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Comparing the Fire Requirements for Low Smoke Zero Halogen Communications Cables Before and After the Introduction of the EU Construction Product Regulation for Cables

1.0 Introduction

The original Construction Product Directive (CPD), 89/106/EEC was introduced in 1989 and applies to all construction products. One of the essential requirements of the CPD relates to safety in the case of a fire. A new testing and classification scheme was agreed for the implementation of the CPD and in particular, relating to the harmonisation of reaction to fire testing of construction products. In 2006, power and communications cables permanently installed in buildings and civil works were accepted as construction products and the CPD Euroclassification for cables (2006/751/EC) was published in the Official Journal of the European Union and later in EN 13501-6.

In 2011, the CPD became the Construction Product Regulation (CPR), EU/305/2011 and became applicable from 1st July 2013 for all construction products except cables. As an EU Regulation, the CPR is directly applicable in all countries of the EU without further transposition.

The classification of the reaction to fire performance of all construction products (including cables) was published in 2016 under 2016/364/EU and the mandatory date to establish CE marking for cables is 1st July 2017.

Questions have been asked by some end users regarding the difference between the fire performance requirements for low smoke zero halogen (LSZH) communications cables before and after the introduction of the CPR. This paper will address this question in detail.

2.0 Pre-CPR and Post-CPR Cable Fire Performance Requirements

Table 1 shows the cable classification scheme. Classification criteria are mandatory requirements and additional classification are optional requirements.

There are seven Euroclasses: A_{ca}, $B1_{ca}$, $B2_{ca}$, C_{ca}, D_{ca}, E_{ca} and F_{ca}, with A_{ca} having the highest performance and Fca having the lowest. These Euroclasses reference several fire test standards, specifically EN 50399, EN 60332-1-2 and EN ISO 1716. Euroclass E_{ca} cables meet the minimum requirement of EN 60332-1-2. EuroClass F_{ca} is applicable to outdoor cables.

Table 2 shows the main differences between some of the test methods. EN 50399 test chamber is based on the IEC 60332-3 test chamber but with the addition of a hood and an exhaust system above the test chamber for the collection of combustion gases which allows the measurement of heat release rate and smoke production.

Class	Test Methods	Classification Criteria	Additional Classification
A_{ca}	EN ISO 1716	PCS ≤ 2.0 MJ/kg [(1)]	
$B1_{ca}$	EN 50399 (30 kW flame source) and	FS ≤ 1.75 m and THR_{1200s} ≤ 10 MJ and Peak HRR ≤ 20 kW and FIGRA ≤ 120 Ws^{-1}	Smoke production[(2), (5)] and Flaming droplets/particles[(3)] and Acidity (pH & conductivity)[(4)]
	EN 60332-1-2	H ≤ 425 mm	
$B2_{ca}$	EN 50399 (20.5 kW flame source) and	FS ≤ 1.5 m and THR_{1200s} ≤ 15 MJ and Peak HRR ≤ 30 kW and FIGRA ≤ 150 Ws^{-1}	Smoke production[(2), (6)] and Flaming droplets/particles[(3)] and Acidity (pH & conductivity)[(4)]
	EN 60332-1-2	H ≤ 425 mm	
C_{ca}	EN 50399 (20.5 kW flame source) and	FS ≤ 2.0 m and THR_{1200s} ≤ 30 MJ and Peak HRR ≤ 60 kW and FIGRA ≤ 300 Ws^{-1}	Smoke production[(2), (6)] and Flaming droplets/particles[(3)] and Acidity (pH & conductivity)[(4)]
D_{ca}	EN 50399 (20.5 kW flame source) and	THR_{1200s} ≤ 70 MJ and Peak HRR ≤ 400 kW and FIGRA ≤ 1300 Ws^{-1}	Smoke production[(2), (6)] and Flaming droplets/particles[(3)] and Acidity (pH & conductivity)[(4)]
E_{ca}	EN 60332-1-2	H ≤ 425 mm	
F_{ca}	EN 60332-1-2	H > 425 mm	

(1) For the product as a whole, excluding metallic materials, and for any external component (i.e. sheath) of the product
(2) **s1** = TSP_{1200} ≤ 50 m2 *and* Peak SPR ≤ 0.25 m2/s
s1a = **s1** and transmittance in accordance with EN 61034-2 ≥ 80 %
s1b = **s1** and transmittance in accordance with EN 61034-2 ≥ 60 % < 80 %
s2 = TSP_{1200} ≤ 400 m^2 *and* Peak SPR ≤ 1.5 m^2/s
s3 = not s1 or s2
(3) **d0** = No flaming droplets/particles within 1200 s
d1 = No flaming droplets/particles persisting longer than 10 s within 1200 s
d2 = not **d0** or **d1**
(4) EN 60754-2: **a1** = conductivity < 2.5 µS/mm *and* pH > 4.3
a2 = conductivity < 10 µS/mm *and* pH > 4.3
a3 = not **a1** or **a2**
(5) The smoke class declared for class $B1_{ca}$ cables must originate from the EN 50399 test (30 kW flame source)
(6) The smoke class declared for class $B2_{ca}$, C_{ca}, D_{ca} cables must originate from the EN 50399 test (20.5 kW flame source)

PCS - gross calorific potential
FS - flame spread
H - flame spread
THR - total heat release
HRR - heat release rate
FIGRA - fire growth rate
TSP - total smoke production
SPR - smoke production rate

Table 1: Classes of reaction to fire performance for cables

Test Methods	Burner	Duration	Airflow	Additional
EN 60332-1-2	1 kW	1 - 8 mins	Convection	No backboard
EN 50399-2-2	30 kW	20 mins	8000 litres /min	Non-combustible backboard
EN 50399-2-1	20.5 kW	20 mins	8000 litres /min	No backboard

Table 2: Comparison between fire test methods

Since the CPR only applies to cables **permanently installed** in buildings, patch cords and work area cords, in general, are excluded from the regulation. The exception is Portugal where patch and work area cords are included in the Portuguese CPR.

In addition, each member country can adopt whichever Euroclass the country deems suitable. As a result, different EU countries may require cables with different Euroclassification for use in the same installation environment. For example, some countries may require Euroclass $B2_{ca}$ cables to be installed in hospitals whereas other countries may accept Euroclass C_{ca} cables.

Prior to the introduction of the CPR, the main fire performance requirements for LSZH communications cables were as follow:

- Flame Spread: IEC 60332-1-2 (identical to EN 50265-2-1) or IEC 60332-3-22 (identical to EN 50266-2-2) or IEC 60332-3-24 (identical to EN 50266-2-4). Table 3 shows the main differences between the IEC 60332-3 and EN 50399 test methods.
- Smoke Production: IEC 61034-2 (identical to EN 50268-2). The requirement is to meet a minimum light transmittance of 60%.
- Acid Gases Production: IEC 60754-2 (identical to EN 50267-2-2). The requirement is to meet:
  - pH > 4.3
  - conductivity < 10 µS/mm

	EN 50399	IEC 60332-3-22	IEC 60332-3-24
Test Requirements	Flame spread, Heat release, Smoke production, Flaming droplets, Time-to-ignition	Flame spread, Oxygen index (optional)	Flame spread, Oxygen index (optional)
Ignition source	30 kW or 20.5 kW (see Table 2)	(1) 20.5 kW	20.5 kW
Airflow	8000 litres/min	5000 litres/min	5000 litres/min
Flame application time	20 mins	40 mins	20 mins
Length of test sample	3.5 m (11.5 ft)	3.5 m (11.5 ft)	3.5 m (11.5 ft)
Cable layers and spacing	Single layer spaced	Number of layers depends on non-metallic volume. Touching for cable diameter ≤ 6.7 mm	Number of layers depends on non-metallic volume. Touching for cable diameter ≤ 6.7 mm
Pass/Fail Criteria	Depends on EuroClassification (see Table 1)	Charred portion < 2.5 m (8.2 ft) above bottom edge of burner. (Flame extinguish after 1 hr).	Charred portion < 2.5 m (8.2 ft) above bottom edge of burner. (Flame extinguish after 1 hr).

Table 3: Comparison between IEC 60332-3 and EN 50399 test methods

The EN 50399 test is sometimes referred to as integrated fire test since it measures essential fire hazard properties such as flame spread, smoke generation, heat release and flaming droplets, all in one test. This is far more useful than the traditional IEC 60332-3 test which just measure only one variable, that is, charred length (a possible indicator for flame spread).

Based on CommScope legacy cable designs and CPR testing, the IEC 60332-3 test provided a good indicator that a product would meet at least a EuroClass Dca classification with the new EN 50399 CPR test.

For smoke production, the prior CPR requirement is the same as the CPR requirement of s1b.

For some installation environments such as underground train stations (for example, London Underground) where a lower smoke production requirement exist prior CPR, the CPR requirement will be s1a.

For acid gases production, the prior CPR requirement is the same as the CPR requirement of a2.

Another major difference is in the certification process and this is discussed in the next section

3.0 Cable CPR Certification

The whole process of certification and labelling is defined in EN 50575. This standard details the fire requirements for cables permanently installed in construction works, allowing a Declaration of Performance (DoP) to be made so that CE marking can be applied (either to the cables or their packaging).

EN 50575 provides three systems of attestation of conformity depending on the required Euroclasses and this is shown in Table 3.

Euroclass	Attestation of Conformity System	Comments
A_{ca}, $B1_{ca}$, $B2_{ca}$, C_{ca}	1+	(1) Testing to be carried out by approved Notified Bodies who will then issue the certificate of constancy of performance for the cable, surveillance assessment and continuous evaluation of factory production control (1) The manufacturer will then issue a DoP according to the Euroclass format, for eg: C_{ca} – s_1, d_1, a_1 and the necessary CE marking
D_{ca}, E_{ca}	3	(1) Testing to be carried out by approved Notified Bodies who will then issue a technical report (2) The manufacturer will then issue a DoP according to the Euroclass format, for eg: D_{ca} – s_1, d_1, a_1 and the necessary CE marking
F_{ca}	4	Self certification by manufacturer

Table 3: EN 50575 attestation of conformity systems

Figure 1 shows the procedures for CE marking of communications cables.

Hence, for EuroClass A_{ca}, $B1_{ca}$, $B2_{ca}$ and C_{ca} cables under System 1+ certification, continuous surveillance of FPC and annual audit testing are required. EuroClass D_{ca} and E_{ca} cables under System 3 certification do not require continuous surveillance and annual audit testing. Prior CPR requirement is similar to System 3 certification.

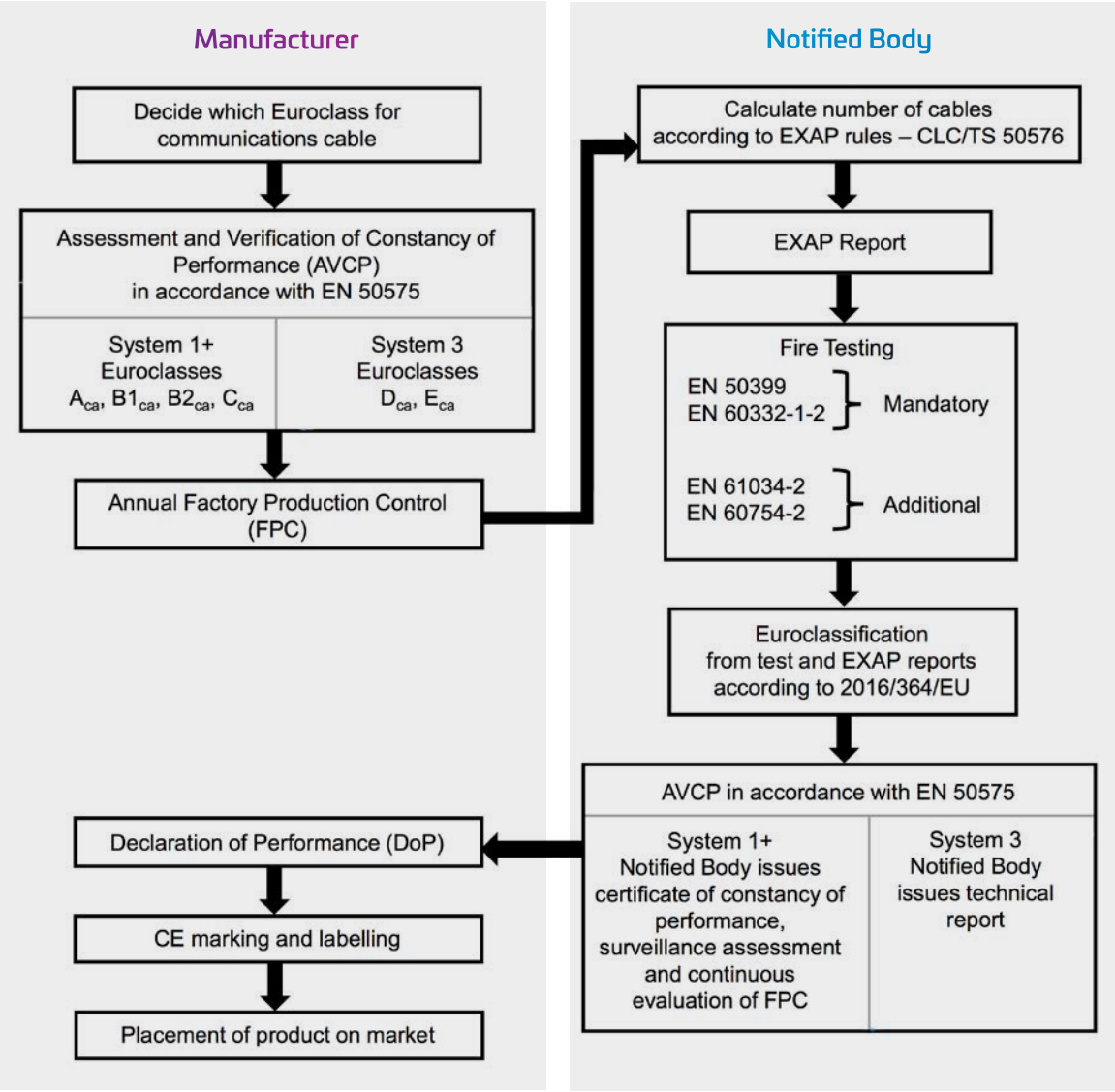

Figure 1: Procedures for CE marking of communications cables

4.0 Conclusion

In summary, the CPR fire performance requirements are more onerous that those before the CPR. In addition, System 1+ certification requires continuous surveillance of FPC and annual audit testing. Therefore, the CPR has impacted the testing and manufacturing cost of communication cables, especially for the higher Euroclasses.

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