Afterbody flows

1. Non-propelled afterbody
2. Propelled afterbody without base
3. Propelled afterbody with base
4. Rectangular section afterbody
5. Two-nozzle afterbody
6. Flow past an automobile
Non-propelled axisymmetric afterbody at incidence
Skin friction line pattern

Body, side view  Seen from above  Seen from below

Base  Base at zero incidence
Non-propelled axisymmetric afterbody at incidence
Skin friction line pattern

On the base

On the afterbody
Non-propelled axisymmetric afterbody at incidence
Flow in the vertical symmetry plane
Non-propelled axisymmetric afterbody at incidence
Detachment surface
Non-propelled axisymmetric afterbody at incidence
Flow projected in a vertical downstream plane

Improbable symmetric organisation

More probable asymmetric organisation
Non-propelled axisymmetric afterbody at incidence
Skin friction line pattern (upstream part developed)
Non-propelled axisymmetric afterbody at incidence
Main detachment surfaces
Non-propelled axisymmetric afterbody at incidence
Flow projected in a vertical downstream plane or wake structure
Propelled afterbody without base at incidence
Skin friction line pattern and separation surface
Details at node $N_1$

Details at saddle point $C_1$

Propelled afterbody without base at incidence
Skin friction line pattern at nozzle exit

Detachment node
Propelled afterbody without base at incidence with jet pluming
Skin friction line pattern on the fuselage and jet surface

Symmetry plane and jet separation surface
Propelled afterbody without base and jet pluming
Main detachment surfaces
Propelled afterbody with base at incidence
Skin friction line pattern on the fuselage

Seen from above
Leeside

Seen from below
Windward side

Side view
Propelled afterbody with a base

Skin friction line pattern on the base
Propelled afterbody with base at incidence

Skin friction lines on the afterbody

Streamlines in the symmetry plane and on the jet separation surface
Propelled afterbody with base at incidence

Attachment surface

Detachment surface

Jet separation surface

Main separation surfaces
Afterbody with rectangular cross section

Skin friction line pattern on the suction side
Afterbody with rectangular cross section

Jet separation surface

Main separation surfaces
Afterbody of a twin-nozzle fighter aircraft

Dassault Aviation *Jaguar* fighter aircraft
Afterbody of a twin-nozzle fighter aircraft
Simplified afterbody geometry
Afterbody of a twin-nozzle fighter aircraft

Surface flow visualization
Afterbody of a twin-nozzle fighter aircraft

Skin friction line pattern
Afterbody of a twin-nozzle fighter aircraft
Skin friction line pattern. Details at the nozzle lip

Details in the vicinity of saddle point $C_4$
Afterbody of a twin-nozzle fighter aircraft

Schlieren visualisation of the jets
Afterbody of a twin-nozzle fighter aircraft

Flow in the symmetry planes

Plane containing the nozzle axes

Perpendicular plane
Afterbody of a twin-nozzle fighter aircraft

(One half of the surface is drawn for clarity)

Detachment surface attached to the afterbody extremity
Afterbody of a twin-nozzle fighter aircraft

Details

Detachment surface attached to the nozzle lip

(Only one surface is represented)
Afterbody of a twin-nozzle fighter aircraft

Representation of the main separation surfaces
Afterbody of a twin-nozzle fighter aircraft

Flow projected in a normal downstream plane

Traces of the jets
Aerospike type nozzle with 24 peripheral jets

Surface flow visualisation
Aerospike type nozzle with 24 peripheral jets

Surface flow visualisation. Close up of the jet exit region
Aerospike type nozzle with vectoring lateral jet
Surface flow visualisation
Aerospoke type nozzle with vectoring lateral jet

Surface flow visualisation. Lateral jet exit region
Aerospike type nozzle with lateral jet

Skin friction line pattern

Nozzle jet impacts

Detachment induced by the lateral jet

Lateral jet
Water tunnel visualisation of the flow past the Citroën DS21 car
Sedan type or three-box automobile

- Radiator grille
- Bonnet
- Windshield
- Passenger cell
- Roof
- Rear window
- A-pillar
- Side
- Boot
- Rear part
- Rear
Sedan type or three-box automobile

Surface flow visualizations with viscous film

Wind tunnel S2Ch. Document Onera- PSA Peugeot-Citroën
Sedan type or three-box automobile

Skin friction line pattern. Front part
Sedan type or three-box automobile

Skin friction line pattern. View from above
Skin friction line pattern. Side view

Sedan type of three-body automobile
Sedan type automobile

Formation of windshield and A-pillar vortices

Start of the A-pillar vortex

Skin friction line pattern in the vicinity of focus F2

Windshield detachment

Starting of the detachment surfaces
Sedan type automobile
Skin friction line pattern. Rear part

First interpretation: One boot vortex
Second interpretation: Two boot vortices
Sedan type or three-box automobile
Separation surfaces. Windshield detachment
Sedan type or three-box automobile
Separation surfaces. A-pillar detachment
Sedan type or three-box automobile
Separation surfaces. Rear window detachment
First possibility: One horseshoe vortex

Sedan type or three-box automobile
Separation surfaces. Trunk detachment
Sedan type or three-box automobile
Separation surfaces. Trunk detachment

Second possibility: Two horseshoe vortices
Sedan type or three-box automobile
Main detachment surfaces
Sedan type or three-box automobile
Field projected in a vertical downstream plane