

GUIDELINES FOR CORRECT CONSTRUCTION PRIOR TO HOT DIP GALVANIZING

1 Use of standards

The elements / units must be prepared for galvanizing according to the following standard:

SIST EN ISO 14713 1999 Protection against corrosion of iron and steel in structures

Pocinkovalnica executes hot dip galvanizing in accordance with the following standard:

SIST EN ISO 1461 1999 Hot dip galvanized coatings on fabricated iron and steel articles

2 Construction dimensions

The size of a construction is limited due to the dimensions of the bath and is the following:

$$\mathbf{L \times W \times H = 12600 \times 1700 \times 2900 \text{ (mm)}}$$

Maximum weight of unit allowed is 7000kg.

3 Element and construction surface cleaning

The surface of the elements must not contain the remains of paint, varnish, colour markings, fats that cannot be removed by base materials and oils (long lasting mineral oils, fats, oils and fats that are hard to emulsify ...), welding sprays, conservatives, paraffin, tar, other coats and leftovers from other surface protecting materials. Pipes and corner constructions should not have any remains of sanding (steel balls, quartz, powder).

4 Openings




Each element or construction must have openings (boreholes, cut-outs and similar) in accordance with the SIST EN ISO 14713 (1999) standard for:

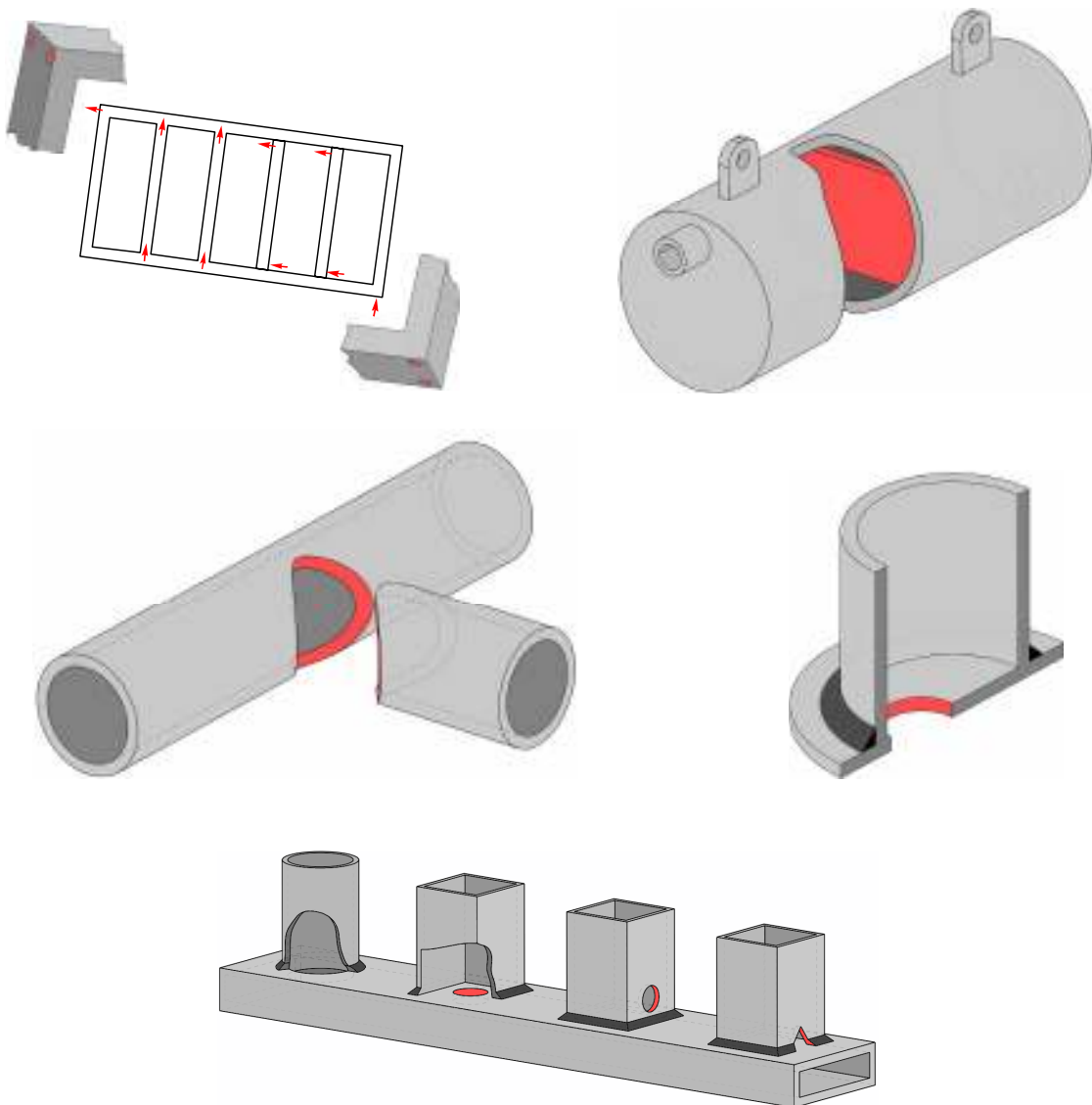
a) The outflow of air and zinc from closed pipes and corners

These openings must be in the farthestmost upper or lower points just next to the welds (Figures 1, 2, 3, 4, 5). If the construction has any invisible openings for the outflow of air and zinc (Figure 6), the customer is under obligation to bring the plan for those elements.

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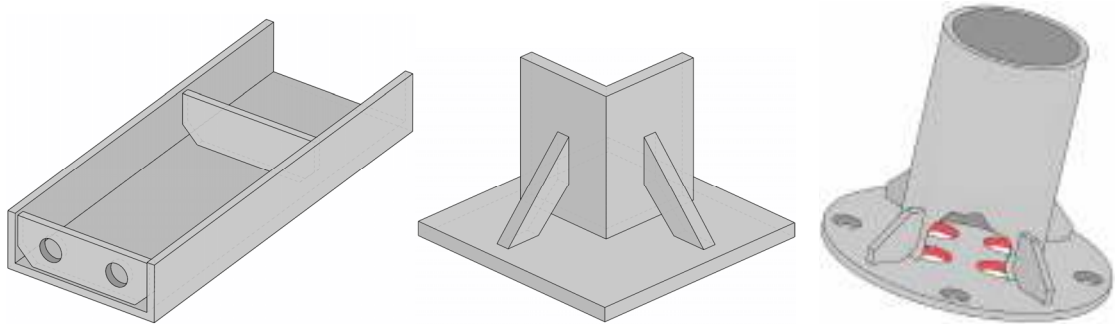
Table 1: Necessary diameter for aeration boreholes

Steel pipes – dimensions in mm			Smallest Φ of opening in mm
			
15	15	20 x 10	6
20	20	30 x 15	8
30	30	40 x 20	10
40	40	50 x 30	12
50	50	60 x 40	16
60	60	80 x 40	20
80	80	100 x 60	20
100	100	120 x 80	25
120	120	160 x 80	25
160	160	200 x 120	32
200	200	260 x 140	32



Figures 1, 2, 3: Examples of the arrangement of openings on pipe constructions

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Figures 4, 5: Aeration of ribs and slabs on profiles

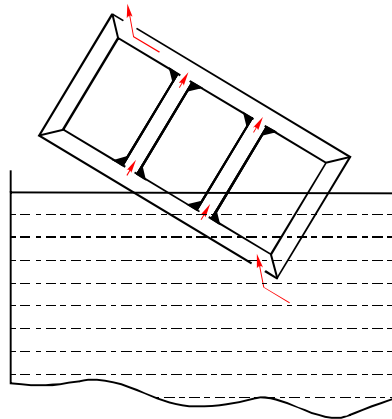


Figure 6: "Invisible" openings on a pipe construction

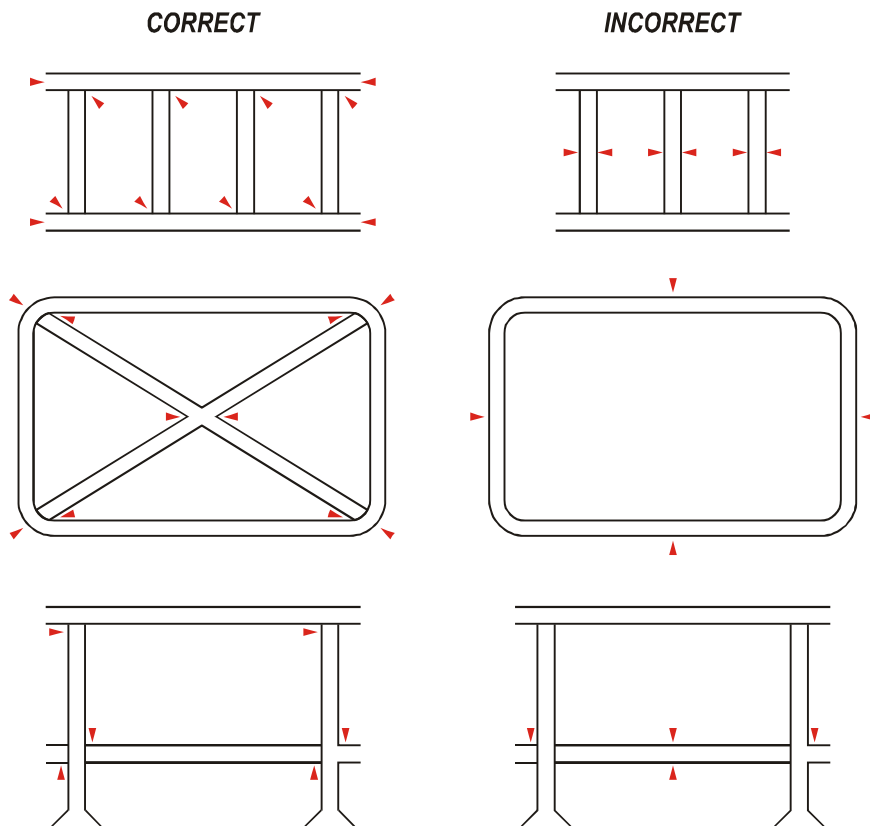


Figure 7: Correct and incorrect placement of openings

b) Hanging

The construction can also be hung onto specially welded ears. For a simple element, up to 2800mm in length, it is enough to have one hanging point at least 20mm from the edge; for longer constructions and elements it is necessary to have two or more hanging points. In order to prevent profiles longer than 6000mm from sagging it is necessary to place at least two hanging points and those would be at $\frac{1}{4}$ of the length on each side (Figure 9).

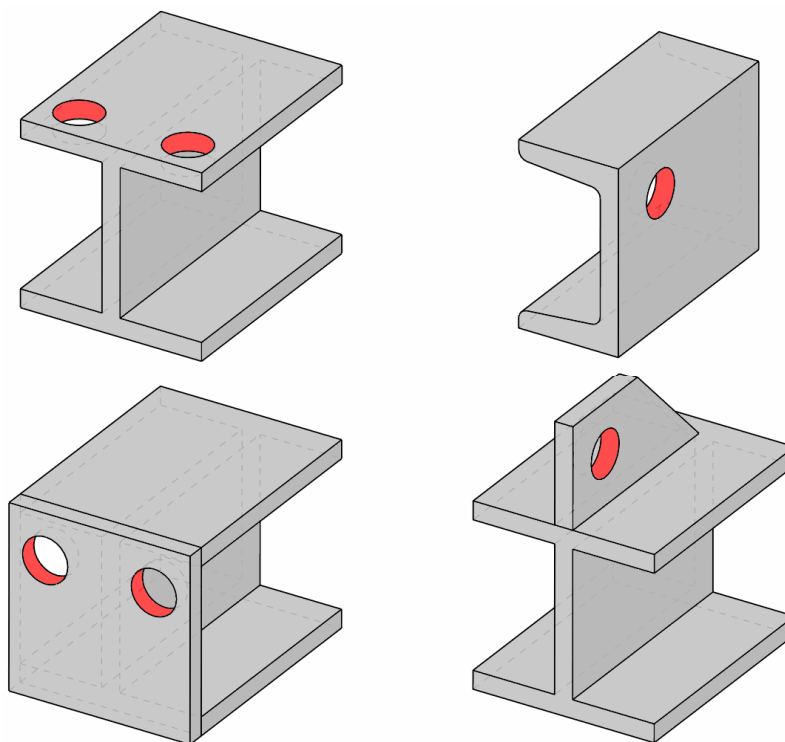


Figure 8: Boreholes for hanging I- and U- profiles

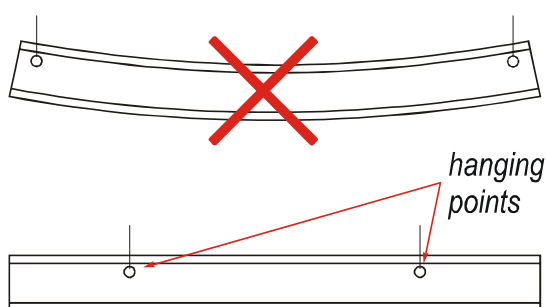


Figure 9: Optimal points for hanging a long profile

c) The aeration of closed volumes between two flat surfaces, which are entirely welded among themselves in order to prevent exploding during the galvanizing process (Figure 7). The opening can be on only one flat surface or can go through both surfaces. For areas above 25cm² it is necessary to place two such openings which are to be diagonally or maximally distanced.

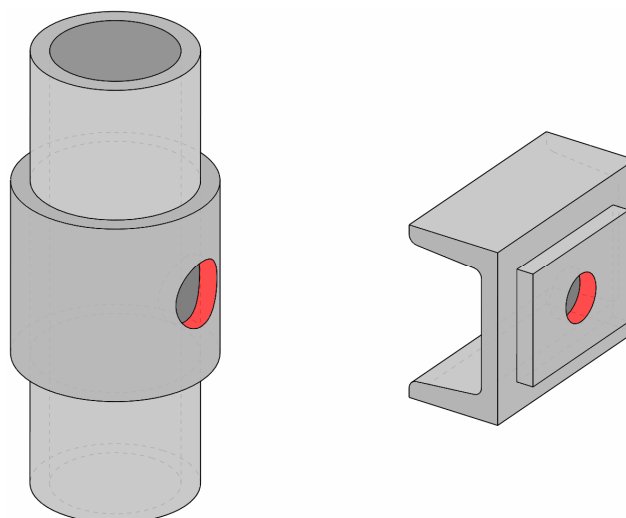


Figure 10: Aeration of closed volumes

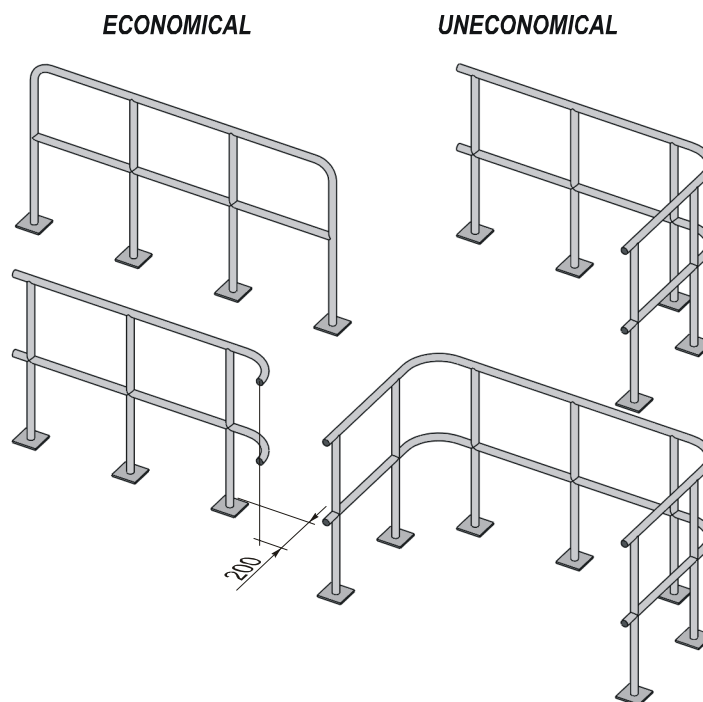


Figure 11: Economical construction of a fence for galvanizing

5 Joints and unions

As with any **joining of two flat surfaces** there is a danger of subsequent outflow of acid from the intermediate space because it was not covered with zinc.

Welds must be non-porous, finished, welding scales and droplets cleaned. A weld can according to the thickness of the zinc layer be separated from the adjacent surfaces due to a different chemical composition (silicon), therefore when welding it is necessary to use additional material with the same content of silicon as was used with the steel parts. In general it is necessary to use material with very low silicon content or completely silicon free.

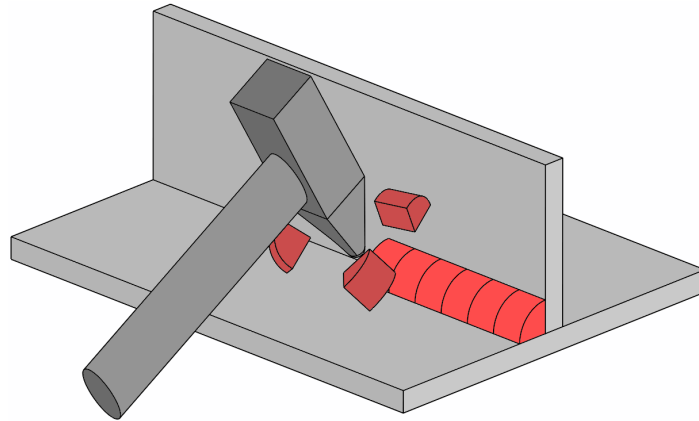


Figure 12: Remove the welding scale

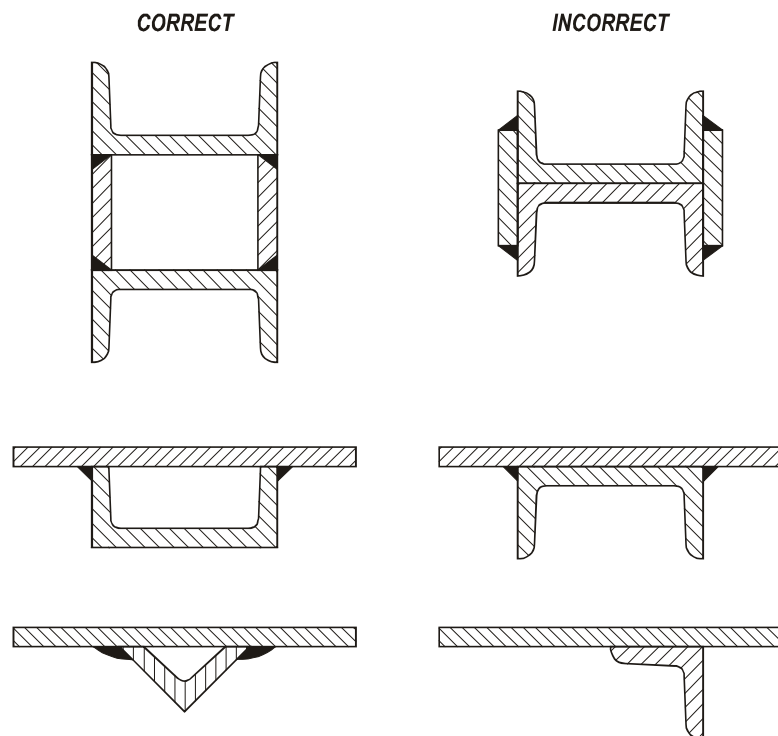


Figure 13: Correct joining of profiles for hot dip galvanizing

Joints may not be wrought with rivets from non-ferrous metals.

It is not possible to galvanize **soft soldered joints**. **Hard soldered joints** must be tested first but in general are not suitable for hot dip galvanizing.

Coils (nut, screw) need to be re-cut after galvanizing; therefore it is necessary to consider the permissible limits of the thickness of the zinc coating (50–200µm). It is possible to protect the screws and nuts prior to galvanizing with a special paint or with a linen strip. Screw material is suitable only for the procedure of hot dip galvanizing with centrifuge.

Hinges and sliding elements (e.g.: circular pipes or profiles in profile) should be delivered by the customer separately, they should be joined after galvanizing. During construction it is necessary to consider the permissible limits due to the thickness of the zinc layer. The stable part of the hinges (on the same construction) with only one opening should be facing the same direction or they should be open on both ends. In

case of subsequent joining of pipes it is necessary to predict at least a 3-millimeter tolerance range, bigger with greater lengths.

The minimal aeration when joining pipes should be 3mm

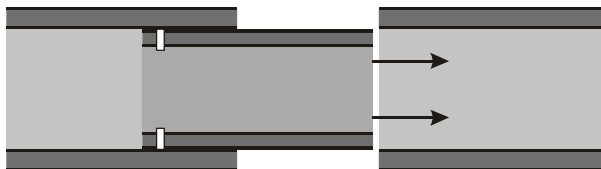


Figure 14: Predicted tolerance range in case of joining pipes – 3mm

6 Cold reshaping and forging

The sheet metal should not have any furrows or reams on the surface as a result of cold reshaping. These errors become very evident after galvanizing (the coating is coarse).

The cut edges of pipes must be skimmed (there should be no remains of needles, scrapings and shavings).

Cold reshaping after galvanizing damages the coating especially for elements with a wall thicker than 1mm, because these have a thicker coating with poorer flexing attributes.

7 Thermal deformations

A certain amount of tension occurs in materials when putting together elements and constructions – in the processes of rolling, welding, flattening and cold reshaping. Under the influence of high temperatures from the molten zinc these tensions are released and the construction element can deform.

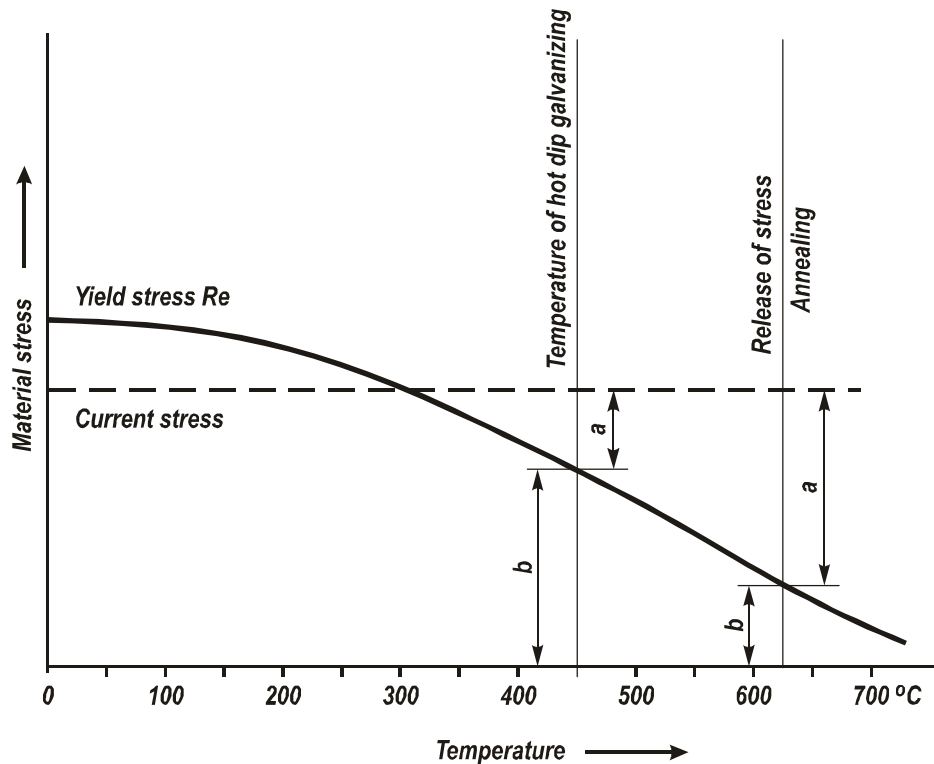


Diagram 1: A schematic course of the limits of the plasticity of steel at a higher temperature and deformations present as a result of inner tensions

The extent of the deformation depends on:

- the size of the inner tensions (Figure B)
- the heat taken up in relation to the position of the centre of gravity on the construction
- profile:
 - a) symmetrical or asymmetrical construction
 - b) open (U- and T- profiles) or closed construction (pipes)

The inner tension is reduced by portion a due to the heat (plasticity deformation sets in) inner tension in the size of b still remains.

The most frequent cases of thermal deformations occur at:

- thin sheet metal of larger dimensions,
- constructions, welded together from sheet metal of different sizes,
- nets, either framed or stand-alone,
- longer pipes or profiles – poles.

Deformations can be avoided or reduced by:

- screwing instead of welding,
- welding, where the welds are symmetrical, as close as possible to the centre of gravity and not stronger than they need to be,
- prior annealing – releasing the tension in the material,
- pre-tensing the construction,
- placing supports, which have to be from the same material and of similar thickness,
- cross or pyramid impressions 20 – 30mm in height and by bending the sheet metal – anti deflection,

- hanging the construction at more points in order to prevent sagging (if the execution of the construction permits so).

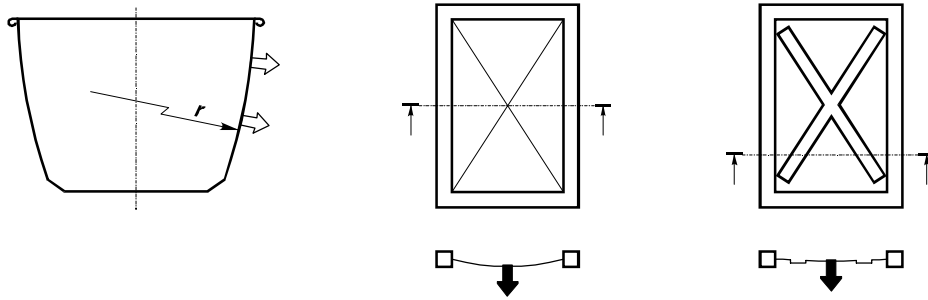


Figure 15: The manner of reducing thermal deformations with impressions

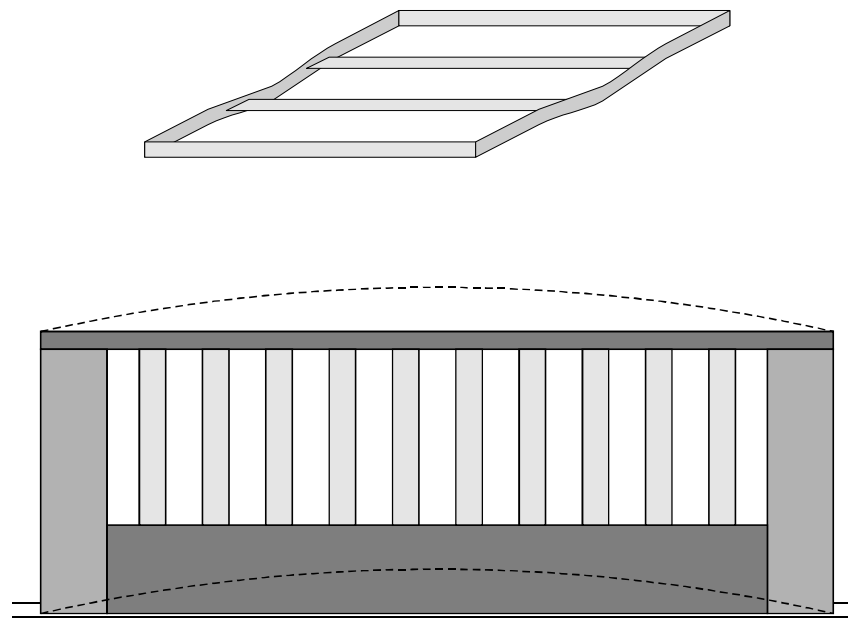


Figure 16: The possibility of deformation of longer elements

8 Chemical composition of the steel

The chemical composition of the steel decisively influences on the thickness, appearance and quality of the zinc coating. Silicon has by far the greatest influence (Figure 11) therefore the steel must not be placated with silicon.

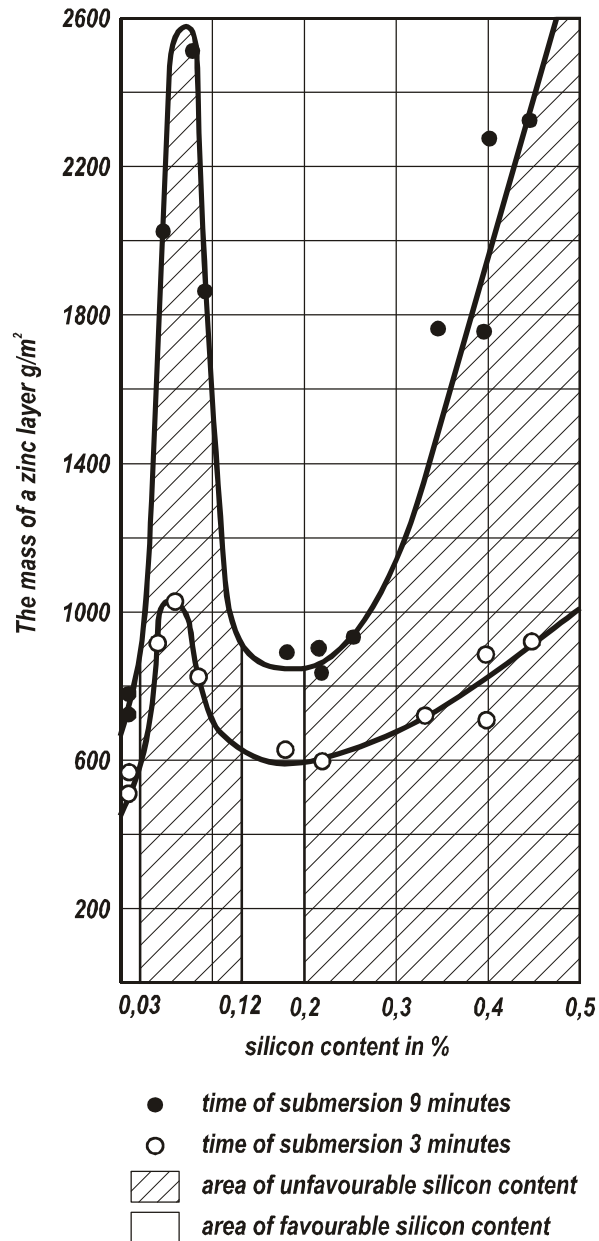


Diagram 2: The dependence of mass layer on the content of silicon in the steel

**The content of silicon and phosphorous is favourable in the following area:
Si + P < 0.03% (usually light coatings)**

A less favourable content is:

Si + P < 0.03% > = 0.28% (sebisty area) (light or dark grey coatings)

An unfavourable content is:

Si + P > 0.28% (thick, dark grey coatings, poorer grip)

Impermissible content:

Si + P \geq 0.03% - \leq 0.13% (*sandelin* area) (dark grey coatings, coarseness, peeling)

In fact all types of steel that are in accordance with the DIN EN 10 025 standard are suitable provided they have the right chemical composition.

The super hard and fine-grained construction steel is problematic. Steel can break due to hydrogen absorption in the process of leaching. The hardness of the steel must not be greater than the mark 34 HRC, 340 HV or 325 HB.

9 Steel surface condition

The steel must not contain any mistakes caused by:

- double layering,
- rolling, visible in the form of parallel lines,
- rolled scales
- unclean emulsion and impurities (oxides)

The surface of the steel is the most suitable if it is of a metal light matt colour. A very smooth surface, for instance: polished, can cause thicker layers. The errors, after galvanizing, are reflected on the uneven coating (unevenly leached surface), strong parallel or localised coarseness (dotting), grey appearance and a very intense peeling of the zinc layer.

10 Non-ferrous metals and cast iron

Non-ferrous metals are not to be galvanized.

It is imperative that cast iron is sanded prior to galvanizing so that oxides, sand, impurities and graphite are removed from the surface. Grey cast iron with 1.7 – 4.5% of carbon is very difficult to galvanize because during leaching in hydrochloric acid carbon spreads to the surface and prevents sticking to the zinc coating. There is a danger of the cast iron breaking after galvanizing.

11 Thickness of coating

The thickness of the layer should be in accordance with the SIST EN ISO 1461 (1999) standard.

Table 2: The thickness of the zinc layer on elements not centrifuged

Pieces and their wall thickness	Local thickness (μm) (smallest value) (a)	Average thickness (μm) (smallest value) (b)
Steel $\geq 6\text{mm}$	70	85
Steel $\geq 3\text{mm}$ to $< 6\text{mm}$	55	70
Steel $\geq 1.5\text{mm}$ to $< 3\text{mm}$	45	55
Steel $< 1.5\text{mm}$	35	45
Cast iron $\geq 6\text{mm}$	70	80
Cast iron $< 6\text{mm}$	60	70

(a) The medium value of thickness obtained from a defined number of individual measurements within the framework of one referring surface on the basis of a magnetic procedure or obtained value by using the gravimetric method.
 (b) The medium value of localised thickness obtained from one larger piece or from all the pieces of the control unit.

12 Repair of ungalvanized parts

The total ungalvanized area to be repaired can take up only up to 0.5% of the entire area of one element. An individual ungalvanized area can be up to 10cm^2 large. The repair can be done by thermal layering of zinc or with an adequate coating on the basis of zinc powder, which of course satisfies the quality requirements.

13 White rust

Is the result of the formation of zinc hydroxide on a freshly galvanized element and primarily on surfaces where there was an inflow of carbon dioxide in the presence of condensation (humidity). White rust is not cause for claim.

14 Storing of pallets and transport

Elements sent for galvanizing must be correctly sorted on pallets so there is no possibility of mechanical or chemical damage to the construction or the zinc layer during internal and external transport. Steel pallets must be surface protected. The sorting on pallets must enable transport of the elements into the galvanizing unit on the pallets without having to reload beforehand and without ever having to be in direct contact with the transport vehicle itself.