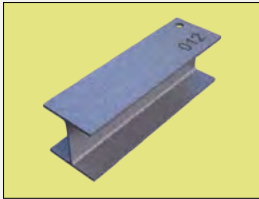
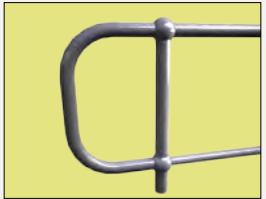




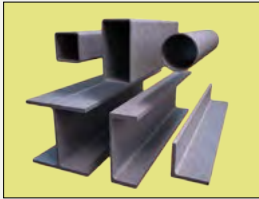

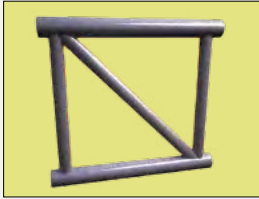




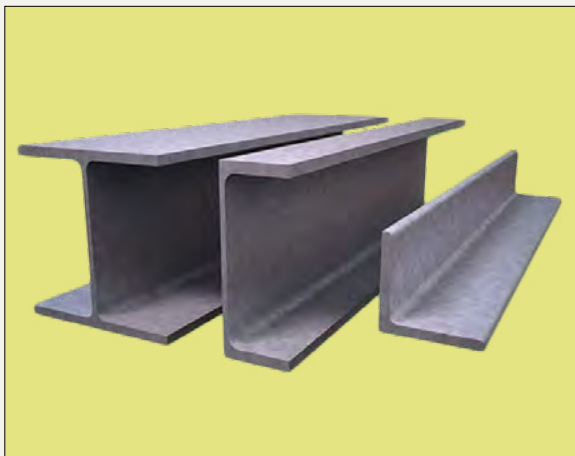
Design Guide for Hot Dip Galvanizing – best practice for venting and draining

galvanizers
ASSOCIATION OF AUSTRALIA



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Hot Rolled Sections

- End plates, gussets and stiffeners all restrict drainage. Vent and drain holes or openings (e.g. snipes) need to be provided in the corners of connected structural member (Figure 9 and Figure 10).
- The corners of end plates, gussets and stiffeners can also be cropped (referred to in industry as 'snipes') to allow for venting and draining (Figure 9 and Figure 10).
- See the Snipe Guide (Figure 11) for the recommended snipe sizes for various structural members.

Figure 9: Hot Rolled Profiles – Typical Designs

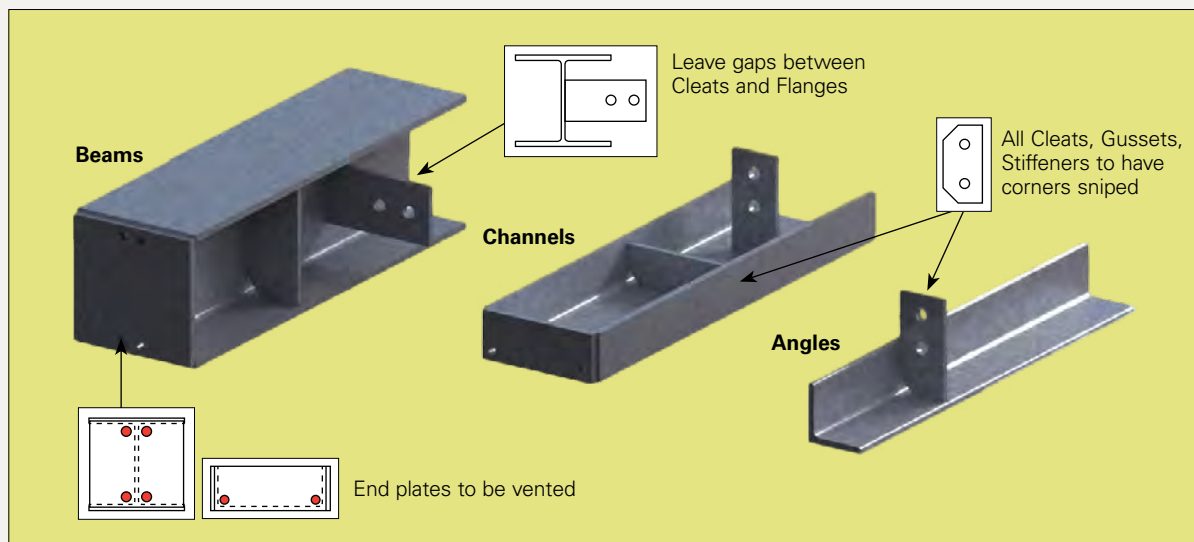


Figure 10: End Plate Options

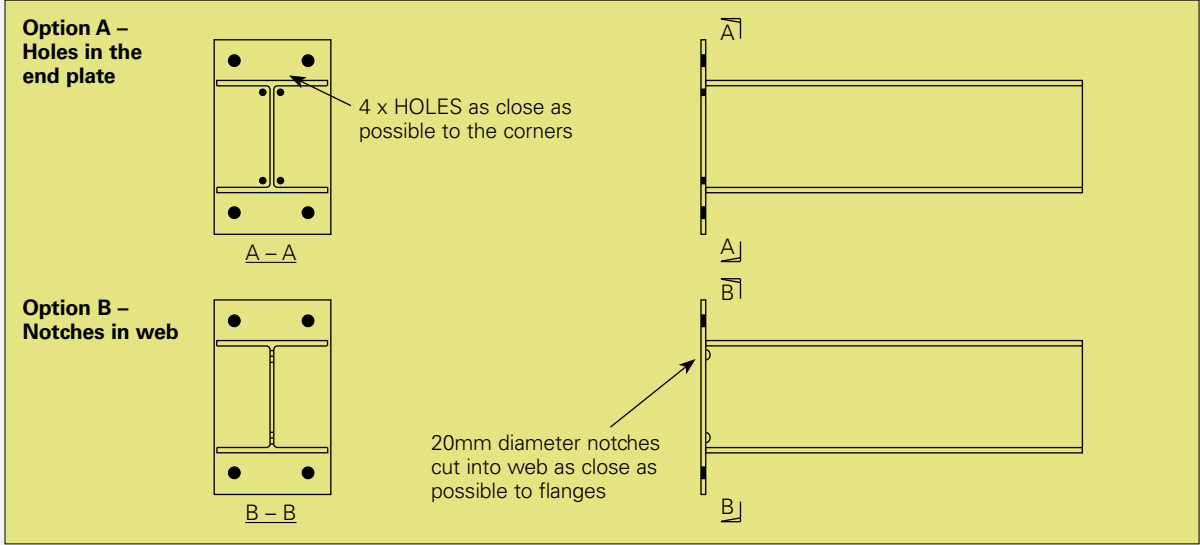


Figure 11: Snipe Guide

	Nominal Section	Snipe Size (mm)
	PFC	
	150 to 250	25x25
	above 250	30x30
	Angle	
	100 to 150	25x25
	above 150	30x30
	UB	
	up to 250	25x25
	above 250	30x30
	UC	
	up to 200	25x25
	above 200	30x30
	(For the smaller sections, a hole is the more preferred option for venting.)	

Figure 12: Snipe Gussets

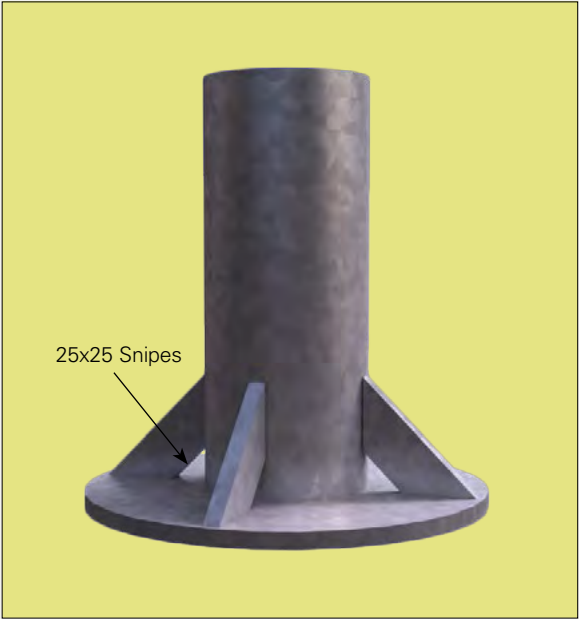


Figure 13: Design Orientation Options



Frames and Fabrications



Design details are important when fabricated articles are to be hot dip galvanized.

Figure 14 to Figure 24 show basic design practices to ensure articles are able to be successfully galvanized and a quality hot dip galvanized coating is achieved.

Some designs can provide adequate natural drainage without requiring holes (Figure 24).

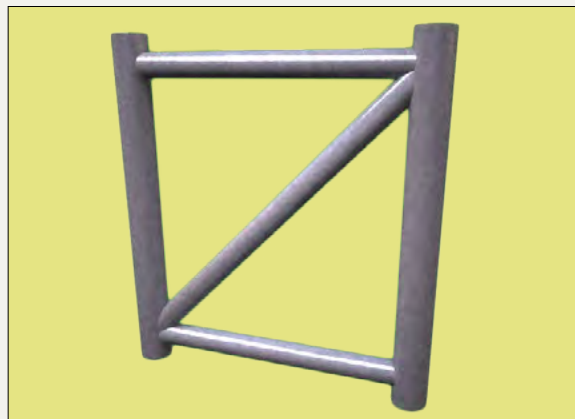
Using Hollow Sections

External holes

- External holes are needed to ensure quick visual inspection and verification that work is safe to galvanize.
- Each member should have two holes in each end orientated in the plane of the fabrication.
- External holes are to be placed as close to the connection as possible.
- External holes size determined by 25% of the cross section. See '*Standard Hole Size Tables*'.

Internal holes

- Internal vent holes must be at least 50% of the connecting section. It is recommended they be the same size as the internal diameter of the connecting section where practical. See Figures 14 and 18.
- Internal venting must be shown on shop detail drawings and be approved by the galvanizer prior to fabrication. This method of venting is also recommended to be approved by the structural engineer.
- Internal holes must be visible or be able to be otherwise proven to be satisfactorily formed for inspection purposes.



- A $\varnothing 10\text{mm}$ external check hole must be included at each location where internal venting is specified on the shop detail drawings. This best practice requirement will allow the galvanizer to safely proceed with dipping the article.

See '*Location of holes*' and '*Size of holes*' for more information.

Figure 14: Closed Hollow Sections – Unsatisfactory

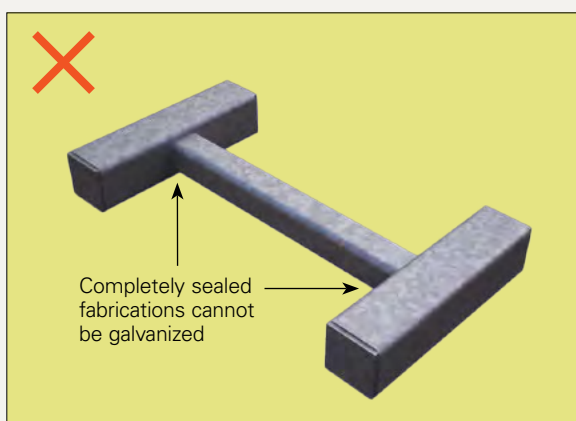




Figure 15: Mitred Joints – Preferred

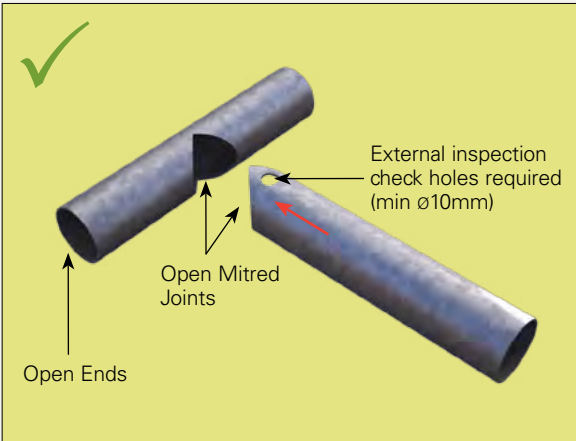


Figure 16: External Venting Shop Detail – Preferred

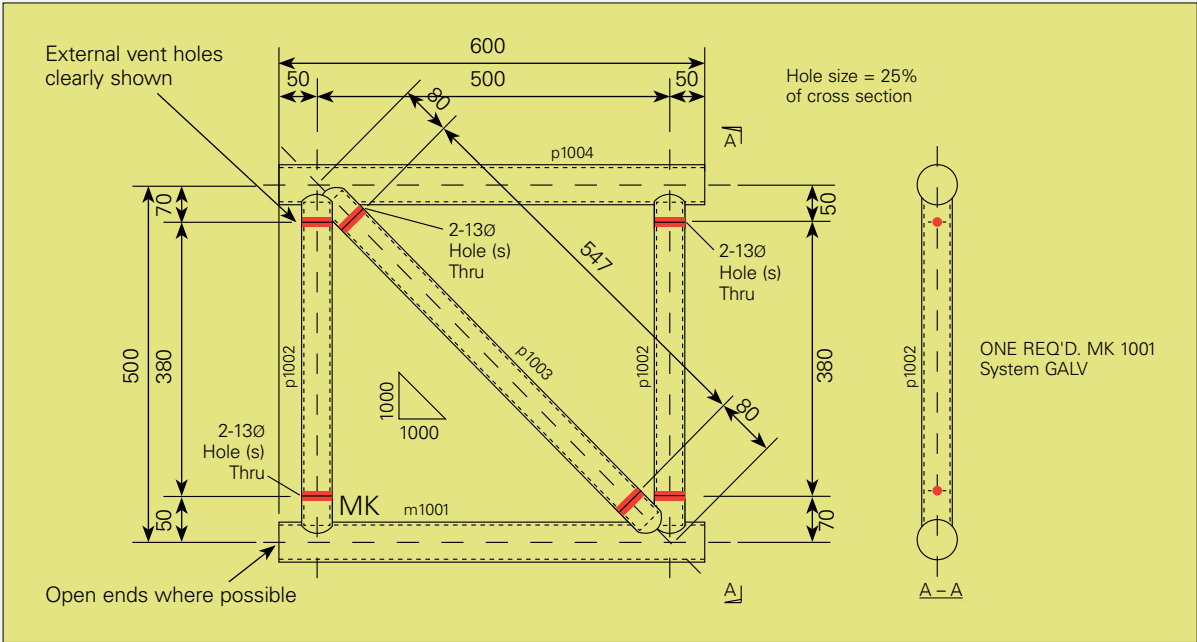


Figure 17: Internal Vent Holes with No Inspection Holes – Non-Preferred

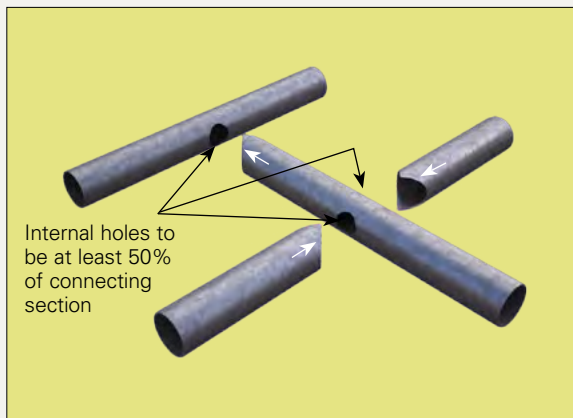


Figure 18: Internal Vent Holes – Drawing to clearly show items are "Internally Vented" with Inspection Holes - Preferred

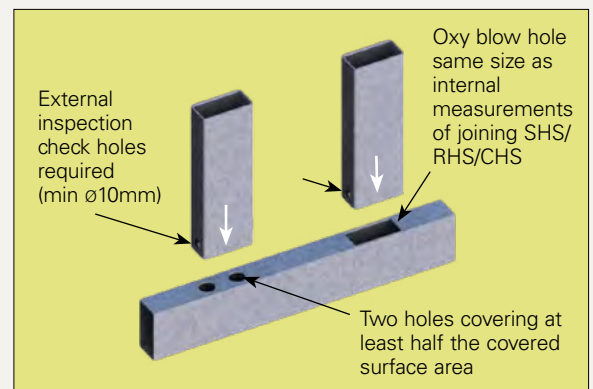
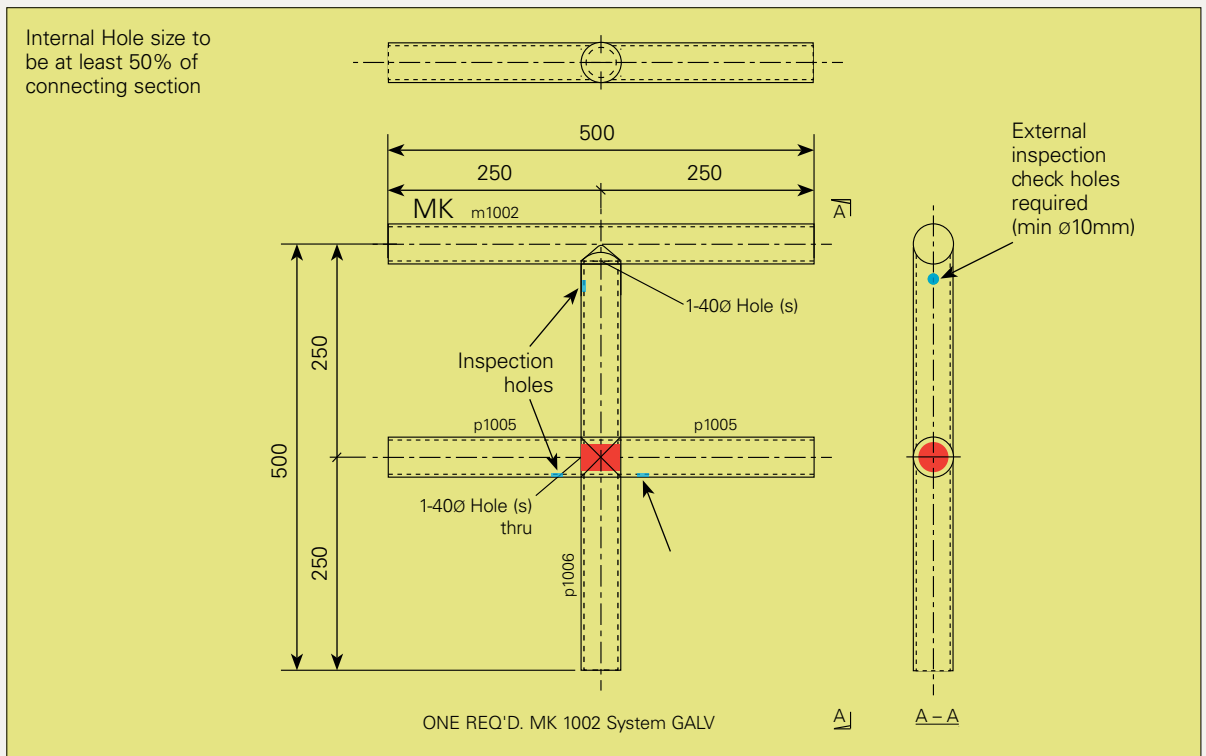


Figure 19: Internal Venting Shop Detail



Using Other Structural Sections

Basic guidance on design, venting and draining for fabricated frames or articles using structural sections are given in Figures 20 through 24.

The same design principles related to '*Hot Rolled Sections*' should also be applied to the use of these sections in frames and general fabrications.

Figure 20: Venting Hot Rolled Frames

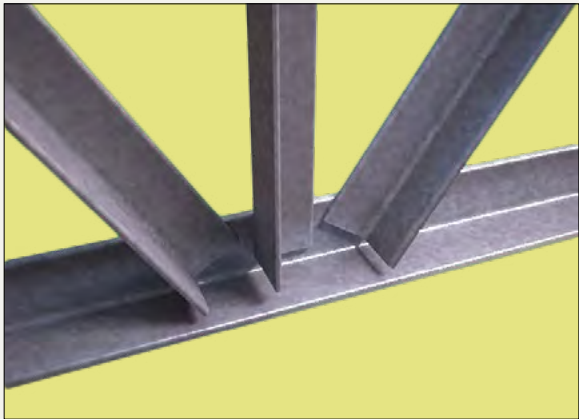
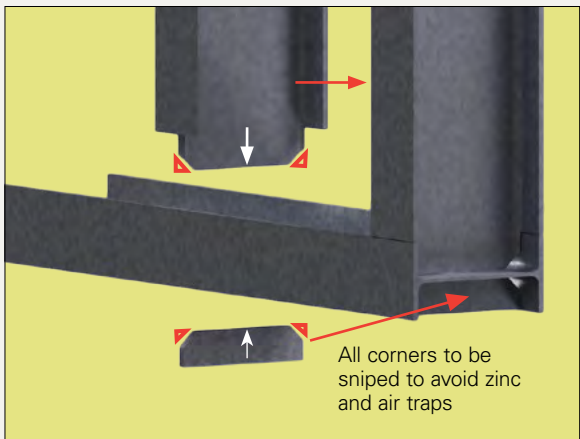


Figure 21: Angle Connections Options

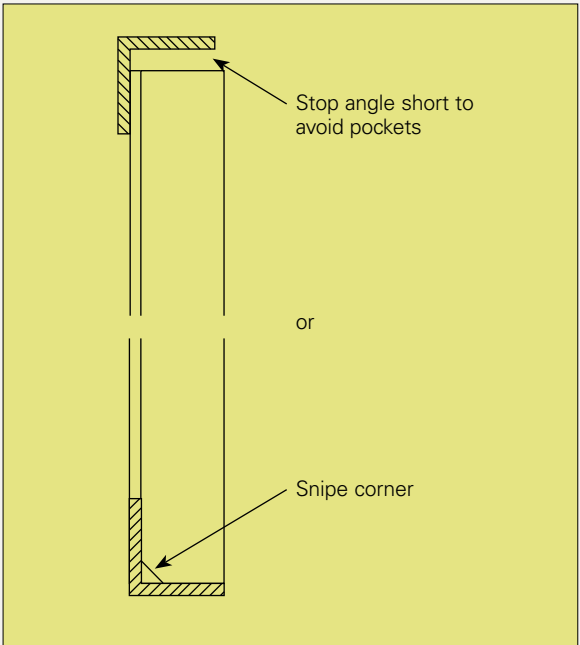


Figure 22: Vented Frame

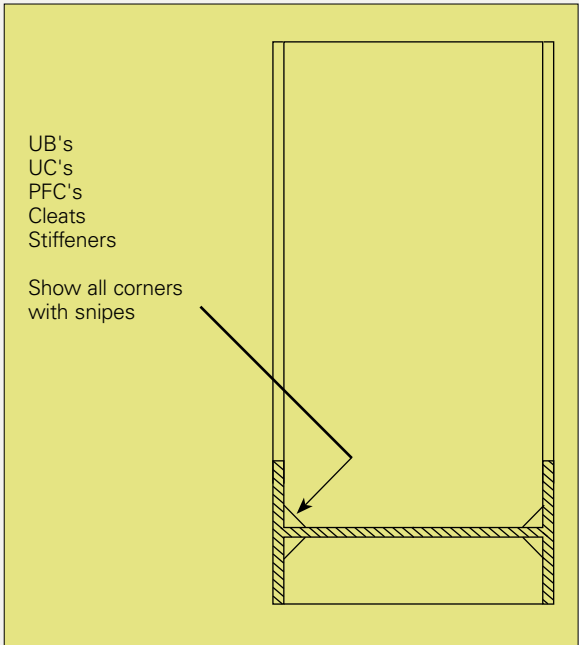


Figure 23: Inward Facing Angles – Venting Required

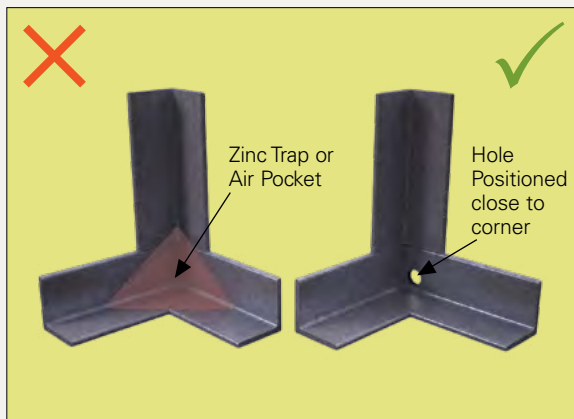
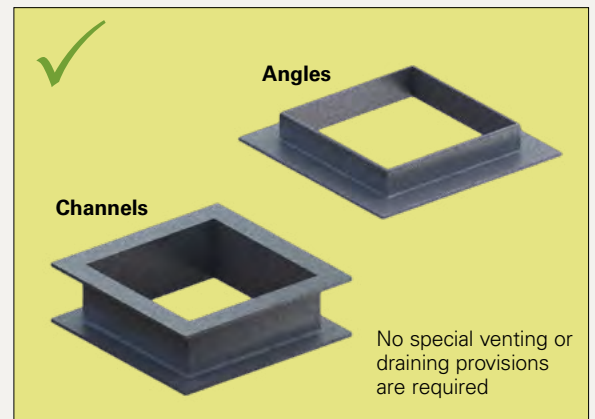
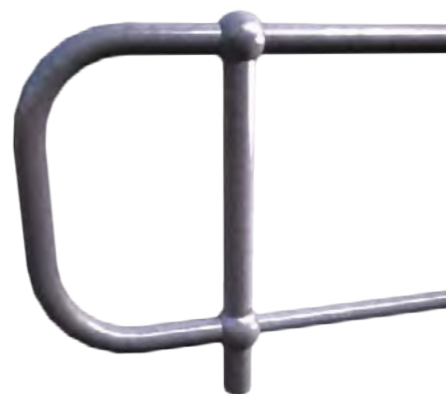


Figure 24: Outward Facing Sections – Preferred



Handrails/ Balustrades



There is a large variety of handrail and balustrade designs. Handrail may be galvanized in panels or individual parts prior to assembling.

Handrails constructed with hollow sections will require specific attention to detail for the highest quality galvanizing outcomes. Figures 26 show the typical detailing and hole positioning required for standard designs.

Designs which will provide the highest quality HDG finish are:

- Modules within a single plane (straight sections).
- Modular designs that can be bolted together on-site.
- Large vent and drain holes in the hollow sections which will allow the zinc to flow freely and air to escape from inside the article.
- Internal venting of the portion of the rail inside the ball of a stanchion is required if the tube runs through the ball.

Figures 25 and 26 offer best practice guidance on hole placement for modular straight sections of handrails, which will also provide the galvanizer with more options for hanging the article.

For designs where a higher quality finish of the handrail are essential, for example where touch marks and runs or spikes on visual surfaces are minimised, hanging, venting and draining requirements should be agreed with the galvanizer prior to fabrication.



Figure 25: Handrail Hole Positions

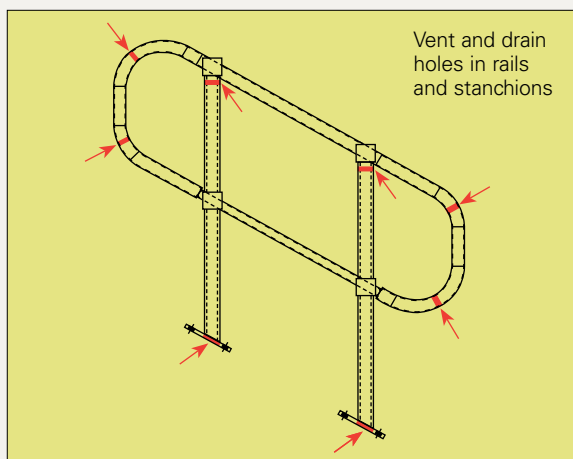
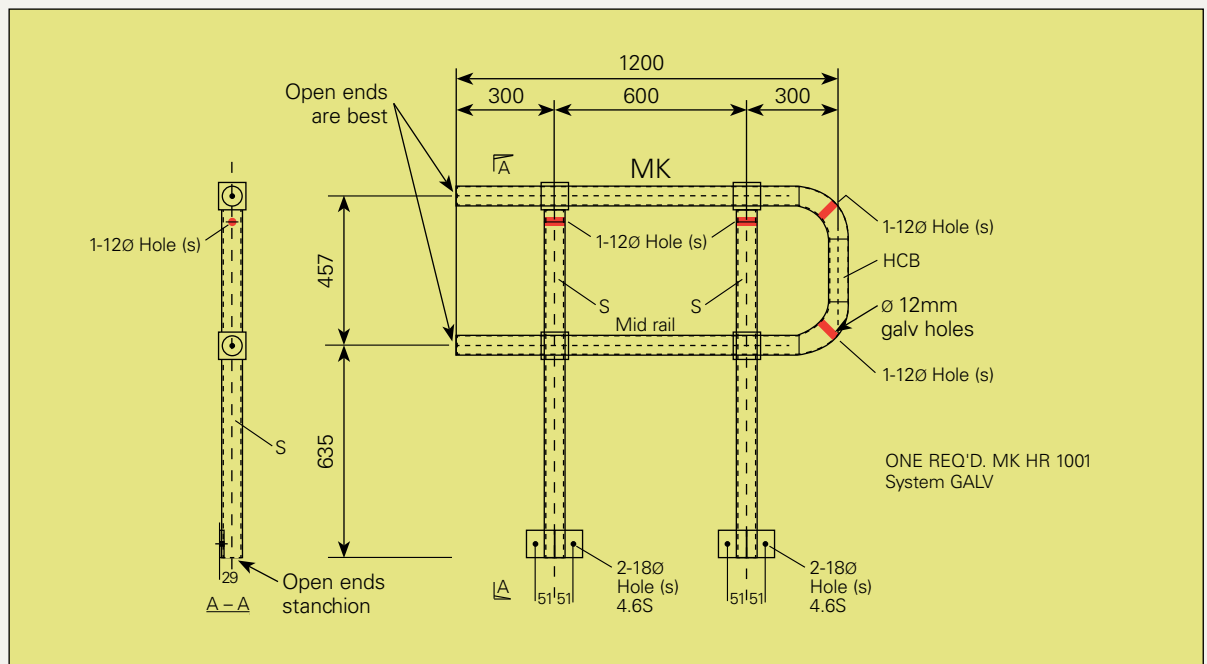


Figure 26: Handrail Detail

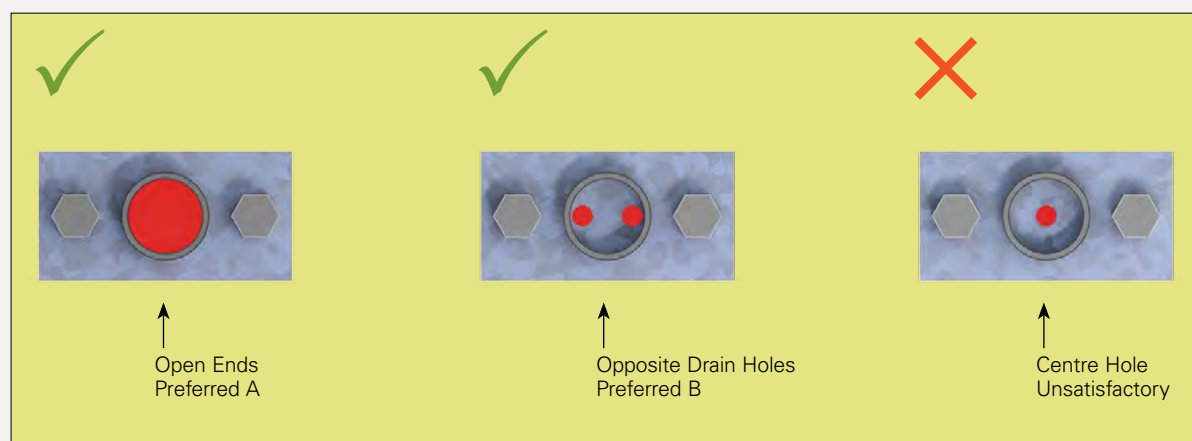


Designs which will need special consideration to provide the highest quality HDG finish are:

- Handrails with multiple planes (corner or bent sections) so that some parts of the handrail vent and drain slower than others parts within the same handrail. This can affect available hanging angles due to both vent and drain designs and bath size restrictions which could reduce coating quality.
- Vent and drain holes that are internal so the existence of the holes can be verified.



Figure 27: Stanchion Base Plates



Hollow Vessels



- Hollow vessels may require temporary stays during the galvanizing process to prevent distortion
- Hollow vessels should have at least 1 vent hole and 1 drain hole
- Standard minimum venting and draining for an enclosed volume is a 50mm diameter hole for each 0.5m³ (see Table 4)
- Openings should finish flush inside the vessel
- Baffles inside vessels should have openings to allow free flow of liquid throughout. A minimum of 75mm snipes is required. See Figures 8 to 11 for more information on snipes.

Table 4: Minimum hole sizes for hollow vessels

Section Volume (litres)	1 Hole ø (mm)	2 Holes ø (mm)	4 Holes ø (mm)
500	50	35	25
1000	70	50	35
1500	90	65	45
2000	100	70	50
2500	115	80	55
3000	125	90	65
3500	135	95	70
4000	145	100	70
4500	150	110	75
5000	160	115	80
5500	165	120	85
6000	175	125	90
6500	180	130	90
7000	190	135	95
7500	195	140	100
8000	200	145	100
8500	210	145	105
9000	215	150	110
9500	220	155	110
10000	225	160	115

Figure 28: Hollow Vessels - Good Design

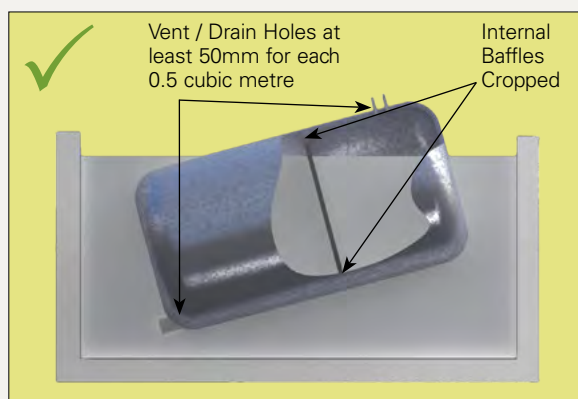
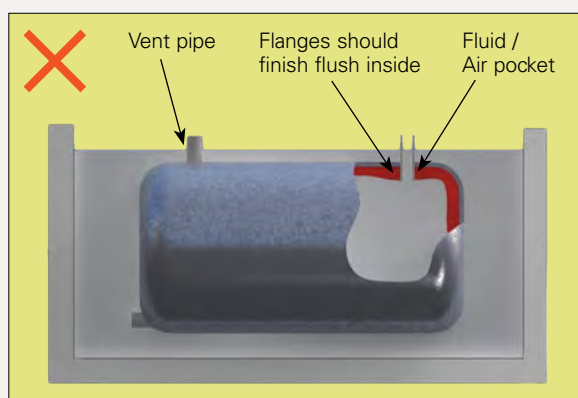
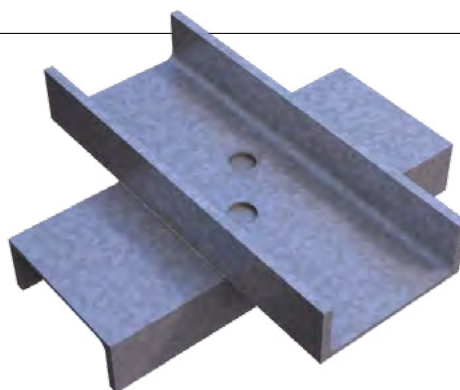


Figure 29: Hollow Vessels - Bad Design



Overlapping Surfaces



Large, seal welded overlapping surfaces require venting in the form of a hole(s) drilled in one of the overlapping surfaces. An enclosed area between overlapping surfaces may contain condensation or the welds may contain pin holes that will allow pre-treatment solutions to enter the enclosed area during the galvanizing process. This is unsafe when the articles are heated to 450°C in the molten zinc.

- Overlapping surfaces can be particularly dangerous if not designed correctly for galvanizing, so communication with the galvanizer is essential to ensure the correct venting is provided.
- Avoid narrow gaps between plates, overlapping surfaces, and back to back angles and channels, as fluid may get trapped leading to the possibility of an explosion or later corrosion of uncoated overlapped surfaces. See '*For intermittent weld design*' for more information.

The **general rules** are:

- a. Overlapping surface areas under 10,000mm² generally do not require venting.
- b. Overlapping surface areas between 10,000mm² and 40,000mm² shall be vented with a minimum Ø10mm vent hole.
- c. Above 40,000mm² in overlapping surface area, the vent holes shall be minimum Ø12mm.
- d. When the overlapped surface area reaches 250,000mm², vent holes shall be minimum Ø20mm and progressively placed every 250,000 mm².

Alternatively, the use of intermittent welding can be considered, but is not preferred.

Figure 30: Overlapping Surfaces

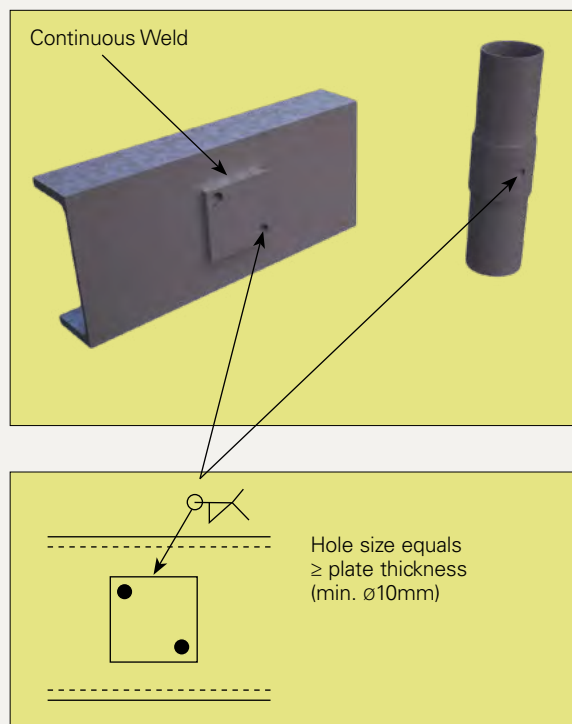


Figure 31: Overlapping Sections

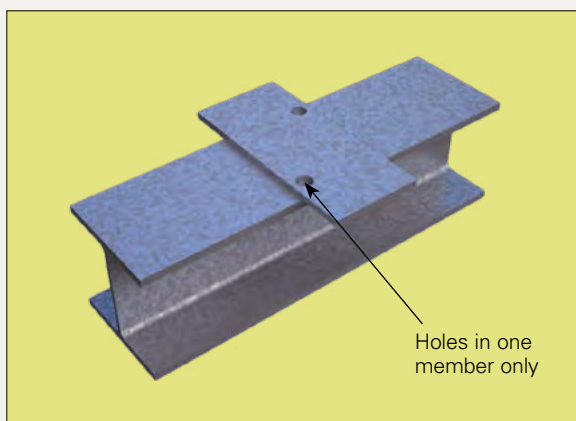
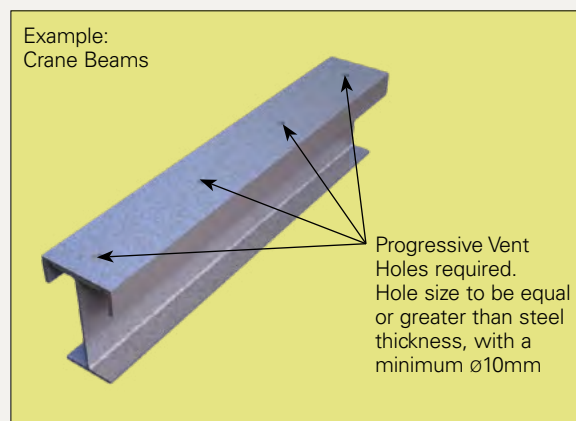


Figure 32: Large Overlapping Areas



When overlaps are unavoidable:

- Seal edges using pinhole-free continuous welding and provide 2 vent holes for best outcomes.
- Pinholes from welding are very dangerous in articles to be galvanized and must be avoided.
- Size of the hole(s) should be equal to or greater than the steel thickness, with the minimum being 10mm.
- Avoid gaps between members or have at least a **2.5mm** gap and stitch weld so all the surfaces can be galvanized. In this case, additional vent holes would not be required (see '*For intermittent weld design*').
- Intermediate sized overlaps should be judged on the basis of weld integrity and residual welding heat in the joint to ensure total dryness at time of sealing.
- Longer or larger overlapping areas require spaced holes for progressive venting. Very large overlapping areas should be avoided as they are an undesirable design for galvanizing and are areas of high risk for crevice corrosion.
- The same principles used for general venting and draining should be used for location of vent holes in overlapping areas, i.e. in corners and diagonally opposite.
- There should be a flush fit-up of the items.
- Putting the hole through both sections can also be helpful.

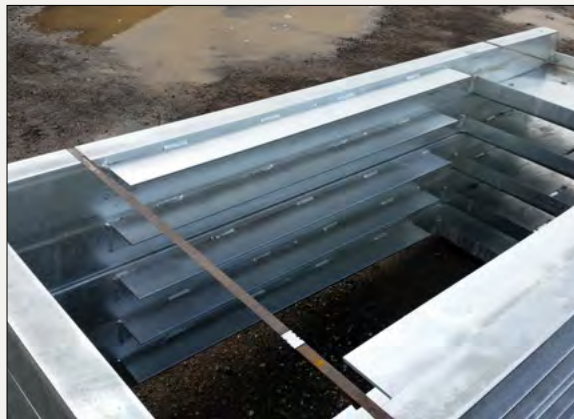
For intermittent weld designs

The minimum space between the surfaces of the two components shall be at least **2.5mm**.

This ensures:

- a. The overlapped area is self-venting.
- b. Avoids pre-treatment solutions being trapped in the gaps during the galvanizing process and seeping out over time.
- c. Allows all surfaces to be galvanized.

Figure 33: Overlapping Areas - Venting Unsatisfactory



Moving Parts



Where articles require free movement of parts, e.g. drop handles, hinges, shackles, shafts or spindles:

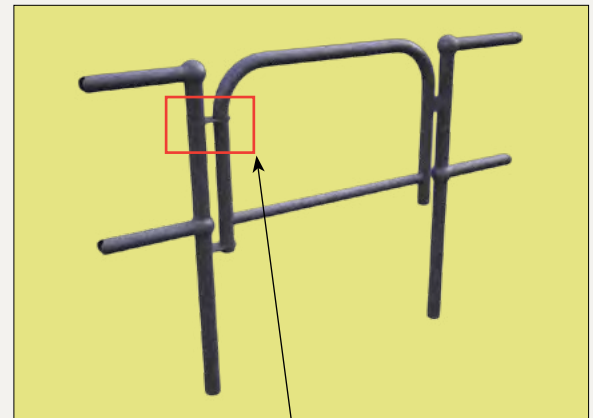
- A radial clearance should be applied to the part to allow for the galvanized coating thickness. Recommended minimum radial clearances are shown in Table 5.
- Parts need to be disassembled and galvanized separately.

Table 5: Recommended minimum radial clearance before galvanizing

Shaft or spindle size (mm)	Minimum radial clearance (mm)
< Ø10	1.0
≥ Ø10 to ≤ Ø30	2.0
> Ø30	2.5

Note: Some fettling may be required after galvanizing to enable parts to be free moving.

Figure 34: Moving Parts – Swinging Gate



Threaded Items

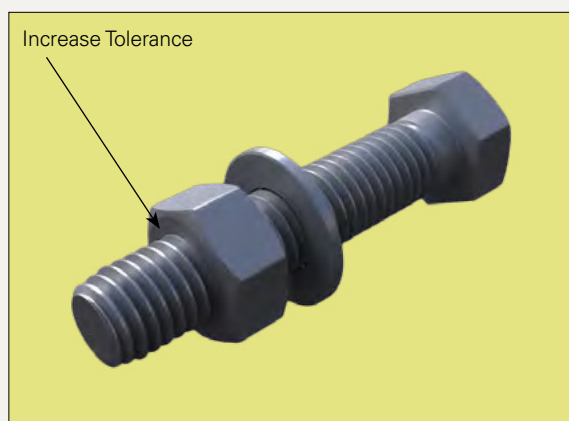


Due to their small relative size, threaded fasteners, nuts and washers are usually hot dip galvanized via the centrifuge process. Like other moving parts, each part needs to be galvanized separately.

- The HDG process develops a coating of a minimum average thickness of 50µm on threads, as defined in AS/NZS 1214. Hence, it is necessary to form bolt threads to special limits to accommodate the coating.
- There are two different methods of manufacture which take into account the necessary clearances for the HDG coating applied to fasteners.
- The usual method consists of using nuts tapped oversize to tolerance class 6AZ or 6AX after coating, to mate with bolts manufactured with threads to tolerance position g or h before coating. AS/NZS 1214 provides detailed information on tolerances for bolt manufacturers and marking requirements.

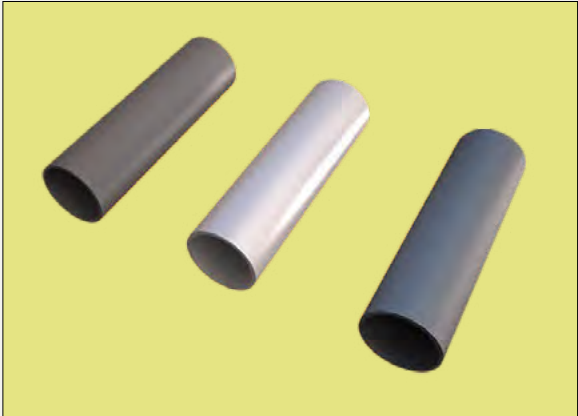
The galvanized coating on the thread of the stud or bolt will provide corrosion protection for the internal thread of the nut.

Figure 35: Internal Threads



Appendices

Appendix A – Suitable Materials

- Most ferrous materials are suitable to be hot dip galvanized, including sound stress-free castings.
 - Non-ferrous materials such as brass, aluminium and copper are not suited to the hot dip galvanizing process.
 - It is not recommended to galvanize stainless steels.
 - Most hot rolled or cold formed steels, including structural angles, UB's, UC's, welded beams, channels, welded CHS, RHS & SHS, reinforcement steels and fastener grade steels can be galvanized. In general, the mechanical properties of structural steels are not affected by the galvanizing process.
 - High strength steel up to 340HV are also able to be galvanized when acid pickling is not used in the pre-treatment of the steel.
 - Steel composition (particularly silicon and phosphorus content) can affect the characteristics of the hot dip galvanized coating.
 - Sulphur-containing free-cutting steels (for example S1214) are normally unsuitable for hot dip galvanizing.
 - Grey cast iron and malleable cast iron can be galvanized, but special considerations need to be met. For more information, refer to Clauses 2 and 9 of AS/NZS 2312.2.
- 
- Combinations of ferrous materials or surface conditions
 - Fabrications containing a combination of castings and steels, or rusted and mill scaled surfaces may be abrasive blast cleaned before galvanizing to provide a more consistent initial surface finish.
 - Weld slags must be removed, which can be done via chipping, grinding, or using a pneumatic needle gun.
 - Brazed assemblies may be galvanized, but check first with your galvanizer.
 - Soft soldered assemblies cannot be galvanized.

Appendix B – Identification & Marking

The type of identification needed for steel articles influences the recommended method of identification.

Permanent identification

For permanent identification, recommended methods are:

- Heavily embossed markings
- Punched markings
- Welded markings

Temporary identification

Before and after galvanizing: the recommended method is the use of heavily embossed metal tags, generally attached to the article via wire.

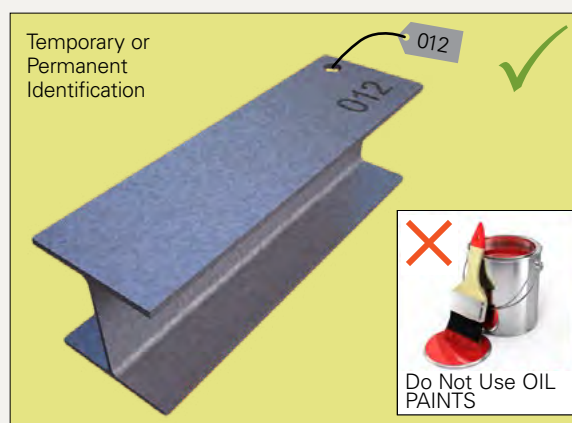
Prior to galvanizing: recommended methods are water-based paints or marking pens.

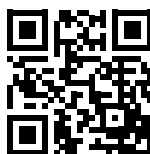
Identification methods not acceptable:

- Oil-based paints or marking pens
- Stickers

Oil-based paints or marking pens and adhesive residue from stickers cannot be fully or effectively removed by the normal pre-treatment performed during the galvanizing process and will generally result in ungalvanized areas on the article where the identification was located.

Figure 36: Identification Markings





GAA website

We provide information, publications and assistance on all aspects of design, performance and applications of hot dip galvanizing.

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