Manoeuvring Speed and Maximum Load Factor at a Speed

Stall speed, design manoeuvring speed from the limit load factor, and the largest load factor the wing can produce at a given speed before stalling.

Method: Stall boundary of the V–n diagram

Input parameters

Unit system: SI

Parameter	Value	Unit
Aircraft weight	11,000	N
Wing area	16.200	m²
Maximum lift coefficient (clean)	1.5000	
Positive limit load factor (normal 3.8, utility 4.4, aerobatic 6)	3.8000	
Speed to check (equivalent airspeed)	198.00	km/h
Altitude (ISA)	0	m

Calculated results

Parameter	Value	Unit
1 g stall speed (EAS)	97.868	km/h
Manoeuvring speed V_s√n	190.78	km/h
Largest load factor available at V (stall-limited)	4.0930	
Ratio to the limit (above 1: full control deflection could overstress)	1.0771	
Manoeuvring speed as true airspeed at the altitude	190.78	km/h

Notes for this case

• In equivalent airspeed the stall line of the V–n diagram is n = ½ρ₀V²SC_L,max/W. Below V_A the wing stalls before reaching the limit load; V_A falls with lighter weight (√W).

Formula and method

$$V_s = \sqrt{\frac{2W}{\rho_0 S C_{L,max}}}, \quad V_A = V_s\sqrt{n_{lim}}, \quad n_{max}(V) = \frac{\rho_0 V^2 S C_{L,max}}{2W}$$

Variables

W	Aircraft weight	N
S	Wing area	m²
$C_{L,max}$	Maximum lift coefficient (clean)	-
n_{lim}	Positive limit load factor (normal 3.8, utility 4.4, aerobatic 6)	-
V	Speed to check (equivalent airspeed)	m/s
h	Altitude (ISA)	m
V_s	1 g stall speed (EAS)	m/s
V_A	Manoeuvring speed V_s√n	m/s
$n_{max}(V)$	Largest load factor available at V (stall-limited)	-
$n_{max}(V)/n_{lim}$	Ratio to the limit (above 1: full control deflection could overstress)	-
$V_{A,TAS}$	Manoeuvring speed as true airspeed at the altitude	m/s

Method and standards

Stall-limited load factor.

Assumptions and limits

- Quasi-steady lift, clean configuration.

References

Stall boundary of the V–n diagram

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/aerospace/manoeuvring-speed-load-factor

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Reopens the calculator with the inputs of this report.