Corus Building Systems

FalZinc® for Roofs and Walls

Foldable Aluminium with Zinc Surface for High-Quality Formability

Kalzip®

Corus Bausysteme

FalZinc® for Roofs and Walls

Foldable Aluminium with Zinc Surface for High-Quality Formability

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Note:
The information, data and details compiled in this manual are based on practical experience, guidelines, standards and information from third parties. They have been carefully checked and according to the knowledge of the publisher constitute the current state of technology. This information and these illustrations serve as help manual. However, this does not release the user from his own responsibility. The publisher shall not assume any responsibility, neither for the completeness and correctness nor for possible errors or omissions.

Preface

This manual is a compilation of checked details and contains information for planners and installers handling FalZinc®. Under no circumstances should it replace established rules and regulations or standards, but supplement them where the modern building material FalZinc® requires special attention due to its specific advantages and characteristics.

Presentation, and illustration of the selected details have been chosen in such way that a practitioner will find suggestions to solutions, whilst the planner, construction supervisors and construction management will gain a quick overview of FalZinc®. Therefore this manual is particularly suited for training or self-studies.

We hope for the greatest possible distribution of this manual and we are happy if it provides many valuable suggestions to the experienced practitioner as well as to those who simply want a quick overview of FalZinc®.

At the same time we wish to enter into an expert discussion with the reader. Please, let us know your suggestions and experience; our Marketing Department will look into every suggestion and liaise with the appropriate department.

Corus Building Systems /Corus Bausysteme
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www.falzinc.com can be examined for additional support and illustrations.

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FalZinc® is an aluminium sheet metal with a two-sided metallic surface coating, which was especially developed for handling by craftsmen and which gives it its characteristic, modern appearance. The weathering exposure behaviour of the zinc-aluminium coating system is determined mainly be the favourable behaviour of the aluminium substrate. That is, the weathering wear and tear behaviour is mainly that of aluminium, including the good corrosion resistance of aluminium.

FalZinc® was optimised with the particular aim of being able to fold it, turn it on edge, crimp it and even form it by beating out / drawing / stamping, using standard craftsman processes even under unfavourable conditions on a construction site. FalZinc® has all the positive characteristics of aluminium. With regard to its use as roof and wall covering or as flashings produced by tinsmith work, these are the great strengths of aluminium and especially its excellent corrosion resistance, which makes aluminium stand out as a working material. The metallic coating on both sides of the surface gives FalZinc® its characteristic, titanium-grey appearance, which suits modern architecture in particular, without denying its character as a light metal.

Surfaces covered with FalZinc® can be combined with almost any kind of construction elements made of aluminium, titanium zinc, or laquered or coil-coated sheet metals. Thus FalZinc® can be used for new buildings as well as for renovation work or for supplementing and expanding existing roof and wall structures.

Technological Information

The sheet metal core of FalZinc® consists of the sea-water resistant aluminium alloy Al Mn1 Mg0.5 EN AW3005 in accordance with DIN EN 573-3, which is subjected to a final rolling process that is adjusted exactly to its strength characteristics and which afterwards is further adjusted by a very special temperature treatment in such a way that the sheet metal achieves its outstanding forming behaviour

The subsequent application of the metallic surface coating is carried out within a process-monitored low temperature range so that the mechanical-technological characteristics set during the targeted temperature treatment are not affected. The structure of the metallic surface coating is the same on both sides and only a few µm (1/1000mm) thick. In spite of that the very thin metallic layer has very interesting characteristics with regard to corrosion, because it is able to protect any area of surface treatment damaged during seam forming of Falzinc®. Even if the metallic surface coating has been greatly damaged through corrosion, the metallic coating has a favourable effect, because a particularly stable passivation is established, which exhibits its natural titanium-coloured appearance.

Table 1: Mechanical-Technological Information

Characteristic	Unit	Value
0.2 %-Expansion limit,in the case non-proportional expansion $R_{p0,2}$	N/mm^2	80-100
Tensile strength R_m	N/mm^2	min. 150
Breaking elongation A_{50mm}	%	min. 10
Bending test (Folding test) with radius 0 and subsequent opening up again	-	no cracks in the bending edge
Thickness tolerance	mm	± 0.04
Specific weight (Density)	kg/dm^3	2.72
E-Module	N/mm^2	70,000
Length expansion coefficient, parallel to the rolling direction	m/(m K)	23.2×10^6
Melting point	°C	approx. 650
Heat conductivity	W/(m K)	180
Electrical conductivity	mS/m	25

Delivery Forms and Transport

FalZinc® is available in two thicknesses. FalZinc® with a sheet metal thickness of 0.7mm is eminently suitable for all folding and forming work; in principle the installing is done on a full-surface sub-structure, the maximum intervals between the fixation points can be found in the provisions of ATV DIN 18339 (Tinsmith Works) and trade regulations for craftsmen (Tinsmith Trade Regulations, Metal Roof Regulations).

FalZinc® with a metal sheet thickness of 1.0mm is particularly suitable for coverings, connections and flashings as well as for the production of additional assembly parts, e.g. for the transition from a trapezoidal profile facade to a standing seam roof made of FalZinc®. FalZinc® with a sheet metal thickness of 1.0mm is, of course, also foldable and has the same good forming characteristics; in spite of this FalZinc® with a sheet metal thickness of 1.0mm is, as a rule, only used for folding work in exceptional cases, for example if there is a special requirement for flatness in the area of walls.

FalZinc® is supplied with a protective film (b = 530mm) The protective film protects the visible high-quality surface against dirt and damage until the time of the installation. If the panels/sheets are pre-profiled and turned on edge, the protective film can be left on the surface without problems if the profiling machine is adjusted accordingly; the film can be profiled together with the sheet metal without being damaged and thus ensures the protection of the surface until the time of the installation.

The protective film has to be removed at the latest 2 months after the delivery of the material as well as immediately after the installation; after which FalZinc® should no longer be walked upon.

During transport and storage FalZinc® has to be dry and ventilated. Storage must be arranged in such a way that the formation of condensation is avoided within the coils or stacks.

Coils

- Width: 600 mm and 670 mm. ID = 508, with 500 – 1000 kg standard coil, axis horizontal ID = 400, with 100 kg standard coil, axis vertical standard coil weight 100 kg
- Thickness: 0.7 mm and 1.0 mm, other sheet metal thicknesses for minimum purchases of 5000 kg available per order on request

Sheet Metal Flat

- Standard dimensions: 600/670 x 2000 mm – 6000 mm
- Thicknesses: 0.7 mm and 1.0 mm.

Slit Coil

- Width: Any division up to a maximum of 600mm, adjusted to the gross width for the panels or the construction components, which are produced from it.
- Thickness: 0.7mm and 1.0mm

Strips

- Width: Any division up to a maximum of 600mm, adjusted to the gross width for the panels or the construction components, which are produced from it.
- Length: from 1000mm to max. 6000mm
- Thickness: 0.7mm and 1.0mm

Construction Elements / Profiles

Traditional contractors offer many types of wall profiles, accessories and system construction components, manufactured in accordance with standards, manufacturer's specifications or customer requirements. Corus Building Systems supports the production of construction components in a manner suitable for the material, be this with regard to questions concerning forming techniques or joining problems. In general, FalZinc® can be bent, rolled or turned on edge like normal aluminium sheet metal, copper, steel or titanium zinc sheet metal.

FalZinc® is also particularly well suited for production in a factory because in addition to the manual processing procedures, FalZinc® also has outstanding welding characteristics. Construction elements and profiles made of FalZinc® are also available directly from Corus Building Systems.

Surfaces, Appearance, Evenness

The titanium-grey surface of FalZinc® is slightly mat, so that reflections or mirror images will not be so obvious. The natural weathering process further reduces the degree of reflection. Depending on the angles of sight and sunlight, newly executed wall coverings and visible roof surfaces occasionally show a small amount of undulation as a result of minor unevenness in the sheet metal due to handling and processing. From close up (for example from the scaffold) those undulations are almost invisible and will only become visible from a greater distance. These undulations that are visible from a greater distance are mostly very shallow, but can be seen due to differences in the reflection of light. After some weathering, when a natural weathering coating has developed and the surface becomes increasingly mat, these reflections will decrease.

Even though FalZinc® is highly corrosion resistant, the surface has to be treated carefully during transport and processing in order to prevent the accumulation of dirt and damages to the high-quality surface. Like all construction metals FalZinc® requires an unhindered air flow in order to form the natural oxide layer, which means that phases of moisture accumulation and drying have to alternate. Therefore the penetration of moisture in between stacked sheet metal panels or the windings of coils has to be prevented until the time of the installation, because that moisture would only dry off very slowly. After a prolonged period of reaction, moisture that cannot dry off may lead to the discolouration of the surface in spots, which will only decrease after several months of weathering; under very unfavourable conditions, spots that were created by improper storage may remain visible for many years. Surfaces also have to be protected against mechanical or chemical influences. Moist mortar or concrete residues, acidic as well as alkaline cleaning agents attack the high-quality surface and also lead to spots, which disturb the uniform appearance of a high-quality FalZinc® facade.

Sheet Metal Thickness and Weight Information

FalZinc® is available in two thicknesses. FalZinc® of 0.7mm sheet metal thickness for roof and wall coverings as well as construction elements and profiles with preformed coil widths of up to approx. 670mm.

FalZinc® with 1.0mm thickness for coverings and flashings as well as the production of equipment parts, e.g. for the transition from a Kalzip® facade to a standing seam FalZinc® roof or vice versa.
Due to the nature of the material, a FalZinc® covering is almost always lighter than one executed for example in titanium zinc, whilst having the same or even higher strength. In the case of renovation therefore the weight of the new or supplemented covering will hardly be a problem.

The low weight of FalZinc® also favours the transport and handling at the construction site and the installation.

Table 2

Sheet Metal Thickness	Weight 600 mm Panel /1 m Length	Weight 670 mm Panel /1 m Length	Weight per m²
0.7mm	1.14kg	1.27kg	1.90KG
1.0mm	1.63kg	1.82kg	2.70KG

Narrow Thickness Tolerances

FalZinc® is produced using the latest technology. Due to the high-precision production process, variations in thickness are very minor. Therefore the processor can select his machine settings (e.g. seam closing machine) very accurately and form the folds very precisely. In the case of the production in a workshop, bending radii, turned edges and profiles will always be very even.

Fire Behaviour
Including the two-sided metallic coating, FalZinc® is purely metallic and therefore not flammable (Class 1 surface, speed of flame and non combustable).

However, the fire resistance for a construction component (e.g. wall component) depends on the interplay of all components, that is including the support structure etc. The fire resistance class that can be achieved is therefore determined to a significant degree by the fire characteristics of the support structure. With the help of appropriately allocated boarding, long fire resistance times can be provided.

Lightning Protection
Roofs made of FalZinc®, which are connected to an electrically conductive surface via a lock seam (standing seam or angled seam), are considered collector installations in terms of German Standards, because the specifications with regard to the minimum diameter are met.

Grounding can be carried out via separate discharging devices, which are connected via special clamps to the lock seams . If roof surfaces are planned as collector installations, all metallic installation parts have to be connected to each other in a conductive manner. Large, non-metallic openings in the roof, such as for example sky lights or light cupolas, will be secured with additional collector rods, which can be connected to a separate discharge line or to the FalZinc® roof surface via clamps.

It is important that there are expert grounding and adherence to the respective standards and VDE guidelines!

Environmental Compatibility
Aluminium is a natural element found everywhere in the earth's crust. That makes FalZinc® absolutely environmentally safe. The production of aluminium sheet metal is carried out according to the most up-to-date ecological points of view, so that the smelting of the initial alloy as well as the rolling process are executed with energy savings in mind.

Recycling rates of over 95% are achieved in transport and building.
Aluminium can be recycled repeatedly for only 5% of the original energy comsumption with no loss of quality.

Typically, for every tonne of aluminium used in place of traditional heavier metals there is a 20 tonne reduction in CO_2 emissions over the life of a car.

More than 55% of the worlds primary aluminium is produced using hydroelectric power which is clean, carbon dioxide free and renewable.

2. General Information on the Use of FalZinc®

Minimum Sheet Metal Thickness
Expansion caused by Temperature
Weathering
Contact Corrosion, Pairing of Metals

FalZinc® is optimised for hand crafting and designed for all practical uses in the construction business. Observing simple basic rules allows the construction of demanding, safe and long-lasting roof and wall coverings, which are characterised by being maintenance-free and by a long service life. Early consultations between planner and installer are preferable and minimise difficult, time-consuming and costly reworking.

Minimum Sheet Metal Thicknesses

For many construction components minimum thicknesses are stipulated in standards or trade rules (depending on dimensions or the width of the coil) or minimum sheet metal thicknesses have developed, which are based on experience and should be observed in practice. These also take into consideration the (minimum) specifications in standards and trade regulations.

Table 3: Sheet Metal Thicknesses in Accordance with Corresponding Standards and Experience

Construction Component	Type/Dimension	Rated Sheet Metal Thickness
Roof covering	Double Standing Seam	0.7mm
	Roll Cap Roofing	0.7mm, 1.0mm
	Angled Standing Seam (steep incline)	0.7mm, 1.0mm
Wall covering	Double Standing Seam	0.7mm, 1.0mm
	Angled Standing Seam	0.7 mm, 1.0mm
Gutter, external	Metal width 333	0.7mm
	Metal width 400	1.0mm
Gutter, internal	Metal width 333	1.0mm
Valley gutter	Fully supported	0.7mm, 1.0mm
Rain down pipe, circular	Diameter up to ø 150	0.7mm
Rain down pipe, square	Nominal 100 x 100	0.7mm
	Nominal 120 x 120	1.0mm
Eaves strip		0.7mm
Coverings	Metal width < 400mm	0.7mm
	Metal width ≥ 400mm	1.0mm
Aprons		0.7mm, 1.0mm
Flashings		0.7mm, 1.0mm
Fixing strip sheet metal		1.0mm

Expansion caused by Temperature

Changes in temperature result in movement. Roof coverings, which are subject to a high degree of radiation from the sun, and wall coverings have to absorb and compensate for expansion and contraction of length, without this resulting in tension and deformations.

Construction measures for the compensation of expansion caused by temperature are:-

- Inclusion of expansion solutions in the planning stage,
  e.g. through indirect fixation (sliding clips etc.).
- Adherence to the minimum sheet metal thickness and recommended sheet metal thickness in accordance with Table 3.
- Production of movable details for connections to rigid installation components (e.g. windows and pipes)
  or, in the case of adjoining roof surfaces, components that have different expansion directions (e.g. roof surface to dormer)

Calculating the Change in Length caused by Temperature

In special installation situations, in which the expansion possibilities have to be determined more exactly, the expected change in length will have to be calculated. The basis of the calculation will be the length of slope or sheet, expansion coeffcient and difference of the actual temperature to the temperature at the time of installation. This change in length is to be taken into consideration during construction to ensure that the maximum expansion and contration is catered for .

Calculation is as follows:-

Example:

Assuming the standard temperature interval of 100K (-20°C to +80°C) and an installation temperature (metal temperature) of 20°C, 60K will affect the expansion and 40K the contraction of the sheet.

FalZinc® has a thermal expansion coefficient of 0.0232mm/m K. For a sheet length of 10m this results in the following values:

Expansion:	10 x 0.0232 x 60	=	13.9mm
Contraction:	10 x 0.0232 x 40	=	9.3mm
Total change in length:			23.2mm

Weathering Exposure

Roof and wall coverings as well as fabrications made of FalZinc® have the high corrosion resistance of aluminium; due to the metallic coating the corrosion resistance is even further increased. Still, precipitation out of the air, which are also for example ‘washed out’ of the air by rain, lead to dirt on the surface, unless washed away by subsequent ‘clean rain’.

If such dirt, which very often is quite strongly acidic in nature, affects the surface over a longer period of time, this might result in discolourations being extremely difficult to remove. Generally, this is not a (significant) corrosive attack, but only a change in the colour of the surface, which most of the time occurs over such large areas that is is only visible as ‘darker shades’.

Still, where the accumulation of dirt is to be expected or unavoidable, the roof pitch should be chosen as steep as possible, so that in the event of strong rain as much as possible of the accumulated dirt is washed away due to the greater speed of the water run off.

Experience shows that this 'self-cleaning' of roof surfaces only becomes really effective from a roof pitch of approx. 10° onward, so that it is always advantageous, to plan the pitch as steep as possible. In a normal atmosphere as well as in a polluted industrial atmosphere FalZinc® is very durable due to the natural formation of its covering layer. However, if the surrounding atmosphere is very highly polluted, e.g. with aggressive chemical exhaust gases, then the surface in the affected area should be provided with additional protection.

This is also recommended by the trade regulations of the tinsmith trade for all construction metals in cases where roof surfaces or construction parts come into contact with unprotected bituminous roof surfaces. Even though the particularly corrosion-resistant surface of FalZinc® is not attacked by water running off, visible discolourations might still occur, which are almost impossible to clean off. In such (limited) cases or in small areas measures seem sensible in the case of particularly aggressive deposits, additional protection can be achieved with a good coating ("varnishing") with suitable varnishes. Freshly laid surfaces of FalZinc®, which have not yet been dirtied or intensively weathered can be coated with practically all varnishes that are suitable for NE metals.

The colour shade RAL 7030 is recommended, which corresponds approximately to the colour shade of a fresh FalZinc® surface or colour shade RAL 7023, which is similar to a weathered FalZinc® surface.

Because varnishes under the influence of the weather decay with time and then develop cracks, only absolutely weather-resistant varnishes should be used, which can be applied in thick coats.

If a FalZinc® surface has been exposed to aggressive weather influences or agents, then the surface should be cleaned intensively using mechanical aids before the coating is applied. Depending on the degree of dirt, it might be necessary to use such an intensive means of cleaning, e.g. using a corundum fleece with a surface-active agent, this action results in the titanium-grey surface first becoming glossy where rubbed and the foam of the surface-active agent turning grey in colour.

If the foam turns grey that is a sign that the metallic coating is already dissolving under the scouring influence, meaning that all surface dirt has definitely been removed. Afterwards the cleaned surface has to be rinsed with plenty of clean water and should be coated as soon as possible.

Please Note:
Even high-quality varnishes will degrade in the course of weathering and therefore have to be regularly checked and after some time renewed. In contrast to FalZinc® surfaces, coated surfaces are therefore not maintenance-free. Additional coating should only be proposed where this is sensible and necessary due to special circumstances.

Contact Corrosion

In the event of direct contact of metals with different 'electro-chemical' potential, local corrosion damage may result due to the influence of moisture or wetness or electro-chemical reactions. Copper ions loosened by rain water, too, may lead to discolourations or a local corrosion attack, if they constantly affect one spot where the water is dripping. Other construction metals, e.g. titanium zinc or hot-galvanised steel, are non-critical in the case of direct contact as well as in cases where rain water drips from a zinc surface onto FalZinc®.

In principal the following rules should be observed:

- Any direct contact between copper and FalZinc® components has always to be avoided.
- Effects of copper ions loosened by rain water can be prevented by avoiding the placement of copper above FalZinc® in the direction of drainage. Rain water dripping from FalZinc® onto copper, on the other hand, is not a problem.
- FalZinc® that is not exposed to weather, is more sensitive with regard to appearance changes than FalZinc® that has already been exposed to the natural influences of weather over a longer period of time.

Metal Pairings

Assembly with Other Metals

Even though the effects actually occurring in each individual case depend greatly on the state of weather exposure of the paired materials, metal pairings that are marked as doubtful or unfavourable in Table 4, should always be avoided where the addition of moisture might have an effect.

The pairings marked with + are always non-critical from an electro-chemical point of view. Due to the formation of a cover layer that is typical for aluminium and which reduces the electro-chemical effects even in the case of critical pairings, it is always to be assumed that FalZinc® surfaces that have been exposed to natural weathering processes will have an even more favourable behaviour.

Independent of the potential effects of the contact corrosion, joints between construction parts or overlaps should in principle be formed in such a way that there will be no gaps, into which moisture and in particular oxygen-enriched rain water can be bound in a capillary manner. Gap corrosion will occur independent of the metal pairing. The effects of a potential contact corrosion may be increased through this situation.

As the effect of other metals on top of FalZinc® can in principle be different from the effects of FalZinc® on one of the pairing materials reviewed, the following Table 4 is to be read accordingly: The material under review is always that partner of the pairing, whose behaviour is shown in contact with the pairing material.

eg: Aluminium does not have a negative effect on copper. But copper has a negative effect on aluminium. This means that water from a roof covering made from copper cannot be drained off into an aluminium gutter. However, this pairing is non-critical when it is the other way round.

Table 4: Allowed Pairings of Metals in Direct Contact

	Pairing Material							
Material Considered	**FalZinc®**	**Al**	**BauSt**	**Pb**	**Cu**	**6ms**	**nrSt**	**Zn**
FalZinc®	+	+	-	-	-	+	+	+
Aluminium: **Al**	+	+	-	-	-	+	+	+
Construction Steel: **BauSt**	+	+	+	2)	2)	+	2)	+
Lead: **Pb**	+	+	+	+	+	+	+	+
Copper: **Cu**	+	+	+	+/-	+	+	+	+
Hot-galvanised steel: **6ms**	+	+	2)	2)	1)	+	2)	+
Stainless Steel: **nrSt**	+	+	+	+	+	+	+	+
Zinc, Titanium zinc: **Zn**	+	+	2)	+	1)	+	2)	+

eg: Copper is critical for aluminium, however aluminium is non-critical for copper.

1) Generally critical, but possible for small surface ratio Cu / Material Considered
2) Critical for small surface ratio of Material Considered / Pairing Material, otherwise not critical

3. Types of Folding

Folding Connections
Double Standing Seam
Angled Standing Seam
Cross Joint Formation
Roll Cap Roofing
Choosing the Sheet Metal Thickness

Folding Connections

Roof coverings completed by craftsmen using time tested folding techniques are durable and offer almost unlimited opportunities for designing a roof. FalZinc® was optimised in such a way that the sheet metal could be folded, turned on edge or crimped using tried and proven craftsmanship processes, even under unfavourable conditions common on construction sites.

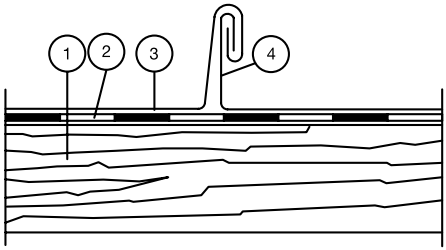
Proven folding techniques are used, for which a great number of devices and profiling machines have been developed. FalZinc® can be processed with all devices and machines that are commonly used for the metal work of tinsmiths'.

It is recommended to leave the protective film applied to the outer surface until the actual installation of the sheet. The protective film can be formed without problems during the rolling of the sheets or during the turning of the edge.

Double Standing Seam

A double standing seam connection offers the highest degree of water tightness and can be used for all roof pitch ranges with a pitch ≥ 3°. In the pitch range below 5° folds have to be additionally sealed with sealing strips in accordance with the installation regulations of the trade.

In the case of an expert installation process, the double folded connection will be able to absorb the lateral expansion of the sheets due to temperature without 'locking up'. Therefore roof surfaces of any width can be covered using fully supported standing seam sheets, without having to install expansion compensators; however, building expansion joints should not be overlaid, but should be executed separately, because at those places the movements of the support structure may be very big due to the settling of the building. Therefore the implementation of an expansion joint detail is recommended.



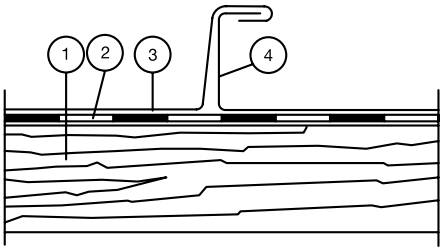
1 Wood boards, 24mm
2 Separation layer, if necessary
3 FalZinc®
4 Double standing seams, 25mm

Angled Standing Seam

The angled standing seam is a variation of the double standing seam, in which the fold is not turned over completely, but finished horizontally, so that the visual effect of the sheet cover widthi is observed.

Roof coverings with an angled standing seam require a greater roof pitch. According to the trade regulations, only roofs with a pitch of ≥ 25° may be executed using an angled standing seam technique.

The additional sealing of the seam using inserted sealing tape is not possible in the case of an angled standing seam; areas with a considerable amount of snow or areas next to valleys, in which snow accumulates and possibly only melts in spring, should have pitches of at least 35°, if an angled standing seam is used.



1 Wood Boards, 24mm
2 Separation Layer, if necessary
3 FalZinc®
4 Angled Standing Seam, 25mm

Due to the outstanding foldability of FalZinc® it is possible, to produce a transition from angled standing seam to double standing seam in the course of the fold. Therefore it is possible to close the angled standing seam into a double standing seam (under circumstances even with an inserted sealing tape), for example in places where it is feared that a snow trap might form.

The classic area of application of the angled standing seam is the wall covering; in the majority of roofs the double standing seam is used, even in places where an angled standing seam could be used due to the steep pitch of the roof.

Cross Joint Formation

In the case of long sheet lengths, for which the maximum length of individual sheets is exceeded, cross joint formations are to be arranged. Cross joint formations can also be arranged for reasons of design.

The formation of the cross joints has to be executed in such a way, that they are watertight whilst a sufficient degree of strength is achieved in the cross connections and that compensation for thermal length changes can take place.

The requirement for tightness is dictated by the pitch or gradient. However, even in the case of steep gradients additional sealing measures may become necessary if the folds become flooded due to particular circumstances (e.g. in the case of valleys).

The are gradients to be observed for the various designs in accordance with ATV DIN 18339 and the trade regulations are shown in Table 5 (Based on German Standards) .

Table 5: Cross Joint Formation in Dependence of the Roof Pitch

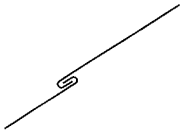
Roof pitch	Type of cross seams
≥ 30° (57.7%)	Overlap 100mm
≥ 25° (46.6%)	Simple cross seam
≥ 10° (17.6%)	Simple cross seam with additional fold
≥ 7° (12.3%)	Double cross seam (without sealing)
< 7° (12.3%)	Watertight design through off-set riveting with sealing insert or welding

Simple Overlap
In most cases this connection is only used for flashings. The connection should only be used in areas that are not subject to the risk of flooding and have a steep roof pitch. Thermal longitudinal expansion is fully compensated.

Simple Cross Fold
For steep roof pitches without strong driving rains (or build up for water). The connection is well secured against rain, but not safe in case of flooding. Thermal longitudinal expansion is well compensated.

Simple Cross Fold with Additional Fold
In case of roof pitches that are not too flat, without driving rain (or build up of water). The connection is well secured against rain, but not safe in case of flooding. Thermal longitudinal expansion is well compensated.

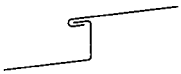
Double Cross Fold (with and without sealing)
The double cross fold is the usual connection for sheets. If a sealing strip is folded into it as well, the connection is considered water-tight, that is safe against (minor) build ups of water. However, this cross connection should not be used in areas planned for water build up (e.g. for gutters) or in the case of greater water pressure situations.



Simple cross fold
Roof pitch
≥ 47% (25°)

Simple cross fold
with additional fold
≥ 18% (10°)

Double cross fold
Roof pitch
≥ 13% (7°)

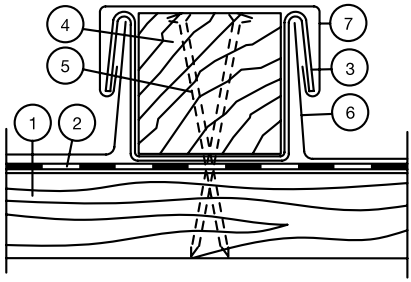


Drip
Roof pitch
≥ 5% (3°)

Roll Cap Roofing
If a tender or a quotation is issued in accordance with VOB, the German System is stipulated as roll cap roofing (ATV DIN 18339). Regionally it is quite common to use the Belgian System or the Swiss System or variants thereof.

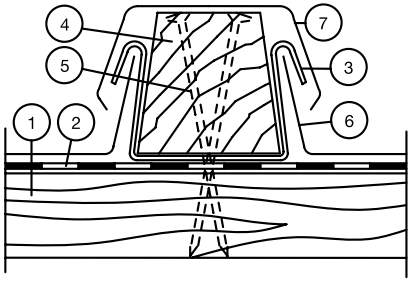
However, the installing contractor should always point out and advise the party issuing the tender or the architect as to what system they want to use, in order to prevent discussions later on.

Belgian System



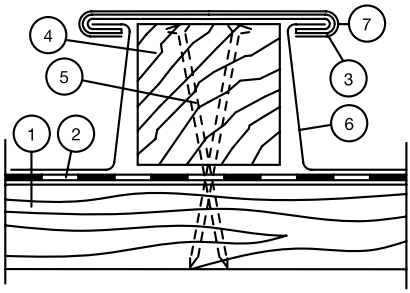
1 Wood boards
2 Separation layer, if necessary
3 Continuous strip
4 Wood ledge
5 Nails, alternating angled
6 Sheet upstand
7 Roll cap

Swiss System



1 Wood boards
2 Separation layer, if necessary
3 Continuous clip
4 Wood ledge
5 Nails, alternating angled
6 Sheet upstand
7 Roll cap

German System



1 Wood boards
2 Separation layer if necessary
3 Clip plate
4 Wood ledge
5 Nails, alternating angled
6 Sheet standup, with back bend
7 Roll cap

The special feature of the roll cap roofing is that the separation of the panels is strongly emphasised. Due to the ledge height of 40mm, 38mm is possible in the UK (as opposed to the height of a double standing seam or an angled standing seam of approx. 23 to 27mm) the separation of the sheets are particularly visible due to the resulting light / shade effect.

For batten cap or ledge roofs (in accordance with the German System) a minimum roof pitch of 7° applies. However, one should not choose a roof pitch that is too low, in particular in exposed locations, where frequent driving rain or the accumulation of large snow traps are to be expected. For all ledge systems a minimum roof pitch of approx. 15° should be chosen, in order to ensure that water is not drawn into folded ledge covers during severe weather conditions.

A ledge timber section of at least 40 x 40mm should be used. This ledge width will determine the width of the ledge cover (= top view surface) of approx. 70mm for the German ledge system and approx. 55mm for the Belgian System or the Swiss System.

Selecting the Sheet Metal Thickness

Due to the high degree of durability and weather resistance of FalZinc® increasing the sheet thickness is not necessary for the roof area. Therefore FalZinc® with 0.7mm sheet metal thickness is normally used for all folding work in the roof area, because this sheet metal thickness can be folded particularly well.

If, in exceptional cases, FalZinc® with 1.0mm sheet metal thickness is proposed for roof areas, the flashings have to be pre-formed in the workshop or in the case of smaller girth flashings the edges have to be pre-turned, so that the folding work on the roof is easier to finish. In principle pre-forming should be carried out in the workshop or in the case of larger jobs through transportable profiling devices at the construction site. In that way this preliminary work can be carried out more efficiently and the roof can be closed up faster.

After the appropriate pre-forming work, the folds can be executed very evenly to give a pleasing appearance.

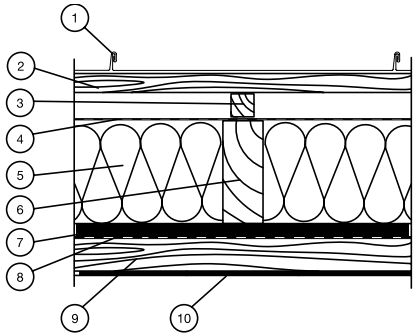
4. Roof Coverings

Roof Structure with Ventilation
Roof Structure without Ventilation
Roof Pitch
Ventilation (two-wall, ventilated roof structure)
Support Structure
Planking
Separation Layer
Sound Insulation
Heat Protection
General Information concerning Execution

Roof Structure with Ventilation

The proven, traditional roof structure for metal roofs is the two-wall, ventilated roof structure 'cold roof'. The advantage of this roof construction is that minor amounts of moisture that might penetrate into the roof structure from the inside of the building due to an ineffective vapour control layer, will be safely carried off in the ventilation cavity. Therefore the ventilation void is a safety level for the safe carrying off of moisture, which has penetrated at unplanned or at defective points in the interior of the roof construction.

Ventilated Roof Structure



1 FalZinc® Standing seam covering
2 Wood boards 24mm
3 Board
4 Breather paper
5 Thermal insulation
6 Rafter/Joist
7 Wood material panel (often left out)
8 Vapour barrier
9 Installation level
10 Internal lining

During certain atmospheric conditions metal cools down to the point that condensation forms on the lower side of the sheet, which cannot evaporate through the closed skin of metal. Due to this 'Additional Safety' the two-walled, ventilated roof structure has become the de-facto standard of metal roofings.

As FalZinc® is unaffected by underside corrosion, the separation layer common with other metal systems can be omited (see also Page 24).

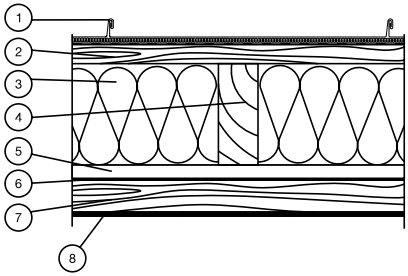
Roof Structure without Ventilation

Due to the thickness of thermal insulation used in roofing structures the air cavity is omitted to save money and depth. In the case of renovation when formerly bituminuous sealed surfaces are re-constructed, the planner will also examine the possibility of a warm roof structure. The execution of a one-deck, non-ventilated roof structure requires particular care in the execution of the vapour control layer system to prevent possible saturation of insulant at ceiling and moisture penetration of the roof elements. FalZinc® however, as an especially corrosion-resistant cladding material is unaffected by internal condensation provided that the boarding does not contain any contaminates or treatments as defined in table 4 page 15. Thus FalZinc® is also suitable for roof claddings in a non-insulated roof.

When deciding on which system, it should already be taken into consideration that the structure of a non-insulated roof makes particularly high demands on the structure and material components.

The selection and installation of the vapour barrier has to be such that even in the event of temperature differences between the inner and outer layers of the roof package, no moisture will be able to penetrate. Usually the minimum S_d-value of 100m is not sufficient to exclude the inward diffusion of room-side air humidity; foil based vapour barriers serve the purpose and are very diffusion-tight when installed properly.

Non-ventilated Roof Structure



1 FalZinc® Standing Seam Covering
2 Separation layer, structured
3 Wood boards 24mm
4 Heat-insulation
5 Rafters
6 Wood material panel (often left out)
7 Vapour barrier, $s_d \geq 100$ m
8 Installation level
9 Internal lining

When using a non ventilated insulated system, it is common to use a special insulating layer which provides a cavity between the metal sheet and the deck to prevent entrapped moisture becoming an issue during certain climatic conditions. expert advice should be sought for such situations.

Calculations are based on proven values gained through experience; however, the calculation of the diffusion fails because no sensible s_d-value can be calculated for the metal roof layer. It is recommended to have the vapour barrier approved separately immediately after its installation. The vapour barrier also has to be executed as an airtight barrier (against air streams).

Roof Pitch

The recommended minimum roof pitch for metal roof coverings is generally 7° (13%). The generally acknowledged expert rule of the tinsmith trade establishes this limit for all metal roof coverings, independent of the material used. With appropriate additional measures, lower roof pitches of down to 3° incline are technically possible; however, in that case additional sealing measures become necessary. The recommended minimum roof pitch of 7° to 10° is based on the practical experience that at this roof pitch the rain will wash off dirt deposited through the air and very fine dust particles and air-born pollution carried by air movements. The greatest possible pitch is always to be preferred, because then the natural cleaning effect of the faster flowing rain water becomes effective.

In the case of a conventional, ventilated roof structure, the roof pitch also determines the difference in height between the eaves (air inlet opening) and roof ridge (outgoing air). A height difference as large as possible has a favourable influence on the effectiveness of the ventilation, because a greater pitch improves the upward movement of the air.

To a certain extent the execution of the seams is dependent on the pitch. The lower the pitch, the better the seam needs to be. According to German Standards the folds have to have additional sealings in the case of a roof pitch below 5°; this can be achieved by folding compressable, long-term elastic sealing tapes into the folds, which prevent the capillary penetration of water into the fold.

Ventilation
(Two-deck, ventilated roof structure)

Safe ventilation requires certain minimum apertures at the air inflow and outflow openings. The difference in height between the inflow and the outflow opening influences the effectiveness of the ventilation. Therefore it is important to arrange the air inlet openings at the lowest possible location, e.g. below the eaves, and the air outlet opening at the highest location in the area of the ridge. In addition the following has to be taken into consideration:

- The utilisation of the building
- Quantity and frequency of the potential moisture penetration
- Form of the roof and roof pitch
- Length of the distance to be ventilated between incoming and outgoing air
- Position of the building in relationship to the main wind direction

On the basis of practical building experience the guideline values for the dimensioning of the ventilation level that are listed in Table 6 below are generally recognised.

Table 6: Recommended Minimum Values for the Dimensioning of the Ventilation

	3-15° (5-27%)	**> 15° (27%)**
Unobstructed air inlet opening	1/500 = 0.2% of the roof surface	1/1000 = 0.1% of the roof surface
Unobstructed air outlet opening	1/400 = 0.25% of the roof surface	1/800 = 0.125% of the roof surface
Height of the open air space	min. 8cm	min. 4cm

These values are valid for lengths of the distances to be ventilated of up to approx. 15m (distance measured at the roof level between air inlet and outlet opening).

In the case of greater lengths it may become necessary to enlarge the apertures or to plan alternative measures.

The space, through which the air flows, should enable air movement to be as unimpeded and even as possible; objects restricting the air flow are unfavourable as well as are major changes to the aperture size. Both circumstances will cause deterioration of air flow.

The values listed in Table 6 for the “unobstructed” air inlet and outlet openings are the aperture sizes for the openings; if, for example, perforated sheet or mesh is planned as protection against insects or driving snow, then the unobstructed opening is the sum total of the aperture openings, which in the case of perforated sheets may be less than 50%.

Ventilation for Minimal Pitch Roofs (special case)
For very flat roofs or in the case of an inverted roof, ventilation is achieved by wind pressure / suction effect, so that the air inlet and outlet openings as well as the height of the ventilation should be as large as possible.

From experience, the following principle requirements have been established:
- unobstructed ventilation diameter at least 2 x 1/400 = 2 x 2.5% of the roof area or
- ventilation slit on all sides of at least 2 to 5cm width.
- free height of the ventilated air space at least 20cm.

Support structure
Falzinc® should be fully supported throughout its entire area. The deck is most suitable for the attachment of clips using nails and screws. As a rule the support structures for a two-deck ventilated roof structure as well as for a non-ventilated roof with full depth rafter insulation using timber construction erected by carpenters/joiners.

In principle other support structures, e.g. the direct fastening of the clips in foamed composite panels or high density insulation boards, are achievable. However, a pre-condition is always that the support structure is sufficiently stable, does not contain corrosion-aggressive components, is stable and resistant even under the influence of moisture and enables the secure fastening of the clips.

Relevant Standards demand of the installing party expressly:
During his examination the contractor has to voice his doubts in the event of:-
- Unsuitable condition of the substrate, e.g. surfaces that are too rough, too porous, wet, dirty or greasy
- Insufficient thickness of boarding, boarding edges and burrs that are too sharp, unevenness, etc.
- Decking/substrate/support surface is deemed not to be securely fixed to the structure
- Missing or unsuitable fastening points, e.g. on connections, recesses, cut-outs
- Missing ventilation for roofs and wall coverings that need to be ventilated
- Unsuitable type and location of cut-outs, drainages, connections, thresholds and such
- Deviations from the horizontal or the incline that are stipulated for good practice or are necessary according to the situation

Timber Linings

Timber linings are manufactured from dry (≤ 30 % moisture) pine wood, rough sawn, parallel trimmed, at least 24mm thick, plank widths 8 -14 cm. The two-cuts are laid parallel to the eaves or at a right angle to the eaves. For the end of the eaves the use of an eaves board (40 x 150mm) is recommended. Its surface should be installed approx. 5mm lower than the roof surface so that the additional sheet metal thickness of the eaves-side attachment of the flashings is compensated for.

Separation Layer

Separation or 'slip' layers have various tasks:

- They are to separate the metal roof covering from the support structure, in order to prevent corrosive influences from aggressive wood protection agents or alkaline influences from fresh concrete or mortar on the underside of the metal.
- They act as a temporary weather protection during the assembly phase. (Subject to type selected)
- The separator also aids movement – reducing noise from movement over hard or changing surfaces

For ventilated roof structures, the use of a separation layer can generally be dispensed with if the decking, does not contain any aggressive wood impregnation agents (considered aggressive would be chlorine naphthalene preparations or wood protection agents that contain salts such as copper or mercury salts or fluoride compounds). The installation of the FalZinc® roof covering can be done directly onto the clean, dry decking, after any protective temporary films or foils have been removed.

If a separation layer is ordered, which will be necessary, where due to the geometry of the roof snow traps formation, or in the case of large roof overhangs snow spill formations have to be expected, the installation of diffusion dispersing separation layer with top-side distance mesh is recommended, several variants have been developed by different manufacturers.

We do not reccomend sheathing for welding fusion or films; the seams are to be overlapped, but under no circumstance to be glued. If the separation layer has been applied as a temporary roof cover for the protection of the boarding and the seams have been glued because of that, this seam gluing has to be cut open again in the course of the covering with FalZinc®.

Not allowed are moisture-storing boards, such as roofing paper, felt or cover strips. The arrangement of several separation layers on top of each other is not allowed either.

Sound Insulation

Again and again - in spite of contrary practical building experience - fears are voiced that metal roofs will be ‘particularly noisy’ in the event of strong rain or, for example, hail. Feared are ‘drumming noises’ which then might also be heard inside the building.

Those ‘drumming noises’ do not occur in the case of a regular roof structure with metal covering. The support structure, which in turn consists of several layers, dampens the sound so that, as a rule, there will be no noise pollution inside the building.

Heat Insulation

As a rule, rolled insulation materials that are easy to install are arranged in the case of ventilated roofs. For a flat roof pitch these are often covered by a difused isolating layer. It is important that the heat insulation is securely installed so that even in the event of severe wind pressure through the ventilation level it is not disturbed and attempts to block the ventilation cavity.

Especially for roof constructions without ventilation there exist board systems, which are already equipped with fastening strips for clips, which can be nailed down, so that the element forms thermal insulation and support structure all in one.

The use of foam glass insulant as a simultaneous vapour barrier and support structure has proven itself. These insulation slabs are offered with already foamed-in fastening strips. Fastening claws, are inserted in the course of the installation and which then form a base for the fastening of the clips.

General Information Regarding the Execution

Width and Length of Panels

In accordance with trade regulations the length of the sheets for normal installation is limited to 10m. However, for roof coverings with FalZinc® longer can be accomodated provided its effects on thermal movement are considered using appropriately designed fastening elements (long sliding clips, extended fixing strip sheet metal at the eaves and corresponding expansion at the ridge accomodation).

In the case of lengths of more than approx. 15m, the panels should be executed with transverse joints. The design of those joints depends on the roof pitch. In principle the lower the pitch the move important is the choice of transverse joints, refer to page 18 for details.

The cover width of the installed double standing seam is the result of the coil width minus the side laps. For a coil width of 600mm and after the deduction of the two folding edges of 35mm + 45mm = 80mm this results in a cover width for the double standing seam of 520mm for a seam height of 25mm.

If higher seams are selected in special cases, the cover width is reduced further.

The regulations in Germany stipulate a minimum height of 23mm. To a certain extent the width of the folding edges depends on the settings of the folding machine. 25mm is common for the UK.

For angled standing seams the resulting heights and sections are the same, because the connecting of the sheets, as for the double standing seam, is executed through the simple turning over of the higher panel upstand. The only difference is that the fold is not completely turned over as in the case of the double standing seam. (see Illustration Pg.17).

The angled standing seam is used mainly for walls, because it may only be used for inclines ≥ 25°.

Table 7: Panel Widths and Coil Widths for 25mm Folding Height

Width of coil	670mm	600mm	500mm	400mm
Cover width of standing seam	590mm	520mm	420mm	320mm
Used surface part	88%	87%	84%	80%

Fastening using Clips

The fastening of standing seam roof coverings is done with clips, which are folded into the seam of the sheet. FalZinc® is fastened using one or multiple-part clips made of stainless steel (sheet metal thickness at least 0.4mm).

Fixed clips and sliding clips are required, which are arranged in such a way that the expansion of the sheets caused by temperature is possible without jamming.

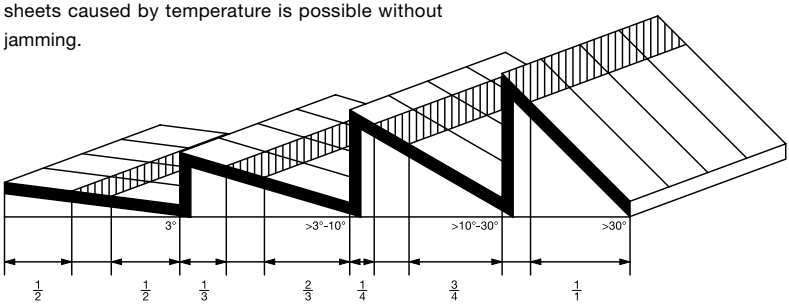
It has proven useful to move the fixed clip area closer to the ridge of the roof for steep pitch roofs. For a roof pitch of 3° the fixed clip area is arranged in the middle between the ridge of the roof and the eaves; the steeper the pitch of the roof, the closer to the ridge of the roof is the fixed clip area. From approx. 30° roof pitch and above the fixed clip area lies entirely at the ridge and the sheets are 'hung' from the ridge.

Design of the Clips

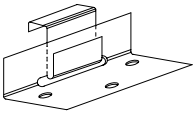
In principle FalZinc® is fastened with clips made of stainless steel. With that, the foldings of the clips into the fold can be formed very precisely and without markings. Clips are available ready-made and in various designs. During the closing of the folds the fixed clips are folded in such a way that they hold the sheets whilst not hindering the temperature expansion perpendicular to the seam direction. Sliding clips are available with different sliding distances, depending on the pre-calculated temperature movement.

Table 8: Movement Space and Sheet Metal Thickness of the Sliding Clips (Recommended)

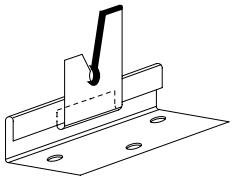
Sheet length	**up to 10m**	**10 to15m**	**over 15m**
Movement	20mm	25 mm	calculate
Clip thickness	0.4mm	0.4mm	0.4mm
Note	max. length acc. to std.	possible, fixed clip area see Pg.37	possible with special measures



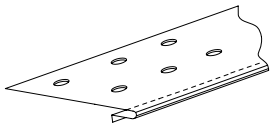
Diagramatic illustration of the area of the fixed clips in dependence of the roof pitch



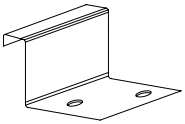
Sliding clip for machine folding



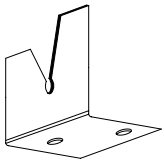
Sliding clip for manual folding



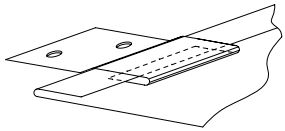
Fixing strip or eaves sheet



Fixed clip for machine folding



Fixing clip for manual folding



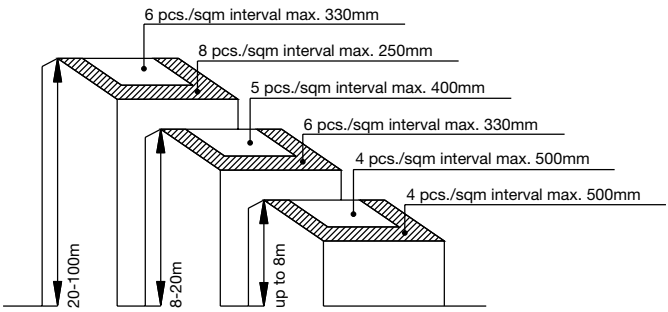
Verge clip

Number and Intervals between Clips

The number of clips differs according to the wind loads in the normal range of the roof surface and the corner and perimeter areas under higher stress. As a rule the clips are fastened with at least two broad-headed pins (cover pins) 2.8 x 25mm made of stainless steel with a binding depth of at least 20mm. Alternatively, clips can also be fastened using countersunk head screws of at least 4 x 25mm or with approved clamps made of stainless steel.

The maximum distance between clips is 500mm, even in the case of a low suction load this distance must not be exceeded.

As the wind load depends on the height of the roof above the ground (height of the building), different maximum clip intervals have been laid down for different building heights, in order to maintain the necessary number of clips per m^2.



Number and intervals of the clips

Table 9: Width and length of sheets, minimum coil thickness, clip quantity and spacing

Height of Building	**up to 8 m**		**over 8 and up to 20m**		**over 20 and up to 100m**	
Sheet width1) in mm	520	590	520	590	520	590
Material sheet length m	Minimum coil thickness mm					
Aluminium = 10	0.7	0.7	0.7	0.7	0.7	0.7
Roof area	**Clips: quantity (above) and spacing (below)**					
Centre mm	500	500	500	500	500	500
no. of clips/m2	3.9	3.9	3.9	3.9	3.9	3.9
Edge mm	500	500	350	360	250	200
no. of clips/m2	3.9	3.9	5.5	5.5	7.7	8.5
Corner mm	300	300	200	200	150	150
no. of clips.m2	6.4	6.4	9.6	9.6	12.8	12.8

The values/load spans are according to the German directives and suitable for installations in Germany. Installations in other countries may require proof to the relevant national standard/regulation, if so, please contact the FalZinc technical department for further advice.

1) The sheet lengths are calculated from the coil or sheet metal widths of 600mm, 670mm minus ≈80 mm in the case of standing seam roofs. When a profiling machine is used, the coil sheets have a greater width ≈10 mm. In the case of batten roll roofs, the width of the coil sheets will be less depending on the batten roll cross section.

Installation of long sheets

ATV DIN 18339 limits the maximum length of sheets for the regular design to 10m.

This reflects the craftsmen's experience that with increasing length of the sheets, the measures for the absorption of changes in the length caused by temperatures have to be laid down in greater detail than in the case of standard designs.

In the case of very long sheets, roof pitch (location of the fixed point area, friction of sheet metal / foundation), separation layer ('sliding' of the sheet), form of the support structure (level, concave, convex), straight / angled panel ends (jamming), design of the roll cap, impediments through projections etc. have to be evaluated with reference to the project.

In principle it applies that for sheet lengths of more than 10m, the fixed clip area should be moved slightly to the middle, even for steep inclines, in order to limit the maximum sliding length to approx. 10 - 12m.

Approx. 15 to 16m without a break are considered the maximum sheet length for FalZinc® (under ideal conditions). If panel lenghts of more than 12m are planned, Corus should be contacted.

5. Wall Cladding

General Consideration
Folding Types for Wall Cladding
Support Structure
Ventilation (two-deck structure)
Separation Layer
Heat Protection
General Information on Installation

General Considerations

Technically speaking, wall coverings are roof coverings with a roof pitch of 90°.

Yet the design expectations that are raised with regard to the 'Calling Card of the Building' result in additional requirements, of which a careful planner and executive should take note.

While roof surfaces as a rule only occasionally have added ellements, such as for example light cupolas, skylights or chimneys, pipes going through it etc, compulsory points such as windows, light bands, and other features, have almost always to be taken into consideration in the design and construction planning of wall coverings.

Daylight situations, in particular angled light or striped light, which accentuates the play of light and shadow of the seams with extreme clarity, as well as unavoidable minor undulations in the surface that are optically increased, pose special problems for the exactness of the installation work. The same requirements have to be made of the supporting structure because surface differences between the boards can become visible.

However, careful planning and exact implementation will result in a special, lively visual appearance, which will highlight the skills of the craftsmen in an exemplary manner..

From the very beginning FalZinc® has the characteristic titanium-grey appearance, which reduces mirroring and reflections.

With its characteristic surface FalZinc® can also blend inconspicuously with the character of the building.

Types of Folding for Wall Coverings

The design most often selected for metal wall coverings, is the angled standing seam technique (see also Pg. 16/17). The Norms in Germany even provide that other designs are to be treated as 'deviation from the rule'.

FalZinc® can be processed in all variations without limitations, that is FalZinc® can be installed in

- Angled standing seam technique, folding direction vertical
- Angled standing seam technique, folding direction up to 45° out of vertical
- Double standing seam technique, folding direction vertical
- Double standing seam technique, folding direction practically horizontal, folds angled slightly upward
- Batten cap folding technique, folding direction vertical
- Batten cap folding technique, German system, folding direction up to 60° out of vertical
- Special folding designs

Length limitations for roof sheet coverings (see Pg.36) also apply to wall coverings. However, for optical reasons the sheets are chosen much shorter most of the time.

In the case of very large wall surfaces without any breaks, elevations are also executed with emphasis on design, that is, the sheets are manufactured from shorter lengths and installed with an arrangement of cross seams chosen for a design appearance.

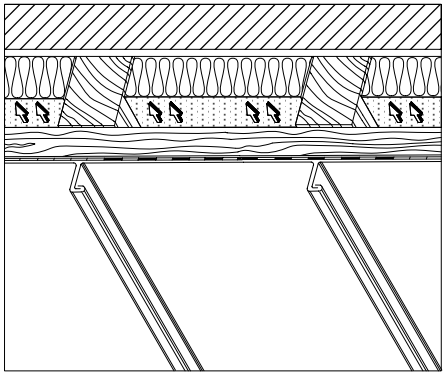
The connection of the longitudinal edges of the panels can be executed using all types of folding techniques; as a rule for panel coverings the connection of the longitudinal edges is executed using angled standing seams or double standing seams for strictly vertical or only slightly angled arrangement of the folding directions.

Support Structure

Great demands are made on the evenness of the support structure for wall coverings. Even a slight unevenness, e.g. due to boards that have slightly bowed or warped, will 'read' through the panels.

Even though FalZinc® sheet metal is a high-quality panel system and very stable which minimises any 'reading' of imperfections in the support structure. If the FalZinc is free to move however, steps or unevenness in the boarding create narrow-ridge waves, which may become clearly visible when the light falls on them from a certain angle, if the panels are fixed to rigidly.

In certain rain-protected positions (e.g. below large roof overhangs) dirt deposits may build up in such waves, which further increase the impression of unevenness.



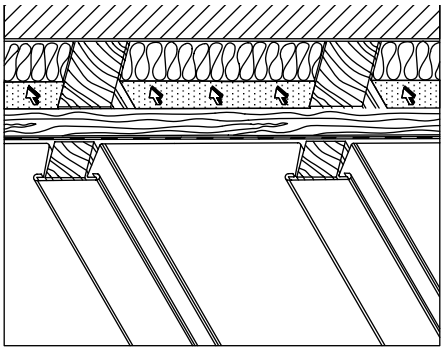
Construction Principle
Angle Folding Technique

Structure:
FalZinc® outer layer
in double standing seam or
angle folding technique
0.7mm material

Separation layer
Wood boards, min. 24mm

Ventilation space,
Thermal insulation,
Concrete, brick work, or
similar

Height of seam min. 23mm
Fastening and ventilation
according recommendations.

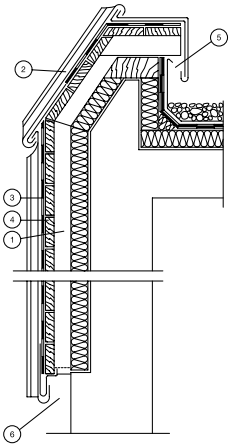


Construction principle of the roll cap technique , for a FalZinc® outer wall covering

Structure:
FalZinc® outer sheet in roll cap technique

Wood ledges, min. 40/40mm,
Separation layer
Wood boards, min. 24mm
Ventilation space,
Thermal insulation, concrete, brick work and similar
Fastening of the panels with continuous clips of stainless steel 0.4mm;
at the high point using continuous clip strips.
Intervals and fastening of the clips, sheet metal thickness and ventilation in accordance with regulations.

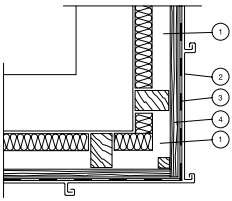
Seam height min. 23mm
Fastening and ventilation in accordance with trade regulations



FalZinc® external wall covering

Vertical section
Transition external wall / roof gradient

1 Continuous ventilation space
2 FalZinc® external wall covering
3 Separation layer
4 Wood boards, min. 24mm
5 Outward ventilation at high point
6 Inward ventilation (in podium or drip area)



FalZinc® external wall covering

Horizontal section
Corner area of building

1 Continuous ventilation space
2 FalZinc® External wall covering
3 Separation layer
4 Wood boards, min 24mm

In principle high-quality FalZinc® material should be installed as fully supported wall coverings. For so-called ‘saving boardings’, for which the boards are installed with planned intervals of up to approx. 25cm, there is a great risk, that with time the pattern of the planking boards will become visible.

The support structure has to be suitable for the fastening of the clips with nails or screws.

While planks from wooden materials are less suitable in the roof area, panels of sufficient thickness that are glued for weather resistance (exterior grade plywood may be used) in the wall area or as support structure of attic or verge board covering. It is important that these panels do not swell and that their form remains stable in the event of moisture penetration and that even under the influence of moisture they do not give off corrosive substances.

In principle other support structures that are common in the roof area are possible, for example, the direct attachment of the clips on special fastening strips in Foamglas® insulation boards or high density mineral fibre insulation. However, a pre-condition is always. that the support structure is sufficiently strong, does not contain any corrosive elements or components. That its form is stable even under the influence of moisture and allows the secure attachment of the clips.

The German Norms (DIN 28339) require the installing party expressly:
During his examination the contractor has to voice his doubts in the case of:-

- Unsuitable condition of the substrate, e.g. in case of surfaces that are too rough, too porous, moist, dirty or oily
- Insufficient boarding thicknesses, boarding edges and burrs that are too sharp, unevenness, no rounding at corners and edges
- Missing or unsuitable attachment opportunities, e.g. at connections, recesses, cut-outs
- Missing ventilation for ventilated roofs and wall coverings
- Missing height reference points for each floor

Boarding
Boarding is produced from dry (≤ 30% moisture) pine wood, rough sawn, parallel trimmed, at least 24mm thick, plank width 8 -14cm. The boards are installed horizontally.

In principle a board width of 140mm should not be exceeded, because in the case of wider boards the risk of bowing is high.

According to experience tongues and grooves does not offer advantages. More important is the secure attachment of the individual boards to the stucture.

Even though the drying out of boards that have become moist is very effective in particular in the case of ventilated wall structures, the boarding has to be well protected against rain during the assembly stage, because the wood used may ‘warp’ during moisture penetration / drying processes and thus fails to meet the need for a high-quality (level) wall supporting structure.

Wood Materials (Boarding)
In particular as support structure for attic and dormer panelling, but also for wall coverings, on which special demands regarding evenness are made, high-quality glued panels, OSB panels or ply boarding are used.

These types of support boards are proven exterior grade ply and the like must offer unlimited weather resistance. The boards have to be diffusion-open and have to be able to rebuff moisture.

Wall covering's

Non-Flammable Wood Boards

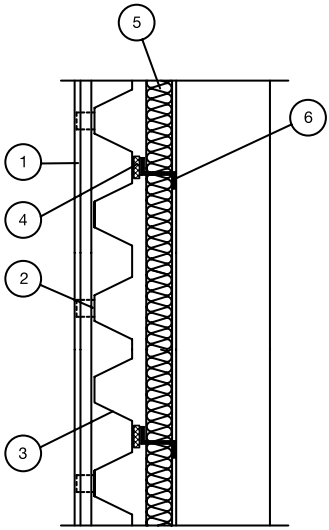
In the area of entrances, emergency exits or due to special building situations, the traditional wooden planking is occasionally unsuitable.

In such cases boards that are converted to non-flammable have proven themselves, in which the attachment of the clips is mainly done via screws. Otherwise the structure reverts to normal performance.

An inexpensive variation for wall construction to carry FalZinc® angled standing seam or double standing seam is the horizontal installation of trapezoidal steel profiles between structural supports in such a way, that the outer face of the trapezoidal profile forms the support surface for the FalZinc®. The clips are fastened directly to the trapezoidal construction using rivets.

This is the construction of a non-ventilated wall system, in which a sufficient degree of air tightness is given through the carefully executed vapour sealing of the overlap of the trapezoidal profile joints.

FalZinc® External wall covering
Vertical section



1 FalZinc® External wall covering
2 Clip
3 Trapezoidal profile
4 Vapour control layer
5 Insulation
6 Distance profile

This offers a wall system using non-flammable rigid board insulation, it is possible to achieve long fire resistance durations, because the wall covering itself, which is made of FalZinc®, is non-flammable and does not contribute to the fire.

In the case of such a structure, the separation layer between the FalZinc® and the deck are not necessary; it has been shown that the movement of the FalZinc® sheets on the upper face of the trapezoidal profile, takes place without jamming even without a separation layer.

Ventilation (two-deck structure)

As for the roof structure, correctly functioning ventilation requires a certain minimum size for the air inlet and outlet openings. In the case of an undisturbed air flow the ventilation will always be effective. Therefore it is important to enable air movement evenly and unhindered. Obstacles projecting into the air space as well as large variances in throat openings are unfavourable, because the air movement will be diminished.

Also to be taken into consideration:

- The utilisation of the building
- Quantity and frequency of incoming moisture
- Length of the distance to be ventilated between incoming (bottom) and outgoing (top) air.

On the basis of practical construction experience, the guideline values listed in the Table 10 below for the dimensioning of facade ventilations are generally agreed on. These values are valid for the lenghts of the distance to be ventilated (between air inlet opening, bottom, and air outlet opening, top) up to approx. 15m.

For longer distances it may be necessary to enlarge the dimensions or to provide other measures.

The values for the unrestricted air inlet and outlet openings stated in Table 10 are the actual dimensions of the openings; if for example perforated sheet metal is used as protection against insects or incoming snow, then the 'clear opening' is the sum total of the holes. In the case of perforated sheet metal that may be less than 50% in some cases.

In the case of wall coverings, the ventilation level is often broken up by windows or light bands. In those cases the wall area up to and from the interruption is always to be regarded as independent wall area, that is, an appropriate connection of the ventilation level to the outside air, has to be provided below and above the interruption.

In order to ensure the necessary ventilation for roof and wall coverings, it is recommended for complicated cases, to have the values examined by a construction physics expert on the basis of calculations.

Table 10: Recommended Minimum Values for Dimensioning of Ventilation

Unobstructed air inlet opening	1/1000 = 0.1% of the wall surface
Unobstructed air outlet opening	1/800 = 0.125% of the wall surface
Unobstructed height of the open air space	min. 2cm, but not smaller than the height resulting from the calculation of the air outlet opening

Separation Layer

Separation layers have various tasks:

- They are meant to separate the metal covering from the support structure, to prevent corrosive influences from aggressive wood protection agents or adhesives and resins attacking connections on the underside of the metal
- They act as temporary weather protection during assembly
- They improve the sliding ability between the FalZinc® wall coverings and the substrate

Due to the physical conditions of wall coverings, the moisture resistance in the case of condensate precipitation on the underside of the sheet metal is of less importance than in the case of unventilated roofs, in particular those with a low pitch. Under normal circumstances a separation layer can generally be left out, if the wood boarding consists of planking and does not contain aggressive wood impregnation agents (see also Pg.32).

In those cases the installation of FalZinc® wall covering can be done immediately on top of the clean, dry wood boarding after any temporary sealing (film or packaging) has been removed.

When a separation layer is ordered, something that is always recommended in the case of plywood panels, the gluing of which is not exactly known, the arrangement of diffusion-open separation layers is recommended, Various manufacturers have developed such layers especially for metal roof and wall coverings. (Layers using distancing methods for air gapping is not necessary). The installation of FalZinc® wall coverings as non-ventilated wall structure on trapezoidal steel profiles or similar elements is generally done without separation layer, especially since the trapezoidal steel profiles as a rule have a coil coated surface, which ensures the free gliding of the FalZinc® on the deck.

Not allowed are moisture-storing separation layers, such as tar roofing paper, felts or cover strips. Not allowed in principle are also the arrangement of several layers of separation layers on top of each other.

Thermal Insulation

The thermal insulation has to be sufficiently stable. Proven are insulants that are characterised as ‘resistant against mechanical vibrations’ and which retain their form when being wet throughout.

General Notes on Execution

FalZinc® wall coverings should be seen as vertically executed roof coverings. The criteria for fastening, ventilation and design of the connections therefore apply correspondingly. Insofar as the connection system is adjusted for it, the sheets can also be installed at an angle to the horizontal.

In general the installation with a pitch of 90° provides particularly good security and minimises the effects of weathering. Metallic coverings are often used as design elements for parts of the overall appearance. That may mean particular requirements with regard to quality of installation as well as due consideration for the increased wind loads found at corners and exposed edges.

Width and Length of Panels

The limitation of the sheets to a maximum of 10m (for 'normal' installations) in accordance with the German DIN Norms and the trade regulations applies to wall coverings. In practise the lengths of the sheets should rarely exceed 9m (corresponding to approx. the height of 3 storeys), because for higher wall areas the covered surface can be divided by the arrangement of cross joints and the resulting design effect can be made use of.

As even minor 'wave formation' may be optically conspicuous in the area of wall coverings, all 'locking-up' and material tension should be avoided from the very beginning by working clean and carefully; according to experience this is easier to achieve if the sheets are not overly long.

The cover width of an installed angled standing seam or a double standing seam is based on the width of the coil minus the part of the seams. Assuming a coil width of 600mm and deducting folding upstands on both sides of 35mm + 45mm = 80mm, the result is a cover width for the standing seam of 520mm for a seam height of 25mm.

If other seam heights are chosen in special cases, the axial dimension will change correspondingly.

For wall coverings as well the minimum height should not be less than 23mm. To a certain degree the width of the seam edges depends on the settings of the folding machine.

Fastening with Clips

The fastening of FalZinc® wall panels is always indirect, that is using clips, which are folded into the connection of the panels.
FalZinc® is fastened using single-part or multi-part clips made of stainless steel (Sheet metal thickness at least 0.4mm).

Fixed clips are required, which fix the panels in the 'fixed clip area' (always at the top) and sliding clips, (arranged in the area lying below it) in such a way, that the temperature expansion of the panels is possible without jamming.

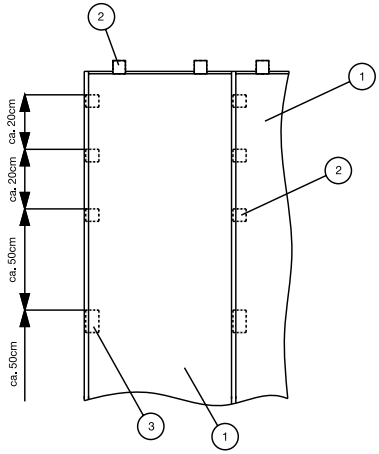
A proven method is to arrange the fixed clips area at the very top (for panel lengths above 5m, consisting of 2 or 3 fixed clips arranged at a distance of approx. 20cm vertical dimension above each other), so that the panels are 'hung' on the fixed clip area and will expand only towards the bottom.

In the case of panel covering (tower covering) with greatly off-set cross joints, the division into fixed clip and sliding clip areas is generally not possible (see Pg.38).

Table 11: Widths of Bays and Coil Widths for Seam Height of 25 mm

Cut width	670mm	600mm	500mm	400mm
Axis dimension standing seam	590mm	520mm	420mm	320mm
Utilised surface part	88%	87%	84%	80%

Fastening of FalZinc® facade panels



1 FalZinc® External wall covering
2 Fixed clips
3 Sliding clips

Design of Clips

In principle FalZinc® is fastened in the wall area using the same clips made of stainless steel as in the roof area. In that the folding of the clips into the seam can be formed very exactly and free of markings.

During the closing of the seams the fixed clips are folded into the seam in such a way that they hold the panel in place without play and do not hinder the temperature expansion perpendicular to the folding direction. Sliding clips are available with sliding distances of various lengths, depending on the pre-calculated temperature movements.

The upper or cross joints of each panel are fixed by additional clips.

Number and Intervals of Clips

The number of clips varies according to the wind loadings on the surface area of the facade and the higher stresses at the corner and edge areas.

As a rule the clips are fastened with at least two clout nails (covering nails) of 2.8 x 25mm, made of stainless steel and with a penetration depth of at least 20mm. Alternatively clips can also be fastened using countersunk head screws of at least 4 x 25mm or approved clamps made of stainless steel.

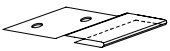
The standard interval between clips is 330mm; even in the case of lower wind loads, this distance should not be exceeded. In areas of greater load the distance may be reduced to 250mm (see also ATV DIN 18339).

Notes on Divison of Panels

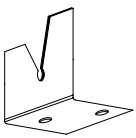
A well planned and well thought-out division of the area will result in a technically faultless execution and an optically pleasing appearance of the high-quality FalZinc® wall covering.

For economic reasons this is often based on the standard width of 600mm, which results in a cover width of 520mm. In the corner and connection areas overall cover widths can be adjusted using adaptor pieces.

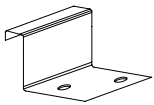
The width of the panels is often determined exactly on the basis of the building structure, so that the seams are adjusted exactly to window lines or are fitted within uniform division between certain lines of the building.



Standard clip



Fixed clip for manual folding work



Fixed clip for machine folding work

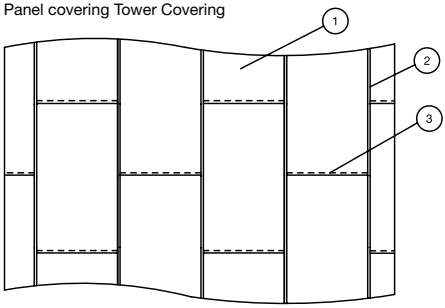
Special cover widths incur addition costs due to waste, but it leads to an especially pleasing appearance.

The length of the panels chosen should not be too long. It is the experience of craftsmen, that even with the most careful handling, the pre-profiled bays are somewhat unstable until they are attached to the facade; bends or undulations, which form during the installation of the bay are extremely difficult to remove or make ‘invisible’.

Notes on Partitioning of Panels (panel covering, ‘tower covering’)

For the panel covering the arrangement of the cross seams is utilised as a design feature. Alternating cross seams are arranged at alternate heights.

Panel covering Tower Covering



1 FalZinc®
External wall covering
2 Angled standing seam
3 Cross seam

The length of the individual elements (panels) is limited, because the longitudinal expansion of the individual panels is always restricted by the adjacent panels (that are arranged at a different height). Traditionally, this type of covering made of sheet metal panels was produced with a length of 2000mm, so that the maximum length of the elements was limited. Even though these days it is theoretically possible to manufacture a panel covering from sheet metal coils of any length - depending on the coil - this no longer corresponds to the classical appearance of this traditional type of covering and may lead to expansion problems under the influence of temperature.

Bays with panel lengths of up to approx. 2000mm can be fastened all around using fixed clips, without jamming due to the short expansion lengths.

6. Connections and Stop Ends for Roof Claddings

Roof Ridge and Eaves Formation
Other Connections and Stop Ends
Installation of External Gutters
Special Characteristics of Internal Gutters
Valleys
Snow Guards

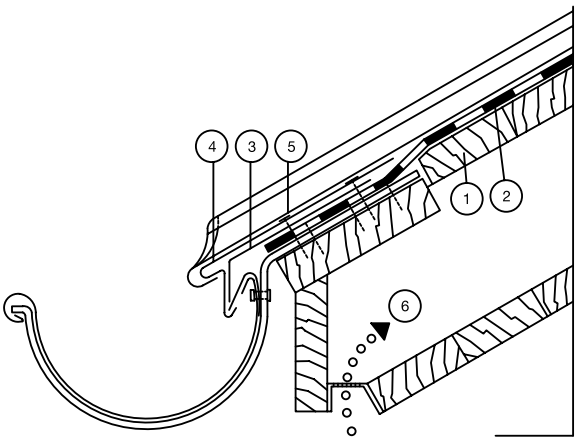
Roof Ridge and Eaves Formation

The design of roof ridge and eaves differs depending on whether air inlets or air outlets are to be provided in the roof ridge or in the eaves. Independent of the design, the panels have to be fastened in such a way that the roof covering is securely fixed for storm conditions. However, at the same time they must be able to accommodate the movements at the stop ends of the panels due to thermal longitudinal changes without jamming.

The necessary movability is determined by the maximum sliding distance, which can be calculated from the distance of the fixed clip area (see also Pg. 36 and 37). In the case of very long panels the sliding distance may go up to approx. 12mm. That means a change of length during an annual cycle of approx. 28mm, which has to be absorbed by the fastening.

For ventilated support structures a sufficient air inlet opening has to be arranged at the eaves and at the ridge, air outlet openings are to be provided. This can be ensured through various constructions, depending on the size of the roof and utilisation of the building.

The feeding of the ingoing air (eaves) always takes place between the rafters, as a rule covered by a facia hung in front of it. Making sure of a sufficient air inlet size has been allowed for during the construction design and the execution of the wood work. For this purpose information should be provided in the list of services and the special importance of the air inlet openings should be well understood.



1 Wood Boards
2 Separation layer, if necessary
3 Fixing strip angle
4 Hanging eaves strip
5 Double standing seam covering
6 Ventilation

The installer shoud satisfy himself, insofar as he is able to without dis-assembly or changes in the prior work, whether the ingoing air situation is as it should be, in accordance with the regulations.

A proven design for the outgoing ventilation on the side of the roof ridge is the formation of a ventilated ridge, which can also be installed as a one-sided variation in the case of lean-to roofs or in the case of a connection of the roof surface to an upcoming wall.

In the case of a ventilated ridge, the arriving panels are to upstand for at least 100mm to 150mm - depending on the incline - vertically along an appropriately formed timber, so that the air will be able to escape via an air outlet opening, formed between the vertical timber and the upper covering.

This air outlet opening will be covered securely against rain and - depending on the exposure - high impact rain. The clear opening should be secured against birds or insects by perforated sheet metal.

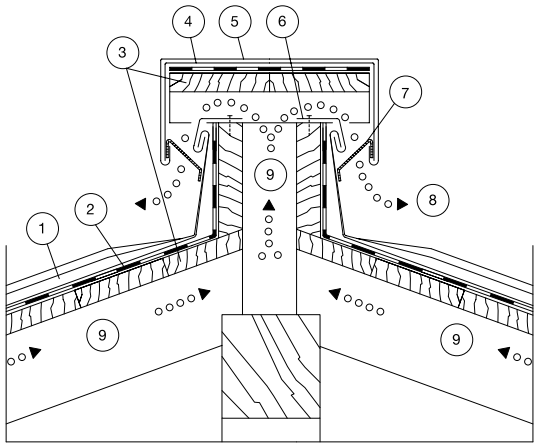
An alternative to the ventilation roof ridge is the installation of smaller individual ventilators (ventilation hoods). However, these can only be installed with a sufficiently good roof pitch in such a way that they are protected against driving rain and snow.

The individual ventilators have to be installed into each rafter field, because they are effective only for the allocated field.

In the case of large roof surfaces (long distances between roof ridge and eaves) it may become difficult to waterproof a sufficiently larger ventilation cowel.

In principle it is possible, to arrange several individual ventilators adjacent to or below each other in a field; however, these point-type ventilation gablets will only be effective, if they are arranged very high up in the pertaining rafter field, that is, just below the roof ridge.

Roof ridge with ventilation roof ridge top



1 Double standing seam covering
2 Separation layer, if necessary
3 Wood board
4 Fixing strip angle
5 Covering flap
6 Clip
7 Holed strip
8 Air outlet opening
9 Ventilated zone

In the case of hipped roofs it is possible to design the ridges, as ventilation hip ridges. Ventilation via individual ventilators is often planned for aesthetic reasons in the case of lean-to roofs. This is the case if the roof areas that run at an angle towards the ridge rafter cannot be connected to the roof area above via recesses in the respective rafter, so that a continuous air stream of the volume required is achieved.

As a rule ventilation hoods are pre-produced in the workshop according to trade regulations. Ready-to-install ventilation hoods are also available, which as a rule are designed for roof pitches 20° and above.

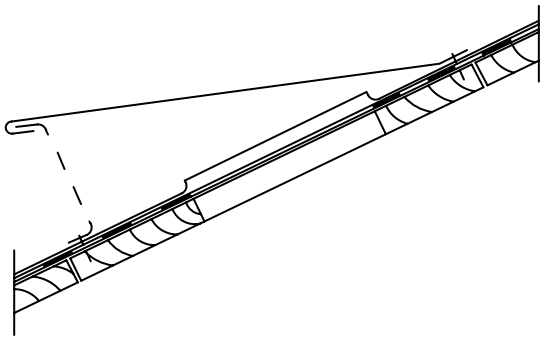
Ventilation hoods are installed into the completed roof surface after the cut-out has been cut through the FalZinc® sheet metal and the boarding,and if installed, the separation layer.

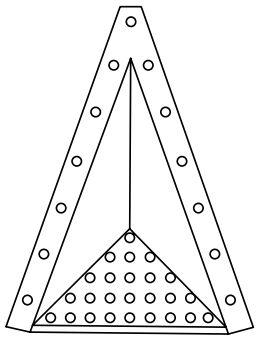
The connection to the FalZinc® roof covering is done with rivets inclusive of sealing washers (see Paragraph 8).

For roof areas without roof ridge ventilation, the roof ridge or the corresponding ridge as well, can be designed with a standing seam (directly folded or a double angled seam with folded-in cover ledge) or with roof ridge ledge, (batten cap arrangement).

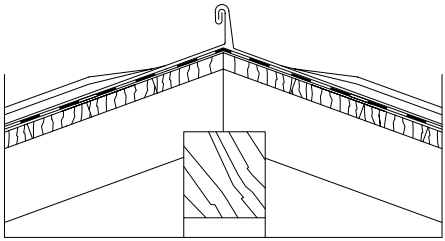
If the panels are symmetrical to the roof ridge line, then the design with roof ridge ledge or as double angle seam is recommended; in the case of direct folding of the panels arriving on both sides, the panels have to be arranged offset (staggered), because otherwise the layers of sheet metal that have to be folded, would become too thick.

Individual ventilator (ventilation hood)

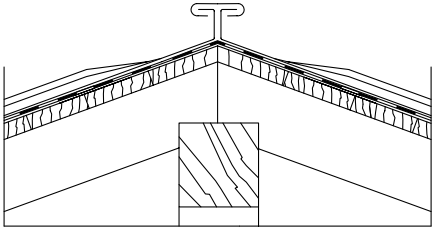




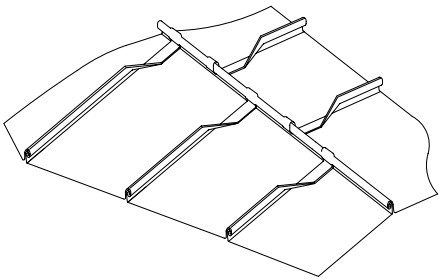
Roof ridge fold (folded directly)



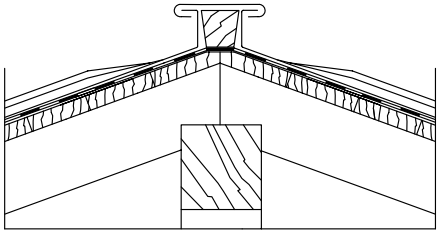
Double angle with covering ledge



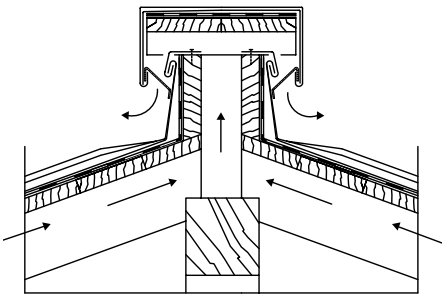
Off-set arrangement of the bays on both sides of the directly folded roof ridge



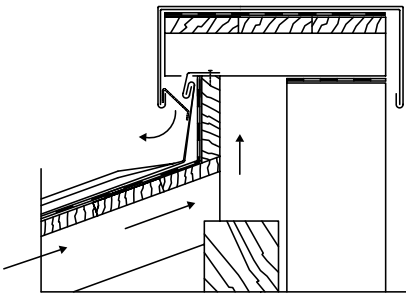
Roof ridge ledge



Ventilation roof ridge (two-sided, standard)



One-sided connection with ventilation (e.g. lean-to roof)



Other Connections and Stop Ends

FalZinc® is suitable for the pre-production of all tinsmith details in a workshop as well as for the production of technically and aesthetically demanding connections, stop ends, flashings, coverings.

The dimensions have to be chosen in accordance with the respective country regulations, the trade regulations of the tinsmith trade and the metal roof trade regulations.

Connections and stop ends produced by craftsmen are produced from FalZinc® with 1.0mm sheet metal thickness as standard. Due to the good forming characteristics this allows the production of very exact edges and components that are stable in their form.

Due to the great strength of FalZinc® with a sheet metal thickness of 1.0mm, it can also be used for 'turned-on-edge' roof ledge stop ends.

In case of doubt Corus will support planners and contractors with the calculation of the details.

Edge Projections, Drip Edges

Often there are discussions about the design of drip edges, which are partly seen as 'design element' and partly as 'a necessary evil' for coverings or stop ends.

Rainwater running off FalZinc® does not produce deposits of conspicuous colour, for example on light brick work, so that the design of the drip edge should be done according to functional points of view. In spite of this it should be taken into consideration, that according to experience, rainwater is not always completely pure, but filters dirt particles from the air and that therefore dirty streaks may be created over time where rain drainage tends to be concentrated.

Independent of the installation situation and the height of the construction, ATV DIN 18339 stipulates a distance from the drip edge to other elements of at least 20mm. Based on practical construction experience the following projections should be chosen:

Table 12: Recommendations for Formation of Edge Projections

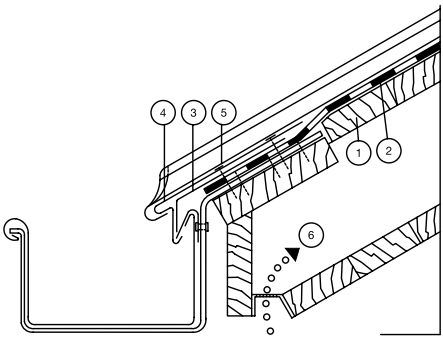
Height of Building	Distance of drip edge from brick work	Height of projection or covering
up to 8m	20-30mm	> 50mm
over 8m up to 20m	30-40mm	> 80mm
over 20m	40-60mm	> 100mm

Installation of External Gutters

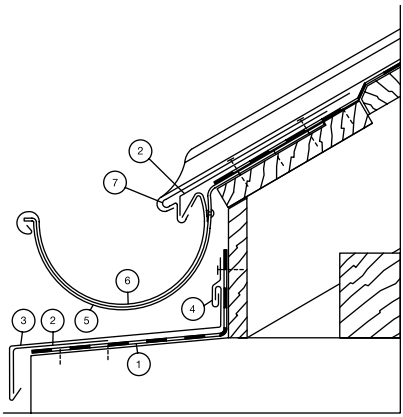
The normal case for roof areas pitched outward is the arrangement of an external gutter (hanging gutter), the dimensions of which are standardised in accordance with DIN EN 612. There are no general regulations as to how external gutters have to be arranged, because the height of the eaves, as a rule is determined in accordance with regional tradition and the preference of the designer. The gutters are arranged in such a way that rainwater running off from the roof surface is collected to the greatest possible degree. For semi-circular or box gutters, the rear edge of the gutter always has to lie 10 to 15mm higher than the front edge of the gutter, so that overflowing water flows off towards the front.

External gutters are fastened to the eaves using gutter holders (brackets). The gutter holder are fastened to the eaves board with at least 2 fasteners. In order to avoid an unsightly sag in the line of the gutter and also in order to ensure the unimpeded flow of water even in the case of roofs with a low pitch, the gutter holders should be installed flush in the eaves board.

The connection between the roof surface and the gutter forms the eaves detail. The eaves drip is meant to guide the rain water into the gutter and can be hung into the water fold of the gutter. The installation of eaves strips is not generally stipulated; there are regions where eaves strips are stipulated on principle as well as regions where eaves strips are mainly left out. In the case of roofs with a low pitch, the use of eaves strips is recommended in order to protect the support structure. Preferably, they are to be executed as overlapping eaves strips that are fastened with clips. In exceptional cases and in particular in the case of shorter lengths, the eaves details may also be fastened with nails, if the fastening with clips is too difficult.



1 Wood boards
2 Separation layer, if necessary
3 Fixing strip angle
4 Flashing eaves strip
5 Double standing seam cover
6 Ventilation



1 Separation layer, if necessary
2 Fixing strip angle
3 Cornice cover
4 Clip
5 Gutter holder
6 Gutter
7 Eaves strip

Special Features of Internal Gutters

For roof areas that are pitched inwards, (butterfly roofs) internal gutters can be arranged as a 'gutter box' or for lean-to roofs. Thus they form a part of the roof covering and therefore are to be executed with particular care and must be long lasting.

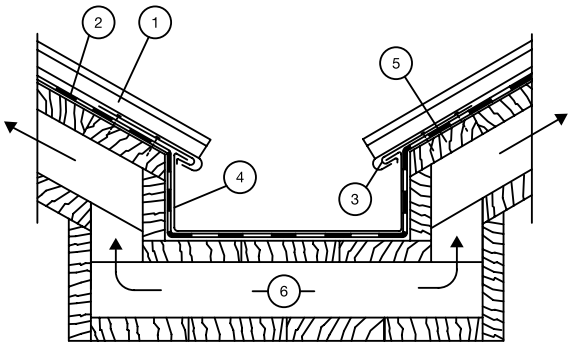
When planning internal gutters it has to be ensured that no backed-up water can penetrate into the building, even in unfavourable weather conditions (strong rain, strong wind) or for example in the case of the outlets becoming blocked (clogging of a drain; snow, ice).

The connection of the gutter to the roof cannot be fully sealed against backing-up, because the gutter as well as the roof covering have to be fastened in such a way that temperature movements are not impeded. Therefore sufficient depth needs allowing with the inclusion of 'weiss' or overflows set to drain before the gutter to the roof detail were to become flooded.

Internal gutters always require special planning of details, because

- They are a part of the roof covering that is susceptible due to its low incline or completely horizontal position
- They have to be accessible for maintenance and inspection
- They often are heat conductors due to their arrangement
- The ventilation level often has to be omitted below the trough, which requires addition construction height.

Internal, trough-type gutter with double standing seam on both sides with continuation of the ventilation under the gutter.



1 Double standing seam cover
2 Separation layer
3 Eaves strip or fixing strip
4 Valley gutter
5 Boarding
6 Ventilation

Valleys

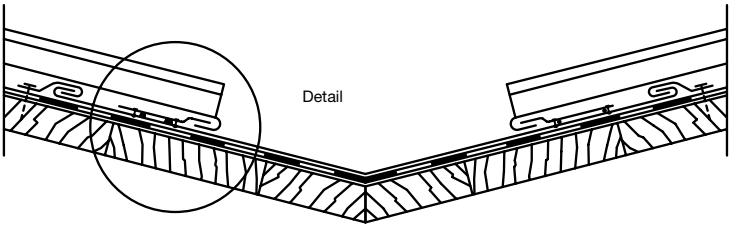
Valleys always have to lie completely flat on the support structure. They form a part of the roof covering, but have to be connected to the roof surface whilst allowing for lateral movements, so that the expansion of the panels that run at right angles towards the valley are not impeded. On both sides valleys have to be executed with water tight folds. Below 15° the overlap of the roof panel to gutter has to be a minimum of 100mm and be watertight using off-set riveting and sealant.

The roof pitch determines the method to be employed in connecting the panels to the valley gutter. Various connection methods can be employed in accordance with rules for cross joint connections.

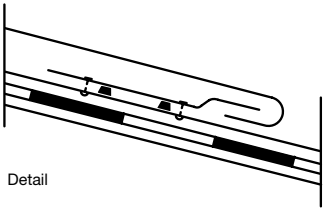
Snow Guard

If snow guards are planned due to local construction regulations or because sliding masses of snow may endanger passer-by, then the snow guards have to be fastened on the standing seams, using clamping systems. Similar clamping systems are also available for retaining methods, which hold back sliding snow and are aesthetically less conspicuous.

Fastening systems that are screwed through the roof covering into the support structure are not suitable, because those fastenings obstruct the necessary temperature expansion of the FalZinc® roof covering.



Tight-folded valley panel with additional fold



Detail

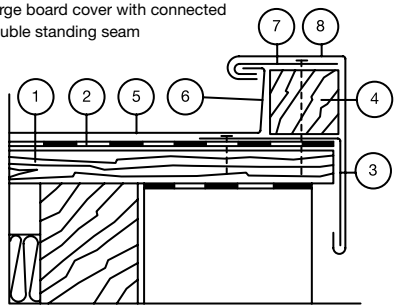
7. Aprons and Coverings

Types of Designs
Taking into Consideration Temperature-Related Changes in Length
Installation Notes
Accessory Parts for Coverings and Aprons – Terms, Short Explanations

Types of Design

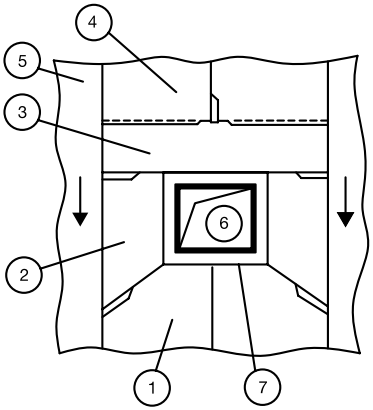
Aprons and coverings are generally complicated construction parts, because they have to create watertight connections between the construction parts and at the same time have to ensure the movability without jamming in the case of temperature-related expansion. Allowances must be made for the fact that projections and details are not always ideally placed and warrant 'care' when setting out.

Verge board cover with connected double standing seam



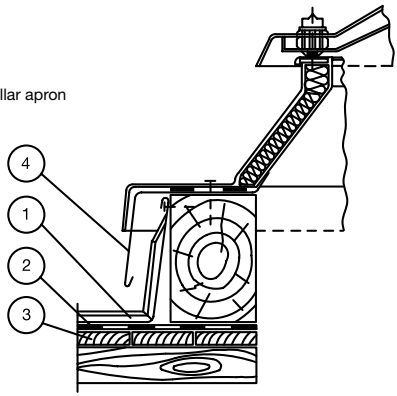
1 Wood board
2 Separation layer, if necessary
3 Fixing strip angle
4 Wood ledge
5 Double standing seam cover
6 Edge upstand
7 Clip
8 Verge board cover

Chimney connection (Top view)



1 Apron
2 Sidings
3 Valley gutter
4 Upper connection bays
5 Side connection bays
6 Penetration
7 Wood roll

Collar apron



1 Double standing seam cover
2 Separation layer, if necessary
3 Wood boarding
4 Cover

The profiles for aprons and coverings are manufactured individually for the project in question, using coil and flat sheet material.

Aprons that are manufactured on site, are often executed in 0.7mm thick sheet metal. Coverings and other edge parts and profiles that can be pre-produced in the workshop are often manufactured from 1.0mm sheet metal, even though they may be produced from 0.7mm thick sheet metal, if the cuts are not too wide.

It is generally recommended to choose the sheet metal as thick as possible for those construction parts that are highly visible, because that way a particularly good inherent stability is achieved.

Table 13: Sheet Metal Thicknesses Based on Experience

Construction part	Type / Dimension	Rated Sheet Metal Thickness
Coverings	Cut < 400mm Cut ≥ 400mm	0.7mm 1.0mm
Aprons		0.7 mm, 1.0mm
Connections		0.7 mm, 1.0mm
Fixing strip sheet metal		1.0mm

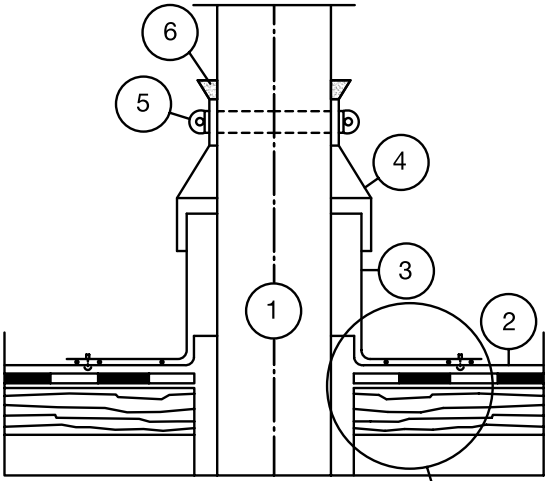
Taking into Consideration Temperature-Related Changes in Length

Due to temperature changes there are constantly alternating movements. Roof coverings that are subject to sun radiation to an especially high degree, have to be able to absorb and compensate for thermal changes in length without this resulting in tension or deformation. This condition applies in particular for all connections and stop ends, because roof surface have to be connected to rigid construction parts.

Such rigid construction parts are light cupolas, the crown collar of which has to be firmly anchored to the support structure, chimneys, rising walling etc., but also cut-outs through the roof surface, e.g. for ventilation pipes.

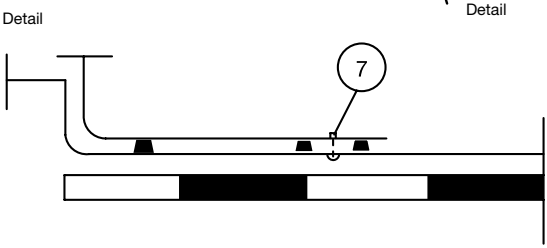
For the apron of light copulas or connections to walling, sufficient movability needs to be created by establishing sufficient expansion possibilities between the upstand and the fixed connection.The locations of pipe cut-outs are often arranged on the roof so that it is difficult to take these points into consideration when distributing the sheets.

If it is not possible to take the location of the cut-outs into consideration, then the connection of the cut-outs may have to be raised from the water-carrying level by building a small podium around the cut-out, which in turn can be skirted in accordance with the regulations.



1 Pipe lead-through
2 FalZinc® roof covering
3 Lower apron
4 Upper apron
5 Clamp
6 Sealing
7 Aluminium cup type rivet

Detail



Constructive measures for compensating temperature-related expansion are:

- Planning of the expansion possibilities, e.g. through indirect fastening (sliding clips, roof cap sheet metal, delaprene expansion material etc.).
- Adherence to the minimum sheet metal thicknesses and recommended sheet metal thicknesses in accordance with Table 13.
- Creation of movable connections to rigid installation parts (e.g. pipe cut-outs of the roof surface) or for adjacent roof surfaces, which have different expansion directions (e.g. roof surface of a dormer).

In special installation situations, where the expansion possibilities have to be defined more exactly, the expected change in length has to be determined by calculation.

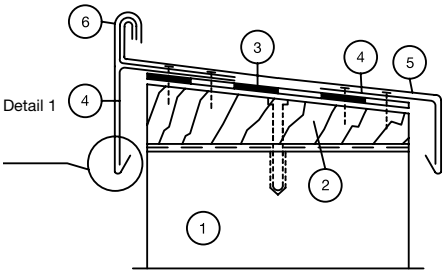
Basis for the calculation is the panel or construction part length, expansion coefficient and temperature difference to the installation temperature. In this a temperature difference of 100, that is a temperature variation from -20°C to +80°C has to be assumed.

Installation Notes

Special accessories and support structures are used for the assembly of the apron and connection sheet metal coverings as well as for their connections.

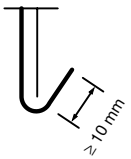
Wall coverings are in principle fastened indirectly, unless in exceptional cases direct fastening through screws with sealing or something similar is chosen in the case of very short lengths (up to a maximum of approx. 2m).

Coverings can be fixed using continuous adhesive strips or fixing strip angles, which are firmly fixed on the support structure, by bending the lower edge of the covering sheet metal around the adhesive strip or fixing strip in such a way that the lifting off is made impossible even in a storm. On the other hand a sliding movement in the longitudinal direction of the construction part must not be impeded.



1 Crest of wall
2 Wood board
3 Separation layer, if necessary
4 Fixing strip angle
5 Covering profile
6 Front apron

Detail 1



For level, firm supports, gluing with permanently elastic adhesive material is also possible. The soft-plastic adhesive material allows expansion movements due to its elasticity (see also Chapter 8 concerning this).

If timber is used, it has to be impregnated against rot and pests. Edge boards and dowel strips are to be firmly anchored in the supporting structure.

The interconnection of coverings also has to be done so that there will be no jamming in the case of temperature expansion. Expansion compensators (standing seams, sliding possibilities, inserted delaprene expansion material) have to be installed every 8m in accordance with ATV DIN 18339 (Germany).

For aprons within the water level, delaprene compensators have to be provided every 6m, for aprons, connections and stop ends above the water level every 8m. Half of the distance is to be maintained from corners and edges, which may hinder the longitudinal expansion.

Cut-outs in roofs and coverings, e.g. due to chimneys, roof windows or pipe cut-outs are to be skirted and rainproof with the covering or are to be connected in a movable fashion. In accordance with the recommendations of the tinsmith trade, a distance of at least 20cm should be maintained for this between the cut-out and the connection of the panels (longitudinal fold, cross fold).

Gradient

Wherever possible coverings and aprons are to be installed in such a way that water runs off and cannot remain stagnant. Wall copings should have a 'back fall' of 2° to 3° in such a way, that the water runs off to the side of the roof. How the gradient is to be created in each individual case depends on the type of design of the support structure.

Separating Layer

As protection against damaging influences from contact with other construction materials (e.g. fresh mortar and concrete, aggressive wood protection agents) coverings, aprons and connection sheet metal are generally separated from the decking by an intermediate layer of glass fleece bitumen roof band or other suitable separation layers.

Edge Design, Drip Edge

For the design of coverings and the design of edges it has to be observed that the rainwater that is running off contains dirt particles washed out of the air, which may lead to the soiling of parts of the building below (see Pg. 50).

The edge of the panels is executed as a drip edge, which apart from the draining of the water also serves to make the edge of the sheet metal edge more rigid.

Accessories for Coverings and Aprons – Terms, Short Explanation

Clips

Clips are fastening elements for the indirect fastening of FalZinc® coverings, aprons and connections on the support structure. This enables changes in the length caused by temperature, without allowing moisture to penetrate into the support structure.

Particular careful fastening of the clips and roll caps on the support structure achieves the desired high retention values (wind stress) in the area of the eaves as well as on gables and roof ridges. Normally clout nails of stainless steel, minimum 2.8 x 25mm, are sufficient for the fastening of the clips.

The most important designs considerations are:

Standard Clip:
For the hanging of edge sheet metal, moulding coverings etc.

Plate Clip:
For holding down of smaller aprons, allowing for movement of a sheet metal edge.

Trapezoidal Clip:
For securing wall connections and edge sheet metal against sliding off. Its teeth alternately grip above and below the sheet metal.

Tapered Wing Clip:
In the case of sliding and soldering joints of wider wall and moulding coverings it prevents the flapping under wind attack and enables the (working) of the covering sheet metal in longitudinal and cross directions.

Strip Clip, Clip Strip:
Continuous clip strip for hanging up of edge sheet metal that are subject to greater stress.

Fixing Strip Profiles
Fixing strips are turned on edge from FalZinc® or aluminium sheet metal of at least 1,0mm or in the case of special stresses, zinc-coated steel sheet metal (0,8mm or 1,0 mm). Fixing strip sheet metal hold down the covering in the area of the drip edges, ensure good edge and surface area stability and allow thermal changes in length. Depending on the width of the surfaces to be covered, they are installed on both sides in the edge area or cover the top of the wall across the entire width. The fastening on the support structure is done with nails or by screwing them to the edge board.

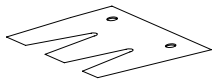
Counter Flashings
Counter flashings of upstands should be securely fixed and sealed to the upstand of the structure.

Support Structure
In principle various types of support structure are possible; however, a pre-condition is always that the support structure is sufficiently stable, does not include corrosive components, is constant and stable in its form even under the influence of moisture and that the clips for the fastening of the panels can be affixed with a sufficient degree of security.

Support Structure Boarding (Standard Case)
The boarding is produced from dry (≤ 30 % moisture) pine wood, unfinished, parallel trimmed, at least 24mm thick, width of boards 8 -14cm.

All constructional pecularities, e.g. recessed valleys, troughs, air inlet and outlet openings, gradient jumps, verge flashing and roof ridge ventilation are to be stipulated during planning and are to be discussed and agreed on with the contractor. Anchoring on the construction is to be ensured in accordance with DIN 1055.


Standard Clip


Trapezoidal Clip

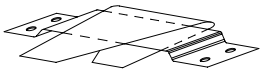

Trapezoidal Wing Clip


Plate Clip

8. Processing of FalZinc® Sheet Metal and FalZinc® Accessories

FalZinc® has to be folded, edge-formed, cut, turned on edge, profiled, using established processing and handling techniques of the trade. For all types of processing, the protective film should only be removed after the processing, in order to prevent abrasion of the surface.

When FalZinc® sheet metal is exposed to weather, the protective film must be removed imediately because the film becomes brittle after prolonged exposure to UV radiation and will become difficult to remove. The protective film has to be removed at the latest 2 months after the delivery of FalZinc® .

The following types of fastening are available for the installation of FalZinc® sheet metal and accesssories.
- indirect fastening using clips, fixing strips etc.
- direct fastening using screws, clamps, nails.

Indirect fastening is a movable and expansion-compensating connection using, for example, clips and clip strips, fixing strip sheet metal or angles for securing edges, coverings and stop ends.

Direct fastening is a rigid, fixed connection, which is executed with clout nails, screws, nails or clamps. Area-wide gluing using longlife flexible adhesive is only to be seen as expansion-compensating fastening under certain conditions, it does not provide free movement. Irrespective of what type of fastening is used for a particular situation, the unimpeded longitudinal expansion due to temperature changes always has to be ensured. ATV DIN 18339 specifies unimpeded expansion within the temperature range of 100K (-20°C to +80°C). Rigid fastening would definitely lead to jamming and thus to damage. Guideline values for the maximum intervals between expansion allowance are shown in Table 14.

Table 14: Guideline Values for the Maximum Intervals between Expansion Allowances

Installation Situation	Maximum Interval
Directly fastened or lflexible adhesive coverings and flashings	approx. 3m
Aprons adhered at the water level, valley gutters, corners and junctions	6m
Valley gutters	6m
Indirectly fastened wall coverings, roof edge ends above the water-dispersing area internal, non-adhered gutters with sheet girth of > 500 mm	8m
Max. panel length of wall coverings with particularly high requirements for evenness internal, non-adhered gutters with sheet girth of > 500 mm	6 to 8m
Externally hung gutters (“hanging gutters”) with sheet girth of > 500 mm	10m
Max. sheet length for roof coverings and external wall coverings without special measures	10m
Externally hung gutters (“hanging gutters”) with sheet girth of > 500 mm	10m
Max. sheet length for roof coverings with special long sliding clips and special eaves point and roof ridge fastening	approx. 15m

The distances apply to the expanded length; in the case of a restriction to the expansion, e.g. at corners or projections, half the values have to be taken respectively.

Adhering of FalZinc® Construction Accessories using Gluing Agents

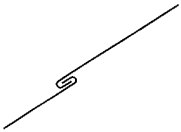
The adhering of accessories made of FalZinc® using suitable adhesives that have been tested for that use is well established. Used are adhesives such as Enkolit (Manufacturer: ENKE-WERK Johannes Enke KG, Düsseldorf, Germany) or similar, which are adjusted for long-term elasticity and have good adhesiveness.

Fastening via adhesives is used especially in horizontal areas or areas with a slight incline, such as window sills and wall coverings .

Due to its long-term elasticity, temperature-related movements of the adhered parts are possible within limits.

The high degree of adhesiveness guarantees the firm hold of the FalZinc® construction components on cement mortar, concrete, brick work etc. The use of adhesives requires a level, firm substrate, which has to be clean, free from dust and dry. In corners, adhered connections of coverings that are jutting out are to be secured until the adhesive has hardened.

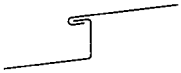
Connecting of FalZinc® Sheet Metal and FalZinc® Accessories



Simple cross fold
Roof pitch
≥ 47 % (25°)

Simple cross fold
with additional fold
≥ 18 % (10°)

Double cross fold
Roof pitch
≥ 13 % (7°)



Drip
Roof pitch
≥ 5 % (3°)

Folding:

Depending on the design of the folds, the temperature-related changes in the length of the sheet or the accessories are absorbed.

FalZinc® can be formed across a wide range of temperatures; therefore there is no particular temperature limit for the carrying out of seaming work. For reasons of safety for the operative it is recommended not to carry out site work at temperatures below 0°C.

Cross Joints

Cross connections facilitate increased sheet length whilst absorbing thermal movement to allow projections or just for reasons of design. The design of cross connections is, as a rule, rainproof. In certain cases, subject to the gradient of the roof, additional sealing measures may become necessary. An overview of the cross seams can be found in Table 5 on Page 17.

Simple Overlap:

This type of cross connection is only used for flashings. In the area of the roof, this type of connection may only be executed in the case of a roof gradient of ≥ 30° with a minimum overlap of 100mm.

Simple Cross Fold:

The minimum cover for a simple cross fold is 40mm. This type of cross connection may be used for roof gradients ≥ 25°.

Double Cross Fold:

The double cross fold is the standard connection for panel coverings. The double cross fold can be executed with and without sealing strip. The minimum overlap is 40mm.

Gradient Level:

For a stepped transverse joint as illustrated on Page18, the upstand must be a minimum of 60mm. If a ‘tapering’ fillet is to be used for the step, the minimum pitch must still be maintained.

Longitudinal Joints
Longitudinal connections serve the connecting of adjacent sheets, the receiving of fastenings as well as the compensation for lateral expansion caused by temperature.

Standing Seam:
The connection is executed by the folding of the higher edge. The main wind direction should be taken into consideration in the folding direction. The height of the seams in their finished state has to be at least 23mm; common folding heights are 25mm.

Simple Horizontal Fold:
Here the connection is achieved through the interlocking of opposing turned edges. The width of the seam should, depending on the amount of incoming water, be at least 35mm long. The fastening is done by clips and clip strips hung into the turned edge of the underlap.

Double Standing Seam:
For a double standing seam two adjacent sheets are connected by turning over of the edges twice, with the edges having different heights. The seam is closed in such a way that no cut edge is visible.

Angled Standing Seam:
For the angled standing seam the connection is effected by the simple turning over of the higher panel upstand and subsequent turning over of the fold at a right angle to the edge.

Ledge Seam:
The ledge seam is produced by the folding in of ledges from panel upstands and adding a ledge cover. Normally, the ledges have a width of 40mm. The ledge strongly emphasises the structure of the surface.

Welding
FalZinc® sheet metal can be welded, even at the construction site. However, they should only be welded by specialists, who have been trained in the welding of thin aluminium sheet metal.

Even though the zinc coating is removed at the seam, it is recommended not to retreat the narrow weld afterwards.

If it is absolutely necessary, then the weld alone should be coated with the colours RAL 7023 or 7030, using a fine brush. Under no circumstances should a spray can be used. Consideration should be given to the impact of the welding to the material immediately beneath it.

Riveting
The joining of FalZinc® sheet metal using blind rivets is a frictional method, which, with sealing inserted, can also be used within the water-carrying level.

The combination of aluminium alloy / stainless steel is considered a corrosion-resistant combination of materials for rivets / spikes and other fittings.

In order to create a watertight connection, the rivets have to be set in two lines, offset against each other and with sealing inserted.

Screws
Countersunk head screws can be used for the fastening of clips in the wooden support structure. For FalZinc® screws made of stainless steel are used. Two screws are used for each clip.

Clamping
Clamps are allowed as alternatives to screws and nails for the fastening of clips, provided they are used with care. Clamps are to be made of stainless steel with a wire diameter of 1.5mm.

A minimum distance of approx. 5-8mm is to be maintained between the individual clamps. The pull-out resistance of the clamps is dependent on the moisture of the wood and therefore it is recommended to use more clamps for wood moisture contents of over 25%.

Nailing
For FalZinc®, nails (valley nails, clout nails, nails for tarred felt) made of stainless steel are used for the fastening with clips. Clips fastened with two nails achieve an average pull-out value of more than 500 N. The nails can be hammered or inserted using air pressure nail guns.

Adhesives
Pre-condition for the permanent adherence of Falzinc® is the preparation of the surfaces in accordance with the recommendations of the manufacturer of the adhesive.

In practice the products 'Sikabond-T1' and 'Sikabond-T2' have proven themselves. (Sika GmbH, Kornwestheimer Str. 103-107, 70439 Stuttgart / Germany).

Using these moisture-hardening polyurethane adhesives for example, the gluing of valleys as well as the attachment of ventilation hoods, can be carried out simply and safely. However, if the stresses on the construction components to be joined are higher, then additional rivets are recommended.

Cleaning and Protection from Dirt
Finished surfaces are to be protected against dirt and damage by subsequent construction. For a short period of time the protective film applied at the plant can be left on the material (outside of the areas that are worked on), if there are no special weather conditions to be taken into consideration.
However, it has to be taken into consideration that after some time the protective film will become brittle when exposed to UV radiation. When that has happened the removal of the film becomes difficult.

Variations in temperature may also cause the formation of condensation under the film (which is not impervious), which will cause marks on the high-quality metallic coating after a short period of time. Therefore the surfaces should be protected in such way that moisture caused by changes in weather or temperature can quickly dry off in the way that the alternation between getting wet and drying off also takes place in the course of the normal use of roof coverings, flashings and trims respectively.

If dirt has accumulated or marks developed in spite of this, cleaning will be possible in principle, but often is difficult, time-consuming and cost-intensive. If the dirt or marks cannot be removed by rinsing with clear water or spraying with a strong water jet, the type and cause of the dirt should be determined in order to chose suitable remedies.

For the cleaning of small areas the spray cleaning agent 'Rotanium Multi Stripper 34402' (Manufacturer Premier Industrial Deutschland GmbH, D-47877 Willich) has proven suitable. The cleaning agent must be used only in accordance with the specifications of the manufacturer and by observing the stated safety measures. It is recommended to rinse cleaned surfaces thoroughly with cold or lukewarm water.

Appendix

Standards and Regulations
Trade practice and experience are supplemented by stipulations in standards and trade rules, which apply to construction applications of aluminium in general or to all “construction metals”.

Due to its characteristics that are optimised for construction, FalZinc® can often be used within a wider area than defined by standards and trade regulations.

Corus has tried and tested system solutions, which take into consideration the special characteristics of FalZinc®. If standard and regulations do not (yet) provide information for a particular type of application, because the revision and advance development of standards is very time consuming, specifiers and contractors should contact Corus.

DIN EN 485	Aluminium and Aluminium Alloys; Coils, Sheet Metal and Panels
DIN EN 573	Aluminium and Aluminium Alloys – Chemical Composition and Form of Semi-Finished Products
DIN EN 612	Hanging Gutters and Rain Down Pipes made of Sheet Metal; Terms, Division, specification
DIN 1052	Wooden Structures, Calculations and Execution
DIN 1055	Load Assumptions for Buildings
DIN 4070	Cross Section Dimensions and Statistical Values for Cut Timber
DIN 4074	Quality Conditions for Construction Timber
DIN 4102	Fire Behaviour of Construction Material and Construction Components
DIN 4108	Heat Protection in High-Rise Buildings
DIN 18165	Fibre Insulation Materials for the Construction Industry, Insulation Materials for Heat Insulation
DIN 18202	Dimension Tolerances in High-Rise Buildings
DIN 18334	Room and Wood Construction Work
DIN 18338	Roof Covering and Roof Sealing Work
DIN 18339	Tinsmith Work
DIN 18516	Part 1, Outer Wall Coverings, Ventilated
DIN 48801	Wires and Screws for Lightning Protection Installations; Dimension, Material, Execution
DIN 68800	Wood Protection in High-Rise Buildings
DIN V EN V 61024	Lightning Protection of Construction Installations

ZVSHK Guidelines for Wall Coverings with and without Support Structure (ZVSHK, St. Augustin)

ZVSHK Guidelines for the Execution of Metal Roofs – Outer Wall Coverings and Construction Tinsmith Work (Tinsmith Trade Rules) (ZVSHK, St. Augustin)

ZVDH Guidelines for the Planning and Execution of Roofs with Sealings (ZVDH, Cologne)

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