

Differences of the requirements and tests of medium voltage cables



Between IEC 60502-2 and VDE 0276-620

Overview and summary

This report shows the differences of the requirements and tests of medium voltage cables between VDE 0276-620 and IEC 60502-2. The following table is a summary with some significant differences in case of the required test conditions:

Test	IEC		VDE	
	part	condition	part	condition
partial discharge	16.3	$Q < 10 \text{ pC @ } 1.73 U_0$ / IEC 60885-3	3.1.3	$Q < 2 \text{ pC @ } 2 U_0$ / IEC 60885-3
bending + partial discharge	18.1.4	$5 \text{ pC @ } 1.73 U_0$ / IEC 60885-3	3.3.1.2	$Q < 2 \text{ pC @ } 2 U_0$ / IEC 60885-3
voltage test	18.1.8	$4 \times U_0$ 4 h / no breakdown	3.3.1.6	$3 \times U_0$ 4 h / no breakdown
impulse test	18.2.4	60 kV peak, 10 pos. + 10 neg. pulses IEC 60230	3.3.1.5	75 / 125 / 170 kV peak, 10 pos. + 10 neg. pulses EN 60230
determination of hardness of PE sheaths			3.4.4.3	HD 605, 2.2.1 Shore-D Hardness ≥ 55

Following you find a detailed comparison of the routine, sample and type tests that are required by VDE 0276-620 and IEC 60502-2.

1. Routine test

Test	IEC		VDE	
	part	condition	part	condition
conductor resistance	16.2	IEC 60228 / --	3.1.1	EN 60228 / HD 605 3.1.1
partial discharge	16.3	$Q < 10 \text{ pC @ } 1.73 U_0$ / IEC 60885-3	3.1.3	$Q < 2 \text{ pC @ } 2 U_0$ / IEC 60885-3
voltage test	16.4	$3.5 U_0$ 5 min. / --	3.1.2	$3.5 U_0$ 5 min. / --

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2. Sample test

Test	IEC		VDE	
	part	condition	part	condition
conductor construction	17.4	IEC 60228 / IEC 60811-1-1	3.2.1	p. 1.2-1.5 / EN 60811-1-1 p. 8.3
insulation thickness	17.5.2	IEC 60502 / IEC 60811-1-1 $W_{Imin} \geq W_{Inom} - (0,1 + 0,1 \times W_{Inom})$	3.2.2	p. 3.2 / HD 605
conductor screen thickness			3.2.3.1	p. 2.4 / HD 605, 2.1.11.1 / EN 60811-1-1, p. 8.2 / p. 2.5 / HD 605, 2.1.10.2
core screen thickness			3.2.3.2	p. 4.4 / HD 605, 2.1.11.1 / EN 60811-1-1, p. 8.2 / p. 4.5 / HD 605, 2.1.11.1
insulation diameter			3.2.4	p. 3.4 Tab. 2
inner covering			3.2.5	p. 8.3
metallic screen			3.2.6	p. 6.1-6.5 / HD 605
thickness of non-metallic sheath	17.5.3	IEC 60502 / IEC 60811-1-1 Smooth: $S_{Imin} \geq S_{Inom} - (0,1 + 0,15 \times S_{Inom})$ Irregular: $S_{Imin} \geq S_{Inom} - (0,1 + 0,2 \times S_{Inom})$	3.2.7	p. 13.3 / EN 60811-1-1 p. 8.2
armour wires and tapes	17.7	IEC 60502 13.5		
outer diameter	17.8	IEC 60811-1-1 clause 8	3.2.8	p. 16 & Tab. 6 / EN 60811-1-1 p. 8.3
voltage test	17.9	$U_0 > 3.6 \text{ kV}$: 4 h @ 4 U_0 / no breakdown		
marking			3.2.9	p. 11 / visual test
hot set test (200 °C, 15 min., 20 N / cm ²)	17.10	tables 21 / 22 IEC 60811-2-1 clause 9	3.2.10	HD 620, p. 1, Tab. 2 A Typ DIX 8 / EN 60811-2-1 p. 9
shrinkage of PE-sheath			3.2.11	< 7 mm / HD 605 p. 2.4.4.1
6 test items p.a. from the last 2 years			3.2.12	HD 605 p. 5.4.15

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3.1 Type test (electrical)

Test	IEC		VDE	
	part	condition	part	condition
partial discharge	18.1.3	5 pC @ 1.73 U ₀ / IEC 60885-3	3.3.1.1	2 pC @ 2 U ₀ / IEC 60885-3
bending + partial discharge	18.1.4	5 pC @ 1.73 U ₀ / IEC 60885-3	3.3.1.2	2 pC @ 2 U ₀ / IEC 60885-3
tan delta (2 kV)	18.1.5	U ₀ > 6 kV XLPE: < 80 x 10 e-4 @ 95 °C EPR/HEPR: < 400 x 10 e-4 @ 95 °C	3.3.1.3	40 x 10 e-4 @ 20 °C < 80 x 10 e-e @ 95 °C
heating cycle test	18.1.6	5 pC @ 1.73 U ₀ / IEC 60885-3 20 x 95 °C / 8 h	3.3.1.4	2 pC @ 2 U ₀ / IEC 60885-3 20 x 95 – 100 °C / 5 h
impulse + voltage test	18.1.7	table 14, 10 pulses / IEC 60130		
voltage test	18.1.8	4 x U ₀ 4 h / no breakdown	3.3.1.6	3 x U ₀ 4 h / no breakdown
long-term test			3.3.1.7	6 test items p. a. from the last 2 years
resistance of semi-conducting screens	18.1.9	1000 Ω x m / 500 Ω x m / annex C		
insulation resistance measurement at ambient temperature	18.2.1	3.6 / 6 kV cables unscreened: 80 ... 500 V DC, duration 1 ... 5 min PVC / B: ρ > 10 e 14 Ω x cm		
insulation resistance measurement at maximum conductor temperature	18.2.2	3.6 / 6 kV cables unscreened: 80 ... 500 V DC, duration 1 ... 5 min PVC / B: ρ > 10 e 11 Ω x cm EPR / HEPR: ρ > 10 e 12 Ω x cm		
voltage test for 4 h	18.2.3	3.6 / 6 kV cables unscreened: 4 h @ 4 U ₀ / no breakdown		
impulse test	18.2.4	60 kV peak, 10 pos. + 10 neg. pulses IEC 60230	3.3.1.5	75 / 125 / 170 kV peak, 10 pos. + 10 neg. pulses EN 60230

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3.2 Type test (non electrical)

Test	IEC		VDE	
	part	condition	part	condition
thickness of insulation	19.1	8.1 / IEC 60811-1-1 $t_{\min} \geq t_{\text{nom}} - (0.1 + 0.1 \times t_{\text{nom}})$		
thickness of non-metallic sheaths (incl. extruded fillers)	19.2	17.5.3 / IEC 60811-1-1		
insulation after ageing	19.3	IEC 60811-1-1 p. 9.1 IEC 60811-1-2 p. 8.1	3.4.1.1.	EN 60811-1-1 p. 9.1 EN 60811-1-2 p. 8.1
mechanical properties non-metallic sheaths	19.4	table 18 / IEC 60811-1-1 p. 9.2	3.4.3.1	EN 60811-1-1 p. 9.2 EN 60811-1-2 p. 8.1
ageing tests complete cable	19.5	table 17 & 18 / IEC 60811-1-2 p. 8.1.4	3.4.4.2	EN 60811-1-2 p. 8.1.4
loss of mass for PVC ST2	19.6	table 19 / IEC 60811-3-2 p. 8.2	3.4.3.4	EN 60811-3-2 p. 8.2
pressure test at high temperature	19.7	tables 19 & 20 / IEC 60811-3-1 p. 8	3.4.3.2	EN 60811-3-1 p. 8.2, 6 h
test on PVC-sheaths at low temperature	19.8	table 19 / IEC 60811-1-4 p. 8	3.4.3.3	EN 60811-1-4 p. 8.4
heat shock test of PVC	19.9	table 19 / IEC 60811-3-1 p. 9	3.4.3.5	EN 60811-3-1 p. 9.2
ozone resistance test for EPR and HEPR insulations	19.10	table 21 / IEC 60811-2-1 p. 8		
hot set test of XLPE insulations	19.11	see 17.10		
oil immersion test for elastomeric sheaths	19.12	table 22 / IEC 60811-2-1 p. 10		
water absorption	19.13	tables 19 & 21 / IEC 60811-1-3 p. 9.1 or 9.2	3.4.1.2	EN 60811-1-3 p. 9.2
flame retardance	19.14	IEC 60332-1 (if required)	3.4.4.4	EN 60332-1-2 for PVC sheaths
measurement of carbon black	19.15	table 20 / IEC 60811-4-1 p. 11	3.4.3.8	EN 60811-4-1 p. 11
shrinkage test for XLPE-insulation	19.16	table 21 / IEC 60811-1-3 p. 10	3.4.2.1	EN 60811-1-3 p. 10, 300 mm
thermal stability test for PVC insulation	19.17	table 19 / IEC 60811-3-2 p. 9	3.4.3.6	EN 60811-3-2 p. 9
determination of hardness of HEPR insulation	19.18	IRHD min 80 annex E		
determination of hardness of PE sheaths			3.4.4.3	HD 605, 2.2.1 Shore-D Hardness ≥ 55
determination of the elastic modules of HEPR insulation	19.19	min. 4.5 N / mm ² / IEC 60811- 1-1 p. 9		
shrinkage test for PE-sheaths	19.20	table 20 / IEC 60811-1-3 p. 11		
strippability for insulation screen	19.21	4 N < F < 45 N before and after ageing		

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Test	IEC		VDE	
	part	condition	part	condition
water penetration test	19.22	annex D		
thermal expansion of conductor and core screen			3.4.2.2	EN 60811-2-1 p. 9 EN 60811-1-1 p. 9.1.3
resistance to stress cracking for PE sheaths			3.4.3.7	EN 60811-4-1 p. 8 test method B, 1000 h
impact resistance for cold PVC insulation			3.4.4.1	EN 60811-1-4 p. 8.5
propagation of water in cables with water blocking tape			3.4.4.5	HD 605 2.4.9.3 f 126 cycles