



## Distortion Becoming a Thing of the Past

## Advisory Note

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There is a perception that distortion of fabricated steel items is a significant problem, however, in reality, distortion occurs in only a very small number of instances. Distortion has become a rare occurrence as both sizes and handling facilities have improved.

Over recent years the after fabrication galvanizing industry has undergone major upgrades in terms of steel handling capabilities and larger plant capacity which has resulted in a further reduced incidence of distortion occurring when fabricated steel articles are galvanized.

### Occurrence

Galvanizing will not generally cause distortion provided that design and fabrication principles are correct. When steel fabrications do distort during galvanizing, the reasons have usually been 'built-in' at an earlier stage. Distortion almost always arises from the relief of stresses as the steel is heated to the galvanizing temperature (usually 445-465°C). Although such stresses may be inherent in the steel and may vary from batch to batch, they are more commonly caused during fabrication. Distortion may also occur if steels of significantly different thicknesses are joined together in a fabrication. Only very rarely is it caused by handling in the galvanizing plant.

Basic design points and other means of minimising distortion are outlined in this leaflet. Symmetrical section (I - beams, tubes), have less inherent tendency to distort than asymmetrical ones (channels). Similarly, cylindrical vessels are less liable to distort than rectangular or elliptical ones. Other things being equal, the lighter the gauge of steel, the greater the risk of distortion.

Designer, fabricator and galvanizer should pool their knowledge at an early stage to get best results.

### Inherent Stresses In Steel

Steel invariably contains internal stresses, hot dip galvanizing can release or vary the amount of stress, making distortion possible.

### Fabrication Stresses

#### Minimising introduction of stresses during welding.

Welding results in extreme differences in temperatures within small areas of an assembly and hence in significant residual stresses.

In general it is recommended that,

- Components of an assembly should be preformed accurately so that they need not be forced, sprung or restrained during welding.

depending on whether or not heat is conducted rapidly away from the weld, although more stress may arise at the starting point of the weld.

- As far as possible, welded assemblies should be aligned so that the stresses are balanced rather than all pulling in the same direction.

### Other design features to avoid or minimise distortion

Steel sections should vary as little as possible. Thick and thin sections absorb and lose heat at different rates and so can expand and contract unevenly. Large unsupported flat sheets may tend to buckle so stiffeners should be included in the design. Frames around the flat panel, whether of solid steel or open material such as welded mesh should be galvanized separately, as the frame would offer a constraint and so tend to cause buckling rather than reduce it.

Where there is an inherent tendency to distort e.g. in asymmetrically shaped fabrications (including fabricated girders or lattice beams with top or bottom chords of different sections), the effect can be minimized or possibly eliminated if the fabrications is of such a size and design that it can be rapidly immersed in a single dip. Whether or not this can be done will depend on both the size of the sections in relationship to the galvanizer's dipping facilities, and also on the extent to which hollow sections are involved. The galvanizer should be consulted to decide on the maximum advisable lengths. There is little or no distortion in standard symmetrical components whether they are single or double-end dipped - however if larger fabrications need to be double-end dipped, the significant thermal gradient created by this procedure may give rise to distortion.

Where some bowing, twisting or bending has occurred it may be possible to straighten the object after the galvanizing process.

### Stress Relief

Fabrication stresses can sometimes be eliminated by stress relieving before galvanizing.

Early consultation between galvanizer, fabricator and designer is the key to success in avoiding distortion, through the incorporation of good design features.

Basic design considerations are shown on the reverse side of this leaflet.

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- Thick sections should be continuously welded, thin sections and sheet fabrications may benefit from intermittent welding.
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