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**Petroleum, petrochemical and natural gas  
industries — Collection and exchange of  
reliability and maintenance data for  
equipment**

*Industries du pétrole, de la pétrochimie et du gaz naturel — Recueil et  
échange de données de fiabilité et de maintenance des équipements*



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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 14224 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*.

This second edition cancels and replaces the first edition (ISO 14224:1999), which has been technically modified and extended. Annex B, which contains failure and maintenance notations, has been made normative. Further, additional informative Annexes A, C, D, E and F give recommendations on the use of reliability and maintenance data for various applications.

## Introduction

This International Standard has been prepared based on ISO 14224:1999, experience gained through its use, and know-how and best practices shared through the international development process.

In the petroleum, natural gas and petrochemical industries, great attention is being paid to safety, reliability and maintainability of equipment. The industry annual cost of equipment unreliability is very large, although many plant owners have improved the reliability of their operating facilities by such attention. A stronger emphasis has recently been put on cost-effective design and maintenance for new plants and existing installations among more industrial parties. In this respect, data on failures, failure mechanisms and maintenance related to these industrial facilities and its operations have become of increased importance. It is necessary that this information be used by, and communicated between, the various parties and its disciplines, within the same company or between companies. Various analysis methodologies are used to estimate the risk of hazards to people and environment, or to analyse plant or system performance. For such analyses to be effective and decisive, equipment reliability and maintenance (RM) data are vital.

These analyses require a clear understanding of the equipment technical characteristics, its operating and environmental conditions, its potential failures and its maintenance activities. It can be necessary to have data covering several years of operation before sufficient data have been accumulated to give confident analysis results and relevant decision support. It is necessary, therefore, to view data collection as a long-term activity, planned and executed with appropriate goals in mind. At the same time, clarity as to the causes of failures is key to prioritizing and implementing corrective actions that result in sustainable improvements in reliability, leading to improved profitability and safety.

Data collection is an investment. Data standardization, when combined with enhanced data-management systems that allow electronic collection and transfer of data, can result in improved quality of data for reliability and maintenance. A cost-effective way to optimize data requirements is through industry co-operation. To make it possible to collect, exchange and analyse data based on common viewpoints, a standard is required. Standardization of data-collection practices facilitates the exchange of information between relevant parties e.g. plants, owners, manufacturers and contractors throughout the world.

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# Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment

## 1 Scope

This International Standard provides a comprehensive basis for the collection of reliability and maintenance (RM) data in a standard format for equipment in all facilities and operations within the petroleum, natural gas and petrochemical industries during the operational life cycle of equipment. It describes data-collection principles and associated terms and definitions that constitute a “reliability language” that can be useful for communicating operational experience. The failure modes defined in the normative part of this International Standard can be used as a “reliability thesaurus” for various quantitative as well as qualitative applications. This International Standard also describes data quality control and assurance practices to provide guidance for the user.

Standardization of data-collection practices facilitates the exchange of information between parties, e.g. plants, owners, manufacturers and contractors. This International Standard establishes requirements that any in-house or commercially available RM data system is required to meet when designed for RM data exchange. Examples, guidelines and principles for the exchange and merging of such RM data are addressed.

Annex A contains a summary of equipment that this International Standard covers.

- This International Standard recommends a minimum amount of data that is required to be collected and it focuses on two main issues:
  - data requirements for the type of data to be collected for use in various analysis methodologies;
  - standardized data format to facilitate the exchange of reliability and maintenance data between plants, owners, manufacturers and contractors.
- The following main categories of data are to be collected:
  - equipment data, e.g. equipment taxonomy, equipment attributes;
  - failure data, e.g. failure cause, failure consequence;
  - maintenance data, e.g. maintenance action, resources used, maintenance consequence, down time.

NOTE Clause 9 gives further details on data content and data format.

- The main areas where such data are used are the following:
  - reliability, e.g. failure events and failure mechanisms;
  - availability/efficiency, e.g. equipment availability, system availability, plant production availability;
  - maintenance, e.g. corrective and preventive maintenance, maintenance supportability;
  - safety and environment, e.g. equipment failures with adverse consequences for safety and/or environment.

- This International Standard does not apply to the following:
  - data on (direct) cost issues;
  - data from laboratory testing and manufacturing (e.g. accelerated lifetime testing);
  - complete equipment data sheets (only data seen relevant for assessing the reliability performance are included);
  - additional on-service data that an operator, on an individual basis, can consider useful for operation and maintenance;
  - methods for analysing and applying RM data (however, principles for how to calculate some basic reliability and maintenance parameters are included in the annexes).

## 2 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.

IEC 60034-1:2004, *Rotating electrical machines — Part 1: Rating and performance*

IEC 60076-1:2000, *Power transformers — Part 1: General*

IEC 60076-2:1993, *Power transformers — Part 2: Temperature rise*

IEC 60076-3, *Power transformers — Part 3: Insulation levels, dielectric tests and external clearances in air*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP Code)*

IEC 62114, *Electrical insulation systems — Thermal classification*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**NOTE** Some derived RM parameters, which can be calculated from collected RM data covered by this International Standard, are contained in Annex C. References to Annex C are given as deemed appropriate.

### 3.1 availability

ability of an item to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided

**NOTE** For a more detailed description and interpretation of availability, see Annex C.

### 3.2 active maintenance time

that part of the maintenance time during which a maintenance action is performed on an item, either automatically or manually, excluding logistic delays

**NOTE 1** A maintenance action can be carried out while the item is performing a required function.

**NOTE 2** For a more detailed description and interpretation of maintenance times, see Figure 4 and Annex C.