Firestone GeoGard™ EPDM
Review of Technical Performances

Firestone GeoGard™
Lining in Action™

Introduction

This document presents a summary of the characteristics of the **Firestone GeoGard™ EPDM** membrane produced by Firestone Building Products, a company part of the Bridgestone Group, a world recognized leader in rubber polymer technology for over 100 years.

Firestone GeoGard EPDM is a vulcanized synthetic rubber geomembrane. It is available in two thicknesses: 1.1 mm and 1.5 mm. Its highly crosslinked polymer structure grants a stable chemical composition over time and exceptional mechanical properties.

The technical properties of Firestone GeoGard EPDM are summarized in the table included in the Technical Information Sheet (TIS) on page 9.

Firestone GeoGard EPDM is used throughout the world in **a wide variety of applications:**

- Irrigation reservoirs and canals
- Agricultural ponds and dung pits
- Aquaculture ponds
- Constructed wetlands
- Settlement lagoons
- Waste water reservoirs
- Artificial snow reservoirs
- Hydroelectric reservoirs and canals
- Fire reservoirs
- Stormwater reservoirs
- Landfill covers
- Artificial lakes

The present document makes reference to various publications (scientific studies, test results, etc) which are available to readers on request, or available on www.firestonebpe.com.

1. Exceptional durability

The chemical composition of Firestone GeoGard™ EPDM (high proportion of carbon black and saturated carbon chains) and the fact that it is vulcanized, means that the geomembrane benefits from an unmatched resistance to UV, heat, ozone, micro-organisms and extreme weather conditions.

Firestone GeoGard™ EPDM does not contain any plasticizers or antioxidants likely to migrate or degrade and cause the geomembrane to age prematurely.

Tests conducted on Firestone GeoGard EPDM and the observations made on membranes exposed to actual weather conditions (exposure to water, UV, ozone, heat, thermal variations and microorganisms, etc) over several years have shown that under normal exposure in Western Europe and when properly installed, Firestone GeoGard EPDM has a service life of more than 50 years without any apparent sign of ageing such as cracks, crazing, bleaching, etc.

Standard Tests:

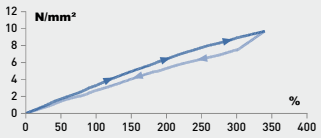
	Standard	1.1 – 1.5 mm
Durability – weathering tests (25 years)	EN 12224	Pass
Durability – oxidation	EN 14575	Pass

2. High elasticity and tensile strength

Given the significant level of crosslinking in its carbon chains, Firestone GeoGard EPDM can be elongated over 300% in all directions and return to its initial shape afterwards. This high elasticity allows the membrane to absorb substrate movements without its physical properties being affected.

Standard Tests:

	Standard	1.1 mm	1.5 mm	Tolerance	Unit
Tensile Strength	ISO R 527	9	10	- 1	N/mm²
Elongation at break	ISO R 527	≥ 300	≥ 300		%



3. Highly flexible, even at low temperatures

Firestone GeoGard EPDM is highly flexible even at temperatures as low as -45 °C. This facilitates installation as the geomembrane adapts to irregular shapes and lays flat on the substrate, whatever the outside temperature.

When mechanically stressed at low temperatures, Firestone GeoGard EPDM retains all of its flexibility and its resistance is not jeopardized.

Standard Test:

	Standard	1.1- 1.5 mm	Unit
Foldability at low temperature	EN 495-5	≤ - 45	°C

4. High puncture resistance

In view of its highly flexible and elastic nature, Firestone GeoGard EPDM also has excellent puncture resistance. This is a very important characteristic in withstanding the mechanical stresses which the geomembrane sustains during installation and service, and consequently guarantees long-term watertightness of the lining system.

Standard Test:

	Standard	1.1 mm	1.5 mm	Tolerance	Unit
Resistance to static puncture	EN ISO 12236	0.7	0.9	- 0.1	kN

5. High resistance to hydrostatic pressures

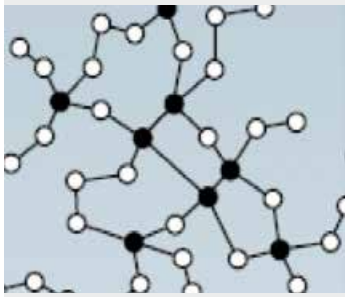
Firestone GeoGard EPDM has an almost unlimited resistance to hydrostatic pressure, which enables it to be used in deep, large capacity water reservoirs. Firestone has conducted laboratory pressure tests which have shown that the EPDM geomembrane can withstand pressure up to 35 kg/cm² (equivalent to 350 m water column or 3.4MPa).

Tests carried out according to the EN 1928:2000 standard showed that, when an equivalent pressure of 40 m water column (400 KPa) is applied, Firestone GeoGard EPDM and its seams remain watertight.

Standard Test:

	Standard	1.1 – 1.5 mm + seams
Watertightness under high pressure	EN 1928 :2000	Watertight

6. Stable chemical composition



As a result of its chemical composition (saturated highly crosslinked carbon chains, without plasticizers and antioxidants) and its production method (heat vulcanized), Firestone GeoGard EPDM is considered an inert material as its chemical composition is very stable over time (when in contact with authorized products).

A stable chemical composition is vital in guaranteeing the mechanical properties of the geomembrane on a long term basis.

Unlike thermoplastic geomembranes, no reduction in density has been noted on Firestone GeoGard EPDM following loss of membrane components.

7. Highly compatible with living organisms

Because of its very stable chemical composition, Firestone GeoGard EPDM does not release components on contact with water.

Tests have demonstrated that the Firestone GeoGard EPDM membrane and its seaming system can be used for the storage of irrigation water, as a liner for aqueous food production and aquaculture and for the storage of water prior to the necessary treatment required for human consumption.

8. Environmentally friendly geomembrane

Given the chemically inert nature of Firestone GeoGard EPDM, the membrane has no effect on air or water quality and does not release any pollutants into the environment.

The environmental impact of a geomembrane essentially takes place in its production and disposal. Taking into account its exceptional durability (compared with other geomembranes) and the numerous possibilities for recycling, Firestone GeoGard EPDM offers an environmentally friendly solution.

9. Root penetration resistance

Firestone GeoGard EPDM and its seams have successfully passed various root penetration resistance tests (DIN 4062, CEN/TS 14416: 2005, FLL). Nevertheless, it is necessary to remain extremely careful with regard to certain plants which develop particularly aggressive rhizomes (a non exhaustive list of plants which develop rhizomes can be obtained on request or from www.fbb.de). When confronted with such plants, a protection barrier must be implemented to protect the EPDM geomembrane.

Standard Test:

	Standard	1.1 – 1.5 mm + seams
Resistance to root penetration	CEN/TS 14416	Pass

10. Broad range chemical resistance

Firestone GeoGard EPDM has a relatively broad spectrum chemical resistance. Nevertheless, some products are not compatible with EPDM membranes (hydrocarbons, grease, etc). A list of compatible chemical compounds is available on request. In case of doubt, it is strongly advised to contact the technical department of Firestone Building Products.

In addition to water storage, Firestone GeoGard EPDM is highly suitable for applications such as livestock effluent storage and waste water storage. Firestone GeoGard EPDM must not under any circumstances be used for storing chemical products.

11. Resistance to microorganism corrosion

The high level of crosslinking in its carbon chains and the presence of sulfur in its molecular structure (a compound which bacteria, likely to corrode the geomembrane, are not able to withstand), make Firestone GeoGard EPDM almost impervious to micro-organism corrosion.

12. High friction angle

Friction tests conducted on the EPDM geomembrane demonstrated that the friction angle between the geomembrane and a standardized ground surface is 27.5° (± 1°).

Firestone GeoGard EPDM friction angle is relatively high compared with other geomembranes. A high friction angle means that the geomembrane is easier to install (workers do not slide on it and the membrane stays in place); that it is more stable on the slopes and that it is not necessary to use a textured membrane.

Standard Test:

	Standard	1.1 – 1.5 mm	Tolerance	Unit
Friction angle	EN ISO 12957-2	27.5	± 1	°

13. Quick and easy installation

The combination of its dimensions, mechanical characteristics and seaming method make Firestone GeoGard EPDM fast and easy to apply. In a trade which is highly dependent on weather conditions, the speed of installation of Firestone GeoGard EPDM represents a major advantage.

Dimensions

Firestone GeoGard EPDM is available in large panel sizes, up to 15.25 m wide and 61 m long in a single piece, which translates into up to 930 m² without any seam. This allows for a significant reduction in the number of seams to be carried out on site and considerably reduces the risks in installation.

The panels are available in numerous sizes which can be selected to accommodate the dimensions of the project. This reduces losses and limits the cutting and field seaming. The list of available Firestone GeoGard EPDM panel sizes is included in the Technical Information Sheet (TIS) on page 9.

Characteristics

Installation of Firestone GeoGard EPDM is greatly facilitated by its flexibility, as it adapts to the substrate and is easy to manipulate (moving unfolded sheets on an air cushion), and also by its high friction angle as workers do not slide on the membrane when it is dry and the membrane is less likely to slip on the slopes.

Field seaming method

Firestone GeoGard EPDM field seaming method using Firestone QuickSeam™ Splice Tape provides the following advantages:

- The quality of the seams is consistent over the entire length.
- Assembly is so easy that the quality of the seams is not dependent on the skill of the installer.
- The completion of seams is only slightly dependent on weather conditions.
- The tools used do not risk damaging the geomembrane.
- It does not require the use of electricity or special equipment.

The completion and quality of the seams are not affected by folds or waves which are likely to form with temperature variations.

14. High quality installation details

For the sealing of pipe flashings and penetrations, Firestone uses QuickSeam™ FormFlash™, an uncured EPDM flashing (which cures progressively after installation) laminated to self-adhesive QuickSeam Splice Tape. This material dresses each sealing detail perfectly and without any stress, whatever its shape.

Firestone also offers accessories for carrying out waterproof mechanical connections on concrete structures and adhesives, which allow the membrane to be adhered to any type of surface (concrete, wood, steel etc).

15. Quality installation

The performance of a lining system is directly linked to the quality of the installation. For this reason, Firestone GeoGard EPDM is exclusively installed by Firestone trained and authorized lining contractors. They guarantee that the installation meets the quality standards set by the manufacturer.

Firestone Building Products' technical department offers its contractors first rate support in theoretical and practical training by professional technicians. Firestone also provides on-site technical assistance and quality inspection of finished works.

16. Seam testing

There are two main types of seaming control methods which provide accurate information regarding the quality of the field seams:

- **Non-destructive seam testing:**
  - **Visual inspection :** in the case of Firestone GeoGard EPDM, a series of elements may be easily checked visually, which gives a very good indication of the quality of the seams.
  - **Air lance :** enables the watertightness of the seams to be checked on a continuous basis.
  - **Vacuum chamber :** enables inspection of individual points on field seams.
- **Destructive seam testing:** tensile and peel tests conducted on seam samples at least 24 hours after a seam has been made.

A more detailed description of the seam testing methods is given in the Firestone Quality Assurance Plan (available on request).

17. Easy to repair

Given the inert nature of Firestone GeoGard EPDM, its composition does not vary over time. Consequently, the geomembrane can still be assembled and/or repaired many years after being installed and having been exposed to climatic elements. All that is required is that the geomembrane is thoroughly cleaned before commencing the repair.

The installation techniques for repairs do not differ from the techniques for the initial installation of Firestone GeoGard EPDM. Therefore, repairs are quick and easy to carry out. The Firestone Repair Guide (available on request) describes in detail the various repair operations.

18. National and International Technical Approvals

Firestone GeoGard EPDM has obtained CE marking, which proves that it meets current European requirements for health, safety, consumer protection and environment.

The Firestone GeoGard EPDM is CE-marked for the following applications:

- **EN 13361**: Construction of reservoirs and dams.
- **EN 13362**: Construction of canals.
- **EN 13492**: Construction of liquid waste disposal sites, transfer stations or secondary containment.
- **EN 13493**: Construction of solid waste storage and disposal sites.

Firestone's EPDM manufacturing facilities also hold ISO 9001 and ISO 14001 certifications, which reflect respectively Firestone's commitment to quality and environmental management system.

Firestone GeoGard EPDM has been tested and certified by many national and international bodies (i.e. French ASQUAL certification).

Within the context of these certifications, regular audits are conducted at Firestone Building Products' factories to verify the production process, quality control monitoring and the quality of the end product. Consequently, Firestone Building Products can guarantee that its EPDM geomembrane is of a consistently high quality.

The main approvals and certifications are summarized in the Technical Specification table on page 9.

FM 32845

EMS 52644

19. Technical Information Sheet Firestone GeoGard™ EPDM (1.1 & 1.5 mm)

Description

The Firestone GeoGard EPDM 1.1 mm (.045") and 1.5 mm liner (.060") is a cured single-ply synthetic rubber membrane made of ethylene-propylene-diene terpolymer (EPDM). It is available in a variety of panel sizes. Depending on the dimensions of the liner, the waterproofing surface may be seamless (up to 930 m²). In other situations, seams can be made using a self-adhesive tape.

The Firestone GeoGard™ EPDM can be supplied in the following dimensions:

Thickness	**1.1 mm (.045")**	**1.5 mm (.060")**
Max. surface	930 m²	
Length	30.5 m - 61.0 m	30.5 m - 45.72 m - 61.0 m
Width	3.05 m - 6.10 m - 7.62 m - 9.15 m - 12.20 m - 15.25m	

Note: not all panel widths are available in all lengths.

Preparation

Product: Allow the membrane to relax for approximately 30 minutes before splicing.

Substrate: The substrate needs to be smooth, dry and free of sharp objects, oil, grease and other materials that may damage the membrane.

Application

Install the Firestone GeoGard EPDM in accordance with current specifications and details.

Coverage

The dimensions of the membrane are calculated to cover the base of the reservoir, slopes and anchor trenches, including seam overlaps.

Characteristics

Firestone GeoGard EPDM is a rubber material with the following properties:

Physical	• Elastomeric membrane with a good combination of high elasticity and tensile strength	
	• Retains its flexibility at low temperature (-45°C)	
	• Resists to temperature shocks up to 130°C	
	• Excellent resistance to alkali rains	
	• Excellent resistance to U.V. radiation and ozone concentration	
	• Contact with some kind of oils, petroleum products, hot bitumen and grease must be avoided	
Technical	• Base	synthetic rubber
	• Colour	black
	• Solvents	none
	• Solids (%)	100
	• State	cured
	• Storage	Store the membrane in a dry place until use

Technical Specifications

Physical Properties	Standard	Declared Value 1.1 mm (.045")	Declared Value 1.5 mm (.060")	Tolerance	Unit
Mass per unit area	EN 1849-2	1288	1695	± 5%	g/m²
Tensile strength (MD/CD)	ISO R 527	9	10	-1	N/mm²
Elongation (MD/CD)	ISO R 527	≥ 300	≥ 300		%
Dimensional stability	EN 1107-2	≤ 0.5	≤ 0.5		%
Foldability low temperature	EN 495-5	≤ -45	≤ -45		°C
Resistance to static puncture	EN ISO 12236	0.7	0.9	-0.1	kN
Liquid tightness under high pressure application (4 bar = 40 m depth)	EN 1928:2000	Watertight	Watertight		
Water permeability (Liquid tightness)	EN 14150	$3.0\ 10^{-6}$	$3.0\ 10^{-6}$	$\pm 10^{-6}$	m³/m²d
Methane permeability (Gas tightness)	ASTM D1434	$2.25\ 10^{-3}$	$2.25\ 10^{-3}$		m³/m²d
Durability - weathering (25 y)	EN 12224	Pass	Pass		
Durability - oxidation	EN 14575	Pass	Pass		
Friction angle	EN ISO 12957-2	27.5	27.5	±1	°
Resistance to root penetration	CEN/TS 14416	Pass	Pass		

Precautions

Take care when moving, transporting or handling to avoid sources of punctures and physical damage. Isolate waste products, such as petroleum products, greases, oils (mineral and vegetable) and animal fats from Firestone GeoGard EPDM.

Firestone Building Products Europe
Ikaroslaan 75 I 1930 Zaventem I Belgium
Tel +32 2 711 44 50 I Fax +32 2 721 27 18
info@fbpe.be I www.firestonebpe.com

I FOR FURTHER INFORMATION, PLEASE CONTACT YOUR LOCAL FIRESTONE GEOGARD EPDM DISTRIBUTOR OR FIRESTONE BUILDING PRODUCTS I

Firestone
BUILDING PRODUCTS
NOBODY COVERS YOU BETTER.™

MIX
Paper from responsible sources
FSC® C011145