Conventional Radiography-A Few Challenging Applications

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Abstract

Radiography is one of the most widely used volumetric NDT methods, which is based on the differential absorption of penetrating radiation by the component. Using radiography one can examine wide variety of materials ranging from light to heavy elements, components of different size and shapes ranging from miniature electronics parts to large vessels and different products forms such as castings, weldments, composite etc. Conventional radiography, which uses X-ray machine and radioactive isotopes such as Iridium-192 and Cobalt 60 for generating penetrating radiation, is used for recording the internal defects of the object on a radiographic film. Advance radiography methods such as Micro Focal Radiography, Digital Radiography, and Real Time Radiography have been developed to offer an edge over conventional radiography for better definition and detectability of small defects, quick result and image processing. However, with all its limitations, conventional radiography can give results beyond expectation, provided the technique selected is proper and adequate. At Centre for Design and Manufacture (CDM) capability of conventional radiography was explored for the examination of Boron Carbide Pellets and Friction Stir Welded Aluminium plates, having challenging requirements.

Boron Carbide (B₄C) is an extremely hard ceramic material used in tank armor, bulletproof vests and numerous industrial applications. Control rods of nuclear reactor contain pellets of Boron Carbide, which act as neutron absorber. Pellets of Boron Carbide are manufactured by sintering process in which objects of different shapes are formed by heating metal powder at temperature below its melting point. Pores and microscopic imperfections in ceramic give rise to cracks, which can lead to potentially dangerous equipment failure. Radiography technique was developed to detect cracks, micro pores and local density variation in pellets having diameter of 11.85/11.47 mm and length in the range of 5mm to 20mm as an effective quality control tool.

Friction Stir Welding (FSW) is a solid state welding process in which metals are joined together without fusion or filler metal. The welds are created by the combined action of frictional heating and mechanical deformation due to rotating tool. This process is primarily used on Aluminium, and most often on large pieces which cannot be easily heat treated post weld to recover tempering characteristics. To establish the FSW process for
welding of 5mm aluminium plates, number of trials using different parameters were carried out at BARC. In one of the welded pieces, it was a tricky task to detect lack of penetration under the Titanium foil, which was sandwiched between two Aluminium plates butting each other. This paper presents a brief description of these two jobs, radiographic technique developed for their examination and analysis of the results.