TEST REPORT

N°: 148429-703082-B **Version : 01**

Subject	**TEST ACCORDING TO REQUIREMENTS STANDARD NF EN 50508 (06 :2009) ON MULTI-PURPOSE INSULATING STICKS FOR ELECTRICAL OPERATIONS ON HIGH VOLTAGE INSTALLATIONS**
Issued to	**FAMECA** 2, rue Gutenberg BP 13 68173 RIXHEIM CEDEX
Apparatus under test	
↳ Product	**INSULATING STICK**
↳ Trade mark	**FAMECA**
↳ Model	**TP12SC45, TP13PM and TP3345kV**
Conclusion	Compliant
Composition of document	22 pages
Document issued on	June 26th, 2017

Supervised by:
David TELLIER
Technical Test, May 30th 2017

Ali BEN ABDEL JELIL
Technical Reviewer, June 08th and 09th 2017

Approved by:
Alain POSLUSZNY
Technical manager

LABORATOIRE CENTRAL DES INDUSTRIES ELECTRIQUES
S.A.S au capital de 15.745.984 €
RCS Nanterre B 408 363 174
33 avenue du General Leclerc
F - 92266 FONTENAY AUX ROSES

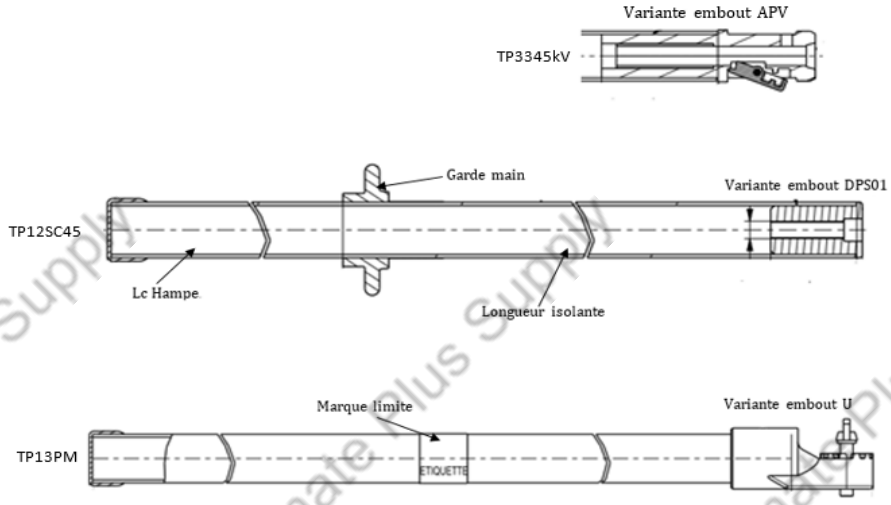
PUBLICATION HISTORY

Version	Date	Author	Modification
01	26/06/2017	Ali BEN ABDEL JELIL	Creation of the document

1 – MATERIAL TESTED

Three sticks 1 element composed of hollow tube with a diameter of 32 mm which validated all range of sticks and its type head, the different were specified below:

Designation	References of tested product and its length (mm)	References validated
Insulating stick	TP12SC45 (L_T = 1435 mm)	TP12ECSC (L_T = 1435 mm) TP12EC (L_T = 1640 mm) TP1245KV (L_T = 1640 mm)
	TP13PM (L_T = 1485 mm)	-
	TP3345kV (L_T = 1495 mm)	TP3345kV-C28 (L_T = 1510 mm)



Nameplate

2 – PROGRAM TESTING AND EXECUTION MODALITY

Program testing, established in agreement with the applicant, included the achievement in the premises of the company FAMECA, under supervision of LCIE, Type test of the Publication NF EN 50508 version June 2009.

Tests order

Description of the test	Paragraph test	Requirement
Visual verification	5.3.1	4.1
Dimensions	5.3.2	4.2
Insulating tube verification	5.3.4	4.1/4.2.2
Marking verification	5.3.5	4.5
Durability of marking	5.4.7	4.5
Head verification	5.3.3	4.2.9
Fiiting and removal of tools in the head	5.4.4	4.3.1
Bridging test	5.2.3	4.4.1
Dry leakage current	5.2.2.1	4.4.2
Pulling test	5.4.3	4.3.1
Bending test	5.4.1	4.3.2
Torsion test	5.4.2	4.3.5
Drop resistance	5.4.5	4.3.4
Water penetration	5.4.6	4.3.3
Shock resistance on couplings	5.2.4	4.4.2

1/ VISUAL VERIFICATION
(Requirement §4.1 – Test §5.3.1)

Test :
Verifications shall include:

- **The good condition of the insulating part of the stick, the couplings, the head, the handle and the cap ;**
- **The correct assembly of the different sections ;**
- **The fixing of the hand guard ;**
- **The contrast colour of limit mark and the hand guard.**

Acceptance criteria :
The test shall be considered as passed if all requirements are fulfilled**.**

Results :

Sample	STATE						
	stick	coupling	Head	Limit mark	handle	Hand guard	cap
TP12SC45	✓	NOT CONCERNED	✓	✓	✓	✓	✓
TP13PM	✓		✓	✓	✓	✓	✓
TP3345kV	✓		✓	✓	✓	✓	✓

☑ : good ☒ : bad

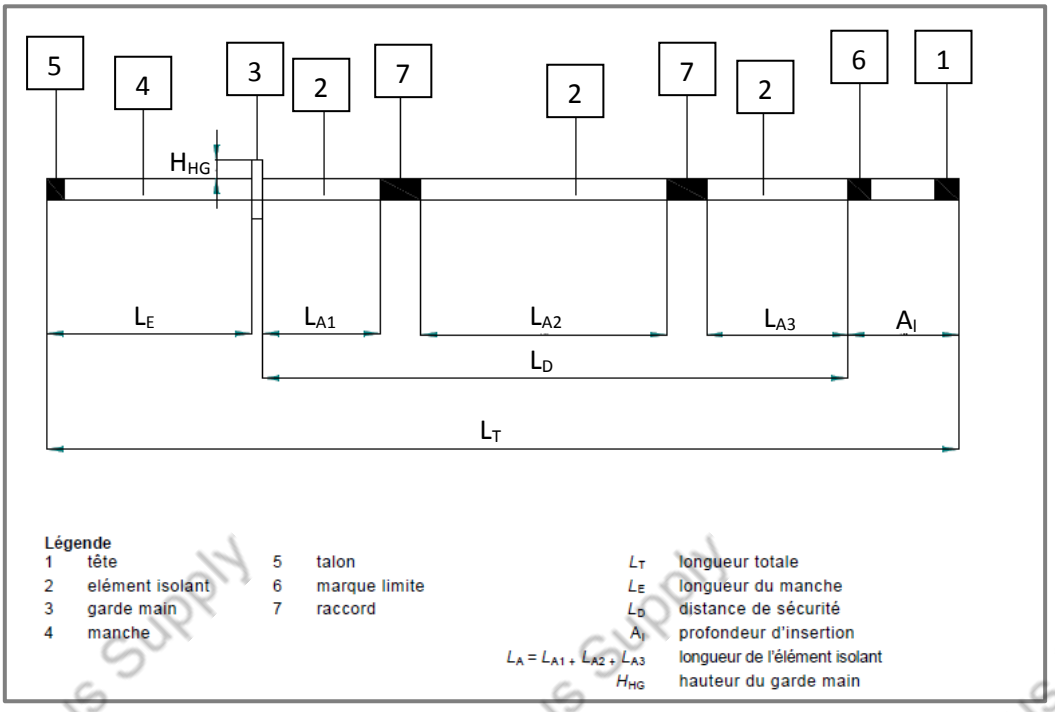
Sample	Correct assembly of the different sections	Fixation of the hand guard	Contrast colour (limit mark/hand guard)	Validation stick
TP12SC45	✓	✓	✓	✓
TP13PM	✓	✓	✓	✓
TP3345kV	✓	✓	✓	✓

☑ : good ☒ : bad

☑ COMPLIANCE / ☐ NOT CORRESPONDING

2/ DIMENSIONS
(Requirement §4.2 – Test §5.3.2)

Test:



Légende

1	tête	5	talon	L_T	longueur totale
2	elément isolant	6	marque limite	L_E	longueur du manche
3	garde main	7	raccord	L_D	distance de sécurité
4	manche			A_I	profondeur d'insertion
				$L_A = L_{A1} + L_{A2} + L_{A3}$	longueur de l'élément isolant
				H_{HG}	hauteur du garde main

Measure the following lengths :

- **Total length of stick (±1%, L_T) and each section (±1%) ;**
- **Handle : length (±2mm, L_E) and external perimeter (±2mm) ;**
- **Width of limit mark (±2mm) ;**
- **Dimensions of the hand guard (±2mm) ;**
- **Minimum length between the limit mark and the hand guard (2mm, L_D) ;**
- **Length of the insulating element (±2mm, L_A).**

Acceptance criteria :

The test shall be considered as passed if all the measurements are within the required limits.

Results :

Samples	Total length (Lt) in mm			
	Value on drawing (LB) (mm)	Tolerance (±1%)	Measure (mm)	Validation stick
TP12SC45	**1435**	**14 mm**	1438	✓
TP13PM	**1485**	**15 mm**	1485	✓
TP3345kV	**1495**	**15 mm**	1493	✓

☑ : good ☒ : bad

with LB : Total length of sticks on drawing 314674_B dated 15/03/17, 39017_C dated 15/03/17, 39016_C dated 15/03/17, 314673_B dated 15/03/17.

Sample	Handle						
	Length (Le) in mm			Perimeter in mm			
	Le (mm)	Tolerance (±2mm)	Measure (mm)	Value on drawing (mm)	Tolerance	Measure (mm)	Validation stick
TP12SC45	403	±2mm	402	32Π soit 100,5 mm	≤175	100,3	✓
TP13PM			401				✓
TP3345kV			402				✓

☑ : good ☒ : bad

On drawing, the handle length is determined by :

$$L_e = L_c + 3\ mm$$

With Lc : length of sheath and 3 mm = wrapping end on drawing 314674_B dated 15/03/17, 39017_C dated 15/03/17, 39016_C dated 15/03/17, 314673_B dated 15/03/17.

Sample	Dimensions of the hand guard (mm)		Validation stick
	Tolerance (mm)	Measure (mm)	
TP12SC45	≥ 20	25,3	✓
TP13PM		24,0	✓
TP3345kV		25,2	✓

☑ : good ☒ : bad

Sample	Minimum length between the limit mark and the hand guard in mm					Validation stick
	Minimum length of the insulating element according to NF EN 50508	Value on drawing (mm)	Tolerance	Measure (mm)	Nominal voltage indicated (kV)	
TP12SC45	980	1035	1035	±2mm	45	✓
TP13PM		1085	1084			✓
TP3345kV		1495	1093			✓

☑ : good ☒ : bad

On drawings, the length of the insulating element is calculated by:

$$L = L_B - L_c$$

With L_B : total length et Lc : length of sheath on drawing 314674_B dated 15/03/17, 39017_C dated 15/03/17, 39016_C dated 15/03/17, 314673_B dated 15/03/17.

☑ COMPLIANCE / ☐ NOT CORRESPONDING

3/ INSULATING TUBE VERIFICATION (Requirement §4.1/4.2.2 – Test §5.3.4)

Test:

The insulating tube shall be verified for compliance with the requirements indicated in **EN 60855** or EN 61235 and respected the following table:

Tension nominale de l'installation U_n (kV)	Distance isolante minimale [a] [b] mm	Distance ergonomique [b] mm	Longueur minimale de l'élément isolant mm
≤ 15	160	500	660
≤ 30	320	500	820
≤ 45	480	500	980
≤ 66	630	500	1 130
≤ 110	1 100	500	1 600
≤ 132	1 300	500	1 800
≤ 150	1 500	500	2 000
≤ 220	2 100	500	2 600
≤ 380	3 400	500	3 900
≤ 480	4 100	500	4 600
≤ 735 / 800	6 400	500	6 900

[a] Suivant le HD 637 S1 en considérant les surtensions d'exploitation et celles de foudre.

[b] Ces valeurs peuvent changer suivant les réglementations nationales.

Table 2: Recommended minimum length

Acceptance criteria :

The test shall be considered as passed if all the measurements are within the required limits

Results :

Sample	Minimum insulating length (mm)	Nominal voltage associated (kV)	Value on drawing (mm)	Nominal voltage indicated (kV)	Validation stick
TP12SC45	**480**	**≤ 45**	1035	45	✓
TP13PM			1085		✓
TP3345kV			1095		✓

☑ : good ☒ : bad

On drawing, the insulating length Li is determined by :

$$L_i = L_B - L_C$$

With L_B : total length et Lc : length of sheath on drawing 314674_B dated 15/03/17, 39017_C dated 15/03/17, 39016_C dated 15/03/17, 314673_B dated 15/03/17.

☑ COMPLIANCE / ☐ NOT CORRESPONDING

4/ MARKING VERIFICATION (Requirement §4.5 – Test §5.3.5)

Test:
All the stick sections shall contain the following information in the insulating part:

- **Double triangle and the reference to this standard ;**
- **Manufacturer's name or trademark ;**
- **Serial batch or month and year of manufacture of the section ;**
- **Manufacturer's reference for the section.**

In addition to the previous information, the triangle section shall contain a label with the nominal voltage of use according to the possible mounting combinations. A stick reference can be added to this label if necessary. In the case the hand guard is a band it should have inscription "hand limit" in national language. The marking shall be legible and indelible or be firmly adhered; the characters shall be at least 3 mm high. The marking shall not affect the quality of the stick.

Acceptance criteria :
The test shall be considered as passed if all inscriptions are within the requirement.

Results :

Sample	Observations		
	Serial number and batch (1)	Double triangle + reference standard (2)	Nominal voltage accordding to combinations (3)
TP12SC45	✓	✓	✓
TP13PM	✓	✓	✓
TP3345kV	✓	✓	✓

☑ : good ☒ : bad

Sample	Observations			
	Manufacturer's name (4)	Hand guard « hand limit » (5)	Legibility of marking	Validation stick
TP12SC45	✓	✓	✓	✓
TP13PM	✓	✓	✓	✓
TP3345kV	✓	✓	✓	✓

☑ : good ☒ : bad

☑ COMPLIANCE / ☐ NOT CORRESPONDING

5/ DURABILITY OF THE MARKING (Requirement §4.5 – Test §5.4.7)

Test :

The durability of the marking is verified by thoroughly cleaning the marking for at least one minute with a piece of lint-free cloth soaked with water and the rubbing it vigorously for a further one minute minimum with a piece of lint-free cloth soaked with isopropanol.

Acceptance criteria :

The test shall be considered as passed if the marking remains legible and the letters do not smear. No signs of loosening shall be present for labels.

Results :

Sample	With water	With isopropanol	Observations	Validation stick
TP12SC45	✓	✓	NTR	✓
TP13PM	✓	✓	NTR	✓
TP3345kV	✓	✓	NTR	✓

☑ : good ☒ : bad

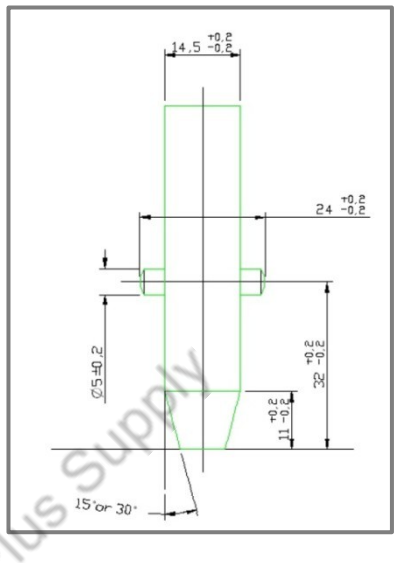
NTR : Nothing to report

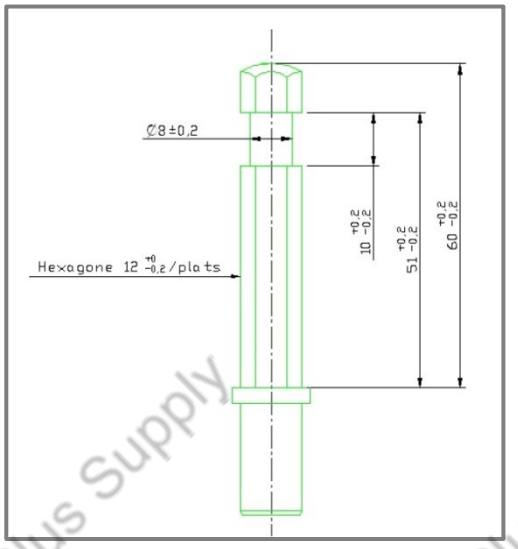
☑ COMPLIANCE / ☐ NOT CORRESPONDING

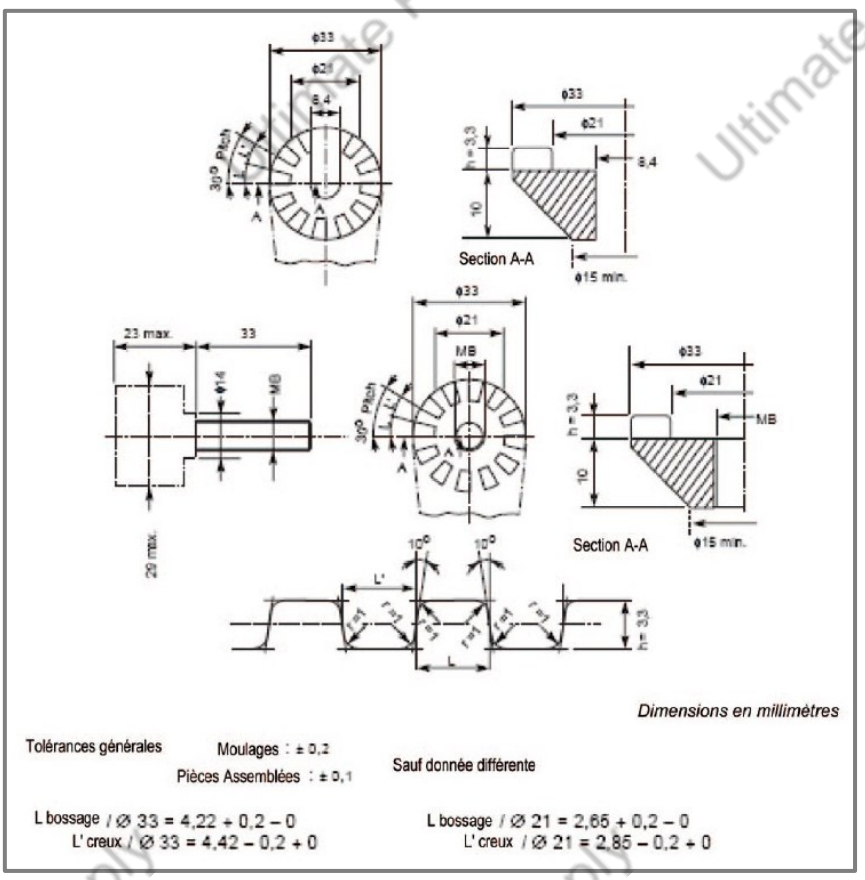
6/ HEAD VERIFICATION
(Requirement §4.2.9 – Test §5.3.3)

Test:

The dimensions of the head affecting the coupling of the tool shall be verified. This verification shall be performed measuring the head or alternatively using a suitable test tool. For recommended type heads, see tests tools in following plans:







Acceptance criteria :

The test shall be considered as passed if the measures are within the required limits or the test tool can be coupled easily on the head and remain firmly attached.

Résultats :

Echantillons	References drawings	Agreement customers-Manufacturer	Dimensions verification	Validation tip
Bayonet type head	38268_A dated 26/06/02	**NOT CONCERNED**		
U type head	36526_B dated 26/02/08	**NOT CONCERNED**	✓	✓
APV type head	46603_C dated 26/03/02		✓	✓

☑ : good ☒ : bad

☑ COMPLIANCE / ☐ NOT CORRESPONDING

7/ FITTING AND REMOVAL OF TOOLS IN THE HEAD (Requirement §4.3.1 – Test §5.4.4)

Test :

This test shall be performed for sitck heads that permit disengage automatically the tool.
The head section of the stick shall be rigidly fixed to the proximity of the head. A test tool appropriate to the type of head shall be introduced inside the head up to the point where the connection takes place.
The puch force value shall be measured.

Acceptance criteria :

hexagonal (APV) type head: **7 N < Fp < 12 N**
Bayonet type head: **40 N < Fp < 50**

Results :

Samples	Head type	Tolerance (N)	Measure (N)	Validation head
TP12SC45	DPS01	**NOT CONCERNED**		
TP13PM	Universel			
TP3345kV	APV	7 à 12	7,2	✓

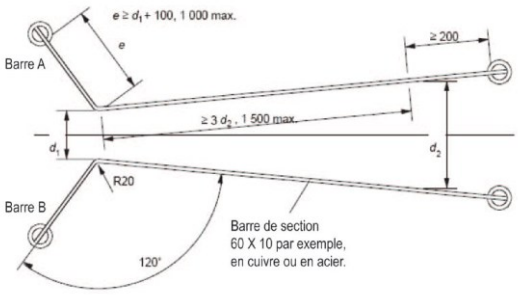
☑ : good ☒ : bad

☑ COMPLIANCE / ☐ NOT CORRESPONDING

8/ BRIDGING TEST
(Requirement §4.4.1 – Test §5.2.3)

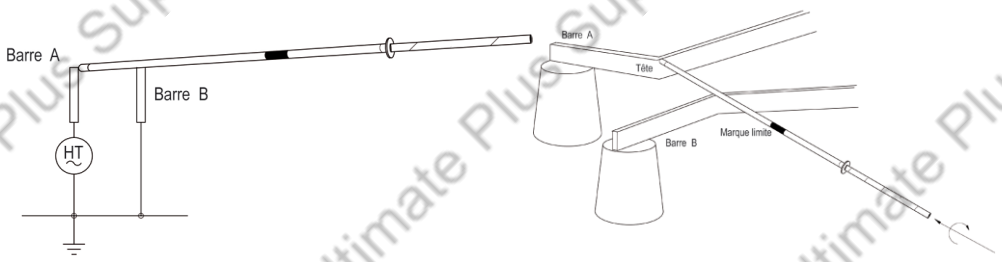
Test :

This test shall be performed only on sticks that can be used with nominal voltage equal or inferior to 52 kV



U_n kV	d_1 Distance entre les barres de fer mm
$U_n \leq 7{,}2$	50
$7{,}2 < U_n \leq 12$	60
$12 < U_n \leq 17{,}5$	85
$17{,}5 < U_n \leq 24$	115
$24 < U_n \leq 36$	180
$36 < U_n \leq 52$	240

For this test, two iron bars must be used in accordance the figure above. The distance d_1 between bars shall be adjusted according to table above. The distance d_2 is determined with : $d_2 = A_i + d_1 + 200$ where Ai is the distance between the head and limit mark. The test voltage shall be applied to the iron bars as indicated in figure below :



Acceptance criteria :

The test shall be considered as passed if no flashover or breakdown occurs.

Results :

Sample	Ur=Un (kV)	Ue (kV)	d_1 (mm)	A_i (mm)	d_2 (mm)	Observations	Validation stick
TP12SC45	45	52	240	1035	1475	NTR	✓
TP13PM				1085	1530	NTR	✓
TP3345kV				1095		NTR	✓

☑ : good ☒ : bad

NTR : Nothing to report

☑ COMPLIANCE / ☐ NOT CORRESPONDING

9/ LEAKAGE CURRENT (Requirement §4.4.2 – Test §5.2.2.1)

Test :

In the case of multi section stick with different section compositions, the test shall be carried out for all the compositions and at the maximum nominal voltage that each composition allows.

The voltage test shall be :

- $U_{essai} = 1{,}2U_r$ **if** $U_n \leq 123kV$;
- $U_{essai} = 1{,}2U_r/\sqrt{(3)} < 148kV$ **if** $U_n \geq 123kV$.

Tension nominale U_n (kV)	Largeur des électrodes-rubans mm	Anneaux concentriques	
		Diamètre extérieur mm	Diamètre de la section mm
$U_n \leq 245$	20	200	30
$U_n > 245$	40	600	160

Table 3 : Dimensions of concentric rings and band electrodes

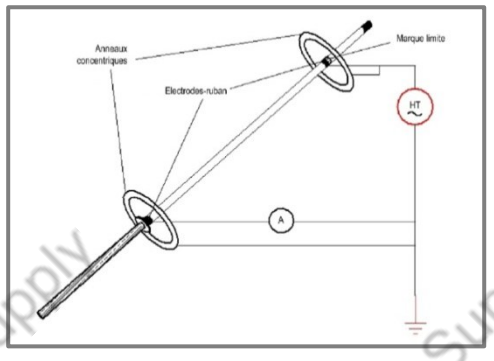


Figure 3 : Leakage current test

The test voltage shall be applied for 1 min.

Acceptance criteria :

The test shall be considered as passed if the leakage current never exceeds 50 µA.

Results

Sample	Ur=Un (kV)	Ue (kV)	Width of band electrodes (mm)	Concentric rings		Leakage current measured (µA)	Validation stick
				Ø ext (mm)	Ø section (mm)		
TP12SC45	45	54	20	200	30	1,0	✓
TP13PM						0,9	✓
TP3345kV						1,0	✓

☑ : good ☒ : bad

☑ COMPLIANCE / ☐ NOT CORRESPONDING

10/ PULLING TEST
(Requirement §4.3.1 – Test §5.4.3)

Test :
With the stick supported on a flat surface or one or several intermediate supports, the handle shall be rigidly held with knot whose edge is 50 mm from the hand guard and a pulling force is progressively applied on the head by means of a test tool appropriate to the type of head. The applied force will reach 1500 N and be maintained for 1 min.

Acceptance criteria :
The test shall be considered as passed if all the element of the stick show no signs of loosening or mechanical damage.

Results :

Sample	Total length (mm)	Holding the handle	Applied force (N)	Observations			Validation stick
				Mechanical damage	Distortions	NTR	
TP12SC45	1435	50 mm of the guard hands	1500 / 1 min	✓	✓	✓	✓
TP13PM	1485			✓	✓	✓	✓

☑ : good ☒ : bad

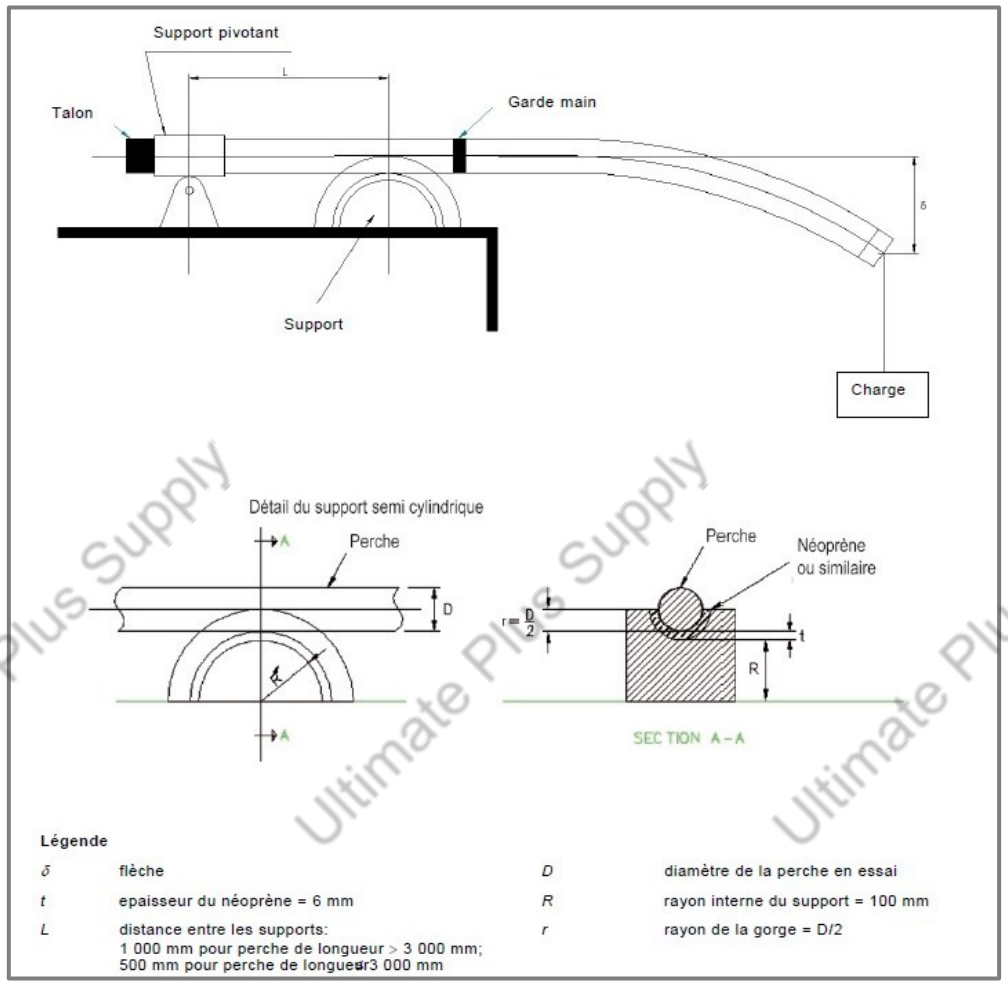
NTR : Nothing to report

☑ COMPLIANCE / ☐ NOT CORRESPONDING

11/ BENDING TEST
(Requirement §4.3.2 – Test §5.4.1)

Test :

This test shall be performed for sticks with a total length greater than or equal to two meters.



Légende

δ	flèche	D	diamètre de la perche en essai
t	epaisseur du néoprène = 6 mm	R	rayon interne du support = 100 mm
L	distance entre les supports: 1 000 mm pour perche de longueur > 3 000 mm; 500 mm pour perche de longueur ≤ 3 000 mm	r	rayon de la gorge = D/2

The end of the stick at the handle section is fixed to a swiveling support. Then a bending force of 50 N for sticks of up to 3 m or 100 N for sticks longer than 3 m shall be applied to the head and the deflection measured.

Acceptance criteria :

The test shall be considered as passed if the deflection (δ) does not exceed the value in the following table:

L (mm)	2000	2500	3000	3500	4000	4500	5000	5500	6000
δ (mm)	90	200	240	420	700	1080	1600	2250	3070

Results :

- Test with 50N during 30 s

Sample	Total length (mm)	Distance between supports (mm)	Maximum deflection (mm)	results		Validation stick
				Deflection measure (mm)	Observations	
TP12SC45	1435	NOT CONCERNED				
TP13PM	1485					
TP3345kV	1495					

☑ : good ☒ : bad

- Test with 75N during 30 s

Sample	Total length (mm)	Distance between supports (mm)	Observations	Validation stick
TP12SC45	1435	NOT CONCERNED		
TP13PM	1485			
TP3345kV	1495			

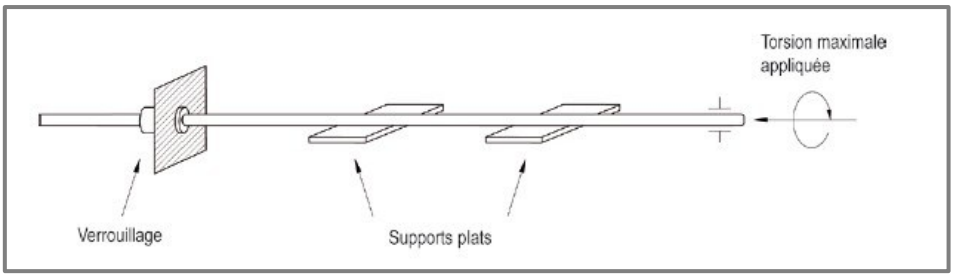
☑ : good ☒ : bad

☑ NOT APPLICABLE / ☐ NOT CORRESPONDING

1 12/ TORSION TEST
(Requirement §4.3.5 – Test §5.4.2)

Test:

A torque of T(N.m) = ØTube (mm) shall be applied around the axis of the stick with the help of a test tool appropriate to the type of head. The torque shall be applied in one direction for 1 min and the in the inverse direction for 1 min. The torsion angle in each direction will be measured.
Then the torque shall be increased up to 1,2T for both directions and maintained for 30 s.



Acceptance criteria :

The test shall be considered as passed if the sum of the absolute values of the angles measured in both directions does not exceed 25°/m of the total length of the stick. The test shall be considered as passed if the stick shows no signs of mechanical damage

Results :

Sample	Total length (mm)	torque 1 (Nm)	Torsion angle measured (°)		Results		observations
			Left	Right	Sum of the angles measured	Tolerance (25°/m)	
TP12SC45	1435	32	10	10	20	soit ≤ 35,9°	✓
TP13PM	1485		10	9	19	soit ≤ 37,1°	✓
TP3345kV	1495		9	9	18	soit ≤ 37,4°	✓

Sample	Total length (mm)	torque 2 (Nm)	Observations			Validation stick
			Deformations	Mechanical damage	NTR	
TP12SC45	1435	38,4			✓	✓
TP13PM	1485				✓	✓
TP3345kV	1495				✓	✓

☑ : good ☒ : bad

NTR : Nothing to report

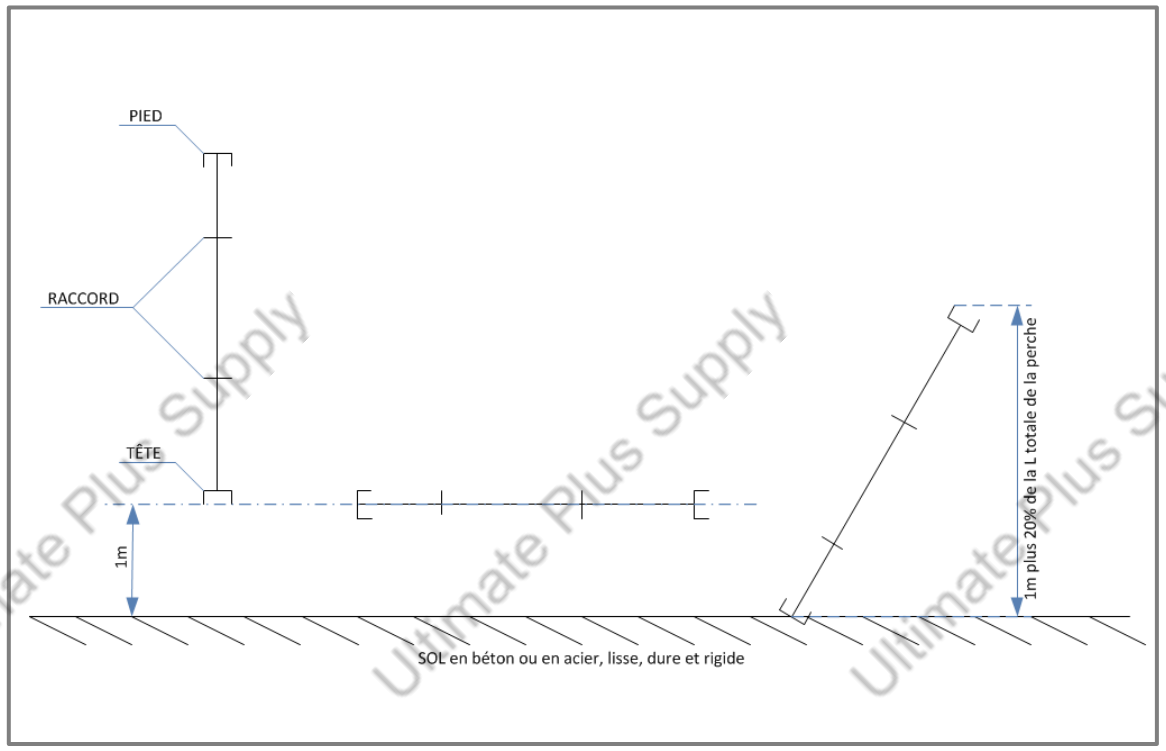
☑ COMPLIANCE / ☐ NOT CORRESPONDING

13/ DROP RESISTANCE
(Requirement §4.3.4 – Test §5.4.5)

Test:

This test shall be performed in accordance with the following parameters :

- The test surface shall be concrete or steel,
- The test surface shall be smouth, hard and rigid,
- The number of falls shall be one per position.
- The stick shall be dropped from 3 positions indicated in the following figure:



Acceptance criteria :

The test shall be considered as passed if the coupling shows no signs of mechanical damage and the connection is still working properly.

Results :

Sample	Total length (mm)	Position 1 horizontal	Position 2 vertical	Position 3		Validation stick
				Drop height (mm)	observations	
TP12SC45	1435	✓	✓	1287	NTR	✓
TP13PM	1485	✓	✓	1297	NTR	✓
TP12SC45	1495	✓	✓	1299	NTR	✓

☑ : good ☒ : bad

NTR : Nothing to report

☑ COMPLIANCE / ☐ NOT CORRESPONDING

14/ WATER PENETRATION
(Requirement §4.4.2 – Test §5.2.4)

Test :

The complete stick in one piece, or disassembled if it is composed of several sections, is immersed for 24 h in water having a resistivity of 100 Ω.m and then removed from the water bath. The leakage current test shall be performed in less than 30 min.

Acceptance criteria :

The test shall be considered as passed if leakage current never exceeds 50 µA.

Results :

Sample	Ur=Un (kV)	Ue (kV)	Width of band electrodes (mm)	Concentric rings		Leakage current measured (µA)	Validation stick
				Øext (mm)	Ø section (mm)		
TP12SC45	45	54	20	200	30	0,8	✓
TP13PM						0,8	✓
TP12SC45						0,7	✓

☑ : good ☒ : bad

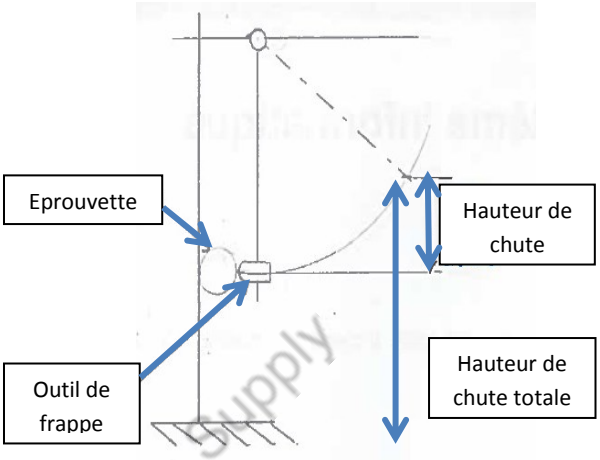
☑ COMPLIANCE / ☐ NOT CORRESPONDING

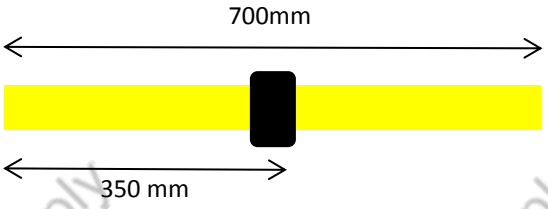
15/ SHOCK RESISTANCE ON COUPLINGS (Requirements §4.3.3 – Test §5.4.6)

Test :

The method testing shall be in agreement with EN 60068-2-75.

The test shall be performed on three test samples of 700 mm long with the coupling in the middle, taken from each stick. The samples shall be cooled to -25°C during 1 h. The most fragile part of the coupling shall be submitted to shock five times. The same location shall be subjected to shock only once.





Acceptance criteria :

The test shall be considered as passed if the coupling shows no signs of mechanical damage and the connection is still working properly.

Results :

Sample	couplings	Before test		Drop height (mm)	After test		Validation stick
		Visual verification	Couplings connection		Visual verification	Couplings connection	
TP12SC45	NOT CONCERNED						
TP13PM							
TP12SC45							

☑ : good ☒ : bad

☑ NOT APPLICABLE / ☐ NOT CORRESPONDING

16/ ANNEXE

Matériels	N° Enregistrement	N° Certificat	Laboratoire accrédité	Date de certification	Périodicité préconisée	Certificat
Machine d'essais de traction/compression	4309	1312057/1	Centre de certification de Metz	06/12/2013	4 ans	oui
Cellule dynamométrique (jauge de contrainte) 25kN	903315	-	**Contrôle interne** réalisé avec machine d'essais n°4309	-	4 ans	non
Dynamomètre KERN CH15K20 (15 daN)	BCE15	WD150064662	KERN & Sohn Gmbh	07/12/2015	3 ans	oui
Couple-mètre (1000N.m)	TT001	LQ40952/11002	A+ Métrologie	20/04/2016	3 ans	oui
Couple-mètre (100N.m)	CPLM201605	-	**Contrôle interne** réalisé avec machine d'essais n°TT001	-	3 ans	non
Boîte de 43 cales étalon en acier	516.963	B1404999	A+ Métrologie	10/04/2014	4 ans	oui
Pied à coulisse	PCN120	-	**Contrôle interne** réalisé avec cales n°516.963	-	2 ans	non
Balance vernissage (max 15kg)	24608274	9fbossharth 160205 _093329	Precia molen service	05/02/2016	2 ans	oui
Transformateur de tension 300kV	896149	2014042634	High Voltage Test Systems	26/03/2014	5 ans	oui
Multimètre	30429084	74PC0911	Manumesure	15/03/2017	2 ans	oui
Conductimètre	8497	11.C.16.00009	A+ Métrologie	08/04/2016	5 ans	oui
Thermohygromètre	D0094741	16-05-09H05179-LC	RS Components SAS	13/05/2016	5 ans	oui