



VICTORIA FLYING CLUB

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- Bookings, Questions



## Part II – Climbing and Descending Turns, Steep Turns

- Review *Basic* Turns, Climbs and Descents
- Definition and Motivation
- Initiating, Maintaining and Recovering Coordinated **Climbing** and **Descending Turns**
- Initiating, Maintaining and Recovering Coordinated **Steep Turns**
- Summary and Questions
- Pre-Flight Briefing



# Review Basic Turns, Climbs and Descents

- What **controls** are to be used to **maintain** a *coordinated level turn* and what do they achieve individually?
- Mentally perform a **medium** (30° bank angle) *coordinated level turn* describing all required actions.
- Describe **overbanking** and how it has to be corrected for during a medium level turn.
- Mentally perform a **basic climb** and **level off** and state all required actions. (**APT**)
- Mentally perform a **basic power-off descent** and **level off** and state all required actions. (**PAT**)
- How do we establish and maintain a **combined nose-up** and **left-banked** attitude?



# Climbing and Descending Turns



- Turning *while* climbing or descending
- **Heading** and **altitude** change *simultaneously*
- Applications: **Departures, Arrivals, Circuits**





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# Initiating a Climbing Turn



*Constant Speed Climb*



*Constant Rate Turn*

- In cruise-attitude **lookout** ahead and above in turn direction
- Establish a *stable* constant speed **climb** first – **APT**
- Establish a *coordinated* constant rate **turn** second
- Climbing turn will be established *simultaneously* later



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# Maintaining a Climbing Turn

## Corrections



## References

## Lookout



## Instruments

- Apply **elevator** as *required* to maintain **pitch attitude** and **airspeed**
- Apply **aileron** as *required* to maintain **bank attitude** *while* correcting **overbanking** tendencies
- Apply **rudder** as *required* to maintain *coordinated* **constant rate turn**
- Continue **lookout** and monitor outside **references** and **instruments**



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# Recovering a Climbing Turn



*Landmarks*



- Continue to **lookout** observing **references** during recovery
- Recovery order depends on achieved target (heading or altitude) and may require *simultaneous* control inputs
- **Anticipate** turn recovery to establish desired **heading** – *half bank angle*
- **Anticipate** climb recovery to establish desired **altitude** – *10% VSI*
- Remain **coordinated** using **rudder** and apply **APT** to recover climb





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# Initiating a Descending Turn



- In cruise-attitude **lookout** ahead and below in turn direction
- Establish a *stable* **constant speed descent** first – PAT
- Establish a *coordinated* **constant rate turn** second
- Descending turns will be established *simultaneously* later





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# Maintaining a Descending Turn

*Corrections*



*Lookout*



*References Instruments*

- Apply **elevator** as *required* to maintain **pitch attitude** and **airspeed**
- Apply **aileron** as *required* to maintain **bank attitude** *while* correcting **underbanking** tendencies
- Apply **rudder** as *required* to maintain *coordinated* **constant rate turn**
- Continue **lookout** and monitor outside **references** and **instruments**



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# Recovering a Descending Turn



- Continue to **lookout** observing **references** during recovery
- Recovery order depends on achieved target (heading or altitude) and may require *simultaneous* control inputs
- **Anticipate** turn recovery to establish desired **heading** – *half bank angle*
- **Anticipate** climb recovery to establish desired **altitude** – *10% VSI*
- Remain *coordinated* using **rudder** and use **PAT** to recover climb





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# Steep Turns



- **Steep** turns – beyond **30°** bank angle
- **Evasive actions** and collision avoidance (consider climbs and descents), **canyon turns**, **steep descending turns**
- Control **coordination practice**
- Higher **load factor**, **stall speed** and **required power**



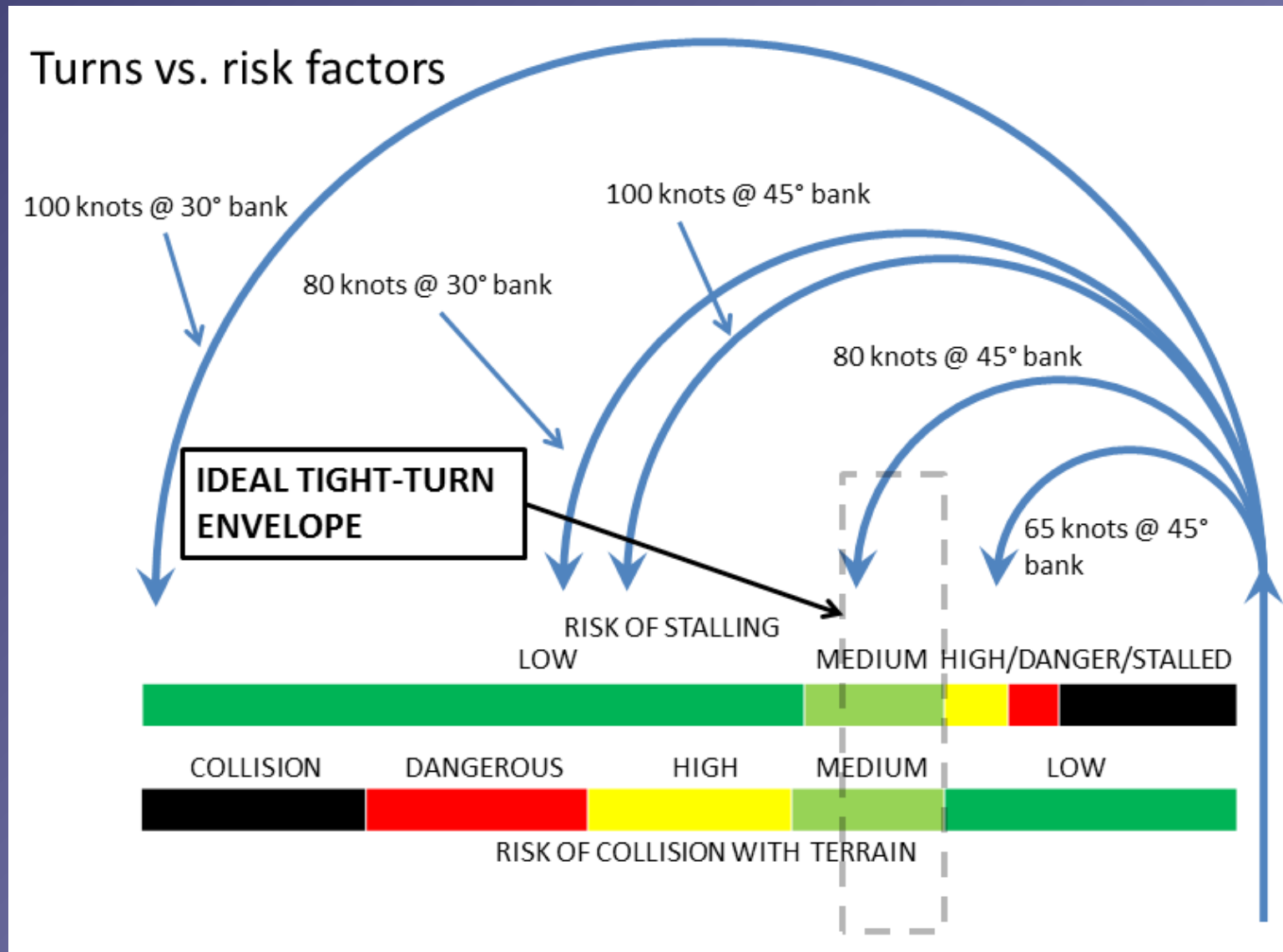


# Performing a Steep Level Turn

- Initiate steep level turn like medium level turn
- Increase **power** *slightly* beyond **30°** bank angle to maintain **safe airspeed** above increased stall speed
- Correct as *required* to maintain **pitch** and **bank attitude**
- Remain **coordinated** and correct **overbanking** tendencies
- Left and right turns require *different* control inputs
- Reduce **power** smoothly during recovery
- Transition from left to right requires *smooth* **control** and **power** adjustments



# Minimum Radius Turn - Entry Speeds





# Performing a Safe Radius Turn

- Perform **lookout** before safe radius turn
- Consider **wind** for minimum radius over ground
- *Operational use* of power and configuration
- Slow down to **safe airspeed** ( $V_e = 80 \text{ KIAS} \geq V_y = 74 \text{ KIAS}$ ) and extend **flaps** to  $10^\circ$  (partial flaps)
- Establish a *coordinated* steep level turn adding **power** as *required* to maintain **safe airspeed**
- Recover and accelerate to **cruise airspeed**
- Retract **flaps** *conservatively* at the top of **white arc**





# Performing a Minimum Radius Turn

- Perform **lookout** before minimum radius turn
- Consider **wind** for minimum radius over ground
- *Operational use* of power and configuration
- Slow down to **minimum airspeed** ( $V_e = 60 \text{ KIAS}$ ) and extend **flaps** in stages to  $30^\circ$  (full flaps)
- Establish a *coordinated* steep level turn adding *full* **power** to maintain **minimum airspeed**
- Recover and accelerate to **cruise airspeed**
- Retract **flaps** to  $10^\circ$  *immediately* and to  $0^\circ$  *conservatively* at the top of **white arc**



# Performing a Steep Descending Turn

- Perform **lookout** before steep descending turn
- Reduce **power** to **idle** maintaining **safe airspeed** ( $V_e = 70$  **KIAS**  $\geq 68$  **KIAS** (best glide))
- Initiate steep descending turn like descending turn
- *Operational / situational use* of configuration (clean flaps)
- Correct *as necessary* to maintain **pitch** and **bank attitude**
- Remain *coordinated* and correct **underbanking** tendencies
- Avoid spiral dive and monitor **safe airspeed**
- Recover like descending turn adding **power** first – PAT



## Summary / Quiz

- Mentally perform a *coordinated climbing* (2000' to 3000') **medium** (30° bank angle) **turn** to the right (270° to 090°) describing all required actions.
- Mentally perform a *coordinated descending* (3000' to 2800') **gentle** (15° bank angle) **turn** to the left (090° to 270°) describing all required actions.
- Mentally perform a *coordinated steep* (45° bank angle) **level turn** to the left (090° to 270°) describing all required 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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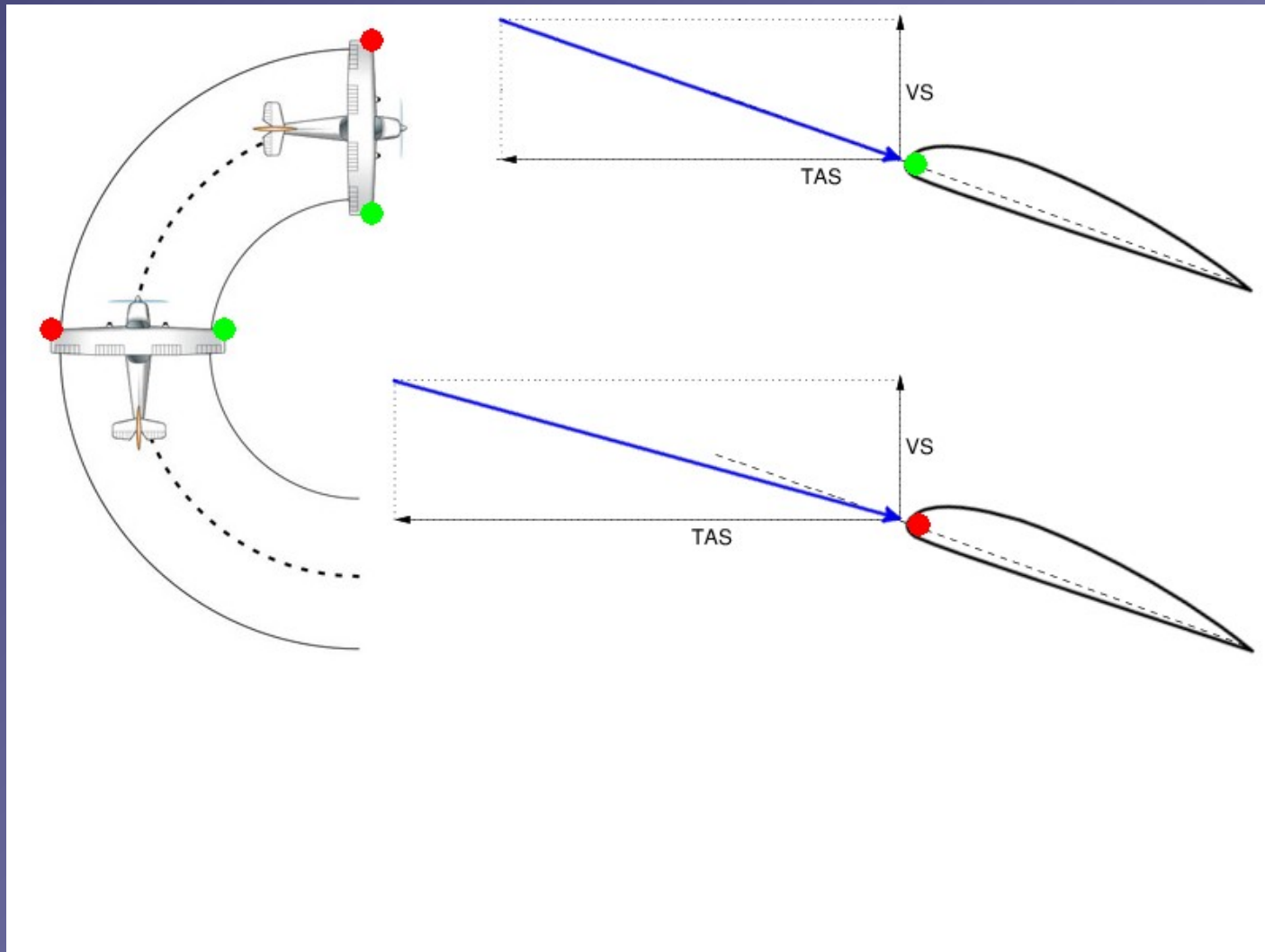
# Additional Materials

- Additional materials for turns
- Flight Instructor Guide – Exercise 9, Lesson Plans 2, 7, 8



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# Climbing Turn – Overbanking

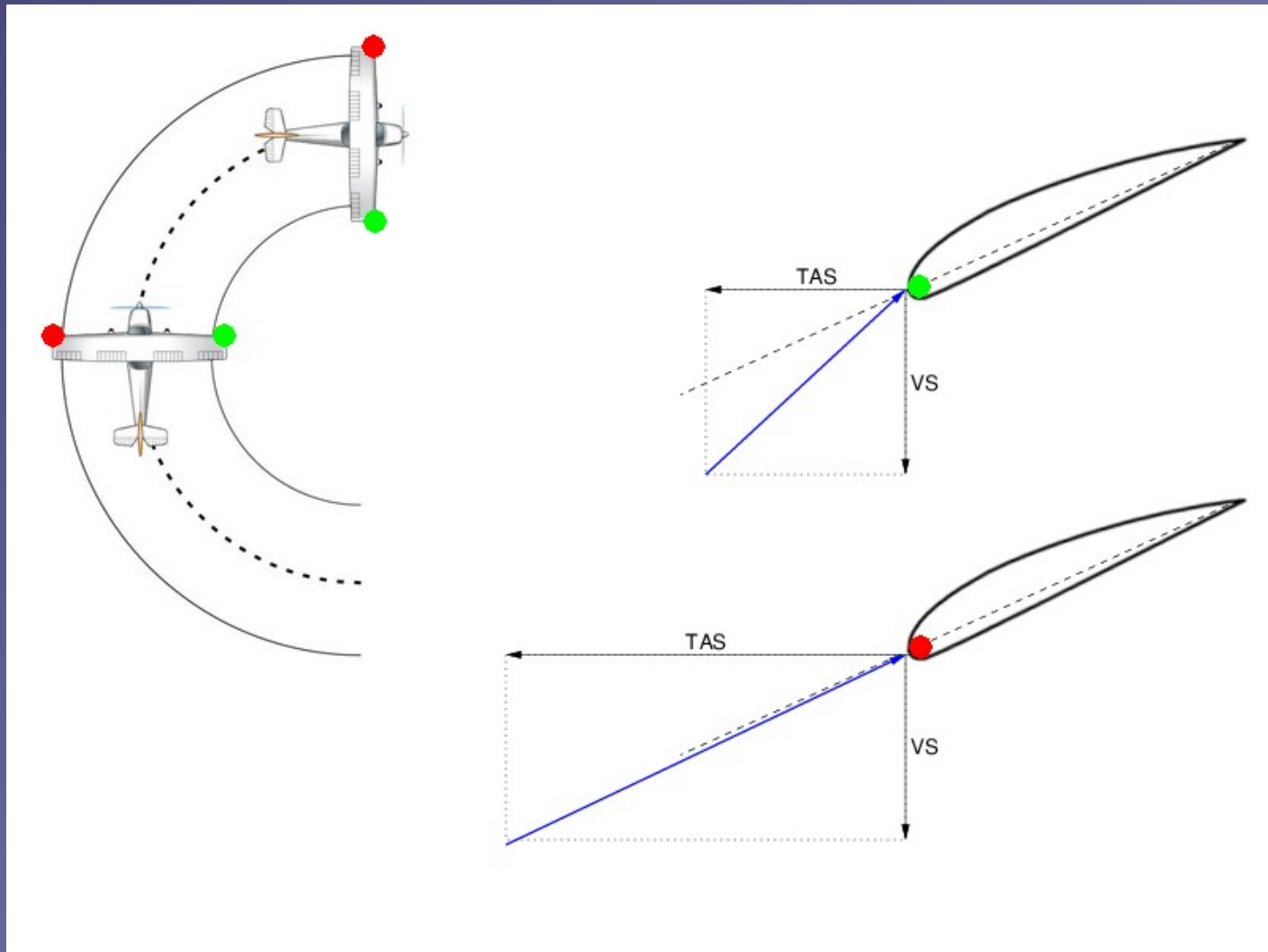






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# Descending Turn – Underbanking





# Turn Factors

## Turn Facts and Factors

- At a constant TAS, increasing the bank decreases the turn radius and increases the rate of turn.
- To maintain a constant rate of turn, more speed requires more bank.
- At a constant bank angle, increasing speed increases the turn radius and decreases the rate of turn.
- A steeper bank angle reduces radius and increases rate of turn, but produces a higher load factor.
- Load factor is directly related to bank angle, so the load factor for a given angle is the same at any speed.
- Reducing TAS reduces turn radius and increases rate of turn without increasing the load factor.
- A given TAS will give a specific rate and radius of turn in any aeroplane.
- If TAS is doubled at constant bank, radius is quadrupled.
- If TAS is doubled at constant bank, rate of turn is halved.

$$\text{Old Rate of Turn} = \frac{V}{\text{Radius}}$$

$$\text{New Rate of Turn} = \frac{V \times 2}{\text{Radius} \times 4} = \frac{1}{2} \text{ old rate}$$

### Radius and Rate of Turn Relationship

- Bank
- Load Factor
- TAS

Circle Circumference  $C = 2\pi r = \pi d$   
Derive standard turn radius with given TAS  
Assumption: no wind