Abstract

With the advancements in weapon technology, ammunitions have become more precise and lethal. The civil structures required for storage of ammunition and for carrying out special operations have become vulnerable to the blast and shock loads of modern weapon systems. There is a need of innovative and indigenous design of Blast Valve which can fulfil the requirements of ventilation of such structures. The design demands that this device shall be automatic, inexpensive, reliable, reusable, maintenance free, self or remote actuating type and should avoid any leakage of blast pressure. In the present work, an innovative design incorporating best features of remote and self-actuated blast valves is proposed. Since it is a challenge to validate and optimise the design of a valve against blast loads using full-scale experiments, Finite Element Method (FEM) and Computational Fluid Dynamics (CFD) are employed for modelling and simulation of blast valve. The shock-structure interaction analysis of different configurations of the blast valve are performed using ANSYS AUTODYN in order to optimise the design. One of the most important components of the blast valve is circular plate exposed to blast loadings. To understand the effect of blast wave on circular plate and hemispherical shells, the experiments are performed using a shock tube test facility. Plates and shells of different thickness and curvature are subjected to varying blast loads, and strains at different locations are measured in order to optimise the same. The whole exercise in the present research work is carried out to address leakage problem in existing blast valves in order to achieve a design of blast valve with minimum or no leakage.

Based on the detailed simulations, the final blast valve design is obtained. The impor-

tant features of the final design are: VLC-shaped air flow channel with the outer body materials SS304 and closure mechanism materials DOMEX700MC grade steel, overall length = 750 mm, outer diameter = 420 mm and inlet diameter = 100 mm. The connecting rod is of 10 mm diameter and 614.58 mm long. Hemispherical shell with 96 mm radius of curvature with gradually decreasing thickness from 5 mm at center till 2.5 mm at periphery is used for front and rear closure. The valve is designed for incident pressure of 3 bar and 3.7 ms duration and peak reflected pressure of 7 bar. The air flow rate is 0.14 kg/s under 3000 Pa pressure difference between inlet and outlet.