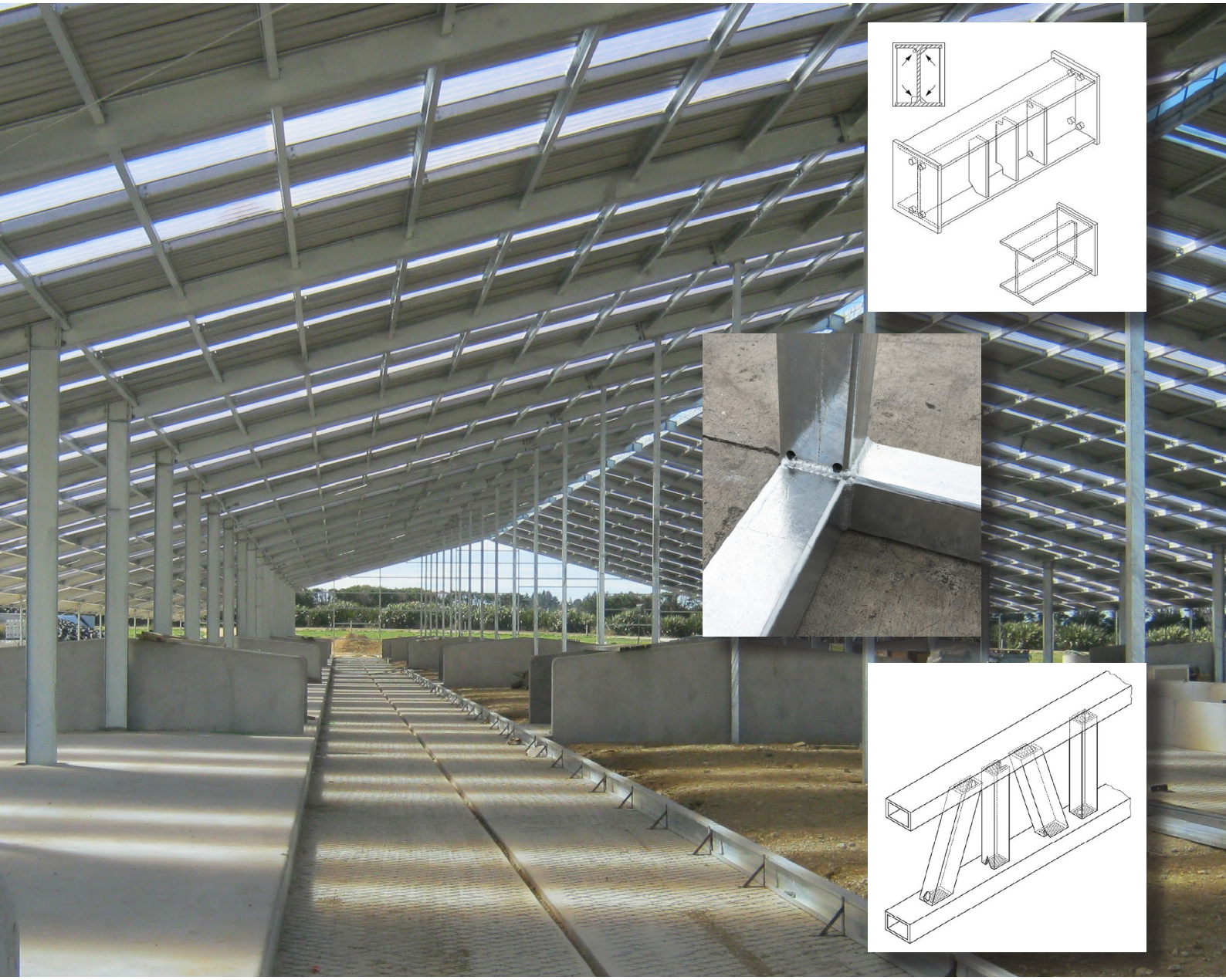
Hot Dip Galvanizing by Perry Metal Protection

DESIGN PRINCIPLES



It's simple to specify and more cost effective than alternative coating systems.

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steel&tube

PERRY METAL PROTECTION

We've got you covered

DESIGN PRINCIPLES

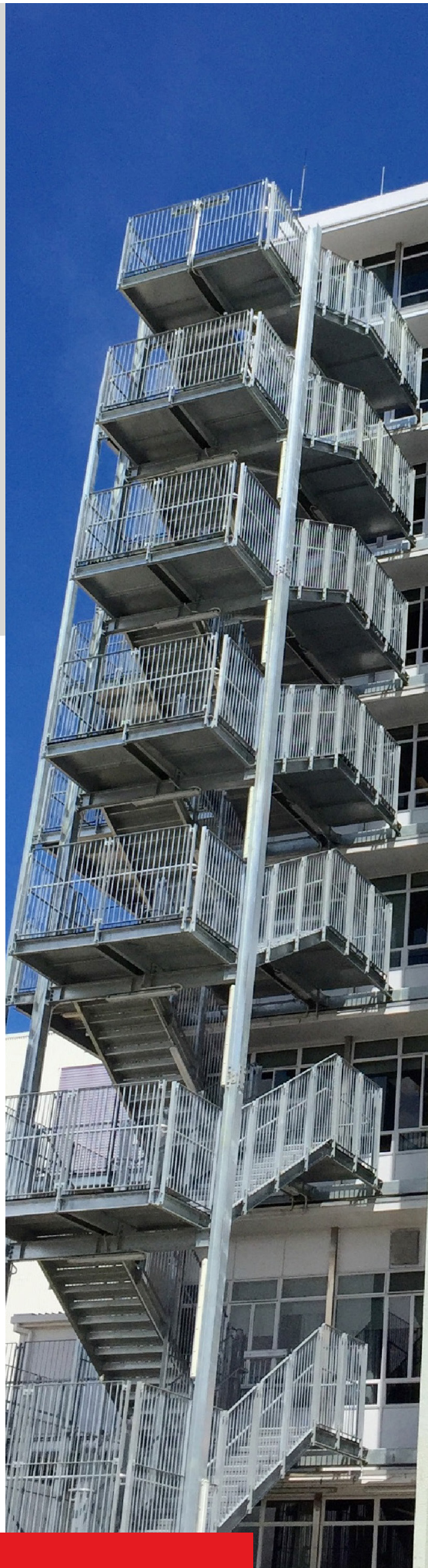
BATH DIMENSIONS

Perry Metal Protection has four galvanizing sites in New Zealand and also operates a collection depot in Tauranga. The working internal dimensions for each site are detailed below:

Plant Bath Dimentions (long x wide x deep)

Hamilton	9.5m x 1.6m x 2.8m
Auckland	5.0m x 1.5.m x 2.4m
Wellington	7.0m x 1.3m x 2.4m
Christchurch	7.0m x 1.3m x 2.4m

Please note the bath sizes show the physical dimensions of our zinc baths but the actual dipping capability of each bath is slightly less than the actual size of the bath. Items larger than the bath's size may be handled by double-dipping.
Please contact your local Perry Metal Protection site for full details.



DESIGNING FOR CORROSION PROTECTION

Galvanized coatings provide outstanding corrosion protection for steel. Treatment of design details in accordance with good corrosion design practice will further increase the life of galvanized steel fabrications.

Many of the design requirements for good galvanizing will also ensure good drainage and optimum corrosion resistance. Fabricated assemblies should be designed to eliminate un-drained areas which will collect water and sediment in service, producing localised corrosion pockets.

The following rules should be followed:

- ☑ Use butt welds in preference to lap welds
- ☑ Where lap welds are used face joints downwards to avoid collection of moisture and sediment
- ☑ Avoid use of horizontal boxed sections, ledges, seams and flat un-drained areas
- ☑ Use rounded internal corners rather than squared corners in vessels and containers to avoid build-up of sediment
- ☑ Design to eliminate crevices and unnecessary openings
- ☑ Avoid contact of galvanized surfaces with brass or copper
- ☑ Provide ventilation where possible in condensation areas
- ☑ Under conditions of extreme humidity use an inhibitive jointing compound between contacting galvanized surfaces such as roof overlaps
- ☑ Provide maintenance access where anticipated service life of certain components is less than that of the complete structure

SUITABLE MATERIALS

All ferrous materials can be galvanized, including mild and low alloy steels. Steel fabrications which incorporate stainless steel parts and fittings are also readily galvanized. Soft-soldered assemblies cannot be galvanized. Brazed assemblies may be galvanized, in consultation with Perry Metal Protection.

Castings

The galvanizing of sound stress-free castings with good surface finish will produce high quality galvanized coatings.

The following rules should be applied in the design stages and in preparation of castings for galvanizing.

- ☑ Design for uniform section thicknesses wherever possible
- ☑ Use large radii at junctions with webs
- ☑ Avoid deep recesses and sharp corners
- ☑ Large grey iron castings should be normalised by the fabricator
- ☑ Castings should be abrasive blast cleaned by the fabricator to remove foundry sand and surface carbon

Combinations of ferrous materials and surfaces

There may be appreciable variation in the pickling times of various ferrous metals and differing surface conditions. Fabricated assemblies containing a mixture of materials and surfaces – such as a combination of castings with other steels – must be abrasive blast cleaned to minimise differences in pickling time.

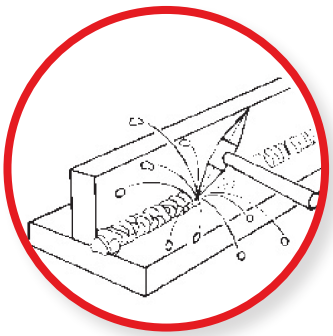
Omission of the abrasive blast cleaning stage is likely to result in combined under and over pickling of the different surfaces, resulting in poor quality galvanizing.

Heavy mill scale on rolled steel surfaces should be removed by abrasive blast cleaning before galvanizing. Thicker than normal galvanized coatings are produced when abrasive blast cleaned surfaces are galvanized.

When ordering from the merchant 'Not oiled or painted', steel pipe and RHS for fabrication of galvanized assemblies and heavy gauge seamless pipe should be specified by the fabricator. Otherwise, expensive manual stripping before pickling may be required to ensure satisfactory galvanizing.

Weld areas

Due to the silicon content of some welding rods, weld areas may produce localised grey coatings when galvanized. The galvanized coating is likely to be slightly thicker in these areas and will have no detrimental effect on coating life. The development of grey coatings due to silicon steels is entirely related to steel composition and cannot be controlled by the galvanizer.



Welding slags

Arc welding slags are chemically inert in acid cleaning solutions and must be mechanically removed before articles are delivered to Perry Metal Protection. The fabricator should remove these by chipping, wire brushing, flame cleaning, grinding or abrasive blast cleaning.

DRAINING AND VENTING

Venting and draining of 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.

Perry Metal Protection requires visual identification of venting from the outside when the assembly is received.

This is necessary to check the adequacy of the venting as well as determining that it has not been omitted by mistake.

Venting

It is mandatory that tubular fabrications and hollow sections be properly vented. (Refer Fig 1)

Any pickling acid or rinse waters that might be trapped in a blind or closed joint connection will be converted to super-heated steam. This is a serious potential hazard to galvanizing equipment and to personnel.

Galvanizing demands 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.

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.

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.

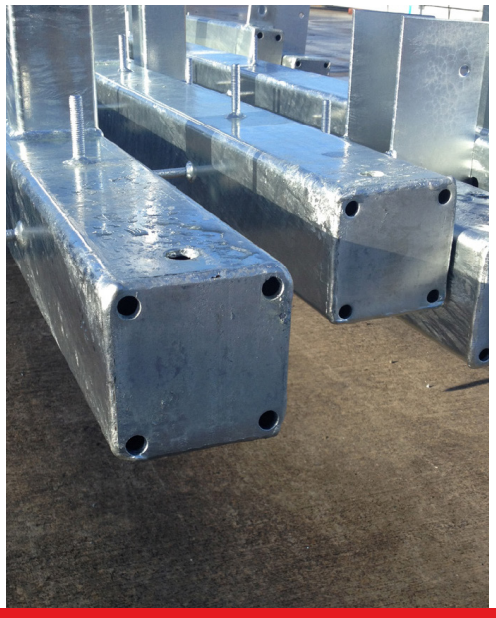
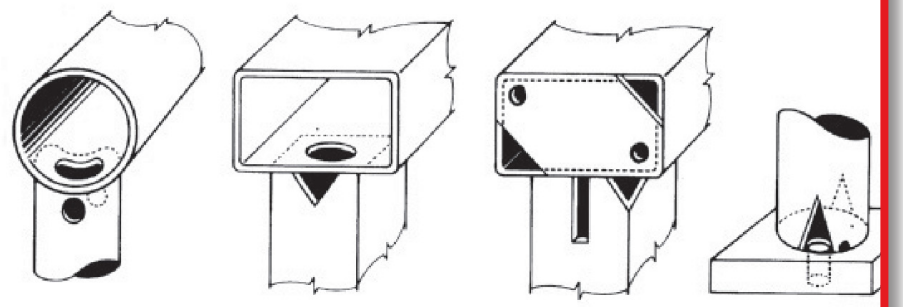


FIG 1. Hollow Components

DON'T BLOW IT
Air inside any hollow component turns instantly to superheated steam when immersed in molten zinc (450oc) and like a boiler will explode if sealed!

VENTING METHODS
Common cases with two methods of venting each shown



1. For drilling use only water-soluble cutting fluids
2. Holes must be as close as to section ends as possible

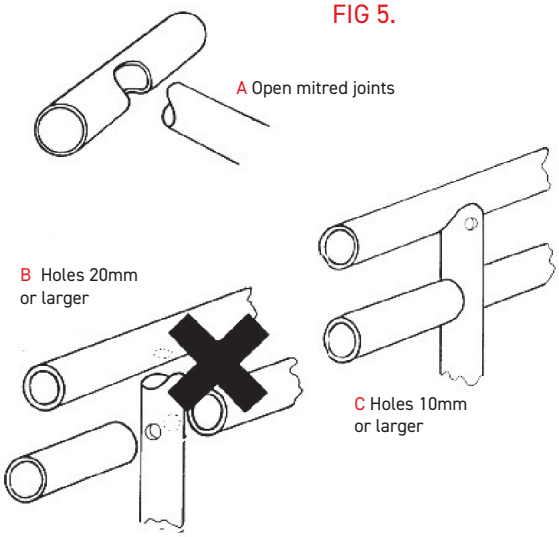
Tubular fabrications and hollow structural

Holes should be placed at locations agreed with Perry Metal Protection – ideally at both sides of members or diagonally opposite each other. (Refer Fig 3 and 4)

Welded pipe sections

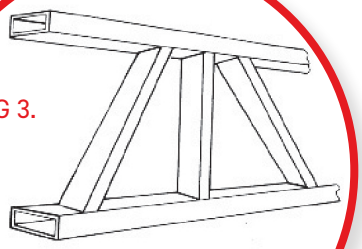
Closed sections must never be incorporated (Refer Fig 5). Sections should be interconnected using open mitred joints as illustrated at 'A'. Interconnecting holes as in 'B' are not acceptable unless there is an external viewing hole to confirm the venting is appropriate. External holes may be positioned as in 'C', a method which is the preferred by the galvanizer, since quick visual inspection shows that the work is safe to galvanize.

FIG 5.



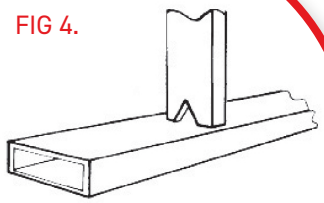
- ☑ Pipe ends should be left open or provided with removable plugs
- ☑ Small tubular fabrications must be vented, with holes not less than 6mm in diameter
- ☑ Unwanted vent holes may be closed by hammering in lead plugs after galvanizing, filing off flush with surrounding surfaces

FIG 3.



Holes placed at locations agreed with the galvanizer - ideally on both sides of members or diagonally opposite other

FIG 4.



Alternatively "V" notches can be cut in ends of members before welding

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

HOLLOW SECTION TYPE & SIZE				MINIMUM VENT & DRAIN HOLE SIZE (DIA)	
CIRCULAR H.S.		SQUARE H.S.	RECTANGULAR H.S		
Nominal Bore (mm)	Outside Dia. (mm)	Outside Dimn's (mm)	Outside Dimn's (mm)	Vent (mm)	Drain (mm)
8	13.5	-	-	8	10
10	17.2	-	-	10	10
15	21.3	13 x 13	-	10	10
20	26.9	16 x 16	-	10	10
25	33.7	19 x 19	-	10	10
32	42.4	25 x 25	38 x 19	10	10
40	48.3	32 x 32	38 x 25	10	10
50	60.3	38 x 38	51 x 25	12	12
65	76.1	51 x 51	64 x 38, 76 x 38	16	16
80	88.9	64 x 64	76 x 51, 89 x 38	20	20
100	114.3	76 x 76	-	25	25
-	-	89 x 89	-	25	25
-	-	-	102 x 51, 102 x 76	25	25
-	-	-	127 x 51, 127 x 64	25	25
125	139.7	102 x 102	127 x 76, 152 x 76	32	32
150	165.1	127 x 127	152 x 102	38	38
200	219.1	152 x 152	203 x 102, 203 x 152	50	50
250	273.0	203 x 203	254 x 152	63	63
300	323.9	254 x 254	305 x 203	75	75
350	355.6	305 x 305	305 x 254	88	88
400	406.4	-	-	100	100

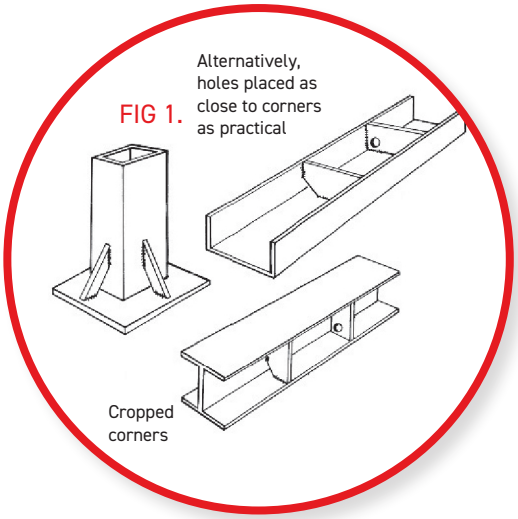
- ☑ The drain and vent hole sizes represent the minimum acceptable and it is preferred that the full tube cross section be provided.
- ☑ The table is also applicable to hollow sections fabricated from channels and angles etc. Use the table with the appropriate outside dimensions of the boxed section.
- ☑ For larger sections use the associated table for tanks.
- ☑ 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.

GUSSETS AND WEBS

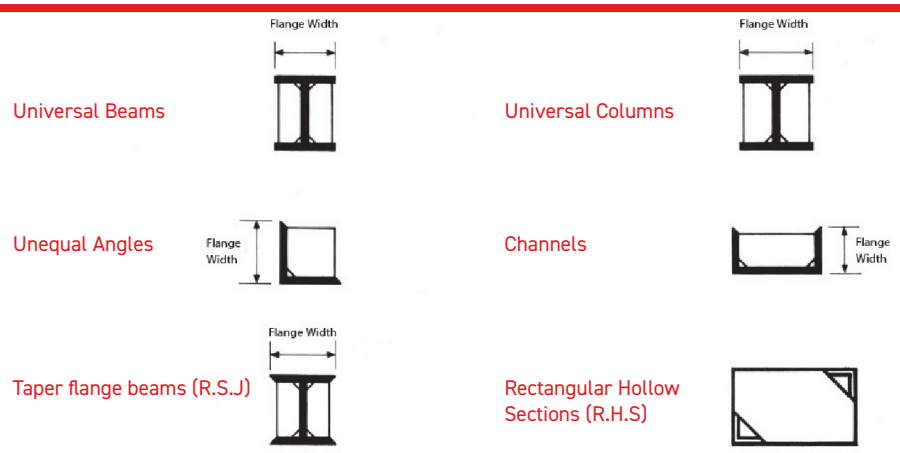
Welded strengthening gussets and webs on columns and beams, along with strengthening gussets in members fabricated from channel sections, should have corners cropped or holed:

- to prevent the entrapment of air in pockets and corners allowing complete access of pickle acids and molten zinc to the entire surface of the work, and
- to facilitate drainage during withdrawal from acid and rinse tanks and from the galvanizing bath (Refer Fig 1)

FIG 1.



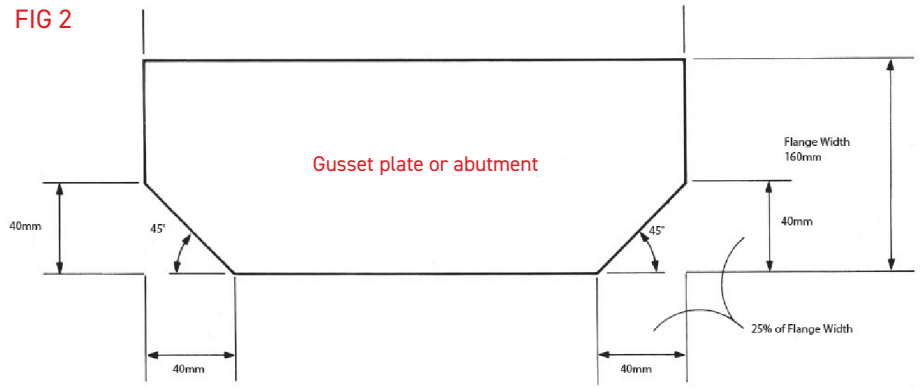
Gusset plate or abutment mitre sizes



Bevel sizes

Bevel cuts for angles and channels = 25% of flange width.
Bevel cuts for I Beams and columns = 25% of half the flange width.
Bevel cuts for RHS End plates = 25% of half the widest side.

FIG 2



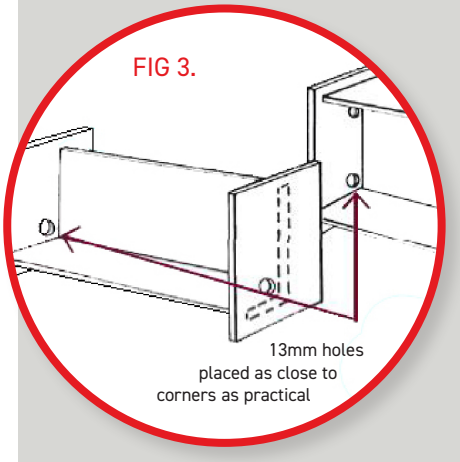
Example

1. All bevel sizes listed are 45°– e.g. 40mm bevel = 40 x 40 x 45 (see Fig 2).
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.

End Plates

Provide holes at least 13mm in diameter in end plates on rolled steel shapes, to allow access of molten zinc in the galvanizing bath and drainage during withdrawal.
(Refer Fig 3)

FIG 3.

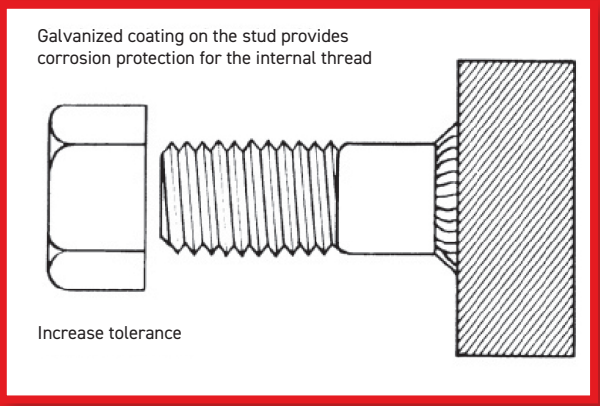


GALVANIZED THREADS

Internal threads and nuts must be tapped oversize after galvanizing to accommodate the thickness of the galvanized coating on the stud or bolt. The galvanized coating on the stud provides corrosion protection for the internal thread.

For economy, nuts are sometimes galvanized as blanks and threads are tapped after galvanizing. Uncoated internal threads are acceptable since the zinc coating on the external thread provides full corrosion protection.

Bolted assemblies should be presented for galvanizing in the disassembled condition. Nuts and bolts or studs for galvanizing should also be supplied disassembled. When internal pre-tapped threads included in components are required not to be galvanized they may be plugged temporarily by means of bolts or studs screwed fully in.



Talk to your Perry Metal Protection representative for specific advice and recommendations.

For safety reasons, high strength bolts must not be welded to galvanized structures for use as high strength studs. Galvanized bolts and the bolting of galvanized structures should be discussed in detail with Perry Metal Protection.

AUSTRALIAN STANDARD 1214 SPECIFIES THE FOLLOWING OVERSIZE TAPPING ALLOWANCES:

NOMINAL DIAMETER OF INTERNAL THREADS	ALLOWANCE (mm)
Up to M22	0.40mm
M24	0.45mm
M27	0.50mm
M30	0.55mm
M36	0.60mm
M36-48	0.80mm
M48-64	1.0mm

MINIMUM EDGE DISTANCES

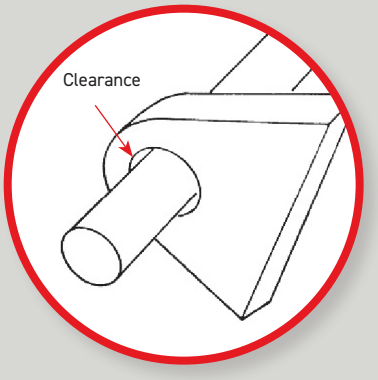
In bolted connections, minimum edge distances from the centre of any bolt to the edge of a plate or the flange of a rolled section should be used as specified in the table below, taken from the Australian Standard 4100 'Steel structures'.

Rolled edge of a rolled section - 1.25df
Sheared or hand flamecut edge - 1.75df
Rolled plate machine flamecut, sawn or planed edge - 1.50df

Note: Edge distance may also be affected by clause 9.3.2.4, AS4100

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.



SIZE OF SPINDLE SHAFT	MINIMUM RADIAL CLEARANCE
Up to 10mm diameter	1.0mm
10 to 30mm diameter	2.0mm
Over 30mm diameter	2.5mm

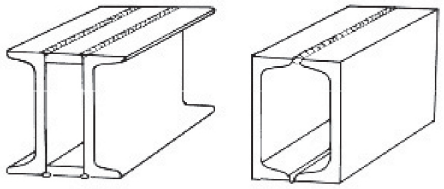
OVERLAPPING SURFACES

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

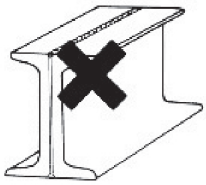
If contacting surfaces cannot be avoided, a hole, 6mm in diameter for every 100cm² of overlap area should be placed in one of the members and the perimeter of the contacting area should be continuously welded. The vent hole in one member will ensure the safety of galvanizing personnel and prevent damage to the article. If in doubt, contact your local Perry Meta

FIG 1



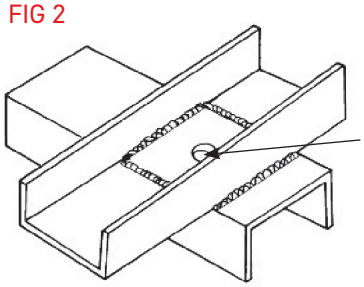
A Satisfactory

B Satisfactory



C Unsatisfactory

FIG 2



Vent holes 6mm diameter for every 100cm² of overlap area

PLATE STRUCTURES FOR GALVANIZING

1. One hole or lifting lug required in plates where detailed in Fig 1, 2 & 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 11/2 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.

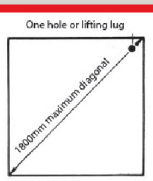


FIG 1 Square Plate

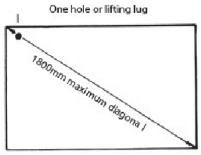


FIG 2 Rectangular Plate

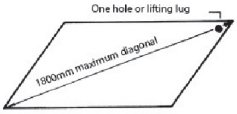


FIG 3 Shaped Plate

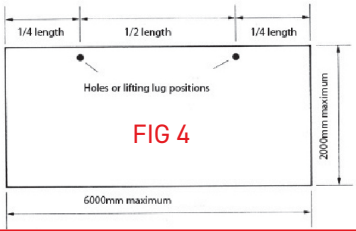


FIG 4

FIG 5

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 jigging techniques.

FOR HOLLOW VESSELS

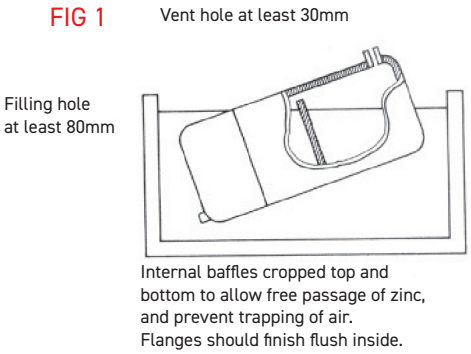
When both internal and external surfaces are to be galvanized at least one filling and draining hole must be provided, with a vent diagonally opposite to allow the exit of air during immersion. Check the drainage table for minimum drainage and vent hole sizes for various tank capacities.

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 (Note Figs 5 and 6 are 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



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

FIG 2

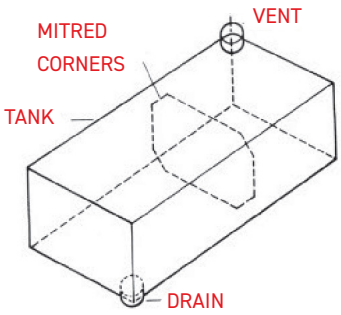
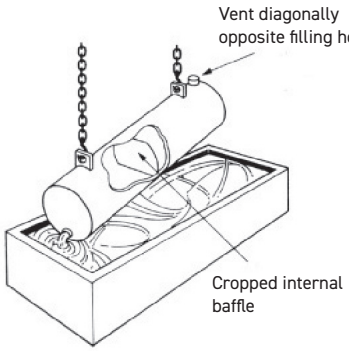


FIG 3



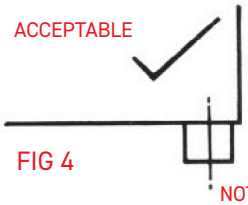


FIG 4

NOT ACCEPTABLE

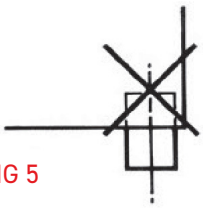


FIG 5

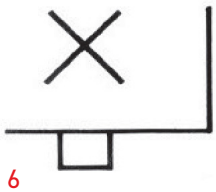
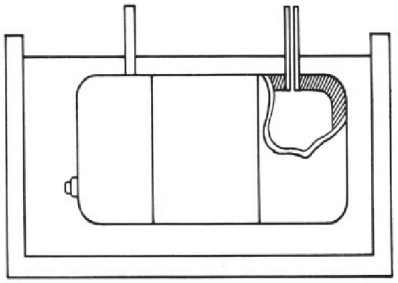


FIG 6

FIG 7

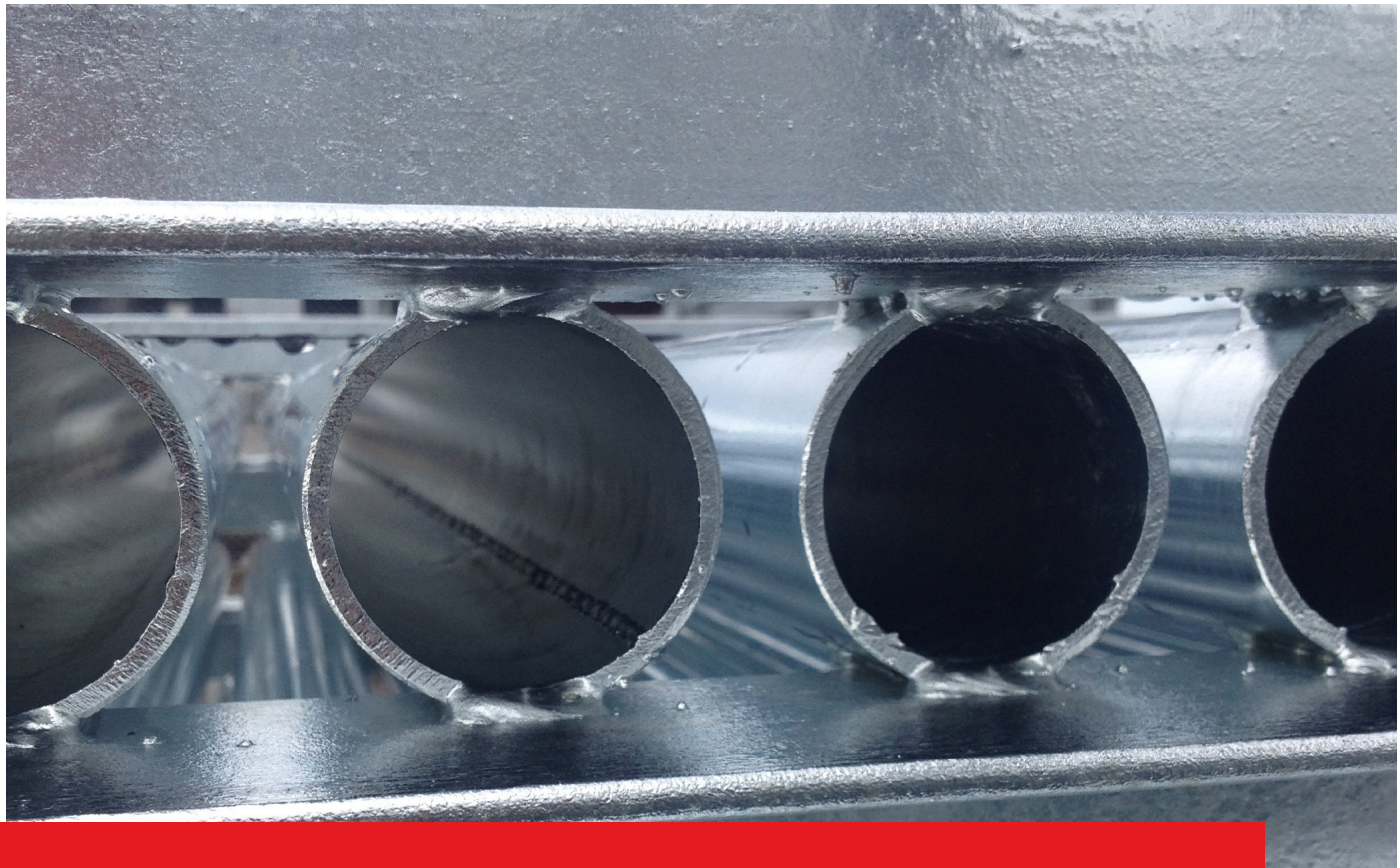


Vent pipes connect interior to the atmosphere

Drain and vent hole sizes (min) for various tank capacities

CAPACITY		DRAIN AND FILLING HOLES SIZES (MM)					
		SINGLE HOLE		DOUBLE HOLE		AIR VENT HOLE	
m^3	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

- ☑ Calculate cylindrical tank capacity as follows: Capacity (M3)+ 0.785 x D2 x L (Dia. and length in metres).
- ☑ For tanks smaller than listed above the min. size for drain hole = 50mm dia. and vent hole = 30mm dia.
- ☑ Refer Fig 1 and 2 for drain and vent hole location.
- ☑ Should the above hole sizes be unacceptable contact your local Perry Metal Protection representative for further advice.



DIMENSIONAL STABILITY

In certain cases, fabricated assemblies may be liable to loss of shape when heated to galvanizing temperatures. This is due to the release of stresses induced during manufacture of the steel and in subsequent fabrication operations.

Following these simple recommendations will improve dimensional stability:

- ☑ Avoid designs which require double-end dipping to fit into the galvanizing bath. It is preferable to build assemblies and sub-assemblies in suitable modules so that they can be immersed quickly and fully in a single dip
- ☑ Use symmetrical sections in preference to angles or channels
- ☑ Use sections of near equal thickness at joints
- ☑ Bend members to the largest acceptable radii
- ☑ Accurately preform parts to avoid force or restraint during joining
- ☑ Continuously weld joints, if possible using balanced welding techniques to reduce uneven thermal stresses. Balanced, staggered welding is permissible. For staggered welding of material of 3mm and lighter, weld centres should be closer than 100mm
- ☑ Large grey iron castings should always be normalised by the fabricator and then abrasive blast cleaned prior to galvanizing

Use of symmetrical sections minimises distortion during galvanizing. Avoid combinations of thick and thin materials. (Refer Fig 6 and 7)

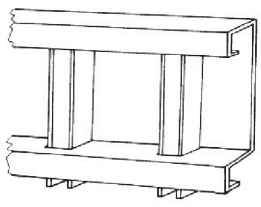


FIG 6

Use of symmetrical sections minimises distortion during galvanizing.
Avoid combinations of thick and thin materials

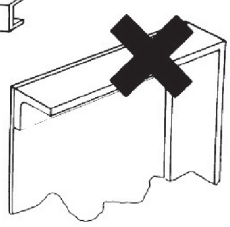


FIG 7

Heavy angle

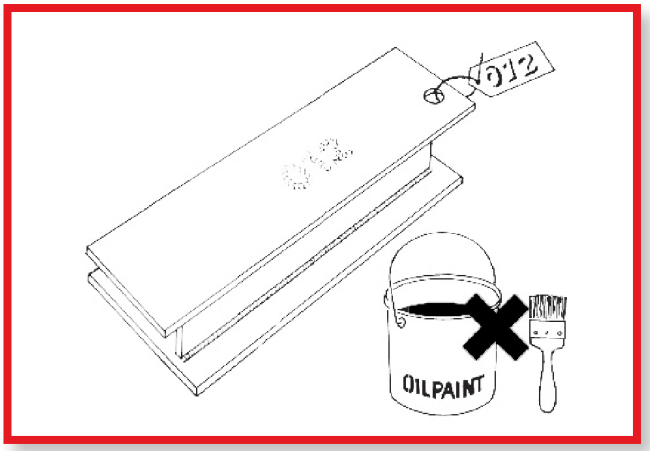
HANDLING POINTS

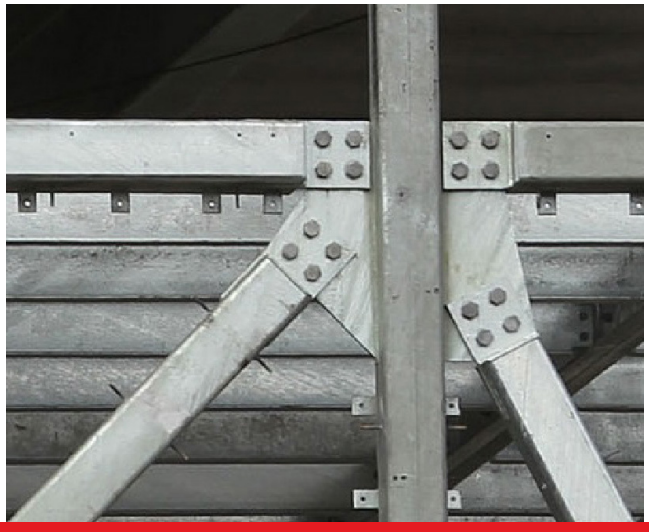
Parts may require suspension holes if there is no convenient point to attach a jig or hook. No special requirements apply if the work can be handled by chains, baskets or racks. Perry Metal Protection can advise you of the provision best suited to the handling equipment available. Large pipe sections, open top tanks and similar structures may require cross stays to maintain the shape of the article during handling and galvanizing.

IDENTIFICATION MARKING

For temporary identification, water-soluble paints or markings are recommended. Oil-based paints should not be used as they must be removed manually before galvanizing. For temporary identification, use heavily embossed metal tags wired to the work.

For permanent identification, intended to remain legible after galvanizing, the fabricator should provide heavily punched or embossed figures either on the work or on steel (not aluminium) tags wired to the work.





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.

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.

Throughout New Zealand

Perry Metal Protection has four sites conveniently located throughout New Zealand.

All four plants have the capacity to galvanize a wide range of steel structures including mild and low alloy steels, and iron and steel castings.

We are the only galvanizer in New Zealand with the capacity to hot dip galvanize lengths up to 18m in length, giving you the flexibility to tackle any kind of job.

Why Perry Metal Protection

Perry Metal Protection is New Zealand's largest hot dip galvanizer, operating an ISO 9001 Quality Management System.

Part of Steel & Tube, a proud New Zealand company - locally owned by every day New Zealanders, Perry Metal Protection has been in operation since 1974 and is a founding member of the Galvanizing Association of New Zealand.

We strive to deliver the highest quality galvanizing in a timely turnaround, at a competitive price.

CALL OUR TECHNICAL HELPLINE 0800 508 506

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www.perrymetalprotection.co.nz

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