

ANALYSIS AND QUALIFICATION





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COMPANY

AMR ELECTRONIQUE

Located in Saint just (FRANCE) over 35 years AMR Electronique develops and manufactures new production processes for winding trades. Our expertise which has steadily developed allows us to accompany our customers in areas such as :

- The agglomeration of winding wires with polymerization by Joule Effect
- Analysis and qualification of enameled wire (for new product)
- Connection without unenamelling with COSDEM
- Prototyping of specific products manufactured for the imposed constraints
- The qualification and validation of connections
- Bench Test motors



QUALITY AND MEANS

Now present in 5 continents, we give special attention quality tools in both :

- Analysis and qualification means
- Production
- Production management of our equipment

AREAS OF ACTIVITIES

AMR Electronique delivers reliable and sustainable business solutions to our partners in Aeronautics, Automotive, Energy, Medical, Nuclear, Railway ...



P R E S E N T A T I O N



ENAMELLED WIRES

ENAMELLED WIRES

Our analysis laboratory allows to get all the qualifications required in the enamelled wires industries. Major magnet wires manufacturers have already used our knowledge and the qualifications conducted in the past used baseline today. This level of expertise has allowed AMR to be present in sectors such as Nuclear, Energy, Automotive and Aerospace.

Provided test

Tests are driven according to the standards (IEC 60851 - IEC 60216, ...) or to the customers specified needs.




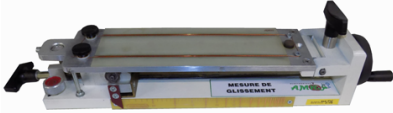

Why wires analysis ?

Standard tests managed by wires manufacturers have shown their limitations as final customers can obviously notice. Analysis and tests processes must be defined in order to satisfy the specific customers needs. Tests procedures can be managed with a confidentiality contract with final customers or wires manufacturers.





TEST RESOURCES



TEST RESOURCES (Mechanical test)		
Equipment for measuring the characteristics of enameled wires described by the standard IEC 60851-3		
Test equipment spinginess	BRAND : AMR Electronique	
	MODEL : AMRESSORT 1	
	N° : AMR 0882	
	DISPLAY : Angle °	
	CAPACITY : Ø of conductor ≤ 1,6 mm	
Test equipment spinginess	BRAND : AMR Electronique	
	MODEL : AMRESSORT 2	
	N° : AMR0883	
	DISPLAY : Angle °	
	CAPACITY : Ø of conductor ≤ 1,6 mm	
Test equipment peel test	BRAND : AMR Electronique	
	MODEL : AMRPEELTEST	
	N° : AMR1102	
	DISPLAY : NUMBER OF LAP	
	Ø de fil : de 1 à 4,5 mm	
Test equipment dynamic coefficient of friction	BRAND : AMR Electronique	
	MODEL : AMRGLISS	
	N° : AMR 1045	
	DISPLAY : Angle °	
Test equipment breaking	BRAND : AMR Electronique	
	MODEL : AMRUPT	
	N° : AMR1240	
	DISPLAY : Newton	
	CAPACITY : to 0 of 30 Newton	

ENAMELLED WIRES



TEST RESOURCES

E N A M E L L E D W I R E S

TEST RESOURCES (Mechanical test)		
Control of gauges and measuring instrument	Calibration bar Standard weight	
Steamed traction bench	BRAND : AMR Electronique	
	MODEL : TRACTECTUVE	
	N° : AMR 0123	
	CAPACITY max : 200 N	
	ACQUISITION SYSTEM : Force / Time / temperature	
	PRECISION : ± 1 N	
	DIMENSION mm : 2020 x 360 x 100	
	INTERFACE : MAC OS 10.4-10.5-10.6...10.11	



STANDARD

Winding Wires

Binder N°12

NFC 31023

Methods of test for winding wires

IEC 60851-1

Methods of test for winding wires - Part 1: General

IEC 60851-3

Winding wires - Test methods - Part 3: Mechanical properties

IEC 60851-5

Winding wires - Test methods - Part 5: Electrical properties

IEC 60851-6

Winding wires - Test methods - Part 6: Thermal properties

IEC 60172

Test procedure for the determination of the temperature index of enamelled and tape wrapped winding wires

Winding Wires

Binder N°13

IEC 60317-0-1

Specifications for particular types of winding wires - Part 0-1: General requirements - Enamelled round copper wire

IEC 60317-0-2

Specifications for particular types of winding wires - Part 0-2: General requirements - Enamelled rectangular copper wire

IEC 60317-0-2-A2

Enamelled rectangular copper wire

IEC 60317-0-3

Specifications for particular types of winding wires - Part 0-3: General requirements - Enamelled round aluminium wire

IEC 60317-0-6

Specifications for particular types of winding wires - Part 0-6: General requirements - Glass-fibre wound resin or varnish impregnated, bare or enamelled round copper wire

IEC 60317-1

Specifications for particular types of winding wires - Part 1: Polyvinyl acetal enamelled round copper wire, class 105

IEC 60317-2

Specifications for particular types of winding wires - Part 2: Solderable polyurethane enamelled round copper wire, class 130, with a bonding layer

IEC 60317-3

Specifications for particular types of winding wires - Part 3: Polyester enamelled round copper wire, class 155

IEC 60317-4

Specifications for particular types of winding wires - Part 4: Solderable polyurethane enamelled round copper wire, class 130



STANDARD

Winding Wires

Binder N°14

IEC 60317-7

Specifications for particular types of winding wires - Part 7: Polyimide enamelled round copper winding wire, class 220

IEC 60317-8

Specifications for particular types of winding wires - Part 8: Polyesterimide enamelled round copper wire, class 180

IEC 60317-12

Specifications for particular types of winding wires - Part 12: Polyvinyl acetal enamelled round copper wire, class 120

IEC 60317-13

Specifications for particular types of winding wires - Part 13: Polyester or polyesterimide overcoated with polyamide-imide enamelled round copper wire, class 200

IEC 60317-14

Specifications for particular types of winding wires - Part 14: Polyvinyl acetal enamelled round aluminium wire, class 105

IEC 60317-15

Specifications for particular types of winding wires - Part 15: Polyesterimide enamelled round aluminium wire, class 180

IEC 60317-19

Specifications for particular types of winding wires - Part 19: Solderable polyurethane enamelled round copper winding wire overcoated with polyamide, class 130

IEC 60317-20

Specifications for particular types of winding wires - Part 20: Solderable polyurethane enamelled round copper wire, class 155

IEC 60317-22

Specifications for particular types of winding wires - Part 22: Polyester or polyesterimide enamelled round copper wire overcoated with polyamide, class 180

Winding Wires

Binder N°15

IEC 60317-25

Specifications for particular types of winding wires. Part 25: Polyester or polyesterimide overcoated with polyamide-imide, enamelled round aluminium wire, class 200

IEC 60317-26

Specifications for particular types of winding wires. Part 26: Polyamide-imide enamelled round copper wire, class 200

IEC 60317-27

Paper tape covered rectangular copper wire

IEC 60317-30

Specifications for particular types of winding wires. Part 30: Polyimide enamelled rectangular copper wire, class 220

IEC 60317-32

Specifications for particular types of winding wires - Part 32: Glass fibre wound, resin or varnish impregnated, bare or enamelled rectangular copper wire, temperature index 155

IEC 60317-34

Specifications for particular types of winding wires - Part 34: Polyester enamelled round copper wire, class 130L

IEC 60317-39

Specifications for particular types of winding wires - Part 39: Glass-fibre braided resin or varnish-impregnated, bare or enamelled rectangular copper wire, temperature index 180

IEC 60317-40

Specifications for particular types of winding wires - Part 40: Glass-fibre braided resin or varnish-impregnated, bare or enamelled rectangular copper wire, temperature index 200



STANDARD

Winding Wires

[Binder N°16](#)

IEC 60317-43

Specifications for particular types of winding wires - Part 43: Aromatic polyimide tape wrapped round copper wire, class 240

IEC 60317-44

Specifications for particular types of winding wires - Part 44: Aromatic polyimide tape wrapped rectangular copper wire, class 240

IEC 60317-45

Specifications for particular types of winding wires - Part 45: Polyester enamelled round copper wire, class 130

IEC 60317-47

Specifications for particular types of winding wires - Part 47: Aromatic polyimide enamelled rectangular copper wire, class 240

IEC 60317-48

Specifications for particular types of winding wires - Part 48: Glass-fibre wound resin or varnish impregnated, bare or enamelled round copper wire, temperature index 155

IEC 60317-49

Specifications for particular types of winding wires - Part 49: Glass-fibre wound high temperature resin or varnish impregnated, bare or enamelled round copper wire, temperature index 180

IEC 60317-50

Specifications for particular types of winding wires - Part 50: Glass-fibre wound silicone resin or varnish impregnated, bare or enamelled round copper wire, temperature index 200

IEC 60317-51

Specifications for particular types of winding wires - Part 51: Solderable polyurethane enamelled round copper wire, class 180

Winding Wires

[Binder N°17](#)

IEC 60317-52

Specifications for particular types of winding wires - Part 52: Aromatic polyamide (aramid) tape wrapped round copper wire, temperature index 220

IEC 60317-53

Specifications for particular types of winding wires - Part 53: Aromatic polyamide (aramid) tape wrapped rectangular copper wire, temperature index 220

IEC 60317-54

Specifications for particular types of winding wires - Part 54: Polyester enamelled round copper wire, class 155L

IEC 60317-55

Specifications for particular types of winding wires - Part 55: Solderable polyurethane enamelled round copper wire overcoated with polyamide, class 180



INSULATION

New developments today lead to increase the dielectric performance of the insulation. The increase in operating frequency causes accelerated aging. The life of insulation also requires an improvement . These new needs are growing day by day at the moment when the conversion of energy is undergoing a revolution.

Partial discharges

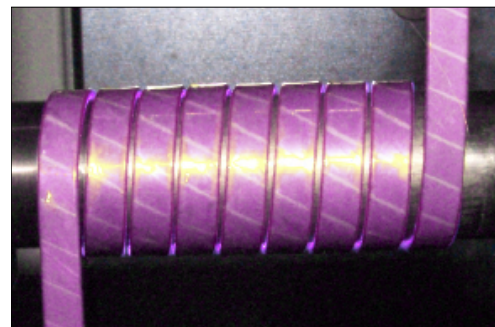
Partial discharges are a consequence of a stress in a dielectric insulation during the high voltage application in high frequency. This is caused by several anomalies, among which the not homogeneous distribution of the electric field, the presence of bubbles within the insulation, the effect of spikes on the insulating material, the presence of moisture or cracks, the presence of surface contaminants insulators.

Partial discharges are present on insulation defects on joints type cables XLPE / EPR, elbows and terminations of cables in the electrical equipment MV and HV in metal casings (high voltage cells) and distribution transformers, or in all industrial facilities such as power switching systems (molded bridges transistors), rotating machines windings (asynchronous & synchronous machines) ...

The aim of these measures is the establishment of test campaigns for the purpose of safety and preventive maintenance or for the qualification of finished products after manufacture.







« Corona » effect

The "corona" effects appear on a high electrical potential conductor. The electric field in the vicinity thereof may become intense enough to cause ionization of air molecules. It causes a chemical decomposition causing erosion and deterioration of the metal surfaces. This phenomenon is called "corona effect" or "crown" and it is still characterized by a bluish tint rich in ultraviolet around the conductors and sometimes emits an audible sound to the ear. One consequence of this is the loss of energy in electricity grids and reducing the lifetime of the insulation.





TEST RESOURCES

TEST RESOURCES (Electrical test)		
Control of gauges and measuring instrument	Standard shunts 1 A to 1500 A Precision : $\pm 1\%$ Standard resistances 9 m Ω to 56 Ω Precision : $\pm 0,5\%$	
Generator high voltage	BRAND : AMR Electronique	
	MODEL : Diélectrique / Diélectrique 2	
	N° : 0112 / 0114	
	TENSION RANGE : De 1 à 6000 V	
	PRECISION : $\pm 1\%$	
RESOLUTION :		
Voltage amplifier & DC Contrôler	BRAND : AMR Electronique	
	MODEL : AMPLITEN	
	N° : AMR 0541	
	POWER : 250W	
PRECISION : $\pm 1\%$		
Voltage amplifier & DC Contrôler	BRAND : AMR Electronique	
	MODEL : AMPLITEN	
	N° : AMR 0542	
	POWER : 6000W	
PRECISION : $\pm 1\%$		
Frequency generator	BRAND : MCP Instrument	
	MODEL : SG1639A	
	N° : 1204215536	
	FREQUENCY RANGE : 1Hz à 15 MHz	
	PRECISION : $\pm 0,003\% \pm 1$ Digit	
RESOLUTION : 5 Digits		
Dielectric chamber	BRAND : AMR Electronique	
	MODEL : AMRDIELE	
	N° : 0934	
	MATERIAL : PA66	
	BALL CHARACTERISTIC : Ball 2 or 1,5 mm	
	VACUUM SYSTEM	
CONTROL : Temperature and Humidity		



ELECTRICAL INSULATION





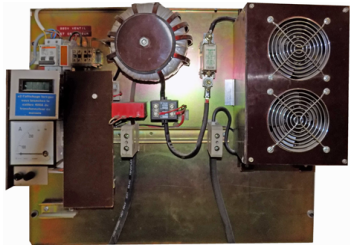



TEST RESOURCES

TEST RESOURCES (Electrical test)		
Control of gauges and measuring instrument	Standard shunts 1 A to 1500 A <i>Precision : ± 1 %</i> Standard resistance 9 mΩ to 56 Ω <i>Precision : ± 0,5 %</i>	
Voltage amplifier & DC Contrôler	BRAND : AMR Electronique	
	MODEL : AMPLITEN	
	N° : AMR	
	Control : Current -voltage- times	
	PRECISION : ± 1%	
Voltage amplifier & DC Contrôler	BRAND : AMR Electronique	
	MODEL : AMPLITEN	
	N° : AMR	
	POWER : 3000 W	
	PRECISION : ± 1%	
Transformers HF	BRAND : AMR Electronique	
	MODEL :	
	N° : AMR	
	Working Frequency : 1050 Hz and 10 Kz	
Dielectric chamber	BRAND : AMR Electronique	
	MODEL : AMRDIELE 2	
	N° : 0934	
	MATERIAL : PA66	
	BALL CHARACTERISTIC : Ball 2 or 1,5 mm	
	VACUUM SYSTEM	
	CONTROL : Temperature and Humidity	








TEST RESOURCES

TEST RESOURCES (Electrical test)		
Control of gauges and measuring instrument	Voltage stadard <i>Precision : $\pm 0,02$ %</i>	
LCR meter	BRAND : AMR Electronique	
	MODEL : LCR mètre	
	N° : 0976 & 0977	
	L : 0,1 nH à 100 H / C: 0,1 pF à 100 mP/ R: 0.1 Ω à 1G Ω	
	PRECISION : 0,05 %	
LCR meter	BRAND : ISO-TECH	
	MODEL : LCR-1703	
	N° :	
	C max : 20 mF- R Max 200 M Ω - I Max : 20 KH	
	PRECISION : 0,2 %	
Distortion meter	BRAND : HAMEG	
	MODEL : HM8027	
	N° : 27911 P 3728	
	RATE DISTORTION mini : 0,005 %	
	FREQUENCY RANGE : De 20 Hz - 20 kHz	
PRECISION : 0,01%		
Current generator Ac	BRAND : AMR Electronique	
	MODEL : GENCOURALT	
	N° : AMR 0754	
	CURRENT max : 400 A	
	PRECISION : Class 1,5	
Machine polymerization	BRAND : AMR Electronique	
	MODEL : GProuvette	
	N° : 0212	
	POLYMERIZATION RANGE : de 10 m Ω à 2 Ω	
	PRECISION : $\pm 0,5$ %	
RESOLUTION :		

ELECTRICAL INSULATION







TEST RESOURCES

TEST RESOURCES (Electrical test)		
Control of gauges and measuring instrument	Voltage standard Precision : $\pm 0,02 \%$	
Oscilloscopes	BRAND : Keysight Technologies	
	MODEL : DSOX1102G	
	N° : CN57126287	
	CHOPPING FREQUENCY : 0,5 MHz	
	BANDWIDTH: 2X 0 à 100 MHz	
	RELEASE : 0-130 MHz	
High Voltage for oscilloscope Probe	BRAND : PINTEK	
	MODEL : HVP-15 HF	
	N° :	
	Max Working voltage : 0-15 KV DC	
	BANDWIDTH: DC- 50 MHz	
	Accuracy : 2 % (DC to 10 KV)	
Multi-meter	BRAND : METRIX	
	MODEL : MX 5060	
	N° :	
	MEASUREMENT RANGE cc: 0mV-1000V	
	PRECISION : 0,05%	
	RESOLUTION : 0,0001 mV-0,1 V	
Multi-meter	BRAND : METRIX	
	MODEL : MX 5006	
	N° :	
	MEASUREMENT RANGE cc: 0mV-1000V	
	PRECISION : 0,05%	
	RESOLUTION : 0,0001 mV-0,1 V	



TEST RESOURCES



TEST RESOURCES (Electrical test)		
Control of gauges and measuring instrument	Voltage standard <i>Precision : ± 0,02 %</i>	
Multi-meter	BRAND : AGILENT	
	MODEL : U1273A	
	N° : MY54160047	
	MEASUREMENT RANGE cc: 300mV-1000V	
	PRECISION : 0,05%	
	RESOLUTION : 0,001 mV-0,1 V	
Micro-ohm meter	BRAND : ndp technologie	
	MODEL : DRM-10A	
	N° : AMR 1015	
	RANGE: 0,01 $\mu\Omega$ TO 200 $\mu\Omega$ Résolution: 0,01 $\mu\Omega$ PRECISION : 0,1 %	
Current generator Dc	BRAND : AMR Electronique	
	MODEL : GCC	
	N° : AMR 0712	
	RANGE : 0,01 / 0,1 / 1 / 10 A	
	MEASUREMENT : 4 WIRES	
	PRECISION : ±2% de la lecture	

ELECTRICAL INSULATION



TEST RESOURCES



TEST RESOURCES (Thermal test)		
PID controller with power limiting		
High temperature furnace	BRAND : BOREL	
	MODEL : FP 1100-10	
	N° : S12131	
	POWER : 2,9 KW	
	TEMPERATURE RANGE : 0 à 1100 °C	
	DIMENSION mm : 200 x 200 x 250	
	PRECISION : ± 1 °C	
Heat Chamber	BRAND : AMR Electronique	
	MODEL : ETUVE1	
	N° : AMR1205	
	TEMPERATURE RANGE : 0 à 300°C	
	PRECISION : ± 1 °C	
	DIMENSION mm : 560 x 400 x 330	



STANDARD

Insulation 1

[Binder N°9](#)

IEC 60085

Electrical insulation – Thermal evaluation and designation

IEC 60216-1

Electrical insulating materials - Thermal endurance properties

IEC 60216-2

Electrical insulating materials - Thermal endurance properties - Part 2: Determination of thermal endurance properties of electrical insulating materials - Choice of test criteria

IEC 60216-4-1

Thermal endurance properties

IEC 60216-5

Determination of relative thermal endurance index of an insulating material

IEC 61006

Electrical insulating materials - Methods of test for the determination of the glass transition temperature

IEC 60626-1

Combined flexible materials for electrical insulation - Part 1: Definitions and general requirements

IEC 60626-2

Combined flexible materials for electrical insulation - Part 2: Methods of test

DIN EN ISO 6721

Determination of dynamic mechanical properties-
Part 2 : Torsion-pendulum method

DIN ISO 178

Plastics- Determination of flexural properties

Insulation 2

[Binder N°10](#)

IEC 60071-1

Insulation co-ordination - Part 1: Definitions, principles and rules

IEC 60071-2

Insulation co-ordination - Part 2: Application guide

IEC 61857-21

Electrical insulation systems - Procedures for thermal evaluation - Part 21: Specific requirements for general-purpose models - Wire-wound applications

IEC 60343

Recommended test methods for determining the relative resistance of insulating materials to breakdown by surface discharges

IEC 61857-22

Electrical insulation systems - Procedures for thermal evaluation - Part 22: Specific requirements for encapsulated-coil model - Wire-wound electrical insulation system (EIS)

IEC 61858

Electrical insulation systems - Thermal evaluation of modifications to an established wire-wound EIS

Insulation 3

[Binder N°11](#)

IEC 60270

High-voltage test techniques - Partial discharge measurements

IEC 60664-1

Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests

IEC 60064-4

Consideration of high frequency voltage stress



CALCULATION

TEST RESOURCES (Calculation program)

Calculation copper and aluminium conductor

Harmonic calculation

Calculation Litz wires

Calculation Arrhenius laws

Calculation Pressure Temperature



CONNECTION

It is important to remember that an electrical connection is a set between :

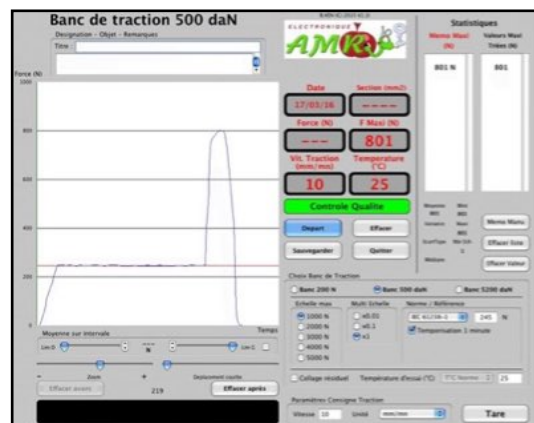
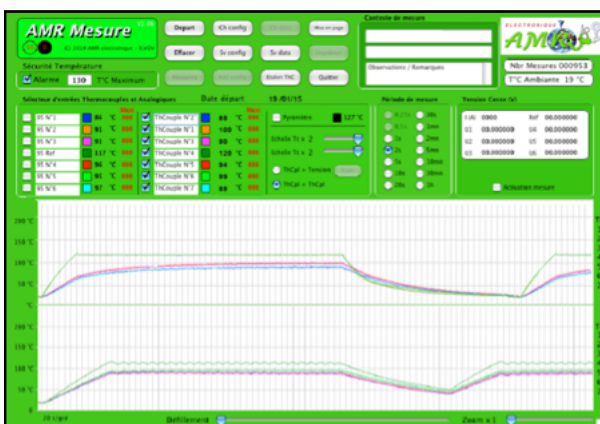
- An unanemelled standard cable
- A terminal of dimensions corresponding to the cable
- A crimping die which correspond to the cable and to the terminal



The use of enamel wires or conductor wrapped in winding wires requires a quality approach which has not always implemented. This forgetting frequently led to significant failures in electrical systems.

The use of a standardized terminal and a non-standard cable corresponds to an **"invention"** that must be qualified with :

- Mechanical tests
- Electrical tests
- Visual tests



ELECTRICAL CONNECTION





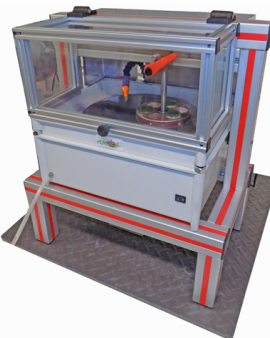

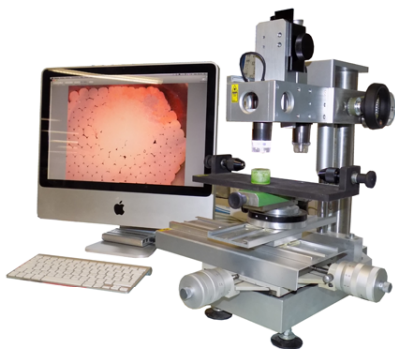
TEST RESOURCES

TEST RESOURCES (Dimensional control)		
Control of gauges and measuring instrument	Set of parallel gauge blocks DIN 861 connected BNM COFRAC	
Sliding caliper	BRAND : TESA	
	MODEL : 0-150 mm	
	N° : 11W50	
	DISPLAY : 0,01 mm	
	CAPACITY : 0-150 mm	
Micro-meter	BRAND : TESAMASTER	
	MODEL : DIGITMASTER	
	N° : 54.100000	
	LIMI ERROR : 2 μm	
	MEASUREMENT RANGE : 0-25 mm	
Control gauge	BRAND : AMR Electronique	
	MODEL : Matrix Hexagonal à 60°	
	N° : AMR 2815	
	DISPLAY : 0,01 mm	
Measuring column	BRAND : AMR Electronique	
	MODEL : Colonne de mesure	
	N° : AMR 0614	
	DISPLAY : 0,01 mm MEASUREMENT RANGE : 0-600 mm	
	SUPPORT : Marble precision class 0 DIMENSION (mm) : 800 x 500 x 100	






TEST RESOURCES

ELECTRICAL CONNECTION

TEST RESOURCES (Visual examination)		
Control of gauges and measuring instrument	BLADE GLASS CALIBRATION Precision : 0,01 mm	
Pendulum saw	BRAND : AMR Electronique	
	MODEL : AMR CUT	
	N° : AMR 1213	
	Saw teeth fine HSS	
	Nb of lap/min : 38	
Polishing machine	BRAND : AMR Electronique	
	MODEL : AMR POLISH	
	N° : AMR 1115	
	TRAY CAPACITY : 200 à 300 mm	
	CAPACITY POLISHING : 6 samples	
Chemical polishing	REVELATION AND NEUTRALIZATION	
	Iron Chloride 40 - 45 %, n° CE 231-729-4	
	Hydrochloric acide : 23 % min, n°CE 231-595-7	
	WATER	
Digital microscope	BRAND : AMR Electronique	
	MODEL : AM7013MZT4 AM7013MZT	
	N° : AMR 0314	
	MAGNIFICATION : 20-200x et 400-470x	
	CROSS TABLE Mitutoyo : Précision 0,005 mm	








TEST RESOURCES

TEST RESOURCES (Tensile test)		
Control of gauges and measuring instrument	Calibration bar Standard weight	
Traction bench	BRAND : AMR Electronique	
	MODEL : BT1 & BT2	
	N° : AMR0856 - AMR0123	
	CAPACITY max : 5 000 N & 200 N	
	ACQUISITION SYSTEM : Force / Time / temperature	
	Accuray : ± 1 N	
Traction bench	BRAND : AMR Electronique	
	MODEL : BT3	
	N° : AMR0427	
	CAPACITY max : 40 000 N	
	ACQUISITION SYSTEM : Force / temps	
	Accuray : ± 5 N	









TEST RESOURCES

ELECTRICAL CONNECTION

TEST RESOURCES (Electrical test)		
Control of gauges and measuring instrument	Standard shunt 1 A to 1500 A <i>Precision : ± 1 %</i> Standard resistance 9 mΩ to 56 Ω <i>Precision : ± 0,5 %</i>	
multi-muer	BRAND : AGILENT	
	MODEL : U1273A	
	N° : MY54160047	
	MEASUREMENT RANGE cc:300mV-1000V	
	Accuray : 0,05%	
	Résolution : 0,001 mV-0,1 V	
Current clamp	BRAND : ISO-TECH	
	MODEL : ICM 2000	
	N° : 13130789	
	Accuray ca : +-3% +-5digits	
	Accuray cc : +-2% de la lecture	
	Résolution ca et cc : 0,1-400 A	
Current generator DC	BRAND : AMR Electronique	
	MODEL : GCC	
	N° : AMR 0712	
	RANGE : 0,01 / 0,1 / 1 / 10 A	
	MEASUREMENT : 4 Wires	
	PRECISION : +-2% of read	
Micro-ohm meter	BRAND : ndp technologie	
	MODEL : DRM-10A	
	N° : AMR 1015	
	MEASUREMENT RANGE : 0,01 μΩ à 200 μΩ RESOLUTION: 0,01μΩ Accuray : 0,1 %	



TEST RESOURCES

TEST RESOURCES (Electrical test)		
Control of gauges and measuring instrument	Stallion shunt to 1 A of 1500 A <i>Precision : ± 1 %</i> Stallion resistance to 9 mΩ of 56 Ω	
AMR-SCOPE for temperature measurement	BRAND : AMR Electronique	
	Modèle : AMR-SCOPE	
	N° : AMR0887	
	CHARACTERISTIC : Thermocouple K TIME MEASUREMENT: 1 mesure/ Sec COMPUTER : IMAC 2 GHz	
Generator by Joule effect	BRAND : AMR Electronique	
	MODEL : GEJ1	
	N° : AMR0876	
	HEATING RANGE : 0,5 to 16 mm2	
Generator by Joule effect	BRAND : AMR Electronique	
	MODEL : GEJ2-GEJ3	
	N° : AMR0877 - AMR0878	
	HEATING RANGE : 16 to 70mm2 - 70 to 300 mm2	
Aging system	BRAND : AMR Electronique	
	MODEL : TDV	
	N° : AMR0954	
	CHARACTERISTIC : Thermostaté Longueur : 7 mètres Mesure de chute de tension : Automatique	
Short circuit bench	BRAND : AMR Electronique	
	MODEL : BBC	
	N° : AMR0898	
	HEATING RANGE à 250°C : of 0,5 to 300mm2	



CALCULATION

TEST RESOURCES (Calculation program)

Calculation
selecting
connector

AMOR Ca Maitrise de l'Effet Joule

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<http://www.amr-electronique.com> & <http://tcode.com/fr/index.html>

Version 2. 98

Calcul du choix des Cosses et des Mors

Diamètre d'un Fil 0,310 mm Nombre de Fils 927 Cuivre Nu	Taux de remplissage câble 91% Section Câble Cuivre 69,97 mm ² Section Interne mini_cosse 77,15 mm ² Ø Interne mini_Cosse 9,91 mm Section interne corrigée 78,69 mm ² <small>78,5 mm² 78,5 mm²</small>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Normes et Sections Nominales des Cosses Cuivre correspondantes</th> </tr> <tr> <th>2</th> <th>3</th> <th>4</th> <th>5</th> </tr> </thead> <tbody> <tr> <td>Norme</td> <td>NFC 20-130</td> <td>NFF 00363</td> <td>DIN 46235</td> <td>IEC 61338-1</td> </tr> <tr> <td>Scu</td> <td>70,0 mm²</td> <td>50,0 mm²</td> <td>50,0 mm²</td> <td>50,0 mm²</td> </tr> <tr> <td>S Int.</td> <td>95,0 mm²</td> <td>91,6 mm²</td> <td>78,5 mm²</td> <td>78,5 mm²</td> </tr> <tr> <td>Ø Ext.</td> <td>15,0 mm</td> <td>14,0 mm</td> <td>14,5 mm</td> <td>13,0 mm</td> </tr> <tr> <td>Ø Int.</td> <td>11,0 mm</td> <td>10,8 mm</td> <td>10,0 mm</td> <td>10,0 mm</td> </tr> </tbody> </table>	Normes et Sections Nominales des Cosses Cuivre correspondantes		2	3	4	5	Norme	NFC 20-130	NFF 00363	DIN 46235	IEC 61338-1	Scu	70,0 mm ²	50,0 mm ²	50,0 mm ²	50,0 mm ²	S Int.	95,0 mm ²	91,6 mm ²	78,5 mm ²	78,5 mm ²	Ø Ext.	15,0 mm	14,0 mm	14,5 mm	13,0 mm	Ø Int.	11,0 mm	10,8 mm	10,0 mm	10,0 mm
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Tolérance dimensionnelle 2% Ø Int. Cosse 10,0 mm Ø Ext. Cosse 14,5 mm S Ext. Cosse 165,1 mm ² Rapport de sertissage Sr/Scu = 1,12 Section Ext. sertissage 147,11 mm ²	Il faut privilégier le choix de la Norme en Automatique Norme Définie Automatiquement Choix de la Norme DIN 46235 Automatique	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>a Int.</td> <td>5,19 mm</td> <td>Rapport Ø Int. Cosse / H Int. Totale</td> <td>1,11</td> </tr> <tr> <td>h Int.</td> <td>4,49 mm</td> <td>Section Ext. sertissage</td> <td>148,43 mm²</td> </tr> </table>	a Int.	5,19 mm	Rapport Ø Int. Cosse / H Int. Totale	1,11	h Int.	4,49 mm	Section Ext. sertissage	148,43 mm ²																							
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Seules les cellules en vert sont modifiables

Il faut privilégier les mors 4.a.h lorsque le nombre de fils est inférieur à 100, et/ou, lorsque la cosse est trop grande par rapport au faisceau de fils.

Mors Standards (type 6 = 3.a.h)

Il faut privilégier les mors 4.a.h lorsque le nombre de fils est inférieur à 100, et/ou, lorsque la cosse est trop grande par rapport au faisceau de fils.

Mors Larges (type 6 = 4.a.h)

Mors à Privilégier

Taux de sertissage 100%
Calcul avec déformation intérieure hexagonale

Vérifier le taux de remplissage en

ELECTRICAL CONNECTION



STANDARD

Crimping

Binder N°1

NF EN 61238-1

Compression and mechanical connectors for power cables for rated voltages up to 30 kV ($U_m = 36$ kV) - Part 1: Test methods and requirements

DIN 46235

Cable lugs for compression connections

NF EN 60352-2

Solderless connections - Part 2: Crimped connections - General requirements, test methods and practical guidance

IEC 60352-4

Solderless connections - Part 4: Solderless non-accessible insulation displacement connections - General requirements, test methods and practical guidance

NF C20130

Cosse nues, à sertir, en cuivre ou en alliage de cuivre

NFC 20131

Cossé à plage en cuivre ou en aluminium pour conducteurs en aluminium.

NF C63-023

Embout à collerette isolante

NF F00363

Produits à sertir pour connexion électriques

NF F61-011

Assemblage vissées pour connexions électrique en cuivre

BS EN 3373-014

Aerospace series- Terminal lugs and in-linesplices for crimping on electric conductors

Connecting devices

Binder N°2

IEC 61210

Connecting devices - Flat quick-connect terminations for electrical copper conductors - Safety requirements

IEC 61545

Connecting devices - Devices for the connection of aluminium conductors in clamping units of any material and copper conductors in aluminium bodied clamping units

IEC 60998-1

Connecting devices for low-voltage circuits for household and similar purposes - Part 1: General requirements

IEC 60999-1

Connecting devices - Electrical copper conductors - Safety requirements for screw-type and screwless-type clamping units - Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)

IEC 60999-2

Connecting devices - Electrical copper conductors - Safety requirements for screw-type and screwless-type clamping units - Part 2: Particular requirements for clamping units for conductors above 35 mm² up to 300 mm² (included)



STANDARD

Connectors for electronic equipment

Binder N°3

IEC 60512-1-1

Connectors for electronic equipment - Tests and measurements - Part 1-1: General examination - Test 1a: Visual examination

IEC 60512-1-2

Connectors for electronic equipment - Tests and measurements - Part 1-2: General examination - Test 1b: Examination of dimension and mass

IEC 60512-2-1

Connectors for electronic equipment - Tests and measurements - Part 2-1: Electrical continuity and contact resistance tests - Test 2a: Contact resistance - Millivolt level method

IEC 60512-5-1

Connectors for electronic equipment - Tests and measurements - Part 5-1: Current-carrying capacity tests - Test 5a: Temperature rise

IEC 60512-4-3

Connectors for electronic equipment - Tests and measurements - Part 4-3: Voltage stress tests - Test 4c: Voltage proof of pre-insulated crimp barrels

IEC 60512-9-5

Connectors for electronic equipment - Tests and measurements - Part 9-4: Endurance tests - Test 9d: Durability of contact retention system and seals (maintenance, ageing)

IEC 60512-11-1

Electromechanical components for electronic equipment - Basic testing procedures and measuring methods - Part 11: Climatic tests - Section 1: Test 11a - Climatic sequence

IEC 60512-11-4

Connectors for electronic equipment - Tests and measurements - Part 11-4: Climatic tests - Test 11d: Rapid change of temperature

IEC 60512-11-9

Connectors for electronic equipment - Tests and measurements - Part 11-9: Climatic tests - Test 11i: Dry heat

IEC 60512-11-13

Connectors for electronic equipment - Tests and measurements - Part 11-13: Climatic tests - Test 11n: Gas tightness, solderless wrapped connections

IEC 60512-16-1

Connectors for electronic equipment - Tests and measurements - Part 16-1: Mechanical tests on contacts and terminations - Test 16a: Probe damage

IEC 60512-16-4

Connectors for electronic equipment - Tests and measurements - Part 16-4: Mechanical tests on contacts and terminations - Test 16d: Tensile strength (crimped connections)

IEC 60512-16-8

Connectors for electronic equipment - Tests and measurements - Part 16-8: Mechanical tests on connections and terminations - Test 16h: Insulating grip effectiveness (crimped connections)

IEC 60512-19-3

Electromechanical components for electronic equipment - Basic testing procedures and measuring methods - Part 19: Chemical resistance tests - Section 3: Test 19c - Fluid resistance



STANDARD

IEC 60068 *Environmental testing*

Binder N°4

IEC 60068-2-1

Test A : Cold

IEC 60068-2-6

Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)

IEC 60068-2-18

Environmental testing - Part 2-18: Tests - Test R and guidance: Water

IEC 60068-2-21

Environmental testing - Part 2-21: Tests - Test U: Robustness of terminations and integral mounting devices

IEC 60068-2-30

Environmental testing –
Part 2-30: Tests – Test Db: Damp heat, cyclic (12 + 12 h cycle)

IEC 60068-2-31

Environmental testing - Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens

IEC 60068-2-42

Environmental testing - Part 2-42: Tests - Test Kc: Sulphur dioxide test for contacts and connections

IEC 60068-2-57

Environmental testing - Part 2-57: Tests - Test Ff: Vibration - Time-history and sine-beat method

IEC 60068-2-58

Environmental testing - Part 2-58: Tests - Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)

IEC 60068-2-75

Environmental testing - Part 2-75: Tests - Test Eh: Hammer tests

IEC 60068-2-78

Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state



STANDARD



It is important to consider the application and the environment in which the product will evolve. This is why some standards show their limits in the constraints and requirements expected by customers.

We must therefore go further in the knowledge of standards and regulations related to electronic trade, electricity, rotating and static machines ...

This allows to provide a response tailored to customer demand.



IEC 61000 CEM

Current and short circuit

IEC 60034 Rotating machine

IEC 60076 Transformers

Cable

Metrology and calibration

Insulation et rotating machine

Plastic and insulation

Plastic and thermoplastic

PEEK

Properties of metals

Technical engineering

Aluminum

Technical specifications

EDF Specifications

Q U A L I F I C A T I O N



STANDARD

IEC 61000 *ECM1*

Binder N°5

IEC 61000-3-2

Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

IEC 61000-3-3

Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

IEC 61000-3-8

Electromagnetic compatibility (EMC) - Part 3: Limits - Section 8: Signalling on low-voltage electrical installations - Emission levels, frequency bands and electromagnetic disturbance levels

IEC 61000-4-2

Electromagnetic compatibility (EMC) –
Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test

IEC 61000-4-4

Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

IEC 61000-4-5

Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test

IEC 61000 *ECM2*

Binder N°6

IEC 61000-4-11

Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests

IEC 61000-4-30

Electromagnetic compatibility (EMC) - Part 4-30: Testing and measurement techniques - Power quality measurement methods

IEC 6000-6-2

Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments

ETSI EN 301 843-1

Electromagnetic compatibility and radio spectrum matters
Common technical requirement



STANDARD

Current and short circuit

Binder N°6

IEC 60949

Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects

IEC 60287-1-1

Electric cables - Calculation of the current rating - Part 1-1: Current rating equations (100 % load factor) and calculation of losses - General

IEC 60287-2-1

Electric cables - Calculation of the current rating - Part 2-1: Thermal resistance - Calculation of the thermal resistance

IEC 60865-1

Short-circuit currents - Calculation of effects - Part 1: Definitions and calculation methods

214

The mechanical effects of currents of short-circuit currents

IEC 60034 Rotating machines

Binder N°7

IEC 60034-1

Rotating electrical machines - Part 1: Rating and performance

IEC 60034-2-2

Rotating electrical machines - Part 2-2: Specific methods for determining separate losses of large machines from tests - Supplement to IEC 60034-2-1

IEC 60034-7

Rotating electrical machines - Part 7: Classification of types of constructions and mounting arrangements (IM Code)

IEC 60034-12

Rotating electrical machines - Part 12: Starting performance of single-speed three-phase cage induction motors

IEC 60034-14

Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity

IEC 60034-18-22

Rotating electrical machines –Part 18-22:
Functional evaluation of insulation systems – Test procedures for wire-wound windings – Classification of changes and insulation component substitutions

IEC TS 60034-18-41

Rotating electrical machines - Part 18-41: Partial discharge free electrical insulation systems (Type I) used in rotating electrical machines fed from voltage converters - Qualification and quality control tests

IEC 60034-30

Rotating electrical machines –
Part 30-1: Efficiency classes of line operated AC motors (IE code)



STANDARD

IEC 60076 *Transformers*

Binder N°8

IEC 60076-3

Insulation levels, dielectric tests and external clearance in air

IEC 60076-4

Power transformers - Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors

IEC 60076-5

Power transformers - Part 5: Ability to withstand short circuit

IEC 60076-7

Laoding guide for oil-immersed power transformers

IEC 60078-8

Power transformers – Application guide

IEC 60076-10

Power transformers - Part 10: Determination of sound levels

IEC 60076-11

Part 11: Dry-type transformers

Cable

Binder N°18

IEC 60228

Conductors of insulated cables

IEC 60227-5

Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Part 5: Flexible cables (cords)

IEC 61442

Test methods for accessories for power cables with rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)

IEC 60502-1

Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) –

IEC 60099-5

Surge arresters - Part 5: Selection and application recommendations

Métrology and calibration

Binder N°20

BS EN 10204

Metallic products-Type of inspection documents

Guide d'accréditation Metrologie dimensionnelle

Guide d'accréditation :

Metrologie des forces

ISO 7500-1

Tension/compression testing machine- Verification and calibrationof the force-measuring system

Recommandation internationale OIML R 65

Système de mesure de force des machines uniaxiales d'essai des matériaux

Recommandation internationale OIML G 10

Equipement d'un service national de métrologie



STANDARD

Railway Applications

Binder N°21

BS EN 61373

Equipment - Shock and vibration tests.

BS EN 50382-1

Railway rolling stock high temperature power cable having special fires performance.

BS EN 50382-2

Railway rolling stock high temperature power cable having special fires performance. Single core silicone rubber insulated cable for 120° C or 150°C

IEC 61287-1

Power converters installed on board rolling stock- Characteristics and test methods.

Q U A L I F I C A T I O N



PRESCRIPTION

Machine tournantes et Isolation

Binder N° 22

Technique de l'ingénieur

Bobinage des machines tournantes à courant alternatif

Schneider

Démarrage et protection des moteurs

AMR

Guide utilisateur BEM

Schneider 207

Les moteurs électriques pour mieux les piloter et les protéger

Schneider 83

Pertes supplémentaires dans les conducteurs pour forte intensité par effet de peau et de proximité

Rocwell

Notions fondamentales sur la protection des moteurs

Machine tournantes et Isolations

Binder N° 23

Thèse Vasil MIHAILA

Nouvelle conception des bobinages statoriques des machines à courant alternatif pour réduire les effets négatifs de dV/dT

Thèse Fabrice AYMUNIMO

Etude du comportement des systèmes d'isolation des machines tournantes à courant alternatif fonctionnant sous hautes températures (200°C-400°C)

Thèse d Walid BOUGHANMI

Eco-conception des motorisations électriques : Application à la machine asynchrone.

Thèse Vincent BOUCHER

Etude du vieillissement de matériaux hautes températures pour machines tournantes et définition de méthodes d'essai accélérées.

Thèse Benoit PETITGRAS

Origin of the failure occurring in high temperature electrical machine : a route to improve the electrical behavior of enamel wires.



PRESCRIPTION

Plastiques et Isolation

Binder N°24

Thèse Paul SABATIER

Modélisation du vieillissement organique sous contrainte électrique
Application à la fiabilité des matériaux

Thèse Sébastien DOMINGUEZ

Relation structure / propriétés de polymères et mélange thermoplastiques thermostables-application aéronautique hautes température

Thèse Piotr WERYNSKI

Vieillissement des diélectrique et surveillance in situ des machines électrique

Science des matériaux de l'électrotechnique

Travaux pratiques et exercices

Thèse Anh Tho VU THI

Etude de l'origine des décharges partielles sur les substrats céramiques enrobés

Thèse Sergei SAVIN

Nouvel indicateur de vieillissement de l'isolation inter-spires des machines électriques utilisées en aéronautique

Plastique et thermoplastique

Binder N°25

Thèse Jean LAMETHE

Etude de l'adhésion de composites thermoplastiques semi-cristallins; application à la mise en oeuvre par soudure.

Quadrant

Plastique technique

AMR

Thermoplastique et thermodurcissable

ISOSUD

Programme de livraison

PEEK

Binder N°26

Thèse Isabelle Giraug

Elaboration d'ensimages thermoplastiques thermostable :
Influence sur le comportement mécanique des composites PEEK/ fibre de carbonnes

Thèse Marion DASRIAUX

Evolutions microstructurales du PEEK au dessus de sa température de transition vitreuse lors de maintient sous pression et température

Technique de l'ingénieur

PEEK

VICTREX

Document action complète de la mise en oeuvre du PEEK



PRESCRIPTION

Spécifications techniques

Binder N°27

TE Connectivity

Durable, fully automatic termination of Al stranded conductors using the LITEALUM crimp

TECA

Technique de raccordement pour câble HT

EUROAIRPORT

Cahier des directives technique pour l'exécution des armoires électrique basse tension

Sertissage de contact électrique dans l'aéronautique

Modélisation, corrélation et étude paramétrique

ST 128

Revêtement électrolytique de nickel et de chrome

Spécification militaire

Terminal, Lugs, conductor crimp style, copper.

MOLEX

Guide su sertissage

Spécification EDF

Binder N°28

HN 68-S-90

Raccordement par poinçonnage profond de câble isolés à âme en aluminium

HN 63-S-61

Tableaux basse tension (TIPI) des postes HTA/BT de distribution publique à 440 V

HN 20-S-62

Dispositions préventives contre la corrosion de l'aluminium et de ses alliages dans les matériels de postes



PRESCRIPTION

Haute fréquence et cable de lits

Binder N°29

Thèse Wei Shen

Design of high-density Transformers for High-frequency High-power Converters

Thèse Raphaël SCAPOLAN

Modélisation électromagnétique 3D d'inducteurs multi-brins- Développement d'une méthode intégrale parallélisme

Jordi-Roger Riba

Analysis of formulas to calculate the AC resistance of different conductors' configurations.

Q U A L I F I C A T I O N



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Localization (GPS)



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COMMUNICATION