

Core sheath DC integrity measurement at three core subsea cables in dry condition

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ABSTRACT

IEC60229 ([1]) provides guidance on DC integrity testing of insulating cable sheaths. It differentiates between the manufacturing process on the one hand and commissioning on the other hand. While 8 kV/mm (25 kV maximum) apply for manufacturing, 4 kV/mm (10 kV maximum) apply for the installed cable. In a real case, during a sheath test in the factory with 25 kV DC on the power cores within a long AC cable, arcing was observed between the semi conductive layer of the cable cores under test and an external structure. This paper summarizes the root cause analysis of the phenomenon, the physical background, as well as the consequences, the risks, and advisable precautions to be taken during testing.

KEYWORDS

DC voltage sheath integrity test, long cable in dry condition, IEC60229;

INTRODUCTION

DC voltage sheath testing is a commonly accepted method for verifying the integrity of single core power cables which exhibit an insulating outer sheath with a metallic component (e.g., foil) underneath. For application of the voltage across the sheath material, the insulating layer is purposely covered by a semi-conductive skin layer.

For medium and high voltage three phase AC subsea cables, three such single core cables, as well as suitable fillers, and in most cases also fibre optic elements are laid up together. A typical design is shown in figure 1 and described in table 1. In the context of this paper, items 8, 9, 11, and 12 are the most relevant.

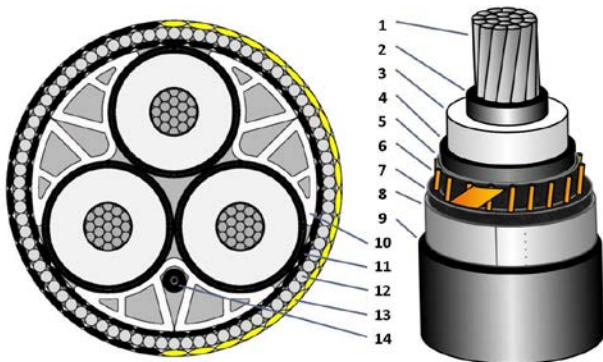


Fig. 1: Typical subsea cable design; left: three core cable, right: power core

No.	Description	Remarks
1	conductor	
2	conductor screen	
3	insulation	
4	insulation screen	
5	water blocking	
6	metal screen	
7	water blocking	
8	radial water barrier	metal foil
9	extruded core sheath	insulating PE with semiconductive skin layer
10	fillers	
11	armour bedding	PP yarns
12	armouring	galvanized steel wires
13	servicing	PP yarns
14	fibre optic cable	

Table 1: Typical subsea cable design, description

Usually, the outer sheath of such cables is tested according to the requirements listed in IEC60229, chapter 3. The test voltage for routine tests during the manufacturing process is 8 kV/mm, but 25 kV maximum. It should be noted here that all single core cables are usually already tested under this condition before being laid up, and that IEC60229 does not mention any specific testing conditions for laid up cores.

In this context, it is also worth noting that in chapter 3.9 of CIGRÉ TB 722 a length limit of 5 km for any sheath test is mentioned, but without further elucidation. Further, in chapter 3.9.1.1, DC sheath testing is only mentioned to be performed after core jacket extrusion.

PRACTICAL OBSERVATION

An intermediate DC sheath test was conducted at a semi-finished subsea cable, i.e., the cores laid up and covered by a PP yarn bedding layer, but not yet armoured. The cable length was approximately 10 km. While applying the DC test voltage between the radial water barrier (item 8) and the semiconductive skin layer on top of the insulating PE sheath (item 9), arcing was observed between the semi-finished cable and an edge of an external metallic structure, see figure 2.



Fig. 2: Arcing during DC sheath test

Investigations showed that the arcing occurred in the middle section of the cable under test.