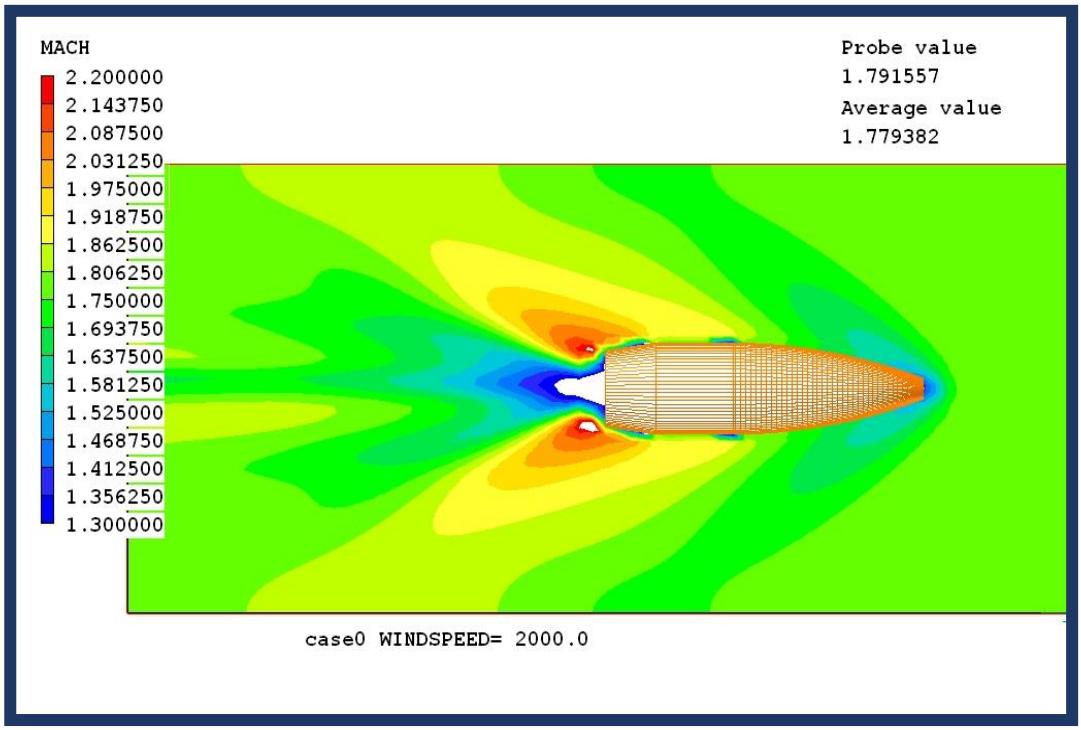
CHAM

PHOENICS – Your Gateway to CFD Success
Bullet Aerodynamics – Winter Sports Ammunition

British ammunition manufacturers, Eley Limited, approached CHAM to have PHOENICS model the flow of air, pressure point and aerodynamic properties of different bullet shapes used in various shooting events with a view to gaining a greater understanding in order to optimize the profile/shape of their bullets to maximize consistency and stability.

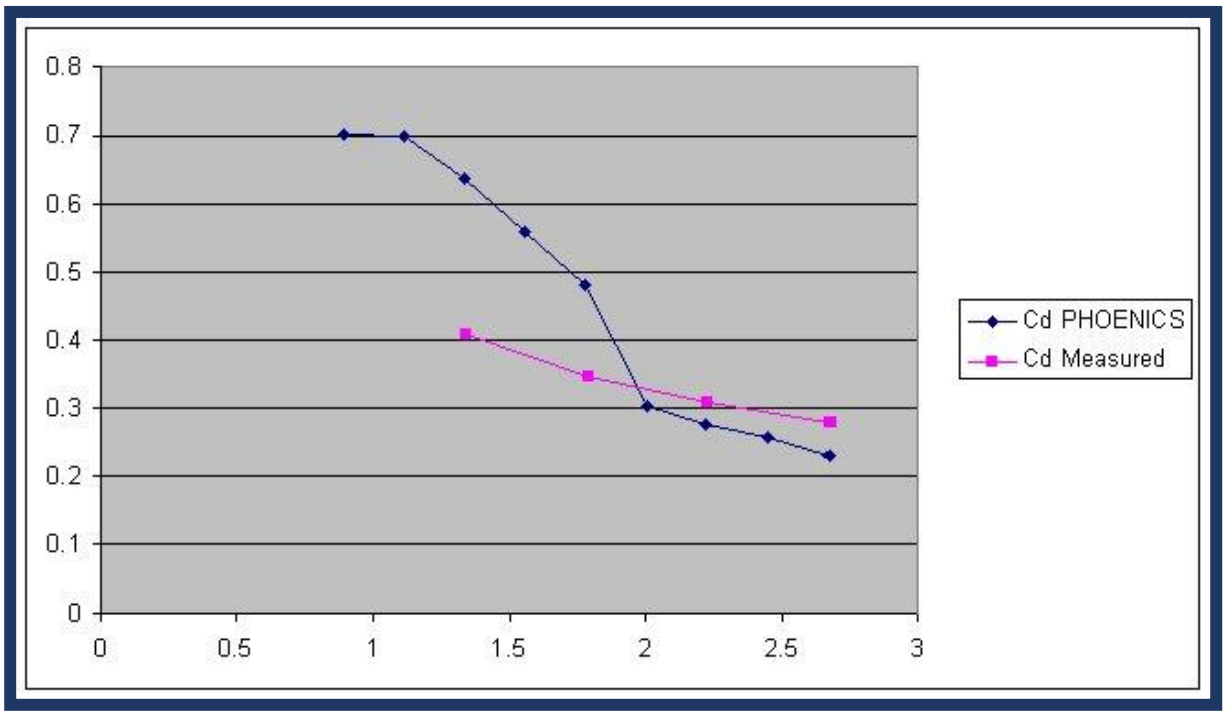
Before turning to Eley's ammunition range, CHAM produced results for flow around bullets to validate the process against existing measured data. Whilst PHOENICS offers options for using a body-fitted-coordinate grid or unstructured grid, an initial demonstration case was performed using quite a coarse 3D Cartesian mesh, to highlight the robustness of PARSOL for this type of application.



Above is shown an example bullet travelling at 2000 feet/sec (609 m/sec, Mach 1.78).

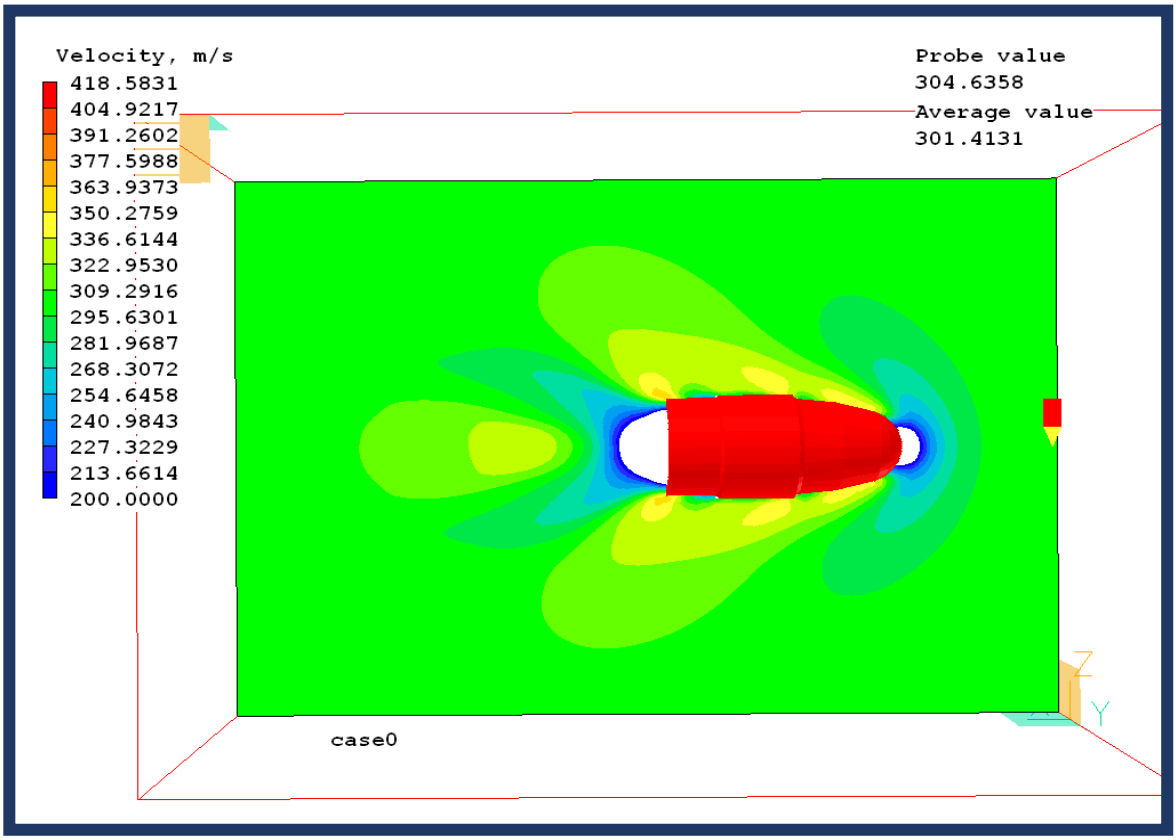
A range of Mach numbers were run producing the comparison against measurement shown below.

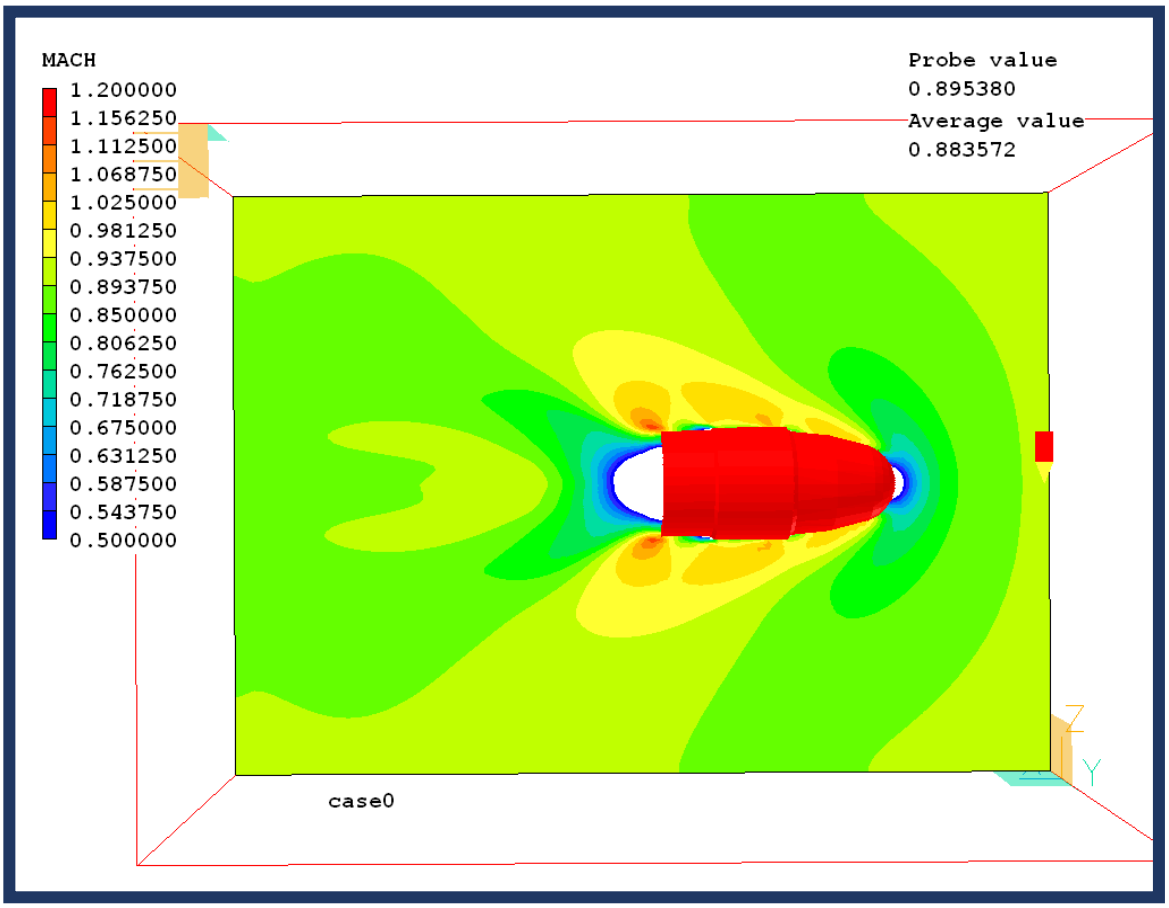
Concentration Heat and Momentum Limited, Bakery House, 40 High Street, Wimbledon, London SW19 5AU, UK
Telephone: 020 8947 7651 Fax: 020 8879 3497
E-mail: phoenics@cham.co.uk, Web site: http://www.cham.co.uk

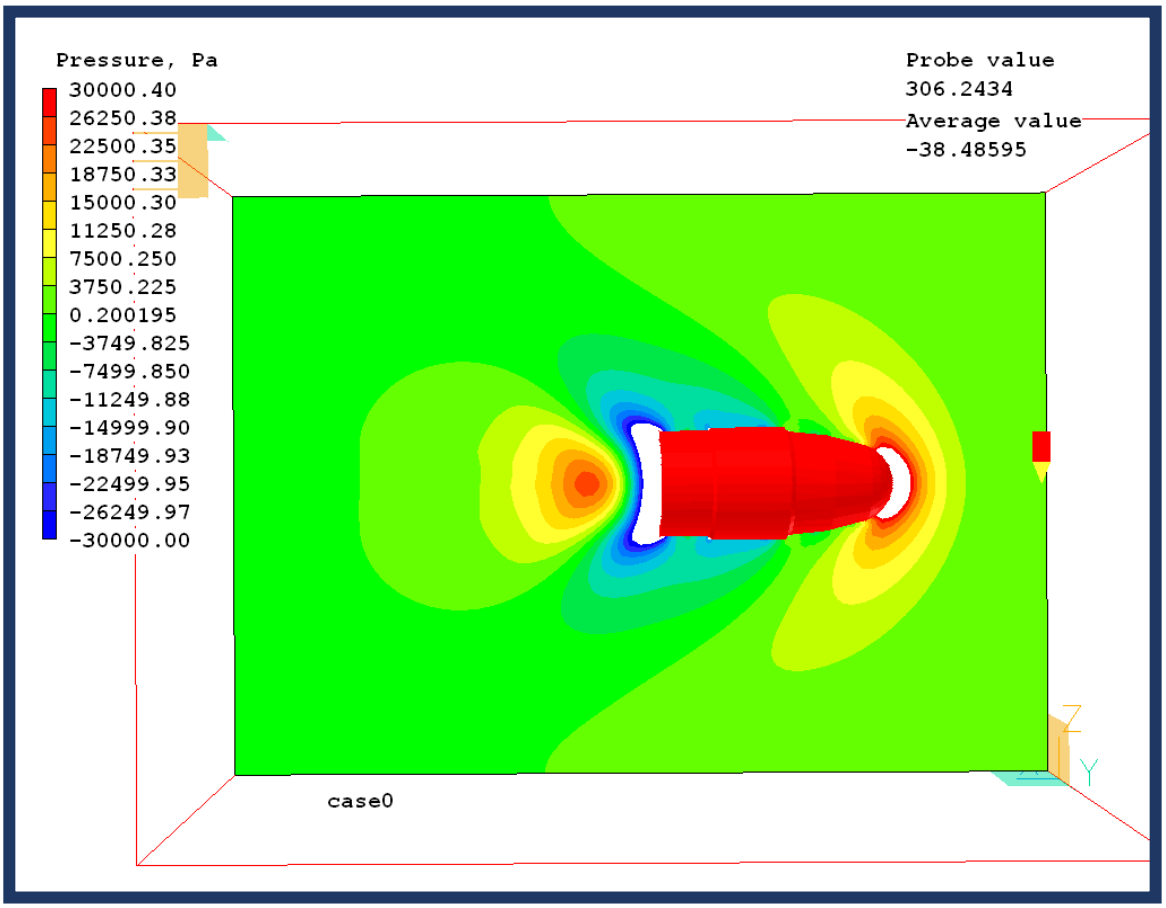


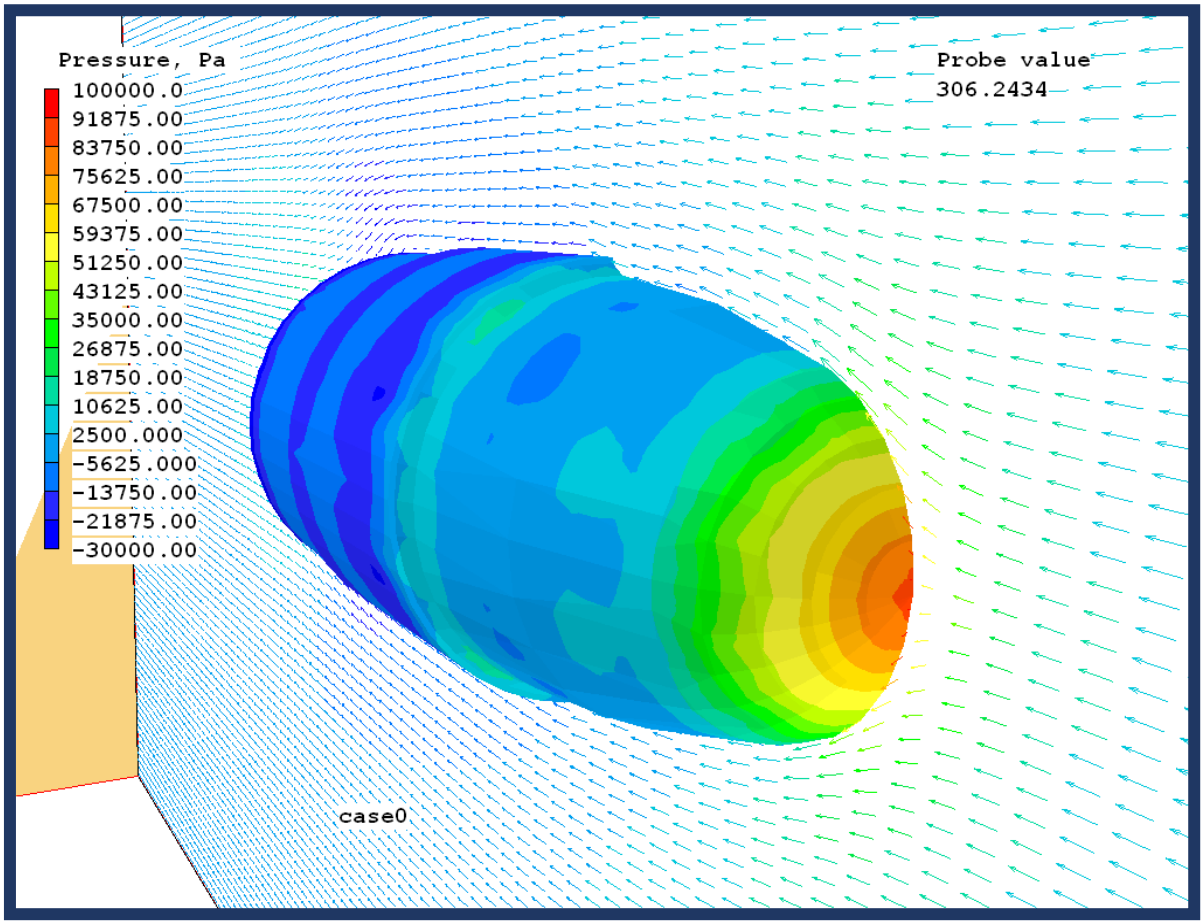
The graph compares PHOENICS results (blue) with experimental data (red). Experiments show a slightly higher drag coefficient which may be due to the bullet flying at a small incidence as it 'cones' around its direction of flight.

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.




MACH
1.200000
1.156250
1.112500
1.068750
1.025000
0.981250
0.937500
0.893750
0.850000
0.806250
0.762500
0.718750
0.675000
0.631250
0.587500
0.543750
0.500000
Probe value
0.895380
Average value
0.883572
Z
Y
case0


Pressure, Pa
30000.40
26250.38
22500.35
18750.33
15000.30
11250.28
7500.250
3750.225
0.200195
-3749.825
-7499.850
-11249.88
-14999.90
-18749.93
-22499.95
-26249.97
-30000.00
Probe value
306.2434
Average value
-38.48595
Z
Y
case0



A spherical indented base was added, and the calculated mass of the bullet matched 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.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).