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**Ships and marine technology —  
Computer applications — General  
principles for the development and use of  
programmable electronic systems in  
marine applications**

*Navires et technologies marines — Applications informatiques —  
Principes généraux pour le développement et l'utilisation des systèmes  
électroniques programmables pour applications marines*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17894 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 10, *Computer applications*.

## Introduction

Systems which include programmable electronic systems (PES) are not exact substitutes for the electromechanical systems and/or crew tasks which they replace. A new technology is involved, which can provide opportunities for integration of traditional system components (including crew tasks) and more complex behaviour. This allows increases in efficiency and safety through improved monitoring, better situational awareness on the bridge, etc. However, PES are complex products and, like all products, they can contain defects. These defects cannot be seen. Software does not respond to traditional engineering methods for the testing of soundness. The combination of complexity, replacement of a combination of mechanical and crew functions with computer hardware and software, and industry practice in developing and maintaining marine PES leads to a wide range of potential defects which cannot be guarded against by prescriptive standards.

The use of a PES in the management, monitoring or control of a ship may have several effects:

- potential to enhance the ability and efficiency of the crew;
- changes in the organization of work through the automation of lower-level tasks;
- integration of systems through use of several systems by one seafarer;
- shift in the role of the crew towards the management of many linked, complex PES;
- shift of the crew's perception of the ship to that presented by the interfaces of the PES;
- layers of embedded and/or application software interposed between the crew and the ship;
- physical interconnection of ship systems through the use of computer networks.

The overall effect of the use of PES is that the ship becomes one **total system** of inter-linked PES and crew which work together to fulfil the operator's business goals for the ship. In order for this total system to be dependable, both the design of the PES and the management of its use have to support the safe and effective performance of the crew as a critical component of the total system. Such a **human-centred** approach has to be based on a thorough knowledge of the particular skills, working environment and tasks of the crew using the PES. The total system concept is described further in A.2.

In the traditional approach to maritime safety, ship systems are built to and operated against precise, prescriptive standards. These standards were developed in response to feedback about incidents or risky behaviour of previous ship systems. This approach is appropriate for relatively simple systems in a time of slow technical innovation. However, suppliers and operators nowadays want to innovate with complex, new solutions. In addition, the base technologies for PES are evolving very quickly. The assurance of dependability in this case cannot rely on knowledge of previous systems. The solution is for the developer and operator to assess the risks from and to the particular ship, its systems, crew and its operating philosophy, and to address these specific risks in the design and operation of the PES. Components of the system can then either be re-designed or operated in such a way as to minimize these risks. The quality of construction, operation and maintenance of the system to be sure of the achievement of a required level of dependability of the PES is also defined.

This International Standard is based on best practice in PES development as stated in existing marine, electrical and electronic, IT, ergonomics and safety standards. It is not intended to replace any of these standards. It presents a synoptic view of the requirements of these standards as a framework of principles for the development of dependable PES.

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# Ships and marine technology — Computer applications — General principles for the development and use of programmable electronic systems in marine applications

## 1 Scope

This International Standard provides a set of mandatory principles, recommended criteria and associated guidance for the development and use of dependable marine programmable electronic systems for shipboard use. It applies to any shipboard equipment containing programmable elements which may affect the safe or efficient operation of the ship. It contains information for all parties involved in the specification, operation, maintenance and assessment of such systems. The principles and guidance in the document are largely based on requirements in national and International Standards. The source standards and their contribution to this International Standard are presented in the bibliography.

**NOTE** This International Standard does not directly address performance, test or test results requirements associated with specific types of equipment or functions. In such instances existing application or component standards may be applied, e.g. IEC 60945, in respect of navigation and radio-communications equipment. The responsible body (e.g. National Administration, Classification Society or other contracted party) will determine the applicability of this International Standard, and its specific requirements where any potential conflict arises.

## 2 Conformance

An organization demonstrating compliance to this International Standard shall provide evidence of how its system fulfils the principles stated in Clause 7. The evidence shall be to the satisfaction of an independent assessor. This can be achieved through compliance with the criteria given in Clause 7 or by an alternative means which is to the satisfaction of an independent assessor.

**NOTE** The criteria for assessment are given in an itemized list below each principle in Clause 7.

## 3 Normative references

The following referenced documents are indispensable for the application 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.

ISO 9000:2000, *Quality management systems — Fundamentals and vocabulary*

ISO 9241-2, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 2: Guidance on task requirements*

ISO 9241-10, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 10: Dialogue principles*

ISO 9241-11, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability*

ISO 10007, *Quality management systems — Guidelines for configuration management*

ISO 13407, *Human-centred design processes for interactive systems*

ISO/IEC 2382-1, *Information technology — Vocabulary — Part 1: Fundamental terms*

ISO/IEC 9126-1, *Software engineering — Product quality — Part 1: Quality model*

ISO/IEC 12207, *Information technology — Software life cycle processes*

ISO/IEC 12207:1995/Amd.1:2002, *Information technology — Software life cycle processes — Amendment 1*

ISO/IEC 12207:1995/Amd.2:2004, *Information technology — Software life cycle processes — Amendment 2*

IEC 61069-1, *Industrial-process measurement and control — Evaluation of system properties for the purpose of system assessment — Part 1: General considerations and methodology*

IEC 61508-4, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 4: Definitions and abbreviations*

IEEE 610.12, *Standard glossary of software engineering terminology*

BS 4778-3.1, *Quality vocabulary. Availability, reliability and maintainability terms. Guide to concepts and related definitions*

BS 4778-3.2, *Quality vocabulary. Availability, reliability and maintainability terms. Glossary of international terms*

## 4 Terms and definitions

For the purposes of this document, the following terms and definitions apply. The following referenced definitions are stated here since there is some inconsistency between the listed standards and also because the listed definitions are used frequently in this document. Annex A elaborates the concepts behind key terms used in this International Standard.

### 4.1

#### **context of use**

the users, goals, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used

[ISO 9241-11]

NOTE See A.2 for an elaboration of this term as used in this International Standard.

### 4.2

#### **dangerous failure**

failure which has the potential to put the safety-related system into a hazardous or fail-to-function state

[IEC 61508-4]

NOTE Whether or not the potential is realized may depend on the architecture of the system; in systems with multiple channels to improve safety, a dangerous failure is less likely to lead to the overall dangerous or fail-to-function state.

### 4.3

#### **dependability**

the extent to which a system can be relied upon to perform exclusively and correctly a task under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided

[IEC 61096-5]