ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025 and EN 15804

Declaration holder	**FDT FlachdachTechnologie GmbH & Co. KG**
Publisher	Institute Construction and Environment e.V. (IBU)
Programme holder	Institute Construction and Environment e.V. (IBU)
Declaration number	**EPD-FDT-20130061-IAA1-EN**
Issue date	04.04.2013
Valid until	03.04.2018

Rhepanol hg

FDT FlachdachTechnologie GmbH & Co. KG

Institut Bauen und Umwelt e.V.

www.bau-umwelt.com

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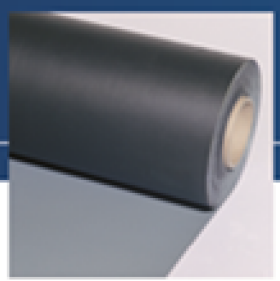


1. General information

FDT FlachdachTechnologie GmbH & Co. KG	Rhepanol hg
Programme holder IBU - Institut Bauen und Umwelt e.V. Rheinallee 108 D-53639 Königswinter	**Holder of the Declaration** FDT FlachdachTechnologie GmbH & Co. KG Eisenbahnstr. 6-8 D-68199 Mannheim
Declaration number EPD-FDT-20130061-IAA1-EN	**Declared product/unit** 1 m² produced roofing membrane Rhepanol hg 1.8 mm
This Declaration is based on the Product Category Rules: Plastic and elastomer roofing and sealing membrane systems, 09.07.2012 (PCR tested and approved by the independent Committee of Experts (SVA))	**Area of validity:** Rhepanol hg and Rhepanol hv are manufactured in 68199 Mannheim-Neckarau, Germany. The holder of the Declaration is liable for the information and evidence on which it is based.
Issue date 04.04.2013	
Valid until 03.04.2018	
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	**Verification** The CEN EN 15804 standard serves as the core PCR. Verification of the EPD by an independent third party in accordance with ISO 14025 ☐ internal ☒ external
Prof. Dr.-Ing. Hans-Wolf Reinhardt (Chairman of the Expert Committee (SVA))	Matthias Schulz, Independent auditor appointed by the SVA

2. Product

2.1 Product description

This EPD outlines the technical data of Rhepanol hg and hv but the results of the Life Cycle Assessment in section 5 refer exclusively to Rhepanol hg 1.8 mm (see also section 6) as its Life Cycle Assessment results also apply for Rhepanol hg 1.5 mm and Rhepanol hv 1.5 mm.

Rhepanol hg is a bitumen-compatible polyisobutylene (PIB) synthetic roofing membrane comprising PIB of high molecular weight, co-polymers and functional additives as well as a central glass fleece as an internal layer. Rhepanol hg seams are hot air welded.

Rhepanol hv is a bitumen-compatible PIB synthetic roofing membrane comprising PIB of high molecular weight, co-polymers and functional additives as well as a central woven or non-woven fabric as reinforcement. Rhepanol hv seams are hot air welded.

2.2 Application

Rhepanol hg is suitable for sealing green, gravel ballasted or used roofs. Rhepanol hg is also used as a damp-proof sheet (type A) and as a tanking sheet (type T).

Rhepanol hv is used for sealing purposes on flat and inclined roof areas in mechanically-fastened layers.

The manufacturer's installation instructions must be observed during processing.

2.3 Technical data

Rhepanol hg and Rhepanol hv

Description	Value	Unit
Water vapour diffusion resistance value µ, DIN EN 1931 (method B)	≥ 160,000	
Tensile strength (Rhepanol hg), DIN EN 12311-2 (method B)	≥ 4	N/mm²
Tensile force (Rhepanol hv), DIN EN 12311-2 (method A)	≥ 1000	N/50 mm
Tensile strain (Rhepanol hg), DIN EN 12311-2 (B)	≥ 400	%
Tensile strain (Rhepanol hv), DIN EN 12311-2 (method A)	≥ 15	%
Seam peel resistance, DIN EN 12316-2	≥ 150	N/50 mm
Seam shear resistance, DIN EN 12317-2	≥ 200 (tearing outside the seam)	N/50 mm
Resistance to abrupt loads, rigid underlay / flexible underlay, DIN EN 12691	≥ 700 / ≥ 700	mm
Resistance to static loads, DIN EN 12730 (method A/B)	≥ 20	kg
Hail, rigid underlay / flexible underlay, DIN EN 13583	≥ 20 / ≥ 30	m/s

Tear resistance, DIN EN 12310-2	≥ 150	N
Resistance to root penetration, FLL, EN 13948	Root- and rootstock-proof	
Dimensional stability after warm storage, DIN EN 1107-2	≤ 0.5	%
Folding at low temperatures, DIN EN 495-5	≤ - 60	°C
Performance when exposed to bitumen, DIN EN 1548	passed	
Resistance to chemicals, DIN EN 1847 (List in Annex C)	fulfilled	
UV radiation, DIN EN 1297	Class 0 (5000 h)	h
Water tightness, DIN EN 1928 (method B)	≥ 400	kPa

2.4 Placing on the market / Application rules

Rhepanol hg is a bitumen-compatible PIB synthetic roofing membrane with a central glass fleece in accordance with the general construction test certificates P-K 021 / 03.11 and P-K 022 / 03.11 based on DIN EN 13956 / DIN EN 13967 and DIN V 20.000-201: DE/E1 PIB-BV-E-GV-1.5 and DIN V 20.000-202: BA PIB-BV-GV-1.5.
FPC certificate no. 1343-CPD-K06-0660.10 / 1343-CPD-K06-0660.11 / 1343- CPD-K06-0660.12 / 1343-CPD-K06-0660.18
Rhepanol hv is a bitumen-compatible PIB synthetic roofing membrane with a central woven or non-woven fabric in accordance with DIN EN 13956 and DIN V 20.000-201: DE/E1 PIB-BV-V-PG-1.5.

2.5 Delivery status

Rhepanol hg: Nominal thicknesses are 1.5 mm and 1.8 mm; standard membrane dimensions are 15 m x 2.05 m x 1.5 mm and x 1.8 mm.
Rhepanol hv: Nominal thicknesses are 1.5 mm and 1.8 mm; standard membrane dimensions are 15 m x 2.05 m / 1.5 m / 1.03 m / 0.68 m x 1.5 mm and x 1.8 mm.

2.6 Base materials / Auxiliaries

Rhepanol hg comprises (20-30)% high-molecular polyisobutylene, (30-50)% co-polymers, (20-35)% functional, mineralogical aggregates, (5-10)% titanium dioxide, (0.5-2.0)% carbon black and additives (a sterically-hindered amine as a light stabiliser and a phenol as an anti-ageing agent). Rhepanol hg is also reinforced with a glass fleece as an internal layer.
Rhepanol hv has the same structure but with polyester woven or non-woven reinforcement.

2.7 Production

Rhepanol hg and Rhepanol hv compounds are produced by a continuous operating mixer in which the individual raw materials are combined to form a homogeneous mass and granulated through a perforated plate. The granulate is then added to a calender via another plasticising mixing extruder and mixing roll which shapes the membranes. A doubling calender then merges two ~~roofing~~ membranes with the central glass fleece or polyester woven or non-woven fabric. The roofing membranes are packed at the end of the doubling calender.
Production is subject to the quality management system introduced in accordance with ISO 9001 (certificate register 12 100 22279 TMS). The certification agency is TÜV Süd Management Service.
External quality monitoring and tests (are also performed by the State Material Testing Institute in Darmstadt.

2.8 Environment and health during manufacture

Over and beyond national guidelines, environmentally-friendly processes are used in the production of Rhepanol hg and Rhepanol hv, e.g.
> an electric separator is used for waste air which achieves a high degree of waste air purity,
> waste heat for heating and hot water is used in the energy-efficient production processes (EMS as per DIN 50 001) and
> the production waste incurred is redirected to the production circuit in the form of in-company recycling.
In order to ensure the health and safety of employees, workplace designs are continuously improved for the purpose of physical relief and optimised ergonomics and regular seminars are held on the topic of health and safety.

2.9 Product processing/installation

Rhepanol hg and Rhepanol hv are rolled out on the roof and joined at the seams by hot air welding.
When cleaning seams with cleaning agents containing solvents, the following points must be observed:
- Avoid contact with the skin and eyes
- Wear gloves,
- No smoking, no naked flames, avoid sparking,
- Do not inhale vapours; only use outdoors or in well-ventilated rooms.
No particular measures concerning health and safety are required when hot air welding Rhepanol hg or Rhepanol hv.
Rhepanol hg is laid loosely and ballasted e.g. with gravel or tile surfaces and under green areas.
Rhepanol hv is mechanically fastened.
More information on installation is outlined in the technical manual.

2.10 Packaging

Nine rolls of Rhepanol hg or Rhepanol hv are stored on two Euro pallets covered with a PE hood. A protective separating layer made of cardboard is between the Euro pallets and rolls and the top side of the rolls features a protective cardboard sheet. The rolls are secured by four wooden wedges. The pallet is shrink-wrapped in PE stretch foil and bound by four plastic straps.
All packaging materials are recyclable and re-usable.

2.11 Condition of use

On the basis of long-term experience, there are no relevant changes concerning material composition for the period of use of Rhepanol hg and Rhepanol hv.

2.12 Environment and health during use

There are no references to possible material emissions during the use phase for Rhepanol hg and Rhepanol hv.

2.13 Reference Service Life (RSL)

Under normal conditions and correct installation, Rhepanol hg and Rhepanol hv have a life cycle of 35 years and more.

2.14 Extraordinary effects

Fire

Description	Value
Reaction to fire tests EN 11925-2 / EN 13501-1	Class E / passed

Performance in case of external fire exposure to roofs ENV 1187 / EN 13501-5	B (t1) / passed

Comments:
Rhepanol hg: No additional requirements are made on fire safety (ballasted roofs).
Rhepanol hv: The B roof (t1) test results to ENV 1187 apply for the roof build-ups tested on behalf of FDT.

Water
The materials used for Rhepanol hg and Rhepanol hv are not water-soluble.

Mechanical destruction
There are no known negative consequences for the environment in the event of unforeseen mechanical destruction of Rhepanol hg or Rhepanol hv.

2.15 Re-use phase
Rhepanol hg and Rhepanol hv are not re-used in their original form once the use phase has expired. When separated by type, Rhepanol hg and Rhepanol hv can be directed to the "ROOF COLLECT" collection system (recycling system for synthetic roofing and sealing sheet systems). This collection system manufactures a recyclate from the old roofing membranes which can be used or re-used for a variety of applications, e.g. for garden slabs or noise-insulating boards.
Thermal utilisation is also possible with the result that the energy contained in Rhepanol hg and Rhepanol hv is released and used during incineration.

2.16 Disposal
After Rhepanol hg and Rhepanol hv have fulfilled their function, they are directed towards thermal utilisation; please refer to 2.15. The roofing sheet systems can be allocated to number 170904 or 200139 in the List of Wastes Ordinance.

2.17 Further information
More information on Rhepanol hg and Rhepanol hv in the form of brochures, data sheets, installation instructions and technical manuals can be found on the FDT Web site (www.fdt.de).

3. LCA: Calculation rules

3.1 Declared unit
The declared unit is 1 m² Rhepanol hg 1.8 mm of roof membrane produced.

Description	Value	Unit
Declared unit	1	m^2
Basis weight	1.97	kg/m^2
Strength	1.8	mm
Sealing type	Thermal welding	-

3.2 System boundary
This Life Cycle Analysis addresses the life cycle stage of product manufacturing (cradle to gate). The product stage comprises Module A1 (Raw material supply), A2 (Transport), A3 (Production) in accordance with EN 15804 including the provision of all materials, products and energy. Waste indicated in A1-A3 only concerns that which is recycled internally.

3.3 Estimates and assumptions
Polybutylene was used as a conservative estimate for polyisobutene as the exact data record for the polymer was not available. This is modelled as 100% for raw material mixtures in which one component accounts for at least 95%.

3.4 Cut-off criteria
All data from the operating data survey was taken into consideration in the analysis, i.e. all starting materials used according to the recipe, the thermal energy used as well as electricity. Transport costs were considered for all inputs and outputs.

3.5 Background data
The primary data was provided by FDT FlachdachTechnologie GmbH Co. KG. The background data was taken from the GaBi software data base offered by PE INTERNATIONAL AG (GaBi 5 2011). The German power mix was applied.

3.6 Data quality
The data recorded by FDT FlachdachTechnologie GmbH Co. KG for production year 2011 was used for the various recipes for modelling the product stage associated with the synthetic roofing membranes. All other relevant background data records were taken from the GaBi 5 software data base and are less than 7 years old. The representativity can be classified as very good.

3.7 Period under review
The data for this Life Cycle Analysis is based on data records from 2011. The volumes of raw materials, energy, auxiliaries and consumables used are considered as average annual values in the Hemsbach and Mannheim-Neckarau manufacturing plants.

3.8 Allocation
Production waste which is re-used internally (the edge trims in production) is modelled as closed-loop recycling in Modules A1-A3.

3.9 Comparability
As a general rule, EPD data can only be compared or evaluated when all of the data records to be compared have been drawn up in accordance with EN 15804 and the building context or product-specific performance features are taken into consideration.

4. LCA: Scenarios and other technical information

Disposal
It can be assumed that in 80% of current roof refurbishments the roofing membranes remains on the roof and serves as an underlay for a new covering. Accordingly, in most cases disposal of the roofing membranes occurs later when the building is demolished and this subsequent use means that it is no longer within the system boundaries considered here. Under such conditions, disposal as municipal solid waste can therefore be assumed for 20% of waste (25% incineration, 75% landfilling).
No scenarios are considered in this Life Cycle Analysis of synthetic roofing sheet systems.

5. LCA: Results

SYSTEM BOUNDARIES (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

Product stage			Construction process stage		Use stage							End-of-life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Production	Transport	Construction installation process	Use / Application	Maintenance	Repairs	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste treatment	Landfilling	Re-use, recovery or recycling potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

LCA RESULTS - ENVIRONMENTAL IMPACT: 1 m² roofing sheet system

Parameter	Unit	A1 - A3
Global Warming Potential	[kg CO_2 equiv.]	6.46E+00
Ozone Depletion Potential	[kg CFC11 equiv.]	1.49E-08
Acidification Potential of Soil and Water	[kg SO_2 equiv.]	1.93E-02
Eutrification Potential	[kg PO_4^3 equiv.]	1.19E-03
Photochemical Ozone Creation Potential	[kg ethene equiv.]	3.58E-03
Abiotic Depletion Potential non-Fossil Resources	[kg Sb equiv.]	6.68E-06
Abiotic Depletion Potential Fossil Fuels	[MJ]	1.40E+02

LCA RESULTS - USE OF RESOURCES: 1 m² roofing sheet system

Parameter	Unit	A1 - A3
Renewable primary energy as energy carrier	[MJ]	4.90E+00
Renewable primary energy as material utilisation	[MJ]	0.00E+00
Total use of renewable primary energy sources	[MJ]	4.90E+00
Non-renewable primary energy as energy carrier	[MJ]	8.59E+01
Non-renewable primary energy as material utilisation	[MJ]	6.21E+01
Total use of non-renewable primary energy sources	[MJ]	1.48E+02
Use of secondary materials	[kg]	0.00E+00
Renewable secondary fuels	[MJ]	1.74E-03
Non-renewable secondary fuels	[MJ]	1.82E-02
Net use of fresh water*	[m³]	2.74E-02

LCA RESULTS - OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² roofing sheet system

Parameter	Unit	A1 - A3
Hazardous waste for disposal**	[kg]	-
Disposed of, non-hazardous waste**	[kg]	-
Disposed of, radioactive waste**	[kg]	-
Components for re-use	[kg]	-
Materials for recycling	[kg]	-
Materials for energy recovery	[kg]	-
Exported electric energy	[MJ]	-
Exported thermal energy	[MJ]	-

** In accordance with the transition solution approved by the SVA on 4.10.2012, the following applies: LCI information on cardboard packaging does not contain sufficient information for calculating the water volume. This involves a data record in which the data for the "Blue water consumption" method is not available for evaluation. The water value depicted in the table above refers therefore to the system under review but excluding the cardboard packaging. The mass percentage of the overall product accounted for by this packaging is 0.3% for Rhepanol hg 1.8 mm. As this share < 3%, it is not regarded as significant and the parameter can be ignored even if this parameter is associated with increased uncertainty.*

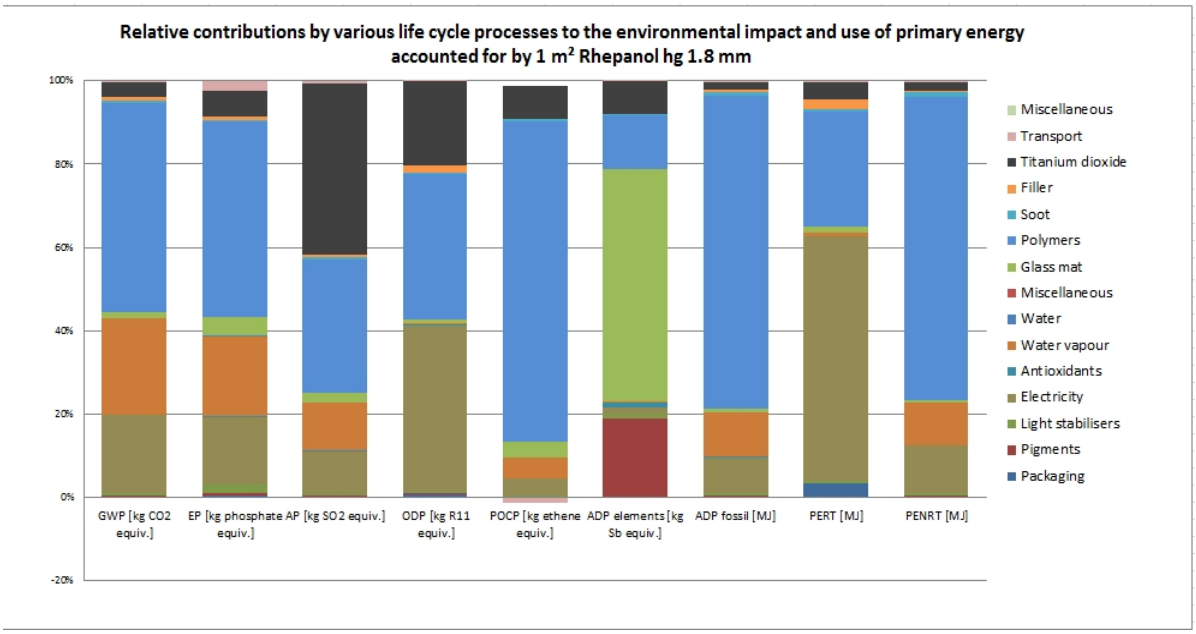
*** The Expert Committee (SVA) at IBU clearly defined the calculation rules for declaration of waste in its last meeting on 4 October 2012. The background data records from the data bases must be revised to that effect. Accordingly, this Environmental Product Declaration follows the transition solution approved by the SVA and is drawn up without a waste declaration.*

6. LCA: Interpretation

Fig. 6-1 depicts the relative contributions by the individual raw materials and processes to the various environmental impact categories and the use of primary energy in the form of a dominance analysis. This type of presentation can be used to identify the main influential factors in terms of the product's environmental performance.

Indicators of the life cycle inventory analysis
The absolute value of the use of non-renewable as primary energy carrier (PENRT) is approx. 31 times higher than the use of renewable primary energy carriers (PERT).
For Rhepanol hg 1.8 mm, 73% of the PENRT is accounted for by polymers (31% is attributable to the main polymer PIB while 42% is accounted for by the co-polymers), 12% by electricity and 10% by steam vapour. In terms of the PERT, 60% is accounted for by electricity and 29% by the polymers (11% by PIB, approx. 18% by co-polymers).
The figures are similar for Rhepanol hv 1.8 mm; the polymers are responsible for 67% of the PENRT, 11% is attributable to electricity, 10% steam vapour and 7% PES non-wovens. In terms of the PERT, 56% is accounted for by electricity, 25% by the polymers and 9% by PES non-wovens.

Indicators of estimated impacts
In the dominance analysis for Rhepanol hg 1.8 mm, it is apparent that energy (electricity and steam vapour) and PIB represent the main drivers in the various environmental categories. At 50%, the polymers have the greatest share of GWP (25% is accounted for by PIB alone), EP (polymers make up for a total of 46% while PIB accounts for 25%), POCP (polymers account for a total of 80% with PIB making up for 64%) and ADP Fossil (total polymers account for 75% with PIB accounting for 32%). Titanium dioxide R-TC 30 accounts for the greatest share of the AP (41%). Electricity consumption makes up for the largest percentage of the ODP (40%). Glass mat inlays account for the largest share of ADP Elements (56%).
In the case of Rhepanol hv 1.8 mm, the polymers account for 45% of the GWP, 44% of the EP, 29% of the AP, 31% of the ODP and 72% of the POCP. At 42%, TiO2 makes the greatest contribution towards the AP. Electricity consumption also makes up for the largest percentage of the ODP (39%).



7. Requisite evidence

No evidence is required.

8. References

Institut Bauen und Umwelt e.V., Königswinter (pub.): General Principles for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2011-06

Product Category Rules for building products Part A: Calculation rules for the Life Cycle Assessment and requirements on the background report, 2012-09

PCR 2012, Part B: PCR instructions for building-related products and services in the building products group pertaining to synthetic and elastomer roofing sheet systems (2012).

DIN EN 495-5:2012-10 Flexible sheets for waterproofing – Determination of foldability at low temperature – Part 5: Plastic and rubber sheets for roof waterproofing

DIN EN 1107-2: 2001-04 Flexible sheets for waterproofing – Determination of dimensional stability – Part 2: Plastic and rubber sheets for roof waterproofing

DIN CEN TS 1187: 2012-03 Test methods for external fire exposure to roofs

DIN EN 1297: 2004-12 Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing - Method of artificial ageing by long-term exposure to the combination of UV radiation, elevated temperature and water

DIN EN 1548:2007-11 Flexible sheets for waterproofing – Plastic and rubber sheets for roof waterproofing – Method for exposure to bitumen

DIN EN 1847:2010-4 Flexible sheets for waterproofing – Plastics and rubber sheets for roof waterproofing – Methods for exposure to liquid chemicals, including water

DIN EN 1928:2000-07 Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of water-tightness

EN 1931:2001-03, Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of water vapour transmission properties

ISO 9001:2008-12 Quality management systems – Requirements

DIN EN ISO 11925-2:2011-02 Reaction to fire tests - Ignitability of products subjected to direct impingement of flame

DIN EN 12310-2:2000-12 Flexible sheets for waterproofing – Determination of resistance to tearing – Part 2: Plastic and rubber sheets for roof waterproofing

DIN EN 12311-2:2010-12 Flexible sheets for waterproofing – Determination of tensile properties – Part 2: Flexible sheets for waterproofing

DIN EN 12316-2:2012-10 Flexible sheets for waterproofing – Determination of peel resistance of joints – Part 2: Plastic and rubber sheets for roof waterproofing

DIN EN 12317-2:2010-12 Flexible sheets for waterproofing – Determination of shear resistance of joints – Part 2: Plastic and rubber sheets for roof waterproofing

DIN EN 12691:2006-06 Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of resistance to impact

DIN EN 12703:012-06 Adhesives for paper and board, packaging and disposable sanitary products – Determination of low temperature flexibility or cold crack temperature

DIN EN 13501-1:2010-01, Classification of building products and methods by fore performance – Part 1: Classification with the Results of Tests on Fire Performance of Building Products

DIN EN 13583:2012-10 Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing - Determination of hail resistance

DIN EN 13948:2008-01 Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of resistance to root penetration

DIN EN 13956:2012-05 Flexible sheets for waterproofing - Plastic and rubber sheets for roof waterproofing - Definitions and characteristics

DIN EN ISO 14025:2009-11 Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

EN 15804:2012-04 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

DIN V 20000-201:2006-11 Use of building products in construction works – Part 201: Adaptation standard for flexible sheets for waterproofing according to European standards for use as waterproofing of roofs

DIN V 20000-202:2007-12 Use of building products in construction works – Part 202: Adaptation standard for flexible sheets for waterproofing according to European standards for use as waterproofing

DIN EN ISO 50001:2011-12 Energy management systems – Requirements with guidance for use

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