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BBA APPROVAL INSPECTION TESTING CERTIFICATION
TECHNICAL APPROVALS FOR CONSTRUCTION

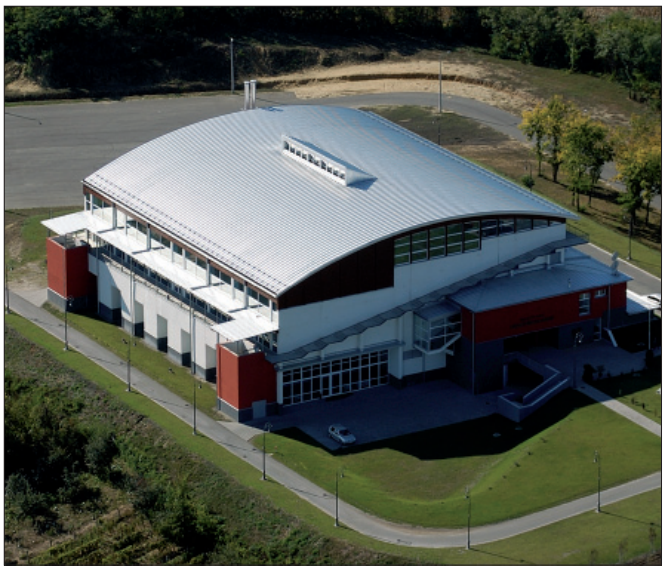
Agrément Certificate
13/5014
Product Sheet 1

ASTRON BUILDINGS

ASTRON LMR 600 ROOF SYSTEMS

This Agrément Certificate Product Sheet(1) relates to Astron LMR 600 Roof Systems, comprising profiled aluminium-zinc coated steel panels, insulation and accessories for fixing to purlins and rafters of steel on roofs with a finished slope of between 1° and 30° and curved roofs with a radius of 70 m or greater, for use in non-domestic buildings.

(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 if installed in accordance with the provisions of this Certificate, and deflections will not be excessive under normal service conditions (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 systems can provide adequate insulation to contribute to the building meeting the requirements of the national Building Regulations (see section 8).

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

Durability — durability of the roof systems depends on the location, environment and coating finish used (see section 13).

The BBA has awarded this Agrément 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 First issue: 9 July 2013

Brian Chamberlain
Head of Approvals — Engineering

Claire Curtis-Thomas
Chief Executive

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

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

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Regulations

In the opinion of the BBA, the Astron LMR 600 Roof Systems, if installed, used and maintained in accordance with the provisions of this Certificate, will meet or contribute to meeting 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 loads in accordance with sections 6.1 to 6.5 of this Certificate.
Requirement:	**B2**	**Internal fire spread (Linings)**
Requirement:	**B3(2)**	**Internal fire spread (structure)**
Comment:		The interior exposed surfaces of the systems have been assessed as having the surface classification given in section 11.2 of this Certificate.
Requirement:	**B4(2)**	**External fire spread**
Comment:		The external surface of the sheets has been assessed as having a B_{ROOF}(t4) classification in accordance with EN 13501-5 :2005, therefore constructions incorporating the system are not subject to the limitations of a minimum distance from a boundary. See section 11.1 of this Certificate.
Requirement:	**C2(b)**	**Resistance to moisture**
Comment:		When subjected to the maximum design loads given in sections 6.1 to 6.4, the systems will resist the passage of moisture to the inside of the building. See sections 9.1 to 9.6 of this Certificate.
Requirement:	**C2(c)**	**Resistance to moisture**
Comment:		The risks of harmful effects arising from interstitial and surface condensation will be minimal. See sections 7.1 and 7.2 of this Certificate.
Requirement:	**F1**	**Means of ventilation**
Comment:		A roof construction incorporating one of the systems can be designed to satisfy this Requirement. See sections 10.1 to 10.3 of this Certificate.
Requirement:	**L1(a)(i)**	**Conservation of fuel and power**
Comment:		The systems can contribute to meeting the requirements of this Regulation. See sections 8, 9 and 10.1 to 10.3 of this Certificate.
Regulation	**7**	**Materials and workmanship**
Comment:		The systems are acceptable. See section 13 and the *Installation* part of this Certificate.
Regulation	**26**	**CO_2 emission rates for new buildings**
Comment:		The systems can contribute to meeting the requirements of this Regulation. See sections 8, 9 and 10.1 to 10.3 of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)(2)**	**Fitness and durability of materials and workmanship**
Comment:		The use of the systems satisfies the requirements of this Regulation. See sections 12 and 13 and the *Installation* part of this Certificate.
Regulation:	**9**	**Building standards in relation to construction**
Standard:	1.1(a)(b)	Structure
Comment:		The systems have sufficient strength and stiffness to transfer the design load, with reference to clause 1.1.1[1]. See sections 6.1 to 6.5 of this Certificate.
Standard:	2.5	Internal linings
Standard:	2.6	Spread to neighbouring buildings
Comment:		The interior exposed surfaces of the systems have been assessed as having the risk classification given in sections 11.1 and 11.2 of this Certificate, with reference to clause 2.5.1[1].
Standard:	2.8	Spread from neighbouring buildings
Comment:		The sheets have a low vulnerability classification, with reference to clause 2.8.1[1]. See sections 11.1 and 11.2 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]. See sections 7.1 and 7.2 of this Certificate.
Standard:	3.15	Condensation
Comment:		The systems will have a minimal risk of surface condensation or of damage due to interstitial condensation with reference to clauses 3.15.1[1] to 3.15.7[1]. See sections 9.2 to 9.4 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		The systems can contribute to satisfying, in full or part, clauses 6.1.2[1], 6.2.1[1], and 6.2.4[1]. See sections 8.1 to 8.4 of this Certificate. The system can also contribute to satisfying clauses 6.2.5[1] and 6.2.6[1]. See sections 8 and 10.1 to 10.4 of this Certificate.

Standard:	7.1(a)	Statement of sustainability
Comment:		The systems can contribute to meeting 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 product can contribute to a construction meeting a higher level of sustainability as defined in this Standard, with reference to clauses 7.1.4(1) [Aspect 1(1)], 7.1.6(1) [Aspect 1(1)] and 7.1.7(1) [Aspect 1(1)]. See section 10 of this Certificate.

(1) Technical Handbook (Domestic).

The Building Regulations (Northern Ireland) 2012

Regulation:	23	Fitness of materials and workmanship
Comment:		The systems are acceptable. See section 13 and the *Installation* part of this Certificate.
Regulation:	28	Resistance to moisture and weather
Comment:		When subjected to the maximum design loads given in sections 6.1 and 6.2, the systems will resist the passage of moisture to the inside of the building. See sections 7.1 and 7.2 of this Certificate.
Requirement:	29	Condensation
Comment:		The roof systems can be designed and constructed to meet the requirements of this Regulation. See sections 9.1 to 9.6 of this Certificate.
Regulation:	30	Stability
Regulation:	31	Disproportionate collapse
Comment:		The systems have sufficient strength and stiffness to sustain and transmit the design load without excessive deflection or deformation. See sections 6.1 to 6.5 of this Certificate.
Regulation:	34	Internal fire spread — Linings
Regulation:	35(1)(3)(4)	Internal fire spread — Structure
Comment:		The interior exposed surfaces of the systems have been assessed as having the surface classification given in section 11.2 of this Certificate.
Regulation:	36(b)	External fire spread
Comment:		The external surface of the sheets has been assessed as having a B_{ROOF}(t4) classification in accordance with EN 13501-5: 2005 and therefore constructions incorporating the systems are not subject to a minimum distance from a boundary. See section 11.1 of this Certificate.
Regulation:	39(a)(i)	Conservation measures
Comment:		The systems can meet the requirements of this Regulation. See sections 8 and 10.1 to 10.3 of this Certificate.

Construction (Design and Management) Regulations 2007

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

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

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

Additional Information

CE marking

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

- LMR 600 profile sheets to EN 14782 : 2006
- Steel structural components (Clips and tabs, Bridge beam and brackets, Omega rail and brackets) to EN 1090-1:2009

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

General

This Certificate relates to Astron LMR 600 Roof Systems consisting of seamed profiled sheets used as a structural roof with a finished slope of between 1° and 30° where access is provided for maintenance and repair only.

Astron LMR 600 Roof Systems comprise:

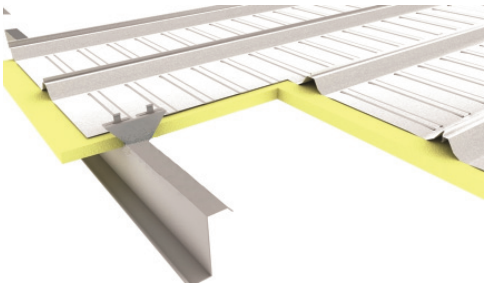
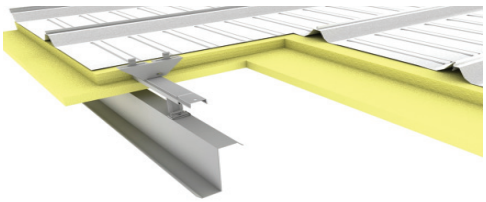
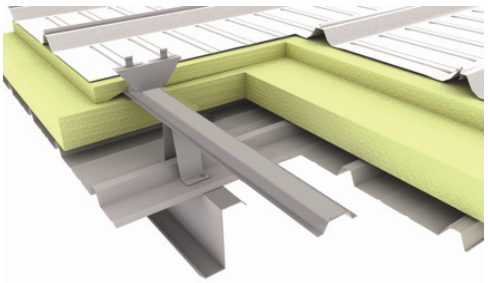
— coverings of interlocking profiled aluminium-zinc coated steel sheets secured to the roof with hidden fixings such that through-fixing of the roof sheeting is not required
— clips and supporting substructure
— insulation
— vapour control barrier (single skin) or liner panel (double skin)

The supporting purlins as well as the gutters and gutter support hangers are outside the scope of this Certificate.

1 Description

1.1 The Astron LMR 600 Roof Systems construction types covered in this Certificate are described in Table 1:

Table 1 LMR 600 systems

System make-up	Construction type/Description
1. Single skin roof with or without Isobloc bar	
	The sheets are attached together by a clip assembly system fixed by mechanical fasteners to the roof purlins. For thicknesses above 40 mm, an Isobloc bar is incorporated between clips under the profiled sheet and over the insulation blanket in line with the purlins. The inner face of the insulation has a bonded vapour control layer. Insulation thicknesses between 40 mm and 120 mm are available.
2. Single skin roof with bridge beam	
	The sheets are attached together by a clip assembly system fixed by mechanical fasteners to the roof purlins via a bridge beam and a bridge support bracket which lift the roof panels above the purlins. The inner face of the insulation has a bonded vapour control layer. Insulation thicknesses between 140 mm and 200 mm are available.
3. Double skin roof	
	The sheets are attached together by a clip assembly system fixed by mechanical fasteners to the roof purlins via an omega rail and an omega bracket which lift the roof panels above the purlins. An Isobloc bar is incorporated between clips under the profiled sheet and over the insulation blanket in line with the omega rails and the purlins. A liner panel is fixed above the purlins under the inner face of the insulation. Insulation thicknesses between 120 mm and 260 mm are available.

1.2 The main components of these systems are:

Profile sheets

Aluminium-zinc coated steel profiled sheets (see Figure 1) are available in two thicknesses in lengths up to 18 m (with a tolerance of ±3 mm). Where necessary, the ends of the sheets are punched to provide notches and bolt holes for use during installation. Specification of the sheet is given in Table 2.

Figure 1 LMR 600 Profile (all dimensions in mm)

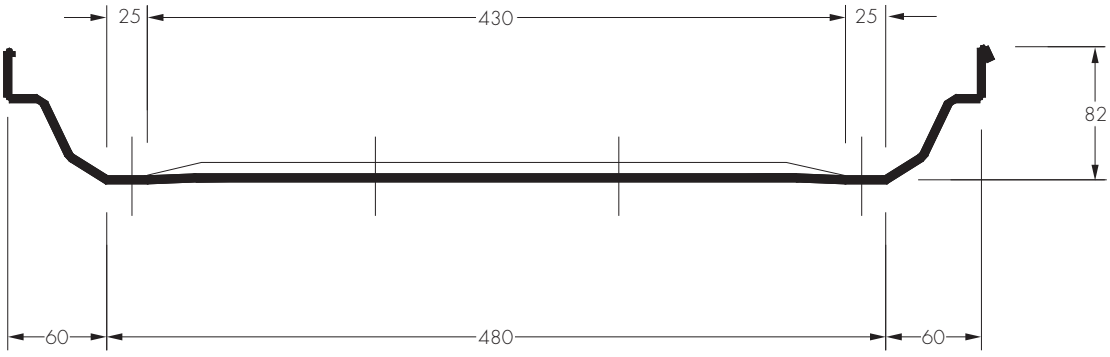


Table 2 LMR 600 profiled sheet specifications

Material	Thickness (nominal) (mm)	Manufacturing Standard	Yield strength ($N \cdot mm^{-2}$)	Ultimate tensile strength ($N \cdot mm^{-2}$)	Minimum elongation in 50 mm (%)
Hot-dip aluminium-zinc alloy coated steel sheet	0.66	BS EN 10346 : 2009 - S320GD + AZ 185 or other structural grades to BS EN 10346 : 2009	320 – 400	390	18
	0.75	BS EN 10346 : 2009 - S420A YP + AZ 185 or other structural grades to BS EN 10346 : 2009	420 – 490	490 – 560	16

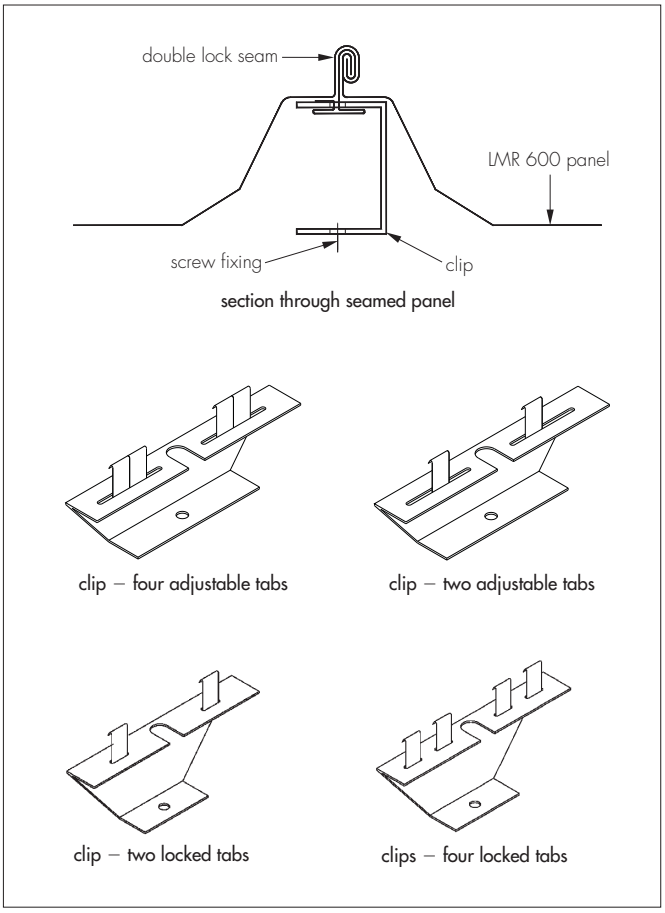
Clip assembly

C-section clips (see Figure 2) manufactured from 2 mm thick galvanized steel (grade S390GD + Z275-N-A-C) manufactured in accordance with BS EN 10346 : 2009 interlock the profile sheets and are secured to the roof structure with one self-tapping screw with an integral sealing washer. The clips are available in two heights with two or four lock tabs as shown in Table 3 and Figure 2. The lock seam tabs are formed from 0.6 mm thick stainless steel strip, number 1.4301 to BS EN 10088-2 : 2005.

Table 3 Clip and tab identifiers

Clip height (mm)	Tabs	Part identifiers	
		Two lock tab configuration	Four lock tab configuration
60	Not fixed	HY02024	HY02034
84		HY02026	HY02036
60	Fixed	HY02044	HY02054
84		HY02046	HY02056

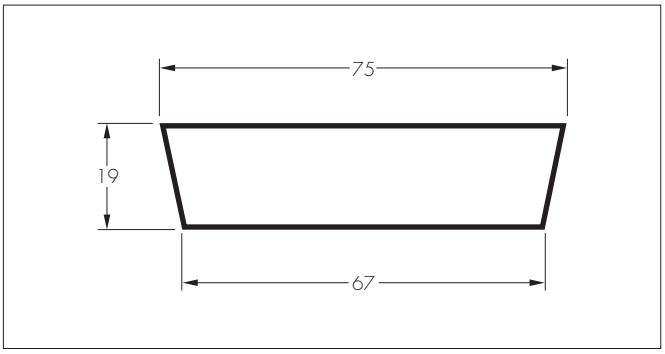
Figure 2 Clip and tab assembly



Isobloc bar

Isobloc bar insulating strips are manufactured from extruded polystyrene to EN 13164 : 2012 with a minimum nominal density of 35 kg·m^{-3} and a declared thermal conductivity of λ_D 0,029 W·m^{-1}·K^{-1}*. The Isobloc bars have the dimensions given in Figure 3 and are installed between clips under the profile sheets and over the insulation blanket, in line with the purlins, to reduce thermal bridging. They are used in the single skin roof system with insulation thicknesses over 40 mm and in the double skin roof system.

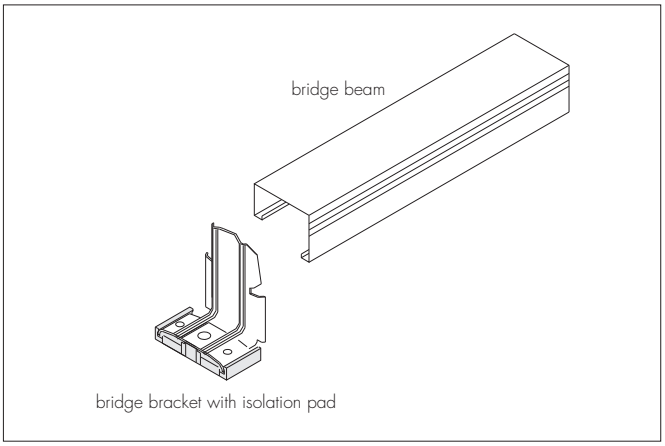
Figure 3 Isobloc bar (dimensions in mm)



Bridge beam and bracket (see Figure 4)

The beam is manufactured from 1.54 mm galvanized steel (grade S390GD + Z275N-A-C) in accordance with BS EN 10346: 2009. The bridge beams are slid on top of bridge support bracket which is built from the same specification as the beam and available in 80 mm and 100 mm in height. The bracket sits on an isolation pad made of polypropylene.

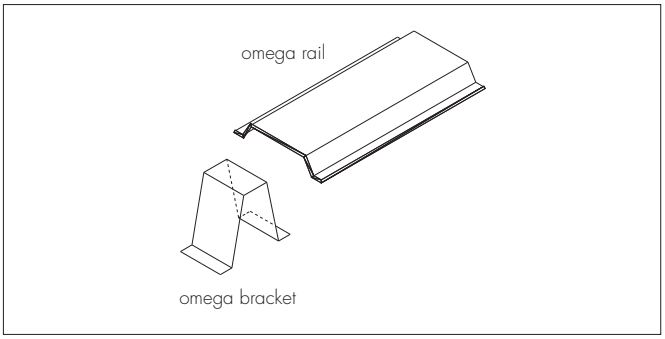
Figure 4 Bridge beam and bracket with isolation pad



Omega rail and bracket (see Figure 5)

The rail is manufactured from 1.54 mm galvanized steel (grade S390GD +Z275 CO) in accordance with BS EN 10346 : 2009. The Omega brackets from 1.95 mm (for roof thicknesses 120 mm, 140 mm, 160 mm, 180 mm) or 2.04 mm (for roof thicknesses of 200 mm and 260 mm in height) thick galvanized steel and to the same material specification as the rail.

Figure 5 Omega rail and bracket



Insulation

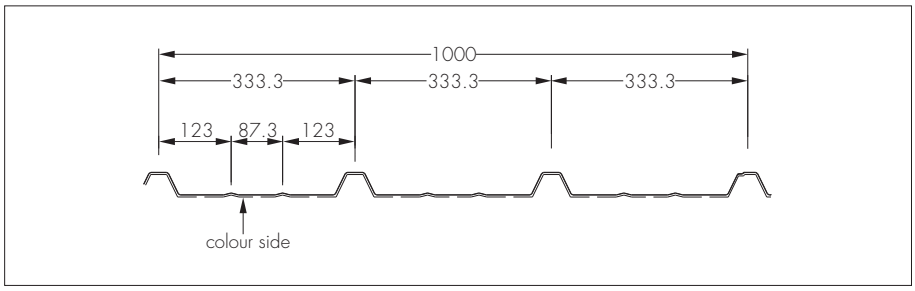
There are two types of insulation available:

- Astrotherm insulation is a glass wool blanket manufactured in accordance with BS EN 13162 : 2012 and available in thicknesses of 40 mm, 60 mm, 80 mm, 100 mm and 120 mm. Thicknesses of 140 mm, 160 mm, 200 mm and 260 mm are obtained with two or three layers of insulation. The declared thermal conductivity is 0.037 $W \cdot m^{-1} \cdot K^{-1}$* and the density 16 $kg \cdot m^3$. It is used for the double skin roof type.
- Astrotherm ASA is a glass wool blanket (used for single skin roof systems) with the same characteristics as Astrotherm but in addition, has a vapour barrier bonded to the inner face which consists of:
  - — A white varnish lacquered aluminium foil 20 µm thick
  - — A fibreglass scrim reinforcement
  - — An aluminium foil 12 µm thick
  - — A flame resistant adhesive.

Liner profile

The liner panel is a galvanized steel profile sheet of 0.54 mm thickness (grade S550GD+ Z275-M, ZA255-M or AZ150-M) or 0.62 mm thickness (grade S350GD+ Z275-M, ZA255-M or AZ150-M) manufactured to BS EN 10346 : 2009 (see Figure 6) 38 mm deep with 1000 mm cover width. The sheets are coated on both sides with 25 or 35 µm polyester or 25 µm PVDF. The liner panel is also available perforated for improved acoustic properties (designated LPG1000). The acoustic properties are not part of the scope of this certificate.

Figure 6 LPS 1000 liner profile



Fasteners

The mechanical fasteners used in the system are given in Table 4.

Table 4 Fastener specification

Fastener type	Description	Reference	Use	Number of fasteners
self tapping screw	9.3 mm diameter by 26 mm long with an integral sealing washer.	HC02022	attach C clips to the roof purlins (single skin roof) attach C clips to the bridge beam (single skin roof with bridge) attach C clips to omega rail (double skin roof)	1
stainless steel self-tapping screw	7.1 mm diameter by 25 mm long	HC00162	used in conjunction with a metal-backed rubber washer to fix the sheets to the eave structural member to the splice plate at overlap and to end closure at ridge	4/600 mm
Low carbon steel case hardened self drilling screws	6.3 mm diameter by 32 mm long	HC00163	connect the bridge beams together (single skin roof with bridge) attach the support brackets to the purlins (single skin roof with bridge) attach omega brackets to the purlins (double skin roof) attach omega rail to omega bracket (double skin roof)	1 2 2/4 1
Stainless steel washered self-drilling fasteners	5.5 mm diameter by 35 mm	HC00310	to fix the liner panels to the purlins	1/ 333 mm(1)

(1) 3/333 mm at panel overlap.

1.3 Other components of the system are:

- Ridge panel — 0.66 mm thick pitched profile sheet galvanized steel (grade S320GD+ AZ185-B-CO or AZ185-B-S)
- Tape sealant — pre-formed butyl rubber-based sealant used for sealing of exterior joints
- Silicone sealant — used in sealing various lap-type joints of metal panels
- Rubber closure — used at eave to close the LMR600 profile
- Panel end closures — 0.62 or 0.63 mm thick galvanized steel (grade S320GD) used at ridge with panel end closure between LMR600

- Panel splice plate — galvanized steel (grade S250GD) used at ridge with panel end closure and also overlapping panels together with an aluminium strap
- Solid foam fillers — Closure (polyethylene foam) for liner panel used at eaves.

1.4 Accessories such as flashing panels, gutters, skylights, smoke vents or ventilators can be provided by the Certificate holder but are outside the scope of this Certificate.

2 Manufacture

2.1 The sheets are strengthened, fluted and roll formed to the required profile. During the manufacturing rolling process, a flexible hot-melt sealant is applied to the underside of the partially formed standing seam on one side of the sheet.

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 non-conformities
- 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 Lindab SA has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2008 by Bureau Veritas (Certificate number: 11000430)

3 Delivery and site handling

3.1 The panels are transported in crates carrying a label bearing CE mark. They must be stored flat, away from the risk of abrasion and impact, in a dry, well-ventilated area.

3.2 The rolls of insulation must be handled carefully and must not be stored on end. They should be left in their protective wrapping until ready for installation.

3.3 All fasteners and sealants used for the roof construction should be checked, separated and stored in a dry, protected area to ensure they are not damaged before installation.

3.4 Trims and flashings must be stored in a protected area and strategically placed to prevent excessive handling.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Astron LMR 600 Roof Systems.

Design Considerations

4 General

4.1 The Astron LMR 600 Roof Systems when fixed to purlins, is satisfactory for use as a fully-finished structural roof deck, for roofs with slopes from 1° to 30° and curved roofs with a radius of 70 metres or greater, where access is provided only for maintenance and repair.

4.2 The roof structure is designed in accordance with BS EN 1993-1-3 : 2006.

4.3 The systems are fixed to steel purlins at least 1.5 mm thick and designed in accordance with BS EN 1993-1-3 : 2006.

5 Practicability of installation

The systems should only be installed by installers who have been trained and approved by the Certificate holder.

6 Structural performance

6.1 When supported on purlins spaced horizontally at not more than 1500 mm, the panels have adequate strength and stiffness to sustain the loads given in Table 5.

Table 5 Maximum characteristic resistance to snow and wind loads for LMR 600 roof system

Span (m)	Maximum positive (snow) loading ($kN \cdot m^{-2}$)		Maximum negative (wind) loading ($kN \cdot m^{-2}$)	
	84 mm height clips	60 mm height clips	Four tab clips	Two tab clips
1.0	4.19	3.22	2.66	1.46
1.5	2.26	1.67	1.84	1.01

Notes:

- The span is the horizontal distance between adjacent purlins.
- Values are applicable for uniformly distributed loads for double and multiple span roofs where all spans are equal to or within 15% of the largest span.
- The data has been prepared in accordance with the national annexes (NA) to BS EN 1990 : 2002 and BS EN 1993-1-3 : 2006, and has been verified by testing.
- Partial safety factors used for generating the above data are:
  - dead loads: 1.35 in the same direction as imposed loads, 1.00 the opposite direction to imposed loads
  - imposed loads: 1.50 (snow and wind)
  - attachment: 2.00.
- The resistance values given in the table should be compared to the characteristic (unfactored) snow and wind loads.
- The data takes into account the self-weight of the roof sheets.
- Positive deflection limit = span/150 and negative deflection limit = span/50.
- For single spans, excessive loads or spans, different deflection criteria, different factors of safety and different metals, advice should be sought from the Certificate holder.

6.2 The loads listed in Table 5 incorporate safety factors accounting for the properties of the materials, the method of design and analysis and details of construction and workmanship. Wind loads must be checked in accordance with the recommendations of BS EN 1991-1-4 : 2005. Imposed snow loads must be established in accordance with the recommendations of BS EN 1991-1-3 : 2003.

6.3 The systems are designed to withstand normal foot traffic without sustaining damage. The sheets are capable of withstanding impacts associated with normal handling, installation and service.

6.4 At the maximum wind uplift pressures given in Table 5, the fluted part of the panels may deflect, sometimes producing noise. This is a characteristic of the system and is not detrimental to performance.

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

7 Weathertightness

7.1 When installed in accordance with the Certificate holder's instructions and the installation part of this Certificate, the systems are weathertight when used on roofs with a finished fall of 1° to 30° or curved roofs and within the maximum positive and negative loadings shown in Table 5.

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 systems must be evaluated in accordance with the relevant Building Regulations, and is the responsibility of the overall designer of the building.

8.2 Acceptable thermal transmittance values (U values) are given in Table 6. Unless otherwise stated, the thermal conductivity (λ_D based on $\lambda_{90/90}$ data) value of the insulation has been taken as 0.037 $W \cdot m^{-1} \cdot K^{-1}$. The LMR 600 roof types not listed in Table 6 are only available to use for unheated buildings.

Table 6 Acceptable U values ($W \cdot m^{-2} \cdot K^{-1}$) for LMR 600 Roof Systems

Type of construction	Thickness of insulation (mm)		
	160	200	260
Single skin bridge	–	0.25[1]	–
Double skin	0.25[1]	0.20	0.17

Note:
Standard LMR roof construction with 1.5 m purlin spacing
(1) Not valid for Scotland.

8.3 It is essential that a suitable continuous air barrier is installed to limit air infiltration (see sections 10.1 to 10.4 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 Figure 7.

8.4 The systems can contribute to maintaining, continuity of thermal insulation at junctions between elements and openings. For Accredited Construction Details, the corresponding psi values in BRE Information Paper IP1/06 Table 3

may be used in carbon emission calculations in Scotland and Northern Ireland. 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) (for new-build, see also SAP 2009, Appendix K, and the *iSBEM User Manual*.

Scotland — Accredited Construction Details (Scotland)

Northern Ireland — Accredited Construction Details (version 1.0).

9 Condensation risk

9.1 In common with all metal roof constructions, there is a risk of condensation. This can arise as 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 In buildings likely to experience high internal relative humidities (eg building internal humidity class 5 as defined in BS EN ISO 13788 : 2012 and BS 5250 : 2011) there is a small 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.

Interstitial condensation

9.4 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 and 2 (see Table 7), under the normal climatic conditions experienced in the UK, interstitial condensation and consequent reductions in the thermal and structural performance of the roof systems are unlikely to be a significant problem. This assessment is only valid provided the following details are carried out in accordance with the Certificate holder's instructions and this Certificate:

- the vapour control layer remains undamaged, is continuous over ridges, and is sealed at penetrations/abutments
- vapour control layer laps are adequately sealed
- for installations without the separate vapour control layer (for some building internal humidity classes 1 and 2 only, the risk of interstitial condensation should be established in accordance with BS EN ISO 13788 : 2012 and BS 5250 : 2011), the liner panel laps must be adequately sealed.

Table 7 Building internal humidity classes

Humidity class[1]	Building type
1	Storage areas
2	Offices, shops
5	Special buildings, eg laundries, breweries, swimming pools

(1) Partially reproduced from BS EN ISO 13788 : 2012 and BS 5250 : 2011.

9.5 For buildings or areas of a building with special internal design conditions, a hygrothermal assessment of the proposed roof system 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.

10 Air permeability

10.1 The airtightness of the systems are reliant on the careful sealing of the liner or vapour control layer. 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 vapour control layer 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 envelope 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 testing air permeability 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 in demonstrating compliance under Mandatory Standard 6.1, testing is not required.

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

11 Performance in relation to fire

11.1 The external surfaces of the Astron LMR 600 Roof sheets have been assessed as having a $B_{roof}(t4)$* designation in accordance with BS EN 13501-5: 2005 ('low vulnerability' in Scotland) and therefore, constructions incorporating the system are not subject to a minimum distance from a boundary.

11.2 The internal surface of the LPS liner sheets has been assessed as class 0 or 'low risk' as defined in the Building Regulations.

11.3 The reaction to fire classification of the internal surface of the single skin system (Astrotherm ASA) has been assessed as A1* in accordance with BS EN 13501-1 : 2007.

12 Maintenance

12.1 The systems should be inspected regularly (at least once a year) for accidental damage to the roof sheets and the coatings. Any build-up of dirt and debris should be removed. The frequency of the inspection will depend on the environment and use of the building.

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

13 Durability

13.1 The service life(1) of the Astron LMR 600 Roof Systems will depend upon the environment in which it is used. When used in the context of this Certificate the minimum service life will be 25 years for rural environments and 20 years for industrial or urban environments. A shorter service life will be given if particular local conditions are chemically corrosive, eg in the immediate vicinity of and downwind from chemical works, cement works, copper foundries or coal mines.

(1) Service life, in the context of this Certificate, is defined as the life to the first major maintenance.

13.2 The panels do not need painting for corrosion resistance in normal environments.

13.3 It is important that the design of installation avoids the possibility of salt deposits on the sheltered side of the panels in coastal conditions. The panel should not be used for installations within 0.5 km of the sea, and for installations proposed within 5 km of the sea the Certificate holder should be consulted.

14 Reuse and recyclability

The metal components of the systems are fully recyclable.

Installation

15 General

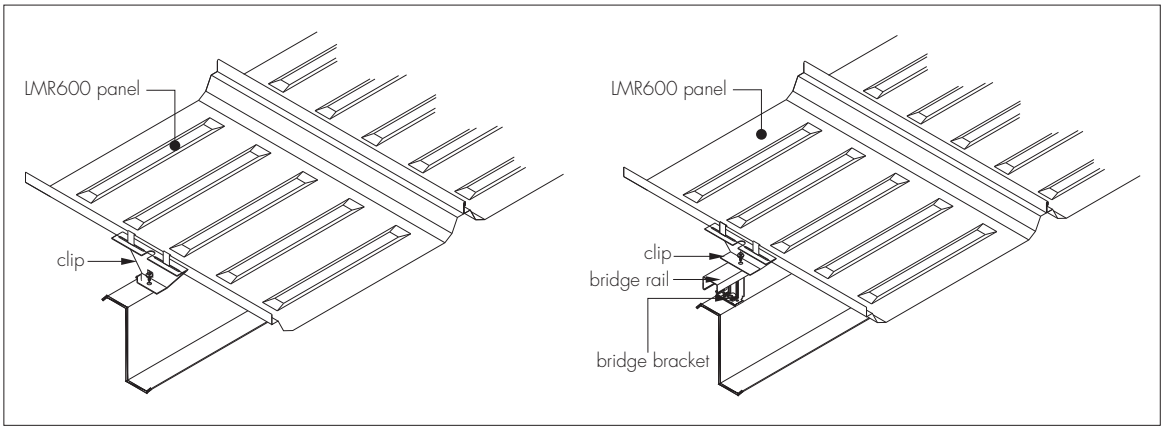
The Astron LMR 600 Roof Systems, including panels, panel splices, panel end closures, ridge end covers, gutter supports and gable fascias, are installed by certified contractors, working in accordance with the *LMR 600 Roof System Technical & Erection Manual*.

16 Procedure

16.1 The installation procedure commences once the supporting steel frame has been erected.

Single skin and single skin with bridge systems (see Figure 7)

Figure 7 Single skin systems (insulation not shown for clarity)

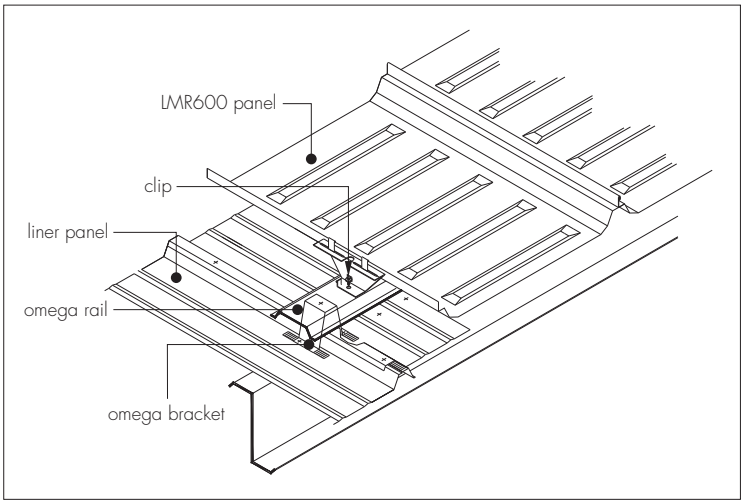


16.2 The insulation is placed over the purlins in one run from eaves to ridge, with the faced side down. However, when roll lengths are insufficient to ensure continuity, an overlap of 100 mm must be made. The edges of the vapour barrier of adjacent rolls are folded up and stapled together at 150 mm centres and the two layers are then folded back on themselves and stapled at 150 mm centres between the previous staples. The clips (or clips and bridge brackets) are fixed to the purlins through the insulation and a second layer of insulation put in place if required.

16.3 If installing the single skin with bridge system, the bridge beams are located over the bridge support brackets.

Double skin system (see Figure 8)

Figure 8 Double skin systems (insulation not shown for clarity)



16.4 The liner panels are positioned with all joints lapped, and fixed to the roof purlins. Side and end laps of the liner panels are sealed using mastic sealant. Any swarf or debris is removed.

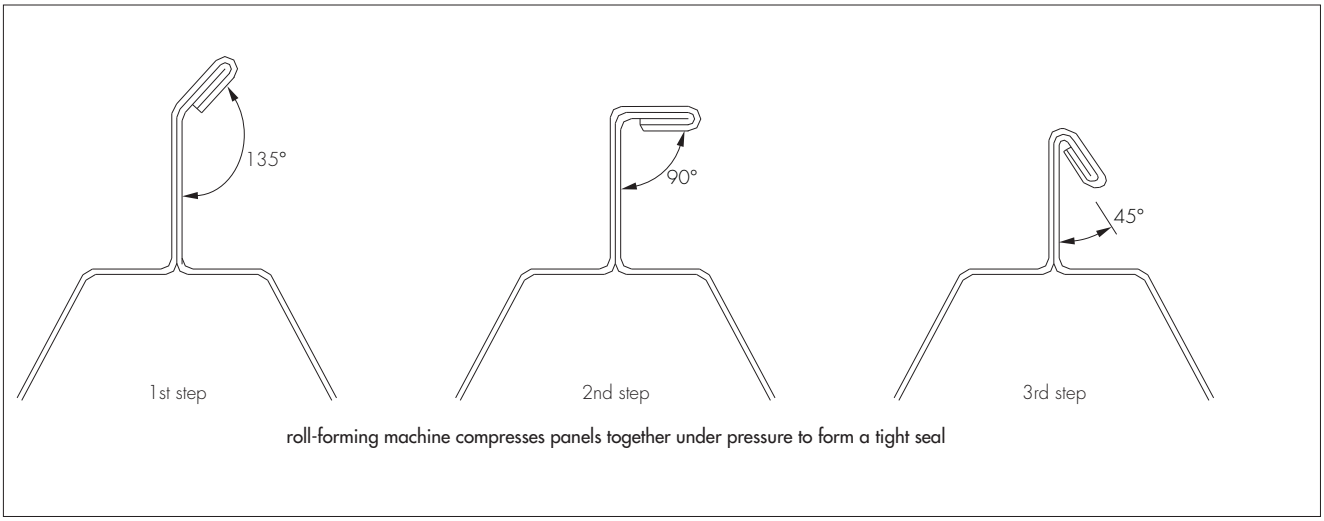
16.5 The insulation is laid directly over the liner panel and the Omega brackets are fixed through the liner to the purlin. Where practical, insulation should be laid in one continuous run from eaves to ridge. However, when roll lengths are insufficient to ensure continuity, an overlap of 100 mm must be made.

16.6 In some cases, the insulation can be laid in two or three layers, the first prior to the Omega brackets and the second and third cut and tucked around the brackets.

16.7 The Omega rails are located over the Omega brackets and the clip and tab assembly fixed onto the Omega rails.

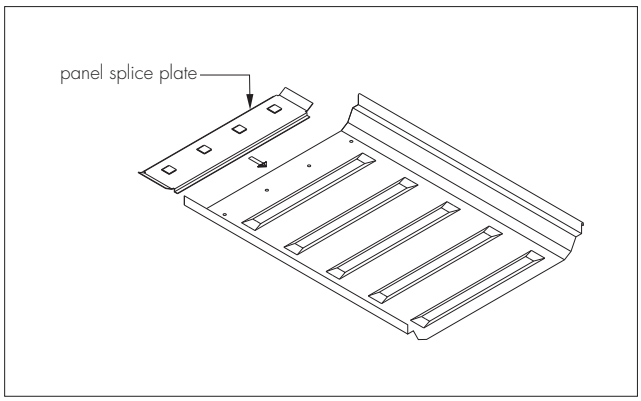
16.8 The LMR 600 sheets are installed, working from right to left. The sheets are joined using a self-propelling roll-forming machine to create a standing seam. As the machine progresses from eaves to ridge, the tabs are rolled into the standing seam and a factory-applied bead of non-hardening sealant is compressed inside the first turn of the seam (see Figure 9). The tabs are free to move back and forth in the clips in the direction of the seams allowing for thermal movement of the panels, except for single skin bridge roof where fixed clips are used. The tabs are located in the centre of the slots of the clip, as determined by correct positioning of the centring device. The sheets are secured by rolling the seam around the upstand on the clips.

Figure 9 Creating the standing seam



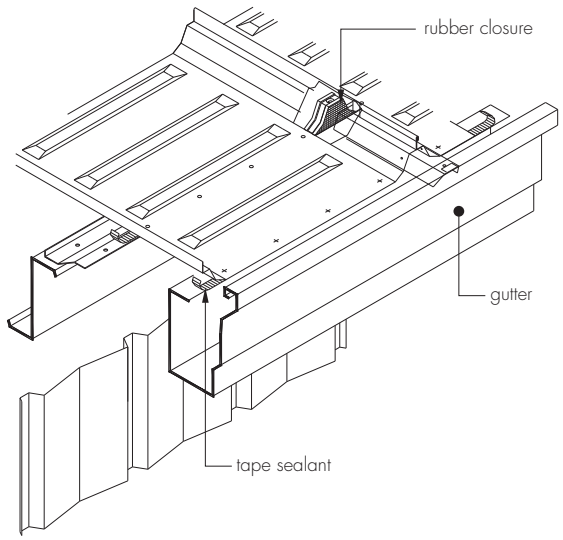
16.9 End joints between adjacent sheets are made using a splice plate, a panel strap, screws and sealant (see Figure 10).

Figure 10 End lap detail

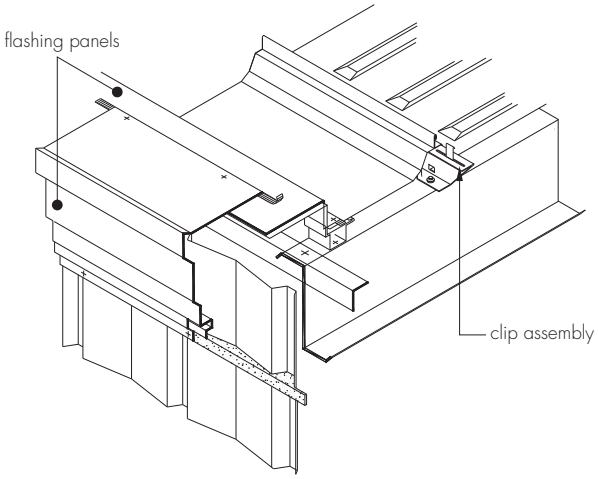


16.10 After joining the sheets, the various ridge, eaves and gutter details are completed (see Figure 11).

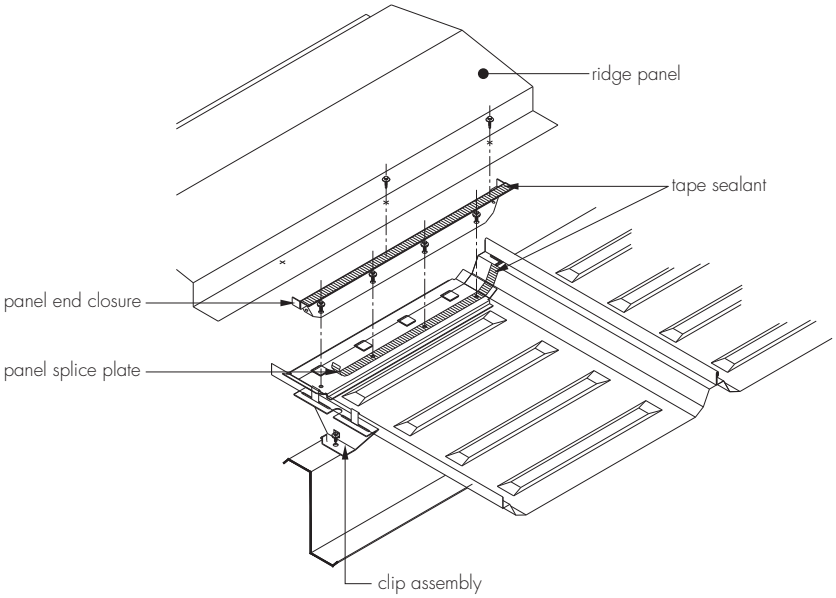
Figure 11 Typical details (insulation not shown for clarity)



eaves



gable



ridge

17 Tests

Tests were carried out on the weathertightness of the roof systems to establish:

- resistance to air and water penetration under various wind loading conditions
- resistance to gusting and cyclic loading.

18 Investigations

18.1 An examination was made of the existing data on:

- structural performance of the systems
- performance in fire of similar roof systems
- condensation risk of the systems, and
- rate of corrosion of aluminium alloy and aluminium-zinc coated steel in various environments and compatibility with other materials.

18.2 An assessment was made of the durability of the systems.

18.3 The thermal properties of the system were evaluated by 3-dimensional modelling of the constructions.

18.4 The manufacturing process was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

18.5 A visit was made to a construction in progress to examine the practicability of installation of the systems.

Bibliography

BRE Information Paper IP1/06 *Assessing the effects of thermal bridging at junctions and around openings*

BS 5250 : 2011 *Code of practice for control of condensation in buildings*

BS 5925 : 1991 *Code of practice for ventilation principles and designing for natural ventilation*

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

BS EN 1990 : 2002 + A1 : 2005 *Eurocode — Basis of structural design*

BS EN 1991-1-3 : 2003 *Eurocode 1 : Actions on structures — General actions — Snow loads*
BS EN 1991-1-4 : 2005 + A1 : 2005 *Eurocode 1 : Actions on structures — General actions — Wind actions*

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BS EN 10346 : 2009 *Continuously hot-dip coated steel flat products — Technical delivery conditions*

BS EN 13162 : 2012 Thermal insulation products for buildings — Factory made mineral wool (MW) products — Specification

BS EN 13501-1 : 2007 + A1 : 2009 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests

BS EN 13501-5 : 2005 + A1 : 2009 *Fire classification of construction products and building elements — Classification using data from external fire exposure to roof tests*

BS EN ISO 9001 : 2008 *Quality management systems — Requirements*

BS EN ISO 13788 : 2012 *Hygrothermal performance of building components and building elements — Internal surface temperature to avoid critical surface humidity and interstitial condensation — Calculation methods*

EN 13164 : 2001 *Thermal insulation products for buildings — Factory made products of extruded polystyrene foam (XPS) — Specification*

EN 1090-1 : 2009 *Mandatory CE Maark for structural metallic components*

EN 14782 : 2006 *Self-supporting metal sheet for roofing, external cladding and internal lining. Product specification and requirements*

19 Conditions

19.1 This Certificate:

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

19.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

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

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

19.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

19.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
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- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

19.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

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