Mr. Cooper explains that there are two types of retarding force that a vehicle must overcome — rolling resistance and aerodynamic drag. Rolling resistance, related to vehicle weight and including the "drag" of tires, wheel bearings and transmission, is nearly constant with speed. Aerodynamic drag on the other hand is proportional to the square of the speed — at low speeds it is of considerably less significance than rolling resistance — but as speed increases, it rapidly becomes a force to be reckoned with. For most heavy trucks, aerodynamic drag is equal to rolling resistance at a speed of 50 - 60 mph (90 - 100 km/h), so any reduction in drag will have a significant effect.

The exact speed at which aerodynamic drag begins to overtake rolling resistance is dependent upon the "density" of the vehicle — the relationship between vehicle weight and frontal area. "You can see the significance of this," says Mr. Cooper, "if we compare the typical highway tractor-trailer unit with a single chassis truck. With the tractor-trailer, you have quite a "dense" vehicle. But with a single-chassis truck you will have about the same frontal area, but only one-third of the weight, so aerodynamic drag is going to be an important factor at lower speeds, typical of city operation. We've been able to show CP Transport that they may be able to save as large a fraction of fuel on their straight truck operations around cities as they can on their intercity tractor-trailers by improving the aerodynamic performance."

Aerodynamically, trucks are very badly shaped. The blunt contours of tractor units, and the box-shaped trailers, offer considerable air resistance in the form of pressure forces, positive on the front faces of the trailer and negative at the rear face of the trailer. One method of gaining noticeable reduction in the positive pressures is to deflect the airstream flowing over the tractor cab's roof upwards and over the trailer. Deflectors of this kind, first introduced by the Rudkin-Wiley Corporation as the "Airshield", are essentially slightly curved plates mounted on the cab roof. And they achieve a significant reduction in drag, providing fuel savings of 6 to 8 per cent.

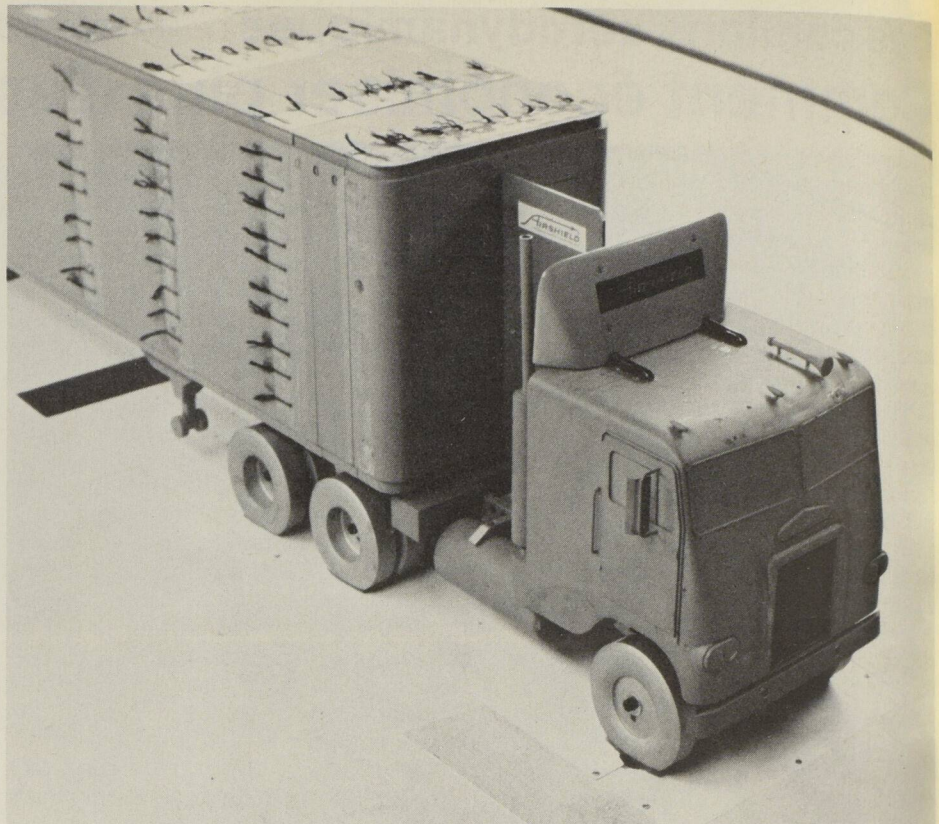
Even more complex roof-mounted deflectors have been developed. While the basic deflector is essentially a curved plate, more sophisticated models are designed to be effective in the lateral as well as the longitudinal plane. Mr. Cooper points out: "these deflectors have a more three-dimensional shape and they offer further improvements, especially in strong side winds. Potentially, up to a 20 per cent reduction in fuel consumption might be brought about through aerodynamic modifications to tractor-trailer units." Though enclosing the whole tractor-trailer unit in a carefully designed streamlined structure would give dramatic drag reductions, Mr. Cooper points out it would be totally impractical from an economic viewpoint. "It is the old story of the law of diminishing returns," he says. "The first 60 to 70 per cent of the possible drag reduction can be obtained fairly easily; the last 30 or 40 per cent is much more difficult to achieve and may not be cost-effective."

Previous work by the Low Speed Aerodynamics Laboratory on elevated transit vehicles showed that significant aerodynamic improvements could be achieved by "rounding off" the sharp edges of the rectangular vehicles.

Mr. Cooper is particularly interested in several future areas of investigation — the refinement of wind-tunnel testing techniques and, on a more immediately applicable level, improvement of the aerodynamic performance of both the tractor unit as well as the front and rear ends and the underside of the trailer. "More and more people are using wind tunnels to evaluate vehicle performance," says Mr. Cooper, "especially in the field of heavy transportation, but we need to refine our techniques and establish some generally accepted testing standards."

While Mr. Cooper is quick to point out that significant fuel economies can be realized by other than aerodynamic means (he cites radial-ply tires, electrically driven radiator fans and revised engine design), he emphasizes that aerodynamic modifications will probably make the largest single contribution to fuel economy and that truck operators are likely to adopt these modifications as the price of fuel continues to rise. It seems, then, that giant transporters fitted out with various kinds of air deflectors, aerofoils and other devices will become an increasingly familiar sight to highway motorists. □

David Mosey



National Aeronautical Establishment, NRC/Établissement aéronautique national, CNRC

A model truck, equipped with a deflector on the tractor roof and a "gap shield" to seal the space between tractor and trailer. Wind tunnel tests indicated, and full-scale road tests confirmed, that this prototype design is very effective for reducing aerodynamic drag. The wool tufts attached to the model enable researchers to "see" the air flow.

Maquette de camion avec déflecteur installé sur le toit de la cabine du tracteur et «panneau intercalaire vertical» occupant la partie médiane séparant le tracteur de la remorque. Les essais en soufflerie, confirmés par les essais routiers, ont montré que cette configuration est très efficace pour réduire la traînée aérodynamique. Les brins de laine fixés sur la maquette permettent aux chercheurs de visualiser l'écoulement.