



**International  
Standard**

**ISO 27996**

**Aerospace fluid systems —  
Elastomer seals — Storage and shelf  
life**

*Systèmes de fluides pour l'aéronautique et l'espace — Joints  
élastomères — Stockage et durée de conservation*

**Second edition  
2024-02**



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Published in Switzerland

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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.

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 document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

This second edition cancels and replaces the first edition (ISO 27996:2009), which has been technically revised.

The main changes are as follows:

- change of the term [3.1](#) “date of vulcanization” to “cure date”;
- extension of shelf life for EPDM ([Table 2](#)) based upon practical experience.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

In fluid power systems, power is transmitted and controlled through a fluid (liquid or gas) under pressure within an enclosed circuit. Testing of components to meet performance requirement provides users a basis of assurance for determining design application and for checking component compliance with their stated requirements.

The requirement for packaging is an integral part of the controlled storage procedure and provides a means of positive product identity from the time of manufacture to the time of assembly into a component.

This information is intended to be utilized by those organizations who do not have specific requirements or recommendations already in place for the control of elastomeric seals and seal assemblies. This standard can be specified in control, storage, and procurement documents. However, when the requirements of this document are in conflict with the customer's requirements or specifications, the requirements of the customer's detailed specification govern.



# Aerospace fluid systems — Elastomer seals — Storage and shelf life

## 1 Scope

This document specifies the general requirements for data recording procedures, packaging, and storing of elastomeric seals and seal assemblies which include an elastomeric element prior to the seal being assembled into hardware components.

This document does not establish limitations or storage times for assembled components, or the operating life of the said components.

## 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.

ISO 1629, *Rubber and latices — Nomenclature*

ISO 5598, *Fluid power systems and components — Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1 cure date

the date on which the *elastomer* (3.2) product was vulcanized, expressed in quarters (Q) of a year

EXAMPLE 4Q04 (October to December, 2004).

### 3.2 elastomer

material that possesses elastic properties and has undergone vulcanization and/or conversion into a finished product

Note 1 to entry: The basic building block of the elastomer is the *rubber* (3.6) polymer it contains.

### 3.3 extended storage life

period for which an *elastomer* (3.2) *seal* (3.7) element moulded from class III material and properly packaged may be stored after the initial storage period and the successful reinspection and testing of representative samples

### 3.4 hardware component

unit in which the elastomeric *seal* (3.7) element is installed

### 3.5

#### **limited storage life**

period during which an elastomeric *seal* (3.7) element which has not been properly packaged by the manufacturer in an expedient manner after vulcanization may be installed without first testing for product integrity

### 3.6

#### **rubber**

polymeric building block of an *elastomer's* (3.2) chemical composition

Note 1 to entry: Rubbers are further defined in ISO 1629.

### 3.7

#### **seal**

elastomeric element which prevents the excursion of media on one side of the product from migrating to the other side

### 3.8

#### **storage life**

period, in quarters of a year, from the date of cure until installation into a *hardware component* (3.4)

Note 1 to entry: The storage life is counted from the quarter following the date of cure (vulcanization).

### 3.9

#### **storage life limit**

maximum period, starting from the quarter following vulcanization, that an elastomeric *seal* (3.7) element, appropriately packaged, may be stored under specific conditions, after which time it is regarded as unserviceable for the purposes for which it was originally manufactured

## 4 General

The life of elastomeric seal elements is reduced by the influence of environmental factors, e.g. ozone, heat, light. To extend life to the full storage life limit, the seal elements shall be properly packaged and certified as so by the manufacture as quickly as possible following vulcanization. If the seal elements are not properly packaged and certified as so by the manufacturer, then the limited storage life requirement is followed and package labels so shall indicate.

Components shall be designed to meet these requirements under varying conditions.

## 5 Packaging

### 5.1 General

Unless otherwise specified by the customer at the time of order, the elastomeric seal or seal assembly shall be packaged:

- a) in individually sealed envelopes by the manufacturer, or
- b) in individually sealed packets in multiple envelopes by the manufacturer provided that individually packaged elastomeric seals or assemblies can be removed without affecting the seal integrity of the other packets.

The packaging shall be carried out in an atmosphere in which the relative humidity is not greater than 65 %. Contamination by oil, grease, etc. shall be avoided.

Seal assemblies (all components) shall be packaged in the same sealed envelope so that all elements of the assembly are present when the package is opened.



## 5.2 Packaging materials

All packaging materials shall be free of copper naphthenates or creosote preservatives which can degrade rubber.

Suitable materials include kraft bags and polyethylene bags more than 0,075 mm thick and certified to be UV resistant. Opaque packaging is preferred but certified UV resistant materials can be used if available. Metal foil bags can be used provided they are salt free.

## 5.3 Labelling

Each package or container shall be labelled with the following information which shall be visible from the outside of the package without breaking the seal:

- a) manufacturers' part number;
- b) specification number and revision level;
- c) customer's part number and/or contract number (if requested);
- d) quantity in package;
- e) manufacturer's name and/or identity number (such as CAGE code, supplier number);
- f) cure date or date of manufacture of the rubber component (e.g. July to September 2004 3Q04);
- g) manufacturer's batch number;
- h) rubber class designation per ISO 1629;
- i) identity of packager and package date, if different than manufacturer.

Expiration date is not required to be on the label and is added only when purchaser specifically requests the addition.

## 6 Storage

### 6.1 Temperature

The storage temperature should not exceed 30 °C, except when higher temperatures are caused by temporary climate changes, and articles shall be stored away from direct sources of heat such as boilers, radiators, and direct sunlight.

If the storage temperature is below 10 °C, care should be exercised during the handling of stored articles as they can have stiffened and become susceptible to distortion if not handled carefully.

The temperature of articles stored below 10 °C shall be raised to approximately 20 °C throughout their mass before being installed into a component.

### 6.2 Humidity

The relative humidity shall be such that given the variations of temperature in storage, condensation does not occur. In any event, if the elastomers are not stored in sealed moisture proof bags, the relative humidity of the atmosphere in storage shall be less than 70 % or if polyurethanes are being stored, shall be less than 65 %

### 6.3 Light

Elastomeric seals shall be protected from light sources, in particular direct sunlight or intense artificial light having an ultraviolet content. The individual storage bags offer the best protection as long as they are UV resistant.

Windows of storage rooms where elastomers are stored in bulk should be covered with a red or orange coating or screen.

### 6.4 Radiation

Precautions shall be taken to protect stored articles from all sources of ionizing radiation likely to cause damage to stored articles.

### 6.5 Ozone

As ozone is particularly deleterious to some elastomeric seals, storage rooms shall not contain any equipment that is capable of generating ozone such as mercury vapour lamps, high voltage electrical equipment giving rise to electric sparks or silent electrical discharges. Combustion gases and organic vapour shall be excluded from storage rooms as they can give rise to ozone via photochemical processes.

### 6.6 Deformation

Elastomeric seals shall be stored free from superimposed tensions and compressive stresses or other causes of deformation. Where articles are packaged in a strain-free condition, they shall be stored in their original packaging. In case of doubt, the manufacturer's advice shall be sought.

Rings of large inside diameter shall be formed into three equal superimposed loops so as to avoid creasing or twisting.

NOTE It is not possible to achieve this condition by forming just two loops.

### 6.7 Contact with liquid and semi-solid materials

Elastomeric seals shall not be allowed to come into contact with liquid or semi-solid materials (e.g. gasoline, greases, acids, disinfectants, cleaning fluids) or their vapours at any time during storage unless these materials are by design an integral part of the component or the manufacturer's packaging. When elastomeric seals are received coated with their operational media, they shall be stored in this condition.

### 6.8 Contact with metals

Certain metals and their alloys (in particular, copper, manganese, and iron) are known to have deleterious effects on elastomers. Elastomeric seals shall not be stored in contact with such metals (except when bonded to them) but shall be protected by individual packaging.

### 6.9 Contact with dusting powder

Dusting powders shall only be used for the packaging of elastomeric items in order to prevent sticking. In such instances, the minimum quantity of powder to prevent adhesion shall be used.

### 6.10 Contact between different elastomers

Contact between different polymeric elastomers and elastomers of different seals shall be avoided. They shall not be packaged together in the same envelope.

### 6.11 Elastomeric seals with metal parts bonded to them

The metal part of bonded elastomeric seals shall not come in contact with the elastomeric element of another seal. The bonded seal shall be individually packaged. Any preservative used on the metal shall be such that it does not affect the elastomeric element or the bond to such an extent that the seal does not comply with the product specification.

### 6.12 Stock rotation

Elastomeric seal stock should be rotated on the FIFO (first in first out) principle so that the most recent manufactured parts remain in inventory.

## 7 Recording of data during storage

A record shall be kept of the initial physical properties and the dimensional characteristics of the elastomeric seal elements placed in storage. The records shall include the actual numerical results of the physical property tests for that batch of seals and the range of properties observed during testing. This record shall be maintained by the user's quality organization until such time that the stock of seals has been depleted.

In situations where limited service life seals are used, the testing results prior to installation shall also be maintained by the user's quality organization until such time that the stock of seals has been depleted.

In addition to the inspection and testing reports, a record shall be maintained of the label information so that all information can be cross referenced.

## 8 Discarding of seals

### 8.1 After limited storage life has been exceeded and negative test results

Once the limited storage life requirement has been exceeded for those elastomeric seals not packaged by the manufacturer, the physical properties of the seals shall be verified and if found to be within  $\pm 15\%$  of the original properties of the seals, the seals can be installed in the hardware component. If any of the physical properties of the seals are outside of the  $\pm 15\%$  window, then the seals should be removed from inventory and destroyed per internal company procedures for the destruction of such materials.

### 8.2 After storage life limit has been exceeded

Once the storage life limit has expired, the elastomeric seals should be removed from inventory and destroyed per internal company procedures for the destruction of such materials.

## 9 Storage period

### 9.1 Duration of storage

Unless otherwise specified in the product specification or purchase order notes, the maximum storage periods for unassembled elastomeric seal elements shall be those described in [Tables 1](#) and [2](#). This presupposes that the stored elastomers meet the current specification revisions. If they do not, there shall be a "use to depletion" comment on the current specification revision or they shall be discarded since only those elastomeric seals that meet the current specification revision shall be used in applications to provide the highest integrity seal for the current system requirements.

**Table 1 — Limited storage life requirements**

| Material class | Material   | Material symbol according to ISO 1629    | Limited storage life in quarters of years |
|----------------|--|--|---|
| I              | Styrene-butadiene rubber<br>Polyester urethane, polyether urethane   | SBR<br>AU, EU                            | 12  |
| II             | Acrylonitrile-butadiene rubber<br>Hydrogenated NBR<br>Butyl-, chlorobutyl-, bromobutyl rubber<br>Chloro-butadiene rubber | NBR<br>HNBR<br>IIR, CIIR, BIIR<br>CR     | 28  |
| III            | Ethylene-propylene rubber  | EPM, EPDM                                | 40  |
| IV             | Fluorosilicone rubber<br>Fluoro rubber<br>Perfluoro rubber<br>Silicone rubber<br>Tetrafluoroethylene — propylene         | FVMQ<br>FKM<br>FFKM<br>VMQ, PVMQ<br>FEPM | 40  |

**Table 2 — Storage life limits for properly packaged and stored elastomeric seals**

| Material class | Material   | Material symbol according to ISO 1629    | Storage life limits in quarters of years |
|----------------|--|--|--|
| I              | Styrene-butadiene rubber<br>Polyester urethane, polyether urethane   | SBR<br>AU, EU                            | 20                                       |
| II             | Acrylonitrile-butadiene rubber<br>Hydrogenated NBR<br>Butyl-, chlorobutyl-, bromobutyl rubber<br>Chloro-butadiene rubber | NBR<br>HNBR<br>IIR, CIIR, BIIR<br>CR     | 60                                       |
| III            | Ethylene-propylene rubber  | EPM, EPDM                                | 100 <sup>a</sup>                         |
| IV             | Fluorosilicone rubber<br>Fluoro rubber<br>Perfluoro rubber<br>Silicone rubber<br>Tetrafluoroethylene — propylene         | FVMQ<br>FKM<br>FFKM<br>VMQ, PVMQ<br>FEPM | Unlimited                                |

<sup>a</sup> The storage life of class III material can be extended for an additional 20 quarters if [9.2](#) is followed.

## 9.2 Extension of storage life for class III materials

### 9.2.1 General

Where it is necessary to consider extending the storage life of class III materials, the following procedure should be followed.

At or before the expiration of the storage life listed in [Table 2](#), six to nine representative samples of the seals shall be removed from their packages and subjected to visual inspection and testing. If the samples all pass the visual inspection and testing, the storage life of the remaining seals may be extended an additional 20 quarters provided they remain in their original packaging.

### 9.2.2 Visual inspection

Each of the samples shall be visually inspected for the following:

- permanent distortions, such as creases or flats;
- mechanical damage, such as cuts, tears, abraded areas or surface cracking;
- changes in surface condition, such as hardening, softening or tackiness.

### 9.2.3 Testing

If the samples are found to be visually acceptable, they should then be tested to ascertain that their relevant performance characteristics are within the acceptable performance characteristics for the appropriate specification that they have been certified to.

Testing to demonstrate that the product is serviceable should be carried out in accordance with the appropriate batch test requirements for the certified specification.

### 9.2.4 Extended storage life

If the samples pass the testing requirement, the test results shall be recorded; and the shelf life extended for the remaining seals that have the same cure and batch. There shall be only one extended storage life period.

## 10 Identification statement

Use the following statement in test reports, catalogues and sales literature when electing to comply with this document:

"Storage and shelf life requirements are in accordance with ISO 27996, *Aerospace fluid systems — Elastomer seals — Storage and shelf life*."

## Bibliography

- [1] ISO 2230:2002, *Rubber products — Guidelines for storage*
- [2] ISO 16031-1, *Aerospace fluid systems — O-rings, inch series: Inside diameters and cross sections, tolerances and size-identification codes — Part 1: Close tolerances for hydraulic systems*
- [3] ISO 16031-2, *Aerospace fluid systems — O-rings, inch series: Inside diameters and cross-sections, tolerances and size-identification codes — Part 2: Standard tolerances for non-hydraulic systems*
- [4] AMS 2817, *Identification and packaging, preformed packings*
- [5] AS5316: 2017, *Storage of elastomer seals and seal assemblies which include an elastomer element prior to hardware assembly*
- [6] MIL-PRF-121-G: 2019, *Barrier Materials, Greaseproof, Waterproof, Flexible, Heat-Sealable*
- [7] MIL-PRF-131K: 2019, *Barrier Materials, Watervaporproof, Greaseproof, Flexible, Heat-Sealable*





**ICS 49.080; 83.140.50**

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