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Agrément Certificate
04/4151
Product Sheet 2

EUROCLAD ROOF SYSTEMS

EUROCLAD EUROSEAM 400 ROOF SYSTEMS

This Agrément Certificate Product Sheet(1) relates to Euroclad Euroseam 400 Roof Systems, comprising interlocking profiled steel sheets, insulation and accessories for fixing to steel or timber purlins and structural decking on roofs with a finished fall from 1° to 70° or a minimum self-curve radius of 45 metres convex, 50 metres concave.

(1) Hereinafter referred to as 'Certificate'.

CERTIFICATION INCLUDES:

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

KEY FACTORS ASSESSED

Structural performance — the roof systems will remain structurally stable and deflections will not be excessive under normal service conditions if installed in accordance with the requirements of this Certificate (see section 6).

Weathertightness — the roof systems will resist the passage of rain and wind-driven snow when installed in accordance with the provisions of this Certificate (see section 7).

Thermal insulation — the roof systems can provide sufficient insulation to contribute to enabling a building to meet the requirements of the national Building Regulations (see section 8).

Condensation risk — the likelihood of condensation forming under normal service conditions is negligible (see section 9).

Air permeability — the roof systems will remain reasonably airtight provided that the sealing of the liner and vapour control layer (where required) is maintained and other building elements have incorporated appropriate design details and building techniques to limit air permeability to the building envelope (see section 10).

Performance in relation to fire — the profiled sheets have a notional designation national class/European class of AA/B_{ROOF} (t4) in accordance with BS EN 14782 : 2006, ('low vulnerability' in Scotland) as defined in BS 476-3 : 2004 and the liner sheets have a Class 0 or 'low risk' internal surface spread of flame classification (see section 11).

Durability — durability depends on the location, environment and coatings used (see section 14).

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

On behalf of the British Board of Agrément

Date of Second issue: 24 September 2015 Brian Chamberlain, Head of Technical Excellence

Claire Curtis-Thomas, Chief Executive

Originally certificated on 25 July 2011

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

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

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Regulations

In the opinion of the BBA, Euroclad Euroseam 400 Roof Systems, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):

The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	A1	Loading
Comment:		The systems have sufficient strength and stiffness to sustain and transmit the design load in accordance with section 6 of this Certificate.
Requirement:	B2	Internal fire spread (linings)
Requirement:	B3(2)	Internal fire spread (structure)
Comment:		The exposed interior surfaces of the systems have been assessed as having the surface rating class given in section 11.1 of this Certificate.
Requirement:	B4(2)	External fire spread
Comment:		The external surfaces of the sheets have a notional AA designation as defined in BS 476-3 : 2004 and, therefore, are not subject to the limitations of a minimum distance from any point on a boundary. See section 11.2 of this Certificate.
Requirement:	C2(b)	Resistance to moisture
Comment:		When subjected to the maximum design load given in this Certificate, the systems will resist the passage of moisture to the inside of the building. See section 7 of this Certificate.
Requirement:	C2(c)	Resistance to moisture
Comment:		The systems will have a minimal risk of surface condensation or damage due to interstitial condensation. See sections 9.1, 9.2, 9.4 and 9.5 of this Certificate.
Requirement:	L1(a)(i)	Conservation of fuel and power
Comment:		The systems are acceptable. See sections 8 and 10.1 to 10.3 of this Certificate.
Regulation:	7	Materials and workmanship
Comment:		The systems are acceptable. See sections 14.1, 14.3, 14.4 and 14.5 and the *Installation* part of this Certificate.
Regulation:	26	CO_2 emission rates for new buildings
Regulation:	26A	Fabric energy efficiency rates for new dwellings (applicable to England only)
Regulation:	26A	Primary energy consumption rates for new buildings (applicable to Wales only)
Regulation:	26B	Fabric performance values for new dwellings (applicable to Wales only)
Comment:		The systems can contribute to satisfying the requirements of these Regulations. See sections 8 and 10.1 to 10.3 of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Durability, workmanship and fitness of materials
Comment:		The systems can contribute to a construction satisfying the requirements of this Regulation. See sections 13 and 14.1, 14.3, 14.4 and 14.5 and the *Installation* part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	1.1(a)(b)	Structure
Comment:		The systems have sufficient strength and stiffness to transmit the design load, with reference to clause 1.1.1[1][2], in accordance with section 6 of this Certificate.
Standard:	2.1	Compartmentation
Comment:		The exposed interior surfaces of the systems, with reference to clause 2.1.15[2], have been assessed as having the risk classification given in section 11.1 of this Certificate.
Standard:	2.2	Separation
Comment:		The exposed interior surfaces of the systems, with reference to clauses 2.2.7[2] and 2.2.10[1], have been assessed as having the risk classification given in section 11.1 of this Certificate.
Standard:	2.5	Internal linings
Comment:		The exposed interior surfaces of the systems, with reference to clause 2.5.1[1][2], have been assessed as having the risk classification given in section 11.1 of this Certificate.
Standard:	2.8	Spread from neighbouring buildings
Comment:		The sheets have a 'low vulnerability' classification and satisfy this Standard, with reference to clause 2.8.1[1][2]. See section 11.3 of this Certificate.
Standard:	3.10	Precipitation
Comment:		When subjected to the maximum design load given in this Certificate, the systems will resist the passage of moisture to the inside of the building, with reference to clause 3.10.1[1][2]. See section 7 of this Certificate.
Standard:	3.15	Condensation
Comment:		The systems will have a minimal risk of surface condensation or damage due to interstitial condensation, with reference to clauses 3.15.1[1], 3.15.2[1], 3.15.3[1] and 3.15.4[1]. See sections 9.4 and 9.5 of this Certificate.

Standard:	6.1(b)	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		The systems can contribute to satisfying clauses, or parts of, 6.1.1(1), 6.1.2(1)(2), 6.1.3(2), 6.1.6(1), 6.2.1(1)(2), 6.2.3(1) and 6.2.4(2). See section 8 of this Certificate. The systems can also contribute to satisfying clauses 6.2.4(1) and 6.2.5(1)(2). See sections 10.1, 10.2, 10.4 and 10.5 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The systems can contribute to satisfying the relevant requirements of Regulation 9, Standards 1 to 6, and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard. In addition, the systems can contribute to a construction meeting a higher level of sustainability as defined in this Standard, with reference to clauses 7.1.4(1)(2) [Aspects 1(1)(2) and 2(1)], 7.1.6(1)(2) [Aspects 1(1)(2) and 2(1)] and 7.1.7(1)(2) [Aspect 1(1)(2)]. See sections 10.1, 10.2, 10.4 and 10.5 of this Certificate.

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

The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	23a(i)(iii)b	Fitness of materials and workmanship
Comment:		The systems are acceptable. See sections 14.1, 14.3, 14.4 and 14.5 and the *Installation* part of this Certificate.
Regulation:	28	Resistance to moisture and weather
Comment:		When subjected to the maximum design load given in this Certificate, the systems will resist the passage of moisture to the inside of the building. See section 7 of this Certificate.
Regulation:	29	Condensation
Comment:		The risk of harmful effects on the building due to interstitial condensation within the systems will be minimal. See sections 9.4 and 9.5 of this Certificate.
Regulation:	30	Stability
Comment:		The systems have sufficient strength and stiffness to sustain and transmit the design load in accordance with section 6 of this Certificate.
Regulation:	34	Internal fire spread — linings
Regulation:	35	Internal fire spread — structure
Comment:		The exposed interior surfaces of the systems have been assessed as having the class surface given in section 11.1 of this Certificate.
Regulation:	36	External fire spread
Comment:		The external surfaces of the sheets have a notional AA designation as defined in BS 476-3 : 2004 and therefore are not subject to the limitations of a minimum distance from any point on a boundary. See section 11.2 of this Certificate.
Regulation:	39	Conservation measures
Comment:		The systems can satisfy the requirements of this Regulation. See sections 8 and 10.1 to 10.3 of this Certificate.

Construction (Design and Management) Regulations 2015

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

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

See section: 3 *Delivery and site handling* (3.1 and 3.2) of this Certificate.

Additional Information

NHBC Standards 2014

NHBC accepts the use of Euroclad Euroseam 400 Roof Systems, provided they are installed, used and maintained in accordance with this Certificate, in relation to *NHBC Standards*, Part 7 *Roofs*.

CE marking

The Certificate holder has taken the responsibility of CE marking the following components of the systems:

— Euroseam ESA 400 profiled aluminium roof sheet, steel and aluminium liner sheets in accordance with harmonised European Standard BS EN 14782 : 2006.

— Quattro bar, brackets and SS110 halters in accordance with European Technical Assessment 13/0698.

An asterisk (*) appearing in this Certificate indicates that data shown is given in the manufacturer's Declaration of Performance.

All other components within Elite guaranteed systems supplied via Euro Clad Ltd are CE marked by the supplier where required:

- insulation — mineral wool to BS EN 13162 : 2012
- vapour control layers (VCL) to BS EN 13984 : 2013
- structural deck to BS EN 1090-1 : 2009 and BS EN 1090-2 : 2008.

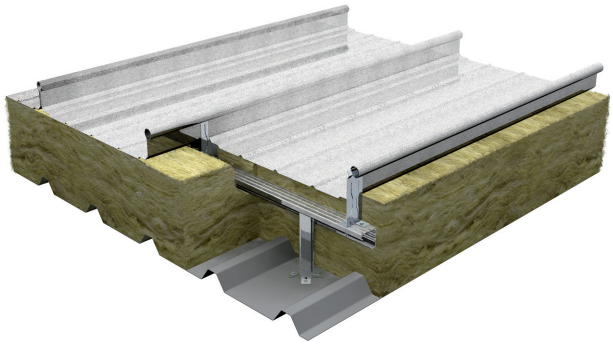
1 Description

1.1 Euroclad Euroseam 400 Roof Systems consist of coverings of interlocking profiled coated and uncoated aluminium sheets, attached to the roof substructure by stainless steel or aluminium halters. The seams of adjacent sheets are rolled over the halter heads to secure them without penetration of the outer sheet. The halters are mechanically fixed to the Quattro bar and bracket support system which, in turn, is attached by mechanical fasteners either directly to the roof purlins or mounted on top hat sections fixed to structural decking or timber structures. Halters may also be attached directly to suitable structural plywood (18 mm minimum thickness), timber or OSB decking. The system also comprises insulation and accessories for fixing to steel or timber purlins and structural decking on roofs with a finished fall from 1° to 70°. The sheets can be manufactured with convex and concave curves or tapered. The curved sheets are installed with a minimum self-curved radius of 45 metres convex, 50 metres concave. Access for maintenance and repair, if required, should be considered during the design process.

1.2 The systems covered by this Certificate are shown below (Figures 1 to 6):

Construction type	Description (outside to inside)

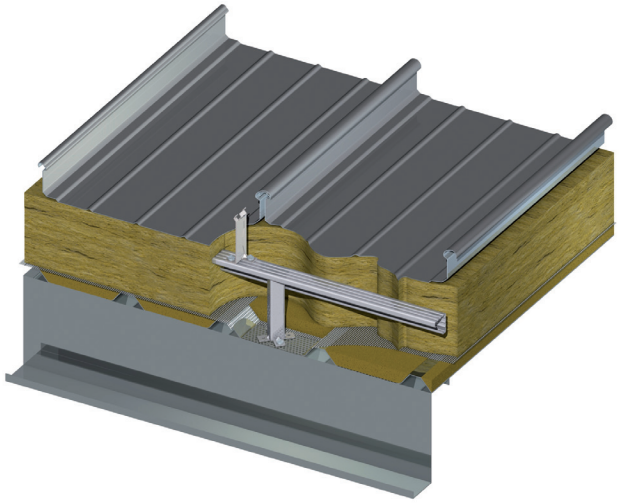
Figure 1 System 4 — over purlins — Euroseam with Quattro bar and bracket and MW5 liner



- Euroseam ESA 400 interlocking profiled sheet (see section 1.4 and Figure 7)
- SS110 halter (see section 1.5 and Figure 8)
- Insulation (see section 1.7)
- Quattro bar and bracket (see section 1.6)
- MW5 liner sheet (see section 1.8)

System reference (Quattro bracket height)
4.15 (260 mm), 4.16 (240 mm)
4.18 (220 mm), 4.24 (150 mm).

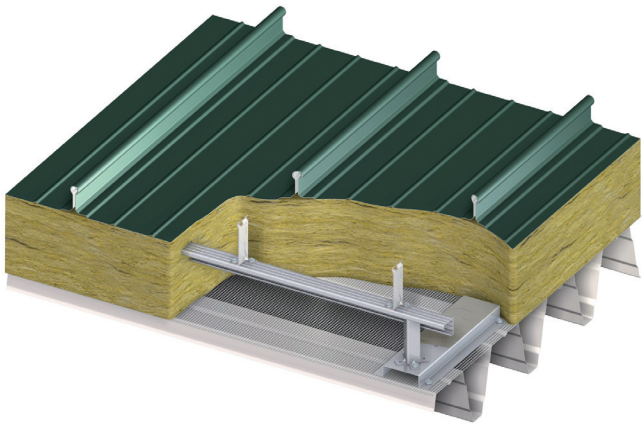
Figure 2 System 4A2 — over purlins — Euroclad Acoustic Absorption System



- Euroseam ESA 400 interlocking profiled sheet (see section 1.4 and Figure 7)
- SS110 halter (see section 1.5 and Figure 8)
- Insulation (see section 1.7)
- Quattro bar and bracket (see section 1.6)
- Vapour control layer (see section 1.10)
- Pre-cut acoustic slab insulation shaped to fit into the liner (see section 1.9)
- Perforated MW5 liner sheet (see section 1.8)

System reference (Quattro bracket height)
4.15A2 (260 mm), 4.16A2 (240 mm)
4.18A2 (220 mm), 4.24A2 (150 mm).

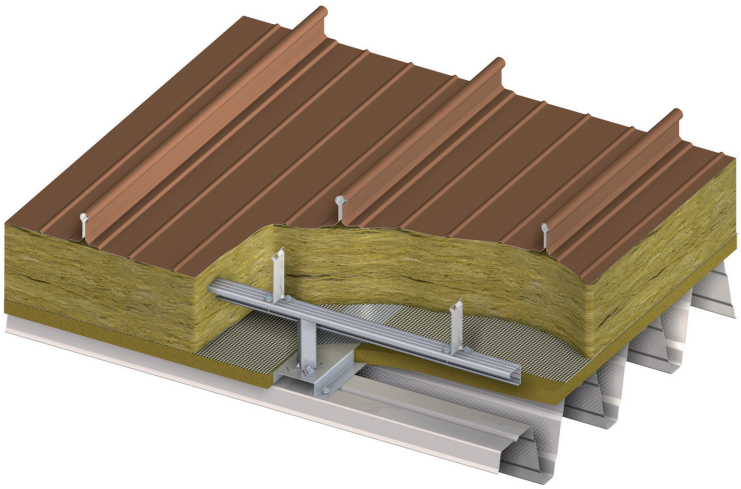
Figure 3 System 5 — on structural decking



- Euroseam ESA 400 interlocking profiled sheet (see section 1.4 and Figure 7)
- SS110 halter (see section 1.5 and Figure 8)
- Insulation (see section 1.7)
- Quattro bar and bracket (see section 1.6)
- Top hat section (see section 1.13)
- Vapour control layer (see section 1.10)
- Structural deck (outside the scope of this Certificate)

System reference (Quattro bracket height)
5.15 (220 mm), 5.16 (200 mm)
5.17 (180 mm), 5.24 (100 mm).

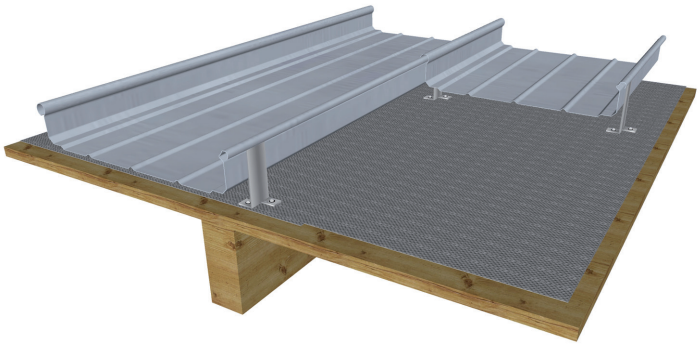
Figure 4 System 5A1 — on structural decking — Acoustic Absorption System



- Euroseam ESA 400 interlocking profiled sheet (see section 1.4 and Figure 7)
- SS110 halter (see section 1.5 and Figure 8)
- Insulation (see section 1.7)
- Quattro bar and bracket (see section 1.6)
- Top hat section (see section 1.13)
- Vapour control layer (see section 1.10)
- 30 mm acoustic insulation (see section 1.9)
- Perforated structural deck (outside the scope of this Certificate)

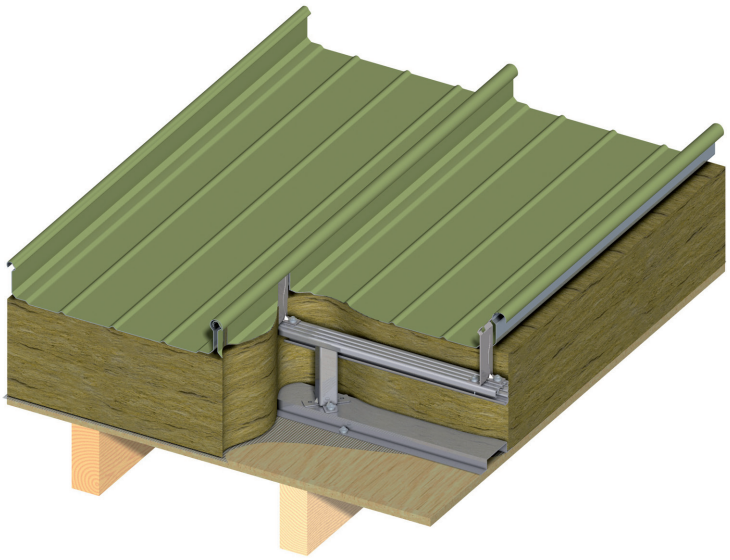
System reference (Quattro bracket height)
5.15A1 (220 mm), 5.16A1 (200 mm),
5.17A1 (180 mm), 5.24A1 (100 mm)

Figure 5 System 8 — on timber decking



- Euroseam ESA 400 interlocking profiled sheet (see section 1.4 and Figure 7)
- SS110 halter (see section 1.5 and Figure 8)
- Breather membrane (see section 1.11)
- Timber deck (outside the scope of this Certificate).

Figure 6 System 9 — on timber decking



- Euroseam ESA 400 interlocking profiled sheet (see section 1.4 and Figure 7)
- SS110 halter (see section 1.5 and Figure 8)
- Insulation (see section 1.7)
- Quattro bar and bracket (see section 1.6)
- Top hat section (see section 1.13)
- Vapour control layer (see section 1.10)
- Timber deck (outside the scope of this Certificate)

System reference (Quattro bracket height)
9.15 (220 mm), 9.16 (200 mm)
9.17 (180 mm), 9.24 (100 mm).

1.3 When used in other constructions or assemblies, not covered by this Certificate, the full system performances given in this Certificate cannot be assumed. The Euroclad Roof System 4 and 5 structural details, fire performance and durability as described in this Certificate will apply but the designer must be satisfied with other aspects of performance, ie thermal insulation, risk of condensation and acoustic performance. The designer should contact the Certificate holder for more information.

Component information

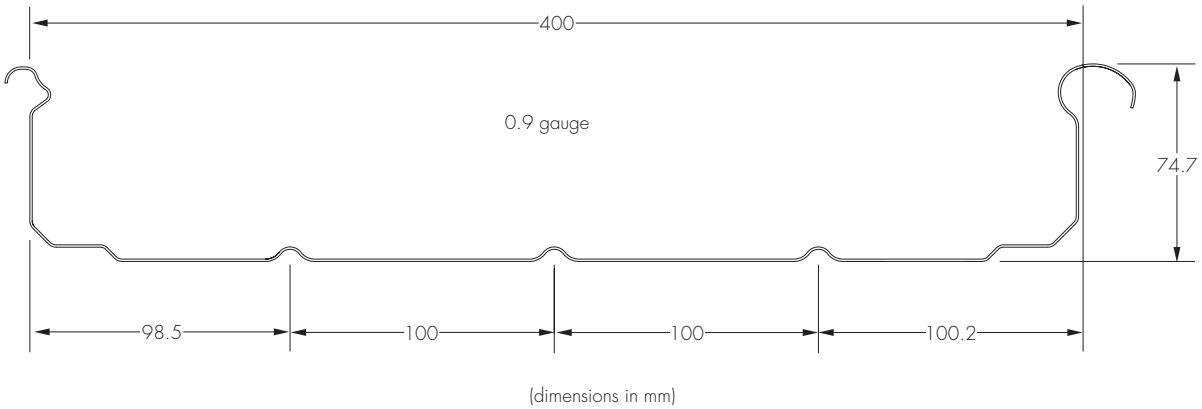
1.4 Euroclad ESA 400 profiled roofing sheets (see Figure 7) are roll-formed to the full length of the roof, eliminating the need for end laps. Sheet lengths greater than 14 metres are generally rolled on site. Sheets are formed from 0.9 mm or 1.2 mm thick aluminium alloy and are available in mill finish or with the following coatings (other gauges and materials are available but are outside the scope of this Certificate):

— Euramax ARS or PVF2, as covered by BBA Certificate 93/2922

— Hydrocoat PVF2, as covered by BBA Certificate 93/2918

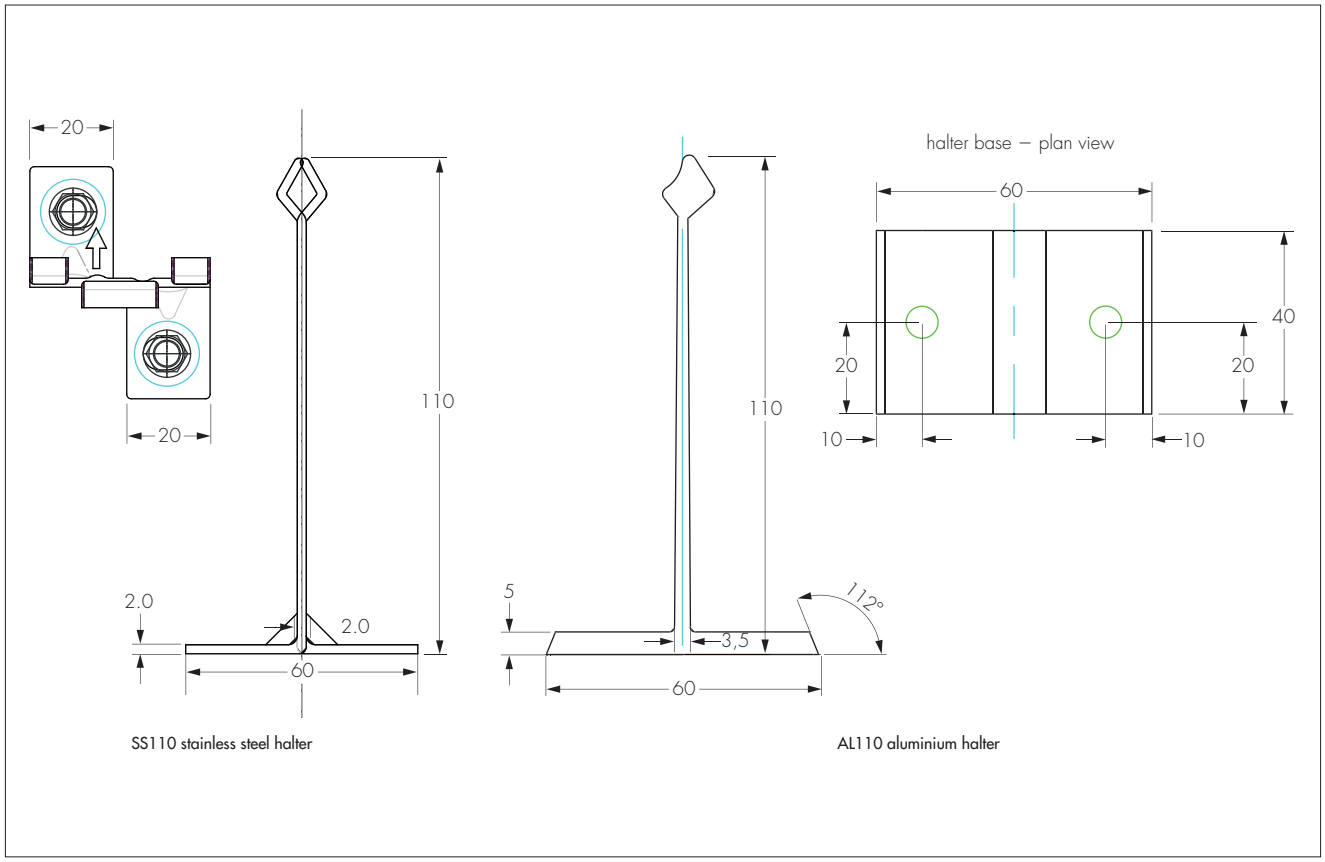
— Alcoa Reynolux PVF2, Duragloss 5000, polyamide or polyester as covered by BBA Certificate 87/1964.

Figure 7 Euroseam ESA 400 sheet profile



1.5 SS110 stainless steel halters and A110 aluminium halters with pre-fitted WT75 barrier tape to foot, which are used to create fixed points and verge detailing. Both halters are 110 mm high. See Figure 8.

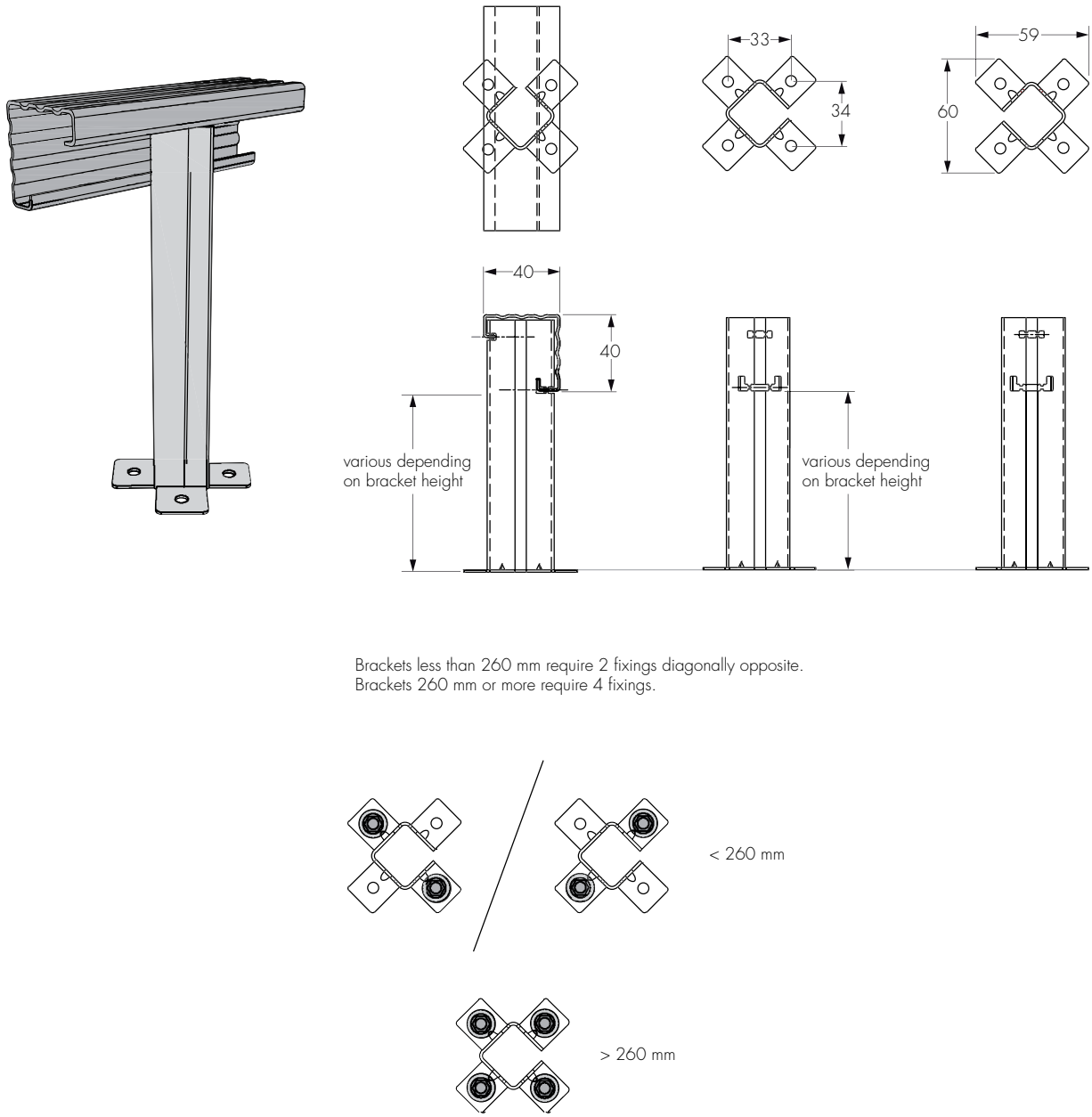
Figure 8 Euroclad halters (dimensions in mm)



1.6 Euroclad Quattro bar and bracket (see Figure 9) comprise:

- Quattro bar — formed from 1.2 mm thick, galvanized steel S390 GD Z275 to BS EN 10346 : 2009, supplied in 3.6 m lengths
- Quattro bracket — formed from 1.5 mm thick galvanized steel DX51D + Z275-N-A-C to BS EN 10346 : 2009.

Figure 9 Quattro bar and brackets (dimensions in mm)



1.7 Insulation — blanket thermal insulation material, comprising:

- quilt blanket insulation, mineral wool to BS EN 13162 : 2001 with a thermal conductivity (λ_D *value*) of 0.040 $W \cdot m^{-1} \cdot K^{-1}$, 0.037 $W \cdot m^{-1} \cdot K^{-1}$, 0.035 $W \cdot m^{-1} \cdot K^{-1}$ or 0.032 $W \cdot m^{-1} \cdot K^{-1}$.

1.8 Two types of liner sheet are used depending on the construction:

- Euroclad MW5 (non-perforated and perforated) rolled from 0.7 mm thick steel with bright white lining enamel coating (perforated sheets are used for acoustic constructions)
- Euroclad MW5 (perforated) rolled from 0.9 mm thick aluminium liner sheets with white PVF2 coating, used for acoustic constructions in aggressive environments such as swimming pools(1).

(1) Aluminium structural decking of various thicknesses may also be used in such cases. However, the performance of these decks is outside the scope of this Certificate.

1.9 Acoustic insulation – two types are used depending on the construction:

- Euroclad Elite Acoustic Slab 30 mm thick, tissue faced and to BS EN 13162 : 2012 with a thermal conductivity (λ_D *value*) of 0.034 $W \cdot m^{-1} \cdot K^{-1}$
- Euroclad Elite Pre-cut Acoustic Slab 32 mm thick, tissue faced, pre-cut to fit into the MW5 liner trough, and to BS EN 13162 : 2012 with a thermal conductivity (λ_D *value*) of 0.034 $W \cdot m^{-1} \cdot K^{-1}$.

1.10 Vapour control layer (VCL) (where required):

- Euroclad Elite VCL — reinforced polyethylene with 500 $MN \cdot s \cdot g^{-1}$ vapour resistance (minimum)
- Euroclad Elite VCL — sealing tape, minimum12 mm x 1.5 mm, suitable for the VCL
- Euroclad HH VCL[1] — foil-faced reinforced polyethylene with 30 000 $MN \cdot s \cdot g^{-1}$ vapour resistance (minimum)
- Euroclad HH VCL[1] — sealing tape, minimum 12 mm x 1.5 mm (2 rows).

(1) For use in Class 5 humidity environments.

1.11 Breather membrane — Euroclad Elite Roof Breather Membrane or other breather membranes BBA-approved for roofing applications.

1.12 Fixings[1] — supplied by the Certificate holder or to the Certificate holder's specification and incorporating:

- carbon or stainless steel self-tapping screws for halter fixing
- carbon or stainless steel screws for Quattro bracket fixing
- carbon or stainless steel, self-tapping screws for liner fixing
- aluminium closed end rivets with stainless steel mandrel, for use on sheet drip angles, verge channels, ridge zeds, ridge closures, flashings and fixed points
- carbon or stainless steel screws for fixing halter, top hat or spacers to timber purlins, rafters or suitable structural plywood, timber or OSB decking[2].

(1) Further details of fixings and their use are given in section 17, Table 8.

(2) The designer should confirm the number and length of fasteners necessary to give sufficient pull-out resistance for the grade and size of material used. Guidance is available from the Certificate holder.

1.13 Other accessories covered by this Certificate (unless otherwise stated) and used with the systems, include:

- Verge and ridge components fabricated from aluminium 6005 alloy and comprising:
  - — ECZIP-VCP verge clips — ECZIP-VCN5 verge channels — ECZIP-VCLS5 verge closures — ECZIP-VH verge halters
  - — ECZIP-RC ridge closures — ECZIP-RZ5 ridge support zeds — ECZIP-SSC sliding ridge clip, used where required
  - — ECZIP-DA3 drip angles.
- eaves and ridge foam filler pieces, closed-cell EPDM or MP with gaps to provide adequate ventilation
- top hat sections consisting of:
  - — galvanized steel (minimum grade S220GD + Z225 to BS EN 10346 : 2009) with a minimum thickness of 1.6 mm and
  - — aluminium alloy (minimum 0.2% proof stress of 180 $N \cdot mm^2$) with a minimum thickness of 2 mm (for use in association with aluminium decking).
- sealant, type A butyl rubber strip, 4 mm wide or 1 mm by 50 mm side lap tape
- mechanical seaming tool (MST) for securing sheet laps (supplied by the Certificate holder).

1.14 Accessories which can be incorporated into the roof, but which are outside the scope of this Certificate, include:

- flashings
- eaves, bullnoses and soffits
- walkways, guardrails, fall protection systems and PV arrays (all attached via specialised non-penetrative clamps supplied by Euroclad)
- GRP or polycarbonate rooflights
- welded details such as hips, valleys and soakers
- openings to details such as vents.

2 Manufacture

2.1 The Euroseam and liner sheets are manufactured from aluminium or steel coils on roll formers.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

2.3 The management system of Euro Clad Ltd has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2000 by BSI (Certificate Q10647).

2.4 Euroclad Euroseam Sheets, Quattro spacer system, halters and liner sheets are manufactured in the UK and are marketed/distributed in the UK by the Certificate holder.

3 Delivery and site handling

3.1 Euroclad Euroseam Sheets are packed in bundles weighing a maximum of one tonne and carrying a label bearing the BBA logo incorporating the number of this Certificate, the quantity and lengths of the panels and site location. A lifting beam must be used to unload lengths exceeding 8 m.

3.2 Where sheets are to be temporarily stored on the roof, the loadbearing capacity of the structure on which they are being stored must be considered, and they must be restrained from movement caused by either gravity or wind action.

3.3 Where sheets are to be stored on the ground, the base must be dry, firm and gently sloped to allow drainage, and the sheets should be protected from the risk of damage.

3.4 Any damage to components before or during installation will affect the durability of the roof systems. Items should therefore be handled and stored in accordance with the following guidelines:

- liner and decking sheets should be handled in the same manner as the profiled sheets
- rolls of VCL must be handled carefully to avoid puncturing and to prevent damage, and must not be stored on end. For long-term storage the rolls should be protected from ultraviolet light and stored indoors or under non-translucent covers. The VCL should be dry during installation
- blanket insulation is delivered to site in polyethylene-wrapped rolls. For long-term protection these must be stored indoors or under a waterproof covering.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Euroclad Euroseam 400 Roof Systems.

Design Considerations

4 General

4.1 Euroclad Euroseam 400 Roof Systems are satisfactory for use as structural roofing in installations with a finished fall of between 1° and 70° and curved installations with a minimum self-curve radius of 45 metres convex, 50 metres concave, where access is available for maintenance and repair only. The systems are intended to be fixed to steel or timber purlins and structural decking of buildings used for industrial, commercial, retail and leisure purposes as well as residential and non-residential buildings such as schools and hospitals.

4.2 If architectural features, through fittings or rooflights are required on the roof, special care and attention is necessary to ensure that, in common with all metal roofs, these features have been correctly detailed and fitted.

5 Practicability of installation

Euroclad Euroseam 400 Roof Systems are designed to be installed by a competent general builder or a roofing contractor, experienced with these types of systems. The Certificate holder can provide guidance to contractors and assistance in design.

6 Structural performance

6.1 The systems have adequate strength and stiffness to sustain anticipated loads. Load/span values are given in Table 1 and should be used as follows:

- based on span, it must be confirmed that the proposed specification is adequate to resist the design loads (see section 6.2)
- the spacing between Quattro brackets must be checked to ensure that it is adequate. Values given in Table 1 are based on 1.2 m bracket spacings.

Table 1 Maximum permissible snow and wind load for ESA 400

Span (m)	Maximum positive uniform distributed loading ($kN \cdot m^{-1}$)	Snow drift	Maximum negative wind loading ($kN \cdot m^{-1}$)
1.0	3.00(1)	6.87	2.80(2)
1.5	2.92	2.92	1.82
2.0	1.69	2.69	1.61

(1) Value limited by deflection L/200.

(2) Value limited by deflection L/90.

Notes:

- the resistance values given in the table should be compared to the characteristic (unfactored) snow and wind loads
- the values given are for uniformly distributed loads on multiple spans. All spans are assumed to be equal or within 15% of the largest span
- the values are based on full scale tests and incorporate an overall safety factor of 2.0 for negative loading (attachment resisting wind uplift) and 1.5 for positive loading
- the deflection of the seam at the unfactored loads is limited to span/200 for snow and span/90 for wind uplift
- the values for the spans between 1 m and 1.5 m and 1.5 m and 2 m can be interpolated
- the span is the distance between the centreline of the purlins or Quattro bars if fitted to a structural deck.

General notes:

- the data has been prepared in accordance with BS EN 1990 : 2002 and BS EN 1993-1-3 : 2006 and their respective National Annexes
- the self-weight of the Euroclad Euroseam sheeting has been taken into account in preparing the data
- for single spans, excessive loads or spans, different deflection criteria and different factors of safety, advice should be sought from the Certificate holder.

6.2 When evaluating the design loads, the wind loads must be calculated in accordance with the recommendations of BS EN 1991-1-4 : 2005 and its National Annex, and the imposed snow loads must be checked in accordance with the recommendations of BS EN 1991-1-3 : 2003 and its National Annex.

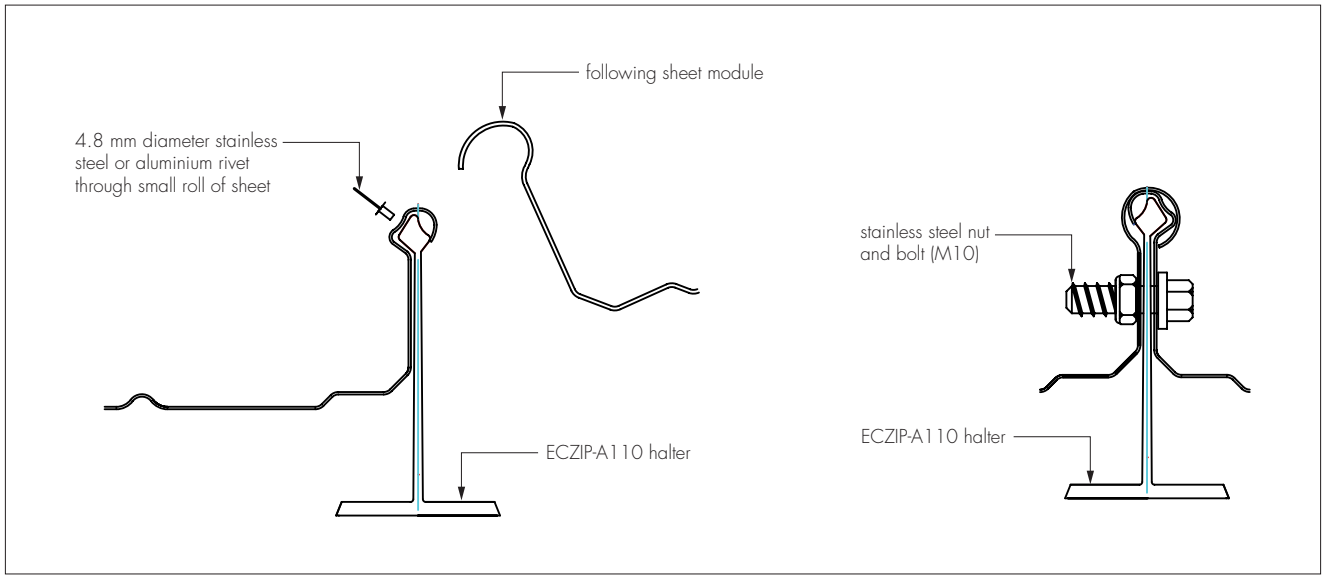
6.3 Where lateral restraint of the liner or deck is part of the structural steel design, the detail of the fixing between purlin and liner must be determined by the structural engineer responsible for the overall roof design.

6.4 The profiled sheets are capable of withstanding impacts associated with normal handling, foot traffic, installation and service.

6.5 The roof systems are capable of accommodating thermal movement of the outer sheets provided they are installed in accordance with this Certificate and the Certificate holder's instructions.

6.6 A fixed point should be designed into the roof, generally at the ridge (though it may be at the eaves or a midpoint). The loading on this fixed point must be verified by the Certificate holder or confirmed by a structural engineer and the appropriate fixing detail used (see Figure 10). For loads up to 0.524 kN, one aluminium rivet (ASC-D-48110) may be fixed through the sheet underlap into the halter head. For loads between 0.525 kN and 1.04 kN, two aluminium rivets may be fixed through the sheet underlay into the halter head. For loads between 1.05 kN and 3.14 kN, one 10 mm diameter bolt should be fixed through the halter stem and the upstands of the two sheets adjacent to the halter. For loads higher than 3.14 kN, the advice of the Certificate holder should be sought.

Figure 10 Typical fixed point details



7 Weathertightness

7.1 When installed in accordance with the Certificate holder's instructions, the systems are weathertight when used in installations with finished falls of 1° to 70° or curved roofs with a minimum self-curve radius of 45 metres convex, 50 metres concave, and within the recommended maximum design wind pressures and exposure conditions.

7.2 The weathertightness of the systems will not be adversely affected by normal service deflections.

8 Thermal insulation

8.1 The thermal performance of each building incorporating the roof systems must be evaluated in accordance with the relevant national Building Regulations, and is the responsibility of the overall designer of the building.

8.2 Thermal transmittance (U values) for example constructions are given in Table 3. These have been calculated with Quattro brackets at 1.2 m centres (see section 1.6). Unless otherwise stated the thermal conductivity (λ_D *value*) of the mineral wool quilt has been taken as 0.040 $W \cdot m^{-1} \cdot K^{-1}$.

Table 2 Description of Euroclad Euroseam 400 Roof Systems

System	Outer sheet	Insulation	Spacer	Liner sheet
4	Euroseam ESA 400	Various depths of quilt various conductivities	SS110 halters on Quattro bar and bracket various heights[1]	0.7 mm thick steel MW5 profile sheet
4A2	Euroseam ESA 400	Various depths of quilt various conductivities	SS110 halters on Quattro bar and bracket various heights[1]	0.7 mm thick perforated steel MW5 profile sheet*
5	Euroseam ESA 400	Various depths of quilt various conductivities	SS110 halters on Quattro bar and bracket various heights[1] on 30 mm deep top hat section	Structural deck in steel or aluminium in various profiles and thicknesses
5A1	Euroseam ESA 400	Various depths of quilt various conductivities	SS110 halters on Quattro bar and bracket various heights[1] on 30 mm deep top hat section	Structural deck with perforation in steel or aluminium in various profiles and thicknesses
8	Euroseam ESA 400	None – cold roof	SS110 halters	Ply, timber or OSB deck[2]
9	Euroseam ESA 400	Various depths of quilt various conductivities	SS110 halters on Quattro bar and bracket various heights[1] on 30 mm deep top hat section	Ply, timber or OSB deck[2]

Note: For internal sheet – 0.9 mm perforated aluminium liner can be used for acoustic constructions in buildings with aggressive internal environments.

(1) From 80 mm to 320 mm under the scope of this Certificate.

(2) Plywood, timber or OSB deck – outside scope of this Certificate.

Table 3 U values ($W \cdot m^{-2} \cdot K^{-1}$) for example constructions

System 4[1]	Quattro bracket height (mm)	Span (m)[2]	*U values ($W \cdot m^{-2} \cdot K^{-1}$)*
4 (and A2 variant)	260	1.5 m	0.15
4 (and A2 variant)	240	1.5 m	0.16
4 (and A2 variant)	220	1.5 m	0.18
4 (and A2 variant)	150	1.5 m	0.24
System 5[1]	**Quattro bracket height (mm)**	**Span (m)[3]**	***U values ($W \cdot m^{-2} \cdot K^{-1}$)***
5 (and A1 variant)	220	1.5 m	0.15
5 (and A1 variant)	200	1.5 m	0.16
5 (and A1 variant)	180	1.5 m	0.17
5 (and A1 variant)	100	1.5 m	0.25

(1) See section 1.2 for system descriptions.

(2) The span is the distance between purlins and Quattro bars.

(3) The span is the rail spacing of the Quattro system.

(4) General spacing of 1.5 m is applicable for the most commonly-specified deck profiles. The spacing is larger for some deck profiles. Contact the Certificate holder for more information.

Notes: Other combinations of bracket height and insulation are available. For U value calculations in accordance with the requirements of the national Building Regulations for individual projects, consult the Certificate holder.

Quilt insulation installed is larger than the void it fills and will be lightly compressed within the systems. Please contact the Certificate holder for further information.

Standard Quattro bracket set out along the rails is at 1.2 m.

8.3 The systems can contribute to maintaining continuity of thermal insulation at junctions between elements and openings.

8.4 For Accredited Construction Details, the corresponding ψ-values (psi) in BRE Information Paper IP 1/06, Table 4 may be used.

8.5 Alternatively, to help reduce calculated CO_2 emissions for the whole building values, details provided by the Certificate holder or contained in The Metal Cladding and Roofing Manufacturers Association (MCRMA) Technical Paper 17 can be used. The Certificate holder also provides calculations for ψ-values of details and *F* factors in accordance with the requirements of the Building Regulations and MCRMA Technical Paper 18.

8.6 Detailed guidance for other junctions and on limiting heat loss by air infiltration can be found in:

England and Wales — Approved Documents to Part L and for new thermal elements to existing buildings, Accredited Construction Details (version 1.0). See also SAP 2009 *The Government's Standard Assessment Procedure for Energy Rating of Dwellings*, Appendix K and the iSBEM User Manual for new-build

Scotland — Accredited Construction Details (Scotland)

Northern Ireland — Accredited Construction Details (version 1.0).

8.7 It is essential that a suitable continuous air barrier is installed to limit air infiltration (see sections 10.1 to 10.5) and that details such as eaves and gables are designed to adequately limit heat loss by conduction (for example, by filling with insulation to maintain the insulation envelope and by minimising thermal bridges). Typical details are shown in Figures 11a, 11b, 11c and 11d.

9 Condensation risk

9.1 In common with all metal roof constructions, there is a risk of condensation, either interstitial condensation within the roof construction or surface condensation at thermal bridges.

Surface condensation

9.2 The temperature at which surface condensation will occur on the internal surfaces of the roof is dependent on the internal relative humidity and the internal and external temperatures. The risk of surface condensation and mould growth for a particular construction should be assessed in accordance with BS EN ISO 13788 : 2012. Additional guidance in connection with this can be found in BS 5250 : 2011.

9.3 When assessed by computer modelling, insulated roof systems with Quattro brackets deeper than 100 mm (the smallest Quattro bracket suitable for the MW5 liner profile depth) can achieve a negligible risk of condensation occurring on the internal surfaces. This is not verified by the BBA, but further information and *F* factor calculations can be provided by the Certificate holder.

9.4 In buildings likely to experience high internal relative humidities (eg building internal humidity class 5, as defined in the BS EN ISO 13788 : 2012 and BS 5250 : 2011), there is a minimal risk of intermittent condensation forming on the fixing screws penetrating the purlin. The designer should anticipate the areas of the structure that could be at risk from sustained sources of humidity and take the necessary measures to prevent any such problems (see section 9.6 of this Certificate).

Interstitial condensation

9.5 The systems have been assessed by computer modelling for the risk of damage and harmful effects on the building due to interstitial condensation. The modelling predicts that, for buildings in internal humidity classes 1 to 4 (see Table 4), under the normal climatic conditions experienced in the UK, interstitial condensation is unlikely to be a significant problem. As a result, the risk of interstitial condensation reducing the thermal and structural performance of the roof systems will be limited. This assessment is only valid if the following conditions are fulfilled in accordance with the Certificate holder's instructions and this Certificate:

- the VCL remains undamaged, is continuous over ridges and hips, and is sealed at penetrations/abutments
- VCL laps are adequately sealed
- for installations without the separate VCL, the liner panel laps are adequately sealed (in accordance with the Certificate holder's specifications)
- the ribs of the ESA 400 profile are ventilated by air passing along them from and to open areas at the eaves and the ridge.

Table 4 Building internal humidity classes

Humidity class[1]	Building type
1	Storage areas
2	Offices, shops
3	Dwellings with low occupancy
4	Dwellings with high occupancy, sports halls, kitchens, canteens, buildings heated with unflued gas heaters
5	Special buildings, eg laundries, breweries, swimming pools

(1) As referenced in BS EN ISO 13788 : 2012 and BS 5250 : 2011.

9.6 For buildings in internal humidity class 5 and in buildings or areas of a building with special internal design conditions, a hygrothermal assessment of the proposed roof systems should be undertaken using the guidance given in BS 5250 : 2011, BS 5925 : 1991 and BS 6229 : 2003, to establish whether special provisions are required.

9.7 Where a breather membrane is required, such as for System 8, an appropriate membrane with relevant third party accreditation must be used.

9.8 A separate VCL is required if the roof systems are used in buildings such as dwellings. This is also required for roof Systems 5 and 9 and for acoustic systems with a perforated liner or deck, in all applications.

10 Air permeability

10.1 The airtightness of the systems are reliant on the careful sealing of the liner or VCL. The airtightness of a roof system is dependent on maintaining the integrity of seal throughout. In addition to sealing at all joints, the liner or VCL must be suitably sealed at the perimeter and all penetrations. Details of sealing at all laps, eaves, ridges, hips, valleys and penetrations must be in accordance with the Certificate holder's instructions.

10.2 The airtightness of the building will also be dependent on the performance of the other building elements. Provided these also incorporate appropriate design details and building techniques, air infiltration through the building fabric should be minimal and the building reasonably airtight.

10.3 In England, Wales and Northern Ireland, completed buildings are subject to pre-completion testing for airtightness in accordance with the requirements of Approved Documents L1A and L2B (section 20A), Technical Booklet F1 (sections 2.59 to 2.69) and Technical Booklet F2 (sections 2.72 to 2.77) respectively.

10.4 In Scotland, completed dwellings are subject to air permeability testing in accordance with the requirements of Mandatory Standard 6.2 (clause 6.2.5). Alternatively, where a default design value of 15 $m^3 \cdot m^{-2} \cdot h^{-1}$ at 50 Pa is stated by demonstrating compliance under Mandatory Standard 6.1, testing is not required.

10.5 Air leakage design test data is available from the Certificate holder.

11 Performance in relation to fire

11.1 The internal surface of the liner sheets has been assessed as Class 0 or 'low risk' as defined in the national Building Regulations.

11.2 The external sheets have a notional AA designation as defined in BS 476-3 : 2004 and B_{ROOF}(t4).

11.3 In Scotland, the external sheets have a 'low vulnerability', provided the blanket insulation installed has a 'non-combustible' classification when tested in accordance with BS 476-4 : 1970.

12 Acoustic performance

12.1 The systems covered by this Certificate are described in Tables 5 to 7. Other constructions are available covering a wider range of acoustic performances and U values but are outside the scope of this Certificate (details are available from the Certificate holder).

12.2 Test data to BS EN ISO 10140-2 : 2010 and BS EN ISO 717-1 : 2013 indicate the sound reduction indices given in Table 5.

Table 5[1] Sound reduction indices

System	Quilt insulation	Depth of Quattro bracket (mm)	U Value	Sound reduction index (dB)
4.18[1]	Knauf 0.040	220	0.18	42 (–2 –8)
4.15[1]	Knauf 0.040	260	0.15	43 (–2 –7)
4.25A2[1]	Knauf 0.040	150	0.25	37 (–1 –6)

(1) Data from report C/22349/T01, *The Laboratory Determination of The Airborne Sound Transmission of Various Roof Systems.*

Note: For System 5 applications, please consult the Certificate holder for advice.

12.3 Test data to BS EN ISO 354 : 2003 indicate the absorption coefficients given in Table 6.

Table 6 Sound absorption coefficients

System[1]	Octave frequency bands (Hz)	Sound absorption coefficient (a)	Practical sound absorption coefficient[2] (ap)
4A2 with 150 mm Quattro brackets and Knauf 0.040 insulation[3][4]	125	1.20	1.00
	250	1.15	1.00
	500	1.05	1.00
	1000	0.99	1.00
	2000	0.98	0.95
	4000	0.96	0.95
5A1 with 150 mm Quattro brackets and Rockwool 0.040 insulation[5][6]	125	1.43	1.00
	250	0.98	0.95
	500	0.85	0.85
	1000	0.42	0.45
	2000	0.27	0.30
	4000	0.26	0.25

(1) See section 1.2 for full system descriptions.

(2) Calculated in accordance with BS EN ISO 11654 : 1997.

(3) Knauf factory-clad 40 quilt.

(4) The weighted sound absorption coefficient (aw) was calculated as 1.00 in accordance with BS EN ISO 11654 : 1997, giving a class A rating. The noise reduction coefficient (NRC) was calculated as 1.05 in accordance with ASTM C 423-01.

(5) Rockwool Cladding Roll quilt.

(6) The weighted sound absorption coefficient (aw) was calculated as 0.35 in accordance with BS EN ISO 11654 : 1997, giving a class D rating. The noise reduction coefficient (NRC) was calculated as 0.65 in accordance with ASTM C 423-01.

13 Maintenance

13.1 The systems should be inspected regularly for accidental damage to the roof sheets and their coatings, and also for any build-up of dirt and debris. Damage must be repaired and accumulated dirt and debris removed. The frequency of inspections will depend on the environment and use of the building.

13.2 In industrial and coastal areas, it may be necessary to clean the installation periodically by hosing with water and a neutral detergent to restore its appearance and to remove corrosive deposits. It may be necessary to clean soffits in any environment.

13.3 A planned maintenance cycle should be introduced if any extended design life is required.

13.4 Damaged sheets can be removed and replaced. The Certificate holder should be contacted for details.

14 Durability

14.1 The durability of the sheets will depend upon the coating material, the immediate environment, aspect faced and use.

14.2 When used in the context of this Certificate, uncoated roofing sheets will have the minimum service life given in section 14.10 of this Certificate.

14.3 Maintenance painting may be necessary to restore the appearance of coated sheets or to extend their design life, and should be considered at the intervals given in Table 7.

Table 7 Service life

Sheet Material	Minimum service life (years)[1] Environment	
	Rural/suburban	Industrial/coastal
Hydrocoat PVF2 coated aluminium[2]	20	15
Euramax PVF2 coated aluminium[3]	20	15[4]
Euramax ARS coated aluminium[3]	20	15
Reynolux PVF2 coated aluminium[5]	20	15
Reynolux Duragloss 5000 coated aluminium[5]	15	10
Reynolux Polyester coated aluminium[5]	15	10
Reynolux Polyamide coated aluminium[5]	20	15

(1) Minimum service life is that when first maintenance painting is required.
(2) Full details of Hydrocoat coated materials are given in BBA Certificate 93/2918.
(3) Full details of Euramax coated materials are given in BBA Certificate 93/2922.
(4) This value is not given in BBA Certificate 93/2922 but has been individually assessed.
(5) Full details of Alcoa Reynolux coated materials are given in BBA Certificate 87/1964.

14.4 For coated sheets, if the building has an exposed eaves detail and is in an aggressive environment, or if there are corrosive conditions inside, a more durable specification of the reverse-side coating should be used. Details can be obtained from the Certificate holder.

14.5 A planned maintenance cycle (see section 13) should be introduced if an extended design life is required. The Certificate holder can recommend a suitable system for maintenance painting.

14.6 Colour changes will be slight and uniform on any one elevation.

14.7 Stucco-finished uncoated aluminium sheets must not come into contact with the materials listed below:

in any conditions

- ungalvanized mild steel
- copper and its alloys (including the run-off from copper roofs)
- timber treated with fire retardants
- mortar
- alkali-bearing materials.

in damp conditions

- timber preserved with copper compounds
- other metals (ie bimetallic contact).

in coastal environments

- lead
- stainless steel (other than the unexposed supporting halters).

in industrial environments

- lead.

14.8 Where compatibility problems are likely to occur, barriers such as paints, tapes or pads appropriate to the materials and environment should be incorporated.

14.9 Under normal exposure conditions aluminium sheets do not need painting for corrosion resistance but, if desired, can be painted using conventional techniques for the materials.

14.10 Roofing constructed with uncoated stucco-finished aluminium sheet will have a minimum service life of 40 years in rural and suburban environments and a minimum of 25 years in more aggressive areas, eg severe industrial or coastal environments.

15 Reuse and recyclability

The roofing systems can be 100% recycled and/or reused. However, detailed advice should be sought from the Certificate holder when considering reuse.

Installation

16 General

16.1 Installation of Euroclad Euroseam 400 Roof Systems is carried out by experienced roofing contractors in accordance with the Certificate holder's instructions. Guidance can be provided by the Certificate holder for contractors who are unfamiliar with the systems.

16.2 Euroclad MW5 liner sheets can be fitted to achieve a non-fragile class B rating in accordance with ACR[M]001 : 2014. Copies of drawings detailing the installation may be obtained from the Certificate holder.

16.3 Roof surfaces can be slippery when wet, the designer, contractors and others accessing the roofs should consider this in preparing the Health and Safety plans for projects.

17 Procedure

17.1 The liner or decking sheets are placed in position with all joints lapped, stitched and sealed (where necessary) and fixed to the roof purlins/top hat sub-purlins/rafters/main structural frame. Solid filler blocks are located in the liner or decking profile at details such as eaves, hips and ridges to ensure adequate airtightness at these points.

17.2 Where a sealed liner is used to achieve vapour control in place of a separate VCL, the end laps must be a minimum of 100 mm and sealed with 4 mm type A butyl rubber strip positioned above fixing positions parallel to the edge of the sheet.

17.3 The liner side laps are sealed with 50 mm by 1 mm type A butyl rubber strip positioned centrally along the side lap joint. Alternatively, 4 mm type A butyl rubber strip can be positioned inside the lap with stitching screws at 500 mm centres.

17.4 All fixings penetrating the liner must have bonded washers to provide an air seal.

17.5 Swarf or debris must be removed from the liner, timber or metal decking, or acoustic insulation before being covered with the VCL, if required. The VCL is laid over the liner or decking sheets and acoustic insulation, if present, and is made continuous by lapping all joints by a minimum of 150 mm and sealing with VCL sealing tape. Sealing tape should be a minimum of 12 mm x 1.5 mm. One strip of VCL sealant tape in the lap is used for standard environments; two strips are used for high humidity environments. For A2 systems over perforated liner, the VCL is laid over the acoustic insulation slabs and into liner troughs where Quattro brackets are to be fitted. In these cases it is preferable to roll the VCL out from verge to verge, starting at the bottom of the roof slope and overlapping each subsequent roll. Further guidance can be provided by the Certificate holder. The VCL sheets should be continuous over ridges/hips and sealed to penetrations, abutments and perimeters. Breather membrane, if required, should be rolled out from verge to verge, starting at the bottom of the roof slope and overlapping each subsequent roll. All joints should be lapped by a minimum of 150 mm.

17.6 The Quattro brackets are inserted into the rail at appropriate centres and fixed, using appropriate fasteners, through the VCL and liner sheet directly to the purlins or top hat section, if used. All fixings must have bonded washers to provide an air seal. The appropriate halters are fitted to the rail at appropriate centres using the template and guidance provided by the Certificate holder. Pan support fillers are fitted as required to the rail between halters, typically at ridge and eaves lines. Aluminium A110 halters are used at the verges and fixed points only, while stainless steel SS110 halters are employed at all other locations.

17.7 The first layer of mineral fibre blanket insulation is laid between and underneath the Quattro bar. The second layer is laid over the Quattro bar, taking care to ensure continuity and that the space is fully filled, ie no voids.

17.8 The Euroseam ESA 400 sheet underlap is offered up to the second row of halters and lowered and engaged over the halter heads. The sheet overlap then locates over the first row of halters and is closed with the seaming tool, prior to fitting the verge components to secure the sheet edge.

17.9 The fixed point detail should be completed prior to laying the next sheet, if fixing a rivet through the sheet underlap. If alternative details are being used, they should be completed at the appropriate stage.

17.10 The next sheet underlap is offered up to and engaged with the next row of halters and the sheet overlap is lowered until it laps over the preceding sheet underlap.

17.11 The sheet lap is secured using the mechanical seaming tool and the fixing of the sheets continues as above.

17.12 On completing the installation of the sheets on the roof, the ending verge components are fitted and the various ridge perimeter and eaves fittings are fixed. Typical details are shown in Figures 11a, 11b, 11c and 11d.

17.13 The barge board flashing is fixed to the verge/perimeter to complete the detail, using the appropriate fasteners at 600 mm centres.

17.14 The sheet pan must be turned up at the ridge and down at the eaves using the turn up/down tool provided.

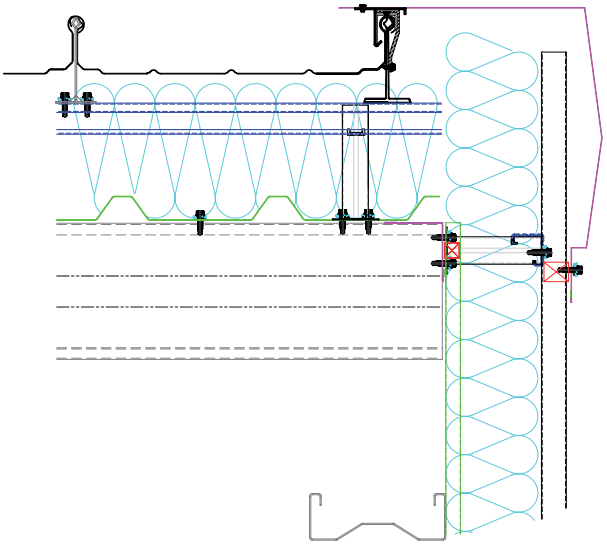
17.15 The turn down detail should be made after the 3 mm drip angle and eaves fillers have been fitted.

17.16 The ridge detail with fixed point (Figure 11b) is constructed by clipping the ridge filler blocks into the ridge closure that is positioned close to the apex at 90° to the profiled sheets. The ridge closure is secured with an appropriate fastener to the ridge zed which is fixed, in turn, through each sheet crown.

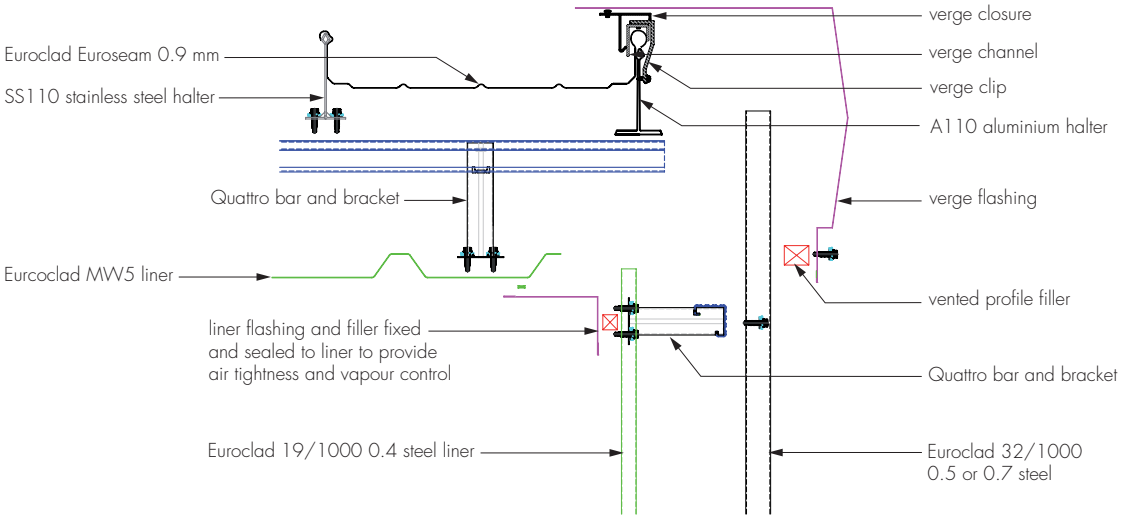
17.17 The ridge flashing is secured to the ridge zed using an appropriate fixing every 400 mm, positioned between the sheet upstands. Care must be taken to avoid damage/penetration of the profiled sheets when fixing the ridge flashing to the ridge zed. If the fixed point is not located at the ridge halter, a sliding ridge detail should be used, as illustrated in Figure 11c.

17.18 Eaves details may vary but a typical construction is shown in Figure 11d.

Figure 11a Typical verge installation detail



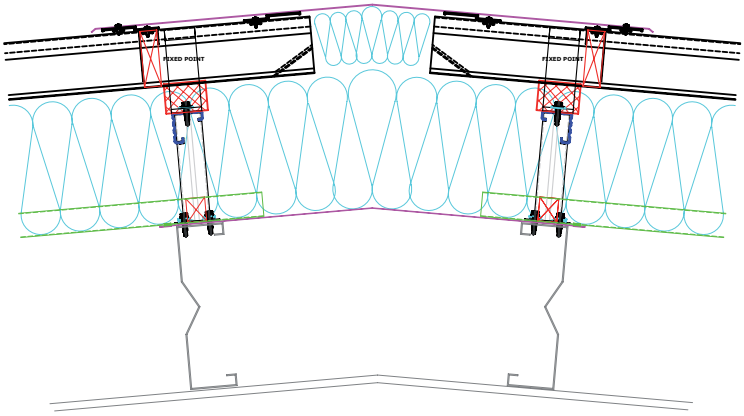
EUROCLAD ELITE SYSTEM 4 ROOF CONSTRUCTION



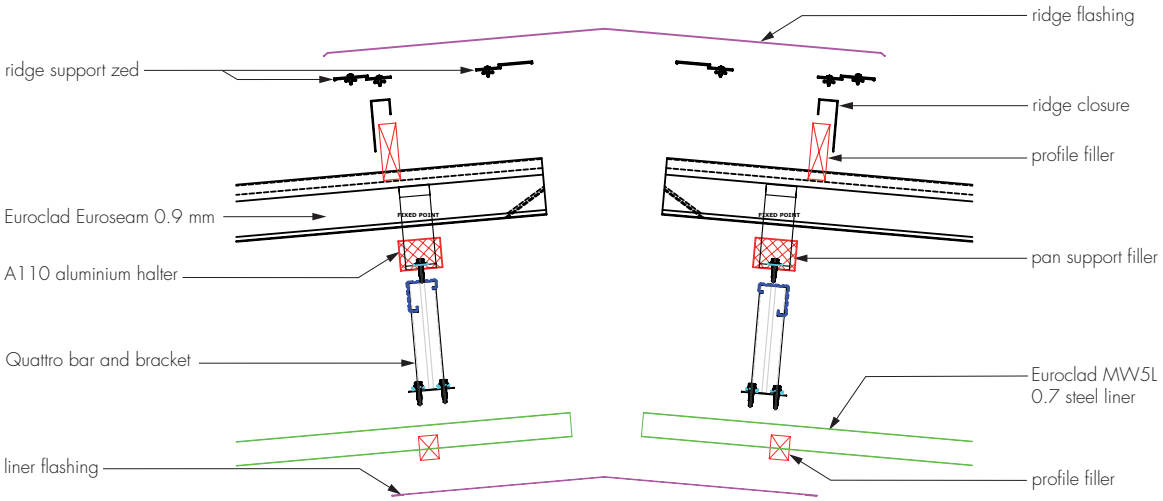
Insulation excluded for clarity.
A range of mineral and glass wool insulations are available for different requirements

Verge

Figure 11b Typical ridge (fixed point) installation detail



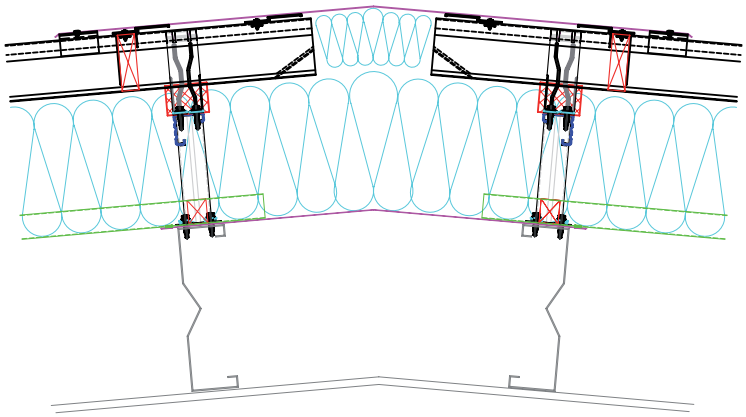
EUROCLAD ELITE SYSTEM 4 ROOF CONSTRUCTION

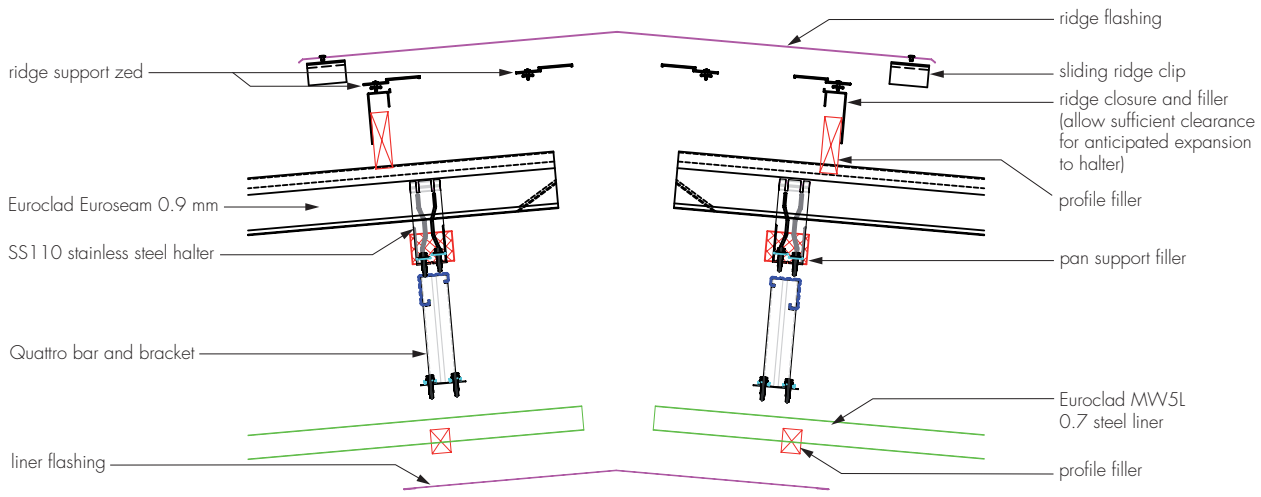


Insulation excluded for clarity.
A range of mineral and glass wool insulations are available for different requirements

Ridge (fixed point)

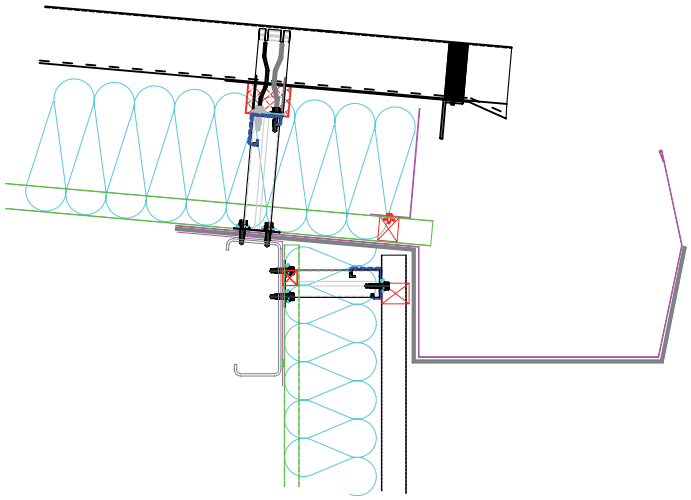
Figure 11c Typical ridge (sliding) installation detail



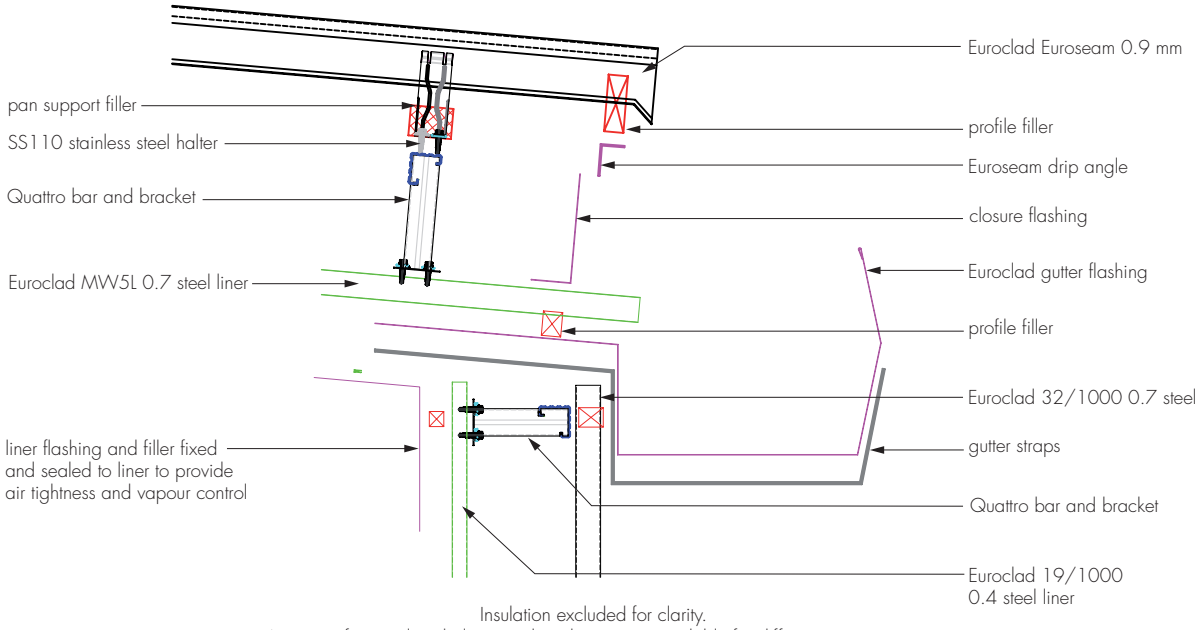


Ridge (sliding)

Figure 11d Typical eaves installation detail



EUROCLAD ELITE SYSTEM 4 ROOF CONSTRUCTION



Insulation excluded for clarity.
A range of mineral and glass wool insulations are available for different requirements

Eaves

17.19 Closures and fillers for hip details are cut according to roof pitch and plan angle for each side of the hip to suit project requirements. They are positioned parallel to the centre line of the hip.

17.20 Details of fixings and their appropriate use are given in Table 8 of this Certificate.

Table 8 Details of fixings

Application	Description	Frequency
SS110 halter and A110 halter to Quattro bracket	6 mm minimum diameter self-drill fixing 25 mm to 29 mm 304 grade stainless steel	2 per halter
Quattro bracket to cold-rolled steel purlins — max 3 mm thick (including liner)	5.5 mm diameter self-drill 25 mm to 28 mm long with washer (304 grade stainless steel for Elite Plus, carbon steel for Standard and Elite)	2 per bracket. 4 per bracket for 260 mm and over
Quattro bar to bracket fix	5.5 mm diameter self-drill 25 mm to 28 mm long with washer (304 grade stainless steel for Elite Plus, carbon steel for Standard and Elite)	1 through rail into bracket at beginning and end of each run of rail
Systems 5, 5A and 9 Quattro bracket to 1.6 mm galvanized top hat sections	5.5 mm diameter self-drill 25 mm to 28 mm long with washer (304 grade stainless steel for Elite Plus, carbon steel for Standard and Elite)	2 per bracket. 4 per bracket for brackets 260 mm and over
0.7 mm MW5 steel liner to cold rolled steel purlins — max 3 mm thick. Standard (and perforated)	5.5 mm diameter self-drill 25 mm to 28 mm long with washer (304 grade stainless steel for Elite Plus, carbon steel for Standard and Elite)	Sheet ends and end laps: Every corrugation (perforated liner: Minimum 29 mm washer and 140 mm end laps for non-fragile Class C). Intermediate supports: alternate corrugations
Anchor fixings at eaves sheet to drip angle to sheet	Aluminium body closed-end rivet with stainless steel mandrel	2 per sheet pan
Verge channel to sheet	Aluminium body closed-end rivet with stainless steel mandrel	At approximately 400 mm centres
Verge flashing to verge closure	Aluminium body closed-end rivet with stainless steel mandrel	At approximately 600 mm centres
Ridge zed to sheet	Aluminium body closed-end rivet with stainless steel mandrel	1 fixing at each sheet upstand
Ridge flashing to ridge zed	Aluminium body closed-end rivet with stainless steel mandrel	At approximately 400 mm centres (over the pan of each sheet). Hips — over the pan of each sheet
Ridge Closure to ridge zed	Aluminium body closed-end rivet with stainless steel mandrel	1 per closure

Technical Investigations

18 Tests

Tests were carried out on the systems and the results assessed to determine:

- resistance to dead and imposed (snow) loading
- resistance to wind loading
- behaviour of fixings and profile under static and cyclic loading
- resistance to impact
- behaviour under concentrated loads
- behaviour under thermal movement.

19 Investigations

19.1 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained relating to the quality and composition of the materials used.

19.2 An assessment was made of:

- fire resistance
- practicability of installation
- condensation risk and thermal transmittance
- weathertightness of fixed cladding and details.

19.3 Existing information, relating to the durability of the systems, performance in fire and compatibility of materials in contact, was assessed.

19.4 A visit was made to a site to assess the practicability of installation.

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