Burst Tests on Pipeline Containing Corrosion in the Seam Weld

Sérgio I. O. Bueno1, Adilson C. Benjamin2, Jose L. F. Freire3, Ronaldo D. Vieira3 and Marco A. P. Rosas3

1PETROBRAS E&P
2PETROBRAS R&D Center
3Catholic University of Rio de Janeiro
Rio de Janeiro, Brazil

ABSTRACT

In this paper the burst tests of five tubular specimens containing corrosion in the seam weld are presented. Each of the five specimens had one external corrosion defect, machined using spark erosion. These defects encompass a portion of the seam weld, of the HAZ and of the base metal.

Measurements were carried out in order to determine the actual dimensions of each tubular specimen and its respective defect. Tension tests, Charpy V-notch impact tests, guided-bend tests, chemical analysis and metallographic examination were performed with the objective of determining the properties of the base material and of the weld material.

The failure pressures measured in the burst tests are compared with those predicted by six assessments methods, namely: the ASME B31G method, the RSTRENG 085dL method, the DNV RP-F101 method for single defects, the RPA method, the RSTRENG Effective Area method and the DNV RP-F101 method for complex shaped defects.

KEY WORDS: corroded pipeline, seam weld, burst test

INTRODUCTION

Several methods for the assessment of corrosion defects in the base metal are currently available, for example, the ASME B31G method (ASME B31G, 1991), the RSTRENG 085dL method (Kiefner and Vieth, 1989), the DNV RP-F101 method for single defects (Part B) (DNV RP-F101, 2004), the RPA method (Benjamin and Andrade, 2003), the RSTRENG Effective Area method (Kiefner and Vieth, 1989) and the DNV RP-F101 method for complex shaped defects (DNV RP-F101, 2004).

However there is a concern that the use of these methods in the assessment of corrosion in or adjacent to the pipe seam weld may produce nonconservative results.

In this paper the burst tests of five tubular specimens containing corrosion in the seam weld are presented. In these tests the tubular specimens were loaded with internal pressure only.

The specimens were cut from longitudinal welded tubes made of API 5L X46 with a nominal outside diameter of 457.2 mm (18 in) and a nominal wall thickness of 6.35 mm (0.25 in). Each of the five specimens had one external corrosion defect, machined using spark erosion. These defects encompass a portion of the seam weld, of the HAZ and of the base metal.

Measurements were carried out in order to determine the actual dimensions of each tubular specimen and its respective defect. Tension tests, Charpy V-notch impact tests, guided-bend tests, chemical analysis and metallographic examination were performed with the objective of determining the properties of the base material and of the weld material.

The failure pressures measured in the burst tests are compared with those predicted by six assessments methods, namely: the ASME B31G method, the RSTRENG 085dL method, the DNV RP-F101 method for single defects, the RPA method, the RSTRENG Effective Area method and the DNV RP-F101 method for complex shaped defects.

MATERIAL CHARACTERIZATION

The raw material used in this research was composed of five API 5L X46 UOE tubes, named T11, T13, T14, T15 and T16. These tubes are corroded pipe segments that were removed from the ORBEL I oil pipeline, as part of its rehabilitation. The tubes were produced in the 60’s and had more than 30 years of operation. The pipes nominal outside diameter and nominal wall thickness $t_w$ were, respectively, 457.2 mm (18 in) and 6.35 mm (0.25 in).

It was assumed that the five tubes were made of different plate and weld materials and could have different properties. Tension tests, Charpy V-notch impact tests, guided-bend tests, chemical analysis and metallographic examination were performed in specimens cut from each tube, in order to determine the material properties.