Version 4.0
August 2010

Building Code
External Moisture

Clause E2
Alternative Solution

De Boer DuO
Torch Applied Membrane

Equus Industries Limited
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Company Profile

Equus Industries Limited

COMPANY PROFILE

HISTORY

Equus Industries Limited is a private limited liability Company (#120201) incorporated in Blenheim New Zealand in 1982.

The Company commenced business, immediately after formation, as a manufacturer of specialist coating systems for commercial buildings. This remains the main thrust of the operation to this day, with additional high quality complementary products introduced to extend the range to encompass a full range of coating and waterproofing materials for all types of construction.

The Company has been an exporter of specialist lines from late 1983 to date. The Company has exported regularly to Australia, the South Pacific and South East Asia, and presently has strong links with distributors in Australia and South East Asia.

Since formation, growth has been steady and continuous at an average 15% annual compound rate. The Company now has a multi-million dollar turnover and is respected as a supplier of quality protection materials to the construction industry.

PRODUCT RANGE

Equus Industries markets a wide range of high build waterproof finishes, textured coatings, and protective coatings under the brand names Chevaline, Traxx, Protexx, Thermexx and Equus. Our expertise is particularly in the areas of high build acrylic coatings and membranes, waterborne epoxies and high solids one - and two component urethane coatings. The Company is most probably the leading Australasian manufacturer in the area of liquid-applied acrylic roofing membranes, and single-component moisture-cure urethane coatings. The Company has established very close relationships with its principal raw material suppliers in these fields, and operates in the forefront of technology in these areas.

Our prime object has been to place the Company in the position of being able to supply all finishes and waterproofing materials required to protect buildings from sub-basement to roof levels. Where the technology or manufacturing requirements are outside of our standard capabilities, the Company has secured distribution arrangements for appropriate products from leading manufacturers in their respective fields as noted under `Agencies' later in this profile.

Where appropriate, materials are covered under a Warranty system which is operated in conjunction with the Certified Applicator from the Equus Network who carries out the work on any particular project.

All products are manufactured under strict Quality Assurance standards monitored and controlled by our in-house laboratory. The Company has a TQM philosophy and is at present working within the parameters of an ISO9002 framework.

FACILITIES

The Company's production facility, laboratory and Head Office are located on 1.2 hectares of land in the Riverlands Industrial Estate, Blenheim, New Zealand.

The production equipment is modern and standardised, and the Plant has a capacity of up to 1.2 million litres of product per annum when operated on a single-shift basis. There is considerable room for expansion of the facility to cope with all requirements in the foreseeable future.

Additionally, the Company operates stores in Auckland, Wellington, Christchurch, Tauranga and Melbourne where basic stocks of commonly used products are held for immediate supply. The Company regards itself as a custom-formulator, rather than a manufacturer of conventional products, and stock holdings of standard products are rationalised for maximum stock turnover.

Technical representatives service both Clients and Certified Applicators, working from offices associated with the stores in all areas. Full technical back up to the sales staff is provided from the Head Office/Laboratory facility in Blenheim.

DISTRIBUTION NETWORK

Equus Industries Limited is not directly involved in retail sales. Distribution of Equus products is normally to Certified Applicators who are familiar with and trained in the use of the Equus range of products either in part, as Specialist Applicators for product ranges within the Network, or in total for major Applicators and those working in smaller centres.

A close relationship between Equus Certified Applicators and Equus Industries ensures that there is full co-operation on site between the Manufacturer's Supervisory/Technical Staff, and the Applicator's own staff. Quality Assurance Programmes instituted by the Manufacturer are therefore meaningful, noting that programmes are generally written for individual contracts to take in all aspects of work on that particular contract. This facet of the operation is controlled by the Company Compliance Manager. The Company is now operating within a similar framework in Australia.

DIRECTORATE

The Company was founded, and has been operated since inception, by the current Directors, who are:

Brian J Greenall BE (Chem), MNZIC, FTSC, AMIChemE
Managing Director

Marinus Wagenvoort BSc, MNZIC, ATSC
Technical Director

They have recently been joined by:

Dean Barr – Business Development Director

Rob Roxburgh – New Zealand Sales Director

Nikki Brown – Administration Director

These new Directors have all been associated with the Company for a number of years including time in Senior Management roles and bring youth, skills and vitality to ensure the continued strength of the organisation into the future.

It should be noted that the Directors and senior technical representatives have amongst them over 250 years combined experience in the surface coatings and construction industries.

ASSOCIATED PARTNER COMPANIES

As mentioned previously, Equus Industries Limited has formed a firm association with a number of companies outside New Zealand to ensure that the best possible products to fulfil market requirements, and to meet our objective of ensuring that we have available all protective materials required on a project, which can then be sourced from one supplier, generally through one Approved Applicator.

These companies include:

De Boer N.V – Belgium
Unique quality torch-on roofing and tanking membranes and ancillary products.

Kingspan Insulation Ltd - UK
Polyisocyanurate board roofing insulation.

Schomburg GMBH & Co KG - Germany
Crystalline, cementitious and bituminous waterproofing, plasters and adhesives.

RPM - Belgium/Alteco - Belgium/Germany
MMA and urethane flooring and waterproofing systems.

Texsa SA - Spain
Torch-on and self adhesive roofing and tanking membranes.
Tecsound acoustic insulation.

Tremco Pty Limited (subsidiary of Tremco Inc of USA) - Australia
Torch-on roofing and tanking membranes, construction sealants and liquid membranes.

Keimfarben GMBH & CO KG - Germany
Silicate paints and plasters.

Texmastic International Inc - USA
Self-adhesive membranes, protection board and associated materials.

Asahi Denka - Japan
Hydrophilic waterstops.

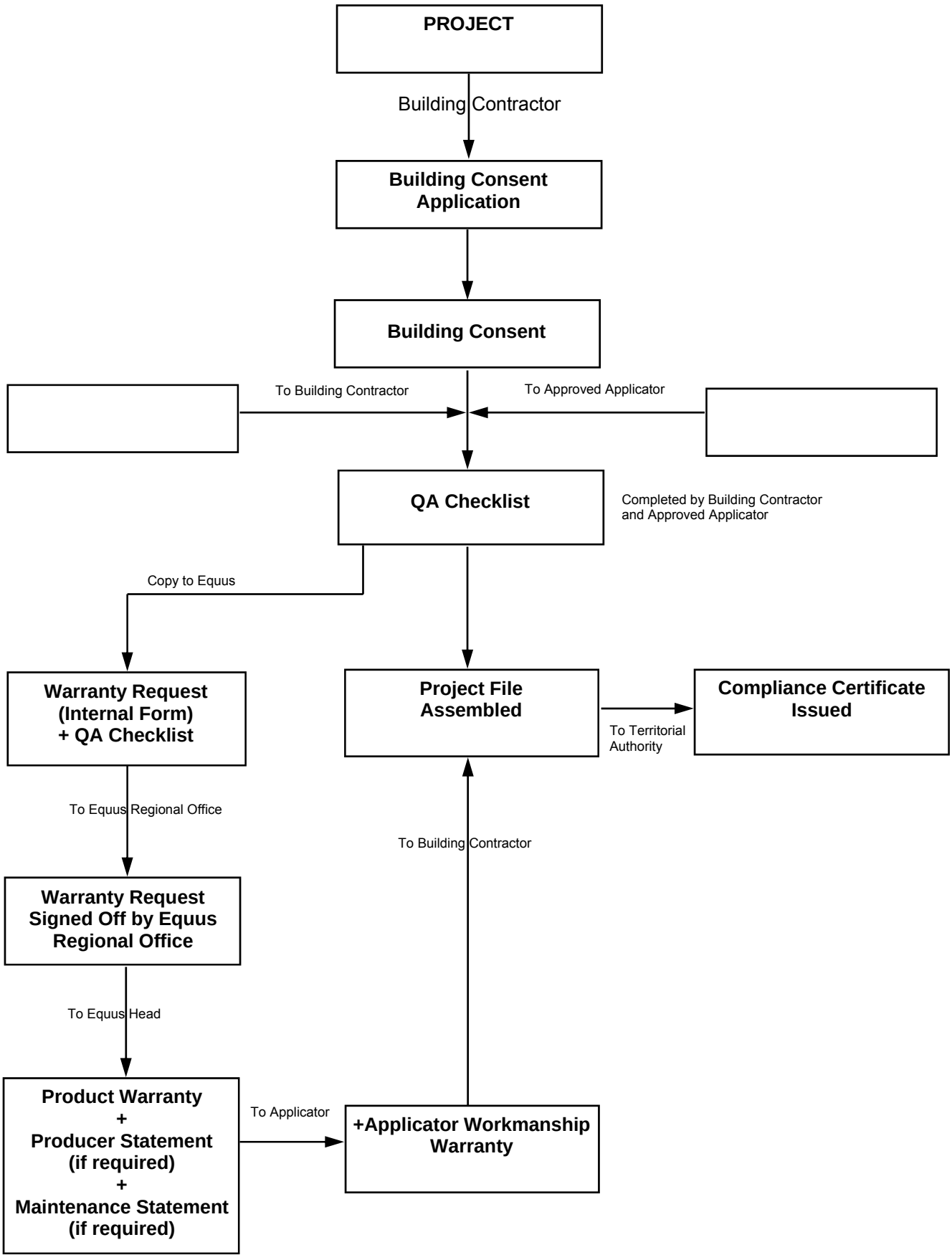
Shobond Construction Company - Japan
Epoxy Injection Systems for concrete repair.

In all cases, Equus Industries Limited has the distribution rights for the New Zealand Market.

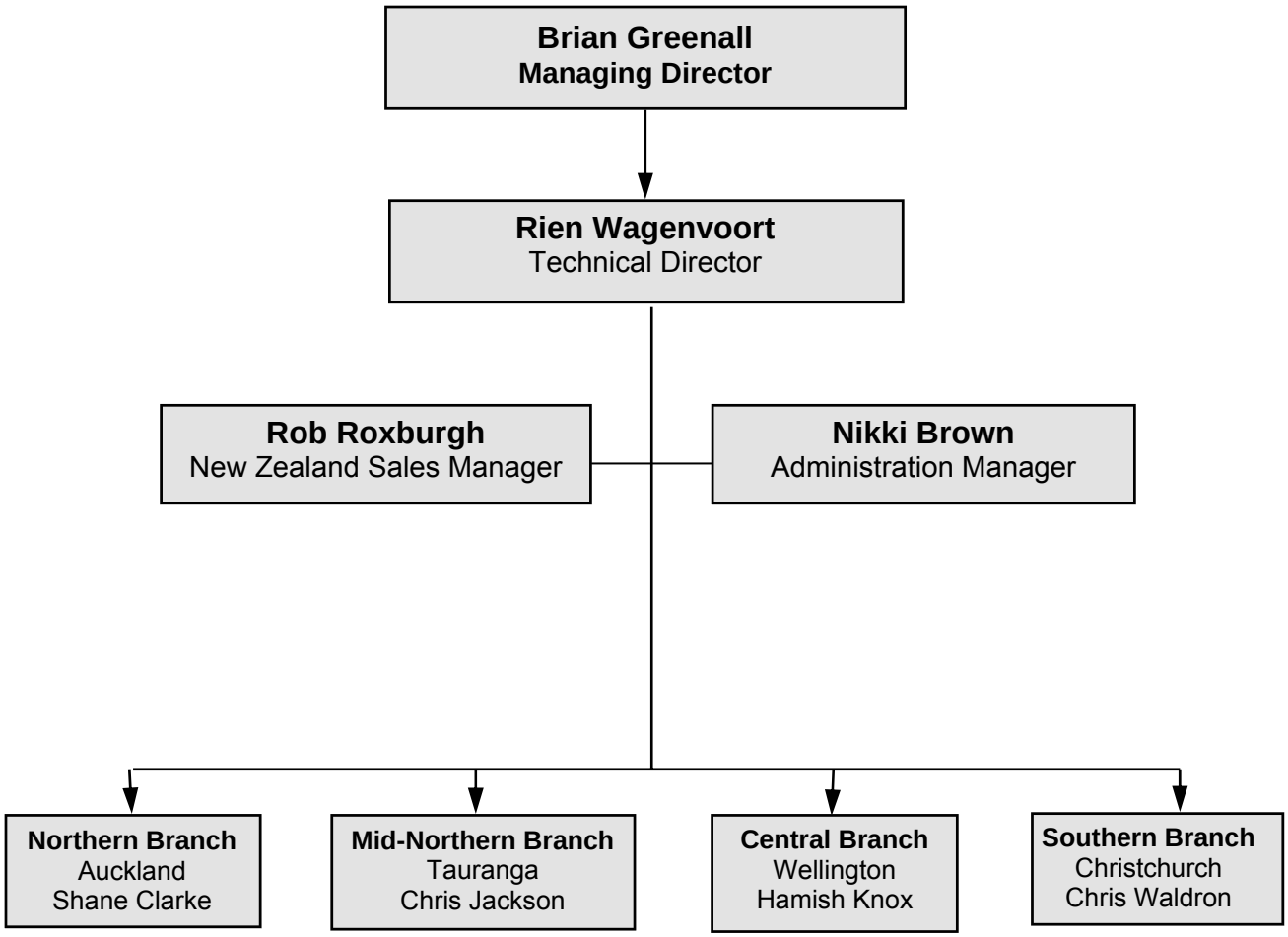
OUR MISSION STATEMENT

Through teamwork, to profitably manufacture and distribute the optimum in waterproofing and protective materials to the construction and allied industries.

Building Consent Process


PROJECT
Building Contractor
Building Consent Application
Building Consent
To Building Contractor
To Approved Applicator
QA Checklist
Completed by Building Contractor and Approved Applicator
Copy to Equus
Warranty Request (Internal Form) + QA Checklist
Project File Assembled
Compliance Certificate Issued
To Territorial Authority
To Equus Regional Office
To Building Contractor
Warranty Request Signed Off by Equus Regional Office
To Equus Head
Product Warranty + Producer Statement (if required) + Maintenance Statement (if required)
To Applicator
+Applicator Workmanship Warranty

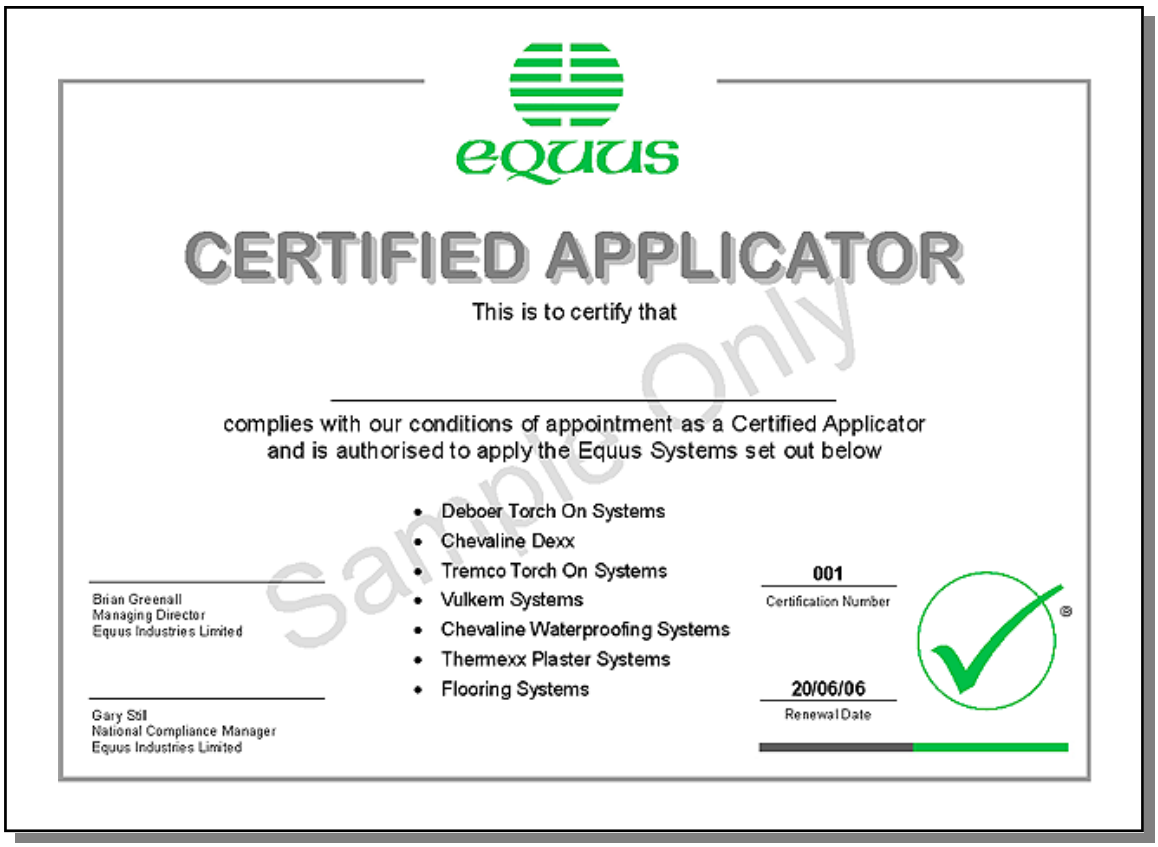
Equus Compliance Chain Of Command



Equus Industries Limited

Tick of Approval

Equus Industries is aware that the current market requires a high level of surety, not only for the performance of products that either have been manufactured locally by Equus over the last 22 years, or imported specifically for local conditions, but also that the Certified Applicator has the experience to perform the tasks covered by Equus technical requirements and also the requirements of all Regularity Authorities. The 'tick' represents our approval and certification of the applicator. The 'tick' is the achievement of experience within the industry being recognised by Equus Industries.



Approved Applicator List

A list of Certified Applicators qualified to apply De Boer DuO Torch-on Systems can be found by visiting our website at www.equus.co.nz

Specifications

Standard Specification for the application of DeBoer Duo 4.3mm Two-Layer roofing membrane to plywood surfaces with the use of timber battens to provide a rolled cap Liste finish.

Ref: P3400 Rev 1
Dated: June 2006

1.0 PREAMBLE:

This specification is for the application of a **DeBoer Duo 4.3mm**-roll roofing membrane system, in a two-layer configuration with the use of treated battens to obtain a rolled cap finish.

The two layer system consists of a basesheet of 2.5mm thick polyester reinforced **Deboplast 2.5mm APP** torched to the preprimed substrate, with the 4.3mm thick **DeBoer Duo** torched over the base-sheet to form a 6.8mm thick total system.

Duo roofing membrane provides a hard **APAO** UV-resistant but flexible coating on the upper side and an **SBS** elastic adhesive mass on the underside, both are then supported by a polyester and glass fibre combination carrier to act as a shrink-free and strong reinforcing agent.

A two-layer system as detailed has a particular advantage over a single layer system apart from being thicker and stronger. The basesheet can be laid overall to provide waterproofing and protection, while other trades carry out their tasks over the surface. Upon completion of other trade access the base-sheet is checked, repaired as required, and then the Mineral capsheet is applied as the final installation on the roof surface. This reduces the likelihood of presenting a patched new roof as can occur with single layer systems. On plywood surfaces, a two-layer system is mandated in the Membrane Group Torch-on Code of Practice (CoP).

2.0 SURFACE PREPARATION:

2.1 General - Responsibility:

Unless expressly agreed otherwise at time of contract pricing, all work in this section shall be the responsibility of the main contractor, whether carried out by his own staff, other sub-trades or the roofing membrane sub-contractor.

2.2 Plywood:

.1 Plywood Grade and Thickness – Standard: refer WA223

Plywood shall be minimum 17mm C-D structural plywood, unless otherwise expressly stipulated by the specifier. Refer to Plywood manufacturers and Torch-on CoP for ply thickness/ support centres ratio. Treated Plywood (H3.2) is to be used.

.2 Sheet Layout: refer WA223

All sheets shall be laid out so as to maximise the use of whole sheets. All sheet joints shall be laid over framing members, in a staggered brick-bond pattern (where possible), running across the fall in the roof.

.3 Sheet Spacing: refer WA223

Sheets shall be laid tight butt jointed, i.e. with sheets butted but not cramped up.
In areas where condensation is likely, prepare sheet edges with **Chevaprime PBT.**

.4 Sheet Fixing: refer WA223

Plywood must be fixed in accordance with the Manufacturers instructions taking into account wind loading, frame spacing and ply thickness.

Screw-fixing using countersunk 10g stainless steel screws, approx length 3x plywood thickness. All sheets should be laid in a bead of construction adhesive along all framing members. Where two-layer plywood surfaces are installed, the first layer may be power-nailed, but the second layer must be screw-fixed with all joints offset from the first layer. All fastener heads shall be recessed below the level of the sheet face. Generally screws shall be at 150mm centres on sheet perimeter and 200mm through the body of the sheet.

.5 Falls: Refer WA223

Falls shall be a minimum of 1:40 for roofs and 1:60 for decks, in accordance with E2/AS1 and the CoP. Where the roof falls into a gutter, the gutter shall have a good fall to outlets, generally a minimum of 1 in 50.

.6 Corners

All leading edges of plywood shall be chamfered with a 5mm radius corner. All internal corners shall have min. 20x20 H3.2 treated timber fillets installed.

.7 Outlet Types: Refer WA223

These are available in varying shapes and sizes in bronze, brass, aluminium or torch resistant polymer. Premade items are available. On smaller roofs and decks many outlets may be made in situ from sheet-galvanised steel, or copper. Refer to Equus for further assistance.

Ensure that outlets are sufficiently sized for anticipated run-off.

2.3 Battens (to be done after basesheet installation)

.1 Type

To be treated timber of at least H3.

.2 Dimensions

Timber battens are to be configured with a base 100mm wide with the top face of the batten being 50mm wide. This gives a 50mm height of the batten. The sides are angled and all sharp edges are to be lightly sanded.

.3 Fixings

All fixings are to be stainless steel screws and are to be at least 75mm in length. Pre-drill all fixings with a smaller diameter than the screw; fill with **Duokit** bitumen sealant prior to fixing through. Ensure the head of the screw is just below the top level of the batten.

.4 General

Consideration on site needs to be taken with regards to layout. The Duo capsheet is a 1 metre wide sheet with an 80mm selvedge edge. In this configuration the rolls can be laid length ways down the roof with the chipped edge of the capsheet beginning on one side of the batten which is then torched up, over and down the batten, then continued across the roof by 800mm where the selvedge edge meets the batten. This is then torched up and just on to the top of the next batten. The next roll is then torched onto the selvedged edge up, over and down the batten and continuing the sequence to the next batten.

This is but one method of applying Duo to battens. The installer must communicate with all parties concerned with respect to checking layout and dimensions prior to application of any works

3.0 MEMBRANE APPLICATION:

3.1 Primer:

To the dried and prepared surface apply one (1) full coat of **De Boer Duo Bitumen Primer** by brush/roller at a spreading rate of 5sqm/litre. Allow to dry for 4-24 hours depending upon prevailing conditions.

3.2 De Boer Deboplast 2.5mm APP (Base Sheet):

Decide the most suitable direction to follow then unroll and align the first roll, cut to length as required, re-roll both ends to the middle then torch evenly overall to both basesheet and primer as this is unrolled. Ensure even heat application. Repeat in sequence with all rolls, maintaining laps of approximately 75-80mm. This lap automatically closes during the torching process. Offset end laps in adjacent runs if possible. For application in conjunction with battens the installer shall allow to consult with all parties with respect to layout taking into consideration the final layout and expectations of the client

3.3 De Boer Duo 4.3mm Cap Sheet:

This is applied in the same manner as the basesheet. All laps shall be offset to prevent coincidence with the base-sheet laps. Following application of the cap sheet all joints are back sealed separately to ensure they are neatly and correctly closed.

If required, during the back-sealing operation, **Duo Mineral Chip** may be carefully scattered over the joint to provide a uniform appearance. This may also be carried out in areas of detailing to provide protection and uniformity of finish.

3.4 Detailing:

This shall include all outlets, pipe penetrations, gutter stop ends, parapet upstands, machinery plinths and anything above or below the roof surface. This is carried out before, during or in some cases after laying of the membrane depending on the detail type. All detailing shall be done in accordance with recommended procedures. Where special detailing accessories and chase sealants are required, confirm with Equus.

3.5 Completion:

Upon completion of the system it shall be inspected and left for a short period (up to 2-3 weeks) to stabilise. At this time the entire installation shall be rechecked prior to any warranties being issued.

Note: Any damage caused to the completed installation by other trades working over the membrane after the initial inspection shall be the responsibility of the Main Contractor, who shall arrange appropriate protection as required.

4.0 GENERAL NOTES:

4.1 Alternative Basesheet:

On regular plane roof areas, where for aesthetic reasons the number of lap joints must be minimised, it is possible to lay the **De Boer Deboplast 2.5mm APP** base sheet butt-jointed in a bead of **Duokit** with a further bead applied and tooled over the butt. This technique is not practical on irregular surfaces, and Equus should be consulted before any such decision is made.

5.0 MAINTENANCE AND WARRANTY:

5.1 Maintenance:

The finished roof areas should be inspected at least annually to ensure everything is in order; all outlets are free of blockages, the roof clear of unwanted debris, and all associated flashings and cappings are sound.

In this way any structural or mechanical damage found can be quickly and economically corrected, before leaking or severe breakdown occurs.

5.2 Warranty:

The **DeBoer Duo Two-Layer Roofing System** described in this specification may be warranted as to sheet integrity and to be waterproof for a period of up to twenty (20) years providing that:

.1 All work is carried out by an approved Equus Applicator.

.2 All work is carried out in accordance with this specification, or any amendments or additions thereto made by the Manufacturer or his Representative.

.3 The Warranty is issued in conjunction with an appropriate Maintenance Statement.

The period of warranty is determined by the situation of the installation; e.g.: old or new, substrate, plain roof or open plant roof etc. The warranty period shall be determined for any contract in consultation with the Manufacturer or his representative.

The warranty is provided to the client by the Equus Applicator carrying out the work and is backed by the Manufacturer as to the fitness for the purpose of the materials supplied for the contract.

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Standard specification for the application of De Boer Duo HT4 C180 Slate Two-Layer waterproof roofing membrane to concrete.

Specification number: P3401
Dated: March 2007

1.0 PREAMBLE:

This specification is for the application of a **De Boer Duo HT4 C180 Slate** roll-roofing membrane system, in a two-layer configuration.

The two layer system consists of a basesheet of 2.5mm thick polyester reinforced **DeBoer DeboPlast 2.5mm T/F K180** (APP-modified bitumen) torched to the pre-primed substrate, with the 4.3mm thick **DeBoer Duo** torched over the basesheet to form a 6.8mm thick total system.

Duo roofing membrane provides a hard **APAO** UV-resistant but flexible coating on the upper side and an **SBS** elastic adhesive mass on the underside. Both are then supported by a polyester and glass fibre combination carrier to act as a shrink-free and strong reinforcing agent.

A two-layer system as detailed has a particular advantage over a single layer system apart from being thicker and stronger. The basesheet can be laid overall to provide waterproofing and protection, while other trades carry out their tasks over the surface. Upon completion of other trade access the basesheet is checked, repaired as required, and then the Mineral capsheet is applied as the final installation on the roof surface. This reduces the likelihood of presenting a patched new roof as can occur with single layer systems.

De Boer Duo water proofing membrane system has been assessed for the use on roofs, decks and gutters installed on treated plywood or concrete substrate on buildings within the following scope:

Specifically designed buildings constructed to comply with the New Zealand Building Code.

2.0 SURFACE PREPARATION:

2.1 General - Responsibility:

Unless expressly agreed otherwise at time of contract pricing, all work in this section shall be the responsibility of the main contractor, whether carried out by his own staff, other sub-trades or the roofing membrane sub-contractor.

2.2 Concrete:

.1 Concrete structures must be specifically engineered to meet the requirements of the New Zealand Building Code.

When applying to existing substrates and structures, they must be thoroughly inspected to ensure that they will not affect the performance of the membrane when applied.

Curing times vary dependant on location, mixes and climate conditions. After the slab has been poured allow sufficient drying time, generally between 14 – 28 days. To verify concrete has sufficiently dried, a measurement can be taken using a hygrometer. A maximum relative humidity of 75% is required, measured at the time of membrane application.

It is not recommended that curing compounds are used. When they are, ensure that all traces of the compound are gone or removed.

.2 Shall be finished to NZS3114:1987 U3, with a light trowel texture.

.3 Shall have all ridges and protrusions stoned flush.

.4 Depressions shall be flushed with a **Thermexx** or **Chevacryl Admix-**gauged patch mix and allowed to cure at least 48 hours before overcoating.

.5 Seams should be constructed parallel with the fall, minimising ponding and flow restriction when ever possible.

Roofs shall be laid to a minimum fall of 1:40 min (1.5°) in accordance with E2/AS1
Decks shall be laid to a minimum fall of 1:60 min (1.0°) in accordance with E2/AS1
Gutters shall be laid to a minimum fall of 1:100 min (0.57°) in accordance with E2/AS1

.6 Shall have leading edges chamfered to 5mm radius and min. 20x20 cement mortar or H3.2 treated timber fillets installed in internal corners.

.7 Shall be water blast-cleaned to remove all detritus, and allowed to dry.

.8 ***Outlet Types:***

Roof and deck outlets shall be installed as per clause 8.5.6 of E2 External Moisture of the New Zealand Building Code.

Outlets shall be sized in accordance with E1 Surface Water of the New Zealand Building Code.

.9 When concrete and plywood is used as the substrate a specifically designed expansion joint is required to be installed between the dissimilar materials.

3.0 MEMBRANE APPLICATION:

3.1 Primer:

To the dried and prepared surface apply one (1) full coat of **DeBoer Duo Primer** by brush/roller at a spreading rate of 5sqm/litre. Allow to dry for 4-24 hours depending upon prevailing weather conditions.

3.2 De Boer Deboplast 2.5mm T/F K180 (APP Base Sheet):

Decide the most suitable direction to follow then unroll and align the first roll, cut to length as required, re-roll both ends to the middle then torch evenly overall to both basesheet and primer as this is unrolled. Ensure even heat application. Repeat in sequence with all rolls, maintaining laps of 70mm. This lap automatically closes during the torching process. Offset end laps in adjacent runs.

3.3 De Boer Duo HT4 C180 Slate Cap Sheet:

This is applied in the same manner as the basesheet. All laps shall be offset to prevent coincidence with the base-sheet laps. Following application of the cap sheet all joints are back sealed separately to ensure they are neatly and correctly closed.

If required, during the back-sealing operation, **Duo Mineral Chip** may be carefully scattered over the joint to provide a uniform appearance. This may also be required in areas of detailing.

3.4 Detailing:

This shall include all outlets, pipe penetrations, gutter stop ends, parapet upstands, machinery plinths and anything above or below the roof surface. This is carried out before, during or in some cases after laying of the membrane depending on the detail type. All detailing shall be done in accordance with the manufacturer's technical literature, Duo Application Manual current at the time of design, use, installation and maintenance.

3.5 Completion:

Upon completion of the system it shall be inspected and left for a short period (up to 2-3 weeks) to stabilise. At this time the entire installation shall be rechecked prior to any warranties being issued. Where possible, particularly on the deck areas, a pond-test (24 hours) should be carried out.

Note: Any damage caused to the completed installation by other trades working over the membrane after the initial inspection shall be the responsibility of the Main Contractor, who shall arrange appropriate protection as required.

4.0 MAINTENANCE AND WARRANTY:

4.1 Maintenance:

Equus Industries Limited recommends as normal maintenance, the finished roof areas are inspected every six months for cleaning and annually by a Certified Installer to ensure weather tightness and durability.

Ensure the roof and all outlets are free of blockages and clear of unwanted debris, all associated flashings and cappings are sound, the general condition of the membrane, the membrane is free from surface moss, mould or lichen.

Check all associated building elements that can impact on the durability of the membrane.

Higher risk areas such as sheet joints, substrate movement, edging, gutters, penetrations, corners, upstands, outlets and overflows require a thorough weather tight inspection on an annual basis.

4.2 Warranty:

The **De Boer Duo Two-Layer Roofing System** described in this specification may be warranted as to sheet integrity and to be waterproof for a period of up to twenty (20) years providing that:

.1 All work is carried out by a Certified Equus Applicator.

.2 De Boer Duo must be installed in accordance with the manufacturer's technical literature, Duo Application Manual current at the time of design, use, installation and maintenance

.3 The Warranty is issued in conjunction with an appropriate Maintenance Statement.

The period of warranty is determined by the situation of the installation; e.g.: old or new, substrate, plain roof or open plant roof etc.. The warranty period shall be determined for any contract in consultation with the Manufacturer or his representative.

The warranty is provided to the client by the Equus Applicator carrying out the work and is backed by the Manufacturer as to the fitness for the purpose of the materials supplied for the contract.

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Standard specification for the application of De Boer Duo HT 4 C180 Slate Two-Layer waterproof roofing membrane to plywood surfaces.

Ref: P3402
Dated: March 2007

1.0 PREAMBLE:

This specification is for the application of a **DeBoer Duo HT4 C180 Slate** roll-roofing membrane system, in a two-layer configuration.

The two layer system consists of a basesheet of 2.5mm thick polyester reinforced **De Boer DeboPlast 2.5mm T/F K180 (APP-modified bitumen)** torched to the pre-primed substrate, with the 4.3mm thick **De Boer Duo** torched over the basesheet to form a 6.8mm thick total system.

Duo roofing membrane provides a hard **APAO** UV-resistant but flexible coating on the upper side and an **SBS** elastic adhesive mass on the underside, both are then supported by a polyester and glass fibre combination carrier to act as a shrink-free and strong reinforcing agent.

A two-layer system as detailed has a particular advantage over a single layer system apart from being thicker and stronger. The basesheet can be laid overall to provide waterproofing and protection, while other trades carry out their tasks over the surface. Upon completion of other trade access the basesheet is checked, repaired as required, and then the Mineral capsheet is applied as the final installation on the roof surface. This reduces the likelihood of presenting a patched new roof as can occur with single layer systems.

De Boer Duo water proofing membrane system has been assessed for the use on roofs, decks and gutters installed on treated plywood or concrete substrate on buildings within the following scope:

Buildings where the supporting structure and associated elements is designed and constructed within the scope of New Zealand Building Code E2/AS1 clause 1.1. Specifically designed buildings constructed to comply with the New Zealand Building Code.

2.0 SURFACE PREPARATION:

2.1 General - Responsibility:

Unless expressly agreed otherwise at time of contract pricing, all work in this section shall be the responsibility of the main contractor, whether carried out by his own staff, other sub-trades or the roofing membrane sub-contractor.

2.2 Plywood:

.1 Plywood Grade and Thickness – Standard:

Plywood shall be minimum 17mm C-D structural plywood complying with AS/NZS 2269, with the sanded C face upwards.
Plywood shall be treated to a minimum grade of H3 CCA treated
The moisture content prior to installation of the membrane system must not exceed 20%.
LOSP treated plywood must not be used.

When applying to existing substrates and structures, they must be thoroughly inspected to ensure that they will not affect the performance of the membrane when applied.

Closed-in construction spaces under membrane roofs and decks shall have adequate ventilation to prevent the accumulation of moisture under the membrane. There should be a minimum gap of 20 mm between the underside of the substrate and any insulation. For roof or deck areas over 40 m2, roof vents may be required. The design of roof vent layout has not been assessed and falls outside this verification report.

.2 Sheet Layout:

All sheets shall be laid out so as to maximise the use of whole sheets. All sheet joints shall be laid over framing members, in a staggered brick-bond pattern, running across the fall in the roof in accordance with E2/AS1.

.3 Sheet Spacing:

Sheets shall be laid with a 3mm gap between all joints and not cramped up except where tongue and grooved joints are used in accordance with E2/AS1.

In areas where condensation is likely, prepare sheet edges and underside with **Chevaprime PBT.**

.4 Sheet Fixing:

Plywood must be fixed in accordance with the Manufacturers instructions taking into account wind loading, frame spacing and ply thickness.

Screw-fix using countersunk stainless steel screws, gauge 10 and a length 3 times the thickness of the plywood in accordance with E2/AS1.

All sheets should be laid in a bead of construction adhesive along all framing members. Where two-layer plywood surfaces are installed, the first layer may be power-nailed, but the second layer must be screw-fixed with all joints offset from the first layer. All fastener heads shall be recessed below the level of the sheet face. Screws shall be fixed at 150mm centres on sheet perimeter and 200mm through the body of the sheet.

Substrate framing must support the plywood at a minimum 400mm centres each way. All sheet joints must be fully supported.

The substrate preparation may change to meet "specific design" requirements or engineering requirements. Confirmation will be required prior to application.

.5 Falls:

Seams should be constructed parallel with the fall, minimising ponding and flow restriction when ever possible.

Roofs shall be laid to a minimum fall of 1:40 min (1.5°) in accordance with E2/AS1
Decks shall be laid to a minimum fall of 1:60 min (1.0°) in accordance with E2/AS1
Gutters shall be laid to a minimum fall of 1:100 min (0.57°) in accordance with E2/AS1

.6 Corners

All leading edges of plywood shall be chamfered with a 5mm radius corner. All internal corners shall have min. 20x20 H3.2 treated timber fillets installed.

.7 Outlet Types:

Roof and deck outlets shall be installed as per clause 8.5.6 of E2 External Moisture of the New Zealand Building Code.

Outlets shall be sized in accordance with E1 Surface Water of the New Zealand Building Code.

3.0 MEMBRANE APPLICATION:

3.1 Primer:

To the dried and prepared surface apply one (1) full coat of **De Boer Duo Primer** by brush/roller at a spreading rate of 5sqm/litre. Allow to dry for 4-24 hours depending upon prevailing weather conditions.

3.2 De Boer Deboplast 2.5mm T/F K180 (APP Base Sheet):

Decide the most suitable direction to follow then unroll and align the first roll, cut to length as required, re-roll both ends to the middle then torch evenly overall to both basesheet and primer as this is unrolled. Ensure even heat application. Repeat in sequence with all rolls, maintaining laps of approximately 70mm. This lap automatically closes during the torching process. Offset end laps in adjacent runs.

3.3 De Boer HT4 C180 Slate Cap Sheet:

This is applied in the same manner as the basesheet. All laps shall be offset to prevent coincidence with the base-sheet laps. Following application of the cap sheet all joints are back sealed separately to ensure they are neatly and correctly closed.

If required, during the back-sealing operation, **Duo Mineral Chip** may be carefully scattered over the joint to provide a uniform appearance. This may also be carried out on areas of detailing to provide protection and uniformity of finish.

3.4 Detailing:

This shall include all outlets, pipe penetrations, gutter stop ends, parapet upstands, machinery plinths and anything above or below the roof surface. This is carried out before, during or in some cases after laying of the membrane depending on the detail type. All detailing shall be done in accordance with the manufacturer's technical literature, Duo Application Manual current at the time of design, use, installation and maintenance.

3.5 Completion:

Upon completion of the system it shall be inspected and left for a short period (up to 2-3 weeks) to stabilise. At this time the entire installation shall be rechecked prior to any warranties being issued. Where possible, particularly on deck areas a pond test (24 hours) should be carried out.

Note: Any damage caused to the completed installation by other trades working over the membrane after the initial inspection shall be the responsibility of the Main Contractor, who shall arrange appropriate protection as required.

4.0 MAINTENANCE AND WARRANTY:

4.1 Maintenance:

Equus Industries Limited recommends as normal maintenance, the finished roof areas are inspected every six months for cleaning and annually by a Certified Installer to ensure weather tightness and durability.

Ensure the roof and all outlets are free of blockages and clear of unwanted debris, all associated flashings and cappings are sound, the general condition of the membrane, the membrane is free from surface moss, mould or lichen.

Check all associated building elements that can impact on the durability of the membrane.

Higher risk areas such as sheet joints, substrate movement, edging, gutters, penetrations, corners, upstands, outlets and overflows require a thorough weather tight inspection on an annual basis.

4.2 Warranty:

The **De Boer Duo Two-Layer Roofing System** described in this specification may be warranted as to sheet integrity and to be waterproof for a period of up to twenty (20) years providing that:

.1 All work is carried out by a Certified Equus Applicator.

.2 De Boer Duo must be installed in accordance with the manufacturer's technical literature, Duo Application Manual current at the time of design, use, installation and maintenance

.3 The Warranty is issued in conjunction with an appropriate Maintenance Statement.

The period of warranty is determined by the situation of the installation; e.g.: old or new, substrate, plain roof or open plant roof etc. The warranty period shall be determined for any contract in consultation with the Manufacturer or his representative.

The warranty is provided to the client by the Equus Applicator carrying out the work and is backed by the Manufacturer as to the fitness for the purpose of the materials supplied for the contract.

--oo0oo--

Data Sheets

Duo Primer

Solvent-base bitumen primer

BRANZ Appraised
Appraisal No.685 [2010]

Product Description:

Duo Primer is a solvent-base bitumen coating. It may be used on a dry and porous surface.

Uses:

Easily applied surface conditioning primer to use before welding or gluing of all types of De Boer modified bitumen membranes.

Characteristics:

Flashpoint:	min 40ºC (Pensky-Martens)
Viscosity at 20ºC :	+/- 25ºC Engler
Specific gravity:	+/- 0.9 kg/l (at 20ºC)
Drying time:	3-5 hours (depending on weather conditions.)
Toxicity:	solvents used meet the agreement of the Belgium Labour Protection Regulations (art. 393+ 394 R.G.P.T.)

Directions For Use:

Duo Primer is ready for use, applicable with spray equipment or by roller on clean surfaces.

Application Rate:

4 to 5 sqm/litre (on porous surfaces)
6 to 7 sqm/litre (on non-porous surfaces)

Cleaning:

Clean equipment with White Spirits or Mineral Turpentine immediately after use.

Packaging:

4 litre and 25 litre pails

Components:

Bitumen + solvent (white spirit).

Storage:

Store pails in a dry place always in upright position, out of direct sunlight. Do not store Duo Primer in the neighbourhood of open flames, because of its solvent content.

Transport Classifications:

IMDG Class 3.3
UN No. 1999

Equus Industries Ltd
PO Box 601
Blenheim
Phone: 03 578 0214 Fax 03 578 0919
Email: admin@equus.co.nz

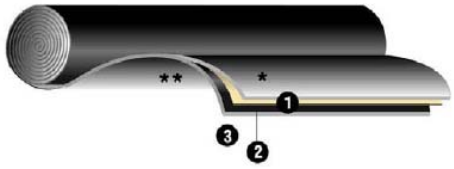
Edition 2
June 2010

DeboPlast 2.5 T/F C175

BRANZ Appraised
Appraisal No.685 [2010]

Description & Application:

A flexible waterproofing membrane consisting of a mixture of penetration bitumen, improved with APP (Atactic PolyProplene). The material is reinforced with a composite reinforcement of 175 g/m^2 polyester and glass.
Thickness 2.5 mm measured on overlap.
The upper side is finished with a mixture of talcum and sand, the underside with a sacrificial film.
It is used as an underlay for torched or mechanical application.



* Mixture of talcum and sand
1. Upper coating in APP plastomeric bitumen.
2. Composite reinforcement 175 g/m^2 of polyester and glass
3. Under coating in APP plastomeric bitumen
** Sacrificial film

Packaging:

Roll size:	1x10 m
Roll weight:	25 kg
Number of rolls on a pallet:	30

Technical Data:

Characteristic	Test method / classification	Units	Expression of result	Value or statement
Length x width	EN 1848-1	m x m	MLV ≥	10 x 1
Thickness	EN 1849-1	mm	MDV ± 5%	2.5
Visual defects	EN 1850-1	-	Visual defects	none
Straightness	EN 1848-1	-	Pass/no pass	Pass
Reaction to fire	EN 13501-1	-	In accordance with prEN13501-1	F
Tensile strength (L/T)	EN 12311-1	N/50 mm	MDV ± 20%	820/620
Elongation	EN 12311-1	%	MDV ± 15 abs	45
Resistance to tearing (nail shank) (L/T)	EN 12310-1	N	MDV ± 50	300
Dimensional stability	EN 1107-1	%	MLV ≤	0.5
Flexibility at low temperature	EN 1109	°C	MLV ≤	-5
Flow resistance at elevated temperature	EN 1110	°C	MLV ≥	145
Water tightness	EN 1928:2000 A or B	-	Pass/no pass	Pass

MDV: Manufacturer's Declared Value
MLV: Manufacturer's Limiting Value

Health & Safety:

Duo Bitumen Primer is solvent-based and must be used with adequate ventilation. Remove all naked flames and sources of ignition. Adequate ventilation is required to minimise exposure to bitumen fumes during the torching process. Material Safety Data Sheet (MSDS) must be read and understood prior to use of product.

Storage:

Duo rolls should be stored in a dry area, always in an upright (vertical) position. Do not lay rolls flat (horizontal) when storing.

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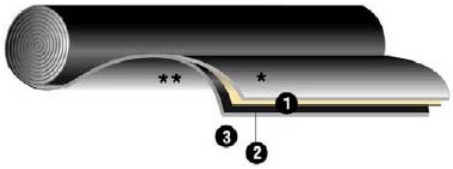
Edition 3
June 2010

DeboPlast 2.5 T/F K180

BRANZ Appraised
Appraisal No.685 [2010]

Description & Application:

A flexible waterproofing membrane consisting of a mixture of penetration bitumen, improved with APP (Atactic PolyProplene). The material is reinforced with a non woven polyester of 180 g/m^2.
Thickness 2.5 mm measured on overlap.
The upper side is finished with a mixture of talcum and sand, the underside with a sacrificial film.
It is used as an underlay for torched or mechanical application.



* Mixture of talcum and sand
1. Upper coating in APP plastomeric bitumen.
2. Composite reinforcement 180 g/m^2 of polyester
3. Under coating in APP plastomeric bitumen
** Sacrificial film

Packaging:

Roll size:	1x10 m
Roll weight:	25 kg
Number of rolls on a pallet:	30

Technical Data:

Characteristic	Test method / classification	Units	Expression of result	Value or statement
Length x width	EN 1848-1	m x m	MLV ≥	10 x 1
Thickness	EN 1849-1	mm	MDV ± 5%	2.5
Visual defects	EN 1850-1	-	Visual defects	none
Straightness	EN 1848-1	-	Pass/no pass	Pass
External fire performance	ENV 1187	-	In accordance with prEN13501-5	NPD
Reaction to fire	EN 13501-1	-	In accordance with prEN13501-1	F
Tensile strength (L/T)	EN 12311-1	N/50 mm	MDV ± 20%	820/620
Elongation	EN 12311-1	%	MDV ± 15 abs	45
Resistance to tearing (nail shank) (L/T)	EN 12310-1	N	MDV ± 50	300
Dimensional stability	EN 1107-1	%	MLV ≤	0.5
Flexibility at low temperature	EN 1109	°C	MLV ≤	-5
Flow resistance at elevated temperature	EN 1110	°C	MLV ≥	145
Water tightness	EN 1928:2000 A or B	-	Pass/no pass	Pass

Health & Safety:

Duo Bitumen Primer is solvent-based and must be used with adequate ventilation. Remove all naked flames and sources of ignition. Adequate ventilation is required to minimise exposure to bitumen fumes during the torching process. Material Safety Data Sheet (MSDS) must be read and understood prior to use of product.

Storage:

Duo rolls should be stored in a dry area, always in an upright (vertical) position. Do not lay rolls flat (horizontal) when storing.

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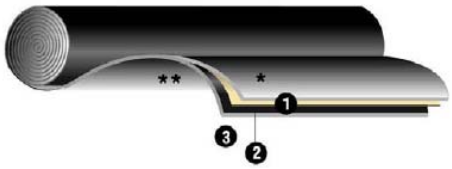
Edition 3
June 2010

DeboFlex 2.5 T/F C175

BRANZ Appraised
Appraisal No.685 [2010]

Description & Application:

A flexible waterproofing membrane consisting of a mixture of penetration bitumen, improved with SBS (Styrene Butadiene Styrene). The material is reinforced with a composite reinforcement of 175 g/m^2 polyester and glass.
Thickness 2.5 mm.
The upper side is finished with a mixture of talcum and sand, the underside with a sacrificial film.
It is used as an underlay for torched or mechanically fixed application or as a vapour control layer..



* Mixture of talcum and sand
1. Upper coating in SBS elastomeric bitumen.
2. Composite reinforcement 175 g/m^2 of polyester and glass
3. Under coating in SBS elastomeric bitumen
** Sacrificial film

Packaging:

Roll size:	1x10 m
Roll weight:	25 kg
Number of rolls on a pallet:	30

Technical Data:

Characteristic	Test method / classification	Units	Expression of result	Value or statement
Length x width	EN 1848-1	m x m	MLV ≥	10 x 1
Thickness	EN 1849-1	mm	MDV ± 5%	2.5
Visual defects	EN 1850-1	-	Visual defects	none
Straightness	EN 1848-1	-	Pass/no pass	Pass
Water vapour properties (μ)	EN 12524	-	Fixed Value	20.000
Reaction to fire	EN 13501-1	-	In accordance with prEN13501-1	F
Tensile strength (L/T)	EN 12311-1	N/50 mm	MDV ± 20%	780/650
Elongation	EN 12311-1	%	MDV ± 15 abs	30
Resistance to tearing (nail shank) (L/T)	EN 12310-1	N	MDV ± 50	300
Flexibility at low temperature	EN 1109	°C	MLV ≤	-15
Flow resistance at elevated temperature	EN 1110	°C	MLV ≥	110
Water tightness	EN 1928:2000 A or B	-	Pass/no pass	Pass

MDV: Manufacturers Declared Value
MLV: Manufacturers Limiting Value

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Edition 3
June 2010

Duo HT 4 Slates/F C180

Technical approvals: Butgb ATG 1924, KOMO certificate, CTG-056, NL-BSB, BBA no 98/3537

BRANZ Appraised
Appraisal No.685 [2010]

Description & Application:

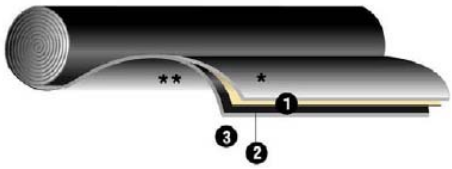
A flexible waterproofing membrane with a dual reinforcement and a double polymeric bitumen coating. The upper coating consists of APAO (Amorphous Poly Alpha Olefins) - modified bitumen, resulting in a high mechanical resistance and is UV resistant. The undercoating consists of SBS (Styrene Butadiene Styrene) - modified with high elasticity and strong adhesion properties. The selvedge is coated with SBS modified bitumen to ensure a SBS-SBS seal. This provides and easy application technique and perfectly sealed joints.

The composite reinforcement of polyester and glass scrim, (180 g/m^2) combine to provide strength and stability. The upper side is finished with mechanically pressed in, coloured slates; and the underside is finished with a sacrificial film.

This membrane is especially designed as a cap sheet for multi-layer or single layer torched applications.

Packaging:

Roll size:	1x8 m
Roll weight:	+/- 37 kg
Number of rolls on a pallet:	23



* Upper finishing: coloured slates
1. Upper coating in APAO plastomeric bitumen.
2. Composite reinforcement 180 g/m^2 of polyester and glass scrim
3. Under coating in SBS elastomeric bitumen

** Under finishing: sacrificial film

Technical Data:

Test (Units)	Mean results	Method
Ring & ball (°C) APAO top coating SBS under coating	 154.5 128	 MOAT 30:6G MOAT 31:6G
Low temperature flexibility (°C) APAO top coating SBS under coating	 -15 -20	 EN 1109 EN 1109
Heat resistance (°C)	≥ 110	EN 1110
Fatigue cycling	pass	MOAT 64 :4.3.5
Tensile strength (N/50mm) Longitudinal Transversal	 1101 702	 MOAT 30:6C MOAT 30:6C
Elongation at break (%) Longitudinal Transversal	 65 56	 MOAT 30:6C MOAT 30:6C

Technical Data continued:

Test (Units)	Mean results	Method
Tear resistance (N) Longitudinal Transversal	 229 260	 MOAT 27:5.4.1 MOAT 27:5.4.1
Dimensional stability (%) Longitudinal Transversal	 -0.3 -0.2	 MOAT 27:5.1.6 MOAT 27:5.1.6
Static indentation	L_{25}	EN 12730
Dynamic indentation	I_{10}	EN 12691

Health & Safety:

Duo Bitumen Primer is solvent-based and must be used with adequate ventilation. Remove all naked flames and sources of ignition. Adequate ventilation is required to minimise exposure to bitumen fumes during the torching process. Material Safety Data Sheet (MSDS) must be read and understood prior to use of product.

Storage:

Duo rolls should be stored in a dry area, always in an upright (vertical) position. Do not lay rolls flat (horizontal) when storing.

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Edition 3
June 2010

Duo **à la carte.**

You ask, we deliver.

DUO LANDSCAPE
Complete with a root suppressant additive which stops roots and moss from forming.

Application:
Garden roofs, flower troughs.
Underground application where there is a risk of root penetration.

DUO AERO
Under finishing complete with soft elastomere bitumen ribbons.

Application:
Upper layer with vapour distributing function.

DUO BRIDGES & TUNNELS
Complete with harder coatings and an armature consisting of polyester and glass reinforcement. Ideal for waterproofing of bridges and parking decks in combination with a specific asphalt protection layer.

Application:
Bridges and works of art with specific requirements.

DUO FIRECARE
Complete with a fire retardant additive and fireproof reinforcing layer, which makes the product resistant to fire spread according to the DIN 4102/7 and prEN-1187-1 standard test.

Application:
Obligatory fire-safe seals.

DUO MECANO
Complete with an additional wide overlay of 13cm and especially adapted reinforcement. When the membrane is fastened by mechanical means this allows an extra overlay width to be created which is compatible with existing norms for single-layer sealing. Composite reinforcement with extra tear strength.

Application:
Single-layer sealing with mechanical fastening.

DUO NO FLAME
Complete with a micro-perforated polypropylene under-side finish for optimal adhesion with the cold adhesive. In conjunction with DUO elastomere adhesive this makes the membrane especially suitable for all cold adhesive applications.

Advantages:
No vapour-distribution layer required.
Fireproof installation possible by joining with hot air equipment.

The spin-off from the Duo concept has led to a number of specific applications in a minimum of time. The basic ingredients and benefits remain the same, and by adding a number of specific additives, we can create a complete range of Duo products for a variety of applications and techniques.

Colour Selection:

AGR-F (Black)

WGG (White Green Grey)

BO (Terracotta)

GW (Concrete)

Equus Industries Limited
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Email: admin@equus.co.nz

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Fax: 03 379 9122
Email: southern@equus.co.nz

Central:
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Ph: 04 576 0333 Fax: 04 576 0334
Email: central@equus.co.nz

Mid-Northern:
31 Totara Street, Mt Maunganui
Ph: 07 575 4362 Fax: 07 575 4387
Email: midnorthern@equus.co.nz

Northern:
Unit D, 1 Henry Rose Pl., Albany, Auckland
Ph: 09 415 4314 Fax: 09 415 4315
Email: northern@equus.co.nz

Quality Assurance Checklists

Quality Assurance

De Boer Duo 4.3mm

Two layer membrane system
Plywood and Concrete

Specification No: P3401 / P3402 **Warranty No:** _____

Project & Address: _____

_____

Certified Applicator: _____

Building Owner: _____

Property Manager: _____

1. Statement of Intent

(a) This checklist is to be completed by both the Equus Applicator and the Equus Technical Consultant, as a step by step record of compliance with both the Equus Specification provided for the contract, and the requirements of the Manufacturers for Warranty
(b) A copy of this checklist must be forwarded to the nearest Regional Office of Equus Industries Ltd. A Warranty will not be issued by Equus Industries Ltd. without a copy of this Checklist being filed.
(c) A copy of this checklist should form part of the Contract Documentation filed with the Property Manger on job completion.

2. Areas Treated

The areas to which Membrane is applied are detailed below, with reference to plans (where appropriate).

_____

_____

_____

3. Sign Off

We confirm that all applicable processes listed in Section 4 have been correctly completed and that sign-off on each stage has been made by a person with the authority to do so.

For: _____ _____ (Signature)
(Building Contractor)
Date: / / _____ (Name)

For: _____ _____ (Signature)
(Equus Applicator)
Date: / / _____ (Name)

4. Checklist And Method Statement

No.	Process	Completed On	Building Contractor	Equus Contractor
1.	**Concrete:** Refer to specification P3401 March 2007 2.2 Concrete. Must be complied with for curing times.			
2.	Concrete to have all ridges and protrusions stoned flush.			
3.	Shall be finished to NZS3114:1987 U3, with light trowel texture.			
4.	Depressions flushed with **Thermexx** or **Chevacryl Admix** and allowed to cure 48 hours before overcoating.			
5.	Falls on concrete roofs to be in accordance with E2/AS1 unless otherwise specified. Refer P3401 Specification.			
6.	Roof & deck outlets shall be sized and installed as per the NZ Building Code unless otherwise specified.			
7.	**Plywood:** shall be a minimum 17mm C-D structural plywood H3 CCA treated. Where condensation likely, prepare all edges and undersides with **Chevaprime PBT** prior to installation.			
8.	All sheets laid out to maximise use of whole sheets. All sheet joints to be laid over framing members. Refer to sheet layout in specification.			
9.	Sheets shall be laid in accordance with E2/AS1 unless otherwise specified. Refer to Sheet Spacing on specification.			
10.	Screw fixing using countersunk stainless steel screws, gauge 10 and a length three times the thickness of the plywood in accordance with E2/AS1. Refer Specification			
11.	With two layer plywood installation the first layer may be power–nailed but second layer screw fixed.			
12.	Falls shall be in accordance with E2 AS1 with seams being parallel with the fall to minimise ponding and flow restriction whenever possible.			
13.	Certified Equus Applicator/Main Contractor/Builder all to be satisfied with the installation of the plywood surface.			
14.	Apply one full coat of **De Boer Duo Primer,** refer to specification for spread rates and drying/curing times. This is weather dependant.			
15.	Check that **Deboplast 2.5mm T/F K180** (APP Basesheet): is installed as per the specification, maintaining laps of 70mm.			
16.	Check **De Boer Duo HT4 C180 Slate** Capsheet: is offset to the base sheet and capsheet is applied in the same manner as the basesheet. Ensure all joints are back sealed, neatly and correctly closed. Refer to specification.			
17.	Detailing shall occur on all outlets, pipe penetrations, gutter stops ends, parapet upstands, machinery plinths and anything above or below roof surface. Refer Duo Application Manual.			
18.	Roof membrane must be inspected and signed off on completion by all parties (Applicator/Main Contractor/ Builder).			
19.	Re-inspect after two to three weeks to check for surface damage by others.			

Warranty

Equus Industries Ltd.
Sheffield Street
Riverlands
PO Box 601
Blenheim
Phone: 03 578 0214
Fax: 03 578 0919
Email: admin@equus.co.nz
Web: www.equus.co.nz

WARRANTY/PRODUCER STATEMENT REQUEST FORM

Date: _____

Project: _____

Tick Document Required	
Warranty	☐
Producer Statement	☐

Spec. No: _____ **Warranty Period:** _____

Owner: _____ **Ph:** _____

Site Address: _____

Post Code: _____

Building Consent No: _____ **Date Issued:** _____

Issuing Territorial Authority: _____

Building Contractor: _____

I/We _____ have undertaken work at the above address in accordance with Equus Specification No. _____

I/We confirm that the work was completed in a tradesman like manner using products supplied by Equus Industries Ltd.

SPECIFIC AREAS PERTAINING TO WARRANTY / PRODUCER STATEMENT:

_____

_____

_____

Please use separate sheet if required (attach to this form).

COMMENTS IN RELATION TO PROJECT WHICH MAY AFFECT WARRANTY/PRODUCER STATEMENT:

_____

_____

_____

_____

Please use separate sheet if required (attach to this form).

Photos of project attached or emailed: ☐ **Yes** ☐ **No**

The undersigned agrees to comply with all conditions of his appointment as an **Approved Equus Applicator.**

Date: _____ Authorised Signatory: _____ Certificate No. : _____

Completed project sighted and signed off: _____ Equus Representative

Date: _____

PRODUCER STATEMENT

(INSERT DEBOER PRODUCT APPLIED) TO
FLAT ROOFS AND DECK AREAS

Building Type:
Location:
Owner:
Building Contractor:
Equus Certified Applicator:
Building Consent #:

Ref: Date:

This statement confirms the following

1. Inspection
The above completed _____ has been inspected by an Approved Person employed by Equus Industries Ltd and the standard of installation has been found to be satisfactory.

2. Applicable Specification
The _____ has been applied to flat roof and deck areas in accordance with Equus Standard Specification _____, which was the applicable specification at the time of installation.

3. Compliance
When the _____ has been applied to flat roof and deck areas in accordance with Standard Specification _____ and the recommendations of Equus Industries Ltd, it complies with and meets the relevant provisions of the New Zealand Building Code Clauses:

B2 – Durability
E2 – External Moisture
E3 – Internal Moisture
F2 – Hazardous Building Materials

4. Recommended Maintenance
It is recommended that the installation be inspected six monthly for cleaning and annually to ensure that all drainage points are clear and working and that no detrimental mechanical damage has been caused to the membrane. Any such damage must be repaired immediately. This is a requirement in terms of compliance with clause B2-Durability of the New Zealand Building Code.

For Equus Industries Ltd.

B J Greenall B.E.(Chem) AMIChemE MNZIC FTSC
Director

Project Name
Address
(Building Contractor - ….)
(Building Consent - #### - Territorial Authority)
DE BOER DUO (insert product) TO FLAT ROOFS AND DECK AREAS
(Standard Specification _____)

Dear Sirs

Further to our discussions regarding a material warranty covering coating materials supplied for the above contact, we would confirm the Terms and Conditions of the Warranty as set out in this letter as follows:

1. **Limitations of Cover:**

   The terms and conditions of Warranty as set out in this letter refer specifically to materials supplied by Equus Industries Limited ('Equus'), acting as Sales Agents for De Boer N.V, (De Boer), Metropoolstraat 33, 2900 Schoten, Belgium, who are the Manufacturers of the materials. The materials supplied to your Company as an Certified Applicator of De Boer Materials.

2. **Warranty Cover:**

   The Warranty covers quality and suitability for use of materials supplied for exterior application and relates to film integrity in the sense that it covers waterproofing integrity of the applied membrane.

3. **Warranty Period:**

   The maximum period for which such materials are covered by a materials warranty is fifteen (15) years from such date as stipulated in any form of warranty entered into by (Certified Applicator Name).

4. **General Terms and Conditions:**

   (a) This warranty is applicable only to materials manufactured by De Boer, supplied by Equus Industries Ltd., and applied by (Certified Applicator Name) on the above contract.

   (b) This warranty is supplied to (Certified Applicator Name) as the purchase of materials. It is not an application or Process Performance Warranty and may not replace or supplant any warranty required of (Certified Applicator Name) for application/process performance.

   (c) The warranty is valid only for the satisfactory performance of materials which are applied to this contract strictly in accordance with specifications supplied for this contract, information contained in relevant Know How's, and any other specific written instructions supplied by De Boer or Equus Industries Ltd., or amendments thereto.

5. **Limitation of Liability:**

No responsibility is taken by Equus or De Boer., for any failure of the applicator to apply materials in the correct manner to correctly nominated, prepared and designed surfaces. No responsibility is taken by Equus or De Boer., for any alteration to performance of the materials caused by work carried out on the coated surfaces without prior written approval of Equus, or any change in the use of the coated structure from that pertaining at the time coating work was completed.

There shall be no liability for Equus or De Boer in respect of damage to or deterioration in performance of the coatings caused by Act of God, exceptional weather conditions, fire or riot civil commotion, vandalism, nuclear explosions or fall out, damage caused by objects dropped from above, bursting or other forms of destruction or failure of gas or fluid carrying pipes or other vessels, electrical faults, negligence or willful damage by the main contractor, owner and/or occupier of the building and/or any visitors to the building on which the coatings are applied, or any criminal act, or any consequential damage, or any physical damage from mechanical causes, spillage of any substance or disruption of the surface to which the coatings are applied by any natural disturbance of the structure.

6. **Indemnity:**

If it is established that faulty materials have been supplied to (Certified Applicator Name), for this contract and the Terms and Conditions set out above have been satisfied, Equus or De Boer., will there by indemnify (Certified Applicator Name), against the costs of rectification or upgrading of any coated surfaces where such materials have been used, so that the original warranty period and performance are met.

7. **Payment for Materials:**

This warranty shall not be binding on Equus until payment in full is received by Equus Industries Ltd for materials supplied to (Certified Applicator Name) for the contract described above.

8. **Disputes:**

Should there be any dispute in regard to any provisions of this warranty or the manner in which it is exercised or interpreted, the decision of an independently appointed arbitor will be accepted as final and binding.

Yours faithfully

EQUUS INDUSTRIES LTD
Brian J Greenall
Director

Workmanship Warranty
Sample

WORKMANSHIP AND APPLICATION
WARRANTY

Certified Number:_____
Consent Number:_____
Issuing Authority :_____

To _____**(the Client)**

We (Applicator Company Name) an Certified Equus Applicator

having completed our contract on

(Project Name/Location)

with the (Name of Equus System)

Hereby undertake that we will rectify at our own cost, any failure in performance by the above mentioned system or systems resulting from defective workmanship and application or incorrect system nomination by the Applicator, which occurs within the period of ..... years from the date of completion of our contract.

Namely
.....

The systems nominated in this Warranty have been applied as fully representative of the Manufacturer's current specification for each system to permit performance as claimed for that system.

Our liability under this Warranty is subject to the following terms and conditions:-

1. The Warranty shall not be binding on the Applicator until payment in full is received by the Applicator in respect of the above described contract.

2. This Warranty shall be void and of no effect, and the Applicator shall have no liability in respect thereof, if the Applicator is not given notice in writing of any alleged failure or fault or deterioration relating to the processes within seven days of the discovery by the Client if such alleged failure, fault or deterioration.

3. In the event of liability being established pursuant to this Warranty the Applicator shall repair and reinstate the systems as may be required to make good the areas requiring repair PROVIDED that the Applicator shall be entitled to demand and be reimbursed by the Client for all expenses incurred in the investigation of any alleged failure, fault or deterioration, if, on investigation and in accordance with the foregoing terms and conditions, it is found that this Warranty shall not apply, and it shall not be the responsibility under the terms of this Warranty for the Applicator to rectify such alleged failure, fault or deterioration.

4. The Applicator does not warrant that any repair work carried out pursuant to the terms of this Warranty when completed shall exactly match the existing applied systems in respect to colour and/or texture.

5. All other warranties, guarantees or conditions of whatsoever nature, relating to the application of the systems and whether expressed, implied or given to be expressed, implied or given by any agent or employee of the Applicator, or implied or prescribed, or to be implied or to be prescribed by law are hereby excluded.

6. There shall be no liability for the Applicator in respect of this warranty for any damage to the applied processes caused by act of God, exceptional weather conditions, fire, war, riots, civil commotion, vandalism, nuclear explosion and/or fallout, damage caused by objects dropping or falling from aeroplanes or other airborne devices, bursting or other forms of destruction or failure of gas or fluid carrying pipes or other vessels, electrical faults including fusion and short circuits, negligence or wilful damage by the main contractor, owner and/or occupier of the building and/or visitors to the building on which the processes are placed, and any criminal act or illegal act or any consequential damage.

7. There shall be no liability for the Applicator for any deterioration of the applied system resulting from physical damage by point loads or mechanical causes, spillage of any substance onto the surface however caused whether during construction work or thereafter which were not allowed for in the original design and specification contract documents or arising from any natural disturbance of the structure.

8. This Warranty is null and void if any work is carried out on the applied system without prior written consent of the Applicator or if a change in use of the building from that of which it was designed at the time of completion of the Applicator's contract affects the performance of the application.

9. The benefit of this Warranty is not assignable without prior written consent of the Applicator.

Signed .....

For .....
(APPLICATOR COMPANY)

A copy of the Warranty from Equus Industries Limited WW .....

Dated ....., for materials supplied for this contract, is appended herewith.

Certification

BRANZ Apprasial
No. 685 (2010)

BRANZ Appraised
Appraisal No.685 [2010]

BRANZ Appraisals

Technical Assessments of products for building and construction

BRANZ APPRAISAL No. 685 (2010)

DE BOER DUO ROOF MEMBRANE SYSTEMS

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WFTAO

Product

1.1 De Boer DuO Roof Membrane Systems are waterproofing membranes for nominally flat, pitched and curved roofs, gutters and parapets. They are installed as multi-layer system with a mineral chip finished product or as a single layer system onto a concrete substrate with traffic protection such as paving slabs or a topping screed if required.

1.2 The products are supplied as torch-on, reinforced, polymer-modified bitumen sheets in roll form.

Scope

2.1 De Boer DuO Roof Membrane Systems have been appraised as roof waterproofing membranes on buildings within the following scope:

- the scope limitations of NZBC Acceptable Solution E2/AS1, Paragraph 1.1 with respect to building height and maximum floor plan areas; and,
- with building structures designed and constructed to meet the requirements of the NZBC; and,
- with roof supporting structures of timber framing with substrates of plywood; and,
- with substrates of suspended concrete slabs; and,
- situated in NZS 3604 Building Wind Zones, up to, and including 'Very High'.

2.2 De Boer DuO Roof Membrane Systems have also been appraised for use as roof waterproofing membranes on specifically designed buildings within the following scope:

- with building structures designed and constructed to comply with the NZBC; and,
- with roof supporting structures of timber framing with substrates of plywood; and,
- with substrates of suspended concrete slab; and,
- subjected to maximum wind pressures (Refer Paragraph 8.1); and,
- with the weathertightness design of all junctions being the subject of specific design by the designer.

Note: The design of these junctions has not been appraised by BRANZ and is outside the scope of this Appraisal.

2.3 Roofs waterproofed with De Boer DuO Roof Membrane Systems must be designed and constructed in accordance with the following limitations:

- nominally flat, curved or pitched roofs constructed to drain water to gutters and drainage outlets complying with the NZBC; and,
- constructed to suitable falls (Refer Paragraph 14.3 and 14.4); and,
- with no integral roof gardens.

2.4 The design and construction of the substrate and movement and control joints is specific to each building, and therefore is the responsibility of the building designer and building contractor and is outside the scope of this Appraisal.

2.5 The membranes must be installed by Equus Industries Ltd Certified Applicators.

Building Regulations

New Zealand Building Code (NZBC)

3.1 **In the opinion of BRANZ, De Boer DuO Roof Membrane Systems, if designed, used, installed and maintained in accordance with the statements and conditions of this Appraisal, will meet the following provisions of the NZBC:**

Clause B2 DURABILITY: Performance B2.3.1 (b), 15 years. De Boer DuO Roof Membrane Systems meet this requirement. See Paragraph 10.1.

Clause E2 EXTERNAL MOISTURE: Performance E2.3.1 and E2.3.2. De Boer DuO Roof Membrane Systems meets these requirements. See Paragraphs 14.1 – 14.9.

Clause F2 HAZARDOUS BUILDING MATERIALS: Performance F2.3.1. De Boer DuO Roof Membrane Systems meet this requirement and will not present a health hazard to people.

3.2 This is an Appraisal of an **Alternative Solution** in terms of New Zealand Building Code compliance. The membranes are an alternative to the membranes specified in NZBC Acceptable Solution E2/AS1, and an Alternative Solution subject to specific design for other buildings not covered within E2/AS1.

Technical Specification

4.1 Materials supplied by Equus Industries Ltd are as follows:

DeboPlast 2.5 mm T/F K180

– is a 2.5 mm thick, APP modified bitumen-based sheet waterproofing membrane with a mixture of talcum and sand on the upper surface and an ultra thin Polyethylene foil on the under layer used as a base layer in multi layer systems. It has a 180g/m² polyester reinforcement and is supplied in 1 m x 10 m rolls.

DeboFlex 2.5 mm T/F K180

– is a 2.5 mm thick, SBS modified bitumen-based sheet waterproofing membrane with a mixture of talcum and sand on the upper surface and an ultra thin Polyethylene foil on the under layer used as a base layer in multi layer systems. It has a 180g/m² polyester reinforcement and is supplied in 1 m x 10 m rolls.

DeboPlast 2.5 mm T/F C175

– is a 2.5 mm thick, APP modified bitumen-based sheet waterproofing membrane with a mixture of talcum and sand on the upper surface and an ultra thin Polyethylene foil on the under layer used as a base layer in multi layer systems. It has a composite reinforcement of 175 g/m² polyester and glass and is supplied in 1 m x 10 m rolls.

DeboFlex 2.5 mm T/F C175

– is a 2.5 mm thick, SBS modified bitumen-based sheet waterproofing membrane with a mixture of talcum and sand on the upper surface and an ultra thin Polyethylene foil on the under layer used as a base layer in multi layer systems. It has a composite reinforcement of 175 g/m² polyester and glass and is supplied in 1 m x 10 m rolls.

DuO HT 4 Slates/F C180

– is a nominal 4 mm thick APAO/SBS composite bitumen, torch applied sheet waterproofing membrane with a coloured slate granule upper surface finish and a polyethylene under finish used as a cap sheet in a multi layer system. It has a composite reinforcement of polyester and glass of 180 g/m². It is supplied in 1 m x 8 m rolls.

DuO HT 4 Slates/F C180 Aero

– is a nominal 4 mm thick APAO/SBS composite bitumen, torch applied sheet waterproofing membrane with a coloured slate granule upper surface finish and an under layer of pure SBS strips with polyethylene foil finish to allow vapour distribution under the waterproofing, used as a cap sheet in a single-layer system. It has a composite reinforcement of polyester and glass of 180 g/m². It is supplied in 1 m x 8 m rolls.

DuO HT 4 Slates/F C180 Mecano

– is a nominal 4 mm thick APAO/SBS composite bitumen, sheet waterproofing membrane with a coloured slate granule upper surface finish and an under finish of polyethylene foil which is designed to be mechanically fastened to the roof, used as a cap sheet in a single-layer system or multi layer system. It has a composite reinforcement of polyester and glass of 180 g/m². It is supplied in 1 m x 8 m rolls.

DuO 4 HT Slates/PP C180 No Flame

– is a nominal 4 mm thick APAO/SBS composite bitumen, sheet waterproofing membrane with a coloured slate granule upper surface finish and an under finish of polypropylene fleece which can be fully bonded without heat, used as a cap sheet in a multi layer system. It has a composite reinforcement of polyester and glass of 180 g/m². It is supplied in 1 m x 8 m rolls.

DuO B&T 4 Gran/F C250

– is a nominal 4 mm APAO/SBS composite bitumen, torch applied sheet waterproofing membrane with a grey granule upper surface finish and an under finish of polyethylene foil. It has a composite reinforcement of polyester and glass of 250 g/m² to provide a higher reinforcement level for greater heat resistance, elongation and strength used as a cap sheet under hot applied asphalt mixes. It is supplied in 1 m x 8 m rolls.

DuO HT 4 Slates/ F C180 Landscape

– is a nominal 4 mm APAO/SBS composite bitumen, torch applied sheet waterproofing membrane with a coloured slate granule upper surface finish and an under finish of polyethylene foil. It has a composite reinforcement of polyester and glass of 180 g/m². It is root resistant according to EN13948 and applicable for green roofs. It is used as a cap sheet in multi layer systems. It is supplied in 1 m x 8 m rolls.

DuO HT 4 Slates/ F C180 Firecare

– is a nominal 4 mm APAO/SBS composite bitumen, torch applied sheet waterproofing membrane with a coloured slate granule upper surface finish and an under finish of polyethylene foil. It has a composite reinforcement of polyester and glass of 180 g/m². It is designed for fire resistant applications and used a cap sheet in multi layer systems. It is supplied in 1 m x 8 m rolls.

DuO Primer

– is a solvent-based, bituminous vanish used to prime dry and porous surfaces. It is supplied in 25 lt containers.

DuO Kit

– is a bituminous adhesive/sealant used for cold bonding and sealing when necessary. It is a black paste, supplied in 310 ml cartridges.

DuO Cold Glue

– is a bituminous cold adhesive for adhering DuO No Flame waterproofing membranes. It is supplied in 25 kg cans.

Handling and Storage

5.1 Handling and storage of all materials whether on or off site is under the control of the Equus Industries Ltd Certified Applicators. Dry storage must be provided for all products and the rolls of membrane must be stored in an upright position.

Technical Literature

6.1 Refer to the Appraisals listing on the BRANZ website for details of the current Technical Literature for the De Boer DuO Roof Membrane Systems. The Technical Literature must be read in conjunction with this Appraisal. All aspects of design, use, installation and maintenance contained in the Technical Literature and within the scope of this Appraisal must be followed.

Design Information

General

7.1 De Boer DuO Roof Membrane Systems are for use on roofs, gutters and parapets where an impervious waterproof membrane is required to prevent damage to building elements and adjoining areas. The products can be used on new or existing buildings. Equus Industries Ltd should be consulted as to the suitability of any existing substrates prior to using De Boer DuO Roof Membrane Systems.

7.2 The effective control of internal moisture must be considered at the design stage due to the impermeability of the membranes. Refer to BRANZ publication "Good Practice Guide - Membrane Roofing".

Structure

8.1 De Boer DuO Roof Membrane Systems fully bonded double layer systems are suitable for use in areas subject to maximum wind pressures of 4 kPa Ultimate Limit State.

Substrates

Plywood

9.1 Plywood must be treated to H3 (CCA treated). **LOSP treated plywood must not be used.** Plywood must comply with NZBC Acceptable Solution E2/AS1 Paragraph 8.5.3 and 8.5.5. Where specific design is used (i.e. outside the scope of E2/AS1) the plywood thickness and fixing size may increase and centres may decrease to meet specific wind loadings. Timber framing must comply with NZS 3604, or where specific engineering design is used, the framing shall be of at least equivalent stiffness to the framing provisions of NZS 3604, or comply with the serviceability criteria of AS/NZS 1170. In all cases, framing must be provided so that the maximum span of the substrate as specified by the substrate manufacturer is met and all sheet edges are fully supported.

Concrete

9.2 Concrete substrates must be to a specific engineering design meeting the requirements of the NZBC, such as concrete construction to NZS 3101.

Existing Construction

9.3 A thorough inspection of the substrate must be made to ensure it is in fit condition and does not contain any materials that will adversely affect the performance of the membrane.

9.4 Repairs must be undertaken, where applicable, to ensure the substrate is sound, the joints are sealed, and the flashings are sound. Plywood substrates must be checked for screw fixings, and if necessary refixed as for new plywood.

Durability

Serviceable Life

10.1 De Boer DuO Roof Membrane Systems will have a durability of at least 15 years and an expected serviceable life of over 20 years, provided they are designed, used, installed and maintained in accordance with this Appraisal and the Technical Literature.

Chemical Resistance

10.2 Industrial air pollutants and windborne salt deposits should not significantly affect the durability of the membranes. However, the long term properties of the material may be affected by contact with petroleum-based products such as oils, greases and solvents.

Maintenance

11.1 The membrane roof system, must be regularly (at least annually) checked for damage, rubbish or debris. Damage, such as small punctures and tears, must be repaired as recommended by Equus Industries Ltd.

11.2 Special care must be taken when inspecting the membrane roof systems to ensure the continuing prevention of moisture ingress, and repairs must be undertaken where required.

11.3 Drainage outlets must be maintained to operate effectively.

Outbreak of Fire

12.1 Separation or protection must be provided to the membranes and plywood substrate from heat sources such as flues and chimneys.

12.2 NZBC Acceptable Solution C/AS1 Part 9 and Verification Method C/VM1 provide methods for separation and protection of combustible materials from heat sources.

Spread of Fire

13.1 The membranes may be used on roofs of buildings intended for all Purpose Groups, including SC and SD, subject to the requirements of NZBC Acceptable Solution C/AS1 Part 7, Paragraph 7.11.1.

13.2 The membranes may be used for cladding fire-rated roof construction, providing the roof construction complies with the requirements of NZBC Acceptable Solution C/AS1 Part 7.

External Moisture

14.1 Roofs must be designed and constructed to shed precipitated moisture. They must also take account of snowfalls in snow prone areas. A means of meeting code compliance with NZBC Clause E2.3.1 is given by the Technical Literature which aligns with details in NZBC Acceptable Solution E2/AS1.

14.2 When installed in accordance with this Appraisal and the Technical Literature, De Boer DuO Roof Membrane Systems will prevent the penetration of water and will therefore meet code compliance with Clause E2.3.2. The membranes are impervious to water and will give a weathertight roof.

14.3 Roof falls must be built into the substrate and not created with mortar screeds applied over the membrane.

14.4 The minimum fall to roofs is 1 in 40 and gutters are 1 in 60. All falls must slope to an outlet. Inadequate falls will allow moisture to collect and increase the risk of deterioration of the membrane.

14.5 Allowance for deflection and settlement of the substrate must be made in the design of the roof to ensure falls are maintained and no ponding of water can occur.

14.6 De Boer DuO Roof Membrane Systems are impermeable; therefore a means of dissipating construction moisture must be provided in the building design and construction to meet code compliance with Clause E2.3.6.
14.7 Drainage flanges must be used for any outlet and must be fitted with a grate or cage to reduce potential sources of blockages. An overflow must be provided where the roof does not drain to an external gutter or spouting.
14.8 Penetrations and upstands of the membranes must be raised above the level of any possible flooding caused by the blockage of roof drainage.
14.9 The design of details not covered by the Technical Literature is subject to specific weathertightness design and is outside the scope of this Appraisal.

Water Supplies

15.1 Water is not contaminated by De Boer DuO Roof Membrane Systems and they complies with the provisions of NZBC G12.3.1. De Boer DuO Roof Membrane Systems have been tested against, and shown to comply with AS/NZS 4020.
15.2 The first 25 mm of rainfall from a newly installed De Boer DuO Roof Membrane Systems roof must be discarded before drinking water collection starts. This is to remove residues which may have developed in the processes involved in the production of a De Boer DuO Roof Membrane Systems membrane roof.
15.3 Though De Boer DuO Roof Membrane Systems have been shown to comply with AS/NZS 4020, it must be noted that all water collected off roof surfaces made from any material is considered to be non-potable due to possible contamination from other sources. Water collection in this way can only be considered potable if it has been passed through a suitable sterilization system. Sterilization systems such as this have not been assessed and are outside the scope of this Appraisal.

Installation Information

Installation Skill Level Requirement

16.1 Installation of the membranes must be completed by Equus Industries Ltd Certified Applicators.
16.2 Installation of substrates must be completed by tradespersons with an understanding of roof construction, in accordance with instructions given within the Equus Industries Ltd Technical Literature and this Appraisal.

Preparation of Substrates

17.1 Substrates must be dry, clean and stable before installation commences. Surfaces must be smooth and free from nibs, sharp edges, dust, dirt or other materials such as oil, grease or concrete formwork release agents. All surface defects must be filled to achieve an even and uniform surface.
17.2 The relative humidity of concrete substrates must be 75% or less before membrane application. The concrete can be checked for dryness by using a hygrometer, as set out in BRANZ Bulletin No. 424.
17.3 The moisture content of the plywood and timber substructure must be a maximum of 20% and the plywood sheets must be dry at time of membrane application. This will generally require plywood sheets to be covered until just before the membrane is laid, to prevent rain wetting.
17.4 All substrates must be primed with DuO Primer and left to dry before the membrane is installed.

Membrane Installation

18.1 The membranes must be installed in accordance with the Technical Literature.
18.2 All roof and wall junctions must have a 20 mm x 20 mm wooden fillet installed at the junction. Concrete substrate junctions must have a 20 mm x 20 mm cement mortar fillet installed. All external edges must be chamfered to a 5 mm radius to remove sharp edges.
18.3 The membrane is installed from the lowest point and each layer is installed across the roof fall allowing a 80 mm side overlap and a 100 mm end overlap. The cap sheet layer must be offset against the base sheet layer.
Note: These are minimum overlap widths. Please refer to Manufacturer's Instructions for the specific overlap widths for the product being specified.

Inspections

19.1 Critical areas of inspection for waterproofing systems are:

- Construction of substrates, including crack control and installation of bond breakers and movement control joints.
- Moisture content of the substrate prior to the application of the membrane.
- Acceptance of the substrate by the membrane installer prior to application of the membrane.
- Installation of the membrane to the manufacturer's instructions.

Health and Safety

20.1 Safe use and handling procedures for De Boer DuO Roof Membrane Systems are provided in the Technical Literature. The products must be used in conjunction with the relevant Material Safety Data Sheets for each membrane.

Basis of Appraisal

The following is a summary of the technical investigations carried out:

Tests

21.1 The following is a summary of the testing and test reports on De Boer DuO Roof Membrane Systems:

- Physical properties in accordance with MOAT 30 and MOAT 27 for tensile strength, elongation, tear strength, dimensional stability.
- Service performance testing included low temperature flexibility, heat resistance, static and dynamic indentation, fatigue cycling and peels resistance.
- Testing by SGS for dimensional stability, tear resistance, tensile strength, elongation at break, low temperature flexibility, heat resistance and tensile shear at joints.
- British Board of Agrément evaluation for the issue of the current BBA Certificate covering these products.

The above test methods and results have been reviewed by BRANZ and found to be satisfactory.

Other Investigations

22.1 A durability opinion has been provided by BRANZ technical experts.
22.2 Installation of the membranes has been assessed by BRANZ for practicability of installation and found to be satisfactory.
22.3 The Technical Literature has been examined by BRANZ and found to be satisfactory.

Quality

23.1 The manufacture of the membranes has not been examined by BRANZ, but details regarding the quality and composition of the materials used were obtained by BRANZ and found to be satisfactory. The manufacturer of De Boer DuO Roof Membrane Systems has been assessed and registered as meeting the requirements of ISO 9001: 2000, ISO 14001: 2004 and EN13707: 2004 as per European Directive 89/106/EEC.

23.2 The quality of the supply of products to the New Zealand market is the responsibility of Equus Industries Ltd.

23.3 Quality on site is the responsibility of the Equus Industries Ltd Certified Applicators.

23.4 Designers are responsible for the building design, and building contractors are responsible for the quality of construction of substrate systems in accordance with the instructions of Equus Industries Ltd and this Appraisal.

23.5 Building owners are responsible for the maintenance of the membrane systems in accordance with the instructions of Equus Industries Ltd and this Appraisal.

Sources of Information

- AS/NZS 1170: 2002 Structural design actions.
- AS/NZS 2269: 1994 Plywood – structural.
- AS/NZS 4020: 2005 Testing of products for use in contact with drinking water.
- BBA Certificate No. 98/3537, DuO High Tech Waterproofing Systems.
- BRANZ Good Practice Guide – Membrane Roofing, reprint October 2003.
- NZS 3101: 1995 The design of concrete structures.
- NZS 3604: 1999 Timber framed buildings.
- Compliance Document for New Zealand Building Code External Moisture Clause E2, Department of Building and Housing, Third Edition July 2005.
- New Zealand Building Code Handbook and Approved Documents, Department of Building and Housing May 2007.
- The Building Regulations 1992, up to, and including August 2008 Amendment.

BRANZ

In the opinion of BRANZ, De Boer DuO Roof Membrane Systems are fit for purpose and will comply with the Building Code to the extent specified in this Appraisal provided they are used, designed, installed and maintained as set out in this Appraisal.

The Appraisal is issued only to De Boer Waterproofing Solutions nv, and is valid until further notice, subject to the Conditions of Appraisal.

Conditions of Appraisal

1. This Appraisal:
a) relates only to the product as described herein;
b) must be read, considered and used in full together with the technical literature;
c) does not address any Legislation, Regulations, Codes or Standards, not specifically named herein;
d) is copyright of BRANZ.
2. De Boer Waterproofing Solutions nv:
a) continues to have the product reviewed by BRANZ;
b) shall notify BRANZ of any changes in product specification or quality assurance measures prior to the product being marketed;
c) abides by the BRANZ Appraisals Services Terms and Conditions.
d) Warrants that the product and the manufacturing process for the product are maintained at or above the standards, levels and quality assessed and found satisfactory by BRANZ pursuant to BRANZ's Appraisal of the product.
3. BRANZ makes no representation or warranty as to:
a) the nature of individual examples of, batches of, or individual installations of the product, including methods and workmanship;
b) the presence or absence of any patent or similar rights subsisting in the product or any other product;
c) any guarantee or warranty offered by De Boer Waterproofing Solutions nv.
4. Any reference in this Appraisal to any other publication shall be read as a reference to the version of the publication specified in this Appraisal.
5. BRANZ provides no certification, guarantee, indemnity or warranty, to De Boer Waterproofing Solutions nv or any third party.

For BRANZ

P Burghout
Chief Executive

Date of issue: 9 June 2010

BBA Certificate

De Boer Waterproofing Solutions NV
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BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

Agrément Certificate
98/3537
Product Sheet 1

DUO HIGH TECH WATERPROOFING SYSTEMS

PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate of Confirmation relates to DuO High Tech Waterproofing Systems, comprising polyester/glass composite reinforced polymer-modified bitumen membranes.

AGRÉMENT CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Weathertightness — the systems will resist the passage of moisture to the interior of the building (see section 5).

Properties in relation to fire — the systems, when used in a suitable specification, will enable a roof to be unrestricted under Building Regulations (see section 6).

Resistance to wind uplift — tests indicate that the systems will enable a roof to be unrestricted under Building Regulations (see section 7).

Resistance to foot traffic — the systems will accept the limited foot traffic and loads associated with installation and maintenance of the system without damage (see section 8).

Durability — under normal service conditions the systems will provide a durable waterproof covering with a service life of up to 30 years (see section 10).

The BBA has awarded this Agrément Certificate to the company named above for the systems described herein. The systems have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 27 August 2008
Certificate originally issued on 12 November 1998

Simon Wroe
Head of Approvals — Materials

Greg Cooper
Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

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Regulations

In the opinion of the BBA, DuO High Tech Waterproofing Systems, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations:

The Building Regulations 2000 (as amended) (England and Wales)

Requirement:	B4(2)	External fire spread
Comment:		Test data to BS 476-3 : 1958 indicate that on suitable non-combustible substructures the systems will enable a roof to be unrestricted under this Requirement. See sections 6.1 to 6.3 of this Certificate.
Requirement:	C2(b)	Resistance to moisture
Comment:		Data for water resistance on the membranes, including joints, indicate that the systems meet this Requirement. See section 5.1 of this Certificate.
Requirement:	**Regulation 7**	Materials and workmanship
Comment:		The systems are acceptable. See section 10 and the *Installation* part of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	**Fitness and durability of materials and workmanship**
Comment:		The use of the systems satisfy the requirements of this Regulation. See sections 9 and 10 and the *Installation* part of this Certificate.
Regulation:	9	**Building standards — construction**
Standard:	2.8	Spread from neighbouring buildings
Comment:		Test data to BS 476-3 : 1958 indicate that on suitable non-combustible substructures the use of the systems will be regarded as having low vulnerability under clause 2.8.1[1][2] of this Standard. See sections 6.1 to 6.3 of this Certificate.
Standard:	3.10	Precipitation
Comment:		Data for water resistance on the membranes, indicate that the use of the systems will enable a roof to satisfy the requirements of this Standard, with reference to clauses 3.10.1[1][2] and 3.10.7[1][2]. See section 5.1 of this Certificate.
Regulation:	12	**Building standards — conversions**
Comment:		All comments given for these systems under Regulation 9, also apply to this Regulation, with reference to clause 0.12.1[1][2] and Schedule 6[1][2].

(1) Technical Handbook (Domestic).
(2) Technical Handbook (Non-Domestic).

The Building Regulations (Northern Ireland) 2000 (as amended)

Regulation:	B2	Fitness of materials and workmanship
Comment:		The systems are acceptable. See section 10 and the *Installation* part of this Certificate.
Regulation:	B3(2)	Suitability of certain materials
Comment:		The systems are acceptable. See section 9 of this Certificate.
Regulation:	C4(b)	Resistance to ground moisture and weather
Comment:		Data for water resistance on the membranes indicate that the use of the systems will enable a roof to satisfy the requirements of this Regulation. See section 5.1 of this Certificate.
Regulation:	E5(b)	External fire spread
Comment:		Test data to BS 476-3 : 1958 indicate that on suitable non-combustible substructures the use of the systems will be unrestricted by the requirements of this Regulation. See sections 6.1 to 6.3 of this Certificate.

Construction (Design and Management) Regulations 2007

Construction (Design and Management) Regulations (Northern Ireland) 2007

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See section: 1 *Description* (1.2) and 2 *Delivery and site handling* (2.3).

Non-regulatory Information

NHBC Standards 2007

NHBC accepts the use of DuO High Tech Waterproofing Systems, when installed and used in accordance with this Certificate, in relation to *NHBC Standards*, Chapter 7.1 *Flat roofs and balconies*.

Zurich Building Guarantee Technical Manual 2007

In the opinion of the BBA, DuO High Tech Waterproofing Systems, when installed and used in accordance with this Certificate, satisfy the requirements of the *Zurich Building Guarantee Technical Manual*, Section 4 *Superstructure*, Sub-section *Flat roofs*.

General

This Certificate relates to DuO High Tech Waterproofing Systems, comprising polyester/glass composite reinforced polymer-modified bitumen membranes.

The membranes are manufactured in Belgium by De Boer Waterproofing Solutions NV. The membranes are marketed in the United Kingdom by De Boer UK, c/o 48 Howard Road, Coulsdon, Surrey CR5 2EA. Tel: 020 8407 1790, Fax: 020 8407 1790, email: infouk@deboer.uk

The management systems of De Boer Waterproofing Solutions NV have assessed and registered as meeting the requirements of EN ISO 9001 : 2000 by SGS Belgium NV (Certificate No BE 94/1040.QA). De Boer Waterproofing Solutions NV also have been assessed as meeting the requirements of ISO 14001 : 2004 by SGS Belgium NV (Certificate No BE07/102612).

This Certificate is a Confirmation of a Belgian Agrément ATG 1924 issued by Union Belge pour l'Agrément Technique dans la construction (UBAtc) to De Boer N.V., Metropoolstraat 33, B-2900 Schoten, Belgium.

Technical Specification

1 Description

1.1 DuO High Tech Waterproofing Systems comprise membranes reinforced with a polyester/glass composite with an upper coating of APAO modified bitumen and a lower coating of SBS modified bitumen. The upper surface finish of membranes is either slate or talc and the lower a thermofusible polyethylene film or a polypropylene fleece. The following membranes are covered in this Certificate:

- DuO High Tech — the standard membrane for use in single-ply or built-up specifications
- DuO High Tech FC — an enhanced fire resistance version of the standard membrane
- DuO High Tech Aero — designed for use in partially bonded single-ply specifications
- DuO High Tech Aero FC — an enhanced fire resistance version of the DuO High Tech Aero membrane
- DuO High Tech Mecano — for use in mechanical fastened specifications.

1.2 The membranes are manufactured to the nominal characteristics given in Table 1 and use the reinforcement types listed in Table 2.

Table 1 Nominal parameters

Parameters (units)	4	4A	5	5A
Upper surface finish	talc	slate	talc	slate
Thickness (mm)	4.00	4.00	5.00	5.00
Width (m)	1	1	1	1
Length (m)	7.5, 8.0, 10	7.5, 8.0, 10	5.0, 7.5, 8.0	5.0, 7.5, 8.0
Mass per unit area (kgm^{-2})	4.2	4.8	5.2	5.8

Table 2 Reinforcement

Product range name	Reinforcement type	Reinforcement mass per unit area (gm^{-2})
DuO High Tech	polyester/glass scrim polyester/glass fleece	180 and 200 160/50 and 250/50
DuO High Tech FC	polyester/glass scrim polyester/glass fleece	180 and 200 160/50 and 250/50
DuO High Tech Aero(1)	polyester/glass scrim	180
DuO High Tech Aero FC(1)	polyester/glass scrim	180
DuO High Tech Mecano	polyester/glass scrim polyester/glass fleece	180 and 200 160/50 and 250/50

(1) Only 4 and 4A grades available.

1.3 DuO No Flame is the standard Duo membrane with a polypropylene fleece on the underside of the membrane for use in cold adhered systems using Duo Elastomer Adhesive.

1.4 Duo Elastomeric Adhesive is for use in cold bonding installation specifications.

1.5 Other membranes manufactured by De Boer Waterproofing Solutions NV that can be used in conjunction with the system are as follows:

Venting layers

- DeboBase 3 T/BLS VP40 (pour and roll)
- DeboFlex 1300 T/F VP40 (torch-on).

Vapour control layers

- DeboBase 4 T/F-T/T ALU200
- DeboFlex 3 T/F-T/T P180
- DeboFlex 4 T/F ALU200
- DeboTack 2.5 T/F ALU200 (self-adhesive).

Preparation layers

- DeboFlex 2.5 T/F P180 (nailing layer)
- DeboFlex 3 F/PES C175.

Underlays

- DeboPlast 2.5 T/F K180
- DeboBase 3 T/F C175 Aero (partial bond)
- DeboFlex 2700 T/T-T/F C175
- DeboFlex 3000 T/F-T/T C175
- DeboTack 3 T/F K180 (self-adhesive)
- DeboTack 4 T/F C175 (self-adhesive).

1.6 DuO Primer is a solvent-based bitumen primer for preparation of concrete, wood and existing bitumen substrates.

1.7 Quality control checks are carried out on the raw materials, the coating mass and the final product. Tests on the final product include:

- tensile strength
- elongation at break
- heat resistance
- tear resistance
- dimensional stability.

2 Delivery and site handling

2.1 The membranes are delivered to site in rolls on pallets covered in shrink-wrapped polyethylene. Every pallet and roll has a label bearing the product name, Certificate holder's name, production identification numbers and BBA identification mark incorporating the number of this Certificate.

2.2 Individual rolls should be stored upright on a clean, level surface, away from excessive heat and kept dry.

2.3 DuO Primer has a flashpoint of 40°C and therefore is classified as 'flammable' under *The Chemicals (Hazard Information and Packaging for Supply) Regulations 2002* (CHIP3) and should be handled accordingly. The primer must be stored away from ignition sources and extremes of temperature must also be avoided.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on DuO High Tech Waterproofing Systems.

Design Considerations

3 General

3.1 DuO High Tech Waterproofing Systems are satisfactory for use as:

- a fully or partially torch-bonded waterproofing for flat or pitched roofs with limited access as part of a single layer or built-up specifications and where necessary in conjunction with appropriate roofing membranes supplied by the Certificate holder or to BS 8747 : 2007
- a fully or partially hot bitumen bonded waterproofing for flat or pitched roofs with limited access as part of a single layer or built-up specifications and where necessary in conjunction with appropriate roofing membranes supplied by the Certificate holder or to BS 8747 : 2007
- cold bonded for flat roofs with limited access as part of a single layer or built-up specifications and where necessary in conjunction with appropriate roofing membranes supplied by the Certificate holder
- a single-ply, loose-laid waterproofing layer, ballasted with aggregate on flat roofs with limited access, or under heavy protection (eg, concrete slabs) on flat roofs with regular pedestrian traffic
- mechanically-fixed waterproof layer, on flat roofs with limited access
- a single-ply overlay for existing asphalt and bitumen membrane roofs.

3.2 The slate finished membranes are satisfactory for use, where appropriate, as an exposed cap sheet or in detail work.

3.3 Limited access roofs are defined for the purpose of this Certificate as those roofs subjected only to pedestrian traffic for maintenance of the roof covering and cleaning of gutters, etc. Where traffic in excess of this is envisaged special precautions, such as additional protection to the membrane, must be taken.

3.4 Flat roofs are defined for the purpose of this Certificate as those roofs having a minimum finished fall of 1:80. For design purposes, twice the minimum finished fall should be assumed, unless a detailed analysis of the roof is available, including overall and local deflection, direction of falls, etc. Pitched roofs are defined as those having falls greater than 1:6.

3.5 Decks to which the membranes are to be applied must comply with the relevant requirements of BS 6229 : 2003, BS 8217 : 2005 and, where appropriate, *NHBC Standards* Chapter 7.1 *Flat roofs and balconies* or the *Zurich Building Guarantee Technical Manual*, Section 4, *Superstructure*, Sub-section *Flat roofs*, pages 268 to 270.

3.6 Insulation systems or materials used in conjunction with the membranes must be either :

- as described in the relevant clauses of BS 8217 : 2005, or
- the subject of a current BBA Certificate and be used in accordance with, and within the limitations of, that Certificate.

4 Practicability of installation

Installation of DuO High Tech Waterproofing Systems must be carried out by trained operatives, working for approved contractors. The training for UK operatives is supplied by De Boer Waterproofing Solutions NV.

5 Weathertightness

5.1 Data confirm that the membrane and joints in the system, when completely sealed and consolidated, will adequately resist the passage of moisture to the inside of the building and so meet the requirements of the national Building Regulations (see section 14, *Tables for Physical properties — general*):

England and Wales — Approved Document C, Requirement C2(b), Section 6

Scotland — Mandatory Standard 3.10, clauses 3.10.1[1][2] and 3.10.7[1][2]

(1) Technical Handbook (Domestic).

(2) Technical Handbook (Non-Domestic).

Northern Ireland — Regulation C4(b).

5.2 The membranes are impervious to water and when used in the systems described will give a weathertight roofing capable of accepting minor structural movements without damage.

6 Properties in relation to fire

6.1 When tested in accordance with BS 476-3 : 1958, a system comprising an 18 mm thick chipboard substrate, one layer of 2 mm thick, glass reinforced bitumen underlay torch bonded and one layer of DuO High Tech 4A FC, torch bonded achieved an EXT.F.AA rating.

6.2 When used in a loose-laid and ballasted specification including a minimum surface finish of 50 mm of aggregate, the membranes shall be deemed to satisfy BS 476-3 : 2004 designation EXT.F.AA.

6.3 The designation of other specifications (eg on combustible substrates) should be confirmed by:

England and Wales — Test or assessment in accordance with Approved Document B, Appendix A, Clause 1

Scotland — Tests to confirm compliance with Mandatory Standard 2.8, with reference to 2.8.1[1][2]

(1) Technical Handbook (Domestic).

(2) Technical Handbook (Non-Domestic).

Northern Ireland — Test or assessment by a UKAS accredited laboratory, or an independent consultant with appropriate experience.

7 Resistance to wind uplift

7.1 The adhesion of a fully adhered system to a substrate will normally be limited by the cohesive strength of the substrate. Tests indicate that on substrates with high cohesive strength the adhesion of the membranes is sufficient to resist the effect of wind suction, thermal cycling or minor structural movements occurring in practice (see section 14, Table for *Physical properties – general*).

7.2 Where the membranes are fully adhered to insulation boards, the resistance to wind uplift will be dependent on the cohesive strength of the insulation and the method by which it is secured to the roof deck. This should be taken into account when the insulation material is selected.

7.3 The precise ballast requirement for a loose-laid system should be calculated in accordance with the relevant parts of BS 6399-2 : 1997, but should not be below a minimum of 50 mm. The use of concrete slabs, on suitable protective supports should be considered in areas of high design wind loads.

7.4 The resistance to wind uplift of the membranes is provided by mechanical fasteners secured to the deck and passing through the membrane. The number of fixings will depend on a number of factors, including:

- wind uplift forces to be resisted
- elastic limit of the membrane
- pull-out strength of fasteners
- appropriate safety factors.

7.5 The wind uplift forces to be resisted should be calculated in accordance with the relevant clauses of BS 6399-2 : 1997 and the number of fixings required calculated on the basis of a maximum permissible load of 0.45 kN per fixing.

8 Resistance to foot traffic

Tests indicate that the systems can accept, without damage, the limited foot traffic associated with installation and maintenance operations. Reasonable care should be taken to avoid sharp objects or concentrated loads. Where regular traffic is envisaged, ie maintenance of lift equipment, a walkway should be provided using concrete slabs supported on bearing pads.

9 Maintenance

The membranes should be subjected to regular annual inspections and roof drains kept clear as is good practice with all roofing membranes.

10 Durability

The membranes, when subjected to normal conditions of use in a roof, will retain their integrity for a period of at least 30 years.

Installation

11 General

11.1 The installation of DuO High Tech Waterproofing Systems is carried out in accordance with the manufacturer's instructions and the relevant clauses of BS 8000-4 : 1989 and BS 8217 : 2005.

11.2 Deck surfaces must be dry, clean and free from sharp projections such as nail heads and concrete nibs.

11.3 The membrane may be laid in conditions normal to roofing work and must not be laid in rain, snow or heavy fog, nor if the temperature falls below 5°C.

11.4 At falls in excess of 5° (1:11) precautions against slippage, and requirements for mechanical fixing as required by BS 8217: 2005, should be observed.

11.5 If the roof is likely to be subjected to uncontrolled pedestrian access, the substructure must meet the requirements of Clauses 6.12 and 6.13 of BS 8217 : 2005, and to prevent damage to the roof covering one of the surface finishes described in 8.19.3 and 8.19.4 of the Code must be used.

11.6 On completion of the roof, the sanded top layers must have a surface finish applied in accordance with BS 8217 : 2005, Clauses 6.12 and 8.19. Surface finishes in the Code include:

- stone aggregate bonded in dressing compound
- precast concrete paving flags
- proprietary tiles in bonding compound.

11.7 The slate-finished membranes, when used on roofs with limited access, require no further surface protection.

11.8 When used for remedial work, existing waterproofing layers must be made sound and existing surface finishes (eg surface dressing) must be removed and then primed.

12 Procedure

12.1 Membranes can be installed by torch bonding, cold adhesive bonding, loose-laid and ballasted, mechanically fastened and traditional hot bitumen bonding.

12.2 Side laps and end laps for the systems are given in Table 3.

Table 3 Joint dimensions

System	Width of side lap (mm)	Width of end lap (mm)
Cap sheet of Multi-layer	80	100
Single ply	100	150
Aero	100	150
Mecano	130	150

Fully bonded applications

12.3 Prior to application of the membrane the substrate should be primed.

12.4 Bonding is either achieved by traditional pour and roll methods or by melting the lower surface by torching and pressing the membrane down. Care must be taken when torching not to overheat the coating.

Partially bonded applications

12.5 Partially bonded applications can be achieved either by normal BS 8217 : 2005 method or using DuO High Tech Aero membranes.

12.6 When installing in accordance with BS 8217 : 2005, a layer of type 3G felt to BS 8747 : 2007 or a specialist venting layer product from section 1.5 of this Certificate should be loose-laid over the substrate. The membrane is then fully bonded onto the perforated layer ensuring that the bitumen seeps regularly into the perforations.

12.7 DuO High Tech Aero is applied by torching, the pattern on the underside of the membrane producing a partial bond.

Loose-laid applications

12.8 The membrane should be unrolled on the substrate with overlaps and jointing carried out.

12.9 With loose-laid systems the membranes should be ballasted to combat the effects of wind uplift. This can be achieved by:

- at least 50 mm of clean rounded aggregate (20/40 grade) and as free from fines as practicable
- concrete paving slabs on a supporting layer of sand
- concrete paving slabs to BS 7263-1 : 2001[1] on bearing pads.

(1) BS 7263-1 : 2001 has been superseded by BS EN 1339 : 2003.

Mechanical fastened applications (Mecano)

12.10 Fasteners are installed within the overlap with the fastener plate a minimum of 10 mm from the edge of the membrane.

12.11 Once the fasteners are installed the overlap is sealed by torching or hot-air welding.

Cold adhesive bonding (No Flame)

12.12 Following the priming of the substrate, DuO Elastomeric Adhesive is spread evenly across the substrate at a rate of 1 kgm^{-2}.

12.13 The DuO No Flame membrane should be rolled out into the wet adhesive and pressed firmly down.

12.14 Joint overlaps should be sealed by either torching or hot-air welding.

13 Repair

In the event of damage, the sheets can be effectively repaired, after cleaning, by torch bonding.

Technical Investigations

14 Tests

14.1 Samples of the DuO High Tech Waterproofing Systems were obtained from the Certificate holder for testing. The results of the tests carried out by BBRI on behalf of UBAtc are summarised in Tables 4 to 6.

Table 4 Coating masses

Tests (units)	Mean results	Method[1]
APP		
Ring and ball (°C)		MOAT 30 : 6G
unaged	154.5	
heat aged[2]	155.0	
Penetration (dmm)		MOAT 30 : 6M
25°C		
unaged	28	
heat aged[2]	13	
60°C		
unaged	83	
heat aged[2]	53	
Low temperature flexibility (°C)		MOAT 30 : 6D
unaged	–20	
heat aged[2]	–15	
SBS		
Ring and ball (°C)	128	MOAT 31 : 6G
Low temperature flexibility (°C)	–25	MOAT 31 : 6D

(1) The test documents are detailed in the *Bibliography*. Numbers in the table refer to sections/parts of the various documents.

(2) Heat aged at 70°C for 6 months.

Table 5 Physical properties — directional

Test (units)	Mean result		Method[1]
	Long[1]	Trans[3]	
Tensile strength (N per 50 mm)	1101	702	MOAT 30 : 6C
Elongation at break (%)	65	56	MOAT 30 : 6C
Tear resistance (N)	229	260	MOAT 27 : 5.4.1
Dimensional stability (%)	–0.3	–0.2	MOAT 27 : 5.1.6

(1) The test documents are detailed in the *Bibliography*. Numbers in the table refer to sections/parts of the various documents.

(2) Longitudinal.

(3) Transverse.

Table 6 Physical properties — general

Tests (units)	Mean results	Method[1]
Static indentation		EN 12730
EPS	L_{25}	
concrete	L_{25}	
Dynamic indentation		EN 12691
EPS	I_{10}	
Low temperature flexibility (°C)		EN 1109
APAO side		
unaged	≤–15	
heat aged[2]	≤–5	
SBS side		
unaged	≤–20	
heat aged[2]	≤–5	
Heat resistance (°C)		EN 1110
unaged	≥110	
heat aged[2]	≥100	
Fatigue cycling		MOAT 64 : 4.3.5
unaged	pass	
heat aged[3]	pass	
Peel resistance (N per 50 mm)		MOAT 64 : 4.3.3
primed profiled steel	92	
profiled steel	263	
primed concrete	151	
concrete	69	
primed wood	131	
wood	148	
Wind uplift (kPa)		MOAT 64 : 4.3.2
multi-layer system	≥10	
DuO High Tech Aero	≥10	
steel deck[4]	5.5	

(1) The test documents are detailed in the *Bibliography*. Numbers in the table refer to sections/parts of the various documents.

(2) Heat aged six months at 70°C.

(3) Heat aged 28 days at 80°C.

(4) System consisted of a steel profile deck, DeboTack 2.5 T/F K180 self-adhesive membrane, Taurox NP Bitufilm and DuO High Tech fully bonded.

14.2 The following tests were also carried out on the product using EN test methods, unless otherwise stated, and found to be within the manufacturer's declared tolerance and/or meet UEAtc criteria:

- thickness
- adherence of slate protection
- tensile shear of joints
- peel of joints
- aged peel from substrate (MOAT No 64)
- resistance to wind uplift of mechanical system (ETAG 006).

14.3 A test report on samples taken from a number of existing sites of up to 15 years old was assessed, including comparison testing of samples taken for some sites after 10 years and 15 years. The following tests were carried out:

- thickness
- dimension stability
- resistance to nail tear
- tear resistance
- tensile strength
- elongation at break
- low temperature flexibility
- heat resistance
- tensile shear of joints.

15 Investigations

15.1 An examination was made of manufacturing practice and quality control procedures employed in the manufacture of the membranes.

15.2 An examination was made of reports of fire tests carried out to BS 476-3 : 1958.

Bibliography

BS 476-3 : 1958 *Fire tests on building materials and structures — External fire exposure roof test*
BS 476-3 : 2004 *Fire tests on building materials and structures — Classification and method of test for external fire exposure to roofs*

BS 6229 : 2003 *Flat roofs with continuously supported coverings — Code of practice*

BS 6399-2 : 1997 *Loading for buildings — Code of practice for wind loads*

BS 7263-1 : 2001 *Precast concrete flags, kerbs, channels, edgings and quadrants — Part 1 — Precast, unreinforced concrete paving flags and complementary fittings — Requirements and test methods*

BS 8000-4 : 1989 *Workmanship on building sites — Code of practice for waterproofing*

BS 8217 : 2005 *Reinforced bitumen membranes for roofing — Code of practice*

BS 8747 : 2007 *Reinforced bitumen membranes (RBMs) for roofing — Guide to selection and specification*

BS EN 1339 : 2003 *Concrete paving flags — Requirements and test methods*

EN 1109 : 1999 *Flexible sheets for waterproofing — Bitumen sheets for roof waterproofing — Determination of flexibility at low temperature*

EN 1110 : 1999 *Flexible sheets for waterproofing — Bitumen sheets for roof waterproofing — Determination of flow resistance at elevated temperature*

EN 12691 : 2001 *Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roof waterproofing — Determination of resistance to impact*

EN 12730 : 2001 *Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roof waterproofing — Determination of resistance to static loading*

EN ISO 9001 : 2000 *Quality management systems — Requirements*

ISO 14001 : 2004 *Environmental management systems— Specification with guidance for use*

ETAG 006 : 2000 *Systems of Mechanically Fastened Flexible Roof Waterproofing Membranes*

MOAT No 27 : 1983 *General Directive for the Assessment of Roof Waterproofing Systems*

MOAT No 30 : 1984 *Special Directives for the Assessment of Reinforced Waterproof Coatings in Atactic Polypropylene (APP) Polymer Bitumen*

MOAT No 31 : 1984 *Special Directives for the Assessment of Reinforced Homogeneous Waterproof Coverings of Styrene-Butadiene-Styrene (SBS) Elastomer Bitumen*

MOAT No 64 : 2001 *UEAtc Technical Guide for the assessment of Roof Waterproofing Systems made of Reinforced APP or SBS Polymer Modified Bitumen Sheets*

16 Conditions

16.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is granted only to the company, firm or person named on the front page — no other company, firm or person may hold or claim any entitlement to this Certificate
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English law.

16.2 References in this Certificate to any Act of Parliament, Statutory Instrument, Directive or Regulation of the European Union, British, European or International Standard, Code of Practice, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

16.3 This Certificate will remain valid for an unlimited period provided that the product/system and the manufacture and/or fabrication including all related and relevant processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- remain covered by a valid Belgian Agrément; and
- are reviewed by the BBA as and when it considers appropriate.

16.4 In granting this Certificate, the BBA is not responsible for:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including the nature, design, methods and workmanship of or related to the installation
- the actual works in which the product/system is installed, used and maintained, including the nature, design, methods and workmanship of such works.

16.5 Any information relating to the manufacture, supply, installation, use and maintenance of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used and maintained. It does not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the manufacture, supply, installation, use and maintenance of this product/system.

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Sitac Type Approval
Certificate 112/97

SITAC
Swedish Institute for Technical Approval in Construction

SWEDAC ACKREDITERING
1422
STAFS 1995:10

English version

1 (3)

11 December 2002

Proj. No. T 000 563-01

TYPE APPROVAL CERTIFICATE 1112/97

and decision for production control in accordance with 18-20 § Law (1994:847) on technical specification requirements for construction work, etc., BVL

KEY WORD: **ROOF**
Sloping and flat roof
Roof covering

BSAB JSE.1 (L2)

ROOF COVERING WITH DE BOER DUO F1

Issued to

N.V. DE BOER, Metropoolstraat 33, B-2900 SCHOTEN, tel: +32 3-647 14 00, fax: +32 3-645 16 54.

Product

Roof covering with DE BOER DUO F1. Single layer roof covering with a composition of polymer modified bitumen (APP and SBS) on a reinforcement of polyester and glass scrim.

Surface coated with slate granulate and underside coated with plastic foil or talcum.

Nominal thickness is 4 mm or 5 mm.

DE BOER DUO F1 fulfil the performance requirements according to SCBR (Swedish Council for Building Research), Document D22:1990. The class-level requirements are fulfilled as shown below.

Name of system	Class Performance			Method of laying System safety
Roof covering with DE BOER DUO F1	1	1	1	A/B

Method of laying A/ System safety A: Jointing of the material, connections and covering of details are carried out in two separate operations, each of which ensures watertightness.
Method of laying B / System safety B: Jointing of the material, connections and covering of details are carried out in one operation which ensures water tightness, and control in accordance with a defined control system.

Intended use

The membrane is designed for roof covering of new constructions and for renewal of old felts coverings.
It's applied fully bonded or strip bonded by means of welding or using bitumen bonding compound and by mechanical attachment.

Approval

The product fulfils the requirements in 2 § 2, 3, 4 BVL and is approved with regard to the provisions in the following paragraphs of Boverkets Byggregler (Building Regulations of the National Board of Housing, Building and Planning) (*BBR*):

Safety in use,- Surfaces intended to be walked on	8:22 (first paragraph)
Fire protection,- Roof covering class T *	5:22
Moisture, Roof coverings	6:5331

when are applied to:
- combustible backing having a density ≥ 510 kg/m³
- non-combustible backing having a density ≥ 110 kg/m
- renewal of old felt coverings on the above backings

Associated documents

" ROOF COVERING WITH DE BOER DUO F1" dated 1998-06-30, updated 2000-06-20, with the following content:

A. Materials specification
B. Design and laying instructions
C. Details
D. System safety

Control

Production control is to be performed in accordance with instructions for control dated 8 March 1999, revised 12 November 2002, with reg. No. 210-98-0400 and supervised by Swedish National Testing and Research Institute, SP.

The inspection on the building site will ensure that the correct product has been delivered, by identifying by means of the marking. That will further ensure that workmanship and application of the product complies with the specifications in the associated documents.
At the inspection shall be verified that the product has been accompanied by a certificate issued by the manufacturer (*manufacturer's warranty*) which ensures that the delivered product complies with specifications in the type approval and the production control.

Manufacturer

The production control includes the following manufacturer site:
N.V. DE BOER, 2900 SCHOTEN, Belgium.

SITAC
Swedish Institute for Technical Approval in Construction

SWEDAC ACKREDITERING
1422
STAFS 1995:10

11 December 2002 **Certificate No. 1112/97**

Marking

The product is to be marked at the factory. Marking will be made on the each packing (roll) and includes:

Manufacturer/ site of manufacture	**N.V. DE BOER Schoten, Belgium**
Boverket's registered trademark	**Ŧ**
SITAC's accreditation number	**SITAC 1422**
Product-name	**DE BOER DUO F1**
Number of the type approval certificate	**1112/97**
Class performance	**111A/B, Roof covering class T**
Consecutive production No/date of production	**No**
Inspection body	**SP**

Basis for Approval

Following reports form the basis for this approval:
- Report no DE 78A745 / LEF 2960 and DE 78A462 / LEF 2962 from WTCB (Wetenschappelijk en Technisch centrum voor het Bouwbedrijf).
- Fabriekskontrole by SECO (Technisch Controlebureau voor het Bouwwezen) dated 23/01/97.
- Report no 0803-L-92/3 from BDA Keurings- en Certificeringsinstituut BV.
- Report no F 10562 b, Serial no 6833, PF 10779 from Danish Institute of Fire Technology, DBI.
- Report no 97B3,1782, 99B3,1914, BTmF009628, BTmF011999 and F105641 from Swedish National Testing and Research Institute, SP.

Comments

Concerning the wind load see SBCR (Swedish Council for Building Research), Document R 17:85 "Mechanical attached weatherproofing membranes on roofs".

Contractors with thorough knowledge of the system shall carry out work with this roofing system.

The associated documents for the building site shall be supplemented by construction drawings prepared for each building project on the basis of associated documents for design. The type approval certificate, the associated documents for building site and the supplementary construction drawings shall be available on the building site during construction and controls.

This Certificate supersedes previous certificate with the same number dated 20 June 2000, Proj. No T 000 563

Period of Validity

This approval is valid until 03 July 2003.
An approval formally expire after the end of the transition period for the harmonised technical specification that the product can be CE marked against. The technical assessment that the product fulfils Building Regulations of the National Board of Housing is not affected by this.

Björn Holgersson

Stefan Coric

SITAC
Swedish Institute for Technical Approval in Construction

2002-12-11 Proj. No. T 000 563-01

Copy to:
Jan Hertzberg, SP

De Boer, n. v
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BE-2900 SCHOTEN

INGEKOMEN

Swedish Technical Approval No. 1112/97, DE BOER DUO F1.

Your ref.: Peter Van Rysseghem

We have finished the assessment of your application for revision of Swedish Technical Approval No. 1112/97. We have found that the appropriate requirements have been satisfied and consequently we have issued the attached certificate. (Swedish and English version)

If the Approval should have any faults in the text (e.g. address or phone number), we kindly ask you to make the required corrections to the Approval and return it to us within one week. We will then send a new hard copy.

Invoice will be sent separately.

Yours sincerely

Stefan Coric

Appendix: Type approval certificate No 1112/97 (Swedish and English version)

Postadress *Postal address*	Besöksadress *Office*	Telefon *Phone*	Telefax *Telefax*	E-post *E-mail*	Webbsida *Website*	Org. nummer *Reg. nr.*
Box 553	Bastionsgatan. 6	0455-33 63 00	0455-206 88	info@sitac.se	http://www.sitac.se	55 64 69-0120

ISO Certificates

Certificate BE94/01040

The management system of

De Boer Waterproofing Solutions nv

Metropoolstraat 33
BE-2900 Schoten

Has been assessed and certified as meeting the requirements of

ISO 9001:2008

For the following activities

Development, production and sales of waterproofing products for the application on roofs and in other civil works.
Maintenance Solutions.

This certificate is valid from 20/04/2010 until 19/04/2013.
Issue 4. Certified with SGS since 20/02/2004.
Recertification audit due in February 2013.

Authorised by

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Certification Manager

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SGS 9001-8 01 0109

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Certificate BE07/102612

The management system of

De Boer Waterproofing Solutions nv

Metropoolstraat 33
BE-2900 Schoten

has been assessed and certified as meeting the requirements of

ISO 14001:2004

For the following activities

**Development, production and sales of waterproofing products for the application on roofs and in other civil works.
Maintenance Solutions.**

This certificate is valid from 20/04/2010 until 19/04/2013.
Issue 2. Certified with SGS since 04/12/2007.
Recertification audit due in February 2013.

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Test Methods & Reports

What is **Duo?**

A flexible waterproofing membrane with double reinforcement and double polymer bitumen coating.

The upper coating of plastomer bitumen (APAO) features high mechanical resistance and is UV-proof.

The lower coating of elastomer bitumen (SBS) features high elasticity and equally strong adhesive power. That results in flexible material processing with extremely solid welded joints. The internal composite reinforcement of polyester and glass mesh (180 g/sq. m.) combines strength and stability.
Minimum thickness: 4 or 5 mm, measured on the welded joint.

The upper side is finished by means of a mechanically rolled-in design slate; the lower side of the membrane has a foil that can be burnt off.

		ATG 1924
		Minimum value
Tensile strength	(N/5 cm)	700 (lodrätt) / 700 (vågrätt)
Elongation	(%)	45 (lodrätt) / 45 (vågrätt)
Tear strength	(N)	> 110
Cold flexibility	(°C)	-15 (APAO) / -20 (SBS)
Flowing point	(°C)	> 110
Stability - shrinkage	(%)	< 0,3

• Mechanically rolled-in slates
1. Upper coating APAO plastomer bitumen
2. Composite reinforcement 180 g/m² of polyester en glass mesh
3. Lower coating SBS elastomere bitumen
•• Foil to be burnt off.

Laboratories and tests

0. SGS-QUALITEST N.V.

Societé Generale de Surveillance

- World-wide sampling and overall co-ordination
- Inspection report

1. WTCB

Scientific and technical centre for Construction - Belgium

- Visual observation and testing on the site (Belgian building sites only)
- Shear resistance (according to UEAtc - 1982)
- Tensile strength & elongation upon rupture (according to UEAtc - 1984)
- Cold flexibility (according to UEAtc - 1982)

2. TUM

Technical University Munich - Germany

- Nail tear test (according to EN 12310-1)
- Butterfly tear test (according to DIN 53515)
- Rivestyrke test (according to DIN 53356)

3. SP

Swedish Test and Research Institute - Sweden

- Dimensional stability (according to SP 2187)

4. BDA

Bureau for Roof Advice - The Netherlands

- Microscopic examination (according to BDA-test 123)

5. Nynas

Laboratory for bitumen testing - Belgium

- Dynamic Shear Rheometer (according to ASHTE TP 5)

6. De Boer

Production laboratory - Belgium

- Flow resistance at elevated temperature point test - monitored by SGS (according to UEAtc - 1984)

Observation on **site** and **sampling**

Roof incisions were executed by De Boer N.V., under supervision and after indication of the area to be sampled. Involved were a flat part in the middle of the roll, and a part with a joint overlap.

All samples preparations were executed by the De Boer lab, supervised by SGS-Qualitest N.V.. All samples were numbered, dated and signed. Everything was then sent to the respective labs.
The results were taken up in the present report.

It was intended to examine what the effect of naturally ageing of the product is, and not specifically the application. Reserves were made, however, in respect of application defaults. As a matter of fact, we consider it as our mission to offer remedies in case there are systematically problems in matters of application.

Adhesion tests:

On roofs with partially flame-welded, systems, adhesion tests were executed by WTCB (in Belgium only).

The test consisted of gluing metal sheets (150 x 150 mm) on the membrane. The membrane and occurring insulation were cut out according to the circumference of the metal sheets, and the impression test was executed by means of a dynamometer, type 'Satec'.

The test was performed in corner zones, i.e. on spots most exposed to wind.

Resultat:

a. **Coplac** – Erembodegem

- Structure: wood wool sheets + existing sealing + perforated layer + DUO
- Execution: flame wemded

1.	< 20 kPa
2.	31 kPa
3.	< 20 kPa
4.	88 kPa
5.	< 20 kPa

b. **Unilin** - Wielsbeke

- Structure: wooden sheets + existing sealing + primer + perforated layer + DUO skikt + DUO
- Execution: flame wemded

1.	128 kPa
2.	45 kPa
3.	132 kPa
4.	167 kPa
5.	121 kPa

By comparing a. and b., the extra adhesive power of a primer can be very easily noticed. Adequate preparation is very important.

The values above are very good, considering that wind effect (over a period of 65 years) is normally situated between 0,3 and 5 kPa (calculation values according to TV 215 of WTCB).

1. **Tensile strength** and **elongation upon rupture** - lab WTCB

Method used: UEAtc - 1984

Traction speed: 100 mm/minute

The result obtained is the average of 3 separate results.

	Tensile strength (N/50mm)		Elongation (%)		Remarks
	L	V	L	V	New
Required	≥ 700	≥ 700	≥ 45	≥ 45	
1. Whole sales market	1605	1203	43	55	2-layer PES (*)
2. Polderbussen	699	718	47	53	1 layer
3. Coplac	827	798	42	44	2- layer GF (**)
4. Unilin	712	702	53	44	2- layer GF
5. Aalborg	1445	1405	(37)	48	2- layer PES
6. Dusit Thani	728	699	40	38	1 layer

(*) 2-layer PES: under layer with PolyESter fleece + DUO
(**) 2-layer GF: under layer with Glass Fleece (perforated) + DUO
(37) sliding clamps

1. TENSILE STRENGTH

The results are good.
The samples with a under layer with PES support show higher values.

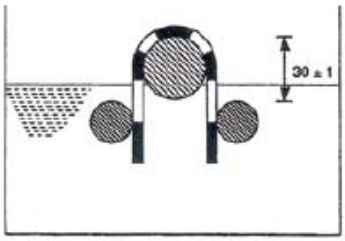
2. ELONGATION UPON RUPTURE

The elongation percentage has decreased at some locations compared to the new state value of 45%.

FOR INFORMATION

In Sweden the requirement for tensile strength after ageing is between 80 and 150% of the new state value, and for elongation it is 50% of the new state value (tests performed at 0°C).

2. Cold flexibility - WTCB-lab



Method used: UEAtc - 1982.

Bending core: dia. 20 mm

The result obtained is the average of 5 separate results.

	L	V	Thickness	Remarks
REQUIRED	**≤ -20 °C**	**≤ -20 °C**		**New**
REQUIRED	**≤ -5 °C**	**≤ -5 °C**		**After ageing**
1. Whole sales market	-5 °C	-3 °C	6,75 mm	2-layer PES (*)
2. Polderbussen	-15 °C	-20 °C	4,74 mm	1 layer
3. Coplac	-5 °C	0 °C	6,79 mm	2- layer GF (**)
4. Unilin	0 °C	0 °C	6,00 mm	2- layer GF
5. Aalborg	-5 °C	-5 °C	6,27 mm	2- layer PES
6. Dusit Thani	-15 °C	-20 °C	4,96 mm	1 layer

(*) 2-layer PES: under layer PolyESter fleece + DUO
(**) 2-layer GF: under layer with Glass Fleece (perforated) + DUO

1. EVALUATION OF THE SINGLE LAYER SYSTEM

The values -15/20 °C are excellent. They approach the initial values. That indicates that ageing hardly exists or not at all.

2. EVALUATION OF THE TWO-LAYER SYSTEM

The evaluation was performed on the under side of the system. The values are not relevant for DUO. In this case, the values for the attached oxidised bitumen on the under side are concerned.

3. **Nail tear** test - TUM-labo

Method used: EN 12310-1

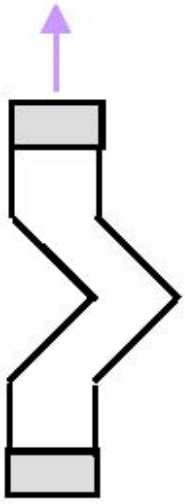
The result obtained is an average of 3 individual results.

	L	V	Remarks
REQUIRED	**≥250 N**	**≥250 N**	**New**
1. Whole sales market	528 N	793 N	2-layer PES (*)
2. Polderbussen	383 N	388 N	1 layer
3. Coplac	443 N	464 N	2- layer GF (**)
4. Unilin	518 N	395 N	2- layer GF
5. Aalborg	482 N	603 N	2- layer PES
6. Dusit Thani	377 N	424 N	1 layer

(*) 2-layer PES: under layer with PolyESter fleece + DUO
(**) 2-layer GF: under layer with Glass Fleece (perforated) + DUO

The results are good. All values exceed requirements remarkably. The samples with an under layer with PES support show higher values.

4. **Butterfly tear** test – TUM-labo



Method used: DIN 53515

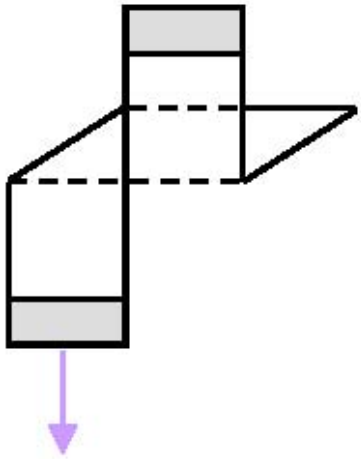
The result obtained is an average of 3 individual results.

	L	V	Remarks
REQUIRED	**≥110 N**	**≥110 N**	**New (see CTG 056)**
1. Whole sales market	266 N	235 N	2-layer PES (*)
2. Polderbussen	143 N	133 N	1 layer
3. Coplac	159 N	149 N	2- layer GF (**)
4. Unilin	155 N	164 N	2- layer GF
5. Aalborg	273 N	258 N	2- layer PES
6. Dusit Thani	169 N	171 N	1 layer

(*) 2-layer PES: under layer with PolyESter fleece + DUO
(**) 2-layer GF: under layer with Glass Fleece (perforated) + DUO
CTG 056 = Dutch hallmark

The results are good. All values exceed requirements remarkably. The samples with an under layer with PES support show higher values.

5. **Rivtestyrke** test - TUM-labo



Method used: DIN 53356

The result obtained is an average of 3 individual results

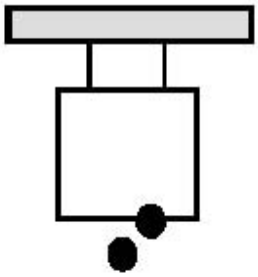
	L	V	Remarks
REQUIRED	**≥50 N**	**≥50 N**	**New (see DTB 6.03)**
1. Whole sales market	328 N	242 N	2-layer PES (*)
2. Polderbussen	142 N	105 N	1 layer
3. Coplac	157 N	181 N	2- layer GF (**)
4. Unilin	199 N	137 N	2- layer GF
5. Aalborg	170 N	185 N	2- layer PES (***)
6. Dusit Thani	122 N	200 N	1 layer

(*) 2-layer PES: under layer with PolyESter under + DUO
(**) 2-layer GF: under layer with Glass Fleece (perforated) + DUO
(***) In sample nr. 5, no lower layer was there in this case.
DTB 6.03 = Danish hallmark

The results are good. All values exceed requirements remarkably. The samples with an under layer with PES support show higher values.

6. Flow resistance

De Boer-labo
(Supervised by
SGS-Qualitest N.V.)



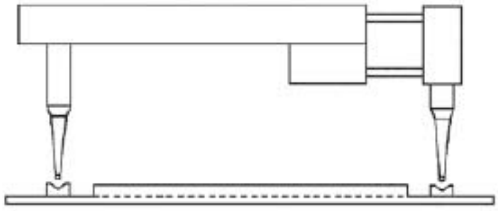
Method used: UEAtc - 1984

Tests were performed on one hand on the complete membrane, and on the other hand on the upper coating only.

	Full membrane	Top coating APAO	Remarks
REQUIRED	**≥ 100 °C**	**≥ 140 °C**	**New**
REQUIRED	**≥ 100 °C**	**≥ 150 °C**	**After ageing**
1. Whole sales market	110 °C	155 °C	Any attached under layer was removed before testing
2. Polderbussen	125 °C	155 °C	
3. Coplac	125 °C	155 °C	
4. Unilin	110 °C	155 °C	
5. Aalborg	120 °C	155 °C	
6. Dusit Thani	115 °C	160 °C	

The values of flow resistance after ageing are largely sufficient. Even in hot countries (Thailand), the upper coating appears to be sufficiently resistant to allow to be walked on in higher temperatures.

7. Dimensional stability - SP lab



Method usedod: SP 2187

The result obtained is an average of 2 individual results

	L	V	Remarks
REQUIRED	**≤ 0,30 %**	**≤ 0,30 %**	**New**
1. Whole sales market	0,28 %	0,04 %	2-layer PES (*)
2. Polderbussen	0,18 %	0,08 %	1 layer
3. Coplac	0,06 %	0,02 %	2- layer GF (**)
4. Unilin	0,26 %	0,03 %	2- layer GF
5. Aalborg	0,16 %	0,06 %	2- layer PES
6. Dusit Thani	0,16 %	0,03 %	1 layer

(*) 2-layer PES: under layer with PolyESter fleece + DUO
(**) 2-layer GF: under layer with Glass Fleece (perforated) + DUO

All results meet the requirements.

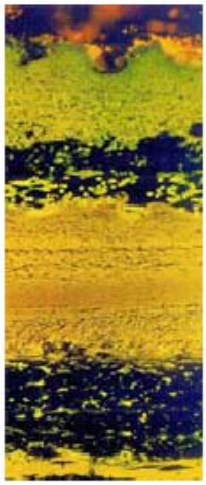
8. Microscopic examination - BDA lab

Method used: BDA-test 123

A. GENERALITIES

By means of fluorescence microscopy, the structure of a bituminous roof membrane can be established. By fluorescent radiation of the test sample, contrast can be obtained between the various components in the test sample.

As such, the following can be assumed:



- Parts containing a lot of polymers highlight in green-yellow, whereas APAO and low molecular parts in the bitumen, mix to a phase containing a lot of polymers.
- SBS highlights in ochre; in case of optimal dispersion, asphaltens can no longer be observed.
- Asphaltens from the bitumen remain black.
- Dispersion needs to be such that asphaltens are surrounded by domains that contain a lot of polymers.
- Asphaltens not resistant to UV should not be linked into streched chains.
- Presence of several layers.
- The fibres of a polyester support highlight in green-yellow, whereas glass fleece is hardly or not visible.
- Cracks depth/width.
- Thickness of the composing layers (top layer, support, ...)

B. DETERMINATION OF THE LAYER THICKNESS

Description	Thickness (in mm) Top coating	Thickness (in mm) Support	Thickness (in mm) Under coating
1. Whole sales market	0,3-1,3	0,7	1,9
2. Polderbussen	0,7-1,1	0,5	1,8
3. Coplac	1,4	0,8	1,6
4. Unilin	0,2-1,1	0,5	1,9
5. Aalborg	0,9-1,3	0,8	1,7
6. Dusit Thani	1,2	1,0	1,4

C. EVALUATION OF THE COMPOSITION

MEMBRANE

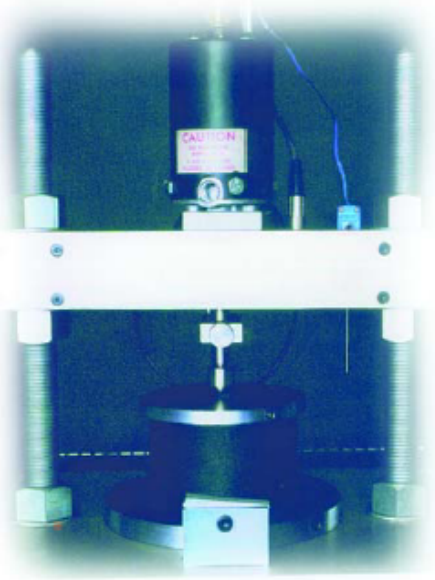
- There is a variation in thickness.
- The bitumen polymer compound has a good (fine) dispersion.
- The impregnation of the support with APAO-modified bitumen does not present the correct image. It even gives the impression that the support has been impregnated with oxidised bitumen! It rather appears to be a migration of polymers.

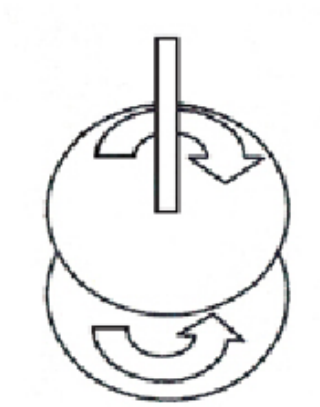
APPLICATION

- The joint overlap has usually been burnt insufficiently. The foil to be burnt off is still present between the composing roof membranes of the overlap, and hardly any bitumen has flown from the overlap. Moreover, no melting with the under layer has been achieved.

Despite the remarks above, the results obtained are good (see 10, shear resistance).

9. **DSR-test** (Dynamic Shear Rheometer) - Nynas lab





Method used: ASHTE TP 5

A. GENERALITIES

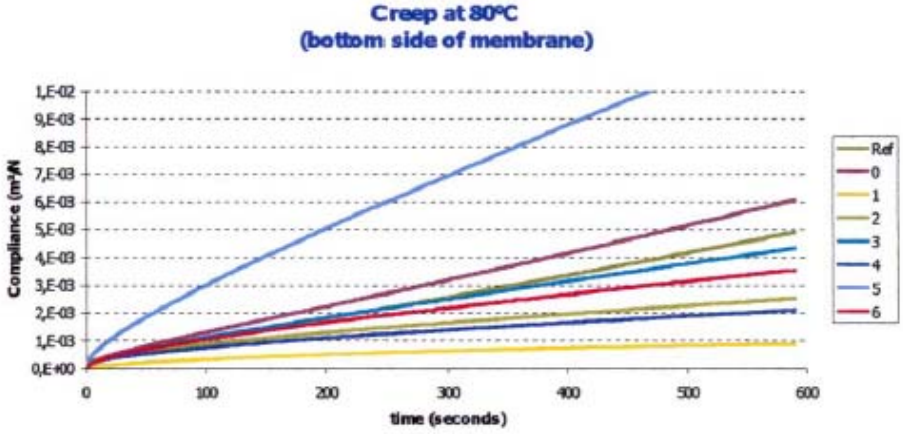
The creep test is an analysing technique, often used at present to evaluate the rheology of bitumen and of polymers.

The principle of the creep test is as follows:

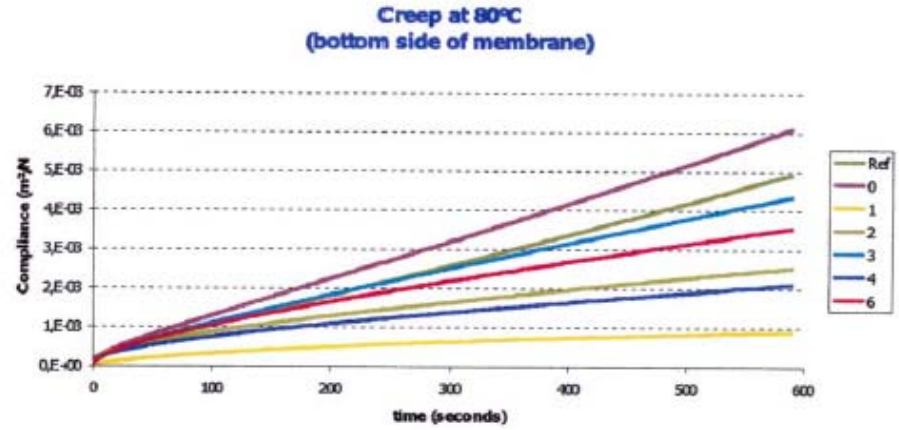
A sample is placed between two plates and is submitted to a constant stress over a length of time. The material will build up a certain resistance and will want to return to its original shape. That is a measure unit for the creep.

This technique has been applied for both the upper and the under coating separately. For samples of the upper coating, there were a number of difficulties. The sample must be 100% clean, i.e. it must be attempted to generate the bitumen compound between the slates and the support (without dirt).
For samples 3,5 and 6, it did not work. Obviously, for the under coating, there were no problems

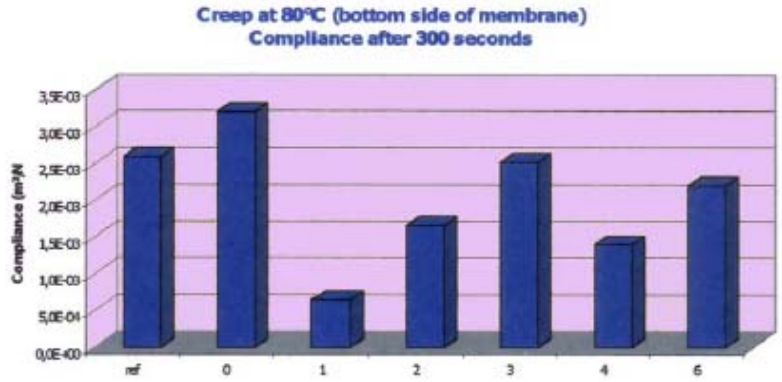
B. GRAPHS



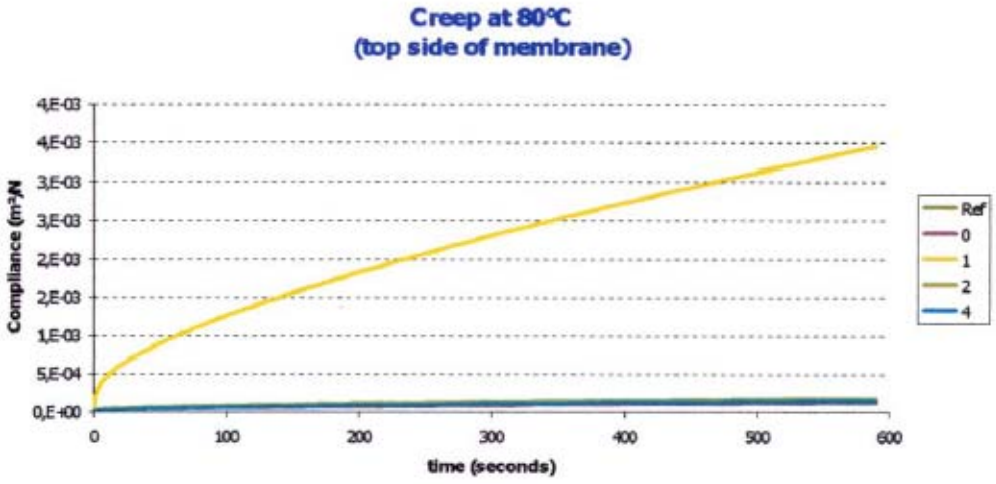
Remark:
Number 5 has been considered as an extreme case.



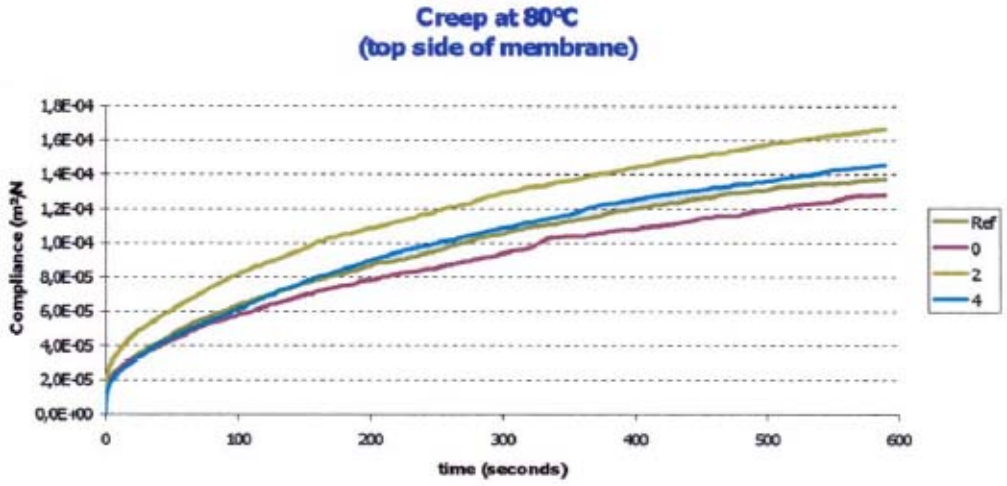
Remark:
Graph without any extreme case.



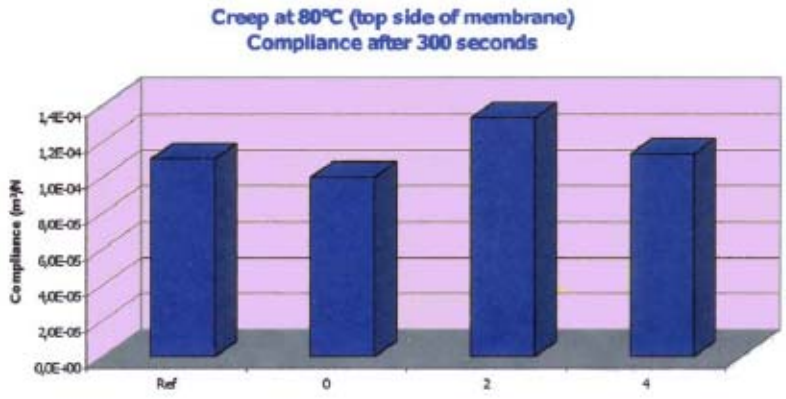
Remark:
Graph without any extreme case.



Remark:
Number 1 has been considered as an extreme case.
Number 3,5 and 6 could not be sampled.



Remark: Graph without any extreme case



Remark:
Graph without any extreme case

C. CONCLUSIONS

From the graphs above we can conclude the following:

Upper coating:

- No significant ageing in comparison with the reference sample.
- APAO is less affective to ageing than SBS is.
- Polymer was not attacked.

Lower coating:

- No significant ageing in comparison with the reference sample.
- Flexibility remained.
- Polymer was not attacked.

10. **Shear resistance** test
WTCB lab

Method used: UEAtc 1982
Traction speed: 200 mm/minute

The result obtained is an average of 3 individual results.

	N/50 mm	Joint	Remarks	
	≥ 500	overlap (mm)	**New, joint made in lab**	
1. Whole sales market	985	80	2-layer PES	
2. Polderbussen	442	120	1 layer(*)	Bad joint
3. Coplac	546	100	2- layer GF (**)	
4. Unilin	688	90	2- layer GF (***)	Broken membrane
5. Aalborg	1105	100	2- layer PES	Broken membrane
6. Dusit Thani	720	100	1 layer	

The difference observed are probably the result of differences in application of the joints.

(*) See inspection report 8440 attached and 8. BDA-rapport
(**) 2-layer PES: under layer with PolyESter fleece + Duo
(***) 2-layer GF: under layer with Glass Fleece (perforated) + Duo

<u>CONCLUSION</u>

The microscopic examination revealed the following:
In most cases, we notice that the overlap has been insufficiently burnt off. The foil to be burnt is still present between the composing roof membranes of the overlap, and hardly any bitumen has bled from the overlap. Moreover, there has been no proper melting with the under layer.
In spite of that, the values obtained during the shear resistance test are good.
On lab level it has been sufficiently demonstrated that the melting of APP with SBS constitutes no problem. The joint can realised perfectly.

Final conclusion

In general, we can affirm that the DUO membrane has resisted well during the first five to ten years on the roof. Only a few visual details must be noticed: pollution, moss forming, ... (see inspection report 8440 attached). They are mainly due to an almost overall lack of maintenance.

In case of flame-welded systems, we could notice that the adhesive strength of Duo to the basic layer was more than satisfying. It should be noticed that proper preparation is important (see note on primer).

In respect of the lab tests, we noticed that the values can be easily compared with the new state values and that hardly any ageing can be detected.

It is intended to examine the same roofs again after 15 and 20 years. As such, we can better understand the life expectance of the DUO membrane after having aged on the roof.

WTCB

A. Lefèbvre
In charge of the tests

E. Meert
Head of the department

SGS-Qualitest N.V.

Marc De Busschere
Project Co-ordinator

Carlo Paessen
Project Manager

Inspection report 8440 – SGS-Qualitest N.V

Addendum:
Inspection report 8440 - SGS-Qualitest N.V.

Project: Duo roof cut-offs 2000

Scope of inspection: Visual inspection + monitored sampling

Roofs inspected and observations:

1) Whole sales market - Antwerp (34 000 m^2)

Year of construction: 1990
Structure: Cellular concrete + single-sided PES coating + DUO
Mechanically fixed

Observations:

- The overall state of the roof is visually still very good. Nowhere have the slates disappeared completely. Generally speaking, no shrinkage could be noticed. At some spots, cracking could be detected in the upright edges. There were hardly any or no colour differences between the various lanes.

  A general remark in the margin: algae grow at various spots. This can be avoided by regular maintenance of the roof.

- Generally speaking, it can be said that the application, as far as visually can be detected, was adequate. No remarks in respect of leakage, joints, vertical edges, ...

- Samples were taken as follows :

  - 1 from a flat section of the roof in the middle of the roll
  - 1 from the slant side on the overlap.

2) Polderbussen Garage - Antwerp (7 500 m^2)

Year of construction: 1996
Structure: old roof + DUO, mechanically fixed - renovation.

Observations:

- The general state of the roof is visually all right. Nowhere have the slates completely disappeared. Generally speaking, no shrinkage could be noticed. Differences of colour between the lanes were hardly or not noticed.
- Generally speaking, the application, as far as visible, was good. No remarks in matters of leakage, joints, vertical edges, ... , except for the following:

Remark: after sampling, it appeared that the sample taken contained an incomplete burnt off lap, what results from the foil not being burnt off completely. That may cause less adhesion.

Samples were taken as follows:
- 1 from the bent roof part in the middle of the roll
- 1 from a bent part on the overlap

3) Coplac - Erembodegem (24 360 m^2)

Year of construction: 1992
Structure: old roof + vapour pressure repartition + DUO flame-welded - renovation

Observations:

- The general state of the roof is visually all right. nowhere have the slates completely disappeared. Only minor shrinkage could be noticed. Slight differences of colour existed between the lanes.

  As a general remark in the margin, it must be noticed that there was light moss forming at various spots. That can be avoided by regular maintenance of the roof.
- Generally speaking, the application, as far as visible, was good. No remarks in matters of leakage, joints, vertical edges.
- Samples were taken as follows:
  - 1 from the flat roof part in the middle of the roll
  - 1 from a flat part on the overlap

4) Unilin - Wielsbeke (12 650 m^2)

Year of construction: 1994
Structure: old roof + primer + vapour pressure repartition + DUO flame-welded - renovation

Observations:

- The general state of the roof is visually all right. Nowhere have the slates completely disappeared. Only minor shrinkage could be noticed. Slight differences of colour existed between the lanes.
- Generally speaking, the application, as far as visible, was good. No remarks in matters of leakage, joints, vertical edges, ...
- Samples were taken as follows:
  - 1 from the flat roof part in the middle of the roll
  - 1 from a flat part on the overlap

5) Aalborg - Danmark (1 500 m^2)

Year of construction: 1990
Structure: old roof + under layer with PES support + DUO flame-welded - renovation

Observations:

- The general state of the roof is visually all right. Nowhere have the slates completely disappeared. Only minor shrinkage lengthways could be noticed. No differences of colour existed between the lanes.
- Generally speaking, the application, as far as visible, was good. No remarks in matters of leakage, joints, vertical edges, ...
- Two samples were taken as follows:
  - 1 from the middle of the roll
  - 1 from the overlap

6) Dusit Thani - Thailand (1 500 m^2)

Year of construction: 1994
Structure: concrete + primer + DUO flame-welded

Observations:

- The general state of the roof is visually all right. Nowhere have the slates completely disappeared. Generally speaking, no shrinkage could be noticed. Differences of colour between the lanes could hardly or not be noticed.

Remark: By means of cold glue and slates in another colour, a logo had been fixed on the existing roof.
From the zone with the logo, samples were taken. It should be noticed that the slates fixed on the existing DUO layer by means of cold glue could affect certain tests, e.g. the cold flexibility test.

- Generally speaking, the application, as far as visible, was good. No remarks in matters of leakage, joints, vertical edges, ...
- Samples were taken from the logo as mentioned above.

Antwerp, 24 November 2000

SGS-QUALITEST N.V.

Marc De Busschere

SINTEF Test Report

SINTEF

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Your ref.:	Our ref.:	Direct line:	Trondheim,
Fax of 2002-05-08, P. van Rysseghem	bk/02.120 A	+47 73 59 10 78	2002-06-20

TEST REPORT

Task no.:	102N010.40 / 02.120 A
Test method/Standard:	NS-INSTA 413, 1.ed. March 1987 NT FIRE 006, Edition 2, approved 1985-11
Intention of test:	Documentation for approval
Test performed at:	**Norges branntekniske laboratorium as** **(Norwegian Fire Research Laboratory)** Tiller bru, Tiller N-7465 Trondheim NORWAY
Total number of pages: *(Appendices included)*	5
Client:	De Boer N.V
Name of product:	**Duo Frost 4.35 mm**
Type of product:	Roofing membrane
Product description:	From the received roll of roofing membrane, 6 specimens were cut with dimensions 400 mm x 1000 mm, thickness 4,35 mm. Nominal and measured square density 4,7 kg/m^2 and 4,8 kg/m^2. Colour: charcoal grey shale. Glassfleece of quality DH-C 55/1, thickness and square density 0,25 mm and 55 g/m^2 respectively, was positioned between the membrane and the underlay of 20 kg/m^2 non-treated EPS.

SINTEF

Manufacturer:	Membrane: De Boer N.V Glassfleece: Johns Manville
Place of production:	Membrane: Schoten, Belgium Glassfleece: Not stated
Samples received:	2002-06-03
Sampling:	The samples were chosen by the client.
Number of single tests:	3 at wind velocity 2 m/s 3 at wind velocity 4 m/s
Conditioning of the specimen:	The specimens were stored in air with a relative humidity of 50 % and at a temperature of 23 °C until constant mass was obtained.
Date of testing:	2002-06-12
Duration of the test:	15 minutes
Operator:	Erling Stenhaug, engineer
Test results:	See Table 1 and Figures 1 and 2, Appendix I
Remarks/deviations:	The product **Duo Frost 4.35 mm, on a backing of EPS** satisfies the criteria to roofings of class Ta according to Norwegian Standard NS 3919.
Appendices:	Appendix I Test results Appendix II Criteria for fire spread for roofings according to the Nordic NKB product rules for roofings and Norwegian Standard NS 3919

Norges branntekniske laboratorium as

Kjell Schmidt Pedersen
Managing Director

Bjarne Kristoffersen
Senior Engineer
Reaction to Fire

TEST RESULTS

Table 1 Results from testing of **Duo Frost 4.35 mm on a backing of EPS** according to NS-INSTA 413 (NT FIRE 006).
Wind velocity 2 m/s.

Test no.		1	2	3	Average
Weight of ignition crib	[g]	41,2	40,5	40,6	
Ignition of specimen	[min:s]	0:30	0:30	0:30	
Flames die out	[min:s]	6:42	7:17	6:09	
Glows die out	[min:s]	10:39	12:17	12:34	
Specimen behaviour during the test		Membrane creeps after 1:30	Bitumen creeps after 1:20	Membrane creeps after 1:20	
Specimen condition after the test		No comment	No comment	No comment	
Length of damaged area of roofing	[mm]	290	320	370	**333**
Length of damaged area of underlay	[mm]	300	330	420	**350**
Damaged area of roofing	[mm^2]	120 x 390	125 x 420	130 x 470	
Damaged area of underlay	[mm^2]	195 x 400	200 x 430	200 x 520	
Maximum depth of specimen damage	[mm]	54	54	54	

Times are given in minutes and seconds (min:s) after start of the test.
The length of the damaged part of roofing and underlay is measured from the centre of the ignition crib.

Criteria for fire spread for roofings according to the Nordic NKB product rules for roofings and Norwegian Standard NS 3919

Test principle:

The test specimen consists of the roofing attached to a backing material, usually EPS, ordinary particleboard/plywood, or mineral wool.

The specimen is mounted at an angle of 30 to the horizontal plane. A burning wooden crib is placed on the surface at the lower end of the specimen, and a forced air flow is passing over the exposed surface. Tests are performed with 2 m/s and 4 m/s wind velocity.

The test is terminated either when flames reach the upper end of the specimen, or after 15 minutes.

After the test the specimen is examined and the extent of damage to both the roofing and the underlay is measured. The criteria for classification are given in NS 3919 and in NKB Product Rules concerning roofings. At least three tests shall be performed at each wind velocity.

Classification criteria:

Roofing is classified in class Ta when it is shown to have a moderate tendency to spread fire.

1. Moderate tendency to spread fire

The roofing is governed to participate moderately in spread of fire if the test results show

- that the damage in the roofing - averaged over all tests - is not exceeding a distance of 550 mm from the center of the wooden crib.
- that the damage in the baseboard - averaged over all tests - is not exceeding a distance of 550 mm from the center of the wooden crib.
- that the length of the damage - both in the roofing and in the baseboard - for each of the six tests is less than 800 mm from the center of the wooden crib.

Table 2 Results from testing of **Duo Frost 4.35 mmon a backing of EPS** according to NS-INSTA 413 (NT FIRE 006).
Wind velocity 4 m/s.

Test no.	1	2	3	Average
Weight of ignition crib [g]	40,3	40,5	41,2	
Ignition of specimen [min:s]	0:40	0:40	0:35	
Flames die out [min:s]	7:53	8:24	6:52	
Glows die out [min:s]	8:30	8:24	8:08	
Specimen behaviour during the test	▪ Bitumen creeps after 1:00 - 1:15 ▪ Fire in EPS after 4:00 – 4:30			
Specimen condition after the test	No comments	No comment	No comment	
Length of damaged area of roofing [mm]	340	350	340	**343**
Length of damaged area of underlay [mm]	350	350	340	**347**
Damaged area of roofing [mm^2]	120 x 430	130 x 430	120 x 430	
Damaged area of underlay [mm^2]	215 x 440	225 x 450	210 x 440	
Maximum depth of specimen damage [mm]	54	54	54	

Times are given in minutes and seconds (min:s) after start of the test.
The length of the damaged part of roofing and underlay is measured from the centre of the ignition crib.

ACSIG Laboratory Tests on Geomembranes

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LABORATORY TESTS ON GEOMEMBRANES

Specimen: Duo 4 Slates/Foil

Submitted to:

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April 2000

1 BACKGROUND

The design and performance of geomembranes generally vary depending on its functions and applications. Geomembranes, which are impermeable, are widely used for lining purposes of canals and ponds, for containment purposes of hazardous wastes and leachates, and for other waterproofing purposes. In this report, the properties of the Duo 4 Slates/Foil geomembrane are presented. The sample was submitted for testing by the Duo Thailand Company. A copy of the pre-testing agreement is included in Appendix.

2 GEOMEMBRANE CHARACTERISTICS

2.1 Tensile Strength

The tensile strength of a geomembrane is that strength of the specimen when it is subjected to a tensile force according to its principal axis, at constant speed, by moving one of the clamps of the tensile machine. The laboratory test was conducted in accordance with ASTM D638 Type IV (Standard Test Method for Tensile Properties of Plastics). In this test, a continually increasing load at a rate of 40 mm/min was applied to the specimen until rupture of the specimen occurred. Values of the breaking load and elongation were obtained through an interfaced computer. Measured tensile strength values of the Duo 4 Slates/Foil geomembrane are presented in Table 1.

2.2 Tear Resistance

The tear resistance was conducted in accordance with ASTM D1004-90 (Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting). In this test method, resistance to tear is calculated from the maximum load at a rate of 40 mm/min was applied to the specimen until rupture of the specimen occurred. Values of the tearing load and elongation were obtained through an interfaced computer. Measured tear resistance values of the Duo 4 Slates/Foil geomembrane are presented in Table 2.

2.3 Puncture Resistance

Puncture resistance is defined as the inherent resisting mechanism of the test specimen to failure by a penetrating or puncturing object. The laboratory test was conducted in accordance with ASTM D4833 (Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products). A 100mm x 100mm geomembrane was clamped without tension between circular plates of a ring clamp attachment secured in the tensile testing machine. A force was exerted against the center of the unsupported portion of the test specimen by a solid steel rod attached to the load indicator. Measured puncture resistance of the Duo 4 Slates/Foil geomembrane are presented in Table 3.

2.4 Seam Strength

The seam strength test was conducted in accordance with ASTM D4545-86 (Standard Practice for Determining the Integrity of Factory Seams Used in Joining Manufactured Flexible Sheet Geomembranes). Five two inch (51mm) wide specimens

were prepared with the seam at the center of the test specimen and perpendicular to the centerline. The distance between the clamps was 2 inches (51) plus the width of the seam with the seam centered between the clamps. An increasing load was applied at a rate of 40mm/min and the values of the tensile strength and the corresponding elongation were obtained through an interfaced computer. Measured seam strengths of the Duo 4 Slates/Foil geomembrane are presented in Table 4.

2.5 UV Resistance

The UV resistance was conducted in accordance with ASTM D4355-92 (Standard Test Method for Deterioration of Geotextile from Exposure to Ultraviolet Light and Water). The samples were exposed to the sunlight for 0, 150, 300 and 500 of ultraviolet exposures. The samples were immediately tested for tensile strength after the given exposure time. The UV resistance measured values of the Duo 4 Slates/Foil geomembrane are presented in Table 5

3 SUMMARY OF TEST RESULTS

The laboratory test results of the properties of the Duo 4 Slates/Foil geomembrane are summarized in Table 6.

4 DISCLAIMER

The client Duo Thailand is hereby forewarned that this report covers only the test results of the Duo 4 Slates/Foil Geomembrane that was submitted February 22, 2000 and tested according to the specified test standards and testing atmosphere of 21 ± 2^{0}C temperature and 65 ± 5% humidity. This report, however, does not necessarily represent the condition of other products with the same nomenclature. No changes will be made in this report and in the data without prior permission from the laboratory. This report will be kept in the active file for six months after which it will be disposed.

Very truly yours,

Prof. Dennes T. Bergado
Director
Asian Center for Soil Improvement and Geosynthetics
Geotechnical Engineering Program
School of Civil Engineering
Asian Institute of Technology

REFERENCES:

ASTM DESIGNATION: D638 Type IV. "Standard Test Method for Tensile Properties of Plastics," Annual Book of ASTM Standards.

ASTM DESIGNATION: D1004-90. "Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting," Annual Book of ASTM Standards.

ASTM DESIGNATION: D4833-88. "Standard Test Method for Index Puncture Resistance of Geotextile, Geomembranes, and Related Products." Annual Book of ASTM Standards.

ASTM DESIGNATION: D4545-86. "Standard Practice for Determining the Integrity of Factory Seams Used in Joining Manufactured Flexible Sheet Geomembranes," Annual Book of ASTM Standards.

ASTM DESIGNATION: D4355-92. "Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water," Annual Book of ASTM Standards.

TABLES

Table 1 Measured tensile strength values of Duo 4 Slates/Foil Geomembrane

Tensile Strength		Trial1	Trial2	Trial3	Trial4	Trial5	Mean
roll direction	Strength, psi	398.67	455.63	378.67	341.72	398.67	394.67
	Elongation,	40	27	42	26	42	35
cross-roll direction	Strength, psi	284.76	398.66	398.67	398.67	398.68	375.89
	Elongation,	32	33	28	43	22	32

Table 2 Measured tear strength values of Duo 4 Slates/Foil Geomembrane

Tear Strength		Trial1	Trial2	Trial3	Trial4	Trial5	Mean
roll direction	Strength, lb	29.66	27.19	27.19	29.66	29.66	28.67
cross-roll direction	Strength, lb	37.07	29.66	29.66	37.07	32.13	33.12

Table 3 Measured puncture resistance values of Duo 4 Slates/Foil Geomembrane

Puncture Resistance	Trial1	Trial2	Trial3	Trial4	Trial5	Mean
kN	0.25	0.34	0.39	0.32	0.44	0.35

Table 4 Measured peel strength values of Duo 4 Slates/Foil Geomembrane

Peel Strength	Trial1	Trial2	Trial3	Trial4	Trial5	Mean
kN	0.76	0.69	0.71	0.80	0.80	0.75

Table 5 Measured UV resistance values of Duo 4 Slates/Foil Geomembrane

UV Resistance	Trial1	Trial2	Trial3	Trial4	Trial5	Mean	% loss
0 hr, psi (unexposed)	398.67	455.63	378.67	341.72	398.67	394.67	
150 h, psi	626.43	455.58	455.58	569.44	341.70	489.75	24.09
300 h, psi	284.75	341.69	398.64	398.63	341.69	353.08	-10.54
500 h, psi	398.68	512.55	398.66	341.72	398.68	410.06	3.90

APPENDIX

Table 6 Summary of The Laboratory Test Results of Duo 4 Slates/Foil Geomembrane

Property	Unit	Test Method	Measured Value
Tensile Strength		ASTM D638-91	
Roll Direction		Type IV	
strength	psi		394.67
elongation	%		35
Cross-roll Direction			
strength	psi		375.89
elongation	%		32
Trapezoidal Tear Strength		ASTM D1004-90	
roll direction, strength	lb		28.67
cross-roll direction, strength	lb		33.12
Puncture Strength	kN	ASTM D4833-88	0.35
Peel Strength	kN	ASTM D4545-86	0.75
UV Resistance	psi	ASTM D4355-92	
0 hr, psi (unexposed)			394.67
150 h, psi			489.75
300 h, psi			353.08
500 h, psi			410.06