RHEINZINK®

STANDING SEAM TECHNOLOGY

Installation Guideline

Design and Application

16th Edition, November 2017

1. Material

1.1 Introduction

This booklet is an important guide for everyone working and designing with RHEINZINK. It is a valuable addition to other planning documents, both at the construction site and in the office. Included in this booklet are basic installation techniques and standard details, along with tables, which must be followed for the proper installation of RHEINZINK.

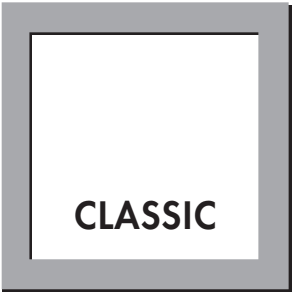
These installation instructions cannot allow for all structural problems or special solutions and do not preclude independent thinking or actions. This booklet provides basic comprehensive information about the material for both the novice and the experienced tradesman or architect. It also serves as an excellent reference book for standard roof and curtain wall standing seam systems.
Country-specific deviations from standards, guidelines and tables, are summarized in Chapter 8.

To give you more design freedom, we offer our material in four different product lines and in numerous finishes. You get the perfect solution for every requirement with the trusted RHEINZINK quality. All products meet the high standards of EN 988 and the QUALITY ZINC criteria of TÜV Rheinland. The high level of manufacture is guaranteed by constant inspections and extensive laboratory tests. We have summarised the characteristic features of our four product lines on this double page. On request, we will gladly send you samples of materials.

Remaining Values

With a service life that spans several generations, RHEINZINK is a material that sets news standards. The 30-year guarantee highlights the durability of the 100 % recyclable material. This offers additional protection.

1.2 Product Lines



RHEINZINK-CLASSIC
The natural material in its most original form

RHEINZINK-CLASSIC is the most original of all material options. The bright rolled version has proven itself for over 50 years of application. Depending on the weather conditions, over time a typical blue-grey patina is formed on the naturally shiny metallic surface. The patina gradually becomes more and more distinctive and develops a unique surface character.

Surface quality:
RHEINZINK-CLASSIC®
bright rolled

RHEINZINK-artCOLOR
Unlimited design in a variety of colours

RHEINZINK-artCOLOR is the coloured version for roofing and facade cladding. A durable coating allows a wide range of colours and opens up a variety of design options for architects, planners, builders and trade customers. Classically elegant, contemporary avant-garde, contrasting or tone-on-tone. If you have a special colour requirement, we will be happy to produce RHEINZINK-artCOLOR in the shade of your choice.

Surface qualities:
RHEINZINK-artCOLOR® anthracite
RHEINZINK-artCOLOR® pure-white
RHEINZINK-artCOLOR® pearl-gold
RHEINZINK-artCOLOR® moss-green
RHEINZINK-artCOLOR® nut-brown
RHEINZINK-artCOLOR® blue
RHEINZINK-artCOLOR® tile-red

prePATINA

THE WORLD'S ONLY NATURALLY PRE-WEATHERED SURFACES

Only RHEINZINK has a special process in which the blue-grey or graphite-grey colour of the natural patina is achieved naturally in production. As the inventors, we called this unique pickling process "pre-weathering". Virtually imperceptible to the human eye, atmospheric influences over time create a natural protective patina that reliably protects the product. In production, any use of artificial coatings, varnishes or phosphat-

ing is avoided completely. The prePATINA line products are the only ready-made natural surfaces in the entire global zinc construction market.

Surface qualities:
RHEINZINK-prePATINA®
blue-grey
RHEINZINK-prePATINA®
graphite-grey

Natural weathering compensates for any installation-related scratches. Only the RHEINZINK-prePATINA and the RHEINZINK-CLASSIC lines offer this self-healing effect. They are environmentally friendly and absolutely maintenance-free.

100 % SELF-HEALING
100 % MAINTENANCE-FREE
Only available from RHEINZINK

1.3 Alloy and Quality*

According to DIN EN 988, RHEINZINK material is titanium zinc. RHEINZINK alloy consists of electrolytic high-grade pure zinc with a purity of 99.995 %, conforming to DIN EN 1179. The alloy has exact percentages of copper and titanium.

RHEINZINK products are certified according to DIN EN ISO 9001:2008 and are subject to voluntary testing by TÜV Rheinland Group (the relevant local inspection and monitoring body) according to the stringent requirements of the Quality Zinc Criteria Catalogue *(available upon request)*.

1.4 Ecological Relevance**

RHEINZINK is a natural, 100% recyclable material that has always complied fully with today's strict ecological requirements. The latest production facilities, sophisticated logistics and favourable processing properties are available. Environmentally-conscious action is documented through the introduction of the environmental management system ISO 14001:2004. It is checked and certified according to TÜV Rheinland. We also document responsible action in regard to the environment through the introduction of an energy management system according to ISO 50001:2011. It is our intention to save as much energy as possible, to save resources and to keep the environmental impact of our products as low as possible.

* *RHEINZINK – Applications in Architecture Chap. I. 2.2*

** *RHEINZINK – Applications in Architecture Chap. I. 2.1*

1.5 Aspects of ecological Assessment

According to the holistic assessment from the Institute for Construction and Environment e.V., RHEINZINK is declared an environmentally friendly construction product according to ISO 14025, type III (EPD) and EN 18504 „Sustainability of construction works. Environmental product declarations". The examination of the environmental and health compatibility criteria also includes the entire life cycle of RHEINZINK products, from the raw material extraction to processing and use to recycling and disposal. It is based on a life cycle assessment according to ISO 14040 (LCA) *(please request the certificate free of charge)*.

1.6 Electromagnetic Radiation is safely shielded

There is much public controversial debate about electromagnetic radiation. The International Society for Electrosmog Research (IGEF e.V.) has provided information here on RHEINZINK's shielding properties. The result: Over 99% of electromagnetic smog present is shielded. Biological measurements on people confirm the technical measurements and show a harmonising effect on heart, circulation and the nervous system. Body relaxation increases.

Environmental Profile Scheme
ENP 453

1.7 Marking

A: RHEINZINK sheets and coils:
Recognisable by the consecutive coloured stamping on the metal underside.

B: RHEINZINK-Palette Identification:
Recognisable by the packaging label with detailed product data

C: RHEINZINK-Roof Drainage Accessories:
Recognisable by the brand embossing.

D: RHEINZINK-Roof Drainage Products:
Recognisable by the brand embossing

A

B

C

D

1.8 Material Properties

- Density (spec. weight) 7.2 g/cm³
- Melting point approx. 420 °C
- Expansion coefficient *: in a longitudinal rolling direction: 2.2 mm/m x 100 K in a transverse rolling direction: 1.7 mm/m x 100 K
- Typical joining techniques: seaming, soft soldering, bonding, screwing, riveting
- Non-magnetic
- Non-combustable
- Electromagnetic radiation shielding
- Recyclability 100 %
- High recycling rate
- Assured material cycle
- Environmentally compatible (EPD)
- Natural material
- Low energy use
- Long service life
- Vital trace element
- Extensive resources

Metal thickness (mm)	Weight (kg/m²)
0.70	5.04
0.80	5.76
1.00	7.20

Metal thickness mm	Nominal size (girth)								
	1000	670	600	500	400	333	280	250	200
1.20	8.64	5.79	5.18	4.32	3.46	2.88	2.42	2.16	1.73
1.00	7.20	4.82	4.32	3.60	2.88	2.40	2.02	1.80	1.44
0.80	5.76	3.86	3.46	2.88	2.30	1.92	1.61	1.44	1.15
0.70	5.04	3.38	3.02	2.52	2.02	1.68	1.41	1.26	1.01

Table 1: Table of weights for standard nominal size and metal thickness in kg/m

** RHEINZINK – Applications in Architecture Chap. I. 2.2.5/I. 3.3*

1.9 Patina Formation

On the natural RHEINZINK-prePATINA surface forms a bonded natural patina in the atmosphere. In so doing all the environmental influences from the air and rain water are integrated into the surface development. The material surface is maintenance free and as a natural product does not require care or cleaning.

When using the natural RHEINZINK-prePATINA line surfaces in areas subject to a marine climate, white deposits may develop on the surface due to the salt in the atmosphere. These natural deposits integrate into the natural patina and because of the colour contrast, are more visible on the darker, RHEINZINK-prePATINA graphite-grey surface. This will not affect the function or expected service life of the material when used on facades, roofs or other cladded building components. The natural patina will appear lighter when used in locations where the air contains chlorides. When used in environments where sulphur levels are higher, (e.g. industrial pollution), the patina may appear somewhat darker than usual.

1.9.1 RHEINZINK-CLASSIC bright rolled

Application for all sheet metal work in seaming and soldering techniques. Natural patina forms at different times depending on the application or roof pitch. In areas protected from rain water e. g beneath eaves or on roof edges sometimes only after a few years.

1.9.2 RHEINZINK-prePATINA blue-grey and graphite-grey

The pre-weathering process was developed by RHEINZINK especially for use in areas where a "finished" picture of the RHEINZINK surface is desired even at the hand-over of keys. This process allows the production of colour of a natural patina although the natural patina itself only forms after installation.

RHEINZINK is the only manufacturer world wide who uses this unique pre-weathering process. The use of a pickling process compared to a coating or phosphating process has two distinct advantages: Pickling gives the surface the appearance of a genuine patina, something that only occurs otherwise after a long time through natural influences. Pickling produces an even colour tone but is not comparable however with a RAL shade. A protective coating applied to the surface achieves temporary protection for storage, transport and processing. This protective film makes oil-free forming possible for processing in the profile roll forming machines.

The RHEINZINK quality prePATINA graphite-grey is the dark alternative and may, after a few years during the formation of patina and depending on the regional climate, develop a slight dark green sheen as with slate.
During the pickling process other natural surface properties are preserved - the surface remains solderable. The visible "Ageing with dignity" is not prevented by pre-weathering and has proved its worth in practice over many decades. The material largely reduces the typical reflections of the surface of thin sheets (oil canning).

1.9.3 Information about Processing

In order to avoid surface reactions from excessive sweating from the skin and other impurities caused by the building site, oil-free clean textile gloves should be worn.
Suitable products can be found at **www.rheinzink.de/werbemittelshop**

1.9.4 Surface Uniformity

We make every effort to supply profiles with surface uniformity. Production-related slight differences can occur, which are purely of appearance in nature and which, in the prePATINA line, usually even out during the formation of patina. In order to exclude specific product-related visual imperfections, particular requirements should be requested with respect to surface uniformity.

1.9.5 Protection during Transportation and Installation

To protect the surface during the transport, storage and installation our façade profiles and also our surface quality artCOLOR line are delivered with a protective plastic film. It also protects against negative influences during the construction phase.

The foliation is a self-adhesive protective plastic film that is applied at the factory and is exposed during installation to UV radiation and temperature variations. If this exposure continues for a long time, the properties of the film may change and cause adhesive residues on the metal surface. To avoid these changes, we recommend removing the film immediately after the installation process. The film should be removed at once from the surface as moisture could be hold back at loose film edges. This could cause visual imperfections (formation of zinc hydroxide).

1.9.6 Waviness

Coils

A characteristic surface phenomenon with strip material is the typical slight wavy structure of thin sheet metal.

These waves (oil canning) are the result of natural internal stresses within the material, after undergoing coiling and de-coiling procedures in the plant as well as corresponding forming processes (profiling, etc.) during fabrication and installation.

The surface finish CLASSIC bright rolled emphasises the changing appearance because of light reflection. With increasing patination this perception reduces. If from the start e. g. for facades and roof surfaces, a high grade appearance is desired, we recommend, the surface finishes prePATINA blue-grey or prePATINA graphite-grey.

Fig. 1: RHEINZINK-prePATINA bright rolled surface, VITRA Administrative Building in CH-Birsfelden

Sheet Material

An improved evenness is obtained by using sheet material, which RHEINZINK can manufacture and supply at lengths up to 6 m. The measurement of corrugations is subject to strict controls and must not exceed the value defined under DIN EN 988 (max. 2 mm per metre). The RHEINZINKworks standard prescribes for each metre of sheet length e. g. max. 1 wave 1 mm in height

1.10 Response to external Influences

1.10.1 Installation under other Metals

Absolutely safe:

- Aluminium, bright rolled or coated
- Lead
- Stainless steel
- Galvanized steel (rust streaking is possible if the cut edges are unprotected)

Questionable:

- Copper

1.10.2 Installation under other Building Materials

Questionable:

- Unprotected bitumen roof sheeting without grit layer/ gravel fill (acid oxidation)
- PVC roof sheeting (hydrochloric acid emissions)

1.10.3 Installation with other Building Materials, including Mortar

- Mineral-based materials such as chalk, cement or plaster plusmoisture have a corrosive effect on metals.
- A suitable separating layer must be fitted between RHEINZINK building profiles and these building materials.
- Installation sequence: Plasterwork prior to RHEINZINK (if possible use material with plastic film)

1.10.4 Influence of Oil Heating Systems

Due to the contents and additives contained in heating oil, discolouration of RHEINZINK surfaces can occur where oil heating is used. This happens to all roofing material; it is a visual impairment and does not affect durability.

Note:
The owner must be made aware of this phenomenon. Discolouration does not occur when gas heating systems are used.

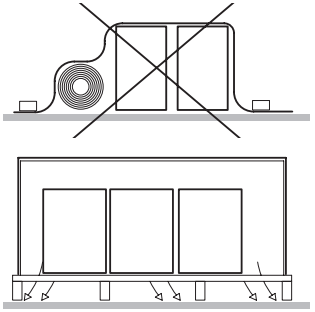
1.10.5 Base and Splash Water Areas, Rock Salt

At base areas splash water can cause staining and disturb the patination process. Rock salt in connection with moisture has a corrosive effect on metals. Therefor facade claddings should be installed with a sufficient space to the ground, not less than 30 cm as a rule.

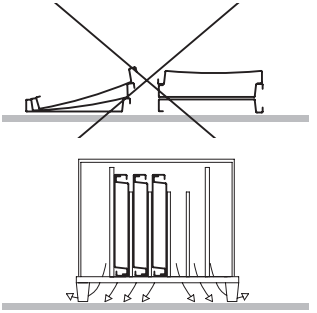
2. Processing

2.1 Storage and Transportation*

Always store and transport RHEINZINK products under dry and well-ventilated conditions.



Dia. 1.1: Storage and transportation of coils, (diagram)



Dia. 1.2: Storage and transportation of profiles, panels, (diagram)

Note:
A dry ventilated area is required for proper storage at the construction site. This must be arranged with the construction supervisor.

** RHEINZINK – Applications in Architecture Chap. I. 3.1*

Fig. 2: Tensile seam test in the RHEIN-ZINK-Quality Control Dept.

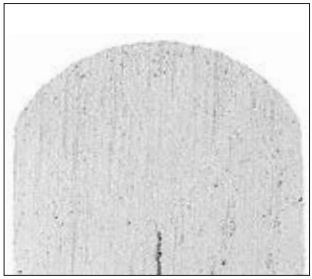


Fig. 3: Metallographic cross section of a flexural test piece after a 180° fold, without an intermediate layer, parallel to rolling direction

2.2 Processing

2.2.1 Marking

- Use soft pens; do not use sharp, pointed objects (marking tools, pocket knives).

2.2.2 Jointing Techniques*

2.2.2.1 Soft Soldering

- Substance-to-substance bonded and waterproof connection of water-bearing profile joints in just one operation (gutters, valleys, copings); install expansion elements (see Tab. 15,19, 20).

Accessories and tools:

- Soldering bit (hammer bit), weight > 350 g, 500 g is better
- Flux by Felder ZD-pro; for surface prePATINA graphite-grey: also use stainless steel wool for abrasive treatment
- RHEINZINK-solder, lead-free, SnZn 801 according to ISO 9453

Note:
Please see RHEINZINK-Processing Instructions "Joining Techniques".

2.2.2.2 Seaming Techniques

Double standing seams, angled standing seams, double angled standing seams, roll cap seams

2.2.2.3 Lapped Joints

- Suitable for valleys on scalloped roofs, such as brick tile, slate, etc.
- Overlap widths valley pitch ≥ 15°, min. 150 mm; valley pitch ≥ 22°, min. 100 mm
- Profile joint design using cranked edges

2.2.3 Forming (Bending and Folding)

When machine forming or forming manually, a bending radius of R ≥ 1.75 mm must be ensured. For metal thicknesses over 1 mm, the bend radius should be R ≥ 1,75 x s.

** RHEINZINK – Applications in Architecture Chap. I. 3.6*

2.2.4 Adhesive Fastening*

- Bonding of coverings has been standard for decades (see A.i.d.A Chap. V. 3.1 Enkolit®).
- For some years now, adhesives have been used successfully with metal facades (e.g. Flat-lock tile system). In extremely unfavourable conditions, such as
  – location of the structure
  – large metal widths
  fluttering sounds are significantly reduced when adhesives are used (e.g. on metal brackets).
- The manufacturer's guidelines for suitable polyurethane adhesives must be followed for the applications mentioned above.
- RHEINZINK-Gutter Adhesive can be used for the joining of RHEINZINK gutters as an alternative to soldering.

Fig. 4: Apply Enkolit® with notched trowel

Fig. 5: RHEINZINK-Flat-lock Tiles – bonding to middle metal bracket using PU-adhesive

** RHEINZINK – Applications in Architecture Chap. V. 3.1*

2.3 Material Temperature

Processing without additional measures ≥ 10 °C:
If the temperature of the material is under 10 °C, and folding, bending or profiling has to take place, then the processing area must be heated. Heating must occur constantly in parallel to the shaping process. Increased costs, if not covered in the contract specification, must be clarified with the building management before commencement. Soft soldering is an option independent of the metal temperature.

2.4 ThermalExpansion and Contraction*

For roofing and facade cladding (panel length), sheet metal work and roof drainage systems (profile length), thermal expansion and contraction must be taken into account during design and construction.

Proper structural measures must be implemented, particularly for

- penetrations
- hips, valleys, eaves, ridges and verges, i.e. panels or profiles must be installed so that expansion is guaranteed.

** RHEINZINK – Applications in Architecture Chap. I. 3.3*

Calculation formula:

$$\Delta l = l_0 \cdot \Delta\vartheta \cdot \alpha$$

Formula symbols:

Δl: Thermal expansion (mm)

l_0: Considered length (m)**

$\Delta\vartheta$: Temperature difference to installation temperature T_{verl} (K)***

α: Expansion coefficient 2.2 mm/ (10 m · 10 K)

** Distance between the fixed point and connection/termination

*** Expansion: $T_{max} - T_{verl}$
Contraction: $T_{verl} - T_{min}$
T_{min} = -20°, 253 K
T_{max} = +80°, 353 K

Fig. 6: Roof area with many penetrations

Example A:
Linear elongation
(theoretical values)

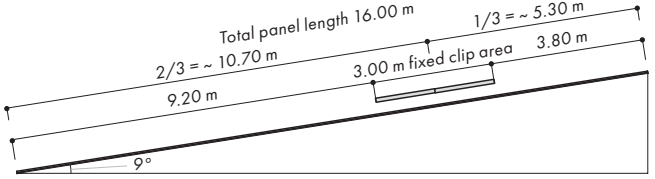
- Installation temperature of RHEINZINK 15 °C
- Panel length: 16.0 m

Expansion:

$$16\,\text{m} \cdot \frac{2.2\,\text{mm}}{10\,\text{m} \cdot 10\,\text{K}} \cdot 65\,\text{K} = 22.9\,\text{mm}$$

Contraction:

$$16\,\text{m} \cdot \frac{2.2\,\text{mm}}{10\,\text{m} \cdot 10\,\text{K}} \cdot 35\,\text{K} = 12.3\,\text{mm}$$



Dia. 2.1: Example, pent roof, roof pitch 9°, panel length 16 m

Example B:
Thermal expansion (field-related values)

- Installation temperature RHEINZINK 15 °C
- Panel length 16.0 m
- Roof pitch 9°
- Fixed clip area 3.0 m

Expansion:
Eave

$$9.2\ \text{m} \cdot \frac{2.2\ \text{mm}}{10\ \text{m} \cdot 10\ \text{K}} \cdot 65\ \text{K} = 13.2\ \text{mm}$$

Ridge

$$3.8\ \text{m} \cdot \frac{2.2\ \text{mm}}{10\ \text{m} \cdot 10\ \text{K}} \cdot 65\ \text{K} = 5.4\ \text{mm}$$

Contraction:
Eave

$$9.2\ \text{m} \cdot \frac{2.2\ \text{mm}}{10\ \text{m} \cdot 10\ \text{K}} \cdot 35\ \text{K} = 7.1\ \text{mm}$$

Ridge

$$3.8\ \text{m} \cdot \frac{2.2\ \text{mm}}{10\ \text{m} \cdot 10\ \text{K}} \cdot 35\ \text{K} = 2.9\ \text{mm}$$

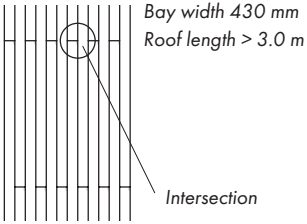
Note:
Through heat irradiation, material temperature can deviate significantly from the ambient temperature. Depending on roof pitch, time of day, season and orientation of the surface to the sun, temperature differences of up to 100 K are possible (-20 °C to 80 °C).

Expansion joints for standing seam

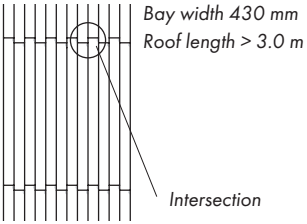
When using double standing seams (3°-25° roof pitch), a cross seam with or without continuous soldered cleat is not always a means of compensation for thermal movements of the panels.

If a different expansion behaviour occurs, due to fixed points installed with staggered joints for adjacent panels, expansion cracks at the assemblage points can be expected. Each section field has its own fixed point area in which the section fields work against each other. When choosing the cross seam, one must differentiate between a linear or staggered course of the seam.

If "mirror cladding" (half staggered cross-seam) has been requested by the customer for reasons of aesthetics, the joined panels have to be treated as one single length, as far as the layout of fixed/sliding clips is concerned - the cross-seams do not allow for expansion.
For the angled standing seam system starting at a roof pitch of ≥ 25°, thermal linear expansion is possible through the seam.

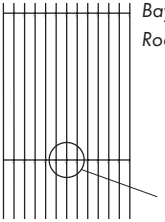


Dia 2.2:
Example pent roof, roof pitch 25°, Division of panels with half staggered joints (displaced cross-seam by half a panel length), double standing seam system



Dia 2.3:
Example pent roof, roof pitch 25°, division of panels with staggered joints with 30 cm offset, double standing seam system

- *All panels below and above are fastened with sliding clips; the cross-seam does not function as an expansion joint.*
- *No clips may be used in the upper back-fold of the lower panels.*
- *Arrange fixed clip areas according to Dia. 6, Page 51*



Dia 2.4:
Example pent roof, roof pitch 35°, division of panels with continuous cross-seams, angled standing seam system

- *With the linear alignment of the cross-seam with and without soldered continuous cleat the expansion of the panel field is possible. The lower standing seam can be designed as a turned down seam (see Chap. 3, Dia. 8.2, 8.3). This technique has been the norm for decades.*

2.5 Fastening*

The type of fastening and the arrangement thereof, depends not only on the nature of the substructure, but also on the dimensions and the function of the elements to be fastened. Distinctions are made between direct, indirect and adhesive fastening. Indirect fastening guarantees linear expansion of the material brought about by a change in temperature

- in the case of panels, by using sliding clips
- in the case of profiles (copings), by using continuous cleats, including expansion elements

Direct fastening of profiles (e.g. flashing strips) using nails, screws or rivets, is permitted for lengths of up to 3.0 m. If the joints of individual lengths (gutters, sheet metal profiles, etc.) are connected by soft-soldering, expansion elements must be installed (see Tables 15, 19, 20).

** RHEINZINK – Applications in Architecture Chap. I. 3.5*

3. Seamed Roof Coverings

3.1 Roof Designs

For the planning and designing of ventilated and non-ventilated roof designs, the thermal insulation in accordance with DIN 4108-2, the German Energy Savings Ordinance (ENEV) and the moisture proofing in accordance with DIN 4108-3 need to be adhered to. In the following we have compiled some important information and two examples of possible roof constructions for you. For further information, please also see our Design recommendations for roof coverings.

3.1.1 Ventilated Designs – Component Layers

- Interior lining
- Installation level
- Diffusion-inhibiting layer, s_d-value acc. to DIN 4108-3
- Thermal insulation acc. to DIN 4108-2 and EnEV
- Breather membrane if required, s_d-value acc. to DIN 4108-3
- Ventilated space, height as per table 2
- Substructure, normally softwood boarding or OSB/ plywood
- Underlay, structured underlay if required
- RHEINZINK roofing

Roof pitch	≥ 3° to ≤ 15°	> 15°
Ventilated space, min. height	80 mm	40 mm
Intake/exhaust vent openings, min. net width	40 mm	30 mm
Gross cross-section of RHEINZINK-Diamond Mesh Sheet with 63 % free ventilation shaft	approx. 65 mm	approx. 50 mm
Gross cross-section of perforated sheet with approx. 45 % free ventilation shaft	approx. 90 mm	approx. 70 mm

Table 2: Height of ventilated space in relation to roof pitch

With a roof pitch of DN ≤ 5°, gabled roofs can be ventilated from eave to eave – with a building width of max. 30 m. In this case the height of the ventilation space amounts min. 100 mm with vent openings at the eaves of 60 mm. Moreover, inside a vapour barrier of s_d ≥ 100 m is required.

The indicated height of ventilated spaces and ventilation openings are standard values. The functionality of the ventilation is not necessarily limited with reduced values. In case of deviations from the above mentioned recommendations, individual condensation analysis must be provided.

In the case of buildings subject to extremely high humidity levels such as swimming pools etc. a condensation analysis as per DIN 4108-3 or EN 15026 is required.

Vapour diffusion-equivalent air layer thickness

Allocation of values for vapour diffusion-equivalent air layer thicknessesof layers above/below the thermal insulation layer; Excerpt from DIN 4108-3

s_d m	
outside $s_{d,e}$ [1]	inside $s_{d,i}$ [2]
≤ 0,1	≥ 1,0
0,1 < $s_{d,e}$ ≤ 0,3	≥ 2,0
0,3 < $s_{d,e}$ ≤ 2,0	$s_{d,i} \geq 6\ s_{d,e}$
> 2,0 [3]	$s_{d,i} \geq 6\ s_{d,e}$ [3]

Table 3: Vapour diffusion-equivalent air layer thickness as per DIN 4108-3

[1] *$s_{d,e}$ is the sum of the values for vapour diffusion-equivalent air layer thicknesses of the layers located above the thermal insulation layer up to the first ventilated air layer.*

[2] *$s_{d,i}$ is the sum of the values for vapour diffusion-equivalent air layer thicknesses of the layers located below the thermal insulation layer or below any under-rafter insulation up to the first ventilated air layer.*

[3] *In the case of non-ventilated roofs with $s_{d,e} \leq 0.2$ m it is possible to dispense with chemical wood preservatives provided that the conditions according to DIN 68800-2 are satisfied.*

Dia. 3.1: Ventilated roof build-up on softwood boarding without underlay

Roof structure of design example 1

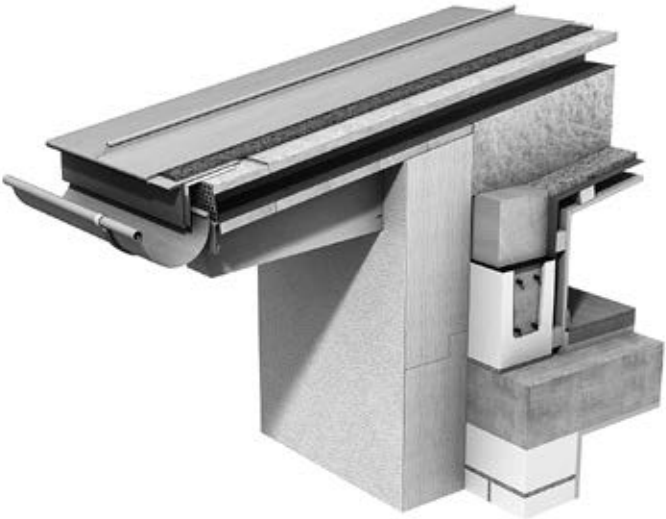
1 RHEINZINK-Double Standing Seam
2 Softwood boarding, b ≤ 160 mm, d ≥ 24 mm
3 Ventilation space, height as per table 2
4 Fully supported flexible underlay as functional layer, s_d-value acc. to table 3
5 Thermal insulation as full-rafter insulation
6 Diffusion-inhibiting layer with s_d-value acc. to table 3, airtight layer
7 Installation level
8 Interior lining

Fire Protection

This design is resistant to flying sparks and radiant heat "Hard Roofing".

Note:

In accordance with DIN 18339 (VOB Part C), structured underlays must be provided for roof pitches up to 15°. Therefore, the non-provision of underlays in this range of roof pitch needs to be agreed upon with the building owner, planner and executing company.



Dia. 3.2: Ventilated roof build-up on OSB/plywood sheathing with structured underlay

Roof structure of design example 2

1 RHEINZINK-Double Standing Seam
2 Structured underlay VAPOZINC as functional layer, s_d-value ≤ 0.1 m
3 Plywood/OSB boards, d ≥ 22 mm, lenght ≤ 2.50 m, e. g. OSB/3
4 Ventilation space, height as per table 2
5 Fully supported flexible underlay as functional layer, s_d-value acc. to table 3
6 Thermal insulation as full-rafter insulation
7 Diffusion-inhibiting layer with s_d-value acc. to table 3, airtight layer
8 Installation level
9 Interior lining

Fire protection:

For roof structures with the underlay VAPOZINC on sheathing with a pitch of < 20°, RHEINZINK possesses a general test certificate issued by an approved building authority, proving the protection against flying embers and radiant heat ("hard roof"). We will gladly send you this upon request. For roof pitches exceeding 20°, we recommend the use of our structural mat AIR-Z on bituminous underlays with glass fibre or fibreglass inlay according to the the specifications in DIN 4102-4.

3.1.2 Non-ventilated Designs

The professional design of various non-ventilated constructions is also possible. This variant has proven to be particularly successful for geometrically complicated roof shapes, for which a clear air intake from the ventilation slot through the rear ventilation room to the exhaust air slot is extremely complex or even impossible. For more information or examples of non-ventilated constructions please request our Design recommendations for roof coverings.

Our consultants for techniques and applications will also gladly assist you on-site.

3.1.3 Underlays

When RHEINZINK is installed on softwood boarding – with or without wood preservatives – no underlay is required. In the case of plywood or large-sized roof sheathing a structured underlay must always be used (regardless of the roof pitch). This also applies for non-ventilated roof designs.

- No underlay on softwood boarding (ventilated structures)
- Structured underlay for large-sized substructures, e. g. OSB boards.
- Structured underlay for all non-ventilated structures

3.1.4 Additional Notes

- Moisture storing underlays are not permitted.
- The installation of a double underlay is only permitted when using structured underlays or structured mats as the top layer (e. g. V13 + structured mat AIR-Z).
- For standing seam roofs, machine seaming is preferred, due to a tighter seam.
- Underlays or membranes permeable to diffusion are only suited for ventilated structures for roof pitches of ≥ 15°, if they do not store water.
- Apart from its function as a vapour pressure equalizing layer, the structured underlay VAPOZINC offers other benefits as well. For example, noise reduction up to 9 db (A), melt water removal, improved material expansion, tolerance equalizer vis-a-vis nail heads, no adhesion of bituminous underlays, etc.
- The structured underlay VAPOZINC is always required in the tropics. The height of standing seams should always be increased to min. 35 mm (downpours). Pay close attention to the substructures used specific to the country in question – please contact our regional consultant.
- The installation of sealant tapes provides the standing seam with increased impermeability. Installation depends on the situation (roof landscape), climate, type of roof (e.g. barrel roof).

3.2 RHEINZINK Roofing*

Roof pitch Deg. °	Roof pitch ca. percent % (cm/m)
3	5
7	12
10	17
15	27
20	36
25	47
30	58

Table 4: Conversion table for roof pitch – degree in percentages

3.2.1 Seam Systems

Selecting the seaming system, as well as additional measures, depends on the roof pitch. As a rule, seam systems are used to ensure rainproof roofing.

** RHEINZINK-Applications in Architecture Chap. III.*

3.2.2 Design Recommendations for ventilated Metal Roof Systems with water-bearing Layers

Underlays consist of suspended or free spanned breather membranes according to EN 13859, which support the roof in its rainproofing function.

- Overlap of at least 10 cm on the edges
- Fastened to the rafters

Rainproof underlay

Sub-coverings are made up of overlapping roofing membranes or sheets supported by the substructure.

- The counter-battening is installed on top and not integrated into the subcovering.
- Sealing strips can be used to seal perforations caused by fasteners

Rainproof under-roof

Under-roofs are designed with the aid of waterproof sheeting. The seam and butt joints must also be waterproof.

- The counter-battening is not integrated.
- Perforations caused by fasteners can be sealed with sealant tapes.
- Penetrations must be rainproof.

Waterproof under-roof

This variation is designed with watertight sheeting and watertight seam and joint areas.

- Penetrations are also integrated and are waterproof.
- Openings and open penetrations caused by fasteners are not permitted.

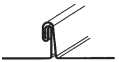
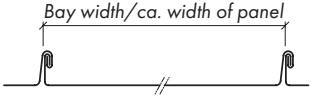
Seam systems	Roof pitch
Click Roll Cap System	≥ 3°
Double Standing Seam 	≥ 3°
Angled Standing Seam 	≥ 25°*

Table 5: Selection of roof system subject to roof pitch.
** In regions with heavy snowfall from 35° roof pitch.*

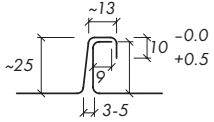
Notes for standing seam roofs:
For roof pitches of ≥ 3° - ≤ 7° and in the event of ice dams in the eaves, a sealant tape should be installed into the seam.

In heavy snowfall areas (high alpine regions, etc.), a sealant tape should be installed into the double standing seams ≥ 2,0 m from the outer edge of the building in the direction of the roof gradient to avoid melt water penetration.

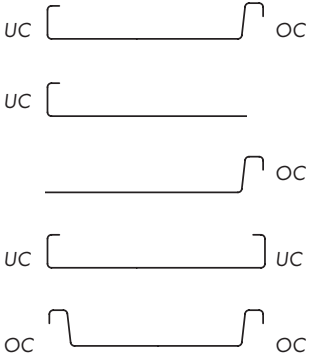
3.2.3 Design of Standing Seam Systems, Terminology/ Dimensions



Dia. 4.1: Double standing seam, bay width/panel width



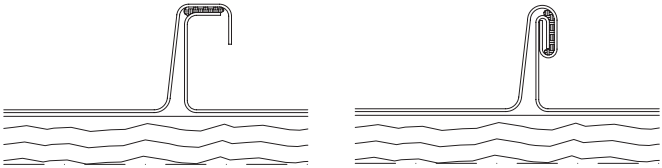
Dia. 4.2: Profile dimensions – Double Standing Seam, manufactured by machine



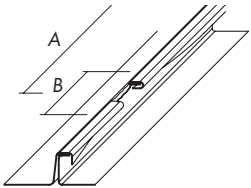
Dia. 4.3: Types of panels available

OC = over-cloak (overlapping seam)
UC = under-cloak (underlapping seam)

3.2.3.1 Sealing Seams with RHEINZINK Sealant Tapes



Dia. 5.1: Location of RHEINZINK sealant tape



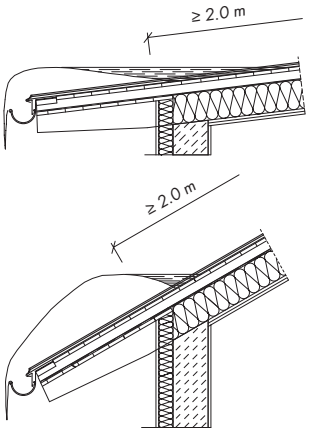
A The open seam should be closed to an angled seam every 50 cm

B ca. 60 mm (width of clinching pliers)

Dia. 5.2: Position of sealant tape; sequence of installation steps

To prevent the sealant tape from forming "bowls" during machine seaming and to ensure the functional efficiency of the seaming machine:

- The over-cloak should be closed as an angled standing seam every 50 cm (width of clinching pliers);
- The seams of the installed panels should be closed immediately, at the latest by the end of the day;
- "Winterset", if required due to cold ambient temperatures, should be set no higher than level 5.



Dia. 5.3:
Isolated case – ice dam formation: Position of RHEINZINK sealant tapes in the event of ice dam formation, regional application. Snow guards as per country-specific requirements.

3.2.3.2 Panel Width/Material Thickness and Number of Clips

RHEINZINK roofing – seamed roof coverings are always fastened indirectly using clips.

- Static requirements according to DIN EN 1991-1-4: Extraction value per RHEINZINK-clip: 600 N, safety factor 1.5
- In order to guarantee the specified extraction value, RHEINZINK-stainless steel clips are properly fastened using two screws.

Note for pent roofs:
Based on practical experience, it is recommended that panel width be limited to 430 mm for mono-pitch roofs with roof overhangs. Material thickness should be 0,8 mm.
This serves to prevent noise which occurs when the panels bend (max. 20 mm) during strong winds.

Coil width [mm]	500		570	
Panel width [mm]	430		500	
Specified wind load [kN/m²]	Number of clips [pcs.]	Clip centre [mm]	Number of clips [pcs.]	Clip centre [mm]
-0.3	5.0	500	4.0	500
-0.6	5.0	500	4.0	500
-0.9	5.0	500	4.0	500
-1.2	5.0	500	4.0	500
-1.5	5.0	500	4.0	500
-1.8	5.0	500	4.0	500
-2.1	5.0	500	4.0	500
-2.4	5.0	500	4.0	500
-2.7	5.0	500	4.5	440
-3.0	5.0	460	5.0	400
-3.3	5.5	420	5.5	360
-3.6	6.0	380	6.0	320
-3.9	6.5	340	6.5	300
-4.2	7.0	320	7.0	280
-4.5	7.5	300	7.5	260
-4.8	8.0	280	8.0	240
-5.1	8.5	260	8.5	220

Table 6: Minimum number of RHEINZINK clips (per m²)/ maximum clip centres in mm subject to wind loads Based on: calculated load capacity $F_{R,d}$ of 600 N/clip (including safety factor 1.5)

600		670		700	
530		600		630	
Number of clips [pcs.]	Clip centre [mm]	Number of clips [pcs.]	Clip centre [mm]	Number of clips [pcs.]	Clip centre [mm]
4.0	500	3.5	500	3.5	500
4.0	500	3.5	500	3.5	500
4.0	500	3.5	500	3.5	500
4.0	500	3.5	500	3.5	500
4.0	500	3.5	500	3.5	500
4.0	500	3.5	500	3.5	500
4.0	500	3.5	460	3.5	440
4.0	460	4.0	400	4.0	380
4.5	400	4.5	360	4.5	340
5.0	360	5.0	320		
5.5	340	5.5	300		
6.0	300	6.0	260		
6.5	280				
7.0	260				
7.5	240				
8.0	220				
8.5	220				

Explanatory Notes:

- Minimum number of clips rounded up to 0.5.
- Maximum clip centre rounded down to 20 mm steps.
- Clip centre refers to distance between the axis of the clips.
- For wind loads above the bold line the maximum clip centre of 500 mm is decisive but not the wind load.
- Recommendation for mono pitch roofs with overhangs: Panel width ≤ 430 mm, metal thickness 0.8 mm

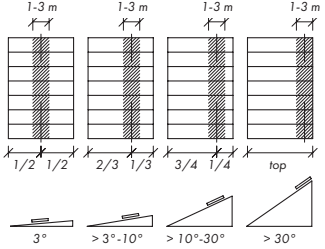
Fig. 7: RHEINZINK sliding clips (pre-assembled) and fixed clips

3.2.4 Sliding Clips to ensure thermal Expansion of Panels during Changes in Temperature

- For roofing panel lengths of > 3 m to ≤ 10 m (standard case)
  For panel lengths >10 m to ≤ 16 m special measures must be observed. Please contact us.
- For facade cladding panel lengths of > 1 m
- If there are penetrations on roof surfaces, please take fixed clip areas into account (see Dia. 7)

3.2.5 Fixed clips to fasten panels on roofing

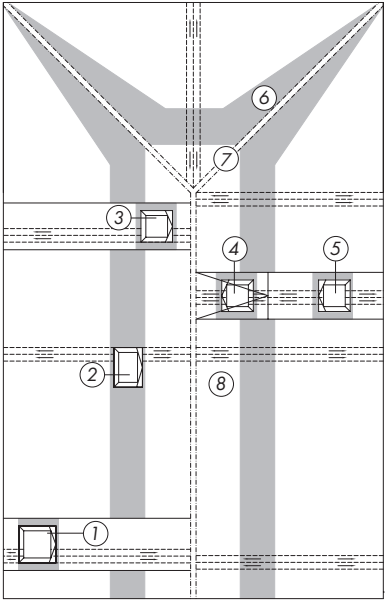
- Panel lengths ≤ 10 m (standard case): Fixed clip area ≥ 1 m to 3 m
- Panel lengths of ≤16 m (only possible up to 30° roof pitch): Fixed clip area 3 m



Dia. 6: Schematic depiction; arrange fixed clips according to roof pitch

3.2.6 Panel length

Panel lengths of ≤ 10 m, (standard case). If the panel is > 10 m to ≤ 16 m and particularly if there are penetrations in the roofing, please contact a RHEINZINK application engineer.



1/3 Penetration outside fixed clip area with expansion strip

2 Penetration within fixed clip area without expansion strip

4/5 Penetrations arranged in a row, elevated design recommended

6 Fixed clip area

7 Hip

8 Ridge

Dia. 7:

Direction of movement

Arrangement of fixed clips

Expansion strip

Hip-/ridge-/ verge profile

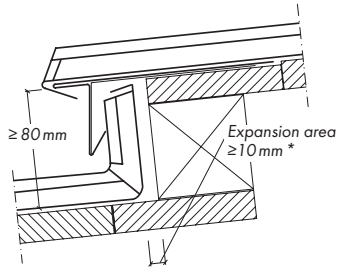
3.2.6.1 Application

Fixed clip area for hipped roof with expansion strips

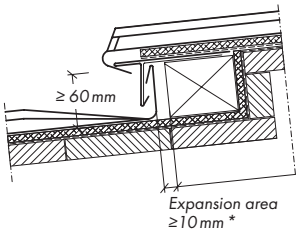
- Roof pitch 9°
- Panel length 16 m
- staggered position with roof penetrations (see examples of calculations Chap. 2.4)

If penetrations are > 3 m wide (elevator shafts, etc.), expansion strips should be installed on the sides in order to accommodate lateral expansion.

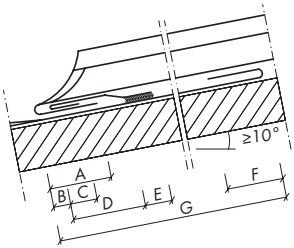
3.2.7 Design of Cross-Joints



Dia. 8.1.1: Stepped falls connected via "pinched seam"; Roof structure according to Dia. 3.1

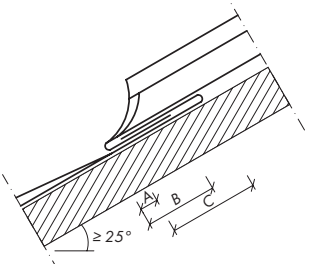


Dia. 8.1.2: Stepped falls connected via "turned down" seam; structured underlay (example), roof structure according to Dia. 3.2



Dia. 8.2: Cross-joint: single seam with continuous soldered cleat

A Back-fold of upper panel
B Expansion area ≥ 10 mm
C Back-fold cleat ca.15 mm (stiffens the edge)
D Width of cleat ca. 40 mm
E Width of soldering ca. 10 mm
F Back-fold of lower panel ca. 30-50 mm
G Overlap area of upper panel ca. 250 mm



A Expansion area ≥ 10 mm*
B Back-fold upper panel ≥ 30 mm*
C Back-fold lower panel ≥ 40 mm*

* If panel lengths are > 10 m, increase expansion area to 15 mm (see Chap. 2.4 – examples).

Dia. 8.3: Cross-joint: single seam

Cross-joint design	Roof pitch
Stepped falls (Dia. 8.1.1 and 8.1.2)	≥ 3°
Single seam with continuous soldered cleat (Dia. 8.2)	≥ 10°
Single seam (Dia. 8.3)	≥ 25°

Table 7: Cross-joint design in relation to roof pitch

3.3 Lightning Protection

Within the framework of European Standardization, lightning protection has been regulated anew and implemented by way of Din EN 62305 – Lighting Protection.

With respect to RHEINZINK roofing, comprehensive testing was conducted, the results of which contributed to the development of the standard.

Part 3 in EN 62305 describes the protection of buildings – Supplementary Sheet 4 of Part 3 explores the utilization of metal roofs in the lightning protection system.

Accordingly, RHEINZINK roofing systems in the surface qualities RHEINZINK-CLASSIC line, RHEINZINK-prePATINA line or the coated option artCOLOR line can be used as outer lightning protection.

For other roofing systems and in the case of coated surfaces, individual certificates may be required.

3.3.1 Lightning Current Arrester and Diversions

According to standard, RHEINZINK roofing systems, roof edges, fascias and surrounds made of RHEINZINK in a material thickness of min. 0,70 mm, function as lightning current arresters. Lightning rods should be installed to divert the lightning current into the ground. The function of these conductors is to divert the lightning current to the grounding system as quickly as possible. These rods should be made of aluminium-wrought alloy, in order to prevent rust streaking. Certification and technical specifications of lightning conductor wires, cables and terminals are outlined in DIN EN 62305

Note:
The supply terminals must be installed so that thermal expansion of the roof is not impeded (Fig. 9).

3.3.2 Requirements of Lightning Protection Systems

The requirements to use a lightning current arrester is regulated in DIN EN 62305 and is often prescribed for public buildings such as hospitals, community centres and data centres. It's up to homeowners to make a decision with respect to their residences. In isolated cases, we recommend consulting the relevant manufacturer.

3.3.3 Jointing Techniques

All of the connections used for RHEINZINK roofing systems such as seaming, edging, folding, clamping, including the use of sealant tapes in standing seams,

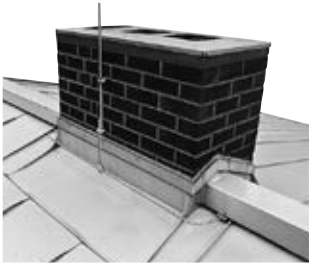


Fig. 8: Lightning protection system complete with lightning rod on chimney head

are approved and suitable connections. The tradesperson must demonstrate to the installer of the lightning protection system that the joints he's using have been constructed according to manufacturers' guidelines.

Fig. 9: Proper installation allows for thermal expansion of panel

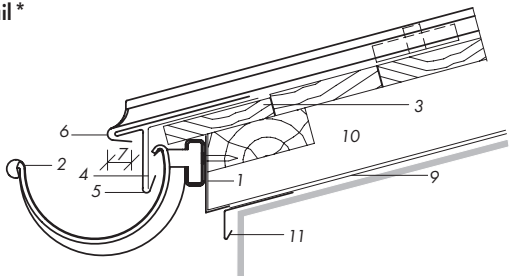
Fig. 10: Incorrect installation of lightning rod terminal to panel

Wires and cables made of aluminium-wrought alloy should be used to connect the lightning rod from the standing seam over the eave gutters. If galvanized steel is used, rust streaking could occur over time because of the wire.

Approved terminals must be used to connect the lightning rod to the metal roof, so that thermal expansion of the roof and gutter is not impeded. Connecting to the eave fold-over could cause damage.

3.4 Roof Detail *

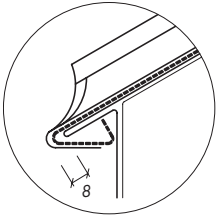
3.4.1 Eave



Dia. 9: Standard eave detail for RHEINZINK-Standing Seam covers, bracket-mounted gutter with snap-lock bracket according to DIN EN 1462 nominal size 280 or 333

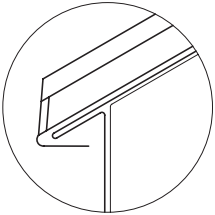
1 RHEINZINK-Diamond Mesh Sheet; free opening A_0 63 %, large air intake opening (see Tab. 2, P. 33 and notes pertaining to individual certificates)
2 Gutter with/without slope
3 Lower eaves board
4 Continuous cleats made of galvanized steel; material thickness ≥ 1 mm if length of side length is ≥ 50 mm
5 RHEINZINK eaves flashing, material thickness ≥ 0.8 mm
6 Back-fold panel, opening ca. 30° (optimum drip behaviour)
7 Hook-in width of eaves flashing ≥ 30 mm
8 Provide space between panel and eaves flashing: ≥ 10 mm (thermal expansion required)
9 Breather membrane (optional)
10 Height of ventilation space
11 Eaves profile

3.4.1.1 Eave Terminations



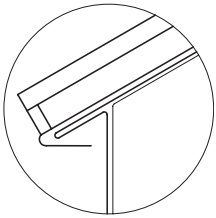
Dia. 9a: Design variation: Eave termination standing round

- *machine pre-fabrication possible*
- *use positioning device (dotted line)*



Dia. 9c: Design variation: standing diagonal

- *pre-fabrication by machine not possible*
- *use positioning device (dotted line)*

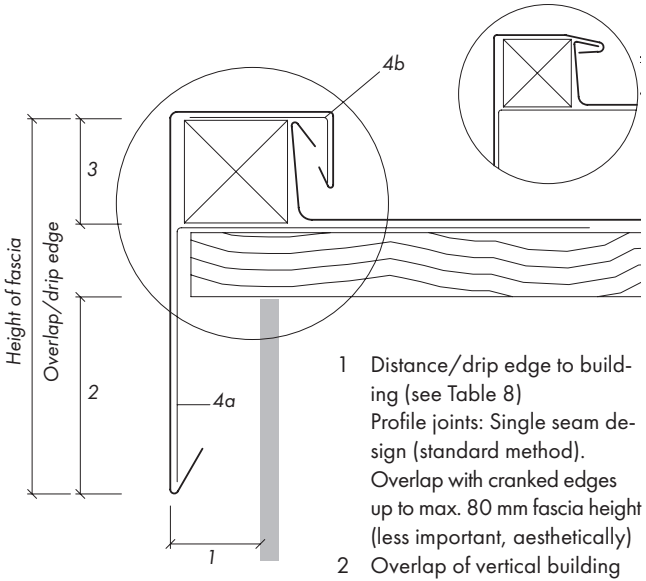


Dia. 9b: Design variation: standing straight

- *pre-fabrication by machine not possible*
- *use positioning device (dotted line)*

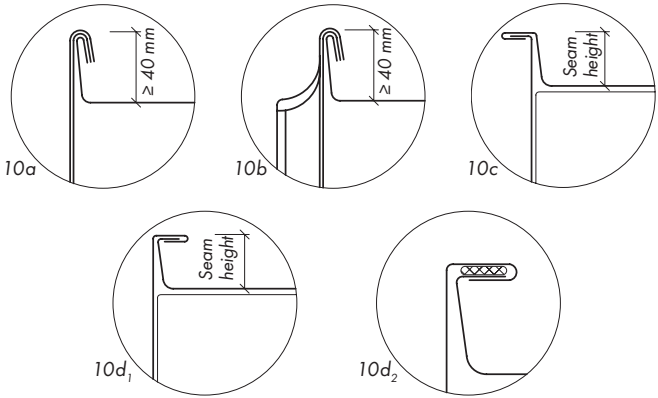
** RHEINZINK – Applications in Architecture Chap. III. 1.3, III. 2.3*

3.4.2 Verge



Dia. 10: Verge with batten and RHEINZINK verge profile

1 Distance/drip edge to building (see Table 8)
Profile joints: Single seam design (standard method).
Overlap with cranked edges up to max. 80 mm fascia height (less important, aesthetically)
2 Overlap of vertical building components
3 Connection height of verge, batten height ≥ 40 mm
4a Fastening with galvanized continuous cleats, material thickness 1.0 mm, with/without return
4b the same as 4a, however, RHEINZINK, material thickness is 0.8 mm



For panel lengths of up to 6.0 m, the following detail solutions may be used:

10a Verge without batten, connection height (see Tab. 8)

10b Seamed verge with upper panel termination, standing round.
Connection height (see Tab.9). Optimum alignment is attained by using additional continuous cleats made of RHEINZINK, material thickness 0.8 mm.

10c Seamed verge as angled seam (over-cloak), e.g. for barrel roofs and round dormers: connection height ca. 25 mm

$10d_1$ Verge as angled seam (under-cloak):
Connection height = seam height

$10d_2$ For roof pitches of < 25°, with sealant tapes

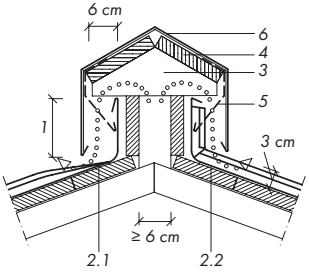
Building height (m)	Overlap (mm)	Distance drip edge (mm)	Connection height verge*(mm)
< 8	≥ 50	≥ 20	≥ 25
8 to 20	≥ 80	≥ 20	≥ 25
> 20 to ≤ 100	≥ 100	≥ 20	≥ 25

Table 8: Cover vertical building components and distance (drip edge) from building

** Coordinate with height of pent roof ridge (aesthetics)*

Note:
See Table 2, P. 33 and instructions for isolated cases.
Depending on the detail design (fascia height/building height), special structures may be required apart from continuous cleats made of galvanized steel.
In the case of pent roof ridges, the height of the fascia is adjusted to the verge overlap and is thus higher and wider than described in Table 8.

3.4.3 Gable Roof Ridge

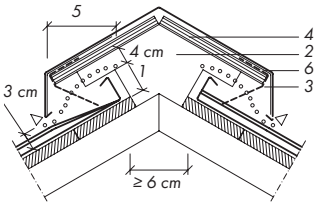


Dia. 11.1: Ridge for a vented gable roof, design variation: high design with ventilation cross-sections

Fig. 11: Flush ridge termination on verge, high design

1 Connection height for roof pitches of
< 5° ≥ 150 mm
< 22° ≥ 100 mm
≥ 22° ≥ 80 mm
2.1 Panel termination, design with turned down seam; not possible with completed timber substructure structure
2.2 Pinched seam panel termination
3 Spacer block
4 Softwood boarding/ OSB sheathing
5 Perforated sheet, RHEINZINK-Diamond Mesh Sheet, A_0 63 %, both sides
6 RHEINZINK coping with continuous cleats (galvanized steel)

Note:
100 % protection from drifting snow is only possible by using sub-roofs. RHEINZINK design recommendations available upon request or contact our application engineering consultants.



Dia. 11.2: Ridge detail for a vented gable roof > 25°, design variation: low design with vent cross-sections

Note:
100 % protection from drifting snow is only possible by using sub-roofs. RHEINZINK design recommendations available upon request or contact our application engineering consultants.

1 Connection heights can be reduced by up to 60 mm by using wider copings.
Panel terminations:
- Pinched seams (height > 80 mm)
- Turned-down seam (height 60-80 mm)

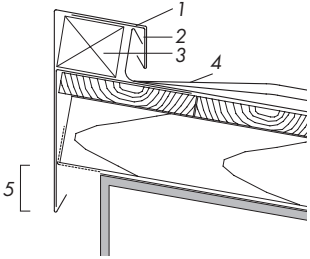
The panel termination should be selected based on the nature of the load, construction and roof pitch.
2 Spacer blocks for ventilation
3 Perforated sheet, RHEINZINK-Diamond Mesh Sheet, A_0 63 %, both sides
4 Softwood boarding/ OSB sheathing
5 Overlap width = ca. double the connection height
6 RHEINZINK coping with continuous cleats, galvanized steel

Fig. 12: Flush seamed ridge termination on verge fascia, low design

Fig. 13: Pent roof ridge with timber batten

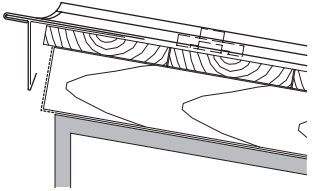
Fig. 14: Ridge as eave termination

3.4.4 Pent Roof Ridge



Dia. 12: Pent roof ridge with batten

1 *RHEINZINK coping*
2 *Continuous cleats made of galvanized steel 1.0 mm*
3 *Timber batten ≥ 60 mm*
4 *Turned down seam*
5 *Facade overlap depending on height of building ≥ 50 mm*



Dia. 13: Pent roof ridge with standing round seam termination

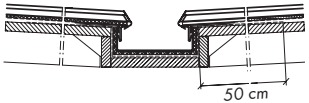
Note: Not recommended
Because the seam termination is too long, the expansion distance to the connection profile is deficient and the back-fold of the panel is completely closed, the standing round seam termination has proven not to be rainproof.

3.4.5 Valley Design

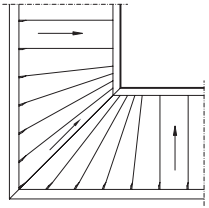
Valleys, design variations as per Table 9.

Note:

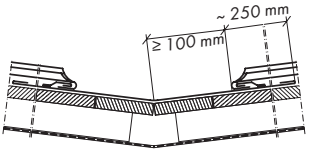
- Provide for ventilation in sub-structure.
- Seamed valley can only be up to 3 m panel length (linear expansion caused by changes in temperature).
- Design variation for "recessed valley", see Chapter on Roof Drainage "interior box gutter", design with overflow gutter, no air intake, primarily for roof pitches of ≤ 5°.
  Recessed valley without overflow gutter, roof pitch > 5° to ≤ 10°.
- Design with tapered panels, alternative solution in the event that recesses for hollow gutters for roof pitch≥ 5° have not been considered in the design, or for aesthetic reasons.



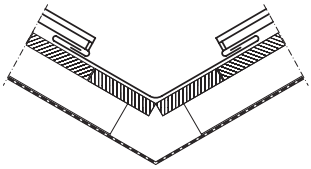
Dia. 14.1: Valley design recessed on both sides without air intake, ***bonded so that it is watertight (ca. 50 cm)*** *and structured underlay, roof pitch ≥ 3° to ≤ 5°*



Dia. 14.2: Valley design with tapered panels



Dia. 14.3: Valley design with single seam and continuous soldered cleat, standard size/girth ≥ 800 mm



Dia. 14.4: Valley design with single seam

Note:
The valley pitch is generally smaller than the roof pitch. If the valley runs in a 45° angle (top view) toward the eave, the conversion factor is 1.414.
Given the above-mentioned conditions, a 10° roof pitch corresponds to a valley pitch of ca. 7°.
Design of valley joints:
- ≤ 10° soft soldering
- > 10° see Table 9.

Roof pitch	Valley design
≥ 3° - ≤ 5°	recessed valley (Dia. 14.1)
> 5° - ≤ 10°	recessed valley or tapered panels (Dia. 14.2)
> 10°	Valley with soldered cleat (Dia. 14.3) ■ Soldered, standard ■ Bended
≥ 25°	Valley with single seam (Dia. 14.4)

Table 9: Valley design depending on roof pitch

3.4.6 Other Connection Heights/Measures

Lateral connection heights:

< 5° = 150 mm
< 22° = 100 mm
≥ 22° = 80 mm
(in the case of tiles, from top edge of cover material 65 mm)

Other connection heights for seamed roofing:

- Pent roof ridge ≥ 60 mm
- Pent roof ridge on rising wall etc. (see Chapter on Ridge for Vented Gable Roof)

Note:
The standard design for a connection profile on a rising wall calls for a water check; if wall material such as slate, etc. is used, no water check is required.

3.4.7 Details for bituminous Roof Edge Sealing

3.4.7.1 Roof Edge Terminations with RHEINZINK-Flat Roof Edge Expansion Element (Wall, Connection, Verge, etc.)

Note:

- Width of adhesive flange on flashing: ≥ 120 mm
- Protective coating of flashing required up to 2 cm above the top edge of roof covering
- Slip flashing
- Never direct the torch flame directly onto the expansion element or the soldered joint of the RHEINZINK flashing without taking precautions.

3.4.7.2 Eaves Flashings, Sealing Function

- Indirect fastening by using continuous cleats and single clips made of RHEINZINK
- Joint design: soft soldering
- Install Flat Roof Edge Expansion Element (see Chap. 7)
- Full-surface protective coating to non-sealed flashing and roof drainage system

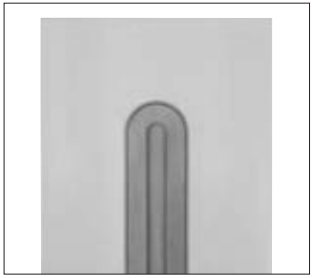


Fig. 15: RHEINZINK-Flat Roof Edge Expansion Element

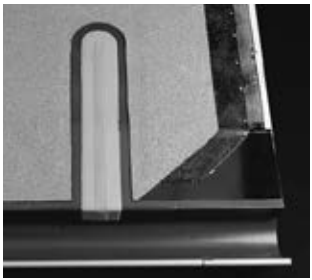


Fig. 16: Eaves detail RHEINZINK-Gutter with eaves flashing and expansion element

3.4.7.3 Eaves Flashings, supporting, non-sealing Function

- Bond the eaves flashing up to the drip edge with roof sealant
- Slip flashings
- Flashing length ≤ 3 m
- Direct fastening, nails/screws
- Loosely overlap profile joints 3-5 cm
- Suitable full-surface protective coating

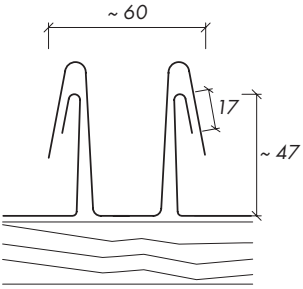
Fig. 17: RHEINZINK-Gutter Heating System with electronic heating element control

3.5 Safety Precautions for Seam Coverings*

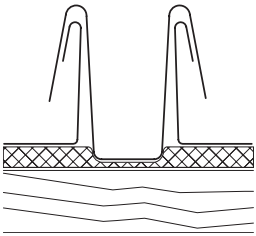
- Personal safety as per DIN EN 516
- Fall prevention as per DIN EN 517
- Snow guard systems according to federal/regional country building codes (seam clamp systems)
- RHEINZINK-Gutter Heating System, ready-to-connect solution with electronic heating element control
- Lightning protection systems/-conductor and grounding systems. Take panel expansion into account when installing clips; do not fix to turned-down edge of eaves. Coordinate with qualified electricians.

Material for safety precautions should be selected based on compatibility with RHEINZINK roofing.

** RHEINZINK – Applications in Architecture, Chap. III. 5.3*



Dia. 15.1: Dimensions for RHEINZINK-Click Roll Cap System



Dia. 15.2: RHEINZINK-Click Roll Cap System with structured underlay

3.6 RHEINZINK-Click Roll Cap System

3.6.1 System Components

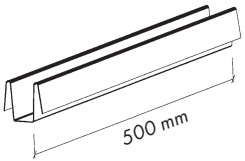
The roll cap system is the oldest installation system still in wide use today. In the case of the RHEINZINK-Click Roll Cap System, panels up to 6 m long are produced ex works in a single operation using profilers. For longer panels, mobile profilers for construction sites can also be leased. The pre-profiled roll cap is available in the standard length of 3 m (lengths of up to 6 m are available upon request). The system is suitable for roof pitches starting at 3° without undertaking additional sealing measures. Increased loads will require the installation of a structured underlay or weather and rainproof sub-roofs.

Note:

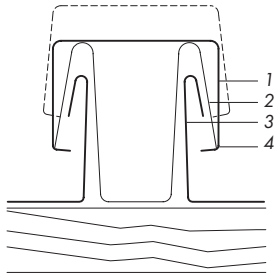
The SM-SL "RZ" snow guard bracket by SM-Systeme, D-71634 Ludwigsburg, is designed specifically for the RHEINZINK-Click Roll Cap System.

3.6.2 Simple Installation

Once the roof area has been divided, the pre-profiled panels are installed at intervals of ca. 50 mm. Using at least two screws, the RHEINZINK-Click Roll Cap Fasteners are fastened to the substructure. The capping is clicked directly on to the fastener and secured to prevent slipping. Five holes have been pre-punched in the base of the fastener to accommodate a variety of applications. Based on normal wind loads, the number of fasteners is 1.5 per m^2 in the middle, 2 per m^2 in the edge area and 3 per m^2 in the corners.



Dia. 15.3: RHEINZINK-Click Roll Cap Fastener



Dia. 15.4: With the RHEINZINK-Click Roll Cap System, the capping is pressed laterally over the fastener, until the cap foot engages audibly (clicks).

1 Roll Cap has been roll-formed specifically to "click-in", with a ca. 6 cm precise-fitting overlap to accommodate expansion (see Dia. 15.5)
2 Fastener, galvanized steel with a double-sided click area and 5 fixing holes, 500 mm long
3 RHEINZINK panels
4 Click area

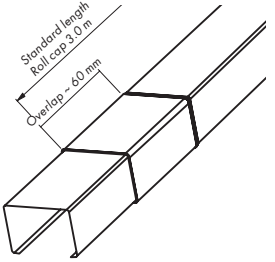
3.6.3 Functional Safety

The fastener ensures unimpeded movement of the RHEINZINK panels in the event of linear expansion due to changes in temperature.
Thus, panel lengths of up to 20 m can easily be realized. Longer panels can be realized when involving RHEINZINK application engineering. The panel is fixed at one point by notching the foldback and bending it over the fastener.
The special advantages of the fastener are particularly evident in non-ventilated roofing structures with insulation on the roof: As this system requires fewer fixing rails per insulating panel than other types of seams, its application is very economical.
Rivets are used to fix the roll caps to one bracket in order to prevent slipping.

3.6.4 System Benefits

- The four RHEINZINK system components: Click Roll Cap Fastener, galvanized steel, ridge termination cap, eaves termination cap for roofs and facades, roll cap, roll cap expansion/opening or plug-in ca. 60 mm (see Dia. 15.5)
- Rainproof linear seam connection ≥ 3°
- Panel length up to 25 m

Fig. 18: Roll cap fastening to prevent slipping



Dia. 15.5: RHEINZINK-Roll Cap, profile joint with plug-in

Arrange roll caps so that the plug-in is on the eaves side. The plug-in offers the potential of an aesthetically pleasing detail. If the roof pitch is flat, the roll cap plug-in should be sealed (e.g. ENKOLIT).

Installation:
In order to prevent the Click Roll Cap panel from damage when drilling holes for rivets, a metal angle should be placed behind the fastener to protect the panel.

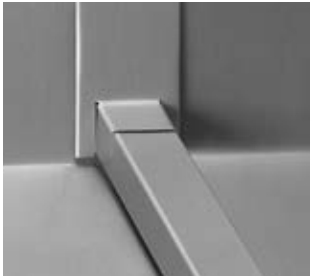


Fig. 19: RHEINZINK ridge termination

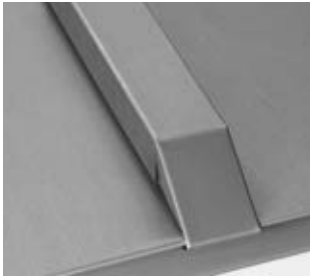


Fig. 20: RHEINZINK eaves termination

The components of the click roll cap system are finished products, which present an economical and visually mature, practical solution. The RHEINZINK eaves termination guarantees straight eave edge. Forced thermal expansion is prevented.

Name	Length mm	Thickness mm
Fastener, galvanized steel with 5 fixing holes, height 52 or 58 mm	500	1.00
Ridge termination cap	167	0.70
Eaves termination cap for roof and wall	500	0.80
Pre-profiled roll cap, straight, plug-in on one side ~ 60 mm	3000*	0.80

Table 10: Components of RHEINZINK-Click Roll Cap System
** other lengths are available upon request*

4. Seamed Facade Cladding

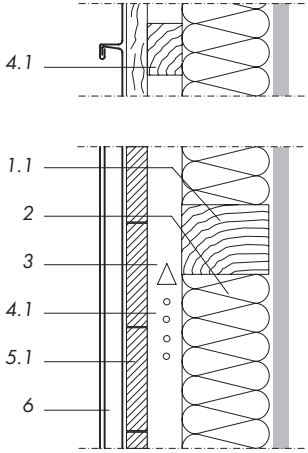
For aesthetic reasons, RHEINZINK-seamed wall cladding is always designed as an angled standing seam.

Note:
Wherever possible, avoid using double standing seams for facade cladding, as tools and machines may cause a disproportionate amount of stress-related deformations and mechanical damage. If this technique is used, please address your concerns in writing to the client.

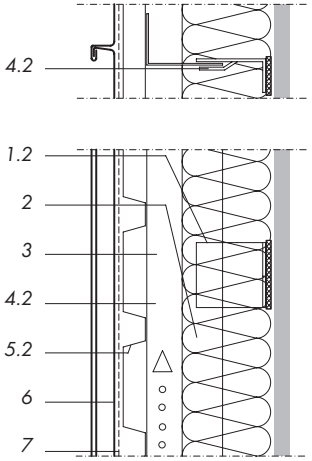
Other design variations:
- Combination of standing seam/ RHEINZINK-Click Roll Cap System
- Roll cap system
- Flat-lock tiles/small tiles (hook-in seam technique)

4.1 Substructure

- Timber (Dia. 16.1)
- Metal (Dia. 16.2)



Dia. 16.1: Angled standing seam cladding on a timber substructure



Dia. 16.2: Angled standing seam cladding on a metal substructure

Wall structure

1 Supporting structure as per fire regulations:
1.1 Made of timber (battens)
1.2 Made of metal with Thermo-stop (bracket system)
2 Thermal insulation (as per DIN 4108)
3 Height of ventilation space ≥ 40 mm (standard is 20 mm), and width of ventilation openings ≥ net 20 mm must be coordinated in the design Please see Table 2, P. 33 and notes regarding isolated cases.
4 Supporting structure:
4.1 Made of timber (battens)
4.2 Made of metal (bracket system)
5 Sheathing:
5.1 Made of softwood boarding (nominal thickness is 24 mm/ width ≤ 100 mm) or OSB/ plywood sheathing
5.2 Made of metal (structural deck profiles), galvanized steel or coated steel)
6 RHEINZINK-Angled Standing Seam System
7 Underlay (acoustic insulation)

As a rule, wall claddings are more demanding aesthetically than roofing. The aesthetics can be optimized through the following:

Material selection:

- Sheet material (up to 6 m length possible)
- When using RHEINZINK-prePATINA, material with the same surface should be ordered for each individual area. Different batches can be used for flashings, base strips, window copings etc.
- Work should not be interrupted in an individual section. Colour deviations in this case are normal and are caused by the natural carbonization process, which occurs over time.
- Coordinate with site management/customers.

Technical data:

- Sheet-/coil width ≤ 600 mm, for aesthetic reasons (fusion process etc.) bay widths of ≤ 430 mm are recommended.
- Material thickness 0.80 mm
- Avoid double standing seam system
- Coordination with planner/site management is required, if details are not described in the specifications.
- Panel layout should be aesthetically pleasing, by using adapter or custom panels.
- Restraints with penetrations, advertising signs and lightning protection clips should be avoided.
- Panel lengths:
  optimal: up to 4.0 m
  maximum: ca. 6.0 m

4.2 Detail Design

4.2.1 Window Opening – symmetrical Division of Panels

Bay width:

a: bay width

~ *a:* max. deviation ± 5 cm (aesthetics)

Types of panels:

B_1: Standard panel OC/UC

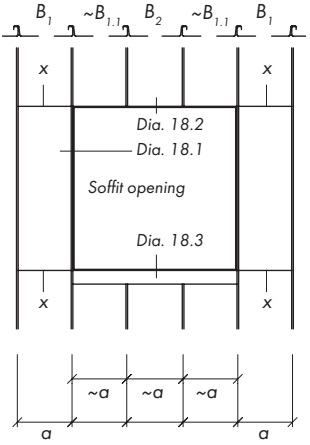
~ $B_{1.1}$: Standard panel OC/UC

B_2: *Custom panel OC/OC*

x: Cross-seam

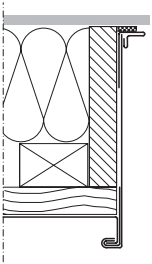
Note:

- Symmetrical division of panels
- Soffit connection with seams facing outwards (left and right should be identical), custom panel (two over-cloak seams OC/OC) required
- Cross-seam at lintel/windowsill (not absolutely necessary)
- Seamed jamb profile at windowsill coping (see Fig. 21).



Dia. 17: Example – window connection with symmetrical division of panel

4.2.1.1 Window Connections

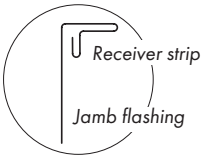


Dia. 18.1: Jamb with window connection using a receiver strip

Fig. 21: Jamb on lateral connection windowsill coping

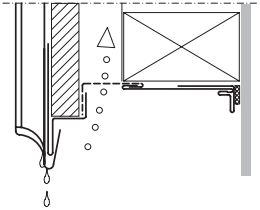
Notes pertaining to Dia. 18.1:

- Indirect fastening of jamb flashing to facade panel
- Installation of receiver strips in window area
- Symmetrical seam layout (see Dia. 17)

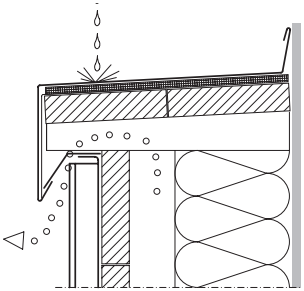


Dia. 18.1.1: Receiver strip detail

Note:
No direct fastening with screws.



Dia. 18.2: Window lintel with ventilation and window connection using receiver strip



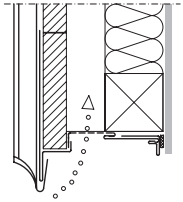
Dia. 18.3: Windowsill coping bonded with Enkolit and ventilation – wall cladding

Notes pertaining to Dia. 18.2:

- Provide ventilation opening (see Table 2 and instructions for isolated cases)
- Two-part design, perforated strip and lintel profile, (substructure is not visible)
- Indirect fastening of flashings
- Installation of receiver strips

Notes pertaining to Dia. 18.3:

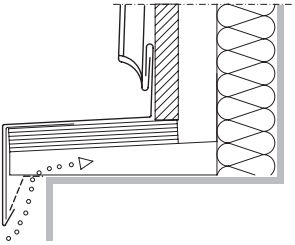
- Windowsill coping fastened with galvanized continuous cleats, material thickness ≥ 1.0 mm.
- To avoid drumming sounds, windowsill copings should be full surface bonded with Enkolit.
- Wherever possible, avoid soldering the joints of the windowsill coping on top of RHEINZINK facade claddings. Use RHEINZINK-UDS-Connectors for fastidious detail.
- Provide a ventilation opening (see Table 2 and notes for isolated cases).



Dia. 19.1: Base detail flush, with ventilation

4.2.2 Base Detail flush or not flush with Cladding

Notes pertaining to Dia. 19.1:
see Dia. and description 18.2

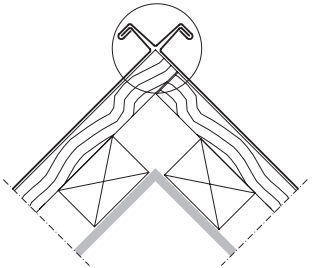


Dia. 19.2: Base detail not flush, with ventilation

Notes pertaining to Dia.19.2:
Design variation: base detail is visible

- With base/cornice coping, e.g. for wall projections
- Provide ventilation opening
- Cornice coping joints; design according to technical requirements
- If there are vertical wall parts made of plaster underneath the cornice coping, other details may be necessary (protection from moisture, dirt, etc.)

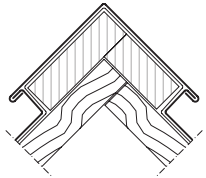
4.2.3 Outside Corner



Dia. 20.1: Design with seam cap (corner profile), design and aesthetics created through symmetry of flashing.

Dia. 20.2: Diagonal seam

Dia. 20.3: Straight seam, one-sided



Dia. 20.4: wide design; flashing with timber substructure

Note:
Pay attention to the dimensions for panel production. In order to avoid excess bulging of the panels, the width must be made to precise dimensions, without any plus tolerances. This applies primarily to Dia. 20.2/20.3.

4.2.4 Inside Corner

Note:
Wherever possible, inside corners of a building should be folded without a seam in the corner. Seam connections to cladding should be executed to suit the direction of the installation.

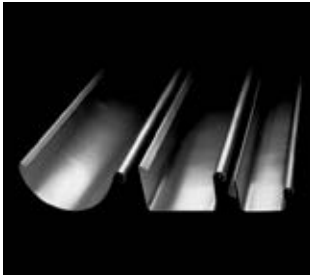


Fig. 22: RHEINZINK-Gutters with pre-fabricated bead notch

5. Roof Drainage System

RHEINZINK offers a variety of eaves gutters, rainwater downpipes and accessories. RHEINZINK roof drainage products are tested and manufactured according to DIN EN 988, DIN EN 612 and the Quality Zinc Criteria Catalogue (TÜV). These products are available in the surface qualities RHEINZINK-CLASSIC line and RHEINZINK-prePATINA line.

5.1 Applicable Standards and additional Requirements

Application of DIN EN 612:

- Eaves gutters are classified as X and Y, depending on the bead diameter or corresponding section modulus (DIN EN 612,Tab. 1) according to metal thicknesses in classes A and B (DIN EN 612, Tab. 3).
- Rainwater downpipes are classified as X and Y (DIN EN 612, Tab.2), depending on the dimension of the seam overlap

All RHEINZINK products fall into the X classification (A) and thus meet the requirements of Y (B).

Application of DIN EN 1462:

- Gutter brackets are divided into three classes, based on their load capacity

Designation according to DIN EN 612 for eaves gutters and rainwater downpipes:

- Cross section and product descriptioN

- The number of this standard (EN 612)
- Identification field: Nominal size of eaves gutter, respectively, the diameter or cross-section of the downpipe in mm; type of material;

Example of designation:
half-round suspended eaves gutter EN 612-333-Zn

DIN EN 612 marking without other declarations for eaves gutters and rainwater downpipes:

- Trade name or trademark of manufacturer
- Abbreviation for country of manufacture
- Number of this European standard (EN 612)
- Identification field: see above

Additional requirements:
Due to different climatic conditions in Germany and, in order to guarantee existing roof drainage systems, compliance with stipulations regarding form and dimensions according to DIN EN 612 is required.

5.2 Dimensioning of bracket-mounted exterior Systems (DIN EN 12 056-3)

For economic reasons and to ensure self-cleaning, pipe work and other components comprising part of the rainwater drainage system should only be calculated for an average rainfall. Within the scope of DIN 1986-100, the ideal rainfall lasts for 5 minutes and is constant. According to DIN 1986-100, rainwater downpipes, collecting and underground pipes should be calculated for a regional five-minute rainfall intensity, which is to be expected every 5 years ($r_{5/5}$). Contrary to the customary blanket regulation of r = 300 l/s/ha for Germany used to date to calculate rainwater drainage systems, in northern and southern Germany, smaller and larger rainfall intensities will need to be used respectively to calculate rainwater drainage systems.

Rainwater runoff is calculated according to the following equation:

$$Q = r_{T/Tn} \cdot C \cdot A \cdot \frac{1}{10000}$$

Q : rainwater run-off in l/s
$r_{T/Tn}$: rainfall intensity in l/s/ha
C : run-off coefficient (C = 1.0 for all roof areas that do not store water, independent of the roof pitch)
A : projected precipitation area in m^2 of the floor plan

Rainfall specifications are available from regional government authorities or through the German Weather Service.

A new principle contained in DIN 1986-100 stipulates that overloading drainage systems should be limited in order to avoid damage. This can be achieved by installing emergency overflow systems and limiting excess pressure in the drainage system. Roofs designed with internal/ secret gutters and light-weight built flat roofs must always have emergency overflows that drain directly to the ground.

Note:
The RHEINZINK-Homepage contains a calculation program to dimension bracket-mounted drainage systems: www.rheinzink.de.

5.2.1 Data/Dimensions of bracket-mounted Eaves Gutters, halfround or box-shaped, outside of Buildings according to DIN EN 612

Nom. size	Min. metal thickness mm	Bead diameter RHEIN-ZINK mm	Bead diameter DIN EN 612 mm	Height of front side Min dim. RHEINZINK half-round mm	Height of front side Min dim. RHEINZINK box-type mm	Height of front side Min dim. DIN EN 612 min. mm	Excessive rise of water check to bead RHEINZINK half-round mm	Excessive rise of water check to bead RHEINZINK box-type mm	Excessive rise of water check to bead DIN EN 612 min. mm
200	0.65	16	14	48	42	40	8	8	6
250	0.65	18	14	61	55	50	10	10	6
280*	0.70	18	14	72	–	55	11	–	6
333	0.70	20	14	86	75	55	11	10	6
400**	0.80	22	18	107	90	65	11	10	6
500	0.80	22	20	136	110	75	21	20	6

Table 11: Nominal sizes, material thickness, bead diameter, see DIN EN 612/production data RHEINZINK GmbH & Co. KG, minimum requirements

* *Box-shaped not available*

** *Note: In accordance with specialist regulation from the Heating and Air Conditioning Association (ZVSHK) and the National Association of Roofers (ZVDH), 0.8 mm material thickness is absolutely essential.*

5.2.2 Data/Dimensions of Gutter Brackets made of RHEINZINK according to DIN EN 1462

Nom. size	c mm	Dimensions for increasing loads b x s, series*, mm			
	± 3	1	2	3	4
200	230 270	25 x 4	25 x 4	25 x 4	—
250	280 330	25 x 4	30 x 4	**25 x 6**	—
	410 500	25 x 4	—	—	—
280	290 350	30 x 4	30 x 5	**25 x 6**	25 x 8
	390 480	30 x 4	—	—	—
Snap-lock bracket**	—	—	—	—	x
333	300 370	30 x 5	**25 x 6**	40 x 5	30 x 8
	450	30 x 5	—	—	—
Snap-lock bracket**	—	—	—	—	x
400	340 430	30 x 5	40 x 5	25 x 8	30 x 8
	410	30 x 5	—	—	—
500	375 515	40 x 5	40 x 5	30 x 8	30 x 8

Table 12: Dimensions (length/cross-sections) for half-round eaves gutters according to DIN 18461 and EN 1462

Nom. Size	c mm	Dimensions for increasing loads b x s, series*, mm			
	± 3	1	2	3	4
200	230 270	25 x 4	25 x 4	25 x 4	—
250	280 330	25 x 4	30 x 4	**25 x 6**	—
333	300 370	30 x 5	**25 x 6**	40 x 5	30 x 8
400	330 420	30 x 5	40 x 5	25 x 8	30 x 8
500	350 490	40 x 5	40 x 5	30 x 8	30 x 8

Table 13: Dimensions (length/cross-sections) for box-shaped eaves gutters, mm

Gutter bracket intervals ± 40 mm	Typical load category Series	High load category Series
700 mm	1	3
800 mm	2	4
900 mm	3	—

Table 14: Gutter loading categories and maximum fixing distances

Explanations of tables 12 and 13:

c Fixing leg
b x s Cross-section of gutter bracket
* for dimensioning see Table 14
** Tested according to DIN EN 1462

Note:
Installation of roof gutters is either horizontal or with an incline, depending on specifications or as agreed with the customer.

5.2.3 Expansion Elements for bracket-mounted Eaves Gutters

Eaves gutter, bracket-mounted	Nominal size	Max. distance (m) Expansion element
Halfround* and	≤ 500	15.0
box-shaped*	> 500	10.0
On roof gutter	≥ 400	8.0
Custom shape	≤ 500	8.0

Table15: installation of expansion elements for bracket-mounted eaves gutters
** according to DIN EN 612*

Note:
As a rule, half the distance should be allowed for fixed points (corners and connections, etc.)
When installing cylindrical gutter connectors (soldering), thermal expansion of the eaves gutters due to changes in temperature, is not guaranteed.

Dia. 21 (right side):
Example: Layout of expansion elements for a RHEINZINK roof drainage system (nominal size ≤ 500 mm), halfround or box-type according to DIN EN 612 on an L-shaped building (bracket-mounted system, dimensions in m).

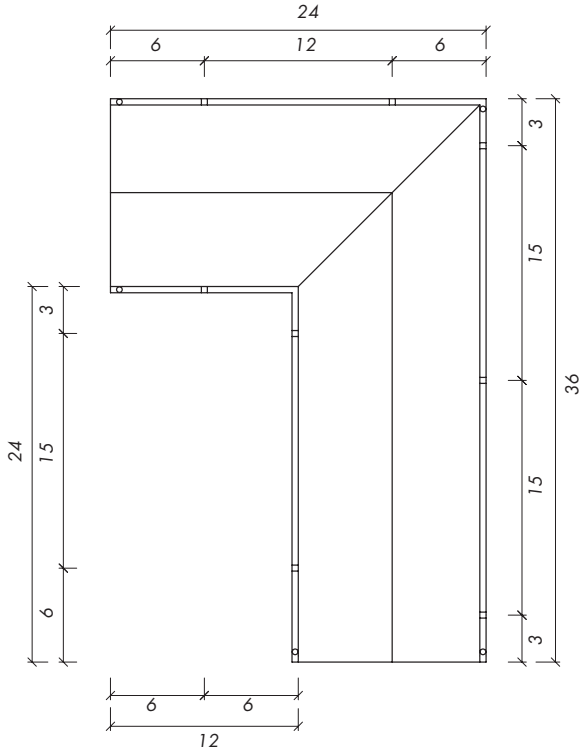

24
6
12
6
3
15
15
3
36
24
3
15
6
6
6
12

Fig. 23: RHEINZINK roof drainage system, complete and precision-fitted – 30 years guarantee

Fig. 24: RHEINZINK-Gutter Heating System with electronic heating element control

5.3 Eaves Gutter Accessories

We strongly recommend that all roof drainage components are used from one system – the RHEINZINK roof drainage system, identified by the RHEINZINK stamp.

Installation products from various sources can cause installation problems and differences in colour during patination.

5.4 Rainwater Downpipes according to DIN EN 612

RHEINZINK-Rainwater Downpipes, round and box-shaped, with additional requirements comply with DIN EN 612. For circular rainwater downpipes, we recommend the high frequency welded (Patent) seam design for reasons of aesthetics and strength.

Each length of pipe is expanded at one end to form a 50 mm long socket. This is done at the plant.

Round diameter (mm), high frequency welded	Square edge length (mm), soldered inside	Material thickness (mm)
≤ 100	< 100	≥ 0.65
> 100	≥ 100, < 120	≥ 0.70
	≥ 120	≥ 0.80

Table 16: Material thickness depends on the diameter or square edge length of rainwater downpipe. Excerpt from DIN EN 612.

Note:

- The standard pipe length of round rainwater downpipes is 2 m and 3 m; other lengths are available upon request.
  The standard pipe length of square rainwater downpipes is 2 m.

Benefits of RHEINZINK-Rainwater Downpipes compared with conventionally manufactured rainwater downpipes:

- Remaining lengths can easily be expanded using the appropriate equipment (e.g. MASC) or can be fitted into each other using the RHEINZINK-Pipe Sockets.
- Strength of weld is approximately equal to strength of material
- 100% recyclable
- Linear, minor dimensional deviations

6. RHEINZINK for Copings

6.1 Sheet Metal Work for all Copings

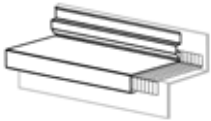
Countless profile shapes are required for sheet metal work. All customary flashings can be produced in our regional Service Centres – according to dimensions or sketches.
Standard profiles are in stock. Standard profile length is 3 m; other profile lengths are available upon request.

Applications:
Flashings for
- Tile and slate roofing, etc.
- Roof sealings (bituminous sheeting, etc.)
- Walls, cornices, connection profiles, valleys, box-shaped gutters, windowsill copings

Fig. 25: RHEINZINK flashing profiles

Fig. 26: RHEINZINK flashing as a wall coping

Dia. 22.1: RHEINZINK detail copings for roof edge



Dia. 22.2: Joint detail for cornice coping with flashing strip and UDS-connector

Width of coverage a	Minimum thickness	
mm	Fastening with continuous cleats mm	Adhesive fastening without continuous cleats mm
a < 300	0.70	0.80
a < 500	0.80	1.00
a ≥ 500	1.00	1.00

Table 17: Widths of coverage and material thickness

Profile	Design/ application	Nom. size mm	Material thickness mm	
			RHEINZINK recommendations	Min. requirements, standards
Valleys	for all roofing materials	≤ 400 > 400 > 800	0.70 0.80 1.00	0.70
Eaves flashings	for roof coverings (tiles, slate, etc.)	≤ 400 > 400	0.70 0.80	0.70
	for RHEINZINK roof coverings/ wall claddings	≥ 167	0.80	

Table 18: Material thickness in relation to nominal size (girth); RHEINZINK recommendations, applicable standards and/or regulations.

Fig. 27: Attic – cornice copings

Note:
RHEINZINK recommendations with respect to material thickness should be complied with for reasons of linearity and aesthetics. All flashings should be fastened indirectly. Avoid direct fastening.

6.2 Jointing Techniques

Jointing of individual RHEINZINK flashings depends on the required water tightness for the specific design detail.

Jointing technique	Pitch (incline) longitudinally	Comment
Soft soldering	unlimited	Expansion elements required for profile lengths of ≥ 3 m
Single seam with additional continuous soldered cleat	≥ 10°	see Dia. 8.2
Single seam	≥ 25°	see Dia. 8.3
Overlap	≥ 15°	valleys, etc. (tile roofing), avoid using on metal roof coverings
Jointing technique	Pitch (incline) horizontally	Comment
RHEINZINK-UDS-Connector, single seam, flat expansion joint	≥ 3°	0° pitch (formation of zinc hydroxide due to formation of puddles = only affects appearance, joint connection through soft soldering

Table 19: Jointing techniques in relation to pitch, minimum requirement

Note:
Where there is no incline, the pools of water on the surface will result in zinc hydroxide (this does not affect service life or durability, only aesthetics).

RHEINZINK recommendation:
due to various watertight jointing techniques, a minimum pitch of 3° in a cross-wise direction (wherever possible, to the roof), is recommended.

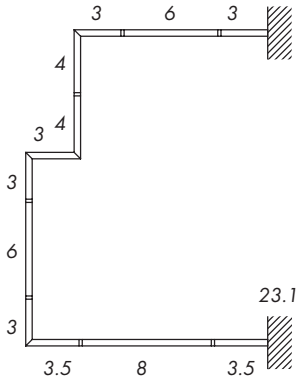
Avoid using standing seams as profile joints, or restrict panel length to 1.0 m.

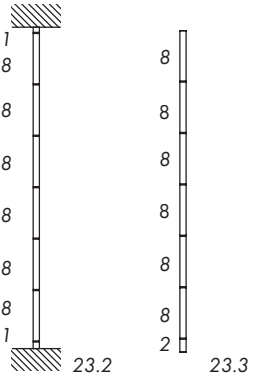
RHEINZINK-UDS-Connectors can be installed for all flashings.

6.3 Design of Flashing Joints to accommodate Expansion

The installation of expansion elements is necessary for soft-soldered connections.

Types of design:
- Commercially manufactured expansion elements
- Flat expansion joints
- Single seam with/without additional continuous soldered cleat
- Joint connections using RHEINZINK-UDS-Connectors





Examples of three design variations: layout of expansion elements for a wall coping made of RHEINZINK, nominal size/girth 600 mm.

Note:
As a rule, half the distance is always required for fixed points (corners, connections, etc.) (see Tab. 20).

Dia. 23.1:
With a total flashing length of 50 m with 2 wall connections and 4 corners to the building, 7 expansion elements are required.
Dia. 23.2:
For the same flashing length with 2 wall connections, 7 expansion elements are also required.
Dia. 23.3:
For the same flashing length without wall connections, only 6 expansion elements are required.

7. Spacing of Expansion Elements for Roof Gutters and Flashings

Eaves gutters, flashing profiles	Nominal size/girth	max. distance of expansion elements (m)	Regulations/ recommendations
Bracket-mounted gutters	≤ 500	15.0	ZVSHK regulations [Central Association for Plumbing, Heating and Air Conditioning], ZVDH [Central Association of German Roofers]
Special shape gutters: quarter round,	≤ 500	15.0	DK-STANDARD
on roof gutters	≥ 400	8.0	RHEINZINK recommendation
On roof gutter (Austria)	> 500	8.0	Ö-STANDARD
Interior gutters, round, box-shaped	≥ 500	8.0	Professional regulations
	< 500	10.0	
Shed roof gutters	> 800	6.0	RHEINZINK recommendation
Flashing profiles, glued on or fastened indirectly	all nom. sizes	8.0	Professional regulations
Flashing profiles, glued in place (roof sheeting)	all nom. sizes	6.0	Professional regulations

Table 20

Note:
Half the distance should always be maintained for fixed points (corners, connections, etc.). The prescribed guidelines can be exceeded slightly.

8. Standards/guidelines

Excerpt from important standards and guidelines, which are also applicable to Germany: National Building Codes; Trade Code for Metal Roofers (ZVSHK, ZVDH);

DIN 1055	Action on structures
DIN 1986	Drainage systems in private ground;
DIN 4102	Fire behaviour of building materials and components;
DIN 4108	Thermal Insulation in buildings; En EV
DIN 4109	Sound insulation in buildings;
DIN 4426	Safety requirements for workplaces and accesses
DIN 18195	Water-proofing of buildings
DIN 18299	General technical contractual conditions
DIN 18334	Carpentry and timber construction works;
DIN 18338	Roofing and roof sealing;
DIN 18339	Sheet metal works;
DIN 68800	Protection of timber in buildings;
DIN EN 1991-1-4	Effects on support structures – wind loads
DIN EN 13859	Flexible sheets for waterproofing – Definitions and characteristics of underlays – Underlays for discontinuous roofing
DIN EN 62305	Protection against lightning – Part 3: Physical damage to structures and life hazard (IEC 62305-3 Supplementary sheet 4)

DIN EN 501	Roofing products from metal sheet
DIN EN 516	Prefabricated accessories for roofing – Installations for roof access
DIN EN 517	Prefabricated accessories for roofing – Roof safety hooks
DIN EN 612	Eaves gutters with bead stiffened fronts and rainwater pipes with seamed joints made of metal sheet;
DIN EN 988	Zinc and zinc alloys;
DIN EN 1462	Brackets for eaves gutters
DIN EN 12056-3	Gravity drainage systems inside buildings, etc.
DIN EN 13501	Fire classification of construction products and building elements
DIN EN 13162	Thermal insulation products for buildings – Factory made mineral wool (MW) products
EN ISO 9001	Quality management systems
EN ISO 14001	Enviromental management systems
ENISO 14025	Environmental labels and declarations

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Norway
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Romania
Russia
Slovak Republic
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Spain/Portugal
Sweden/Finland
Switzerland
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RHEINZINK GmbH & Co. KG
Postfach 1452
45705 Datteln
Germany

Tel.: +49 2363 605-0 Fax:
+49 2363 605-209

info@rheinzink.com
www.rheinzink.com

100396-RZ-GB_INT-012-11-18