

11. Storage and Age Control of Elastomers

Storage Life

According SAE-ARP5316 issue 1998-11, storage life is the maximum period of time, starting from the time of manufacture, that an elastomeric seal element, appropriately packaged, may be stored under specific conditions, after which time it is regarded as unserviceable for the purpose for which it was originally manufactured. The time of manufacture is the cure date for thermoset elastomers or the time of conversion into a finished product for the thermoplastic elastomers.

Shelf life of elastomers when stored properly is especially determined by the specific compound.

Table 3A-3 is taken from MIL-HDBK-695C and distinguishes 3 basic groups of elastomers. The values in this chart are minimal values.

In practice, longer storage periods may be used especially when 10 or 20 year categories are involved provided the parts are properly stored and periodic checks are performed.

Generally, polyethylene bags stored in cardboard containers or polyethylene lined craft paper bags insure optimal storage life.

Due to major improvements in compounding technique, storage life of relatively age-sensitive elastomers in normal warehousing conditions is considerable. MIL-HDBK-695C provides guidelines for recommended shelf life for different O-ring compounds.

Table 3A-3 MIL-HDBK-695C

Type of rubber	Common or Trade Name	ASTM D1418 Abbreviation	ASTM D2000 Abbreviation	MIL-STD-417 Designation
20 YEARS OR HIGHER:				
Silicone	Silicone	Q	FE	TA
Fluorosilicone	Silastic LS	FVMQ	FK	TA
Polysulfide	Thiokol	T	BK	SA
Fluorocarbons	Fluorel, Viton®	FKM	HK	-
Polyacrylate	Acrylic	ACM, ANM	DF, DH	TB
UP TO 10 YEARS:				
Chlorosulfonated Polyethylene	Hypalon	CSM	CE	-
Isobutylene/Isoprene	Butyl	IIR	AA, BA	RS
Polychloroprene	Neoprene	CR	BC, BE	SC
Polyether Urethane	Urethane	EU	BG	-
Polypropylene oxide	Propylene oxide	GPO	-	-
Ethylene/propylene	Ethylene propylene	EPDM	BA, CA	-
Ethylene/propylenediene	Ethylene propyleneterpolymercopolymer	EPM	BA, CA	-
Epichlorohydrin	Hydrin 100	CO	-	-
UP TO 5 YEARS:				
Butadiene/acrylonitrile	Nitrile, NBR	NBR	BF, BG, BK, CH	SB
Butadiene/styrene	SBR	SBR	AA, BA	RS
Cis-polybutadiene	Butadiene	BR	AA	RN
Cis 1, 4, polyisoprene	Natural, pale crepe	NR	AA	RN
Cis 1, 4, polyisoprene	Synthetic natural	IR	AA	RN
Polyester Urethane	Urethane	AU	-	-

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Experience has demonstrated that storage conditions are much more important in determining the useful life of O-rings than is time. SAE-ARP5316 addresses the general requirements for data recording procedures, packaging, and storing of aerospace elastomeric seals:

1. Temperature

The storage temperature shall be below 100°F (38°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.

2. Humidity

The relative humidity shall be such that given the variations of temperature in storage, condensation does not occur. If the elastomers are not stored in sealed moisture proof bags, the relative humidity of the atmosphere in storage shall be less than 75% relative humidity, or if polyurethanes are being stored, shall be less than 65% relative humidity.

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.

Note: It is advisable that windows of storage rooms where elastomers are stored in bulk be covered with a red or orange coating.

4. Radiation

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

5. Ozone

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

6. Deformation

Elastomeric seals shall be stored free from superimposed tensile 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. O-rings of large inside diameter shall be formed into at least three superimposed loops so as to avoid creasing or twisting.

Note: It is not possible to achieve this condition by forming just two loops, three are required.

7. Contact with Liquid and Semi-Solid Materials

Elastomeric seals shall not be allowed to come in contact with liquid or semi-solid materials (for example, gasoline, greases, acids, disinfectants, and cleaning fluids) or their vapors 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.

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.

9. Contact with Dusting Powder

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

10. Contact between Different Elastomers

Contact between different elastomers and elastomers of different seals shall be avoided.

11. Elastomeric Seals bonded to Metal Parts

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 will not affect the elastomeric element or the bond to such an extent that the seal will not comply with the product specification.

12. Stock Rotation

Elastomeric seal stock should be rotated on the FIFO (First In, First Out) principle.

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Further proposals for storage conditions and maximum life of elastomer parts can be found in the ISO 2230: Rubber products – Guidelines for storage. This guideline differs slightly from the one stated 2 pages before in the SAE-ARP5361 and MIL-HDBK-695C.

An appropriate packaging material should be free from substances having a degrading effect on the rubber. Heat-sealable opaque materials should be used unless it is not practicable or can distort the packaged product. Suitable materials are polyethylene (PE)-coated kraft paper, aluminium foil/paper/PE laminate and opaque PE film. PVC film or any other film containing plasticizer is not recommended for direct contact with rubber. PE is suitable as a single wrapping and should be at least 0,075 mm thick. Where there is a serious risk of ingress of moisture, aluminium foil/paper/PE laminate or other similar means of protection should be used to ensure protection.

The storage of rubber parts, such as o-rings, should be indoors under specific conditions. The major differences from the SAE-ARP5361 guidelines are:

- temperature below 25°C, away from direct sources of heat
- be patient at temperatures below 15°C due to risk of distortion due to handling of possible stiffened products – before products are placed in service, they should have been heated to 30°C
- relative humidity in storage should be less than 70%, for polyurethanes less than 65%

The ISO 2230 standard splits the maximum storage time into an initial storage period and an extended storage period which may be applied after representative samples of the stored products were inspected. Inspection should be in accordance with the relevant production specification. A visual inspection should not show permanent distortions (like creases or flats), mechanical damage (cuts, tears, abraded areas), surface cracking when viewed under a magnification of 10X or changes in surface condition such as hardening, softening or tackiness. Testing can show if the relevant performance characteristics are within the acceptable limits.

If the storage temperature is over or under 25°C the storage life will be influenced. Storage at a 10°C higher temperature will reduce the storage time by about 50% and storage at a 10°C lower temperature will increase storage time by about 100%!

In general ERIKS recommends the following storage parameters:

- Ambient temperature (preferably not higher than 25°C (77°F))
- Dry environment and exclusion of contamination
- Protect against direct sunlight
- Protect against radiation
- Protect against artificial light or other light sources containing UV-radiation
- Protect from ozone generating electrical devices
- Store parts without tension (never hang O-rings)

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Initial and extension storage periods for unassembled components following ISO 2230

Abbreviation	Chemical name from ISO 1629	Common name
GROUP A – INITIAL STORAGE PERIOD 5 YEARS, EXTENSION STORAGE PERIOD 2 YEARS		
BR	Butadiene rubber	Polybutadiene
NR	Isoprene rubber, natural	Natural rubber
IR	Isoprene rubber, synthetic	Polyisoprene
SBR	Styrene-butadiene rubber	SBR
AU	Polyester urethane rubber	Polyurethane
EU	Polyether urethane rubber	Polyurethane
GROUP B - INITIAL STORAGE PERIOD 7 YEARS, EXTENSION STORAGE PERIOD 3 YEARS		
NBR	Acrylonitrile-butadiene rubber	Nitrile
XNBR	Carboxylic- acrylonitrile-butadiene rubber	Carboxylated rubber
HNBR	Hydrogenated NBR (with some unsaturation)	Hydrogenated nitrile
CO, ECO	Polychloromethyloxiran and copolymer	Epichlorohydrin
ACM	Copolymer of ethylacrylate (or other acrylates) and a small amount of a monomer which facilitates vulcanization	Acrylic
CR	Chloroprene rubber	Neoprene
IIR	Isobutene-isoprene-rubber	Butyl
BIIR	Bromo-isobutene-isoprene-rubber	Bromobutyl
CIIR	Chloro-isobutene-isoprene-rubber	Chlorobutyl
GROUP C - INITIAL STORAGE PERIOD 10 YEARS, EXTENSION STORAGE PERIOD 5 YEARS		
CSM	Chlorosulfonylpolyethylene	Chlorosulfonated polyethylene
EPDM	Terpolymer of ethylene, propylene and a diene with the residual unsaturated portion of the diene in the side chain	EPDM
FKM	Rubber having fluoro, perfluoroalkyl or perfluoroalkoxy substituent groups on the polymer chain	Fluorocarbon
VMQ	Silicone rubber having both methyl and vinyl substituent groups on the polymer chain	Silicone