WASHER PERFORMANCE CHARACTERISTICS
Selection Guide

Washers General
This product bulletin should be used as a guide to help with the proper selection for the washer to fit on a closure in combination with the filling good.

In general, our standard washer types EPDM, Nitrile and PE will suit most of the packaging solutions for the filling goods, whereas in specific situations an alternative can be offered. For these requirements a valid Packaging Advice recommendation must be requested from our Tri-Sure Sales & Support centre. Requests should always contain a valid Material Safety Data Sheet of the filling good together with the filling and storing conditions.

All Tri-Sure® standard rubber washers are manufactured from extruded tubes which are cured in a vulcanization process step and then cut/sliced into the desired dimensions (square section). Polyethylene (PE) washers can be either extruded & cut and then irradiated (square section) or Injection moulded (round section).

EPDM RUBBER WHITE

Type:	Extruded cut tubes, color off-white
Material:	Copolymer of Ethylene-Propylene-Diene-Monomers (EPDM)
Available executions:	Suitable for G-type plugs metal and plastic range, G-type metal flanges including the 4*s* Closure system, PLASTIPLUG™ plastic plug range, PLASTICAP™ Screwcap range.
Characteristics:	Ideal for outdoor applications because of its excellent resistance to ozone, oxidants, severe weather conditions, excellent heat resistance, good resilience and tensile strength.
Compatibility:	excellent resistance to phosphate ester fluids, glycols, good resistance to ketones, diluted acids and alkalis. Not recommended for applications involving petroleum derivatives, mineral oils, polar -solvents including most chlorinated hydrocarbons and those products which are highly sensitive to trace discoloration.

White EPDM is suitable for medical grade products and FDA food-contact applications.

NITRILE NBR RUBBER WHITE

Type:	Extruded cut tubes, color off-white
Material:	Copolymer of Butadiene and Acrylonitrile also known as BUNA-N or NBR; preferred name Nitrile.
Available executions:	Suitable for G-type plugs metal and plastic range, G-type metal flanges including the 4*s* Closure system and the PLASTIPLUG™ plastic plug range.
Characteristics:	Performs well in oily environments, has good elongation properties, tensile strength, compression set and adequate resilience. Tri-Sure Nitrile rubber washers contain anti-ozone agents to improve the ozone stress crack-resistance.
Compatibility:	Highly recommended for use with petroleum oils, aromatic hydrocarbons, non-polar aliphatic solvents, mineraloils, vegetable oils, and many acids.

White Nitrile is suitable for food-contact applications.

NITRILE NBR RUBBER BLACK

Type: Extruded cut tubes, color black

Material: Copolymer of Butadiene and Acrylonitrile also known as BUNA-N or NBR; preferred name Nitrile.

Available executions: Suitable for G-type plugs metal and plastic range, G-type metal flanges including the 4*s* Closure system and the PLASTIPLUG™ plastic plug range.

Characteristics: Performs well in oily environments, has good elongation properties, tensile strength, compression set and adequate resilience. Tri-Sure Nitrile rubber washers contain anti-ozone agents to improve the ozone stress crack-resistance.

Compatibility: Highly recommended for use with petroleum oils, aromatic hydrocarbons, non-polar aliphatic solvents, mineraloils, and many acids.

Black Nitrile is not suitable for food-contact applications.

VITON® FKM RUBBER

Type: Extruded cut tubes, standard color green. (white and black optional)

Material: FKM Fluoropolymer **Type A** (66% Fluorine polymers)

Available executions: Suitable for G-type plugs metal and plastic range, G-type metal flanges including the 4*s* Closure system, the PLASTIPLUG™ plastic plug range and the PLASTICAP™ screwcap range.

Characteristics: Performs well in chemical environments, has good elongation properties, tensile strength, compression set, adequate resilience and excellent heat temperature resistance. Tri-Sure Viton® rubber washers perform well on the ozone stress crack-resistance.

Compatibility: Highly recommended for use with petroleum oils, aromatic hydrocarbons, non-polar aliphatic solvents, mineraloils, vegetable oils, and many acids. Compatibility with Alkalis and for Amines is moderate to weak.

Green and (White) Viton® rubber are FDA compliant. Black Viton® rubber is not suitable for food-contact applications.

POLYETHYLENE (PE) SQUARE

Type: Square Irradiated extruded washer

Material: (PEVA) Polyethylene Vinyl Acetate copolymer, color natural (virgin)

Available executions: Suitable for G-type plugs metal and plastic range and PLASTIPLUG™ plastic plug range.

Characteristics: Due to cross-linking from the irradiation process this washer type will have improved physical and chemical properties whereas low creep, better tensile and impact strength, hardness, deflection and service temperature, stress-crack, abrasion, heat and fatigue resistance. The chemical compatibility properties will also be enhanced.

Compatibility: Storage time and temperature play a key role when selecting PE washers however good compatibility is shown with weak Acids, Alcohols, Esters and Alkaline Bases.

PEVA is suitable for food-contact applications.

POLYETHYLENE (PE) ROUND

Type: Round Injection moulded

Material: LDPE (Low Density Polyethylene), color natural (virgin)

Available executions: Suitable for G-type plugs metal and plastic range and PLASTIPLUG™ plastic plug range.

Characteristics: Inherent to the Injection moulding process these washers are very sensitive for flash as a result of mould mismatch. Limited heat resistance and Compression set. In general PE is subjected to cold flow and creep due to stress relaxation and as such not a preferred closing solution.

Compatibility: Despite the good to moderate compatibility with various chemicals and filling goods, care should be taken when selecting this washer type as the temperature and storage time plays an important role. Good to fair compatibility is shown with weak Acids, Alcohols, Esters and Alkaline Bases.

PE is suitable for food-contact applications.

OTHER OPTIONS

VITON® and NEOPRENE rubber washers are non-standard washers for use in situations where there is a requirement for resistance against highly corrosive and hazardous liquids, extreme environments and elevated temperatures. These washer types can only be recommended after consulting one of our laboratory advice experts.

COMPLIANCE STATEMENTS

- ✓ Tri-Sure® EPDM, Nitrile and VITON® washers comply with the FDA requirements CFR §177.2600 for food contact. We confirm that the raw materials for our washers have been carefully selected from a positive list of allowed substances for rubber materials according BfR guideline recommendation XXI.
- ✓ Tri-Sure® PE washers are intended for contact with all food types and long-time storage at room temperature, SQR (Square) PE can be used for hot-fill at maximum of 70°C for 2 hours or at maximum of 100°C for 15 minutes they meet the requirements conform the EC Directive 1935/2004 and comply with the FDA regulations for food contact. **RND (Round) PE washers are not recommended for hot-filling applications.**
- ✓ Our washers are in compliance with the regulation Directives on Packaging and Waste regarding Heavy Metal content.
- ✓ Our products are suitable for paint application however; we cannot guarantee that traces of impurity or other contaminations from handling can affect the parts.

TRACEABILITY

Tri-Sure® washers can be identified by means of a color marking on the outer side wall of the washer see table below:

Washer/Gasket Material	Marking Color Code
Black Nitrile	Green (or White)
White Nitrile	Green
EPDM "S" type (off-white)	Black, Blue or Grey
** Black Butyl	Blue
** White Neoprene	Yellow
** PE (Polyethylene)	None
** VITON®	None

** Non-Standard materials
High-bake flange washers will have an additional "Orange" marking

TERMS USED

- Extrusion: Manufacturing process where plastic resin is melted and then pushed via a screw through a die to form a continues tube with fixed diameter and thickness. The same process is also used for elastomers (rubber) to create a cylindrical tube.
- Curing: Process step to improve the material properties by means of heat or radiation.
- Vulcanization: cross-link Chemical process step to rubber material in order to enhance the material properties.
- Injection Moulding: Manufacturing process where plastic resin is melted in a barrel and then forced into a mould cavity and then allowed to cool to give the part its final shape.
- Irradiation: Manufacturing process to cross-link thermoplastic material (PE) by means of electrons (e-Beam). The benefits here are to improve the physical, thermal and chemical properties of a component.

- High-Bake: Non-standard rubber formulation with extended heat resistance and compression set properties for special applications.

GENERAL COMPATIBILITY PERFORMANCE WASHERS/GASKETS

	EPDM White	Nitrile White	Nitrile Black	VITON® Green *(White)*	VITON® Black	(Polyethylene Vinyl Acetate) PEVA (SQR)	Poly-ethylene PE (RND)
Physical Properties							
In general	GOOD	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	GOOD	FAIR
Elasticity	GOOD	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	GOOD	GOOD
Heat resistance	GOOD	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	FAIR	POOR
Chemical Resistance							
Chemicals in general	EXCELLENT	GOOD	GOOD	EXCELLENT	EXCELLENT	EXCELLENT	GOOD
Petroleum products	FAIR	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	GOOD	POOR
Non-polar solvents/chemicals	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	POOR
Most chlorinated hydrocarbons	GOOD	POOR	POOR	EXCELLENT	EXCELLENT	GOOD	POOR
Polar solvents/chemicals	GOOD	POOR	POOR	GOOD	GOOD	GOOD	GOOD
Aqueous products	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
Food stuffs, Edible oils	GOOD	GOOD	Not Applicable	EXCELLENT	Not Applicable	GOOD	FAIR
Compliance with Food Packaging Regulations							
Compliance with §177.2600 of the FDA (Rubber articles intended for repeated use)	YES	YES	NO	YES	NO	YES	YES
Directive 1935/2004 EC on materials and articles intended to come into contact with food[1]	NO	NO	NO	NO	NO	YES	YES
Compliance with Heavy Metal Contents Legislations Compliance with §37.0205 of the CONEG	YES	YES	YES	YES	YES	YES	YES
Compliance with EEC commission directive 2004/12/EC amending Directive 94/62/EC on packaging and packaging waste	YES	YES	YES	YES	YES	YES	YES

[1] *Rubber materials Article 16 of EC 1935/2004, to date there are no specific measures in place; therefore, the Member States (EU) may retain or adopt national provision guidelines. Reference is made to the German BfR guidelines recommendations (BfR category IV), Dutch Packaging and Utensils Regulation (category III product) and the Resolution ResAP (2004)4 on rubber products intended to come into contact with foodstuffs.*