TESTING AND MEASURING EQUIPMENT/ALLOWED SUBCONTRACTING
IEC 60227-1:2007
Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Part 1: General requirements

"R"	Required
"S"	May be subcontracted, see OD 2012
"SP"	Specialized Facility, see IECEE 02-2
"W"	Witness testing in the categories "MED" and "MEAS"
"3PPS"	Three Phase Power Supply required

Clause	Measurement/testing	Testing / measuring equipment / material needed	LISUN Model	Equipment Classification
3	Marking	Piece of cotton wool or cloth and water; Ruler.		R
4	Core identification	Piece of cotton wool or cloth and water; Suitable device for measuring the color distribution; Ruler.		R
5	General requirements for the construction of cables			R
5.1	Conductors	Dial micrometer; Measuring bridge or equivalent electronical equipment; Thermometer or temperature compensation to 20°C; Ruler.		R
5.1.4 (IEC 60227-2,Cl.2.1)	Measurement of the resistance of conductors	Measuring bridge or equivalent electrical equipment; Thermometer or temperature compensation to 20°C; Ruler.		R
5.2	Insulation			R

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5.2.3 (IEC 60227-2,Cl.1.9)	Insulation thickness	Profile projector or measuring microscope of at least 10 x magnification.		R
Table 1 Reference No.1.1,1.2 (IEC 60811-401 and 501)	Tensile strength and elongation at break (Properties in the state as delivered and Properties after ageing in air oven)	Tensile machine; Equipment for punching dumb-bell test pieces and equipment for cutting or grinding the insulation or/and sheath to obtain 2 parallel surfaces; Optical measuring device / dial gauge; Air oven with natural air flow (airflow rate: 8-20 complete air changes per hour).		R
Table 1 Reference No.2 (IEC 60811-409)	Loss of mass test	An oven with natural air flow or air flow by pressure; An analytical balance with a sensitivity of 0,1 mg; Punching dies for dumb-bell test pieces; A desiccator with silica gel or similar material.		R
Table 1 Reference No.3 (IEC 60811-401)	Compatibility test	Tensile machine; Equipment for punching dumb-bell test pieces and equipment for cutting or grinding the insulation or/and sheath to obtain 2 parallel surfaces; Optical measuring device / dial gauge; Air oven with natural air flow (airflow rate: 8-20 complete air changes per hour).		R
Table 1 Reference No.4 (IEC 60811-509)	Heat shock test	An air oven capable of maintaining the temperature and tolerance specified; Mandrels of sufficient length made of metal or other suitable material.	GW-225	R
Table 1 Reference No.5 (IEC 60811-508)	Pressure test at high temperature	Indentation device with a rectangular blade with an edge (0,70 ±0,01)mm wide; loads (weights);Support; Air oven; Microscope or profile projector with two decimal places.	GNGPL-3610-2PA	R
Table 1 Reference No.6 (IEC 60811-504)	Bending test at low temperature	Cold bend test apparatus consisting essentially of a revolving mandrel and guiding devices for the test pieces; Refrigerator/Low temperature chamber; Mandrels with different diameters.		R

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Table 1 Reference No.7 (IEC 60811-505)	Elongation test at low temperature	Tensile machine with a cooling device or elongation machine installed in a cooling chamber.		R
Table 1 Reference No.8 (IEC 60811-506)	Impact test at low temperature	Cold impact test apparatus; Refrigerator/Low temperature chamber; A pad of sponge rubber about 40 mm thick.	DWC-1	R
Table 1 Reference No.9 (IEC 60811-405)	Thermal stability test	Glass tubes closed at one end (e.g. by melting), 110 mm long with an outer diameter of approximately 5 mm and an inner diameter of (4,0± 0,5) mm; Universal indicating paper with a pH range of 1 to 10; Thermostatically controlled heating apparatus for a temperature specified in the standard for the type of cable, or, if the temperature is not specified in the cable standard, at (200 ± 0,5) °C; An oil bath is preferred and shall be used for type tests and in case of doubt; Calibrated thermometer with divisions of 0,1 °C; Stop-watch or a suitable time meter.		R
5.3	Filler			R
5.4	Extruded inner covering			R
5.5	Sheath			R
5.5.3	Sheath thickness	Profile projector or measuring microscope of at least 10 x magnification.		R
Table 2 Reference No.1.1, 1.2 (IEC 60811-401 and 501)	Tensile strength and elongation at break (Properties in the state as delivered and Properties after ageing in air oven)	Tensile machine; Equipment for punching dumb-bell test pieces and equipment for cutting or grinding the insulation or/and sheath to obtain 2 parallel surfaces; Optical measuring device / dial gauge; Air oven with natural air flow (airflow rate: 8-20 complete air changes per hour).	PULL-2000KG	R

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Table 2 Reference No.2 (IEC 60811-409)	Loss of mass test	An oven with natural air flow or air flow by pressure; An analytical balance with a sensitivity of 0,1 mg; Punching dies for dumb-bell test pieces; A desiccator with silica gel or similar material.	GW-225-400	R
Table 2 Reference No.3 (IEC 60811-401)	Compatibility test	Tensile machine; Equipment for punching dumb-bell test pieces and equipment for cutting or grinding the insulation or/and sheath to obtain 2 parallel surfaces; Optical measuring device / dial gauge; Air oven with natural air flow (airflow rate: 8-20 complete air changes per hour).	PULL-2000KG	R
Table 2 Reference No.4 (IEC 60811-509)	Heat shock test	An air oven capable of maintaining the temperature and tolerance specified; Mandrels of sufficient length made of metal or other suitable material.		R
Table 2 Reference No.5 (IEC 60811-508)	Pressure test at high temperature	Indentation device with a rectangular blade with an edge (0,70 ±0,01)mm wide; loads (weights);Support; Air oven; Microscope or profile projector with two decimal places.		R
Table 2 Reference No.6 (IEC 60811-504)	Bending test at low temperature	Cold bend test apparatus consisting essentially of a revolving mandrel and guiding devices for the test pieces; Refrigerator/Low temperature chamber; Mandrels with different diameters.		R
Table 2 Reference No.7 (IEC 60811-505)	Elongation test at low temperature	Tensile machine with a cooling device or elongation machine installed in a cooling chamber.		R
Table 2 Reference No.8 (IEC 60811-506)	Impact test at low temperature	Cold impact test apparatus; Refrigerator/Low temperature chamber; A pad of sponge rubber about 40 mm thick.	DWC-1	R

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Table 2 Reference No. 9 (IEC 60811-404)	Mechanical properties after immersion in mineral oil	Tensile machine; Equipment for punching dumb-bell test pieces and equipment for cutting or grinding the insulation or/and sheath to obtain 2 parallel surfaces; Optical measuring device / dial gauge; Air oven with natural air flow (airflow rate: 8-20 complete air changes per hour); Unless otherwise agreed, the mineral oil to be used shall be oil no. 2 (IRM 902) as described in ISO 1817.		R
Table 2 Reference No.10 (IEC 60811-405)	Thermal stability test	Glass tubes closed at one end (e.g. by melting), 110 mm long with an outer diameter of approximately 5 mm and an inner diameter of (4,0± 0,5) mm; Universal indicating paper with a pH range of 1 to 10; Thermostatically controlled heating apparatus for a temperature specified in the standard for the type of cable, or, if the temperature is not specified in the cable standard, at (200 ± 0,5) °C; An oil bath is preferred and shall be used for type tests and in case of doubt; Calibrated thermometer with divisions of 0,1 °C; Stop-watch or a suitable time meter.		R
5.6	Tests on completed cables			R
5.6.1	Electrical properties			R
Table 3 Reference No.1 (IEC 60227-2,Cl.2.1)	Measurement of the resistance of conductors	Measuring bridge or equivalent electrical equipment; Thermometer or temperature compensation to 20°C; Ruler.		R
Table 3 Reference No.2 (IEC 60227-2,Cl.2.2)	Voltage test on completed cables	AC voltage source (AC 0-2500 V); Water bath.		R

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Table 3 Reference No.3 (IEC 60227-2,Cl.2.3)	Voltage test on cores	AC voltage source (AC 0-2500 V); Water bath.		R
Table 3 Reference No.4 (IEC 60227-2,Cl.2.4)	Measurement of insulation resistance	Insulation resistance tester with DC source between 80 V and 500 V; Heated water bath; Thermometer; Ruler; An oven capable of maintaining the temperature and tolerance specified.		R
5.6.2	Overall dimensions	Profile projector; Dial micrometer; Verniercaliper; Diameter measuring tape.		R
5.6.3	Mechanical strength of flexible cables			R
5.6.3.1 (IEC 60227-2,Cl.2.2)	Flexing test for flexible cables	Flexing apparatus; Pulleys made of metal with different diameters; Weights; For current load a low voltage or a voltage about 230/400V to be used; For voltage load between conductors, about 230 V ac (two-core) and/or about 400 V ac (more cores); Fault detection facilities: Current interruption; Short circuit between conductors and short circuit between test sample and pulleys; Carrier speed: 0,33 m/s; Water tank; timer; AC voltage power supply (AC 2000V).		R
5.6.3.2 (IEC 60227-2,Cl.3.2)	Bending test for tinsel cord	A weight having a mass of 0,5 kg; A current supply of about 0,1 A; A flexing is a movement through 180°. The rate of flexing is 60 per minute.	SW-6	R
5.6.3.3 (IEC 60227-2,Cl.3.3)	Snatch test for tinsel cord	A rigid support; A weight having a mass of 0,5 kg; A current supply of about 0,1 A.		R
5.6.3.4 (IEC 60227-2,Cl.3.4)	Test for separation of cores	The force necessary to separate them at a speed of 5 mm/s shall be measured by means of a tensile machine.		R

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5.6.4 (IEC 60332-1-2)	Flame retardance	Propane gas burner: 1 kW pre-mixed flame including system of confirmation of test flame; 3-sided metallic screen 1200 mm high, 300 mm wide and 450 mm deep with open front and closed top and bottom; Suitable timer; Verniercaliper with an accuracy of 1mm;propane gas with prescribed purity.	RSB-WC	R

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