PRODUCT SPECIFICATION
108-69096-001

SIMAFLEX RANGE OF CLAMPS OF CONNECTORS FOR CONNECTIONS OF OVERHEAD BARE CONDUCTOR USED IN EXTRA HIGH VOLTAGE SUBSTATIONS.

CONNECTORS IN ALUMINIUM ALLOY WITH STAINLESS STEEL FASTENERS

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CONTENTS

1 - DESCRIPTION

1.1 - Applications

"SIMAFLEX" is an Extra High Voltage Range of Clamps and Connectors for AC & DC applications up to 550kV (phase-to-phase voltage).
These products are designed to fit with 15 to 58.8 mm diameter aluminium standed conductors to Copper or Aluminium Equipment Terminals.

1.2 - Benefits

SIMAFLEX connectors range offers multiple technical benefits and customers advantages.

- Mass customization concept. From the same connector design, the products can be delivered with 2 or 3 keepers as per customers requirements.

- The low electrical resistance contact (below 1μΩ). This performance level has been achieved by optimization of the involved performances factors such as:
  - Machining of the electrical contact surfaces to get a perfect geometry of the contact grooves of the connectors,
  - Conpact design, to obtain an optimal contact pressure,
  - Lubricated bolts with high performance wax to get higher contact pressure.

- Components submitted to mechanical stress such as mechanical supports and keepers are advantageously die casted.

- High mechanical safety margin. Each part has been designed with support of FEM (Finite Element Method) calculation to obtain high strength components.

- The products have been designed to withstand actual mechanical strengths required in EHV Substations considering wing and ice loads as well as short circuit fault current up to 80kA with a peak at 200kA.

- Design to manufacturing method has also been applied to the development of this new range to get high quality casting components.

- FEM Calculation has been used to meet EHV connector design requirement. Simulation and calculation of electrical field of the connectors enabled our engineers to get high R.I.V and corona performances before getting confirmation by the test.

1.3 - Scope of functions

SIMAFLEX Range is including the following functions:
- Derivation such as Tee connectors (conductor to conductor or stud/flat terminal),
- Termination to connect conductor or conductor bundle to Termination Equipments such as aluminium or copper pads/studs,
- Mechanical supports on Post Insulators,
- Accessories such as, spacers and Earthing Stirrups…

1.4 - Contacts

The contact surfaces, of our connectors to conductors and equipment terminals, are supplied uncoated and ungreased.
They must be prepared and greased before use in accordance with our Instruction Manual (ref : EPP-2948-6/17).
« ENERTAL® » contact grease is delivered along with our connectors for preparation on site.

2 - MATERIAL

Our Connectors Components are casted from normalized ingots to guarantee a high alloy quality.

2.1 - Body and keepers

Sand and Die cast silicon aluminium alloy: EN AC-42100 SF and EN AC-42200 KF in accordance with EN 1706 (2010) standard.

Mechanical and physical characteristics:

Material	Resistivity at 20° C	Electrical conductivity	R_m (MPa*)	$R_{p0.2}$ (MPa*)	A_{50mm} (%)	Hardness (HBS)
EN AC-42100SF	4 µ␣cm²/cm	> 38 % IACS	140	80	2	50
EN AC-42200KF	4 µ␣cm²/cm	> 38 % IACS	170	90	4	55

R_m = Minimum tensile strength
$R_{p0.2}$ = Minimum elasticity conventional limit
A_{50mm} = Minimum elongation

Material cross - Referencing (designation):

French standard (NF EN 1706)	ASTM standard (ASTM B26/B26M)	DIN standard (DIN 1725.2)	BS standard (BS 1490)
EN AC-42100SF EN AC-42200KF	356	G-ALSi7Mg	LM6M LM25M

2.3 - Fasteners

- H type bolts, ISO thread from M10 to M12.
- Screw and washers of A2 type stainless steel in accordance with International standard ISO 3506, with minimum breaking stress at 700MPa.
A4-80 grade for screws can be provided on customer's demand.
- Nut of A4 type stainless steel in accordance with International standard ISO 3506, with minimum breaking stress at 800MPa.
- U-bolt of A4 type stainless steel in accordance with International standard ISO 3506, with minimum breaking stress at 700MPa.

The tightening operation and the tightening torque have to be applied in accordance with our Instruction Manual (ref. EPP-2948-6/17).

Nuts are supplied waxed in order to improve the contact pressure and avoid any seizure issue.

Nota: Fixing bolts of connectors to terminal equipements are not part of the products. They can be supplied separately on customer's demand.

2.4 -"ENERTAL® Contact grease

The « ENERTAL® » contact grease contains zinc dust and a corrosion inhibitor.

This grease protects the metal surfaces against the action of atmospheric oxygen and prevents the formation of oxides which increases the contact resistance.

Zinc particulars provide a larger contact area to the connectors, so improve the electrical properties.

Physical characteristics:

* Density at 20° C: 1.8 kg/dm^3
* Drop point: greater than 190° C
* Penetration at 25° C: 245/10 to 280/10.

3 - DIMENSIONAL STATEMENTS

The functional and outline dimensions are mentioned on the customer drawings (available on request).
The conductor size range which can be installed with is from **15 to 58.8mm** diameter.

3.1 - Cylindrical terminal interfaces (studs)

The standardized diameters of the studs which can be connected are: 30, 40, 50 and 60 mm. (Other dimensions are possible on request.). If bimetallic interface is required (ie : for copper stud), the connector can be delivered along with a bimetallic sleeve.

3.2 - Flat terminal interfaces (pads)

The standardized dimensions for rectangular and square terminal pads are defined as following:

Type. (standard considered)	*Width (mm).*	*Length (mm).*	*Nb of holes.*	*Hole dia. (mm)*	*Distance between holes (mm).*
D.I.N.	*200*	*100*	*8*	*14*	*50*
E.N.	*125*	*125*	*9*	*14*	*45*
N.E.M.A.	*100*	*100*	*4*	*14.3*	*44.4*
E.N.	*80*	*80*	*4*	*14*	*45*

(Others sizes on request)
If a bimetallic interface is required (ie : for copper flat terminal), the connector can be delivered along with a bimetallic plate.

3.3 - Post-insulator support interfaces (base-plates)

The standardized base-plates dimensions are:

Type. (standard considered)	*Circular position dia. (mm)*	*Nb of holes / slots.*	*Hole dia. (mm)*
C.E.I - «P3»	*76*	*4*	*14*
C.E.I - «P5»	*127*	*8*	*18*
C.E.I - «P7»	*178*	*8*	*22*
C.E.I - «P225»	*225*	*8*	*18*
C.E.I - «P10»	*254*	*8*	*18*
C.E.I - «P275»	*275*	*8*	*18*

4 - PACKAGING

The screws are protected from loosening during transport by an unloosable washers.

5 - PERFORMANCES - TESTS

5.1 - Electrical performance - HEATING TEST

As a connector must not cause any particular temperature rise in a power circuit, it must not export additional heating to other components like the conductors or apparatus terminals. Instead it must perform as a conductor end and equipment terminal temperature regulator.

- The connectors have a temperature rise less than or equal to the hottest connected conductor (ANSI/NEMA CC1, § 2.6 and 3.1 - Publication 2009).
- The temperature rise of the connectors, at an ambient air temperature not exceeding 40°C, is less or equal to 50K (IEC 62271-1, §6.5 and 4.4.2 - Publication 2007).

5.2 - Electrical performance – HEAT CYCLE TEST

Waking outdoor on outside circuits, the connectors are subjected to many large amplitude thermal shocks (up to 80 °C) at a relatively regular frequency (usually 2 shocks per day). This type of thermal stress can bring significant contact damage if the connectors are not well designed.
For this purpose **heat cycling tests are performed according to the ANSI C119.4 class C standard (2011), paragraphs 3.2 & 6.**
It consists of subjecting the circuit (including the connectors to be tested) to a current which heats the conductor to 100 °C above air ambient temperature, then cooling the conductors to ambient temperature by forced convection. This process is repeated a certain number of cycles.
The products must be thermally and electrically stable to meet the requirements of the standard. In addition, the test current causing the temperature rise is much higher than the maximum current which the connectors are supposed to carry on site.

5.3 - Electrical performance - SHORT-CIRCUIT TEST

The connectors are designed to carry the short-circuit current that may flow through the conductors on which it is set in case of default in the installation.
This short-circuit current must not cause any damage to the connectors.
Neither burn on the contact surfaces nor welding between the parts must occur during the current overload.
The tests are performed in accordance to the paragraph 6.6 of the IEC 62271-1 standard.

The typical values of the fault are 40kA/3s and 80kA/1s.

5.4- Electrical performance - DIELECTRIC HIGH VOLTAGE TESTS

Shapes and design are done to have products able to be used on **Phase-to-phase Rated Voltage up to 550kV depending on the configuration.**

5.4.1 - Radio Interference Voltage test

The maximum Radio Interference Voltage level is less than **2500 µV (68dB) at 1.1xUr/√3** (Ur= Rated Voltage up to 550kV) with a 300 Ω test circuit impedance.
The tests are performed in accordance with the paragraph 6.9.1 of the IEC 62271-1 standard.

5.4.2 - Corona effect visual test

Neither Positive Corona spark nor light are observed on the surface of the products with naked eyes at the 10% greater than the nominal voltage (Phase-to-Phase Rated Voltage up to 550kV).

The tests are performed in accordance with the paragraph 3.3.3. of the ANSI/NEMA CC1 standard.

5.5 - Mechanical performance - PULLOUT TEST

The connectors are designed to withstand the mechanical loads which can be applied to the conductor span.
The minimum cantilever strength of conductor span support and/or connector is in accordance with ANSI/NEMA CC1 standard (2009 – §2.7-3.2): an axial load, depending of the conductor cross section, is applied.
No failure or slippage must be observed during the test.

5.6 - Mechanical performance - TORQUE STRENGTH TEST

The conductor(s) are assembled in the connector and the bolts tightened uniformly and alternatively in accordance with their instruction manual (ref : EPP-2948-6/17), increments until **50% over the nominal torque value is achieved (in accordance with ANSI/NEMA CC1 - 2009, §2.9)**.

6 - APPLICABLE STANDARDS

- International Standard I.E.C 62271-1 (2007) for heating, resistance, short-circuit and dielectric tests.
- International Standard I.E.C 273 (1990) for base-plate post-insulator interfaces.
- International Standard I.E.C 518 (1975) for stud interfaces.
- International Special Committee (C.I.S.P.R.) publication n° 16 for R.I.V. tests.
- American Standard ANSI/NEMA CC1 (2009) for heating, CORONA, tensile and torque strength tests.
- American Standard ANSI C119.4 (2011) for heat cycle test.
- European Standard E.N.C 64-020 (1991) for terminal interface dimensions - palms and studs.
- German Standard DIN 46-206 (1989) for terminal interface dimensions.

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