Technical Information

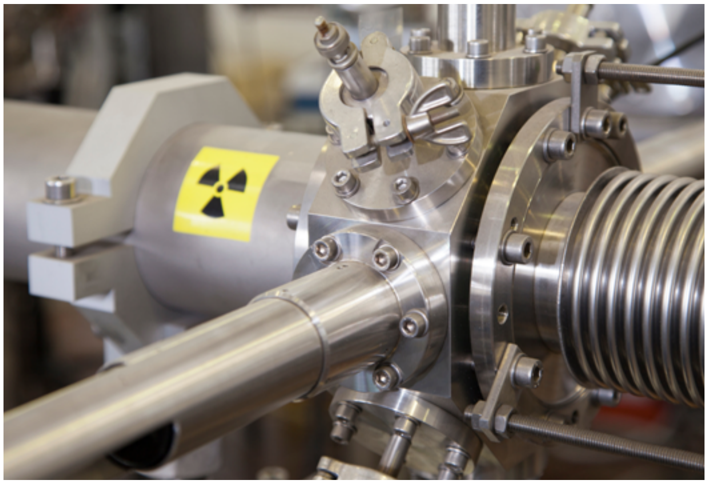
DuPont™ Kalrez® Perfluoroelastomer Parts

Radiation Resistance

Radiation Resistance of DuPont™ Kalrez® perfluoroelastomer parts

The following guidelines and definitions are useful in understanding radiation resistance:

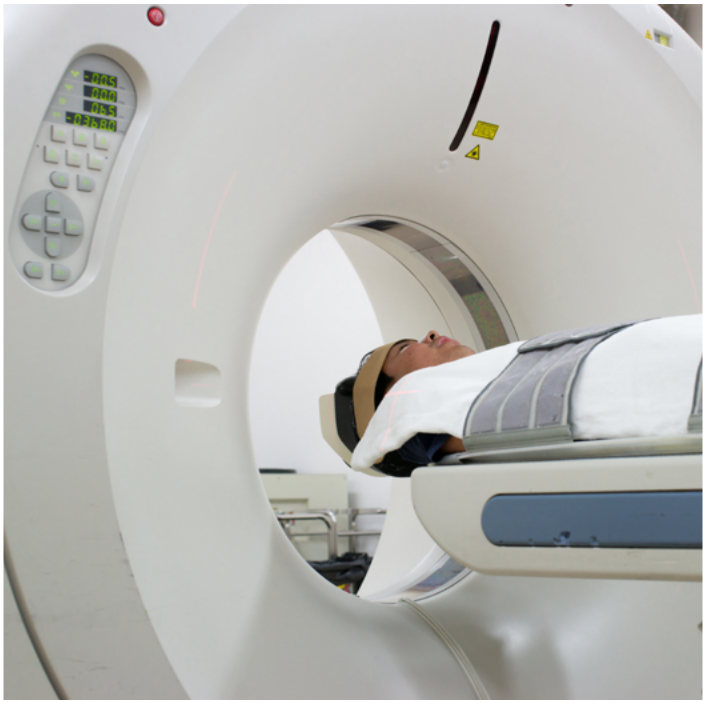
- Radiation can be defined as the transmission of high energy waves or particles through space or through a material medium. Energy absorption by the material may produce a variety of effects such as cross-linking and degradation. Excessive energy absorption usually results in adverse properties, i.e., failure of the substance by embrittlement due to over cross-linking or reversion (degradation) caused by chain cleavage
- Gamma radiation may be considered typical of the type to which elastomers would be subjected and is used in most of the laboratory radiation studies
- Radiation dose is expressed as rads. One rad is the dose that produces an energy absorption of 100 erg/g in 1 cm^3 of air at standard temperature and pressure. 10^6 rad = 1 Mrad
- In general, radiation doses are additive. A material can be assumed to have a "perfect memory" with regard to radiation exposures. Thus, ten exposures of 10^4 rad are equivalent to one exposure of 10^5 rad
- Concerning elastomer serviceability, a Gamma radiation dose less than 5 x 10^6 rad is considered low. Up to 10^8 is considered intermediate and 10^8 to 10^9 is high



Kalrez® parts used in an ION accelerator

DuPont™ Kalrez® parts can withstand 1 Mrad (10^6 rad) with little effect on physical properties. Exposure to 10 Mrad (10^7 rad) produces moderate effect with 40% loss of tensile strength and 25% loss of elongation at break. At 100 Mrad (10^8 rad), there is a severe effect with 80% loss of tensile strength and 80% loss of elongation. The accompanying graphs detail Kalrez® performance up to 100 Mrad.

Other factors need to be evaluated in addition to radiation exposure. The effects of fluids and the operating temperature to which the elastomers are exposed should be determined. Kalrez® parts have excellent high temperature and fluid resistance and should be evaluated for the environment as well as radiation resistance.

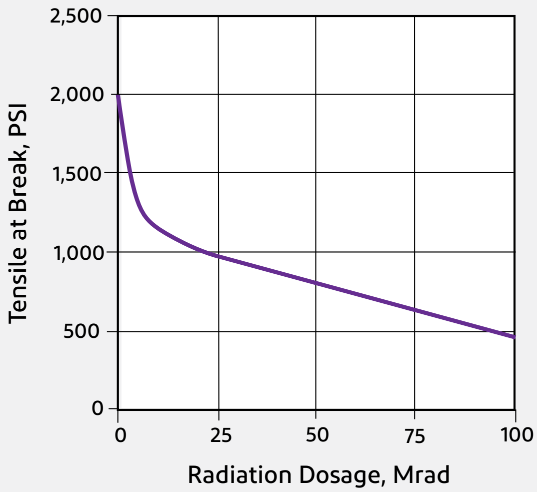


MRI Scanners require radiation-resistant seals

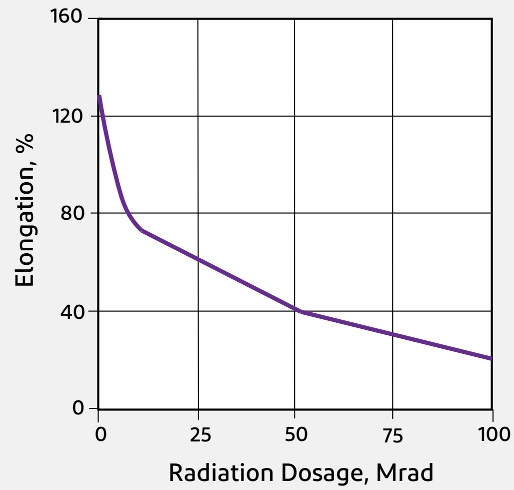
Radiation Results

Electron Radiation Source, G.E. Resonate Beam, Transformer 2 x 10^6V, mA

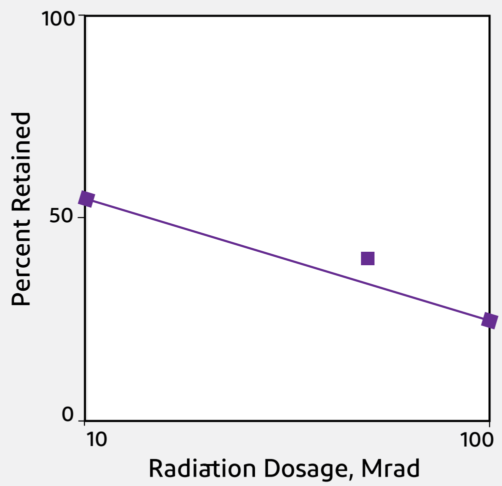
Tensile at Break vs. Radiation Dosage



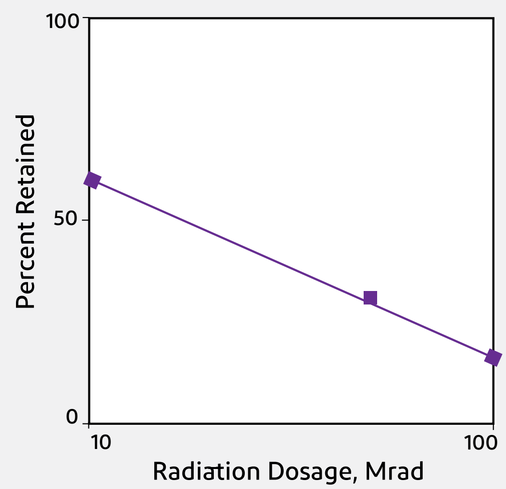
Elongation at Break vs. Radiation Dosage



Retention of Tensile at Break Properties After Exposure to Gamma Radiation



Retention of Elongation After Exposure to Gamma Radiation



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