081 Principles of Flight

$$Pressure = \frac{Force}{Area} \qquad Density = \frac{Mass}{Volume}$$

$Speed = \frac{Distance}{Time}$	m/s
$Acceleration = \frac{Change\ of\ Speed}{Time}$	m/s²
$Force = Mass * Acceleration$	N
$Momentum = Mass * Velocity$	kg m/s
$Kinetic\ Energy = \frac{1}{2} * M * V^2$	J
$Work = Force * Distance$	J
$Power = \frac{Work}{Time}$	W

Gas Laws:

Charles'	$V \propto T$	constant pressure
Boyle's	$P \propto \frac{1}{V}$	constant temperature
Gay-Lussac's	$P \propto T$	constant volume
Universal	$\frac{P * V}{T} = constant$	
Ideal Gas Law	$\frac{P}{\rho * T} = constant$	

$$Wing\ Area = b * c \qquad AR = \frac{b}{c}$$
$$A * \rho * V = constant\ (Mass\ flow)$$

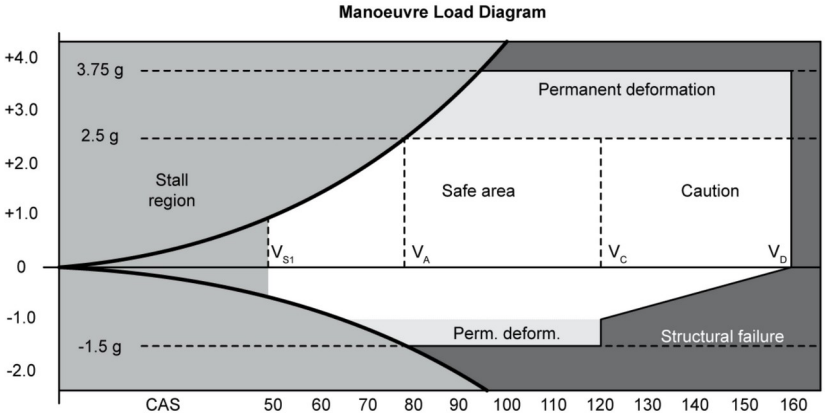
IAS corrected for instrument & position error => CAS
CAS corrected for compressibility => EAS
EAS corrected for relative density (density altitude) => TAS

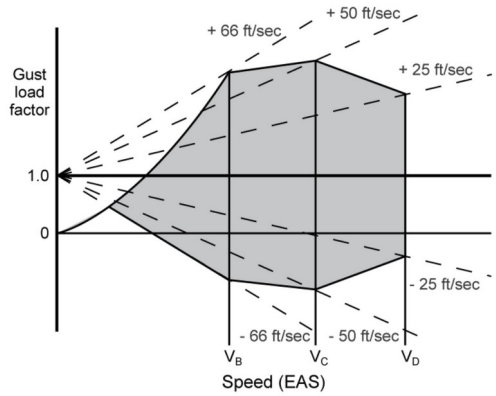
$$TAS = IAS * \sqrt{\frac{Standard\ Air\ Density}{Actual\ Air\ Density}}$$

$$C_{Di} = \frac{c_L^2}{\pi * AR}$$

Large/transport (CS25)	-1g	+2.5g (2g with flaps)
Normal (CS23)	-1.52g	+3.8g
Utility (CS23)	-1.76g	+4.4g
Aerobatic (CS23)	-3g	+6g

V_D	design dive speed	25 ft/sec
V_C	design cruise speed	50 ft/sec
V_B	Max gust intensity	66 ft/sec
V_{MO}	Max operating speed	





	gust load factor
heavy aircraft	small
higher altitude	small
higher wing loading	smaller
steeper CL curve (e.g. higher AR)	bigger
higher speed	bigger
higher wing area	bigger

V_{MCG} - Ground
V_{MCA} - Air
V_{MCL} – Landing/Approach

stick force stability vs stick position stability
bobweight, down-spring, etc.

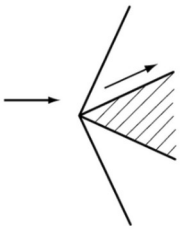
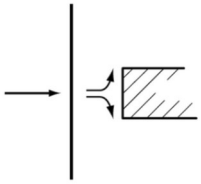
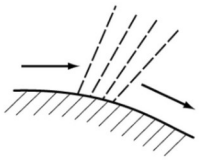
Step1: check stall

$$V_{S0} * \sqrt{n_{old}}$$

Step2: new load factor

$$\frac{speed_{new}}{speed_{old}} = \frac{n_{new} - 1}{n_{old} - 1}$$

Supersonic Wave Characteristics

Type of wave	OBLIQUE Shock wave	NORMAL Shock wave	EXPANSION wave
			
Definition	A plane of discontinuity include more than 90° from flow direction	A plane of discontinuity normal to flow direction	
Flow direction Change	Turned into a preceding flow	No change	Turned away from preceding flow
Effect on velocity and Mach number behind wave	Decreased but still supersonic	Decreased to subsonic	Increased to higher supersonic
Effect on static pressure and density	Increase	Great increase	Decrease
Effect on energy of airflow	Decrease	Great decrease	No change (no shock)
Effect on temperature	Increase	Increase	Decrease