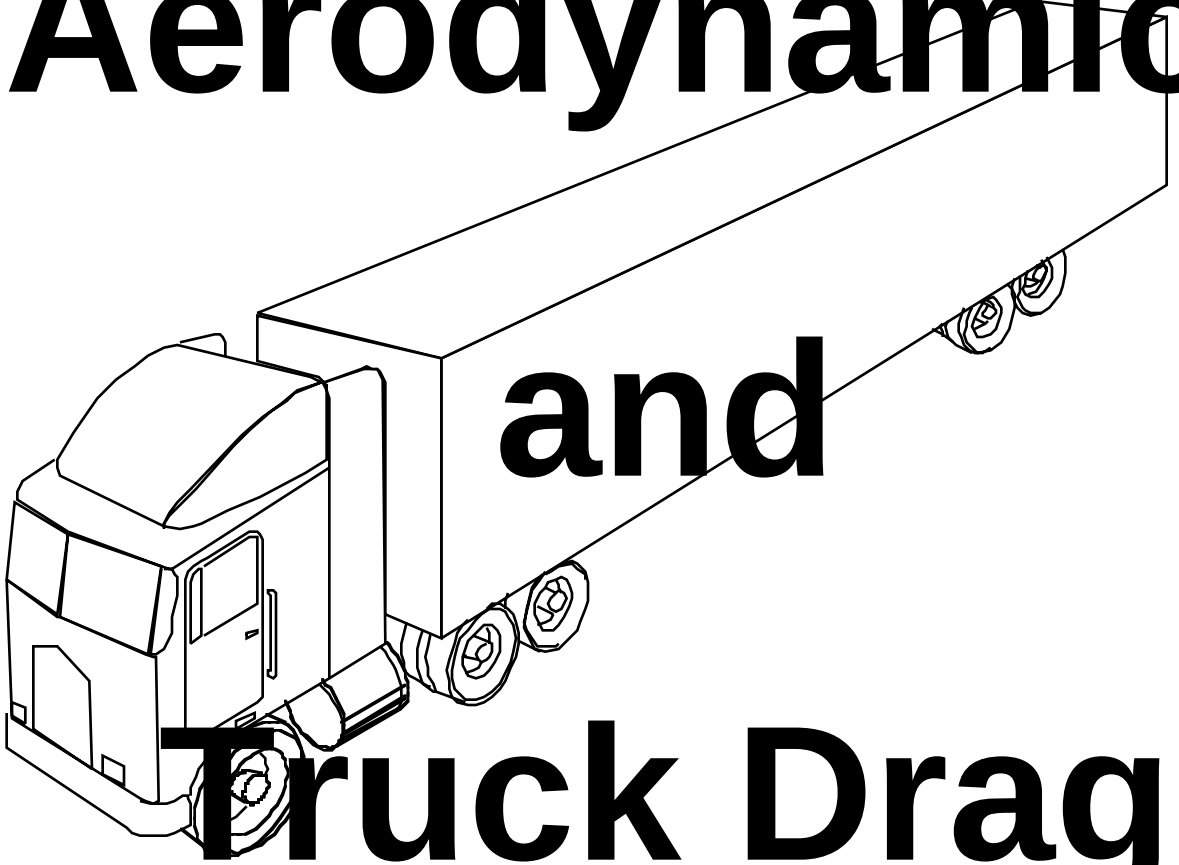
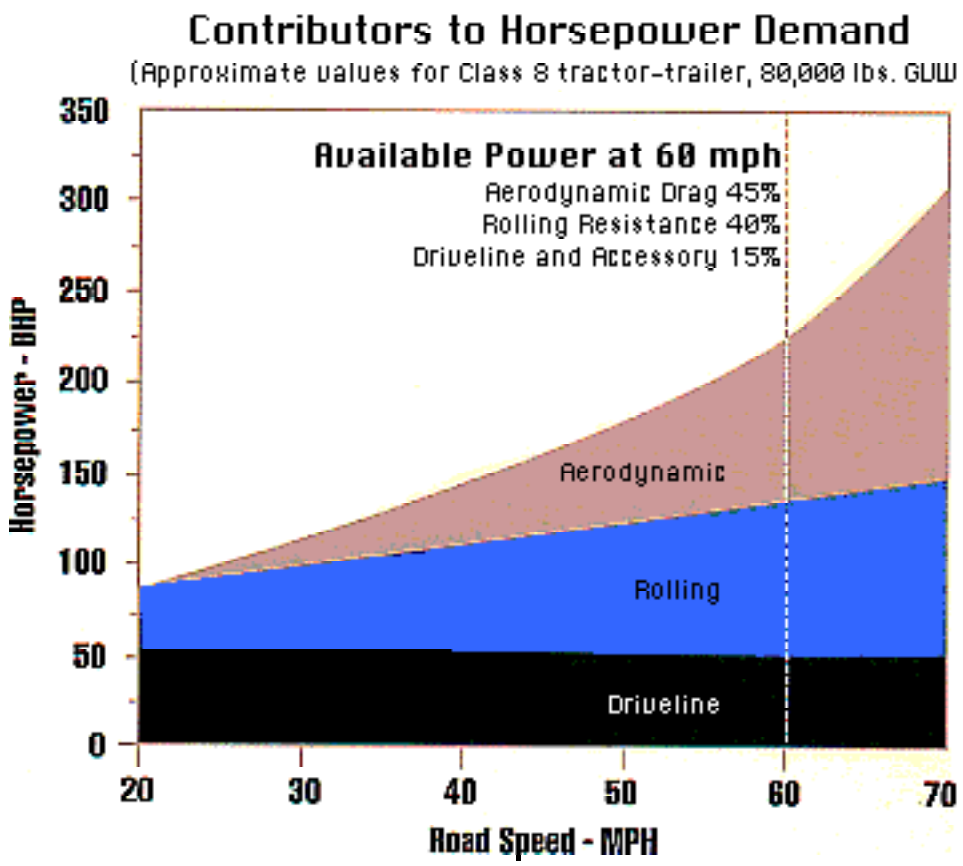
Aerodynamics and Truck Drag



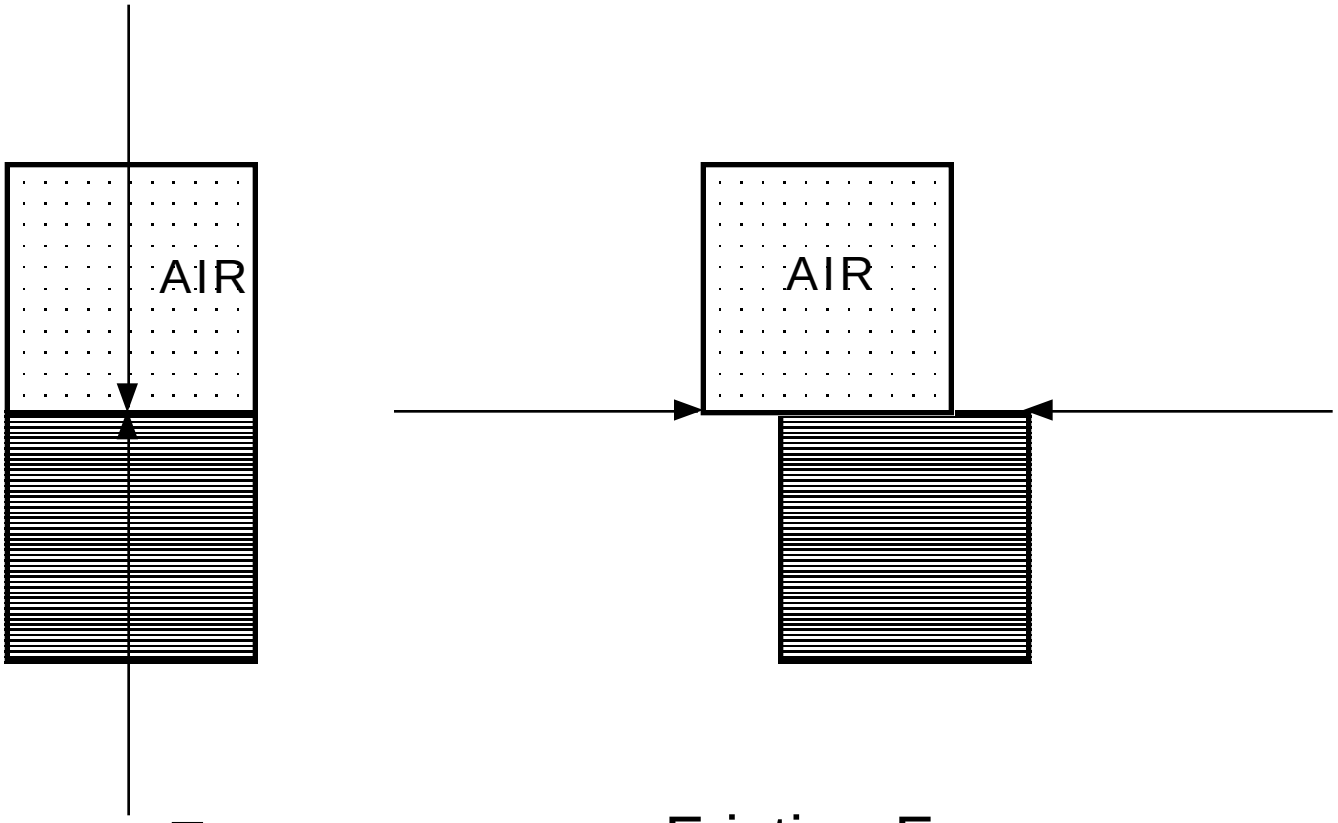
What is Aerodynamics?

Aerodynamics is the science that studies the motion of air and the forces on bodies in motion through air.

The primary aerodynamic force of interest for trucks is the drag force.



What are the Fundamental Forces?



Pressure Force
“Normal”

Friction Force
“Tangential”

What is Drag?

Drag Force is the aerodynamic force opposing the direction of motion.

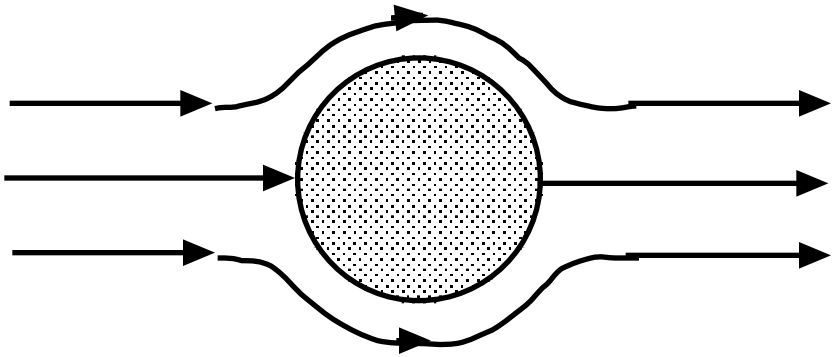
Drag Force = Pressure Force + Friction Force

The friction force is small at speeds below 100 mph

$$C_D = \text{Drag Pressure Force} / .5\rho V^2 S$$

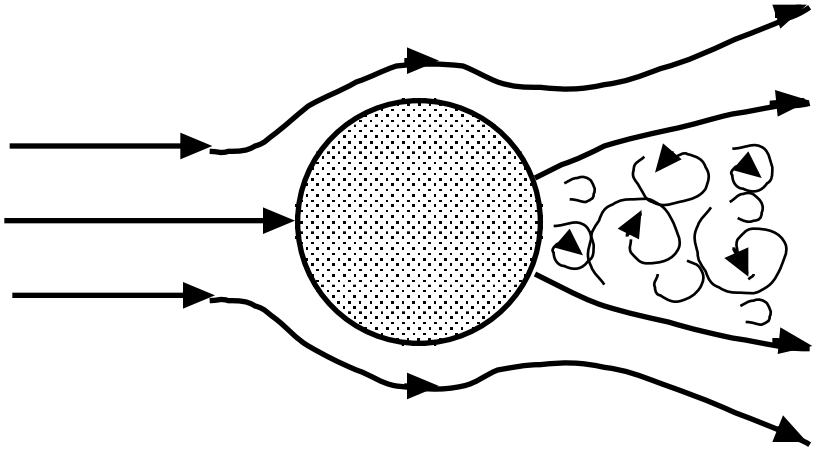
What Types of Flow Exist?

Ideal Flow
Very Low Speed



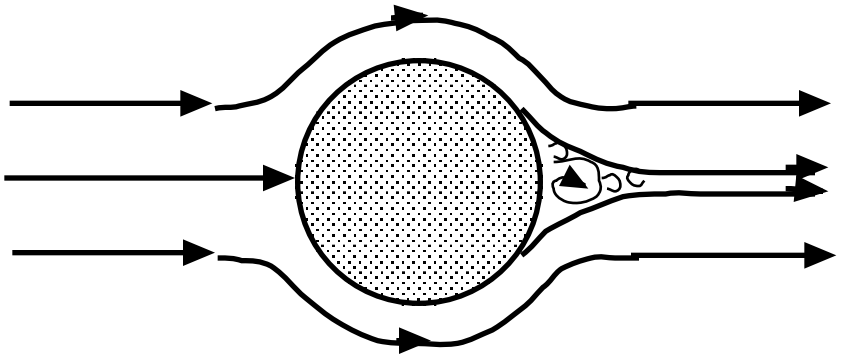
No Drag

Real Flow
High Speed



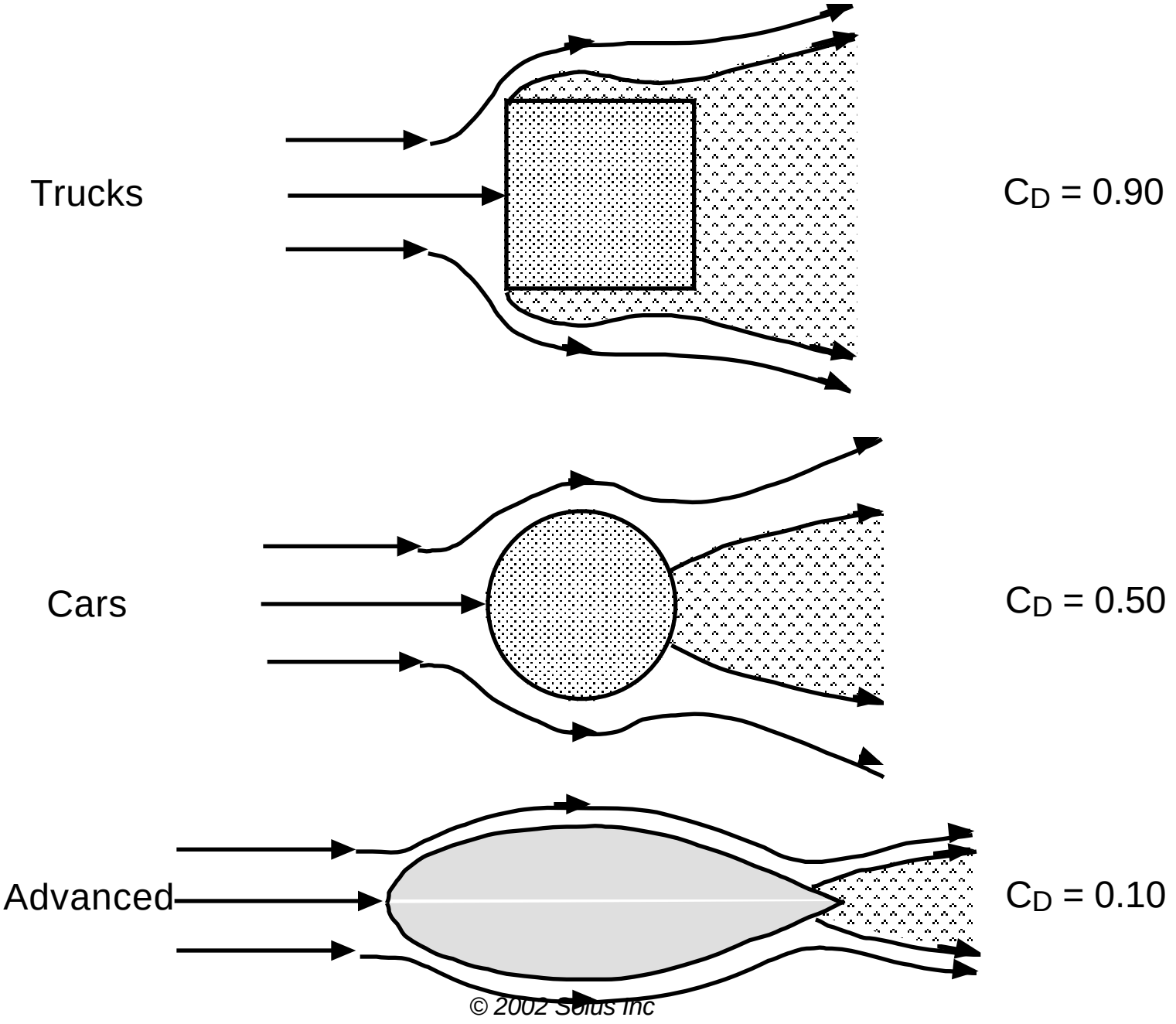
High Drag

Desired
Very Low Speed

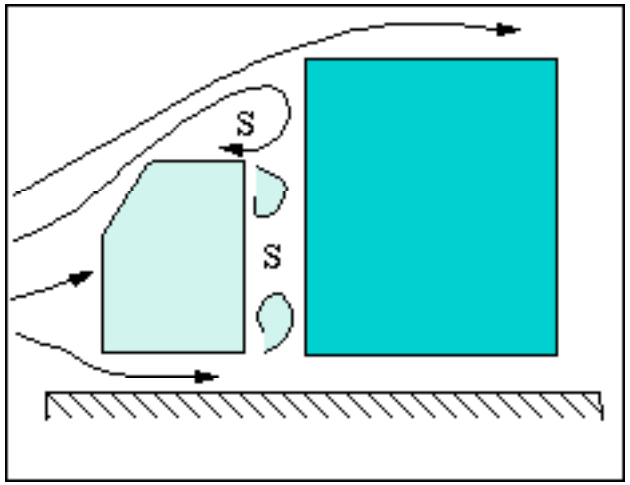


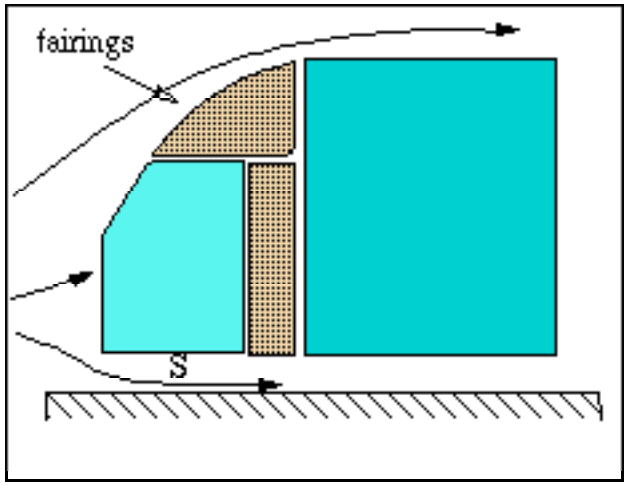
Low Drag

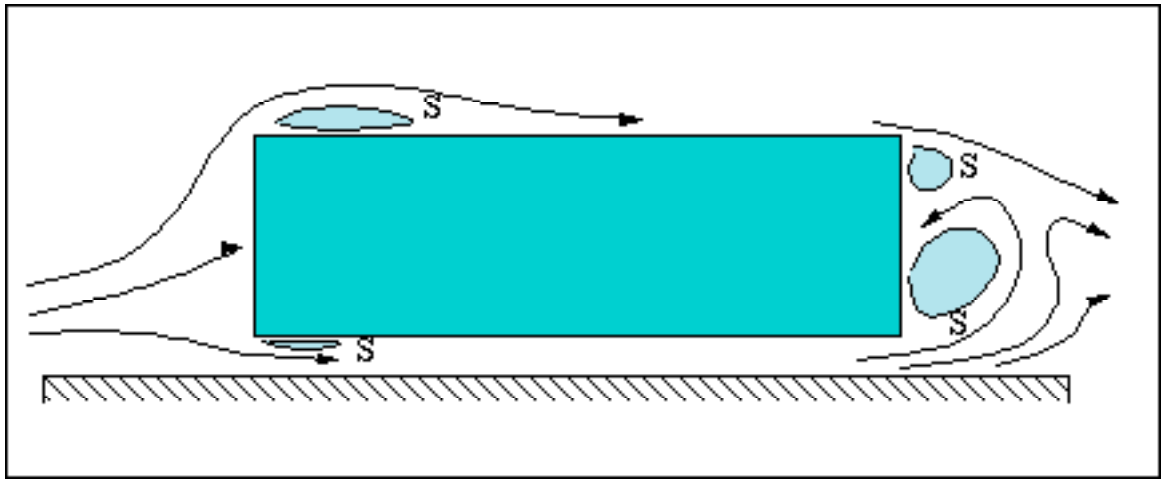
What Do We Want to Achieve?



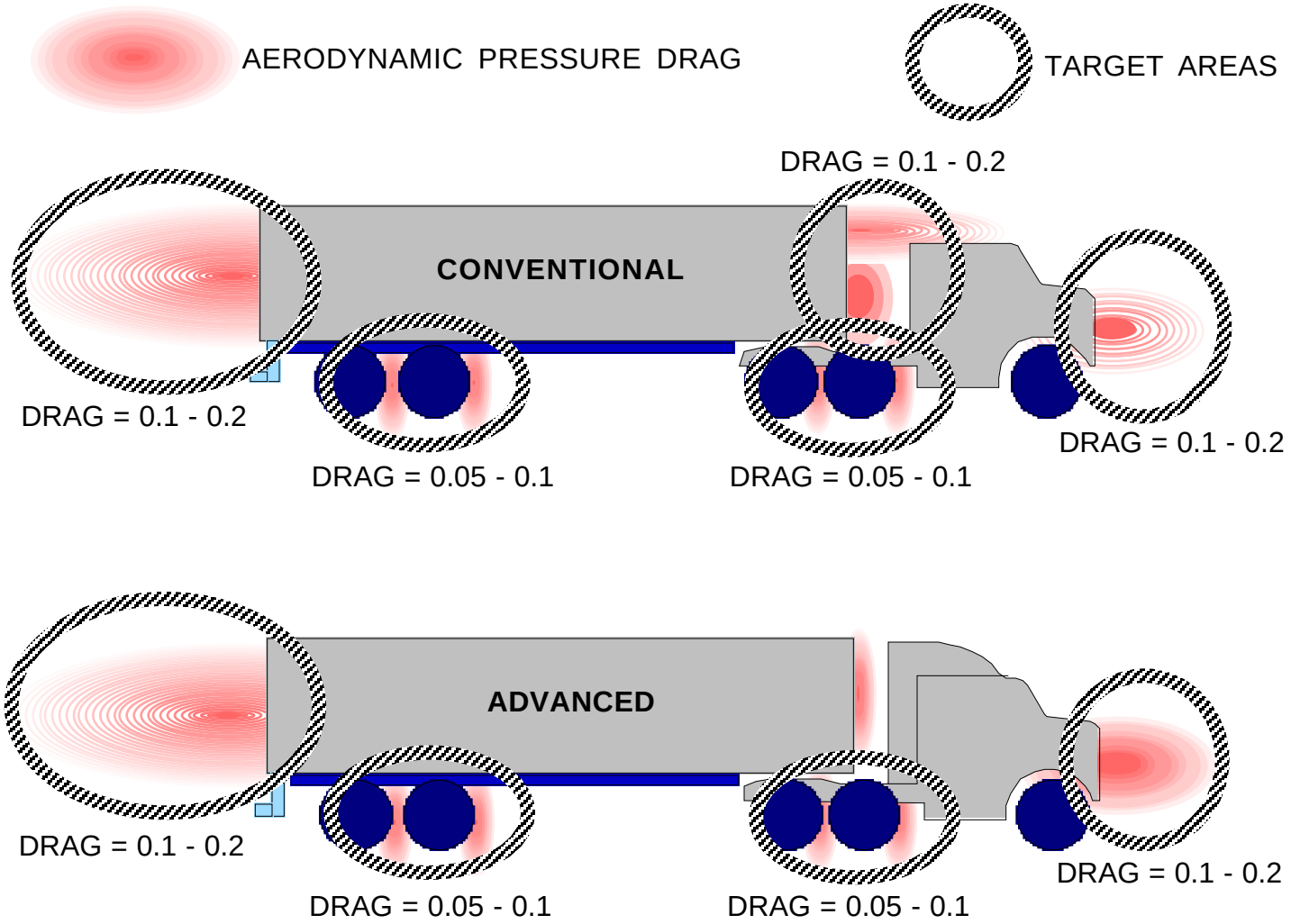
What are the Fundamental Flow Features?



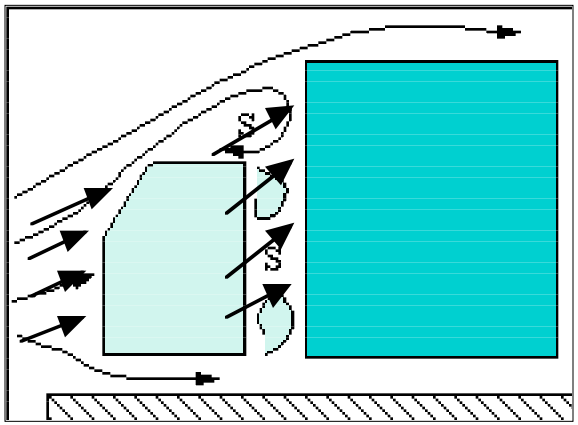


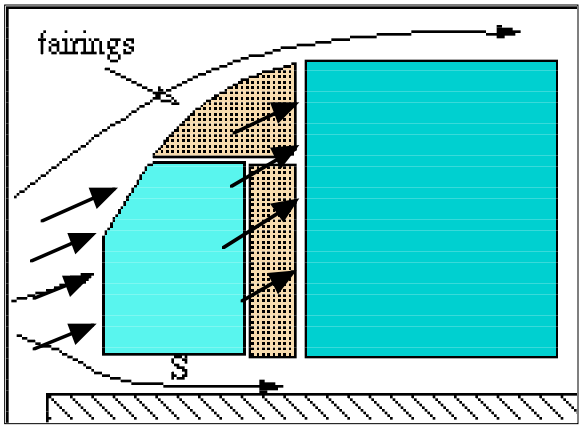


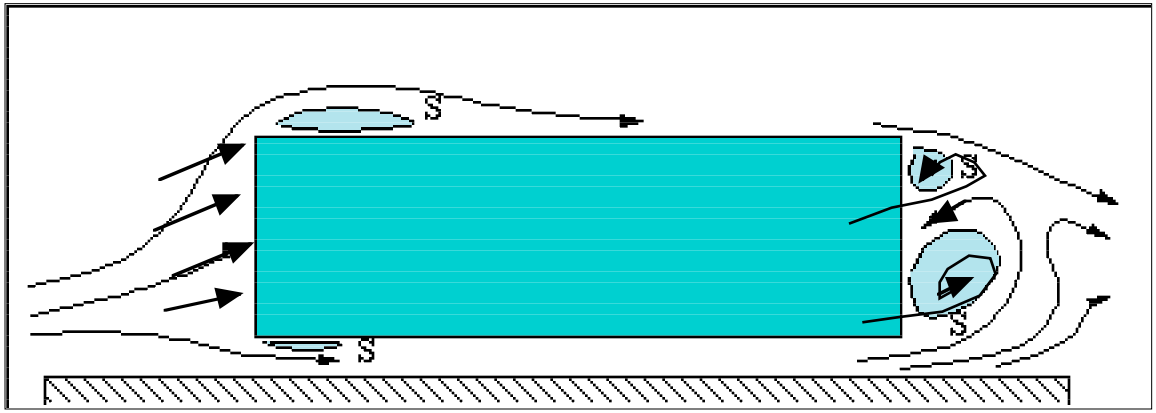
Drag Contributions

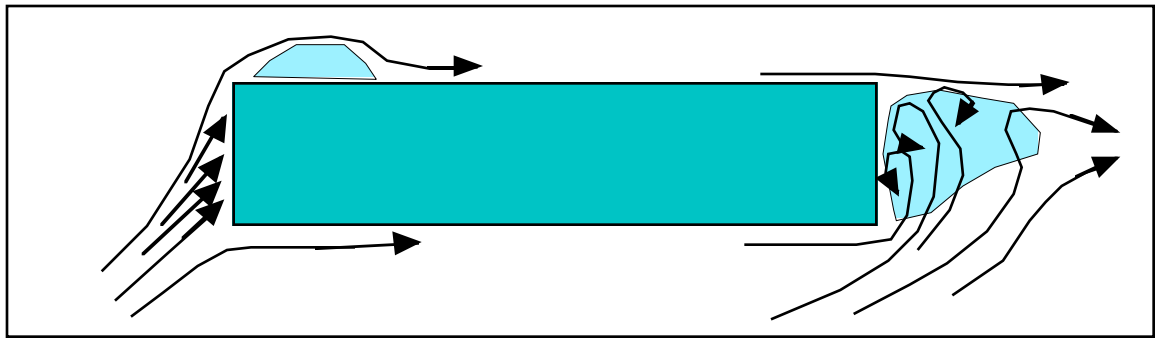


Cross - Flow Features

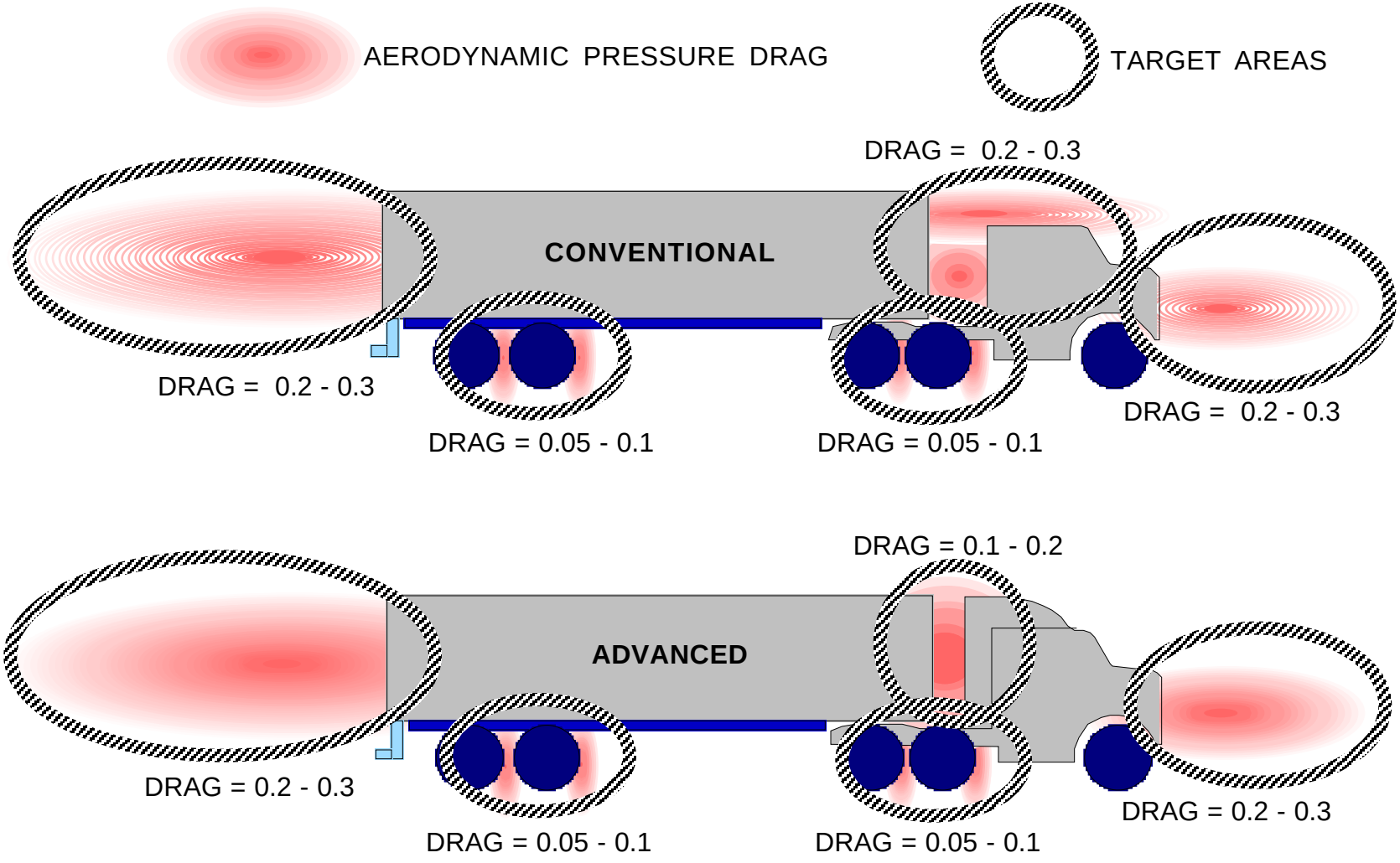




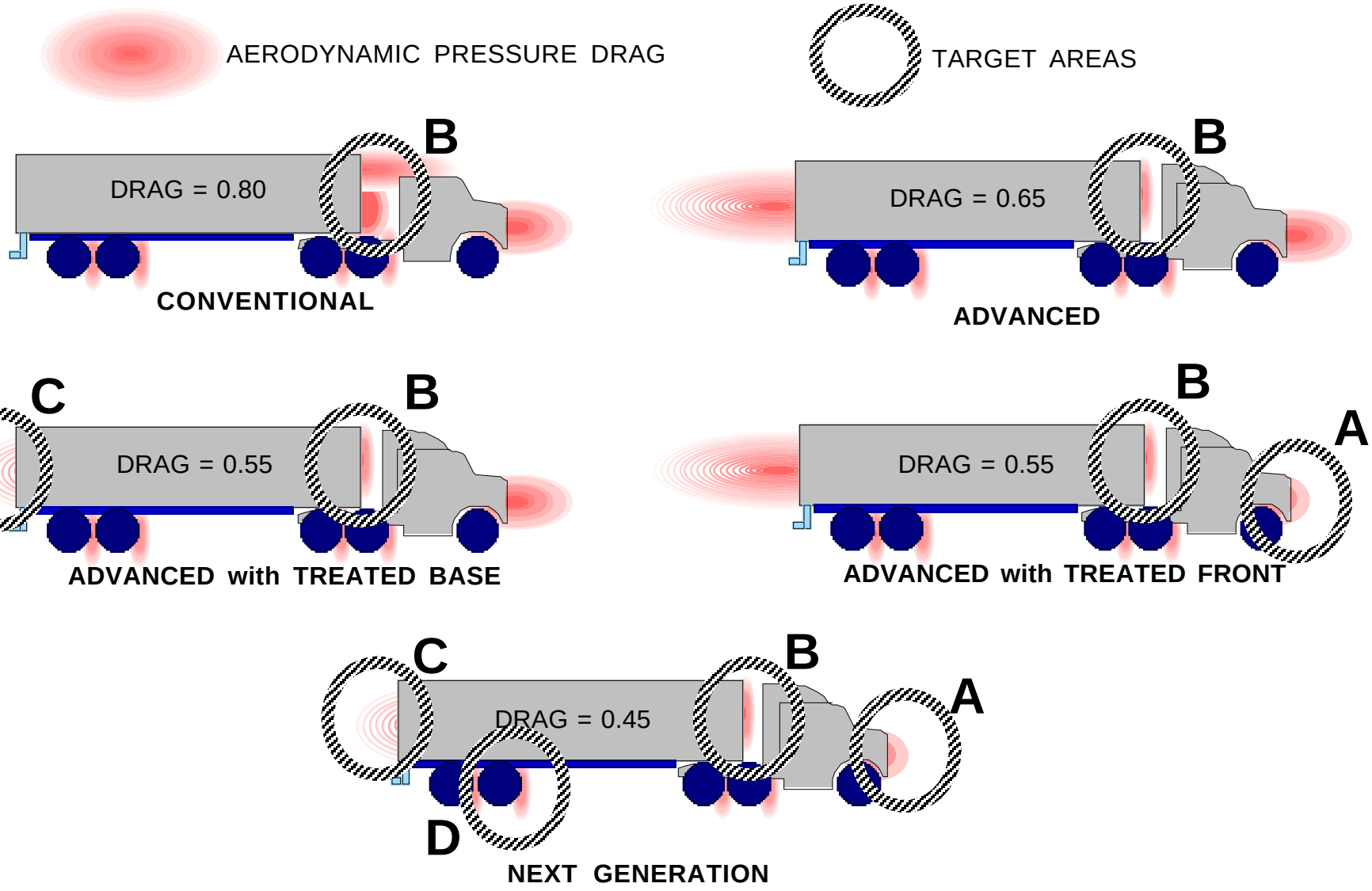




Drag Contributions with Cross-Flow



Design Target Areas



Flow Features on Design Target Areas

AREA	FLOW FEATURE	PRESSURE
A	attached	high
B - tractor base B - trailer face	separated attached or separated	low high or low
C	separated	low
D	attached and separated	high and low

Drag Reduction Design Issues

- Average operational speed of vehicle
- Tractor face design
- Tractor to Trailer gap size
- Tractor cab fairing design
- Tractor cab fairing match to trailer size
- Trailer exterior side and top roughness
- Trailer door type
- Distance of trailer whhels from base of trailer
- others.....