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Explosion-Induced Implosions of Cylindrical Shell Structures[1]

C.M. IKEDA, J.H. DUNCAN, University of Maryland — An experimental study of the explosion-induced implosion of cylindrical shell structures in a high-pressure water environment was performed. The shell structures are filled with air at atmospheric pressure and are placed in a large water-filled pressure vessel. The vessel is then pressurized to various levels $P_\infty = \alpha P_c$, where P_c is the natural implosion pressure of the model and α is a factor that ranges from 0.1 to 0.9. An explosive is then set off at various standoff distances, d, from the model center line, where d varies from R to $10R$ and R is the maximum radius of the explosion bubble. High-speed photography (27,000 fps) was used to observe the explosion and resulting shell structure implosion. High-frequency underwater blast sensors recorded dynamic pressure waves at 6 positions. The cylindrical models were made from aluminum (diameter $D = 39.1$ mm, wall thickness $t = 0.89$ mm, length $L = 240$ mm) and brass ($D = 16.7$ mm, $t = 0.36$ mm, $L = 152$ mm) tubes. The pressure records are interpreted in light of the high-speed movies. It is found that the implosion is induced by two mechanisms: the shockwave generated by the explosion and the jet formed during the explosion-bubble collapse. Whether an implosion is caused by the shockwave or the jet depends on the maximum bubble diameter and the standoff distance.

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