4.1.18. RAIL RESTORATION LIFETIME ON HIGH SPEED LINE

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Electric arc welding process has been widely used by SNCF (French national railways) to repair rails which presents damage on running surface. Depending on the depth of the defect, rails can be more or less grounded and weld beads are deposited on one or more layers (2 to 15 mm) to restore the rail to its initial profile.

In-track observations show that this kind of restoration has a limited lifetime on high speed lines. Indeed, lots of rails are removed due to development of cracks in welding repair. Moreover this cause of removal has been increasing since the late 90s.

SNCF has initiated a study to improve knowledge about this phenomenon. This study is based on the idea that welding repair behaviour cannot be explained without considering its metallurgical quality. One of the main reasons of cracks development on welds is the presence of small gas inclusions spread among the whole repair, which could then cause crack initiation under mechanical stress. Until now, destructive methods were used to determine quantity and size information about porosities in welds. SNCF asked the CEA LIST to develop a non-destructive testing method to check weld integrity. CEA LIST was also asked to develop a specific instrumentation to detect, locate and classify by size gas inclusions bigger than 0.3 mm in the whole repair.

The principle of the method is based on the use of an ultrasonic contact phased-array transducer associated with a specific processing. The transducer is articulated to conform as much as possible to the nominal rail section. The use of a phased-array probe allows limitation of mechanical displacements to only one axis, along the longitudinal plane of the rail. Inspection in the plane perpendicular to the axis of the rail is performed through electronic commutation and beam steering. The data analysis is done using CIVA software. A processing based on ultrasonic field computation was developed. The method was experimentally tested on real repairs in laboratory conditions. A prototype was then designed and realised to carry out the method on rail track.

This device performs two functions:

– Inspection of a repair without any operator intervention thanks to an automatic displacement of the transducer.

– Transportation of the system between two repairs.

The system is autonomous; it has its own power generator and water supply for ultrasonic coupling.

A test campaign was achieved by SNCF on the railway network during which nearly 400 repairs were inspected. Once relationship between integrity and lifetime is established, new porosity thresholds should be considered.

This paper describes the method as well as the instrumentation designed for this study. Experimental results including ultrasonic images and associated analysis are shown. A first assessment of the general health of the repair from the high-speed lines is done.