

Report

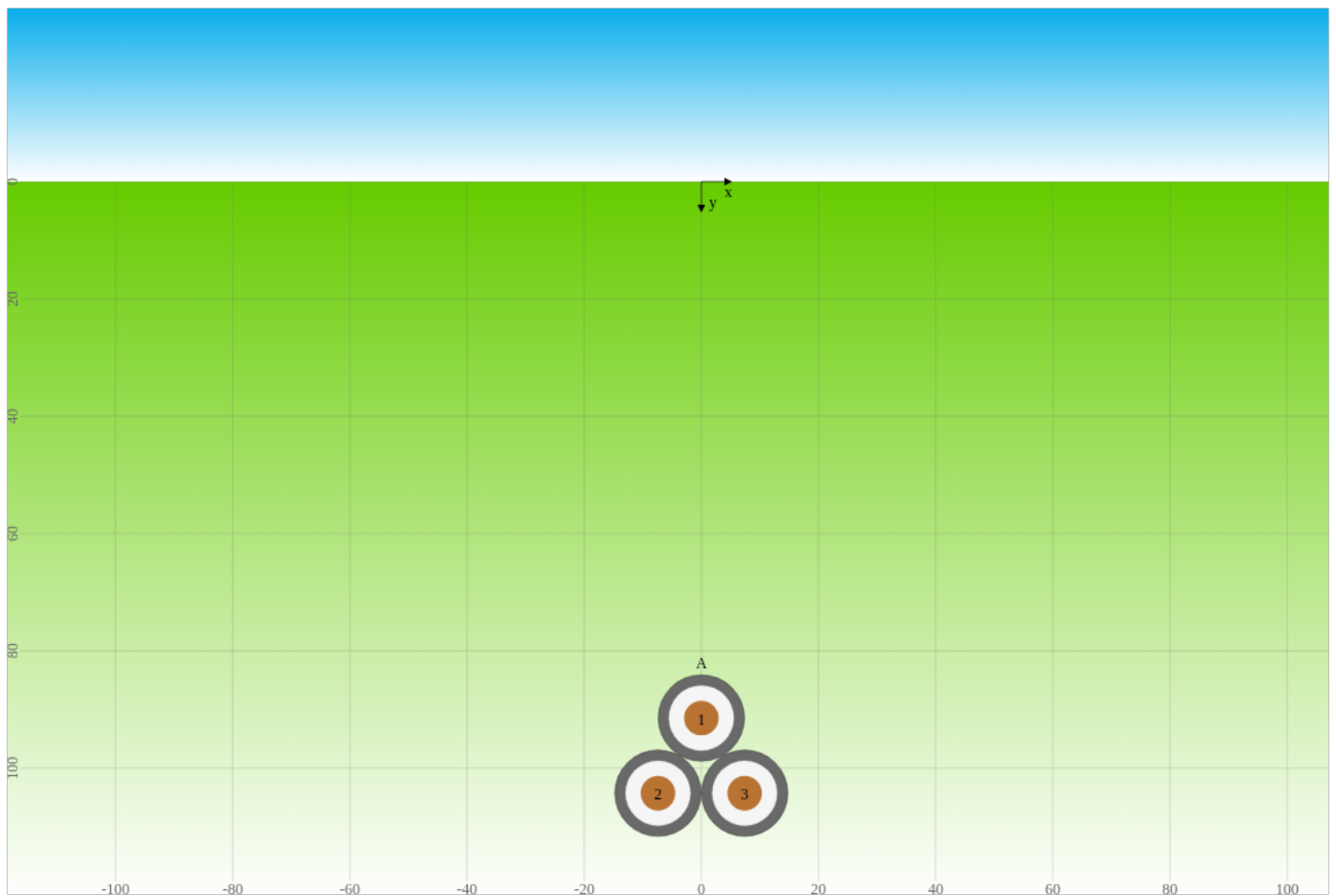
Title	Case study 5-1: A 400kV LPOF Cable (trefoil, sb)
Project	Verification CIGRE TB 880
Created	Date: 2025-05-19 Time: 10:59 Software version: 8482 (2025-05-16)

Arrangement

Arrangement	buried project (#46702)
Options	None
CIGRE TB 880, guidance points	02, 06, 26, 31
CIGRE TB 880, test setting	08, 47
Systems	A

Statistics

Number of iterations of the solver	N_{calc}	10
Sum of currents from all systems	I_{sum}	903.63 A
Sum of average conductor temperatures from all systems	θ_{sum}	85 °C
Number of overheated electrical systems		0
Sum of losses from all systems	W_{sum}	117.485 W/m



Systems

Following systems are active in the arrangement:

#	Object	Current [A]	Temp. [°C]	Losses [W/m]	Load
		I_c	$\theta_c \mid \theta_e$	W_{sys}	LF
A	16320 CIGRE TB 880 Case 5 400kV LPOF Cable	903.6	85.0 69.9	117.5	1.00

Objects

Following objects are used:

16320 CIGRE TB 880 Case 5 400kV LPOF Cable

Ambient

Calculation method		IEC Standard (directly buried)
Ambient temperature	θ_a	20 °C
Thermal resistivity soil	ρ_4	1 K.m/W
Thermal conductivity soil	k_4	1 W/(m.K)
Volumetric heat capacity soil material	$c_{p,soil}$	2136.8 J/(kg.K)
$10^{-4} \frac{k_4^{0.2}}{4.68}$		
Thermal diffusivity soil	δ_{soil}	5.00e-7 m²/s
Ratio thermal resistivity dry/moist soil	v_4	1
$\frac{\rho_{4d}}{\rho_4}$		

Constants

Standard acceleration of gravity	g	9.80665 m/s²
Archimedes' constant π	π	3.141592653589793
Absolute temperature	θ_{abs}	273.15 K
Stefan Boltzmann constant	σ	5.67036713e-8 W/m²K⁴
Vacuum permeability	μ_0	1.2566370614359173e-6 H/m
Vacuum permittivity	ϵ_0	8.854187817620389e-12 F/m

System A (Extra high voltage cable)

Warning! The conductor temperature exceeds the maximum allowable temperature of 80.0 °C under emergency overload operation.

Ampacity

Cable CIGRE TB 880 Case 5 400kV LPOF Cable

Rounded value, CIGRE TB 880

I_c

900 A

Conductor current

I_c

903.63 A

$$\sqrt{\frac{\theta_c - \theta_a + (v_4 - 1) \Delta\theta_x - v_4 \Delta\theta_p - \Delta\theta_d}{R_c (T_1 + n_{ph} (1 + \lambda_1) T_2 + (1 + \lambda_1 + \lambda_2 + \lambda_3) (n_{ph} T_3 + n_{cc} (T_{4i} + T_{4ii} + T_{4\mu} v_4)) + n_{cc} \lambda_4 \left(\frac{T_{4ii}}{2} + T_{4\mu} v_4 \right))}}$$

Operating voltage

U_o

400 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

trefoil

Position cable 1

$x_1|y_1$

0.0 | 914.5 mm

Position cable 2

$x_2|y_2$

-74.0 | 1042.7 mm

Position cable 3

$x_3|y_3$

74.0 | 1042.7 mm

Separation of conductors in a system

s_c

148 mm

Mean distance between the phases

a_m

148 mm

Geometric mean distance between phases of the same system

GMD

0.148 m

S_m

Depth of laying of sources

L_c

1000 mm

Depth of laying

L_{cm}

1 m

Outer diameter

D_o

0.148 m

Substitution coefficient u

u

13.5135

$$\frac{2L_{cm}}{D_o}$$

Geometric constant of circle buried

g_u

27.027

$2u$

Temperature

Temperature conductor

θ_c

85 °C

$$\theta_a + \Delta\theta_c - (v_4 - 1) \Delta\theta_x + v_4 \Delta\theta_p$$

Temperature screen/sheath

θ_s

76.6 °C

Temperature sheath

θ_{sh}

76.6 °C

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

External temperature object

θ_e

69.87 °C

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

Temperature rise

Temperature rise conductor	$\Delta\theta_c$	65 K
$n_{ph} (W_c T_{int} + W_d T_d) + n_{cc} \left(W_d (T_{4i} + T_{4ii} + v_4 T_{4ss}) + (W_c + W_s + W_{ar} + W_{sp}) (T_{4i} + T_{4ii} + v_4 T_{4\mu}) + W_{duct} \left(\frac{T_{4ii}}{2} + v_4 T_{4\mu} \right) \right)$		
Temperature rise dielectric losses	$\Delta\theta_d$	10.4256 K
$W_d (n_{ph} T_d + n_{cc} (T_{4i} + T_{4ii} + T_{4ss} v_4))$		
Temperature rise by other buried objects	$\Delta\theta_p$	0 K
$\sum_{k=1}^q \Delta\theta_{kp}$		
Critical soil temperature rise	$\Delta\theta_x$	0 K

Losses**Ohmic**

Conductor losses (phase)	W_c	10.659 W/m
$I_c^2 R_c$		
Screen/sheath losses (phase)	W_s	22.557 W/m
$\lambda_1 W_c$		
Duct losses	W_{duct}	0 W/m
Ohmic losses (phase)	W_I	33.216 W/m
$W_c (1 + \lambda_1 + \lambda_2 + \lambda_3 + \lambda_4)$		

Dielectric

Dielectric losses (phase)	W_d	5.946 W/m
$\omega C_b \left(1000 \frac{U_o}{\sqrt{3}} \right)^2 \tan \delta_i$		

Total

Total losses (phase)	W_t	39.162 W/m
$W_I + W_d$		
Total losses (object)	W_{tot}	39.162 W/m
$n_{ph} W_t$		
Total losses (system)	W_{sys}	117.485 W/m

Thermal resistance

Thermal resistance ambient	$T_{4\mu}$	1.2733 K.m/W
$= T_{4ss} = T_{4iii} = 3 \frac{\rho_4}{2\pi} (\ln(g_u) - 0.63)$		
Thermal resistance jacket	T_3	0.1721 K.m/W
$1.6 T_3$		

Cable

Internal thermal resistance for current losses	T_{int}	1.1521 K.m/W
$\frac{T_1}{n_{ph}} + (1 + \lambda_1) T_2 + (1 + \lambda_1 + \lambda_2 + \lambda_3) T_3$		
Internal thermal resistance for dielectric losses	T_d	0.48002 K.m/W
$\frac{T_1}{2n_c} + T_2 + T_3$		

Other characteristics

Earthing

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

Loss factor

Loss factor shield (screen/sheath) $\lambda_{11} + F_e \lambda_{12}$	λ_1	2.1163
Loss factor shield, circulating currents $\frac{\frac{R_e}{R_c}}{1 + \left(\frac{R_e}{X_e}\right)^2}$	λ_{11}	1.9156
Loss factor shield, eddy currents $\frac{R_{sh}}{R_c} \left(g_s \lambda_0 (1 + \Delta_1 + \Delta_2) + \frac{(\beta_1 t_{sh})^4}{12 \cdot 10^{12}} \right)$	λ_{12}	0.7093
Electrical resistance shield/armour	R_e	3.4872e-2 Ω/km
Substitution coefficient λ_0 for eddy-currents $3 \frac{m_0^2}{1 + m_0^2} \left(\frac{d_e}{2s_c} \right)^2$	λ_0	0.2296
Substitution coefficient Δ_1 for eddy-currents $(1.14 m_0^{2.45} + 0.33) \left(\frac{d_e}{2s_c} \right)^{0.92 m_0 + 1.66}$	Δ_1	0.1345
Substitution coefficient Δ_2 for eddy-currents	Δ_2	0
Substitution coefficient m_0 for eddy-currents $10^{-7} \frac{\omega}{R_{sh}}$	m_0	0.9009 Hz.m/ Ω
Substitution coefficient β_1 for eddy-currents $\sqrt{\frac{4\pi\omega}{10^7 \rho_{sh} (1 + \alpha_{sh} (\theta_{sh} - 20))}}$	β_1	106.39
Substitution coefficient g_s for eddy-currents $1 + \left(\frac{t_{sh}}{D_{sh}} \right)^{1.74} (10^{-3} \beta_1 D_{sh} - 1.6)$	g_s	1.016253
Factor F_e eddy-current losses $\frac{4M_e^2 N_e^2 + (M_e + N_e)^2}{4(M_e^2 + 1)(N_e^2 + 1)}$	F_e	0.283
Substitution coefficient M_e to calculate factor F_e $\frac{R_e}{X_e}$	M_e	0.6282
Substitution coefficient N_e to calculate factor F_e $\frac{R_e}{X_e}$	N_e	0.6282
Loss factor armour	λ_2	0
Drying-out of soil		
Characteristic diameter drying zone	D_{dry}	0.148 m
Depth characteristic diameter drying zone	L_{dry}	1 m
Geometric constant of circle drying zone	g_{dry}	1 p.u.
Substitution coefficient g	g_a	1

Electrical parameters

System

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

Resistance

Electrical resistance conductor $R_{cDC} (1 + y_s + y_p)$	R_c	$1.3053\text{e-}5 \text{ } \Omega/\text{m} \rightarrow 0.0131 \text{ } \Omega$
Electrical resistance DC conductor $R_{c20} (1 + \alpha_c (\theta_c - 20))$	R_{cDC}	$1.1299\text{e-}5 \text{ } \Omega/\text{m} \rightarrow 0.0113 \text{ } \Omega$
Skin effect factor conductor $\frac{x_s^4}{192 + 0.8x_s^4}$	y_s	0.11107
Factor for skin effect on conductor $\sqrt{10^{-7} \frac{8\pi f}{R_{cDC}} k_s}$	x_s	2.19952
Proximity effect factor conductor $\frac{x_p^4}{192 + 0.8x_p^4} \left(\frac{d_c}{s_c} \right)^2 \left(0.312 \left(\frac{d_c}{s_c} \right)^2 + \frac{1.18}{\frac{x_p^4}{192 + 0.8x_p^4} + 0.27} \right)$	y_p	0.04418
Factor for proximity effect of conductors $\sqrt{10^{-7} \frac{8\pi f}{R_{cDC}} k_p}$	x_p	2.02855
Electrical resistance sheath $R_{sh} (1 + \alpha_{sh} (\theta_{sh} - 20))$	R_{sh}	$3.4872\text{e-}5 \text{ } \Omega/\text{m} \rightarrow 0.0349 \text{ } \Omega$
Electrical resistance shield	R_s	$3.4872\text{e-}5 \text{ } \Omega/\text{m} \rightarrow 0.0349 \text{ } \Omega$
Reduction factor $\frac{R_s}{\sqrt{R_s^2 + X_s^2}}$	RF	0.0575

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	$12.503 \mid 6.769 \text{ kV/mm}$
Radius to point x in insulation	r_x	$30.1 \mid 55.6 \text{ mm}$
Line-to-ground voltage $\frac{1000U_o}{\sqrt{3}}$	U_e	230940.11 V
Capacitance insulation $\frac{1}{2\pi\epsilon_0} \frac{10^{-9}}{18} C_b$	C_b	$2.535\text{e-}10 \text{ F/m} \rightarrow 0.2535 \text{ } \mu\text{F}$
Capacitive load current $U_e \omega C_b$	I_C	$1.839\text{e-}2 \text{ A/m} \rightarrow 18.3911 \text{ A}$
Charging capacity $n_{ph} U_e^2 \omega C_b$	P_C	$4247.2488 \text{ var/m} \rightarrow 4247.2488 \text{ kvar}$
Capacitive earth short-circuit current $U_e \omega C_E$	I_{Ce}	$1.839\text{e-}2 \text{ A/m}$

Reactance

Self reactance conductor X_a 6.668e-4 $\Omega/\text{m} \rightarrow 0.6668 \Omega$

$$\omega \frac{\mu_0}{2\pi} \ln \left(\frac{D_E}{GMR_c} \right)$$

Self reactance screen/sheath X_e 5.551e-5 $\Omega/\text{m} \rightarrow 0.0555 \Omega$

$$\omega \frac{\mu_0}{2\pi} \ln \left(\frac{2s_c}{d_s} \right)$$

Induced current (approximate)

Induced circulating current shield I_s 765.172+0.000j A

$$\max \left(I_c \sqrt{\frac{\lambda_{11, sb} R_c}{R_s}} \right)$$

Loss factor shield, circulating currents $\lambda_{11, sb}$ 1.9156+0.0000j

Load, Voltage drop

Apparent power generator-side S_G 626.056 MVA

$$\sqrt{3} U_o I_c$$

Voltage drop V_{drop} 0.023 V/(A.km) $\rightarrow 20.4 \text{ V} = 0.01\%$

$$\sqrt{3} (R_c \cos \varphi + \omega L_m \sin \varphi)$$

Inductance (mean) L_m 3.732e-7+0.000e0j H/m $\rightarrow 0.3732 \text{ mH}$

$$\frac{\mu_0}{2\pi} \ln \left(\frac{GMD}{GMR_c} \right)$$

Telegrapher equation

Surge impedance Z_C 38.4314-2.1325j Ω

$$\sqrt{\frac{Z_1}{Y_1}}$$

Propagation constant γ_C 1.698e-7+3.061e-6j

$$\sqrt{Z_1 Y_1}$$

Impedance valid up to 100 Hz without earth return

Positive sequence admittance Y_1 0.000e0+7.964e-8j S/m $\rightarrow 0.0000+0.0001j \text{ S}$

$$G + j\omega C_b$$

Positive sequence impedance Z_1 1.305e-5+1.173e-4j $\Omega/\text{m} \rightarrow 0.0131+0.1173j \Omega$

$$R_1 + jX_1$$

Positive sequence reactance X_1 1.173e-4 $\Omega/\text{m} \rightarrow 0.1173 \Omega$

$$\omega \frac{\mu_0}{2\pi} \ln \left(\frac{GMD}{GMR_c} \right)$$

Cable datasheet

Title

CIGRE TB 880 Case 5 400kV LPOF Cable (#16320)

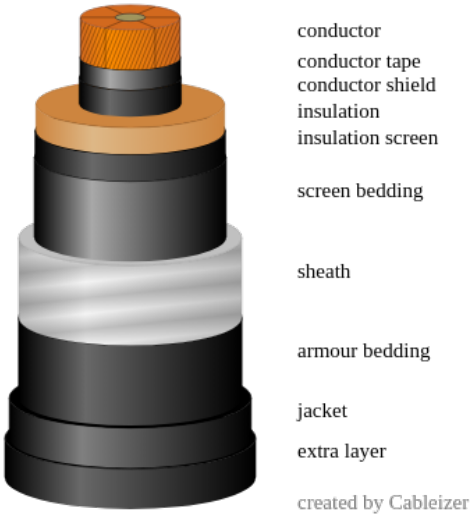
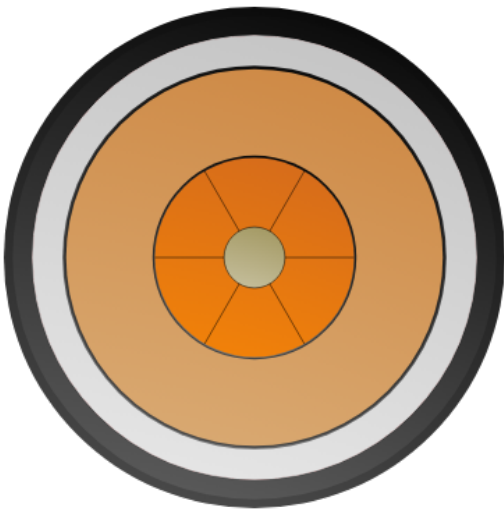
Cable is used in following systems: [A](#)

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	400 kV
Base voltage for tests	U_0	230 kV
Highest voltage for equipment	U_m	420 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 2461 mm ²
Conductor material	M_c	Copper, round Milliken, compacted
External diameter conductor	d_c	58.8 mm
Internal diameter conductor	d_{ci}	18 mm
Radius conductor	r_c	29.4 mm
$\frac{d_c}{2}$		
Thickness of hollow conductor	t_c	20.4 mm
$\frac{d_c}{2} - \frac{d_{ci}}{2}$		

Insulation

Insulation material	M_i	Polypropylene laminated paper (PPLP)
Thickness conductor tape	t_{ct}	0.25 mm
Thickness conductor shield	t_{cs}	0.45 mm
Thickness insulation	t_{ins}	25.5 mm
Thickness insulation screen	t_{is}	0.6 mm

Thickness insulation $t_{ct} + t_{cs} + t_{ins} + t_{is}$	t_i	26.8 mm
Material of conductor tapes		Semiconducting tapes
Screen bedding		
Screen bedding material		Water-blocking tapes, semi-conducting
Thickness screen bedding	t_{scb}	0.45 mm
Sheath		
Sheath material	M_{sh}	Aluminium
Thickness sheath corrugated	t_{sh}	2.9 mm Yes
Depth of corrugation	H_{sh}	5.9 mm
Length corrugated sheath (pitch)	L_{pitch}	28 mm
Armour bedding		
Armour bedding material	M_{ab}	PVC/bitumen tapes
Thickness armour bedding	t_{ab}	0.2 mm
Jacket		
Jacket material	M_j	Polyethylene (LD/MDPE, ST3)
Thickness jacket	t_j	5.5 mm
Thickness of additional layer over jacket	t_{jj}	2.6 mm
Overall		
External diameter object	D_e	148 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}	34.957 kg/m
Electrical		
Conductor		
Electrical resistance DC conductor 20°C	R_{c20}	9.0000e-6 Ω /m
Standard DC resistance of conductor	R_{co}	0.009 Ω /km
Coating of wires		plain
Insulation of wires		bare uni-directional wires
Skin effect coefficient	k_s	0.435
Proximity effect coefficient	k_p	0.37
Geometric mean radius conductor $K_{GMR} r_{z1}$	GMR_c	0.0229 m
Factor geometric mean radius	K_{GMR}	0.779
Constant relating to conductor formation	K_{BICC}	0.051
Number of wires conductor	n_{cw}	127
Diameter of wires conductor (average)	d_{cw}	58.8 mm

Insulation

Capacitance, with approximation (CIGRE TB 880)	C_b	2.535e-10 F/m
$\frac{1}{2\pi\epsilon_0} \frac{10^{-9}}{18} C_b$		
Capacitance (exact)	C_b	2.538e-10 F/m
$\frac{2\pi\epsilon_0\epsilon_i}{\ln\left(\frac{r_{osc}}{r_{isc}}\right)}$		
Capacitance to earth	C_E	2.535e-10 F/m
C_b		
Vacuum permittivity	ϵ_0	8.854187817620389e-12 F/m
Radius above the inner semi-conducting layer	r_{isc}	30.1 mm
$\frac{d_c}{2} + t_{ct} + t_{cs}$		
Radius over capacitive insulation layers	r_{osc}	55.6 mm
$\frac{D_{ins}}{2}$		
Velocity of propagation	v_{prop}	179160.3 km/s
$\frac{1}{1000\sqrt{\mu_0\epsilon_0\epsilon_i}}$		

Screen + Sheath

Electrical resistance sheath	R_{sh}	2.8395e-5 Ω/m
$10^6 \frac{F_{cor,sh}\rho_{sh}}{A_{sh}}$		
Length corrugated sheath	$L_{cor,sh}$	31.2 mm
$\frac{0.25L_{pitch}^2 + H_{sh}^2}{H_{sh}} \left(\arcsin\left(\frac{L_{pitch}H_{sh}}{0.25L_{pitch}^2 + H_{sh}^2}\right) + 0 \right)$		
Effective length per unit pitch length corrugated sheath	$F_{cor,sh}$	1.1145
$\frac{0.25L_{pitch}^2 + H_{sh}^2}{L_{pitch}H_{sh}} \left(\arcsin\left(\frac{L_{pitch}H_{sh}}{0.25L_{pitch}^2 + H_{sh}^2}\right) + 0 \right)$		
Electrical resistance screen/sheath 20°C	R_{so}	2.839e-2 Ω/km

Radius

Radius conductor	r_{z1}	0.0294 m
Radius shield (inner)	r_{z2}	0.0552 m
Radius shield (outer)	r_{z3}	0.0552 m
Radius sheath (inner)	$r_{z2,sh}$	0.0552 m
Radius sheath (outer)	$r_{z3,sh}$	0.06715 m
Radius outersheath	r_{z6}	0.074 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	2.8
Loss factor insulation material	$\tan\delta_i$	0.0014
Thermal resistivity insulation material	ρ_i	5.42 K.m/W
Volumetric heat capacity insulation material	σ_i	2.00e6 J/(K.m ³)
Density insulation material	ζ_i	0.9 g/cm ³
Max. temperature conductor	θ_{cmax}	70 °C
Max. temperature conductor, emergency overload	θ_{cmaxeo}	80 °C
Max. temperature conductor, short-circuit	θ_{cmaxsc}	130 °C

Conductor tape

Thermal resistivity conductor tape	ρ_{ct}	6 K.m/W
Density tape material	ζ_{tape}	0.34 g/cm ³

Conductor shield

Thermal resistivity conductor shield	ρ_{cs}	5 K.m/W
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Insulation screen

Thermal resistivity insulation screen	ρ_{is}	5 K.m/W
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Screen bedding

Thermal resistivity screen bedding	ρ_{scb}	6 K.m/W
Volumetric heat capacity screen bedding	σ_{scb}	2.00e6 J/(K.m ³)
Density tape material	ζ_{tape}	0.34 g/cm ³

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

Armour bedding

Thermal resistivity armour bedding	ρ_{ab}	6 K.m/W
Volumetric heat capacity armour bedding	σ_{ab}	2.00e6 J/(K.m ³)
Density armour bedding material	ζ_{ab}	1.2 g/cm ³

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	1.00e-16 S/m
Density jacket material	ζ_j	0.93 g/cm ³

Thermal resistance**Internal thermal resistances for rating calculation**

Thermal resistance conductor—sheath $T_{ct} + T_{cs} + T_{ins} + T_{is} + T_{scb} + T_{scs} + T_{dsh}$	T_1	0.6158 K.m/W
Thermal resistance armour bedding $T_{ab} + T_j + T_{jj}$	T_2	0 K.m/W
Thermal resistance jacket	T_3	0.1076 K.m/W

Thickness conductor—sheath $t_i + t_{scb} + t_{scs} + \frac{H_{sh} + \Delta H}{2}$	t_1	30.32 mm
Thickness sheath—armour $\frac{H_{sh} + \Delta H}{2} + t_{ab}$	t_2	3.28 mm
Thickness armour—surface $t_j + t_{jj}$	t_3	8.1 mm

Cable elements

Thermal resistance, transient $T_1 + T_2 + T_3$	T_{tot}	0.7234 K.m/W
Thermal resistance insulation $T_{ct} + T_{cs} + T_{ins} + T_{is}$	T_i	0.55775 K.m/W
Thermal resistance conductor tape $\frac{\rho_{ct}}{2\pi} \ln \left(\frac{d_c + 2t_{ct}}{d_c} \right)$	T_{ct}	0.00809 K.m/W
Thermal resistance conductor shield $\frac{\rho_{cs}}{2\pi} \ln \left(\frac{D_{cs}}{D_{cs} - 2t_{cs}} \right)$	T_{cs}	0.01199 K.m/W
Thermal resistance insulation $\frac{\rho_i}{2\pi} \ln \left(\frac{D_{ins}}{D_{ins} - 2t_{ins}} \right)$	T_{ins}	0.52914 K.m/W
Thermal resistance insulation screen $\frac{\rho_{is}}{2\pi} \ln \left(\frac{D_{ins} + 2t_{is}}{D_{ins}} \right)$	T_{is}	0.00854 K.m/W
Thermal resistance screen bedding $\frac{\rho_{scb}}{2\pi} \ln \left(\frac{D_{scb}}{D_i} \right)$	T_{scb}	0.00762 K.m/W
Thermal resistance corrugation filling $\frac{\rho_{scs}}{2\pi} \ln \left(1 + \frac{2 \frac{H_{sh} + \Delta H}{2}}{D_{scs}} \right)$	T_{dsh}	0.05048 K.m/W
Thermal resistance armour bedding $\frac{\rho_{ab}}{2\pi} \ln \left(\frac{D_{ab}}{D_{shj} - (H_{sh} + \Delta H)} \right)$	T_{ab}	0.04868 K.m/W
Thermal resistance jacket $\frac{\rho_j}{2\pi} \ln \left(\frac{D_j - 2t_{jj}}{D_j - 2(t_j + t_{jj})} \right)$	T_j	0.04465 K.m/W
Thermal resistance additional layer $\frac{\rho_{jj}}{2\pi} \ln \left(\frac{D_j}{D_j - 2t_{jj}} \right)$	T_{jj}	0.01423 K.m/W

Dimensions

Diameter

External diameter conductor d_c	d_c	58.8 mm
Diameter over conductor shield $d_c + 2(t_{ct} + t_{cs})$	D_{cs}	60.2 mm

Diameter over insulation $d_c + 2(t_{ct} + t_{cs} + t_{ins})$	D_{ins}	111.2 mm
Diameter over insulation incl. insulation screen $d_c + 2(t_{ct} + t_{cs} + t_{ins} + t_{is})$	D_i	112.4 mm
Diameter over insulation screen $d_c + 2t_i$	D_{is}	112.4 mm
Diameter over screen bedding $d_c + t_{i1} + 2t_{scb}$	D_{scb}	113.3 mm
Equivalent diameter of screen and sheath	d_s	122.35 mm
Mean diameter sheath $D_{shb} + t_{sh} + H_{sh} + \Delta H$	d_{sh}	122.35 mm
Diameter over sheath $D_{shb} + 2(t_{sh} + H_{sh} + \Delta H)$	D_{sh}	131.4 mm
Diameter over sheath jacket	D_{shj}	131.4 mm
Diameter over armour bedding $D_{sh} + 2t_{ab}$	D_{ab}	131.8 mm
Diameter over jacket $D_{ar} + 2(t_j + t_{jj})$	D_j	148 mm

Area

Cross-sectional area conductor	A_c	2461 mm ²
cross-sectional area (calculated) $\frac{\pi}{4}(d_c^2 - d_{ci}^2)$	A_c	2461 mm ²
Cross-sectional area insulation $\frac{\pi}{4}(D_{is}^2 - d_c^2)$	A_i	7207.1 mm ²
Cross-sectional area screen bedding $\pi t_{scb}(D_{scb} - t_{scb})$	A_{scb}	159.5 mm ²
Cross-sectional area sheath $d_{sh} t_{sh} \pi$	A_{sh}	1114.68 mm ²
Cross-sectional area armour bedding $\frac{\pi}{4}(D_{ab}^2 - (D_{ab} - t_{ab})^2)$	A_{ab}	41.4 mm ²
Cross-sectional area jacket $\frac{\pi}{4}(D_j^2 - (D_j - 2(t_j + t_{jj}))^2)$	A_j	3560 mm ²