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Improvement of Contrast and Resolution in X-Ray Radiography of Explosive Bolt by Applying Scattering and Beam Hardening Corrections

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Abstract

Explosive bolt consists of explosive material and the detonator. The explosive bolt has a reduction in thickness & taper portion from the design point of view. In this portion only, the explosive material and detonator are filled inside the bolt and an optimum gap is required to be maintained between the explosive material and detonator. The explosive bolt is evaluated by X-ray radiography technique to measure the gap. The problem is that the reduction in thickness & taper portion of bolt affects the radiographic contrast of the gap due to scatter.

We offered a solution to the above problem by providing a split bush outside the explosive bolt at the thickness reduction portion. The split bush has a matching geometry and sits at the thickness reduction area. It ensures uniform thickness of the bolt. The radiographic attenuation of the bolt and the bush materials are same. The split bush does not interfere with the inner/outer configuration of the bolt and further it can be assembled and disassembled to the bolt easily during the radiographic inspection.

The radiographs of explosive bolt with and without split bush were taken. The radiographs of the bolt with and without bush revealed clearly the explosive material, the detonator and resolved the gap between them. The results of the radiographs demonstrate that the solution offered for the problem is simple and very effective.

X-ray source is poly-energetic (photons of different energies). The attenuation at a point is generally greater for photons of lower energy, the energy distribution (spectrum) of X-ray changes (hardens) as it passes through the object. This is Beam Hardening effect.

The hardware correction for beam hardening effect on the bolt was studied by using different filter materials (Aluminum & Steel) of varying thickness in radiography. The optimum choice of filter material and its thickness were studied to improve further the contrast and resolution of the gap at the split bush portion of the bolt. 50 micron steel filter improved the contrast and resolution in radiography.