template of 80kg suspended in the middle of the distance range) at least equal to 5% of the distance range of the safety line.

Example:

It is recommended to install a 10 meters safety line with a static sag which is at least 50 centimeters.



Note : This last requirement is a recommendation in order to adapt the best construction to the use of the anchor nail. The intention is not to replace the requirements of standard EN 15 567-1 specifically the tree strength assessment (§ 4.3.3 & 3.1.1) and design calculations (§ 8.2.d.1).

3.4 Zip Lines

For the specific case of zip lines, anchor nail shall be used only with axial loading.

It is recommended that the maximum tension of the zip line (when not in use) does not exceed 1000 daN.

An anchor nail used for a zip line connection shall be used for that application only. In other words, it shall not be used simultaneously for the connection of one or more other safety lines.

3.5 Use of the nail for other critical application

Anchor nail for Safety Line can be used for other critical application, particularly, connection of tree houses.

For that purpose, LE CLOU SVA made some test with shear load on the anchor nail. They are applied in the direction of the tree fibres and also in the radial direction.

These tests indicate that the anchor nail for SAFETY LINES, used for tree house connection, can bear a shear load of 1600 daN (including a 3 safety factor in relation with the lowest pull-out resistance obtained during the tests).

3.6 Limit of use for activities

Regarding the activities use, reference should be made to the "instructions for the use of the rope course" set by the manufacturer of the installations, in accordance with Annex B of standard EN 15 567-1.

Verifications

4



4.1. General informations

The recommendations in the following paragraphs apply only to the anchor nails. They are in addition to the other manufacturer's checking guidelines related to the other components of the safety system.

If any problem is detected, please contact LE CLOU S.V.A in order to get an opinion on the appropriate corrective measures to be taken, if needed.

When installation is presenting a risk to the user's safety, they shall be temporarily closed pending corrective maintenance operations.

4.2. Routine visual check (daily)

- **Anchor Nail:** Check that the anchor nail does not show any deformation. Check tension for safety line connected to the nail (visual check with reference to the initial condition). If any problem is detected, carry out a more detailed inspection in order to identify the origin of the over tension.
- **Connectors:** Check that the connectors do not show any deformation. Perform a functional test, specifically on moving parts (swivel, articulated eyebolt,...)
- **Tree:** Check that there is no space between the nail's shoulder and the support tree (or cicatricial bulge, if any).

4.3. Operational inspections (monthly)

The operational inspection includes all the checks required for a routine visual check. In addition, the following points shall also be checked:

- **Anchor Nail:** Check for the appearance of any alterations (cracks) or rust traces.

NOTE: When tightening is carried out with nuts, a marking on the two parts in contact makes it easy to check that the tightening is still correct.

- **Connectors:** Check for the appearance of any alterations (cracks) or rust traces. Check the tightening (if needed) as well as the general condition of the various welds or connections (if applicable)

- **Tree:** Check that there are no cracks in the tree fibers around the anchor nail.



Note: Example picture above taken during pull-off test on Anchor Nail

4.4. Annual periodical inspection

To comply with the requirements of standard EN 15 567-1, it is recommended to use a type 1 carry inspection body according to ISO 17 020 ("third party" type inspection body) to carry out the annual periodical inspection.

MAINTENANCE

5



5.1. Anchors modification on versions 1 & 2 due to supporting tree growth

When the scarred bead of the tree shows no more than 4 centimeters of thread on the lifeline nail, a "LIFELINE EXTENSION" should be added.

This LIFELINE EXTENSION consists of a threaded rod with a diameter of M22 connected with thread lock to a connection sleeve (see photo below):



The LIFELINE EXTENSION designed in this way must be connected to the remaining thread of the lifeline nail using the connection sleeve.

The nail and its LIFELINE EXTENSION can then be used under the same conditions as before.

The breaking load of the assembly thus formed is a minimum of 12 tonnes (see appendix 2).

NOTE 2 : It is advisable to use LIFELINE EXTENSIONS supplied by LE CLOU SVA because they have mechanical properties adapted to their use. If you want to use your own hardware, you should contact LE CLOU SVA to install hardware with equivalent properties.

NOTE 1 : The batch number of the anchor nail for safety line won't be visible once the connecting ferrule is installed so this batch number shall be reported on the connecting ferrule or the site maintenance logbook

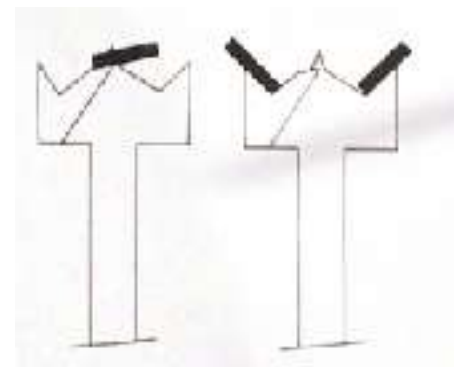
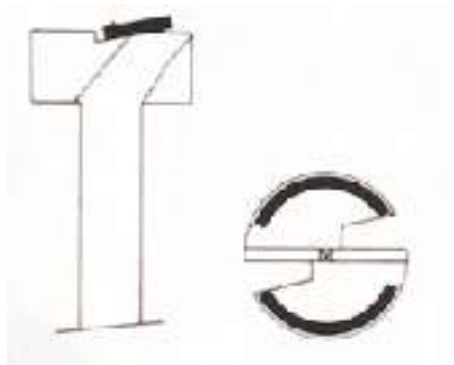
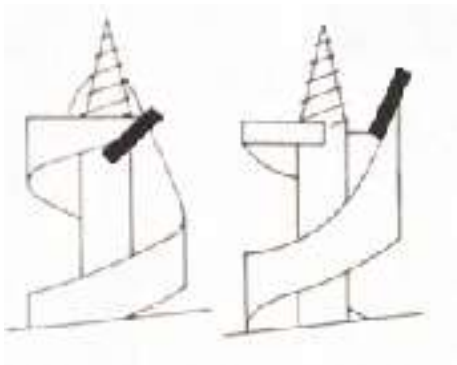


NOTE 3 : A marking between the nut and the connecting ferrule makes it easy to check that the tightening is still correct.

Position a nut at the end of the nail BEFORE installing the extension. Once assembly is complete, tighten the nut (lock nut) against the connecting sleeve (nail/inside side).

5.2. Drill bit

After a certain number of cycles of use, drill bits should be sharpened according to the following instructions:



TESTS OF FORCE

6



6.1 Vertical traction test (Treehouses)



From the 28th of October 2022



Anchor Nail Safety Line



Vertical Shearing (Tree houses)

28/09/2022				
Observations	Beech tree	Oak tree	Larch tree	Pine tree
usage limit	1600 daN	1800 daN	1700 daN	1600 daN
Uprooting	NO	NO	NO	NO
rupture	4860 daN	5565 daN	5202 daN	6003 daN
Break	YES	YES	YES	YES

Only the "lowest reference values" are to be taken into account.


The values designated "as an indication" are to be taken for information only and cannot be taken as a reference.

RESEARCH & DEVELOPMENT

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6.2 Horizontal Shearing & axial Pull



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Société à responsabilité limitée

Anchor Nail Safety Line

From the 28th of October 2022





Horizontal Shearing		28/09/2022	
Observations		Poplar tree	
usage limit		1100 daN	
Uprooting		YES	
rupture		3500 daN	
Axial Pull		28/09/2022	
Observations		larch tree	Poplar tree
usage limit		1500 daN	1200 daN
Uprooting		YES	YES
rupture		4940 daN	3800 daN

only the lowest reference values are to be taken into account.*

The values designated "As an indicator" are to be taken for information only and cannot be taken as a reference.

RESEARCH & DEVELOPMENT
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APPENDIX 1

CERTIFICATE RELATED TO TESTS REALIZED 2020 JANUARY THE 23RD ON ANCHOR NAILS FOR SAFETY LINES

Description of static tests carried out :

The purpose of these tests was to obtain pull-out resistance values for a safety line anchor nail for safety line fixed in a tree (with axial and shear loadings).

12 tests were carried out on two different species of trees (deciduous and resinous trees) under unfavourable conditions for installation and by testing different parameters that could have an impact on the pull-out resistance capacity.

The deciduous tree species used for the tests is TREMBLING ASPEN and the resinous tree species used for the tests is PINE.

These two species are known for having weak densities, volume weight, and mechanical properties (in particular bonding strength).

Test result:

- ✓ Minimum pull-out resistance value measured with axial loads (ASPEN or PINE) : 3 326 daN.
- ✓ Maximum pull-out resistance value measured with axial loads (ASPEN or PINE) : 5 150 daN.
- ✓ Minimum pull-out resistance value measured with shear loads (ASPEN or PINE) : 3 590 daN (higher than pull-out resistance value measured with axial loads).
- ✓ Maximum pull-out resistance value measured with shear loads (ASPEN or PINE) : > 6 120 daN (higher than pull-out resistance value measured with axial loads).
- ✓ There are some result variations between specimen belonging to SAME species.
- ✓ Parameters such as the anchor height, support tree bending capacity and loading angle do not seem to have a systematic impact on the pull-out resistance value measured.
- ✓ Some tests lead to anchor nail deformation but without any breakage observed.
- ✓ Some tests carried out under specific conditions did not allow to reach the sufficient load for the anchor nail pull-out.



HIGHDEA
100 rue de la République - 73100 VIMINES - FRANCE
SIRET 850 78 248 0006 / TVA FR 81 877867192 / APE 7490A



APPENDIX 2



ORDERIE DOR

Société à responsabilité limitée au Capital 1 500 000 €

7, Avenue de Saint-Menet 13011 MARSEILLE

Téléphone : 04 91 18 11 00 - Télécopie : 04 91 44 60 91 - marseille@cordierdor.fr

CLIENT : GRIMP IN FOREST

N° Dossier : M09-2006CD-0126

ATTESTATION de VERIFICATION et D'ESSAIS (CHECK and TEST REPORT)

Désignation du matériel : 2 tiges Filetées M22 avec écrou M22 et 2 anneaux femelles M22 DIN 582
Date de l'essai (date): 05/06/2020



ESSAI DE RUPTURE (BREAKING TEST)

Nombre essayé : 1

Charge de rupture obtenue : 12 100 Kg

Localisation de la rupture (localisation of the break) : Nous observons un arrachement du filet de la tige filetée, ainsi qu'une déformation plastique des 2 anneaux femelles M22 DIN 582.



Le Responsable Essai/Contrôle
Control & Test Surveyor
LATEL ARTHUR
Technicien ORDERIE DOR

Adresse
0491181100
13011
0491446091
0491446091
0491446091
0491446091
0491446091
0491446091

7, Avenue de Saint-Menet - 13011 Marseille
04, Rue de la République - 13001 Marseille
04, Rue de la République - 13001 Marseille
04, Rue de la République - 13001 Marseille
04, Rue de la République - 13001 Marseille
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www.cordierdor.fr
marseille@cordierdor.fr
paris@cordierdor.fr
lyon@cordierdor.fr
bordeaux@cordierdor.fr
nantes@cordierdor.fr
rennes@cordierdor.fr
strasbourg@cordierdor.fr

F-111-00



46, Rue Joseph Sylvestre
05 100 Briançon (France)
Phone. : +33 465 031 031

Email : commercial@leclou-sva.fr & support@leclou-sva.fr
N° DOC : NT-CPTFA-F

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