

ISSUE 573 BULLETIN



FLEXIBLE WALL UNDERLAYS

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■ In E2/AS1, 'wall underlay' describes the range of materials referred to as wraps, building wraps, wall wraps, house wraps, sheathing, pliable building membranes, underlays or building papers.

■ Wall underlays reduce air movement into insulated frame cavities, restrict the occasional transfer of liquid water to the framing, allow water vapour to escape from the inside and, where absorbent, temporarily absorb condensation.

■ This bulletin focuses on the performance, specification and installation of flexible wall underlays applied to wall framing. It replaces Bulletin 470 *Wall underlays*.

1.0 INTRODUCTION

1.0.1 Building papers (bitumen-soaked kraft papers) have been used periodically behind the cladding in timber-framed wall construction in New Zealand since the 1920s. They were first installed in timber-framed buildings to reduce the draughts that occurred, particularly through the weatherboards.

1.0.2 Wall underlay is the term used by E2/AS1 to describe materials previously referred to as wraps, building wraps, wall wraps, house wraps, sheathing, pliable building membranes, underlays or building papers.

1.0.3 Flexible wall underlays covered by E2/AS1 can be:

- absorbent synthetic wall wraps
- non-absorbent synthetic wall wraps
- kraft paper-based building papers – bitumen soaked or fire retardant.

1.0.4 This bulletin focuses on the performance, specification and installation of flexible wall underlays applied to wall framing. It replaces Bulletin 470 *Wall underlays*.

1.0.5 Rigid plywood and fibre-cement sheet wall underlay allowed for in E2/AS1 and proprietary rigid air barrier systems are not covered by this bulletin. Rigid underlays are required for designs to E2/AS1 (note 4 Table 1) in the extra high wind zone and must be overlaid with a flexible wall underlay. While E2/AS1 specifically covers timber framing, E2/AS1 Table 23 can be used for the selection of a flexible wall underlay applied to steel framing.

2.0 FUNCTION

2.0.1 In New Zealand's windy but temperate maritime climate, it is inevitable that some water will penetrate through the wall cladding.

2.0.2 Flexible wall underlays are an important component in the weathertightness of an exterior wall system designed to manage both water and air movement. Good weathertight design is achieved by using wall underlays together with other building elements including the wall cladding, flashings, drained and vented cavity, insulation, air seals and interior linings. They are not a defence against persistent leaks every time it rains.

2.0.3 Flexible wall underlay is installed to the outer face of the framing and must:

- be sufficiently water resistant to provide a last line of defence to allow water that occasionally gets behind the cladding or crosses a drained and vented cavity to drain down its surface and prevent it affecting the framing, insulation and interior linings
- have sufficient breathability to allow the escape of water vapour from the building materials or spaces behind the underlay

- be sufficiently absorbent when installed behind non-absorbent direct-fixed claddings to temporarily absorb any condensation until it evaporates.

2.0.4 In addition, flexible wall underlay is required to:

- remain durable throughout the life of the cladding
- resist tearing
- separate the potentially wet wall elements (such as cladding) from the dry wall elements (such as framing, insulation and interior linings)
- restrict airflow into framing cavities (airflow can reduce the insulation value of bulk insulation)
- support thermal insulation – with a drained and vented cavity, E2/AS1 requires an additional cavity batten or horizontal strapping at 300 mm centres to prevent the wall insulation pushing the wall underlay across the width of the cavity
- help keep the framing drier during construction.

3.0 CODES AND STANDARDS

3.1 NEW ZEALAND BUILDING CODE

3.1.1 The key New Zealand Building Code (NZBC) clauses that apply to the selection and use of flexible wall underlays are:

- B2 *Durability* and Acceptable Solution B2/AS1
- E2 *External moisture* and Acceptable Solution E2/AS1, in particular Table 23.

3.1.2 In some instances, C1–C6 *Protection from fire*, E3 *Internal moisture* and H1 *Energy efficiency* may be referenced.

3.2 B2 DURABILITY

3.2.1 The durability required of a flexible wall underlay under NZBC clause B2 depends on the type of cladding to be installed over the material. Behind brick veneer it must meet a not-less-than-50-year durability requirement (because brick cladding is deemed difficult to replace). Under all other wall claddings, the minimum durability requirement is not less than 15 years. However, the flexible wall underlay is required to remain serviceable (and therefore durable) for the life of the cladding material, which can be significantly more than 15 years.

3.3 C1–C6 PROTECTION FROM FIRE

3.3.1 In exterior walls where spread of fire needs to be considered (close to boundaries, for instance), there is no requirement for the wall underlay itself to be non-combustible or to have a specific flammability index. Where a flexible wall underlay is exposed to view in an occupied space, it must have a flammability index of not more than 5 when tested to NZS/AS 1530.2:1993 *Methods for fire tests on building materials, components and structures – Test for flammability of materials*.

3.4 E2 EXTERNAL MOISTURE

3.4.1 Two functional requirements of NZBC clause E2 are to ensure buildings are constructed to:

- provide adequate resistance to penetration of moisture from outside
- prevent accumulation of moisture in building framing cavities (also covered in E3 *Internal moisture*).

3.4.2 E2/AS1 Table 23 and sections 9.1.5 and 9.1.7 are the key references relating to wall underlays, and wall underlay location is noted on all drawings in section 9.

3.5 E3 INTERNAL MOISTURE

3.5.1 E3/AS1 specifies that wall underlay shall extend from the upper side of the top plate to the underside of the bearers or wall plates supporting the ground floor joists.

3.6 H1 ENERGY EFFICIENCY

3.6.1 The performance requirements of NZBC clause H1 are to ensure that certain categories of buildings (including housing) achieve an adequate level of energy efficiency, but wall underlays are not specifically mentioned.

3.7 APPLICABLE STANDARDS

3.7.1 The standard referenced for the performance of flexible wall underlays in Table 23 of E2/AS1 is NZS 2295:2006 *Pliable, permeable building underlays*.

4.0 PERFORMANCE PARAMETERS

4.1 NZS 2295

4.1.1 Table 23 of E2/AS1 references the performance requirements of NZS 2295:2006 section 2.

4.1.2 Key requirements:

- All wall underlays must meet the vapour-resistance requirements of less than or equal to 7 MN s/g. Vapour transmission resistance is also described as water vapour permeability or breathability. It is the capacity for water vapour to pass through the underlay from inside the building envelope and minimise the risk of that vapour condensing within the wall cavities.
- No minimum wall underlay absorbency requirement for:
 - wall claddings installed over a drained and vented cavity
 - direct-fixed absorbent claddings.
- All wall underlays must meet these performance requirements of NZS 2295:2006:
 - Water resistance – a resistance of 20 mm (static water head).
 - Shrinkage – 0%–0.5% for run lengths up to 10 m and 0.5–1.5% for run lengths up to 7 m.

Excessive shrinkage can cause tearing and failure at the lap joints. Large shrinkage rates may occur in fire-retardant building papers where they remain wet for a period of time, and a lap of at least 200 mm should be specified where this may be a problem.

- pH of extract of between 5.5 and 8.0 (acidity or alkalinity of the water that is released after contact with the flexible wall underlay).
- Mechanical strength as given in Table 1 reproduced from NZS 2295:2006.
- Wall underlays claiming to be fire retardant shall have a flammability index of 5 or less.
- A minimum absorbency for a wall underlay is 100 gm/m² of underlay when installed behind direct-fixed non-absorbent claddings. Absorption is the capacity for the underlay to hold moisture from any condensation or occasional water getting past the cladding temporarily until it can be released through drying.
- Paper-based underlays to be installed only behind direct-fixed profiled metal wall cladding.
- Specific air-barrier properties – water resistance, pH of extract (6.0–9.0), shrinkage (0.5%), edge tear strength and air resistance (0.1 MN s/m³ or greater) – are required of the wall underlay where there are no internal linings that perform the function of an air barrier. (This requirement also applies to wall underlay installed to gable end walls that are not lined internally.)

4.1.3 While not called up in Table 23 of E2/AS1, NZS 2295:2006 also requires that wall underlays retain at least 85% of their mechanical strength when UV exposure testing is carried out.

4.2 ALTERNATIVE METHODS

4.2.1 A number of absorbent synthetic wall underlays have been appraised as meeting the relevant performance requirements of Table 23 of E2/AS1 and are considered suitable for use behind direct-fixed non-absorbent cladding as an alternative method.

4.3 MANUFACTURERS' RECOMMENDATIONS

4.3.1 A number of specific recommendations have been put in place by either the flexible wall underlay supplier or the cladding supplier as to the suitability of products for use together.

4.3.2 A number of metal cladding manufacturers do not recommend using absorbent synthetic wall underlays behind direct-fixed metal wall cladding. Building paper and absorbent synthetic wraps absorb moisture differently, which can have an impact on various performance properties. Building paper holds moisture within the material fibres, whereas absorbent synthetic wall underlays hold moisture as small droplets in the space between the material fibres.

TABLE 1 MECHANICAL STRENGTH PROPERTIES FOR WALL UNDERLAYS (FROM NZS 2295:2006)

Type	Grade	Edge tear resistance (N)		Tensile strength (KN/m)	
		Machine direction	Cross direction	Machine direction	Cross direction
W1 – kraft	standard	28	28	6	4
W2 – kraft	heavy	40	35	9	4.5
W3 – synthetic	non-absorbent	150	100	3	1
W4 – synthetic	absorbent	150	100	3	1

5.0 SPECIFYING A WALL UNDERLAY

5.0.1 Always obtain product-specific performance data and information from both the flexible wall underlay and cladding manufacturers. There can be variability between materials in their performance data and, in particular, the way they deal with water. Also ensure the various products (underlay, flexible flashing tape, battens, cladding, framing) can be used together.

5.0.2 Properties of the different product categories of wall underlays (given in Table 2) can be used as an initial guide to selecting the wall underlay to be installed.

5.0.3 Factors that may influence the selection when specifying or using a particular flexible wall underlay are the:

- requirements of E2/AS1
- absorbency of the cladding
- wind zone – the demands placed on a material are significantly greater on an exposed site during and after construction
- weather protection requirements of the framing supplier/manufacturer
- wall underlay requirements of the cladding manufacturer
- use recommendations of the wall underlay manufacturer

- compatibility of the wall underlay with the flexible flashing tape
- translucency of synthetic wall underlay material – translucent materials can allow sufficient natural light for work to continue inside the building during daylight hours without the need for lighting
- ability of the wall underlay to perform the functions and meet the performance requirements of an air barrier (where there is no internal air barrier such as tight-stopped plasterboard)
- specification of the wall underlay as a component of a weathertightness remediation.

6.0 INSTALLATION

6.0.1 Flexible wall underlays must be properly installed to ensure performance over the life of the building. Too often, the installation quality is below what is considered acceptable.

6.0.2 As part of the building consent application, building designers should nominate a specific wall underlay to suit the conditions and performance requirements of the design, cladding and site application, and this is what must be installed – installing any wall underlay supplied by the building merchant is not acceptable.

TABLE 2 INITIAL SELECTION GUIDE FOR FLEXIBLE WALL UNDERLAYS

	Kraft building paper		Synthetic wall underlays	
	Black	Fire retardant	Absorbent	Non-absorbent
Roll widths	1,350 mm max	1,350 mm max	2,740 mm max	2,740 mm max
Absorbent	Yes	Yes	Yes	No
Tear resistance	Limited	Limited	Very good	Very good
Shrinkage	Possible if wetted	Yes if wetted	None	None
Translucent	No	No	Yes	Yes
Water resistant	Yes	Yes	Yes	Yes
Waterproof (1)	No	No	No	No
Maximum exposure (2)	30 days	30 days	30–60 days depending on product	30–60 days depending on product
E2/AS1 specified use with direct-fixed non-absorbent cladding	Yes	Yes	Yes (3)	No

Notes:

- (1) Flexible underlays may be water resistant to varying degrees but they are not waterproof.
 (2) Check manufacturer’s literature as it may specify that the product must not be wetted before the cladding is installed.
 (3) E2/AS1 does not allow the use of an absorbent synthetic wall underlay with a non-absorbent direct-fixed steel cladding..

6.1 INSTALLATION STEPS

6.1.1 Some important installation requirements (E2/AS1 paragraph 9.1.7) for flexible wall underlays include:

- not mixing and matching different underlay products as they can have different properties
- not using off-cuts and other random pieces over the wall area – unnecessary joints are likely to affect the performance of the flexible wall underlay
- fixing the underlay horizontally in continuous, full-width strips
- ensuring the underlay material extends from the upper side of the top plate to the underside of the bottom plate or bearer – for buildings with suspended floors and where the cladding is taken below the floor level, the flexible wall underlay should finish about 30–40 mm up from the bottom edge of the cladding
- for narrow roll material, starting at the bottom of the wall and lapping the upper material over the lower with a 75 mm minimum lap
- when starting and stopping at corners, wrapping the underlay material around a corner improves its resistance to tearing when compared to an exposed end of a vertical lap
- providing laps of not less than 150 mm at vertical joints over studs
- ensuring end laps are made over framing to provide secure fixing at the lap
- keeping the wall underlay taut and securely fixing the material to stop it flapping during application – loose material that is able to flap in the wind is more likely to be damaged and may also create noise after the building is completed
- integrating the wall underlay with flashing upstands by either installing a second layer over the upstand, taping the upstand to the wall underlay or installing the upstand behind the wall underlay
- installing the material with the correct face against the framing as materials may have a right and wrong side
- returning the material around the jambs and sill of doors and windows, fixing to the inner face of the framing then installing flexible flashing tape before doors and windows are installed
- for buildings with soffits, extending the wall underlay material up to the top plate and installing the soffit framing later
- repairing or replacing any damaged (torn, punctured) flexible wall underlay before cladding is installed – small repairs can be done with compatible flexible flashing tape while larger areas of damage should have new material run from a point above the damage where the new material can be lapped under the existing and run past the damage by 300–400 mm
- ensuring the flexible flashing tape is compatible with the flexible wall underlay
- installing and taping all penetrations through the wall underlay before the cladding is installed
- ensuring the weather exposure limits (between installation and the fixing of the cladding) specified by the supplier are met.

6.2 FIXING

6.2.1 Flexible wall underlays are typically fixed to timber framing with proprietary toothed plates or staples. For steel framing, the flexible underlay is screw fixed preferably through the polypropylene tape.

6.3 LIMITING EXPOSURE TO WEATHER

6.3.1 Flexible wall underlays are commonly used to keep the framing dry until the cladding is installed, but they should be protected as quickly as practicable to minimise the period of time the material is exposed to the weather. The maximum recommended exposure for flexible wall underlays is typically 30–60 days. Wall underlay that has been exposed too long or has been regularly wetted (particularly kraft-based products) may need to be replaced before the cladding is installed, to ensure the durability requirements will be met.

6.3.2 Overexposing the wall underlay to weather will typically cause the material to degrade, reducing strength and durability and resistance to water penetration. This can lead to tearing or bursting.

6.3.3 Currently available flexible wall underlays do not provide weather protection to allow the installation of insulation or internal linings. Moisture can be driven through the wall underlay and will show as dampness along the contacting face between the framing and the underlay. Such work must be delayed until the exterior cladding system is completed. The consenting authority will usually require an inspection before cladding is fixed.

6.4 INTERMEDIATE RESTRAINTS

6.4.1 The flexible wall underlay must be prevented from bulging into a drained and vented cavity when stud spacings are greater than 450 mm. Allowable intermediate restraints (fixed over the wall underlay) that prevent the underlay bridging the cavity are:

- vertical cavity battens at maximum 300 mm centres
- galvanised wire at maximum 300 mm centres installed horizontally and fixed to studs
- polypropylene tape at maximum 300 mm centres installed horizontally and fixed to studs
- 75 mm galvanised wire mesh.



6.5 FLASHING TAPE

6.5.1 For installation following E2/AS1, flexible wall underlay is folded into the rough opening then flexible flashing tape is installed to the four corners of the opening and across the full width of the sill trimmer.

The flexible flashing tape:

- must be compatible with the flexible wall underlay and installed in accordance with the supplier's instructions, which may require a specific minimum temperature when tape is applied
- protects exposed parts of the framing at the corners where the flexible wall underlay is trimmed into the rough opening
- provides extra protection across the sill trimmer where there is a higher risk of water that may get in accumulating.

7.0 FACTORS AFFECTING PERFORMANCE

7.0.1 The performance of flexible wall underlays may be affected by:

- unrepaired damage to the wall underlay due to wind damage or a lack of care as other trades carry out work
- overexposure to UV
- poor installation
- insufficient laps
- installing material with the wrong face to the framing
- installing material diagonally or vertically on walls
- rain wetting, especially with kraft paper-based flexible wall underlays
- extended exposure to weather resulting in UV degradation (particularly with synthetic wraps)
- dirt accumulation on the building paper or synthetic wall underlay, which will absorb and hold moisture
- installing underlay material as a patchwork instead of using full-width sheets with minimal joins
- contact with solvents.

8.0 FURTHER READING

8.1 STANDARDS NEW ZEALAND

NZS 2295:2006 *Pliable, permeable building underlays*

NZS/AS 1530.2:1993 *Methods for fire tests on building materials, components and structures – Test for flammability of materials*

8.2 BUILDING CODE ACCEPTABLE SOLUTIONS

B2/AS1

E2/AS1

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