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# Part II – Climbing and Descending

- Review *Basic* Climbing and Descending
- **Departure and Approach Climbs and Descents**
- **V-Speeds** (POH)
- **Flaps**
- **Balked Landings** – Power, Attitude, Trim
- Summary and Questions
- Pre-Flight Briefing

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# Review *Basic* Climbing and Descending

- Mentally perform a **basic climb** and **level off** and state all required actions. (**APT**)
- Mentally perform a **basic descent** and **level off** and state all required actions. (**PAT**)
- How do we maintain our **airspeed** during a climb with set power?
- How do we estimate our **glide path** during a descent?

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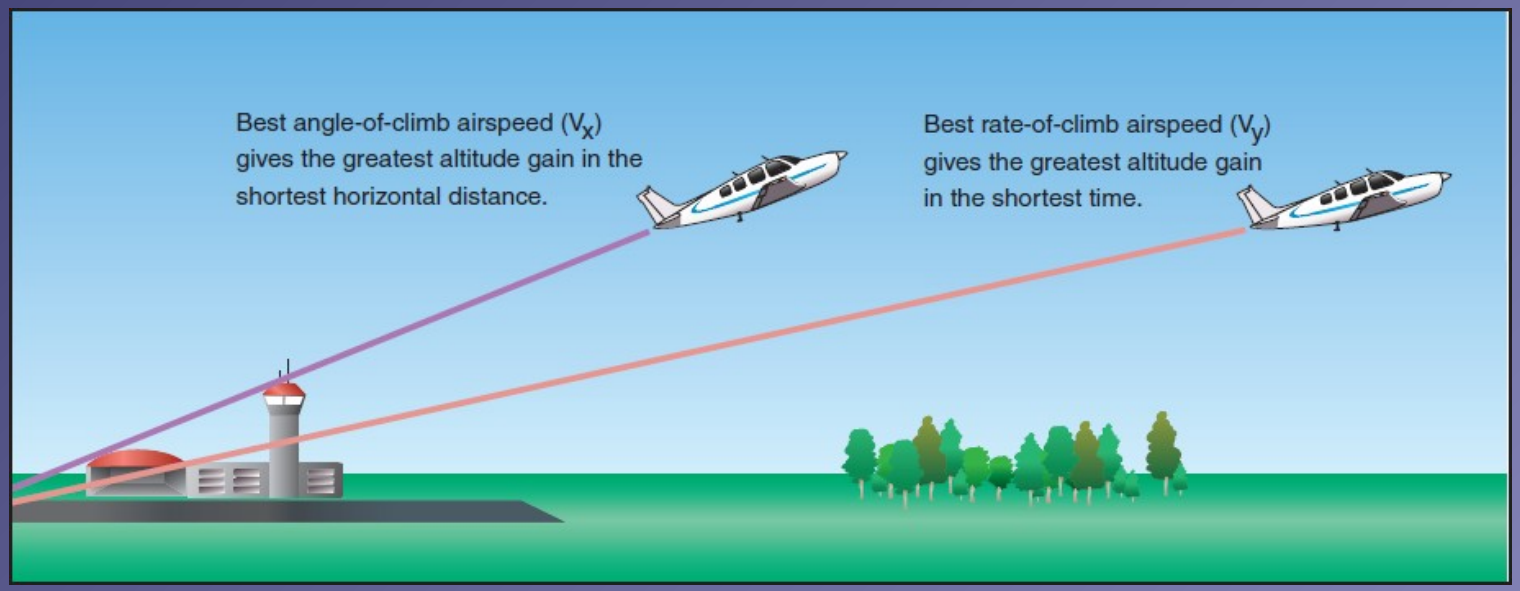
# Departure and Cruise Climbs




- Best **angle** / gradient (*Vx*) – ensures best obstacle **clearance**
- Best **rate** (*Vy*)– minimizes climbing **time**
- **Normal** – improves forward **visibility** and engine **cooling**
- **En-Route** – addresses **ground speed**, **convenience** and **comfort** (*Vcc = Vy + (Vy - Vx)*)

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# Climb Attitudes

- Prolonged climbs require heading or attitude changes for **lookout**
- Control airspeed with **pitch attitude** at **full power**
- *More* **nose-up** attitude requires *more* **rudder** input

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# Reference Climb Airspeeds

**AIRSPEEDS FOR NORMAL OPERATION**

Unless otherwise noted, the following speeds are based on a maximum weight of 2550 pounds and may be used for any lesser weight.

| | |
|---|---|
| Takeoff: | |
| Normal Climb Out | 75-85 KIAS |
| Short Field Takeoff, Flaps 10°, Speed at 50 Feet | 56 KIAS |
| Enroute Climb, Flaps Up: | |
| Normal, Sea Level | 75-85 KIAS |
| Normal, 10,000 Feet | 70-80 KIAS |
| Best Rate-of-Climb, Sea Level | 74 KIAS |
| Best Rate-of-Climb, 10,000 Feet | 72 KIAS |
| Best Angle-of-Climb, Sea Level | 62 KIAS |
| Best Angle-of-Climb, 10,000 Feet | 67 KIAS |

- Reference **climb airspeeds** can be found in the **POH** under *Section 4* **Normal Procedures**

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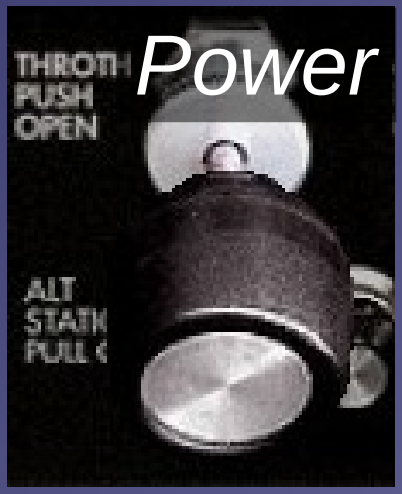
# Establishing a Power-on Descent






- In cruise attitude **lookout** ahead and below
- Reduce **power** for estimated **descent airspeed**
- Keep **straight** and control **yaw** with **rudder**
- Decelerate to **descent airspeed** maintaining cruise attitude
- Establish required **pitch attitude** and **trim**

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# Maintaining a Power-On Descent



- Adjust **power** and **attitude** to attain desired **descent airspeed** and **rate of descent**
- Re-**trim** after power and attitude adjustments
- Continue **lookout** and monitor external **references**, **heading**, **descent airspeed** and **rate of descent**

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# Reference Descent Airspeeds

| | |
|---|---|
| **Landing Approach:** | |
| Normal Approach, Flaps Up | 65-75 KIAS |
| Normal Approach, Flaps 30° | 60-70 KIAS |
| Short Field Approach, Flaps 30° | 61 KIAS |
| **Balked Landing:** | |
| Maximum Power, Flaps 20° | 60 KIAS |

- Reference **descent airspeeds** can be found in the **POH** under *Section 4* **Normal Procedures**

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# Best Glide Airspeed

**AIRSPEEDS FOR EMERGENCY OPERATION**

| | |
|---|---|
| Engine Failure After Takeoff: | |
| Wing Flaps Up | 70 KIAS |
| Wing Flaps Down | 65 KIAS |
| Maneuvering Speed: | |
| 2550 Lbs | 105 KIAS |
| 2200 Lbs | 98 KIAS |
| 1900 Lbs | 90 KIAS |
| Maximum Glide | 68 KIAS |
| Precautionary Landing With Engine Power | 65 KIAS |
| Landing Without Engine Power: | |
| Wing Flaps Up | 70 KIAS |
| Wing Flaps Down | 65 KIAS |

- Best **glide airspeed** for power-off descents can be found in the **POH** under *Section 3* **Emergency Procedures**

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# Operating Flaps






- Operate flaps *conservatively* while **airspeed** in **white arc**
- Flaps permit **lower airspeeds** and *steeper* **descent angles**
- Flaps support **obstacle clearance** approaches
- Retract **flaps** in **stages** within **white arc** (above ***48 KIAS***)

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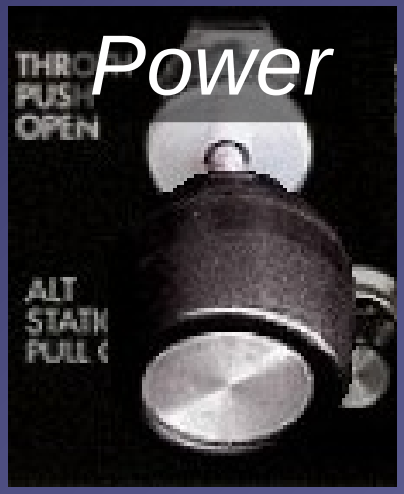
# Balked Landings






- Apply **full power** and keep **straight** controlling **yaw**
- Establish and maintain *slight* **nose-up attitude**
- Control airspeed with attitude and retract **flaps** in **stages**
- **Trim** and continue to monitor **climb airspeed**
- Consider **ground effect** during go around

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# Summary / Quiz

- Why do we use different airspeeds for climbs and descents?
- Where can we find the *Vx* and *Vy* airspeeds?
- Where can we find the best glide airspeed?
- Mentally perform a **power-on descent** and **level-off** describing all required actions. (**PAT**)
- Mentally perform a **balked approach** describing all required actions – remember the flaps. (**PAT**)

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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 Climbing and Descending
- Flight Instructor Guide – Exercises 7 and 8
- Flight Instructor Guide – Lesson Plans 2, 3 and 4

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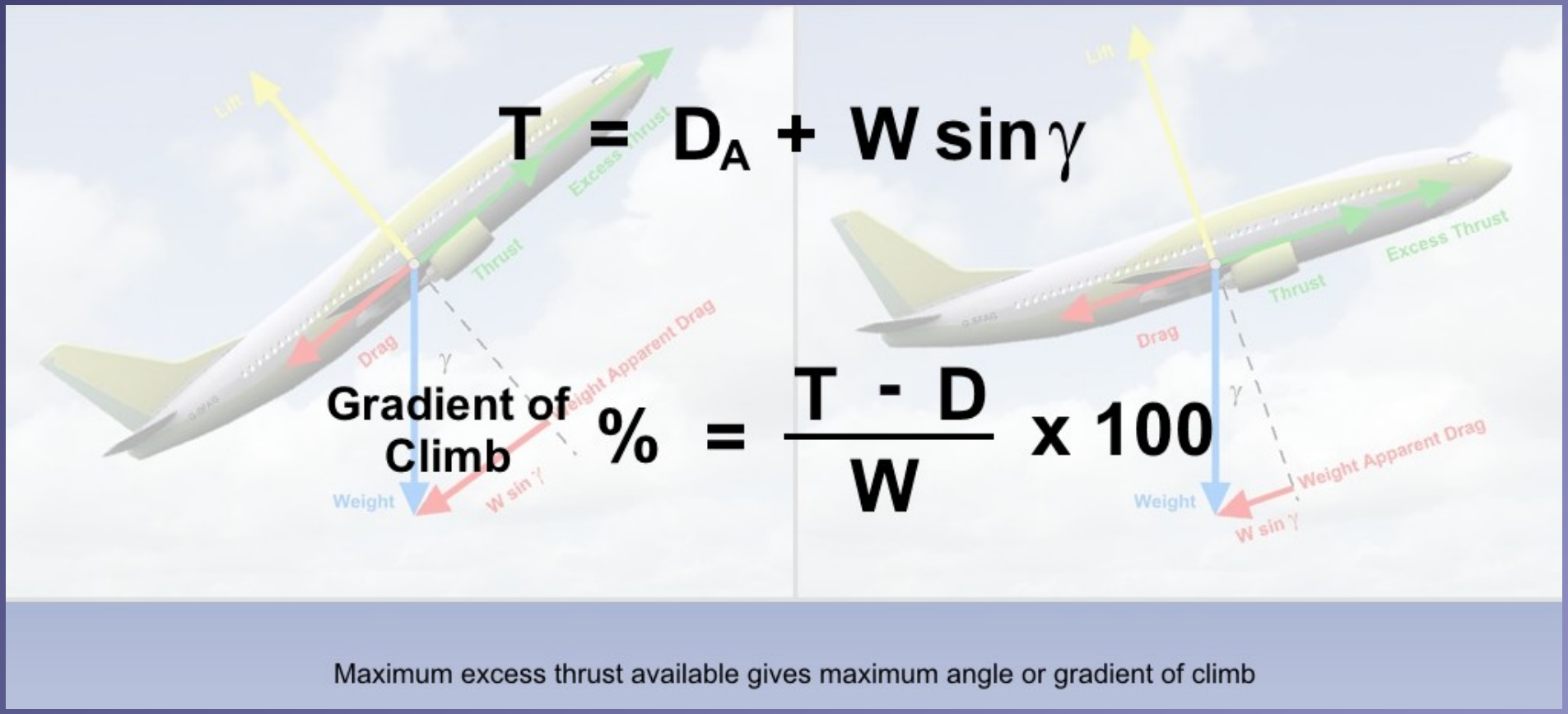
# Angle or Gradient of Climb

$$T = D_A + W \sin\gamma$$




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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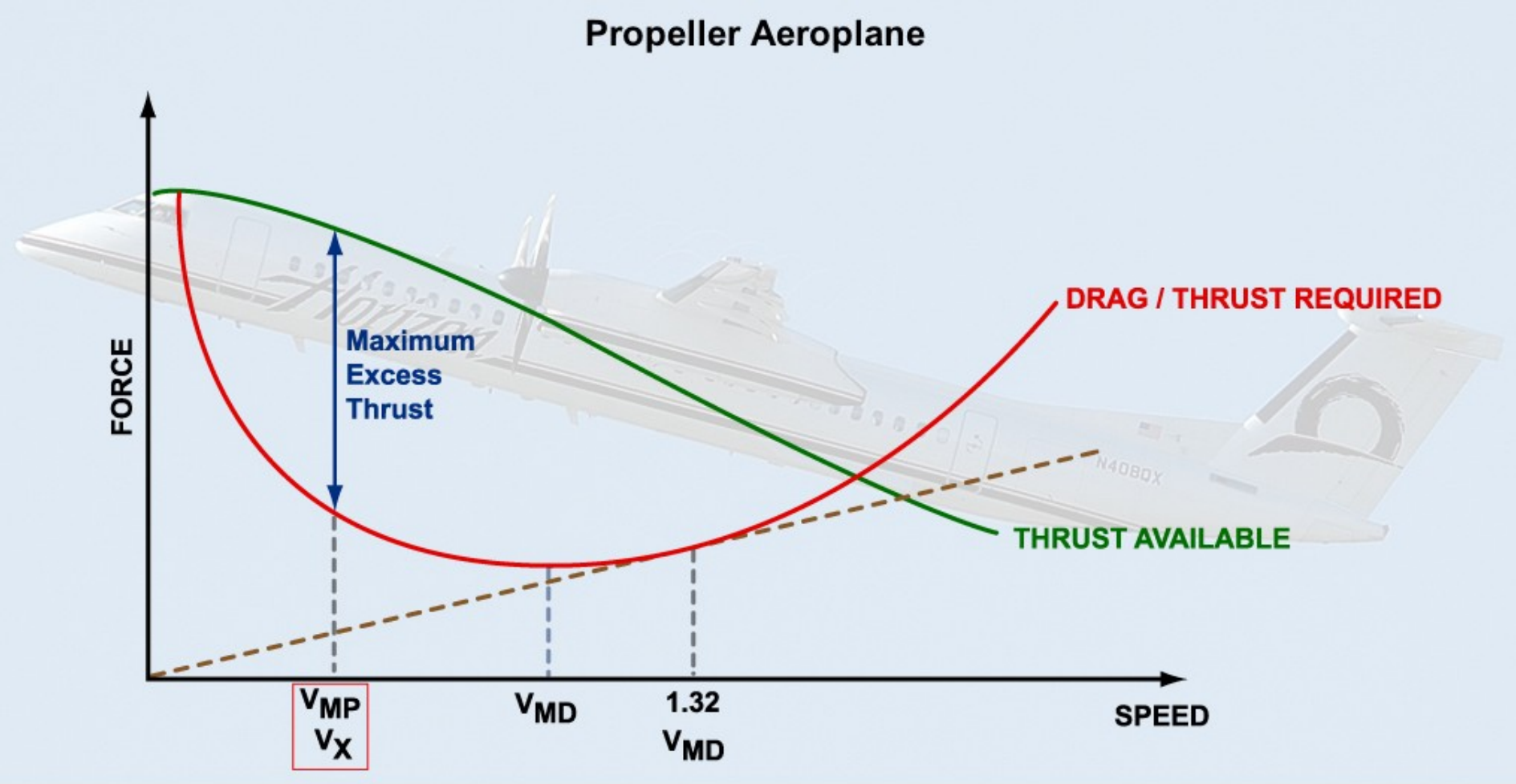
# Maximum Excess Thrust




**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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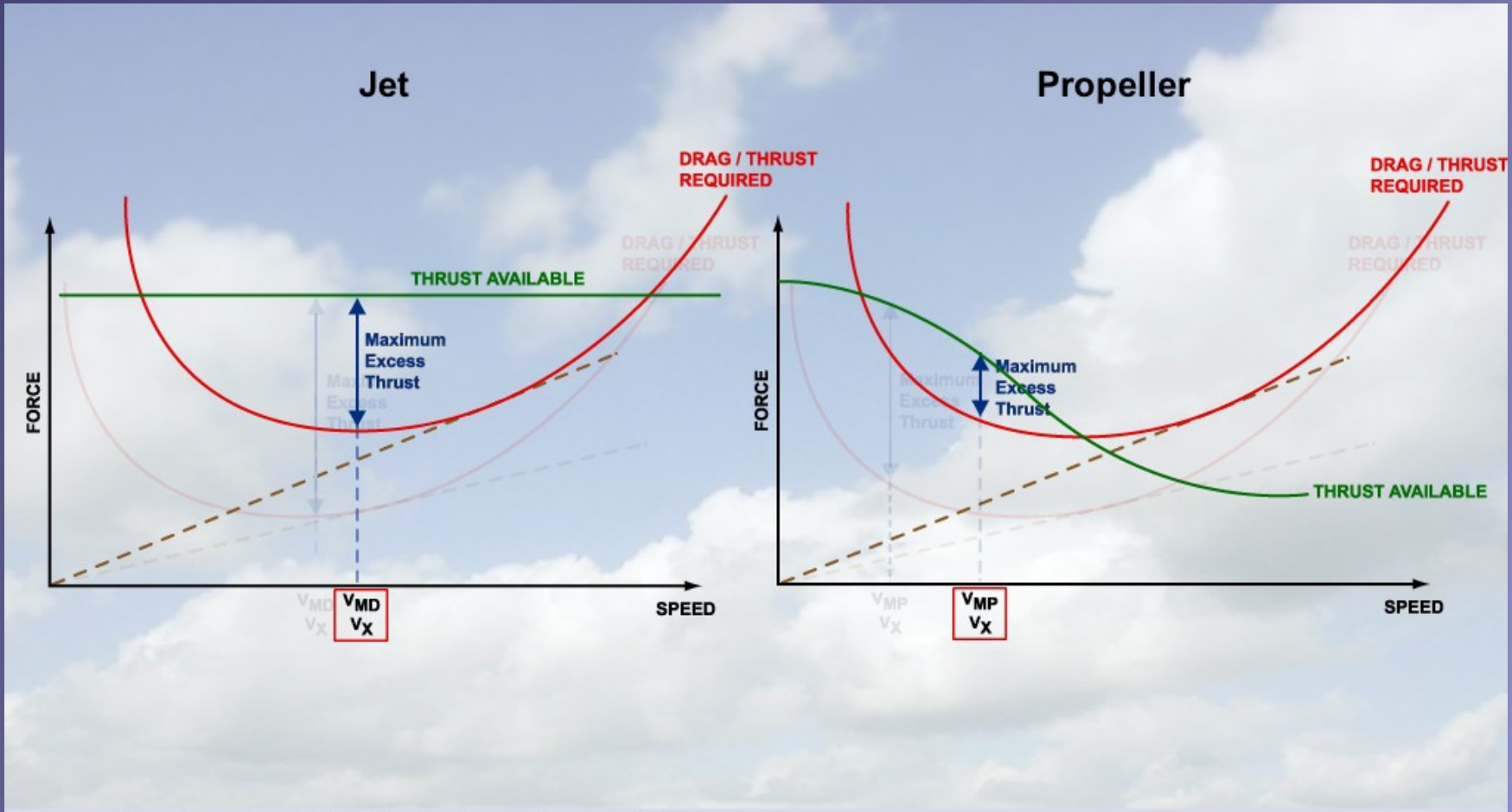
# Weight and Excess Thrust




**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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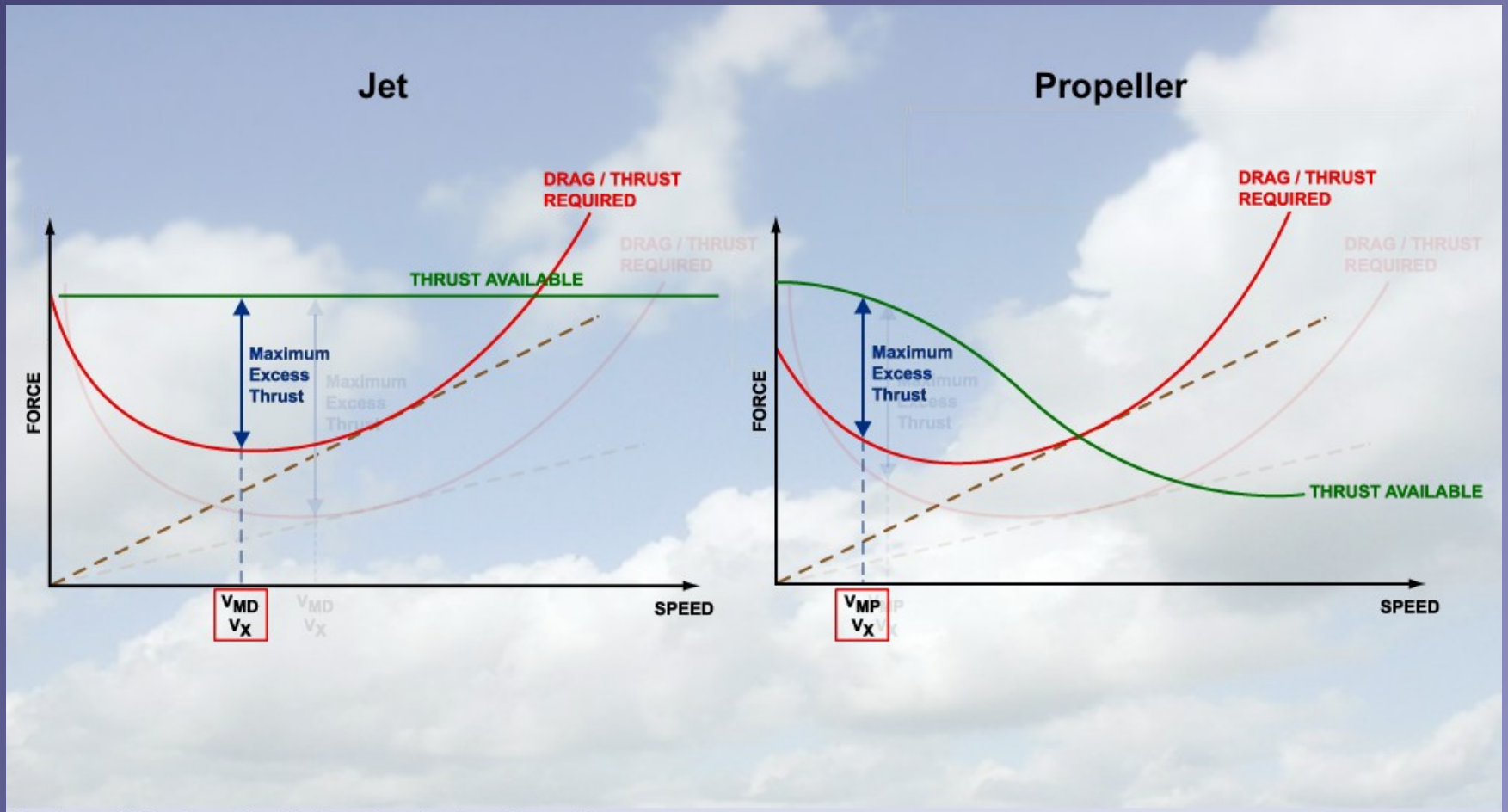
# Configuration and Excess Thrust




**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.

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# 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 * D / T = W / T = P

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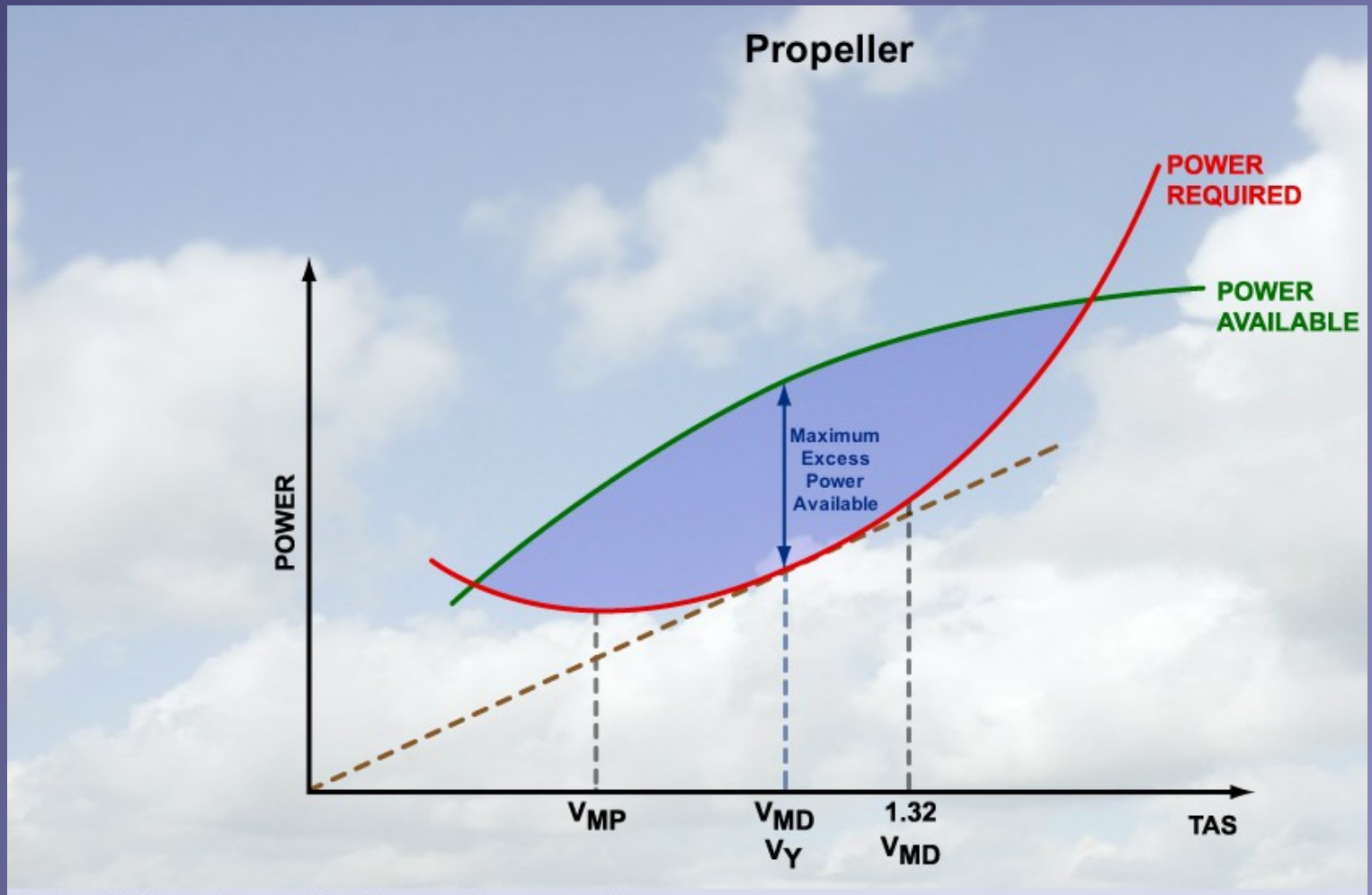
# Maximum Excess Power




**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 $V_{MD}$.