DESIGN FOR GALVANIZING

Guidelines emphasising the need for access and drainage of molten zinc

Birtley galvanizing
SHOT BLASTING & POWDER COATING

When designing a structure which is to be hot dip galvanized, it must be borne in mind that articles are immersed into and withdrawn from a bath containing molten zinc heated to a temperature of 450ºC. Design and fabrication is required to conform to acceptable standards which apply, regardless of whether a galvanized or a painted coating is to be applied. In the case of galvanizing, some additional requirements which aid access and drainage of molten zinc, will improve the quality of the coating and also reduce costs.

With certain fabrications, holes which are present for other purposes may fulfil the requirements of venting of air and draining of zinc; in other cases it may be necessary to provide extra holes for this purpose.

For complete protection, molten zinc must be able to flow freely over all surfaces of a fabrication. With hollow sections or where there are internal compartments, the galvanizing of the internal surfaces eliminates any danger of hidden corrosion occurring in service.

It is essential that work is sent to the galvanizer in a suitable condition for galvanizing.

Failure to do so may affect the quality of the galvanized coating produced.

✓ ACCEPTABLE

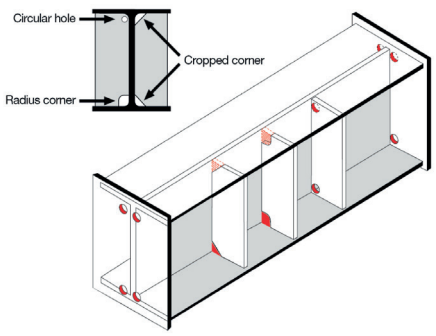
Embossed marking
Welding id
Light rust or
Millscale

✗ UNACCEPTABLE

Welding slag Anti-spatter paint
Grease or oil
Silicone/oil based anti-spatter weld sprays

Unvented sealed hollow sections
Light rust or millscale grease or oil mould sand on castings

Fig 1.



External stiffeners, welded gussets and webs on columns and beams and gussets in channel sections should have their corners cropped. The gaps created should be as large as possible without compromising structural strength. If welding is required around the edge created, a radiused corner is desirable, to facilitate continuity of the weld around the cut end to the other side. Circular holes are less effective; if used, they should be as close to corners and edges as practicable.

Consultation with the galvanizer, regarding the appropriate vent and drainage hole sizes is recommended.

Fig 2.

Angle bracings should, if possible, be stopped short of the main boom flange.

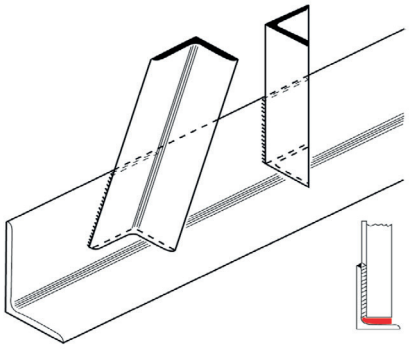


Fig 3.

Internal diaphragms in large box sections should have cropped corners and a "manhole". Internal diaphragms on small box sections should have cropped corners.

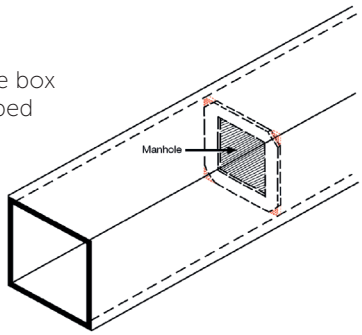
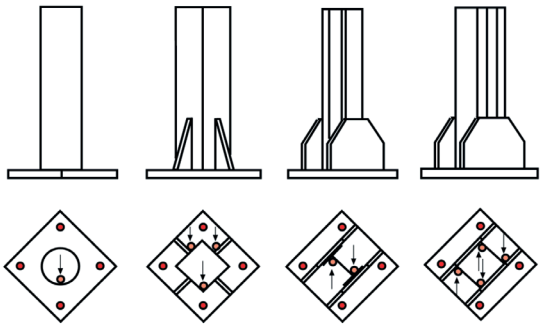
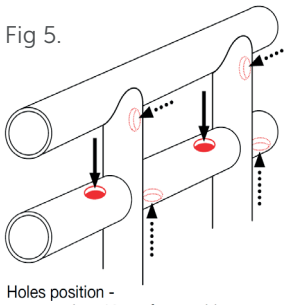


Fig 4



Alternative designs for venting sections fixed to base plates.

Fig 5.



Holes position -
no more than 10mm from weld

WELDED PIPE SECTIONS

Closed sections must never be incorporated in a fabrication. External holes may be positioned as in figure 5, a method which is often preferred by the galvanizer, since quick visual inspection shows that the work is safe to galvanize. Sections could be interconnected using open mitred joints as illustrated in figure 6, or interconnecting holes could be drilled before fabrication as in figure 7. Pipe ends can be left open, or be plugged after galvanizing (see unwanted vent holes).

SMALL TUBULAR FABRICATIONS

Small tubular fabrications must be vented, preferably with holes not less than 10mm diameter.

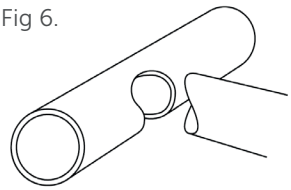
UNWANTED VENT HOLES

These may be closed by hammering in lead or plastic plugs after galvanizing and filing off flush with surrounding surfaces.

TUBULAR FABRICATIONS/HOLLOW STRUCTURALS

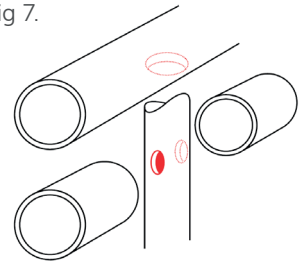
Drain/vent hole sizes should be preferably 25% of internal diameter or diagonal dimension for sections yielding a maximum cross section area of 180cm^2. This percentage can be dependent on the shape of the fabrication, therefore consultation with the galvanizer at the design stage is recommended.

Fig 6.



Open mitred joints

Fig 7.



Holes 20mm diameter or larger

Fig 8.

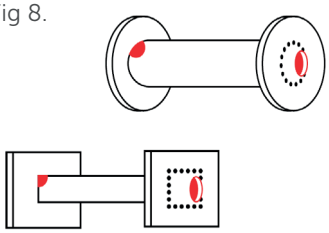


Fig 9.

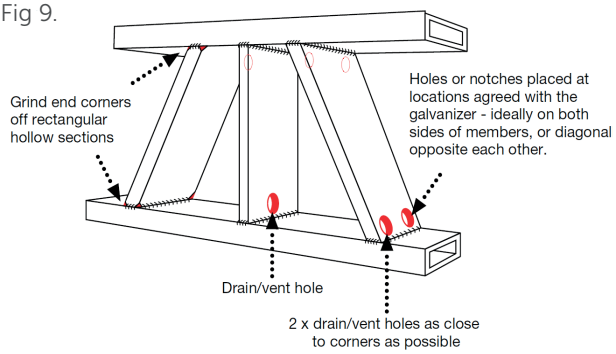
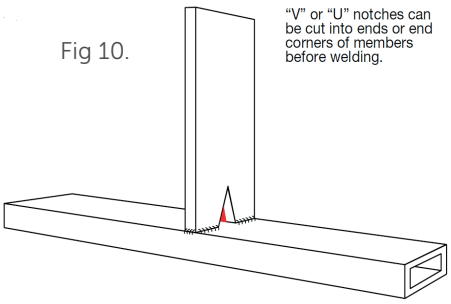


Fig 10.



LOCATION OF VENTING AND DRAINAGE HOLES

Fig 11. **CORRECT**

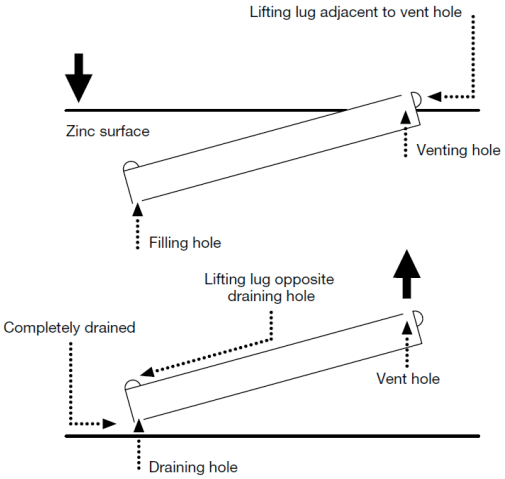
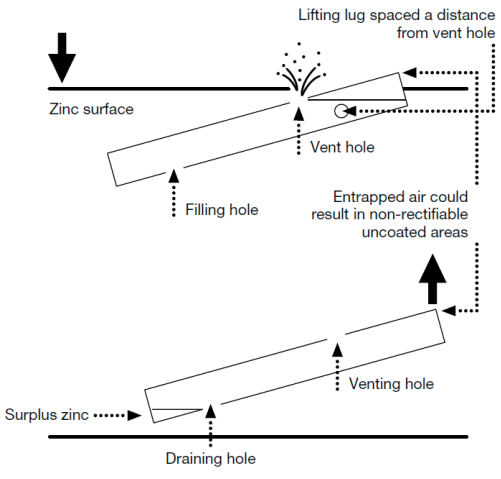


Fig 12. **INCORRECT**



OVERLAPPING SURFACES

A minimum gap of at least 2mm between plates, overlapping surfaces and back-to-back angles and channels, must be provided (figure 14).
When small overlaps are unavoidable, seal edges by welding.
In circumstances where seal welding is not practical, a degree of temporary surface staining at crevices may be apparent after hot dip galvanizing and quenching.
Clean with a bristle brush and mild detergent if necessary.
Crevices of this nature can be sealed after hot dip galvanizing with an appropriate sealant.

LARGER OVERLAPPING SURFACES

If contacting surfaces cannot be avoided, a single hole of 10mm diameter or the thickness of the section, whichever is greater, should be provided in both of the members for every 100cm^2 of overlap area and the perimeter of the contacting area should be continuously welded (figure 16). This requirement is of particular importance when using thin steels. Vent hole sizes for thicker steel >10mm thick and overlap areas >300cm^2 should be agreed upon with the galvanizer prior to fabrication. A vent hole in both members will ensure the safety of galvanizing personnel and prevent damage to the article.

Fig 13.

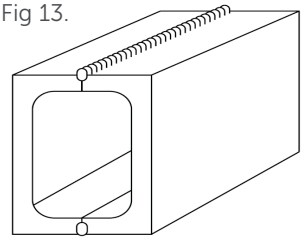


Fig 14.

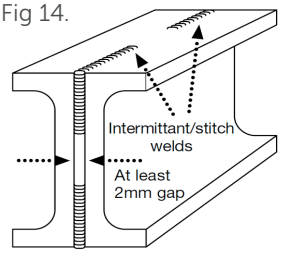


Fig 15.

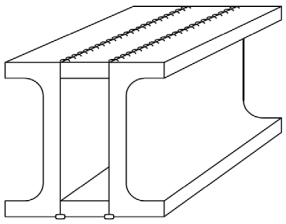
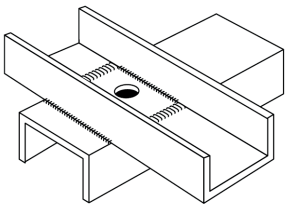


Fig 16.



STRENGTHENING GUSSETS AND WEBS

Welded strengthening gussets and webs on columns and beams, and strengthening gussets in members fabricated from channel or I-beam sections should have corners cropped or holed (figures 1 & 17).
• to prevent the entrapment of air in pockets and corners allowing complete access of cleaning solutions and molten zinc to the entire surface of the work.
• to facilitate drainage during withdrawal from degreaser, cleaning solutions, rinse water, flux and molten zinc.

CLEARANCE FOR MOVING PARTS

Drop handles, hinges, shackles, shafts and spindles require a minimum radial clearance, to allow for the thickness of the hot dip galvanized coating.
(see figure 18) and Table 1.

Fig 17.

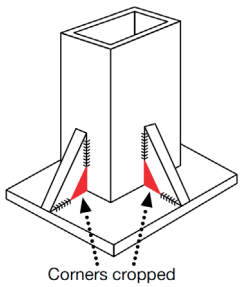


Fig 18.

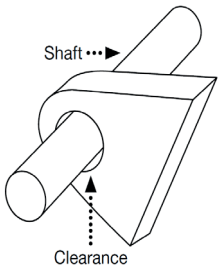


Table 1.

Shaft or spindle size	Minimum radial clearance
Up to 30mm diameter Over 30mm diameter	2.0mm 2.0 - 2.5mm

For tanks, vents should be diametrically opposite and at least 50mm in diameter.

Internal baffles should be cropped top and bottom. Lifting lugs are required as indicated. It should be possible to view the baffles through either the vent holes or an inspection hole – the placement of the inspection hole should be discussed with the galvanizer.

Fig 19.

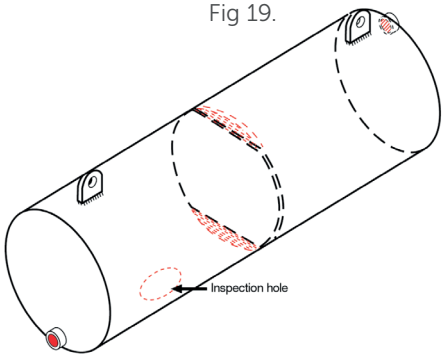
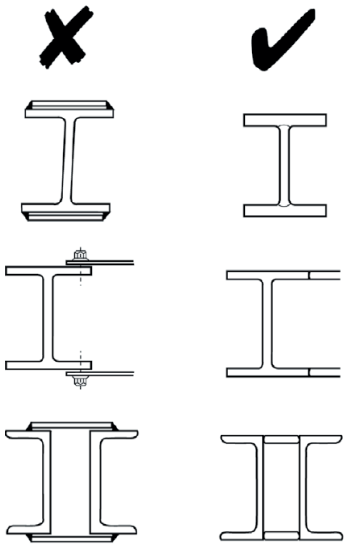


Fig 20.



Welded joints should be continuous if they are not enclosing an otherwise unvented surface.

Bolted joints are best made after galvanizing.

GUIDANCE ON LOCATION AND SIZES OF VENT HOLES

Some general principles for guidance are:

- Holes both for venting and draining should be as large as possible. The absolute minimum hole sizes are given in Table 2.
- Holes for venting and draining should be diagonally opposite one another at the high point and low point of the fabrication as it is suspended forgalvanizing (figure 9 & 11).
- With hollow sections sealed at the ends, holes should be provided,again diagonally opposite one another, as near as possible to the ends of the hollow member (figure 5). In some cases it may be more economical to provide "V" or "U" shaped notches (figure 10) in the ends of the tubes, or to grind corners off rectangular hollow sections. These procedures will provide ideal means for venting and draining.
- Where holes are provided in end plates or capping pieces, they should be placed diagonally opposite to one another, off centre and as near as possible to the wall of the member to which the end plate is connected (figure 8).

Diameter or width of hollow	Minimum diameter of hole (mm)
<25	10
≥25 to 50	12
>50 to 100	16
>100 to 150	20
>150	Consult galvanizer

DISTORTION

Distortion can be minimised by:

- Use of symmetrical designs.
- Use of sections of a similar thickness.
- Use of preformed members with the correct minimum bend radius to minimise stress.
- Use of balanced or staggered welding techniques to minimise stresses.
- Large open fabrications, thin-walled trough sections and tanks may require temporary cross-stays to prevent distortion during hot dip galvanizing (figure 23).
- Air cooling after hot dip galvanizing in preference to water quenching.

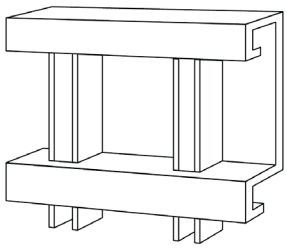
IDENTIFICATION MARKINGS

For permanent identification use heavily embossed, punched or welded lettering.

For temporary identification use heavily embossed metal tags wired to the work, water soluble paint or the correct marking pen.

Do not use enamel/oil paints, adhesive labels or any other coating that cannot be readily removed by degreasing or pickling. Large open top tanks should be stayed to minimise distortion. Where angles are used to rim the tanks, apertures must be provided in the corners. Angles or flats used as stays should be as close as possible to the tank wall thickness.water quenching.

Fig 21.



Use of symmetrical sections minimises distortion during hot dip galvanizing. Avoid combinations of thick and thin materials or where this cannot be avoided, bolt together after individually hot dip galvanizing.

Fig 22.

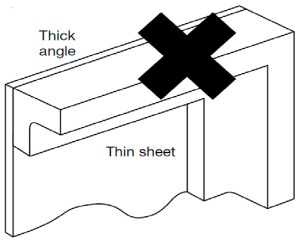
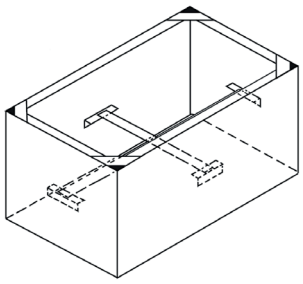
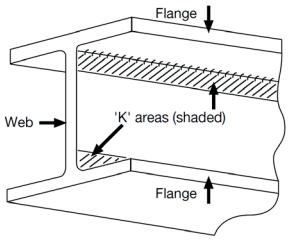
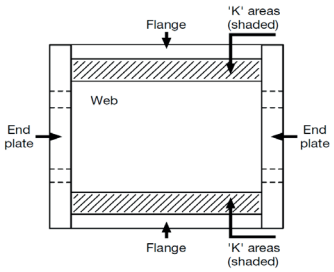


Fig 23.

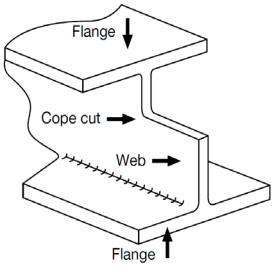


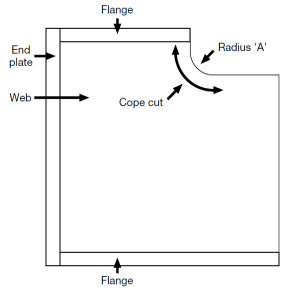
ADDITIONAL GUIDANCE FOR DESIGN OF STRUCTURAL STEELWORK FOR HOT DIP GALVANIZING





In circumstances where, due to design restrictions, general design guidance (as set out above) cannot be followed and the introduction of holes or other fabrication features into the 'K' areas of a section (where the web and flange meet) is unavoidable, please consult GA to discuss how best to finalise the design of the fabrication.





Cope cutting of beams is a common feature in modern steel construction. For optimum results during galvanizing, where flame-cut copes have been introduced into a fabrication, the following steps are recommended;

- use a large radius for the cope - 20mm minimum if possible.
- after cope cutting, grind off any hardened steel surface layer.
- provide a smoothly ground cope cut surface avoiding notches, grooves and other surface irregularities.
- chamfer the edges to the cope cut.