Gamma Compatible Materials

Reference Guide

MDS Nordion

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Radiation Stability of Selected Medical Grade Polymers

Material	Tolerance Level (kGy)	Comments
THERMOPLASTICS		
Acrylonitrile/Butadiene/Styrene (ABS)	1,000	Protected by Benzene ring structure. Avoid high dose on high impact grades.
Aromatic Polyesters (PET, PETG)	1,000	Very stable, retains excellent clarity. Drying is essential. Good in luer connectors.
Cellulosics		
Esters and Ethers	100	
Paper, Card, Corrugated, Fibers	100-200	Paper and natural fibers scission, discolor and embrittle.
Cellulose Acetate Propiconate and Butyrate	100	Retains good clarity and impact.
Fluoropolymers		
Tetrafluroethylene (PTFE)	5	Liberates fluorine gas, disintegrates to powder. Avoid use.
Polychlorotrifluoroethylene (ECTFE)	200	
Polyvinyl Fluoride	1,000	
Polyvinylidene Fluoride (PVDF)	1,000	
Ethylene-Tetrafluoroethylene (ETFE)	1,000	
Fluorinated Ethylene Propylene (FEP)	50	Avoid use.
Polyacetals (Delrin, Celcon)	5	Avoid use due to embrittlement.
Polyacrylics		
Polymethylmethacrylate	100	Yellows at 20-40 kGy; clarity recovers partially on aging.
Polyacrylonitrile	100	Yellows at 20-40 kGy.
Polyacrylate	100	Yellows at 20-40 kGy.
Polycyanoacrylate	200	Adhesives function at 100 kGy with less than 30% degradation.
Polyamides (Nylons)		
Aliphatic & Amorphous Grades	50	Discolours. Avoid thin films and fibers. Dry before molding.
Aromatic Polyamide/Polyimide	10,000	High heat/strength grade.
Polycarbonate	1,000	Discolours, clarity recovers after aging. Dry before molding.
Polyethylene (LDPE, LLDPE, HDPE, UHMPE, UHMWPE)	1,000	Crosslinks to gain strength, loses some elongation. All polyethylene radiation stable, low density most resistant.
Polyimides	10,000	
Polymethylpentene	20	Subject to oxidation degradation. Avoid use.
Polyphenylene Sulfide	1,000	
Polypropylene, Radiation Stabilized		
Homopolymer	20-50	Subject to orientation embrittlement. Validate with real time aging.
Copolymers of Propylene-Ethylene	25-60	More stable than Homopolymer.
Polypropylene, natural	20	Avoid use of unstabilized polypropylene.

Note: Physical properties of polymers that are irradiated may vary due to: section thickness; molecular weight distribution; morphology; moisture; oxygen levels; and either residual or functional stress. Each polymer must be tested in the specific application under consideration.

Material	Tolerance Level (kGy)	Comments
Polystyrene	10,000	All styrenes are stabilized by Benzene ring structure.
Polysulfone	10,000	Amber colour before irradiation.
Polyurethane	10,000	Excellent clarity and chemical resistance to stress-cracking. Drying is essential.
Polyvinylbutyral	100	Yellows.
Polyvinylchloride (PVC)	100	Yellows, can be tinted for colour correction.
Polyvinylidene Chloride (PVDC)	100	Yellows, releases HCL.
Styrene/Acrylonitrile (SAN)	1,000	Yellows at 40 kGy.
THERMOSETS		
Allyl Digylcol Carbonate (Polyester)	5,000-10,000	All thermosets as a class are highly resistant.
Epoxies	1,000	Many good formulations available. Success depends on joint design and application process.
Phenolics	50,000	
Polyesters	100,000	
Polyurethanes	100-1,000	Wide formulation variations for urethanes.
ELASTOMERS*		
Butyl	50	
Ethylene-Propylene Diene Monomer (EPDM)	100-200	Crosslinks, yellows slightly.
Fluoro Elastomer	50	Avoid multiple sterilization.
Natural Rubber (Isoprene)	100	Very stable with sulfur or resin cure systems.
Nitrile	200	Avoid multiple sterilization.
Polyacrylic	50-200	Avoid multiple sterilization.
Polychloroprene (Neoprene)	200	Avoid multiple sterilization.
Silicones (Peroxide & Platinum Catalyst Systems)	50-100	Crosslink density increases more in peroxide systems than in platinum systems.
Styrene-Butadiene	100	Avoid multiple sterilization.
Urethanes	100-200	Wide variations in urethane chemistry applied to medical devices.

***Elastomers:** 1) Radiation tolerance is affected by the base polymer and the curing system used. Sulfur and resin cures are more durable.
2) All elastomers are subject to cross-linking. Avoid folds, coils, curves in the shape packaged. Typical sterilization processing dose: 20-50 kGy (2.0-5.0 Mrads).

Although MDS Nordion compiles this information, we do not verify radiation compatibility of the products listed.
It is recommended that all materials should be tested thoroughly to verify the compounds' performance after irradiation.
An excellent reference source is the Association for the Advancement of Medical Instrumentation web site at **www.aami.org**
for a material qualification technical information report and sterilization standard.

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