

# Hot Dip Galvanizing

## A guide to the benefits

### Why specify galvanizing?

Every part of a galvanized article is protected, both inside and out. No other coating provides the same protection.

Steel does conjure up notions of strength, resilience and durability – but even steel can need the kind of protection that only hot dip galvanizing can provide.

To eliminate long-term costs caused by the need for continuous maintenance, the right metal protection is needed at the very outset. Hot dip galvanizing provides total lifelong corrosion protection for steel. *Do it once. Do it right.*

No other type of metal protection coating matches galvanizing's unique combination of benefits:

### The low cost alternative

The long-term investment in hot dip galvanizing is low compared to many other commonly specified protective coatings for steel. Even where initial cost is higher than alternative coatings, hot dip galvanizing is invariably cheaper in the long-term because of its high life expectancy and low maintenance requirements.

### Speed of application

A full protective galvanized coating can be applied in minutes to even the most complex of structures and application is not dependent on favourable weather conditions or the constraints of a multi-coat application. The simplicity of the process is of real benefit when having to meet an ever-decreasing construction timeline.

### Ease of inspection

Coating quality can be assessed readily by eye. The galvanizing process is such that if the coating appears sound and continuous, it is sound and continuous.

### Total protection

No other coating applied to a structure or fabrication after completion can provide the level of protection achieved by hot dip galvanizing. Appropriate metal protection at the start can bring worthwhile economic benefits by reducing or eliminating the need for maintenance and by extending the physical life of structures and equipment.

### Harder than steel

The reaction of molten zinc with the steel during the hot dip galvanizing process results in a coating that is metallurgically bonded to the steel. Zinc grows onto the steel surface to create zinc-iron alloy layers that are harder than the underlying steel. This super-hard coating can help reduce potential cost overruns caused due to damage during transit or erection.

### Cathodic protection

Zinc galvanized coatings corrode preferentially to steel, providing cathodic or sacrificial protection should any small areas of steel become exposed through damage in erection or transit.

### Experience and expertise

The team at Perry Metal Protection Limited are masters of hot dip galvanizing. They have been galvanizing steel since the early 1970s, with an impressive range of large-scale projects. They offer you industry-leading technical and project management knowledge at no extra cost to the specifier or engineer.

Perry Metal Protection Limited is the only galvanizing company equipped to offer you their unique system of service from design stage to delivery on site.

The following pages give an overview of how to specify for hot dip galvanizing. If you require any further details, please contact your local Perry Metal Protection site or visit our website at [www.perrymetalprotection.co.nz](http://www.perrymetalprotection.co.nz)

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# How to specify design for hot dip galvanizing

## Heavy duty after fabrication galvanizing

AS/NZS 4680 is the standard of galvanizing finish required when aesthetic appearance is needed for the purposes of structural and decorative use. Full details are available from a Perry Metal Protection representative.

## Self-finish coating

The specified finish of the galvanized coating should take account of the need for visual uniformity and be capable of handling physical contact in public areas. These aspects should be agreed with our representative prior to galvanizing.

Steel composition also plays a critical part as silicon and phosphorous levels can affect coating appearance and uniformity. Allow for slightly thicker and rougher coatings if steel containing excessive levels of silicon and phosphorous are used in fabrication. Perry Metal Protection can

help identify the appropriate specification to ensure the best possible finish.

## Design

Discuss your design with our representative during the detailing stage as specifications can have significant effect on the finish and possible cost savings.

Where practical, each structure should fit inside the galvanizing bath in a single dip. Alternatively, modular construction is the solution. The welding quality should be specified to be free from porosity and weld slag and grinding marks minimised as they may appear in the finished galvanized coating.

## Inspection

The finished galvanized work should be inspected prior to dispatch or a sample of the type of finish agreed before galvanizing.

## Drain and vent hole sizes (min) for various hollow sections

Ref. No.	Hollow Section Type and size				Minimum vent and drain hole size (dia)	
	Circular H.S.		Sq. H.S.	Rectangular H.S.	Vent (mm)	Drain (mm)
	Nominal Bore (mm)	Outside Diameter (mm)	Outside Dimn's (mm)	Outside Dimn's		
1	8	13.5	-	-	-	-
2	10	17.2	-	-	-	-
3	15	21.3	13 x 13	-	-	-
4	20	26.9	16 x 16	-	-	-
5	25	33.7	19 x 19	-	-	-
6	32	42.4	25 x 25	38 x 19	8	8
7	40	48.3	32 x 32	38 x 25	-	-
8	50	60.3	38 x 38	51 x 25	-	-
9	65	76.1	51 x 51	64 x 38, 76 x 38	-	-
10	80	88.9	64 x 64	76 x 51, 89 x 38	-	-
11	100	114.3	76 x 76	-	-	-
12	-	-	89 x 89	-	-	-
13	-	-	-	102 x 51, 102 x 76	12	12
14	-	-	-	127 x 51, 127 x 64	12	12
15	125	139.7	102 x 102	127 x 76, 152 x 76	16	16
16	150	165.1	127 x 127	152 x 102	25	25
17	200	219.1	152 x 152	203 x 102, 203 x 152	32	32
18	250	273.0	203 x 203	254 x 152	63	63
19	300	323.9	254 x 254	305 x 203	75	75
20	350	355.6	305 x 305	305 x 254	88	88
21	400	406.4	-	-	100	100

- The above drain and vent hole sizes represent the minimum acceptable and it is preferred that the full tube cross section be provided.
- The above table is also applicable to hollow sections fabricated from channels and angles etc. Use the table with the appropriate outside dimensions of the boxed section.
- For larger sections use the associated table for tanks, on page 8.
- Should the above hole size be unacceptable contact your local Perry Metal Protection representative for further advice.
- Lifting eyes need to be provided for the hanging of steel work, (adjacent same side as vent hole) or provide holes for lifting wires.

# Draining and venting

## Tubular fabrications and hollow sections

Tubular assemblies such as handrails, pipe columns, pipe girders, steel light poles, transmission poles, pipe trusses, and sign bridges are commonly galvanized.

### Cleaning

As with all steel to be galvanized, pipe, R.H.S. and other hollow materials must be thoroughly cleaned before the molten zinc will bond with the base steel to produce the galvanized coating inside and out.

R.H.S and pipe commonly presents two cleaning challenges:

1. The 'mill coating' (varnish, lacquer, 'Japan black' and similar materials) applied by the manufacturer cost extra to remove at the galvanizing plant. Some formulations, both foreign and domestic, are extremely difficult to remove with cleaning solutions and abrasive blasting is required.
2. Use only water-soluble cutting fluids when drilling to avoid steel contamination that may incur extra cleaning costs.

### Venting

It is mandatory that tubular fabrications and hollow sections be properly vented. (Refer Fig 2)

Any pickling acid or rinse waters that might be trapped in a blind or closed joint connection will be converted to super-heated steam and can develop a pressure of up to 26.2mpa (3800 psi) when immersed in molten zinc at 450°C. This is a serious potential hazard to galvanizing equipment and to personnel.

Since proper galvanizing demands that the inside, as well as the outside, be completely cleaned and coated with zinc, air and ash must be allowed to flow in and completely wet the surfaces.

In all tables of draining, venting and gusset bevel calculations, allowance has been made for the speedy and total expulsion of entrapped air and 'ash' produced during the galvanizing process.

Simply stated, the structure must be lowered into the solution without trapping any air. It must be raised from the solution without trapping any solution. Consequently, ample passageways which allow flow in and out must be designed into the assemblies.

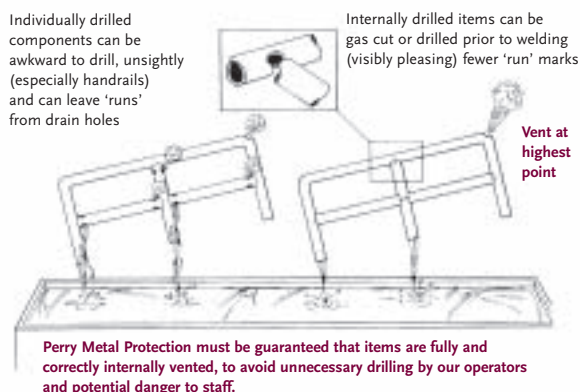
Since items to be galvanized are immersed and withdrawn at an angle, the vent holes should be located at the highest point and drainage holes at the lowest point in each hollow member. (Refer Fig 1)

All components of fabricated hollow sections can be inter-connected with full open tee or with mitred joints. Each closed section must be provided with a vent hole and drain hole.

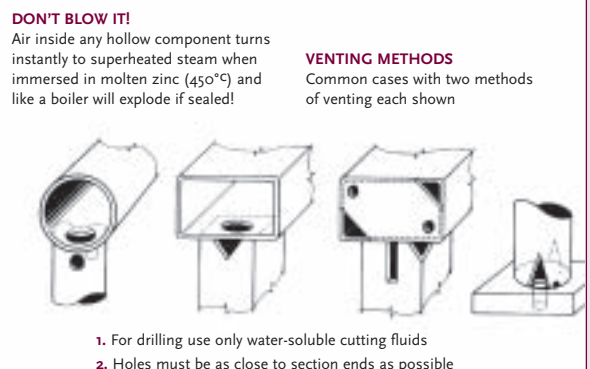
Most galvanizers prefer to visually identify the venting from the outside when the assembly is received. This is necessary to check the adequacy of the venting as well as to determine that it has not been omitted by mistake. Perry Metal Protection must be notified in writing if fabrications are internally vented.

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 hollow sections. Since this is not always possible, the use of vent holes in the plate often provides a solution.

**Fig 1. Aspects of Internal Drilling**



**Fig 2. Hollow Components**



# Design and fabrication

## Steel plate structures for hot dip galvanizing

1. One hole or lifting lug required in plates where detailed in **Fig 1, 2 and 3**.
2. Two holes or lifting lugs required in plates where detailed in **Fig 4** (two holes or lugs in total/see below).
3. **Hole sizes**
  - A. Plates up to and including 10mm thick require 10mm dia. hole(s).
  - B. Plates over 10mm thick and up to and including 16mm thick require 16mm dia. hole(s).
  - C. Plates over 16mm thick require larger dia. holes or lifting lugs (refer your local Perry Metal Protection representative).
4. Gauge or centres of holes/lifting lugs should be  $1\frac{1}{2}$  diameter of holes required for lifting from edge of plate (**Fig 5**).
5. **Lifting Lugs**
  - A. Lifting lugs should be welded into plates in positions detailed.
  - B. Lug thickness should equal thickness of plate being galvanized.
  - C. Lugs should have sufficient weld to support plate during the galvanizing process.

6. Stiffeners or attachments welded to plates at lifting points may be utilized as lifting lugs.
7. It is preferred that lugs be welded to the side of plates where their removal after galvanizing is NOT necessary. (e.g. Floor plates).

## 8. Cutting, shaping and welding of plates

If possible, plates should be cut from one sheet to eliminate or minimize butt welds and stresses.

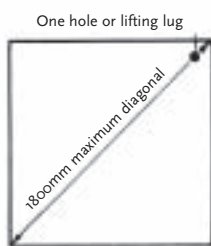
## 9. Platform plate

Welds should be kept to a minimum when welding plates to heavy sub-frames to minimize weld stresses that cause distortion during galvanizing.

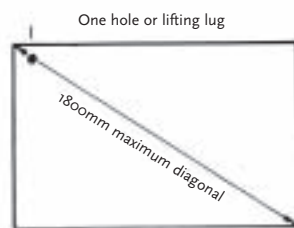
Bolting or set screwing of plates to sub-frames is preferable.

It is preferable that fittings or attachments on plates be designed for bolted connection to plates to minimize weld stresses. When cutting plates to shape, it is preferred that all operations be as uniform as possible. If plates exceed maximum sizes shown in **Fig 4**, refer to your local Perry Metal Protection representative for further guidance.

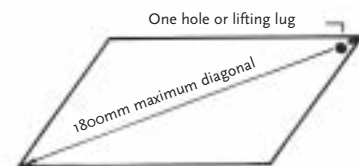
If large quantities of plates or flats of the same shape and size are to be galvanized, refer to your local Perry Metal Protection representative as holes can be eliminated through other jiggging techniques.



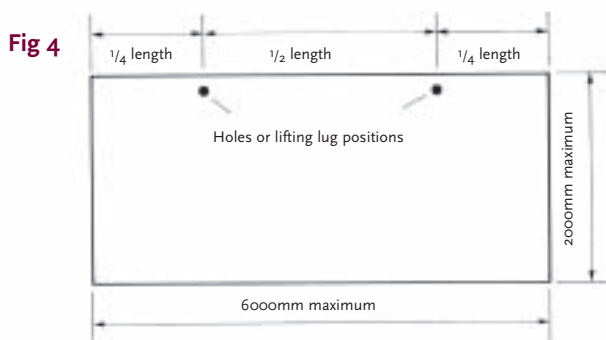
**Fig 1. Square Plate**



**Fig 2. Rectangular Plate**



**Fig 3. Shaped Plate**



**Fig 4**

**Fig 5**



# Positions of drain and vent holes (min)

## For hollow vessels

When both internal and external surfaces are to be galvanized at least one filling and draining hole must be provided, with a vent diagonally opposite to allow the exit of air during immersion. Check the drainage table for minimum drainage and vent hole sizes for various tank capacities.

Internal baffles should be cropped as illustrated. Manholes should finish flush inside to prevent trapping excess zinc.

1. Drain and vent holes are to be placed at diagonally opposite locations, typically as shown in **Fig 1, 2** and **3**.
2. Provide suitable lifting lugs. **Fig 3**
3. Drain and vent holes must be flush internally and be located as close to corner welds as possible.

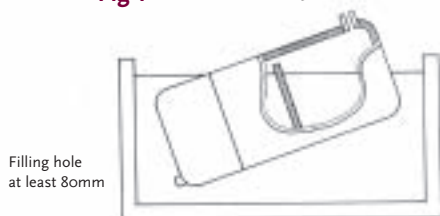
**Fig 4** (NB **Figs 5** and **6** unacceptable).

4. Should above drain and vent hole locations be difficult to include during fabrication, contact your local Perry Metal Protection representative for further advice.

When vessels and air receivers etc. are not to be galvanized inside, 'snorkel' tubes or extended vent pipes may be fitted only after discussion with your local Perry Metal Protection representative to allow air to exit above the level of molten zinc in the galvanizing bath.

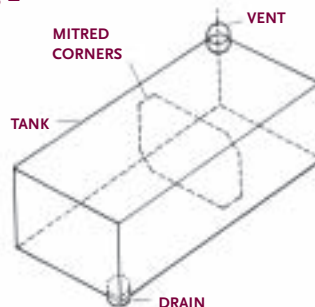
(Refer **Fig 7**)

**Fig 1** Vent hole at least 30mm

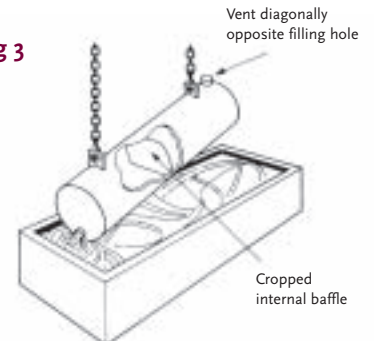


Internal baffles cropped top and bottom to allow free passage of zinc, and prevent trapping of air. Flanges should finish flush inside.

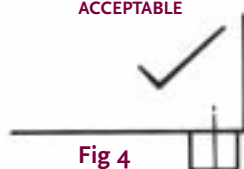
**Fig 2**



**Fig 3**

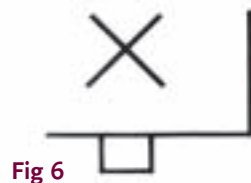
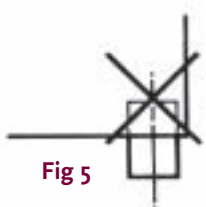


ACCEPTABLE

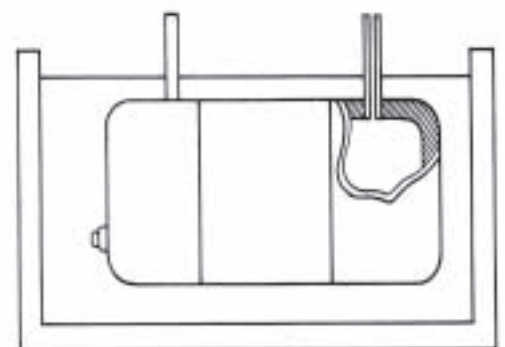


Nearest edge of drain and vent holes to be 10mm maximum from weld or corner (**Fig 4**).

NOT ACCEPTABLE



**Fig 7**



# Gussets and web

Welded gussets and webs on columns, beams and channel sections should have corners cropped or holed:

1. To prevent the entrapment of air pockets in corners.
2. To facilitate drainage during withdrawal from the galvanizing bath.

## Welding

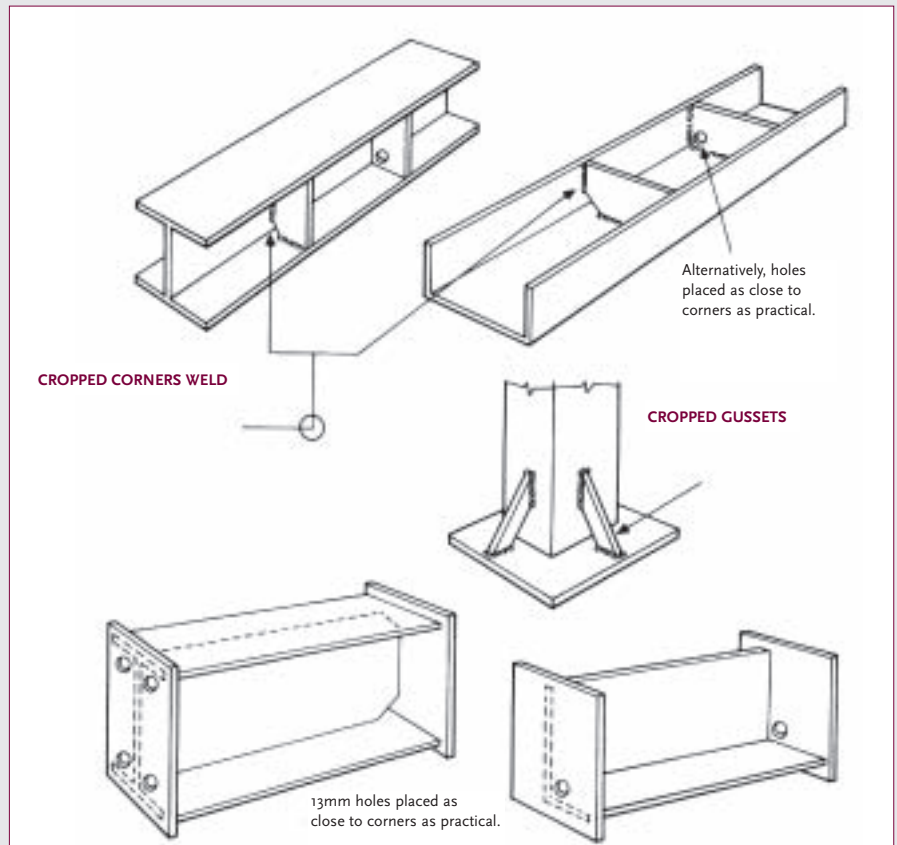
Use continuous welding to avoid moisture traps.

## Drilling

Use only water-soluble cutting fluids.

## End plates

Provide holes in end plates for venting and draining or crop section webs.



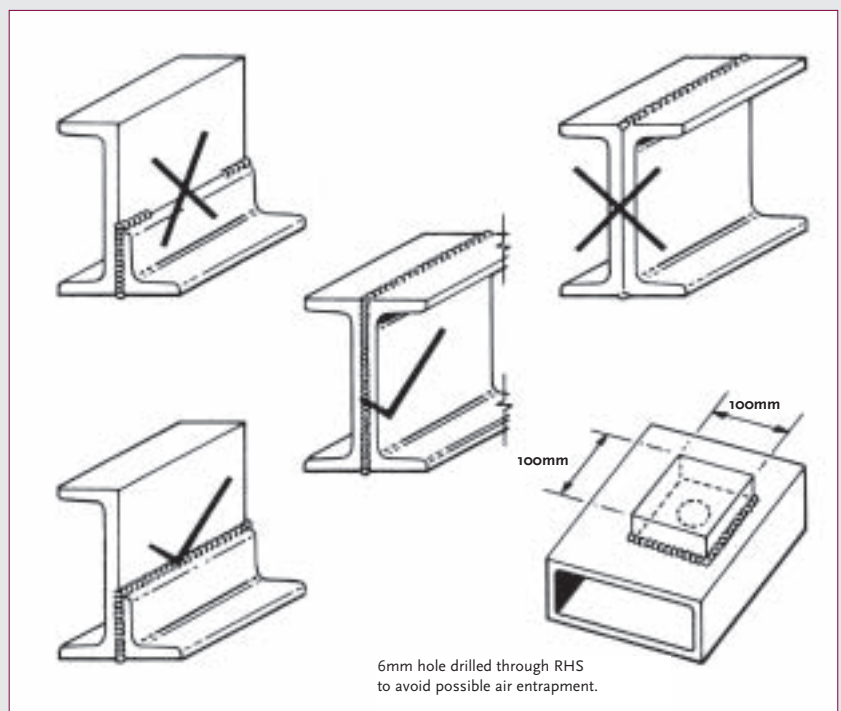
# Overlapping surfaces

Avoid narrow gaps between plates, overlapping surfaces and back-to-back angles and channels. When small overlaps are unavoidable, seal edges by welding.

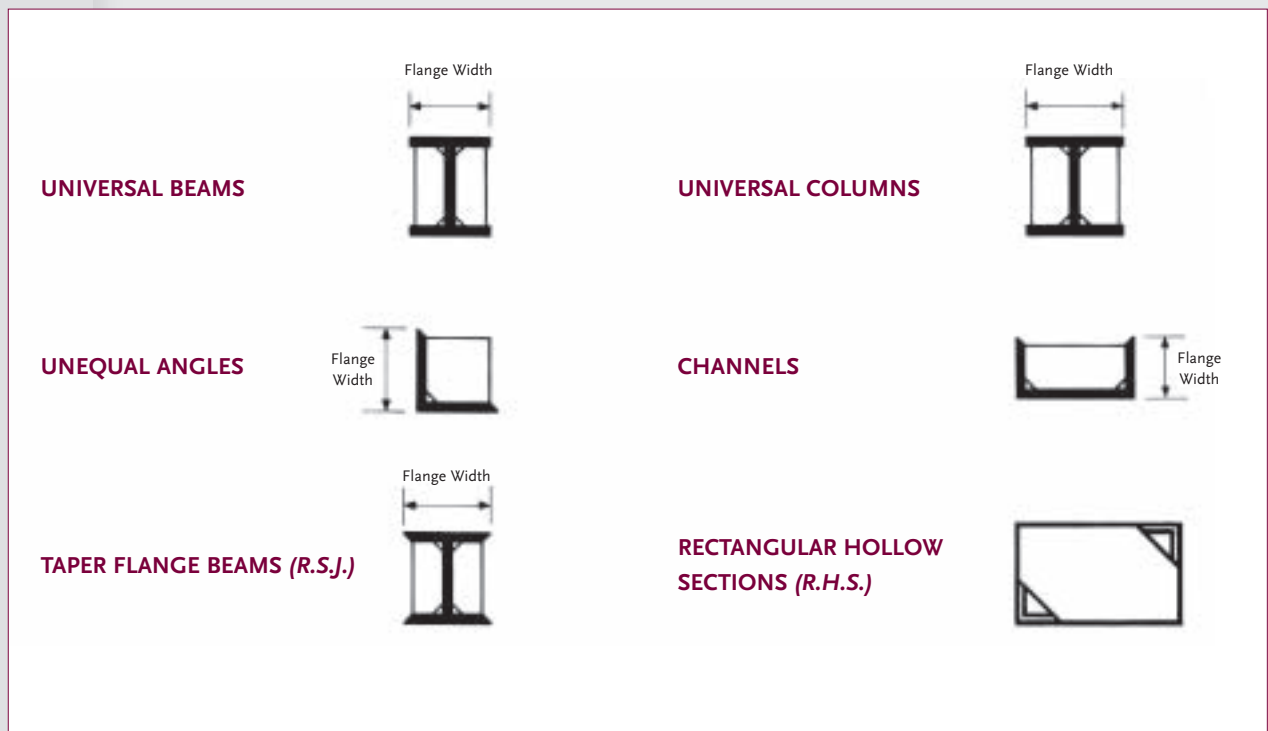
When left unsealed, small overlapping areas may trap pickle acid that can later escape to colour or damage the galvanized coating.

## Larger overlapping surfaces

If contacting surfaces cannot be avoided, a hole 6mm in diameter for every 0.01m<sup>2</sup> of overlap area should be placed in one of the members and the perimeter of the contacting area should be continuously welded. The vent hole in one member will ensure the safety of galvanizing personnel and prevent damage to the article. If in doubt, contact your local Perry Metal Protection representative.



# Gusset plate or abutment mitre sizes

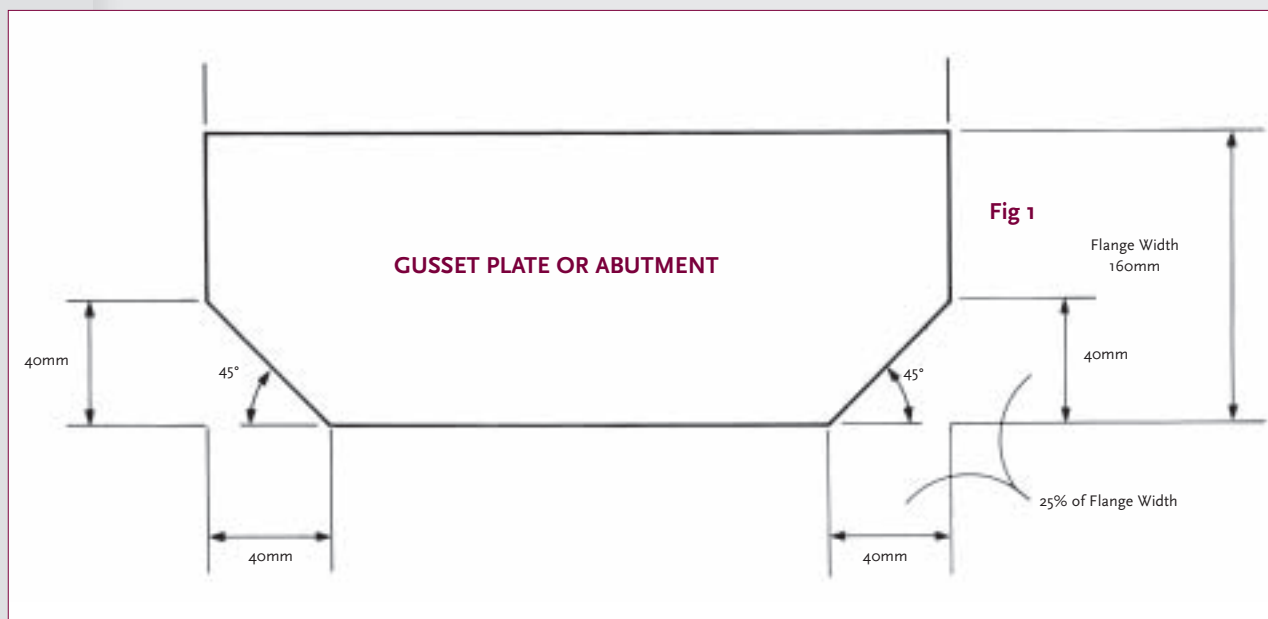


## Bevel sizes

Bevel cuts for angles and channels = 25% of flange width.

Bevel cuts for  $\downarrow$  Beams and columns = 25% of *half* the flange width.

Bevel cuts for RHS End plates = 25% of *half* the widest side.



## Example

1. All bevel sizes listed are 45° – e.g. 40mm bevel = 40 x 40 x 45 (see Fig 1).
2. Gusset plates or abutments in channels and beams have both ends bevelled.
3. If this is unacceptable contact should be made with your Perry Metal Protection representative.

# Drain and vent hole sizes <sub>(min)</sub> for various tank capacities

CAPACITY		DRAIN AND FILLING HOLE SIZES					
		SINGLE HOLE		DOUBLE HOLE		AIR VENT HOLE	
m <sup>3</sup>	Litre	Dia (mm)	Square (mm)	Dia (mm)	Square (mm)	Dia (mm)	Square (mm)
0.5	500	80	70	-	-	30	25
1.0	1,000	112	100	2 x 80	2 x 70	40	35
1.5	1,500	138	122	2 x 98	2 x 86	48	44
2.0	2,000	160	142	2 x 112	2 x 100	56	50
2.5	2,500	178	158	2 x 125	2 x 112	63	56
3.0	3,000	195	173	2 x 138	2 x 122	70	62
3.5	3,500	212	187	2 x 150	2 x 132	75	66
4.0	4,000	225	200	2 x 160	2 x 142	80	70
4.5	4,500	240	212	2 x 170	2 x 150	85	75
5.0	5,000	252	224	2 x 178	2 x 158	90	80
5.5	5,500	265	235	2 x 187	2 x 166	94	83
6.0	6,000	276	245	2 x 195	2 x 173	98	86
6.5	6,500	288	255	2 x 203	2 x 180	102	90
7.0	7,000	300	265	2 x 212	2 x 187	106	94
7.5	7,500	310	274	2 x 218	2 x 194	110	97
8.0	8,000	320	283	2 x 225	2 x 200	114	100
8.5	8,500	330	292	2 x 233	2 x 206	117	103
9.0	9,000	340	300	2 x 240	2 x 212	120	106
9.5	9,500	348	308	2 x 246	2 x 218	122	109
10.0	10,000	356	316	2 x 252	2 x 224	125	112

1. Calculate cylindrical tank capacity as follows:  
Capacity (M<sup>3</sup>) + 0.785 x D<sup>2</sup> x L (Dia. and length in metres).
2. For tanks smaller than listed above the min. size for drain hole = 50mm dia. and vent hole = 30mm dia.
3. Refer **Fig 1** and **2** (page 6) for drain and vent hole location.
4. Should the above hole sizes be unacceptable contact your local Perry Metal Protection representative for further advice.

## Clearance for moving parts

Drop handles, hinges, shafts, and spindles require provision of minimum radial clearances as detailed in the table below, to allow for the thickness of the galvanized coating.

Shaft or spindle size	Minimum hole clearance
Up to 10mm diameter	1mm
10 to 30mm diameter	2mm
Over 30mm diameter	2.0 to 2.5mm

Australian Standard 1214 specifies the following oversize tapping allowances:

Nominal internal thread diameters up to and including M24: **0.4 mm allowance.**

Nominal internal thread diameters over M24 up M36: **0.5 mm allowance.**

### Talking technical – Design, specification and inspection of galvanized products

To ensure consistently good galvanized steel products, it is essential that the basic requirements outlined in these guides are incorporated at the design and fabrication stages of production.

These technical guides are designed to be introductory only. All design features should be discussed with a member of our advisory team. Close liaison between the design engineer, materials engineer, specifier, fabricator and galvanizer will ensure the highest galvanizing standards. Perry Metal Protection also distributes a free wallchart and a summary booklet.

For advice on service, quotations and technical knowledge on hot dip galvanizing, contact your local Perry Metal Protection site:

<b>Hamilton</b>	14 Manchester Place, Te Rapa 07 850 0120
<b>Auckland</b>	14 Timothy Place, Rosebank 09 820 8471
<b>Tauranga</b>	119 Oropi Rd, Greerton 07 541 1344
<b>Wellington</b>	129 Hutt Park Rd, Gracefield 04 568 4139
<b>Christchurch</b>	5 Chinook Place, Hornby 03 349 0290

Alternatively, visit our website [www.perrymetalprotection.co.nz](http://www.perrymetalprotection.co.nz) or email [enquiry@perry.co.nz](mailto:enquiry@perry.co.nz)

