

Vehicle Anatomy and Parameters

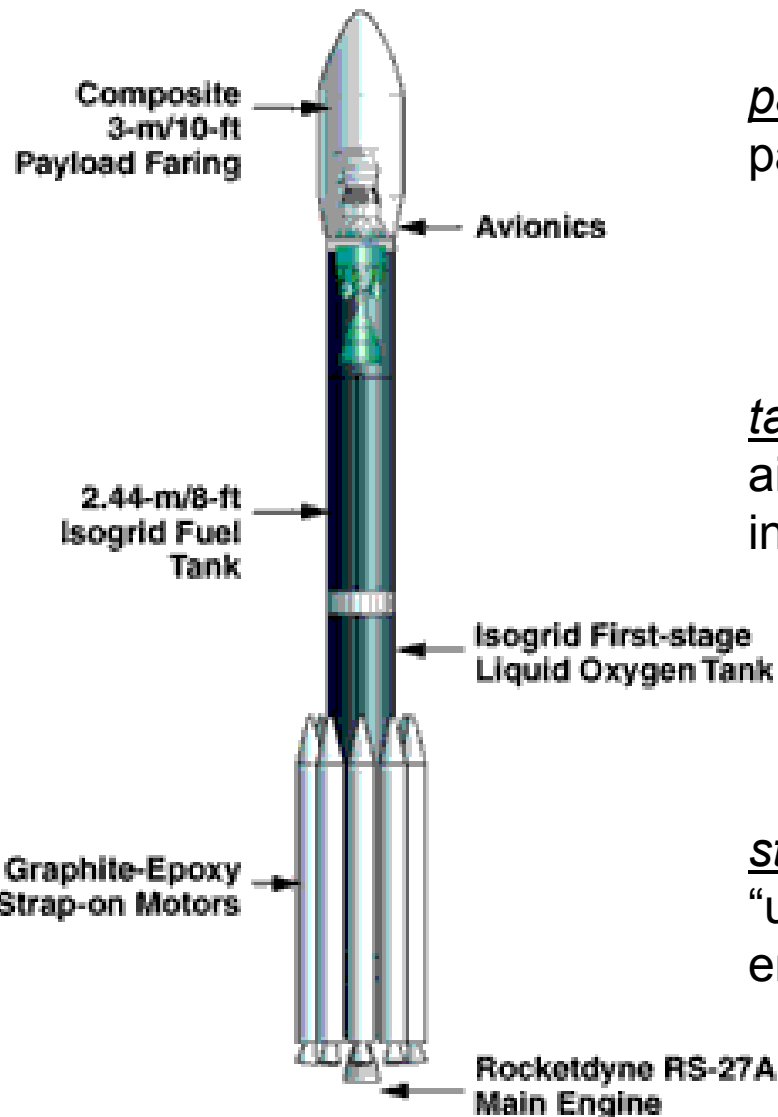
- ◆ Rocket anatomy
 - Components and parts
 - Configuration / arrangement
- ◆ Major rocket parameters
- ◆ Aircraft anatomy
 - Components and parts
 - Configuration / arrangement
- ◆ Major aircraft parameters

Rocket Components and Parts

payload fairing:
protective envelope
around payload

interstage adapter:
structure connecting
stages

nozzles: convert
combustion products
into thrust



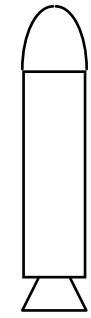
payload adapter: joins
payload to rocket

tanks: carry oxidizer (no
air in space) and fuel;
integrated into structure

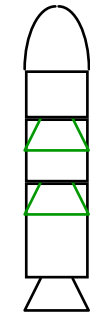
stage: a complete rocket
“unit” (propellant,
engine, structure)

Rocket Configuration / Arrangement

stages



single stage

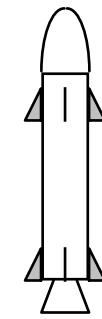


multi-stage

control devices

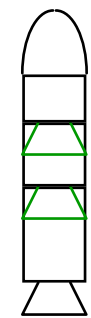


fins

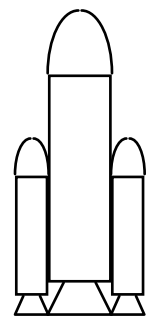


canards

thrust arrangement

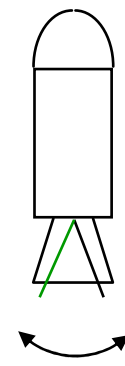


series

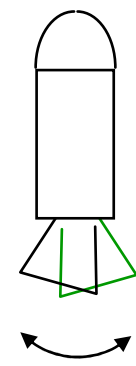


parallel

vanes in nozzle



gimbaled thrust



Major Rocket Parameters

- ◆ Describe the size of the rocket
 - US defense agencies use USCS units
 - NASA, European and Asian companies use SI units
- ◆ Takeoff mass [kg], m_0
- ◆ Propellant mass [kg], m_p
 - mass of fuel and oxidizer needed

Major Rocket Parameters

◆ Payload mass [kg], $m_{payload}$

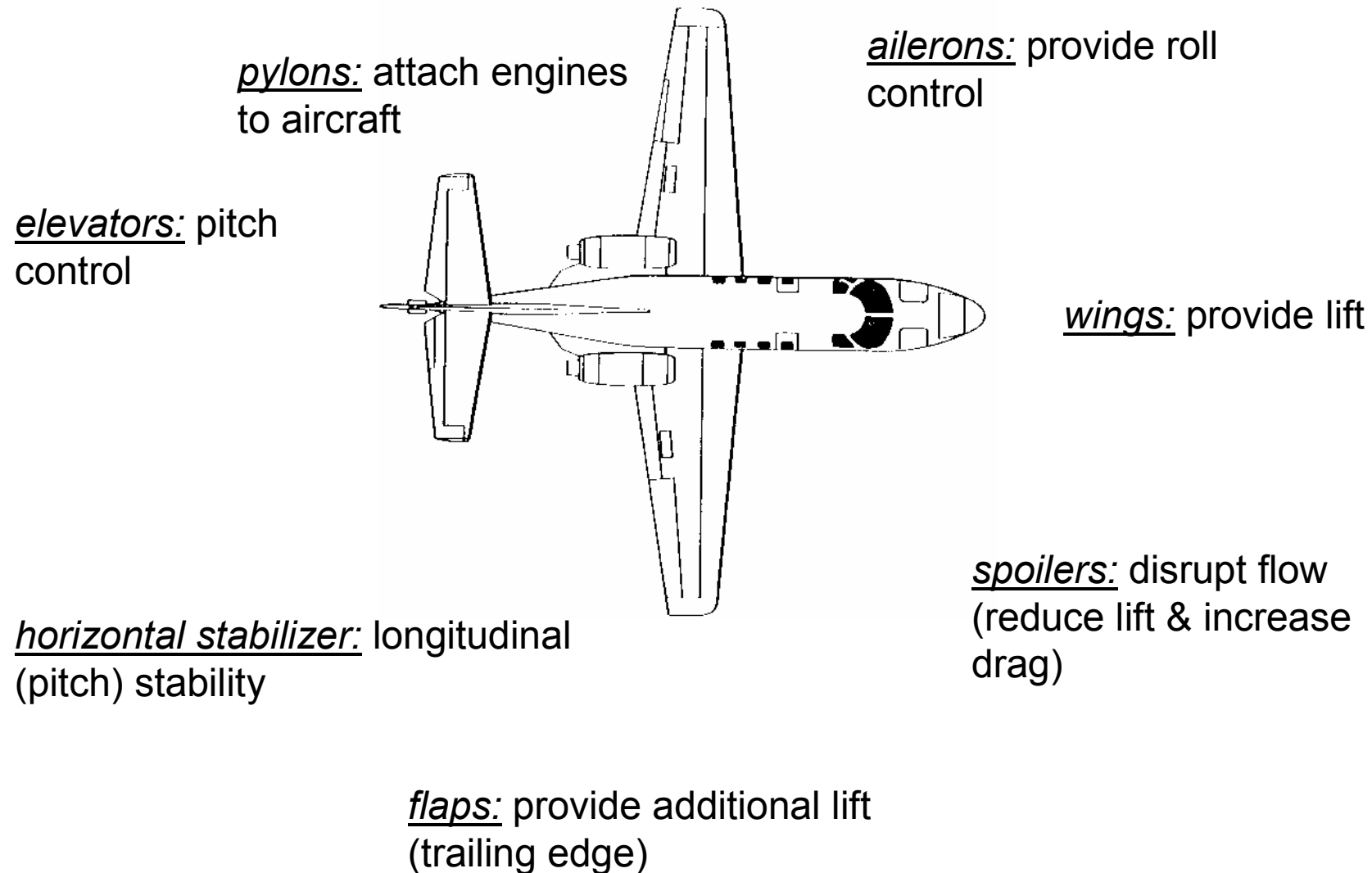
◆ Mass ratio

$$R = \frac{m_o}{m_f}$$

◆ Specific impulse [sec], I_{sp}

<http://www.allstar.fiu.edu/aero/fltmidparts.htm>

Airplane Components and Parts

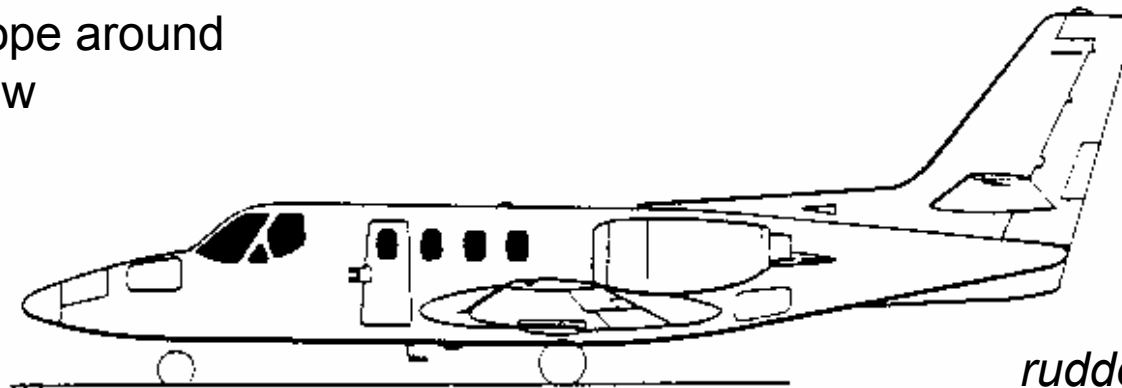


Airplane Components and Parts

nacelles: enclose engines

vertical stabilizer (fin): lateral (yaw) stability

fuselage: envelope around payload and crew



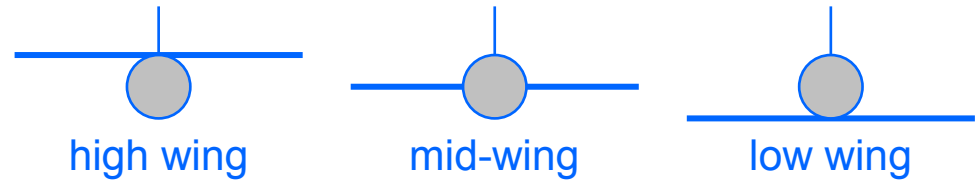
rudder: yaw control

nose gear: ground steering

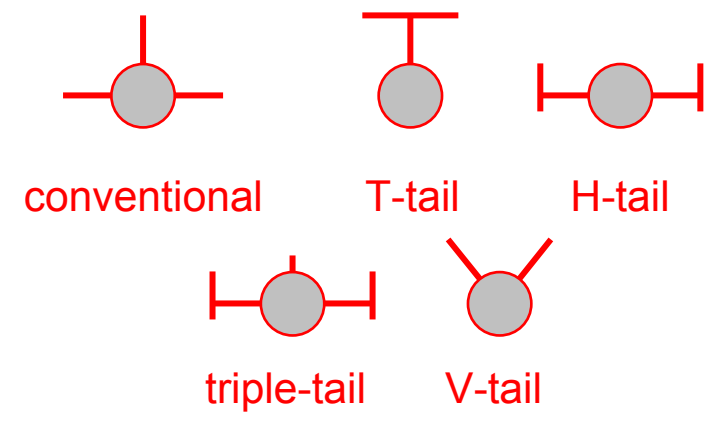
main gear: support aircraft weight on ground

Describing Aircraft Configurations

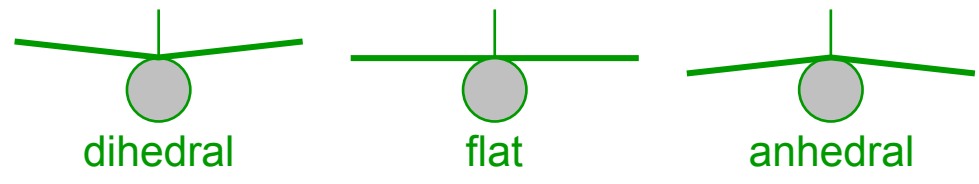
Vertical wing location



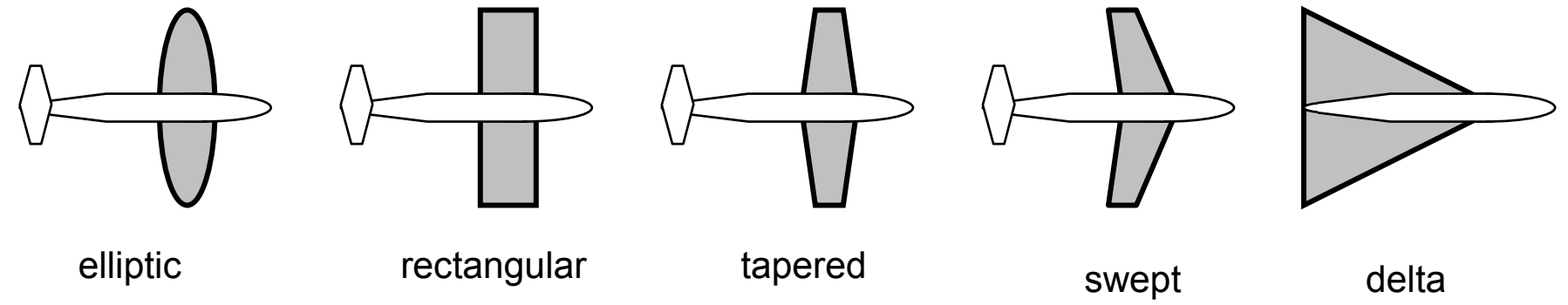
Tail arrangement



Dihedral angle



Wing planform



Aircraft Configuration / Arrangement

General Dynamics F-16



- ◆ Wing location
- ◆ Dihedral
- ◆ Wing planform
- ◆ Tail arrangement

Aircraft Configuration / Arrangement

Fairchild
Republic A-10



◆ Wing location

◆ Tail arrangement

◆ Dihedral

◆ Wing planform

Aircraft Configuration / Arrangement

AVRO RJX regional jet



- ◆ Wing location
- ◆ Dihedral
- ◆ Wing planform
- ◆ Tail arrangement

Major Aircraft Parameters

- ◆ Describe the size of the aircraft
 - US aircraft companies use USCS units
 - European and Asian companies use SI units
- ◆ Gross weight [lb], W_0 or W_g

- ◆ Empty weight [lb], W_e

Major Aircraft Parameters

- ◆ Payload weight [lb], $W_{payload}$
- ◆ Crew weight [lb], W_{crew}
- ◆ Fuel weight [lb], W_{fuel}

Major Aircraft Parameters

- ◆ Empty weight fraction

$$\frac{W_e}{W_0}$$

- ◆ Thrust-to-weight ratio or
Power-to-weight ratio [hp/lb]

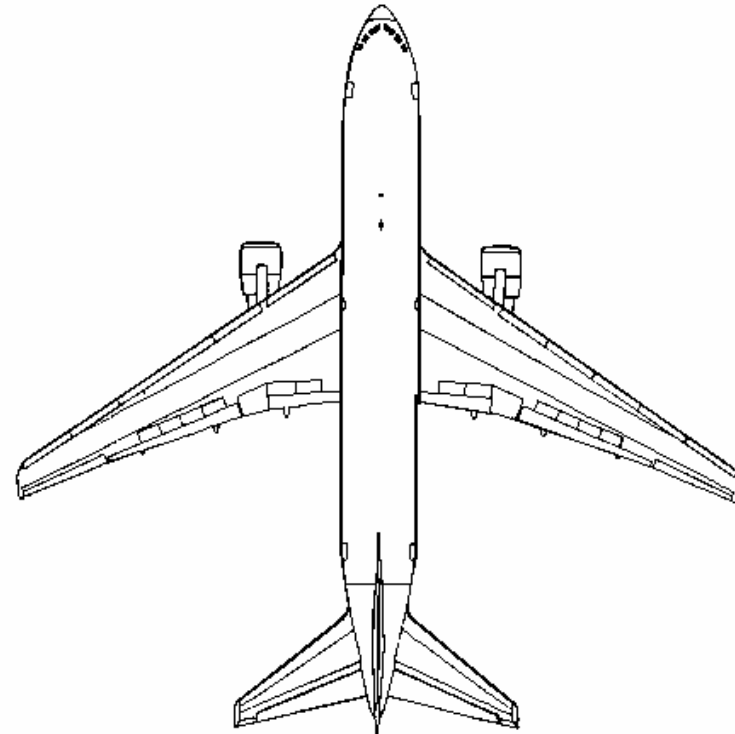
$$\frac{T}{W_0}$$

$$\frac{P}{W_0}$$

Major Aircraft Parameters

- ◆ Wing area [ft²],
 S or S_w
 - planform or projected area
- ◆ Wing span [ft], b
 - tip to tip distance
- ◆ Aspect ratio, AR
 - wing shape

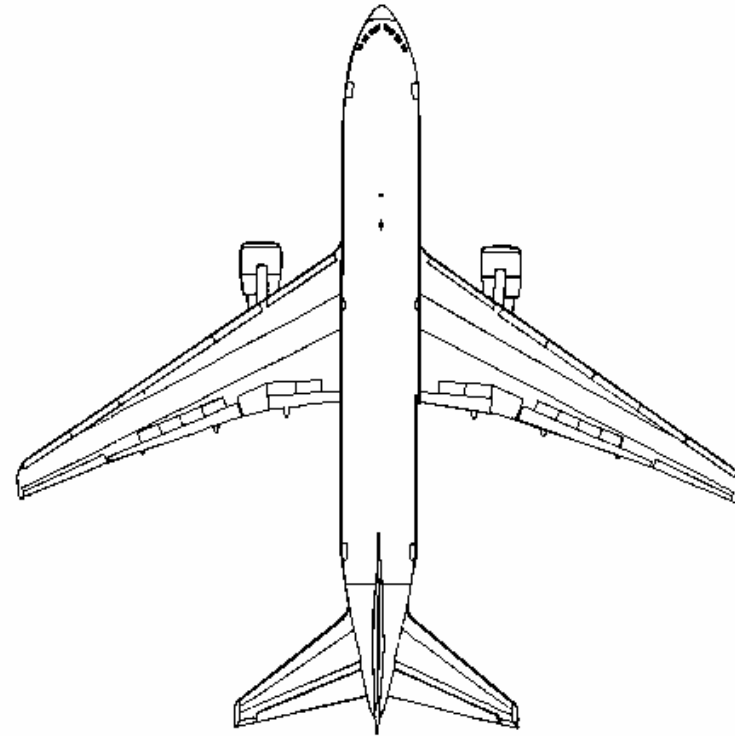
$$AR = \frac{b^2}{S}$$



Major Aircraft Parameters

- ◆ Wing loading [lb/ft^2], W_0/S
 - measure of wing size

- ◆ Wing chord [ft], c
 - leading edge to trailing edge distance
 - at tip, c_{tip}
 - at root, c_{root}



Major Aircraft Parameters

- ◆ Taper ratio, λ
 - wing shape

$$\lambda = \frac{c_{tip}}{c_{root}}$$

- ◆ Mean aerodynamic chord [ft], c_{mac}
 - aerodynamic “average”

$$c_{mac} = \frac{2}{3} c_{root} \left(1 + \lambda - \frac{\lambda}{1 + \lambda} \right)$$

