CHAM

Pioneering CFD Software for Education & Industry

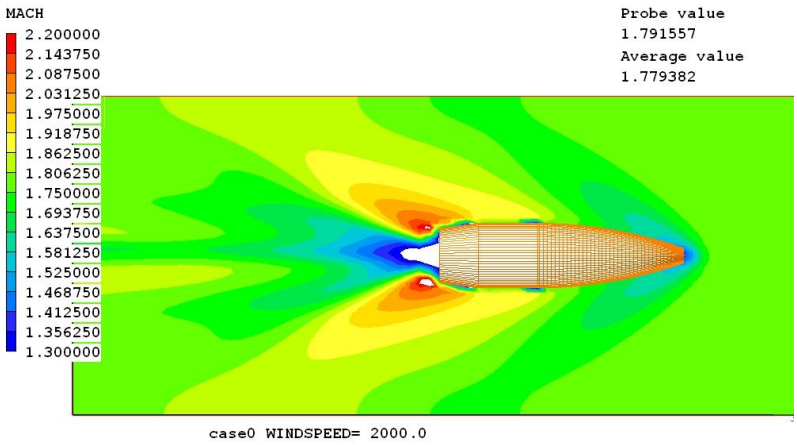
Winter sports ammunition

PHOENICS Case Study – Bullet Aerodynamics

British ammunition manufacturers, Eley Limited, approached CHAM to gain a greater understanding of the flow of air, pressure point and aerodynamic properties of different shapes of bullet used in a variety of sports shooting events with a view to optimize the profile/shape of their bullets to make them more stable and more consistent overall.

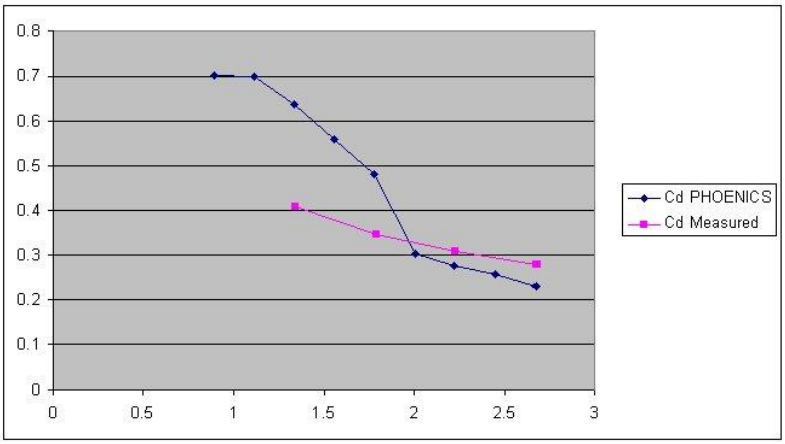
Before modelling Eley's ammunition range, CHAM produced results for flows around bullets for which measured data existed for validation. PHOENICS offers options for using a body-fitted-coordinate grid or an unstructured grid but the initial demonstration case was performed using quite a coarse 3D Cartesian mesh to highlight the robustness of PARSOL for this type of application.

The figure below shows an example bullet travelling at 2000 feet/sec (609 m/sec, Mach 1.78).

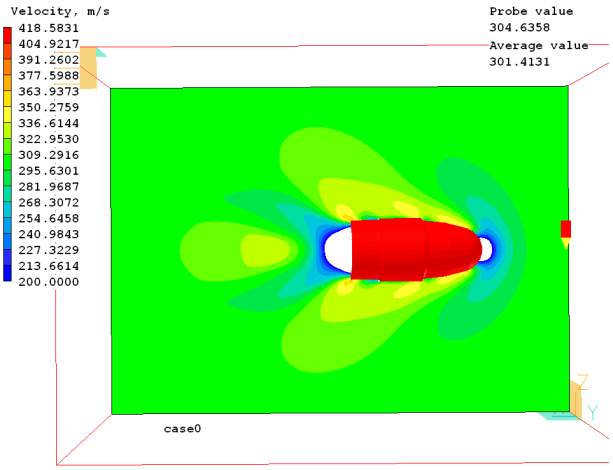


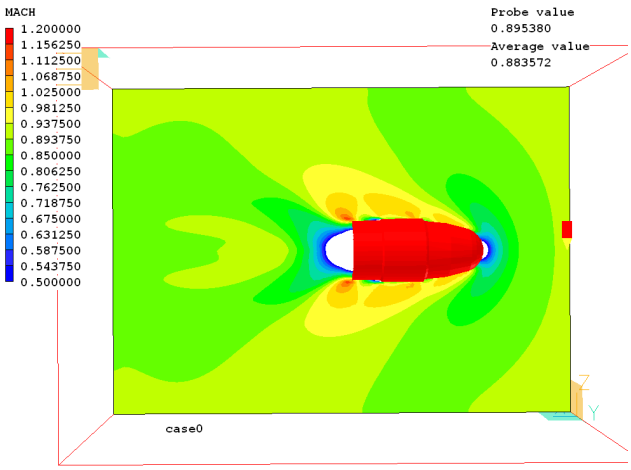
A range of Mach numbers were run producing the comparison against measurement shown below.

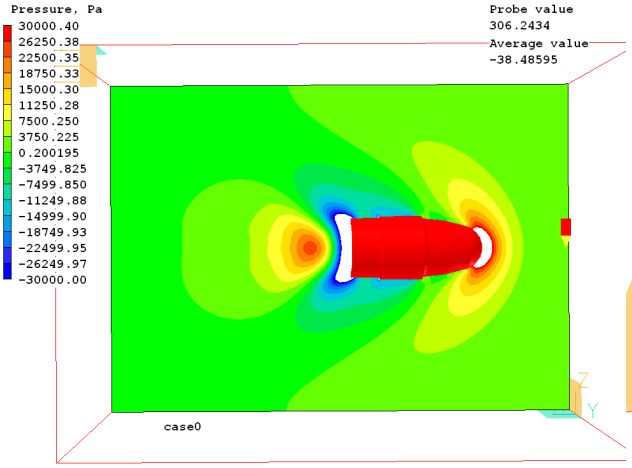
The graph compares a range of PHOENICS results (blue line) with experimental data (red line). The results are quite good. Experiments show a slightly higher drag coefficient; this may be due to the bullet actually flying at a small incidence as the bullet 'cones' around its direction of flight.

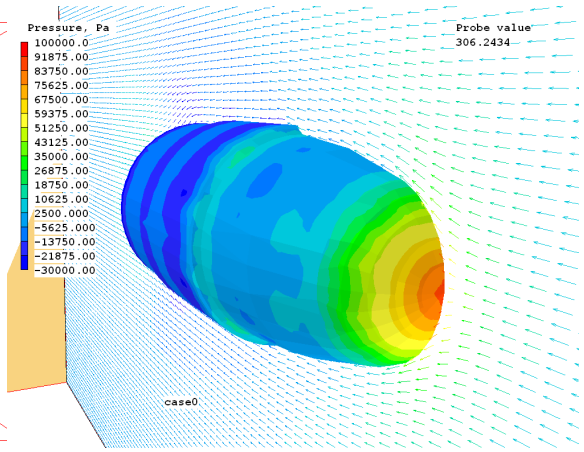


Shown below are more images using a bullet, resembling one of the designs used by Eley, travelling at a muzzle velocity of 1000 feet per second.









A spherical indented base was added, and the calculated mass of the bullet matched the Eley data to about 2% (assuming a bullet-density of Lead). The calculated Cd at this speed, with no angle of incidence, was 0.564 based on the .22 inch diameter and 1000 fps[= 304.8 m/s]. It might be expected that when modelled "at incidence", the drag will increase slightly (perhaps 20% at a few degrees).

There are small regions of transonic/supersonic flow predicted which is a region where CFD has considerable difficulty in predictions. Calculations later in flight, when the bullet has slowed, should be more reliable.

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