

ACCESS HOLES, BOSSES AND PLUGS FOR RADIOGRAPHIC INSPECTION OF PIPE WELDS

Prepared by

Pipe Fabrication Institute Engineering Committee



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METRIC CONVERSIONS

The conversion of quantities between systems of units involves a determination of the number of significant digits to be retained. All conversions depend upon the intended precision of the original quantity and are rounded to the appropriate accuracy.

Pipe sizes together with applicable wall thickness are not shown with metric equivalents.

The SI (metric) values where included with the customary U.S. values in this Standard are the rounded equivalents of the U.S. values and are for reference only.

Metric units were derived utilizing the following conversion factor:

Conversion	Factor
inches to millimeter	25.4

Foreword

Previous versions of this standard provided a simple method for plugging the hole required for inserting a gamma source into a pipe to allow panoramic radiographic exposures. The original radiographic plug designs, (Figures 1 through 7), have been used extensively, providing many years of reliable service, and these designs have not changed. Experience has demonstrated that their time to failure is comparable to the piping systems they were installed in when the systems have not experienced long term creep damage. Creep is plastic deformation under load that is dependent on stress, time, temperature, and material. PFI had been alerted to occurrences of plug seal weld failures where the piping system had experienced significant creep damage. PFI reviewed the reported failures and initiated a research project sponsored by ASME and PFI and published as STP-PT-050.

The initial study used finite element creep simulation to examine a plug geometry compliant with Figures 2 through 5 of this standard and then compared the results with a bored out, or thimble-shaped plug used by some high temperature component manufacturers, using a similar simulation. The results indicate there are no substantial benefits, and possibly a detrimental impact, to using the bored out plugs. However, the study's results also indicated that after prolonged service, for both types of plugs, the stresses initially carried by the plug's threads are increasingly carried by the circumferential plug seal welds. In addition to thread corrosion, creep stretches the hole in which the plug is located, possibly increasing stress on the circumferential plug seal weld. This research was consistent with reported failures of radiographic access port plugs due to creep.

A subsequent study was initiated to evaluate the use of an integrally reinforced boss compliant with Figures 8 through 11. The analysis considered grade P91 pipe at temperatures of 900 °F and 1150 °F using a grade F22 boss in an effort to avoid PWHT of the plug seal weld after radiographic examination. The boss geometry was designed so that the surface that the plug seal weld attaches to meets the B31.1 thickness exemption for PWHT. The analysis confirmed that this geometry will yield a life expectancy comparable to the pipe itself. The analysis also revealed a decrease in service life at 1150 °F due to the dissimilar material interface. For this reason, it is recommended that the use of grade F22 boss on a P91 header be limited to 1100 °F. No other dissimilar material combinations were considered in this analysis.

1. Scope

This standard covers recommendations for access holes, bosses and plugs for the radiographic inspection of pipe butt welds where the radiographic source is located on the inside of the pipe. Radiographic access ports should not be used unless necessary. Since routine double-wall radiography is capable of making high-quality radiographs on pipe that is 5/8" inch thick or less and NPS 16" inch and smaller, radiographic access ports are unnecessary and should not be specified. When digital radiography will be used, greater thickness and larger sizes of pipe may be radiographed without resorting to access ports. Figures 1 through 7 are recommended for applications where temperatures are below the creep range. For RT bosses used in piping systems that may operate within the creep range, alternative bosses, as provided in Sections 6, 7 & 8 are recommended.

2. Access Hole and Plug

2.1 For pipe wall thickness less than 5/8 in. (16mm) thick, the location and design of the access hole and plug shall be as shown in Fig. 1 or Fig. 6.

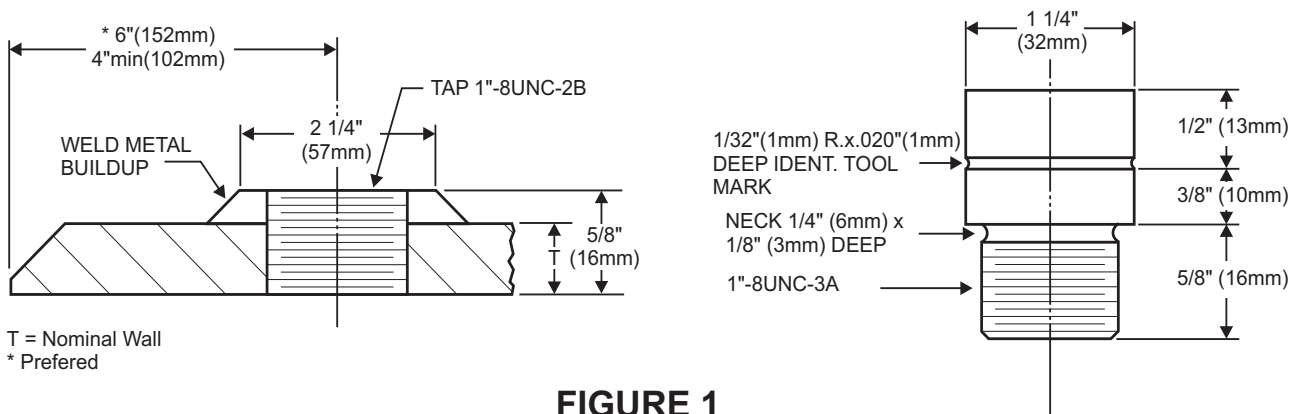


FIGURE 1

[Denotes Revision

- 2.2 For pipe wall thickness $\frac{5}{8}$ in. (16 mm) through $1 \frac{3}{8}$ in. (35 mm), the location and design of the access hole and plug shall be shown in Fig. 2.

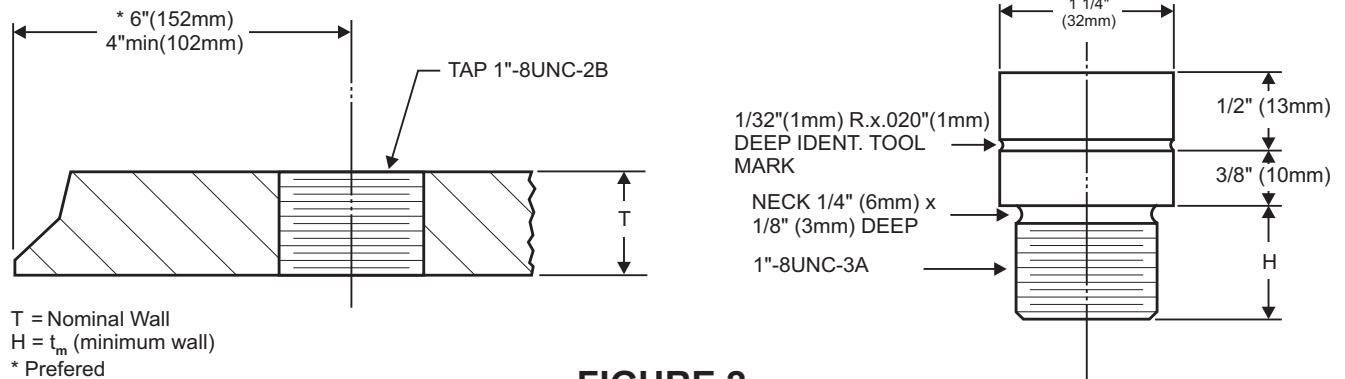


FIGURE 2

- 2.3 For pipe wall thickness over $1 \frac{3}{8}$ in. (35 mm) through 3 in., (76 mm) the location and design of the access hole and plug shall be as shown in Fig. 3.

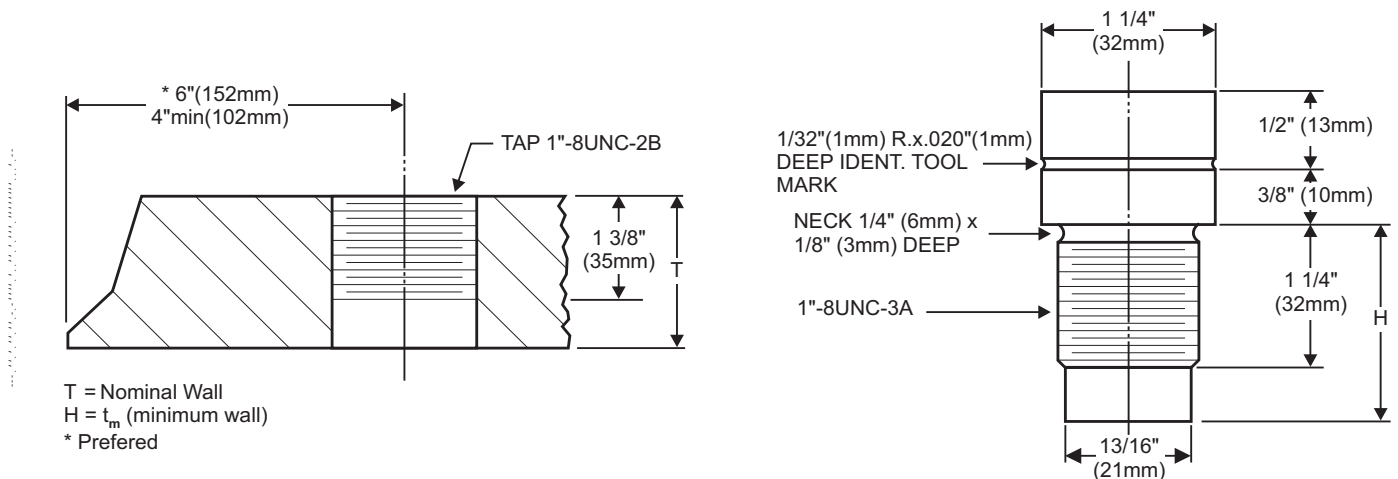


FIGURE 3