2014 SUMMER SEMINAR AND NETWORKING EVENT

Remote Powering
-
The Good, the Bad and the CCA

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Standards Activities

Member
JTC1 SC25 WG3: Generic Cabling
Leader
JTC1 SC25 WG3 Cabling Implementation Task Group: ISO/IEC 14763-2
JTC1 SC25 WG3 Ad-hoc: Bonding - ISO/IEC 30129
Meeting Secretary
JTC1 SC25 WG3 Ad-hoc: AIM - ISO/IEC 18598

Member
JTC1 SC39 WG1: Resource Efficient Data Centres

Convenor
TC215 WG1: Cabling design
Secretary
TC215 WG2: Cabling installation - QA and installation practices
Member
TC215 WG3: Facilities and infrastructures (data centres)

Member
CEN/CLC/ETSI CG Green Data Centres

Past-Chairman
TCT7: Telecommunications - Installation Requirements
Chairman
TCT7/1: Cabling: Infrastructure design, planning and commissioning
Meeting Secretary
TCT7/2: Cabling; Installation and UK implementation
TCT7/3: Facilities and infrastructures

Fibreoptic Industry Association
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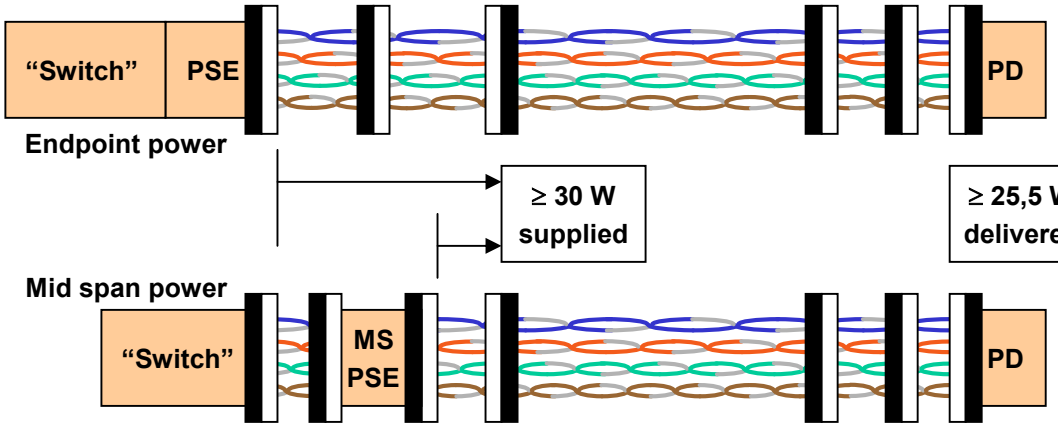
Director
standards@fia

IEEE 802.3at:2009 Type 2

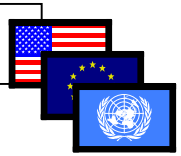


10/100BASE-T
or
1000BASE-T
which supports
10/100BASE-T

2-pair powering

i = 300 mA per conductor

R = 12,5 W Category 5/Class D cabling



V_{max}	V_{min}
57	50

30 - 34,2 W supplied

25,5 - 34,2 W delivered

V_{max}	V_{min}
57	42.5

0,0 - 4,5 W lost

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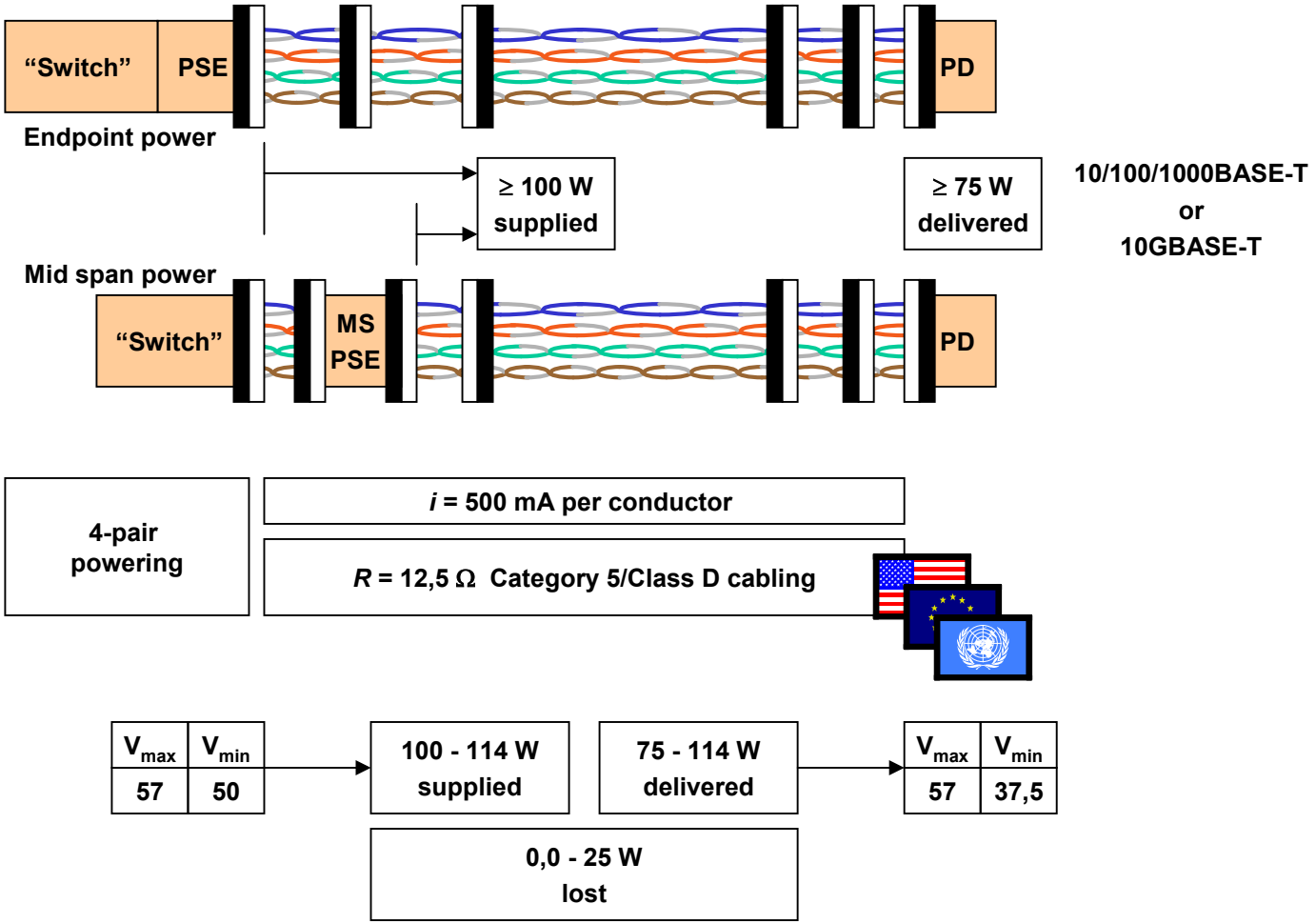
IEEE 802.3bt in Development



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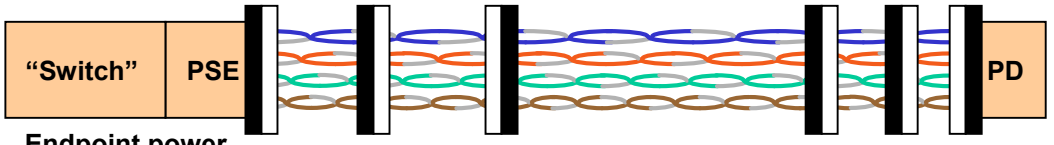
232 W Delivery



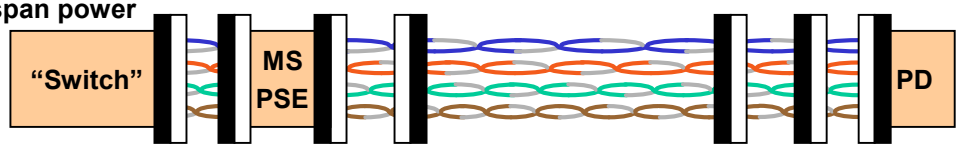
Endpoint power

≥ 230 W supplied

≥ 180 W delivered

TV, larger devices

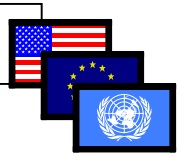
Mid span power



4-pair powering

i = 1000 mA per conductor

R = 12,5 Ω Category 5/Class D cabling



V_{max}	V_{min}
58	??

?? - 232 W supplied

?? - 182 W delivered

V_{max}	V_{min}
58	??

0,0 - 68 W lost

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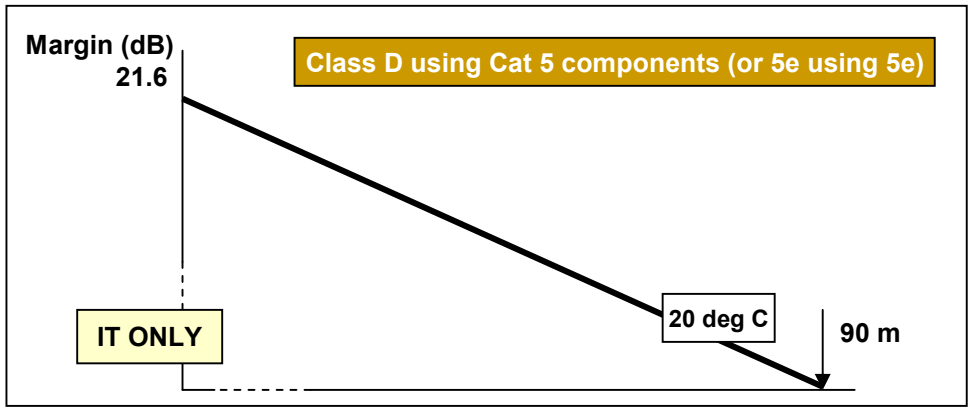
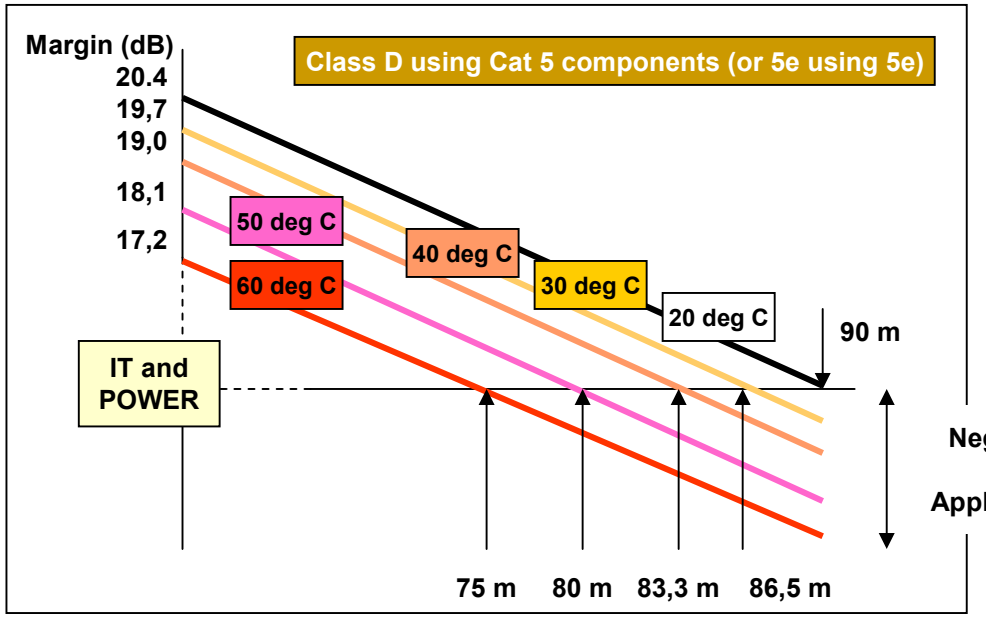
Global Impact





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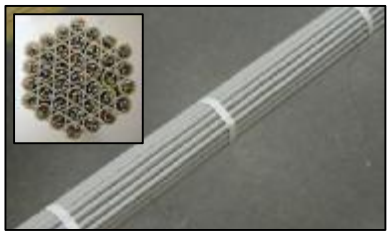
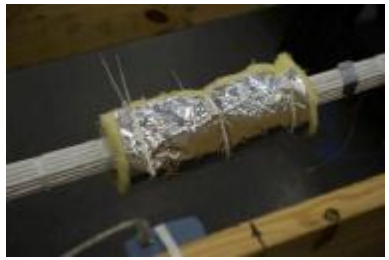
Localised Impacts

Fully ventilated pathways

"Base" temperature rise





- **fire barriers**
- **shorter insulated lengths**
- **limited temperature rises**

- **trunking/conduit**
- **lengths in excess of 2,5 m**
- **temperature rises increase x2**

- **insulated pathways**
- **lengths in excess of 2,5 m**
- **temperature rises increase x6**

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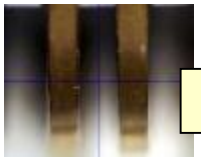
De-mating Under Load

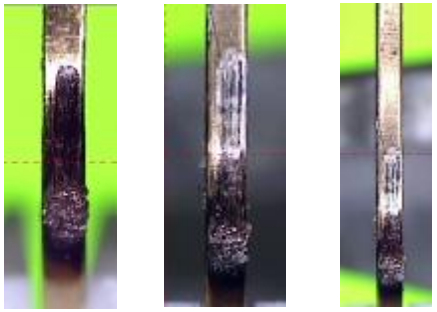
Plug and socket contacts



Before

After

Variations in socket contact design and resulting damage



Sample images courtesy of Nexans

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CLC TR 50174-99-1

2014 SUMMER SEMINAR AND NETWORKING EVENT

CLC TR 50174-99-1	Information technology - Cabling installation: Remote powering

Work began: 2012	Publication: 2015

OBJECTIVES	
1	Definition of a “test configuration” to assess thermal impact of remote powering
2	Testing of different installation conditions and currents
3	Development of a modelling tool to enable predictions of thermal impact
4	The production of requirements/recommendations for cabling installation, planning and operation

OPENING POSITION

None of the CENELEC experts were aware of any problem caused by cable heating where current levels are in accordance with IEEE 802.3at and therefore did not anticipate any need for additional installation or operational instructions for cabling in support of IEEE 802.3at.

- EN 50174-1: Ed.3: 2015
- EN 50174-2: Ed.3: 2015
- EN 50174-3: Ed.2.x: 2015

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Measured Values

INITIAL RESULTS USING CENELEC TEST CONFIGURATION and CATEGORY 6 U/UTP CABLES					Predicted
				7,1 Ω/100 m	9,5 Ω/100 m
				T_{2a} - $T_{ambient}$	
				Steady state	Steady state
37 cables	Fully ventilated	300 mA per conductor		1.2 °C	1.6 °C
		450 mA per conductor		4.3 °C	5.8 °C
		900 mA per conductor		20 °C	26.8 °C
37 cables	Fully insulated	300 mA per conductor	5 °C	7 °C	9,4 °C
		450 mA per conductor	11 °C	17 °C	22.8 °C
		900 mA per conductor	49 °C	75 °C	100,5 °C
			After 120 minutes	After 425 minutes	
				Steady state	

$\Delta T \propto R$

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Modelling Thermal Impact

We have to control the temperature of the channel by:
- **controlling the space ambient**
- **limiting the power supplied**

CLC TR 50174-99-1 Model

Cable bundle heating spreadsheet

8th May 2014

ONLY CHANGE THE FIGURES IN THE WHITE CELLS

Number of cables in bundle	37		p bundle	1.5
Number of loaded conductors	8		p ambient	0.1
Conductor resistance	0.071	ohms		
Cable diameter	0.0075	m		

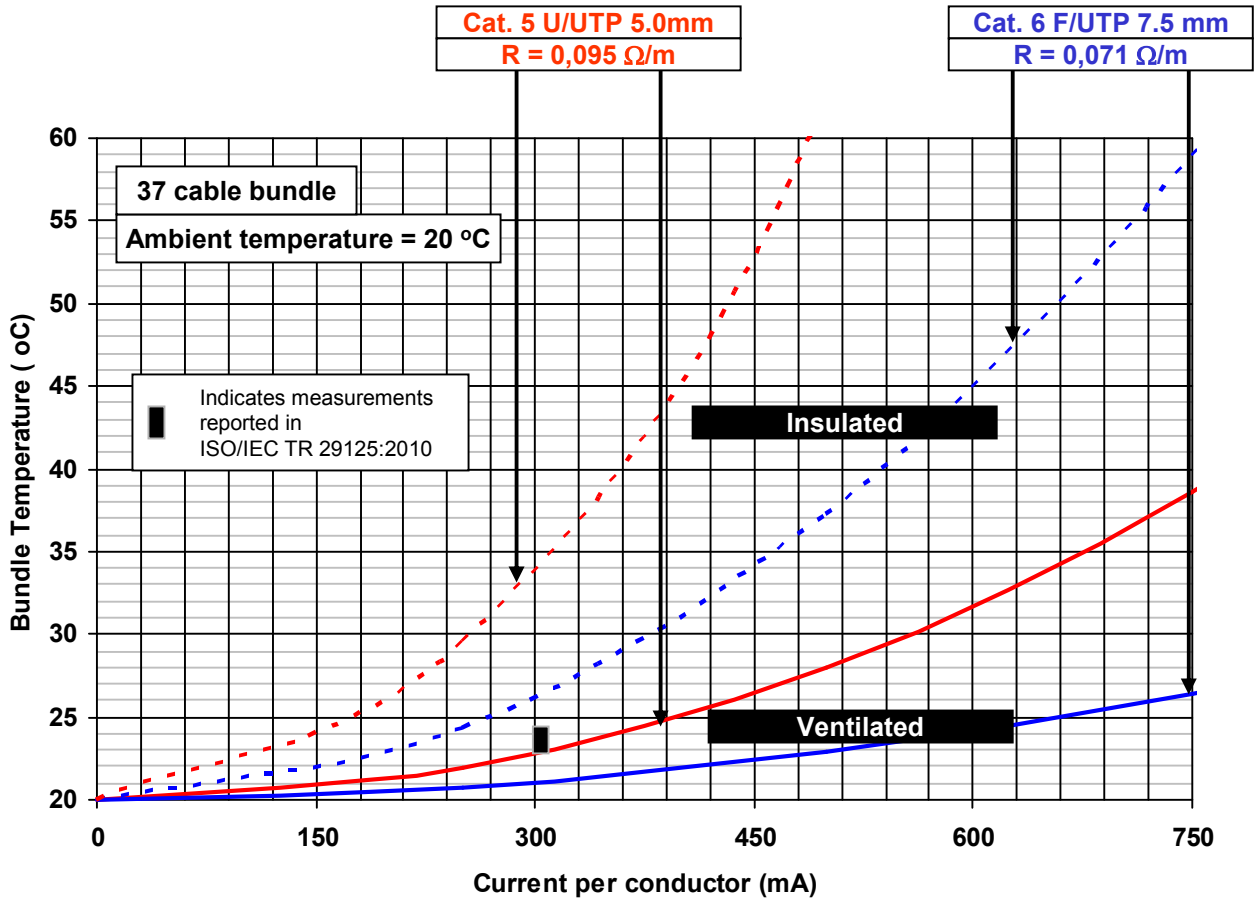
CLC TR 50174-99-1 MODEL

			Delta TOTAL	Delta Surface-Ambient	Delta Surface-Core
Load current per conductor	A	0.1	0.11	0.09	0.03
		0.15	0.26	0.20	0.06
		0.2	0.46	0.36	0.10
		0.25	0.71	0.56	0.16
		0.3	1.03	0.80	0.23
		0.35	1.40	1.09	0.31
		0.4	1.82	1.42	0.40
		0.45	2.31	1.80	0.51
		0.5	2.85	2.22	0.63
		0.6	4.10	3.20	0.90
		0.7	5.59	4.36	1.23
		0.75	6.41	5.00	1.41
		1	11.40	8.89	2.51
		1.2	16.41	12.80	3.61

- **current affects thermal impact (i^2)**
- **resistance affects thermal impact (linear with R)**

- **cable diameter affects thermal impact (non-linear)**
- **cable type affects thermal impact (non-linear with ρ_{bundle})**
- **installation environment affects thermal impact (non-linear with $\rho_{ambient}$)**

Modelling Thermal Impact



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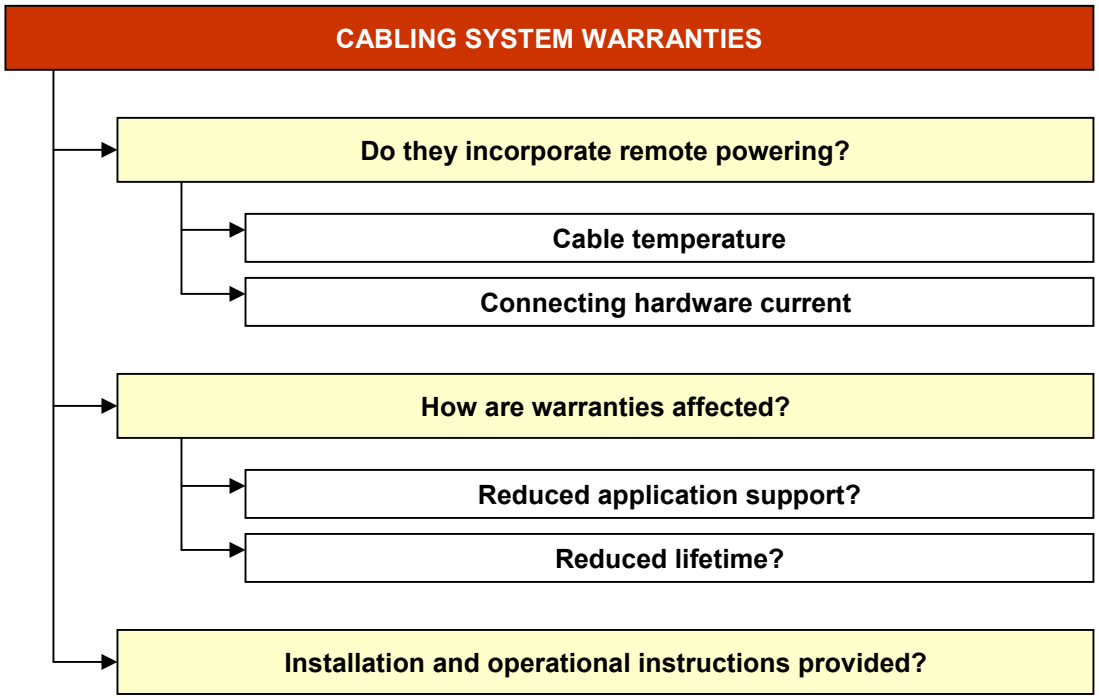
Application Warranties



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Copper Coated Aluminium (et al)

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EN 50173-1:2011 - ISO/IEC 11801 Ed.2.2

DC loop resistance requirements

Channel at T≤ 60 °C	
Class D	25 Ω
Class E	
Class E_A	
Class F	
Class F_A	

PL at T≤ 60 °C		
	Requirement	Limit
Class D	0,22 x L + 0,4 x n	21 Ω
Class E		
Class E_A		
Class F		
Class F_A		

EN 50173-1:2016 - ISO/IEC 11801-1:2016

DC loop resistance requirements

Channel at T≤ 60 °C		Fixed cable at T = 20 °C
Class D	25 Ω	19,0 Ω
Class E	23,8 (ffs) Ω	18,0 (ffs) Ω
Class E_A	21,3 (ffs) Ω	16,0 (ffs) Ω
Class F	21,1 (ffs) Ω	15,0 (ffs) Ω
Class F_A	18,9 (ffs) Ω	14,0 (ffs) Ω
Class I/II	17.6 (ffs) Ω	13,0 (ffs) Ω
		Met by design

PL at, or corrected to, T = 20 °C		
	LR x L + 0,4 x n	
	Requirement	Limit
Class D	LR = 0,19 (ffs)	18,3 Ω
Class E	LR = 0,18 (ffs)	17,4 Ω
Class E_A	LR = 0,16 (ffs)	15,6 Ω
Class F	LR = 0,15 (ffs)	14,7 Ω
Class F_A	LR = 0,14 (ffs)	13,8 Ω
Class I/II	LR = 0,13 (ffs)	12,9 Ω

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System Limits

EN 50173-1:2011 - ISO/IEC 11801 Ed.2.2
Current carrying capacity

Table 20 – Minimum current carrying capacity

Minimum current carrying capacity A	Operating temperature t °C
0,300	$t \leq (T_R\text{-}10)$
0,175	$(T_R\text{-}10) < t \leq T_R$
T_R The lowest specified operating temperature (maximum) of the components comprising the cabling subsystem.	

Built around IEEE 802.3 at Type 2

Relevant application standards and manufacturers' instructions shall be consulted with reference to safety aspects of power feeding.

NOTE See ISO/IEC TR 29125 for information on current carrying capacity in respect of applications using remote power supplied over balanced cabling.

Care shall be taken when using multi-unit or bundled cables due to the possible rise of temperature within the cabling components that may degrade channel performance.

EN 50173-1:2016 - ISO/IEC 11801-1:2016
Current carrying capacity

EN 50173-1 will be amended by removing Table 20.

Further consideration of the remaining content may require additional changes:

- **to indicate the restriction of current carrying capacity to 0,75 A per conductor under continuous operation;**
- **to highlight that this is not the capacity if mating or de-mating under load;**
- **to point out that this current is not a guide for application support;**
- **any equipment connected to the channels or applications operating over them shall be fitted with overcurrent protection at this current level.**

Cabling Capability Assessment

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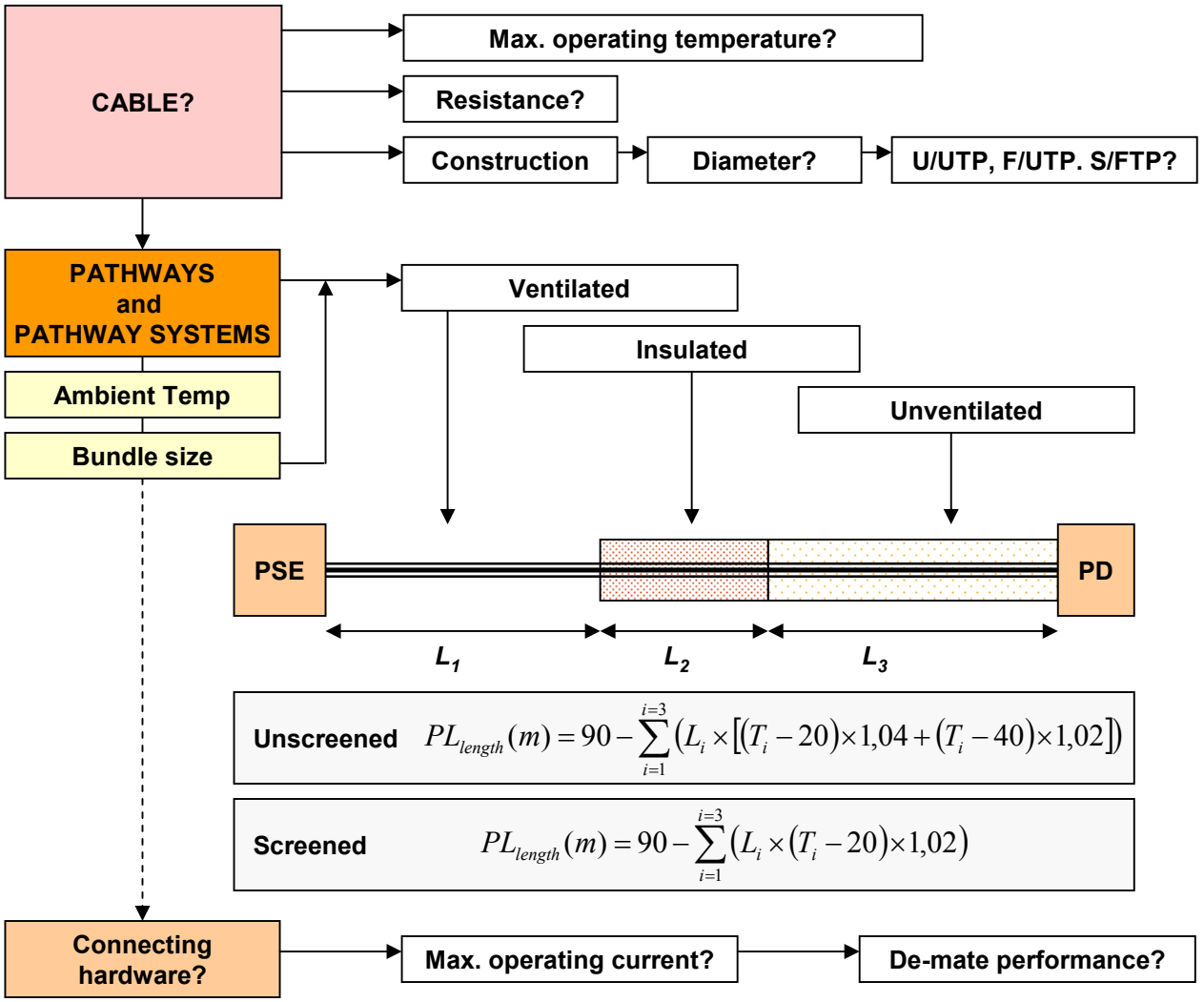

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Power Management

Table 3 - Temperature rise and injected power (Category 5 U/UTP cables)

	Ventilated conditions			Insulated conditions		
ΔT(°C)	i_c(A)	Total bundle current (A) (1)	Injected bundle power (kW) (2)	i_c(A)	Total bundle current (A) (1)	Injected bundle power (kW) (2)
5	0,46	88,3	2,6	0,20	38,4	1,1
10	0,66	126,7	3,8	0,29	55.7	1,67
15	> 0,75 (see 3)	> 144,0 (see 3)	> 4,3 (see 3)	0,35	67,2	2,0
20				0,40	76,8	2,3
25				0,44	84,5	2,5
30				0,48	92,1	2,7
35				0,51	97.9	2,9
40				0,54	103,6	3,1

(1) = 8 x N x i_c

(2) = 60 x 4 x i_c x N

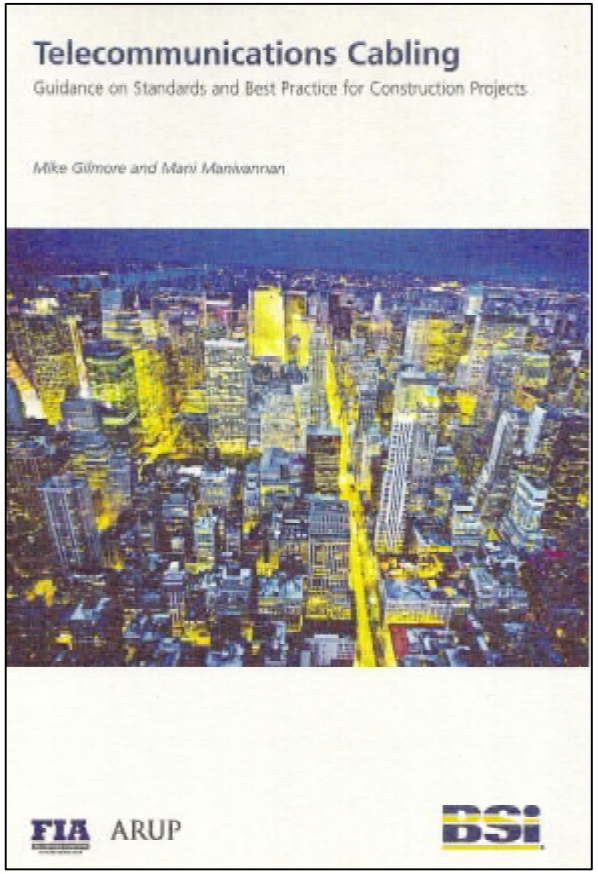
(3) i_c would exceed 0,75A and would be outside the limit specified by standards

NOTE: the above values assume the following modelling conditions

- U/UTP cables
- R = 0.095 Ω/m
- d = 0.005 m

On-going Work

CLC TR 50174-99-1	Information technology - Cabling installation: Remote powering
	Work began: 2012
	Publication: 2015
IET The Institution of Engineering and Technology	Code of Practice for LOW VOLTAGEDIRECT CURRENT POWER DISTRIBUTION IN BUILDINGS
	Work began: 2014
	Publication: 2015



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