designing for galvanizing: venting and draining

For Customers

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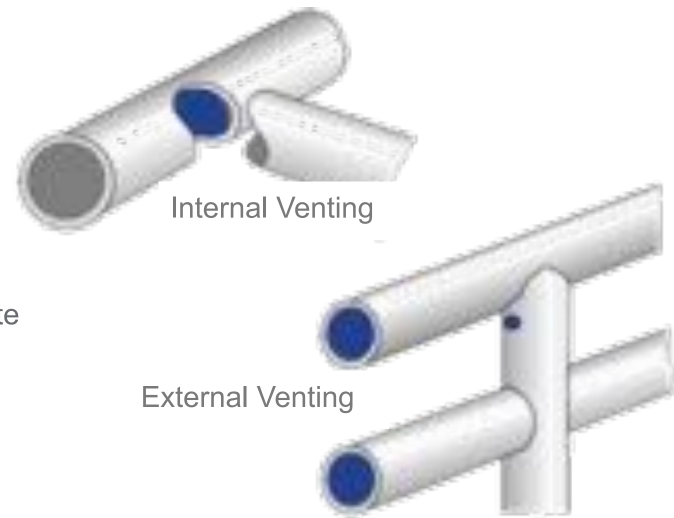
HOT DIP GALVANIZING

Adapted from the American Galvanizers Association

Designing your product for hot dip galvanizing

WHY IS THERE A NEED FOR VENTING AND DRAINAGE HOLES?

In **the hot-dip galvanizing process**, steel is completely coated with corrosion-inhibiting zinc, which forms a highly abrasion-resistant metallurgical bond with the base steel. In order to ensure that all interior and exterior surfaces are protected from corrosion, entire steel fabrications are lowered into and raised out of cleaning solutions, flux solutions, and molten zinc metal. In order to facilitate interior and exterior cleaning and coating, it is necessary to provide holes in fabrications to be galvanized. (These holes can be plugged after galvanizing if needed.)



The primary reason for vent and drain holes is to allow air to be evacuated from within and around the fabrication, allowing it to be completely immersed in the cleaning solutions and molten zinc and for the excess zinc and solutions to drain out and away from the part.

Because items being galvanized are immersed in and withdrawn from all cleaning solutions and molten zinc at an angle, **vent holes should be located at the highest point and drain holes at the lowest point** as mounted during the galvanizing process.

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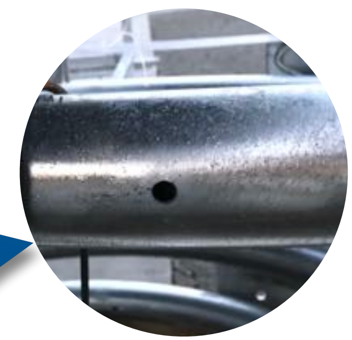
example of venting and drainage

These bike racks are a great example of correct venting and drainage considerations.

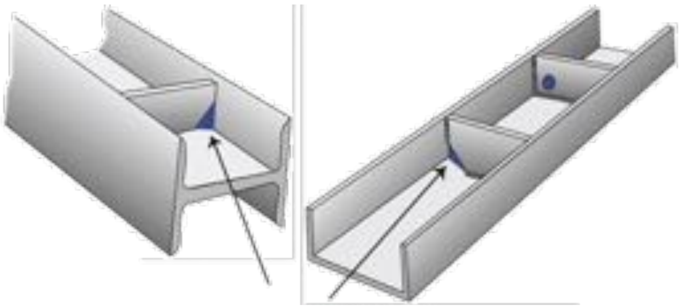
The **base plates** have a large opening to allow air to easily escape and for zinc to flow through.



The **highest point** has a vent hole to allow air to escape during galvanizing.

Designing your product for hot dip galvanizing

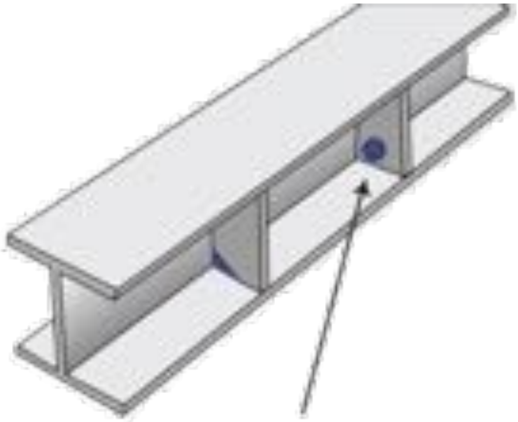
For effective galvanizing, cleaning solutions and molten zinc must flow without undue resistance into, over, through, and out of the fabricated article. Failure to provide for this free, unimpeded flow can result in complications for the galvanizer and the customer. Improper drainage design results in poor appearance, bare spots, and excessive build-up of zinc. All of these are unnecessary and costly, and another example of why communication throughout the project is key.



Cropped corners (preferred)

A few common fabrications where drainage is important are **gusset plates, stiffeners, endplates, and bracing.** Following these best design practices will help ensure the highest quality coatings:

- Where **gusset plates** are used, generously cropped corners provide for free drainage. When cropping gusset plates is not possible, holes at least 1/2” (13 mm) in diameter must be placed in the plates as close to the corners as possible.
- To ensure unimpeded flow of solutions, all **stiffeners, gussets, and bracing** should be cropped a minimum of 3/4” (19 mm).
- Provide holes at least 1/2” (13 mm) in diameter in **end-plates on rolled steel** shapes to allow molten zinc access during immersion in the galvanizing bath and drainage during withdrawal.
- Alternatively, holes at least 1/2” (13 mm) in diameter can be placed in the web within 1/4” (6 mm) of the end-plate. To facilitate drainage, **end-plates** should have holes placed as close to interior corners as possible.



Holes close to corners (alternatively)

example of

gusset plates, stiffeners, endplates, and bracing

This rack shows an example of both good and poor venting and drainage.

The goal is to allow the zinc to flow freely over all surfaces, which the cropped corners allow.

The **cut out** allows zinc to easily flow under and around the joint of the two pieces

This plate **should have cropped corners** in it (shown in red) to allow zinc to flow through easily.

product design specifications

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handrails

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tubular fabrication

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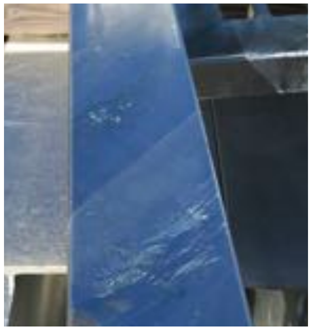
pipe truss

pipe column, girders, and poles



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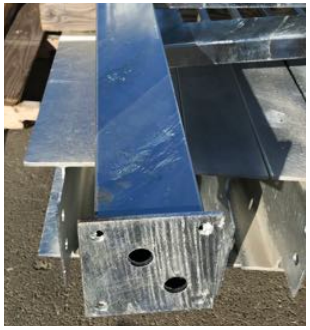
enclosed products



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box sections

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rectangular tubes

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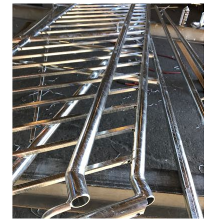
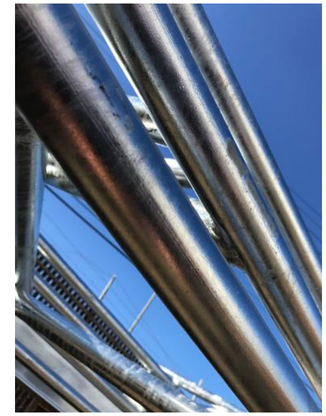
tapered single arm

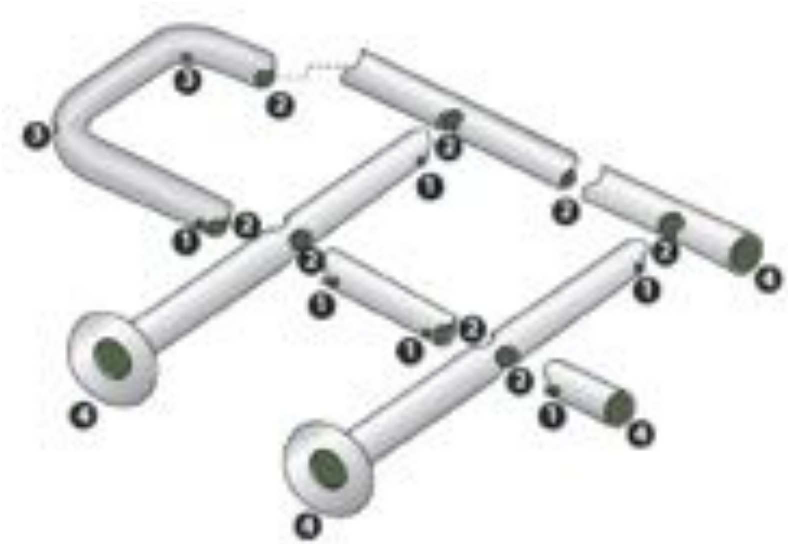
proper venting of

handrails/





The drawing illustrates the recommended design for handrail fabrications. The bullet numbers correspond with number references on the illustration.



1 **External vent holes** must be as close to the weld as possible and not less than 3/8" (9.5 mm) in diameter.

2 **Internal holes** should be the full internal diameter (ID) of the pipe for the best galvanizing quality and lowest galvanizing cost.

3 **Vent holes** in end sections or in similar sections must be 1/2" (13 mm) in diameter.

4 **Ends** should be left completely open. Any device used for erection in the field that prevents full openings on ends of horizontal rails and vertical legs should be galvanized separately and attached a!er galvaniz-

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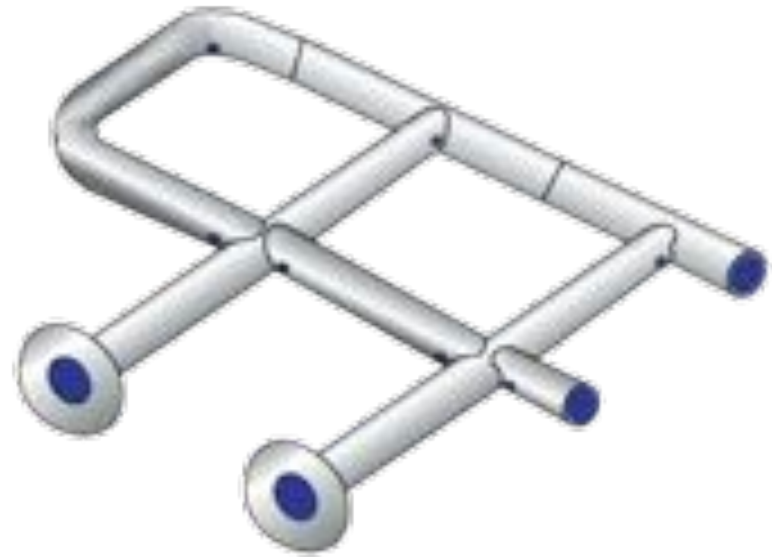
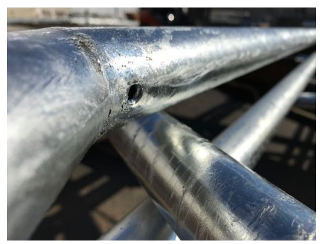
proper venting of

handrails

This illustration shows an acceptable alternative if full internal holes are not used:



Venting Holes



Open Base

1 **External vent holes** must be as close to the weld as possible and must be 25% the size of the ID of the pipe, but not less than 3/8” (10 mm) in diameter.

2 **Vent holes in end sections** or in similar sections must be 1/2” (13 mm) in diameter.

3 **Ends** should be left completely open. Any device used for field-erection that prevents full openings on ends of horizontal rails and vertical legs should be galvanized separately and attached a!er galvanizing.

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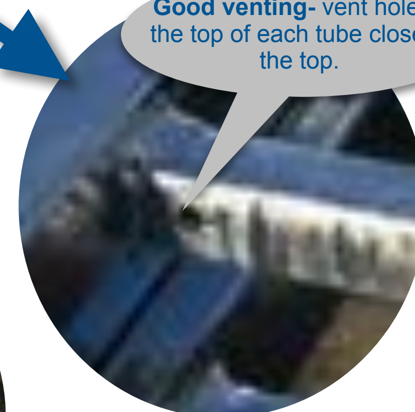
examples of
handrail venting

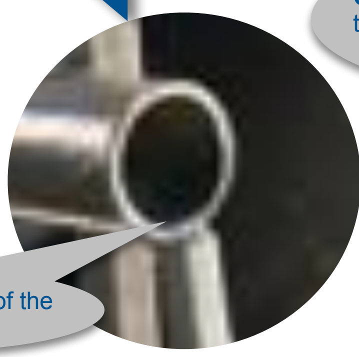
1

Good venting- hole as close to the top of the tube as possible.



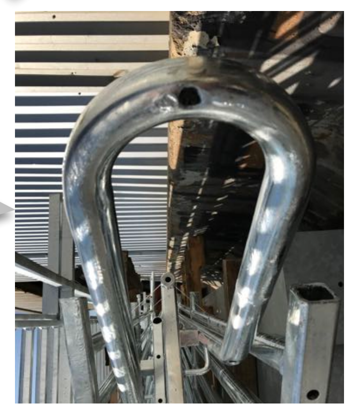
Good venting- vent hole at the top of each tube close to the top.

Good placement of holes at the top of each tube, as close to the top as possible.

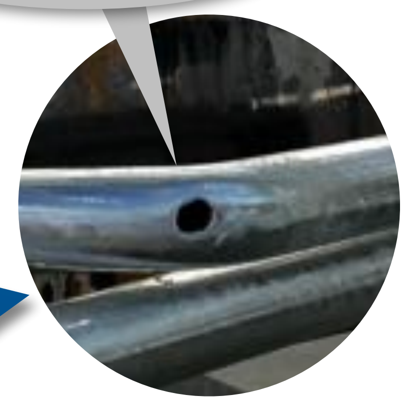


Good venting- end of the tube left open.

Good venting- This railing shows venting at both the highest and lowest part of the bend



Good venting- This railing shows venting at both the highest and lowest part of the bend



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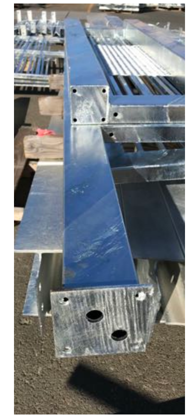
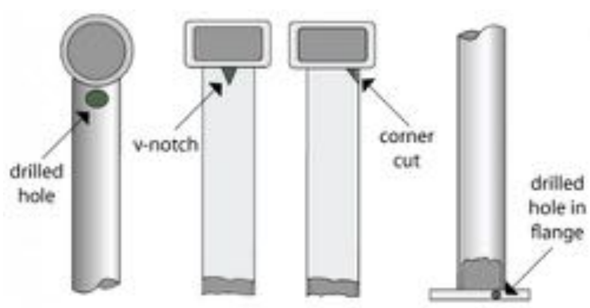
proper venting of

tubular fabrication



Tubular assemblies (handrails, pipe columns, pipe girders, street light poles, transmission poles, pipe trusses, sign bridges) are commonly galvanized to provide interior and exterior corrosion protection of the product. Hollow products require proper cleaning, venting, and drainage in order to grow an optima galvanized coating.

Steel is immersed and withdrawn from the kettle at an angle, so vent holes are located at the highest point and drainage at the lowest. Sections of fabricated pipe-work should use full open-tee or miter joints at interconnections. Vent holes must be provided at each end of every enclosed section.



Base-plates and end-plates must be designed to facilitate venting and draining. Fully cutting the plate provides minimum obstruction to a full, free flow into and out of the pipe. Since this is not always possible, using vent holes in the plate often provides the solution.

Vent holes can be plugged after galvanizing but are frequently left open. If the **holes will be plugged a!er galvanizing, the method of venting should be kept in mind.**

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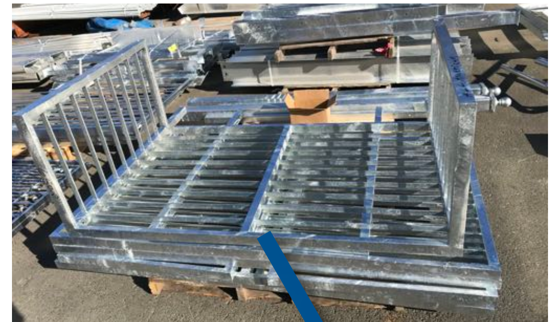
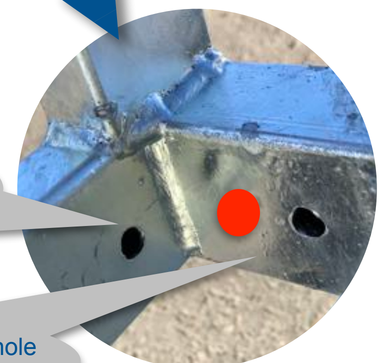
examples of

tubular venting

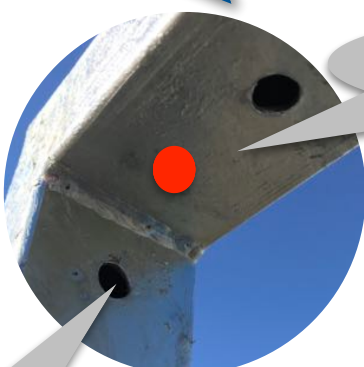
Good venting- hole in each baseplate





Good placement of hole at the top of each tube, as close to the top as possible.

Ideal placement of this hole **would be** closer to the seam



Ideal placement of this hole **would be** closer to the seam

Good placement of hole at the top of each tube, as close

Good placement of hole at the top of each tube, as close to the top as possible.

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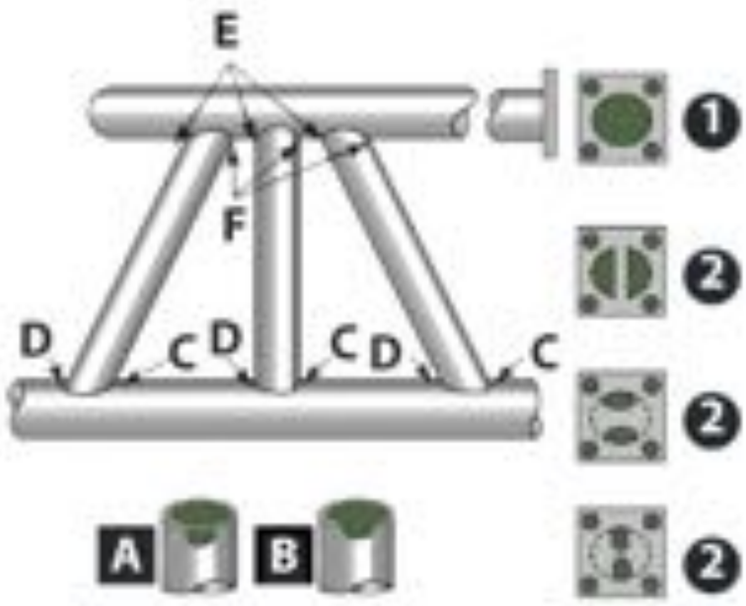
proper venting of

pipe truss

Hole locations for the vertical members should be as shown in **examples A and B** .



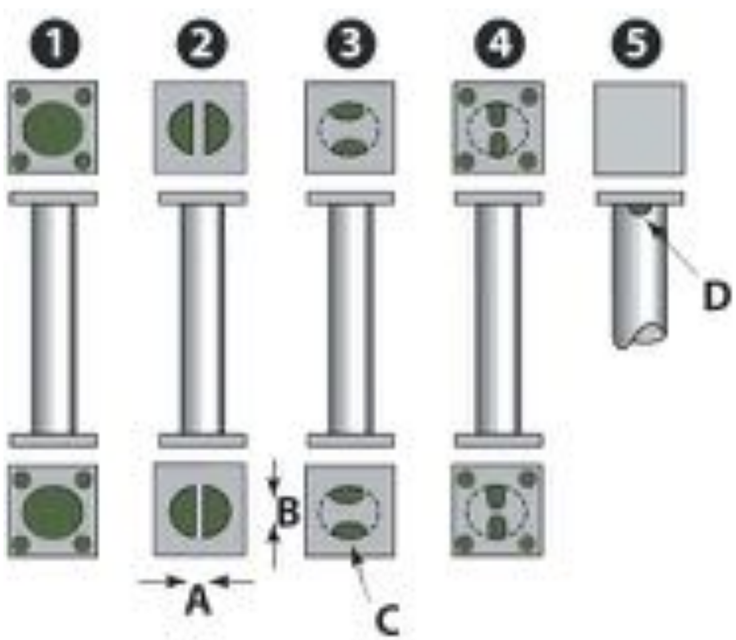
1 **Each vertical member** should have two holes at each end and 180° apart in line with the horizontal members as indicated by the arrows.

2 The size of the holes preferably should be equal and the combined area of the two holes at either end of the verticals (**Areas C and D or Areas E and F)** should be at least 30% of the cross-sectional area.

proper venting of

pipe column girders and poles

This illustration shows the best practice for venting and drainage hole placement and dimensions for pipe columns and girders as well as street light and transmission poles with base-plates and with or without cap-plates.



Openings at each end must be at least 30% of the cross-sectional area of the pipe, for pipe 3” (8 cm) and greater and 45% of the cross-sectional area for pipe smaller than 3” (8 cm).

1 End completely open

2 **Slot A** = 3/4" (19 mm), **Center Hole B** = 3 inches (7.6 cm) in diameter

3 **Half Circle C** = 1 3/4" (4.5 cm) radius (examples of sizes for 6" (15 cm) diameter section)

4 Oval Opening = 1 3/4" (4.5 cm) radius

5 Half Circle D = 5/8" (1.9 cm) radius

1 The most desirable fabrication is to have the end completely open, with the same diameter as the section top and bottom. This is an equal substitute if the full opening is not allowed.

2 This is an equal substitute if the full opening is not allowed.

3 This is an equal substitute if the full opening is not allowed.

4 This must be used when no holes are allowed in the cap or base-plate: two half-circles 180 degrees apart and at opposite ends of the pole.

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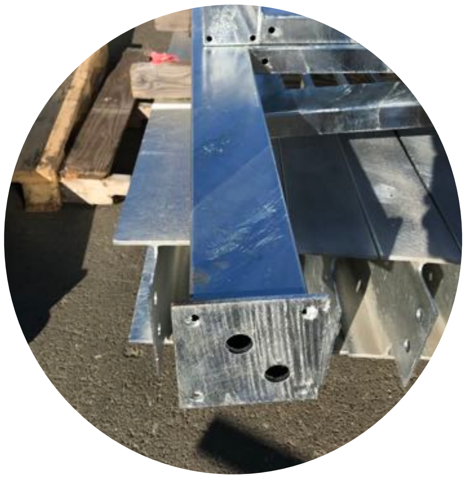
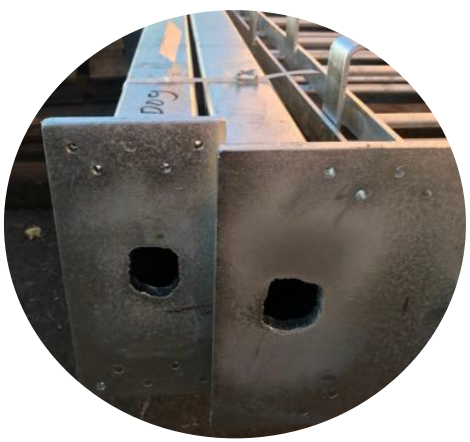
examples

base plates

For tubes **over 10 feet in length**, using at least two holes diagonally opposite each other is the best baseplate design.





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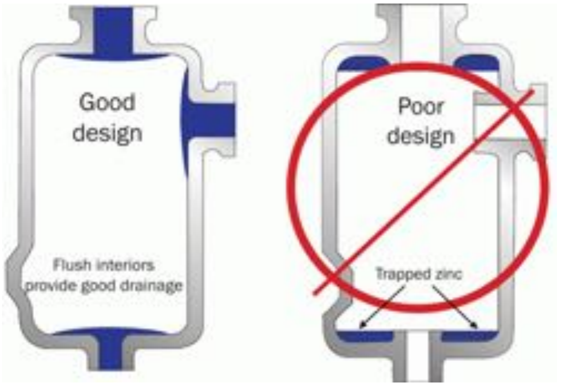
proper venting of

enclosed products

Tanks and enclosed vessels should be designed to allow cleaning solutions, fluxes, and molten zinc to enter at the bottom and air to flow upward through the enclosed space and out through an opening at the highest point. This prevents air from being trapped as the article is immersed. The design must also provide for complete drainage of both interior and exterior details during withdrawal.



The location and size of fill and drain holes are important. As a general rule, the bigger the hole the better the air and zinc flow. When both internal and external surfaces are to be galvanized, at least one fill/drain hole and one vent hole must be provided.

The fill/drain hole should be as large as the design will allow, but at least 3” in diameter for each cubic yard (10 cm in diameter for each cubic meter) of volume. The minimum diameter is 2” (5 cm). Provide vent holes of the same size diagonally opposite the fill/drain hole which allows the air to escape.

In tanks, internal baffles should be cropped on the top and bottoms or provided with suitable drainage holes to permit the free flow of molten zinc. Manholes, handholds, and openings should be finished flush inside to prevent trapping excess zinc. Openings must be placed so the flux on the vessel can float to the surface of the bath. These openings also prevent air-pocket formations that may keep solutions from completely cleaning the inside of the vessel.

Items such as vessels or heat exchangers galvanized on the outside only must have snorkel tubes, or extended vent pipes. These openings provide an air exit from the vessel above the level of molten zinc in the galvanizing kettle. Consult your galvanizer before using these temporary fittings, because special equipment is needed.

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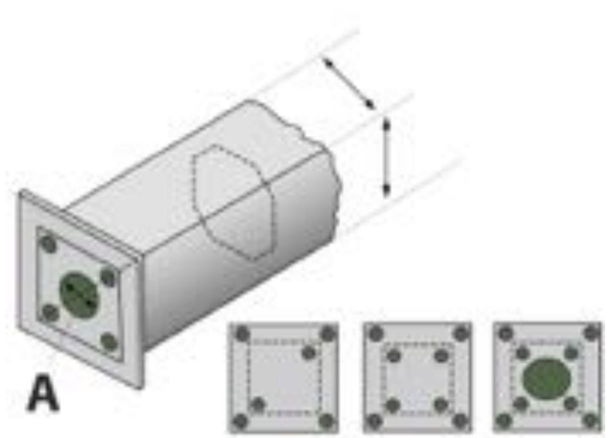
proper venting of
BOX SECTIONS



This figure shows the location of holes and clipped corners, which must be flush.

This table shows typical sizes of holes for square box sections only. For rectangular section, calculate the required area and check with your galvanizer for positioning of openings.

Box Size	Holes A-Dim (H + W)
48” (122 cm(	8” (20 cm)
36” (19 cm)	6” (15 cm)
32” (81.3 cm)	6” (15 cm)
28” (71 cm)	5” (10.2 cm)
24” (61 cm)	5” (12.7 cm)
20” (50.8 cm)	4” (10.2 cm)
16” (40.6 cm)	4” (10.2 cm)
12” (30.5 cm)	3” (7.6 cm)

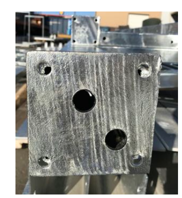
Internal Gussets

- space at a minimum of 36 inches (91 cm)

Box Sections:

- **H + W = 24” (61 cm) or larger**, the area of the hole, plus clips, should equal 25% of the cross-sectional area of the box (H x W).
- **H + W is < 24” (61 cm) but > 16”** (40.6 cm), the area of the hole, plus clips, should equal 30% of the cross- sectional area of the box.
- **H + W is < 16”** (40.6 cm) but > 8” (20 cm), the area of the hole, plus clips, should equal 40% of the cross-sectional area of the box.
- **H + W < 8”** (20 cm), leave completely open, no end-plate or internal gusset.

For tubes **over 10 feet in length**, using at least two holes diagonally opposite each other is the best baseplate design.



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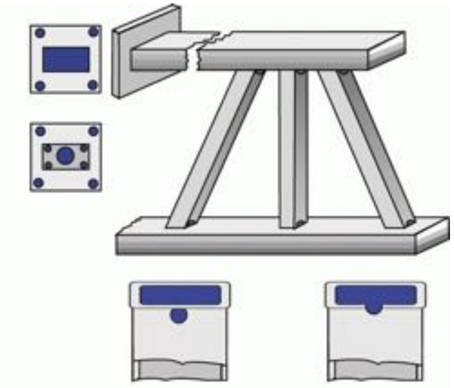
proper venting of

rectangular tubes

VERTICAL SECTIONS



Hole locations for the vertical members should be as shown in **examples A and B.**

Each vertical member should have two holes at each end, 180° apart in line with the horizontal members.

The size of the holes preferably should be equal, and the combined area of the two holes at either end of the verticals should be at least 30% of the cross-sectional area.

END PLATES-HORIZONTAL SECTIONS

The most desirable fabrication is completely open.

From the illustration, **if H + W = 24" (61 cm) or larger,** the area of the hole, plus clips, should equal 25% of the area of the tube (H x W).

If **H + W = less than 24" (61 cm) but more than 16"** (41 cm), the area of the hole, plus clips, should equal 30% of the area of the tube.

If H + W = less than 8" (20 cm), leave it open.

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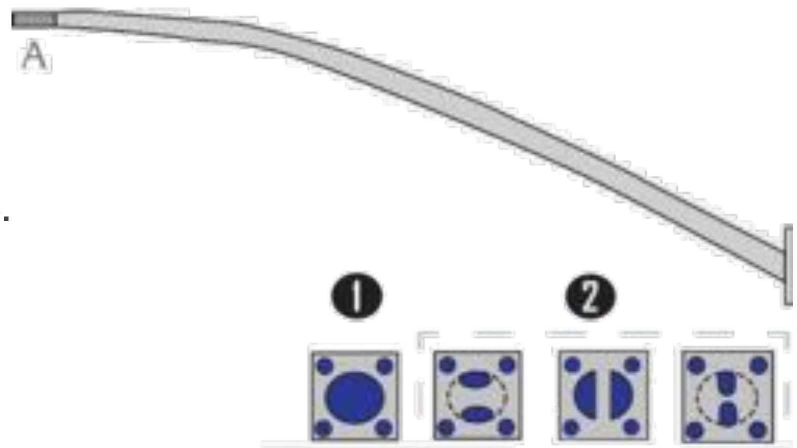
proper venting of

tapered single arm



The small end should be completely open **(A).**

Pole end plate **(1 and 2)**

1. **The end completely open is the most desirable fabrication.**

2. **As an acceptable alternative,** for tapered arm internal diameters 3" (7.6 cm) and larger, the half-circles, slots, and round holes must equal 30% of the area of the pole end's internal diameter. If the ID is less than 3" (7.6 cm), the opening must equal 45% of the area of the pole end of the tapered arm.

Internal gusset-plates and end-flanges should also be provided with vent and drainage holes. In circular hollow shapes, the holes should be located diametrically opposite each other at opposite ends of the member.

In rectangular hollow shapes, the four corners of the internal gusset-plates should be cropped. Internal gusset-plates in all large hollow sections should be provided with an additional opening at the center. Where there are flanges or end- plates, it is more economical to locate holes in the flanges or plates rather than in the section.

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