

Q: My fabricator is asking me what size to make some clearance holes if a hot-dip galvanized bolt is to be placed in the hole?

A: The hot-dip galvanizing process produces a coating that increases the diameter of a bolt and decreases the diameter of a clearance hole. In order to permit proper assembly, clearance holes must be sized to accommodate the decrease in the diameter of the holes and avoid having to clean off excess zinc before the galvanized bolt can be installed. The ultimate responsibility to properly size clearance holes lies with the designer of the product, but as we know, the best way to avoid charge-backs and an unhappy customer and deliver the highest quality product is to utilize a cooperative effort between the designer, the fabricator, and the galvanizer.

The size of a clearance hole using a galvanized bolt depends on the type of connection according to the AISC guidelines in the Load & Resistance Factor Design (LRFD) manual. In *Table 1*, the formulas used for determining both the standard and oversized clearance hole diameters are listed, as well as specific values for nominal bolt diameters using the equations provided.

When clearance holes are designed for hot-dip galvanized coatings, the type of connection plays a significant role in the clearance hole size. For connections designed to be slip critical connections using a standard clearance hole with an added 1/16 in. to the hole size for any size bolt will give a clearance hole that can accommodate a galvanized bolt without need of extra hole cleaning. The bolt head will have sufficient



bearing surface to produce the desired effect for a slip critical connection. The extra 1/16 in. on the hole diameter will give sufficient clearance for zinc coatings on the bolts and on the hole walls. This is the minimum size of a clearance hole for a slip critical connection. For other types of connections that need more hole clearance for alignment reasons the clearance hole may need to be oversized according to *Table 1*.

The one exception to the designing of clearance holes is bearing connections. If HDG parts are to be used in a bearing type connection design, the clearance holes must be designed to the standard clearance hole diameter. This may necessitate unblocking or cleaning of the hole after galvanizing but the AISC guidelines in the LRFD manual are clear oversized holes are not to be used in bearing type connections.

All of the clearance hole information will be added to the ASTM A 385 specification at some time in the future. In addition, a short animation that discusses the potential for improper drainage of zinc due to the previously discussed scenarios can be viewed by visiting www.galvanizeit.org/clearancearticle.

Table 1: Standard vs. Oversized Clearance Hole Diameter

Nominal Bolt Diameter (d_b) (in.)	Standard Clearance Hole Diameter (in.)	Oversized Clearance Hole Diameter (in.)
$d_b \leq 1/2$	$d_b + 1/16$	$d_b + 2/16$
1/4 (4/16)	5/16	3/8 (6/16)
1/2 (8/16)	9/16	5/8 (10/16)
$1/2 < d_b < 1$	$d_b + 1/16$	$d_b + 3/16$
5/8 (10/16)	11/16	13/16
3/4 (12/16)	13/16	15/16
7/8 (14/16)	15/16	1 1/16 (17/16)
$1 \leq d_b < 1 1/8$	$d_b + 1/16$	$d_b + 4/16$
1 (16/16)	1 1/16 (17/16)	1 1/4 (20/16)
$d_b \geq 1 1/8$	$d_b + 1/16$	$d_b + 5/16$
1 1/8 (18/16)	1 3/16 (19/16)	1 7/16 (23/16)

Note: The numbers in parenthesis are equal to the numbers outside of the parenthesis and can be used for quicker and easier calculations

