

DETERMINATION AND QUALIFICATION OF ALTERNATIVE FLANGE ASSEMBLY PROCEDURES

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ABSTRACT

Alternative (non-traditional) flange assembly procedures offer the potential for reduced assembly time and physical effort in many industrial applications. While standards and procedures exist for the traditional, star pattern assembly procedure, there is currently only limited guidance for the selection and use of alternative assembly procedures. This paper summarizes the approach taken by the authors in determining potential assembly procedures, and the ultimate analysis and qualification undertaken to validate their use on a General Purpose Tank Car Hinged/Bolted Manway Connection. This case history study can serve as a guide to others in industry for selecting and qualifying alternative assembly procedures for their flanged equipment.

INTRODUCTION

Current "best practices" for flange assembly typically involve the use of a multi-step, (criss cross) star-pattern bolt tightening sequenceⁱ. This procedure, while proven to be a reliable, effective flange assembly procedure, can often times result in a very time consuming and ergonomically challenging flange assembly process. This is especially true for large diameter, industrial equipment flanges with many fasteners. To date, much of the research on alternative flange assembly procedures has centered on identification and qualification of alternative assembly methods for larger, ASME code or TEMA pressure vessel flanges with the primary goal of reducing assembly time and human effort, without compromising the reliability of the assembled vesselⁱⁱ. The conclusions, guidelines and recommendations provided in this area of research can, and are, being applied to similar size/design vessels throughout industry.

Prevalent throughout industry are bolted, flange connections that differ substantially from the flanges used in these previous research studies, and the guidelines and conclusions from these studies may not directly apply. In these situations, the resultant performance of any alternative flange assembly procedure will need to be specifically analyzed and qualified prior to its actual field use. The subject of this paper is the selection, evaluation and ultimate

qualification of alternative flange assembly procedures for general purpose (GP) tank car hinged manway connections.

GP RAILCAR TOP LOADING MANWAY COVERS

General purpose tank cars are equipped with either an 18" or 20" nominal diameter, hinged manway. The Association of American Railroads (AAR) has approved the use of 44 Styles of manway configurationsⁱⁱⁱ. These manway covers are generally significantly more flexible than their industrial (ASME/TEMA) pressure vessel counterparts, and are secured with six, eight, or ten 7/8" or 1" diameter eyebolt fasteners.



FIGURE 1: GENERAL PURPOSE RAILROAD TANKCAR MANWAY

Depending upon the commodity being shipped, a wide variety of gasket materials are used to seal these connections. The manway and all other connections on the tankcars must be capable of providing leak-free performance at pressures from ambient up to 165 psig. The flexibility of the manway covers, the large spacing between bolts and the relatively large gasket/bolt area ratio (117X), make for a