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## Subsea equipment – Part 1: Power connectors, penetrators and jumper assemblies with rated voltage from 3 kV ($U_{max}$ = 3,6 kV) to 30 kV ($U_{max}$ = 36 kV)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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International Standard IEC/IEEE 61886-1 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units, in cooperation with the Subsea Electrical Applications Working Group of the IEEE Petrochemical and Chemical Industry Committee (PCIC), under the IEC/IEEE Dual Logo Agreement.

This publication is published as an IEC/IEEE dual logo standard.

The text of this standard is based on the following IEC documents:

| FDIS | Report on voting |
|---|---|
| 18/1710/FDIS | 18/1716/RVD |

Full information on the voting for the approval of this document can be found in the report on voting indicated in the above table.

International standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

A list of all parts in the IEC/IEEE 61886 series, published under the general title *Subsea equipment*, can be found on the IEC website.

The IEC Technical Committee and IEEE Technical Committee have decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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# INTRODUCTION

Within the oil and gas industry there is an increasing use of electrical power equipment on the seabed. Subsea processing activities like compression and pumping require increasingly higher amount of electrical power. Power generation, whether onshore or offshore, requires development of equipment both for subsea transmission and distribution.

Current standards for topside equipment do not include requirements related to equipment installed below the sea surface. Project and client specific specifications are used for both design and testing. The fact that equipment is qualified on a project basis, rather than to common standards, has several drawbacks:

- similar equipment is qualified to different type and routine test specifications;
- equipment has to be re-qualified for new projects that have slightly different requirements, for instance increased water depth;
- project specific ratings leading to higher number of equipment versions than strictly required.

All these issues lead to increased costs and schedule (for type testing), and also increased risk for failure (several type test programs are performed on a high number of various designs). By standardizing tests and implement continuous improvement on fewer products, this risk will be reduced in the long term.

The SEPS JIP (Subsea Electrical Power Standardization Joint Industry Project) was established in 2010 by seven oil and gas companies, with the aim to develop common operator standards for subsea electrical power equipment and systems and support further development of these into internationally recognized standards. This document is developed upon base material by SEPS. The aim for the SEPS JIP is to contribute to the development of IEC/IEEE dual logo standards; hence both IEC and relevant ANSI/IEEE standards are referenced where applicable. Relevant equipment manufacturers have contributed with review and comments to the document.

The lack of accessibility (for repair or replacement) defines strict requirements to reliability, beyond what is normally seen in topside applications.

As subsea equipment in many cases is interconnected to topside equipment, specifications for subsea equipment are considered to be within the scope of IEC TC 18 – Electrical installations of ships and of mobile and fixed offshore units.

# SUBSEA EQUIPMENT –

# Part 1: Power connectors, penetrators and jumper assemblies with rated voltage from 3 kV ($U_{max}$ = 3,6 kV) to 30 kV ($U_{max}$ = 36 kV)

## 1 Scope

This document is applicable to single and three-phase wet-mateable and dry-mateable AC connectors, penetrators and jumper assemblies with rated voltages from 3 kV ($U_{max}$ = 3,6 kV) to 30 kV ($U_{max}$ = 36 kV). This document relates to the requirements and tests for products in the "as manufactured and supplied" condition. This document is not applicable to requirements and tests for products that have been subsequently installed, deployed or retrieved.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60156, *Insulating liquids – Determination of the breakdown voltage at power frequency – Test method*

IEC 60243-1:2013, *Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60270, *High-voltage test techniques – Partial discharge measurements*

IEC 60721-3-2:2018, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Transportation and handling*

IEC 60885-3, *Electrical test methods for electric cables – Part 3: Test methods for partial discharge measurements on lengths of extruded power cables*

IEC 60986, *Short-circuit temperature limits of electric cables with rated voltages from 6 kV ($U_m$ = 7,2 kV) up to 30 kV ($U_m$ = 36 kV)*

IEC 61238-1-3:2018, *Compression and mechanical connectors for power cables – Part 1-3: Test methods and requirements for compression and mechanical connectors for power cables for rated voltages above 1 kV ($U_m$ = 1,2 kV) up to 30 kV ($U_m$ = 36 kV) tested on non-insulated conductors*

IEC 61442, *Test methods for accessories for power cables with rated voltages from 6 kV ($U_m$ = 7,2 kV) up to 30 kV ($U_m$ = 36 kV)*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

ISO 7326:2016, *Rubber and plastics hoses – Assessment of ozone resistance under static conditions*

ISO 12103-1, *Road vehicles – Test contaminants for filter evaluation – Part 1: Arizona test dust*

ISO 23936-2:2011, *Petroleum, petrochemical and natural gas industries – Non-metallic materials in contact with media related to oil and gas production – Part 2: Elastomers*

ISO 30013:2011, *Rubber and plastics hoses – Methods of exposure to laboratory light sources – Determination of changes in colour, appearance and other physical properties*

ANSI/ICEA T-27-581/NEMA WC 53, *Standard Test Methods for Extruded Dielectric Power, Control, Instrumentation, and Portable Cables for Test*

ANSI/API Spec 6A:2018, *Specification for Wellhead and Christmas Tree Equipment*

ANSI/NEMA WC 74 ICEA S-93-639, *5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy*

ANSI/NEMA WC 71 ICEA S-96-659, *Standard for Non-shielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy*

ASTM D877, *Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes*

ASTM D1141-98, *Standard Practice for the Preparation of Substitute Ocean Water*

ASTM D1169, *Standard test method for Specific Resistance (Resistivity) of Electrical Insulating Liquids*

ASTM D1816, *Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids using VDE Electrodes*

EN 10204, *Metallic products – Types of inspection documents*

IEEE Std 386, *Separable Insulated Connector Systems for Power Distribution Systems Rated 2,5kV through 35kV*

IEEE Std 4, *Standard for High Voltage Testing Techniques*

NORSOK M-710:2014, *Qualification of Non-Metallic Sealing Materials and Manufacturers*