HIGH VELOCITY IMPACT GENERATED AIR BLAST

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High velocity impactors or re-entry vehicles produce air blast by three very different mechanisms. Because they are supersonic, they will produce a bow shock which is often referred to as a sonic boom. The pressure in the bow shock is a function of the shape of the incoming re-entry body and a function of the velocity. Blunt objects and high velocities form stronger bow shocks. A cylindrical body at 10 kft/sec produces a bow shock of ~150 PSI that extends well behind the incoming vehicle.

The re-entry body forms a long cylindrical cavity in the atmosphere behind the re-entering body. This cavity is tens to hundreds of meters long with a diameter of 1 to 3 times the diameter of the solid body. The air in this cylinder has a velocity of approximately that of the incoming body and a density just below ambient atmospheric. This column of air has a dynamic pressure of about 50 bars at 10 kft/sec near sea level. The stagnation pressure of this column of air will be the order of the dynamic pressure and the total energy released is a function of the length and diameter of the air column.

The greatest amount of energy available for air blast comes from the stagnation of the kinetic energy of the impactor itself. Small scale experiments indicate that the energy going into cratering goes as the 1.74 power of the impactor velocity. The total kinetic energy goes as the velocity squared. The difference in these energies is the energy available to form air blast. At 10 kft/sec, the excess energy is over 90% of the total incoming kinetic energy. The impactor energy available for air blast is therefore nearly twice that of the detonation of the same mass of TNT.

This paper gives examples of the potential generation of air blast by each of the three sources mentioned above; bow shock, air column, and sudden conversion of kinetic energy.

Some recently discovered data from a 1973 Sandia sled test supports the high proportion of kinetic energy converted into airblast.

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