



# Principi del volo

**Filippo Santinello, 18/06/2016**



# Agenda degli argomenti

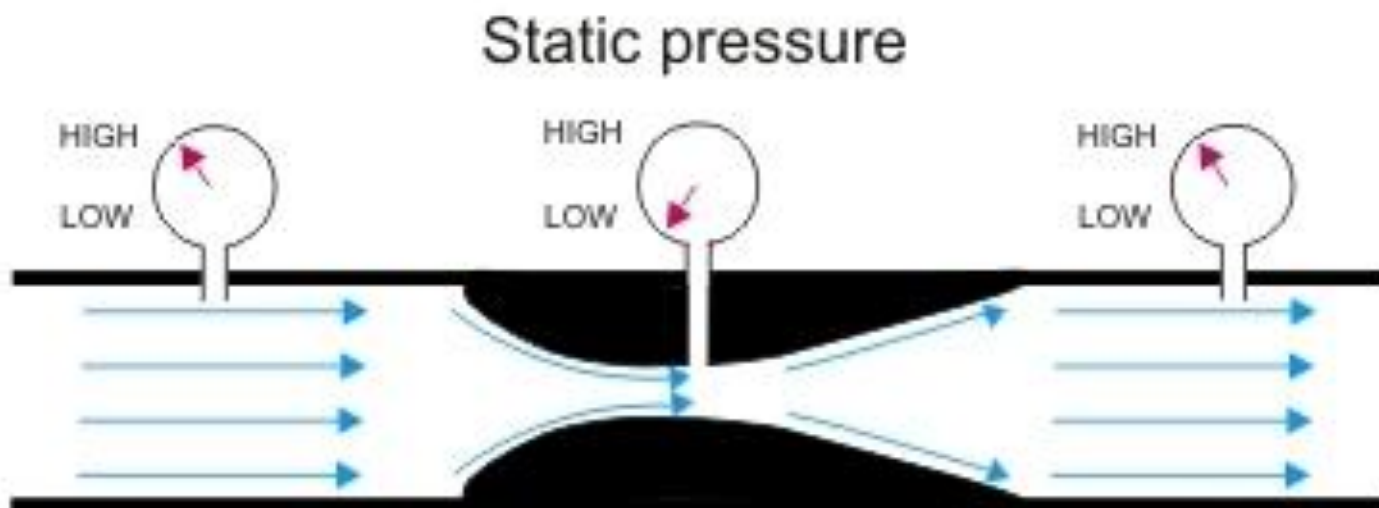
- Cenni sui fenomeni fisici alla base del volo
- Principali elementi di un velivolo
- Propulsione
- Strumentazione di bordo



# Fenomeni fisici del volo

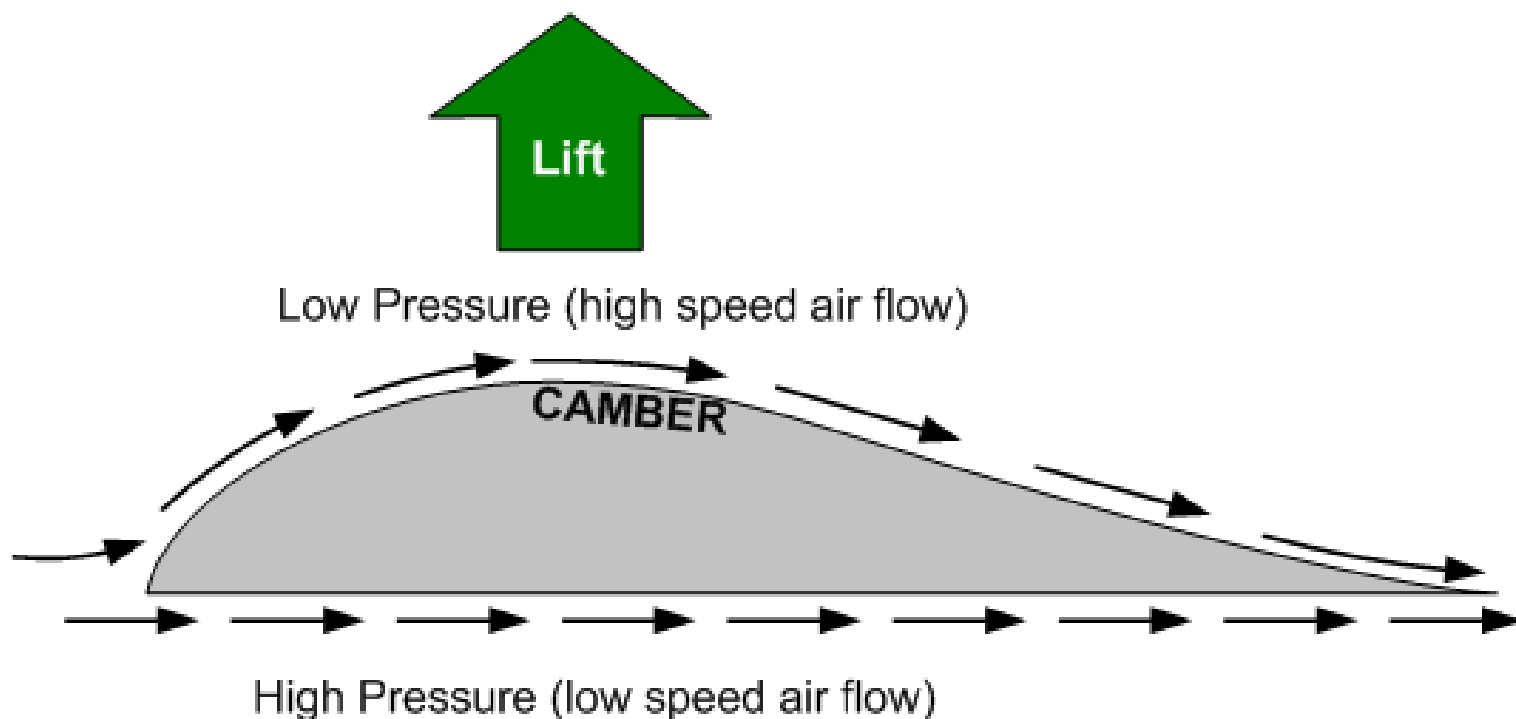


# Effetto Venturi



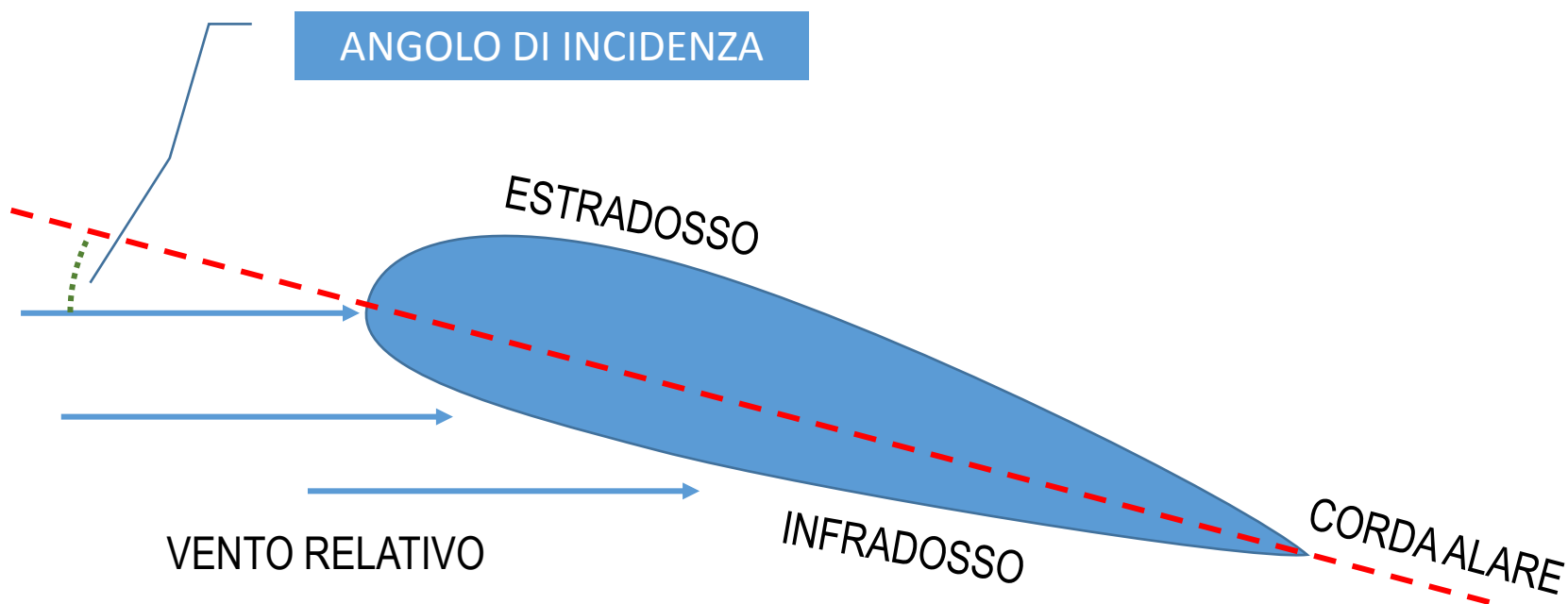


# Effetto Venturi e profili alari



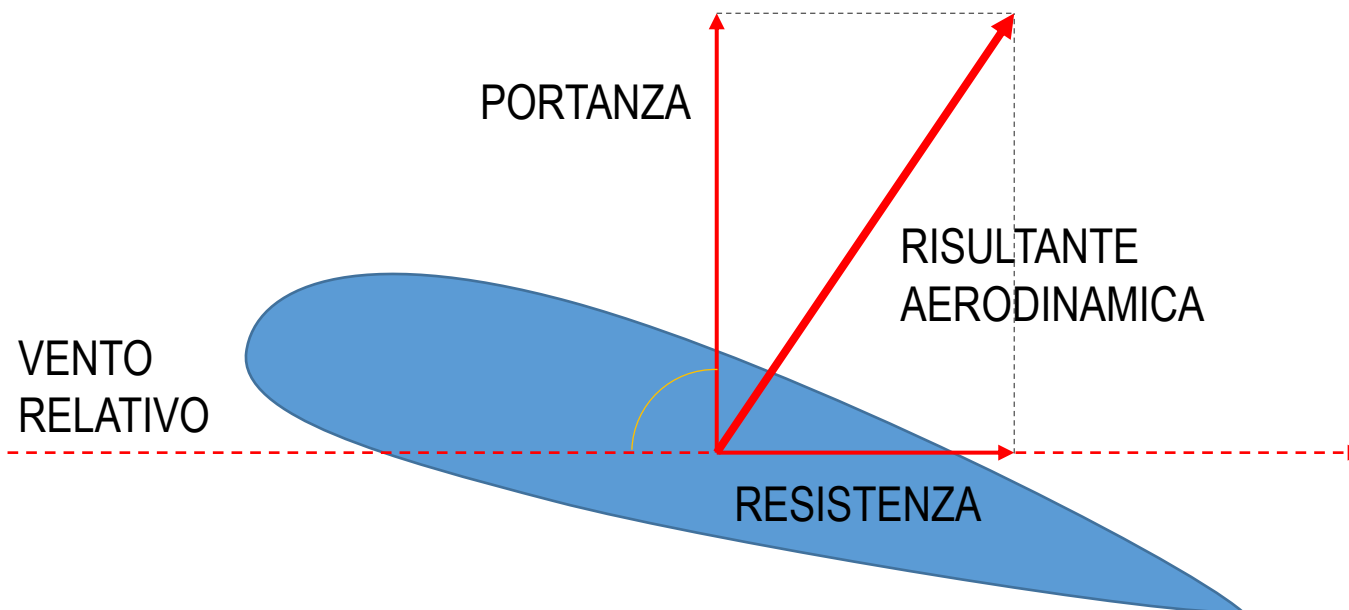


# Terminologia dei profili alari





# Profili alari e risultante aerodinamica





# Portanza e resistenza parassita

$$L = \frac{1}{2} \cdot \rho \cdot S \cdot V^2 \cdot C_L(\alpha)$$

$$D = \frac{1}{2} \cdot \rho \cdot S \cdot V^2 \cdot C_D(\alpha)$$





# Resistenza indotta e vortici

$$D_I = \frac{C_L^2}{\pi R}$$

Dove:

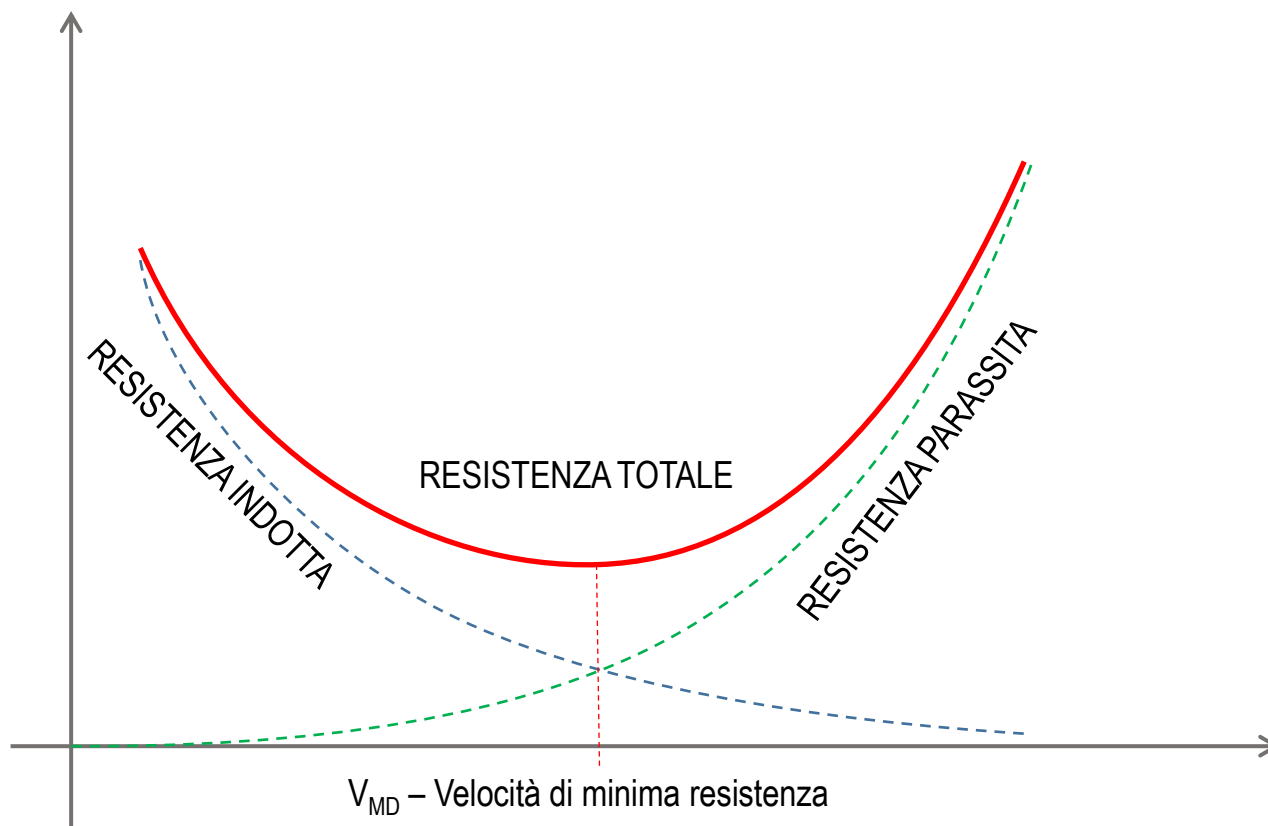
$C_L$  = coefficiente di portanza

$R$  = rapporto d'aspetto





# Resistenza e velocità



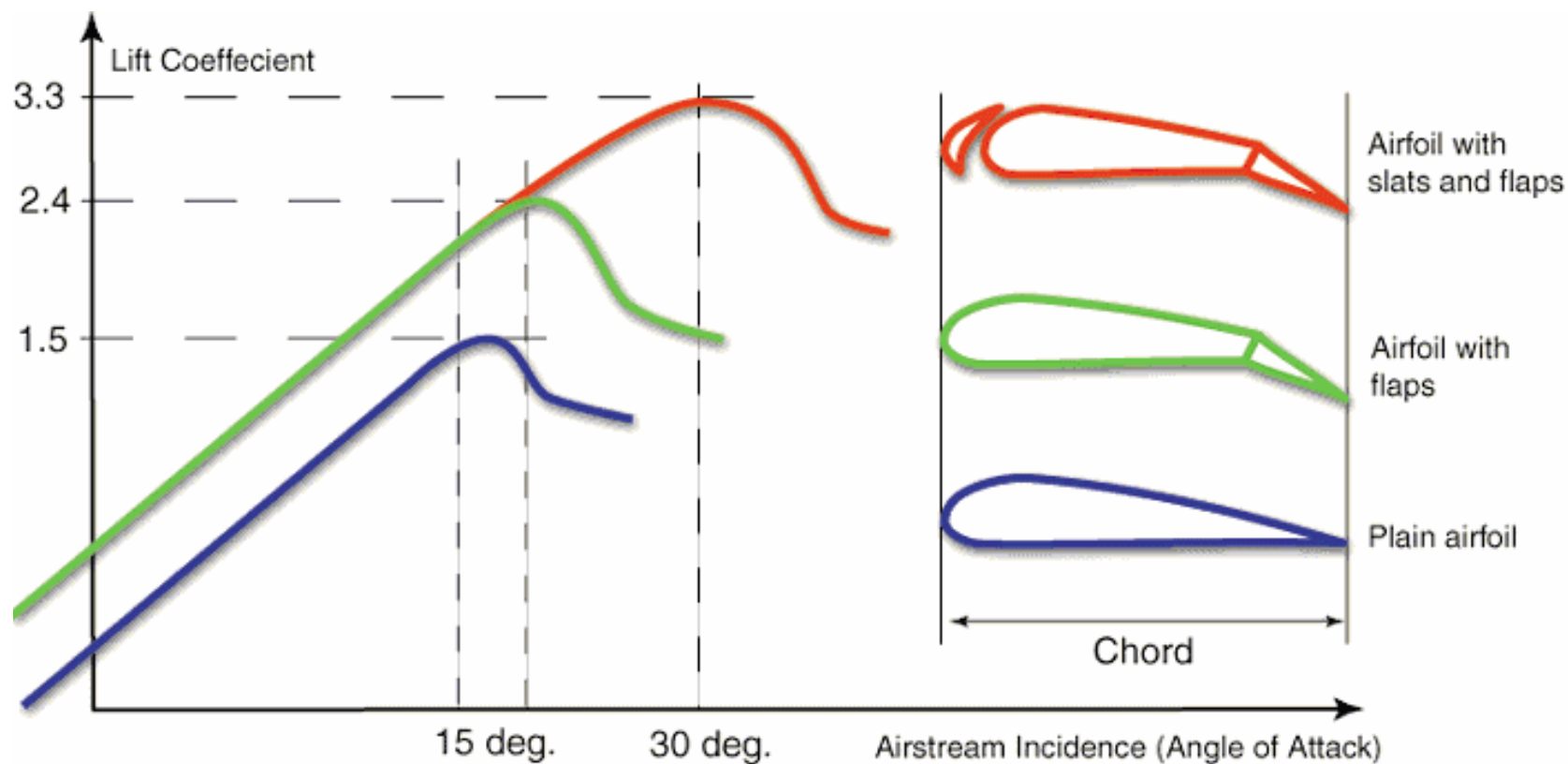


# Fenomeno dello stallo










# Stallo e configurazione alare





# Parametri che influenzano la velocità di stallo

## Angle of Bank in Level Flight

0° Bank	20° Bank	40° Bank	60° Bank	80° Bank
				
Loading: 1.0 g	Loading: 1.06 g	Loading: 1.31 g	Loading: 2.0 g	Loading: 5.75 g
Aerodynamic Weight: 2000 lbs.	Aerodynamic Weight: 2100 lbs.	Aerodynamic Weight: 2620 lbs.	Aerodynamic Weight: 4000 lbs.	Aerodynamic Weight: 11,500 lbs.
Stall Speed: 55 KTS	Stall Speed: 56.6 KTS	Stall Speed: 63 KTS	Stall Speed: 78 KTS	Stall Speed: 132 KTS

$$\frac{W}{\cos \alpha} = \frac{1}{2} \rho S C_{Lmax} V_S^2 \rightarrow V_S = K \sqrt{\frac{W}{\rho \cdot C_{Lmax} \cdot \cos \alpha}}$$
$$K = \sqrt{\frac{2}{S}}$$



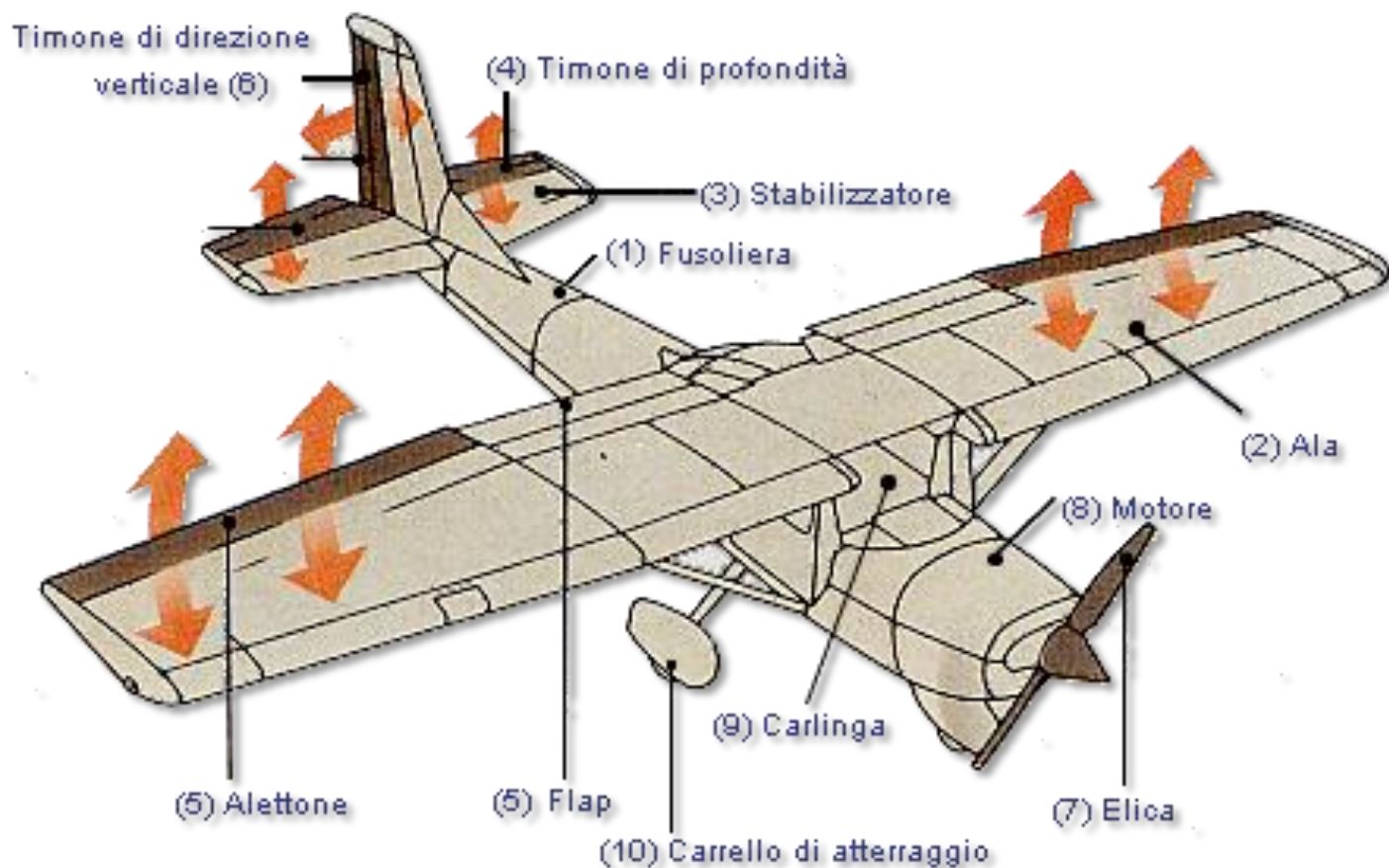


# Principali componenti di un velivolo





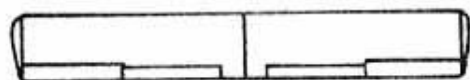
# Nomenclatura







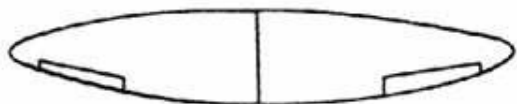
# Ala – esempi di geometria



Rectangular straight wing



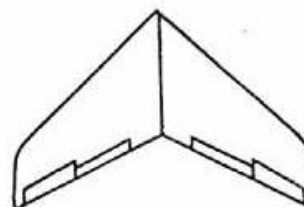
Tapered straight wing



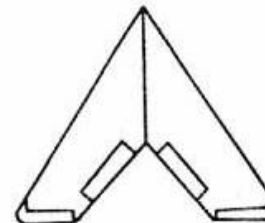
Rounded or elliptical straight wing



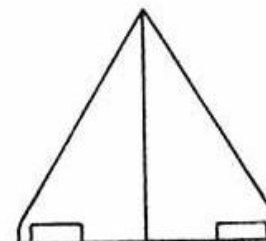
Slightly swept wing



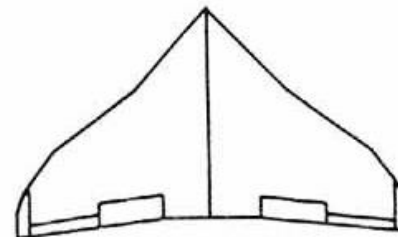
Moderately swept wing



Highly swept wing



Simple delta wing



Complex delta wing



# Superfici primarie

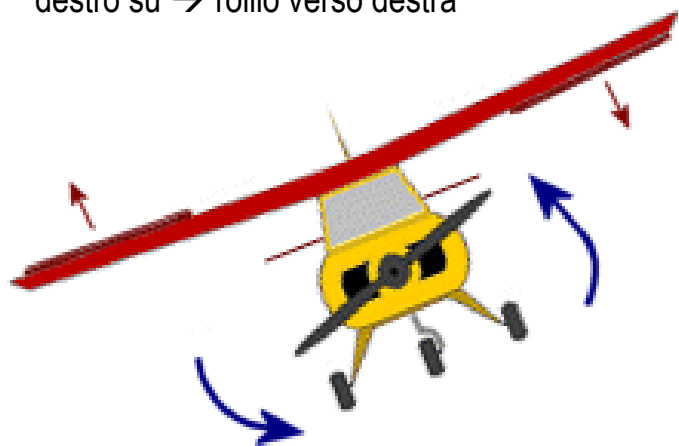
**Scopo:** controllare il movimento del velivolo attorno ai tre assi di rotazione

Asse di rotazione	Superficie primaria di controllo
Asse longitudinale (o asse di rollio)	Alettoni
Asse trasversale (o asse di beccheggio)	Timone di profondità
Asse verticale (o asse di imbardata)	Timone di direzione

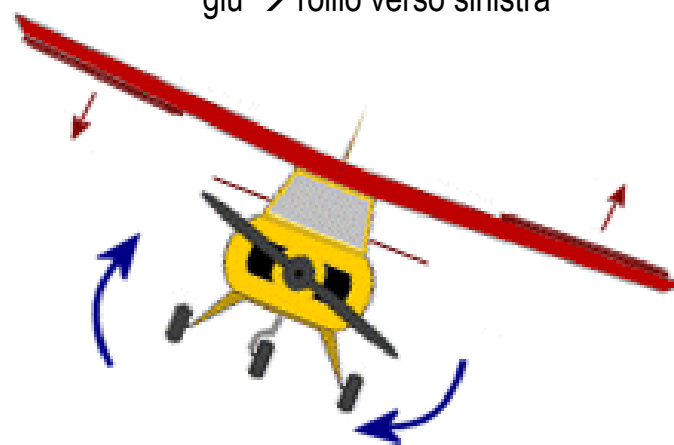


# Alettoni

Alettone sinistro giù, alettone destro su → rollio verso destra

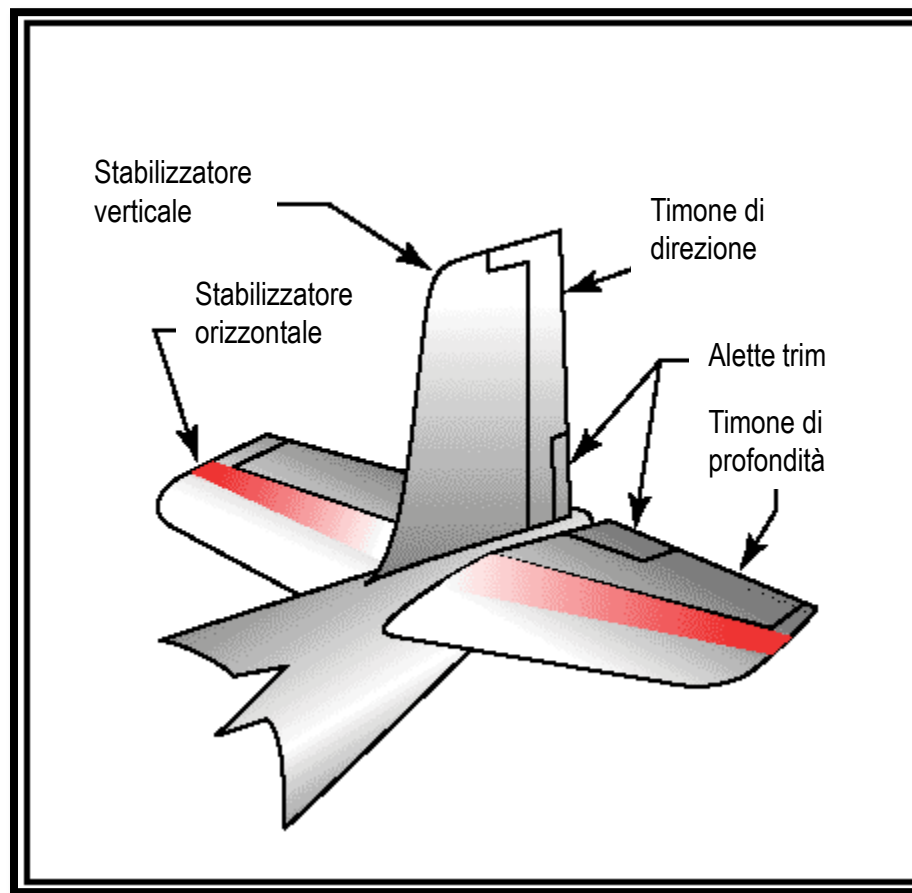


Alettone sinistro su, alettone destro giù → rollio verso sinistra





# Impennaggio





# Superfici secondarie

**Scopo:** manipolare le caratteristiche aerodinamiche del velivolo



SLATS





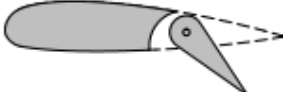




FLAPS



AEROFRENI



# Tipi di flap

	Increase in lift ( $\Delta C_L$ ) compared to basic profile ( $C_L = 1.45$ )	$C_{L \max}$	$\Delta C_{L \max}$
Basic profile		1.45	-
Normal flap		2.25	0.80
Slotted flap		2.60	1.15
Double slotted flap		2.80	1.35
Split flap		2.40	0.95
Zap flap		2.50	1.05
Fowler flap		2.80	1.35



# Strumentazione di bordo



# Disposizione standard degli strumenti







# Strumenti standard

## STRUMENTI A CAPSULA



## STRUMENTI GIROSCOPICI



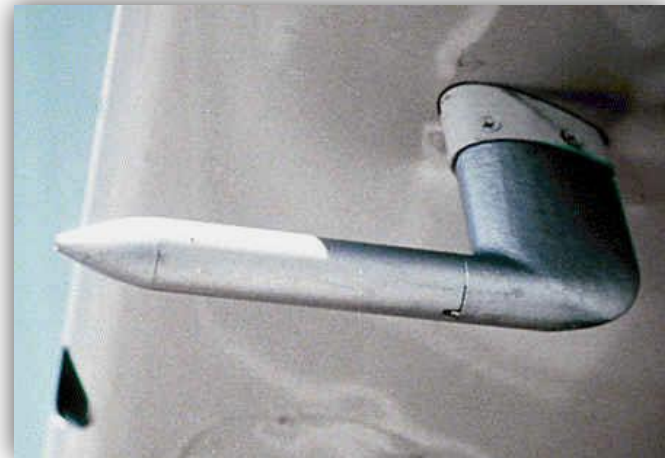


# Presca statica e tubo di Pitot



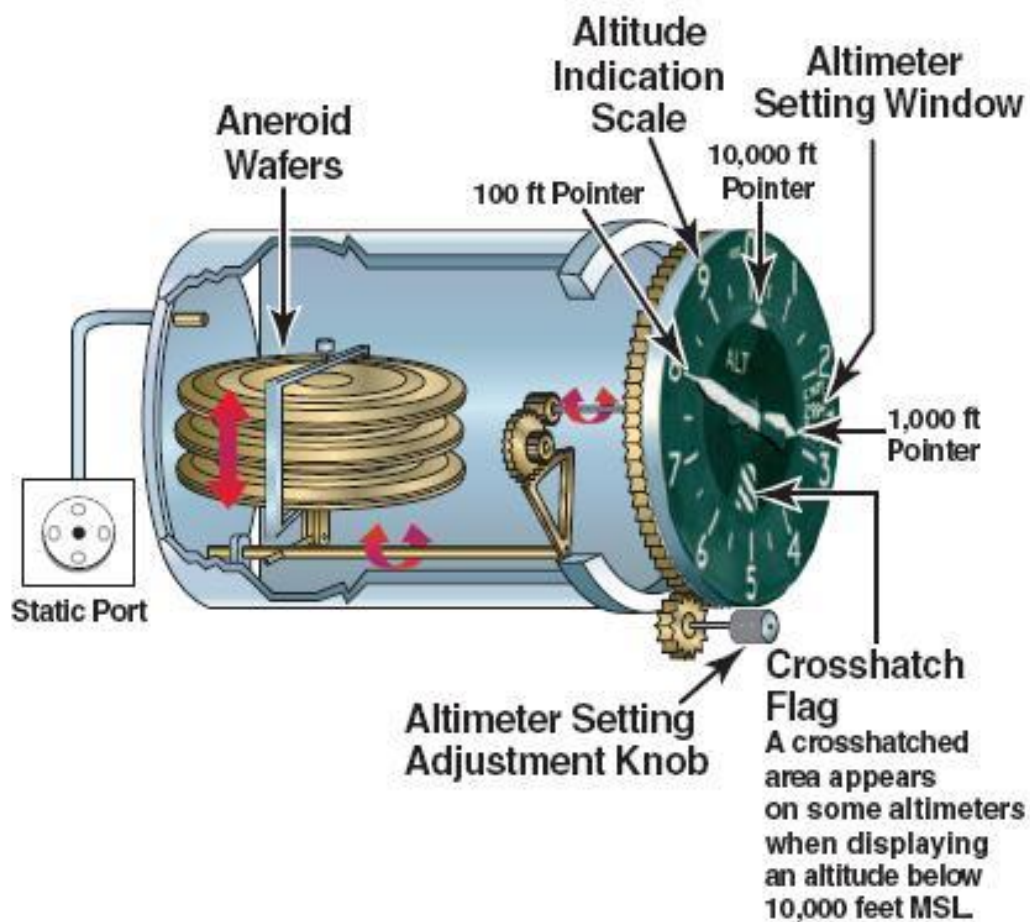
PRESA STATICA

TUBO DI PITOT



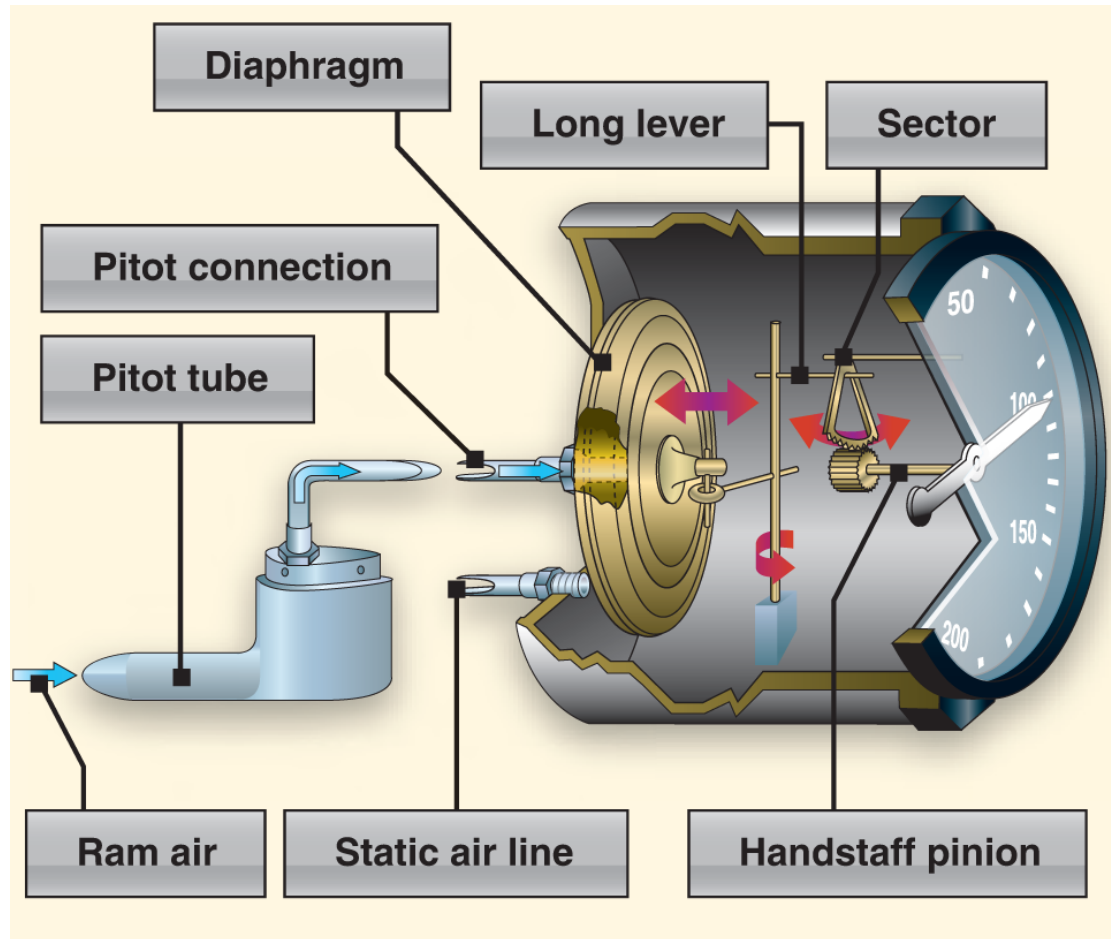


# Altimetro



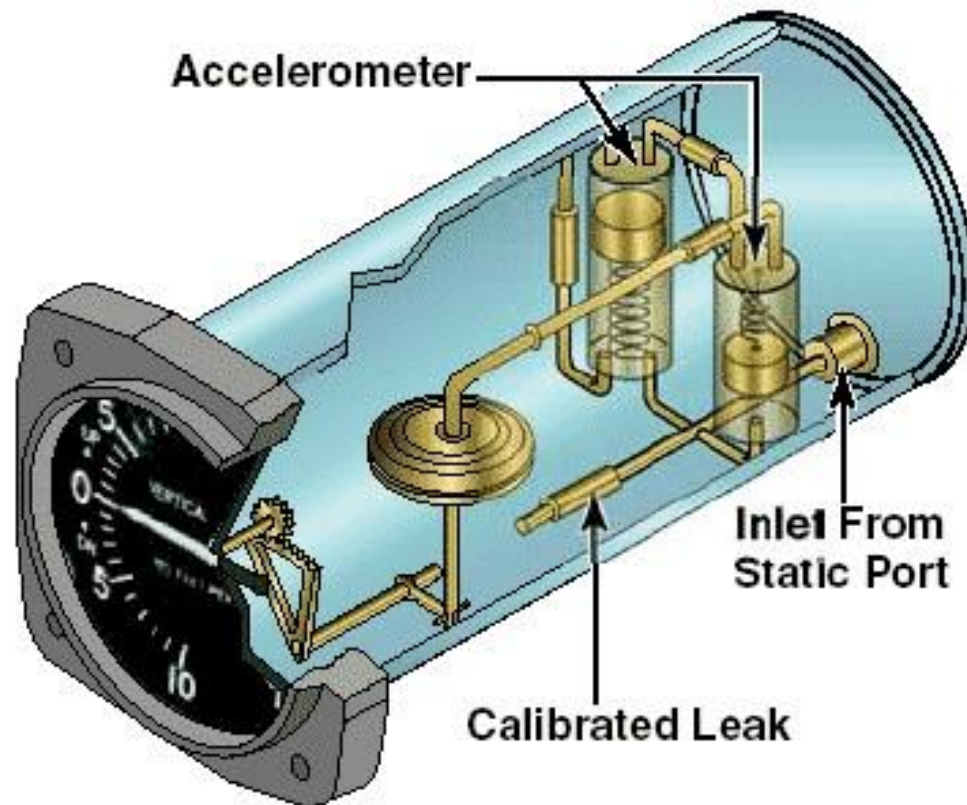


# Anemometro



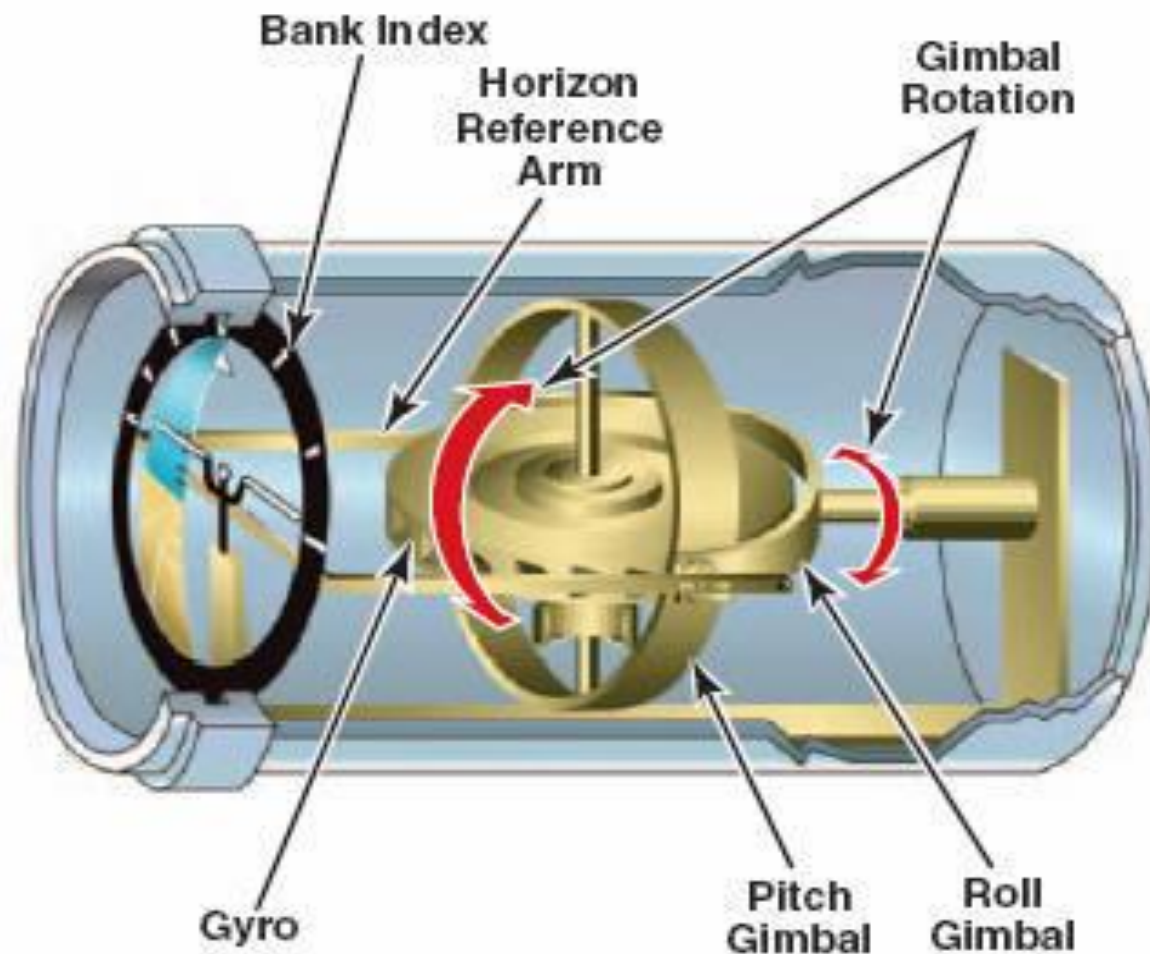


# Variometro





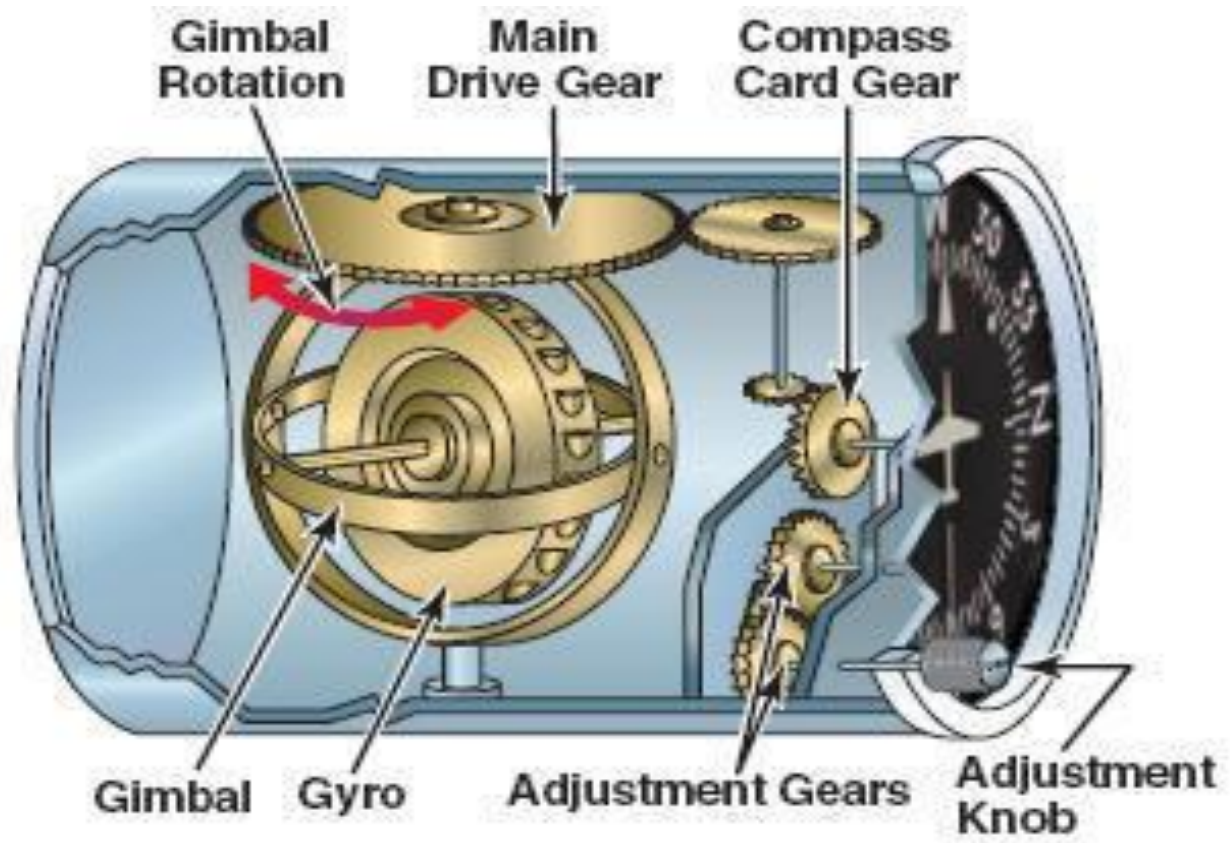
# Orizzonte artificiale





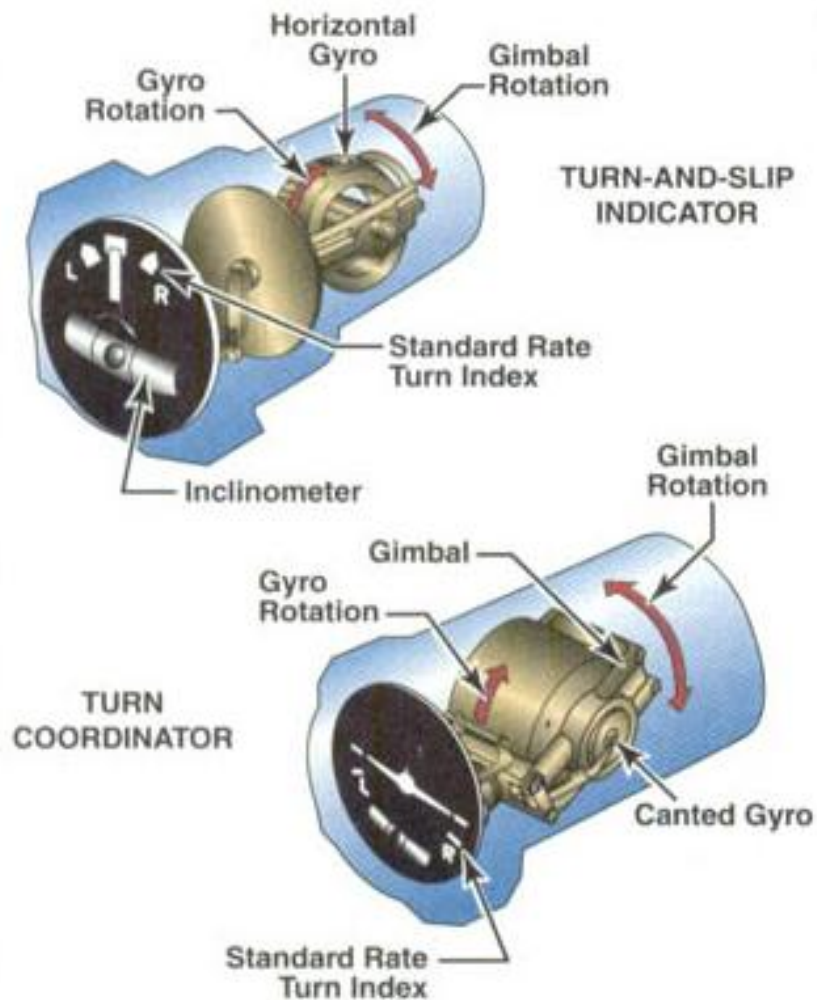


# Bussola giroscopica





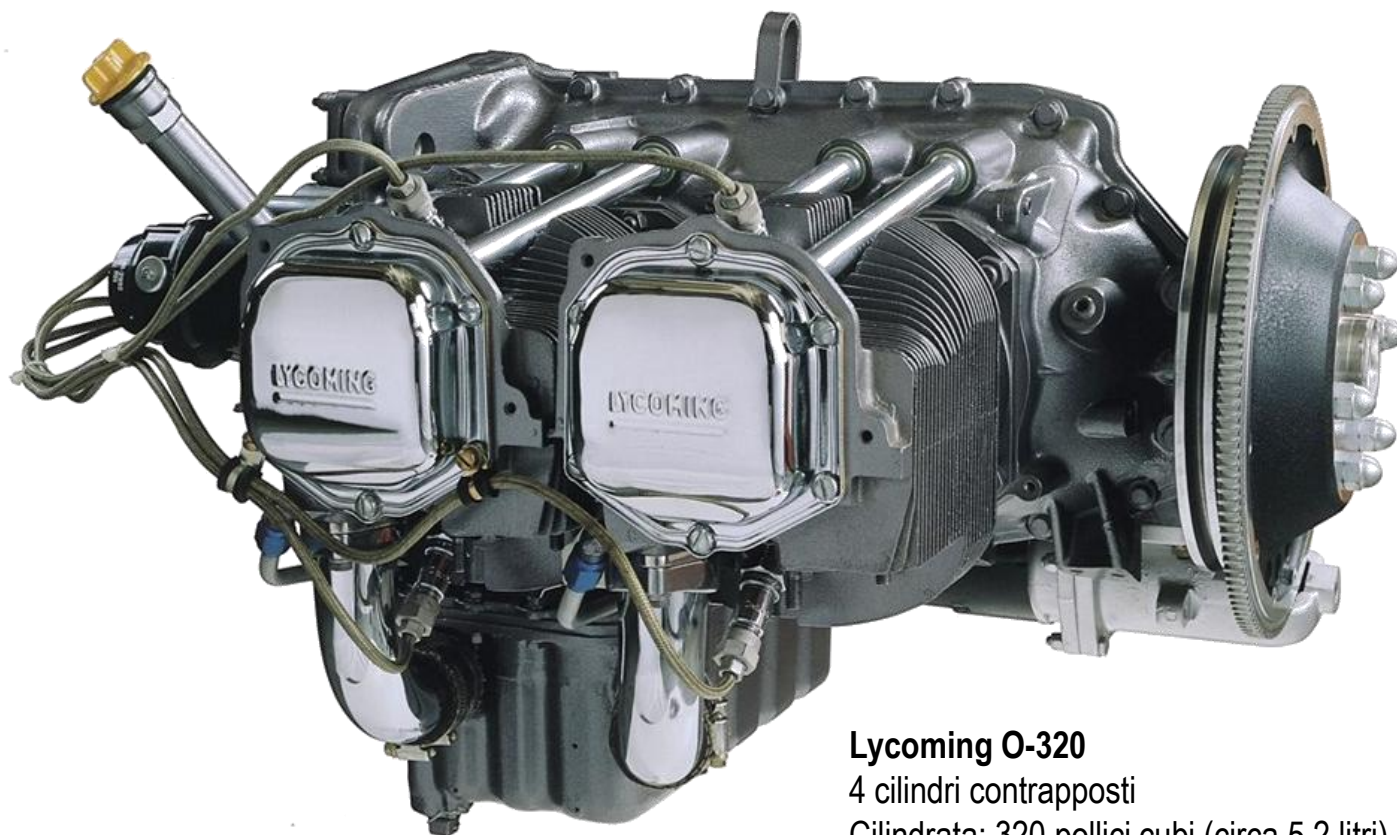
# Virometro







# Propulsione



## **Lycoming O-320**

4 cilindri contrapposti

Cilindrata: 320 pollici cubi (circa 5,2 litri)

Potenza: 160 HP @ 2700 RPM



# Raffreddamento

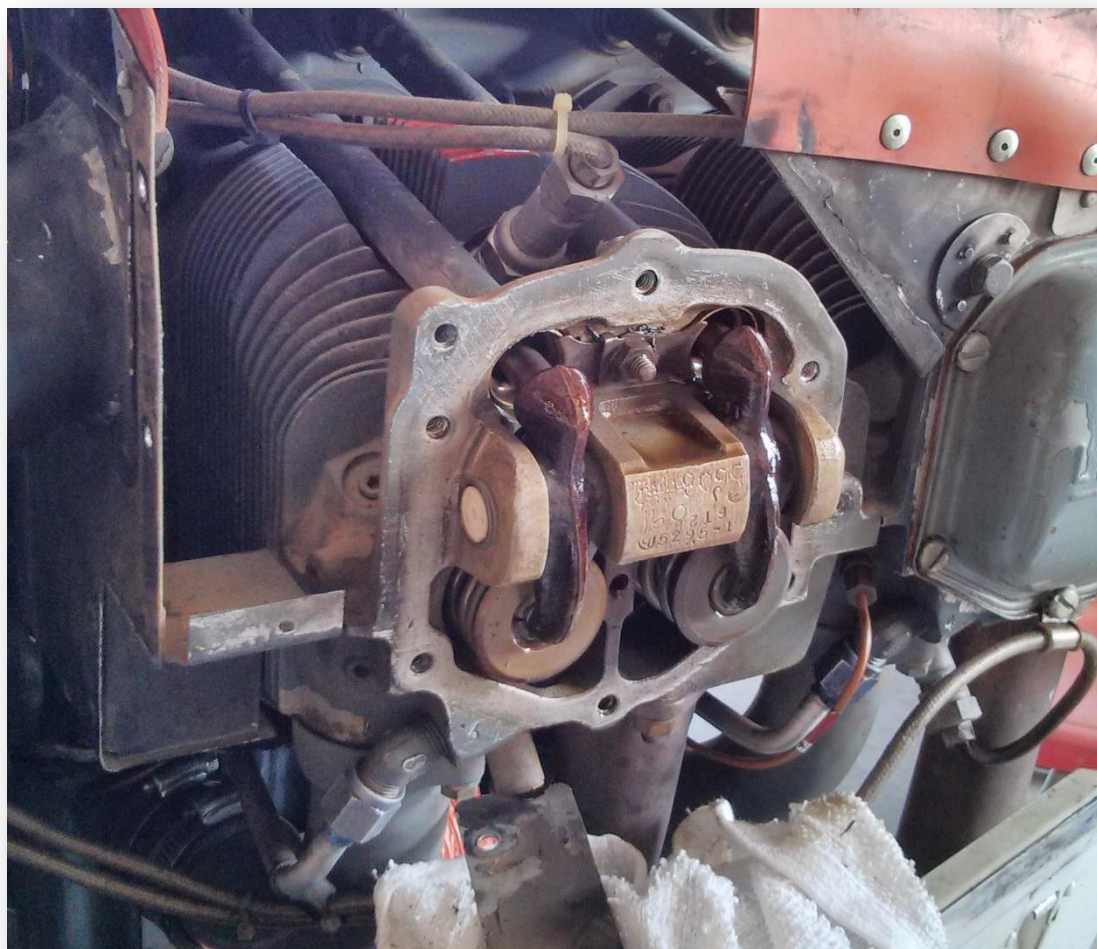


Raffreddamento ottenuto tramite tre sistemi:

1. Aria che investe i cilindri
2. Benzina in eccesso che sottrae calore evaporando
3. Olio lubrificante che asporta calore



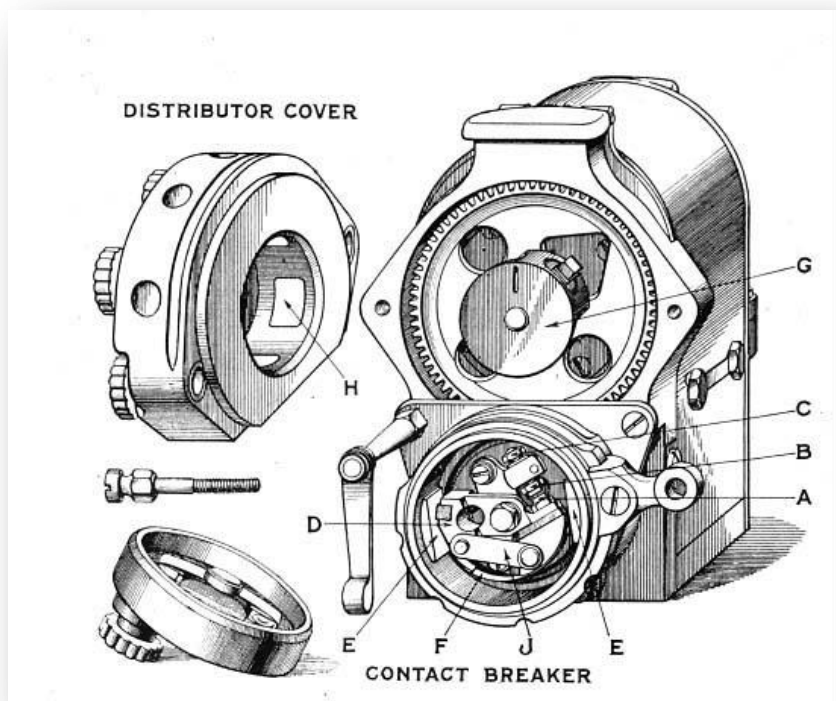
# Distribuzione





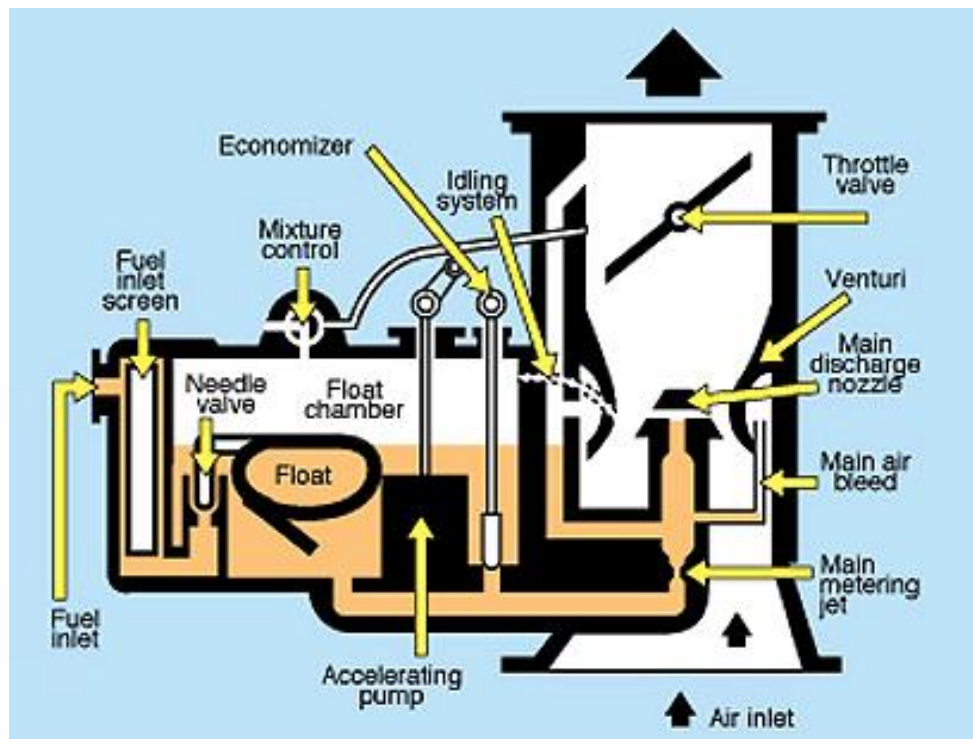


# Accensione





# Alimentazione





# Cosa vedremo nel volo di prova?

- Reazioni del velivolo al variare della potenza applicata
- Volo di primo e volo di secondo regime
- Virate e peso apparente
- Reazioni del velivolo in funzione dell'uso degli ipersostentatori (flaps)