

**TEST LABORATORY**

## **TEST REPORT**

### **QUALIFICATION TESTS OF FSD**

**SIZE 22x58 RATING 100A AND SIZE T00 RATING 160A**


**N° 010-15-02-07**

**06/02/2015**

**REQUESTED BY :** MICHAUD SA's Research Department

**INTRODUCTION :** This document gathers the qualification tests of FSD rating 100A for fuses size 22x58 (K291), and FSD rating 160A for fuses size T00 (K292, K293 and K294). The tested products are of MICHAUD's manufacture.  
The test procedures are the ones of the Standard NF EN 60947-3 dated 2009 (+ Additive A1 dated 2012) which fully duplicates the Standard CEI 60947-3 dated 2008 (+ Additive A1 dated 2012).

The Test Laboratory Head  
N. PETITJEAN



**ISSUANCE :** On 06/02/2015 - 1 original to UR (LE)  
- 1 original to COM (Customer filing)

Any copy of this test report is authorized only as a complete content after written authorisation from the Test Laboratory of MICHAUD SA. The test report hereafter concerns only the samples tested.

This document includes 17 pages (including this page 1).

## **CONTENTS**

	<b>PAGES</b>
<b>I) <u>INTRODUCTION</u> .....</b>	<b>3</b>
1.1 Subject .....	3
1.2 Tested products.....	3
1.3 Order of tests .....	3
 <b>II) <u>STANDARD DOCUMENTS REFERRED TO IN THIS TEST REPORT</u> ....</b>	 <b>4</b>
 <b>III) <u>GENERAL CONDITIONS</u> .....</b>	 <b>5</b>
 <b>IV) <u>TESTS</u> .....</b>	 <b>5</b>
8.2.3 Material enclosures .....	6
8.3.3.1 Heating .....	7
8.3.3.2 Dielectric properties test .....	9
8.3.3.3 Closing and breaking capacities .....	11
8.3.3.4 Dielectric verification.....	12
8.3.3.5 Leakage current.....	13
8.3.3.6 Heating verification.....	15
8.3.4.1 Operational performance test.....	16
8.3.7.1 Overload test.....	17

## **I) INTRODUCTION**

### **1.1 Subject**

This document gathers the qualification tests of FSD rating 100A for fuses size 22x58 (K291), and FSD rating 160A for fuses size T00 (K292, K293 and K294). The tested products are of MICHAUD SA's manufacture.

The test procedures are the ones of the Standard NF EN 60947-3 dated 2009 (+ Additive A1 dated 2012) which fully duplicates the Standard CEI 60947-3 dated 2008 (+Additive A1 dated 2012).

For each test, there is a test sheet gathering procedures and results.

### **1.2 Tested products**

The tested products are Fuse Switch Disconnectors (FSD) for fuse size 22x58 rating 100A and for fuse size T00 rating 160A according to the technical file "FSD". These products are coming from an industrial series and have been received at the Test Laboratory on 09/01/2015.

DESIGNATION	CODE	BATCH NUMBER
SINGLE PHASE FSD 100A (SIZE 22 X 58)	K 291	14 49 09
SINGLE PHASE FSD 160A (SIZE T00)	K 292	14 39 20
TRIPLE POLE FSD 160A (SIZE T00)	K 293	14 38 13
QUADRUPLE POLE FSD 160A (SIZE T00)	K 294	14 30 15

Remark : The triple pole FSD (K293) and the quadruple pole FSD (K294) for fuse size T00 are composed of single pole FSD for fuse size T00 (K292).

The FSD rated characteristics are the following ones :

- ◆ Use rated voltage : 500V for K 291 and 480V for K292, K293 and K294,
- ◆ Use rated current : 100A for K 291 and 160A for K292, K293 and K294,
- ◆ Rated frequency : 50 Hz,
- ◆ Conductors section : 6mm<sup>2</sup> up to 95mm<sup>2</sup>,
- ◆ Tightening torque : 15 N.m  $\pm$  10%.

**K291 : single pole FSD 100A (22x58)**



**K292 : single pole FSD 160A (T00)**



### 1.3 Order of tests

The tests are performed on 4 samples numbered from 1 up to 4 for FSD K291 and K292, and on 1 sample numbered 1 for FSD K293 and K294.

ORDER OF TESTS	SAMPLES N°				TESTS (PARAGRAPH OF THE STANDARD NF EN 60947-3)
	K291	K292	K293	K294	
/	1	1	1	1	8.2.3 Material enclosures
I	2	2	/	/	8.3.3.1 Heating 8.3.3.2 Dielectric properties test 8.3.3.3 Closing and breaking capacities 8.3.3.4 Dielectric verification 8.3.3.5 Leakage current 8.3.3.6 Heating verification
II	3	3	/	/	8.3.4.1 Operational performance test 8.3.4.2 (= 8.3.3.4) Dielectric verification 8.3.4.3 (= 8.3.3.5) Leakage current 8.3.4.4 (= 8.3.3.6) Heating verification
III	/	/	/	/	Non applicable
IV	/	/	/	/	Non applicable
V	4	4	/	/	8.3.7.1 Overload test 8.3.7.2 (= 8.3.3.4) Dielectric verification 8.3.7.3 (= 8.3.3.5) Leakage current 8.3.7.4 (= 8.3.3.6) Heating verification

## II) STANDARD DOCUMENTS REFERRED TO IN THIS TEST REPORT

### - International Standards

- CEI 60269-2** : 2013,  
“Low voltage fuses – Part 2 : Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of type of standardized fuses A up to K”.
- CEI 60947-1** : 2007 + Additive A1 dated 2010,  
“Low-voltage switchgear and controlgear – Part 1 : General rules”.
- CEI 60947-3** : 2008 + Additive A1 dated 2012,  
“Low-voltage switchgear and controlgear – Part 3 : Switches, disconnectors, switch-disconnectors and fuse-combination units”.

Remark : The Australian Standards AS 3947-1 and AS 3947-3 duplicate also the Standards CEI 60947-1 and CEI 60947-3.

### - European and French Standards

- HD 626-S1** : 1996 + Amendment 1 dated 1997 + Amendment 2 dated 2002,  
“Overhead distribution cables of rated voltage U0/U(Um) : 0,6/1 (1,2) kV”.
- NF EN 60529** : 1992 + Additive A1 dated 2000 + Additive A2 dated 2014,  
(Filing C 20-010) “Degree of protection provided by enclosures (IP Code)”.

- NF EN 50525-2-31** : 2012,  
(Filing C 32-525-2-31) “Electric cables – Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U). – Part 2-32 : Cables for general applications – Single core non-sheathed cables with thermoplastic PVC insulation”.
- NF C 33-209** : 1996,  
“Insulated or protected cables for power systems – Bundle assembled cores for overhead systems of rated voltage 0,6/1kV”.
- NF EN 60947-1** : 2007 + Additive A1 de 2011,  
(Filing C 63-001) “Low-voltage switchgear and controlgear – Part 1 : General rules”.
- NF EN 60947-3** : 2009 + Additive A1 de 2012,  
(Filing C 63-130) “Low-voltage switchgear and controlgear – Part 3 : Switches, disconnectors, switch-disconnectors and fuse-combination units”.

### III) GENERAL CONDITIONS

- Temperature

The tests are performed at the room temperature of the Test Laboratory comprised between 20°C and 26°C.

- Conductors used

STANDARD	ORIGIN	NOMINAL SECTION (in mm <sup>2</sup> )	STRANDS NUMBER AND CORE COMPOSITION	ØOVER INSULATION (in mm)	ØOVER CORE (in mm)
<b>HD 626-S1</b>	From Belgium	95 Phase aerial	19 Aluminium strands	15,1	11,4
<b>NF C 33-209</b>	NEXANS	50 Phase aerial	7 Aluminium strands	11,3	8,0
<b>NF EN 50525-2-31</b>	NEXANS	6 H07 VR	7 Copper strands	4,2	2,8

- Fuse links

STANDARD	MANUFACTURER	TYPE	REFERENCE
CEI 60269-2	LEGRAND	22 x 58 100A gG	153 96
CEI 60269-2	LEGRAND	T00 160A gG	163 55

- Bracket

For the tests, the single pole FSD K291 and K292 are fixed on a bracket K297. For the multipole FSD K293 and K294, the brackets are included in the products.

### IV) TESTS

On the following pages, the sheets of each performed test can be found.

TEST DESCRIPTION : 8.2.3 Material enclosures

Page 1/1

DATE : ON 13/01/2015

PLACE : MICHAUD SA Test Laboratory

OPERATOR : JP. RAPHY

N° OF SAMPLES : 1 for all the FSD

TEST EQUIPMENT :

- Degree of protection provided by the enclosures (IP rating)

PROCEDURES

Procedures and acceptance criteria are the ones of § 8.2.3 of the Standard NF EN 60947-3.

The FSD are fitted on conductors of minimum and maximum sections advised for the products use. They are installed as usual.

The IP 33 protection degree is checked according to the standard IEC 60529 :

- \* Verification against access to dangerous parts : the accessibility gauge of 2,5mm diameter shall remain at a sufficient distance of the live parts.
- \* Verification against the penetration of foreign solid elements : the accessibility gauge of 2,5mm diameter shall not penetrate at all.
- \* Verification against water penetration : water falling in fine drops from sprinkling rose in an angle less or equal to 60° on both sides of the vertical shall not have any harmful effects.

TEST RESULTS

FSD TYPE	SAMPLE N°	PREVIOUS TEST	COMPOSITION AND SECTION OF THE CONDUCTORS FITTED ON THE UPSTREAM AND DOWNSTREAM TERMINALS	PROTECTION DEGREE OBSERVED	COMMENTS	FOLLOWING TEST
K291	1	/	6mm <sup>2</sup> Copper and 35mm <sup>2</sup> Copper	IP 33	Satisfactory	/
K292	1	/	6mm <sup>2</sup> Copper and 35mm <sup>2</sup> Copper	IP 33	Satisfactory	/
K293	1	/	6mm <sup>2</sup> Copper and 35mm <sup>2</sup> Copper	IP 33	Satisfactory	/
K294	1	/	6mm <sup>2</sup> Copper and 35mm <sup>2</sup> Copper	IP 33	Satisfactory	/

TEST DESCRIPTION : 8.3.3.1 Heating

Page 1/2

DATE : ON 14 AND 15/01/2015

PLACE : MICHAUD SA Test Laboratory

OPERATOR : JP. RAPHY

N° OF SAMPLES : 2 for FSD K291 and K292

TEST EQUIPMENTS :

- Heating bench 700A
- Measure station SA 32
- Dynamometric equipment GRIN 15N.m and 70N.m
- Multimeter FLUKE 45

PROCEDURES

Procedures and acceptance criteria are the ones of § 8.3.3.1 of the Standard NF EN 60947-3 which refers to § 8.3.3.3 of the Standard NF EN 60947-1.

**1) Assembly**

The FSD is installed as usual on its fixing bracket.

Each terminal is equipped with an aluminium conductor linked to the heating bench terminals by means of deep compression lugs. The screws are tightened at the minimal torque, i.e. 13,5 N.m.

A fuse link is fitted in the sample and dissipates a power approximatively the same than the maximal power declared on the FSD.

FSD		FUSE LINK USED		CONDUCTORS SECTION
TYPE	MAXIMAL POWER	TYPE	POWER DISSIPATED	
K291	6W	22x58	6,1W under 100A	50mm <sup>2</sup> Aluminium (equivalent 35mm <sup>2</sup> Copper)
K292	12W	T00	11,9W under 160A	95mm <sup>2</sup> Aluminium (equivalent 70mm <sup>2</sup> Copper)

A thermocouple is fitted on each jaw (TC1 and TC2) as closely as possible to the contact with the fuse link.

Two other thermocouples (TC3 and TC4) are fitted on each terminal.

Then, two thermocouples are placed on the FSD exterior enclosure : one (TC5) is positioned on the FSD insulating enclosure (superior side) above the fuse link, the other one (TC6) is positioned on the fuse holder.

**2) Test**

A current corresponding to the use rated current, i.e. 100A for K291 and 160A for K292, is flowed in the circuit. The test is performed during a sufficient duration to let the heating reaching an established stabilisation value (that is to say that the heating variation does not exceed 1K/h).

When the stabilisation is reached, the heating values of the different FSD elements are recorded.

The heatings shall not exceed :

- \* 65 K for the terminals,
- \* 50 K for the FSD exterior enclosure.

No limit is defined for the jaws. However, no damage, due to the contacts heating of the fuse link being in a position to damage the FSD ulterior good working, shall occur.

TEST DESCRIPTION : 8.3.3.1 Heating

Page 2/2

TEST RESULTS

FSD 22x58 (K291) :

SAMPLE N°	PREVIOUS TEST	CONDUCTORS SECTION (in mm²)	I <sub>e</sub> (in A)	POWER DISSIPATED BY THE FUSE LINK (in W)	HEATING (in K)						COMMENTS	FOLLOWING TEST
					JAWS		TERMINALS		ENCLOSURE			
					TC1	TC2	TC3	TC4	TC5	TC6		
2	/	50 Aluminium	100	6,1	30,7	32,1	26,3	27,5	14,3	12,7	Satisfactory	8.3.3.2
				Authorised limit value (in K)	/		65		50			

FSD T00 (K292) :

SAMPLE N°	PREVIOUS TEST	CONDUCTORS SECTION (in mm²)	I <sub>e</sub> (in A)	POWER DISSIPATED BY THE FUSE LINK (in W)	HEATING (in K)						COMMENTS	FOLLOWING TEST
					JAWS		TERMINALS		ENCLOSURE			
					TC1	TC2	TC3	TC4	TC5	TC6		
2	/	95 Aluminium	160	11,9	55,1	53,8	47,2	48,3	29,1	25,3	Satisfactory	8.3.3.2
				Authorised limit value (in K)	/		65		50			



TEST DESCRIPTION : 8.3.3.2 Dielectric properties test

Page 1/2

DATE : ON 16/01/2015

PLACE : MICHAUD SA Test Laboratory

OPERATOR : JP. RAPY

N° OF SAMPLES : 2 for FSD K291 and K292

TEST EQUIPMENTS :

- Dielectric test equipment A 1105
- Impact generator P35

PROCEDURES

Procedures and acceptance criteria are the ones of § 8.3.3.2 of the Standard NF EN 60947-3.

**1) Assembly**

The FSD, equipped with aluminium conductors, is installed as usual on its fixing bracket. A fuse link is fitted in the FSD. A metal sheet covers the external surface of the FSD insulating enclosure. This sheet is linked to the bracket.

**2) Tests**

**a) Impacts resistance**

The rated voltage of FSD impacts resistance  $U_{imp}$  is settled according to the Annexe H and the Table 14 of the Standard NF EN 60947-1, and is equal to 6 kV.

The FSD is equipped with the fuse link. 5 impacts voltages of 9,6 kV peak value with positive, then negative polarity, are applied on the terminals linked between them and linked to the bracket.

The fuse link is removed from the FSD. 5 impacts voltages of 9,6 kV peak value with positive, then negative polarity, are applied on the upstream terminal and the downstream terminal.

The waveforms of the impacts voltages are of 1,2/50  $\mu$ s type.

During the test, no breakdown discharge shall occur.

**b) Resistance at industrial frequency**

The FSD is equipped with the fuse link. A voltage of efficient value 1,9 kV at 50 Hz is applied for 1 minute on the terminals linked between them and linked to the bracket.

The increase in voltage is performed at a speed of 1kV/s and the dielectric test equipment is regulated to release at a 100mA leakage current.

During the test, no breakage or flashover shall occur.

**c) Leakage current**

The fuse link is removed from the FSD. A voltage of 1 kV at 50 Hz is applied for 1 minute between the conductors. The dielectric test equipment is regulated to release at a 0,5mA leakage current.

Remark : The test performed is harsher than the one scheduled in the Standard NF EN 60947-3 which plans a leakage current lower than 0,5mA under 1,1  $U_e$ , i.e. 550V or 528V.

The dielectric test equipment shall not release.

TEST DESCRIPTION : 8.3.3.2 Dielectric properties test

Page 2/2

TEST RESULTS

**a) Impacts resistance**

FSD TYPE	SAMPLE N°	PREVIOUS TEST	VOLTAGE APPLICATION POINT		TEST VOLTAGE	COMMENTS
			1 <sup>st</sup> POINT	2 <sup>nd</sup> POINT		
K291	2	8.3.3.1	Terminals linked between them	Fixing bracket	9,6 kV	Satisfactory
			Upstream terminal	Downstream terminal	9,6 kV	Satisfactory
K292	2	8.3.3.1	Terminals linked between them	Fixing bracket	9,6 kV	Satisfactory
			Upstream terminal	Downstream terminal	9,6 kV	Satisfactory

**b) Resistance at industrial frequency**

FSD TYPE	SAMPLE N°	VOLTAGE APPLICATION POINT		TEST VOLTAGE	COMMENTS
		1 <sup>st</sup> POINT	2 <sup>nd</sup> POINT		
K291	2	Terminals linked between them	Fixing bracket	1,9 kV	Satisfactory
K292	2	Terminals linked between them	Fixing bracket	1,9 kV	Satisfactory

**c) Leakage current**

FSD TYPE	SAMPLE N°	LEAKAGE CURRENT	COMMENTS	FOLLOWING TEST
K291	2	< 0,5 mA	Satisfactory	8.3.3.3
K292	2	< 0,5 mA	Satisfactory	8.3.3.3

TEST DESCRIPTION : 8.3.3.3 Closing and breaking capacities

DATE : ON 19/01/2015

PLACE : MICHAUD SA Test Laboratory

OPERATOR : JP. RAPHY

N° OF SAMPLES : 2 for FSD K291 and K292

TEST EQUIPMENTS :

- Connection and breaking on load bench
- Dynamometric equipment GRIN 15 N.m and 70 N.m

PROCEDURES

Procedures and acceptance criteria are the ones of § 8.3.3.3 of the Standard NF EN 60947-3.

The FSD, equipped with aluminium conductors, is linked to the connection and breaking on load bench by means of deep compression lugs.

A fuse link is fitted in the FSD.

The opening / closing movement of the fuse carrier is performed by a pneumatic jack, at a speed of around 0,5 m/s.

The connection and breaking on load bench is regulated with the following parameters :

FSD TYPE	LEAKAGE CURRENT (in A)	TEST VOLTAGE (in V)	COS $\phi$	CYCLES NUMBER	CLOSING TIME (in s)	OPENING TIME (in s)
K291 (100A)	150	525	0,95	5	2	30
K292 (160A)	240	504	0,95	5	2	30

No permanent flashover shall occur. The opening / closing mechanism of the fuse link carrier shall work normally at the end of the test.

TEST RESULTS

FSD TYPE	SAMPLE N°	PREVIOUS TEST	COMMENTS	FOLLOWING TEST
K291	2	8.3.3.2	Satisfactory - No permanent flashover	8.3.3.4
K292	2	8.3.3.2	Satisfactory - No permanent flashover	8.3.3.4

TEST DESCRIPTION : 8.3.3.4 Dielectric verification

DATE : ON 22/01/2015

PLACE : MICHAUD SA Test Laboratory

OPERATOR : JP. RAPY

N° OF SAMPLES : 2, 3 and 4 for FSD K291 and K292

TEST EQUIPMENT :

- Dielectric test equipment A 1105

PROCEDURES

Procedures and acceptance criteria are the ones of § 8.3.3.4 of the Standard NF EN 60947-3.

**1) Assembly**

The FSD, equipped with aluminium conductors, is installed as usual on its fixing bracket.  
A fuse link is installed in the FSD.

**2) Resistance at industrial frequency**

A voltage of efficient value 1 kV at 50 Hz is applied for 1 minute between the terminals linked between them and linked to the bracket.

The increase in voltage is performed at a speed of 1 kV/s and the dielectric test equipment is regulated to release at 100mA.

No breakage or flashover shall occur.

TEST RESULTS

FSD TYPE	SAMPLE N°	PREVIOUS TEST	VOLTAGE APPLICATION POINT		COMMENTS AFTER 1 MIN UNDER 1 kV	FOLLOWING TEST
			1 <sup>st</sup> POINT	2 <sup>nd</sup> POINT		
<b>K291</b>	<b>2</b>	8.3.3.3	Terminals linked between them	Fixing bracket	Satisfactory	8.3.3.5
	<b>3</b>	8.3.4.1	Terminals linked between them	Fixing bracket	Satisfactory	8.3.3.5
	<b>4</b>	8.3.7.1	Terminals linked between them	Fixing bracket	Satisfactory	8.3.3.5
<b>K292</b>	<b>2</b>	8.3.3.3	Terminals linked between them	Fixing bracket	Satisfactory	8.3.3.5
	<b>3</b>	8.3.4.1	Terminals linked between them	Fixing bracket	Satisfactory	8.3.3.5
	<b>4</b>	8.3.7.1	Terminals linked between them	Fixing bracket	Satisfactory	8.3.3.5

TEST DESCRIPTION : 8.3.3.5 **Leakage current**

DATE : ON 22/01/2015

PLACE : MICHAUD SA Test Laboratory

OPERATOR : JP. ROPY

N° OF SAMPLES : 2, 3 and 4 for FSD K291 and K292

TEST EQUIPMENT :

- Dielectric test equipment A 1105

PROCEDURES

Procedures and acceptance criteria are inspired by § 8.3.3.5 of the Standard NF EN 60947-3.

The FSD, equipped with aluminium conductors, is fitted as usual on its fixing bracket. The fuse link has been removed.

A voltage of 1 kV at 50 Hz is applied for one minute :

- \* between both conductors,
- \* between each conductor and the bracket.

The dielectric test equipment is regulated to release at a 2 mA leakage current.

Remark : The test performed is harsher than the one scheduled in the Standard NF EN 60947-3 which plans a leakage current lower than 2 mA under 1,1 U<sub>e</sub>, i.e. 550 V or 528 V.

The dielectric test equipment shall not release.

TEST RESULTS

FSD TYPE	SAMPLE N°	PREVIOUS TEST	VOLTAGE APPLICATION POINT		COMMENTS	LEAKAGE CURRENT	FOLLOWING TEST
			1 <sup>st</sup> POINT	2 <sup>nd</sup> POINT			
<b>K291</b>	<b>2</b>	8.3.3.4	Conductor (upstream terminal)	Conductor (downstream terminal)	Satisfactory	< 2 mA	8.3.3.6
			Conductor (upstream terminal)	Bracket	Satisfactory	< 2 mA	
			Conductor (downstream terminal)	Bracket	Satisfactory	< 2 mA	
	<b>3</b>	8.3.3.4	Conductor (upstream terminal)	Conductor (downstream terminal)	Satisfactory	< 2 mA	8.3.3.6
			Conductor (upstream terminal)	Bracket	Satisfactory	< 2 mA	
			Conductor (downstream terminal)	Bracket	Satisfactory	< 2 mA	
	<b>4</b>	8.3.3.4	Conductor (upstream terminal)	Conductor (downstream terminal)	Satisfactory	< 2 mA	8.3.3.6
			Conductor (upstream terminal)	Bracket	Satisfactory	< 2 mA	
			Conductor (downstream terminal)	Bracket	Satisfactory	< 2 mA	

TEST DESCRIPTION : 8.3.3.5 *Leakage current*

Page 2/2

FSD TYPE	SAMPLE N°	PREVIOUS TEST	VOLTAGE APPLICATION POINT		COMMENTS	LEAKAGE CURRENT	FOLLOWING TEST
			1 <sup>st</sup> POINT	2 <sup>nd</sup> POINT			
K292	2	8.3.3.4	Conductor (upstream terminal)	Conductor (downstream terminal)	Satisfactory	< 2 mA	8.3.3.6
			Conductor (upstream terminal)	Bracket	Satisfactory	< 2 mA	
			Conductor (downstream terminal)	Bracket	Satisfactory	< 2 mA	
	3	8.3.3.4	Conductor (upstream terminal)	Conductor (downstream terminal)	Satisfactory	< 2 mA	8.3.3.6
			Conductor (upstream terminal)	Bracket	Satisfactory	< 2 mA	
			Conductor (downstream terminal)	Bracket	Satisfactory	< 2 mA	
	4	8.3.3.4	Conductor (upstream terminal)	Conductor (downstream terminal)	Satisfactory	< 2 mA	8.3.3.6
			Conductor (upstream terminal)	Bracket	Satisfactory	< 2 mA	
			Conductor (downstream terminal)	Bracket	Satisfactory	< 2 mA	

**TEST DESCRIPTION : 8.3.3.6 Heating verification**

DATE : ON 23 AND 26/01/2015

PLACE : MICHAUD SA Test Laboratory

OPERATOR : JP. ROPY

N° OF SAMPLES : 2, 3 and 4 for FSD K291 and K292

**TEST EQUIPMENTS :**

- Heating bench 700A
- Measure stations SA 32 and SA 70
- Dynamometric equipment GRIN 15N.m and 70N.m
- Multimeter FLUKE 45

**PROCEDURES**

Procedures and acceptance criteria are the ones of § 8.3.3.6 of the Standard NF EN 60947-3.

A heating test is performed according to the procedures of the test 8.3.3.1 of this test report.

The heatings measured shall not be higher than :

- \* 80 K for the terminals,
- \* 60 K for the FSD external enclosure.

**TEST RESULTS**

**FSD 22x58 (K291) :**

SAMPLE N°	PREVIOUS TEST	CONDUCTORS SECTION (in mm²)	I <sub>e</sub> (in A)	POWER DISSIPATED BY THE FUSE LINK (in W)	HEATING (in K)						COMMENTS	FOLLOWING TEST
					JAWS		TERMINALS		ENCLOSURE			
					TC1	TC2	TC3	TC4	TC5	TC6		
2	8.3.3.5	50 Aluminium	100	6,1	33,1	34,2	26,8	28,2	14,5	12,9	Satisfactory	/
3	8.3.3.5	50 Aluminium	100	6,1	41,5	42,8	30,7	31,2	17,3	15,2	Satisfactory	/
4	8.3.3.5	50 Aluminium	100	6,1	30,9	31,7	27,2	28,0	15,0	13,9	Satisfactory	/
				Authorised limit value (in K)	/		80		60			

**FSD T00 (K292) :**

SAMPLE N°	PREVIOUS TEST	CONDUCTORS SECTION (in mm²)	I <sub>e</sub> (in A)	POWER DISSIPATED BY THE FUSE LINK (in W)	HEATING (in K)						COMMENTS	FOLLOWING TEST
					JAWS		TERMINALS		ENCLOSURE			
					TC1	TC2	TC3	TC4	TC5	TC6		
2	8.3.3.5	95 Aluminium	160	11,9	57,6	55,6	48,0	48,9	30,5	28,3	Satisfactory	/
3	8.3.3.5	95 Aluminium	160	11,9	65,2	63,7	52,9	54,3	36,8	34,2	Satisfactory	/
4	8.3.3.5	95 Aluminium	160	11,9	56,2	57,3	48,8	47,5	29,6	30,2	Satisfactory	/
				Authorised limit value (in K)	/		80		60			

**TEST DESCRIPTION : 8.3.4.1 Operational performance test**

DATE : ON 20 AND 21/01/2015

PLACE : MICHAUD SA Test Laboratory

OPERATOR : JP. ROPY

N° OF SAMPLES : 3 for FSD K291 and K292

TEST EQUIPMENTS :

- Connection and breaking on load bench
- Dynamometric equipment GRIN 15N.m and 70N.m

PROCEDURES

Procedures and acceptance criteria are the ones of § 8.3.4.1 of the Standard NF EN 60947-3.

The FSD is linked to the connection and breaking on load bench by means of 2 conductors. The FSD terminals are tightened at the minimal torque, i.e. 13,5N.m. A fuse link is installed in the FSD.

By means of a pneumatic jack, the FSD swing is operated at a speed of around 0,5m/s.

The first part of the opening / closing cycles is performed without current. The second part of the cycles is carried out on a closed circuit.

During the test, no permanent flashover, nor exterior events which might be dangerous for the operator shall occur.

At the end of the test, the swing working shall be satisfactory.

TEST RESULTS

**FSD 22x58 (K291)** : use category AC21B

SAMPLE N°	PREVIOUS TEST	CONDUCTORS SECTION (in mm <sup>2</sup> )	TOTAL DURATION OF A CYCLE (in s)	NUMBER OF CYCLES WITHOUT CURRENT	CYCLE WITH CURRENT				COMMENTS		FOLLOWING TEST
					NUMBER	TEST CURRENT (in A)	TEST VOLTAGE (in V)	COS $\varphi$	DURING THE TEST	AT THE END OF THE TEST	
3	/	50 Aluminium	30	1 700	300	100	500	0,95	Satisfactory	Satisfactory	8.3.3.4

**FSD T00 (K292)** : use category AC21B

SAMPLE N°	PREVIOUS TEST	CONDUCTORS SECTION (in mm <sup>2</sup> )	TOTAL DURATION OF A CYCLE (in s)	NUMBER OF CYCLES WITHOUT CURRENT	CYCLE WITH CURRENT				COMMENTS		FOLLOWING TEST
					NUMBER	TEST CURRENT (in A)	TEST VOLTAGE (in V)	COS $\varphi$	DURING THE TEST	AT THE END OF THE TEST	
3	/	95 Aluminium	30	1 400	200	160	480	0,95	Satisfactory	Satisfactory	8.3.3.4



TEST DESCRIPTION : 8.3.7.1 Overload test

Page 1/1

DATE : ON 21/01/2015

PLACE : MICHAUD SA Test Laboratory

OPERATOR : JP. RAPHY

N° OF SAMPLES : 3 for FSD K291 and K292

TEST EQUIPMENTS :

- Dynamometric equipment GRIN 15N.m and 70N.m
- Heating bench 700A

PROCEDURES

Procedures and acceptance criteria are the ones of § 8.3.7.1 of the Standard NF EN 60947-3.

**1) Assembly**

A FSD is fitted as usual on its bracket.

Each terminal is equipped with an aluminium conductor linked to the heating bench terminals, by means of deep compression lugs. The screws are tightened at the minimal torque, i.e. 13,5 N.m.

A fuse link is fitted in the sample.

FSD TYPE	FUSE LINK USED		
	TYPE	MANUFACTURER	REFERENCE
K291	22 x 58 100A gG	LEGRAND	153 96
K292	T00 160A gG	LEGRAND	163 55

**2) Test**

An intensity current equal to  $1,6 \times I_{th}$  is flowed in the circuit, i.e. 160 A for K291 and 256 A for K292, for one hour or until the fusion of the fuse link.

Within the 3 minutes following the fuse link working, or after one hour, an opening / closing operation is performed. The opening / closing mechanism of the fuse link carrier shall work normally.

TEST RESULTS

FSD TYPE	SAMPLE N°	PREVIOUS TEST	CABLE SECTION (in mm <sup>2</sup> )	TEST INTENSITY (in A)	TEST DURATION	COMMENTS	FOLLOWING TEST
K291	4	/	50 Aluminium	160	44 min	Satisfactory	8.3.3.4
K292	4	/	95 Aluminium	256	32 min	Satisfactory	8.3.3.4