An Experimental and Numerical Investigation of Shock-Cylinder Interaction

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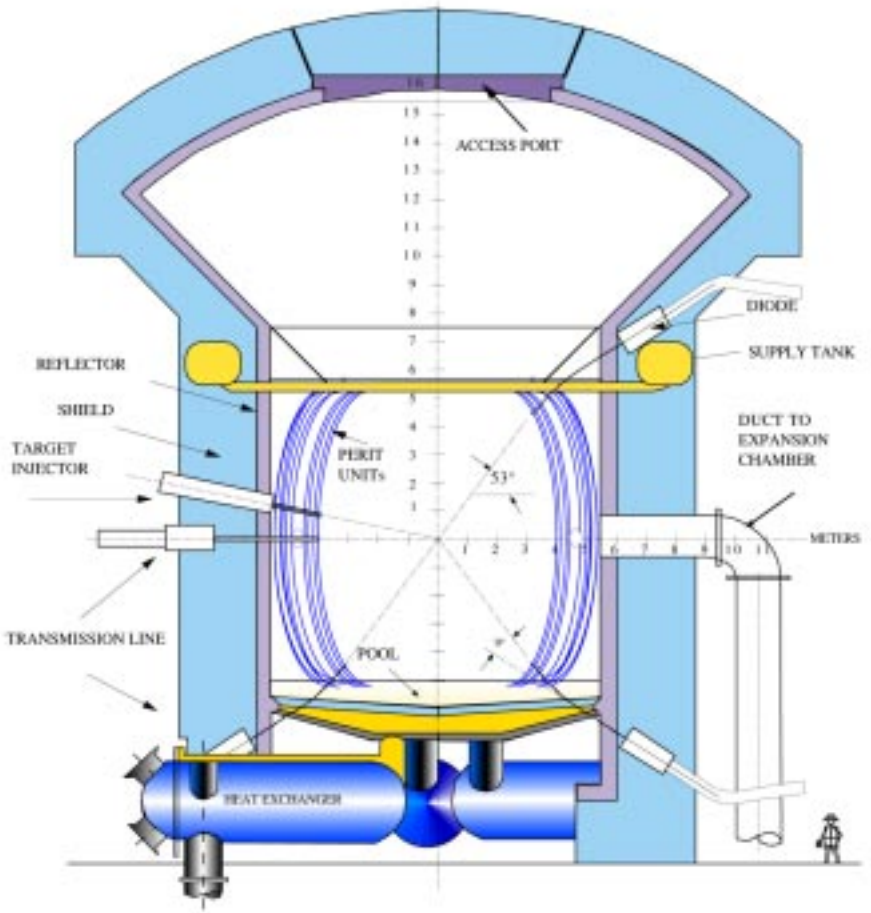
IFE Reactor Concept

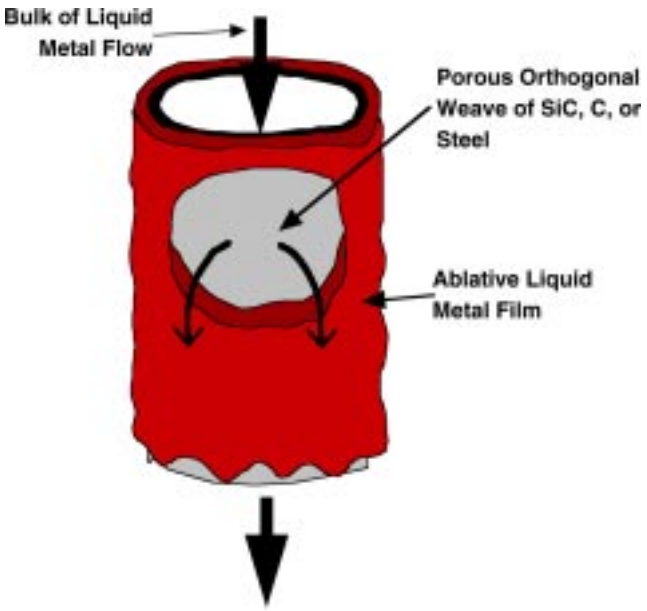


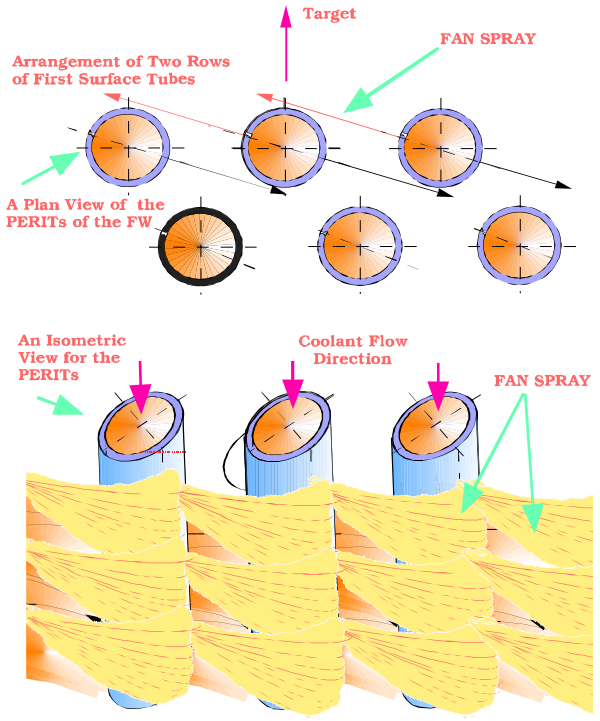
Cross-Section of the LIBRA-SP Target Chamber

LIBRA-SP concept design for inertial fusion energy (IFE) reactor. The DT pellet is injected from the top and detonated at the center of the chamber. The tubes on the walls of the chamber carry liquid metal to absorb the heat and particles. These tubes must also be able to withstand the impulsive loading of the shock wave from the fusion reaction.

Concepts for Cooling Tubes

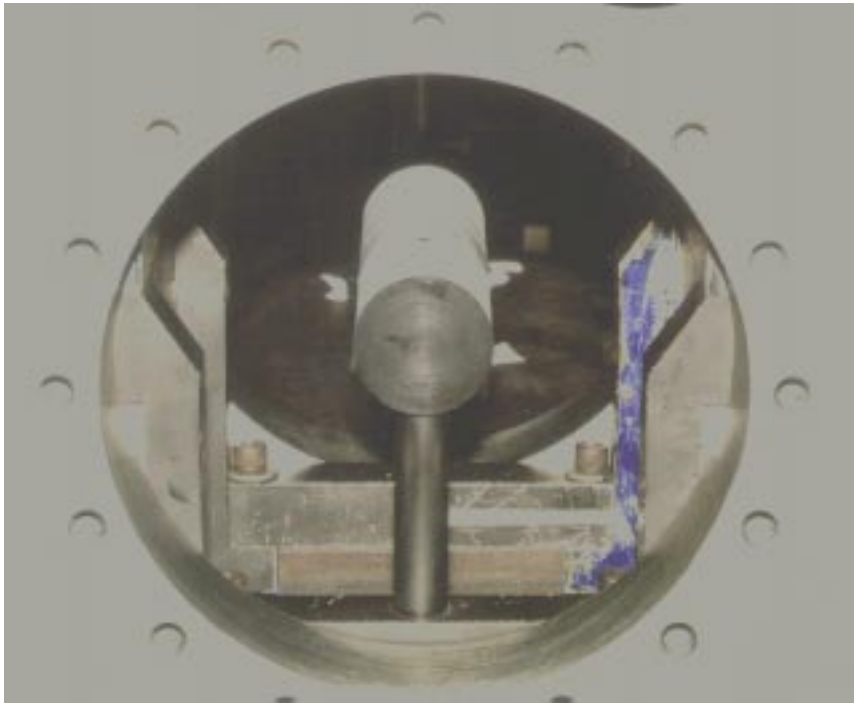
Two designs of the cooling tubes are shown. One uses a porous wall and the other uses jets to create a liquid metal sheet. The layout of the multi-wall tube bank is shown.

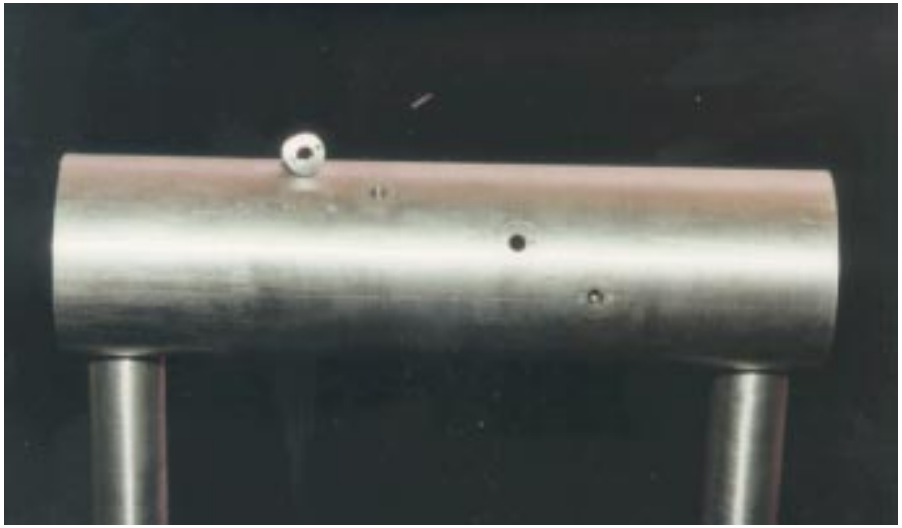




First Surface Protection by Fan Spray

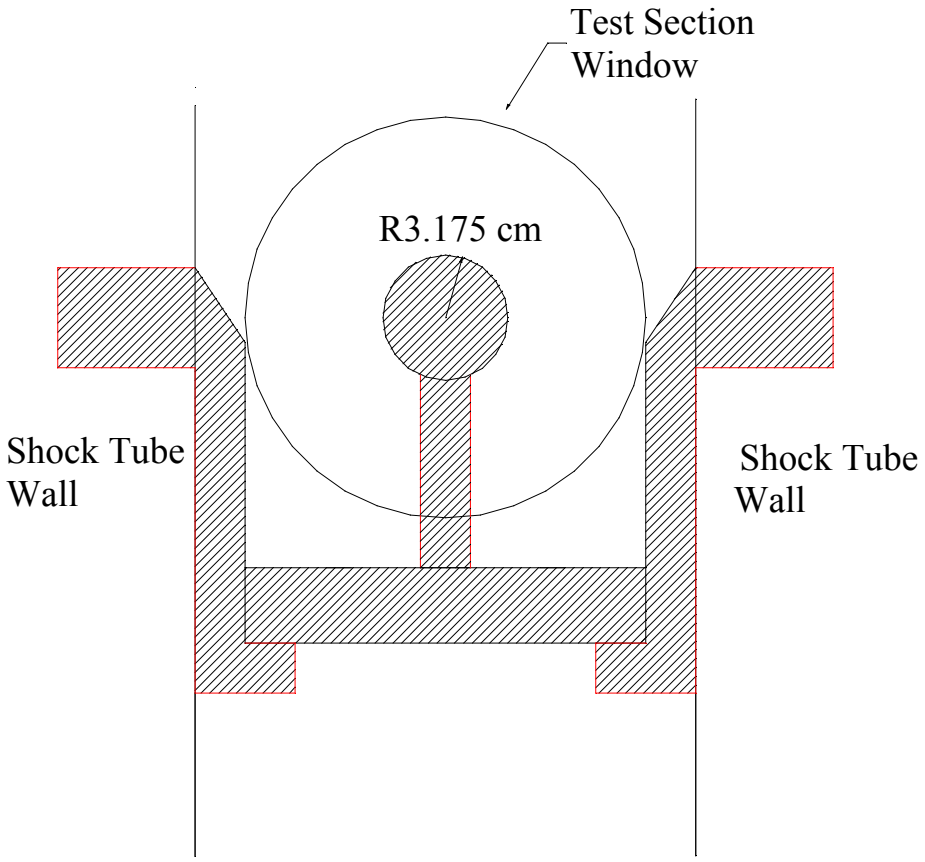
Cylinder Used in Experiments



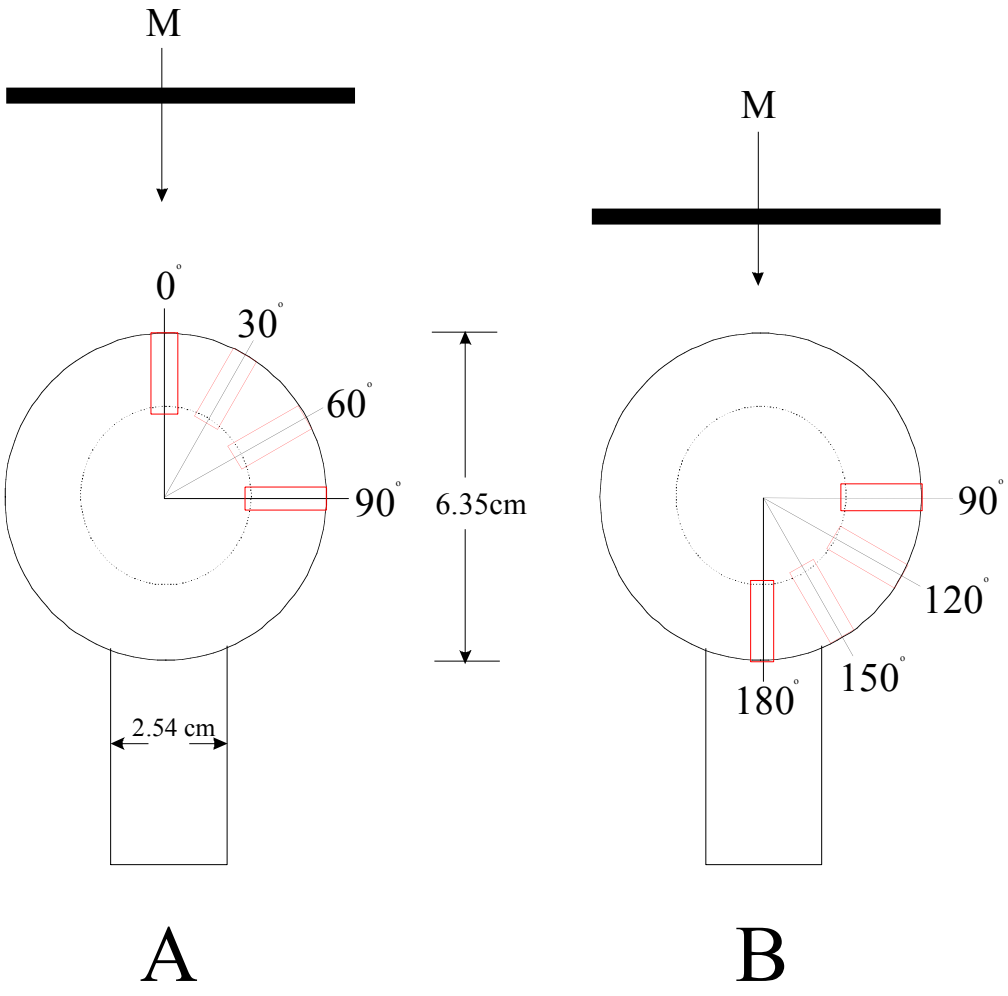


Photographs of the experimental setup used to study the shock-cylinder interaction. The photograph on the left shows the cylinder in the test section. The photograph on the right shows the pressure transducer ports on the surface of the cylinder.

Schematic of Cylinder and Support Structure

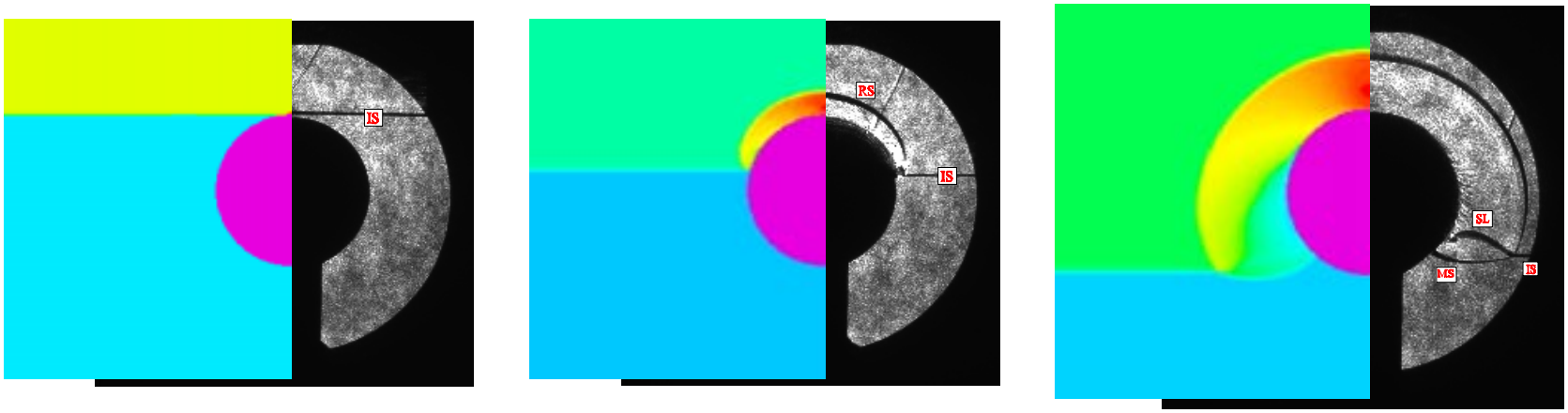


Schematic of Cylinder Arrangement



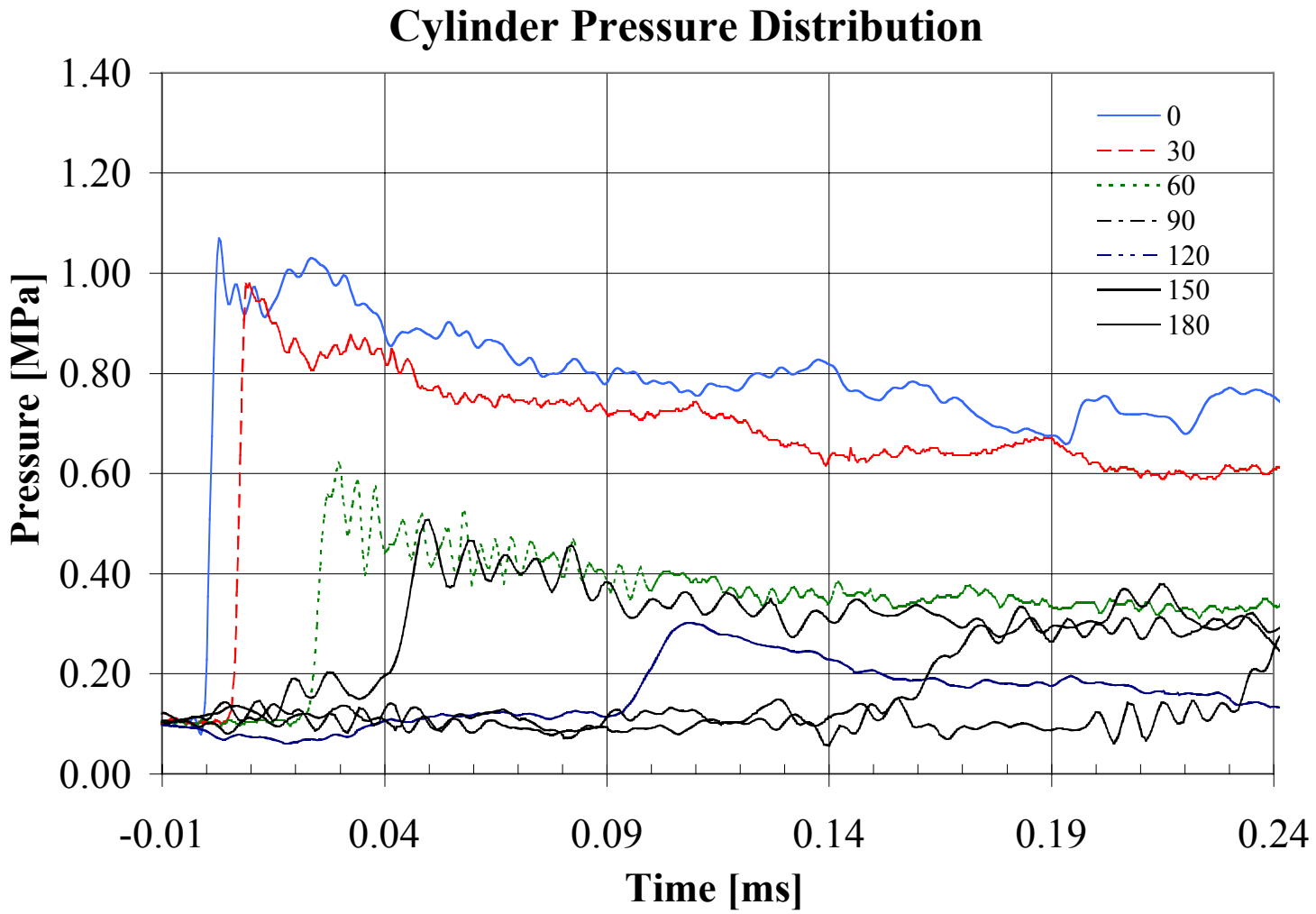
This schematic shows the arrangement of the cylinder and the locations of the pressure transducers.

Density Contour Plot Comparison

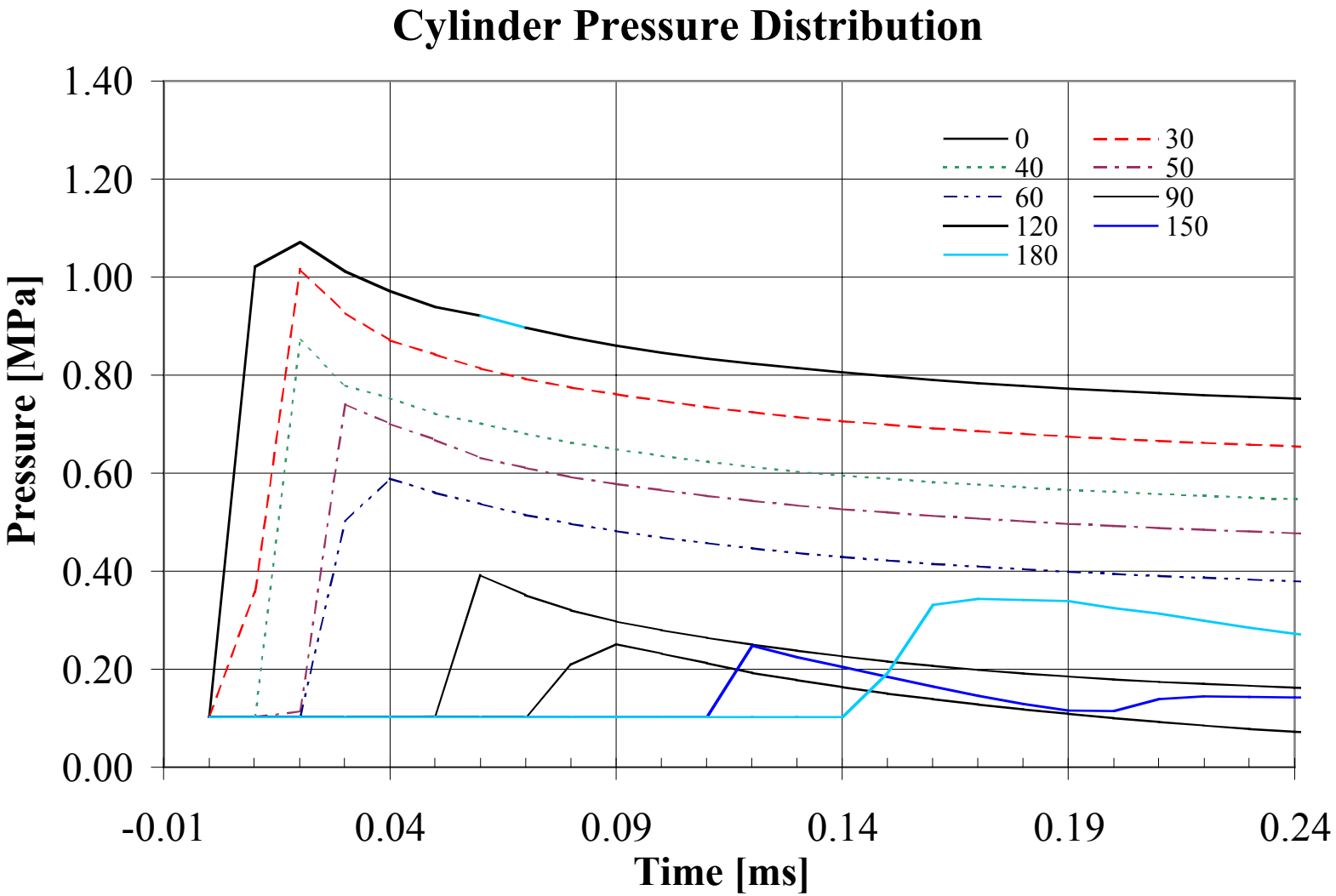


Density contour plots from the numerical simulation using RAGE compared to the experimental shadowgraphs. The times of the numerical simulations are t=0, t=0.03 and t=0.08 ms after a 1.85 Mach shock makes contact with the cylinder. The experimental images were taken at a time of t=0, t=0.05 and t=0.09 ms respectively.

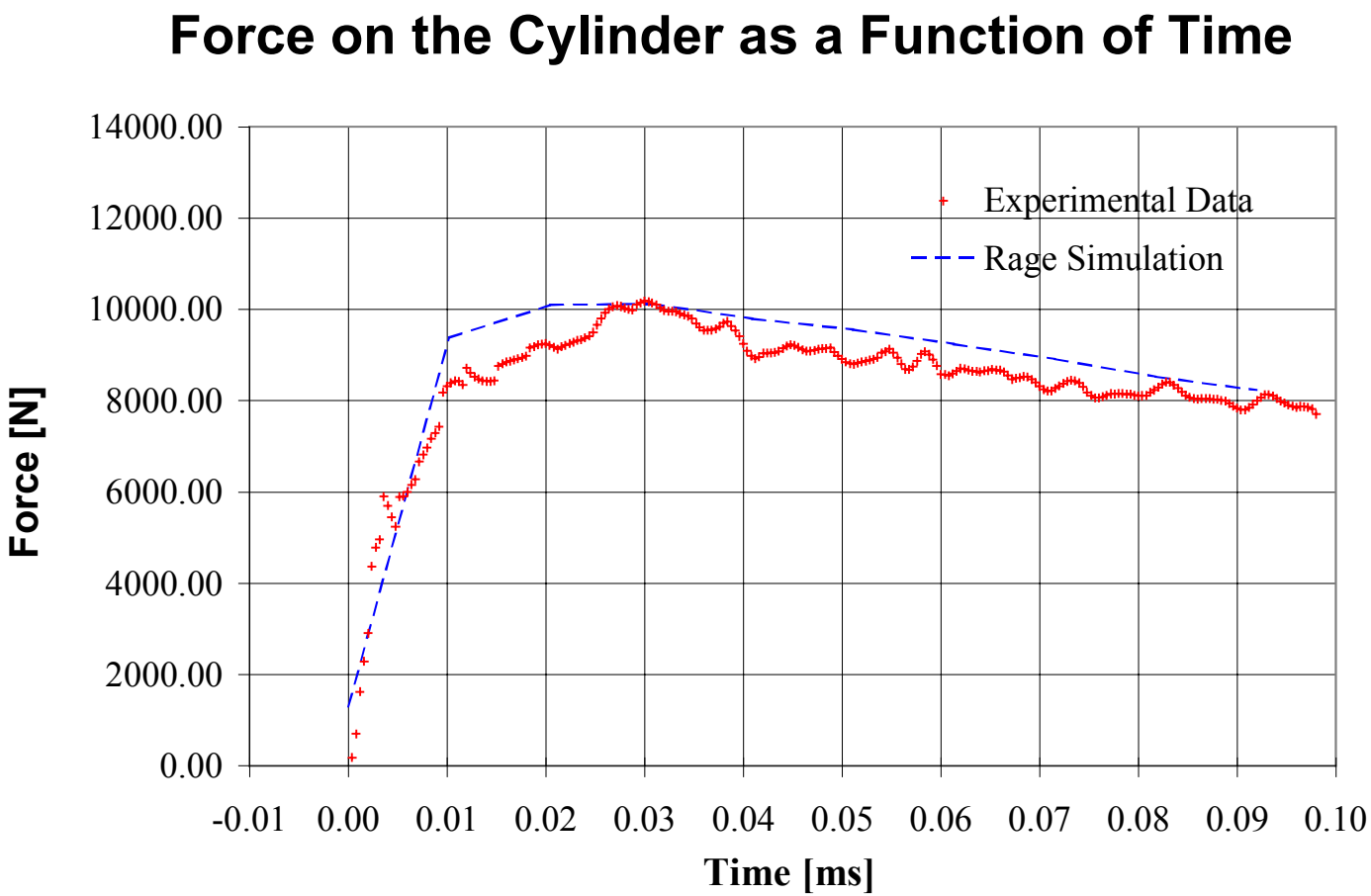
Cylinder Pressure Data (Experiment)



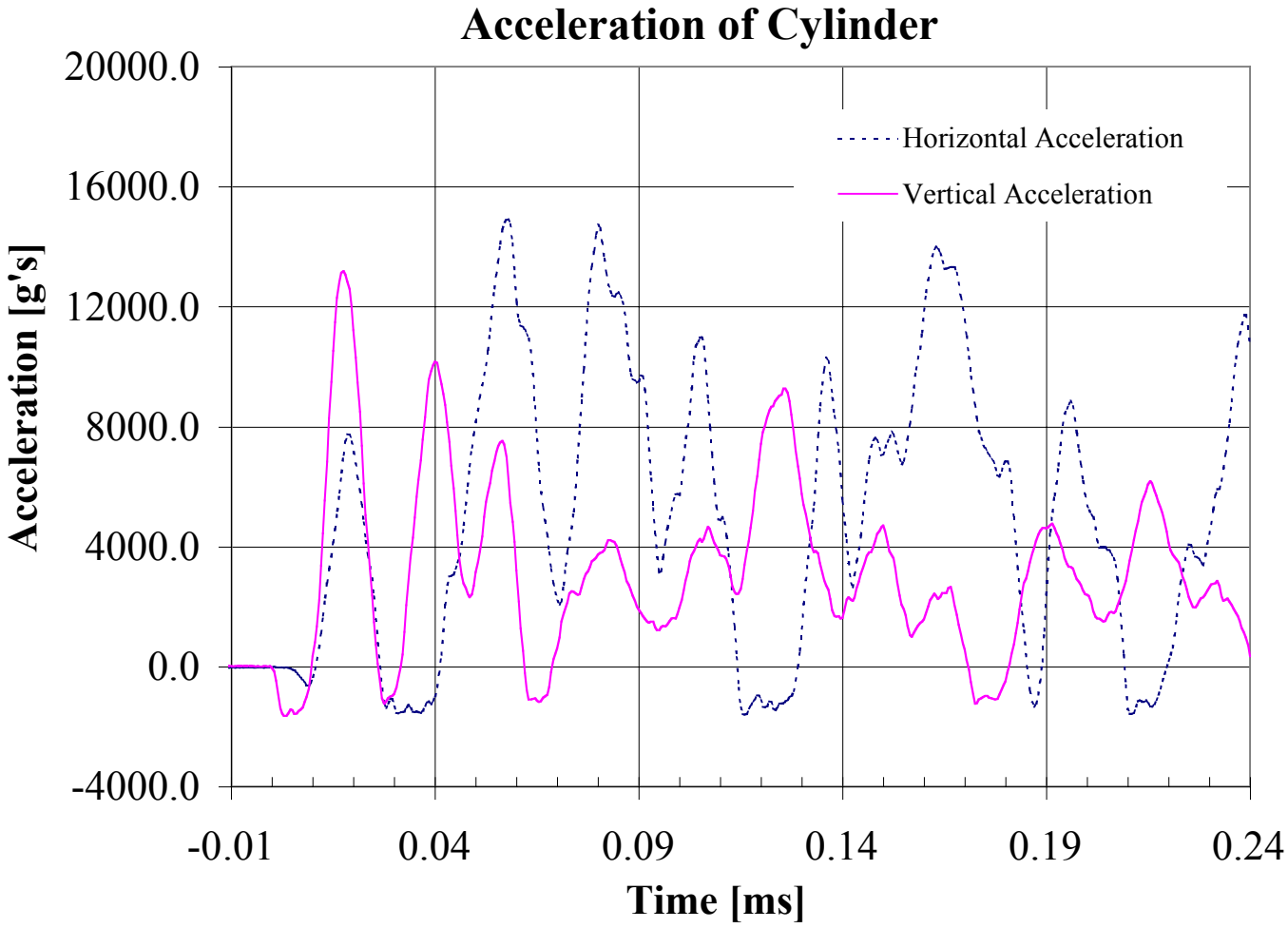
Cylinder Pressure Data (RAGE Simulation)



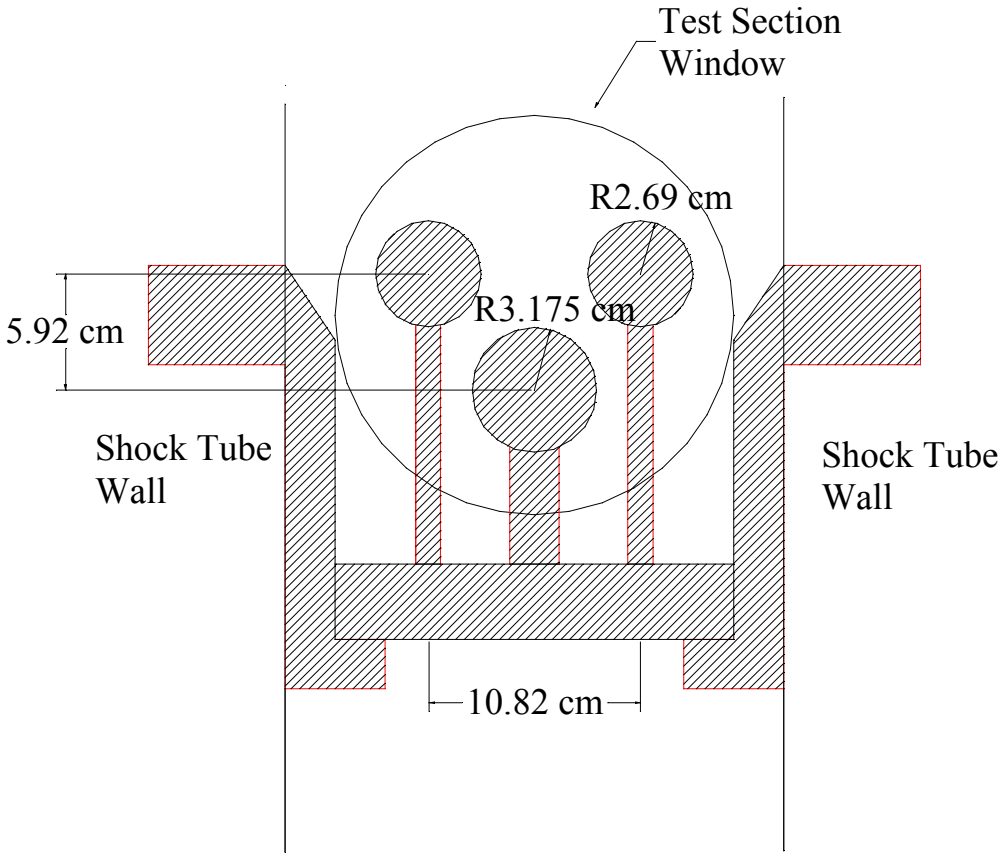
Comparison of Impulse from Experiment and Simulation



Experimental Acceleration History



Schematic of Three Cylinder Arrangement



RAGE Simulation of UW Shock Tube Cylinder Experiment