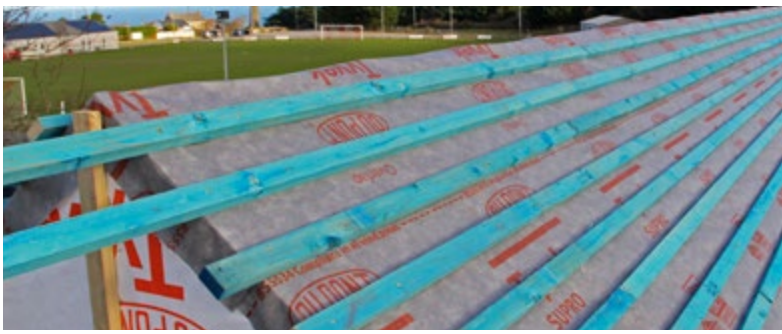
DUPONT™

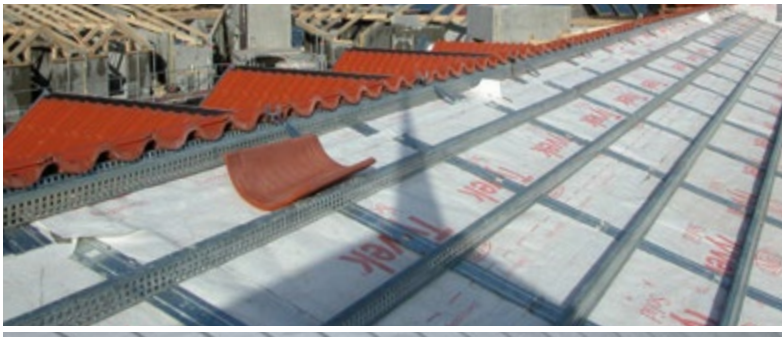
Tyvek®

Technical Manual – Roofs

DuPont™ Tyvek® & DuPont™ AirGuard®

Membranes, Tapes and Accessories





Product Portfolio

DuPont Performance Building Solutions

DuPont™ Tyvek® roofing underlays

- Tyvek® Supro / Tyvek® Supro Plus
- Tyvek® Metal

Medium to High Occupancy buildings e.g. Health, Education, Residential ,Commercial, Leisure...

DuPont™ Tyvek® and DuPont™ AirGuard® accessories

- •• Tyvek® Acrylic Tape with split-release liner
- •• Tyvek® Acrylic Tape
- •• Tyvek® Metallised Tape
- •• Tyvek® Double Sided Tape
- •• Tyvek® Butyl Tape
- • Tyvek® UV Façade Tape
- •• Tyvek® FlexWrap NF Tape
- •• Tyvek® FlexWrap EZ Tape
- • DuPont™ AirGuard® Tape
- • DuPont™ AirGuard® Sealant
- •• Tyvek® Window/Plastering tape
- • DuPont™ AirGuard® FR System Tape
- •• Tyvek® Primer
- • DuPont™ Insta Stik™
- • DuPont™ Great Stuff™
- • DuPont™ Froth-Pak™

• External application
• Internal application

Products and Technical Support for all Building Types from low occupancy, low level buildings to high occupancy, high rise buildings, on-site and off-site construction

DuPont™ AirGuard® air & vapour control layer (AVCL) and DuPont™ Tyvek® AirGuard® Smart (AVCL) membranes

- DuPont™ AirGuard® Control
- DuPont™ AirGuard® Reflective
- DuPont™ AirGuard® Reflective E
- DuPont™ Tyvek® AirGuard® Smart
- DuPont™ AirGuard® A2 FR fire retardant AVCL

(For use in the internal wall lining)

Low Occupancy buildings e.g. Detached, Semi-detatched, Terraced

DUPONT™ Tyvek®

DuPont™ Tyvek® Trifecta™ breather membranes solutions for wall constructions

- Tyvek® Trifecta™
- Tyvek® FireCurb® breather membrane
- Tyvek® StructureGuard™
- Tyvek® Housewrap
- Tyvek® Reflex
- Tyvek® UV Façade/Tyvek® UV Façade Plus

(For use in the external wall lining)

DuPont Tyvek® & DuPont™ AirGuard® - Roof Applications

Introduction

Over 30 years ago , the DuPont™ Tyvek® family of Weather Resistant Barrier (WRB) and superior building performance membranes were introduced into the UK and Ireland construction markets. The inherent qualities of the DuPont™ Tyvek®, range of products, made them an obvious solution in providing protection to buildings against the external elements, offering benefits over traditional materials in terms of water resistance, vapour permeability, flexibility, strength and durability.

The DuPont™ Tyvek® product range was enhanced with the introduction of our internal DuPont™AirGuard® membranes to control internal moisture and enhance energy efficiency. Together with a complete range of adhesive sealing tapes and accessories, the combined product portfolio has evolved to meet the demands of the changing world, providing solutions for the following:

- Weather Protection
- Moisture & Condensation Control
- Energy Efficiency & Airtightness
- Indoor Air Quality
- Thermal Performance
- Fire Safety
- Long Term Durability

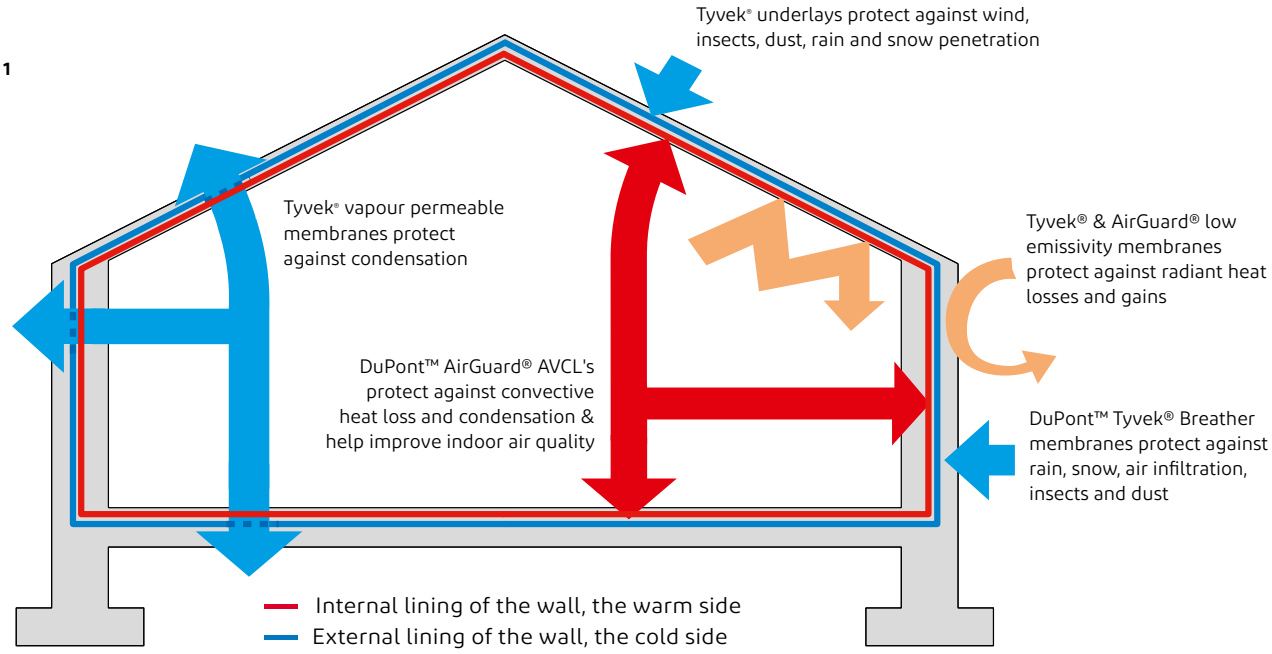
Please also see the Technical Manual - Wall & Floors

Protection in Construction

This technical manual contains detailed information specifically on the use of Tyvek® and AirGuard® membranes in wall and floor construction. By controlling the movements of heat, air and moisture through the building envelope DuPont™Tyvek® and DuPont™ AirGuard® membranes can make a major contribution to protecting the environment by improving the energy efficiency of buildings.

To achieve the required internal conditions with optimum efficiency it is essential to consider air flow and moisture movement together with all aspects of heat transfer, not only by conduction, but also by convection and radiation. The reduction of air leakage, the avoidance of damaging condensation and the provision of thermal insulation must all be considered together to ensure the protection and well-being of the occupants and the long-term protection of the building fabric.

Fig. 1



For information on Tyvek® & AirGuard® membranes for protection against external moisture please contact the DuPont™ Tyvek® Building Knowledge Centre. Details on back page.

DuPont™ Tyvek® membranes: pitched roof applications

Roofing underlay

Tyvek® Supro and Tyvek® Supro Plus are extremely durable flexible sheet materials for use as roofing underlays in pitched roof construction. They can be incorporated into all tiled or slated pitched roofs, whether they be new-build or refurbishment projects. As a secondary water shedding layer a Tyvek® membrane will provide a barrier to minimize the wind load acting on the slates and tiles and will adequately resist wind blown snow and dust from entering the roof construction. Tyvek® membranes are suitable for use as roofing underlays as defined in BS5534:2014 and A2.2018. Tyvek® membranes are also suitable for use in metal clad industrial roofs.

Insulation - Condensation

Tyvek® membranes offer benefits over traditional impermeable roofing underlays by minimising the risk of interstitial condensation occurring within roof constructions: Over the last 30 years or so, as we have become more aware of the need to conserve energy, the required levels of insulation within roofs have become greater. This has had the effect of increasing the likelihood of condensation forming on the underside of the roofing felt. Prior to the introduction of modern vapour permeable membranes, the only way of reducing this risk was to introduce ventilation openings in the roof to effectively "change the air". In order to ensure that a sufficient amount of ventilation was provided to prevent condensation, Building Regulations and Standards were amended.

Satisfying the Building Regulations

Standards across the UK require that the building and the people who use the building are protected from the harmful effects of moisture in all its forms. In England and Wales, the requirements of Approved Document C apply.

In Scotland, The Building Standards section 3.15 provide guidance and in Northern Ireland, Technical Booklet C is used to demonstrate compliance. In Ireland, Technical Guidance C provides examples on how to meet the requirements for all buildings.

Approved Documents contain practical guidance on how to meet the requirements of the Building Regulations. Part C covers Resistance to moisture under C2. The requirement is as follows:

Resistance to moisture

C2. The floors, walls and roof of the building shall be designed and constructed as to prevent the passage of moisture to the inside of the building or damage to the fabric of the building.
b) precipitation and wind driven spray.
c) interstitial and surface condensation; and,
d) spillage of water from or associated with sanitary fittings or fixed appliances.
Protection from external moisture and condensation will ensure the structural performance of a roof construction and thermal performance of the insulation will not be compromised.

DuPont™ Tyvek® Solution

Tyvek® is a vapour permeable material which, as a Type LR roofing underlay (BS5250), will offer a low resistance to the passage of vapour. During the winter, when a bulding is heated and the internal vapour pressure is high, a Tyvek® underlay will, by diffusion, allow water vapour within the roof space to permeate through to the batten space. Natural air movement through the joints of the roof covering will subsequently allow any moisture laden air to escape to atmosphere.

The ability of a Tyvek® underlay to provide this function of condensation control eliminates the need to ventilate any roof voids between the underlay and the insulation.

In every case during the design stage it is important to consider the entire roof element, from the interior dry-lining to the outer roof covering, to assess the capacity of the system to control condensation. This is dependant on a number of factors, but from a fabric point of view efficient external vapour release and internal vapour control must beestablished. In accordance with Section 6 of Approved Document C, moisture transfer through penetrations and gaps in the internal lining should be avoided. This requirement encourages us to address the airtightness of the ceiling and it's ability to reduce convective vapour and heat transfer. Methods for which are described in BS 9250:2007 (Code of practice for design of the airtightness of ceilings in pitched roofs).

Using a Tyvek® underlay in conjunction with a suitable air & vapour control layer (AVCL) will fulfil all the requirements for weather protection, condensation control and convective heat loss (airtightness), across the UK and Ireland, meeting the requirement of Approved Document C2.

Further information on internal air & vapour control can be found on page 11.

Please refer to page 37 for theDuPont™ AirGuard® range of AVCL's

BBA Approvals

In order to determine the risk of condensation in non-ventilated pitched roof constructions using Tyvek® as the roofing underlay, the British Board of Agrément (BBA) conducted a long term research programme. The exhaustive research covered a wide range of pitched roofs, typical to the UK, varying in pitch from 12.5° to 70°, in different locations throughout the country, using various roof coverings. The tests were conducted over two winter periods and data collated and assessed using sophisticated computer modelling. More than 100 cases were analysed using readings taken from sites in Wiltshire and Glasgow, which were selected to reflect the prevailing weather patterns in these regions.

The results from the research were very successful, with insignificant amounts of condensation recorded, especially in the sealed roof systems. The results were further verified by additional measured data that had been gathered from other previous site monitoring.

Not surprisingly, the BBA granted approval in the form of certificate 08/4548 for the use of Tyvek® membranes in non - ventilated and sealed cold pitched roofs.

Together with the warm roof approvals granted originally in 1991 and most significantly in 1994 and 2004, DuPont now have universal approval for the use of Tyvek® membranes in pitched roof constructions.

NHBC

For sites covered by an NHBC warranty, Tyvek® Supro is classed as an LR (vapour permeable) underlay and is fully compliant with NHBC requirement 7.2, which states:

Ridge or high-level ventilation equivalent to a continuous opening of 5mm should be provided at the highest point of each roof slope in accordance with BS 5250.

As BS5534 requires a dry fix ridge system, this ventilation is easily accommodated into normal site practice, regardless of underlay type.

Non-ventilated vs ventilated

BBA certificate 08/4548 states that with Tyvek®, "the risk of condensation is equivalent to, or less than, that attending current conventionally ventilated cold roof systems. "The certificate also states that Tyvek® membranes may be used in "dwellings of any conventional plan and of any size." This documentation is sufficient to satisfy current legislative requirements across the UK and Ireland: Building Regulations Approved Document C2.

The solution of ventilating roof constructions in order to prevent excessive condensation beneath impermeable underlays is often regarded as "the traditional way" of meeting the regulations. However, traditional methods of construction and practices are often superceded by more efficient and effective solutions. From an energy conservation perspective, introducing cold external air into roofs can be to the detriment of the construction by:

- reducing the effectiveness of fibrous insulation.
- promoting warm air leakage from the building into the roof space.
- Increasing air infiltration into the heated building.
- Introducing dirt, dust and insects into the roof construction.
- Introducing external moisture laden air into the construction.

A non-ventilated Tyvek® system will not only prevent excessive condensation, as required, but will also offer substantial gains in energy efficiency by reducing these factors

Agrément certificate coverage

BBA certificate 08/4548 state that Tyvek® underlays are suitable for use in dwellings. Due to the wide range of conditions that they offer, dwellings are used by the BBA for the purposes of assessing product performance. The test environments include appropriate temperature and humidity levels which prevail within bathrooms and kitchens. It is generally accepted that the majority of commercial and industrial buildings will present safer conditions within which the membrane is to perform. An office for instance will generally have lower temperature and humidity levels than a domestic dwelling. Tyvek® membranes can therefore be incorporated into domestic, industrial and commercial specifications. Previous certification was restricted, in that the BBA approved the use of Tyvek® membranes only in roofs of simple plan rectangular shapes. Certification now allows for typical roof detailing such as lean-to roofs, valleys, dormers and Scottish boarded roofs. Certificate 08/4548 approves the use of Tyvek® membranes in both **warm and cold** pitched roof construction. These are categorised according to the positioning of the insulation:

Cold roofs (Fig. 5)

This is where the insulation is installed at joist level with a cold loft - space (attic) between the insulation and roofing underlay. In the main, quilt insulation is laid between and over ceiling joists.

Warm roofs (Fig. 6)

This is where the insulation is installed at rafter level using rigid and/or semi rigid insulation. The insulation would ideally be positioned in a continuous layer above the rafters so that the roof structure is situated in a "warm" environment. However, certain roof specifications can result in the insulation being installed over rafters, between rafters or under rafters. With increasing thermal requirements it is quite common for a combination of these options to be employed.

Room in the roof applications (Fig. 7)

The BBA have assessed room in the roof applications as included in Agrément certificate 08/4548. Tyvek® membranes may therefore be installed into this form of construction without ventilation at eaves or ridge. Room in the roof constructions very often incorporate a combination of both warm and cold roof constructions, employing varying types of insulation. Cold roof areas usually include "vapour open" fibrous insulation such as mineral wool quilt, whereas the sloping ceiling areas include closed cell or foil backed rigid board insulants, of which the majority are highly vapour resistant. This variation in vapour resistance can result in an imbalance in vapour drive. To equalise the internal vapour resistances throughout the construction it is recommended that a AVCL such as DuPont™ AirGuard® Control, DuPont™ AirGuard® Reflective, DuPont™ AirGuard® A2 FR and DuPont™ Tyvek® AirGuard® Smart be installed beneath the "vapour open" quilt insulation.

Air & Vapour Control Layers (AVCL's).

As the regulations of all UK and Ireland authorities tighten and fabric thermal performance levels increase, heat transmission into a cold roof space by conduction will be reduced. In a cold pitched roof this will result in a lower operating temperature within the loft space, which could potentially increase the probability of interstitial condensation occurring. However, in a normal domestic environment of 20°C at 60% RH the expected quantity of vapour should egress the building safely and efficiently via trickle vents and other internal ventilation measures. The Tyvek® underlay can be relied upon to diffuse any normal levels of vapour that migrates into the roof construction to outside atmosphere.

There may however be circumstances where the internal air will contain a higher level of moisture than the system can efficiently manage. Excessive humidity levels can be generated by swimming pools for example or when a new building is undergoing a period of drying-out during a winter season. As heat will displace air in an upwards trend, the majority of vapour will migrate into the roof void. Cold vapour resistant surfaces such as structural steelwork and vapour impermeable (Type HR) underlays are at great risk from a build-up of condensate even when properly ventilated. Similarly, vapour can also potentially condense on vapour permeable (Type LR) underlays (such as Tyvek® Supro) if moisture in the air is excessive. This is most likely to happen whilst the building is drying out.

Once the moisture levels within the building have decreased, so too will the risk of condensation. The relative humidity will balance out and the building will operate within the expected comfort levels. In some cases, the drying out phase may need some assistance with apparatus such as de-humidifiers. This would be particular to buildings which have extreme levels of trapped moisture due to construction processes as described above, or from exposure to precipitation during construction. Specifying an air & vapour control layer (AVCL) such as DuPont™ Airguard will in every case help to safeguard against large volumes of moisture laden air infiltrating the roof construction, resulting in a reduced condensation risk. Coupled with the layer's airtight function and obvious energy saving benefits, it is generally accepted as good practice for an AVCL to be installed into roof systems, regardless of whether they are ventilated or not (Please see following note on Ventilated systems).

Ventilated systems

Due to the detrimental effects that cold air infiltration can have on the thermal performance of insulated systems, windwashing, convective heat loss, etc. an AVCL is of particular importance where the roof system is to be ventilated. Please refer to page 34 for the DuPont™ Airguard range of AVCL's.

Non-ventilated or Sealed roofs?

DuPont promote two methods of application for Tyvek® membranes in pitched roof construction. This reflects the in-depth research that DuPont has undertaken to ascertain the most effective ways of not only controlling condensation, but also improving energy efficiency in roof construction. Extensive monitoring of test houses incorporating Tyvek® membranes at the BRE's test facilities also confirm the benefits of using Tyvek® non-ventilated and sealed roof systems.

Non-ventilated roofs

Roofs with no provision for airflow beneath the underlay will be more energy efficient than conventional, ventilated roofs.

Sealed roofs

Roofs with no airflow beneath the underlay and with all air leakage paths sealed will be more energy-efficient than non-ventilated roofs and will provide a higher degree of comfort.

Results from tests carried out on the non-ventilated systems showed this to be an efficient form of construction. However, further improvements were indicated in tests carried out on the sealed roofs.

Non-ventilated systems

This is where a Tyvek® membrane is laid over the roof, parallel to the eaves, as in traditional practice. A horizontal lap of 150mm minimum is maintained between each consecutive Tyvek® run. No ventilation is incorporated at eaves or ridge.

Sealed roof systems

A Tyvek® membrane is laid over the roof in a taut condition, parallel to the eaves and counter battened. A horizontal lap of 150mm minimum is maintained between each consecutive Tyvek® run. All membrane laps, junctions, pipe penetrations, rooflights and perimeters are sealed with an appropriate sealing tape. No ventilation is incorporated at eaves or ridge.

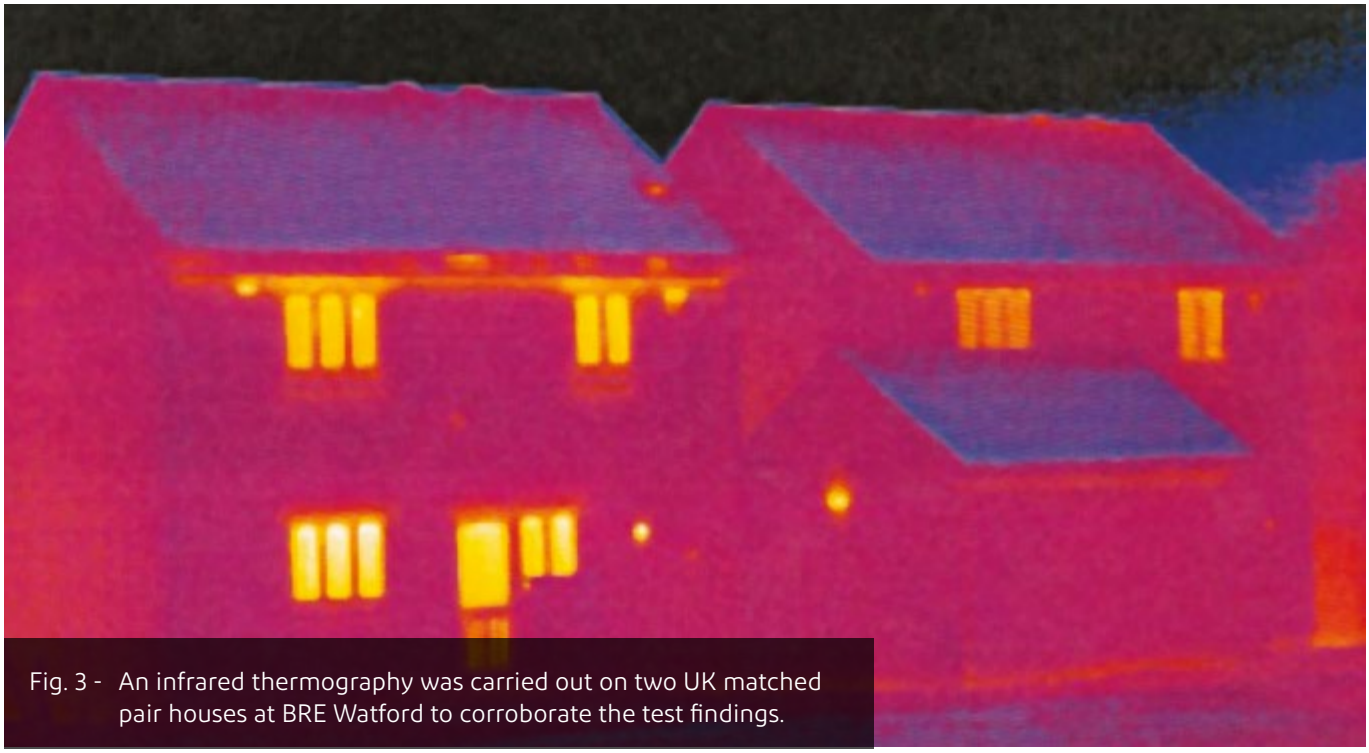


Fig. 3 - An infrared thermography was carried out on two UK matched pair houses at BRE Watford to corroborate the test findings.

Benefits of DuPont™ Tyvek® sealed roof system

Tyvek® non-ventilated roofs will significantly reduce the likelihood of condensation, have less air leakage and are more energy efficient than conventionally ventilated roofs. However, they are still subject to air infiltration at laps, perimeters and penetrations. Air movement through those gaps can result in significant heat losses. Adopting the Tyvek® sealed roof system will not only reduce the risk of condensation, but will also minimise the heat losses caused by air infiltration.

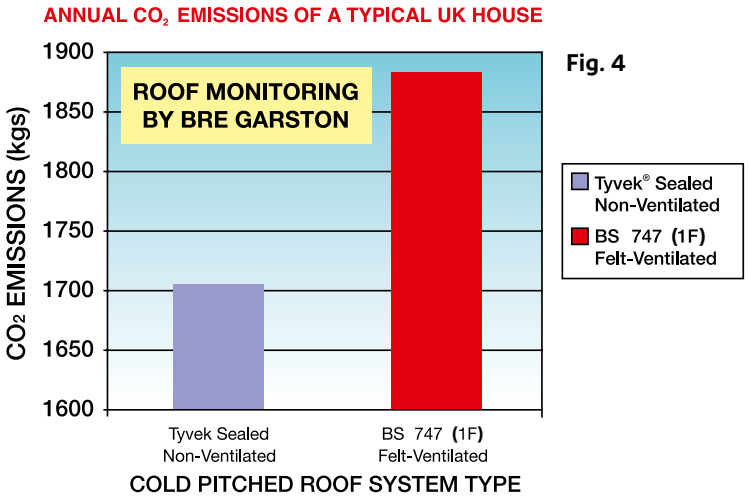


Fig. 4

Eliminating air movement substantially improves energy efficiency

DuPont™ Tyvek® Sealed Roof System was extensively researched during early studies by the BRE and VTT. Further tests were carried out by the BBA for the purposes of independent accreditation. The following results and conclusions were achieved:

- a significant reduction in air leakage
- a 7.1% reduction in overall energy consumption
- 25% saving in heat lost through the roof when compared to a typical ventilated system
- an air leakage rate as low as 2ach.

These test results are indicative of the following energy savings:

- a 3.2kWh saving in energy consumption per day
- a 700kWh saving in energy consumption over a full heating season
- a 135kg reduction in CO2 emissions over a full heating season If correct and thorough sealing work is carried out to the roof construction further improvements in energy savings can be made:
- 4.2kWh saving in energy consumption per day*
- 927kWh saving in energy consumption over a full heating season*
- 79kg reduction in CO_2 emissions over a full heating season*
- Air leakage rate as low as 1.7ach*.

* Data obtained from additional tests after extensive sealing work was carried out.

Please note: It is of benefi t to recognise the importance of making internal linings convection tight when considering the need to reduce uncontrolled air leakage. This is particularly relevant for the purposes of complying with the air permeability requirements of all UK and Ireland regulations, including Approved Document L.

The requirements of regulatory bodies and the BBA certificate 08/4548 should be referred to when sealing work is to be carried out.

With a lower risk of condensation in comparison with a standard roof using a traditional felt underlay and a ventilated loft space.

In addition to this the BBA have concluded: *"In conventionally ventilated roof constructions energy loss by ventilation can account for up to 25% of the total heat lost through the roof. The Tyvek® non-ventilated roof system will substantially reduce this mechanism of heat loss."*

To gain maximum benefit an air & vapour control layer (AVCL) should be installed above the ceiling. DuPont™ AirGuard® Control, AirGuard® Reflective, AirGuard® A2FR and Tyvek® AirGuard® Smart are available for this purpose.

Refurbishment work to existing buildings

In addition to new build projects, a non-ventilated roof system using Tyvek Supro can also be adopted in refurbishment/ re-roofing work. Before such work is undertaken however, it is important to consider the notes below to ensure efficient performance in terms of heat, air and moisture management.

Existing ceiling and thermal efficiency

At the design stage of a new build domestic construction the recommendations of BS 9250:2007 to establish airtightness at the ceiling line can be followed and an AVCL can be specified. As a continuous airtight and vapour-tight layer this important component can greatly reduce condensation within the loft space which can sometimes occur when the building is undergoing a drying-out phase. This is not normally possible in a refurbishment project as there will typically be an existing ceiling already in place. The existing ceiling will very often provide a sufficient level of vapour control as they invariably include layers of paint or textured finishes which will help to diffuse internally generated vapour. In this case the system should perform satisfactorily and ventilation to the loft space will not be necessary. When considering airtightness and thermal efficiency, the integrity of the existing ceiling, whether plasterboard or lathe & plaster is a factor, as any breach in these layers will allow water vapour to infiltrate the construction. Existing loft access hatches should be checked to ensure they are up to current standards and if in doubt, should be replaced with a modern insulated unit that incorporates compressible draught seals. If new light fitments are to be installed within the ceiling line any penetrations made should be formed so as to present minimal disruption to the ceiling's airtightness and vapour controlling abilities. The holes created by light fittings can be made good by sealing the wiring penetration with a suitable sealing tape. The retrospective installation of downlights can present noticeable disruptions in the ceiling, which will allow high levels of internal heat and vapour to flow freely into the roof space. Special care and attention should be paid to fitments of this kind to reduce the detrimental effect that they can have on condensation control and energy efficiency. Where possible, low energy, fire rated and sealed units that are IP65 rated should be considered as best practice.

Insulation

During refurbishment projects, particularly with cold pitched roofs, it is common for the existing insulation to be upgraded or added to with extra thermal layers. The benefits in terms of energy consumption and subsequent lowered heating costs are well known, but a negative effect of this will be lower loft space temperatures. High humidity within the building and/or insufficient air/vapour control at ceiling level could potentially increase the condensation risk within the roof construction. Other updating measures, such as installing double glazing will further improve the building's thermal performance, but will also alter the internal air quality. As it is important to maintain sufficient indoor ventilation, it is crucial that trickle vents within the window units are used.

Note: A Tyvek non-ventilated pitched roof system will efficiently deal with the humidity/moisture levels associated with normal domestic building use.

BBA certificate 08/4548

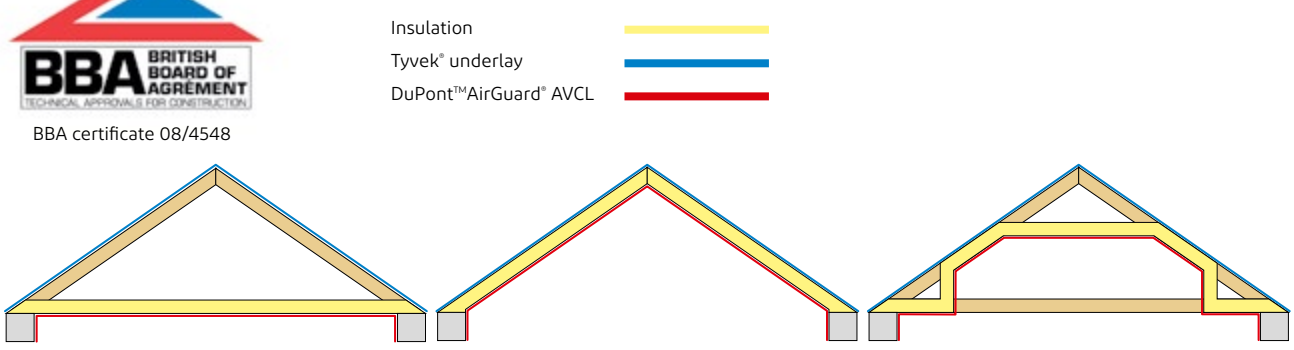


Fig. 5 - Cold roof

Fig. 6 - Warm roof

Fig. 7 - Room in the roof

Tyvek® roofing applications can be broken down into two main categories:

1. UNSUPPORTED APPLICATIONS
2. SUPPORTED APPLICATIONS

The application category will determine which membrane is suitable and how it is to be installed.

1. SUPPORTED APPLICATIONS

DuPont™ Tyvek® Supro - DuPont™ Tyvek® Supro Plus

This is where the Tyvek® membrane is laid directly over a supporting layer such as timber boarding or flexible/rigid insulation. In this condition counter battens over the membrane will be required to lift the tiling battens off the membrane and create an effective drainage path to the eaves.

Fig. 8

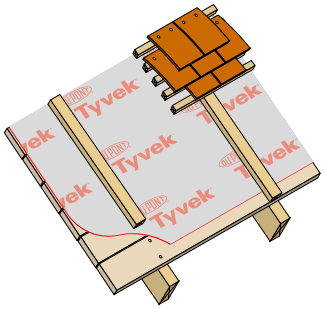


Fig. 9

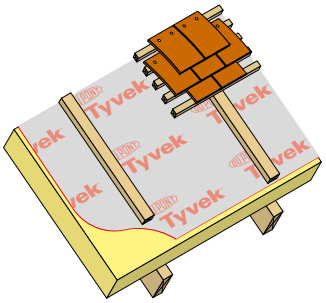
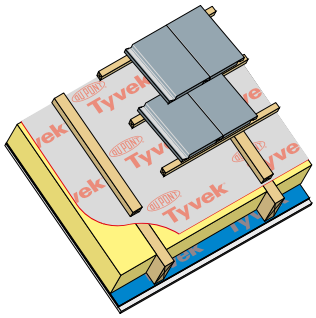


Fig. 10



Scottish boarded roofs are also categorized as supported applications but battens are normally omitted and the slates are nailed directly through the membrane and into the boarding. Recommended grade: Tyvek® Supro.

Fig. 11

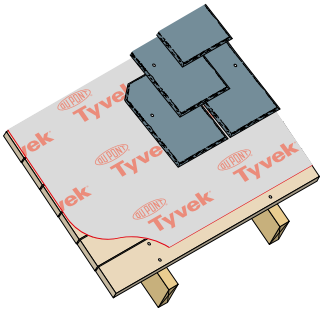
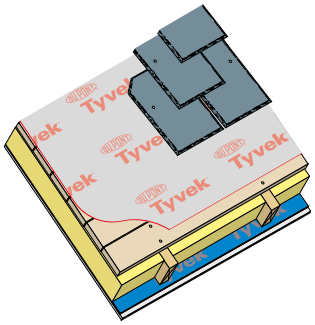


Fig. 12



Sealed Roof System - The supported application gives the end-user the option to upgrade the system to a sealed roof by taping all laps and penetrations in the membrane. Tyvek® Supro Plus is most suitable for this purpose as an integral sealing tape is provided.

Fig. 13

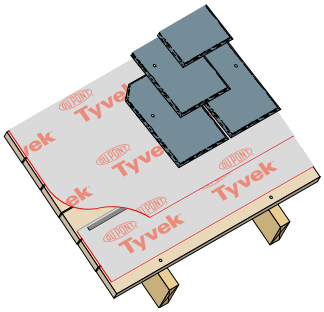


Fig. 14

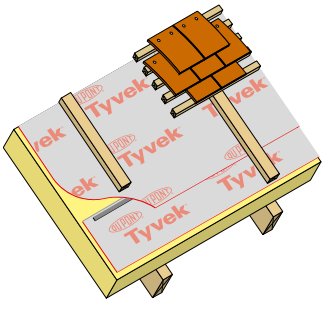
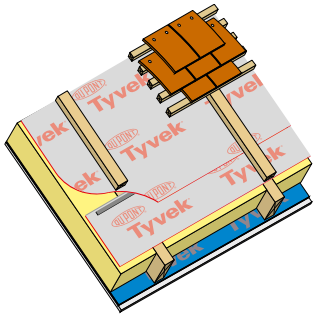


Fig. 15



2. UNSUPPORTED APPLICATIONS

DuPont™ Tyvek® Supro - DuPont™ Tyvek® Supro Plus

Over rafters (the traditional method) - The Tyvek® membrane is laid over rafters and allowed to drape slightly for drainage beneath tiling battens. To accommodate the drape an airspace of approx 10mm beneath the membrane will be required. In order to prevent the risk of wind uplift a maximum drape of 10mm in the membrane is recommended. No counter battens will be required over the membrane in this application. Recommended grade: Tyvek® Supro.

Fig. 16

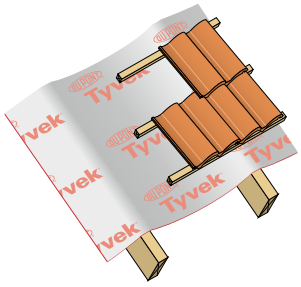


Fig. 17

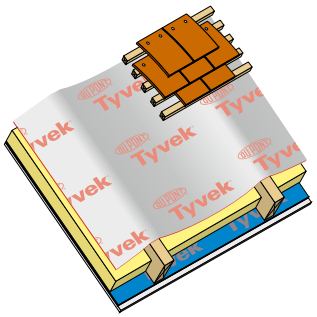
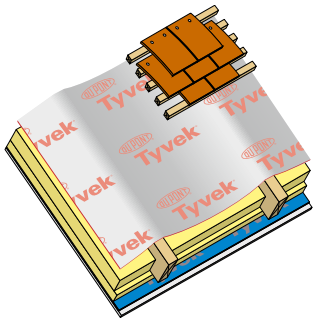


Fig. 18



Over counter battens - Tyvek® can also be draped over counter battens that are installed over timber boarding or rigid insulation. This represents the most practicable approach to on-site membrane installation and corresponds with the majority of rigid insulation manufacturers recommendations. Recommended grade: Tyvek® Supro.

Fig. 19

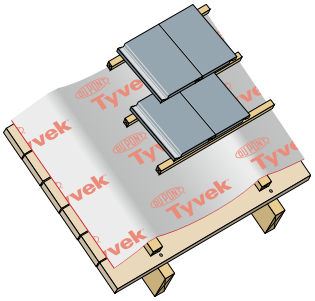


Fig. 20

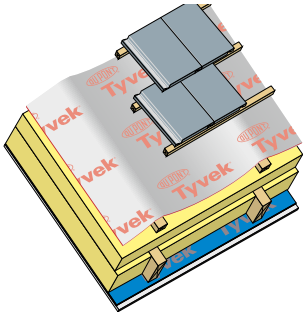
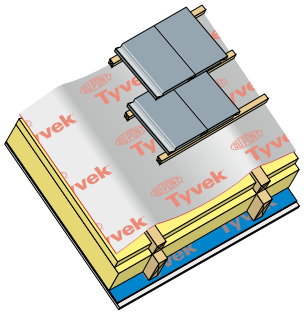


Fig. 21



Sealed Roof System - Tyvek® can also be installed over rafters in a taut condition with counter battens fixed over. This method is normally adopted when a sealed system is specified. Tyvek® Supro Plus is most suitable for this purpose as an integral sealing tape is provided.

Fig. 22

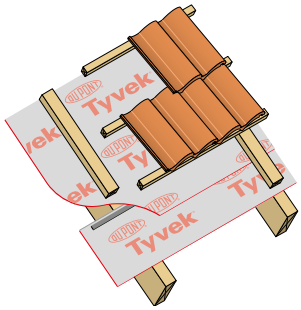


Fig. 23

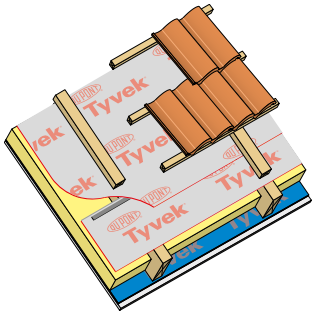
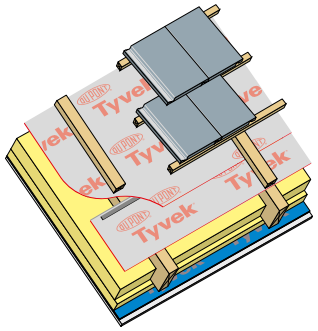


Fig. 24



Agrément certificate 08/4548 covers the use of Tyvek® membranes in non-ventilated and sealed pitched roofs.

Note: Please refer to the wind uplift information on pages 12 & 13 for further guidance on unsupported applications.

DuPont™ Tyvek® roofing underlays - Wind uplift resistance

BS5534:2014 +A2 2018

In the UK, most homeowners at some time will have experienced some sort of damage resulting from extreme weather conditions. In addition to the odd garden fence blowing over, the roof is particularly susceptible to wind damage - the hazards associated with dislodged tiles being very real. Limiting this risk and thus making our roofs safer is the responsibility of BS5534.

For nearly 40 years, anyone engaged in the construction of a pitched roof in the UK has been able to draw upon the recommendations within BS5534. Whilst this document forms the Code of Practice for slating and tiling, its guidance covers many other aspects of pitched roofing, the materials used and the methods employed. The standard does not take the form of a legal document, but for many it could be regarded as 'the roofers bible.'

The latest revision to BS5534, introduced in 2018 was a radical update to the standard with a realistic and future- proof emphasis on roof security and overall safety. The document addresses in detail the specification of mortar bedding, battens, flashings, structural sheathing and underlays as well as a specific focus on fixings.

BS5534: 2018 also includes guidance associated with UK meteorological data, such as exposure to driving rain and a noticeable concentration on the effect of wind pressures on roofing components. Roofing underlays have not been left out and now after many years of debate specific limits on wind uplift resistance have been imposed. By following the guidance and advice given in the standard we can now realistically design and build our homes in a way to better prepare them for high winds and stormy conditions. This is very relevant as the majority of damage reports come from domestic dwellings, where the average cost of damage is at least £300 million per year.

Extreme wind conditions have in the past resulted in entire roofs being lifted off a building. New building codes will have reduced the risk, but these roof failures demonstrate the strong lifting forces that can be exerted upon a roof when wind passes overhead. The suction effect of negative wind pressure, such as on the leeward side of a building can result in tiles or slates being dislodged. BS5534: 2018 has gone some way to safeguard against this risk with its recommendations, not just with more stringent fixing requirements for slates and tiles, but also for the underlay.

The emphasis on underlays

The benefits of a roof underlay positioned beneath a primary water shedding layer have been realised for many years. Even before a pitched roof is completed, a quickly installed underlay will keep the construction dry before the outer layers are in place. Once the roof is completed, the underlay will act as a back-up to the tile or slate covering by providing a secondary water shedding function. The underlay is also expected to resist a significant proportion of wind load imposed on the outer covering and it is this function that is now being addressed.

The potential effect of an underlay subjected to excessive wind loading is for it to balloon upwards, toward the tile or slate covering. If the wind resistance of the underlay is inadequately low or it has been installed with excessive drape, it could balloon to such an extent that it impacts upon the tiles or slates, causing them to dislodge. The tiling batten will help to restrain the underlay to an extent, but in the case of large format tiles where the batten gauge is sizeable the underlay deflection would be more significant.

A greater responsibility has therefore been placed on the underlay to cope with these wind forces and it is appropriate for BS5534: 2018 to set the parameters. The Code of Practice now also includes a new annex which describes the procedure for assessing an underlays' wind uplift resistance to a more stringent level than was previously required. When tested to the new standard the recorded values will determine the product's suitability for use in certain areas of the country. The document consequently includes a UK wind zone map, derived from a map of wind velocities, which correlates with EN 1991-1, the relevant Eurocode concerning Wind Actions.

Wind zones according to Annex A

These minimum wind resistance requirements are applicable for building projects where positive wind pressure from beneath is limited by a continuous internal lining. The ceiling in this case will consequently be considered continuous, which for today's energy efficient modern buildings should be regarded as standard practice. The figures are for an underlay laid with a drape of 10mm and a batten gauge of 345mm.

Zone 1: 820Pa

Zone 2: 975Pa

Zone 3: 1150Pa

Zone 4: 1330Pa

Zone 5: 1600Pa

The following conditions apply:

- ridge height not greater than 15 m;
- roof pitch between 12.5° and 75°;
- site altitude not greater than 100 m;
- no significant site topography;

Additional values according to specification of internal linings and fenestration:

- 1 600 N/m² when a continuous ceiling is present;
- 1 900 N/m² when no ceiling or non-continuous ceiling is present: continuous and non-continuous.
- 2 350 N/m² when no ceiling or no continuous ceiling is present and a permanent dominant opening is present on an external face of the building.

Minimum underlay requirements:

There will undoubtedly be many building projects in the UK where the conditions above do not apply. In these instances the standard requires that additional calculations will need to be taken to determine the values that are required. The values conveyed in the document are indeed minimum standards and careful selection of the underlay will be needed to ensure that the recorded wind resistance values are suitable for the job. Ideally the underlay would be capable of tolerating all the conditions that would be encountered in all 5 wind zones.

The Tyvek® solution

As set out within BS5534: 2018 underlay manufacturers are required to clearly indicate the suitability of their product in accordance with the standard. The tables below indicate zonal suitability for the Tyvek roof underlays currently available in the UK.

Tyvek® Supro			
BATTEN GAUGE	WIND UPLIFT RESISTANCE (Pa)		ZONE SUITABILITY
	Battened lap	Taped lap*	
≤ 345 mm	1643Pa	3371Pa	1 to 5
≤ 250 mm	3272Pa	3371Pa	1 to 5
≤ 100 mm	3272Pa	3371Pa	1 to 5

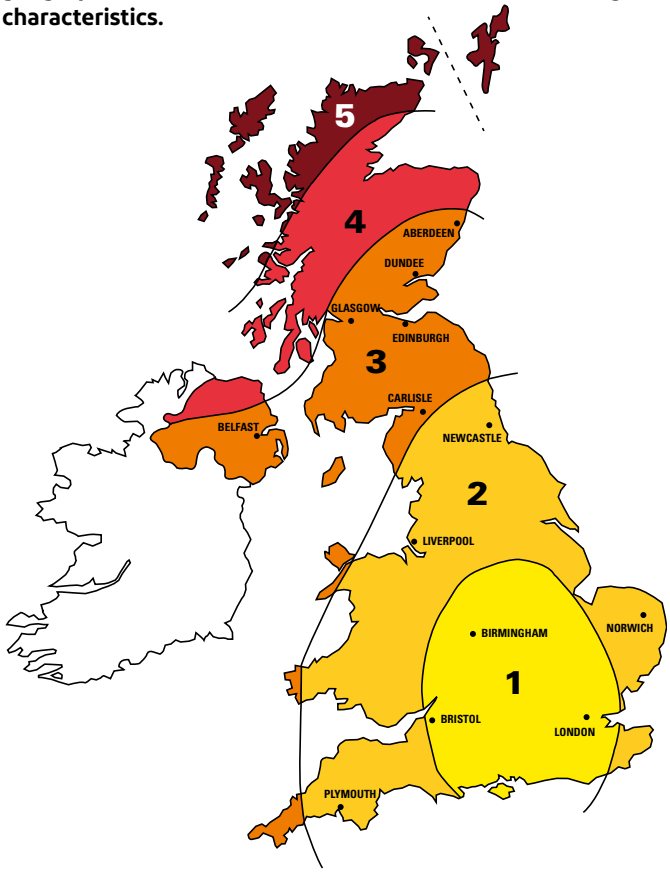
Tyvek® Supro Plus			
BATTEN GAUGE	WIND UPLIFT RESISTANCE (Pa)		ZONE SUITABILITY
	Battened lap	Taped lap*	
≤ 345 mm	1750Pa	3204Pa	1 to 5
≤ 250 mm	1750Pa	3204Pa	1 to 5
≤ 100 mm	1750Pa	3204Pa	1 to 5

Zone Suitability:

The wind uplift resistance figures for the Tyvek® underlays in the tables apply to applications where a well-sealed ceiling is present, ridge height is not greater than 15 m, roof pitch is between 12.5° and 75°, site altitude is not greater than 100 m, and no significant site topography is present. Projects outside of these parameters may require a greater wind uplift resistance. If in doubt please contact the DuPont™ Tyvek® Building Knowledge Centre (details on back page) where specific wind uplift calculation can be carried out.

Tyvek® - unrestricted use:

A Tyvek® underlay with a taped lap will satisfy all geographical locations, all site conditions and all building characteristics.



The designated wind zones range from Zone 1 with moderate conditions to Zone 5 that typically encounter higher wind speeds.

Please note: Ireland is classed as zones 3 and 4.

Discover our design wind pressure calculator

www.windpressure-calculator.tyvek.co.uk

The suitability of underlays in respect to wind uplift is defined by BS5534 (The code of Practice for slating and tiling,) using the zonal method as described previously. Annexe A of the standard describes five geographical wind zones within the United Kingdom with ascending design wind pressures allocated to each zone.

However, these design wind pressures for each zone are only applicable if the site of the construction falls within the following parameters:

- ridge height not greater than 15 m;
- roof pitch between 12.5° and 75°;
- site altitude not greater than 100 m;
- no significant site topography;

Where a construction site falls outside of these parameters the standard suggest that a further calculation be undertaken (as defined by Annexe H of BS5534,) to give a revised Design wind pressure.

To ensure full compliance with the standard the Tyvek® Building Knowledge Centre have created a user friendly, BRE calibrated calculation tool to quickly ensure the suitability of Tyvek® roofing products in all locations across the United Kingdom. This tool is free to use at the following link:

www.windpressure-calculator.tyvek.co.uk

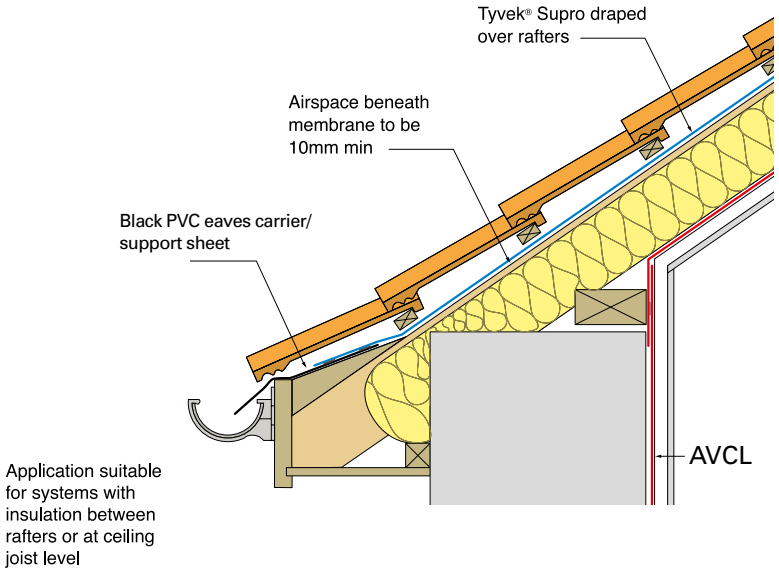
Alternatively, our Building Knowledge Centre can be contacted on 0117 452 9050 Option 1 or the numbers on the back of this manual.

DuPont™ Tyvek® membranes Installation in pitched roofs

Eaves Detailing

The following pages contain information on how best to install Tyvek® membranes in pitched roof constructions. No provision for ventilation at eaves or ridge is included in these recommendations. BBA references are included where appropriate.

Fig. 25 - Membrane unsupported over rafters



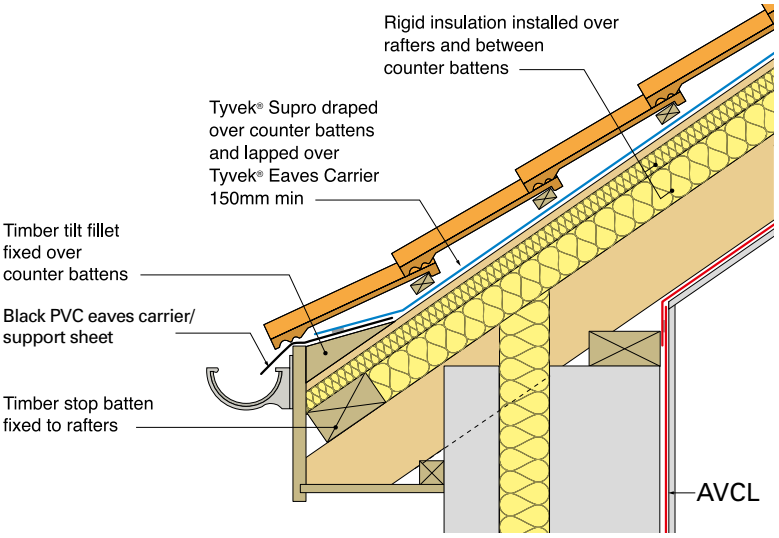
In both of these details, Tyvek® Supro is installed in a draped condition over rafters or counter battens.

A nominal drape in the membrane is required to allow sufficient drainage beneath the tiling/ slating battens.

The membrane may come into contact with the insulation with no risk of tenting (capillary action).

Air infiltration beneath the membrane should be prevented by ensuring air-tightness at the fascia and soffit locations. Insulation pushed up to the underside of the membrane will also be effective, but may obstruct the drainage of moisture over the membrane.

Fig. 26 - Membrane unsupported over counter battens

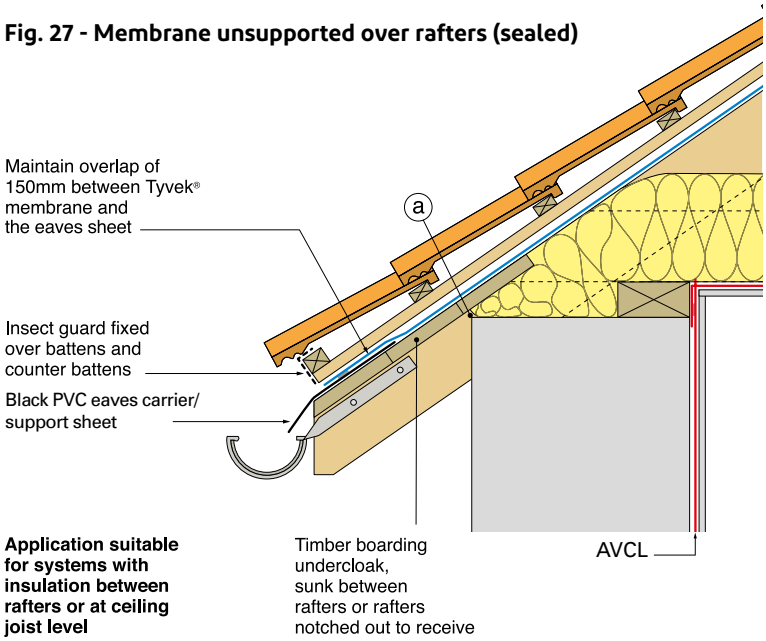


Note:
Please refer to the wind uplift information on pages 15 & 17 for further guidance on unsupported applications.

For the Installation videos, Installation Guide and Installation Sheets please visit our web site www.building.dupont.co.uk

Eaves Detailing

Fig. 27 - Membrane unsupported over rafters (sealed)



Application suitable for systems with insulation between rafters or at ceiling joist level

Both of these details show Tyvek® Supro or Tyvek® Supro Plus installed unsupported over rafters. The membrane is laid in a taut condition with counter battens fixed over. Sealing the system is easily achieved by taping the laps.

An insect mesh should be fixed at the eaves to prevent intrusion into the batten zone.

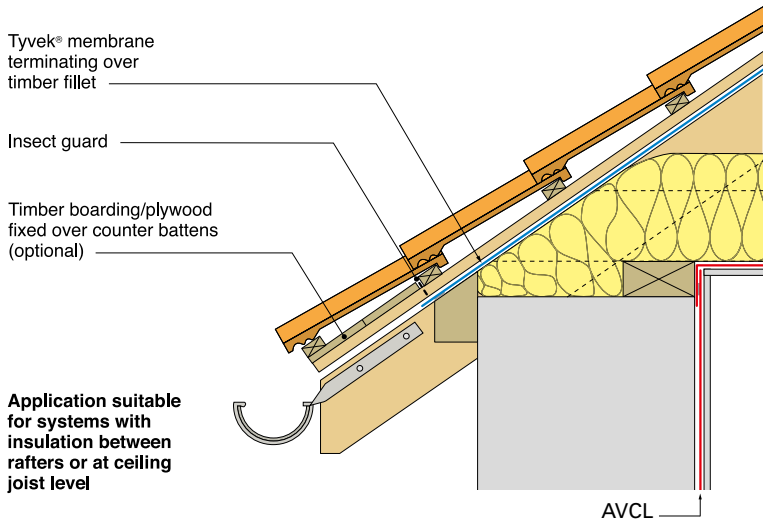
Both details include no fascia board or soffit:

Fig. 27 includes a timber undercloak at the overhang with the membrane unsupported over rafters (sealed) membrane dressed onto an eaves sheet.

Fig. 28 is an alternative arrangement showing the Tyvek® membrane terminating before the gutter.

Air infiltration beneath the membrane should be prevented by ensuring air-tightness at ⓐ.

Fig. 28 - Membrane unsupported over rafters (sealed)



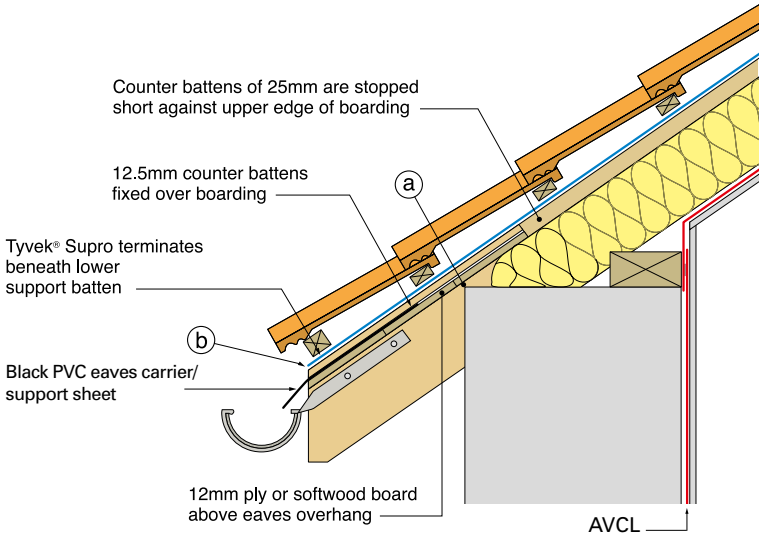
Application suitable for systems with insulation between rafters or at ceiling joist level

Note:
Please refer to the wind uplift information on pages 15 to 17 for further guidance on unsupported applications.

For the Installation videos, Installation Guide and Installation Sheets please visit our web site www.building.dupont.co.uk

Eaves Detailing

Fig. 29 - Membrane unsupported over counter battens



These details illustrate Tyvek® Supro installed in a draped condition and are suggested in order to overcome detailing of the timber undercloak. Once again, both details include no fascia board or soffit:

Fig. 29 includes a timber undercloak fixed over rafters.

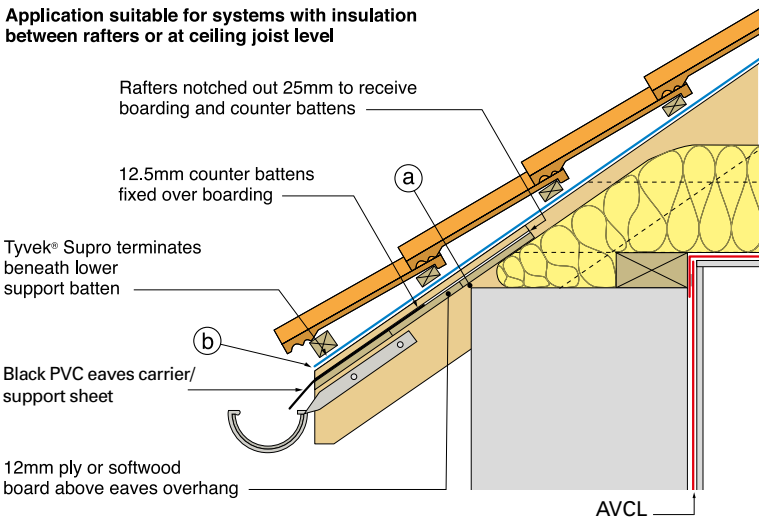
Fig. 30 shows the timber undercloak notched into the rafter.

In both instances a small counter batten or lathe is fixed over the boarding to ensure continuous drainage to the eaves is maintained.

Air infiltration beneath the membrane should be prevented by ensuring air-tightness at ⓐ.

Preventing air infiltration beneath the membrane at ⓑ may be difficult to achieve. Attention at these locations should therefore be paid to minimise air ingress.

Fig. 30 - Membrane unsupported over rafters

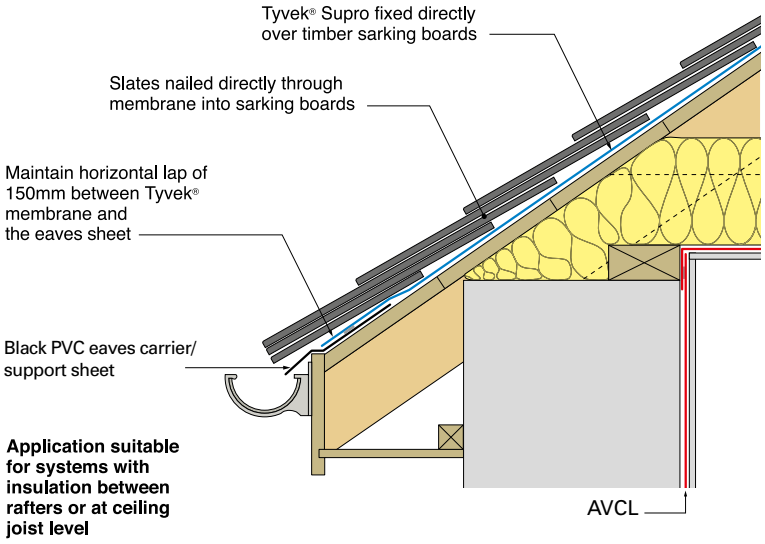


Note:
Please refer to the wind uplift information on pages 15 & 17 for further guidance on unsupported applications.

For the Installation videos, Installation Guide and Installation Sheets please visit our web site www.building.dupont.co.uk

Eaves Detailing

Fig. 31 - Membrane supported over timber sarking



Boarded roofs are common to geographical locations that experience high exposure to driving rain, typically Scotland.

Tyvek® Supro should be laid directly onto the boarding or draped over a counter batten.

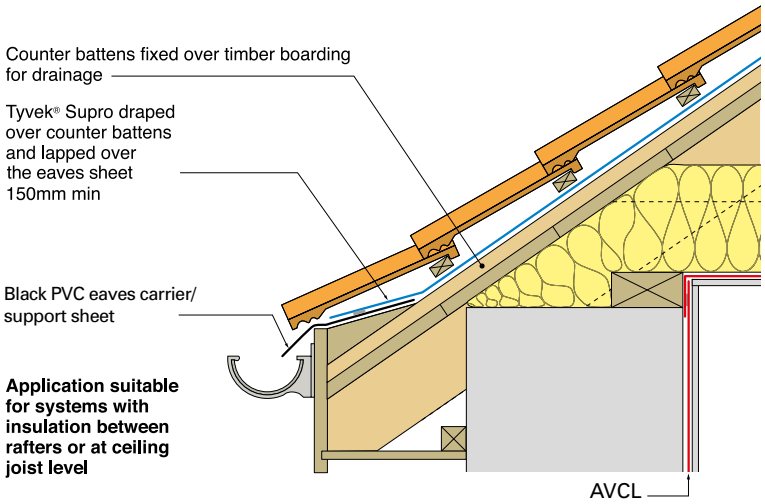
Fig. 31 illustrates typical Scottish practice where the roofing underlay is laid over the sarking board. Slates are then secured directly over the membrane with no battens or counter battens included.

Fig. 32 incorporates battens and counter battens and is applicable to systems with slates or tiles.

A sealed roof system can be achieved with both methods of application by specifying Tyvek® Supro Plus and taping all laps in the membrane. This is feasible only when the membrane is laid in direct contact with the boarding.

Air infiltration beneath the membrane should be prevented by ensuring air-tightness at the fascia and soffit locations. Insulation pushed up to the underside of the sarking board will also be effective.

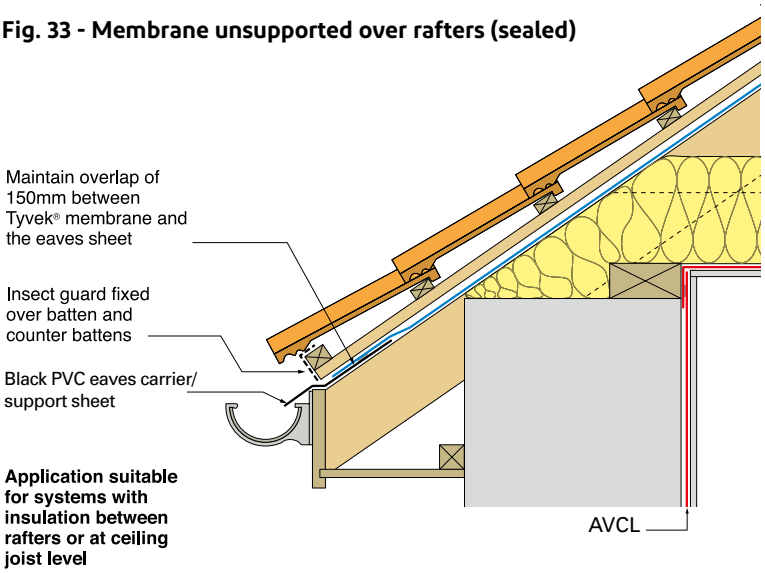
Fig. 32 - Membrane unsupported over timber sarking



For the Installation videos, Installation Guide and Installation Sheets please visit our web site www.building.dupont.co.uk

Eaves Detailing

Fig. 33 - Membrane unsupported over rafters (sealed)



Both of these details are suitable if a sealed system is required, as the membrane is laid in a taut condition with counter battens fixed over. Sealing the system is achieved by taping all horizontal laps.

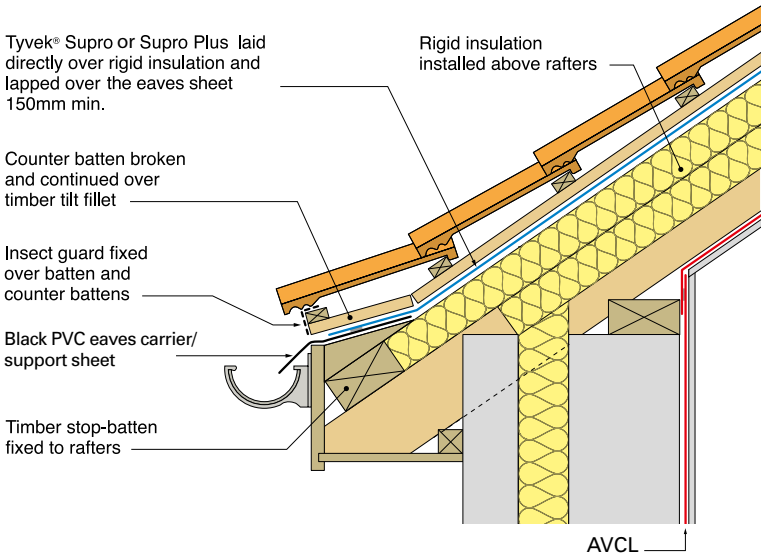
An insect mesh should be fixed at the eaves to prevent intrusion into the batten zone.

Fig. 33 illustrates Tyvek® Supro or Tyvek® Supro Plus laid taut over rafters with counter battens fixed over. The membrane runs down the full length of the rafter and is dressed onto a Tyvek® membrane supported over insulation (sealed) eaves carrier.

Air infiltration beneath the membrane should be prevented by ensuring air-tightness at the fascia and soffit locations. Insulation pushed up to the underside of the membrane will also be effective, but may obstruct the drainage of moisture over the membrane.

Fig. 34 is an alternative arrangement showing Tyvek® Supro or Supro Plus dressed over a timber tilt fillet. In this case a warm roof with insulation over the rafters is shown.

Fig. 34 - Membrane supported over insulation (sealed)

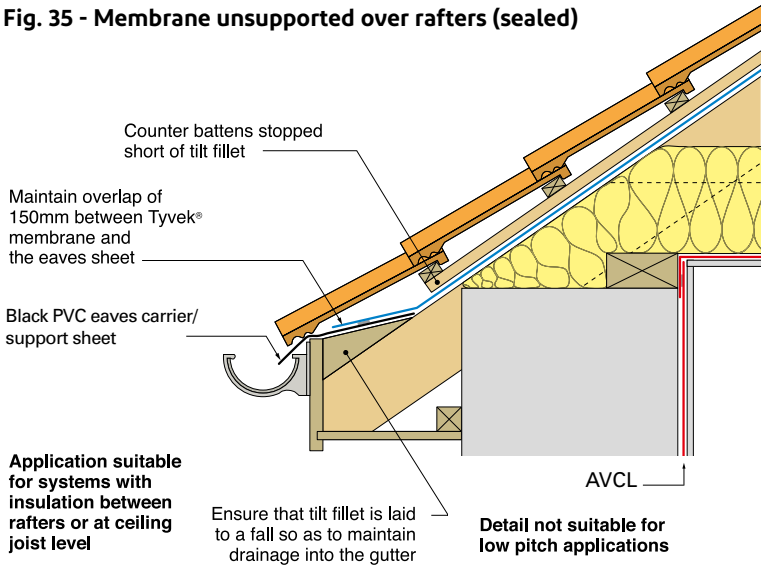


Note:
Please refer to the wind uplift information on pages 15 & 17 for further guidance on unsupported applications.

For the Installation videos, Installation Guide and Installation Sheets please visit our web site www.building.dupont.co.uk

Detailing

Fig. 35 - Membrane unsupported over rafters (sealed)



This is a slight variation on the sealed roof details illustrated on page 17 Again Tyvek® Supro or Supro Plus is laid in a taut condition with counter battens fixed over. The laps can then be sealed using adhesive tape.

In this detail the counter batten is stopped short of an enlarged tilt fillet which supports the tiles/slates.

Air infiltration beneath the membrane should be prevented by ensuring airtightness at the fascia and soffit locations. Insulation pushed up to the underside of the membrane will also be effective, but may obstruct the drainage of moisture over the membrane.

EAVES DETAILING - GENERAL COMMENTS

We have tried to be thorough with the eaves details illustrated in this technical guide in an attempt to match a variety of individual roof specifications. However, it will not always be possible to achieve complete coverage of all roof designs. Care should therefore be taken if adapting a detail to suit certain design parameters. It is most important to ensure that the Tyvek® membrane can adequately shed any water to the eaves efficiently and without risk of penetration into the structure and is not exposed to UV for a period exceeding 4 months.

Ponding of water on the membrane and back-falls on timber tilt fillets should be avoided.

Note:
Please refer to the wind uplift information on pages 15 & 17 for further guidance on unsupported applications.

For the Installation videos, Installation Guide and Installation Sheets please visit our web site www.building.dupont.co.uk

Detailing

Fig. 36 - Membrane unsupported over rafters

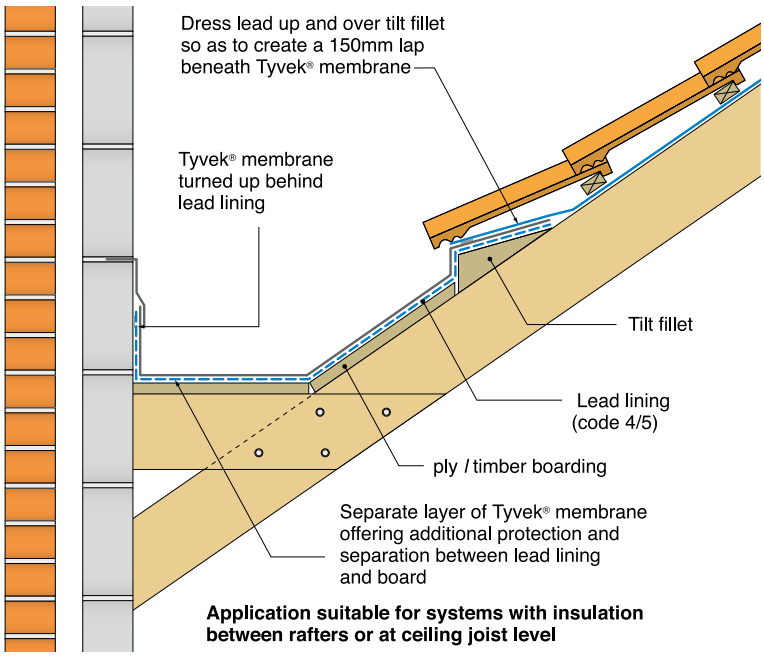
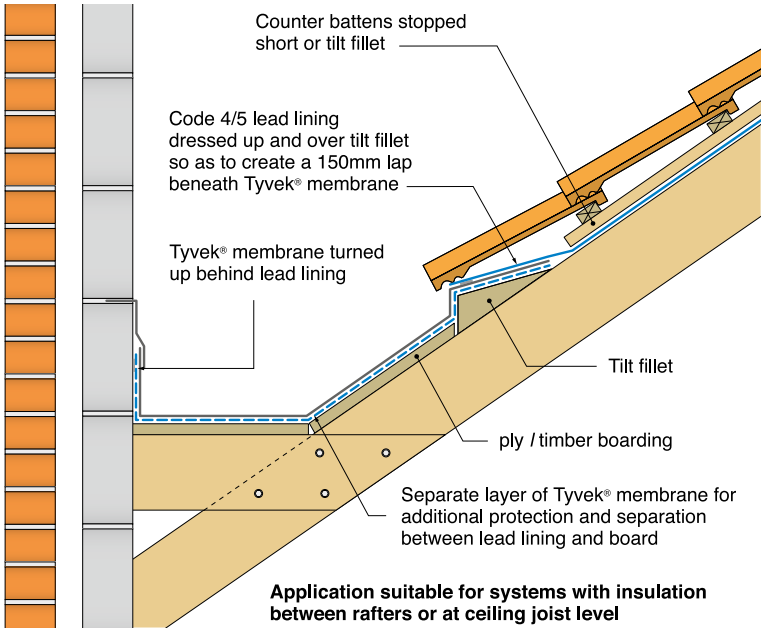


Fig. 37 - Membrane unsupported over rafters (sealed)



Lead lined gutters

A separate layer of Tyvek® beneath a lead lined gutter will provide additional protection against water ingress. As a separation layer the membrane will allow movement to occur between the lead and the supporting board as a result of thermal expansion.

Parapet (Fig. 36)

Lay a strip of Tyvek® over the timber/ply board extending up and over the timber tilt fillet/ edge batten. Dress the Tyvek® membrane up the face of the parapet wall to terminate behind the lead flashing.

The roofing underlay should be dressed over the gutter lining with a 150mm min overlap.

Parapet (Fig. 37)

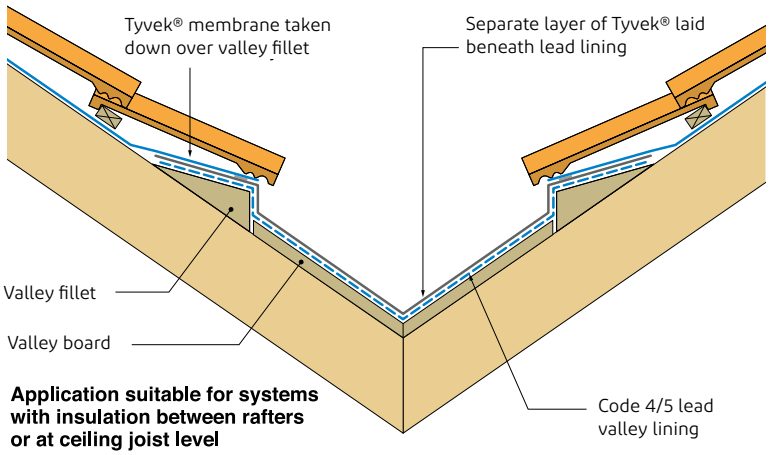
Similar detail includes a counter batten over the underlay.

Note:
Please refer to the wind uplift information on pages 15 & 19 for further guidance on unsupported applications.

For the Installation videos, Installation Guide and Installation Sheets please visit our web site www.building.dupont.co.uk

Detailing

Fig. 38 - Valley: Traditional Method



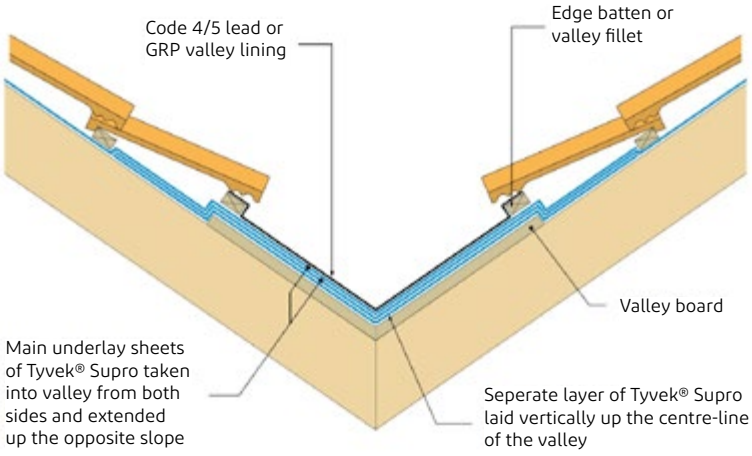
Valley – Traditional Method (Fig. 38)

Lay a strip of Tyvek® vertically up the centre line of the timber/ply board, extending up and over the timber valley fillets on each side. Apply the valley lining, either in lead or GRP. Terminate the main Tyvek® roofing sheets over the valley fillet, maintaining a 150mm lap over the valley lining.

Valley – Preferred Method (Fig. 39)

Lay a strip of Tyvek® vertically up the centre line of the timber/ply board, extending up the roof slope on each side. Dress the main Tyvek® underlay sheets into the valley from both sides and extend up the opposite slope so the they terminate well under the tile or slate covering. The end result is a 3-layer protection system.

Fig. 39 - Valley: Preferred Method

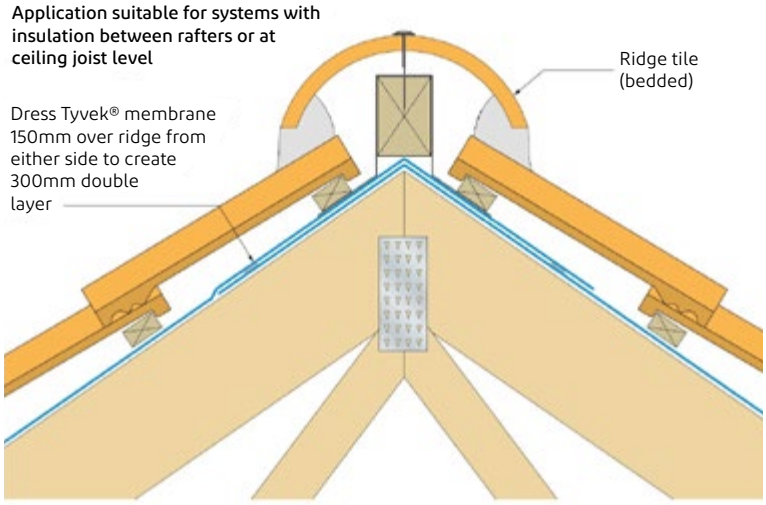


Note:
Please refer to the wind uplift information on pages 15 & 17 for further guidance on unsupported applications.

For the Installation videos, Installation Guide and Installation Sheets please visit our web site www.building.dupont.co.uk

Detailing Non-ventilated and sealed systems

Fig. 40 - Duo-pitch ridge



Ridges

As roof ventilation is not required when using a Tyvek® vapour permeable underlay, it will not be necessary to form a "break" at the ridge. The underlay should therefore continue past the detail helping to maintain a continous secondary water shedding layer across the entire roof area.

Duo-pitch (Fig. 40)

Extend the Tyvek® membrane over the ridge by 150mm either side. A "double felted" layer of min. 300mm will then be achieved.

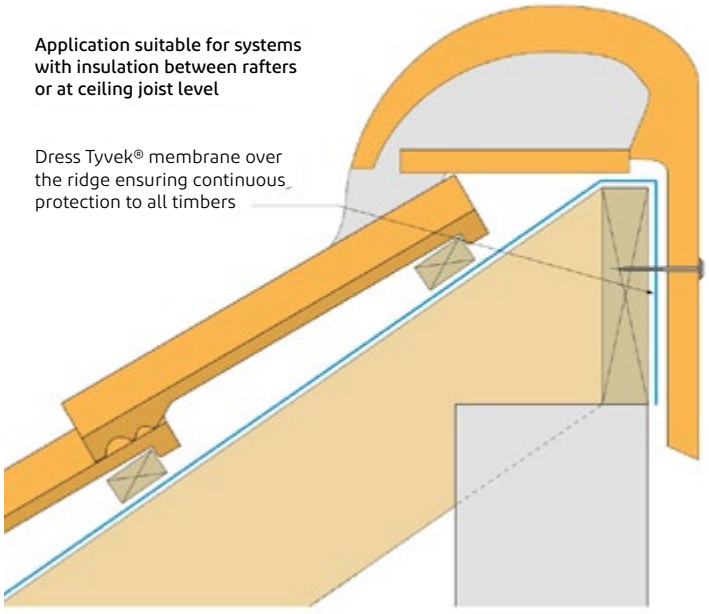
Mono-pitch (Fig. 41)

Dress the Tyvek® membrane over the ridge batten, offering maximum protection to the roof structure, by extending the Tyvek® underlay behind the monoridge tile.

Sealed Systems

The Tyvek® underlay can be sealed at laps and perimeters by using Tyvek® Tape 2060B (single sided) or Tyvek® Double-sided Tape (acrylic).

Fig. 41 - Mono-pitch ridge



Note 1:
Ridge tiles may need to be mechanically fixed to comply with the wind uplift requirements of BS5534 Annex A.

Note 2:
Please refer to separate Technical Guidance where housing projects are covered by specialist insurance schemes such as NHBC Buildmark. This may affect the ridge detail and the provision for ventilation.

Note 3:
Please refer to the wind uplift information on pages 15 & 17 for further guidance on unsupported applications.

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Detailing Non-ventilated and sealed systems

Fig. 42 - Verge

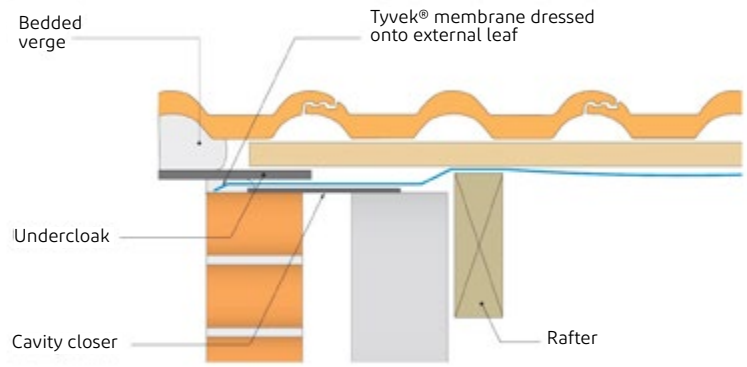


Fig. 43 - Abutment

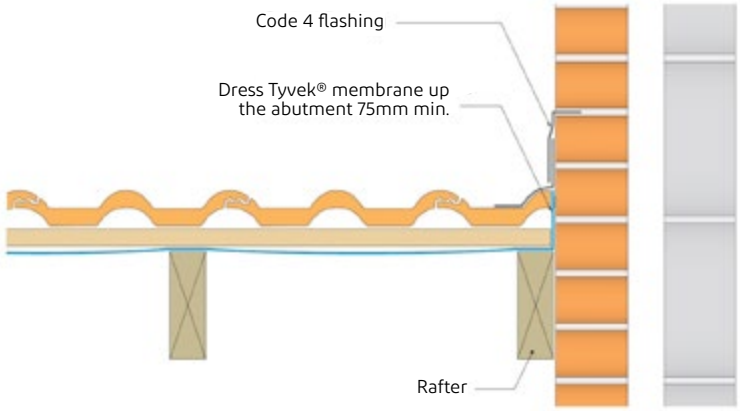
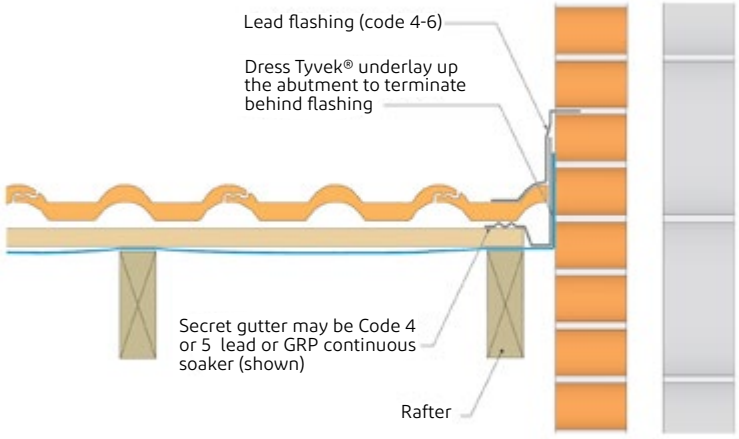


Fig. 44 - Abutment (secret gutter)



Verge (Fig. 42)

It is important to ensure that the Tyvek® membrane is dressed so as to prevent moisture ingress into the roof system.

The membrane should be extended to the external face of the wall and secured with a timber batten or dressed into mortar. If a fascia or barge board is being used, terminate the membrane against the rear face.

Abutment (Fig. 43)

The Tyvek® underlay should be taken up the wall by at least 75mm or ideally behind the lead flashing.

Abutment (Fig. 44)

If a secret gutter is used terminate the membrane over the fixing batten.

Sealed Systems

To further improve the thermal efficiency of the construction the Tyvek® underlay can be sealed at the perimeters by using Tyvek® Butyl Tape (double sided) or Tyvek® Double-sided Tape.

Note:
Please refer to the wind uplift information on pages 15 & 17 for further guidance on unsupported applications.

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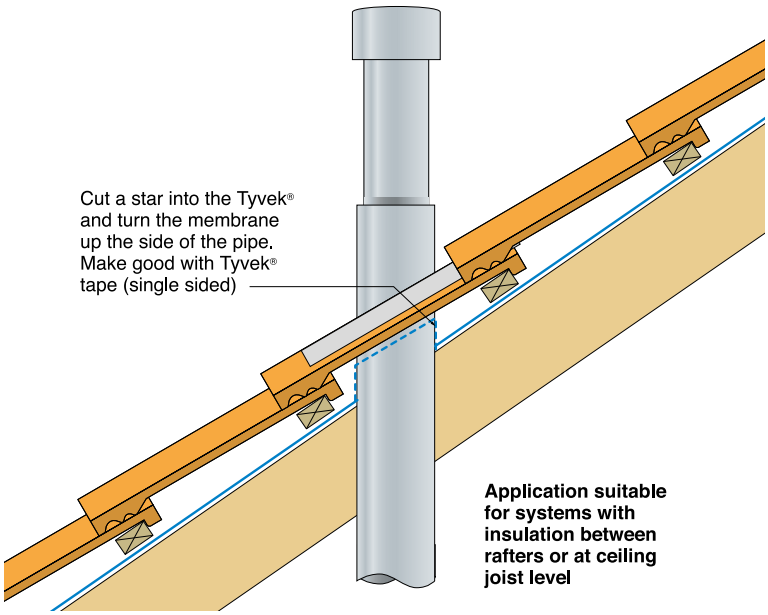
Detailing Non-ventilated and sealed systems

Fig. 45 - Soil vent pipe



Penetrations

As with all roofing underlays, any surface water should be directed around all penetrations that occur.

Soil vent pipe (Fig. 45)

An “asterisk” or “star” shaped cut should be formed in the membrane and triangular flaps folded upwards. The underlay should then be made good with Tyvek® Tape 2060B (single sided).

Chimney (Fig. 46)

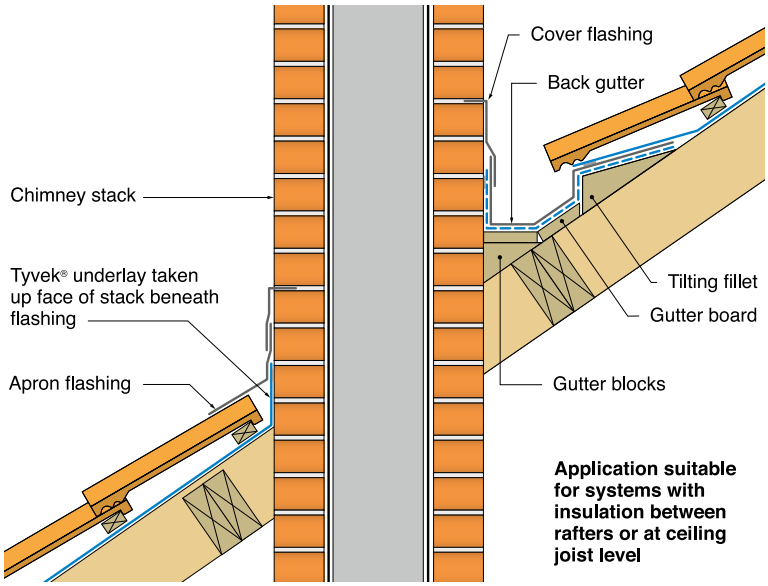
For all intents and purposes the chimney detail incorporates an abutment detail and a parapet gutter, the recommendations for which can be used here.

The main layer of Tyvek® should be taken over the tilt fillet to achieve a 150mm lap over the gutter lining. A separate strip of Tyvek® should be included beneath the gutter lining for thermal movement.

Dress the membrane up the sides of the stack a minimum of 75mm.

At the apron, extend the membrane up the stack and finish behind the flashing.

Fig. 46 - Chimney stack



Note:
Please refer to the wind uplift information on pages 15 & 17 for further guidance on unsupported applications.

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Detailing Non-ventilated and sealed systems

Fig. 47

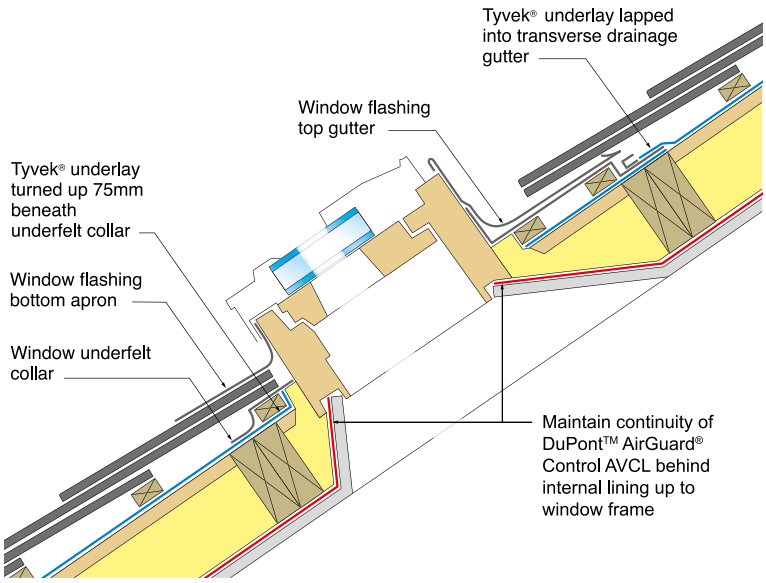
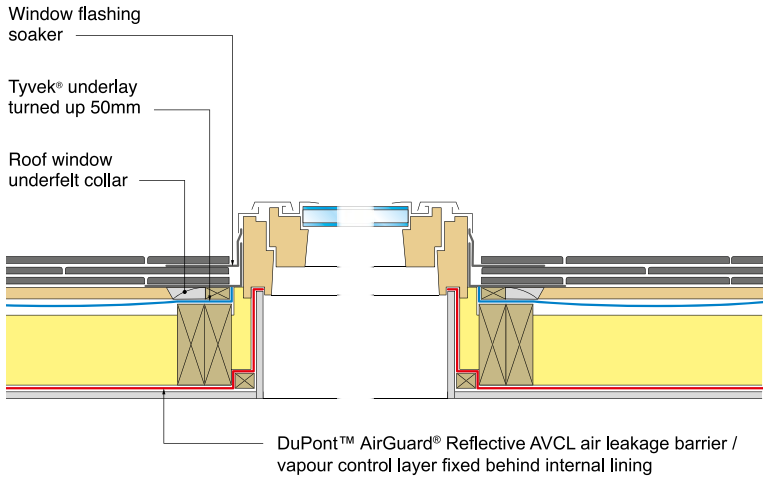


Fig. 48



Roof windows

The criterion when laying an underlay in conjunction with roof windows is the same as for other penetration details, ie. surface water should be directed around the detail.

Top

The Tyvek® underlay should be lapped into transverse drainage gutter above the roof window.

Sides

Turn the membrane up the sides of the window by a minimum of 75mm beneath the underfelt collar. Secure a fixing batten over.

Bottom

Dress the membrane so that it finishes beneath the window's underfelt collar, turning 75mm up a fixing batten if practicable.

Tyvek® Tape 2060B (single sided) may be used for making good to corners and junctions and / or when a sealed system is required.

The recommendations given here represent general advice for laying the Tyvek® underlay around a typical roof window.

Example roof detail is based on Velux GGL centre pivoted roof window by kind permission Velux Company Ltd. For guidance regarding installation of the roof window, the window manufacturer's instructions should be sought.

Vapour control layer

DuPont™ AirGuard® Control or AirGuard® Smart may be installed as the internal AVCL in these details.

Recommendation: Spacing the internal lining off the AVCL with a batten will help maintain the membrane's integrity, as well as to provide a services void for wiring. Please see pages 34 - 37 for details.

For the Installation videos, Installation Guide and Installation Sheets please visit our web site www.building.dupont.co.uk

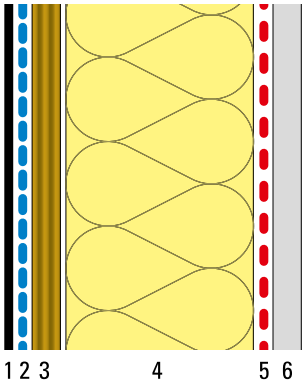
Restricted details

It is accepted that certain roofing elements will not permit the free passage of moisture laden air to outside atmosphere. Such details will include vapour resistant outer surfaces such as dormer cheeks and valleys clad with lead, and flat roofs with built-up roofing systems.

Whilst these details cannot be regarded as breathable, it is acceptable for them to be incorporated into a non-ventilated Tyvek® system, provided that they represent a relatively small proportion of the roof area.

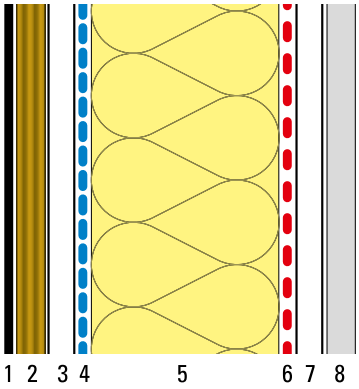
Fig. 49

OPTION 1
VAPOUR CLOSED



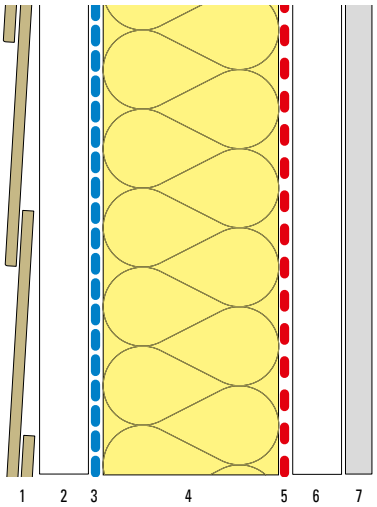
1. External lead cladding
2. Tyvek® Supro
3. Sheathing (ply/OSB)
4. Insulation between frame
5. DuPont™ AirGuard® Reflective AVCL (high vapour resistance)
8. Internal lining

OPTION 2
VAPOUR OPEN (BEST PRACTICE)



1. External lead cladding
2. Sheathing (ply/OSB)
3. Vertical batten (drainage path)
4. Tyvek® Supro
5. Insulation between frame
6. DuPont™ AirGuard® Reflective AVCL (high vapour resistance)
7. Vertical batten (service void)
8. Internal lining

Fig. 50



1- External weatherboarding
2- Vertical batten (drainage path)
3- Tyvek® Supro
4- Insulation between frame
5- DuPont™ AirGuard® Reflective / AirGuard® Control AVCL
6- Vertical batten (service void)
7- Internal lining

Dormer walls (cheeks)

Vapour-closed wall system (Fig. 49)

A Tyvek® membrane can also be used to provide secondary protection to the side walls (cheeks) of dormers.

Option 1 to the left shows the most simplistic arrangement where a Tyvek® membrane is acting as a separation layer, directly behind the lead outer cladding. To avoid condensation, this 'vapour-closed' wall element is hugely dependant on a well installed internal AVCL of high vapour resistance.

Option 2 shows the same type of system, but with additional battening. The external battens (vented top & bottom) produce an airspace to assist with vapour permeability and drainage. The internal battens provide a void for electrical wiring and help minimise penetrations through the AVCL. A great improvement in terms of both condensation control and energy efficiency.

In both options the AVCL is providing vapour control and airtightness. Therefore, sealing laps and any penetrations through this membrane is paramount.

Note: Dormer cheeks clad with a rigid metal sheet finish such as copper, zinc, aluminium or stainless steel may be detailed with Tyvek Metal. This breather membrane incorporates a drainage mesh and sits directly behind the outer sheet.

Breathing wall system (Fig. 50)

Dormers can also be finished externally with a discontinuous covering such as tile-hanging or cladding/weatherboarding. If no external ply/OSB sheathing is installed the vapour permeability of these systems will be much improved and the risk of condensation greatly reduced. A true 'breathing wall' system.

Dormer roofs

Recommendations for dormer roofs clad with lead should follow those of lead clad dormer cheeks by using a suitable AVCL.In addition, the condensation risk in flat roofs can be further reduced by specifying a warm roof detail, ie. insulation installed over the joists or above the decking. Dormer cheeks and/or roofs clad with copper, stainless steel or zinc outer sheeting may be detailed with Tyvek® Metal.

Restricted details

Adjoining ventilated roof constructions

It is acceptable and quite common for Tyvek® membranes to be used in refurbishment or building extension projects in a non-ventilated situation. Invariably, the existing construction will incorporate traditional roofing materials with a ventilated roof space. Air movement from the adjoining roof space will introduce air and external humidity which will reduce the roof space temperature and reduce insulation performance. In these circumstances it is important to ensure that any adjoining ventilated roof spaces are isolated from the non-ventilated Tyvek® system.

In order for the membrane to perform its function as a vapour permeable layer, an airtight dividing partition will need to be constructed between the two types of system, so that no common roof space exists.

In a combined system the membrane will provide a similar function to that of a traditional felt, in which case full ventilation should be provided. Installing a Tyvek® underlay in a fully ventilated roof will not be detrimental to the function of the membrane. Its suitability as a secondary water shedding layer will be similar to that of other traditional roof tile underlays.

DuPont™ Tyvek® Supro – Below Pitch Roof Applications

The 'double-felt' roof system using a Tyvek® underlay provides a solution for roof systems that are built below the minimum pitch for the tile or slate. This has become accepted practice for over 20 years by many local authorities throughout the UK where a building or design constraint existed.

Tyvek® Supro - installed in two layers with staggered laps has proven to be particularly useful for roofs that suffer from height restrictions such as with single storey lean-to extensions. It is quite common for these roofs to present a relatively small area and are therefore ideal for this method as they would be expected to discharge only a limited amount of rainfall. Whilst this method is very effective it's use is limited in main roofs, especially ones of two storey height. However, this method may be considered depending on the proposed pitch, location data and slate/tile selection.

Wherever possible, our standard pitched roof underlay Tyvek® Supro should be laid at a pitch suitable for the slate or tile that is being used. However, we will accept the 'double felt' method using the following rules as a general guide:

Tile/slate min pitch	Double felt allowance
12° - 19°	-3°
20° -29°	-4°
30° - 39°	-5°
40° +	please contact us

Following this system will ensure that the absolute minimum pitch allowed with two layers of Tyvek® Supro is 9° (for a tile which has a minimum pitch of 12°). A lower pitch may be acceptable for profiled metal clad industrial roofs or where a tile effect metal roof sheet is used eg. Metrotile, Britmet Tileform.

Rafter length should not exceed 9m for areas of normal exposure to driving rain and 6m for areas of high exposure.

Attention must be paid to details such as hips, valleys and large tilt fillets (eaves sprockets). These are considered 'weak points' in the system as they incorporate lower pitches than that of the main roof areas.

Consideration should also be given to details that penetrate the Tyvek® underlay such as soil vent pipes, chimneys & roof windows. The underlay should turn up against the detail and be sealed with Tyvek® Acrylic Tape (2060B) or correctly lapped to appropriate flashings.

Any cuts and/or corners should be made good with Tyvek® Acrylic Tape (2060B) or Tyvek® FlexWrap EZ to prevent water ingress.

To improve water sealing around fixing penetrations, Tyvek® Butyl Tape may be applied beneath battens prior to their installation.

These factors all govern the risk of water penetration onto the roof underlay. **In all cases the underlay must be laid to a fall with no ponding of water on the underlay under any circumstances. This means that a counter batten, with a DuPont™ Butyl tape seal to the fixing points may be required.**

This policy is not entirely rigid and approval may be given for pitches lower than those stipulated above, according to specific data associated with the proposed project. In these cases details such as roof area, height and location would need to be considered.

Our warranty for Tyvek® Supro is applicable to the double-felting method, provided it is installed in accordance with these guidelines.

For further advice on the use of Tyvek® membranes please contact BKC Technical: 0117 452 9050 Option 1.

Nick Williams, Technical Manager UK & Ireland, DuPont Safety & Construction

Video installation link: https://www.dupont.co.uk/resource-center.html?BU=pbs&restype=video

Detailing Non-ventilated metal roof systems

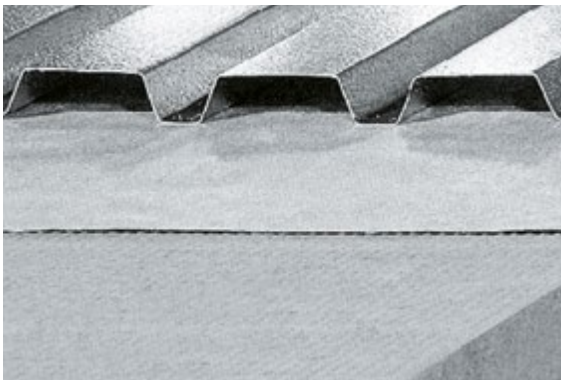
The risks

A potential exists for condensation to form beneath metal clad roofs due to the high vapour resistance of the sheet materials employed in this type of construction.

Water vapour that migrates into the roof construction via the internal lining and insulation can condense on the underside of the outer sheets. If allowed to buildup, there is a risk that this condensation will drip back onto the insulation and affect the layer's thermal performance. Metal fixings, the internal lining and indeed the structure are then at risk of suffering from deterioration as a result.

The cycle of events that can occur as a result of night sky radiation can also present a potential risk for roof components and materials to degrade; the temperature drop that occurs during the night increases the risk of condensation forming on the underside of the outer metal sheeting. It is quite common for this moisture to freeze during very cold periods. When the temperature rises the following day, the trapped moisture thaws and saturates the construction once more. The moisture is trapped within the construction and goes through cycles of evaporation and saturation.

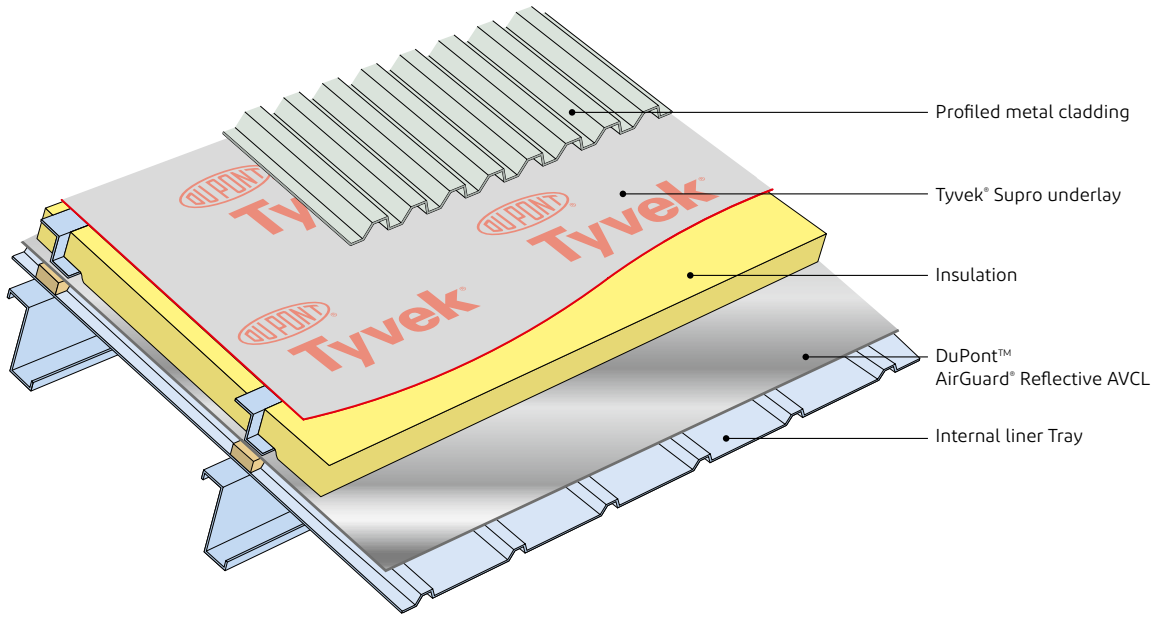
Over time, the weatherproof properties of profiled metal cladding can be compromised by natural weathering and/or the effects of thermally induced movement.
This can displace waterproof seals between laps in the sheeting and enlarge penetration points where the sheets are fixed. The risk of moisture ingress, especially as a result of driving rain is increased.



DuPont™ Tyvek® Protection from condensation

The performance of a profiled metal roof can be significantly improved by installing a Tyvek® membrane over the structure and the insulation layer. The high vapour permeability of the Tyvek® membrane will permit the release of vapour through and away from the insulation. The high water resistance of the Tyvek® membrane will prevent any condensed moisture beneath the outer cladding to re-enter the construction, thus ensuring that the insulation operates in a dry environment.

Fig. 51



Detailing Non-ventilated metal roof systems

DuPont™ Tyvek® Protection from external moisture

As a secondary water shedding layer, a Tyvek® underlay can protect an insulation layer and the roofing structure from external precipitation. Any moisture that penetrates the primary roof covering will be safely channelled to the eaves by the Tyvek® underlay beneath. The long term durability of the construction is then assured.

Fully supported rigid metal sheet roofs

A Tyvek® underlay can also be of benefit in a standing seam metal roof system. Tyvek® Supro, when installed over a sheathing board or insulation will provide temporary protection during construction, prior to the installation of the external metal sheeting. In addition, when installed over the supporting sheathing Tyvek® Supro will act as a 'slip layer' to allow movement between the steel sheet and the timber boarding. The primary weathering material used in rigid standing seam metal roofing is commonly, copper, stainless steel, aluminium and zinc. These materials are quite capable at keeping the rain out, but similarly are effective at preventing internal water vapour from escaping, possibly leading to condensation beneath the outer sheet. Experience has shown that metals will corrode rapidly from the effects of wetting from condensate leading to white rust. It is therefore important to ensure that any condensation build-up beneath rigid metal sheeting is either eliminated or allowed to drain safely away and not be trapped within the construction layers. In many cases, organisations that specialise in the manufacture and development of standing seam systems have their own standard details that describe how such a system is designed and constructed. In the case of zinc roofing we can refer to the technical guidance offered by VM Zinc for instance and would recommend that such an organisation is consulted for any such roof system proposals.

Cold roof systems (fig.52a)

In most cases for cold roof construction, condensation control in a standing seam metal system can be achieved by ventilating beneath the supporting outer deck. This will ensure that any water vapour that permeates the insulation will disperse before it has the chance to settle. With an internal AVCL installed and a vapour permeable underlay such as Tyvek® Supro laid over the insulation, all bases, including temporary protection during construction are covered.

Warm roof systems

By far the most efficient type of system in every respect is where the roof structure is situated in a warm internal environment and the thermal insulation layer is installed continuously above. Risks associated with condensation and thermal bridging are greatly reduced. Tyvek® Supro may be specified here as the underlay between the standing seam metal sheet and the supporting board and is suitable for systems such as structural insulated panels (SiPs). Again, on the internal side of the construction is installed an AVCL to limit water vapour transfer and provide airtightness to the system.

DuPont™ Tyvek® Metal (fig.52b)

Also suitable as the underlay in a warm roof system is Tyvek® Metal.
This product can be termed a "metal roof drainage membrane" and consists of a Tyvek® breather membrane (Supro) bonded to an open mesh of polypropylene strands approximately 8mm deep. The open mesh will provide adequate support for the rigid sheeting, whilst maintaining an airspace to allow any condensate which forms beneath the metal cladding to drain away. The Tyvek® membrane that is bonded to the mesh is highly water resistant. Tyvek® Metal will allow movement between the steel sheet and the timber boarding and will offer a reduction in sound transmission normally generated by structure borne sounds such as rain-clatter.
See installation guidance on page 29.

Air & vapour control layer (AVCL)

A suitable AVCL for use in a standing seam metal roof system is DuPont™ Airguard® Reflective. Continuity of this layer can be maintained by installing a batten between the AVCL and the internal lining. The batten space will also serve as a service void for wiring.

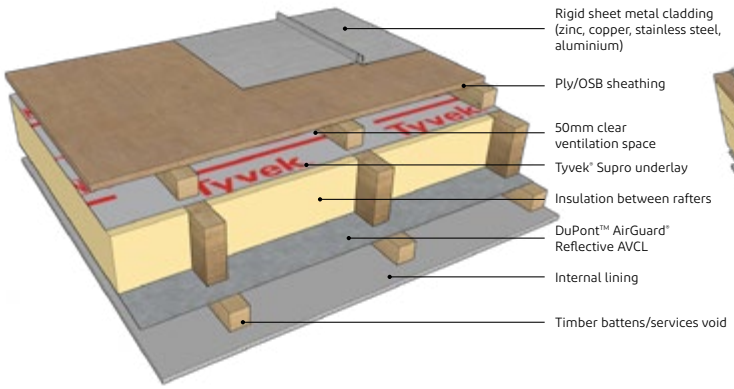


Fig. 52a Cold roof system with Tyvek® Supro

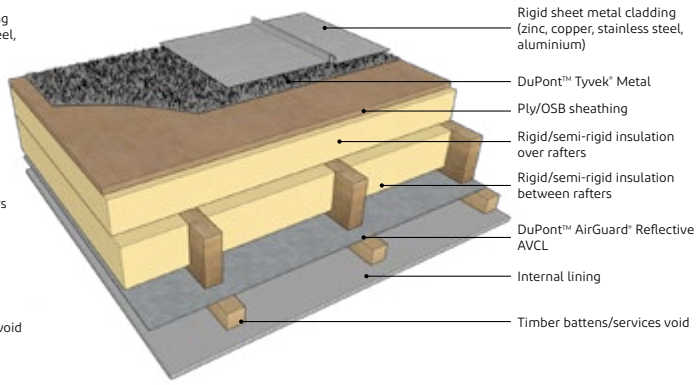
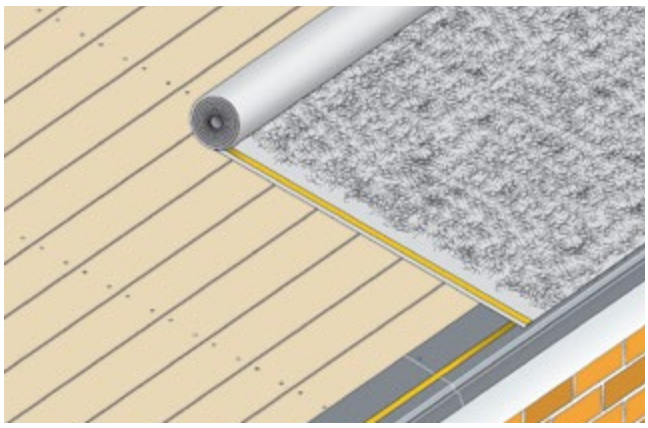


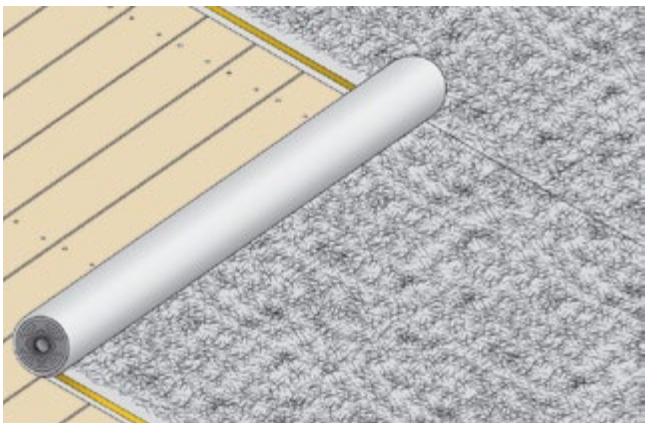
Fig. 52b Warm roof system with Tyvek® Metal

Detailing Non-ventilated metal roof systems

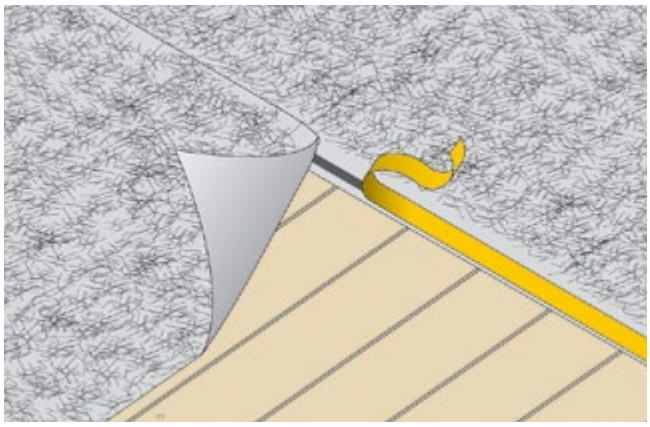
Tyvek® Metal: The installation procedure is as follows:



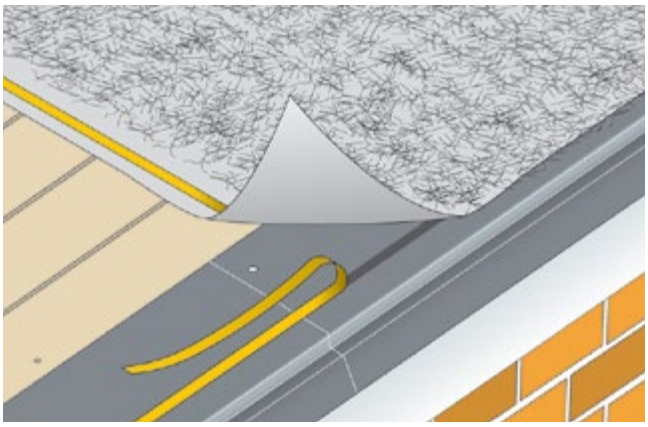
1. Install the eaves sheet as detailed on page 12.
Lay the first run of Tyvek® Metal up-and-over the roof, with the bottom edge lapping on to the eaves sheet. Fix into the board with stainless steel staples or large headed galvanised steel clout nails.



2. Lay the next run of Tyvek® Metal, lapping it 100mm onto the mesh-free selvedge of the first run.



3. Peel the backing paper from the self adhesive tape and press the lap down firmly to form a good seal ; between each sheet...



4. ...and over the eaves sheet.

Drainage of moisture from Tyvek® Metal may also be achieved by forming a drainage slot into a soffit.

Please note: Tyvek® Metal is suitable for use on 'vapour closed' sheathing boards of ply or OSB or on a 'vapour open' supporting layer such as timber boarding of nominal size 150mm wide with a 2mm gap (as illustrated above).
This latter method should be employed only on warm roof systems such as that illustrated in Fig. 52b (Page 30).

Detailing Non-ventilated metal roof systems

Fig. 53

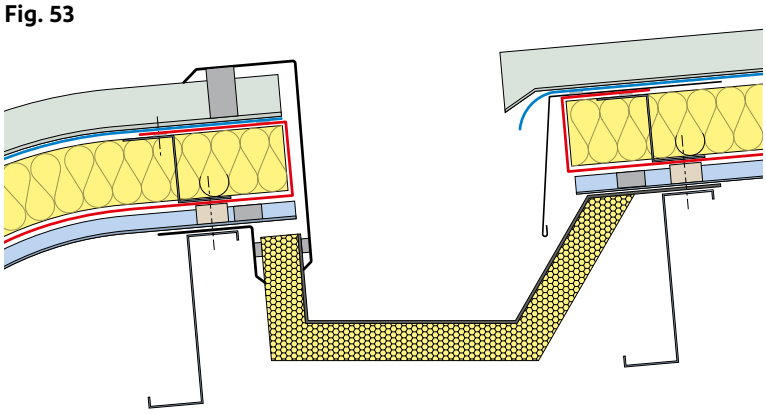


Fig. 54

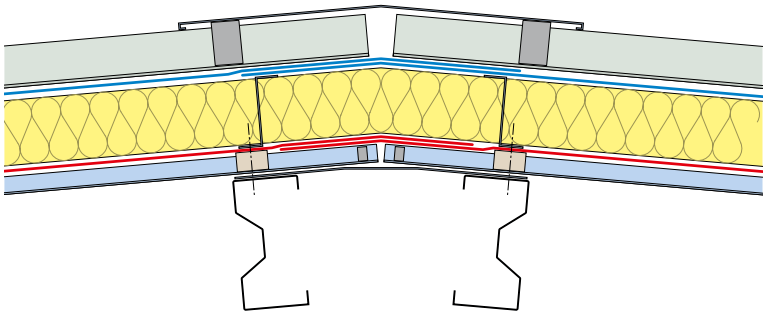
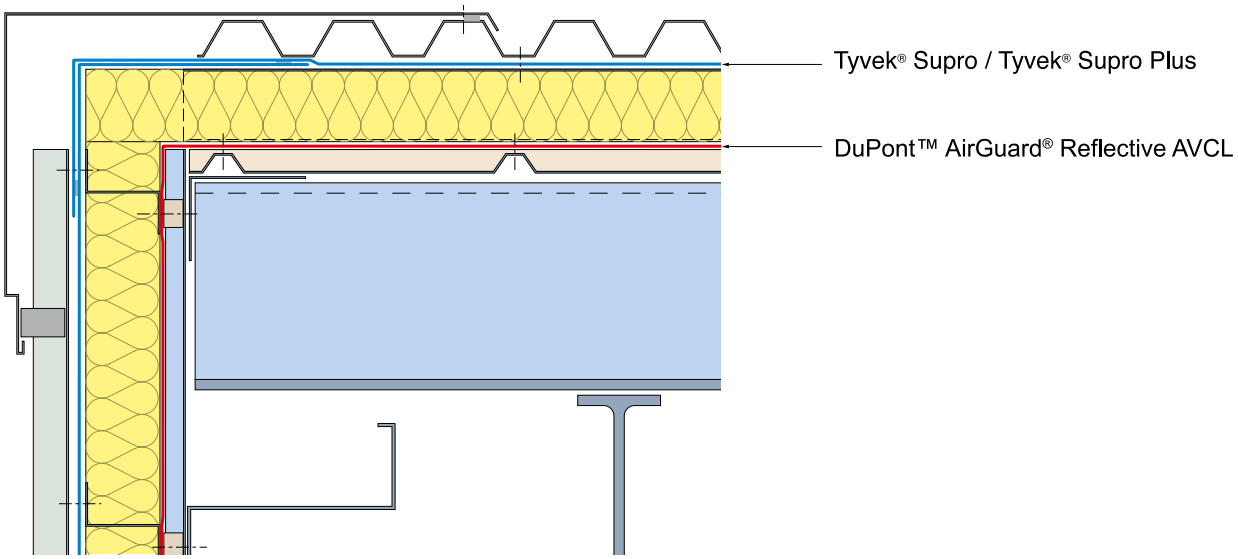


Fig. 55



Eaves (Fig. 53)

Where a Tyvek® membrane is used as the breather membrane in the wall it should be extended onto the roof slope by at least 300mm. The Tyvek® membrane on the roof should be lapped over it and dressed into the gutter. Ensure there is a clear drainage path at the end of the metal sheeting.

Ridge (Fig. 54)

Extend the Tyvek® membrane over the centre line of the ridge by 300mm from both sides, so a double strip of 600mm is formed.

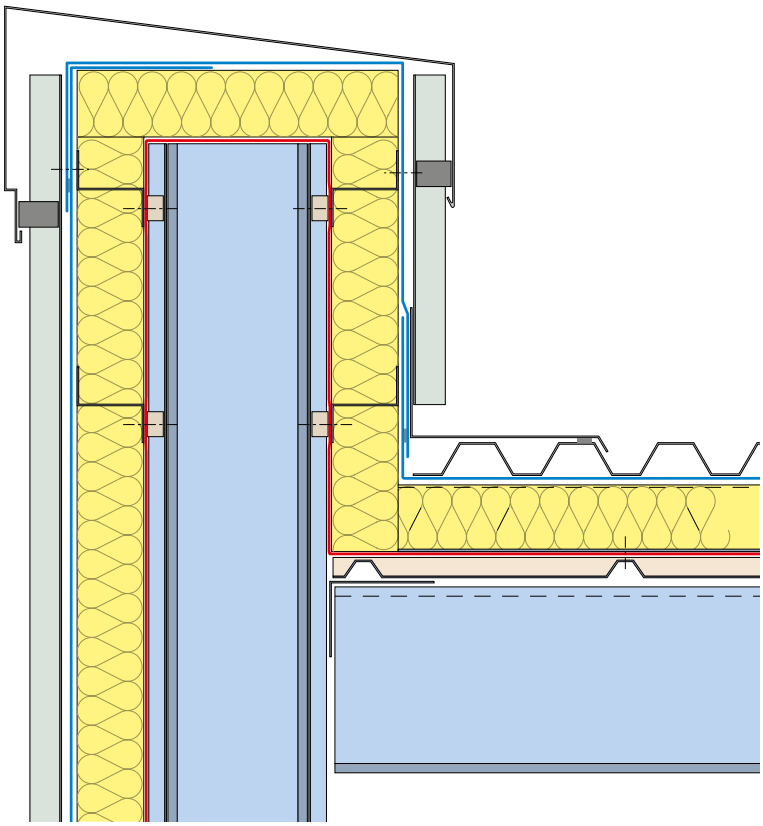
Verge (Fig. 55)

Extend the Tyvek® membrane from the walls 150mm onto the roof. Lap the Tyvek® membrane from the roof a minimum of 150mm over the wall membrane.

The recommended membranes for use in metal clad roof systems is:
Tyvek® Supro

Detailing Non-ventilated metal roof systems

Fig. 56



Abutment / parapet (Fig. 56)

Dress the Tyvek® membrane up the face of the wall so as to finish 150mm above the surface of the roof. Lap with the Tyvek® membrane on the wall face.

Sealed Systems

To further improve the thermal efficiency of the construction, the laps in the Tyvek® membrane can be sealed by using Tyvek® Tape 2060B (single-sided) or Tyvek® Double-sided Tape (acrylic).

Penetrations through the membrane, roof windows and edge details can also be sealed using Tyvek® Tape 2060B, Tyvek® Double-sided Tape (acrylic) or DuPont™ FlexWrap NF.

Alternatively, Tyvek® Supro Plus which has an integral adhesive tape can be specified.

Specification

Specify the roof membrane as Tyvek® Supro or Tyvek® Supro Plus vapour permeable roof underlay as manufactured by DuPont.

Installation

The Tyvek® membrane should be laid as soon as possible after the insulation has been installed to ensure maximum protection from inclement weather.

On commercial buildings clad with metal sheeting, it is quite common for the membrane to be laid vertically from eaves to ridge, lapping successive runs by 150mm. The fully supported condition in which it is laid sometimes makes this a more practicable method of installation. Tyvek® Supro Plus is most appropriate for this application as the vertical laps in the membrane should be sealed.

The membrane can be taken over the ridge by 300mm or taken over the ridge and down the opposite slope in one run.

Internal Air & Vapour Control Layer

Install DuPont™ AirGuard® Reflective on the warm side of the thermal insulation. All laps in the membrane should be minimum 100mm. Seal all laps, penetrations and abutments with Tyvek® Metallised Tape

Internal Lining - DuPont AirGuard Air & Vapour Control Layers (AVCL's)

DuPont™ AirGuard® Control

In today's modern world, a greater emphasis is being placed on environmental issues and the need to significantly reduce CO2 emissions. It has been reported that buildings in the UK contribute 43% of CO2 emissions - 27% from housing alone. For the prevention of global warming and the benefit of future generations it is **our** obligation to improve the energy efficiency of buildings.

The Building Regulations are already addressing these issues in the form of Approved Documents and in particular Part L, The conservation of fuel and power, now separated into L1 (dwellings) and L2 (buildings other than dwellings). For many years this document has addressed heat loss by conduction and includes various solutions and calculation methods on how to meet current u-value requirements. The theory works, but in practice total continuity of insulation layers can be very difficult to achieve. In reality air infiltration and heat loss by convection will occur through gaps between and around insulation and through hairline cracks in plasterboard linings. These invariably occur during the building drying out process, but are also caused by settlement and thermal movement over the life of the building.

Building Regulations Approved Document L raises the issue of heat loss by convection and air infiltration under the heading "Limiting air leakage." It states that: "Reasonable provision should be made to reduce unwanted air leakage."

DuPont™ AirGuard® Control air & vapour control layer

DuPont™ AirGuard® Control has been specifically developed for use as a barrier to air leakage. As the majority of vapour transfer through the building envelope will be via convection the membrane may be termed as an AVCL in this regard. However, the membrane's vapour resistance at 26 MNs/g is relatively low and does not fall within the category of an AVCL to BS5250:2011. DuPont™ AirGuard® Control will therefore be an ideal choice for vapour open constructions where a high resistance AVCL is not appropriate. The membrane can be specified as the airtight layer in the ceilings of cold pitched roof systems, helping to reduce convective heat and vapour transfer into the cold loft space in accordance with BS9250:2007.

Recommendation: Installing a timber batten over DuPont™ AirGuard® Control will help maintain the integrity of the membrane as well as to provide a suitable void for services.

Air & Vapour control layer

DuPont™ AirGuard® Reflective may also be installed where Dupont™ AirGuard® Control is indicated. However, in order to benefit from the extra thermal resistance provided by its low emissivity surface a batten space will need to be incorporated.

DuPont™ AirGuard® Reflective

DuPont™ AirGuard® Reflective is a metallised reinforced polypropylene based membrane designed for use as a continuous air and vapour control layer in walls and warm roof systems. As an internal component the membrane is installed behind a plasterboard lining/ ceiling to provide effective control against interstitial condensation both by diffusion and by convection. The membrane will reduce convective heat loss through the roof construction as well as retaining heat by reflecting it back in. DuPont™ AirGuard® Reflective has been tested in accordance with CE marking and is classified as airtight. The membrane has a very high vapour resistance at 10,000 MNs/g, confirmed by the BBA in Agrement Certificate 08/4548 Product Sheet 4.

To benefit from the membrane's thermal attributes the reflective surface must face a minimum 15mm airspace - usually between the membrane and the plasterboard lining (values for smaller cavities can be established from BS6946).

A standard 25mm batten would be ideal for this and will have the added benefit of providing a services void for electrical wiring and pipework. The batten space will also serve to minimise penetrations through the membrane from plasterboard fixings, light fittings, etc. Whilst this batten space is optional it is highly recommended, as the membrane's continuity is a principal factor in making the complete layer air and vapour tight. A high degree of workmanship is therefore key to a successful pressure test result.

Airtightness

DuPont™ AirGuard® Reflective is completely airtight and therefore will form an integral component in warm roof systems to reduce uncontrolled air leakage and subsequent heat loss. A correctly installed membrane will help to meet the requirements of Approved Document L by limiting the design air permeability well below the required **10m³/(h.m²) at 50 Pa**.

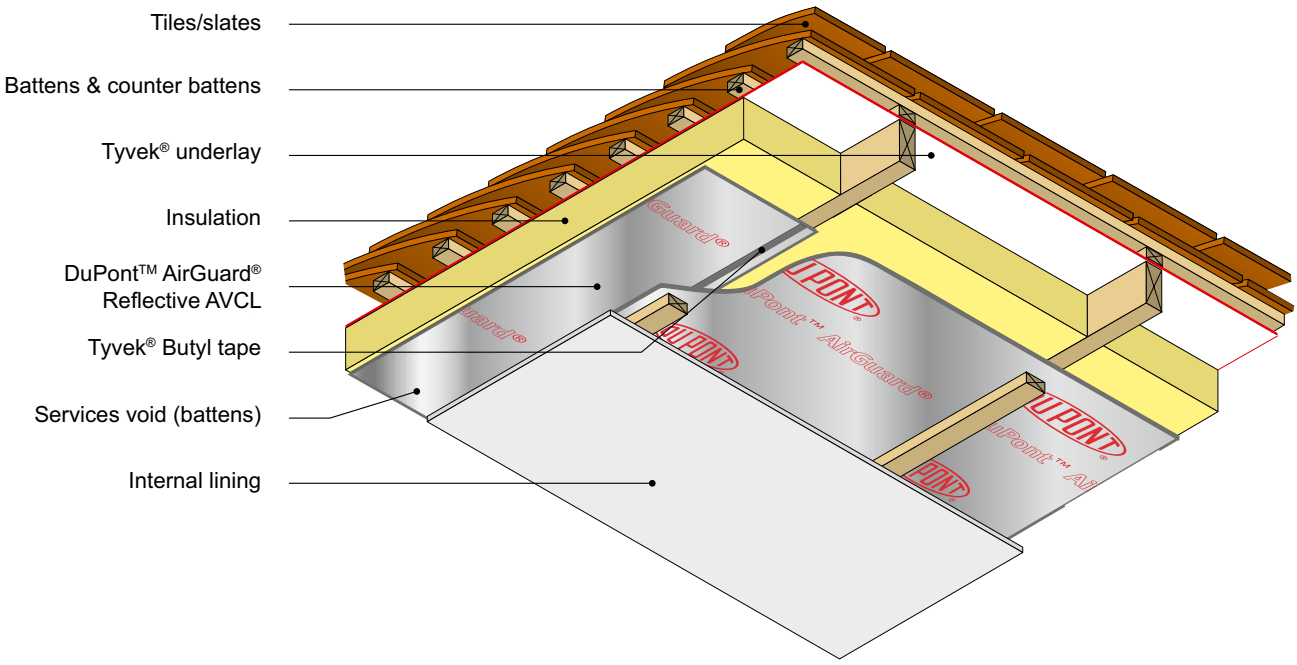
Vapour Control

DuPont™ AirGuard® Reflective provides high resistance to the passage of water vapour both by diffusion and convection. When installed continuously with all laps and penetrations sealed, the membrane will provide effective condensation control for warm roofs in all building types. This includes those of high humidity class, eg. swimming pools, textile factories, etc.

Thermal comfort

The metallised face of DuPont™ AirGuard® Reflective provides a low emissivity surface on the internal side of a warm roof construction. When used with a batten space the membrane will reflect internally generated heat back into the building providing a back-up to traditional insulation. This reduction in heat transmission allows the airspace resistance to be increased to **0.45 m²K/W**, which can be added to the overall U-value of the roof system.

Fig. 57



Please refer to page 37 for detailing

Internal Lining

DuPont™ Tyvek® AirGuard® Smart

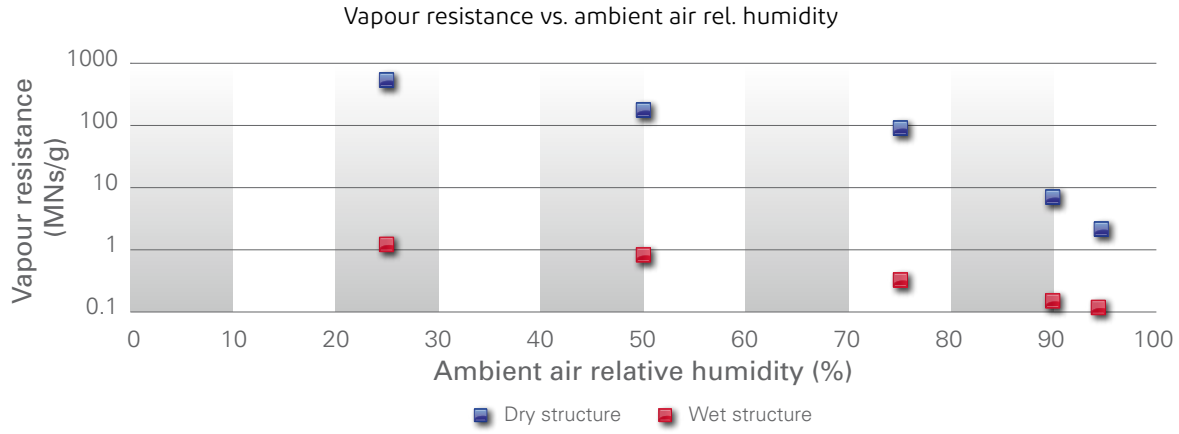
DuPont™ Tyvek® AirGuard® Smart is a strong and lightweight flexible membrane for use as an internally applied airtight vapour control layer (AVCL).

Outstanding properties:

- Extreme vapour resistance range from 0.26 MNs/g to more than 150 MNs/g, (Sd value 0.05 m - more than 30 m), therefore highly adaptable → one of the widest vapour resistance spans known in the market
- Combines drying-out and vapour control function in one layer
- High drying-out potential = maximum protection against structural damage
- High tensile strength offering superior insulation support/retention
- Very robust - offering versatility in site work
- Airtight
- Transparent allowing the timber members to be easily located for fixing
- Easy to install - suitable for use in roof or wall constructions

How DuPont™ AirGuard® Smart works

The graph shows 2 extreme examples:
1. Wet (100%) and 2. dry (0%) building envelope structure and corresponding vapour Rs (resistance) - depending on ambient air relative humidity. The actual vapour Rs is a combination of both the moisture content of the building envelope and relative humidity of the internal air. DuPont™ Tyvek® AirGuard® Smart provides traditional vapour control to the diffusion of vapour from the building interior, whilst offering a high drying-out potential of built-in moisture back into the building.



What happens just after a new build construction or after renovation?

New construction
Condition just after completion: Moisture is confined within the building envelope; damp timbers, insulation, etc, due mainly to wet building processes.

A new-build property will very often have a high relative humidity due to the rapid drying of the building fabric. Hence after completion, the owner has to adequately ventilate the building interior to expel the moisture rather than allow it to migrate through the construction where it can condense and cause harm. If needed the DuPont™ Tyvek® AirGuard® Smart allows moisture within the building fabric to migrate back into the building. Where the moisture content within the structure is high the vapour resistance of DuPont™ Tyvek® AirGuard® Smart will always be low This will allow the structural elements and the insulation to dry out towards the warm side of the building, in addition to the normal process of vapour diffusion through the external DuPont™ Tyvek® breather membrane.

Renovation
Condition just after completion: Building structure and insulation dry after brief humidity stabilisation.

In the case of a dry building structure, DuPont™ Tyvek® AirGuard® Smart acts as a traditional AVCL, providing effective condensation control and airtightness. Even in temporarily high air humidity zones water vapour diffusion is reduced*. The vapour resistance of DuPont™ Tyvek® AirGuard® Smart will be between 0.26 MNs/g and more than 150 MNs/g, (Sd value 0.5 m - more than 30 m). The migration of newly generated moisture through the construction will be significantly reduced.

* **DuPont™ AirGuard® Smart** is not suitable for places with permanent high ambient air humidity, such as saunas or swimming pools.

Product Data

	Acrylic Tapes				
	Tyvek® Acrylic Tape	Tyvek® Acrylic Tape with split-release liner	Tyvek® Metallised Tape	Tyvek® UV Facade Tape	Tyvek® Double Sided Tape
Product Style Code	2060B	2060B	2060M	1312F	1310D
					
Product Type	**Single-Sided**	**Single-Sided**	**Single-Sided**	**Single-Sided**	**Double-Sided**
Composition	Spunbonded polyethylene /single sided acrylic adhesive	Spunbonded polyethylene /single sided acrylic adhesive	Spunbonded polyethylene / single sided acrylic adhesive / metallised paper release liner	Single-sided acrylic tape / high UV-stabilised Polypropylene	PES/PVA-grid / acrylic adhesive / paper liner
Thickness (mm)	0.3	0.3	0.3	0.7	0.15
Weight (g/m²)	320	220	320	410	220
Roll width (mm)	75	60	75	75	50
Roll length (m)	25	25	25	25	25
Roll weight (kg)	0.62	0.45	0.62	0.7	0.3
Rolls/Tubes/Bottles per pallet/box	8	10	8	8	12
Internal use	X	X	X		X
External use	X	X	X	X	X
Overlaps and overall repair					
DuPont™ Tyvek® underlays for roof (EN13859-1)	●	●	●	●	●
DuPont™ Tyvek® underlays for walls (EN13859-2)	●	●	●	●	●
DuPont™ Tyvek® UV Facade (EN13859-2 with open joints)				●	●
DuPont™ AirGuard® AVCL all applications (EN13984)	●	●	●	●	●
Material compatibility and recommended use					
Masonry / concrete / render (smooth)	●	●	●	●	●
Brick / block / concrete / render (rough)	●	●	●	●	●
Plasterboard	●	●	●	●	●
Eaves Carrier					●
Window / door frames (PVC, Wood, Aluminium)	●	●	●	●	●
OSB & Wood fibre	●	●	●	●	●
Timber (rough, sawn)	●	●	●	●	●
Timber (planed)	●	●	●	●	●
Metal (aluminium, steel, copper, ...)	●	●	●	●	●
Construction membranes (PE, PVC, PP, PES, Alu, ...)	●	●	●	●	●
Penetrations & other applications					
Pipe penetrations (plastic & metal)	●	●		●	
Wiring / cable penetrations	●	●		●	
Around electrical sockets	●	●		●	
Windows & Doors to timber frame (inside)	●	●			
Windows & Doors to timber frame (outside)	●	●		●	
Windows & Doors to bricks & blocks (inside) *	●	●			
Windows & Doors to bricks & blocks (outside) *	●	●		●	
Plasterable or under rendering *					
Temporarily fixing AVCL to rafters					●

* Necessity for primer application (Yes/No): see under material compatibility and recommended use

■ recommended to use primer - ● recommended and designed for - ● works out properly but not designed for

				Butyl Tapes			Other
Tyvek® Double Sided Tape (detailing)	Tyvek® Window Tape	DuPont™ AirGuard® Tape	DuPont™ AirGuard® FR System Tape	Tyvek® Butyl Tape	FlexWrap NF	FlexWrap EZ	DuPont™ AirGuard® Sealant
1310D	1310PT	1310V	1310FR	1311B	FLEXNF	2064FW	1211S
							
Double-Sided	**Single-Sided**	**Single-Sided**	**Single-Sided**	**Double-Sided**	**Single-Sided**	**Single-Sided**	**Cartridge**
PES/PVA-grid / acrylic adhesive / paper liner	PET/PA film/acrylic adhesive / PP liner	PE film / acrylic adhesive / PP liner	Glassfibre & Aluminium / acrylic adhesive / paper liner	100% butyl mastic / siliconised paper liner	A crimped DuPont™ Tyvek® top sheet / butyl mass	A crimped DuPont™ Tyvek® top sheet / butyl mass	
0.15	0.3	0.3	0.15	1.2	1.6	1.6	310ml
220	300	375	215	1560	1200	1200	
20	80 150	60	75	50 20	152 228	60	
25	25	25	25	30	23	10	
0.15	0.6 1.13	0.6	0.57	2.5 1.0	4.4 7.5	1.1	
10	6 4	10	20	4 8	1	3	20
X	X	X		X	X	X	X
	X			X	X	X	
	●			●	●	●	
	●			●	●	●	
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DUPONT Tyvek

BUILDING KNOWLEDGE CENTRE

- Science you can build on -

www.building.dupont.co.uk
www.energy-efficiency.dupont.com

The DuPont™ Tyvek® Building Knowledge Centre is a resource for building envelope installation and design best practices. It's a dedicated source for information about evolving building regulations, sustainable building practices and air, water and thermal management, that can help you:

- Select building envelope materials and techniques
- Meet or exceed building standards
- Enhance energy efficiency
- Protect interior air quality
- Improve building durability
- Increase job site efficiency
- Develop project-specific specifications and plans.

We also have a Technical Library which has all our data sheets, installation guides & certificates e.g. BBA, NSAI, CE...

You can contact the technical department by email or phone on:

Technical: 0117 452 9050 Option 1
Sales: Option 2 for pricing enquiries
Technical E-mail: tyvek.construction@dupont.com

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