1.7.9. ACOUSTIC EMISSION TESTING – DEFINING A NEW STANDARD OF ACOUSTIC EMISSION TESTING FOR PRESSURE VESSELS. PART 1: QUANTITATIVE AND COMPARATIVE PERFORMANCE ANALYSIS OF ZONAL LOCATION AND TRIANGULATION LOCATION METHODS

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For decades now, acoustic emission testing of pressure vessels has been used in France, Europe and the rest of the world. Indeed, it enables overall and rapid testing of large structures, significantly reducing maintenance time and shutdown of plants. Methods have changed over the last decades, moving from very traditional and diversified methods to more standardised ones. There are several regulatory texts, codes and standards worldwide which define the application rules of this method. However, some tests are still currently performed according to procedures which have more to do with the service provider's "reputation" rather than on proven technical foundations.

Since 2004, France has officially adopted a 'Best Practices Guideline' used as a reference for customers and service providers to apply this technology to various types of pressure vessels. According to the Guideline, like several other European (European standards) or American (Asme) texts, acoustic emission testing can be applied based on two techniques (zonal location method and planar location method (triangulation)). However, no comparative study of their performance, thus enabling their assessment, has been carried out. This lack of quantitative comparison leads to subjective assessment of performance concerning the techniques and the most cost effective, reputed "basic" solution is often selected. But what is the real detection capacity of an acoustic emission source using these two methods? What is the coverage ratio of the tested structure?

By means of simple simulation calculations, this study highlights the significant differences in performance between these two techniques. The effects of other fundamental parameters, for example, acquisition threshold, or the type of meshing are also quantified. From the study carried out using real case data, we are able to determine that the performance differences authorised between these two techniques are significant and may reach a coefficient of 5 to 7, without being considered when analysing the information gathered, that is to say the test results. Finally, the results of this study show that use of a planar testing configuration must be preferred given that it allows the measuring error levels to be significantly decreased and therefore the impact of the error levels on the testing result, while enabling calculation of the source amplitude.

We propose that any acoustic emission testing be assessed on the basis of the approach developed in terms of location performance by expressing this assessment through quantitative criteria such as detection and location percentage of a defined population of acoustic emission sources. These criteria, that is, the testing coverage ratio may be taken into account in analysing recorded information to obtain a more relevant diagnosis.

Backed by its experience, CETIM may now use these assessment tools and carry out well-controlled acoustic emission testing enabling a greater reproducibility and sensitivity of Acoustic Emission testing. Nevertheless, the professional guides, standards and codes must change so as to allow the industry to take advantage of the real potential of acoustic emission.