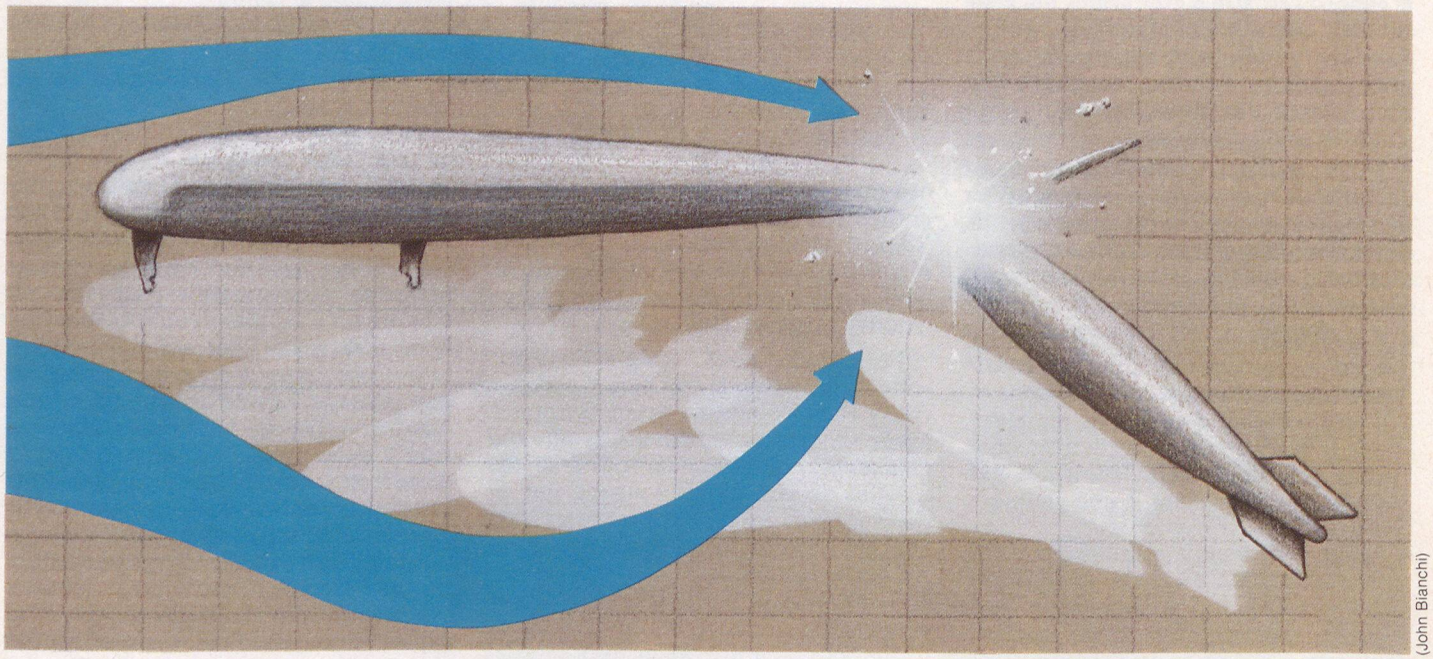
Mediating Mach's mechanics

Bombs away?



(John Bianchi)

Airflow around underwing containers can cause them to loft when released and strike the aircraft.

L'écoulement aérodynamique autour des charges externes peut provoquer la remontée de la charge après son larguage et sa collision avec l'avion.

At the speeds at which modern fighter aircraft travel, approaching or even exceeding the speed of sound, strange things sometimes happen if they're loaded with externally carried cargo (usually fuel tanks, bombs, or other weapons). The pilot finds the aircraft difficult to fly, it loses stability, and severe vibrations occur. Sometimes these vibrations become so violent that they are uncontrollable, developing into what aerodynamics scientists call "flutter," and lead to break-up of the vehicle.

When stores (in military parlance, anything carried externally by a military aircraft) are released near the speed of sound (transonic speeds), a whole new set of problems can arise. It's even possible for something as heavy as a bomb, after falling a metre or so, to rise as the aircraft moves ahead, and collide with the tail section of the craft. Other problems are posed by stores such as extra fuel tanks, rockets, or electronic countermeasures equipment.

At the request of the Department of National Defence (DND), NRC's National Aeronautical Establishment (NAE) has been studying such effects during the past two years. The aim is to ensure that Canada's military aircraft can do the jobs they are meant to do with maximum safety for their crews and minimum damage to themselves.

Until the late 1970s, DND had to buy the knowledge it sought about such problems from other countries. This was not only an expensive method of problem solving, it was not very far-sighted. A contract had to be drawn up for every individual problem encountered, and DND had not identified a Canadian group to deal with problems that were unique to Canada.

The NAE efforts are part of an overall program to acquire complete Canadian capability for what it calls "stores clearance," meaning the safe carriage and release of external stores on aircraft. This involves, besides NAE, Canadair and, of course, DND itself.

NAE calls its project Aircraft External Stores Clearance. More and more military aircraft stores are being carried externally these days, because most of them are so big in relation to the aircraft that they cannot be carried inside.

"We're concerned mainly with the external stores problems of military strike aircraft in this laboratory," says Dennis Brown, of NAE, "the kind of stores that extend the range of the aircraft, or are part of its weapons system."

Aircraft weapons were first carried outside the aircraft fuselage (body) in the early days of aerial warfare. Later, particularly during the Second World War, they were carried inside; bombs, for example, were dropped out of bomb-bays. But, as high-thrust engines became available, the weapons could be shifted outside and carried in considerable numbers, mainly from pylons attached to the lower surface of the wings.

Problems became evident when the speed at which such stores were carried and released became progressively higher. Large and unexpected aerodynamic forces were generated, which caused instabilities and even break-up of aircraft during carriage; another hazard was tumbling and collisions between bombs and aircraft after release. Even without external stores, aircraft travelling at around the speed of sound experienced problems, but carrying stores made the problems worse.

NAE's approach to the solution of such problems is partly theoretical and partly experimental. Some of the experiments are carried out with models in a wind tunnel to measure the aerodynamic characteristics of the shapes of the stores to be carried. This is done using models of the aircraft and their cargoes; force-measuring devices are installed in the models to determine what happens under simulated flying conditions. The results can be scaled up to show what would happen in actual flight conditions, and the approximation can be a good one according to Dr. Brown.

He uses the word "approximation" because, of course, conditions with models in wind tunnels are not exactly the same as those found in flight. For