elZinc
HANDLING, STORAGE AND TRANSPORT, INSTALLATION AND MAINTENANCE

elZinc

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Note:

This brochure is intended to support architects, planners and engineers, along with handlers and installers in all matters relating to handling, storage and transport as well as processing and installation of elZinc® titanium zinc.

elZinc is a material with a particularly high level of quality and outstanding features and was developed and produced to meet the standard requirements for a high-quality sheet for building applications in accordance with standards, technical rules and trade rules.

All the important features and advice on use and on processing of elZinc strips and sheets are dealt with.

However, the applicability of all advice and information for each actual case of application should be carefully checked, since all circumstances and local conditions must be taken into account as a matter of principle. The issuer cannot therefore accept any liability for completeness, correctness or omissions.

ASTURIANA DE LAMINADOS is committed to quality as a supplier of titanium zinc for roofs and walls, as well as for building components, across many regions. ASTURIANA DE LAMINADOS supplies the international markets under the name of elZinc®.

All elZinc® products comply with the relevant standards. The raw materials and alloying components used in production are subject to the strictest reception controls and are regularly monitored by external bodies.

This handbook has been created in an effort to provide all customers and partners of elZinc® with comprehensive, application-oriented and objective technical information. The data have been very carefully compiled and represent state-of-the-art technology.

Advice is given on what measures must be adhered to for transport and storage and what combinations of materials or installation situations are preferable; clear advice is also given as to which applications or conditions may lead to damage. These are to be avoided in terms of design and planning, as well as during processing.

The information is based on the comprehensive experience of elZinc® as a renowned manufacturer which has been supporting and advising its customers and partners in all matters relating to material properties and applications.

The processors and tradespeople can find detailed information for handling and processing the material in an appropriate way, as well as dimensions, sizing and installation. Planners and architects will be able to use the information and proposals in the text for their day-to-day work and the information can of course be supplemented as required and adapted to the conditions relating to each structure.

elZinc® would be happy if this handbook became an important tool to help all construction professionals and was distributed as widely as possible.

Olloniego, 2012

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ASTURIANA DE LAMINADOS, S.A.

With its headquarters in Asturias (Spain), elZinc® has been producing strips and sheets made of titanium zinc, along with zinc anodes for electroplating since 2009.

ASTURIANA DE LAMINADOS is now one of the most important producers of titanium zinc (EN 988). Under the brand name elZinc®, which has been introduced on an international basis, elZinc® supplies its products to more than 20 countries.

elZinc® feels a particular commitment to environmental protection and sustainability. Sustainability and quality are clearly laid down as corporate aims and are converted into actual day-to-day practice in regular in-house training sessions.

This means that all stages of production are continuously optimised and monitored in terms of energy use, efficiency of the individual stages of production, conservation of resources and environmental friendliness. A team of managerial staff regularly evaluates production processes, assesses advice from staff and develops strategies for improving quality, along with optimisation of environmental awareness at the same time.

Milestones in the history of ASLA:
- 2006: Foundation of Asturiana de Laminados, SA
- 2007: Start of construction of the first production unit
- 2009: Delivery of the first order of rolled zinc
- June 2011: Delivery of the first order of elZinc® Slate (pre-weathered, light)
- 2011: Start of construction of the second production unit
- 2012: elZinc® is operating on all 5 continents

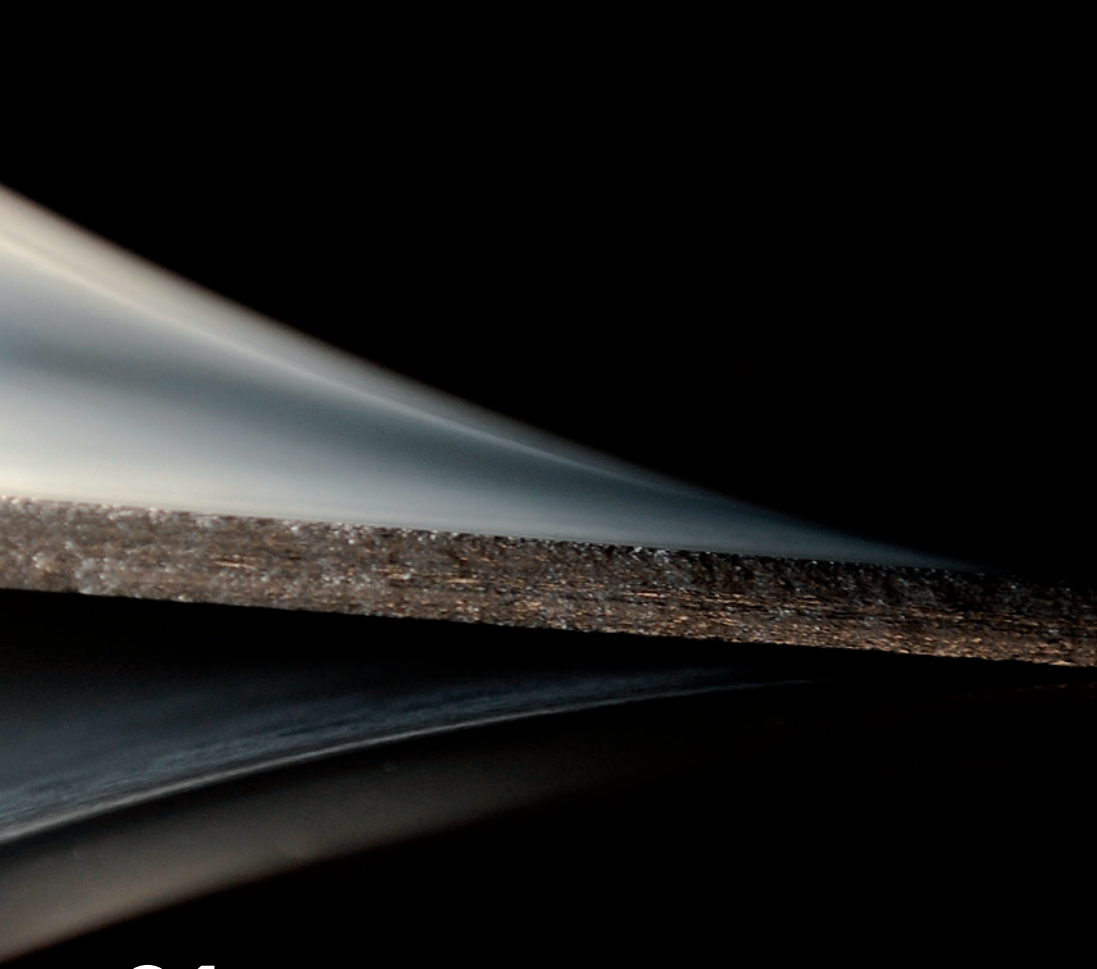
SERVICE AND CUSTOMER ORIENTATION: A PROMISE!

Erecting buildings is a complex process which is split into many interconnected subtasks. The roofing must be incorporated into an initial stage of construction of the building. Façade work is often carried out under time pressure for completion at the end of the building work, when very many trades are still however pressing ahead with their work, both on the exterior and internal fittings.

elZinc® with its internationally experienced consultancy team of materials and processing experts, is a partner for the most demanding projects and supports both industrial and trade processors in all technical matters relating to materials or processing.

Choosing the modern material **elZinc®** titanium zinc means you are sure to receive the competent and unbureaucratic support of elZinc® in every phase of the construction task.

Because your success as a processor and installer is our success.



01.
elZinc: TITANIUM ZINC WITH SPECIAL QUALITY

01.1. QUALITY ASSURANCE AND STRICT PRODUCTION MONITORING

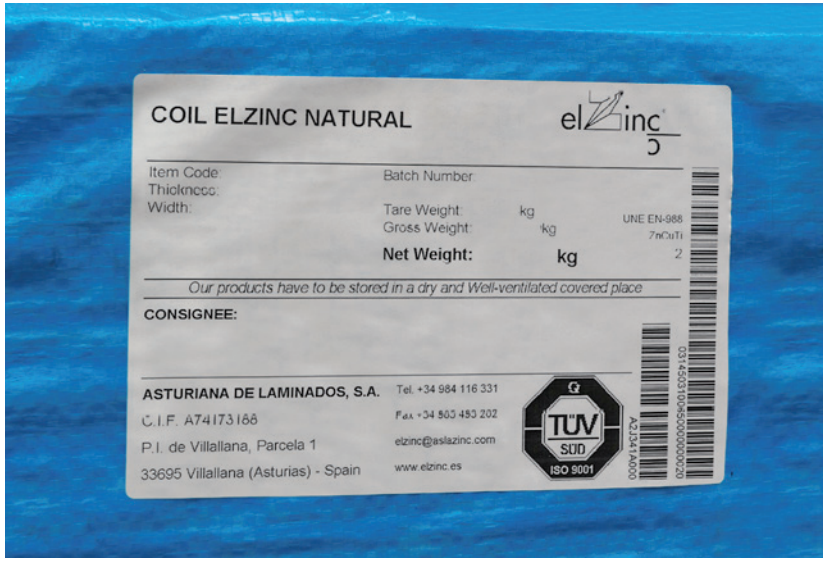
elZinc® has introduced a quality management system in accordance with ISO 9001:2008 and monitors all materials used and stages of production in a very detailed way.

Compliance with tight works specifications, which must be fulfilled in addition to the requirements of the standards of each elZinc® coil or elZinc® sheet, is regularly monitored and confirmed by independent inspections.

Each strip or sheet made of elZinc® is therefore provided with a continuous stamp on the surface of the sheet. The form of the stamp is:

This means that each sheet with the product width of 1,000 mm can be identified at any time due to the stamp. With sheet blanks, longitudinal cutting or cross-cutting of sheets it can happen that the continuous stamp is not identifiable on every blank.

Coils or packs of sheets are marked on the packaging as follows:



01.2. REQUIREMENTS AS PER STANDARDS

Naturally, elZinc® titanium zinc meets all the standards' requirements, both for the finished strips and sheets and for the individual alloying components.

elZinc® titanium zinc comes under the EN 988 standard, which defines the general requirements for titanium zinc strips and sheets for use in the building industry.

The alloying components are high-grade refined zinc of the highest standardised level of purity Zn 99.995 according to EN 1179, with precisely defined additions of copper and titanium. Further components, such as aluminium and other trace elements, are accurately limited and the purity of the alloy is extremely precisely monitored by regular controls.

This makes it possible to ensure that the following mechanical and technological values are adhered to:

PRODUCT REQUIREMENTS	EN 988 STANDARD	ELZINC TITANIUM ZINC
CHEMICAL COMPOSITION		
Zinc	Zn 99,995 (Z1 as per DIN EN 1179)	Zn 99,995 (Z1 as per DIN EN 1179)
Copper	0.08 - 1.0%	0.08 - 0.2%
Titanium	0.06 - 0,2 %	0.07 - 0.12%
Aluminium	max. 0.015%	max. 0.015%
DIMENSIONS/TOLERANCES FOR STANDARD PRODUCTS		
Thickness of sheets/coils	± 0.03 mm	± 0.02 mm
Width of sheets/coils	+ 2 / - 0 mm	+ 1 / - 0 mm
Length of sheets	+ 10 / - 0 mm	+ 2 / - 0 mm
Straightness	max. 1,5 mm/m	max. 1,0 mm/m
Flatness	max. 2 mm.	max. 2 mm.

PRODUCT REQUIREMENTS	EN 988 STANDARD	ELZINC TITANIUM ZINC
MECHANICAL AND TECHNOLOGICAL PROPERTIES IN THE DIRECTION OF ROLLING		
Yield strength elasticity (Rp 0,2)	min. 100 N/mm^2	min. 110 N/mm^2
Tensile strength (Rm)	min. 150 N/mm^2	min. 150 N/m^2
Breaking elongation (A50)	min. 35%	min. 40%
Vickers hardness (HV3)	–	min. 45
Bending test	No cracks at the end of fold	No cracks at the end of fold
Bending back after folding test	–	No cracks
Erichsen test	–	min. 7,5 mm
Remaining stretch in creeping behaviour test (Rp0,1)	máx. 0,1%	máx. 0,1%

PROPERTY	UNIT	VALUE
Coefficient of linear expansion, parallel to the direction of rolling	m/(m K)	22 x 10^{-6}
Melting point	°C	approx. 420
Recrystallisation temperature	°C	min. 300
Heat conductance	W/(m K)	110

Table 1: Mechanical and technological data elZinc® titanium zinc

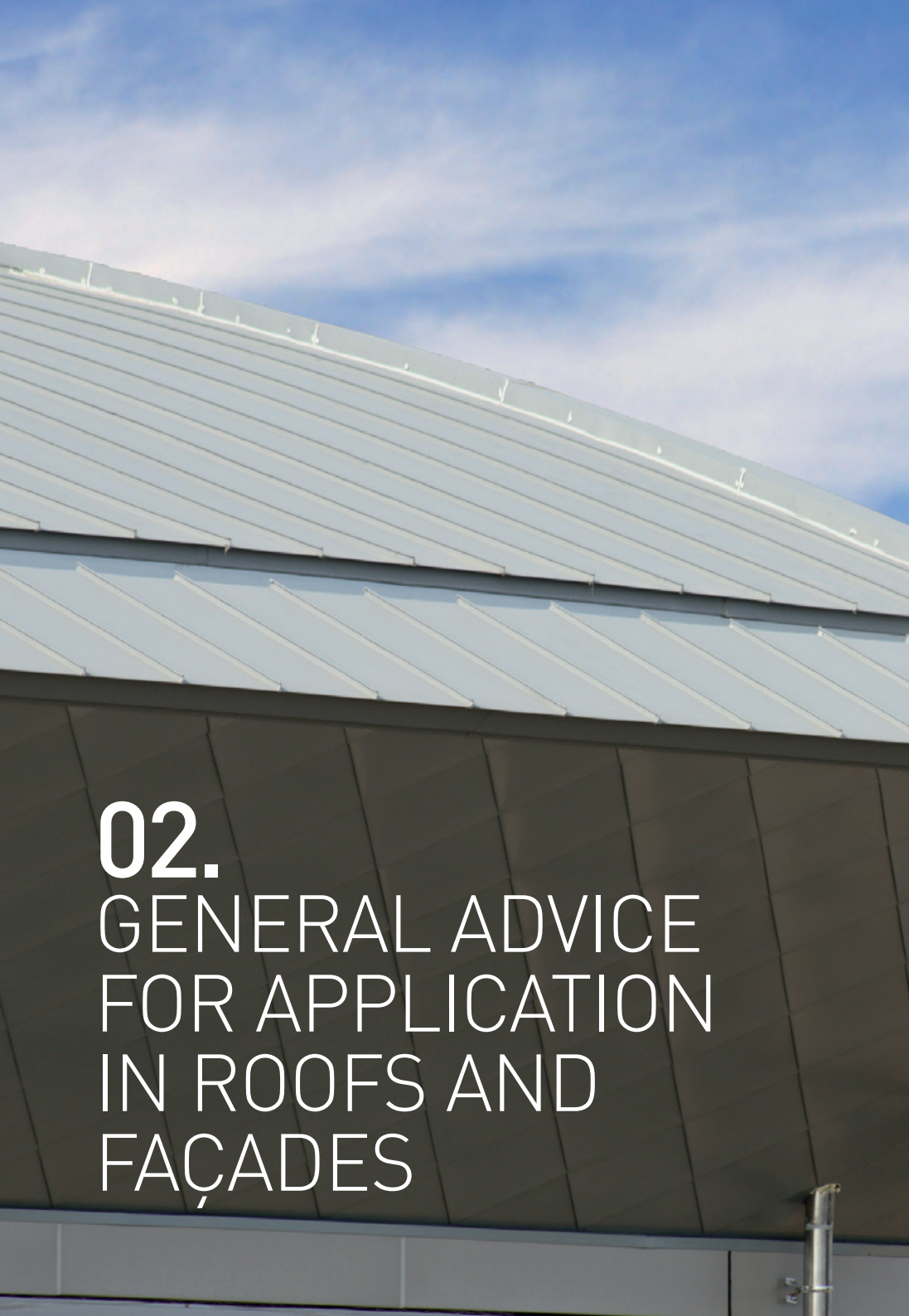
elZinc® titanium zinc has been optimised for use in building applications. Prerequisites for this are the rolling process, which is precisely tailored to the elZinc® alloy, and accurate temperature control during manufacture.

This means the achievement of consistent quality and of compliance with all properties. elZinc® titanium zinc stands out due to

- very good workability irrespective of the direction of rolling
- high creep strength (creep strain limit)
- low cold brittleness
- high recrystallisation threshold, i.e. no grain growth until 300°C;

this is crucial for soldering.

A more extensive compilation of the properties and the importance of the alloying elements for the special properties of elZinc titanium zinc are included in the comprehensive handbook "elZinc Installer's Guide".



02.
GENERAL ADVICE FOR APPLICATION IN ROOFS AND FAÇADES

02.1. PROFESSIONAL HANDLING AND GENERAL TECHNICAL ADVICE

Zinc is the alloying element which is the key factor in determining the property in all titanium zinc according to the standard (EN 988). Zinc is characterised by its high chemical reactivity, which means it very quickly forms the lasting natural protective layer which makes titanium zinc a very durable metal for construction.

elZinc® titanium zinc is only manufactured with zinc that has the highest standardised level of purity (Z1 as per EN 1179), which, in combination with the specially optimised rolling technology of ASTURIANA DE LAMINADOS, is the basis of the high durability and resistance to weathering of both bright-rolled elZinc titanium zinc and pre-weathered elZinc® titanium zinc.

With the formation of the natural top layer ("zinc patina") with the bright-rolled version, the elZinc® titanium zinc gets a very effective protection against all the effects of the weather. The formation of this top layer is optically evident with the bright-rolled version, in that the original metallic brightness changes progressively into a matt grey and develops a significant light to dark grey shade in its final state. The actual formation of the "final colour" is heavily dependent on the environmental conditions, because this natural process also incorporates suspended particles (atmospheric gases) and dusts from the environment into the top layer.

A natural top layer is also formed with the pre-weathered version: the pre-weathering layer developed in the factory is slowly "infiltrated" by the natural reaction and over time forms a top layer of natural patina and pre-weathered layer.

As this process is to a great extent controlled by the precisely formulated, factory-made elZinc® pre-weathering layer, the visual appearance is much more consistent and the final colour is also similar to the freshly delivered elZinc® pre-weathered colour.

In its delivery condition, titanium zinc therefore is not - like all metals for construction - a "dead material", but only develops its definitive surface finish under the influence of the weather and this then ensures the outstanding self-protection of the weathered surface. For titanium zinc, as also for aluminium or copper sheets, this results in the need to avoid harmful effects during this reaction phase, as the natural top layer cannot otherwise form slowly and consistently, which leads to discolourations and staining in the worst case scenario!

The pre-weathered elZinc® surface is protected by surface processing in the factory against potentially disruptive short-term influences.

Nevertheless, processors and installers must always be aware that the elZinc® surface is a reactive one when it is in its unweathered condition, which - intentionally - reacts with the environmental influences to develop the visually appealing, attractive final colour.

As elZinc® titanium zinc is often used for very demanding façades due to its very good workability and very consistent surface finish, it is recommended that there is awareness of the special surface features at all stages of handling and processing for these kinds of prestigious structures and generally for visible roof areas as well.

For visible areas, such as façades, it is recommended to use pre-weathered elZinc® titanium zinc as a matter of principle, as the natural transformation to the top layer proceeds much more consistently for areas that have been weathered in a different way. This means for instance that, under overhangs or rain shadows, where the bright-rolled surface would weather more slowly than in areas directly affected by the rain, there is nevertheless no occurrence of the clear and possibly annoying difference between surfaces which are already weathered to a matt grey and those which are still bright.

02.2. WHAT GENERALLY HAS TO BE TAKEN INTO ACCOUNT WHEN REQUESTING PROPOSALS?

elZinc® titanium zinc is supplied in various surface finishes.

In principle (unless explicitly requested at the time of the order) elZinc® pre-weathered titanium zinc is supplied with an effective, factory-made, temporary surface protection. There are different types of factory-made surface protection, up to supply with a protective film applied in the factory which must not be removed until after installation on the building site.

When requesting proposals and when planning construction times, the specifier must always be aware which influences are to be expected during delivery, processing and storage on the building site right through to installation. This does not just include the actual processing or installation, but significant influences also very often occur as a result of the work of other trades or of the building process, which do not have anything to do with the actual elZinc® work.

The basis of every request for proposals should be the **precisest possible building schedule**.

Naturally, it is not always possible to ensure that the different trades do not affect or influence one another in their work. However, when it is possible, in accordance with the predictable construction process, to bring forward the "dusty activities", or those which may unavoidably contaminate the areas in the vicinity, and complete them before the start of the elZinc® titanium zinc works, then it is the task of the careful specifier to schedule this.

For example, nobody would have the idea of parking their car right next to a building site where there is major dust generation or - even worse - discharge of cement dust or swirling plaster dust. And this is the case, even though automotive paint, in contrast to the living material of titanium zinc with its reactive surface, is to be considered more as a "dead surface", which can be changed back to its original condition after cleaning!

Storage of the building components or prepared sheets on the building site must always be planned to be protected, dry and safeguarded in such a way that contamination or mechanical damage of the stored components is avoided. (Detailed advice for professional storage is given in section 3).

The **natural reaction** can also already start **while still in storage**.

Through a carefully planned quality assurance system and detailed production control, ASTURIANA DE LAMINADOS ensures that the elZinc® coils and elZinc® sheets precisely comply with the agreed condition when they are delivered.

Of course, there is nevertheless an immediate onset of the natural reaction, developing at a greater or lesser speed depending on the packaging and environmental conditions. As elZinc® pre-weathered titanium zinc is given a temporary surface protection in the factory as a matter of principle, which both protects the surface and also slows down the rapid onset of the natural reaction until the material is directly exposed to weathering, no annoyingly rapid development is to be expected under normal conditions of influences.

The surface is nonetheless subject to a slow, continuous development, which is indeed also intentional.

As a general rule it is possible to plan for the **common visible surfaces** to be created with the same material from the same production period. Insofar as this is not possible due to technical procedural conditions, where there are major time interruptions, the possible occurrence of small colour differences at the start must be expected due to the different reaction time.

These kinds of colour differences do indeed balance out over further weathering time, since the first-stage weathering slowly comes to a halt and the second-stage weathering then catches up - however, an initial visual difference due to a different weathering history is not an indication of any manufacturing defect or negative material properties. In contrast, this actually shows that elZinc® titanium zinc and also pre-weathered elZinc® involve using a living, natural material which reacts as planned.

Insofar as longer time delays due to unscheduled interruptions of construction are unavoidable, careful schedule monitoring of the implementation should always make sure that all common visible surfaces are as far as possible completed at the same time.

The protection of the installed building components is the responsibility of the installer through to acceptance (transfer of risk).

If after acceptance, there are still effects to be expected, for instance from cement dust, the planning department or construction management must ensure the protection of installed building components.

Cement dust or plaster dust is still very costly to remove when the dust has become damp due to light rain, fog or dew.

02.3. GENERAL ADVICE FOR PROCESSING AND INSTALLATION

elZinc® titanium zinc is optimised for trade processing and also for industrial conversion into building components and designed for all natural loads that occur in the construction industry.

If some simple rules are adhered to, visually outstanding, durable and safe roofing, flashings and façades can be made, which are characterised by longevity and virtually complete freedom from maintenance.

Minimum sheet thicknesses are laid down in specifications, standards or technical trade rules for many building components, or minimum sheet thicknesses have also emerged that are to be adhered to in practice, which are based on values derived from experience and which supplement the general requirements in standards and other rules.

A comprehensive compilation of the specifications laid down in standards and sheet thicknesses based on trade experience are contained in the comprehensive handbook "elZinc Installer's Guide".

Cleanliness on building sites: Both the bright-rolled elZinc titanium zinc surface and the pre-weathered elZinc surface are reactive when new.

This means that during the processing of elZinc, and on the building site as well, there must be absolute cleanliness. It is frequently not understood by non-specialist tradespeople doing piecework who, for example as concrete construction workers, are used to the surface of their component having practically no role to play...

It is the task of the building supervision to ensure that the high-quality surface of elZinc titanium zinc does not get contaminated or damaged as early as the production or installation phase.

Sheet metal work is fine craftsmanship.
It is not for nothing that the measurements are usually in millimetres, which points out the accuracy and precise care in carrying out the work!

Wooden slats or splinters absorb moisture, which only slowly dries out; over a longer period, this may leave discolourations on the surface. There is no place for adhesive strips on titanium zinc.

Picking up the building components:
Particularly high-quality installations should be carried out with gloves, so as not to let perspiration from fingers have any effect on the elZinc® titanium zinc surface.

However, this is a special measure, which must be specifically indicated in the request for proposals or commissioning of the work and also specially remunerated.

"Fingerprints", due to contact with fingers which are wet with perspiration or dirty, can have a strong influence on the new surfaces of all metals for construction which have not yet been passivated and this can then lead to local oxidation which "perpetuates" the fingerprint over the long term. Hand perspiration can under certain circumstances be really acid, so that the oxidation effect with zinc proceeds particularly quickly.

The factory-based surface treatment of elZinc® pre-weathered titanium zinc is indeed also an effective protection against the short-term effects of perspiration from fingers, but, as often occurs with the installation of building components, repeatedly getting hold of the same spot with heavily perspiring fingers leads to the surface treatment wearing off, so that there is then nevertheless an onset of unsightly oxidation.

Clean craftsmanship with elZinc titanium zinc is characterised by fingerprints, traces of handling, etc. not being visible in an annoying way on the components once they have been finally installed. The temporary surface protection applied in the factory pre-weathered elZinc titanium zinc makes it possible to work quickly and accurately in compliance with the standard rules of cleanliness; assuming the skilled and careful craftsmanship of the installer.

Stepping on the building components during installation:
elZinc® titanium zinc is not "particularly sensitive"; you can tread on both the bright-rolled elZinc® and also the pre-weathered elZinc® with clean shoes.

Titanium zinc is however generally not self-supporting as a covering, that is the sheet relies on the load-bearing substructure when it is under stress. When the roof structure is properly designed and provides support for the loading, elZinc titanium zinc can be walked on directly without any load-distributing intermediate layer or special protection.

Even if slight scratches do "heal", it is a sign of proper, professional work, when a clean, buffering separating layer is laid down under devices or other parts which are placed on the roof during installation.

Walking on the roof with dirty shoes, which actually bring building dusts such as cement, plaster and lime that have a corrosive effect with moisture onto the installed area, **is not recommended!**

03.
STORAGE AND TRANSPORT, HANDLING

03.1. WHAT HAS TO BE TAKEN INTO ACCOUNT WHEN HANDLING ELZINC® TITANIUM ZINC?

elZinc® titanium zinc comprises an alloy of the highest purity zinc with further alloying components. The very highly reactive element of zinc here defines the properties for titanium zinc according to the standard (EN 988).

Zinc reacts both with neutral moisture (rainwater, snow, dew) and with acid fluids (pH < approx. 6) or alkaline fluids (pH > approx. 10). This reactivity of zinc, which ensures that the desired natural top layer ("zinc patina") very quickly forms with weathering, does however also lead to faster reactions locally when there are inconsistent influences - resulting in discolourations or even staining.

The effective temporary protection applied on the preweathered zinc, in the factory which somewhat attenuates the natural reactivity of the fresh titanium zinc surface, nevertheless oxidation does begin as a reaction of the zinc where there is long-term loading.

How do the two things go together - that elZinc® titanium zinc has outstanding corrosion resistance, which withstands rain, snow, fog and dew over decades – and on the other hand must be "kept dry during storage and transport"?

Zinc basically has two different forms of oxidation:

• when the zinc in the titanium zinc surface is loaded with moisture such as neutral rain or condensate over a long period of time, without the moisture being able to dry out, then a powdery, whitish coating forms, predominantly zinc hydroxide Zn(OH)2 ("**white rust**");

This whitish coating can also occur when the impacting fluid hinders the formation of the zinc patina, for instance alkaline or acid fluids or with the effect of sulphur; however, this has nothing to do with hindering drying out.

• when the moisture repeatedly has an effect and then dries off again (as is regularly the case with natural weathering), then there is predominantly formation of zinc carbonate ZnCO3 ("**zinc patina**"), that is the natural top layer which only forms very slowly and therefore incorporates binding atmospheric gases into it as it slowly becomes ever more stable.

Slight white rust can be wiped off shortly after it appears with practically no residue and leaves no visible traces; stronger white rust should be removed, but this can be time-consuming, especially with pre-weathered elZinc® (see section 5).

Which form of oxidation occurs is heavily dependent on the type and duration of the effect of the moisture. If for instance water infiltrates into a stack of sheets, and is even perhaps capillary-bound between the sheets, then this is an adverse "long-lasting exposure to moisture", which is actually particularly critical, because the access of air, and in particular of the carbon dioxide contained in the air, in between the sheets which are laid one on top of the other, is prevented, so that no stable carbonate can form.

This means it is important that moisture can evaporate away. Because this automatically means that air can access the surface, this also then ensures that the stable, natural top layer of zinc carbonate forms.

If there is moisture ingress into the stack of sheets or coils or components laid one on top of the other, then there is often the formation of "stain patterns", which are often not oriented in the direction of installation.
Even if these stains do not appear until shortly after installation, the cause is very clear.

03.2. DRY STORAGE; AND WHAT TO DO ON THE BUILDING SITE?

The basic requirement is that all elZinc® products are stored in dry and well-ventilated conditions until they are fitted and therefore form their natural protective layer (zinc patina) in the natural course of weathering (rainfall - drying).

Proper storage in the open air is only possible with a great deal of effort on the building site. There should therefore be an agreement in good time with the construction management that a suitable room is made available for storage until installation.

CHECKLISTS:

Suitable storage in summer:

- Dry closed room with window or door openings, so that the air changes regularly
- Protected against the ingress of "typical construction contamination", such as cement dust, plaster dust, dust from stone cutting, etc.
  Stone dusts, cement or plaster dust combine with moisture in the air and contaminate the surfaces in a lasting way
- The walls should be dried out to the extent that in the course of solid concrete walls or floors drying out there is for instance no humidification of the ambient air.
  If the air smells strongly of "fresh concrete", it must be assumed that aerosols and humidity will precipitate on the stored surfaces, which may lead to (slight) discolourations
- Storage not directly on the floor, but on supports which are at least 10 cm high, so that it is possible for condensate to dry out
  There can also be very rapid and major temperature changes in summer (for example when there are storms), so that condensate can form
- Storage location outside the movement routes of other trades
- So that for example long building components (prefabricated sheets, profiled sheets, etc.) can be put into and removed from storage without a great effort
- During storage no work is carried out by other trades in the storage area

Suitable storage in the cooler season:

- Dry closed room with window or door openings, so that the air changes regularly, but no cold air falls directly on the stored building components

- Protected against the ingress of "typical construction contamination", such as cement dust, plaster dust, dust from stone cutting, etc.
  In the cooler season interior fitting work is often carried out; for example cutting plasterboards or grinding plastered surfaces generates a very fine dust which spreads very widely
  Stone dusts, cement or plaster dust very quickly combine with moisture in the air in the cooler season and contaminate the surfaces in a lasting way

- Storage not directly on the floor, but on supports which are at least 10 cm high, so that rapid drying of condensate is ensured
  When cooled building components or packaging units are brought into inside spaces (even when these are not "warm"), this gives rise almost inevitably to condensate;
  Packaging units must be disassembled, so that the surfaces are well ventilated; so that the building components can warm up rapidly, the sizes should be kept small; larger coils should not be transported in cold weather and then brought into damp, warm rooms as a matter of principle

- Storage location outside the movement routes of other trades

- So that for example long building components (prefabricated coulters, profile sheets, etc.) can be put into and removed from storage without a great effort

- During the storage period, no work is carried out by other trades in the storage area and the storage room is not used for "ventilation" of the adjoining area, so that there is always a draught.

Suitable storage in the open air:

- In a dry place, elevated as high as possible above what may be damp ground
- Pallets or other wooden supports must not be able to absorb any water; if necessary the wooden supports must be separated from the damp ground by intermediate layers
- Securely (secure against storms) covered against rain and precipitation
- Particularly well ventilated, so that any moisture can quickly dry out
  Specifically with storage in the open air, condensate develops very quickly when the temperature changes and this does not dry out when a rain covering is tightly wrapped around
- For as short a time as possible and adapted to the progress of construction

The company carrying out the work is responsible for
- the building components being protected against contamination, moisture and damage.
- and for moisture that infiltrates or condensate that arises drying off quickly.

The planner or the person issuing the request for proposals is responsible for:
- the company carrying out the work being provided with appropriate storage facilities.

Because the costs of possible additional effort or of the remedying of possible damage are charged to the company carrying out the work (protection of own work until acceptance), it is recommended that the storage facilities are checked before submitting the proposal.

A careful request for proposals will contain information on the storage facilities.

03.3. TRANSPORT AND HANDLING

The basic requirement is that all elZinc® products are kept **dry and protected during transport**, and are loaded in such a way for longer distances that any condensate that may arise when the weather changes can dry off.

When the weather is uncertain or over longer distances, the building components, coils and sheets should not be transported uncovered as a matter of principle. If unforeseen rainfall occurs, the building components or packaging units are to be stored on arrival in such a way that the moisture dries off quickly.

Bright-rolled elZinc® surfaces show even slight scratches due to the high level of reflection; for the most part, these scratches do indeed virtually completely disappear as the natural top layer ("zinc patina") forms, but during reception scratches of this kind often lead to discussions - which can easily be avoided with professional transport.

Pre-weathered elZinc® surfaces should be handled in accordance with their high-quality visual appearance; the protective film which can be supplied on request offers a good protection against dust and contamination. However, no heavy loads or sharp objects must be applied, as the film can be damaged and then no longer provides any protection.

Unloading, transporting on the building site:

The safest way that building components such as long profiles, sheets and edge parts can be transported is on a stable support. This means that unloading is also safe.

Long or extra-long sheets (>10 m) should as a matter of principle be transported and unloaded on a support, to avoid buckles and deformations.

Transport with supports should be used until as close as possible to the installation site. Consistent support is to be provided for delivery to the installation point; even if the elements are not that heavy, long building components or sheets are to be carried so that they are held at least every 3 m to 4 m.

It is important that **no longitudinal buckles** occur; a slight lateral deformation can in most cases be corrected again during installation, as elZinc® titanium zinc is very stable in terms of its shape, but can be reshaped well.

If buckles have occurred, it is simpler in most cases to reshape this buckling at the installation site. If the affected place is not critically highlighted, the visual appearance can in most cases be sufficiently recreated; the function of the sheet is not affected by a buckle.

USUAL ASSESSMENT OF THE ADVERSE EFFECT OF TRANSPORT BUCKLES (REFERENCE VALUES):

INSTALLATION SITE	FORMATIVE ELEMENT	DIRECTLY VISIBLE	LESS NOTICEABLE
Roof area	acceptable with careful reshaping	acceptable with careful reshaping	no functional impairment
Side areas of dormers	acceptable with careful reshaping	acceptable with careful reshaping	OK with reshaping
Verge, fascia claddings	tolerable with careful reshaping	acceptable with careful reshaping	OK with reshaping
Gable area	critical	tolerable with careful reshaping	OK with reshaping
Façades	critical	tolerable with careful reshaping	acceptable with reshaping

03.4. RECOMMENDATIONS FOR THE BUILDING SITE PROCEDURE

SETTING UP THE BUILDING SITE:

Conditions are harsh on building sites. This is an unalterable "trademark" of the construction process. Right up to the interior fitting work, dust, dirt and also mechanical influences are unavoidable.

Nevertheless, the material and the sheets, profiles and accessories must as a general rule be brought to the building site at a much earlier stage of the construction process.

It is all the more important to agree a suitable storage location with the construction management; the checklists on pages 15 and 16 give indications as to what must be taken into account.

The following applies as a matter of principle: only material which is going to be processed within a manageable timescale should be stored on the building site.

PREPARING AND CHECKING THE SUBSTRUCTURE:

As a rule, the substructure is created during preparatory work by other trades, in most cases carpenters or timber construction workers. This means that the correctness and suitability of the substructure for the planned work must be checked before the start of installation.

If this checking of installation capability is not carried out, then installers must take into account any difficulties and additional expenses as their own mistakes - often with considerable financial losses!

As a matter of principle, the following details are to be checked and where defects are detected, concerns are to be raised with the construction management or the planner:

- if the substructure has been transferred without sufficient covering and has got wet (wooden components must be "dry to the touch"; wood moisture should not generally go above 18%)
- unsuitable nature of the subsoil, for example where there are areas which are too rough, too porous, damp, contaminated or oily
- insufficient thickness of the boarding, on which installation is to be carried out, sharp corners on the boarding and burrs, unevenness, rounding off of corners and edges missing
- insufficient fixing of the boarding, nails or fasteners which have come out

- missing or unsuitable fixing options on joints, recesses or penetrations
- missing aeration and ventilation for rear ventilated roofs or wall facings with rear ventilation
- unsuitable type and location of penetrations (for example, so that longitudinal seams would have to be interrupted), drainage, joints (if for instance a sufficient connection height cannot be created), joists, etc.
- variances of pitch or a horizontal run of a joint or end or a smaller roof pitch than was laid down in the specifications, or than would be required professionally
- missing saddles on (wide) roof penetrations
- missing height reference points for locating joints
- due to the planning details insufficient possibilities for expansion and movement to be made
- due to the planning details sheet widths too large

MAKING THE INSTALLED AREA SECURE WHILE WORK IS BEING CARRIED OUT:

Ideally, an installed area should always be completed. This means the seams should be sealed and the ridge connections and the connections at penetrations should be watertight when work is interrupted.

In the normal construction process, this cannot always be ensured, for example because ridge structures with sheets running up on both sides can only be completed after a time lag or the pipes or components that have to feed through have not yet been fitted for planned penetrations. In addition, the edge sheet of a partially installed area is "open" at the side.

Places which are not going to be completed are to be covered using clean and dry tarpaulins. If the completion is only possible after a longer period of time (several days or even weeks), the covering must be carefully planned and carried out: in this case, the covering must meet the requirements which are for example laid down for the protection of building components stored in the open air using coverings (see checklist, page 16).

Every person carrying out the work should be aware of the fact that a careful construction management has a "particularly allergic" reaction to insufficient securing when installation is interrupted or even to seams or joints that are still open when work is finished - even if the installers themselves have to take the responsibility for the damage arising from this!

It is a very clear sign of a lack of professional competence and care in carrying out work, when the installed area is not secured at the end of work and this regularly leads to the assessment and acceptance of the whole work being very critical as a result.

PROTECTION OF ONE'S OWN INDIVIDUAL WORK AFTER COMPLETION:

There are different timescales and rules in the various national laws or building regulations, as to how far the responsibility of the contractor extends for their partially completed or fully completed work.

However, as a matter of principle, the contractor is always responsible for protecting of their work against loads and influences which are to be expected under the circumstances or those which may be detailed in the specifications. As long as the legally defined transfer of risk has not yet taken place, the contractor must therefore remedy external effects (for instance contaminations) or damage at their own expense, if they cannot hold the party which caused these liable.

There are therefore regulations as to how the contractor can if necessary insist on the acceptance, that is the transfer of liability for the partially or fully completed work, after finishing their work or also where there is an interruption of the work for a lengthy period of time which cannot be attributed to the contractor. Acceptance cannot be delayed on the basis of small corrections that still have to be made or small shortcomings that are to be remedied. Acceptance can only be refused where there are significant shortcomings until they are remedied.

The exact timescales and rules on this are listed in detail in the country-specific regulations.

If, due to the continuing construction process, further protection of the completed work that has been handed over is required (for instance because plasterwork or painting above completed covered roof areas still needs to be carried out), the provision and securing of this protection is a task which is to be remunerated separately.

Because the contractor regularly knows the characteristics and special features of their material better than any subsequent outside trades, as a general rule it makes sense in a case of this kind if the construction management or planning staff commission the firm carrying out the work to ensure the continuing professional protection of the completed work.

COVERINGS; APPLICATION OF PROTECTIVE FILM:

The protective film which is applied in the factory has special characteristics which are tailored for use with the high-quality elZinc® titanium zinc. The film itself is more dense than normal "construction film", so that there is no risk of the spread of moisture even when the weather conditions are unfavourable or for example when there is a sudden change in temperature.

In a precisely tailored process the film is applied directly, that is without voids or blisters, onto the surface.

This application of film is the best protection of the completed area for a limited period of time and should only be removed shortly before acceptance.

With protective films, it should be noted that:

- Like all films, the factory-applied protective film becomes brittle under the influence of UV (sunlight) over time.
  Because the film has a very high level of inherent stability and the adhesion to the elZinc® surface is unusually well optimised, the protective effect of the application of the film will indeed hardly decrease even during a long period of weathering, however it becomes increasingly difficult to remove the film after a lengthy period of weathering, since the film which has become fragile breaks in the places where it is brittle when it is pulled off and then increasingly can only be taken off in small pieces!
- In areas exposed to the sun, the protective film should therefore be removed after 3 months at the latest, so as to avoid a possibly very time-consuming detachment "bit by bit";
  In areas with less extensive solar radiation, such as on north-facing façades, the protective film should however also be taken off at the latest after around 4 to 6 months, if you want to avoid unnecessary expense.

Tarpaulin coverings must be aerated.

Overlying tarpaulins hinder rapid drying off, if condensate has formed between the tarpaulin and the sheet.

White rust forms in the covered places.

Installed building components should remain covered for as short a time as possible, as when it rains or the temperature changes, the ingress of moisture under the tarpaulins cannot be ruled out.

If drying off is hindered, white rust forms.

04.
INSTALLATION: AN OVERVIEW

04.1. AGREEMENT BETWEEN THE PLANNER AND CONTRACTOR

The basis for successfully carrying out the work is the specifications, which must give a comprehensive description of the planned work. For their part, the contractor must examine the information carefully and bring their professional experience to bear.

According to the requirements of individual cases, the following points in particular are to be indicated in the specifications:

General information

- Information for the building site
- Specific regulations which supplement the normal regulations and stipulations
- Type and nature of the substructure
- Design of the joints on construction parts
- If applicable, type and number of required sample areas or specimens
- If applicable, permissible loading of the roof areas or load-bearing structures, e.g. for storage of construction parts during installation.
- If relevant (e.g. because of the seam direction): prevailing wind direction
- Roof pitch and roof shape
- Curved part areas or small areas, dormers, bays, roof extensions, special geometrical features for distribution and installation
- Number, type and design of roof penetrations, skylights and rooflight domes
- Joints and cladding of chimneys
- Type and location of roof drainage elements, cut width or benchmark of the guttering, number, type and size of gutter brackets, rainwater downpipes, eaves flashing and similar items and their thickness
- Type and design of safety devices, snow guards and water deflectors
- Gradient levels planned by the client
- Special mechanical, chemical and thermal stresses
- Measures for storm protection during installation
- Requirements for fire prevention, sound and heat insulation and fire protection
- Type and nature of the insulating layers
- Type, location and design of the rear ventilation, along with air intake and air exhaust vents
- Required design effect of areas, e.g. sheet distribution, seaming, etc. or special type of installation
- Type, requirements and dimensions of building components and type and design of their fastening
- Type and design of separating layers
- Type and colour of the surface pretreatment (e.g. elZinc Slate®, elZinc Graphite®, elZinc Rainbow® (red, blue,green))

- Type of chemical wood preservation of the substructure, if applicable other chemical influences
- Sheet width and centre to centre distance
- Provision of installation and fitting plans
- Special features of the substructure and its anchoring
- Expansion elements according to nature, type and number
- Type and implementation of provisional coverings or seals and their fastening
- Special protection of the work while it is being carried out or thereafter

If ambiguities are recognised in the specifications or if contradictions arise while the work is being carried out, concerns must be raised.

The raising of concerns is provided for in the various regulations and is not to be seen as "unfriendly". The discussion between the planner and the contractor, that is attuning the design and the implementation which has been professionally thought through, leads to constructive collaboration and good results.

04.2. PRINCIPLES OF THE VARIOUS ROOF STRUCTURES

04.2.1. "COLD ROOF"; ROOF STRUCTURE WITH REAR VENTILATION:

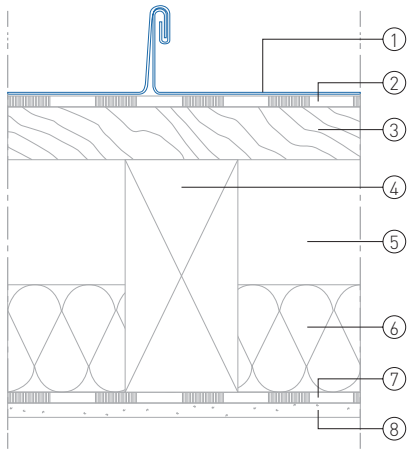
The "double-skin, rear-ventilated roof structure" is the traditional, proven method of metal roofing ("cold roof"). This roof structure takes particularly good account of the fact that metal coverings - in contrast to roof coverings for example with bricks or roofing tiles - are "absolutely watertight".

This means the special advantage of this roof structure lies in the fact that any possible tiny amounts of moisture infiltrating into the roof structure due to low diffusion tightness of the interior layers or leakages of the vapour inhibitor or vapour barrier from the inside can be reliably drained away in the rear ventilation level.

The rear ventilation level is in this respect a security level for the reliable drainage of moisture which infiltrates into the inner roof structure in an unplanned way or at spots where there is damage. Because of this "additional security", the double skin, rear-ventilated roof structure has established and proved itself as the **standard solution for metal roofing**.

A detailed representation of the various roof structures and their advantages and disadvantages with elZinc® titanium zinc is contained in the comprehensive handbook "elZinc® Installer's Guide".

Schematic roof design of an elZinc®double lock standing seam roof with rear ventilation:



1. elZinc® titanium zinc
2. Separation layer (insofar as necessary, according to roof pitch)
3. Wooden boarding
4. Rafters
5. Rear ventilation level
6. Heat insulation
7. Vapour inhibitor / vapour barrier
8. Inner skin

DETAIL	ROOF PITCH 3 – 20° = 5 – 36%	ROOF PITCH > 20° = > 36%
Free air intake vent	1/500 = 2% ‰of the roof area	1/1000 = 1% ‰of the roof area
Free air exhaust vent	1/400 = 2.5%‰ of the roof area	1/800 = 1.25 %‰ of the roof area
Height of the free space with air flowing through	min. 10 cm	min. 5cm

Table 2: Recommended minimum values for rear ventilation

General advantage of the rear-ventilated roof structure:
In specific weather conditions, metal roofs can cool down so much that condensate forms on the underside of the sheet, and this can no longer evaporate away through the sealed metal roof skin.

This means that the gently pitched roofs (up to 15°) are in principle provided with an evaporation level ("drainage level"), by a "separation layer with a drainage function" being installed. Because evaporation, when the moisture can diffuse into the rear ventilation level and be drained away there, is particularly effective, this means that a roof structure with rear ventilation is also preferable from this point of view.

Condensate formation with metal roofs:
All metal roofs enter into a radiation exchange with their ambient area. This means that metal roofs, when they are in an exchange with very cold radiation partners, can become colder than the ambient area.

This phenomenon can be clearly seen where condensate forms on metal surfaces which face up towards the sky when the air is very clear and the sky is completely cloudless.

For example, the car roof is damp after a clear night.

These kinds of weather conditions occur most frequently in the transition time, that is in spring or late autumn, because the air is already very clear at these times and if there are then no clouds or low stratus to provide shelter, metal areas enter into a radiation exchange with "space"; horizontal areas are therefore very much colder than the ones inclined to the side which enter into radiation exchange with "warmer" areas in the vicinity (even if located some distance away).

Since the underside of metal roofing cannot be tightly sealed against the outside air, that means the identical relative humidity also prevails there, as on the topside of the sheet and, because the sheet radiating heat is too thin to develop a temperature difference between the topside and the underside, it must be assumed that at least a film of condensate has formed on the underside of the sheet when a roof is wet with condensate!

Advantages of the twin-skin, rear-ventilated roof structure:
In the event of small leakages of the interior vapour barrier or vapour inhibitor, the moisture which has infiltrated from the inside can evaporate into the rear ventilation level and is taken away from there.

With small leakages, water that has infiltrated will not soak through the whole of the roof structure, but - if there are only very small amounts of water - will evaporate when the sun warms up and then be taken away in rear ventilation level.

Where there is condensate formation on the underside of the sheet, the condensate will evaporate with the warming of the sun and then be taken away in the rear ventilation level.

4.2.2. "WARM ROOF"; ROOF STRUCTURE WITHOUT REAR VENTILATION:

Because local conditions often do not allow a very thick roof structure and because roof structures are becoming thicker and thicker due to increased heat insulation requirements, roof structures are also more and more frequently planned and built without rear ventilation.

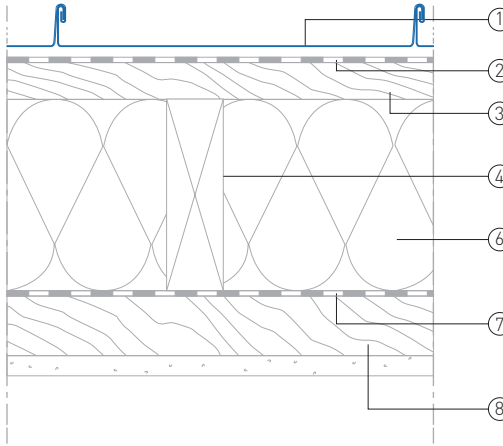
Because the "required centimetres" for making the rear ventilation level are often lacking and because the making of the separate second skin, which the elZinc® titanium zinc covering directly bears, is naturally linked to costs, the necessity of having rear ventilation is called into question. Especially because a twin-wall roof structure requires a greater construction height or in the case of rehabilitation, if areas previously covered with bitumen or using foils are redesigned, planners will also examine the possibility of a warm roof design.

Making a single-skin roof structure without rear ventilation, due to the lack of an "additional security level" determined by the system, does indeed require very special care in making the interior layers that provide a diffusion barrier to avoid soaking the roof system, but with careful planning and implementation a roof structure without rear ventilation using elZinc® titanium zinc is absolutely secure.

This means that elZinc® titanium zinc is also provided for warm roof coverings, if the physical structural framework conditions are right in principle.

Account should be taken as from when the decision on the system is made of the fact that, due to the somewhat higher physical structural sensitivity, the warm roof structure imposes particularly high levels of requirements on the care and coordination of the individual trades right from the planning phase and throughout the whole implementation as well.

Schematic roof design of an elZinc® double lock standing seam roof without rear ventilation:



1. elZinc® titanium zinc
2. Separation layer (insofar as necessary, according to roof pitch)
3. Wooden boarding
4. Rafters
5.
6. Heat insulation
7. Vapour barrier (min. sd-value >100 m)
8. Inner skin

The sizing and installation of the vapour barrier must be designed for the expected temperature gradient between inside and outside layers.

Usually, the minimum sd-value of 100 m is not enough to reliably exclude diffusion of interior air humidity; it is expedient to use vapour barriers with metal strip inserts, which are very impermeable to diffusion when professionally installed.

Because condensate between the underside of the elZinc® titanium zinc and the substrate can never be ruled out (see above), it is recommended, even with steeper roof pitches, that the underside of the sheets is separated from the heat-insulating substrate by means of a separation layer with spacer fabric (“drainage membrane”).

4.2.3. "COMPACT ROOF"; ROOF STRUCTURE WITHOUT REAR VENTILATION ON A VAPOUR BARRIER LAYER:

In principle, with metal roofing systems the compact roof structure is a very reliable solution, if the special features of the compact substructure are taken into account during planning.

As a load-bearing substructure, a compact roof comprises a heat-insulating substrate which is highly impermeable to diffusion and which already includes fixing points for the professional fixing of the elZinc® roof covering.

The advantage of this is that the roof structure is on the whole free of thermal bridges and watertight and is therefore very secure from a physical structural point of view with proper planning and implementation. Since the fixing points are inserted into the heat insulation and embedded in it with adhesive, there are no continuous joints or gaps of any kind in the insulation and vapour barrier.

As there are insulations which are made using special media (for example foamed), which become aggressive in contact with moisture, it always makes sense to ascertain the special features right from the planning phase and incorporate them into the installation specifications.

Because as a rule the whole roof structure, that is including the support layer of the compact roof element, must be taken into consideration, for example whether the design is exposed to vibrations, the inclusion of an appropriately experienced specialist engineer in the planning is recommended for these kinds of solution.

Since very good insulation values and a roof structure with very good vapour impermeability can be "flawlessly" achieved where there is professional design, constructions of this kind are also well suited to large roof areas, such as trade fair halls or roof areas over indoor swimming pools.

04.3. INFLUENCE OF THE ROOF PITCH

The recommended **minimum roof pitch** is 7°. In exceptional cases, flatter roof pitches are technically possible (at least 3° = 5%), which then however require additional sealing measures, such as sealing tapes on the seams or sealing by means of "seam gel". This is the way to prevent water that slowly runs off or is driven by the wind infiltrating into the structure.

For **roof pitches up to 15°** (26.8%), separation layers with a drainage function are to be incorporated in accordance with the general stipulations and technical rules (see section 4.2 Principles of the various roof structures, pg. 23).

In spite of all additional or special sealing measures, which also enable a flat roof pitch, the best protection for every seamed metal roof is however a greater pitch: with an increasing roof pitch, the risk of dammed up seams diminishes and dirt deposits and atmospheric gases are washed off more effectively by the faster flow of the rainwater as it drains off ("self-cleaning effect").

In particular in industrial areas or in the direction of the prevailing wind from dust emissions (e.g. in the vicinity of land used for agricultural purposes as well), thick deposits can build up over time on "very flat roofs", which can then even have a corrosive effect on the metal roof, if the roof is not cleaned occasionally.

In addition, via the height difference between air inlet (eaves) and air exhaust (ridge), the roof pitch defines the pressure difference between outside air and the rear ventilation area and thus also the effect of the lift in the space the air flows through with double-skin, rear-ventilated cold roofs, and therefore the efficiency of the rear ventilation.

This means that a greater **angle of pitch** is preferable, due to the better air flow and so better condensate protection as well.

Furthermore, the height of the space the air flows through and the size of the air inlet and exhaust vents are also dependent on the roof pitch (see also table 2, pg. 23).

Barrel roofs and "smallest possible" roof pitch 3°
With domes or barrel roofs, in the highest area there is inevitably always an increasingly flatter surface up to a nil roof pitch.

elZinc® titanium zinc coverings can of course be used for these kinds of designs as well, in spite of the above-mentioned minimum angle of pitch: due to the special wind exposure of the highest point of a dome or barrel roof, experience tells us that there is no risk in this area of rainwater lying or flowing off so slowly that it could be backed up.

However, attention should be paid to the direction of the prevailing wind when orienting the seams. And, the seams in the area where the roof pitch is under 3 to 5° must be additionally sealed by inserting seals into the fold of the seam as a matter of principle.

In principle, only a **double lock standing seam** is permissible in this area. In particularly critical situations it is possible to increase the seam height, so that driving rain is not driven up into the seam even under unfavourable weather conditions and then possibly drawn into the interlocking joint by capillary action.

04.4. SEPARATION LAYERS

Historically, the configuration of separation layers is justified by the necessity of separating the wood preservation treatments of the boarding, which were in the past very likely to promote corrosion with respect to the underside of the sheets. For environmental protection reasons alone, the treatments are however now much less aggressive and thus neutral with respect to titanium zinc.

Nevertheless, separation layers can also have adverse effects if, with double-skin ventilated roof structures, they hinder the drying off of small amounts of moisture which are present between the underside of the sheets and the separation layer (leaks or dripping condensate in certain weather conditions) and hinder the evaporation of the moisture into the rear ventilation level.

The proper decision for or against a separation layer or the choice of a particular design therefore also take into account questions such as the pitch of the roof, the risk of drifting snow, efficiency of the rear ventilation, etc.

The decision on the **inclusion or exclusion of separation layers** or on taking special measures is a decision for the planner which depends on the structure.

However, it is very clear that the configuration of a separation layer with a drainage function between elZinc® titanium zinc and the wooden boarding up to a pitch of 15° is in line with state-of-the-art technology and is required by the directives and valid technical rules.

The function of separation layers:
Separation layers, which are also known as barrier layers or sliding layers, have various jobs to do:

- They should separate the metal skin from the substructure so as to prevent corrosive effects on the underside of the metal from the wooden structure which are caused by wood preservatives or alkaline effects from fresh concrete or mortar.
- They act as a temporary weather protection during the installation of the roof skin.
- Separation layers between the boarding and the metal skin ensure an improved possibility of movement when there are changes of length related to the temperature which the metal roof skin is constantly exposed to.
- In addition, sound insulation with respect to impact and drumming noises, for instance when there are hailstones, can be improved by special separation layers.

In spite of controversial discussions (see above), configuring a separation layer between the wooden boarding and the metal roof skin is still to be seen as state-of-the-art technology up to a roof pitch of around 30% and - depending on the pitch - is required in the sets of

rules. Bitumen roof sheeting with an inlay of glass fibre, glass fibre reinforced plastic roof sheeting and foils (≥ 0.2 mm) are used as separation layers. Welded sheeting is not to be recommended as this is not impermeable to diffusion.

Separation layers with a drainage function ("drainage membranes" or "structural membranes") are prescribed in the pitch range up to 15°. These membranes are mainly carrier sheets which are specially open to diffusion with spacer fabric laminated on the top side or space-forming embossings. The space formed by this between the underside of the sheets and the carrier membrane is around 6 to 8 mm.

As a matter of principle, hydrophilic or moisture-retaining membranes such as paperboards, raw felts and similar materials are not permitted.

Separation layers as installation sealing:
Because, from a time perspective, the installation of the separation layer precedes the covering using elZinc® titanium zinc, the normal separation layers can be used as a **temporary weather protection** for the boarding, so that the wooden boarding does not get soaked through. Because the separation layers are however not thoroughly weather-resistant, the use of the subsequent separation layer as a temporary protection is only to be recommended over a time period of 3 months at the longest; if a delay in the installation of the metal covering can be foreseen or where there are foreseeable interruptions to the work, the construction covering formed by the separation layer is to be protected by additional tarpaulins.

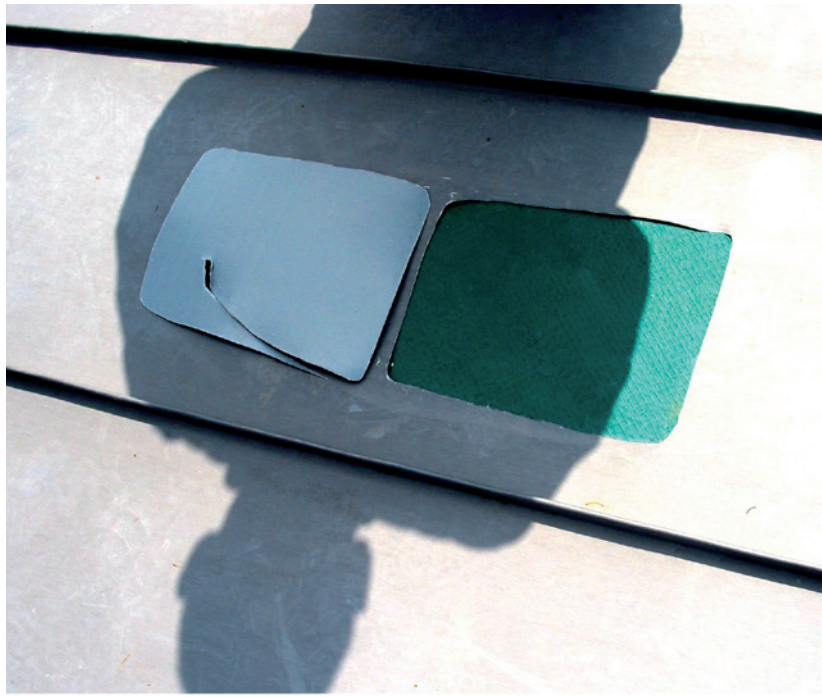
The use of separation layers as a temporary water protection requires the separation layer joints (longitudinal and transverse joints) to be bonded.

If bituminous separation materials are bonded into the joints, the overlaps must be cut immediately before the metal covering is fitted, as these separation layers are not sufficiently impermeable to diffusion. This means it is possible for moisture which may have arisen between the roof skin and the separation layer to evaporate into the rear ventilation through the holes which have been cut in the separation layer.

Because the carrier membrane is usually set up in a way that is very open to diffusion where there are special separation layers with spacer fabric, with these membranes it is not necessary to cut the bonded joints again.

Even if welded sheeting is clearly more weather-resistant in the event of rain due to its special structure and fittings, the use of this welded sheeting as an ongoing construction covering is nevertheless not recommended, as this sheeting is a rather inappropriate

separation layer due to its membrane thickness and the fact that its diffusion permeability is too low. In addition, the sliding behaviour of the underside of the titanium zinc on the top side of the welded sheeting is very unfavourable.

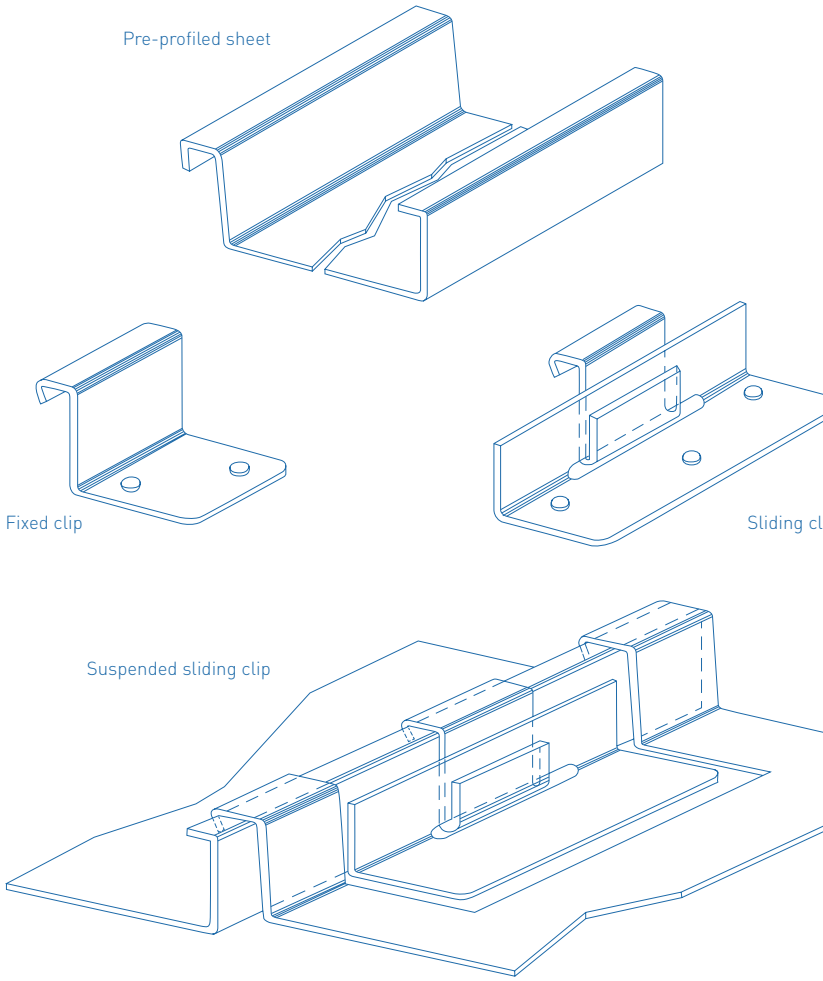


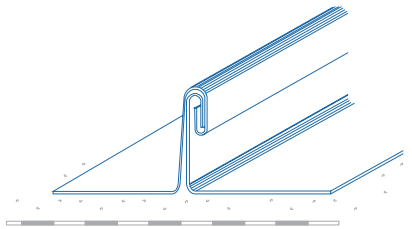
View of a titanium zinc covering which has been cut: you can see the green separation layer between the titanium zinc roof skin and the substrate

04.5. THE VARIOUS SEAMS AND JOINTS

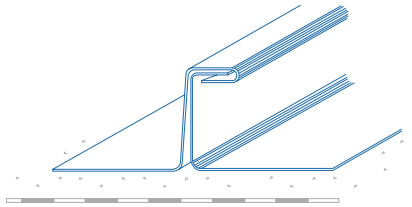
elZinc® titanium zinc is jointed via seams as a matter of principle.

Double lock standing seams are the most frequently used seamed joint, as this kind of seam is the one that provides the sheet joints with the best possible seal.

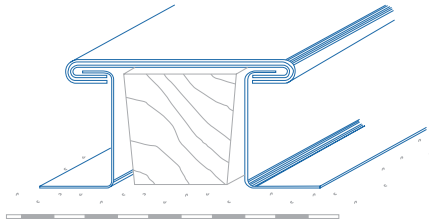




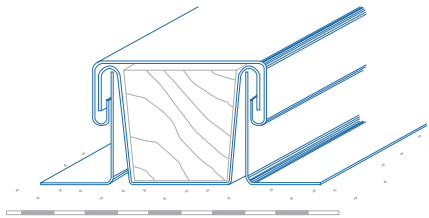
Double lock standing seam covering
The most commonly used type of roof covering via double lock standing seams, fastening to the boarding by means of special clips.
Thin profile - top view



Angled standing seam covering
Versions of the double lock standing seam design, where the last stage in the process, turning over the seam into a double lock standing seam, is not carried out. Only for roof pitches > 25° (in areas where there is a lot of snow or when there is a risk of snow build-up: > 35°).
Frequently used for wall claddings.
Fastening as with double lock seams; accentuated profile.



Batten cap covering (Belgian system)
Traditional type of covering using trapezoidal wooden battens between which the titanium zinc sheets are installed.
Upper cover via batten caps. Fastening by means of strip clips.
Wide, well-defined profile.

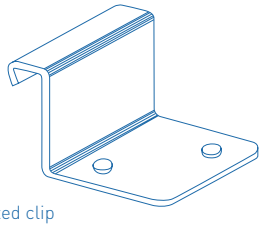


Batten cap covering (German system)
Traditional type of covering, similar to "Belgian batten cap covering", but with additional bending of the sheet upstands and wide covering cap. Fastening as before or by means of plate clips.
Very wide, prominent profile.

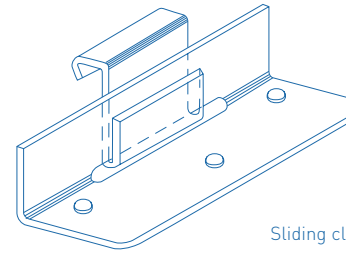
Fastening onto the substructure:
The metal roof skin made of elZinc® titanium zinc strips is fastened to the boarding using **clips**. Clips are single or multiple-part fastening elements made of titanium zinc (minimum thickness 0.7 mm), of galvanised sheet steel (minimum thickness 0.6 mm) or aluminium (minimum thickness 0.8 mm) or of stainless steel (minimum thickness 0.5 mm). Fixed clips and sliding clips are required.

The fastening plate (lower part of the clip) is laid flat onto the boarding and fastened using nails, staples or screws as well. Because the corners of the plates may rise a little at the edge when being fastened, and in particular with stainless steel or galvanised sheet steel, plates with rounded edges should be used as a matter of principle, so that turned up corners do not damage the elZinc® titanium zinc.

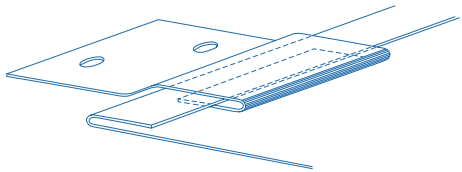
Different types of clips:



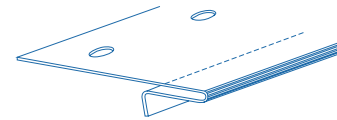
Fixed clip



Sliding clip



Suspended clip



Flap

To allow thermal changes in length of the elZinc titanium zinc covering, the fixed clips and sliding clips must be used in a really specific arrangement.

At the so-called “anchor point”, the sheet is joined to the substructure by fixed clips over an area of around 1 m. Outside the anchor point, only sliding clips are used, which allow movement of the sheets in a longitudinal direction, that is towards the eaves or the ridge. The location of the anchor point depends on the pitch of the roof.

The steeper the pitch of the roof is, the further up the anchor point area is configured. Where the roof pitch is flat, the anchor point area is moved into the upper third as far as the centre line.

Quantity of and distance between the clips, clip fastenings:
Storm-proof fastening of the elZinc® titanium zinc roof skin is ensured via the prescribed quantity of clips per m², their professional embedding in the boarding, adherence to the correct clip spacing and the highest permissible sheet widths in each case. In the process, a distinction is made between the internal area of the roof and the corner and edge areas which have a greater stress.

As a general rule, the clips are nailed on with at least two hot-dip galvanised clout nails (flat-headed nails) 2.8 x 25 mm, with an anchoring depth of at least 20 mm, which gives an average pull-out value of 560 N per clip.

Where there are very high wind stresses, fastening with 4 x 25 mm hot-dip galvanised countersunk screws is expedient; as a pull-out value of around 1,600 N can be reached in this case.

For pneumatic nailers, nails of 3.1 x 25 mm dimensions are used, which can reach a pull-out value of 500 - 800 N in 24 mm thick wooden boarding.

A detailed representation of the fastenings and the layout and quantity of clips is included in the comprehensive handbook “elZinc® Installer’s Guide”.

04.6. SOLDERED JOINTS

elZinc® titanium zinc is joined by substance to substance **soft soldering** to create watertight joints.

This substance to substance jointing process is carried out using standardised fluxes. To do this, the elZinc® metal surface must be metallically clean. Heavily contaminated or greasy surfaces, for example through residues of grease or coolants from the rolling or profiling process, must be degreased, as lack of cleanliness impedes the soldering process and makes the joint less secure.

Pre-weathered elZinc® titanium zinc requires special fluxes, which break through the pre-weathering layer.

Likewise, with elZinc® surfaces that have already been weathered for a long period of time, heavy oxide and dirt layers should be removed by mechanical cleaning with a scraper or sanding.

Fluxes should ensure sufficient cleaning and moistening of the metal surface and prevent oxygen access to the cleaned surface. The use of hydrochloric acid, which was often employed in the past, cannot be recommended for safety reasons.

Lead-tin soft solder with 40% tin as per EN 29453 - LPb Sn 40 (antimony-free) is recommended as a **solder**, because optimum joint fissure filling, good moistening and a high level of strength are achieved with this solder. The melting range of this solder is 183 to 235°C.

The soldering is carried out with the largest possible (heavy) **soldering iron**, the weight of which must not be below 350 g. A soldering iron weighing 500 g ensures sufficient heat storage without the risk of overheating. It is an advantage to have a large contact area for rapid heat transfer to the soldering point.

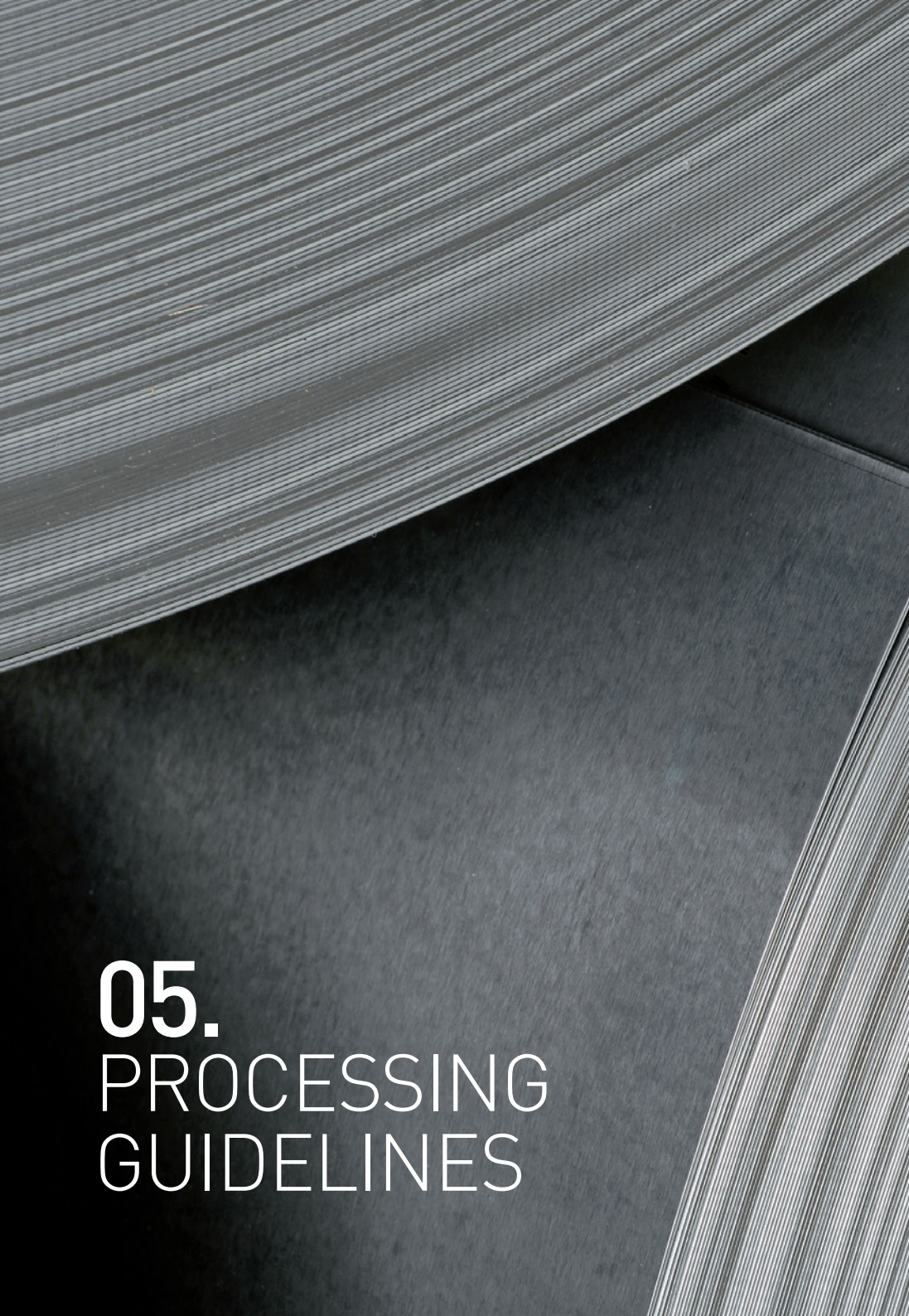
The **soldering joint width** must not be over 0.5 mm, to achieve high seam strength. The minimum overlap (= bonded soldered seam) must be 0 mm in the horizontal range and at least 5 mm for vertical soldered seams, according to generally accepted state-of-the-art technology and the technical rules.

For the soldering of building components with a wide blank cut and a sheet thickness of more than 0.8 mm, pre-tinning of the soldered seam is recommended, as this means better adhesion is achieved. For difficult solders, where the solder joint gap cannot be fixed in a different way, the joint can be secured before soldering using rivets, which are then incorporated in the solder.

Immediately after the solder is completed, all flux residues must be thoroughly removed with a damp rag, as the flux residues have a corrosive effect when there is moisture ingress (dew, condensate, light rain) and therefore form visually unsightly stains on the elZinc surface.

The soldering iron should be cleaned from time to time, so that the thermal conductivity is not affected. To reduce the oxidation of the soldering iron, you can tin the smoothed and cleaned areas of the fin using a salmiak stone with the addition of tin solder.

A detailed representation of the soldering process is included in the comprehensive handbook "Installation and Processing Guidelines for elZinc® Titanium Zinc".



05.
PROCESSING GUIDELINES

05.1. PROCESSING AT LOW TEMPERATURES

All metals for construction can easily be processed at warm temperatures. Because of the characteristics of zinc, titanium zinc is particularly sensitive to temperature. The official directives and technical trade rules therefore specify that titanium zinc must not be processed at a temperature below 10°C.

By means of a carefully tailored rolling process, elZinc® titanium zinc is produced in such a way that processing is also possible at temperatures which are lower than the optimum ones.

Nevertheless, attention should be paid to the processing temperature when there are unfavourable seasonal conditions. The determining factor is the sheet temperature, not the air temperature. Because titanium zinc, like all metals, is very temperature inert and heats up much more slowly than the ambient air, in cool seasons, right from the choice of storage, attention should be paid to the fact that the sheet (in a coil or a package) does not cool down a great deal over night, if complicated processing is planned on the following morning.

If the sheet temperature is significantly lower than 10°C and demanding seaming or bending procedures must be carried out, it is recommended that the sheet is pre-heated in the area of the bend. There are electrical industrial driers for this purpose, with which the sheet can be pre-heated properly, without the high-quality elZinc® surface being damaged.

CONDITIONS	ELZINC® TITANIUM ZINC (BRIGHT-ROLLED)	ELZINC® TITANIUM ZINC PRE-WEATHERED
Sheet temperature > 10°C	No measures required elZinc® titanium zinc has very good forming properties	
Sheet temperature > 7°C	Profiling, edge bending of sheet thicknesses of up to 0.7 mm up to approx. 135°, Closing of double lock standing seams and angled standing seams without any special measures; avoid abrupt deformation	
	Profiling, edge bending of sheet thicknesses of 0.8 mm up to approx. 90°, Closing of double lock standing seams and angled standing seams without any special measures; avoid abrupt deformation	
	Profiling, edge bending of sheet thicknesses ≥ 0.8 mm up to approx. 135°, warming up with a weak flame or an industrial drier	Profiling, edge bending of sheet thicknesses ≥ 0.8 mm up to approx. 135°, warming up with an industrial drier up to a maximum of 60 to 90°C
Sheet temperature < 7°C	Profiling, edge bending up to 180°, complex seams: warming up with a weak flame or an industrial drier	Profiling, edge bending up to 180°, complex seams: warming up with an industrial drier up to a maximum of 60 to 90°C

Measures for processing (seams, edges) at low temperatures

05.2. EDGES AND PROFILING OF THICK SHEETS

elZinc® titanium zinc is well-known for its outstanding forming properties. Nevertheless, with large sheet thicknesses, care should be taken that the bending edge is drawn even more in a purely geometrical way, the thicker the sheet is and the more sharp-edged the bending is.

As far as possible, edge bends should therefore be made with a radius > 2 x the sheet thickness. For thick sheets ≥ 0.8 mm, abrupt deformations with small radii should be avoided as far as possible, so that the particularly ductile elZinc® structure can relieve the inner tension during consistent forming.

Surface scorings (e.g. marking with a scriber) can become starting points for cracks under the tensile stress when bending or edge bending and are therefore to be avoided as a matter of principle.

06.
CARE AND MAINTENANCE

06.1. DIRT, DUST AND FINGERPRINTS

If contaminations or staining have occurred in spite of the best care being taken, cleaning is possible in principle, but this is often arduous, time-consuming and costly. Firstly, the type of contamination must be established, so as to remedy this in a targeted way.

Possible types of staining may be:

- **Paint and mortar sprays, plaster dust, cement**

  They mostly occur through transport or processing of paint or mortar or subsequent trade work at places which have not been properly covered. As long as the splatters and deposits are still quite fresh and liquid, the stains can to a large extent be removed with water or appropriate solvents. It is always recommended that this kind of splatter is removed as quickly as possible.

  Older splatters of this kind or encrustations of contaminations on bright elZinc® titanium zinc can be cleaned by vigorous rubbing with stainless steel wool or a scrubbing machine. The places that have been worked on should then be given subsequent treatment with acid-free façade oil or titanium zinc passivation oil.

  With pre-weathered elZinc® titanium zinc, the removal of dried out contaminations poses considerable difficulties. It may therefore be advisable for small contaminations that are less noticeable not to be removed but rather to wait for these contaminations to be covered over by natural weathering.

- **Rust-red coloured iron oxide coating**

  Red rust spots can occur if steel building components rust above elZinc® titanium zinc surfaces or due to rusting borings / swarf from the processing of the steel which have not been removed. These spots can also be removed from bright elZinc® titanium zinc by abrasive cleaning, as already explained previously.

  With pre-weathered elZinc® titanium zinc, the removal of intensive rust spots is practically impossible, without destroying the pre-weathering layer (locally).

- **Traces of runs and stains from contaminated water or working materials**

  Liquid working materials, such as those required for instance when cleaning masonry or sealing joints, can leave traces behind on the elZinc® titanium zinc through carelessness. Brownish to olive brown stains appear, when water running off from bitumen covered and PVC coated areas contains organic components which have been loosened by weathering.

  Fresh stains can be removed from bright elZinc® titanium zinc relatively easily by hard rubbing, if necessary supported by abrasive cleaning.

  With pre-weathered elZinc®titanium zinc, the removal of intensive stains is only possible by means of appropriate special cleaning agents, provided that the stains have not coloured right through the pre-weathering layer. Old, intensive stains can hardly be completely removed on pre-weathered elZinc® titanium zinc, without destroying the pre-weathering layer (locally).

- **Discolourations due to flux residues that have not been removed**

  Due to the lengthy effect of flux residues from soldering, acidic emulsions and oils, etc., discolourations occur that have penetrated deep into the surface of the titanium zinc and they can no longer be readily eliminated completely.

  A treatment with chemical cleaning agents only leads to an impairment of appearance. In extreme cases, an abrasive treatment must be carried out "right to the base of the discolouration" until the stain is no longer noticeable after the onset of the natural formation of the top layer.

  Because the area is made really extensively reactive by the cleaning, the places that have been worked on should then be given subsequent treatment with acid-free façade oil or titanium zinc passivation oil.

- **Zinc hydroxide - "white rust"**

  Whitish discolourations may appear on new titanium zinc building components or on roof or wall areas which can arise due to the prolonged effects of moisture, e.g. through incorrect storage without the possibility of drying out or intensive dew formation.

  Zinc hydroxide, a loose porous corrosion product, forms at the discoloured spots on the bright elZinc® titanium zinc. The staining is increased when the infiltrating moisture is slightly alkaline. Where there is a short-term effect, only a "foggy whitish discolouration" appears, which changes into the natural matt grey-blue colour in the course of the natural formation of the top layer without leaving any residue.

  When white rust is not too prominent, it can be removed by brushing off (use semi-rigid bristles, not a metal brush!) and subsequent washing with clean warm water without there being any effect on the sheet thickness. Certainly, somewhat darker stains at first remain in these spots, but these are taken over by the surrounding material in the course of the natural formation of the top layer and are then no longer visible.

  With pre-weathered elZinc® titanium zinc, the removal of white rust, when it can no longer be removed by neutral rinsing and light brushing with soft bristles, is only possible using appropriate special cleaning agents, provided that the stains have not coloured right through the pre-weathering layer.

- **Adhesive residues**

  Adhesive residues from adhesive strips, or also protective films that have remained on the surface too long, do not as a general rule corrode either bright or pre-weathered elZinc® titanium zinc. It can certainly take a lot of effort to remove the adhesive residues cleanly.

  You should not attempt to rub off the residues by really hard abrasion or even mechanically; a lot can often already be removed using warm water (without anything added). Resistant adhesive residues must be removed using special solvents which do not corrode the elZinc® surface.

The removal of discolourations and contaminations is often only possible by means of processes and resources which are specifically tailored to the effect, once the media which are having the effect have already reacted with the high-quality elZinc® surface. In addition, it is often hard to assess whether the surface has already been damaged.

Since, where the effects are recent, the corrosion has only had a tiny impact due to the very effective surface treatment at the factory by ASTURIANA DE LAMINADOS, it is often more sensible to wait for the natural development (formation of the natural top layer), which in most cases provides a good covering and alignment of the surface discolourations or stains.

If there is any doubt, the expertise of the technical application consultancy service of ASTURIANA DE LAMINADOS is available to provide support; on no account is it advisable to make any use at all of "chemical metal cleaning agents", as these often affect the surface in a really aggressive way and, if necessary, must be neutralised or supplemented by a subsequent treatment of the cleaned areas.

If chemical cleaning agents are used, then an area which is not noticeable should always be cleaned as a trial and in particular the normal subsequent treatment / neutralisation of the cleaned areas should be tried out. If abrasive cleaning is carried out (bright-rolled elZinc® titanium zinc), the area must then always be passivated (façade oil), to avoid noticeable dark staining.

06.2. OXIDATION AND TEMPORARY DISCOLOURATIONS

The bright-rolled elZinc® surface runs on through the natural passivation process (natural formation of the top layer, "zinc patina") up to the formation of the uniform matt grey colouring.

This process is certainly influenced and controlled by the weathering process, that is areas which have for instance been sheltered by a roof overhang from the direct impact of rain will react somewhat more slowly. And when there are dirt deposits (atmospheric gases or dust carried in by the wind) on the surface, the consistency of the natural reaction can be affected.

It should therefore always be assumed that the development of the change to a matt grey colour will not happen in a completely consistent way; in practice, there will regularly be areas which are already matter and also darker and other areas which still even have the metallic sheen of the fresh elZinc® surface.

Areas which have a flat pitch, which means that individual raindrops have an effect, can begin to show small dark stains at the spots where the raindrops have dried out, especially when the raindrops for instance absorb certain harmful substances from the air after a long dry period. These stain patterns merge in the course of the natural development and then form the characteristic consistent colour of weathered elZinc® titanium zinc.

The colour change (in the case of elZinc® titanium zinc: the formation of the "zinc patina") is a common behaviour of all metals for construction, as all metals for construction only achieve their definitive colouring after a suitably long period of weathering.

When the characteristic colour of the passivated elZinc® surface is required right from the start, pre-weathered elZinc® titanium zinc should be used, as this colouring already anticipates the natural colouration which is to be expected. It should however be noted that (after the pre-treatment layer has weathered as planned and has been replaced by the natural top layer) the colour of the zinc patina is always (slightly) affected by local influences, so that there may be small changes of colour with respect to the condition when new depending on the exposure.

06.3. MAINTENANCE OF ELZINC® ROOFS AND FAÇADES

elZinc® titanium zinc is maintenance-free.

The bright-rolled elZinc® titanium zinc goes through the natural passivation process until the relatively thick top layer is formed. When this top layer is damaged, for example by mechanical scratches, it reforms at these places.

With pre-weathered elZinc® titanium zinc, the pre-weathering layer applied at the factory is replaced by the natural top layer after a long period of weathering as a result of natural processes; this proceeds smoothly.

The natural top layer which is formed is very stable and protects the titanium zinc surface underneath it against corrosive atmospheric pollution. This gives elZinc® titanium zinc its durable protection, which is characteristic of elZinc® titanium zinc.

Dirt which is deposited on the top layer that has formed is sufficiently washed off by rain (self-cleaning), without there being any need for care products.

Only when for example salt deposits lead to heavy salt encrustations in the vicinity of the sea or in the area where de-icing salt which is used in winter gets onto the surface and settles there, must these encrustations and deposits be regularly washed off. Likewise, heavy chemical contaminations must be removed and neutralised.

It is not advisable to clean the surface using chemical cleaning agents as a care measure, since the natural top layer that has formed could be damaged by this. Only when the top layer which has formed is discoloured as a result of particularly intensive discolouring contaminations, can they be locally removed chemically or abrasively. The top layer automatically reforms in these places over time.

Further comprehensive information on creating, installing and forming details with elZinc® titanium zinc can be found in the comprehensive handbook "Installation and Processing Guidelines for elZinc® Titanium Zinc".

Please contact your ASTURIANA DE LAMINADOS representative to request your personal copy.

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