

INTERNATIONAL
STANDARD

ISO
14224

Third edition
2016-09-15

**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 — Collecte
et échange de données de fiabilité et de maintenance des équipements*



Reference number
ISO 14224:2016(E)

© ISO 2016



COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

	Page
Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	2
3 Terms and definitions	2
4 Abbreviated terms	18
5 Application	20
5.1 Equipment coverage.....	20
5.2 Time periods.....	20
5.3 Users of this International Standard.....	20
5.4 Limitations.....	21
5.5 Exchange of RM data.....	22
6 Benefits of RM data collection and exchange	23
7 Quality of data	25
7.1 Obtaining quality data.....	25
7.1.1 Definition of data quality.....	25
7.1.2 Planning measures.....	25
7.1.3 Verification of quality.....	26
7.1.4 Limitations and problems.....	27
7.2 Data collection process.....	27
7.2.1 Data sources.....	27
7.2.2 Data collection methods.....	28
7.2.3 Organization and training.....	28
8 Equipment boundary, taxonomy and time definitions	29
8.1 Boundary description.....	29
8.2 Taxonomy.....	30
8.3 Timeline issues.....	32
8.3.1 Surveillance and operating period.....	32
8.3.2 Data collection periods.....	33
8.3.3 Maintenance times.....	34
9 Recommended data for equipment, failures and maintenance	35
9.1 Data categories.....	35
9.2 Data format.....	35
9.3 Database structure.....	36
9.3.1 Description.....	36
9.3.2 Logical structure.....	36
9.3.3 Database architecture.....	37
9.4 Equipment data.....	38
9.5 Failure data.....	40
9.6 Maintenance data.....	42
9.6.1 General.....	42
9.6.2 Maintenance categories.....	42
9.6.3 Reporting maintenance data.....	43
Annex A (informative) Equipment-class attributes	46
Annex B (normative) Interpretation and notation of failure and maintenance parameters	176
Annex C (informative) Guide to interpretation and calculation of derived reliability and maintenance parameters	205
Annex D (informative) Typical requirements for data	229

Annex E (informative) Key performance indicators (KPIs) and benchmarking	238
Annex F (informative) Classification and definition of safety critical failures	251
Bibliography	260

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*.

This third edition cancels and replaces the second edition (ISO 14224:2006), which has been technically revised. The main changes are:

- Clause 3 — several new definitions;
- Clauses 8 and 9 — changes in some figures and tables;
- Annex A — new equipment classes;
- Annex B — associated new and aligned failure modes;
- Annex C — some changes and new subclauses, e.g. C.3.4 and C.7;
- Annex D — new subclause D.5;
- Annex E — new KPIs;
- Annex F — alignment with ISO/TR 12489:2013.

Introduction

This International Standard has been prepared based on the previous edition (ISO 14224:2006), experience gained through its use, and know-how and best practices shared through the international development process.

In the petroleum, petrochemical and natural gas industries, great attention is being paid to safety, availability, reliability and maintainability of equipment. The industry annual cost of equipment unavailability is very large, although many plant owners have improved the availability of their operating facilities by addressing this challenge. 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 more important. It is necessary that this information is 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's 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 availability, 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 of optimizing 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.

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. This International Standard also provides a framework and guidelines for establishing performance objectives and requirements for equipment reliability and availability performance.

[Annex A](#) contains a summary of equipment that is covered by this International Standard.

This International Standard defines a minimum amount of data that is required to be collected, and it focuses on two main issues:

- data requirements for the categories 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:

- a) equipment data, e.g. equipment taxonomy, equipment attributes;
- b) failure data, e.g. failure cause, failure consequence;
- c) 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:

- 1) reliability, e.g. failure events and failure mechanisms;
- 2) availability/efficiency, e.g. equipment availability, system availability, plant production availability;
- 3) maintenance, e.g. corrective and preventive maintenance, maintenance plan, maintenance supportability;
- 4) safety and environment, e.g. equipment failures with adverse consequences for safety and/or environment.

This International Standard does not apply to the following:

- i. data on (direct) cost issues;