Report

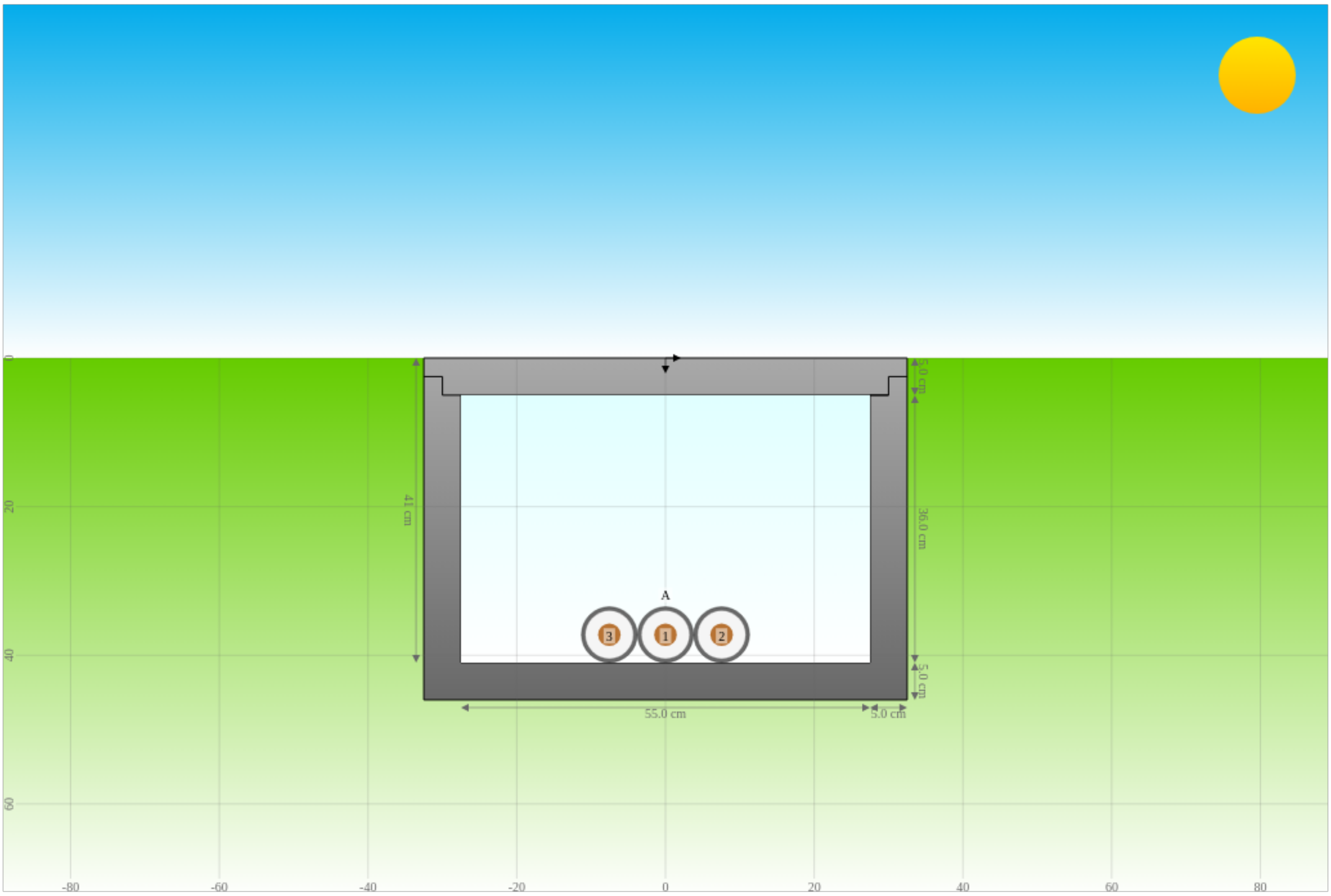
Title	Case study 0-5: Introductory (trough)
Project	Verification CIGRE TB 880
Created	Date: 2025-05-14 Time: 21:34 Software version: 51cac (2025-05-14)

Arrangement

Arrangement	**trough project** (#1861)
Options	None
CIGRE TB 880, guidance points	02, 06, 26, 31
Systems	A

Statistics

Number of iterations of the solver	N_{calc}	16
Sum of currents from all systems	I_{sum}	756.56 A
Sum of average conductor temperatures from all systems	θ_{sum}	86.98 °C
Number of overheated electrical systems		0
Sum of losses from all systems	W_{sum}	108.246 W/m



cableizer
Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Systems

Following systems are active in the arrangement:

#	Object	Current [A]	Temp. [°C]	Losses [W/m]	Load
		I_c	θ_c | θ_e	W_{sys}	LF
A	16173 CIGRE TB 880 Case 0 XLPE insulated ca...	756.6	90.0 | 78.2	108.2	1.00

Objects

Following objects are used:

16173 CIGRE TB 880 Case 0 XLPE insulated cable 132 kV

Ambient

Ambient air temperature	θ_{air}	25 °C

Constants

Standard acceleration of gravity	g	9.80665 m/s^2
Archimedes' constant π	π	3.141592653589793
Absolute temperature	θ_{abs}	273.15 K
Stefan Boltzmann constant	σ	5.67036713e-8 W/m^{2}K^4
Vacuum permeability	μ_0	1.2566370614359173e-6 H/m
Vacuum permittivity	ϵ_0	8.854187817620389e-12 F/m

Trough

Calculation method		IEC 60287-2-1
Thermal resistance trough $\frac{1}{3p_{tr}}$	T_{tr}	0.2625 K.m/W
Effective perimeter trough $w_t + 2h_t$	p_{tr}	1.27 m

Dimension

Width (inner)	w_t	0.55 m
Height (inner)	h_t	0.36 m
Thickness wall	t_t	0.05 m
Depth of laying	L_{cm}	0.41 m

conditions inside

Air temperature with load $(1-\lambda_t)\,\theta_{iter} + \lambda_t\,(\theta_{init} + \Delta\theta_{air})$	θ_{at}	53.41 °C
Temperature increase air $T_{tr}W_{sum}$	$\Delta\theta_{air}$	28.4111 K
Air temperature without load $\theta_{air} + \Delta\theta_{sun}$	θ_{init}	25 °C

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

System A (High voltage cable)

Ampacity

Cable		CIGRE TB 880 Case 0 XLPE insulated cable 132 kV
Conductor current	I_c	756.56 A

$$\sqrt{\frac{\theta_c - \theta_{at} - \Delta\theta_d}{R_c\left(T_1 + n_{ph}\left(1+\lambda_1\right)T_2 + \left(1+\lambda_1+\lambda_2+\lambda_3\right)\left(n_{ph}T_3 + n_{cc}\left(T_{4i}+T_{4ii}+T_{4iii}\right)\right)\right)}}$$

Operating voltage	U_o	132 kV
Angular frequency	ω	314.2 rad/s

$2\pi f$

Number of sources in system	N_c	3
Number of conductors combined	n_{cc}	1

Load

System frequency	f	50 Hz
Continuous load	LF	1 p.u.

Arrangement

Arrangement		flat
Position cable 1	$x_1 \| y_1$	0.0 | 372.3 mm
Position cable 2	$x_2 \| y_2$	75.5 | 372.3 mm
Position cable 3	$x_3 \| y_3$	-75.5 | 372.3 mm
Separation of conductors in a system	s_c	75.5 mm
Mean distance between the phases	a_m	95.12 mm
Geometric mean distance between phases of the same system	GMD	0.09512 m

$2^{\frac{1}{3}}S_m$

Outer diameter	D_o	0.0755 m

Temperature

Temperature conductor	θ_c	1: 82.97 | 2: 87.97 | 3: 90 °C

$\theta_{at} + \Delta\theta_c$

Temperature screen/sheath	θ_s	1: 73.56 | 2: 78.44 | 3: 80.42 °C
Temperature sheath	θ_{sh}	1: 73.56 | 2: 78.44 | 3: 80.42 °C

$$\theta_c - T_1\left(W_c + \frac{W_d}{2}\right)$$

External temperature object	θ_e	1: 71.99 | 2: 76.39 | 3: 78.17 °C

$$\theta_c - T_1\left(W_c + \frac{W_d}{2}\right) - n_{ph}T_2\left(W_c\left(1+\lambda_1\right)+W_d\right) - n_{ph}T_3\left(W_I + W_d\right)$$

Temperature rise

Temperature rise conductor	$\Delta\theta_c$	1: 29.556 | 2: 34.5583 | 3: 36.5899 K

$$n_{ph}\left(W_cT_{int} + W_dT_d\right) + n_{cc}\left(\left(W_c + W_s + W_{ar} + W_{sp} + W_d\right)\left(T_{4i}+T_{4ii}+T_{4iii}\right) + W_{duct}\left(\frac{T_{4ii}}{2} + T_{4iii}\right)\right)$$

Temperature rise dielectric losses	$\Delta\theta_d$	1: 0.3506 | 2: 0.3377 | 3: 0.3334 K

$W_d\left(n_{ph}T_d + n_{cc}\left(T_{4i}+T_{4ii}+T_{4iii}\right)\right)$

Temperature difference surface—ambient	$\Delta\theta_s$	1: 18.8181 | 2: 23.2571 | 3: 25.0742 K

$$\frac{\Delta\theta_c + \Delta\theta_d}{1 + K_A\Delta\theta_s^{0.25}}$$

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Losses

Ohmic

Conductor losses (phase) ${I_c}^2 R_c$	W_c	1: 22.207 | 2: 22.502 | 3: 22.621 W/m
Screen/sheath losses (phase) $\lambda_1 W_c$	W_s	1: 6.321 | 2: 14.864 | 3: 18.576 W/m
Ohmic losses (phase) $W_c\left(1+\lambda_1+\lambda_2+\lambda_3+\lambda_4\right)$	W_I	1: 28.529 | 2: 37.365 | 3: 41.197 W/m

Dielectric

Dielectric losses (phase) $\omega C_b\left(1000\frac{U_o}{\sqrt{3}}\right)^2\tan\delta_i$	W_d	0.385 W/m

Total

Total losses (phase) W_I+W_d	W_t	1: 28.914 | 2: 37.75 | 3: 41.582 W/m
Total losses (object) $n_{ph} W_t$	W_{tot}	1: 28.914 | 2: 37.75 | 3: 41.582 W/m
Total losses (system)	W_{sys}	108.246 W/m

Thermal resistance

Thermal resistance ambient $\frac{1}{\pi D_o h_{bs} {\Delta\theta_s}^{\frac{1}{4}}}$	T_{4iii}	1: 0.6461 | 2: 0.6128 | 3: 0.6014 K.m/W
Coefficient K in air $\frac{\pi D_o h_{bs}}{1+\lambda_1+\lambda_2+\lambda_3} T_{int}$	K_A	1: 0.283 | 2: 0.228 | 3: 0.211
Heat dissipation coefficient for black surfaces in free air $\frac{Z_{bs}}{{D_o}^{g_{bs}}}+E_{bs}$	h_{bs}	3.133 W/m^2/K$^{5/4}$
Installation constant E	E_{bs}	1.95
Installation constant g	g_{bs}	0.25
Installation constant Z	Z_{bs}	0.62

Cable

Internal thermal resistance for current losses $\frac{T_1}{n_{ph}}+\left(1+\lambda_1\right)T_2+\left(1+\lambda_1+\lambda_2+\lambda_3\right)T_3$	T_{int}	1: 0.4895 | 2: 0.5099 | 3: 0.5186 K.m/W
Internal thermal resistance for dielectric losses $\frac{T_1}{2n_c}+T_2+T_3$	T_d	0.26414 K.m/W

Other characteristics

Earthing

earthing screen/sheath	both-side bonding
Variation of spacing	No variation

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Loss factor

Loss factor shield (screen/sheath) λ_1 1: 0.2847 | 2: 0.6606 | 3: 0.8212

$\lambda_{11} + F_e\lambda_{12}$

Loss factor shield, circulating currents λ_{11} 1: 0.1542 | 2: 0.6209 | 3: 0.7935

$$\frac{R_e}{R_c} 4\xi_{X,2}$$

$$\frac{R_e}{R_c}\left(\xi_{X,3} + \xi_{X,2} - \xi_{X,1}\right)$$

$$\frac{R_e}{R_c}\left(\xi_{X,3} + \xi_{X,2} + \xi_{X,1}\right)$$

Parameter ξ calculation of loss factor ξ_X 1: 0.0162 | 2: 0.0073 | 3: 0.1275

$$\frac{2R_eP_XQ_XX_m}{\sqrt{3}\left({R_e}^2 + {P_X}^2\right)\left({R_e}^2 + {Q_X}^2\right)}$$

$$\frac{0.25{Q_X}^2}{{R_e}^2 + {Q_X}^2}$$

$$\frac{0.75{P_X}^2}{{R_e}^2 + {P_X}^2}$$

Loss factor shield, eddy currents λ_{12} 1: 0.1482 | 2: 0.0449 | 3: 0.0313

$$\frac{R_{sh}}{R_c}\left(g_s\lambda_0\left(1 + \Delta_1 + \Delta_2\right) + \frac{\left(\beta_1 t_{sh}\right)^4}{12{\cdot}10^{12}}\right)$$

Electrical resistance shield/armour R_e 1: 2.0294e-1 | 2: 2.0622e-1 | 3: 2.0756e-1 Ω/km

Substitution coefficient λ_0 for eddy-currents λ_0 1: 0.0282 | 2: 0.0068 | 3: 0.0068

$$6\frac{{m_0}^2}{1 + {m_0}^2}\left(\frac{d_e}{2s_c}\right)^2$$

$$1.5\frac{{m_0}^2}{1 + {m_0}^2}\left(\frac{d_e}{2s_c}\right)^2$$

$$1.5\frac{{m_0}^2}{1 + {m_0}^2}\left(\frac{d_e}{2s_c}\right)^2$$

Substitution coefficient Δ_1 for eddy-currents Δ_1 1: 0.0013 | 2: 0.2482 | 3: -0.1216

$$0.86{m_0}^{3.08}\left(\frac{d_e}{2s_c}\right)^{1.4m_0 + 0.7}$$

$$4.7{m_0}^{0.7}\left(\frac{d_e}{2s_c}\right)^{0.16m_0 + 2}$$

$$\frac{-0.74\left(m_0 + 2\right)\sqrt{m_0}}{2 + \left(m_0 - 0.3\right)^2}\left(\frac{d_e}{2s_c}\right)^{m_0 + 1}$$

Substitution coefficient Δ_2 for eddy-currents Δ_2 1: 0 | 2: 0.0006 | 3: 0.0002

$$0$$

$$21{m_0}^{3.3}\left(\frac{d_e}{2s_c}\right)^{1.47m_0 + 5.06}$$

$$0.92{m_0}^{3.7}\left(\frac{d_e}{2s_c}\right)^{m_0 + 2}$$

Substitution coefficient m_0 for eddy-currents m_0 1: 0.1548 | 2: 0.1523 | 3: 0.1514 Hz.m/Ω

$$10^{-7}\frac{\omega}{R_{sh}}$$

Substitution coefficient β_1 for eddy-currents β_1 1: 106.9253 | 2: 106.0711 | 3: 105.73

$$\sqrt{\frac{4\pi\omega}{10^7\rho_{sh}\left(1 + \alpha_{sh}\left(\theta_{sh} - 20\right)\right)}}$$

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Substitution coefficient g_s for eddy-currents $1+\left(\frac{t_{sh}}{D_{sh}}\right)^{1.74}\left(10^{-3}\beta_1 D_{sh}-1.6\right)$	g_s	1: 1.002483 | 2: 1.002458 | 3: 1.002448
Factor F_e eddy-current losses $\frac{4{M_e}^2{N_e}^2+(M_e+N_e)^2}{4\left({M_e}^2+1\right)\left({N_e}^2+1\right)}$	F_e	1: 0.8802 | 2: 0.8834 | 3: 0.8847
Substitution coefficient M_e to calculate factor F_e $\frac{R_e}{X_e+X_m}$	M_e	1: 2.16 | 2: 2.1949 | 3: 2.2091
Substitution coefficient N_e to calculate factor F_e $\frac{R_e}{X_e-\frac{X_m}{3}}$	N_e	1: 5.6552 | 2: 5.7466 | 3: 5.7837
Loss factor armour	λ_2	0

Electrical parameters

System

System length	L_{sys}	1000 m
Power factor	$\cos\varphi$	1

Resistance

Electrical resistance conductor $R_{cDC}\left(1+y_s+y_p\right)$	R_c	1: 3.8798e-5 | 2: 3.9312e-5 | 3: 3.9522e-5 Ω/m
Electrical resistance DC conductor $R_{c20}\left(1+\alpha_c\left(\theta_c-20\right)\right)$	R_{cDC}	1: 3.5303e-5 | 2: 3.5859e-5 | 3: 3.6085e-5 Ω/m
Skin effect factor conductor $\frac{{x_s}^4}{192+0.8{x_s}^4}$	y_s	1: 0.06268 | 2: 0.06085 | 3: 0.06012
Factor for skin effect on conductor $\sqrt{10^{-7}\frac{8\pi f}{R_{cDC}}k_s}$	x_s	1: 1.88668 | 2: 1.87199 | 3: 1.86612
Proximity effect factor conductor $\frac{{x_p}^4}{192+0.8{x_p}^4}\left(\frac{d_c}{s_c}\right)^2\left(0.312\left(\frac{d_c}{s_c}\right)^2+\frac{1.18}{\frac{{x_p}^4}{192+0.8{x_p}^4}+0.27}\right)$	y_p	1: 0.03632 | 2: 0.03545 | 3: 0.0351
Factor for proximity effect of conductors $\sqrt{10^{-7}\frac{8\pi f}{R_{cDC}}k_p}$	x_p	1: 1.88668 | 2: 1.87199 | 3: 1.86612
Electrical resistance sheath $R_{sh}\left(1+\alpha_{sh}\left(\theta_{sh}-20\right)\right)$	R_{sh}	1: 2.0294e-4 | 2: 2.0622e-4 | 3: 2.0756e-4 Ω/m
Electrical resistance shield	R_s	1: 2.0294e-4 | 2: 2.0622e-4 | 3: 2.0756e-4 Ω/m
Reduction factor $\frac{R_s}{\sqrt{{R_s}^2+{X_s}^2}}$	RF	1: 0.3013 | 2: 0.3057 | 3: 0.3075

Electrical field strength, capacitive load current

Electrical field strength insulation inner/outer $\frac{U_e}{1000}\frac{1}{r_x\ln\left(\frac{r_{osc}}{r_{isc}}\right)}$	E_i	6.956 | 3.603 kV/mm

cableizer
Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Radius to point x in insulation	r_x	16.65 | 32.15 mm
Line-to-ground voltage $\frac{1000U_o}{\sqrt{3}}$	U_e	76210.24 V
Capacitance insulation $\frac{1}{2\pi\epsilon_0}\frac{10^{-9}}{18}C_b$	C_b	2.111e-10 F/m → 0.2111 μF
Capacitive load current $U_e\omega C_b$	I_C	5.054e-3 A/m → 5.0536 A
Charging capacity $n_{ph}{U_e}^2\omega C_b$	P_C	385.1382 var/m → 385.1382 kvar
Capacitive earth short-circuit current $U_e\omega C_E$	I_{Ce}	5.054e-3 A/m

Reactance

Self reactance conductor $\omega\frac{\mu_0}{2\pi}\ln\left(\frac{D_E}{GMR_c}\right)$	X_a	7.088e-4 Ω/m → 0.7088 Ω
Self reactance screen/sheath $\omega\frac{\mu_0}{2\pi}\ln\left(\frac{2s_c}{d_s}\right)$	X_e	5.040e-5 Ω/m → 0.0504 Ω
Mutual reactance between conductors flat formation without transposition $\omega\frac{\mu_0}{2\pi}\ln 2$	X_m	4.355e-5 Ω/m
Substitution coefficient P to calculate loss factor by circulating currents $X_e + X_m$	P_X	9.396e-5
Substitution coefficient Q to calculate loss factor by circulating currents $X_e - \frac{X_m}{3}$	Q_X	3.589e-5

Induced current (approximate)

Induced circulating current shield $\max\left(I_c\sqrt{\frac{\lambda_{11,sb}R_c}{R_s}}\right)$	I_s	294.082+0.000j A
Loss factor shield, circulating currents	$\lambda_{11,sb}$	1: 0.1542+0.0000j | 2: 0.6209+0.0000j | 3: 0.7935+0.0000j

Load, Voltage drop

Apparent power generator-side $\sqrt{3}U_oI_c$	S_G	172.972 MVA
Voltage drop $\sqrt{3}\left(R_c\cos\varphi + \omega L_m\sin\varphi\right)$	V_{drop}	0.067 V/(A.km) → 50.8 V = 0.04%
Inductance (mean) $\frac{\mu_0}{2\pi}\ln\left(\frac{GMD}{GMR_c}\right)$	L_m	4.187e-7+0.000e0j H/m → 0.4187 mH

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Telegrapher equation

Surge impedance $\sqrt{\frac{Z_1}{Y_1}}$	Z_C	1: 45.0084-6.4997j | 2: 45.0207-6.5841j | 3: 45.0257-6.6184j Ω
Propagation constant $\sqrt{Z_1 Y_1}$	γ_C	1: 4.310e-7+2.985e-6j | 2: 4.366e-7+2.985e-6j | 3: 4.389e-7+2.986e-6j

Impedance valid up to 100 Hz without earth return

Positive sequence admittance $G + j\omega C_b$	Y_1	0.000e0+6.631e-8j S/m → 0.0000+0.0001j S
Positive sequence impedance $R_1 + jX_1$	Z_1	1: 3.880e-5+1.315e-4j | 2: 3.931e-5+1.315e-4j | 3: 3.952e-5+1.315e-4j Ω/m
Positive sequence reactance $\omega \frac{\mu_0}{2\pi} \ln\left(\frac{GMD}{GMR_c}\right)$	X_1	1.315e-4 Ω/m → 0.1315 Ω

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Cable datasheet

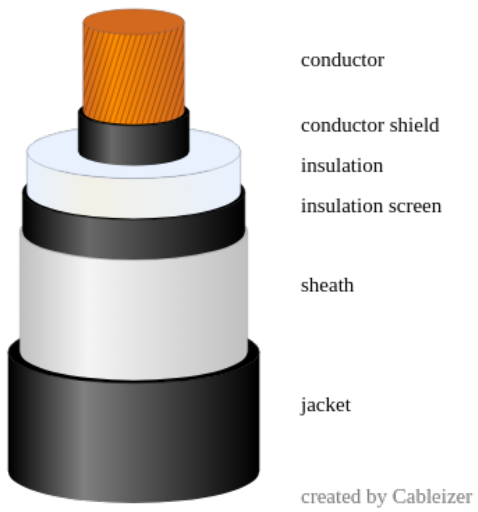
Title	CIGRE TB 880 Case 0 XLPE insulated cable 132 kV (#16173)

Cable is used in following systems: A

CIGRE TB 880, guidance points 15, 20, 23, 25, 30, 32, 33, 34, 38, 39, 42, 44, 45

General Data

Rated line-to-line voltage	U_n	132 kV
Base voltage for tests	U_0	76 kV
Highest voltage for equipment	U_m	145 kV
Nominal system frequency	f	50 Hz
Number of conductors cable	n_c	1
Number of phases in a cable	n_{ph}	1



Cable elements

Conductor

Cross-sectional area conductor	A_c	1 x 630 mm^2
Conductor material	M_c	Copper, round stranded
External diameter conductor	d_c	30.3 mm
Radius conductor	r_c	15.15 mm

$$\frac{d_c}{2}$$

Insulation

Insulation material	M_i	Crosslinked polyethylene (XLPE)
Thickness conductor shield	t_{cs}	1.5 mm
Thickness insulation	t_{ins}	15.5 mm
Thickness insulation screen	t_{is}	1.3 mm
Thickness insulation	t_i	18.3 mm

$$t_{ct} + t_{cs} + t_{ins} + t_{is}$$

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Sheath

Sheath material	M_{sh}	Aluminium
Thickness sheath	t_{sh}	0.8 mm
corrugated		No

Jacket

Jacket material	M_j	High density polyethylene (HDPE, ST7)
Thickness jacket	t_j	3.5 mm

Overall

External diameter object	D_e	75.5 mm
Absorption coefficient solar radiation	σ_{sun}	0.4
Emissivity cable	ϵ_e	0.9
Reflectivity cable $1-\epsilon_e$	η_e	0.1
Mass cable $m_{hollow}+m_{metal}$	m_{tot}	9.418 kg/m

Electrical

Conductor

Electrical resistance DC conductor 20°C	R_{c20}	2.8300e-5 Ω/m
Standard DC resistance of conductor	R_{co}	0.0283 Ω/km
Coating of wires		plain
Skin effect coefficient	k_s	1
Proximity effect coefficient	k_p	1
Geometric mean radius conductor $K_{GMR}r_{z1}$	GMR_c	0.01173 m
Factor geometric mean radius	K_{GMR}	0.774
Constant relating to conductor formation	K_{BICC}	0.0512
Number of wires conductor	n_{cw}	91
Diameter of wires conductor (average)	d_{cw}	2.97 mm

Insulation

Capacitance, with approximation (CIGRE TB 880) $\frac{1}{2\pi\epsilon_0}\frac{10^{-9}}{18}C_b$	C_b	2.111e-10 F/m
Capacitance (exact) $\frac{2\pi\epsilon_0\epsilon_i}{\ln\left(\frac{r_{osc}}{r_{isc}}\right)}$	C_b	2.114e-10 F/m
Capacitance to earth C_b	C_E	2.111e-10 F/m
Vacuum permittivity	ϵ_0	8.854187817620389e-12 F/m
Radius above the inner semi-conducting layer $\frac{d_c}{2}+t_{ct}+t_{cs}$	r_{isc}	16.65 mm
Radius over capacitive insulation layers $\frac{D_{ins}}{2}$	r_{osc}	32.15 mm

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Velocity of propagation $\frac{1}{1000\sqrt{\mu_0 \epsilon_0 \epsilon_i}}$	v_{prop}	189605.4 km/s

Screen + Sheath

Electrical resistance sheath $10^6 \frac{\rho_{sh}}{A_{sh}}$	R_{sh}	1.6691e-4 Ω/m
Electrical resistance screen/sheath 20°C	R_{so}	1.669e-1 Ω/km

Radius

Radius conductor	r_{z1}	0.01515 m
Radius shield (inner)	r_{z2}	0.03305 m
Radius shield (outer)	r_{z3}	0.03305 m
Radius sheath (inner)	$r_{z2,sh}$	0.03305 m
Radius sheath (outer)	$r_{z3,sh}$	0.03465 m
Radius outersheath	r_{z6}	0.03775 m

Material parameters

Conductor

Electrical resistivity conductor material	ρ_c	1.724e-8 Ω.m
Temperature coefficient conductor material	α_c	3.93e-3 1/K
Reciprocal of temperature coefficient conductor material	β_c	2.345e2 K
Volumetric heat capacity conductor material	σ_c	3.45e6 J/(K.m^3)
Thermal conductivity conductor material	k_c	384.62 W/(m.K)
Density conductor material	ζ_c	8.94 g/cm^3

Insulation

Relative permittivity insulation material	ϵ_i	2.5
Loss factor insulation material	$\tan\delta_i$	0.001
Thermal resistivity insulation material	ρ_i	3.5 K.m/W
Volumetric heat capacity insulation material	σ_i	2.40e6 J/(K.m^3)
Density insulation material	ζ_i	0.923 g/cm^3
Max. temperature conductor	θ_{cmax}	90 °C
Max. temperature conductor, emergency overload	θ_{cmaxeo}	105 °C
Max. temperature conductor, short-circuit	θ_{cmaxsc}	250 °C
Conductor shield		
Thermal resistivity conductor shield	ρ_{cs}	2.5 K.m/W
Insulation screen		
Thermal resistivity insulation screen	ρ_{is}	2.5 K.m/W

Sheath

Specific electrical resistivity sheath material	ρ_{sh}	2.840e-8 Ω.m
Temperature coefficient sheath material	α_{sh}	4.03e-3 1/K
Reciprocal of temperature coefficient sheath material	β_{sh}	2.281e2 K
Volumetric heat capacity sheath material	σ_{sh}	2.50e6 J/(K.m^3)
Thermal conductivity sheath material	k_{sh}	208.3 W/(m.K)
Density sheath material	ζ_{sh}	2.712 g/cm^3

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Jacket

Thermal resistivity jacket material	ρ_j	3.5 K.m/W
Thermal resistivity additional layer	ρ_{jj}	2.5 K.m/W
Volumetric heat capacity jacket material	σ_j	2.40e6 J/(K.m^3)
Electrical conductivity jacket material	κ_j	2.00e-15 S/m
Density jacket material	ζ_j	0.941 g/cm^3

Thermal resistance

Internal thermal resistances for rating calculation

Thermal resistance conductor—sheath T_1 0.4199 K.m/W

$$T_{ct} + T_{cs} + T_{ins} + T_{is} + T_{scb} + T_{scs} + T_{dsh}$$

Thermal resistance armour bedding T_2 0 K.m/W

Thermal resistance jacket T_3 0.0542 K.m/W

$$T_{ab} + T_j + T_{jj}$$

Thickness conductor—sheath t_1 18.3 mm

$$t_i + t_{scb} + t_{scs} + \frac{H_{sh} + \Delta H}{2}$$

Thickness sheath—armour t_2 0 mm

$$\frac{H_{sh} + \Delta H}{2} + t_{ab}$$

Thickness armour—surface t_3 3.5 mm

$$t_j + t_{jj}$$

Cable elements

Thermal resistance, transient T_{tot} 0.4741 K.m/W

$$T_1 + T_2 + T_3$$

Thermal resistance insulation T_i 0.41987 K.m/W

$$T_{ct} + T_{cs} + T_{ins} + T_{is}$$

Thermal resistance conductor shield T_{cs} 0.03756 K.m/W

$$\frac{\rho_{cs}}{2\pi} \ln\left(\frac{D_{cs}}{D_{cs} - 2t_{cs}}\right)$$

Thermal resistance insulation T_{ins} 0.36654 K.m/W

$$\frac{\rho_i}{2\pi} \ln\left(\frac{D_{ins}}{D_{ins} - 2t_{ins}}\right)$$

Thermal resistance insulation screen T_{is} 0.01577 K.m/W

$$\frac{\rho_{is}}{2\pi} \ln\left(\frac{D_{ins} + 2t_{is}}{D_{ins}}\right)$$

Thermal resistance jacket T_j 0.0542 K.m/W

$$\frac{\rho_j}{2\pi} \ln\left(\frac{D_j - 2t_{jj}}{D_j - 2\left(t_j + t_{jj}\right)}\right)$$

Dimensions

Diameter

External diameter conductor d_c 30.3 mm

Diameter over conductor shield D_{cs} 33.3 mm

$$d_c + 2\left(t_{ct} + t_{cs}\right)$$

Diameter over insulation D_{ins} 64.3 mm

$$d_c + 2\left(t_{ct} + t_{cs} + t_{ins}\right)$$

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.

Diameter over insulation incl. insulation screen $d_c + 2\left(t_{ct} + t_{cs} + t_{ins} + t_{is}\right)$	D_i	66.9 mm
Diameter over insulation screen $d_c + 2t_i$	D_{is}	66.9 mm
Equivalent diameter of screen and sheath	d_s	67.7 mm
Mean diameter sheath $D_{shb} + t_{sh} + H_{sh} + \Delta H$	d_{sh}	67.7 mm
Diameter over sheath $D_{shb} + 2\left(t_{sh} + H_{sh} + \Delta H\right)$	D_{sh}	68.5 mm
Diameter over sheath jacket	D_{shj}	68.5 mm
Diameter over jacket $D_{ar} + 2\left(t_j + t_{jj}\right)$	D_j	75.5 mm

Area

Cross-sectional area conductor	A_c	630 mm^2
Cross-sectional area insulation $\frac{\pi}{4}\left({D_{is}}^2 - {d_c}^2\right)$	A_i	2794.1 mm^2
Cross-sectional area sheath $d_{sh} t_{sh} \pi$	A_{sh}	170.15 mm^2
Cross-sectional area jacket $\frac{\pi}{4}\left({D_j}^2 - \left(D_j - 2\left(t_j + t_{jj}\right)\right)^2\right)$	A_j	791.7 mm^2

cableizer Cableizer specifically disclaims any warranties, including, but not limited to, the implied warranties of merchantability, accuracy, or fitness for any particular purpose. In no event shall Cableizer be liable to any party for any damages arising out of the use of information in this document.