UNDERWATER TEST DIAGNOSTICS USING EXPLOSIVELY EXCITED ARGON AND LASER LIGHT PHOTOGRAPHY TECHNIQUES

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This paper presents results of photographic methods used to study high-velocity fragment deceleration, deformation and fracture during the perforation of water-backed plates in underwater tests. These methods employed overlapping ultra-high and very-high speed camera recordings using explosively-excited argon and ruby-laser light sources. These two sources gave sample light to penetrate across a 2.3 meter diameter tank of water with enough intensity to photograph displacement-time histories of steel cubes with impact-speeds of 1000 to 1500 m/s at camera framing rates of 150,000 and 17,000 fr/s respectively.
The main objective of the test program was to obtain accurate displacement-time records of performed-steel cubes penetrating thin aluminum plates backed by water. The test facility includes spaced orthogonal x-rays for pre-impact speed and orientation measurements an a Beckman and Whitley 192 (B&W 192) camera framing at near 250,000 fr/s to record preimpact and early post-impact displacement vs. time. Overlapping longer time records were provided by two orthogonal Hycam cameras framing near 17,000 fr/s. The B&W 192 films provide cube displacements vs. time at 3-6 mm intervals from the back of the plate to about 80 mm depth in the water.

The Hycams provide displacement intervals of 3-12 mm from about 25 mm behind the plate to a depth of about 630 mm. The overall displacement measuring accuracy of the system is estimated at +-2.5 mm. These photographic lighting techniques are applicable to other types of underwater events where high-speed motions occur from wither high explosives or mechanical means.