Firestone RubberCover™ EPDM
Review of Technical Performances

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1. Introduction

This document presents a summary of the main characteristics of Firestone RubberCover™ EPDM membrane as produced by Firestone Building Products, a division of the Bridgestone Group, a world-recognized leader in rubber polymer technology for over 100 years.

Firestone EPDM waterproof membranes have been successfully installed worldwide - from the arctic conditions of Siberia to the blistering heat of the Middle East. The membranes ensure the water-tightness of tens of thousands of buildings having become the most popular synthetic material of its generation.

On the strength of this success, the Firestone RubberCover™ EPDM membrane can now be found on residential roofs which require exceptional durability at low depreciation cost.

The Firestone RubberCover™ EPDM membrane is a vulcanized, synthetic rubber membrane. It is available in a thickness of 1.14 mm. Its highly cross-linked polymer structure grants a stable chemical structure over time and exceptional mechanical properties.

This file makes reference to various documents (scientific studies, test results etc) which are available to the reader on request.

Summary of the main advantages of the Firestone RubberCover™ EPDM membrane:

- Excellent resistance to ageing (UV and ozone).
- Highly elastic (> 300% elongation).
- Excellent flexibility at low temperatures (- 45°C).
- High puncture resistance.
- Membrane and seams display high resistance to hydrostatic pressure.
- Fire resistance to external sources (Low-Slope-Fire-Retardant EPDM).
- Inert (no solvents or plasticizers). The membrane composition remains constant over time.
- Collection of rainwater.
- Resistant to micro-organisms.
- Large dimension membranes significantly decrease installation time.
- Reduced environmental impact compared to other waterproof membranes and in line with ecological requirements.
- Compatible with green roofing systems and photovoltaics.
- Easy assembly and repairs even after several years' exposure.

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2. Exceptional durability

The chemical composition of Firestone's RubberCover™ EPDM membrane (high proportion of carbon black (> 25%) and saturated carbon chains) and the fact that it is vulcanized (strongly cross-linked chains) mean that the membrane benefits from an unmatched resistance to UV,ozone, micro-organisms and extreme weather conditions.

Unlike some thermoplastic membranes, the membrane does not contain any plasticizers or antioxidants likely to migrate or degrade and cause the membrane to age prematurely.

Tests conducted on the Firestone RubberCover™ EPDM membrane and the observations made on membranes exposed to several years' worth of actual weather conditions (exposure to rain, UV, ozone, heat, thermal variations and microorganisms etc.) have shown that under normal exposure in western Europe and when fitted according to good engineering practice the Firestone RubberCover™ EPDM membrane has **a service life of more than 50 years**, without any apparent sign of ageing such as cracks, crazing and bleaching etc.

The EMMA test (Equatorial Mount with Mirrors for Acceleration) consists of concentrating sunlight under a tropical climate by using mirrors. The Firestone RubberCover™ EPDM membranes were exposed to more than 2,000,000 Langley under this test, without sustaining any cracking or crazing.

Standard Tests:

	Standard	1.14mm
Ozone resistance:	EN 14575	Compliant
Durability – UV Ageing:	EN 1297	Compliant

SKZ study:

In 2004, a study was conducted by the German Institute of Synthetic Materials (SKZ) to determine the minimum service life of EPDM rubber membranes. Thirty-nine samples of EPDM membranes were taken from roofs in Western Europe that were 20-30 years old. Over a period of 2 years, these samples were subjected to tests for artificial ageing at high temperatures in laboratory conditions.

The results of the study are as follows:

- All the roofs visited where in a perfect condition and operating as intended.
- No external signs of ageing were noted (crazing or cracking)
- None of the elongation at break values obtained were less than 300%.
- Each sample was artificially aged up to the lower threshold of 150% elongation to obtain the values for remaining life span. All results obtained have exceeded the 70 year life span.

Study conclusions: **The life span of EPDM membranes is clearly evaluated at over 50 years** in normal west European climate conditions.

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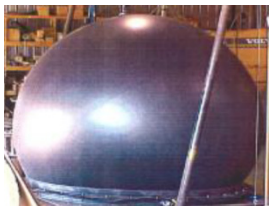
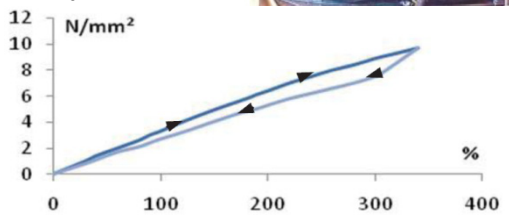
3. High elasticity and tensile strength



Given the significant level of cross-linking in its carbon chains, the RubberCover™ EPDM membrane can be elongated **over 300%** in all directions and return to its initial form afterwards. This high elasticity allows the RubberCover™ membrane to accommodate any substrate irregularities without its physical properties being affected.



Standard Tests:

	Standard	1.14mm	Unit
Tensile Strength:	EN 12311-2 (B)	≥ 7	N/mm^2
Elongation at break:	EN 12311-2(B)	≥ 300	%

4. Highly flexible, even at low temperatures

Firestone's RubberCover™ EPDM membrane is highly flexible even at **low temperatures down to -45°C**. Installation is therefore easily facilitated as it adapts to irregular shapes of the substrate, whatever the outside temperature.

When mechanically stressed at low temperatures, the membrane retains all of its flexibility and its characteristics remain unchanged. Please note that application at low temperatures requires certain precautions to be taken to achieve a high quality result.

Standard Test:

	Standard	1.14mm	Unit
Flexible, even at low temperature	EN 495-5	≥ - 45	°C

5. High puncture resistance

In view of its highly flexible and elastic nature, Firestone RubberCover™ EPDM membrane also provides excellent puncture resistance. This is a very important characteristic in withstanding the mechanical stresses which the membrane sustains during installation and commissioning or under climatic stresses such as hail.

Consequently, the membrane allows for long term water-tightness to be guaranteed.

In France, waterproof surfaces benefit from a performance classification known as "**F.I.T. Classification**" which measures fatigue, resistance to puncture and resistance to heat. The Firestone RubberCover™ EPDM membrane: obtained F.I.T. classification: **F5 I5 T4.**

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Standard Tests:

	Standard	1.14mm	Unit
Resistance to static puncture	EN 12730	≥ 20	kg
		≥ 1700	mm

6. High resistance to hydrostatic pressures

The Firestone RubberCover^{TM} EPDM membrane has an unmatched resistance to hydrostatic pressure. Firestone has conducted laboratory pressure tests which have shown that the membrane can withstand pressure up to 35 kg/cm² (equivalent to 350 m water column or 3.4 MPa) without causing a permeability defect in the membrane.

These tests conducted according to EN 1928 standard showed that when a pressure is applied equivalent to 40 m water column (400 kPa), the Firestone RubberCover^{TM} EPDM membrane and its seams remain impermeable.

Although Firestone recommends an incline allowing adequate runoff, stagnant water does not contribute to an acceleration in the ageing process of the membrane or the seam.

	Standard	1.14mm + seams
Water tightness under water pressure	EN 1928	Compliant

7. Fire resistance

Firestone's *Low-Slope-Fire-Retardant* (LSFR) EPDM compound membranes have been tested for resistance to external exposure to fire:

	Standard	1.14mm + Polyiso Insulation + VCL & Plywood
External fire resistance	BS476-3:2004	Ext. F.AC

	Standard	1.14mm with 50mm stone ballast covering
External fire resistance	BS476-3:2004	Ext. F.AA *(deemed to achieve)*

In accordance with The Building Regulations Part B (England & Wales), Building Regulations (Northern Ireland) Technical Booklet E, and Building Regulations Part B4 (Republic of Ireland) there are **no restrictions** on the use of flat roof coverings designated AA, AB or AC.

Similarly, The Building (Scotland) Regulations classifies roof coverings with a designation AA, AB or AC as 'Low Vulnerability'.

Consult Firestone Technical Services for the external fire resistance performance for other roof construction types.

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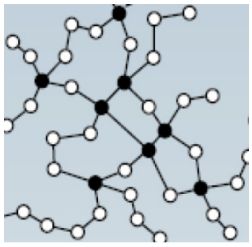
8. Stable chemical composition



As a result of its chemical composition (saturated highly cross-linked carbon chains, without plasticizers) and its production method (heat vulcanized), the Firestone RubberCover™ EPDM membrane 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 membrane on a long term basis. Chemical damage related to climate conditions such as acid rain, have no negative impact on the membrane.

Unlike some thermoplastic membranes, no reduction in density has been noted following loss of membrane components.

9. Collection of rainwater

Owing to its very stable chemical composition, Firestone's RubberCover™ EPDM membrane does not release components when in contact with water.

Physical tests have demonstrated that the Firestone RubberCover™ membrane and its assembly system are compatible with the collection of rainwater.

It is therefore possible to reuse the water collected as domestic water. Note that provision must be made for a filtering system for dusty residues.

10. Environmental suitability

Numerous studies have shown the inherent advantages of EPDM membranes with regard to environmental suitability in providing an optimum solution for "durable" waterproof roofing systems.

Reduced environmental impact and environmentally-sound membrane.

A. The environmental impact of a membrane expressed in GWP (global warming potential) or equivalent CO_2 takes place predominantly in its production and disposal. **The exceptional durability** of the Firestone RubberCover™ EPDM membrane compared to other waterproof membranes, along with its numerous **opportunities for recycling** and **easy repairs**, means that its life span is extended. The membrane is recycled into rubber by-products or devulcanized to be reintroduced into the production chain. The environmental impact of the EPDM membranes is therefore significantly reduced.

GreenTeam[1] Inc. conducted a Life Cycle study analyzing the impact on climate, atmosphere, water and the toxicity of various membranes including modified bitumen.

[1] GreenTeam Inc. is a group of strategic consultants specialising in issues concerning the construction industry and more specifically sustainable construction and environmental matters.

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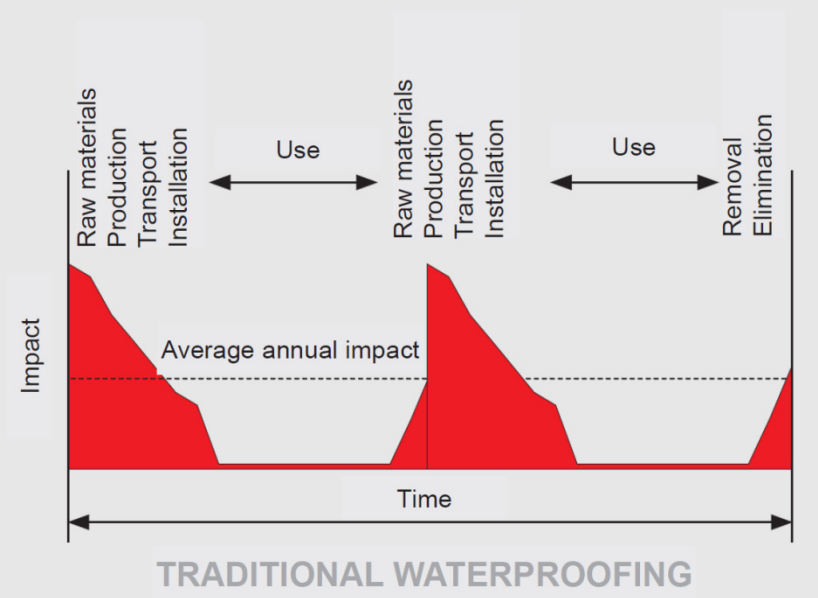
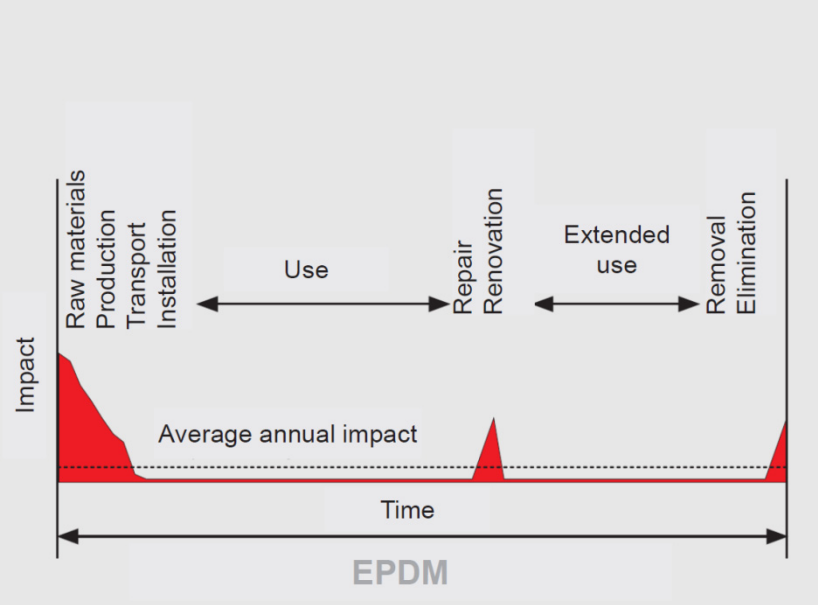
The results show that **the environmental impact of EPDM membranes is less** than that of SBS, PVC and TPO membranes.

The diagrams below represent the difference in environmental impact between two waterproofing membranes. The first diagram shows the environmental impact of a traditional waterproofing membrane.



Due to their larger mass and shorter life span, **bitumen membranes have a more significant environmental impact (GWP)** during production, transportation and installation.

The second diagram shows the environmental impact of an **EPDM** membrane.



EPDM membranes have a longer life span and as they are easy to repair, meaning that complete renovation of the roof which is usually high in CO_2 emissions can be delayed.

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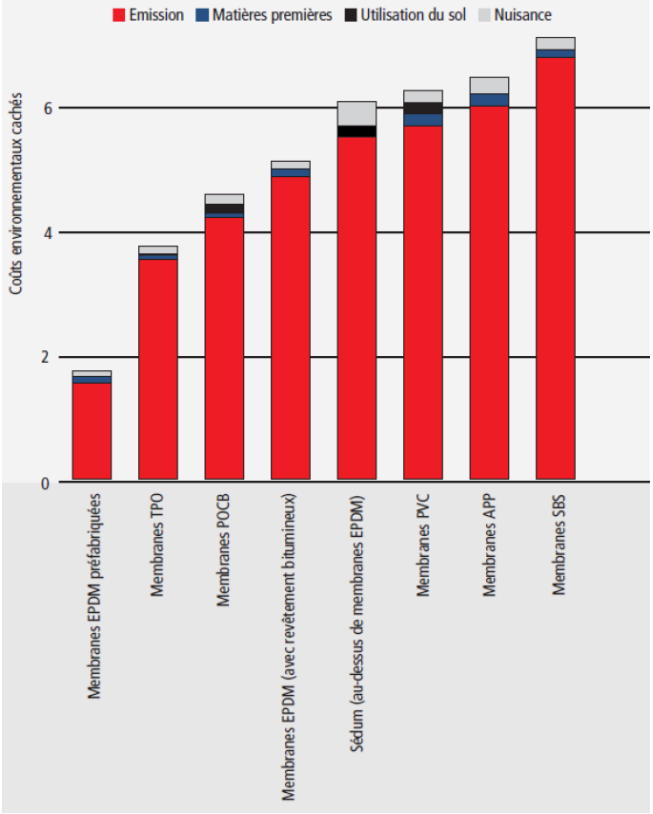
A lower average annual environmental impact can be noted on this second graph compared to the first.

The Dutch institute for building biology and ecology (NIBE) publishes an annual comparative report on a selection of construction materials and their respective environmental impacts. One of these reports evaluated the various waterproofing membranes over a period of 75 years. Two important aspects were analyzed: building costs (installation costs per m^2) and hidden environmental costs (emissions, raw materials, etc.).

Eight waterproofing roofing products were included in the study. **The comparison shows that EPDM is the most ecologically sound product.**



B. For northern European countries such as UK, France, Belgium, etc., the black colour of the membrane allows for **a reduction in heating costs** during heating periods, thereby reducing CO_2 emissions.

C. The Firestone RubberCover™ membrane is chemically inert, non toxic, without any carcinogenic ingredients, therefore the quality of water in contact with the Firestone RubberCover™ EPDM membrane **complies with environmental standards for surface water** and does not contain the presents of abnormal bacteria. The water can be reused as domestic water.

D. Out of concern for the environmental and ecological impact of the Firestone RubberCover™ EPDM membrane, Firestone developed a waterproofing system that is **compatible with photovoltaic systems**. Given its substantial durability over time, the use of EPDM means that complete renovation works can be delayed which would be costly when relating to a photovoltaic system.

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11. Root penetration resistance (garden roof)

Garden roofs consisting of vegetation planted above a waterproof membrane have become a common feature in recent years.

Firestone's RubberCover™ EPDM membrane has successfully passed various root penetration resistance tests (DIN 4062, CEN/TS 14416: 2005, FLL & EN 13948).

The Firestone RubberCover™ EPDM membrane is therefore **compatible with extensive green roofing systems**, using sedum which requires little maintenance.

Nevertheless, it is necessary to remain extremely careful with regard to certain plants which develop particularly aggressive root systems (a non exhaustive list of plants which develop aggressive root systems can be obtained on request or from the website www.fbb.de). When confronted with plants which develop aggressive root systems or rhizomes, a protection barrier must be implemented to protect the waterproofing system. Further information on garden roof systems is available on the Firestone website (http://www.firestonebpe.com).

Standard Test:

	Standard	1.14mm
Resistance to root penetration	EN 13948	Compliant

12. Broad range chemical resistance

The Firestone RubberCover™ EPDM membrane has a relatively broad-spectrum chemical resistance (pH 4 to 10). Nevertheless, some products are not compatible with EPDM membranes, such as hydrocarbons, grease and oils. A list of chemical compounds compatible with the Firestone RubberCover™ EPDM membrane is available on request.

Unlike some waterproofing membranes, the Firestone RubberCover™ EPDM membrane does not have compatibility issues with polyester, old bitumen and PVC membranes. It is compatible with nearly every kind of waterproofing base.

In case of doubt, it is strongly advised to consult with the technical department of Firestone Building Products.

13. Resistance to micro-organisms

The high level of cross-linking in its carbon chains and the presence of sulphur in its molecular structure (a compound which bacteria likely to corrode the membrane are not able to withstand), makes Firestone RubberCover™ EPDM membrane almost impervious to micro-organism degradation.

The Firestone RubberCover™ EPDM membrane is fully compatible with a ballasted system, no modifications to its composition are required. This is not always the case for some other types of roofing membrane.

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14. Quick, easy and reliable application

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

Handling EPDM membranes:

The Firestone RubberCover™ EPDM membrane is available in large dimensions. Consequently there is a significant reduction in the number of seams to be made on the roof and therefore substantially reduces the risks inherent to installation.

The membranes 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 installation of the Firestone RubberCover™ membrane is made significantly easier as a result of its flexibility and light weight (weight per unit of area of 1.51 kg/m^2 for a thickness of 1.14 mm) which enables it to be easily moved by wafting so as to create a cushion of air between the membrane and the base.

Field seaming:

Firestone RubberCover™ EPDM membrane field seaming method using Firestone QuickSeam™ Cover Strip presents 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 EPDM installation does not require the use of electricity or any special equipment.

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

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15. Installation on site Without the use of flame

Unlike other waterproofing membranes, the Firestone RubberCover™ EPDM membrane does not require flame or hot air welding. The seams and roof details are realized with primers and self-adhesive products. The risk of fire during works is therefore significantly reduced. The waterproofing work with Firestone RubberCover™ EPDM membrane do not require buildings to be closed, meaning no interruptions to the use of the building.

16. Complete range of accessories

To waterproof roof details such as: skylights, pipes, roof drains and gutters. Firestone boasts a full range of accessories to complete roof detailing. For example:

- Firestone QuickSeam™ Corner Flashings: Circular unvulcanized EPDM flashing (progressively vulcanized after application) laminated to self-adhesive Firestone QuickSeam™ Splice Tape. This material conforms to each sealing detail perfectly and without any stress.

- Firestone QuickSeam™ Pipe Flashing: Prefabricated sleeves, facilitating the fast and neat waterproof connection of pipes.

- Firestone QuickSeam™ SA Flashing: A 450mm wide strip of cured EPDM laminated to self-adhesive Firestone QuickSeam™ Splice Tape. This material may be used to flash drain details, kerbs and valley gutter amongst other uses.

17. Network of Authorised RubberCover™ Distributors & Trained Contractors

The performance of a waterproofing system is directly linked to the quality of the installation by roofing contractors. For this reason Firestone's RubberCover™ EPDM membrane is installed by trained roofing contractors, who have attended RubberCover™ Regional Training Seminars held regularly by the Firestone Authorised RubberCover™ Distributors. They ensure that the installation meets the quality standards set by the manufacturer.

Firestone Building Products technical department offers its distributors first rate support in theoretical and practical training by their technicians.

Firestone will also provide support to the Authorised RubberCover™ Distributor during the preparatory design phase of a project, on site or during the final inspection of work.

A RubberCover™ roofing video is available on our website www.firestonerubbercover.com, which shows step by step procedure for making different roofing details. The video is also available on DVD format from Firestone Authorised RubberCover™ Distributors.

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18. Seam monitoring test

Whilst seams are very limited on RubberCover™ roofs, there are several different seaming control methods available which provide accurate information regarding the quality of any field seams.

Most commonly, due to the efficient and reliable nature of the QuickSeam™ Cover Strip field seaming detail, a visual inspection will suffice whereby a series of elements may be easily checked visually and which give a very good indication of the quality of the seams.

19. Easy to repair

Given the inert nature of Firestone's RubberCover™ EPDM membrane, its composition does not vary over time. Consequently, the membrane 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 membrane is thoroughly cleaned before commencing the repair.

The installation techniques for repairs do not differ from the techniques for the initial installation of the EPDM membrane. Therefore, repairs are quick and easy to carry out. If in doubt, consult Firestone Technical Services for a recommended solution.

20. Research and development

Since its introduction, improvement to products and services has always been a primary focus at Firestone.

The introduction of QuickSeam technology and products has meant a significant advance in quality and installation.

The use of products with low volatility components or water-based components (Water Based Bonding Adhesive) has led to a reduction in the environmental impact.

An ever-expanding range of accessories means installation times can be reduced.

The provision of polyisocyanurate insulation materials (ISO 95+, RESISTA), and cover boards (ISOGARD HD), thermal barrier (DensDeck Prime) with a M0 classification (non-combustible material), enable a complete and 100% compatible roofing system to be offered.

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21. National and International Technical Approvals

The Firestone RubberCover™ EPDM membrane has obtained **CE marking**, which proves that it meets current European requirements for health, safety, consumer protection and environment.

Firestone's EPDM manufacturing facilities also holds **ISO 9001 and ISO 14001 certifications** which reflect Firestone's commitment to quality and environmental management systems.

ISO 9001:2000
FM 35989

Firestone EPDM membranes have been tested and certified by many national and international bodies.

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 RubberCover™ EPDM membrane is of a consistently high quality.

ISO 14001
EMS 52969

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