VICTORIA FLYING CLUB

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- Bookings, Questions

VICTORIA FLYING CLUB

Take-Off

- Review Climbing and Slipping
- Definition and Motivation
- **Take-Offs**
  - **Normal, Short-Field, Soft-Field, Crosswind**
  - Factors
- Summary and Questions
- Pre-Flight Briefing

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Review Climbing

- Define and state the two important reference speeds for climbing.
- Where do we find the relevant performance data?
- How do we maintain a selected climb airspeed given a fix power setting?
- What factors affect climb performance?
- How do we maintain *coordinated flight* during a climbing turn?

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Definition and Motivation

- *Act of leaving a supporting surface including the immediately preceding and following acts*
- Leaving the ground and *becoming* **airborne**
- Essential maneuver used in every single flight

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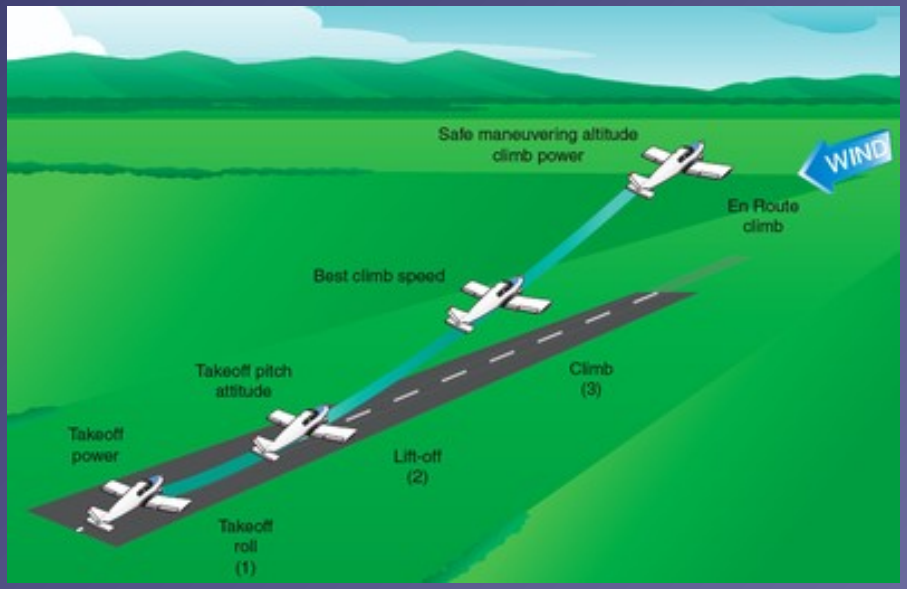
Normal Take-Off



- *Criteria*: *hard uncontaminated* **surface**, *long* **runway**, *no* **obstacles**, *low* **density altitude**, *no* or *steady* **headwind**
- Check **environment** and consult **performance** data in POH
- Pre-take-off checks according to **checklists** in POH
- **Mixture** *full* rich, lean for *maximum* RPM above ***3000 ft DALT***
- Conduct passenger, crew departure and emergency **briefings**

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Normal Take-Off – Line Up

- Check **approach sector** and callout *Approach Sector Clear*
- Align with **runway centerline** using **power**, **rudder** and **brakes**
- Keep **nose-wheel** *centered* and *ideally* stop before take-off run
- Crosscheck **runway heading**, **magnetic compass**, **heading indicator**

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Normal Take-Off – Run

- Callout *Take-Off* before initiating take-off run
- *Smoothly* apply *full* **power** keeping *straight* with **rudder**
- Use **runway end** as **reference** for directional control
- Check RPM/ASI and callout *RPM Checked*, *Airspeed Alive*
- Continue to accelerate to rotation speed (***Vr = 55 KIAS***)
- *Gently* apply **elevator** back-pressure to lift off nose-wheel

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Normal Take-Off – Initial Climb

Positive Rate

Vy

Adjust Attitude

Maintain Airspeed

Control Direction

- Establish **nose-up attitude** aligning nose with **horizon**
- Check altitude and VSI and callout *Positive Rate*
- Accelerate to *normal* **climb airspeed** (***80 KIAS***)
- Adjust and maintain **nose-up attitude** for **climb airspeed**
- **Trim** to eliminate elevator control pressure *as required*
- Maintain directional control and control **yaw** with **rudder**

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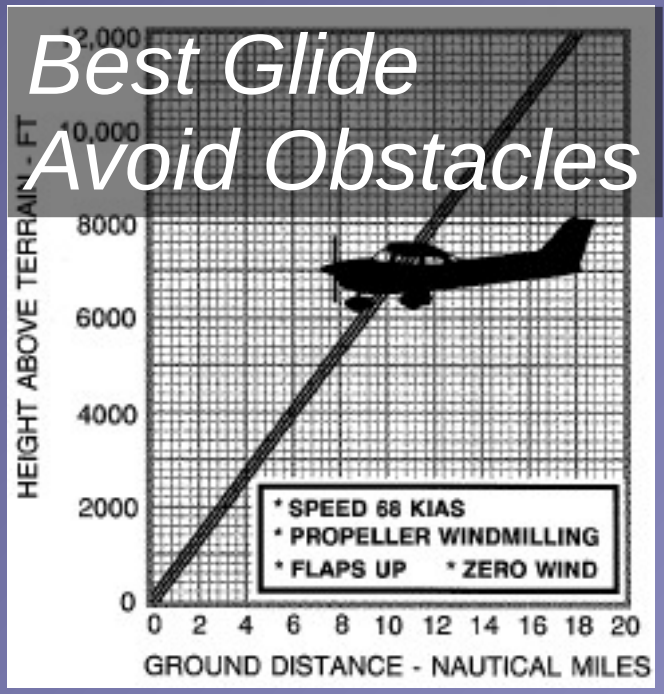
Aborted / Rejected Take-Off

Power Idle

Apply Brakes

Best Glide
Avoid Obstacles



- Reasons: failures, traffic, animals, humans
- During take-off run: **power** *idle*, apply **brakes**, keep *straight*
- Immediately after take-off *with* sufficient runway: **power** *idle*, **flaps** *as required*, land *straight ahead*
- Immediately after take-off *without* sufficient runway: establish **best glide airspeed** (***68 KIAS***), avoid *major* **turns** and **obstacles**

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Safety Considerations

- Continue **lookout** and maintain **situational awareness**
- Remain within ATC **clearance** limits (line-up, take-off)
- Comply with ATC **instructions** (hold short)
- Inform ATC if *unable* to follow instructions
- Consider leaving **ground effect**: *induced* versus *effective* **angle of attack**

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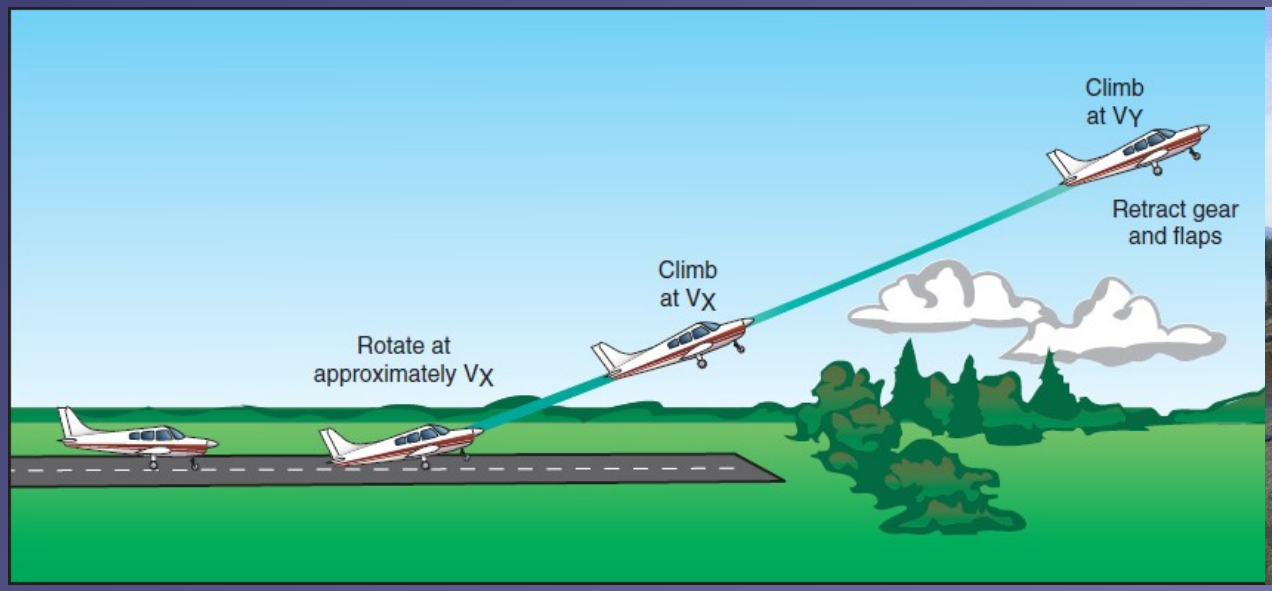
Short-Field Take-Off



- *Criteria*: *hard uncontaminated* **surface**, *short* **runway**, **obstacles**, *high* **density altitude**, *no* or *steady* **headwind**
- Check **environment** and consult **performance** data in POH
- Pre-take-off checks according to **checklists** in POH
- **Mixture** *full* rich, lean for *maximum* **RPM** above ***3000 ft DALT***
- Conduct passenger, crew departure and emergency **briefings**

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Short-Field Take-Off – Line Up

- Check approach sector and callout *Approach Sector Clear*
- Align with **runway centerline** using **power**, **rudder** and **brakes**
- Keep **nose-wheel** *centered* and stop before take-off run
- Crosscheck **runway heading**, **magnetic compass**, **heading indicator**

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Short-Field Take-Off – Run

Flaps 10°

Hold Brakes

Full Power

Release Brakes

- Set **flaps *10°***, apply and *hold* **brakes**
- *Smoothly* apply *full* **power** and check *static* **RPM** (***2300-2400***)
- Callout *Take-Off* before initiating take-off run
- Release **brakes** to initiate take-off run
- Apply *slight* **elevator** back-pressure
- Check RPM/ASI and callout *RPM Checked*, *Airspeed Alive*
- Keep *straight* with **rudder** accelerating to lift-off (***Vr = 44..51 KIAS***)

Slight Back-Pressure

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Short-Field Take-Off – Initial Climb

- Check altitude and VSI and callout *Positive Rate*
- Accelerate to *best angle* of **climb airspeed** (*Vx = 62 KIAS*)
- Adjust and maintain **nose-up attitude** for **airspeed** and **trim**
- Maintain directional control and control **yaw** with **rudder**
- Transition to *best rate* of **climb airspeed** (*Vy = 74 KIAS*) *after* **obstacles** are cleared and **trim**
- Retract **flaps** at **safe altitude** (*400 ft AGL*) in **white arc**

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Take-Off Performance

SHORT FIELD TAKEOFF DISTANCE AT 2550 POUNDS

CONDITIONS:

Flaps 10°
Full Throttle Prior to Brake Release
Paved, level, dry runway
Zero Wind
Lift Off: 51 KIAS
Speed at 50 Ft: 56 KIAS

Press Alt In Feet	0°C		10°C		20°C		30°C		40°C	
	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst
S. L.	860	1465	925	1575	995	1690	1070	1810	1150	1945
1000	940	1600	1010	1720	1090	1850	1170	1990	1260	2135
2000	1025	1755	1110	1890	1195	2035	1285	2190	1380	2355
3000	1125	1925	1215	2080	1310	2240	1410	2420	1515	2605
4000	1235	2120	1335	2295	1440	2480	1550	2685	1660	2880
5000	1355	2345	1465	2545	1585	2755	1705	2975	1825	3205
6000	1495	2605	1615	2830	1745	3075	1875	3320	2010	3585
7000	1645	2910	1785	3170	1920	3440	2065	3730	2215	4045
8000	1820	3265	1970	3575	2120	3880	2280	4225	2450	4615

NOTES:

1. Short field technique as specified in Section 4.
2. Prior to takeoff from fields above 3000 feet elevation, the mixture should be leaned to give maximum RPM in a full throttle, static runup.
3. Decrease distances 10% for each 9 knots headwind. For operation with tail winds up to 10 knots, increase distances by 10% for each 2 knots.
4. For operation on dry, grass runway, increase distances by 15% of the "ground roll" figure.

SHORT FIELD TAKEOFF DISTANCE AT 2400 POUNDS

CONDITIONS:

Flaps 10°
Full Throttle Prior to Brake Release
Paved, level, dry runway
Zero Wind
Lift Off: 48 KIAS
Speed at 50 Ft: 54 KIAS

Press Alt In Feet	0°C		10°C		20°C		30°C		40°C	
	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst
S. L.	745	1275	800	1370	860	1470	925	1570	995	1685
1000	810	1390	875	1495	940	1605	1010	1720	1085	1845
2000	885	1520	955	1635	1030	1760	1110	1890	1190	2030
3000	970	1665	1050	1795	1130	1930	1215	2080	1305	2230
4000	1065	1830	1150	1975	1240	2130	1335	2295	1430	2455
5000	1170	2015	1265	2180	1360	2355	1465	2530	1570	2715
6000	1285	2230	1390	2410	1500	2610	1610	2805	1725	3015
7000	1415	2470	1530	2685	1650	2900	1770	3125	1900	3370
8000	1560	2755	1690	3000	1815	3240	1950	3500	2095	3790

NOTES:

1. Short field technique as specified in Section 4.
2. Prior to takeoff from fields above 3000 feet elevation, the mixture should be leaned to give maximum RPM in a full throttle, static runup.
3. Decrease distances 10% for each 9 knots headwind. For operation with tail winds up to 10 knots, increase distances by 10% for each 2 knots.
4. For operation on dry, grass runway, increase distances by 15% of the "ground roll" figure.

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Soft-Field Take-Off

- *Criteria*: *soft*, *rough* or *contaminated* **surface**, *long* **runway**, *no* **obstacles**, *low* **density altitude**, *no* or *steady* **headwind**
- Check **environment** and consult **performance** data in POH
- Pre-take-off checks according to **checklists** in POH
- **Mixture** *full* rich, lean for *maximum* **RPM** above ***3000 ft DALT***
- Conduct passenger, departure and emergency **briefings**

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Soft-Field Pre-Take-Off

Checks

PREFLIGHT INSPECTION

1. Aircraft documents ---------- ON BOARD
2. Fire extinguisher ---------- CHECK
3. First Aid Kit ---------- CHECK
4. Control Lock ---------- REMOVE
5. Flight controls and trim ---------- CHECK
6. Ignition switch ---------- OFF
7. Electrical equipment, radios -OFF
8. Master switch ---------- ON
9. Flaps ---------- DOWN
10. Fuel gauges ---------- CHECK QUANTITY
11. Master ---------- OFF
12. External inspection

PASSENGER BRIEFING

1. Doors, windows
2. Seatbelts
3. Fire Extinguisher
4. First Aid Kit
5. ELT
6. Controls
7. Smoking
8. Life Vests
9. Loose Articles - Secure

ENGINE START

1. Documents, safety equipment and preflight ---------- COMPLETE
2. Passenger Briefing ---------- COMPLETE
3. Seats/Harnesses ---------- SECURE
4. Brakes ---------- SET
5. Avionics Power Switch ---------- OFF
6. Circuit Breakers ---------- CHECK IN
7. Fuel valve ---------- LEFT
8. Mixture ---------- RICH
9. Throttle ---------- SET
10. Carb Heat ---------- OFF
11. Master ---------- ON
12. Beacon Light ---------- ON
13. Primer ---------- As Req & locked
14. Propeller area ---------- CLEAR
15. Mags ---------- START
16. Throttle ---------- 1000 RPM
17. Oil Pressure ---------- CHECK

AFTER START

1. Avionics Power Switch ---------- ON
2. Flaps ---------- RETRACT
3. Nav Lights ---------- ON
4. Transponder ---------- STANDBY
5. Radios ---------- SET
6. ATIS ---------- COPY
7. Flight Instruments ---------- SET
8. Fuel Valve ---------- RIGHT
9. Taxi clearance ---------- OBTAIN
10. Brakes ---------- CHECK
11. Flight Instruments ---------- CHECK

RUN UP

1. Parking Brake ---------- SET
2. Throttle ---------- BOTH 1700 RPM
3. Propeller ---------- CYCLE (<30)
4. Throttle ---------- 1700 RPM
5. Oil Pressure/Temp ---------- CHECK
6. Suction Gauge ---------- CHECK
7. Ammeter ---------- CHECK
8. Magnetos ---------- CHECK BOTH
9. Carb Heat ---------- CHECK DROP
10. Mixture ---------- CHECK LEANING
11. Full idle with carb heat ---------- ON
12. Oil Pressure/Temp ---------- CHECK
13. Throttle ---------- 1000 RPM

BEFORE TAKE OFF

1. Belts, Doors, Windows, Seats - SECURE
2. Primer ---------- LOCKED
3. Master ---------- ON
4. Mags ---------- BOTH
5. Carb Heat ---------- COLD
6. Mixture ---------- RICH
7. Flaps ---------- AS REQUIRED
8. Trim ---------- SET FOR T/O
9. Fuel ---------- BOTH
10. Flight Instruments ---------- CHECK
11. Flight Controls ---------- FREE & CORRECT
12. Radios ---------- SET
13. Take off clearance ---------- OBTAIN

LINE UP

1. Time off ---------- RECORD
2. Transponder ---------- ALT (check code)
3. Landing Light ---------- ON
4. Strobe Lights ---------- ON

BEFORE LANDING

1. Primer ---------- LOCKED
2. Master ---------- ON
3. Mags ---------- BOTH
4. Carb Heat ---------- ON
5. Mixture ---------- RICH
6. Fuel Valve ---------- BOTH
7. Brakes ---------- CHECK
8. Seats, Belts, Harnesses ---- SECURE

AFTER LANDING

1. Taxi Clearance ---------- OBTAIN
2. Transponder ---------- OFF
3. Carb Heat ---------- OFF
4. Wing Flaps ---------- UP
5. Strobe Lights ---------- OFF
6. Landing Lights ---------- OFF

SHUT DOWN

1. Flight plan ---------- CLOSED
2. Radios ---------- 121.5 (check tone)
3. Avionics Power ---------- OFF
4. Nav Lights ---------- OFF
5. Live mag check at idle
6. Mixture ---------- Idle Cut Off
7. Mags ---------- OFF
8. Master ---------- OFF

Briefings

Mixture

Flaps 10°

- Complete pre-take-off checks and briefings on *supporting* **surface**
- Conduct passenger, crew departure and emergency **briefings**
- **Set flaps** (***10°***) and lean **mixture** *as required* on *supporting* **surface**
- Setup aircraft for *rolling* **take-off** on *soft* **surface**
- Observe ATC clearances and instructions

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Soft-Field Take-Off – Line Up

Relieve Nose-Wheel and Keep Rolling

- Apply and *hold* **elevator** back-pressure to *relieve* **nose-wheel**
- Check approach sector and callout *Approach Sector Clear*
- Perform *rolling* **take-off** – *ideally* do not stop after centerline alignment
- Crosscheck **runway heading**, **magnetic compass**, **heading indicator**

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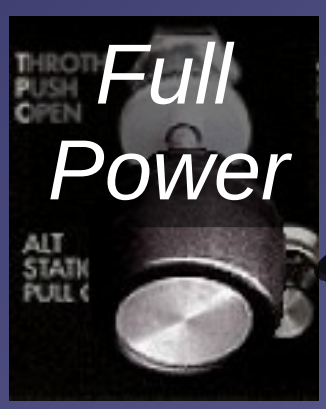
Soft-Field Take-Off – Run



- Callout *Take-Off* before initiating take-off run
- *Smoothly* apply *full* **power** keeping *straight* with **rudder**
- Use **runway end** as **reference** for directional control
- Apply *slight* **elevator** back-pressure to raise **nose-wheel**
- Check RPM/ASI and callout *RPM Checked*, *Airspeed Alive*
- Lift off at *slowest* **airspeed** possible *commensurate*

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Soft-Field Take-Off – Initial Climb

- Level-off and remain in **ground effect** *immediately* after lift-off
- Accelerate in **ground effect** to desired **climb airspeed** (***Vx***, ***Vy***)
- If *best angle* of climb (***Vx = 62 KIAS***) is used for initial climb, then
- Transition to *best rate* of climb (***Vy = 74 KIAS***) after clearing obstacles
- Retract **flaps** at **safe altitude** (***400 ft AGL***) in **white arc**

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Review Slipping

- Define a slip and explain the difference between a side and a forward slip and their applications.
- Mentally perform a side slip and state all observations and actions.

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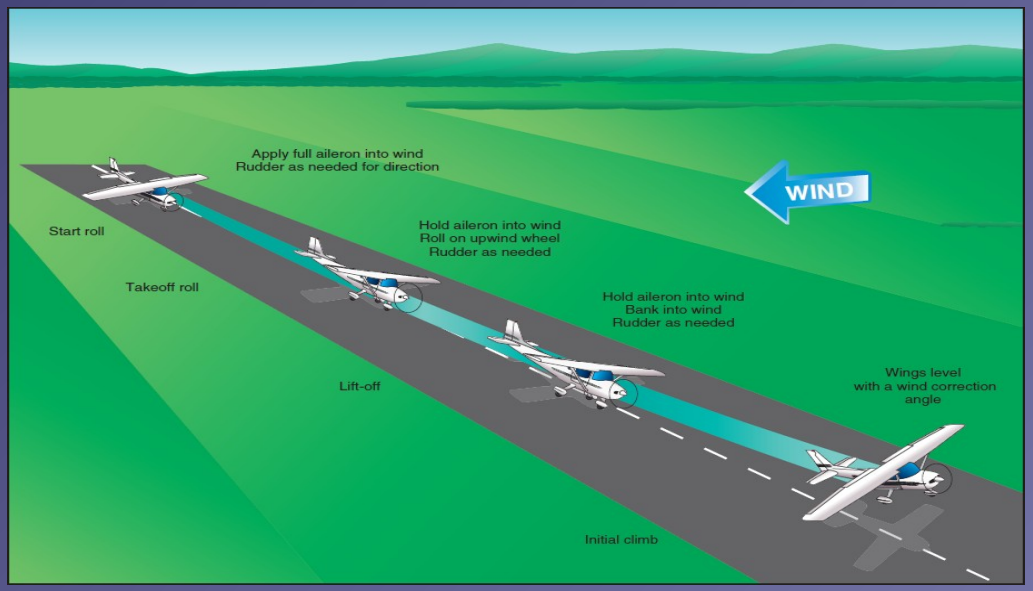
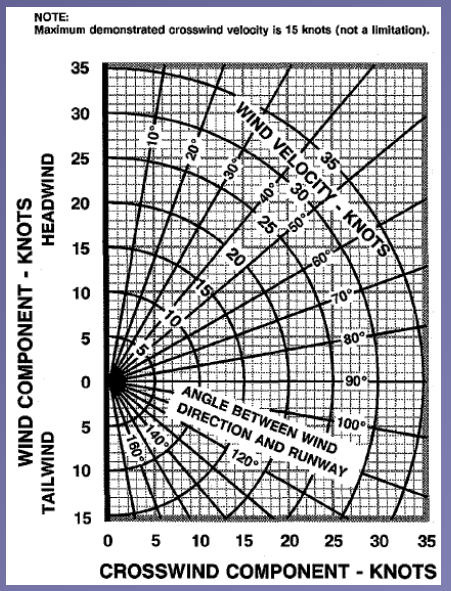
Crosswind Take-Off





- *Criteria*: *steady* or changing *gusty* **crosswind** component
- Check **environment** and consult **performance** data in POH
- Pre-take-off checks according to **checklists** in POH
- *Maximum demonstrated* **crosswind** component ***15 knots***
- Mixture *full* rich, lean for *maximum* **RPM** above ***3000 ft DALT***
- Conduct passenger, departure and emergency **briefings**

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Crosswind Take-Off – Run

- Use *minimum* **flap** setting required and *hold full* **ailerons** *into* the wind
- Callout *Take-Off* before initiating take-off run
- *Smoothly* apply *full* **power** keeping *straight* with **rudder**
- Use **runway end** as **reference** for directional control
- Check RPM/ASI and callout *RPM Checked*, *Airspeed Alive*
- Continue to accelerate to *slightly higher* lift-off speed in gusty conditions
- *Gradually* reduce **aileron** input keeping **wings level** during lift-off
- *Briskly* apply **elevator** back-pressure to lift off

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Crosswind Take-Off – Initial Climb

Level Wings

Coordinated Turn into Wind

- Check altitude and VSI and callout *Positive Rate*
- Perform **coordinated turn** *into* the wind to establish a crab *while* maintaining **runway track**
- Accelerate to desired **climb airspeed** (*Vx, Vy*) and transition to higher climb airspeed as applicable *after* clearing obstacles
- Adjust and maintain **nose-up attitude** for **climb airspeed** and **trim**
- Retract **flaps** at **safe altitude** (***400 ft AGL***) in ***white arc***

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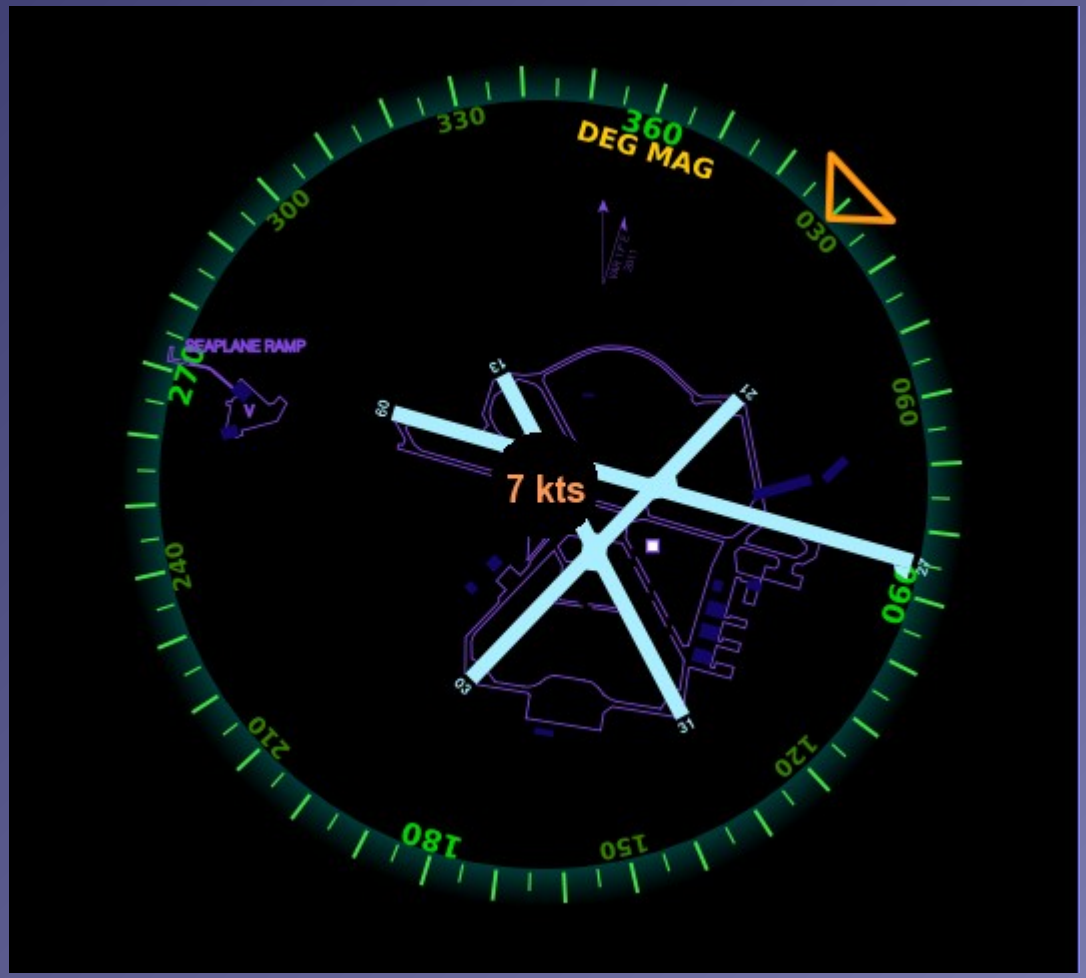
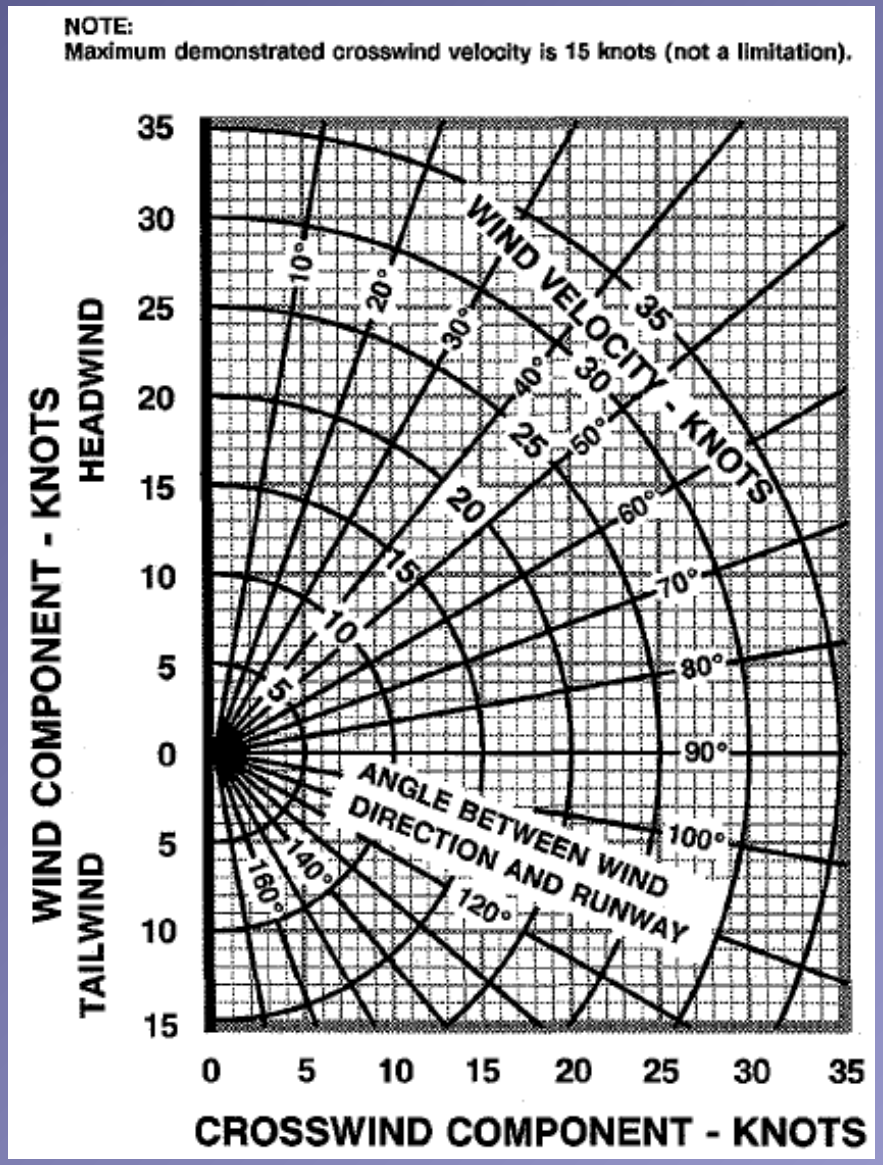
Crosswind Component





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Take-Off Factors

- Runways and **aerodrome** environment
- **Surface** material (hard, soft, rough) and **slope**
- Surface c**ontamination** (wet, dry, slush, snow, ice)
- **Air density** (altitude, pressure, temperature, humidity)
- **Wind** and turbulence (head-/tailwind, gusts, windshear)
- **Wake** turbulence
- **Obstacles**
- **Weight** and **balance**
- Ground effect, wheelbarrowing, weathercocking

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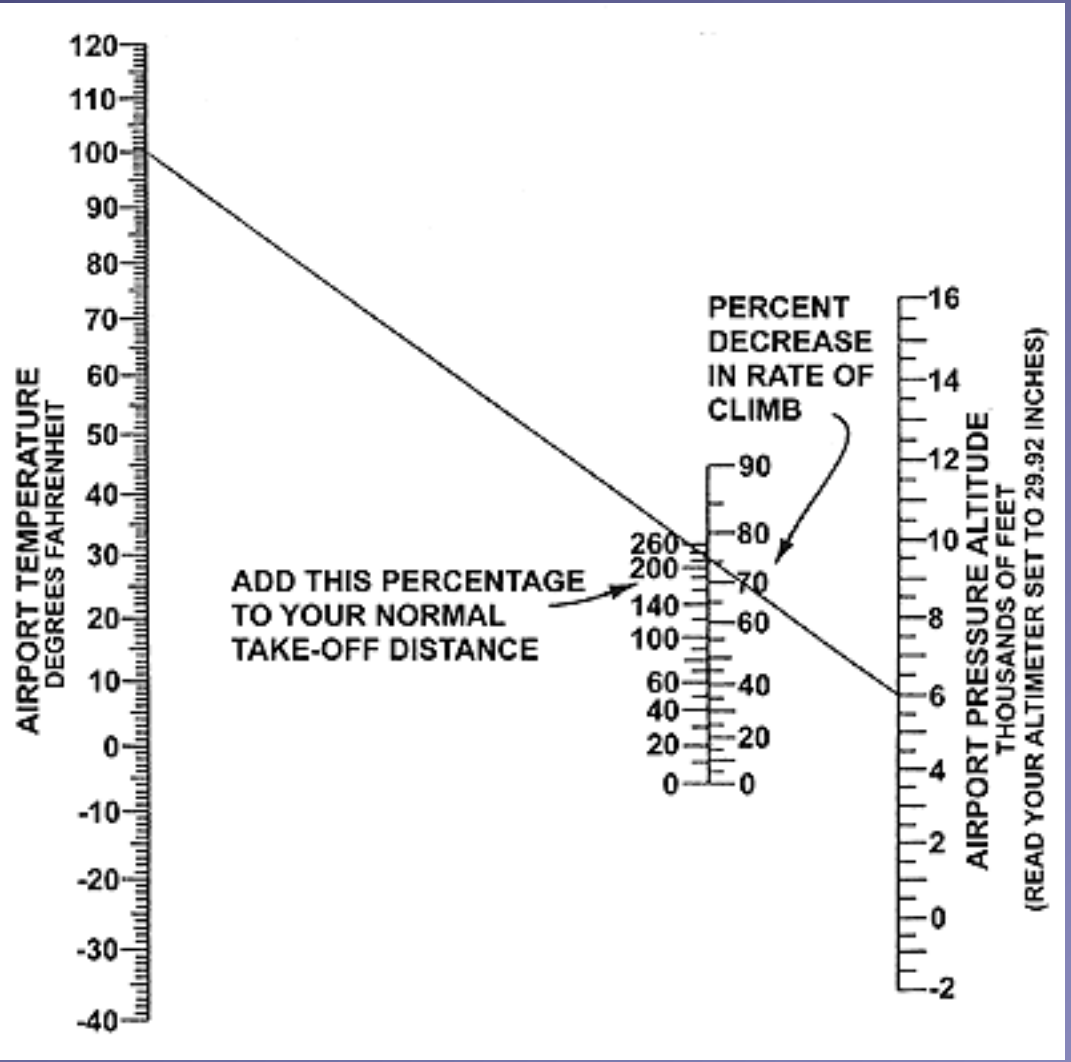
Density Altitude – Koch Chart



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High Density Altitude Operations

- Check **environment** and consult **performance** data in POH
- Pre-take-off checks according to **checklists** in POH
- Lean for *maximum* **RPM** above ***3000 ft DALT***
- *High* (high density altitude = low air density), *hot*, *humid*

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Special Take-Offs

- Take-offs featuring *combined* factors
- Soft, short, high, hot, gusty, heavy, contaminated...

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Wheelbarrowing

- *Higher* load on the **nose-wheel** compared to main wheels
- Tendency to pivot about the nose wheel may result in ground loop
- *Before* pivoting: *ease* back **elevator** to reduce weight on **nose wheel**
- *After* pivoting: *relax* forward **elevator** and abort if not stopped

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Summary / Quiz

- What are the factors affecting take-offs and the selection of a take-off type?
- Mentally perform a short-field take-off and state all observations and actions.
- Mentally perform a soft-field take-off and state all observations and actions.
- Mentally perform a crosswind take-off and state all observations and actions.

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Pre-Flight Briefing

- Exercise
- Training Area
- Departure and Arrival Procedures
- Weather Briefing / NOTAMs
- Aircraft and Documents
- Time and Fuel Requirements
- Safety Considerations and Responsibilities

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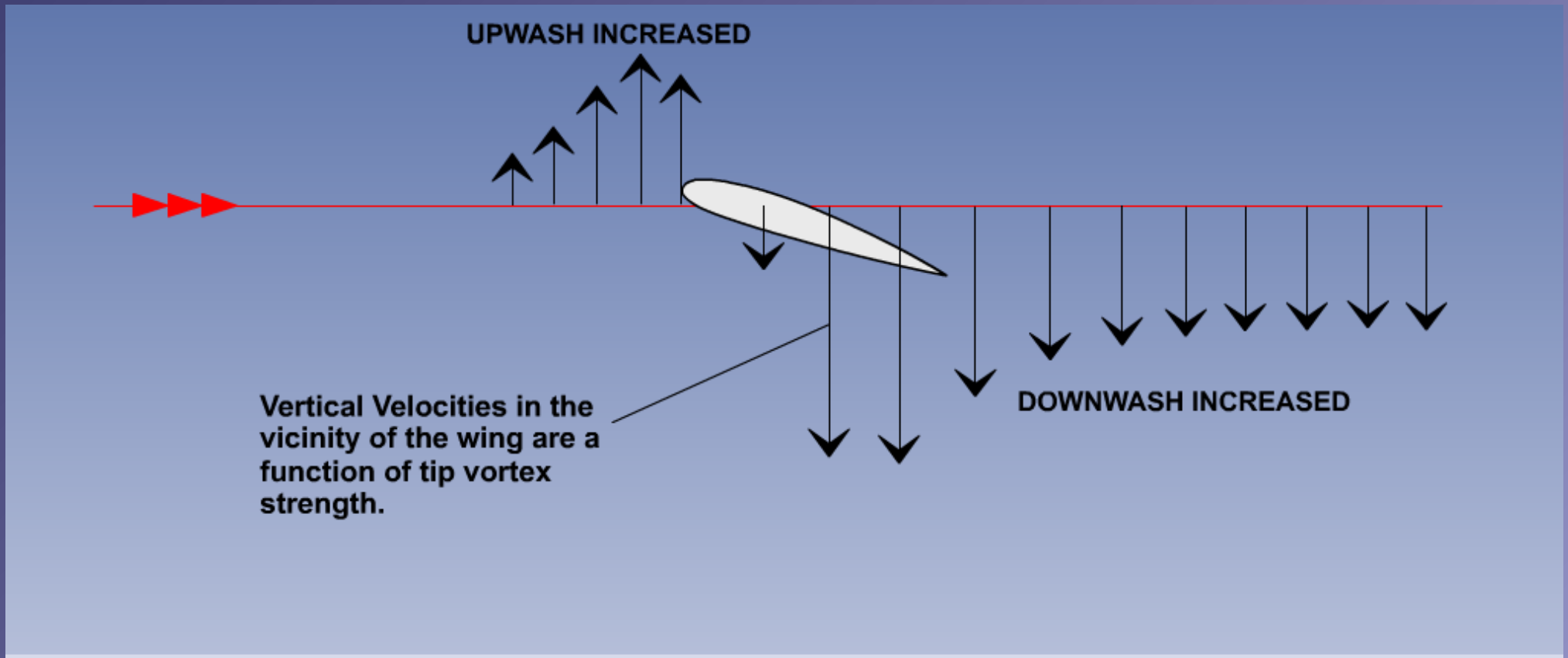
Additional Materials

- Additional materials for Take-Off
- Flight Instructor Guide – Exercise 16
- Flight Instructor Guide – Lesson Plans 3, 4, 12, 14, 16, 18

Induced AoA – Upwash and Downwash



Induced Downwash

The vertical velocities are greatest close to the wing and are a function of vortex strength, with a proportional reduction in effective angle of attack.

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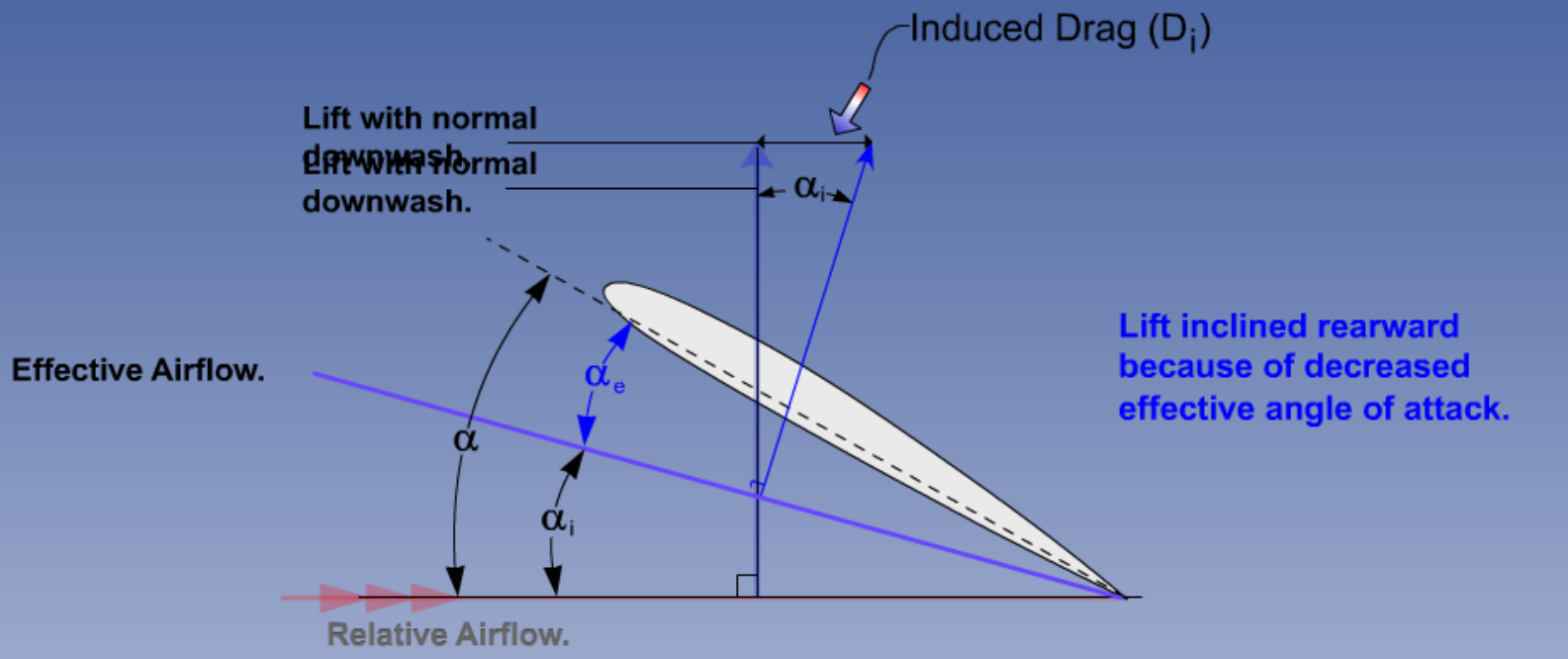
Effective Angle of Attack



Induced Downwash

The localised reduction in effective angle of attack causes the lift generated to be less than it would be if there were no spanwise flow. To replace this lost lift, the wing must be flown at a higher angle of attack, tilting the lift vector rearwards and creating induced drag.

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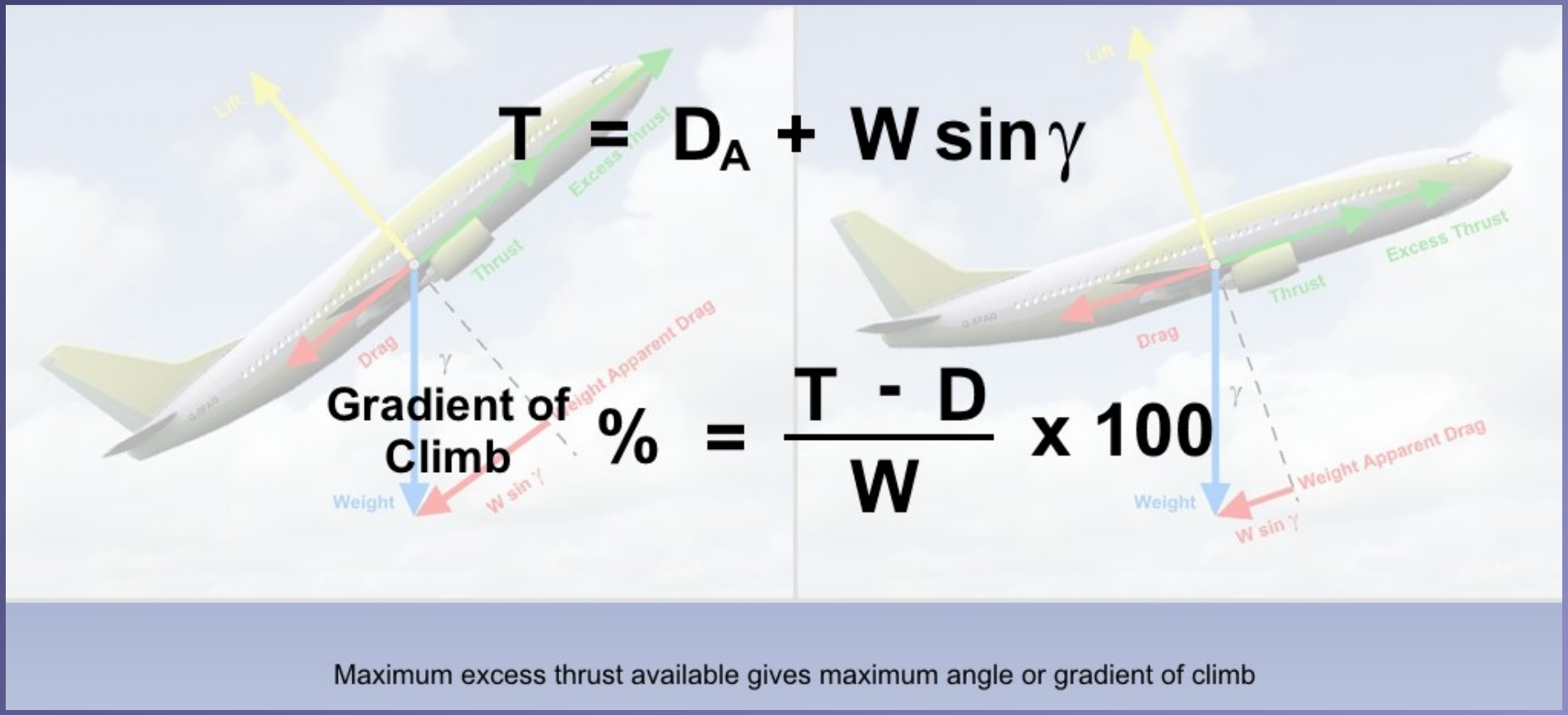
Angle or Gradient of Climb



Maximum excess thrust available gives maximum angle or gradient of climb

- Weight increases weight apparent drag and excess thrust required
- Weight increases lift required and lift induced drag

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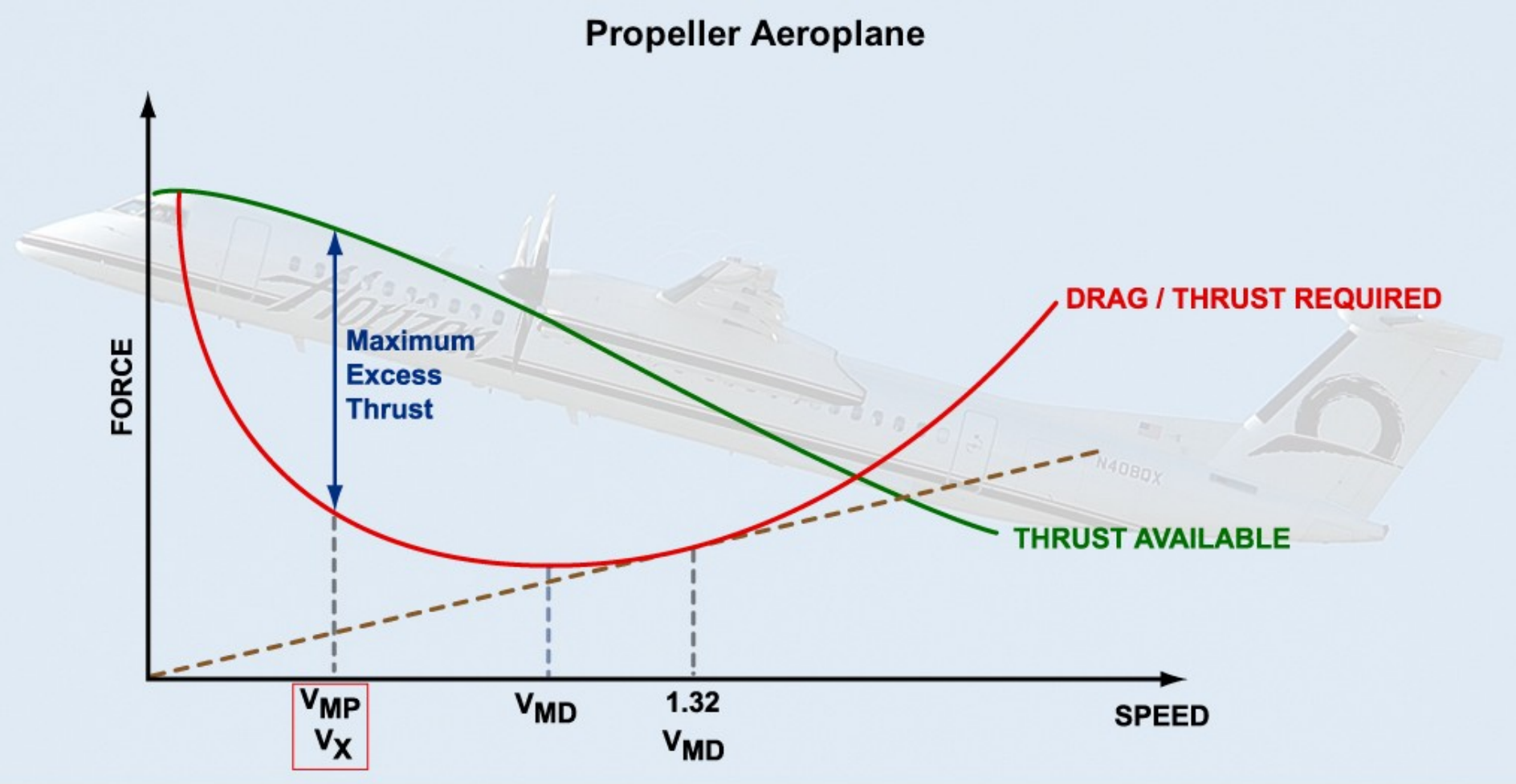
Maximum Excess Thrust



Angle/Gradient of Climb - Propeller Excess Thrust Graph and Vx

Maximum excess thrust occurs at VMP. Vx for a propeller aeroplane occurs at VMP.

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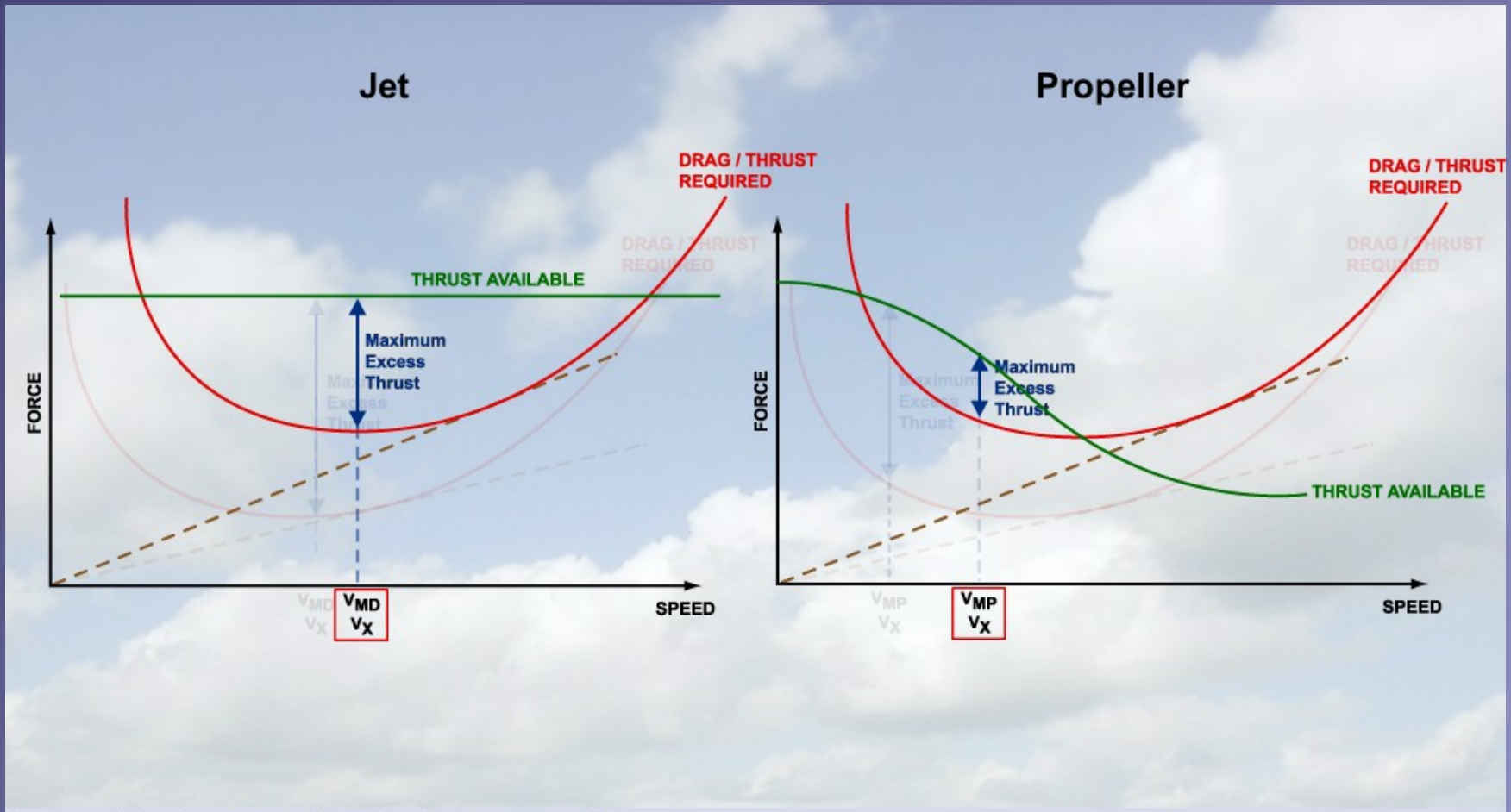
Weight and Excess Thrust



Factors Affecting Angle/Gradient - Increasing Weight

Effects 2 and 3. Increasing weight requires more lift. This increases induced drag and therefore total drag. The result is a decrease in excess thrust and a decrease in the climb angle. Vx increases.

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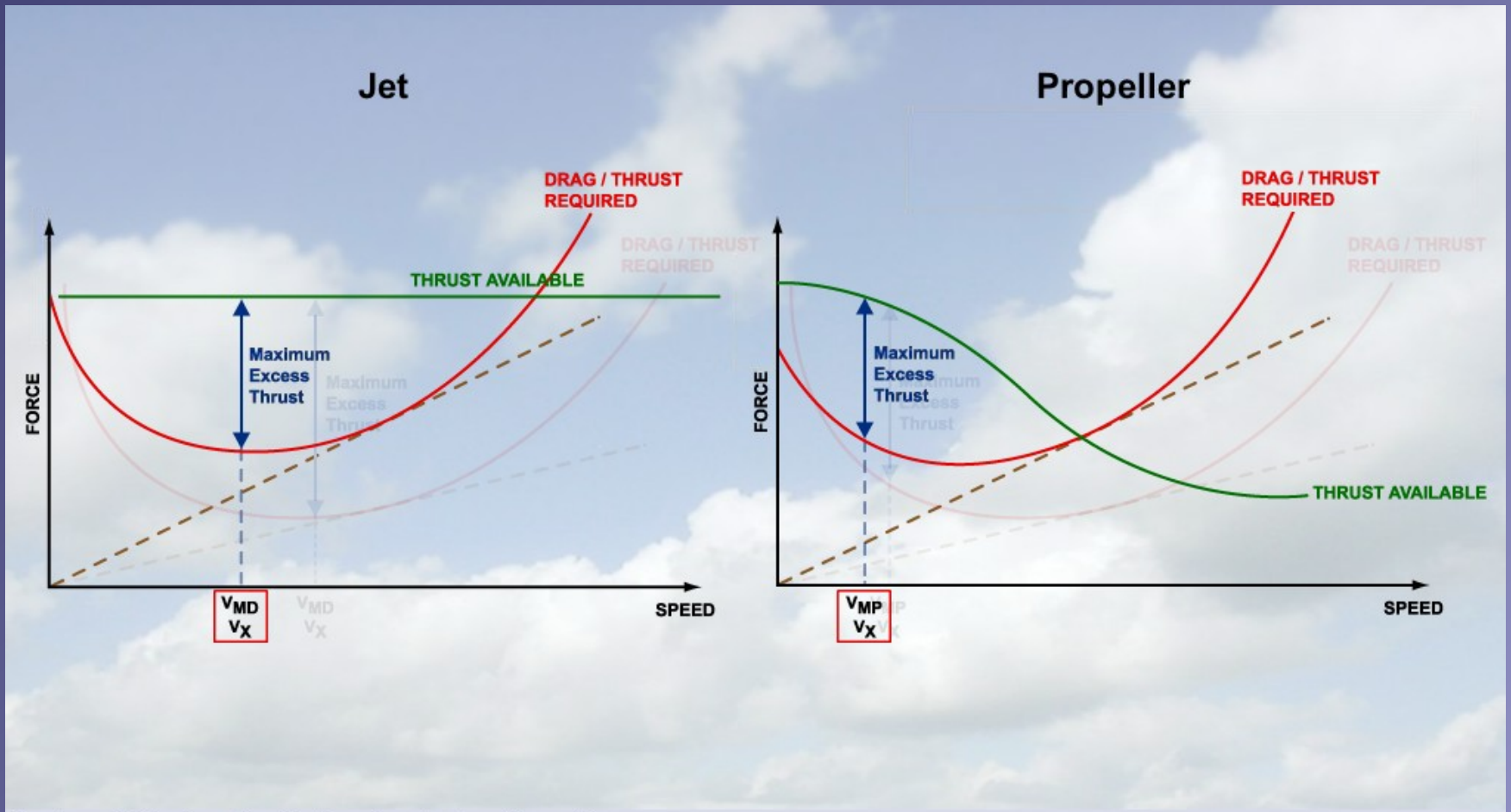
Configuration and Excess Thrust



Factors Affecting Angle/Gradient - Configuration

Flaps and undercarriage deployed increase parasite drag and therefore total drag. The result is a decrease in excess thrust and a decrease in the climb angle. Vx decreases.

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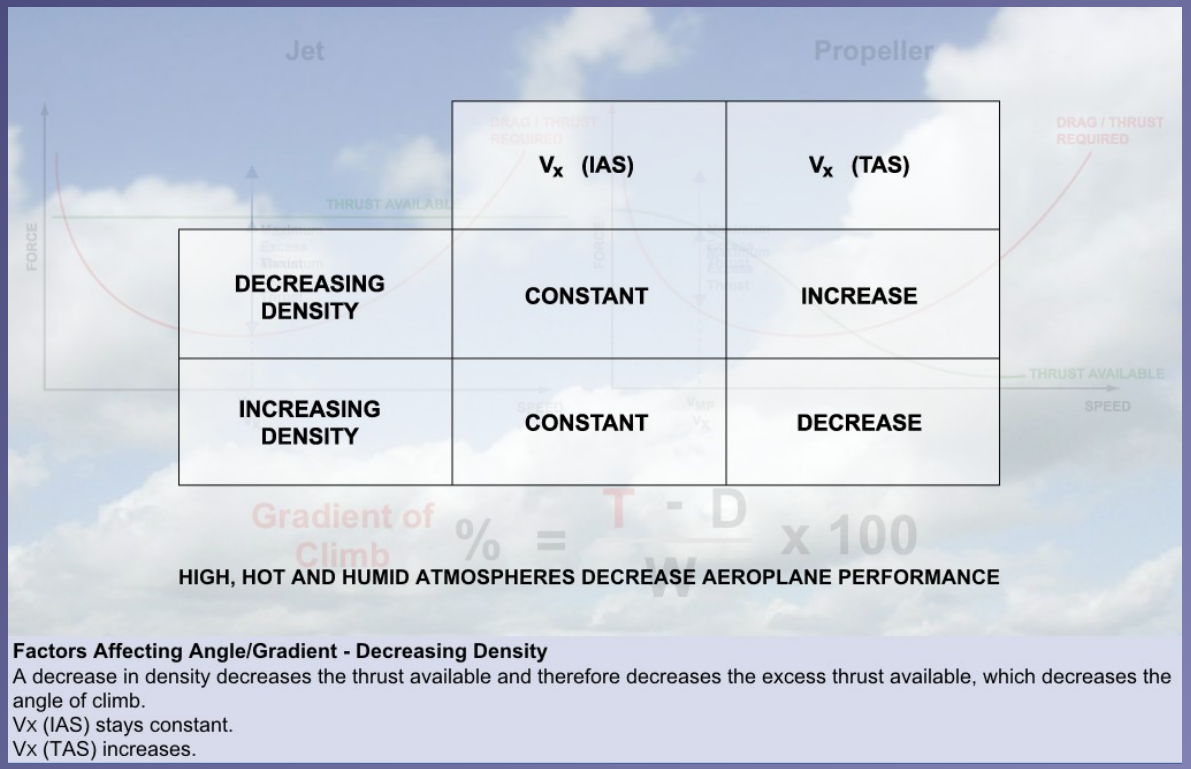
Air Density and Excess Thrust



	V_x (IAS)	V_x (TAS)
DECREASING DENSITY	CONSTANT	INCREASE
INCREASING DENSITY	CONSTANT	DECREASE

HIGH, HOT AND HUMID ATMOSPHERES DECREASE AEROPLANE PERFORMANCE

Factors Affecting Angle/Gradient - Decreasing Density
A decrease in density decreases the thrust available and therefore decreases the excess thrust available, which decreases the angle of climb.
Vx (IAS) stays constant.
Vx (TAS) increases.

- Vx remains essentially **constant** (IAS) for thrust-rated engines (jet)
- Vx may **increase** (IAS) for power-rated engines (piston propeller)

Rate of Climb

$$\text{Rate of Climb} = \frac{\text{Excess Power}}{W} = \frac{\text{Power Available} - \text{Power Required}}{W}$$

Maximum Excess Power Available gives Maximum Rate of Climb

- Rate of climb depends on both angle of climb and airspeed
- Forces multiplied with speeds give powers
- F * v = F * s / t = W / t = P

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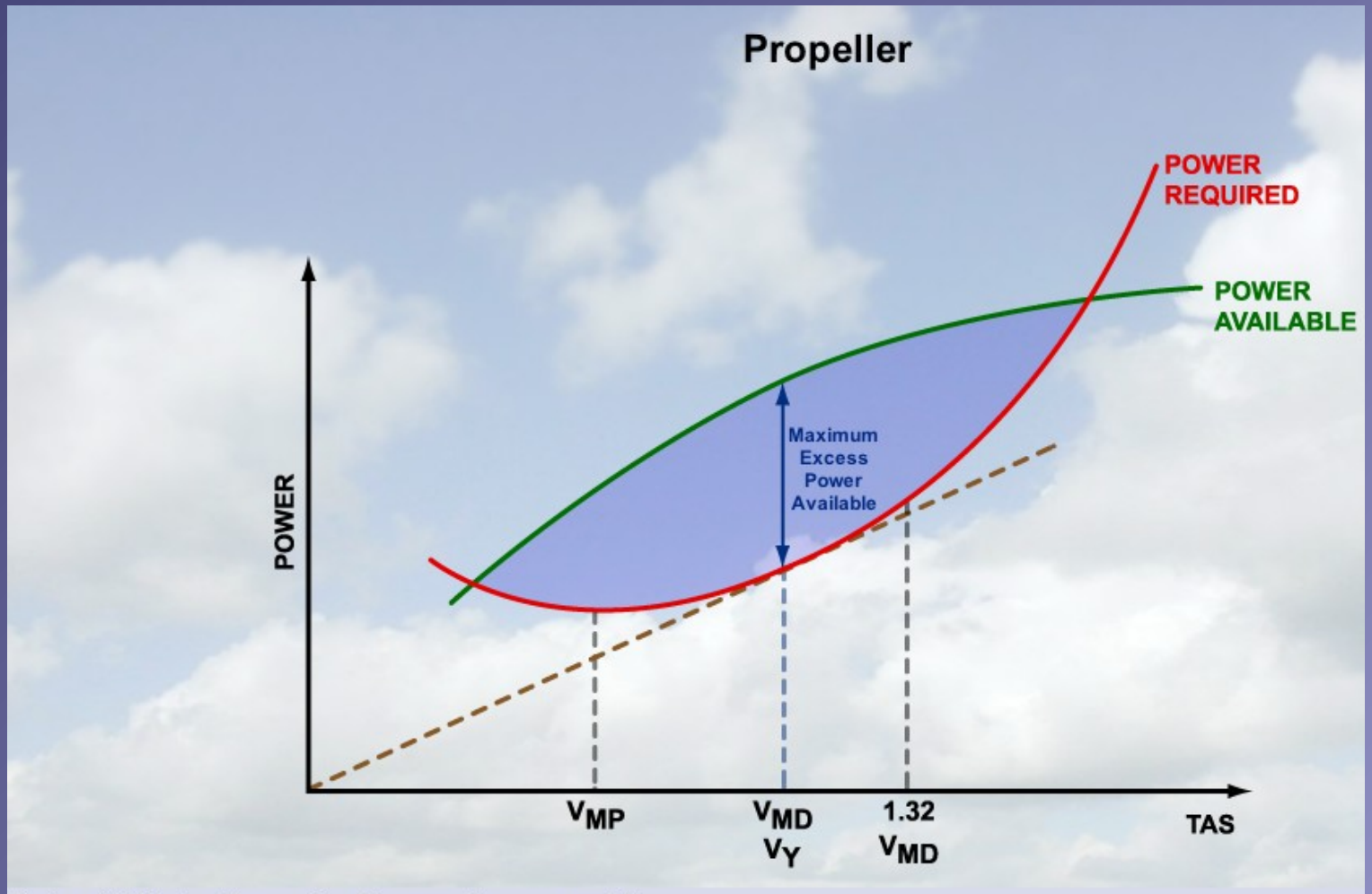
Maximum Excess Power



Rate of Climb - Propeller Excess Power and V_Y.
Maximum excess power available will give maximum rate of climb.
Vy for a propeller aeroplane occurs at V_{MD}.

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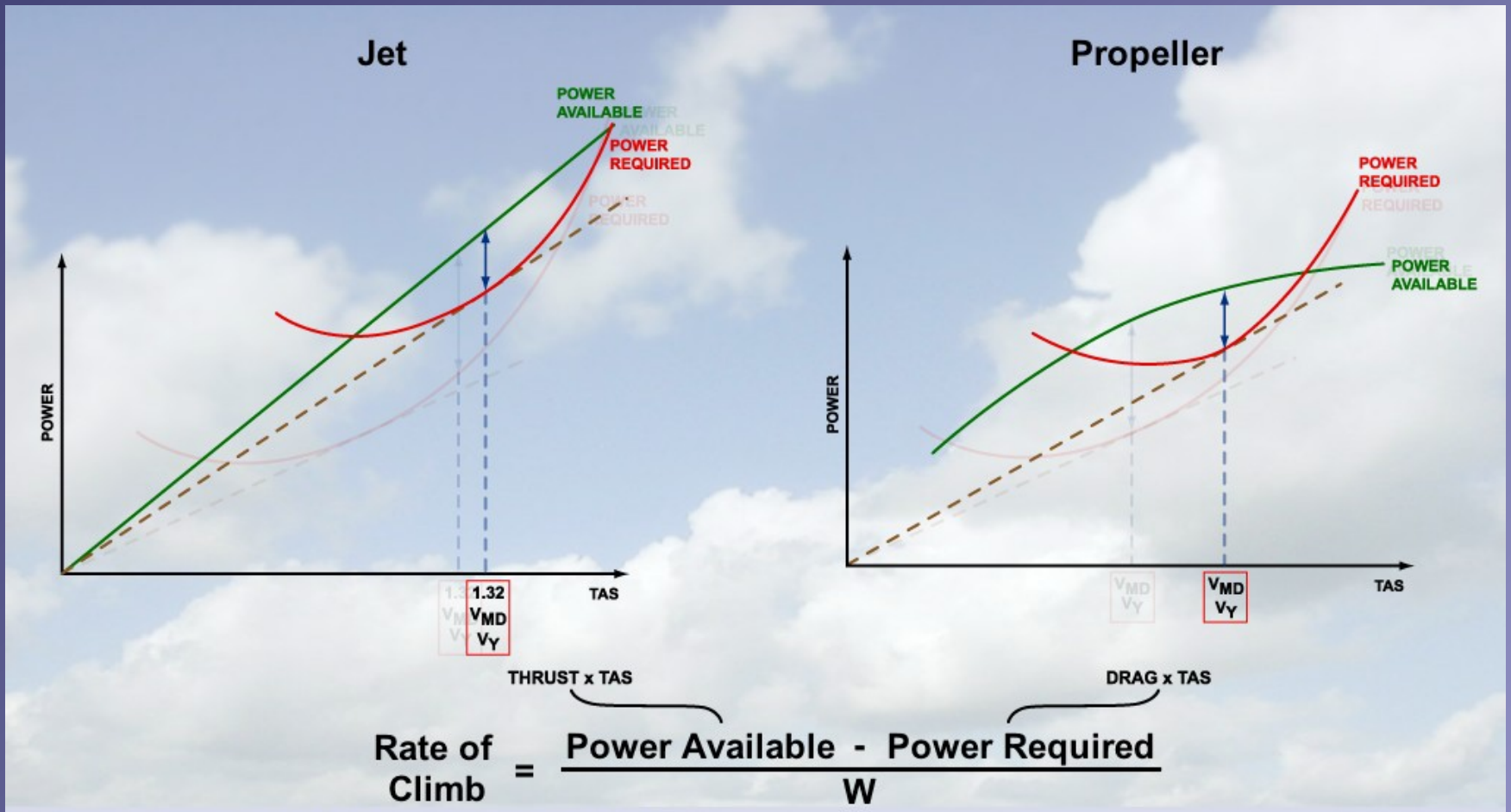
Weight and Excess Power



Factors Affecting Rate of Climb - Increasing Weight

Increasing weight increases the amount of weight apparent drag. This reduces the climb angle and therefore the rate of climb.
Increasing weight requires more lift, which increases drag and therefore power required. This decreases the excess power and therefore decreases the rate of climb.
V_Y increases.

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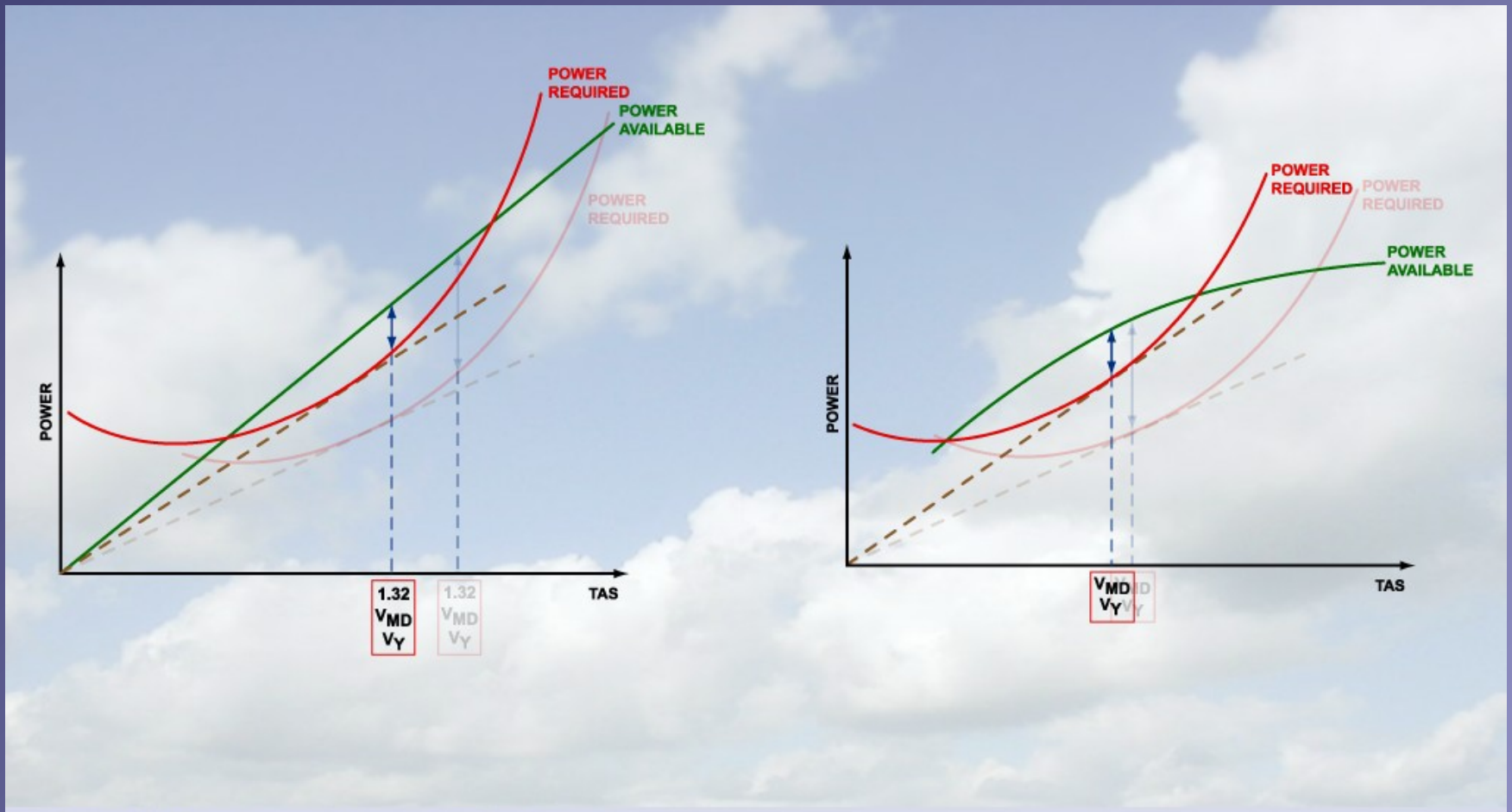
Configuration and Excess Power



Factors Affecting Rate of Climb - Configuration

Flaps and undercarriage deployed will increase parasite drag and therefore total drag. The result is a decrease in excess power and a decrease in the rate of climb.

V_Y decreases.

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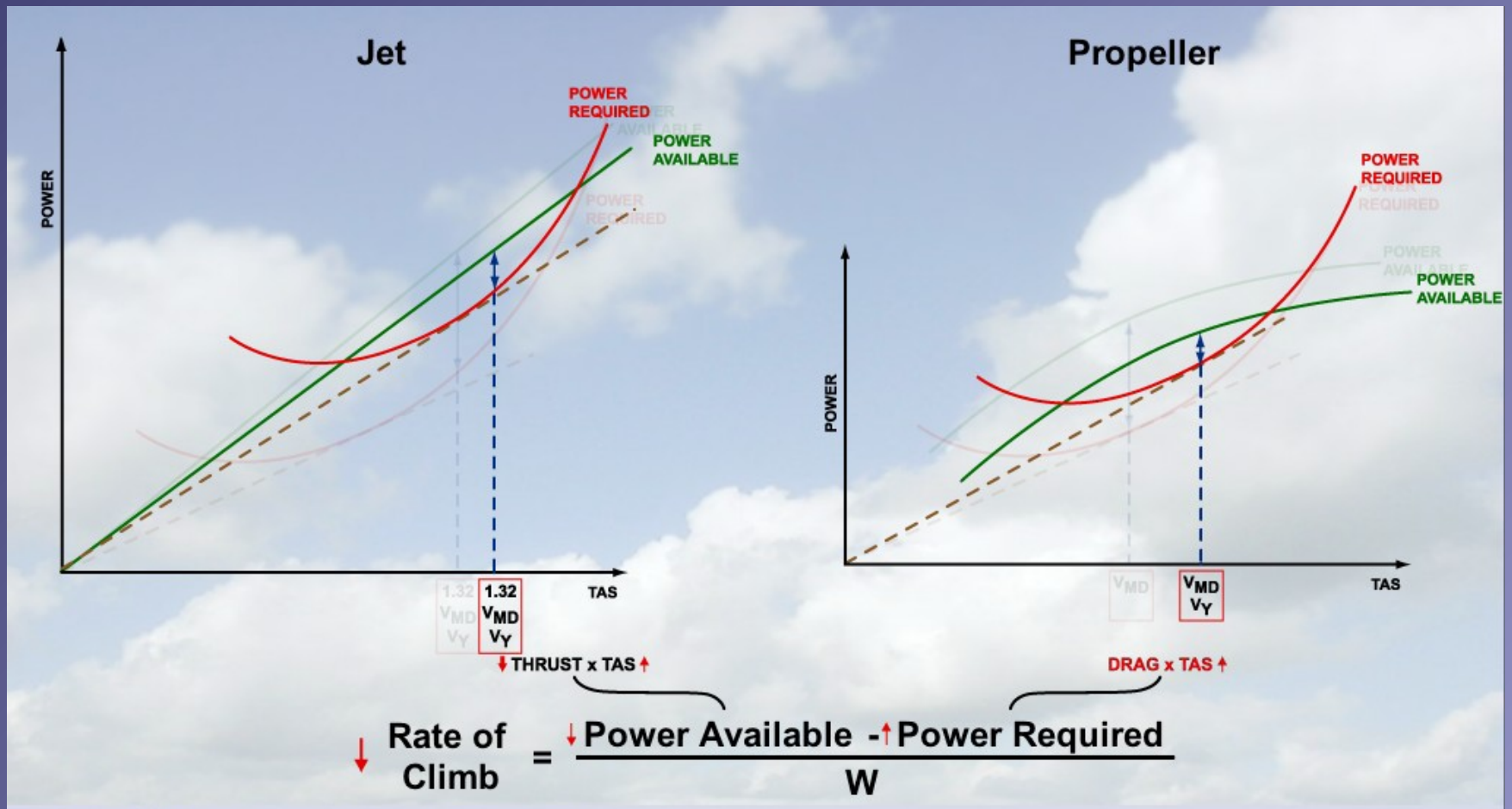
Air Density and Excess Power



Factors Affecting Rate of Climb - Decreasing Density

Decreases power available.

Increases power required.

Decreases excess power available and therefore the rate of climb.

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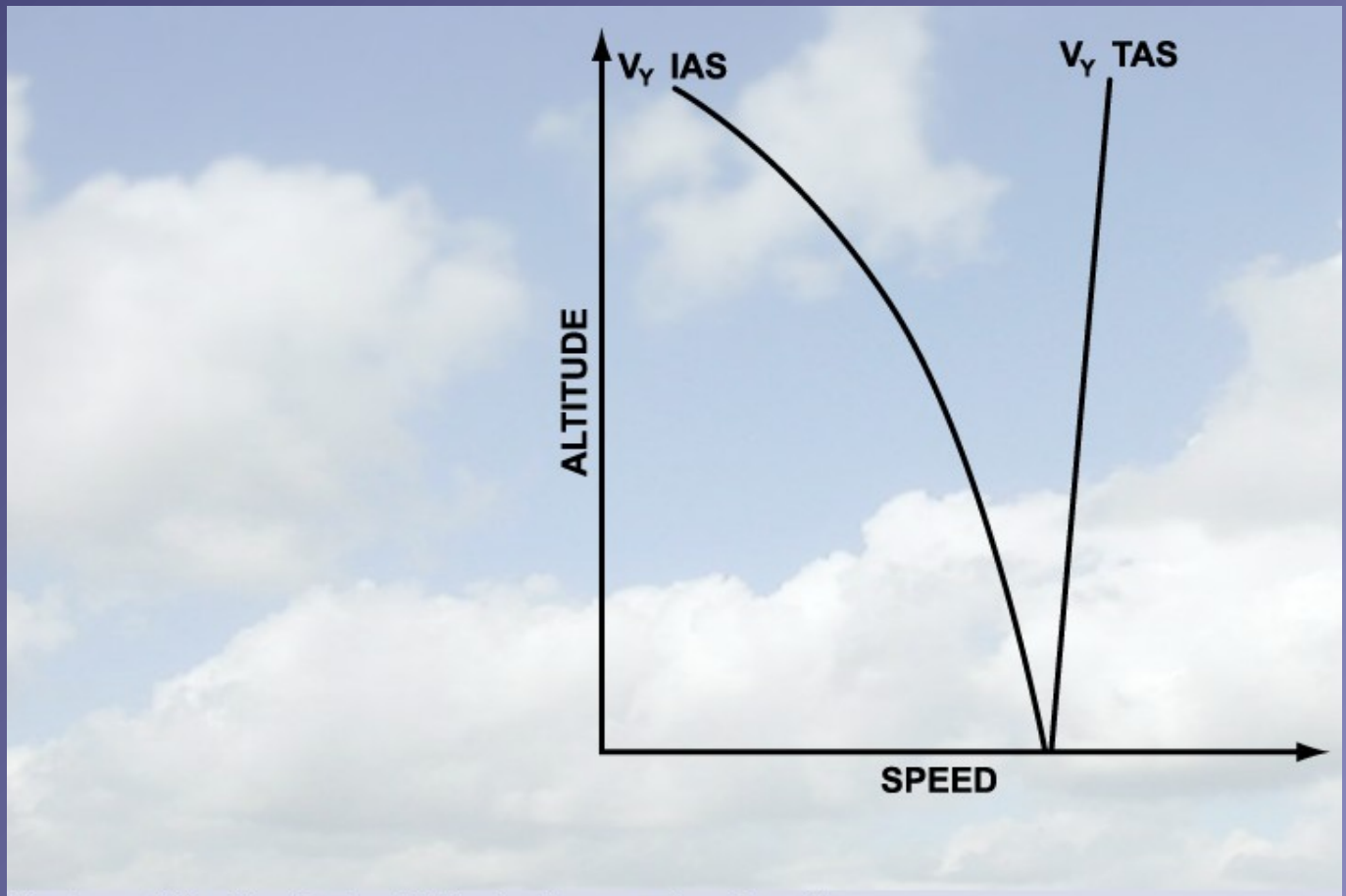
Vy – True versus Indicated Airspeed



Factors Affecting Rate of Climb - Decreasing Density
Decreases power available.
VY (TAS) increases.
VY (IAS) decreases.

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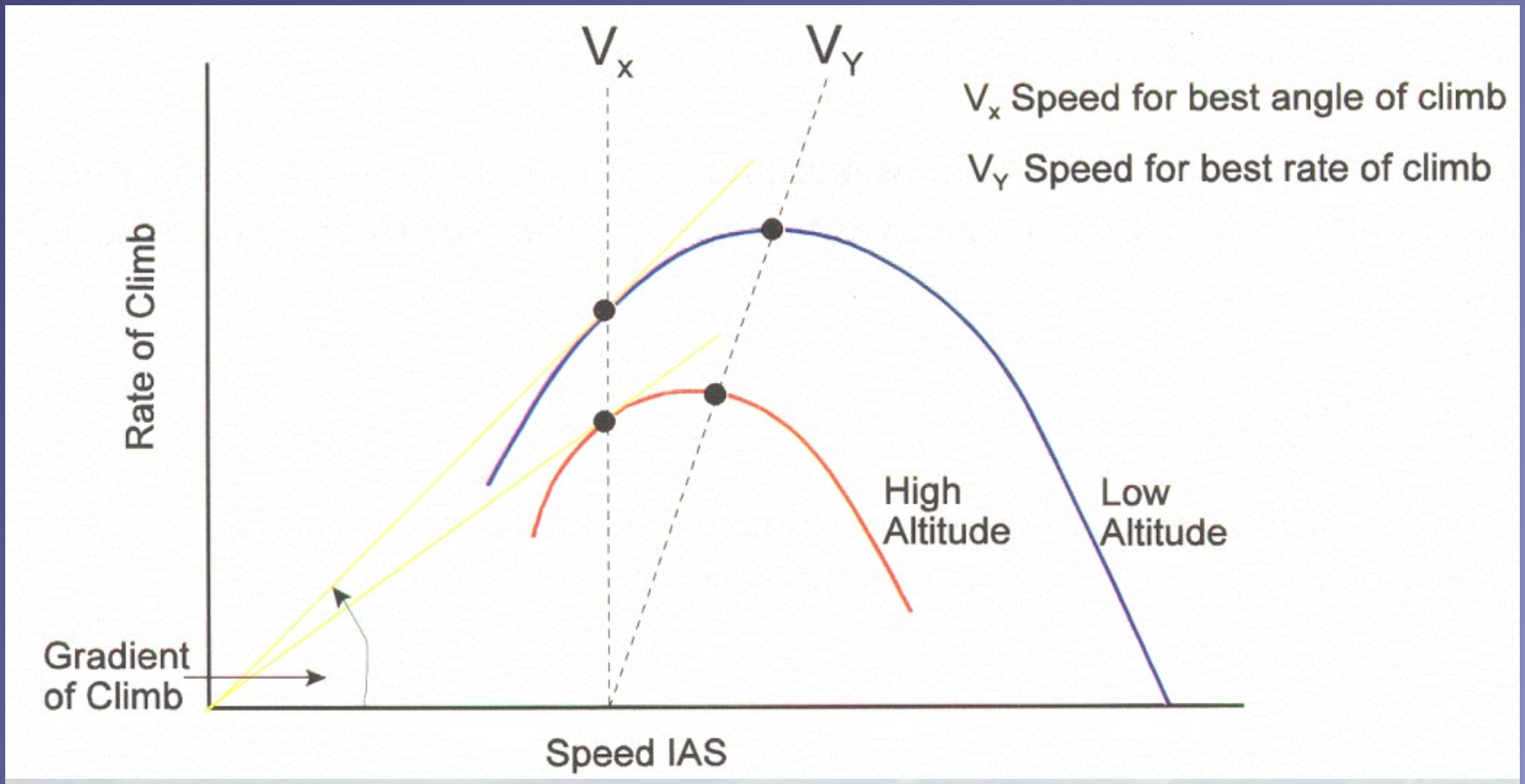
Absolute and Service Ceiling



Factors Effecting Rate of Climb - Ceiling Altitude

Absolute Ceiling - The altitude where the rate of climb is zero and where $V_Y = V_X$

Service Ceiling - The altitude where the best rate of climb airspeed will produce a specific rate of climb.