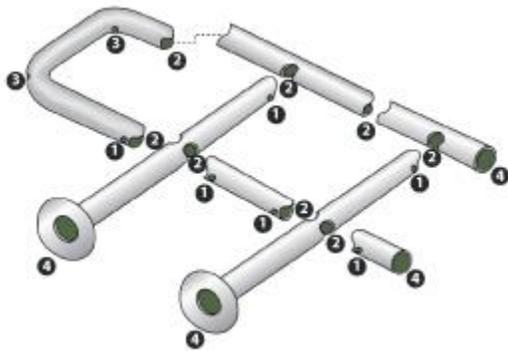


# Handrail

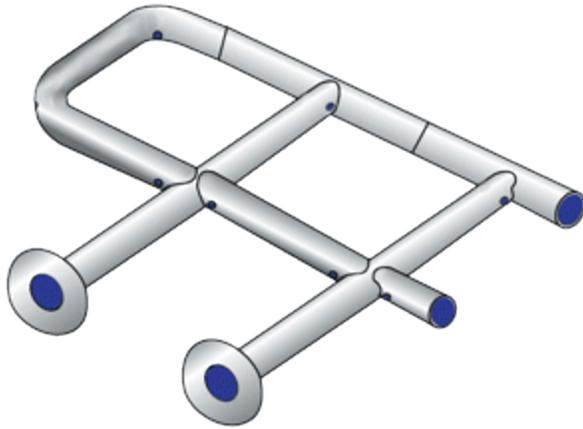
The drawing below illustrates the recommended design for handrail fabrications. The bullet numbers correspond with number references on the illustration.



Vent holes should be visible on the outside of any pipe assembly to provide internal vent verification

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 after galvanizing.

The second illustration (below) shows an acceptable alternative if full internal holes are not used:



of pipe assemblies

External vent holes should be visible on the outside

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 after galvanizing.

## Venting & Drainage

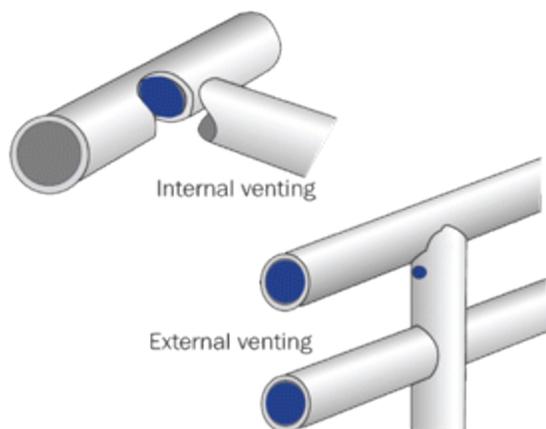
In the [hot-dip galvanizing process](#), steel is completely coated with corrosion-inhibiting zinc, which forms a highly abrasion-resistant metallurgical bond with the base steel. In order to ensure that [all interior and exterior surfaces are protected from corrosion](#), entire steel fabrications are 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.

The secondary reason is that if fabrications to be galvanized are not properly vented, cleaning solutions or rinse waters trapped in overlapping or contacting surfaces flash to steam. The resulting pressure increase (up to 3600 psi [25MPa]) can rupture the fabrication. Additionally, trapped moisture that flashes to steam can result in localized uncoated surfaces.

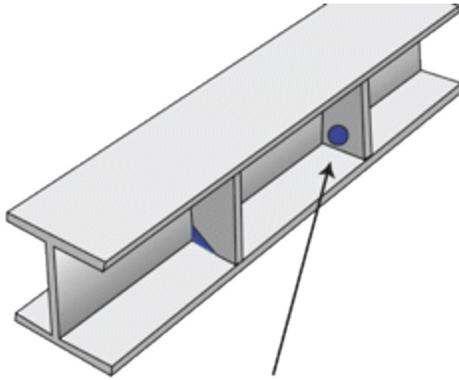
Because items being galvanized are immersed in and withdrawn from all cleaning solutions and molten zinc at an angle, vent holes should be located at the highest point and drain holes at the lowest point as mounted during the galvanizing process.



## Drainage

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.

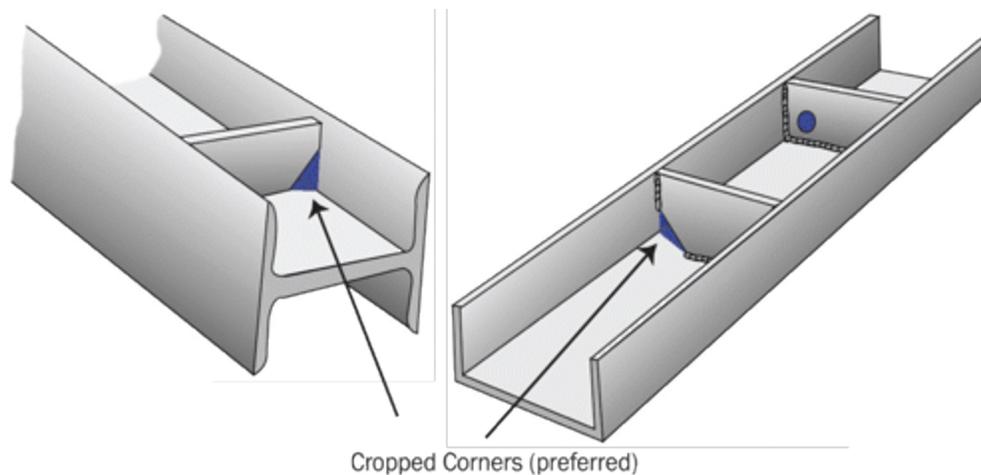
A few common fabrications where drainage is important are gusset plates, stiffeners, end-plates, and bracing. Following these best design practices will help ensure the highest quality coatings:



Holes close to corners (alternatively)

- 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.

The following pages provides more detailed venting & drainage information for specific products:



- [Box Sections](#)
- [Enclosed & Semi-Enclosed Products](#)
- [Handrail](#)
- [Pipe Columns, Pipe Girders, Street Light Poles & Transmission Poles](#)
- [Pipe Truss 3 inches \(8 cm\) & Larger](#)
- [Rectangular Tube Truss](#)
- [Tapered – Single Arm](#)
- [Tubular Fabrications](#)

# Tubular Fabrications

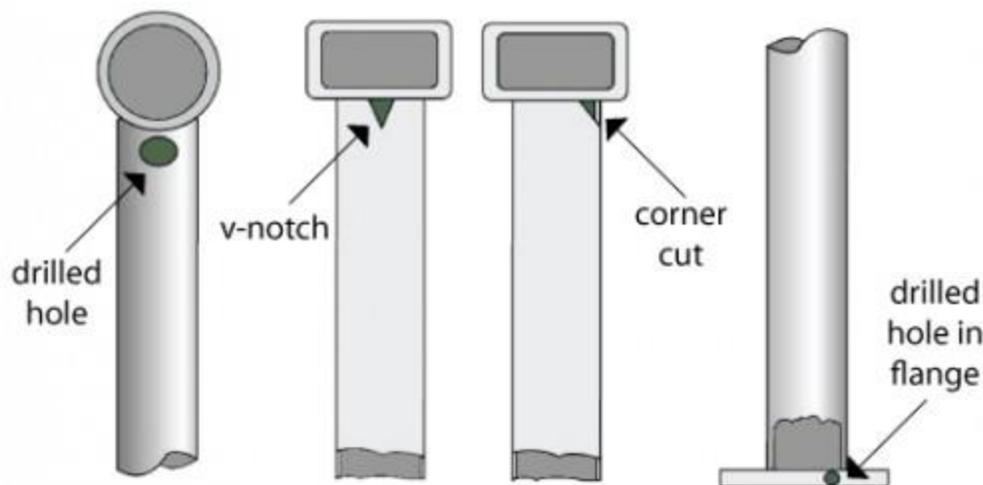
Tubular assemblies (handrails, pipe columns, pipe girders, street light poles, transmission poles, pipe trusses, sign bridges) are commonly galvanized to provide interior and exterior corrosion protection of the product. Hollow products require proper cleaning, venting, and drainage in order to grow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

Most galvanizers prefer to visually identify venting from the outside, in order to verify the adequacy of the venting as well as to determine that venting has not been mistakenly omitted.

Some galvanizers may hesitate to process complicated pipe assemblies unless all venting is visible on the outside and readily accessible for inspection. The diagram below illustrates recommended designs for tubular fabrications and hollow structures.



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 after galvanizing, the method of venting should be kept in mind.

It is recommended tubular structures be completely submerged in one dip into the galvanizing kettle. This minimizes potential internal coating problems that, because of the size and shape of the item, may be difficult to discover during inspection.