

A Guide to

Vehicle Aerodynamics

A streamlined vehicle shape is vital in reducing fuel usage by up to 7%. Anything which changes the vehicle outline can add to fuel usage. This guide gives checklists and advice on commercial vehicle aerodynamics for energy management.



INTRODUCTION

Vehicles with an aerodynamic shape use less fuel. Air flows easily over them and less energy is needed to move them forward. At 95 Km/h 60-70% of a vehicle's energy is used to move it through the air, compared with only 40% at 50 Km/h.

Installing a sloping front roof on a lorry could save you as much as 7% of your fuel costs. Even small changes to design and shape will make a difference.

Take a look at the Aerodynamic Checklist, walk around your vehicle and look at each feature to see what improvements you can make. Don't forget, a driver's daily vehicle check needs to include looking out for these improvements.

This document covers the aerodynamic styling of commercial vehicles. Vehicles that travel at higher speeds and for longer distances will benefit most from aerodynamic styling, giving you greater savings. Drag is the energy lost pushing through air, and it accounts for most of the fuel used on long-distance journeys, regardless of vehicle type.

- Overcoming drag uses approx. 60% of fuel used at cruising speeds when loaded, 70% when empty.
- Sharp corners, racks and parts that stick out will add "parasitic drag", further reducing fuel efficiency.

IDENTIFY & PLAN / EXAMINE

Take a look at the checklist on the next page. Here you will see a list of options that will help you reduce the drag on your vehicles.

- Select features suited to your business (see Reducing Air Drag on the back page).
- Be aware of the limitations of manufacturers claims, test tracks rarely feature traffic congestion.
- Consider all aspects of aerodynamics, weight and capacity when specifying bodywork.

TAKE ACTION / DO

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| ▪ Keep curtains, curtain straps and buckles taut. | ▪ Use a cover or sheet on tipper bodies. |
| ▪ Promptly repair body damage, particularly holes in curtains. | ▪ Match a cab roof deflector to its trailer. |
| | ▪ Emphasize to drivers the importance of aerodynamic aids and adjustments. |

AVOID/DON'T

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|--|--|
| ▪ Heavily ribbed bodywork. | ▪ A cab that has a large frontal surface area. Smaller, streamlined cabs are more aerodynamic. |
| ▪ A body (box, trailer, container etc) higher than the cab or its deflector. | ▪ Fitting roof accessories such as lights and horns. If additional lighting is needed, ask for roof lights to be integrated into a roof deflector. |

ARCTIC AND RIGID BODY VEHICLES

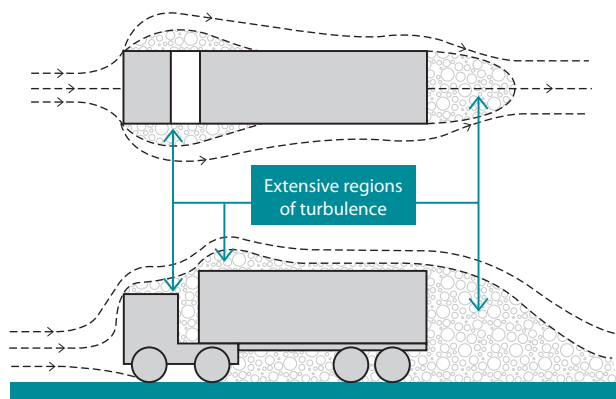
Investing in good aerodynamic styling on new trucks will repay your investment. Manufacturers go to enormous expense using wind tunnels to improve aerodynamic stability and reduce parasitic drag.

The truck pictured is an example of good aerodynamic styling and air management. To understand how this styling reduces your fuel consumption look at the simplified diagram below of an articulated truck without any curved edges. Also note that there is a large gap between the tractor and the trailer. Compare this with the well styled tractor and trailer in the second picture. You'll see that there are fewer areas of turbulence and turbulence causes drag. The second vehicle will use less fuel.

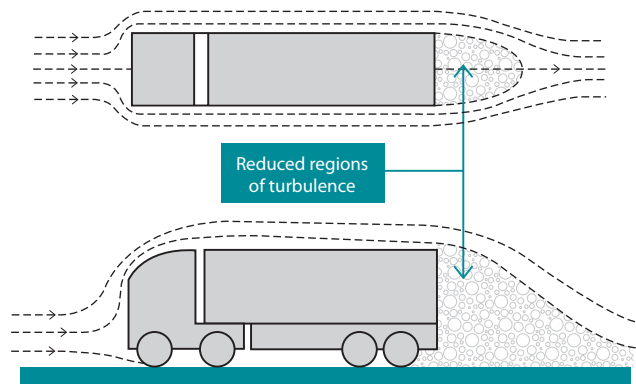
Ensure that air can flow easily and smoothly over the shape of your vehicle, by minimising things that stick out and block the air's passage. Wherever possible chose smooth sided designs, curved edges, hidden buckles and a close gap between your tractor and your trailer.



Images courtesy of Westward Scania.



Poor aerodynamic styling

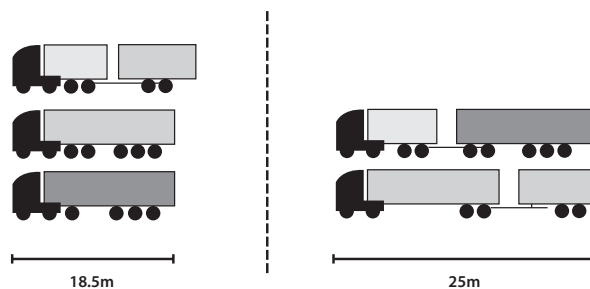


Good aerodynamic styling

EURO-COMBI

Use longer drawbar vehicles wherever possible. A large amount of air resistance is caused by the cab itself. If you replace three shorter trucks with two longer ones, you will make fuel savings because only two cabs will need to overcome wind resistance, rather than three.

Ireland's current legal length limit is 18.5m. This has been exempted in Sweden and Finland, where two Euro-Combi vehicles can replace three normal vehicles: resulting in a 20% CO₂ reduction.

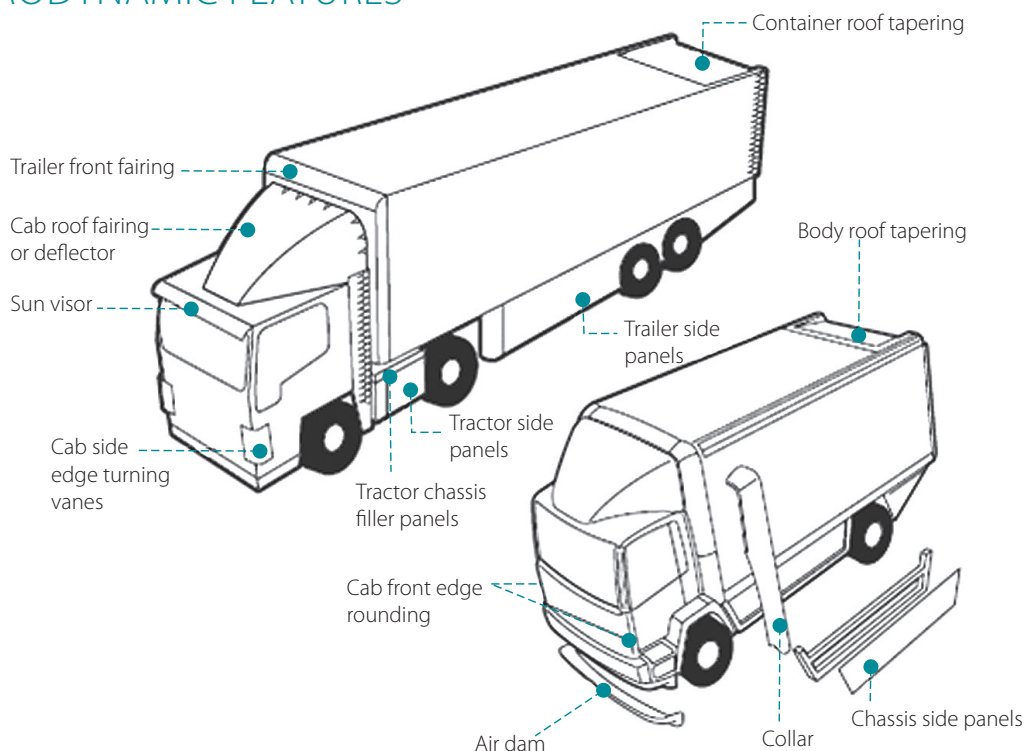


WHERE TO FOCUS YOUR EFFORTS?

Up to 80% of the available aerodynamic efficiency improvements to rigid and articulated vehicles can be derived from installing these items:

- Roof-mounted air deflector or cab roof fairing.
- Side collars or trailer side panels at rear of cab.
- Under-bumper air dam.

COMMON AERODYNAMIC FEATURES



TIPPER BODIES

Vehicles with tipper bodies need special consideration. MIRA (www.mira.co.uk) tested a Volvo FM12.340 8x4 rigid tipper with a gross vehicle weight (GVW) of 11,700 Kg to estimate the effects on fuel consumption of sheeting a tipper body when empty. The vehicle was fitted with an electrically operated sheeting system.

Three runs were performed (two sheeted, one unsheeted) to evaluate the potential savings under dual carriageway and motorway

driving conditions. Each run consisted of 15 laps, five laps each at 60, 80 and 90 Kph, totalling 73.13 Km.

Fuel savings of 6.9% and 10.7% were recorded when the empty body was sheeted compared with when the body was unsheeted, an average improvement of 8.8%. This suggests that tipper operators need to make sure that the vehicle body is sheeted at all times.

TRAILERS

Choosing a sloping front roof trailer (sometimes called a FSC trailer) has been proven to deliver savings of up to 7% in trunking (centre to centre on main roads) operations.



Image courtesy of Johnstone Logistics



Teardrop Trailer



Standard Trailer

Images courtesy of Don-Bur Trailers.

BODY AND TRAILER FEATURES	Estimated Fuel Savings (%)	Weight (Kg)	Cost	Savings for all	Payback (years)
Aerodynamically Sloping Front Roof (FSC)					
Articulated	7.0%	-100 Kg	€3,500	€2,975	1.18
GAP SEALS/VORTEX GENERATORS					
Articulated	0.6%	10 Kg	€450	€255	1.76
Drawbar	0.8%	10 Kg	€450	€340	1.32
CONTAINER/TRAILER ROOF TAPERING					
Rigid	0.5%	1 Kg	€400	€213	1.88
Articulated	0.3%	1 Kg	€400	€128	3.14
Drawbar (Tractor)	0.1%	1 Kg	€400	€43	9.41
Drawbar (Trailer)	0.3%	1 Kg	€400	€128	3.14

Improving a trailer's aerodynamics repays your investment in other ways:

- Improved vehicle appearance.
- Reduced build up of road film and dirt.
- Reduced sensitivity to side winds, thus improving stability.
- Reduced spray.

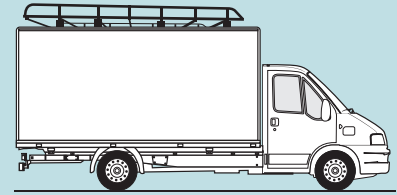
REDUCING AIR DRAG

This table shows you the estimated fuel savings for each additional cab feature. For example, a rigid cab roof deflector will cost you around €500, but after 0.49% of a year (about 6 months), the fuel saving will have paid for the initial installation and materials cost. After that you will be making fuel savings of 2.4% each time the vehicle is used.

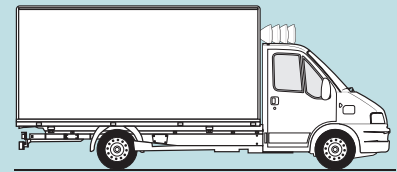
REDUCING AIR DRAG	SAVINGS ALL VEHICLE TYPES BASED ON			LITRE (ON AN ANNUALISED BASIS)	
CAB FEATURES	Estimated Fuel Savings (%)	Weight (Kg)	Cost	Savings for all	Payback (years)
CAB ROOF DEFLECTOR					
Rigid	2.4%	20	€500	€1,020	0.49
Articulated	2.4%	20	€500	€1,020	0.49
Drawbar	1.2%	20	€500	€510	0.98
CAB ROOF FAIRING					
Rigid	4.8%	20 (70)	€800	€2,040	0.39
Articulated	3.7%	21 (70)	€800	€1,573	0.51
Drawbar	2.3%	22 (70)	€800	€978	0.82
CAB COLLAR AND ROOF FAIRING					
Rigid	6.5%	35	€1,000	€2,763	0.36
Drawbar (Trailer)	3.2%	35	€1,000	€1,360	0.74
CAB SIDE EDGE TURNING VANES					
Rigid	0.5%	2	€200	€213	0.94
Articulated	0.3%	2	€200	€128	1.57
Drawbar	0.3%	2	€200	€128	1.57
AIR DAM					
Rigid	0.7%	10	€450	€298	1.51
Articulated	0.3%	10	€450	€128	3.53
Drawbar	0.3%	10	€450	€128	3.53
CAB SIDE EDGE FAIRINGS					
Articulated	0.6%	20	–	€255	–

AERODYNAMIC CHECKLIST

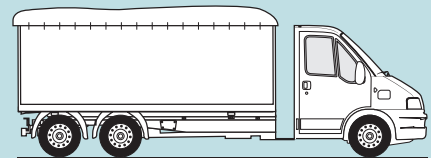
- **Walk around your vehicle and look for any items that stick out from the bodywork:** For example, removing a roof rack can improve fuel efficiency by up to 5%.



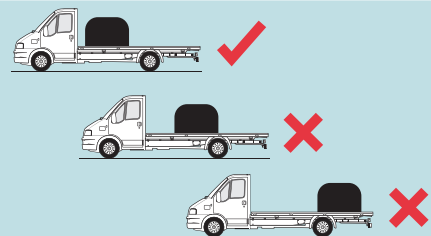
- **Light bars, bull bars etc. increase drag, although the effects are less easily measurable e.g. at 0.1% per spotlight:** Spotlights may be required for safety reasons, so think carefully before removing them. Wing mirrors with rounded front faces will help the aerodynamics of your vehicle.



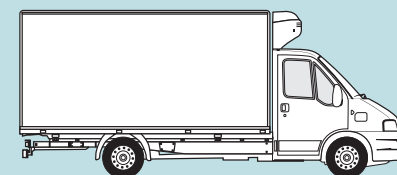
- **Open load areas:** Many lorries and work vehicles feature open load carrying areas for bulk haulage of agricultural produce, waste and construction materials. These are sometimes referred to as tipper trucks. Whilst waste must be covered in transit, these vehicles will benefit from covering their load areas, even when empty, for savings of 5-10%.



- **Loading:** When loading an open load area, place loads as close as possible to the cab. This also applies to ramps or excessively tall tailgates. Reduce their height by splitting or folding them. If a load has an irregular shape, put the larger end near the cab, but be careful not to exceed legal axle weights.



- **Roof mounted refrigeration units:** Refrigeration units need cool flowing air to function efficiently. Mount these units in line with the bodywork, rather than on top of the roof (in picture).



When you are thinking about buying new equipment, the time that you invest in aerodynamic styling is repaid relatively quickly, typically in about 1-2 years.

This depends partly on the distance travelled and your fuel usage. Talk to other local companies running fleets of vehicles to find out what savings they've made.

REFERENCES

Trunking

Point to point or long distance non-stop routes for trucks, for example a fully loaded tractor and trailer travelling Dublin to Cork

Tipper

Truck whose contents can be emptied without handling. The front end of the platform can be raised so that the load is discharged by gravity.

Sheeting

Material, usually flexible, used to cover an open load space. Sheeting is often stored on a roller and extended to cover the load and stop debris falling onto the road.

CONCLUSION

The aerodynamic shape of a vehicle is crucial because it has a large impact on fuel. When buying a new vehicle, carefully consider the impact of aerodynamic features. Remember that time invested in this area will be worth the investment.

For more information refer to SEI's other Transport Energy Guides, visit www.sei.ie/business