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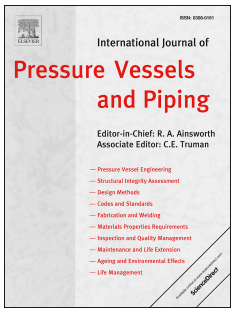

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Non-linear finite element modelling and analysis of the effect of gasket creep-relaxation on circular bolted flange connections

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ABSTRACT

It is well known that gasket creep-relaxation results in a reduction of contact pressure between the surface of a gasket and the face of a flange over an extended period of time. This reduction may result in the subsequent failure of the circular bolted flange connection due to leakage. In this paper a pair of flat and raised face integral flanges, PN 10 DN 50 (in accordance with the European EN 1092-1 standard), with non-asbestos compressed fibre ring gaskets with aramid and a nitrile rubber binder were considered. Finite element modelling and analyses were done, for both the circular bolted flange configurations, during the seating condition. The results of the finite element analyses were experimentally validated. It was found that the number of bolt tightening increments as well as the time between the bolt tightening increments had a significant impact on the effect which gasket creep-relaxation had after the seating condition. An increase in either the number of bolting increments or the time between the bolting increments will reduce the effect which gasket creep-relaxation has once the bolts had been fastened. Based on these results it is possible to develop an optimisation scheme to minimize the effect which gasket creep-relaxation has on the contact pressure between the face of the flange and the gasket, after seating, by either increasing or decreasing the number of bolt tightening increments or the time between the bolt tightening increments.

Keywords: gasket creep-relaxation, contact pressure, flat face flange, raised face flange, bolt tightening increments

1. INTRODUCTION

A reduction in the contact pressure between the surface of a gasket and the face of a flange is primarily due to the effect of creep-relaxation which the gasket exhibits over time [1]. Despite a large number of research papers focusing on this topic over the past two decades it remains a vital research subject [2].

The creep-relaxation behaviour of soft gaskets has been modelled in various ways. Bouzid *et al.* [1] modelled the effect of gasket creep-relaxation by applying a fixed displacement. This was done to avoid specifying a constant bolt load, which is not desired since the bolt load is expected to decrease with time due to the effect of creep-relaxation. The fixed displacement was applied to an equivalent bolt ring. The fixed displacement was determined by initially applying the full bolt load and recording the displacement. Bouzid *et al.*[1] calculated the displacement by following the creep equation (Equation 1) as was suggested by Bazergui [3].

$$e_c = a + b \cdot \ln(t) \qquad (1.)$$

where:

a, b Coefficient as a function of the stress level

e_c Gasket pure creep deflection

t Time

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