1500 ft AEROBATIC ENDORSEMENT

& REVISION of STALLS, SPINS AND BASIC AEROBATICS (3000 FT)

David Pilkington FRAeS

INTRO

- All morning
- Break and BBQ lunch
- Discussions? Fly?

- Who’s interested in doing the 1500 ft endorsement?
- And competition aerobatics?

CONTENT - OVERVIEW

- Admin
- Loss of Control In-Flight
  - Decathlon Accidents
  - Stall training
  - Stall and incipient spin recovery
- Basic Aerobatics
  - Current rules
  - Part 61 competencies example - What is a loop?
- Spin Underpinning Knowledge
- REVISION
  - Physiological Considerations
  - Structural Considerations
- Performance & Handling
- 1500 ft Knowledge
- Flying the Known Sequence
- Designing a Free Sequence
- Plan an Unknown Sequence
- Fly to Win!

Decathlon Accident History

Stall Revision

Part 61 syllabus:

- Stalls without power and with full power, climbing … descending … turning
- Execute an incipient spin from straight & level, climbing and turning
- Sideslipping turn

Stall Revision

Stall Recovery Template	
1. Wing leveler or autopilot	1. Disconnect
2. a) Pitch nose-down b) Trim nose-down pitch	2. a) Apply until impending stall indications are eliminated b) As needed
3. Bank	3. Wings Level
4. Thrust/Power	4. As needed
5. Speed brakes/spoilers	5. Retract
6. Return to the desired flight path	

Figure 4-6. *Stall recovery template.*

How do you know when an airplane has stalled?

Incipient Spin Recovery

An inadvertent stall/spin entry requires immediate action to unstall the wing and to remove the aggravating control deflections. Move the stick forward and get rid of aileron and rudder input. In other words:

Centralise the controls.

Close the throttle.

REGULATORY ASPECTS

Refer Part 61 & MOS

- Minimum height – 3,000 ft AGL – allow for errors
- Spin (upright) endorsement is a prerequisite of aerobatics
- Aerobatic endorsement:

Loop, roll, stall turn and unusual attitude recovery

REGULATORY ASPECTS cont

Note:

- Other manoeuvres do not require endorsement however may require additional training e.g.
- Snap or Flick roll
- Half reverse Cuban Eight
- Quarter roll down
- Inverted spin
- Aerobatic endorsement is not limited to a specific type however may require additional training

UA RECOVERIES

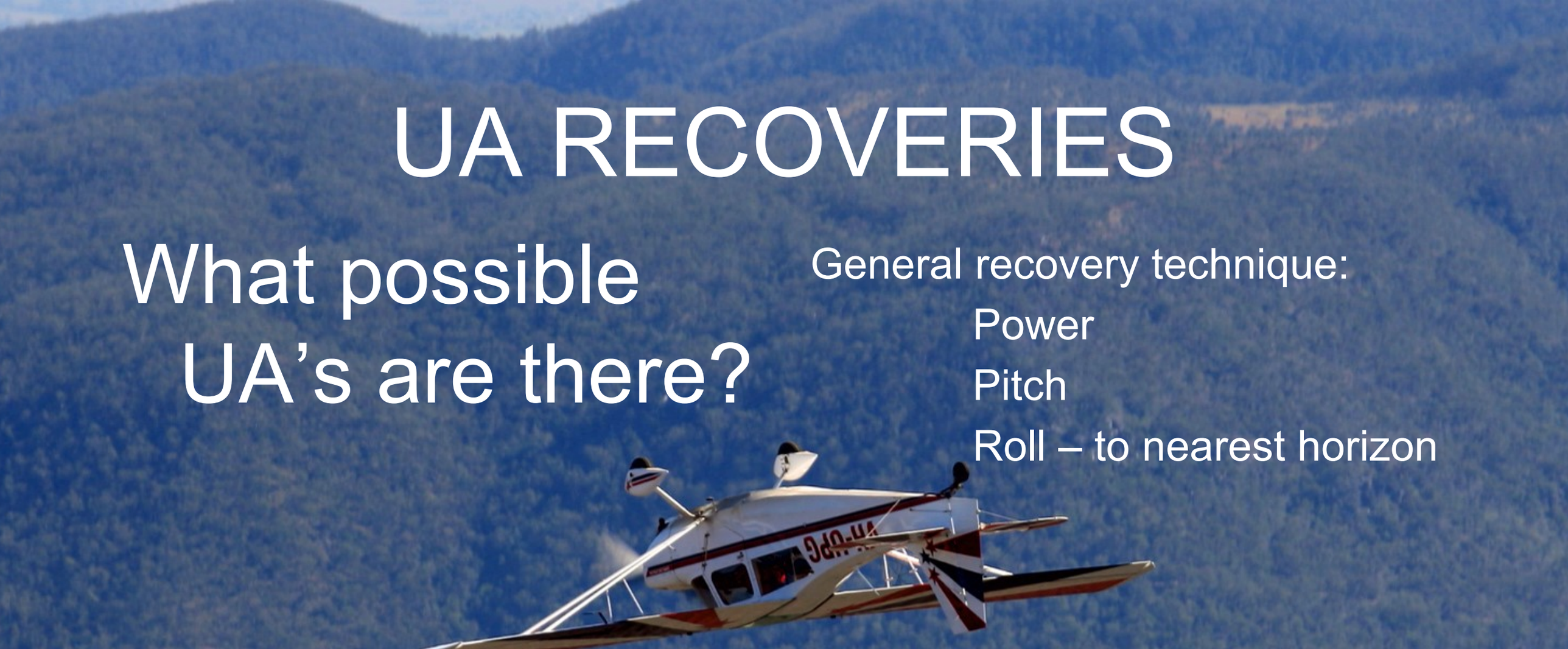
What possible UA's are there?

General recovery technique:

Power

Pitch

Roll – to nearest horizon



Initial post-stall gyration:

- or incipient spin

Spin – upright and inverted

Spiral dive

Two important ones:

Extreme nose high – risk of a tail-slide from a failed stall turn

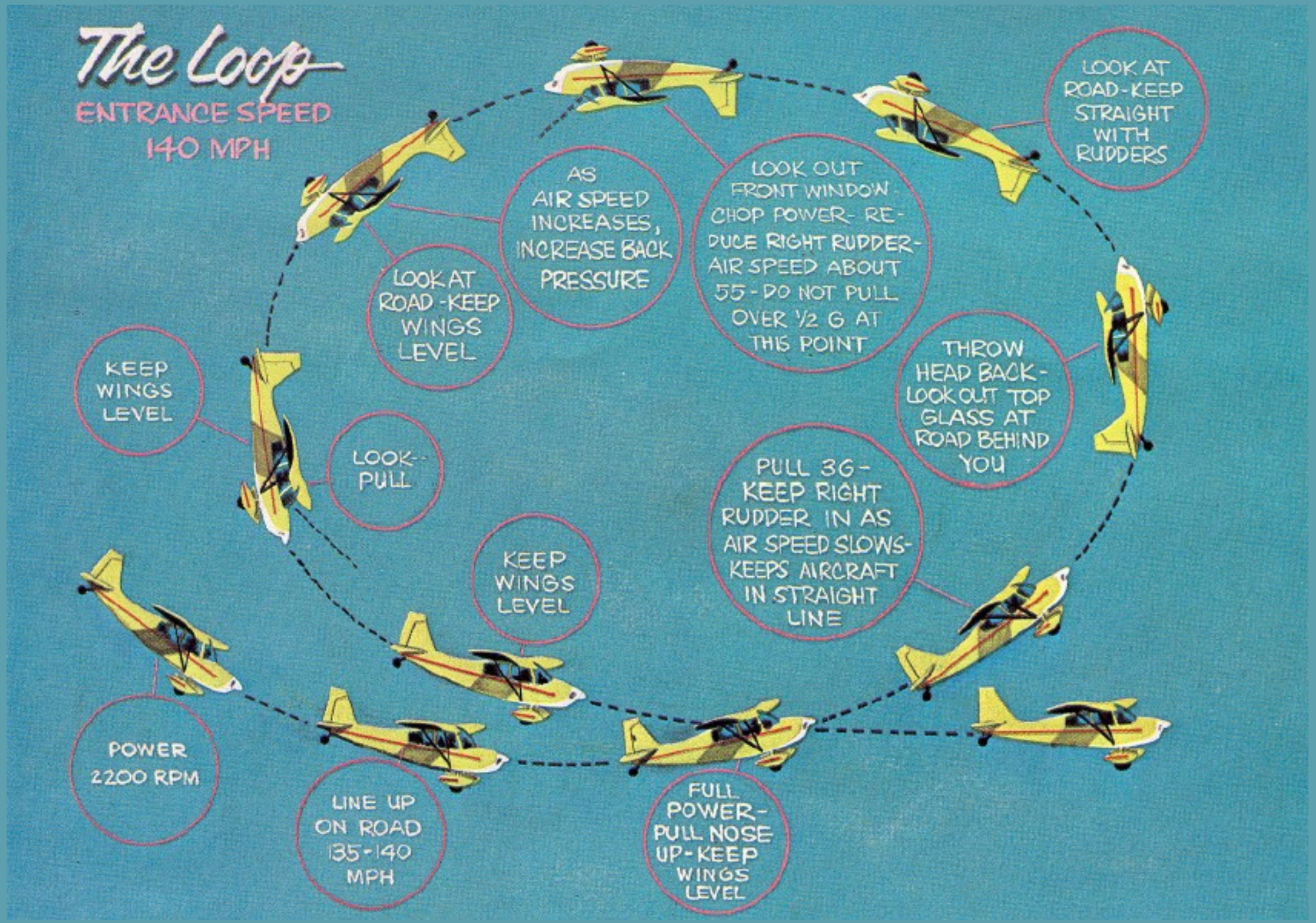
Inverted dive – from a failed roll

PART 61 COMPETENCY STANDARDS

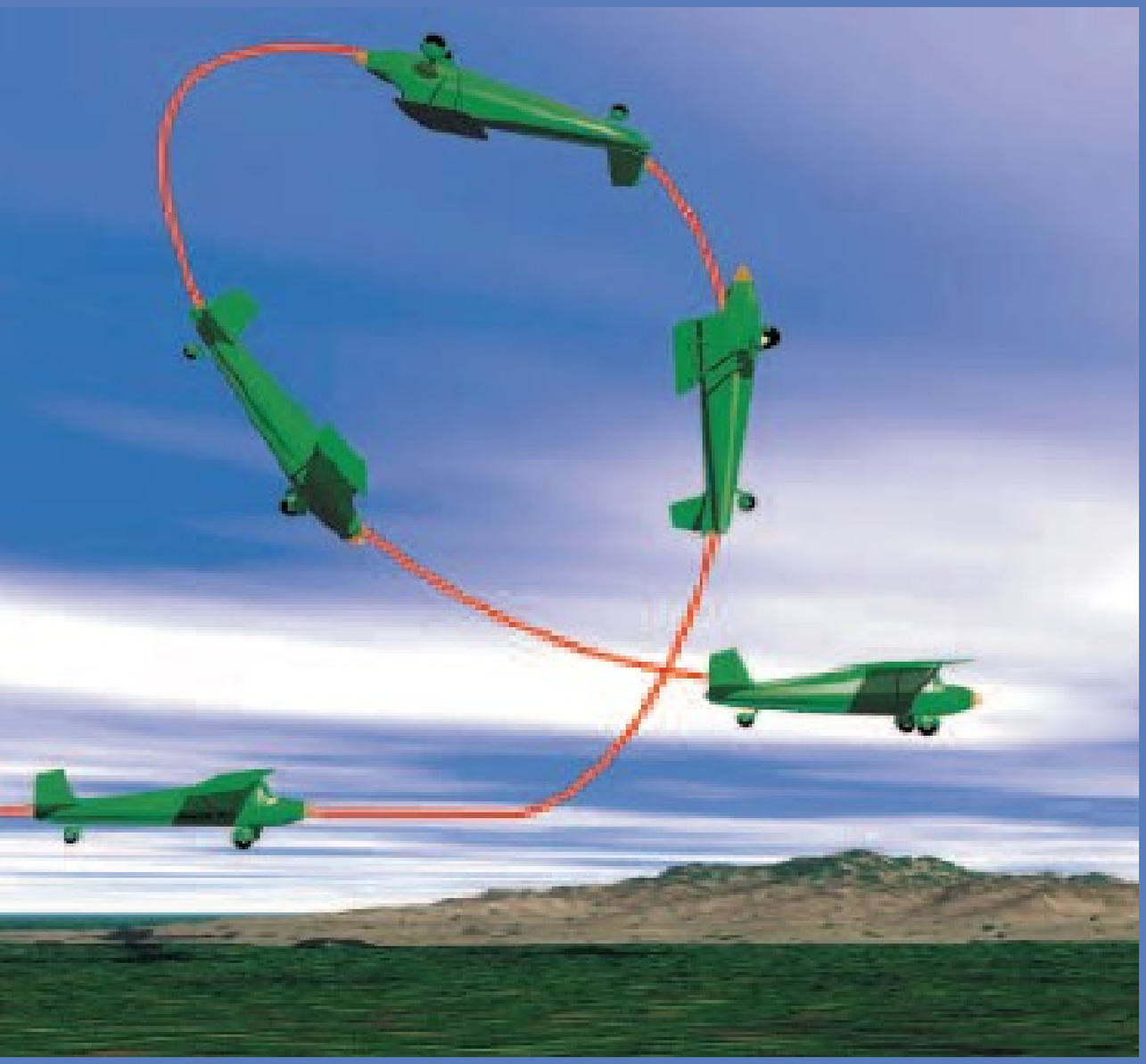
FAE-1.2 – Perform looping manoeuvre

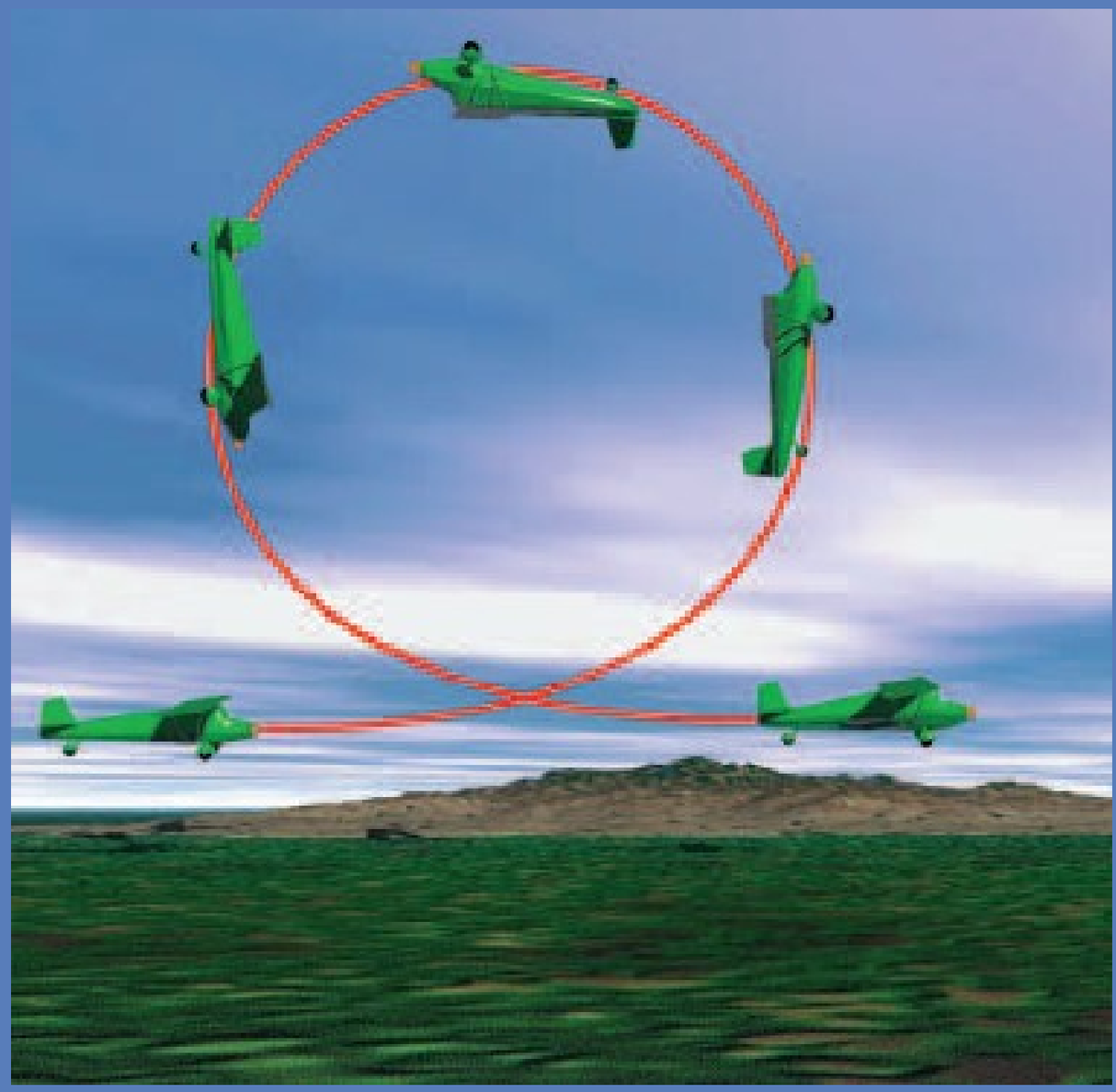
(a) pitch the aircraft vertically at a continuous rate through 360° in balanced flight, maintaining wings parallel to the Earth's horizon, positive 'g', without stalling and maintaining alignment with a nominated line feature from a nominated airspeed that will ensure completion of a loop;

TEACHING A LOOP



ARE THESE LOOPS?





WHAT IS A LOOP?

$$\dot{V}_\theta = \frac{T}{m} - \frac{C_d \rho S}{2m} V_\theta^2 - g \sin\theta,$$

$$\dot{V}_R = \frac{V_\theta^2}{R} + g\cos\theta - \frac{L}{m},$$

$$\dot{\theta} = \frac{V_\theta}{R},$$

where

C_d = coefficient of drag,

ρ = air density,

S = surface area of the airfoil,

L = lift force supplied by the wing,

T = thrust provided by the engine,

m = mass of the aircraft, and

$G = L/m$.

The $(\cdot)$ denotes the derivative with respect to time.

Unfortunately, since θ must vary from 0 to 2π, the small angle approximation of $\theta = \sin\theta$ cannot be used,

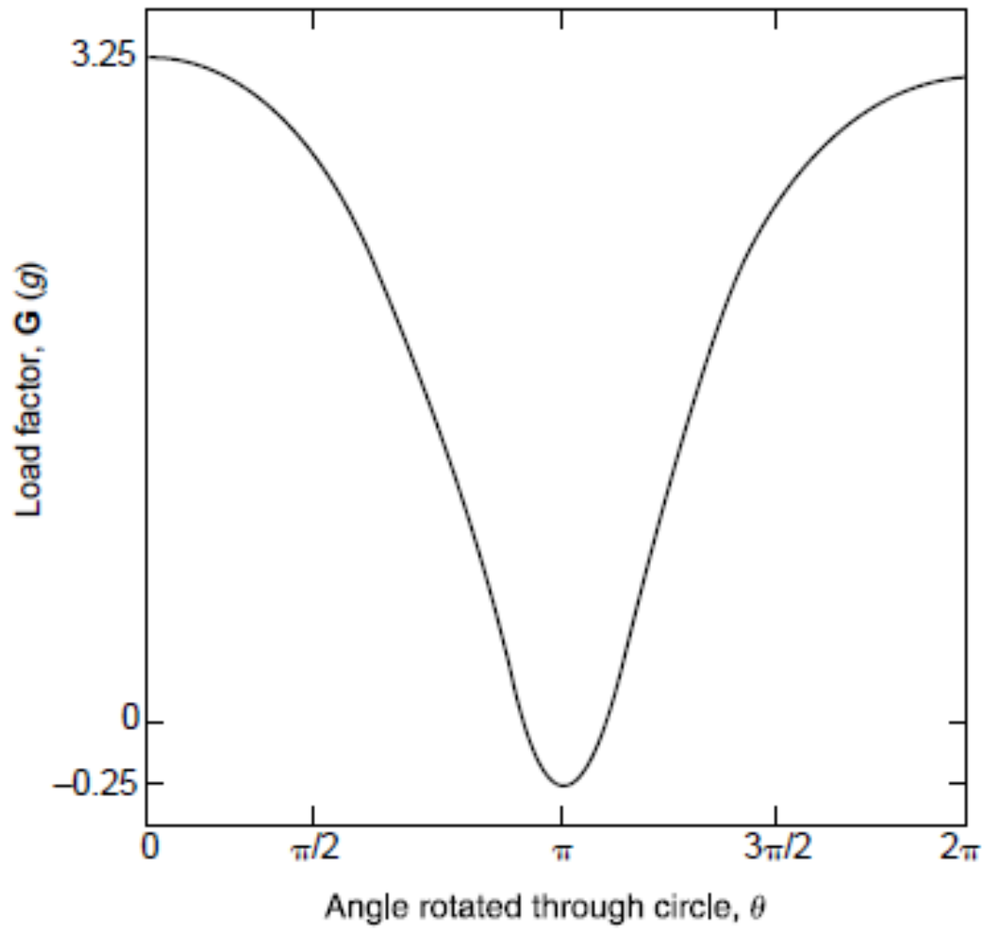
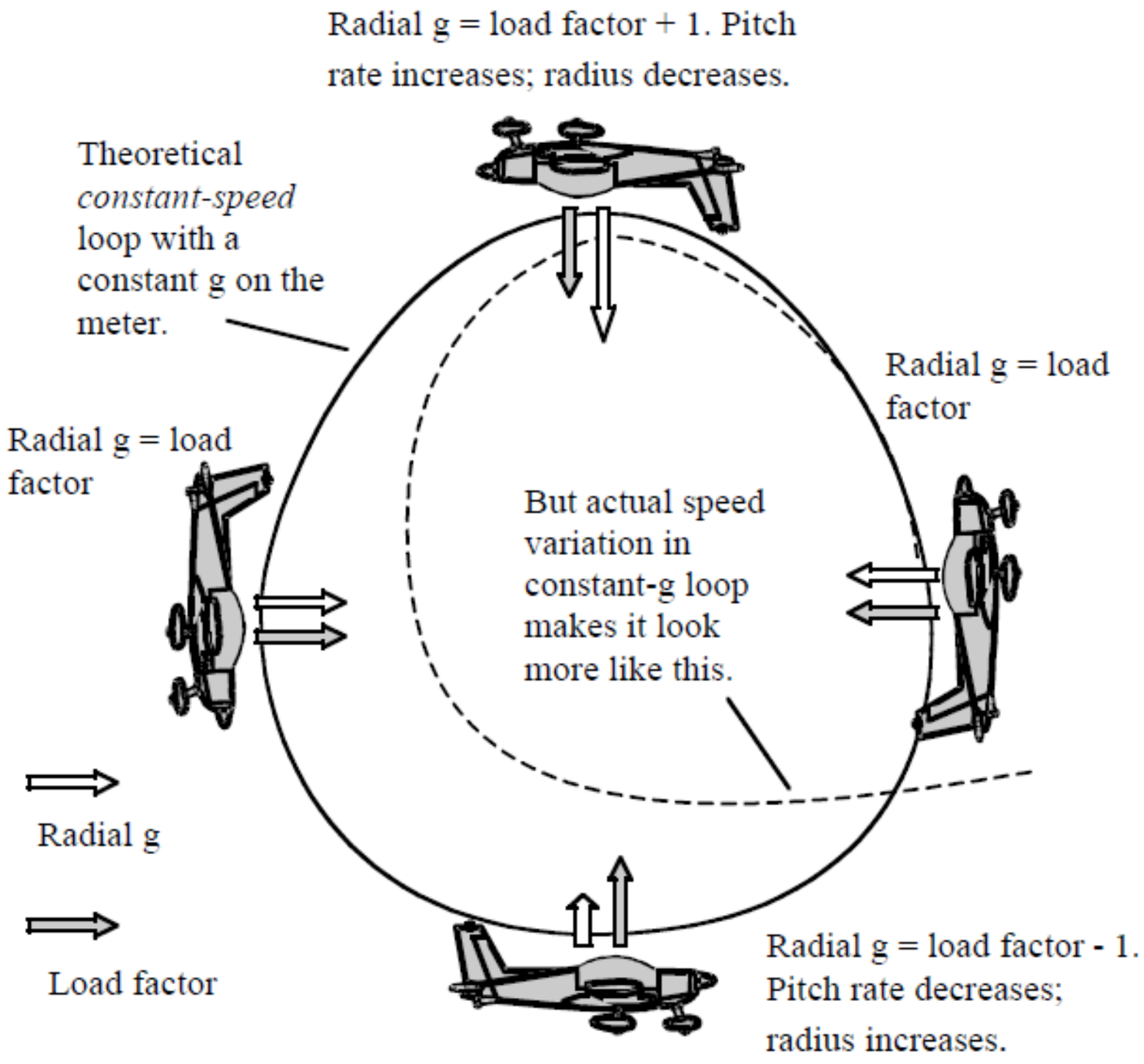
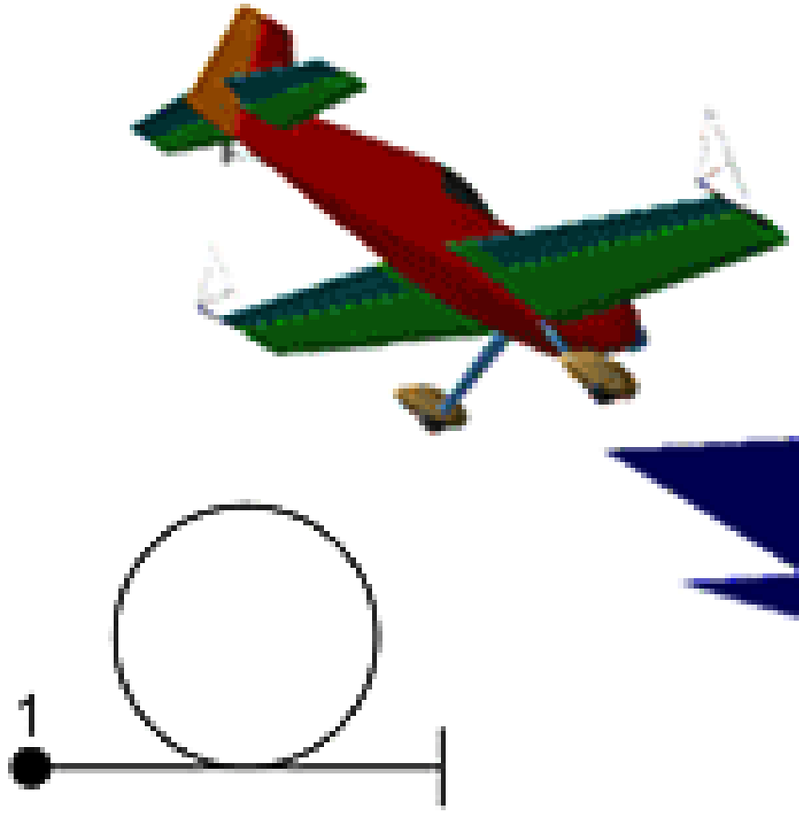


Figure 6. Load factor G experienced by the aircraft and pilot as a function of angle θ.

Shape of a Loop





Aresti symbol
Cat No. 7.4.1.1
Erect positive loop

CGT

Full and part loops are all judged on CGT and the shape must be wind corrected, ie. all looping elements are ROUND!

CGT

CGT

MOS Aerobatics

Manoeuvres	Parameter	Tolerances
Looping manoeuvres	Nominated line feature	±10°
	Nominated airspeed	±10 kts
	Entry and recovery heights	±100 ft
Rolling manoeuvres	Nominated airspeed	±10 kts
	Direction	±10°
	Altitude	±100 ft
Stall turn-hammerhead	Nominated air speed	±10 kts
	Nominated line feature 180°	±15°

SPIN UNDERPINNING KNOWLEDGE

(a) actions required to recover from an incipient spin (wing drop at point of stall);

(b) what control inputs, with an aeroplane in any attitude, at the point of stall, are likely to cause a spin;

(c) blanketing effects the elevator can have on the rudder during spin recovery;

(d) significance of stick and control wheel position with respect to spin recovery;

(e) aerodynamic causes of a spin;

(f) what aerodynamic factor determines the direction of a spin;

(g) how to recognise a stable spin;

(h) difference between a stable spin and an unstable spin;

(i) effects of C of G position on spin performance and acceleration;

SPIN UNDERPINNING KNOWLEDGE

(j) difference between a spin and spiral dive;

(k) factors which may lead to a flat spin;

(l) difference between an upright and an inverted spin;

(m) visual indications used to determine the direction of a spin;

(n) instrument indications used confirm the direction of a spin;

(o) standard spin entry and recovery techniques for the aircraft being flown;

(p) number of turns normally required for spin recovery in the aeroplane type;

(q) height normally required entering and recovering from a stable spin;

(r) Mueller-Beggs spin recovery action and limitations on its application;

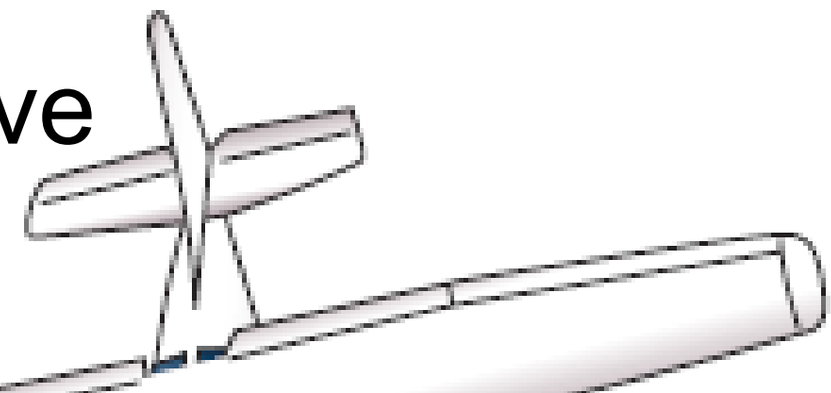
(s) 'g' and any other limitations applicable to spinning for the aeroplane type.

CONSIDERATIONS cont

Types of Spins or Modes:

- Steep
- Flat
- Accelerated
- Inverted

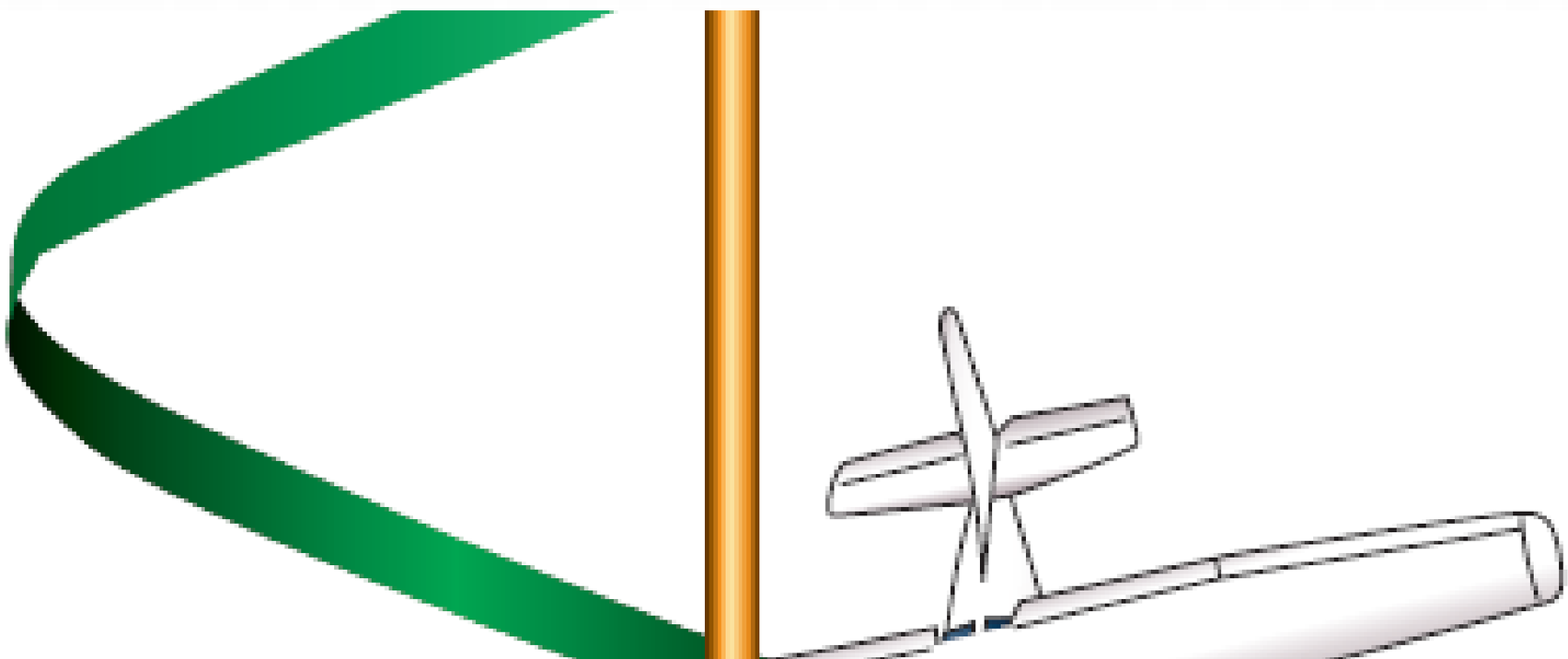
- Combinations of the above



CONSIDERATIONS cont

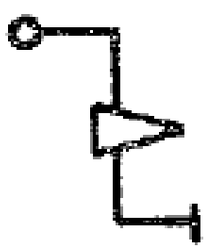
CAUTION – Spins can be aggravated (i.e. flattened and/or accelerated) by incorrect use of power and controls leading to prolonged or impossible recovery.

Engine power was then heard to decrease and the aircraft entered a spin, probably to the left although one of several witnesses believed it was to the right. As the spin progressed, the nose attitude appeared to steepen to the near vertical. After making four complete turns, and after the fifth turn commenced, the aircraft struck the ground some 600 metres south-east of the aerodrome terminal building. There was no fire.



AIR EXERCISE - cont

NORMAL SPINS



Enter from normal stall, power off with full aft stick and full rudder in desired direction of spin. Maintain spin with full pro spin control until 1/4 to 1/2 spin prior to recovery heading. Recover with positive movement of stick to neutral position and full opposite rudder: Hold pro recovery control until rotation stops and positive control and flying speed is restored. Then neutralize rudder and smoothly recover from the dive* to level flight. Free release of controls is not adequate for spin recovery. Positive movement of the controls by the pilot is required.

AIR EXERCISE - RECOVERY FROM A FULLY DEVELOPED SPIN

P – **P**ower check OFF

A – **A**ilerons NEUTRAL

(identify direction of yaw)

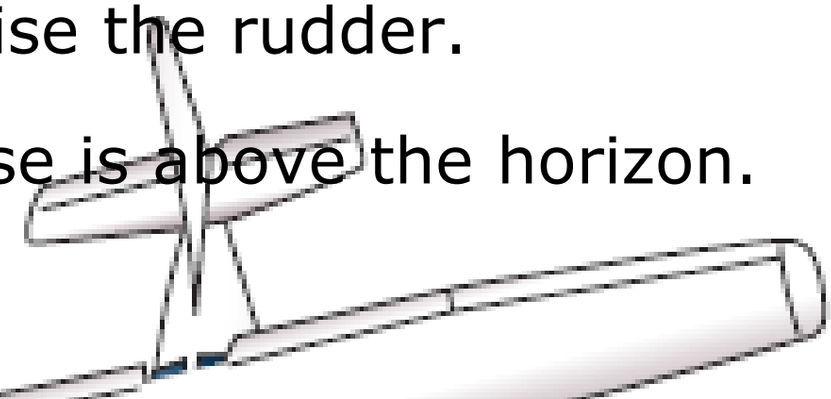
R – **R**udder FULL OPPOSITE the direction of yaw **and then**

E – **E**levator briskly FORWARD towards neutral to unstall the wings

Hold recovery controls, the spin should stop immediately but may take up to one complete rotation.

S - When the rotation **S**tops – centralise the rudder.

Ease out of dive. Power on when nose is above the horizon.



AIR EXERCISE - cont

- These notes apply specifically to the Cessna 150/152, Citabria, Decathlon and Super Decathlon.
- Other aircraft types may have different spin characteristics and require a different recovery method – talk to your instructor before spinning a different type.

Instructor training

The pilot's flight instructor taught and used a method for Chipmunk spin recovery that was reasonably effective in the early stages of a spin, but would become less effective as the spin developed. It was different to the standard method of spin recovery recommended by the Civil Aviation Safety Authority, and to the Chipmunk-specific method recommended by the type design organisation. The flying school's training materials did not include Chipmunk-specific spin recovery methods, and did not clearly emphasise the forward control stick movement necessary for some aircraft.

EMERGENCY PROCEDURES

- **PARES**

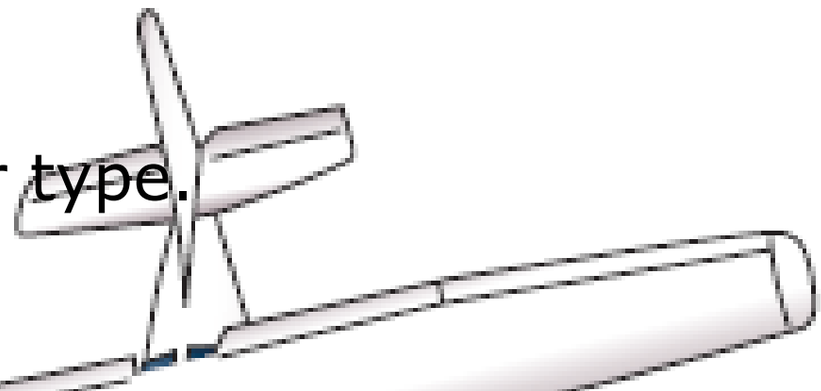
Apply the correct recovery actions - if spin does not stop within one turn – check recovery actions.

- **FLAT SPINS**

Some aircraft require a special recovery technique from a flat spin. Some aircraft which are not approved for spinning, DO NOT recover from a flat spin – regardless of CG.

- **BEGGS-MUELLER**

Apply if known to be applicable to your type.



INVERTED SPIN

PHYSIOLOGICAL CONSIDERATIONS

(h) physiological effects of positive and negative 'g';

(i) the 'g' figure that a normal person may experience 'g' induced loss of consciousness (G-LOC);

(j) differences between grey out, black out, and G-LOC;

(k) conditions under which G-LOC is likely to occur;

(l) time period that disorientation may occur for after recovery from G-LOC;

(m) factors that can reduce G-LOC tolerances;

(n) physiological effects of sustained and rapid changes of 'g' loading;

(o) relationship between tunnel vision and loss of consciousness;

(p) hazards and consequences of performing aerobatics with blocked eustachian tubes;

(q) physiological factors that can reduce 'g' tolerance;

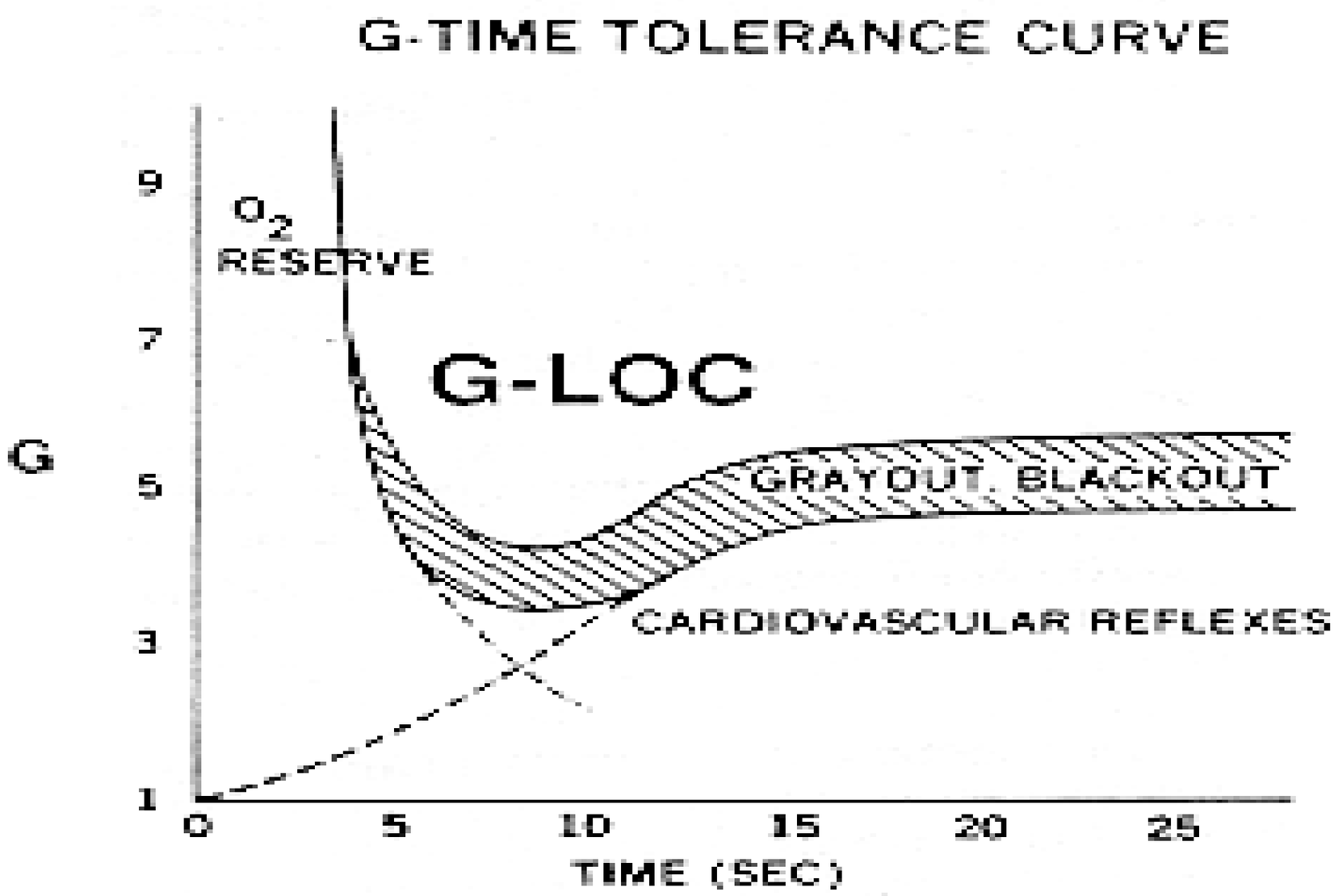
(r) physical actions that may increase 'g' tolerance;

PHYSIOLOGICAL CONSIDERATIONS

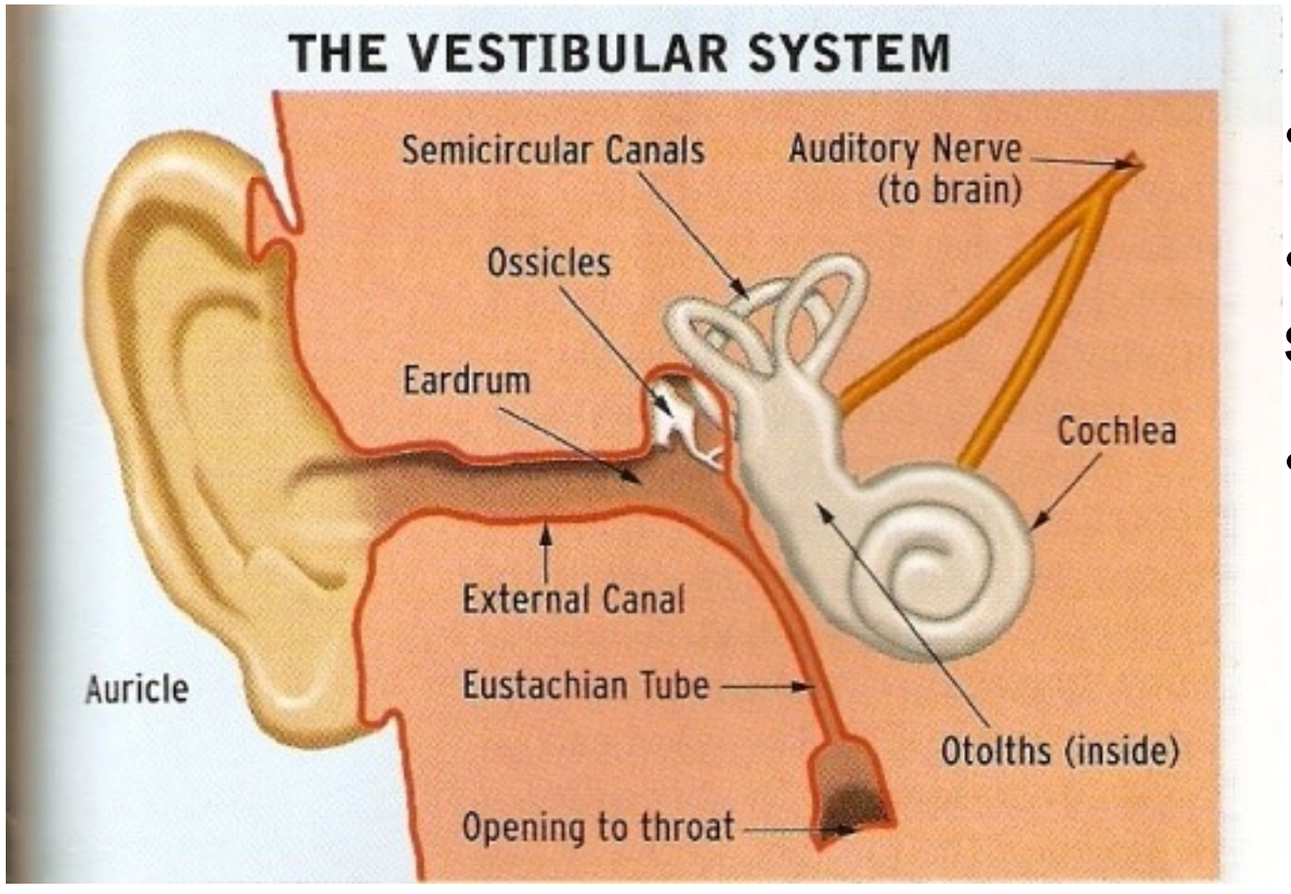
(za) recovery from manoeuvre-induced disorientation;

(zb) how to assess personal fitness for aerobatic flight;

STOHL CURVE


G-TIME TOLERANCE CURVE
9
7
5
3
1
G
O_2
RESERVE
G-LOC
GRAYOUT, BLACKOUT
CARDIOVASCULAR REFLEXES
0
5
10
15
20
25
TIME (SEC)

Eustachian Tube



- Normally equal pressures
- Descents – pressure pushes – swallow etc
- Blocked due cold etc :
  - Pain
  - Dizziness

STRUCTURAL CONSIDERATIONS

(a) meaning of the terms positive and negative 'g';

(b) symmetrical positive and negative 'g' limits for the aircraft flown;

(c) meaning of the term rolling 'g';

(d) rolling 'g' limits for the aircraft flown;

(e) how to calculate the rolling 'g' limitation of an aircraft;

(g) engine RPM limitations for the aircraft flown;

STRUCTURAL CONSIDERATIONS

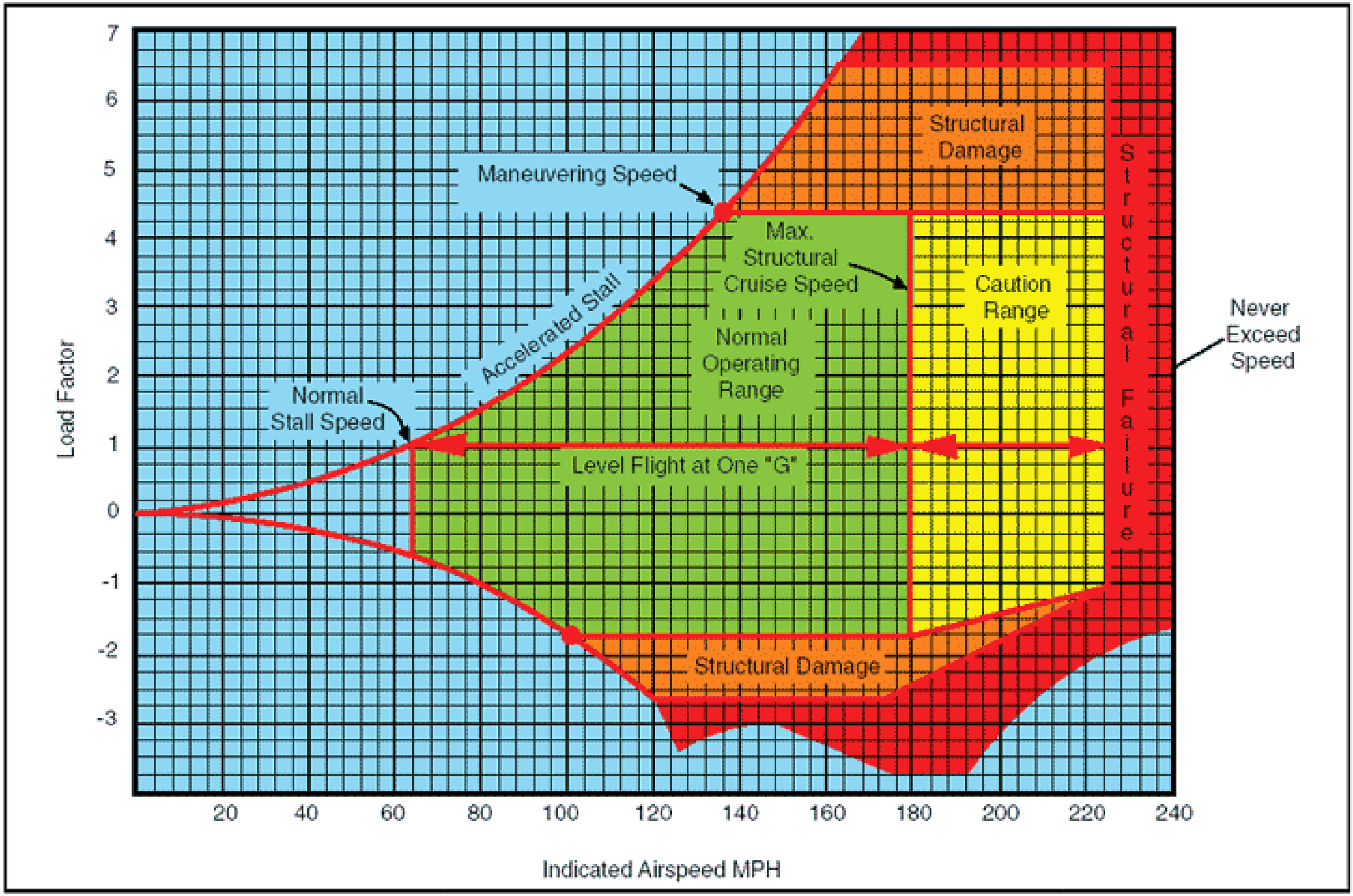
(v) structural irregularities that indicate an aircraft has been overstressed;

(x) airspeed limitations;

(y) V_A, V_{NE} and V_{NO};

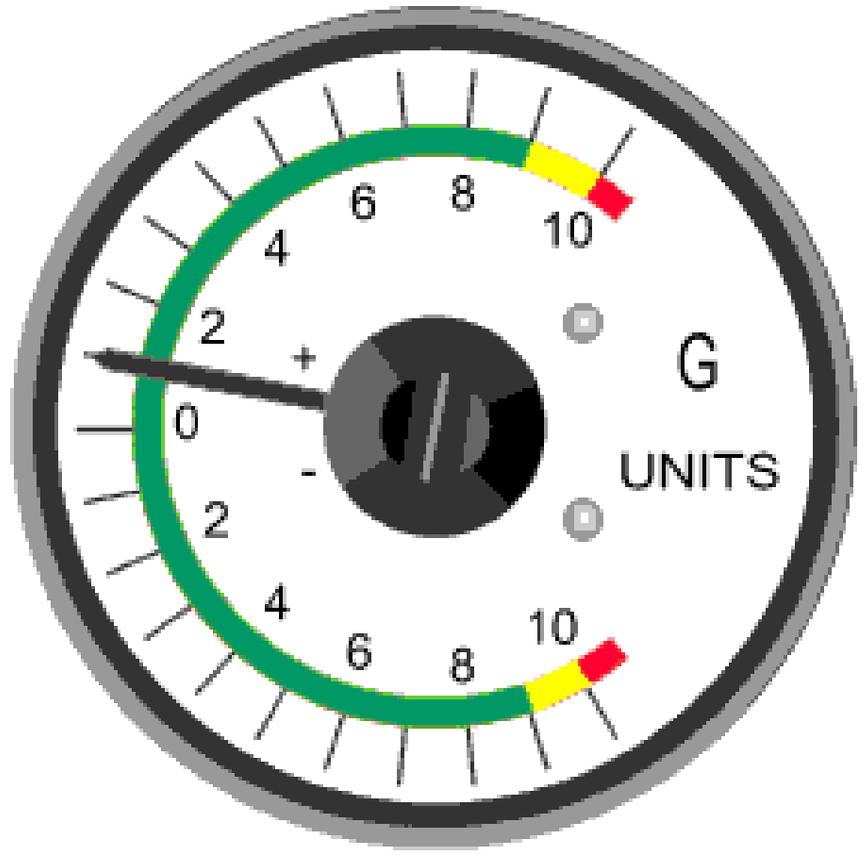
(z) effect of aircraft weight on VA and what precautions must be taken;

FLIGHT ENVELOPE (example only)



MANOEUVRE SPEED

Manoeuvre load factors +6/-5 g (8KCAB only)



V_A 115 KIAS – reduce by 6 kts per 100 kg

One control only at max deflection at V_A

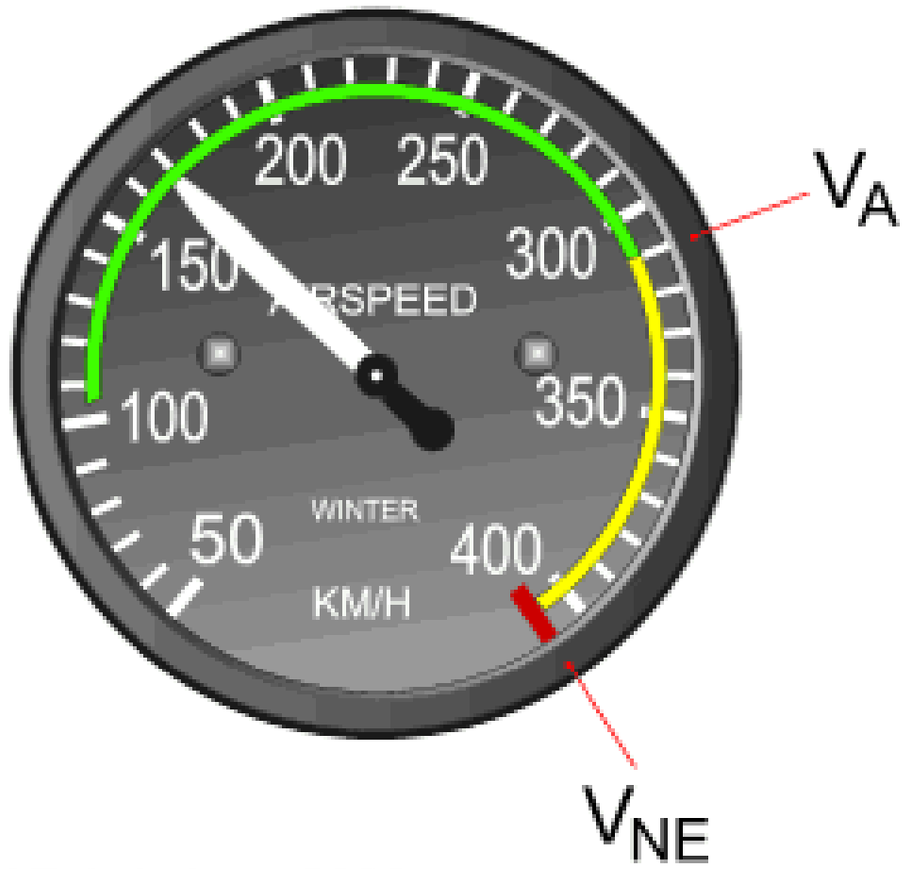
MANOEUVRE SPEED cont

What's wrong with the diagram?

Elevator – full & abrupt up to VA –

beyond that –

remain within limit load factors



MANOEUVRE SPEED cont

From the AFM: Ailerons: full up to V_A at +4g – beyond that – same roll rate as at V_A

From SL 445:

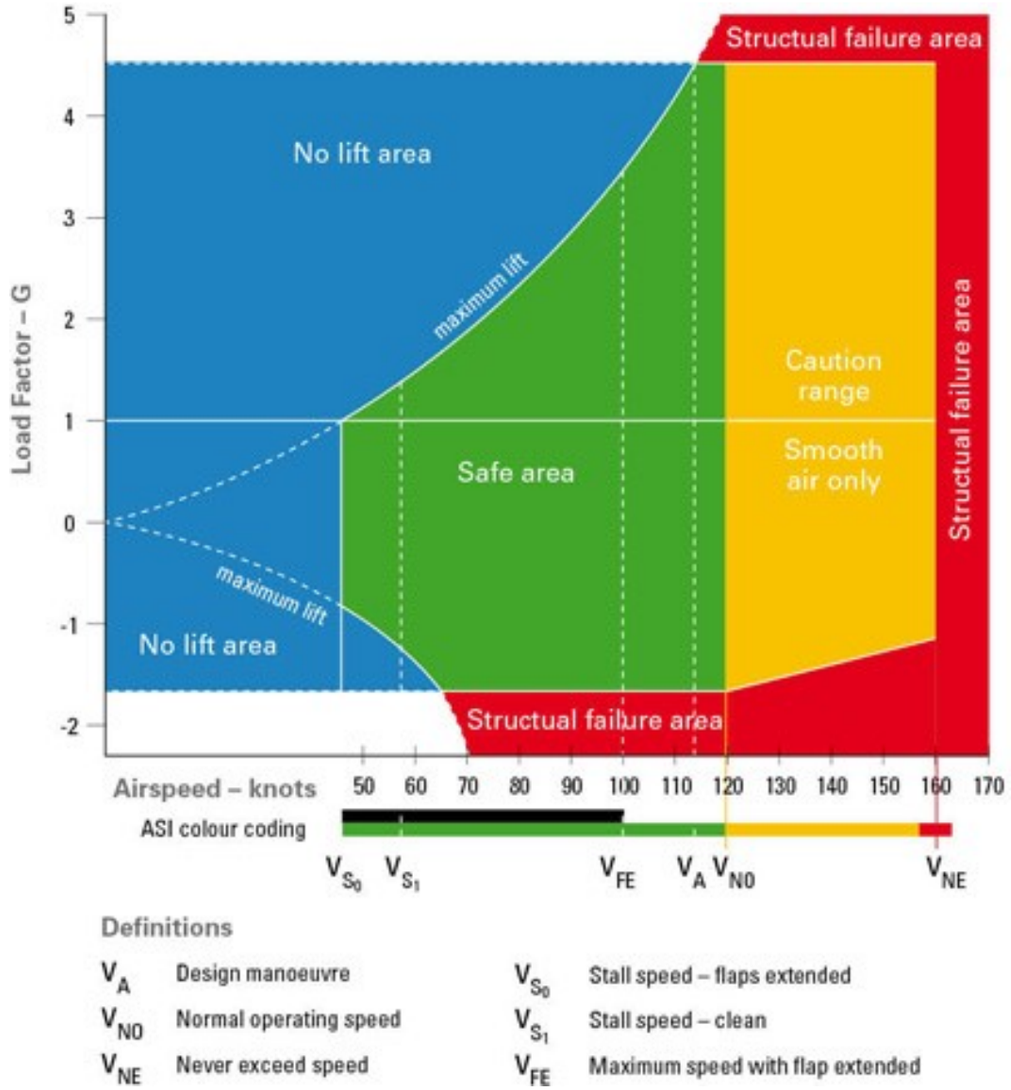
Table I: Aileron Design Speeds and Deflection

Speed	CAS (mph)	Deflection
Aerobatic Maneuvering, V_A	132	Full
Maximum Structural Cruising, V_{NO}	160	3/4
Never Exceed, V_{NE}	200	1/2

Pilots should again operate the airplane as described in the maneuver limits with regard to rolling maneuvers, *Entry Speed 130 IAS (mph), Smooth Application of Controls, No Full or Abrupt Control Movements Above Maneuvering Speed.* In effect - do not exceed the effort required to roll the airplane at V_A.

FLIGHT ENVELOPE (review)

- Limitations of Va
  - Aileron & rudder?
  - Aft & forward stick (elevator)?
- Limitations of Vmo
  - Aileron & elevator?
- Limitations of Vne
  - Aileron and G?
- Maximum speed to apply full elevator plus full aileron?
  - Elevator plus rudder?



MANOEUVRE LIMITATIONS

Refer the POM:

- Lomcevak
- Tail-slide

Plus structural reliability considerations:

- No flick (or snap) rolls

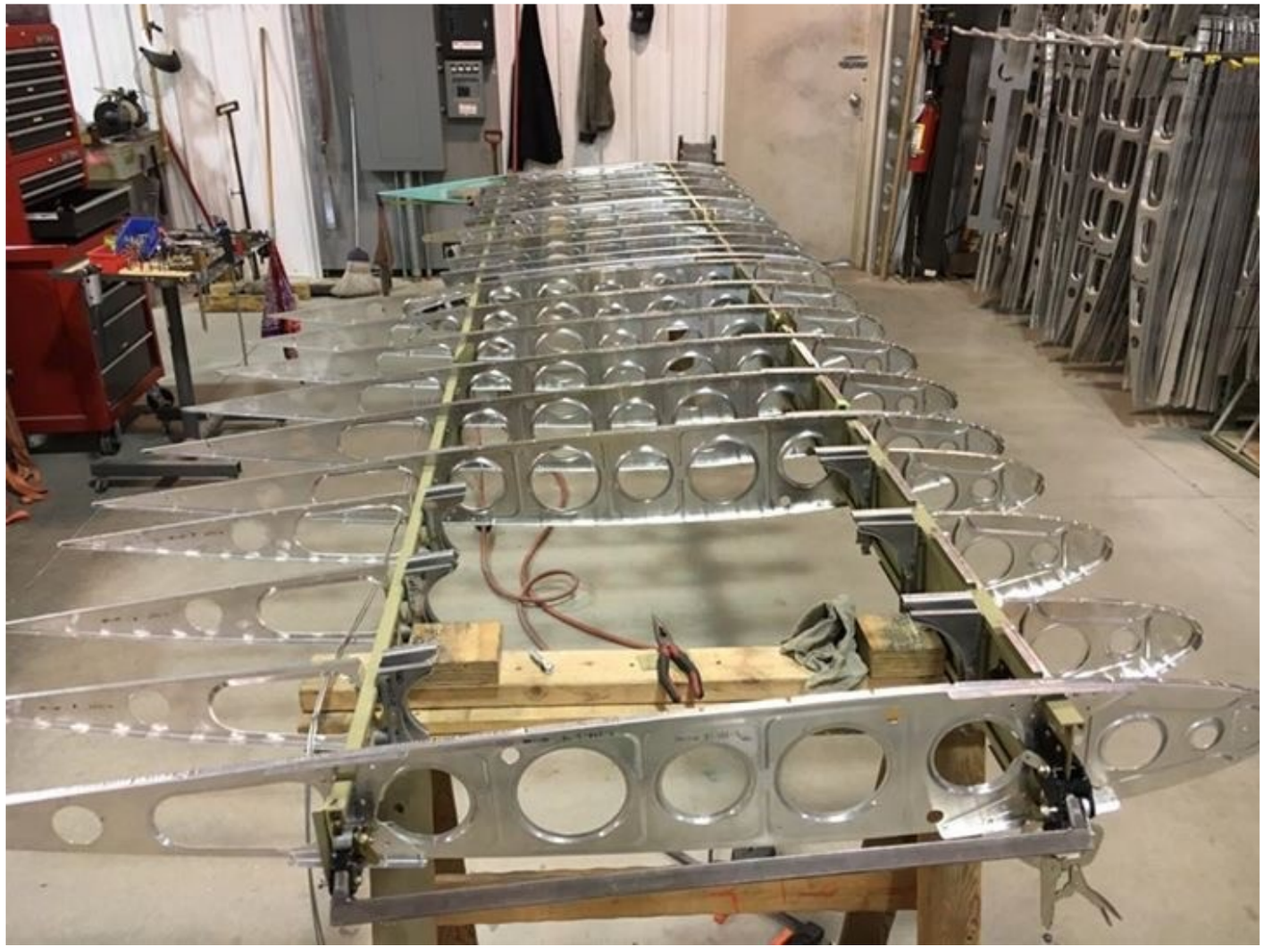
DECATHLON STRUCTURE

STRUCTURE

- Wing Spars - aluminium
- Wing Ribs - Aluminium
- Wing Struts: Front aluminium extrusion, rear steel tube

COVERING

- Fabric
- Wing Leading Edge: Sheet metal



LIFED PARTS

Front wing strut, attach fittings & bolts

Airworthiness Directive AD/CHA/15

"The hours are those actually spent in aerobatic flight and do not include positioning time."

Sequence of 10 figures takes <0.1 hr

A single figure typically 10 - 20 secs

Typical training sortie may be 0.1 to 0.2 hr of aeros

PERFORMANCE and HANDLING

(f) relationship during rolling manoeuvres between pitch angle required on commencement of a roll and rate of roll;

(s) minimum altitude to perform aerobatic manoeuvres;

(t) relationship between pre-stall buffet and rate of turn or rate of pitch;

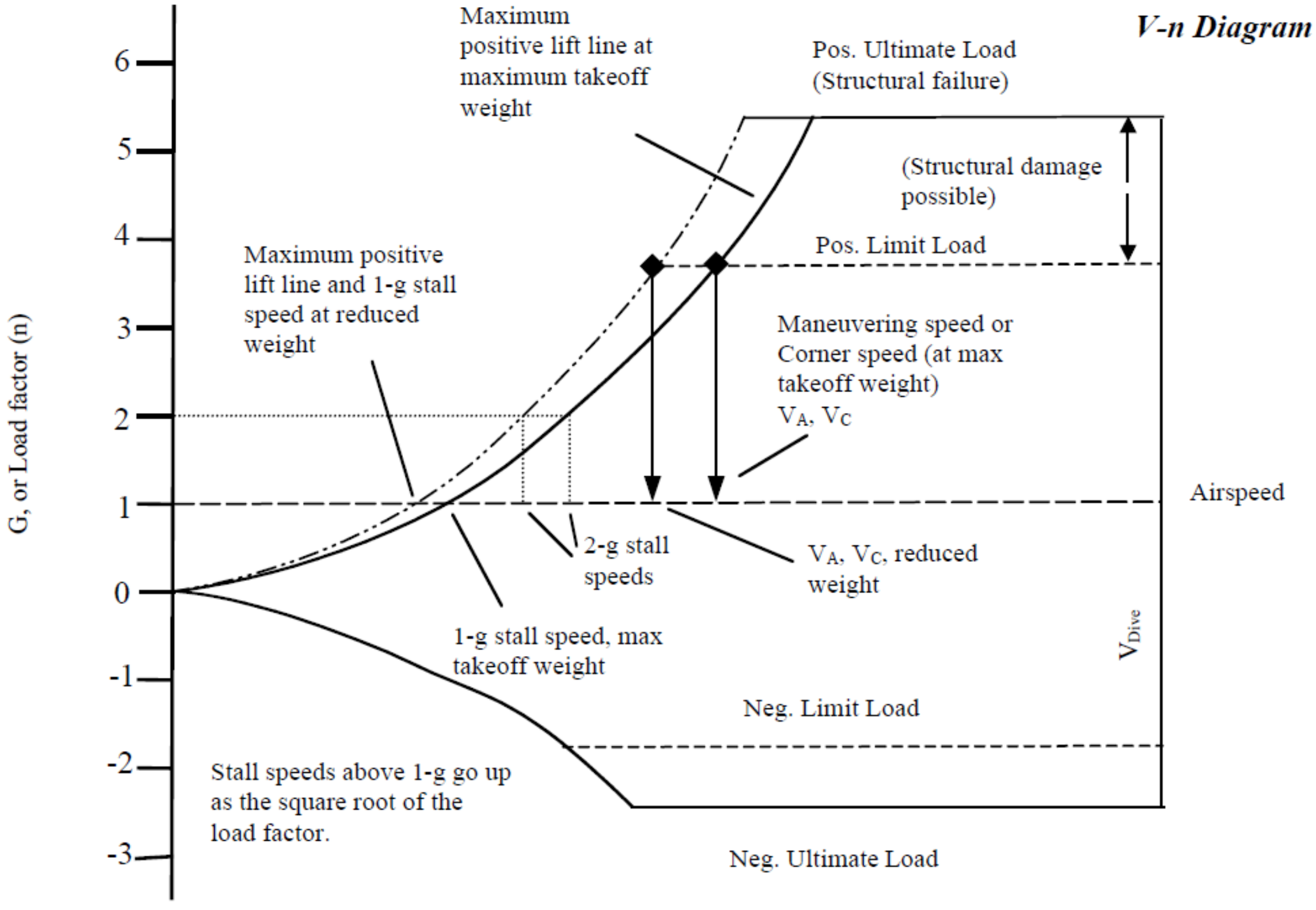
(u) effect of increasing airspeed on stick force;

(w) effect of increased 'g' loading on stall speed;

(zc) maximum rate turn criteria;

(zd) minimum radius criteria.

ACCELERATED STALLS



BALANCE BETWEEN ROLL & PITCH

- Application is at commencement of a roll
- Also relevant to a barrel roll
- Main consideration is for aircraft with low performance, slow roll rate and carburetor
- High performance aircraft have a greater range of capability in rolling manoeuvres
- Consider a Tiger Moth vs a Pitts Special

Turn Radius

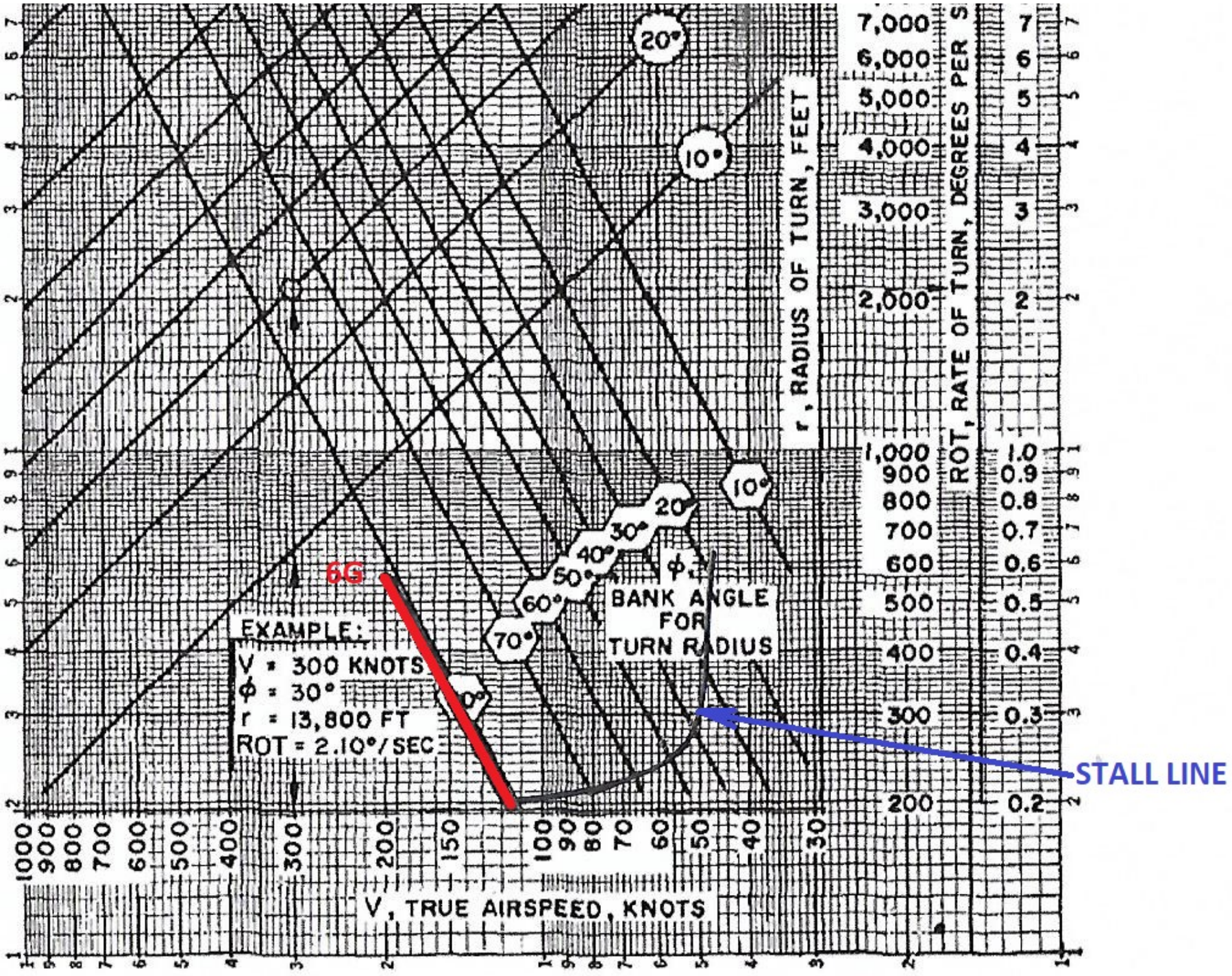
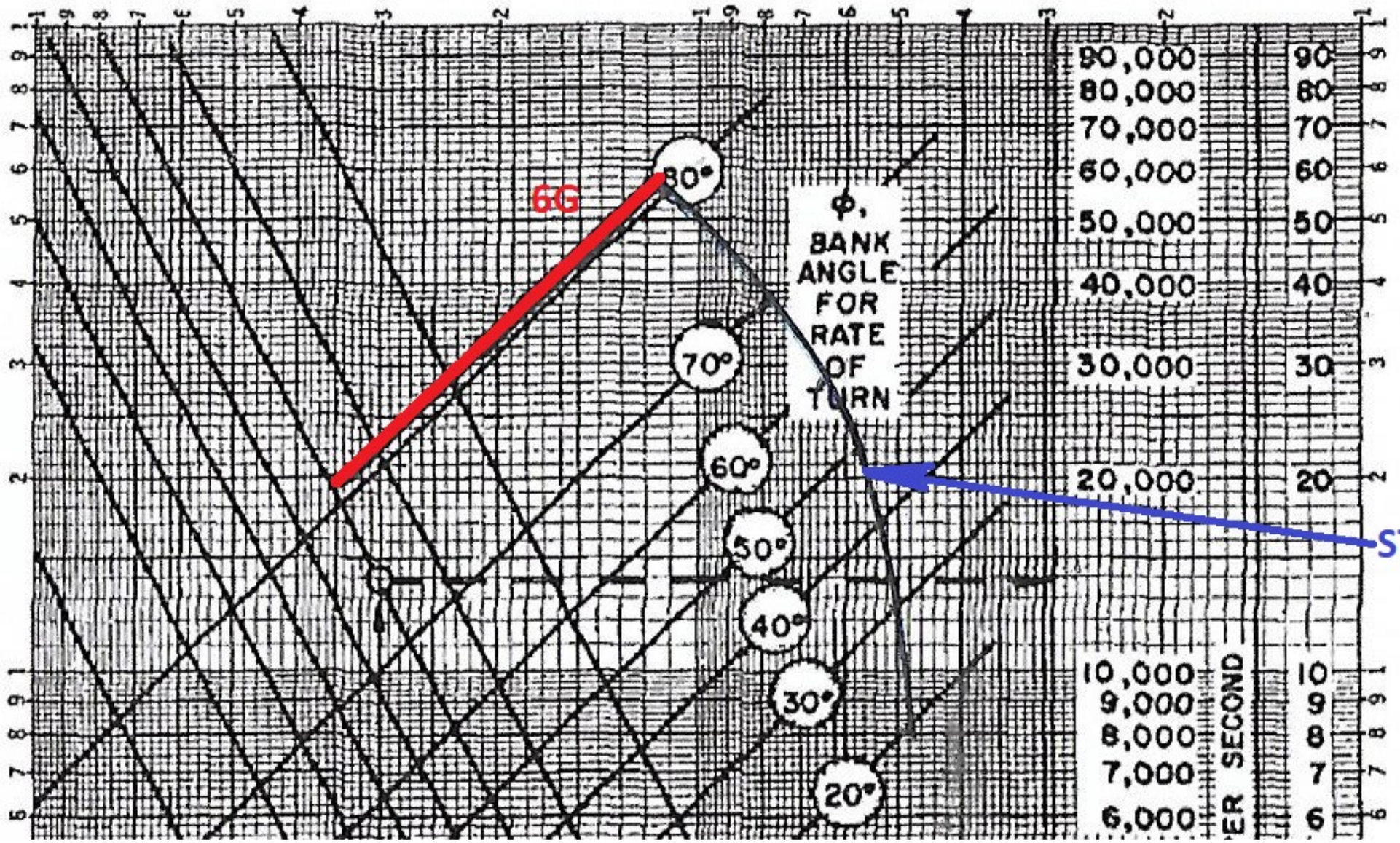


Figure 2.29. General Turning Performance (Constant Altitude, Steady Turn)

Rate of Turn

8KCAB



Stick Forces

Application:

- A measure of aircraft stability
- Control feel to avoid overstressing
- Elevator –
  - Push to dive for speed
  - Pull to increase G

Stick Forces

Aileron – refer SL 445.

- Force varied with airspeed squared

Speed	CAS (mph)	Deflection
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- Do not exceed effort to roll at V_A!

Stick Forces - cont

Decathlon stick force: 15 lb per G

Longitudinal Stability **- Some of the basic longitudinal stability characteristics were documented prior to the aerobatic test program. The stick-fixed neutral point was found to vary from $0.38\bar{c}$ at $C_L = 0.6$ and $V_e = 100$ knots to $0.53\bar{c}$ at $C_L = 1.0$ and $V_e = 70$ knots. The longitudinal stick force gradient was 15 lb/g. Since the pitching maneuverability is appreciably affected by the longitudinal stability characteristics, it should be kept in mind that the center-of-gravity location ($0.23\bar{c}$) used during these tests resulted in a very stable configuration.**

1500 ft KNOWLEDGE

(a) energy management as applied to aerobatic routines;

(b) the minimum height required to complete a pull through manoeuvre, remaining within the structural limits of the aircraft, from inverted flight at 80 kts in the aircraft type being flown;

(c) the minimum height required to recover from a spin in the aircraft type being flown;

(d) the recovery technique to regain physiological and aircraft control when disorientation is experienced;

(e) the 'g' limitations for the aircraft being flown;

(f) the rolling 'g' limitations for the aircraft being flown;

(g) maximum rate turn criteria;

(h) minimum radius turn criteria;

(i) the precautions that should be taken with regard to radius of turn when operating at a high-density altitude;

(j) factors that lead to increased density altitude.

ENERGY MANAGEMENT

Physics of energy height – the roller coaster

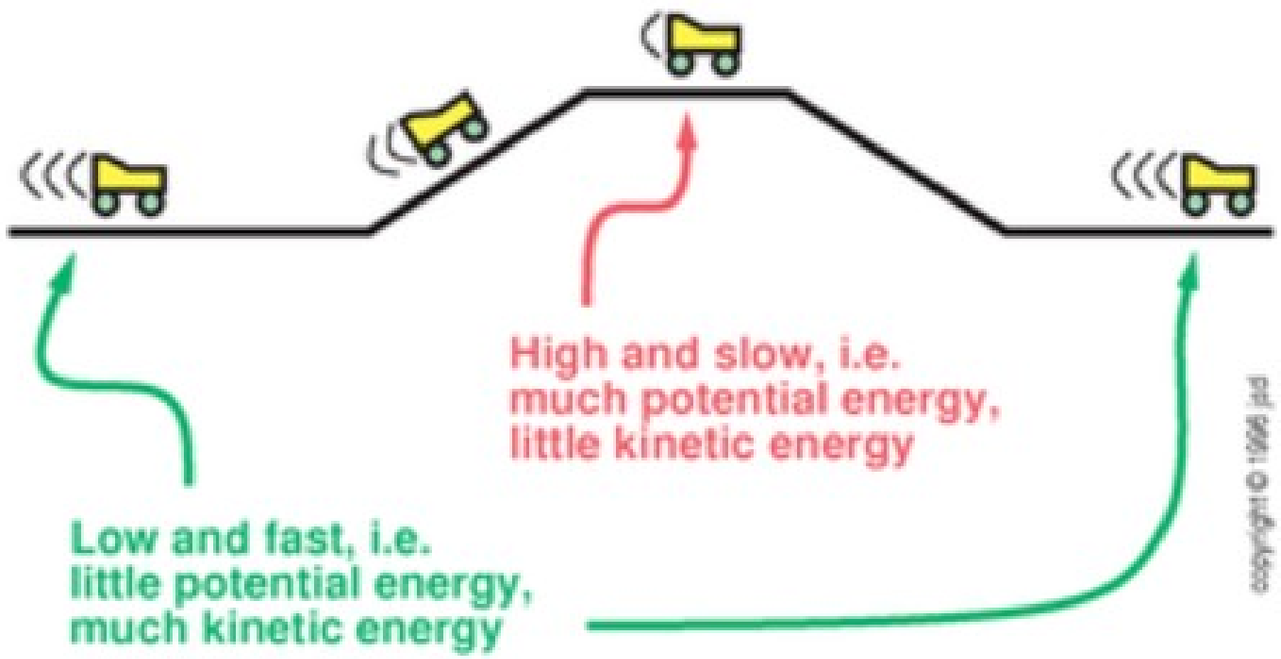


Figure 1.9: The Law of the Roller Coaster

At 100 kts: 9 feet per knot

$$E = PE + KE$$

$$= Wh + \frac{W}{g}\frac{V^2}{2}$$

ENERGY MANAGEMENT

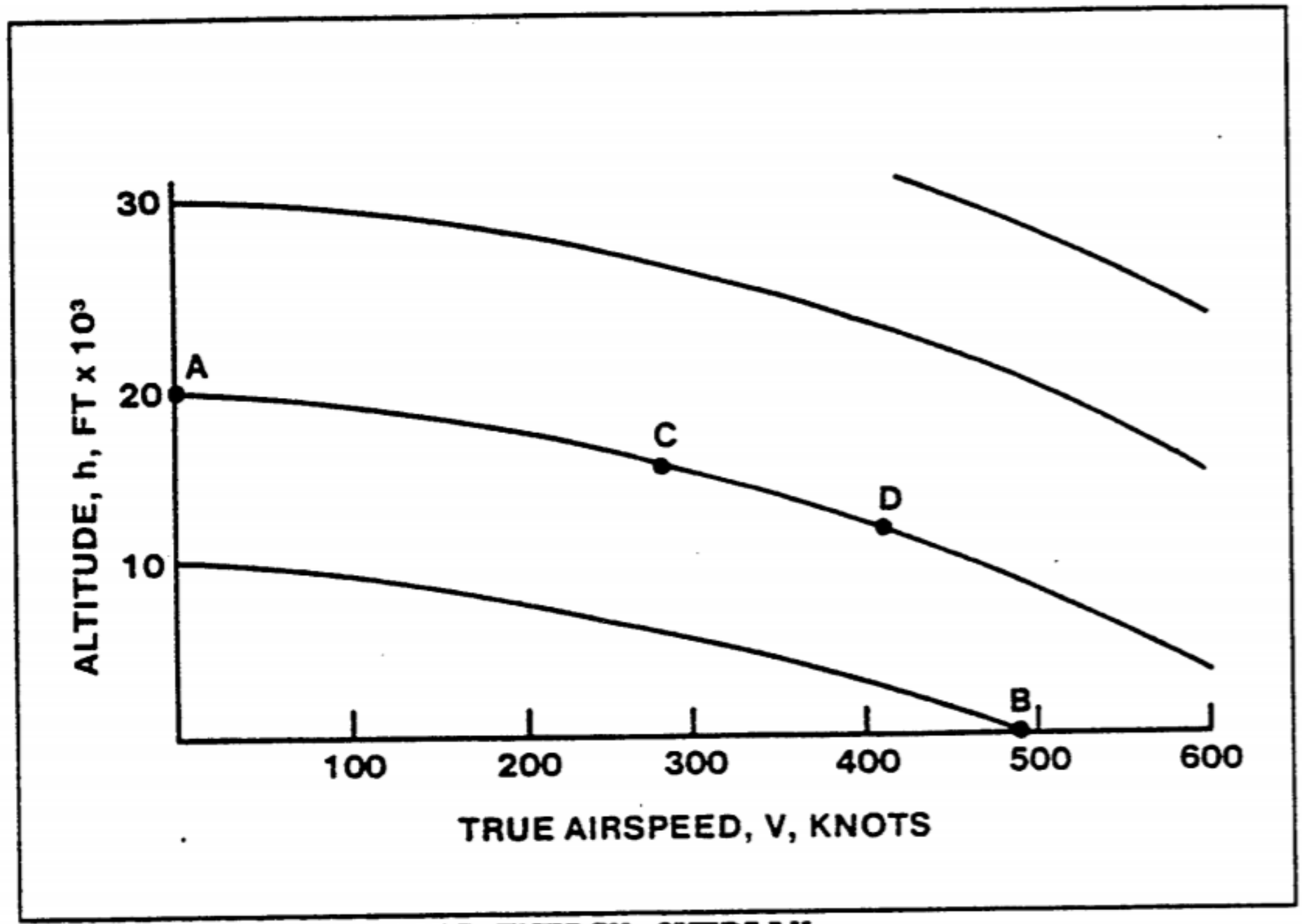


FIGURE 9.16 SPECIFIC ENERGY OVERLAY

ENERGY MANAGEMENT

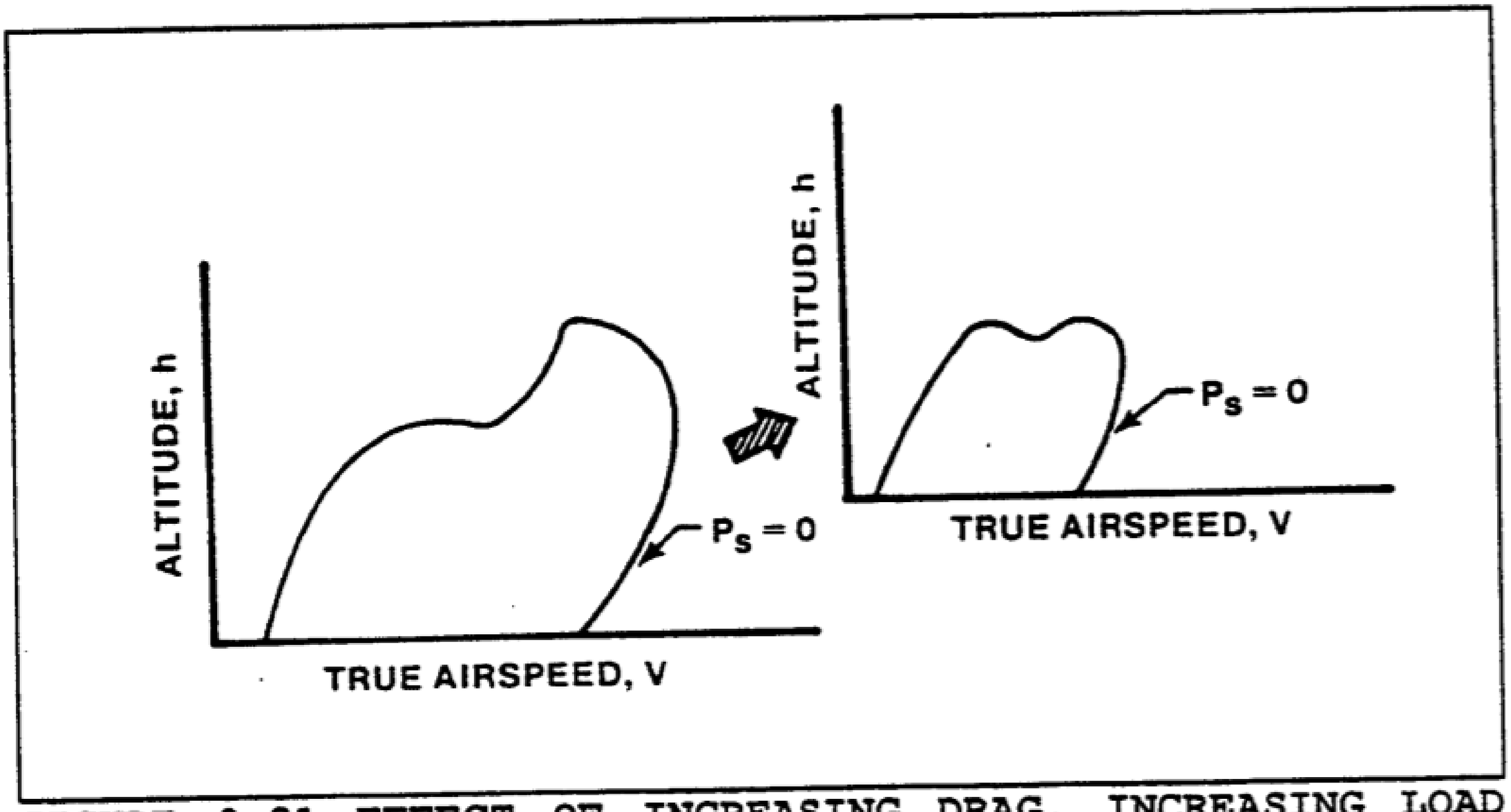


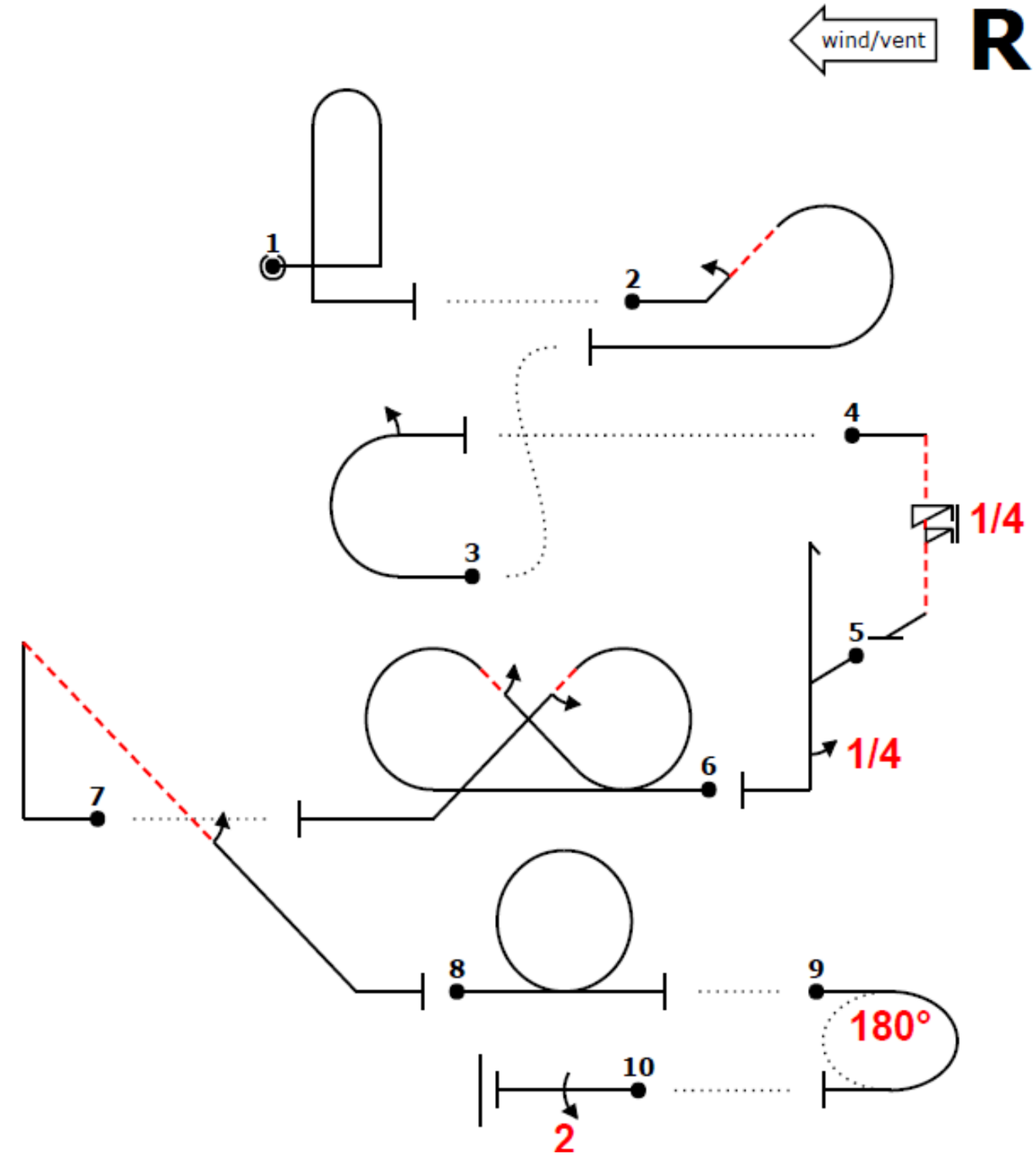
FIGURE 9.21 EFFECT OF INCREASING DRAG, INCREASING LOAD FACTOR, OR REDUCING THRUST

ENERGY MANAGEMENT

Sequence design

Knowledge of range of entry

Speeds and height required!



MINIMUM HEIGHT – PULL THROUGH

Pull-Down

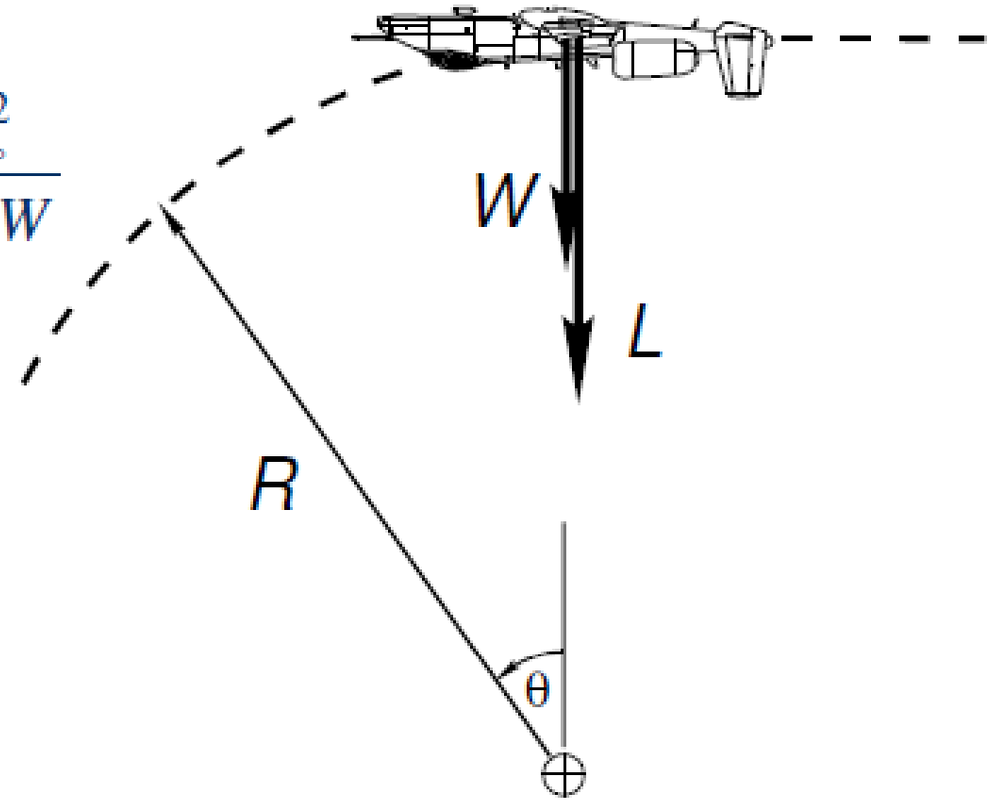
- Now, look at another instantaneous turning maneuver in the vertical plane -- *a "split s"*
  - Using the same approach as for a Pull-Up

at $t = 0;\ \theta = 0$

$$m\frac{V_\infty^2}{R} = L + W \Rightarrow R = m\frac{V_\infty^2}{L+W}$$

$$R = \frac{V_\infty^2}{g(n+1)}$$

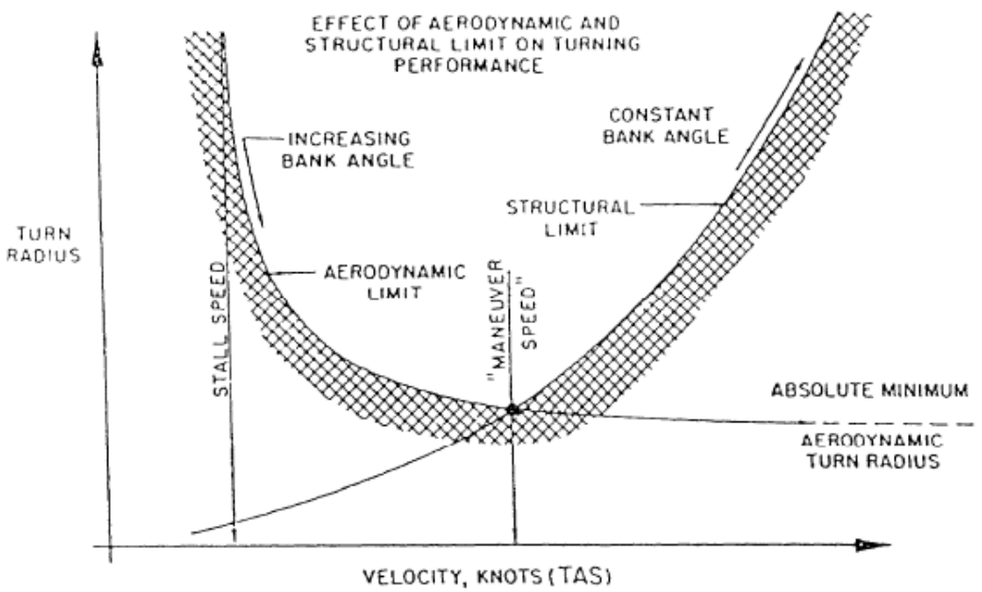
$$\omega = \frac{g(n+1)}{V_\infty}$$



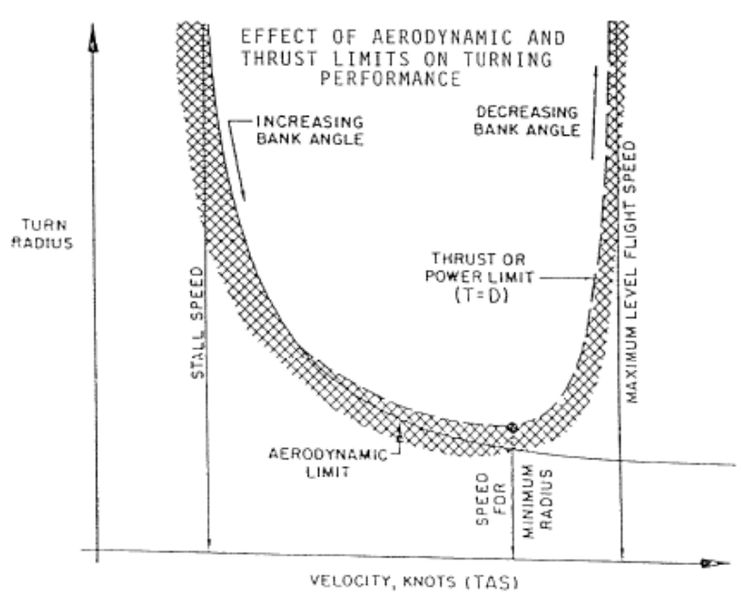
- The rate is improved and the radius is enlarged over pull-ups

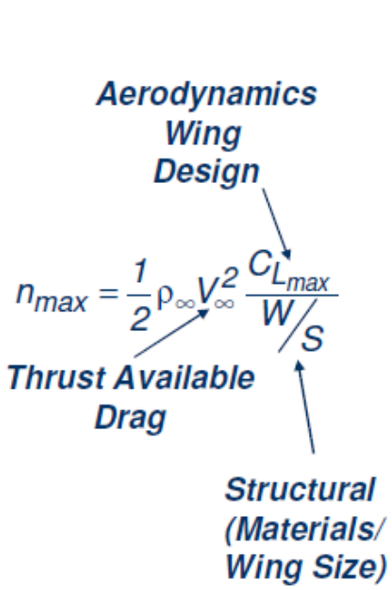
RADIUS of TURN/DENSITY ALTITUDE

- Aerodynamic and structural limits on turn performance



- Aerodynamic and thrust limits on turn performance





FLYING THE KNOWN SEQUENCE

FAE-2.3 – Conduct aerobatics not below 1,500 ft AGL

(a) complete a specified sequence of aerobatic manoeuvres in accordance with display plan in the specified time;

(b) ensure performance parameters required for safe completion of the manoeuvre are achieved prior to commencement of each manoeuvre;

(c) maintain orientation with display axis;

(d) manage the energy potential of the aircraft to ensure completion of manoeuvres and sequences of manoeuvres within aircraft structure and minimum height limits;

(e) recognise the failure to achieve performance parameters (energy requirement) to complete a manoeuvre and manage the aircraft to regain the manoeuvre energy potential;

(f) maintain height at or above a specified altitude not below 1,500 ft AGL.

TIME LIMITS

(a) complete a specified sequence of aerobatic manoeuvres in accordance with display plan in the specified time;

Displays – time slot must be maintained

Contests:

- Practice slots – 10 minutes starting at a specific time
- Contest flight – time limit 10 or 15 minutes from when ylou respond to the Chief Judge

THE GATE!

(b) ensure performance parameters required for safe completion of the manoeuvre are achieved prior to commencement of each manoeuvre;

Three separate considerations generally:

- Entry speed – a range, usually the minimum
- Altitude – allow for errors
- Position – direction & location – refer to the judges

- Others: weather – wind, cloud and rain

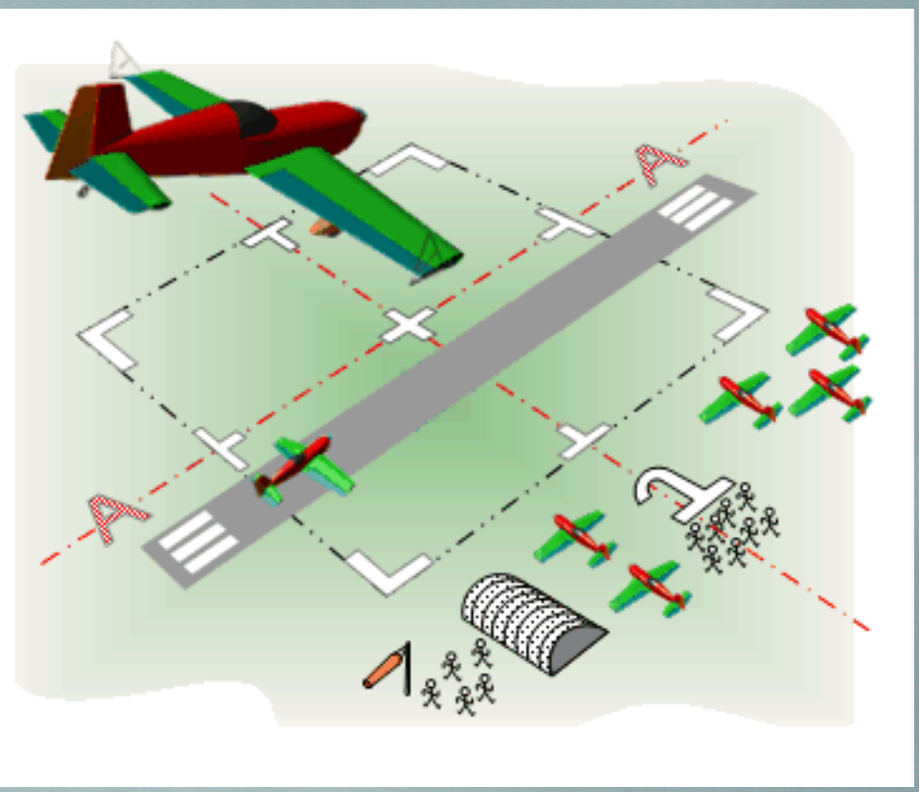
STAY IN THE BOX

(c) maintain orientation with display axis;

One of the gates.

Forget the box and fly for the judges:

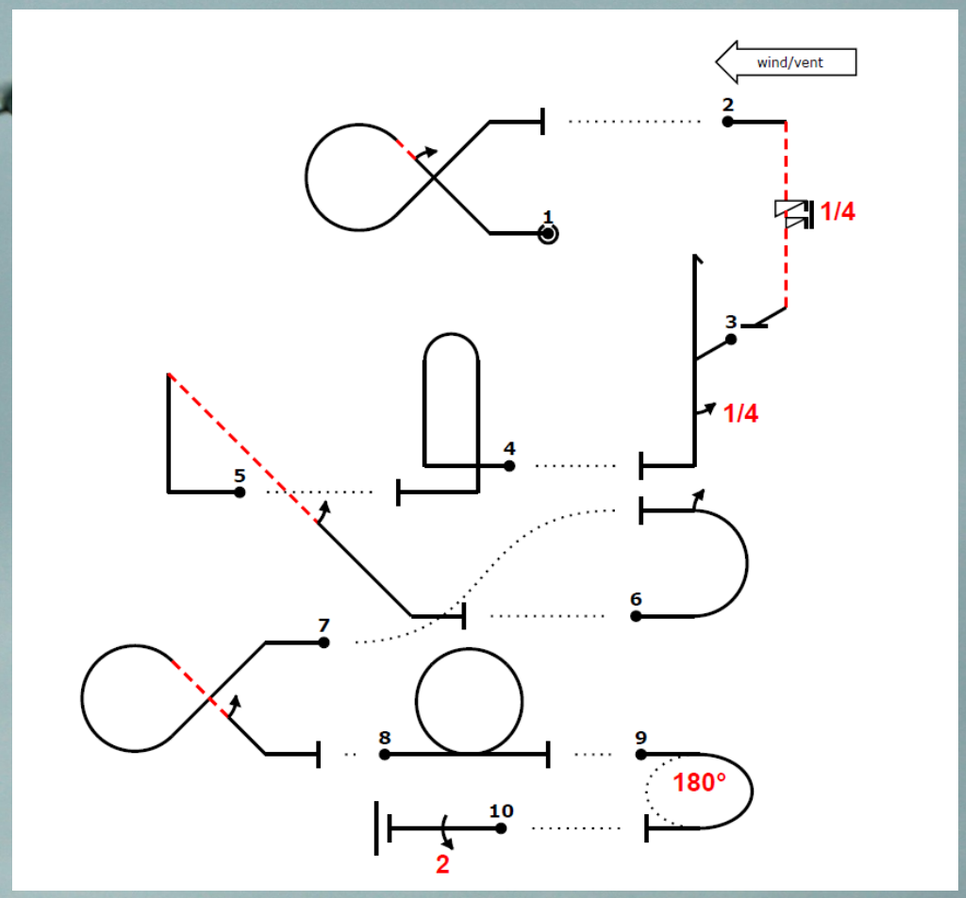
- If you can see them, they can see you
- Where should they be for each figure?



ENERGY MANAGEMENT

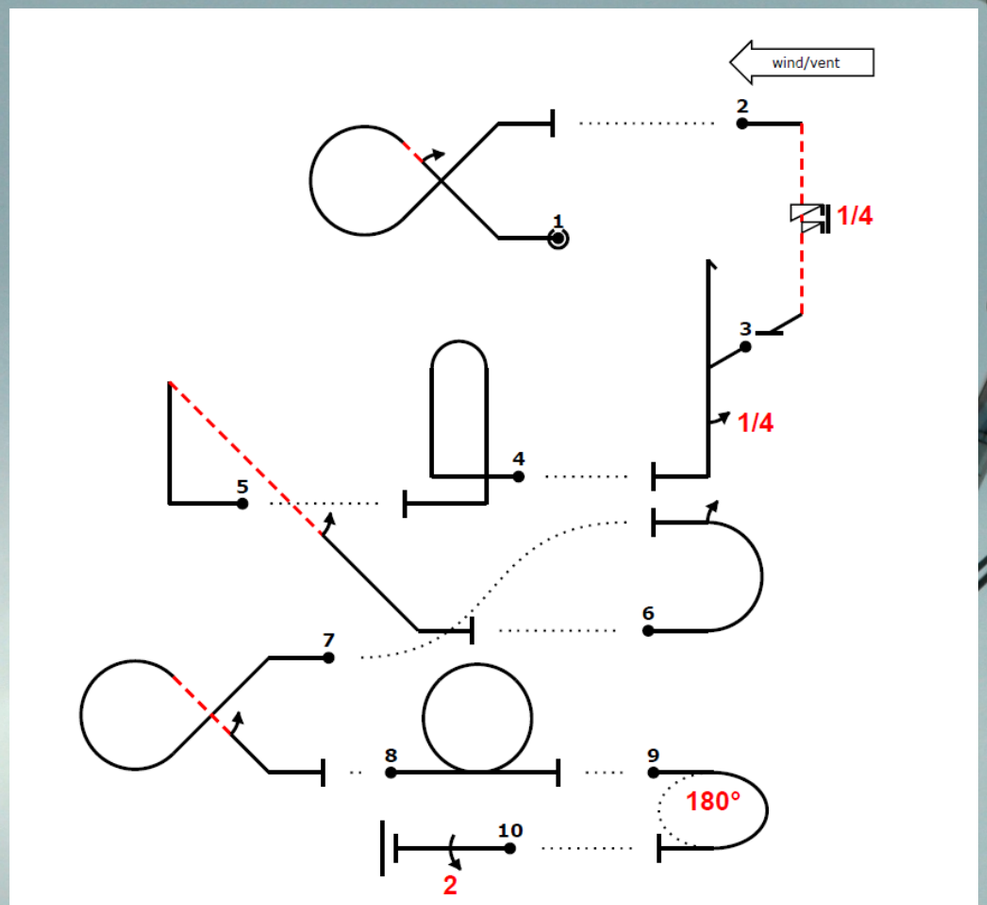
(d) manage the energy potential of the aircraft to ensure completion of manoeuvres and sequences of manoeuvres within aircraft structure and minimum height limits;

- Think/plan/walk
- Establish gates for each
- Especially critical figures:
  - #1 the first one!
  - #2 the spin
  - #3 the stall turn with roll down
  - #5 the wedge
  - #8 the loop



UPSET RECOVERIES

(e) recognise the failure to achieve performance parameters (energy requirement) to complete a manoeuvre and manage the aircraft to regain the manoeuvre energy potential;



- The classic UA situation
- Recognise the situation
- Don't continue with the figure – recover and break the sequence
- Consider:
  - #1 – shallow up line
  - #2 – overshot
  - #5 – slow at top
  - #6 – slow on top

MAINTAIN HEIGHT

(f) maintain height at or above a specified altitude not below 1,500 ft AGL.

- Allow for errors:
  - Extra spin recovery
  - Fall out of a manoeuvre
  - Altimeter setting incorrect – set QNH or ….. ?
- Allow for performance loss (density altitude or weight)
  - Longer down lines to maintain energy
- Consider judging criteria
  - Allow a margin above 1500 ft
- Stay above 1800 ft. Start high if necessary.

DESIGNING a FREE SEQUENCE

FAE-2.1 – Design an aerobatic routine

(a) design a sequence of aerobatic manoeuvres that meet a specified requirement, involve practical transitions between manoeuvres, and identify performance parameters that will ensure safe completion of all manoeuvres not below 1,500 ft AGL;

(b) identify performance parameters based on a combination of aircraft attitude, power setting, altitude and speed that provide go-no go guidance for safe completion of all manoeuvres not below 1,500 ft AGL within the physical limitations of the pilot and structural limitations of the aircraft.

FREE SEQUENCE REQUIREMENTS

(a) design a sequence of aerobatic manoeuvres that meet a specified requirement, involve practical transitions between manoeuvres, and identify performance parameters that will ensure safe completion of all manoeuvres not below 1,500 ft AGL;

- max K factor same as the Known
- max number of figures: 12
- repetition of catalogue reference numbers is allowed from Families 1

And 9 providing that there is no repetition of the combination figure used

Family 1 At least one figure

Family 2.1 - 2.2 At least one figure

Family 7 At least one figure

Family 8 At least one figure

Family 9.1 - 9.4 At least one figure

Family 9.11 or 9.12 Only one figure

DESIGNING a FREE SEQUENCE - OPENAERO

File View Sequence Queue Library Tools Help

b (9,0) ``````````2rc (-3,13) m2 (19,0) iv5s h4 cc(2)2 (-8,0) k.."2.' o (5,0) 2j (-7,0) 22

SEQUENCE INFO | FIGURE EDITOR

Team

Pilot

Aircraft type | Registration

Class: Power | Rules: AAC

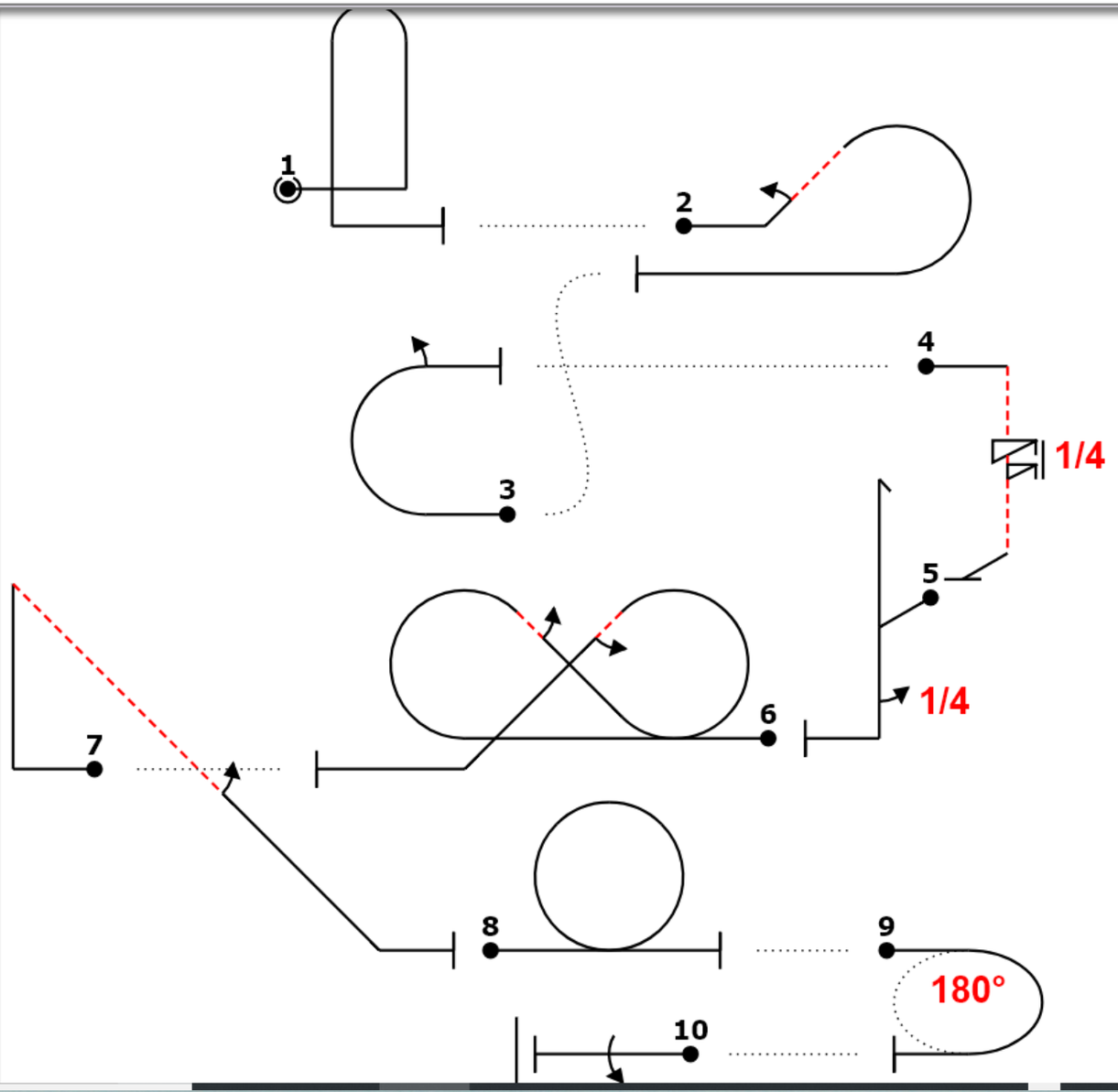
Sportsman | Known

Positioning: 4

Location: Australia | Date: 2018

AUSTRALIAN AEROBATIC CLUB

Notes (top of pages)



Power			
Fig 1	8.4.1.1	13	13
Fig 2	8.5.2.1 9.1.2.2	10 6	16
Fig 3	7.2.2.1 9.1.3.2	6 4	10
Fig 4	1.1.6.3 9.11.1.5	10 4	14
Fig 5	5.2.1.1 9.1.5.1	17 2	19
Fig 6	7.8.4.1 9.1.4.2 9.1.4.2	19 4 4	27
Fig 7	1.2.7.1 9.1.4.2	13 4	17
Fig 8	7.4.1.1	10	10
Fig 9	2.2.1.1	4	4
Fig 10	1.1.1.1 9.2.3.4	2 9	11
Total K = 141			

DESIGNING a FREE SEQUENCE - OPENAERO

File View Sequence Queue Library Tools Help

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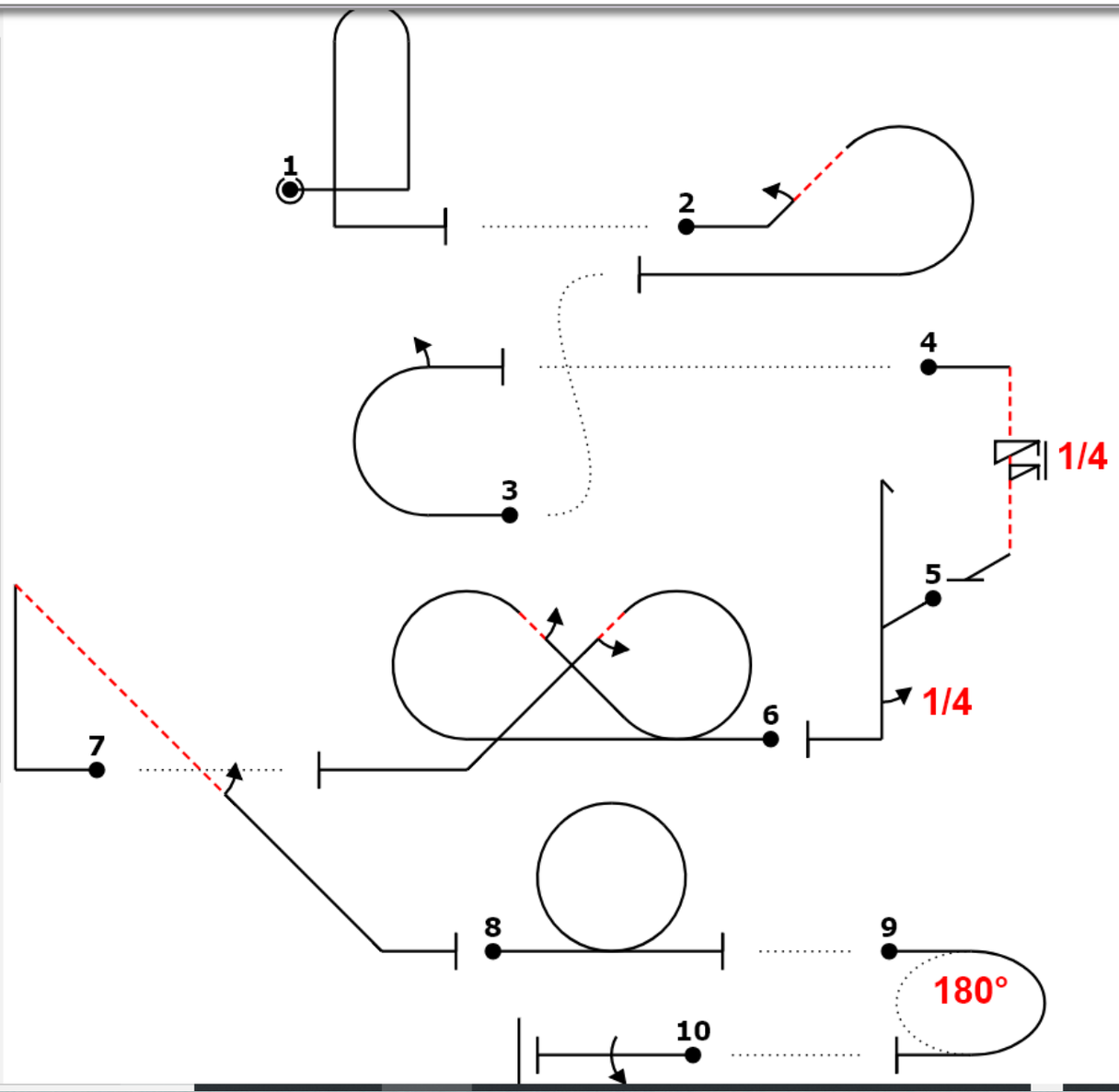

Power			
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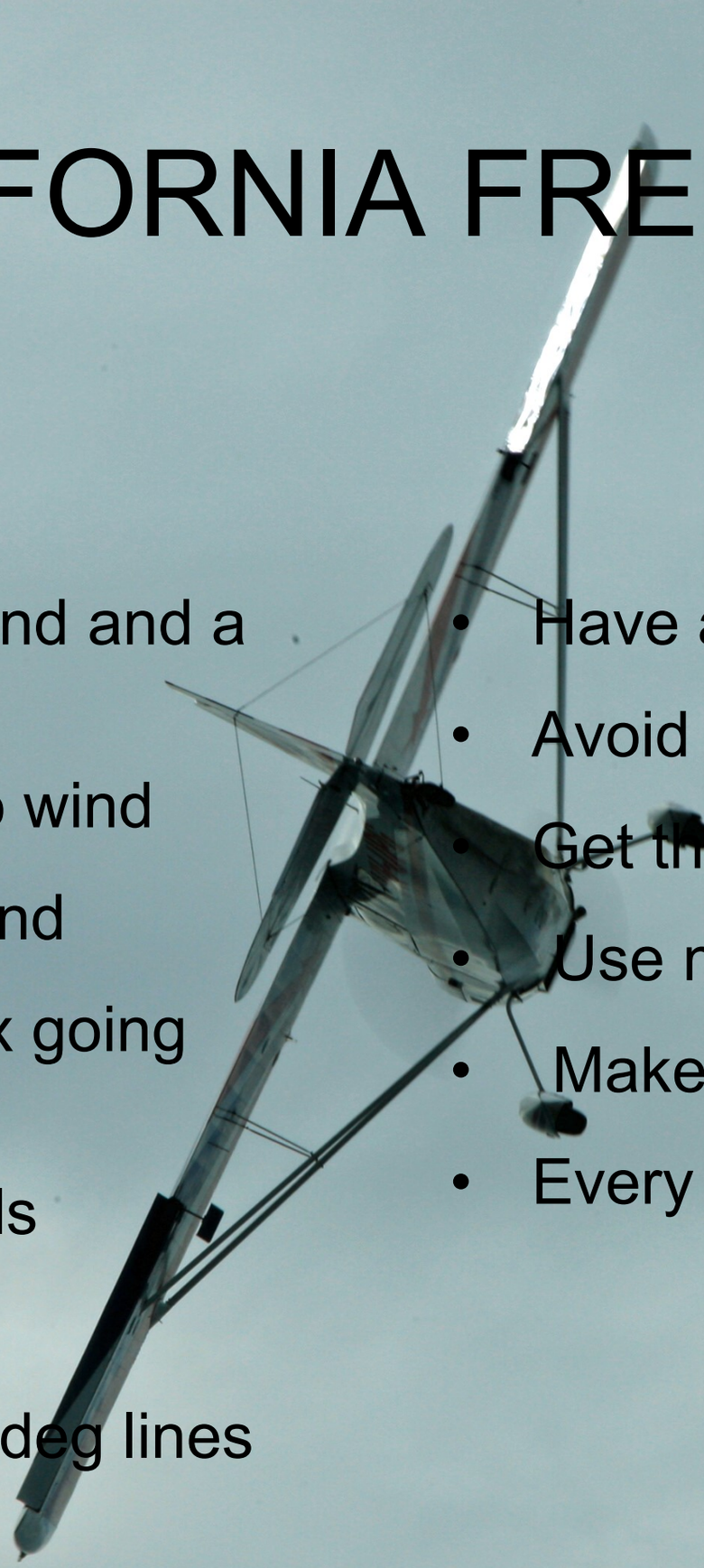
Fig 8	7.4.1.1	10	10
Fig 9	2.2.1.1	4	4
Fig 10	1.1.1.1 9.2.3.4	2 9	11
Total K = 141			

CALIFORNIA FREESTYLE

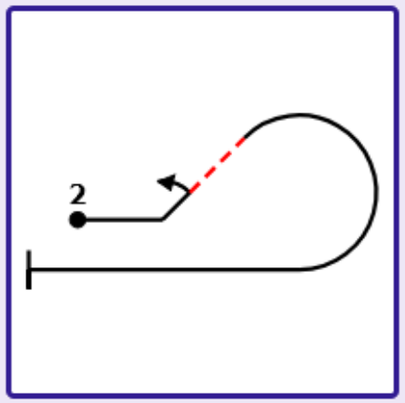


- Assume a headwind and a crosswind
- Put spin entry into wind
- Loop entry into wind
- Nothing centrebox going downwind
- Minimise point rolls
- Avoid full loop
- Avoid multiple 45 deg lines

- Have a xwind corrector
- Avoid spins with ¼ & ¾
- Get the maximum K
- Use maximum number of figures
- Make every figure easy
- Every figure should score well

SEQUENCE INFO | FIGURE EDITOR

Edit figure 2 (16K)



X - 7 +

Y - -1 +

Entry/exit attitude & extension

- 0 + Ω - 0 +

First roll/spin position

1/2

none

Gaps

- -8 + - 0 +

Second roll position

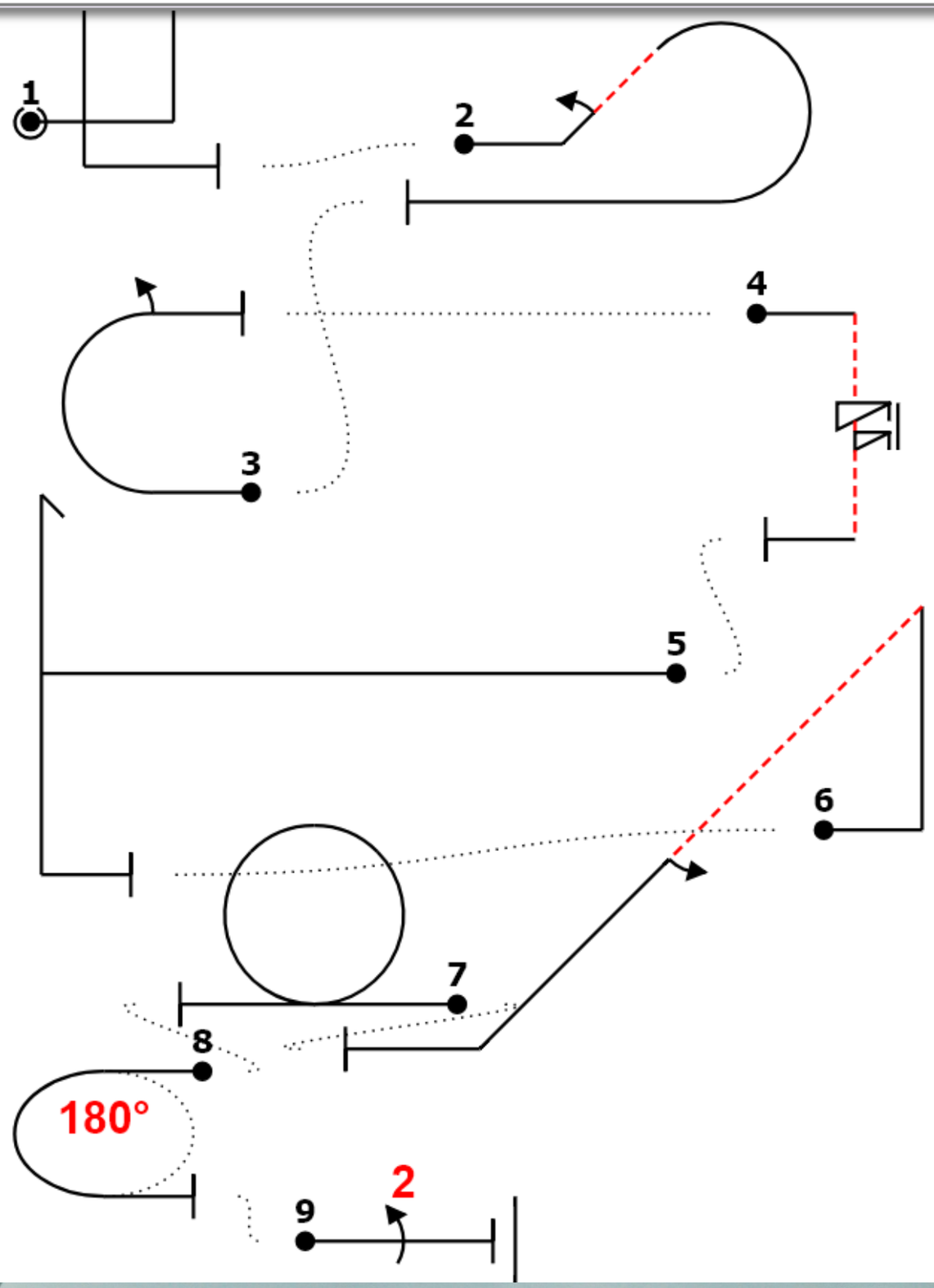


Fig 2	8.5.2.1 9.1.2.2	10 6	16
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Fig 7	7.4.1.1	10	10
Fig 8	2.2.1.1	4	4
Fig 9	1.1.1.1 9.2.3.4	2 9	11
Total K = 111			

DESIGNING a FREE SEQUENCE

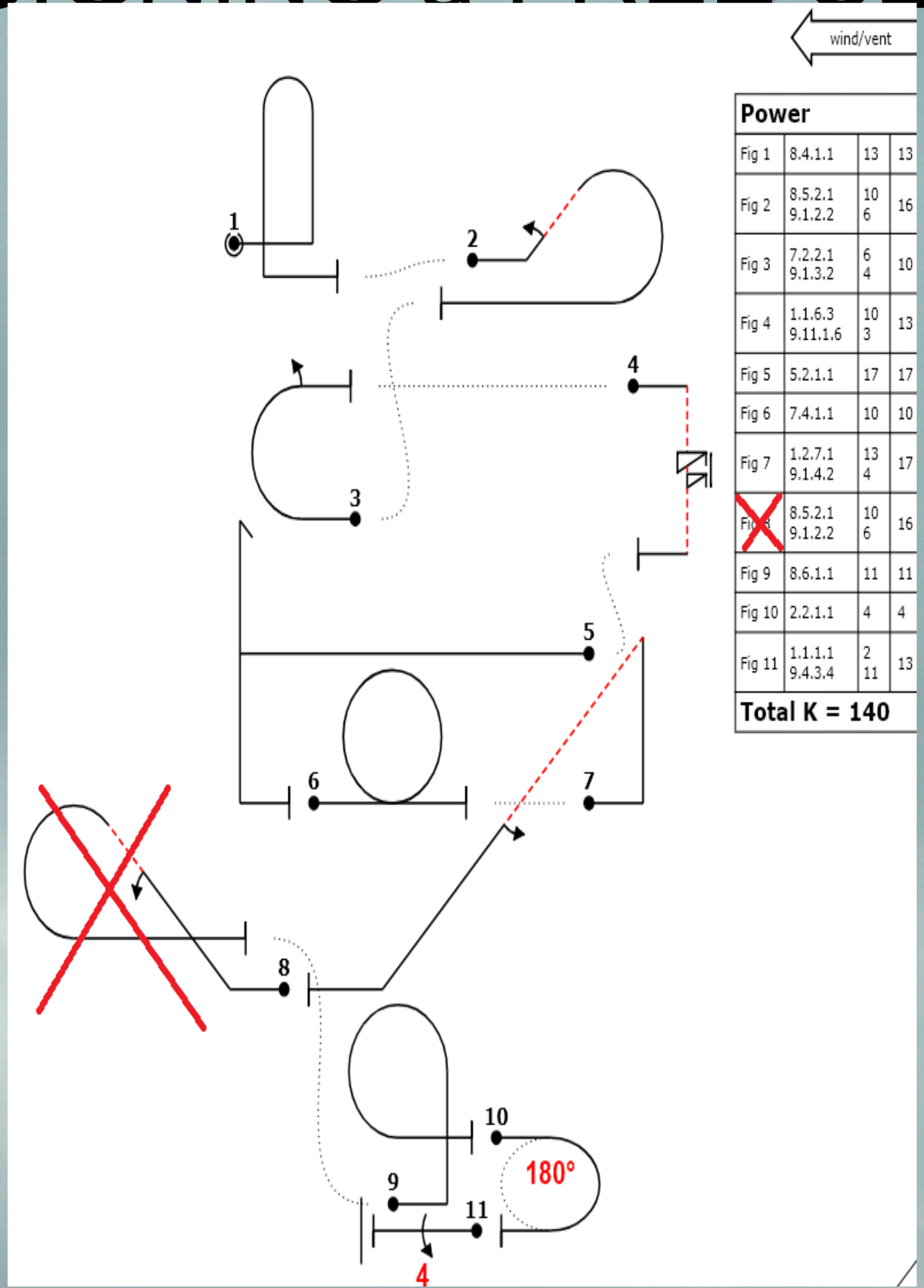

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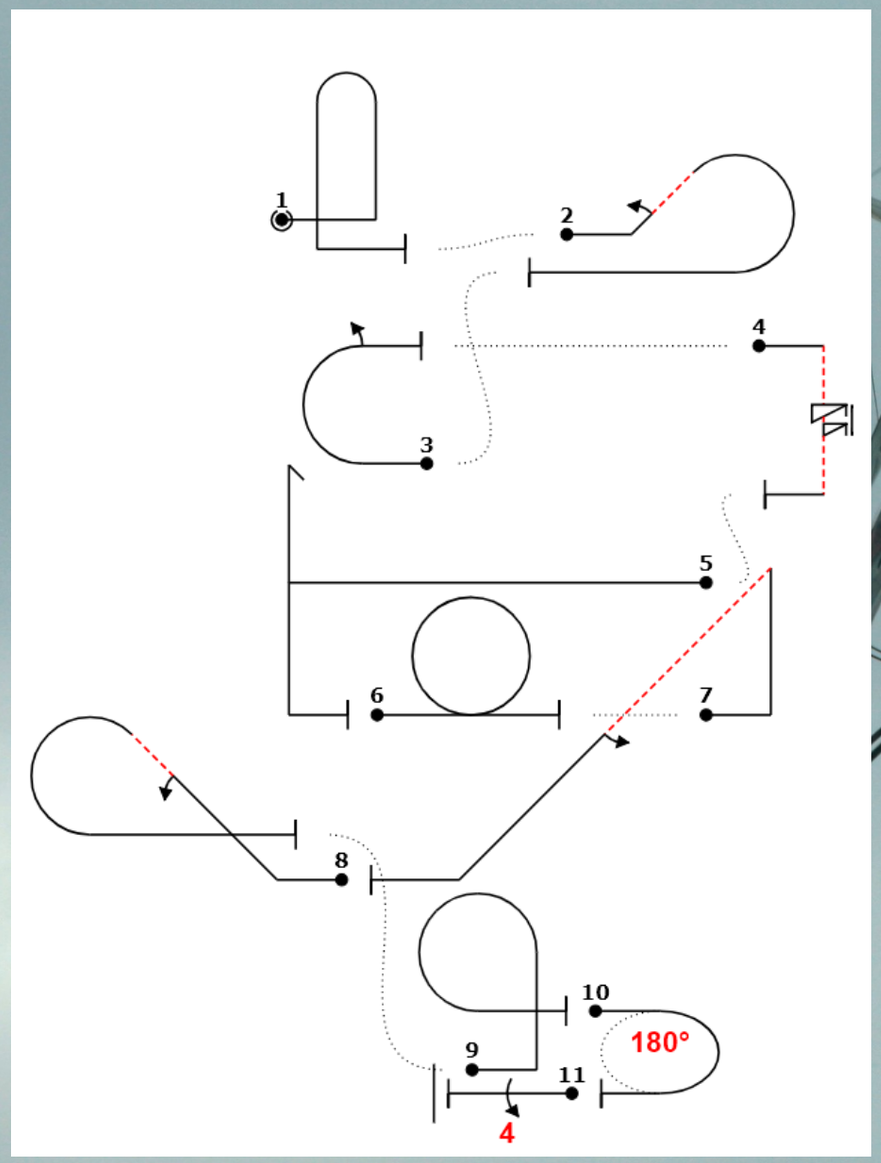
Fig 9	8.6.1.1	11	11
Fig 10	2.2.1.1	4	4
Fig 11	1.1.1.1 9.4.3.4	2 11	13
Total K = 140			

IS IT FLYABLE?



1. Does exit speed match entry?
2. Does wind help each?
3. Correction for xwind?
4. Overall performance? Assess speed/height throughout.
5. Practice.
6. Modify!

PLAN an UNKNOWN SEQUENCE

FAE-2.2 – Plan an aerobatic performance

(a) identify the stakeholder requirements for the aerobatic sequence and formulate a plan to safely present the sequence, meeting the specified requirements;

(b) ensure any required aerobatic approvals are appropriate, valid and current;

(c) analyse prevailing and forecast weather and apply wind velocity, visibility and cloud base to ensure safe and accurate aerobatic performance;

(d) identify the 'aerobatic box' when appropriate, and plan manoeuvres to remain within the box;

(e) modify aerobatic performance if weather conditions cause (or controlling authority imposes) limitations, when appropriate;

(f) recall and apply the identified go-no go performance criteria to plan break-off manoeuvres at any point of the aerobatic sequence where performance criteria are not achievable;

(g) recall escape manoeuvres that could be required during the aerobatic sequence stating the go-no go criteria and detail the escape manoeuvres that will result in (return to) controlled flight not below 1,500 ft AGL.

REQUIREMENTS

(a) identify the stakeholder requirements for the aerobatic sequence and formulate a plan to safely present the sequence, meeting the specified requirements;

- Contest or display?
- Contest rules
- Airfield – Fly Neighbourly Areas
  - Noise and separation from built-up areas
- CASA rules
  - Uncontrolled airfield procedures and use of radio
  - Minimum height
  - Public invitation

PAPERWORK

(b) ensure any required aerobatic approvals are appropriate, valid and current;

- CASA approvals?
- CASA exemptions?
- Airfield owner
- Other local operators
- Current AFR & medical etc
- Aerobatic endorsement – minimum height
- Safety pilot – instructor approved

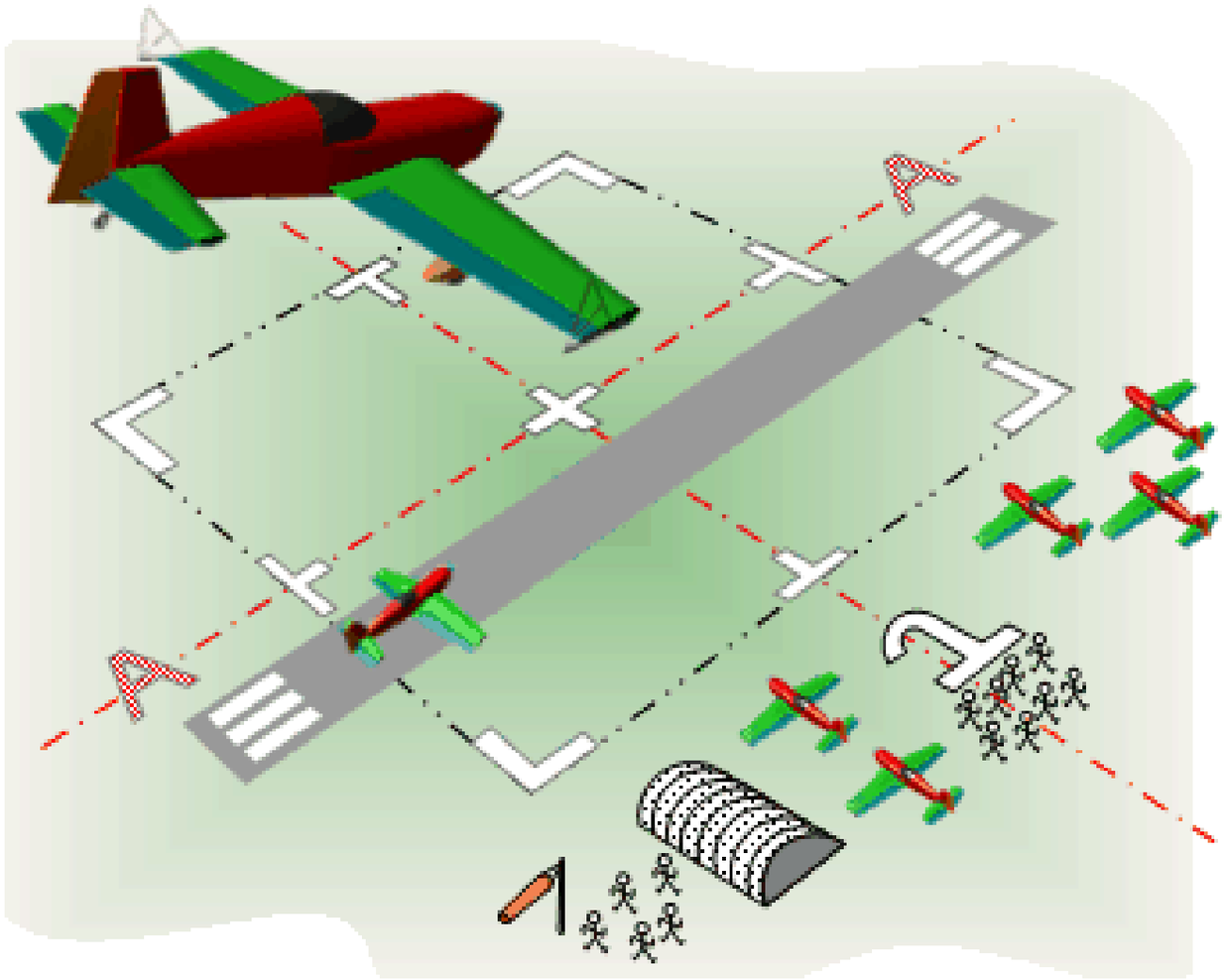
PLAN for WEATHER

(c) analyse prevailing and forecast weather and apply wind velocity, visibility and cloud base to ensure safe and accurate aerobatic performance;

- Contest rules
  - Call it if outside limits
  - You can “buy” a break
- VFR – distance from cloud
- Personal minimums
  - Minimum height overall and especially for a spin
- Bullying and “pressonitis”

FLY THE BOX

nd plan manoeuvres to remain within the box;



- Enter from tight base
- Practice entry with safety check figures
- Use ½ box away from judges
- Fly for the judges – ignore the box markers
- Identify major features eg runway

FLY for WEATHER

(e) modify aerobatic performance if weather conditions cause (or controlling authority imposes) limitations, when appropriate;

- Contest rules and briefing:
  - Optional weather break
  - Take a break – “buy” one, they are cheap
  - Call Chief Judge on the radio
- Stop and land – come back another day, another year

THE GATES

(f) recall and apply the identified go-no go performance criteria to plan break-off manoeuvres at any point of the aerobatic sequence where performance criteria are not achievable;

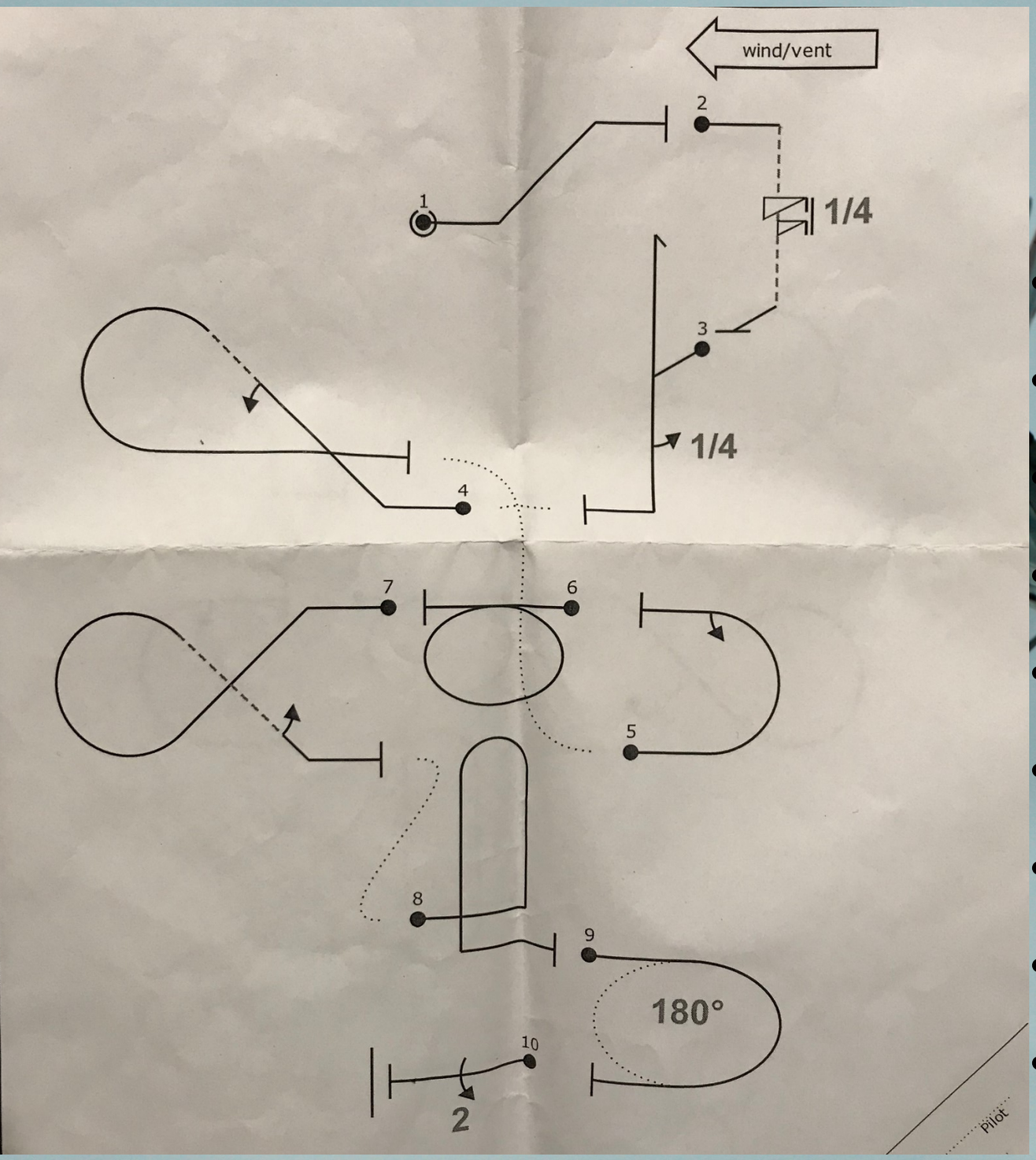
- The gates are essential – plan each figure:
  - Airspeed
  - Altitude
  - Position – location and direction – where are the judges?
- Decide on the ground in advance – do not change decision in the air
- Upset prevention & recovery principles – do not continue with a failing manoeuvre

ESCAPE MANOEUVRES

(g) recall escape manoeuvres that could be required during the aerobatic sequence stating the go-no go criteria and detail the escape manoeuvres that will result in (return to) controlled flight not below 1,500 ft AGL.

- Consider the critical figures for the sequence
- Know the Upset identification and recovery for each

SAMPLE UNKNOWN

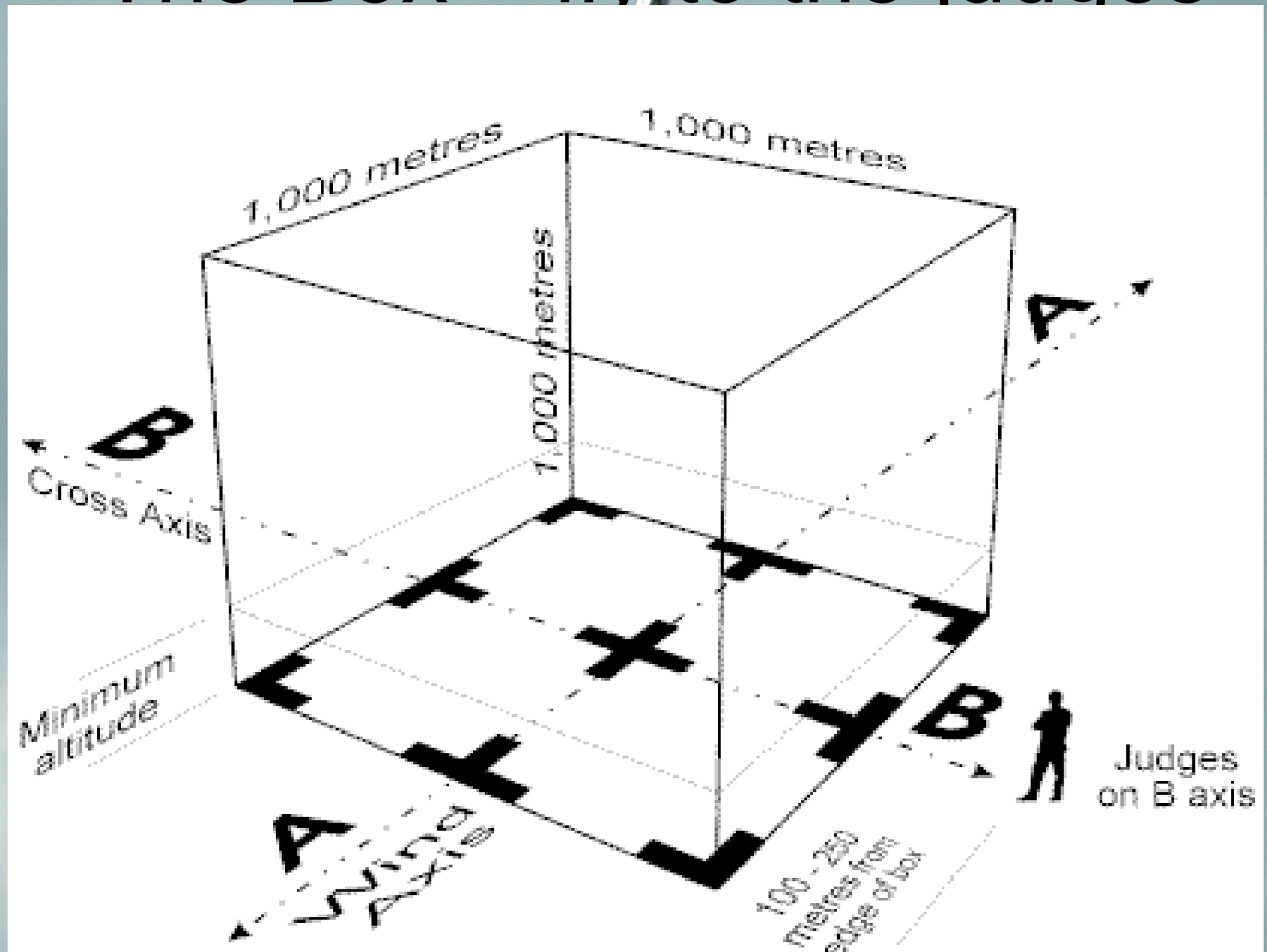


- Anything you have not practiced?
- Plan airspeed/altitude throughout
- Plan for expected winds
- Which way to spin?
- Which way to roll?
- Which way to turn?
- Plan for options at the time
- Decide the gates
- Walk through it – sit in cockpit

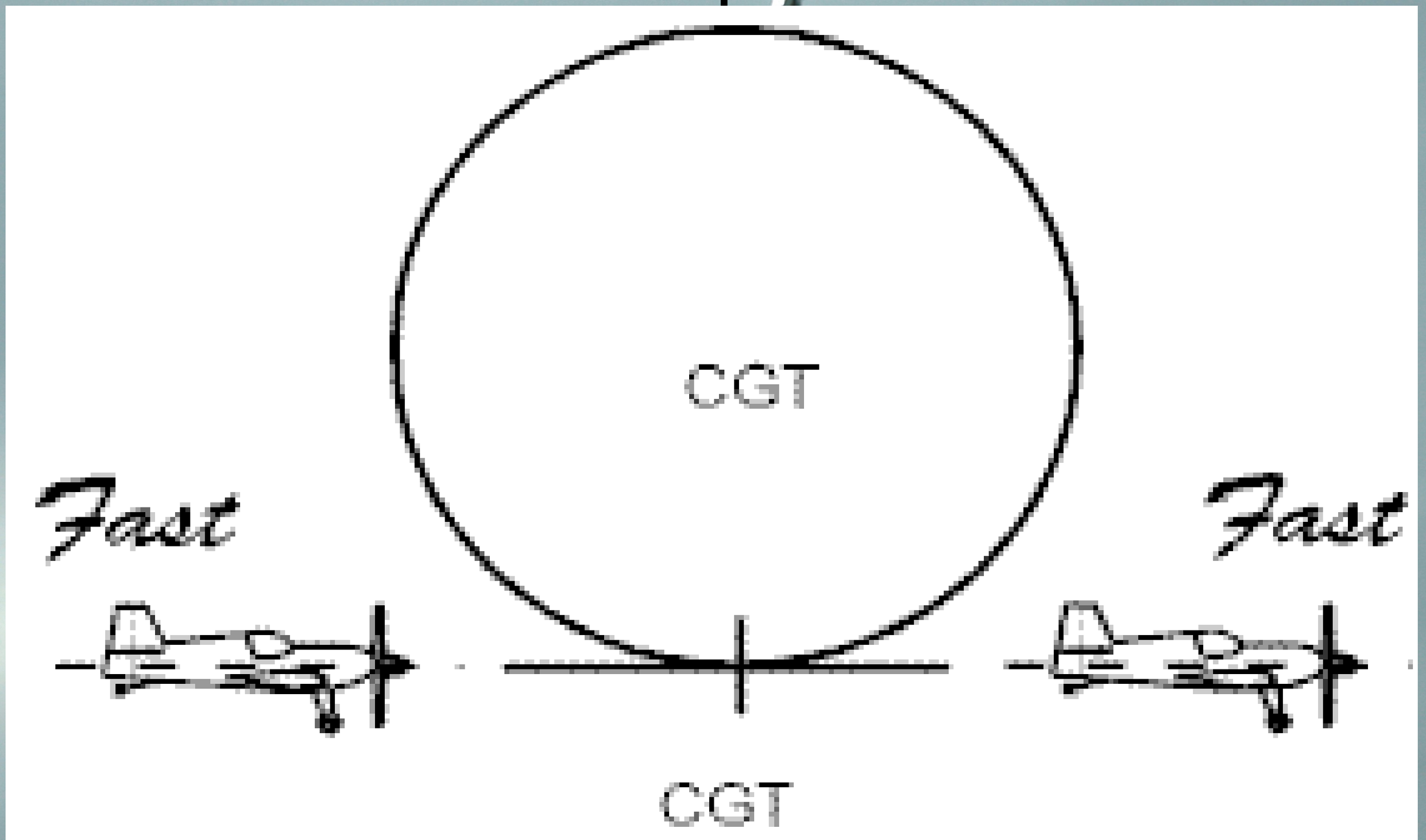
FLY to WIN

- BAeA – judging so fly what the judges want
- Contest rules
- Positioning in the box
- California freestyle
- Coaching

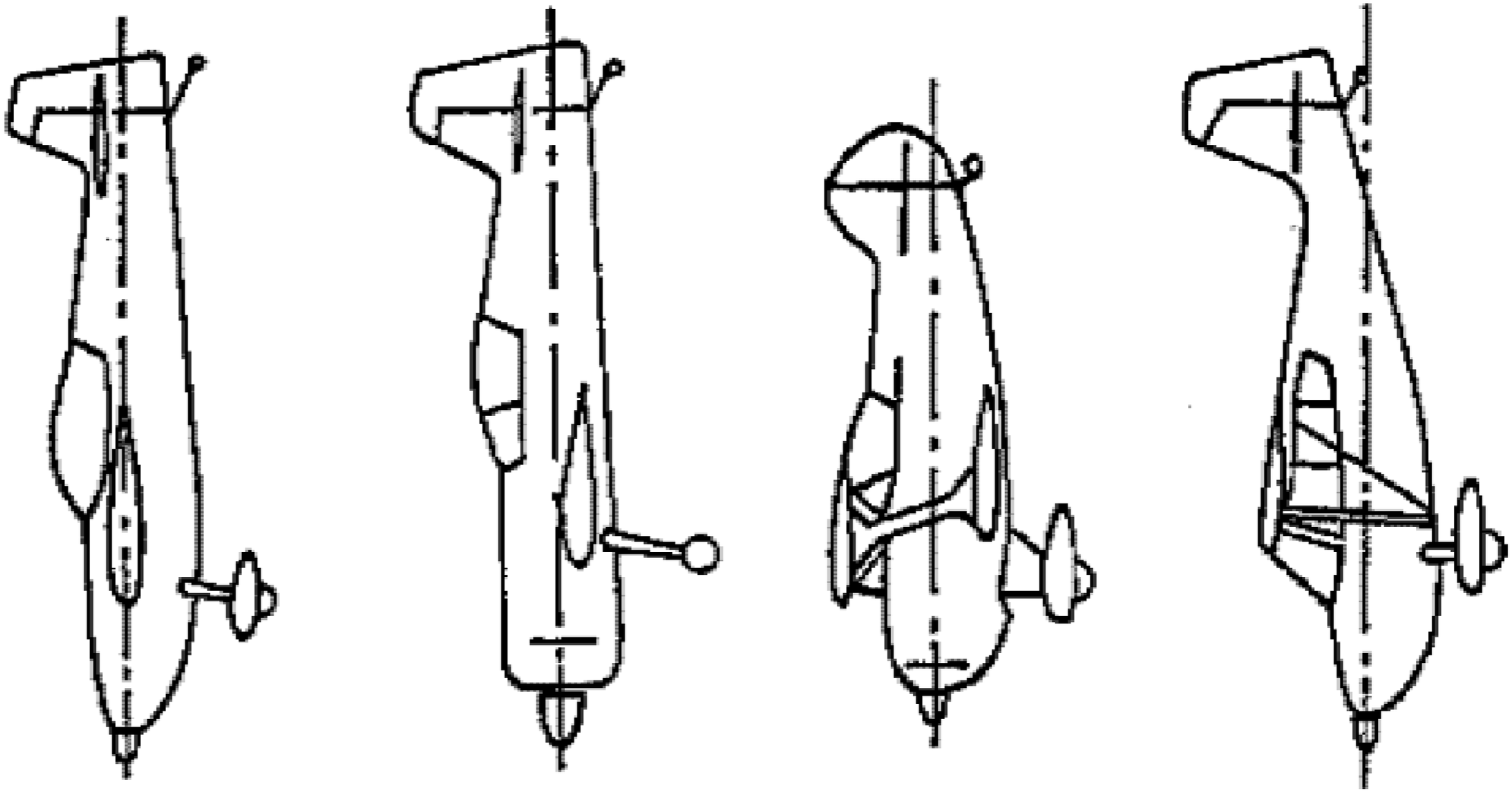
The Box – fly to the judges



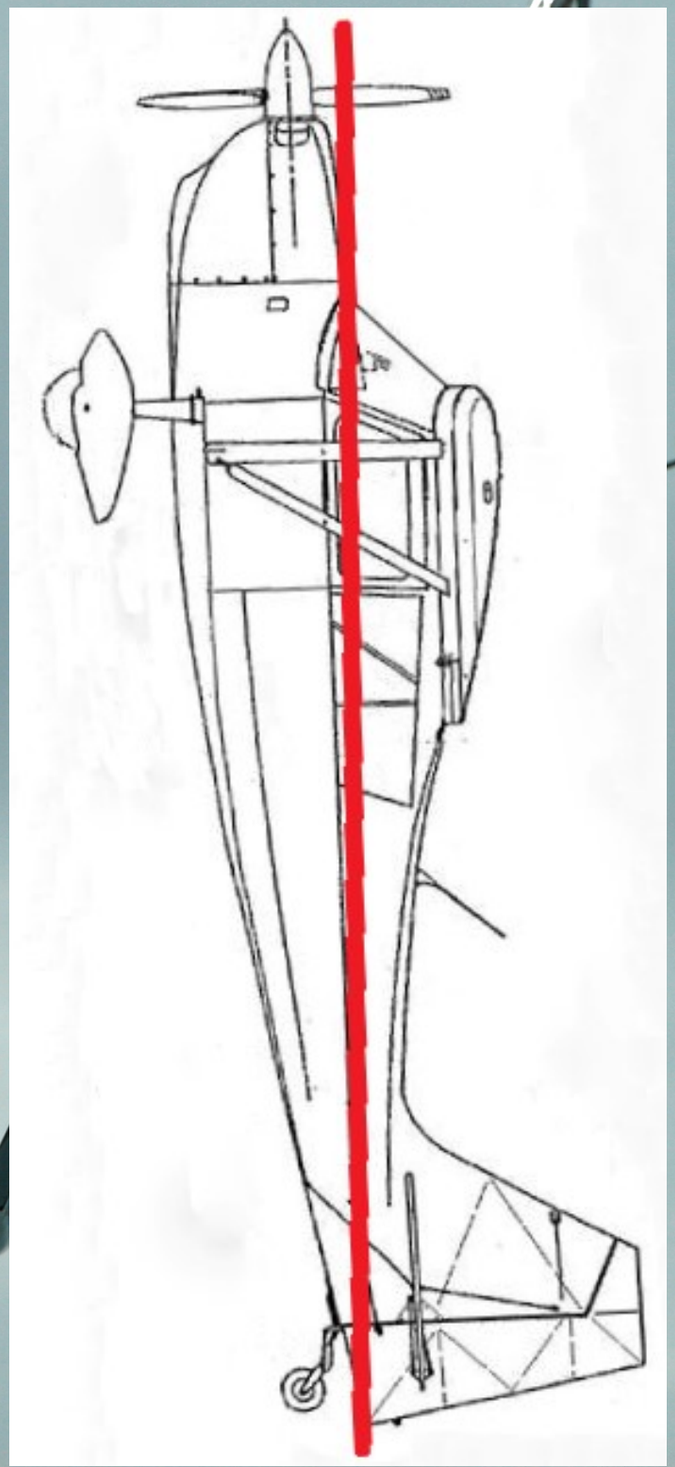
Loops .....



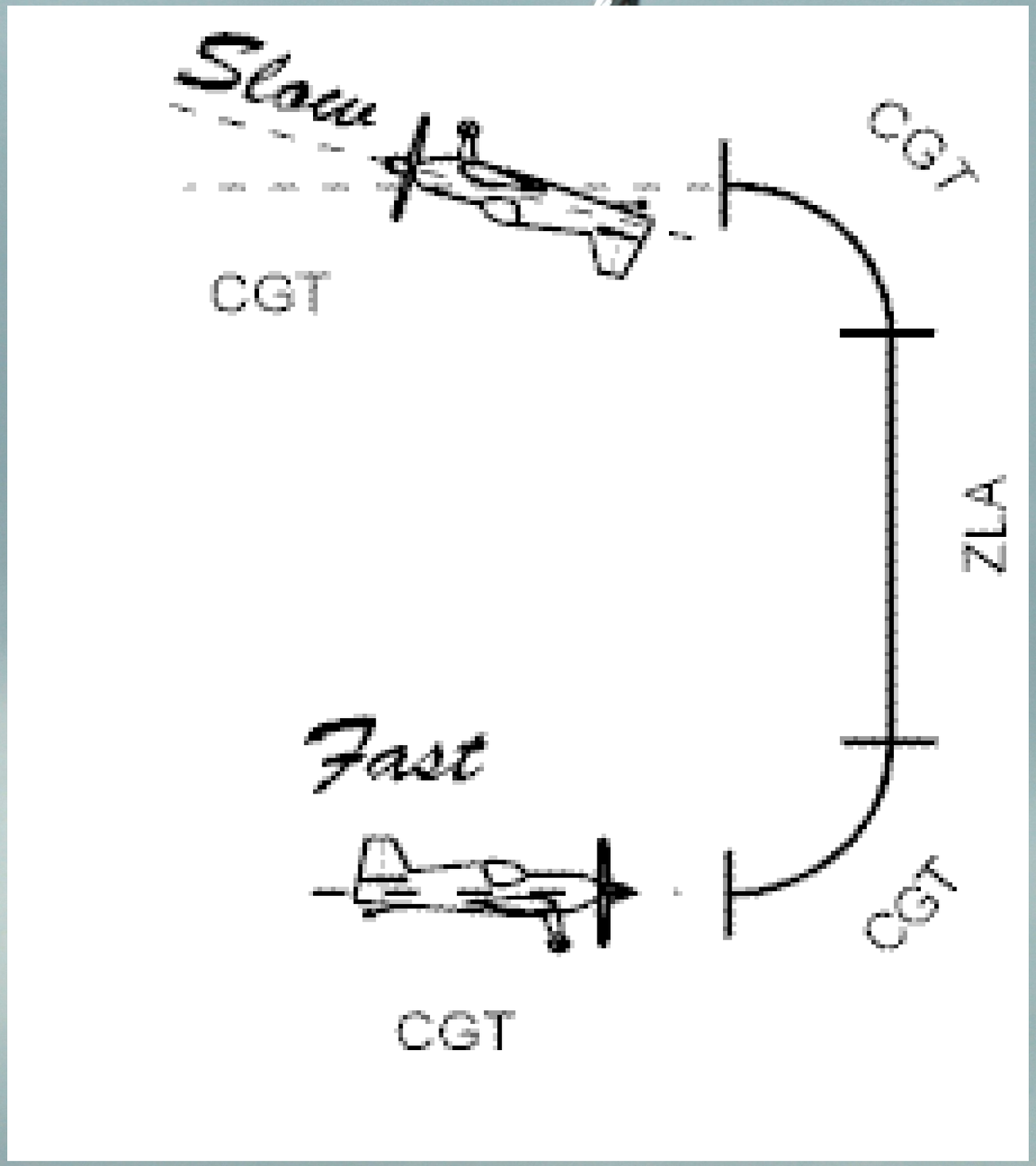
Zero Lift Angle



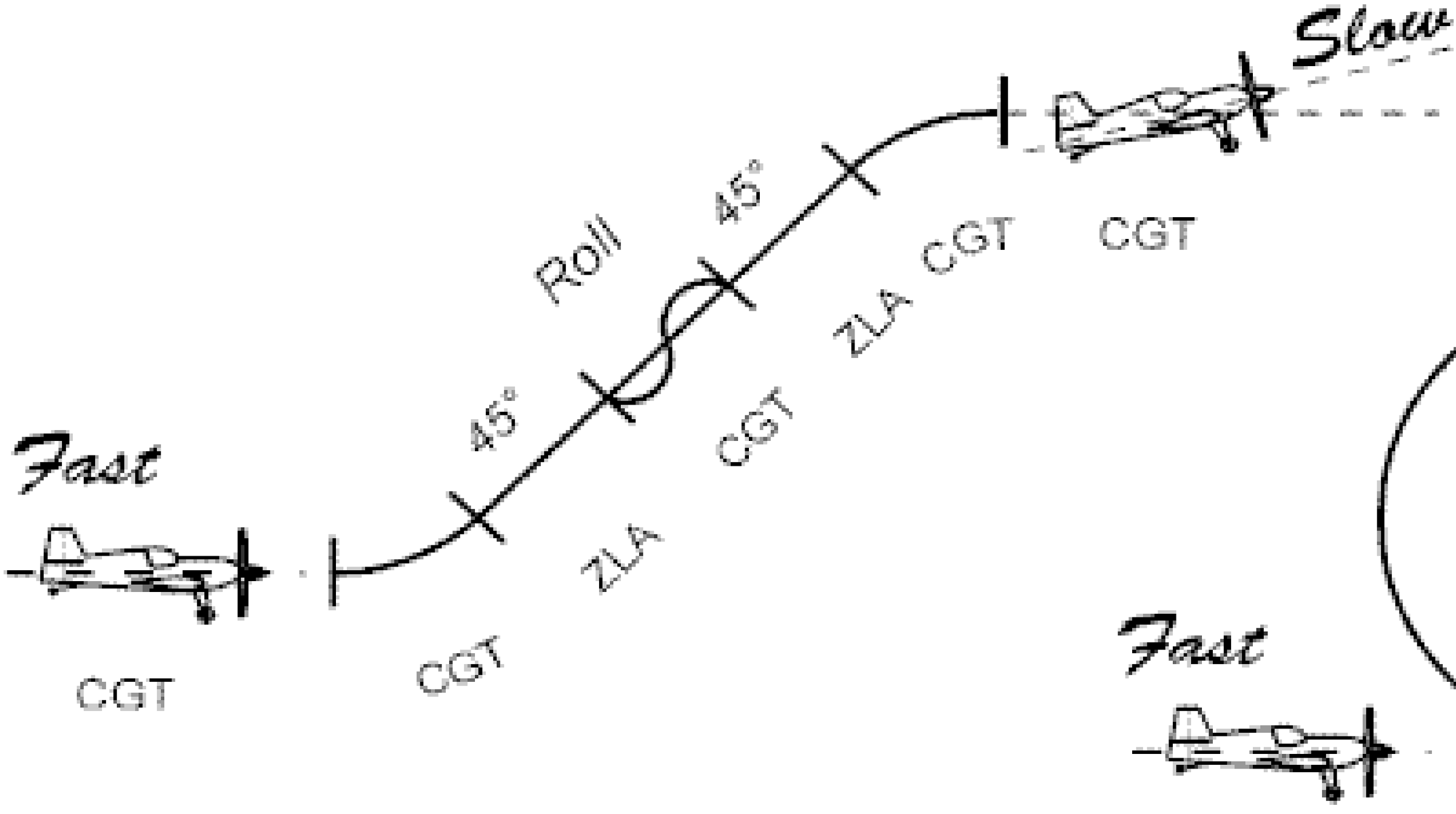
Voices ……. Zero Lift Angle



Voices .....



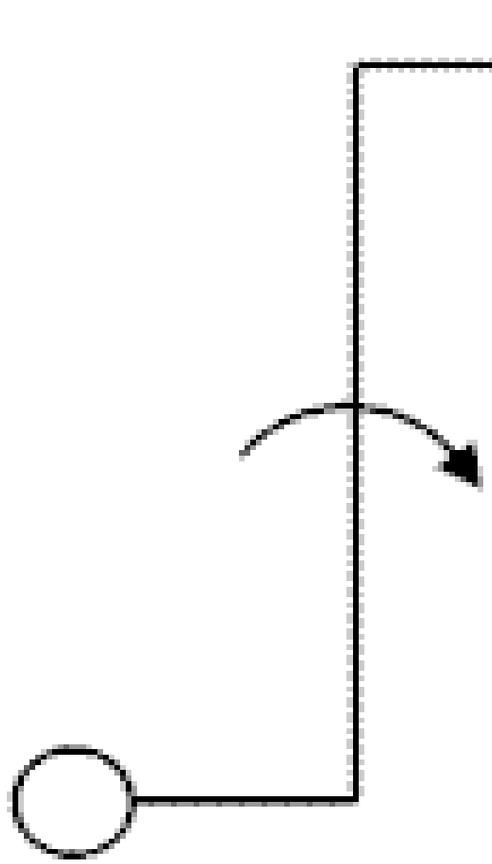
& the fear of …….

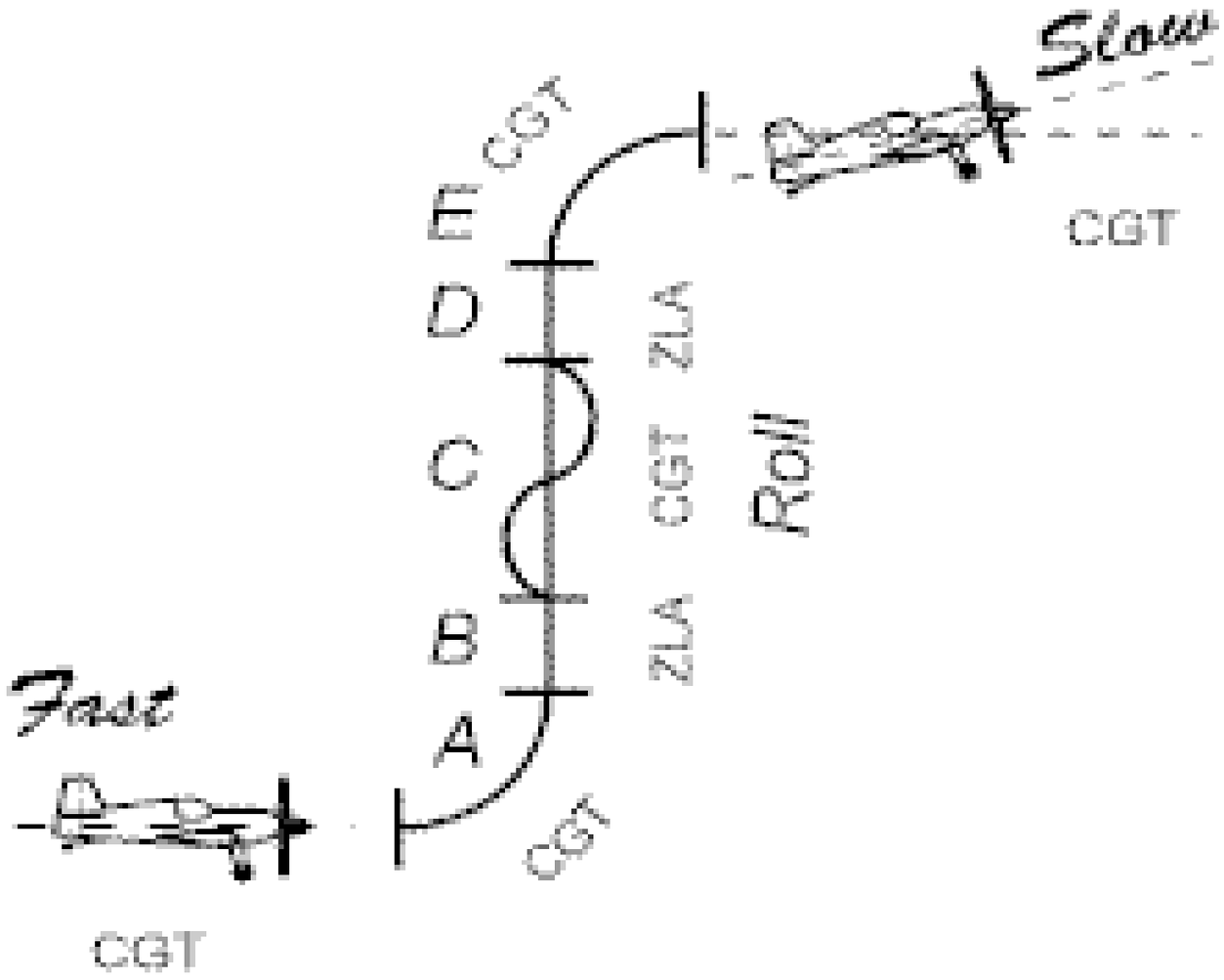


Marking the figures - the basic rules

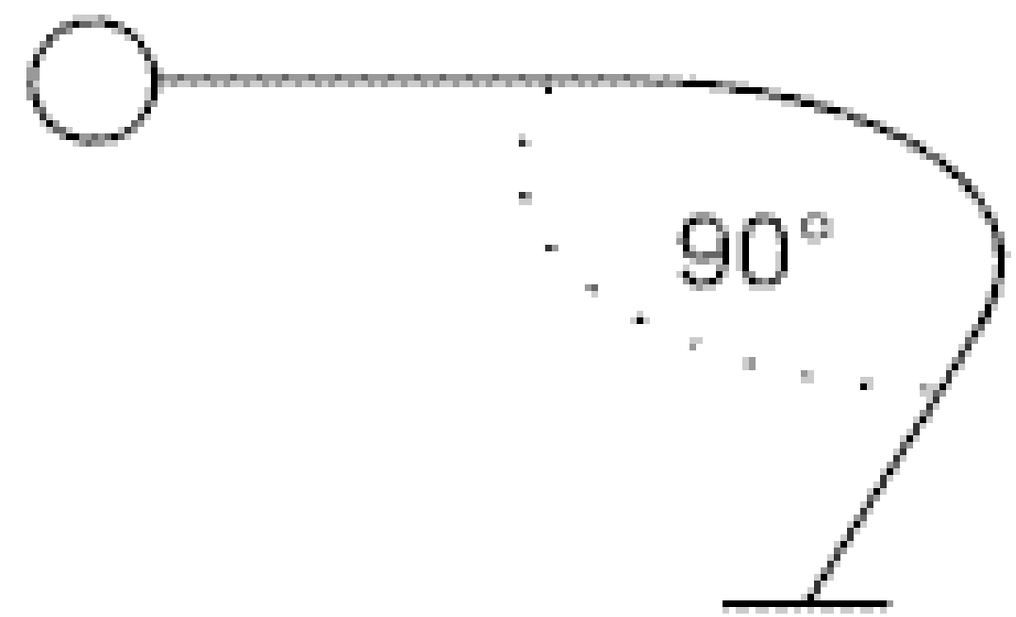
- Start with a perfect 10 – deduct errors seen to nearest ½ point
- Every 5º off line is 1 point
- Zero for:
  - Exceeding 45º off line
  - Wrong way on x axis
  - Wrong figure

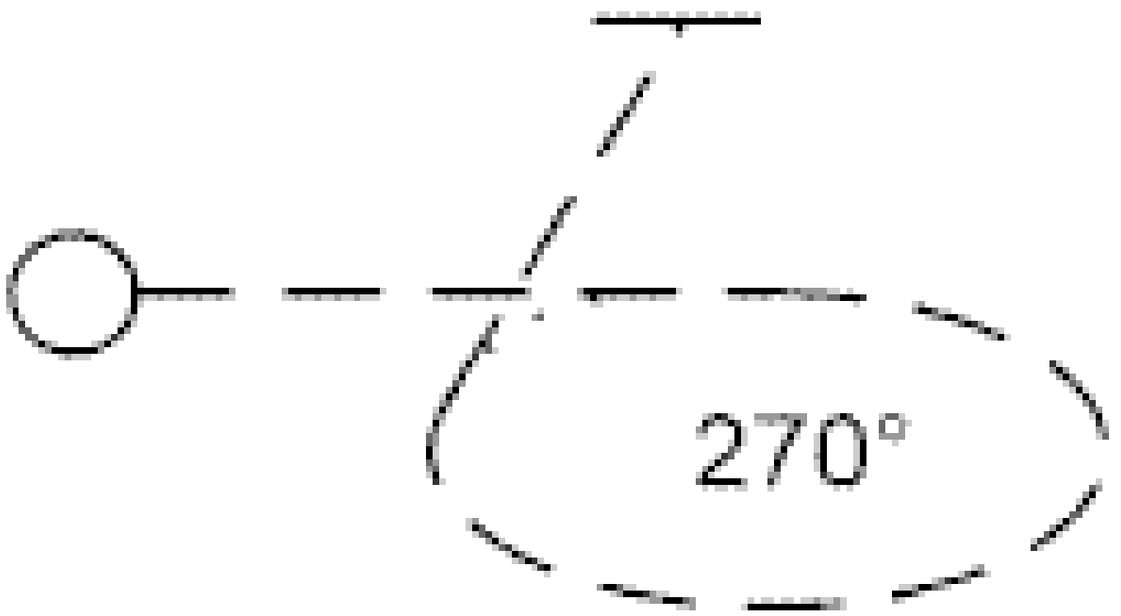
Lines & Curves



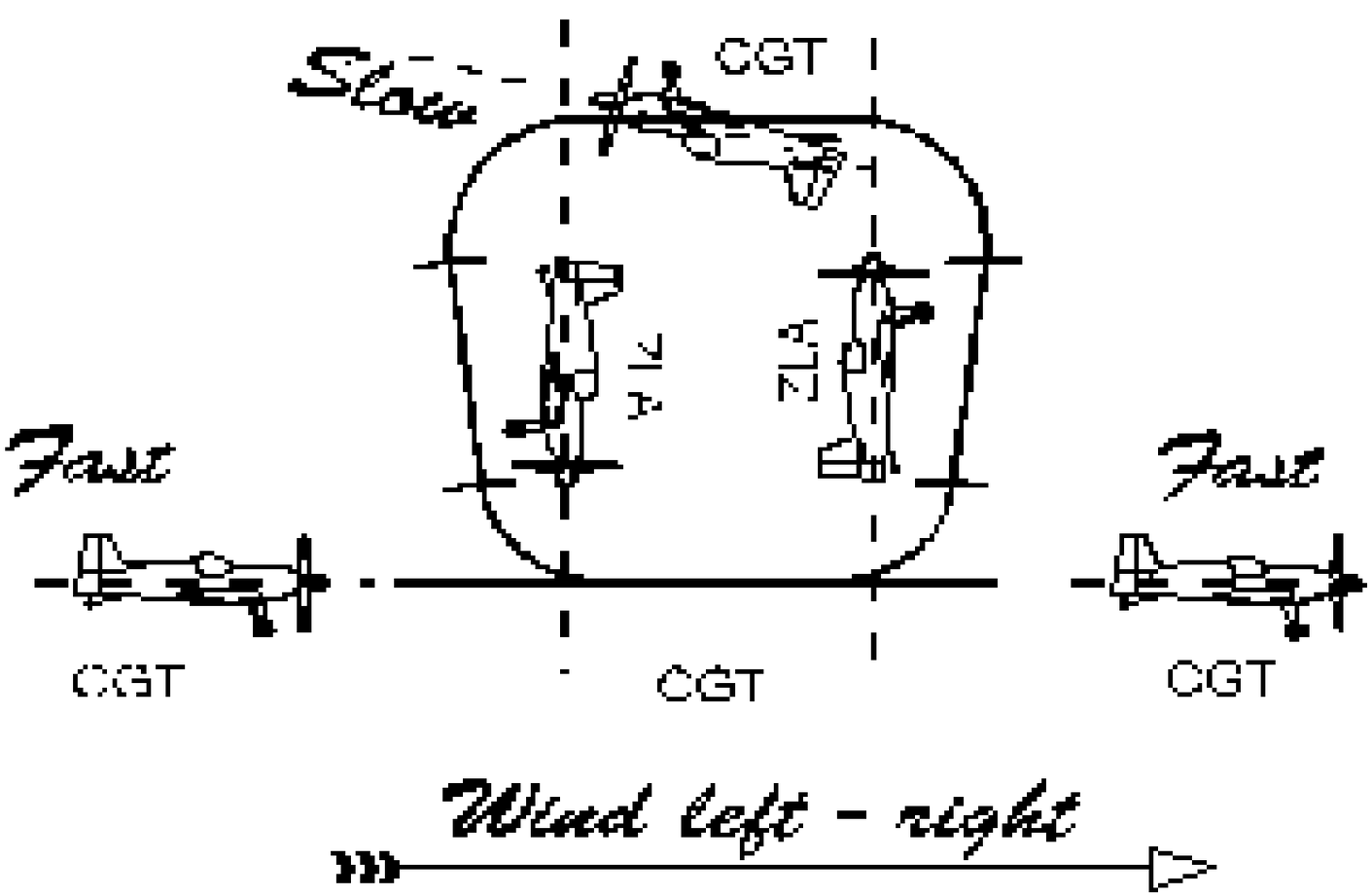


Turns

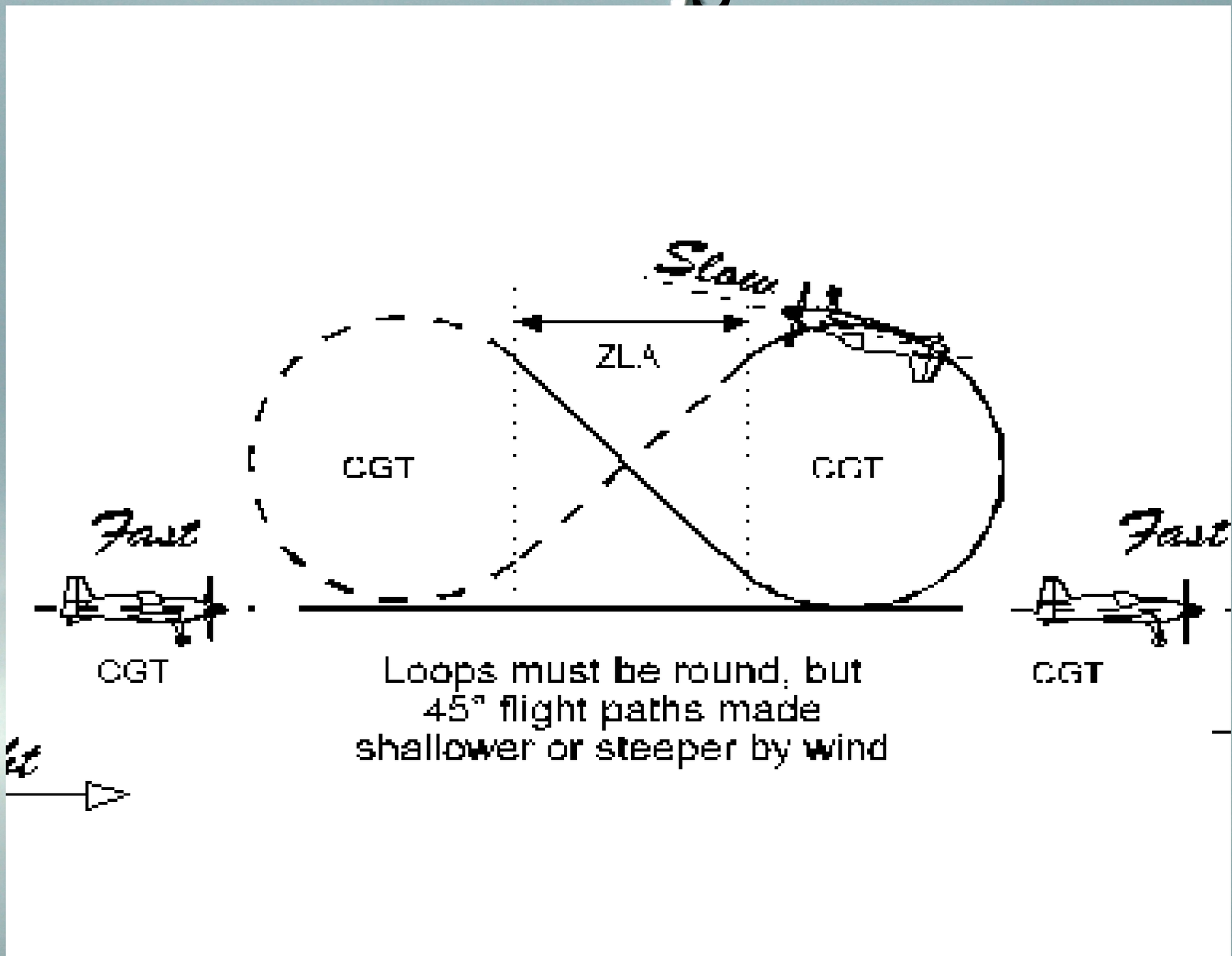




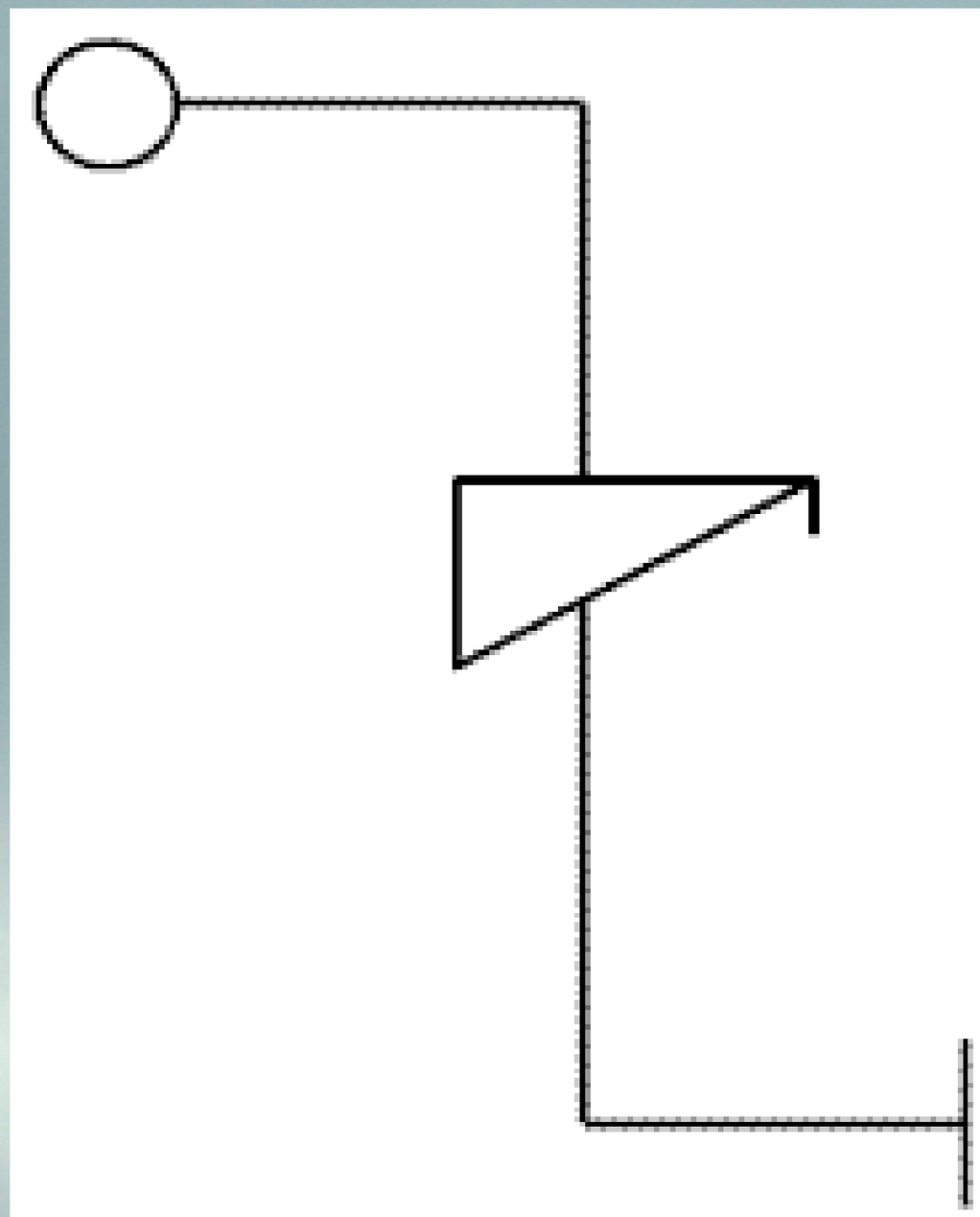
Loops ....

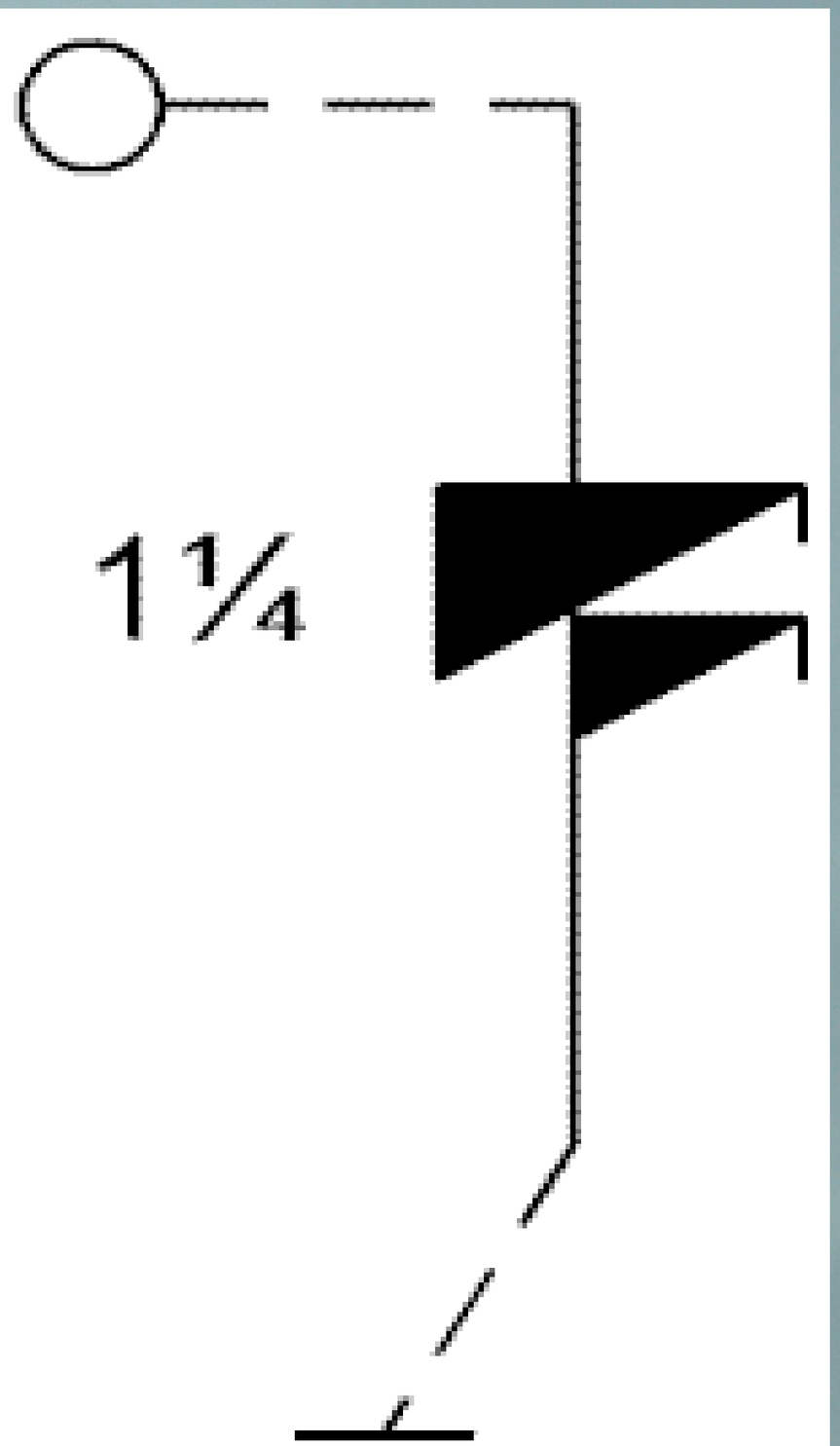


& Eights

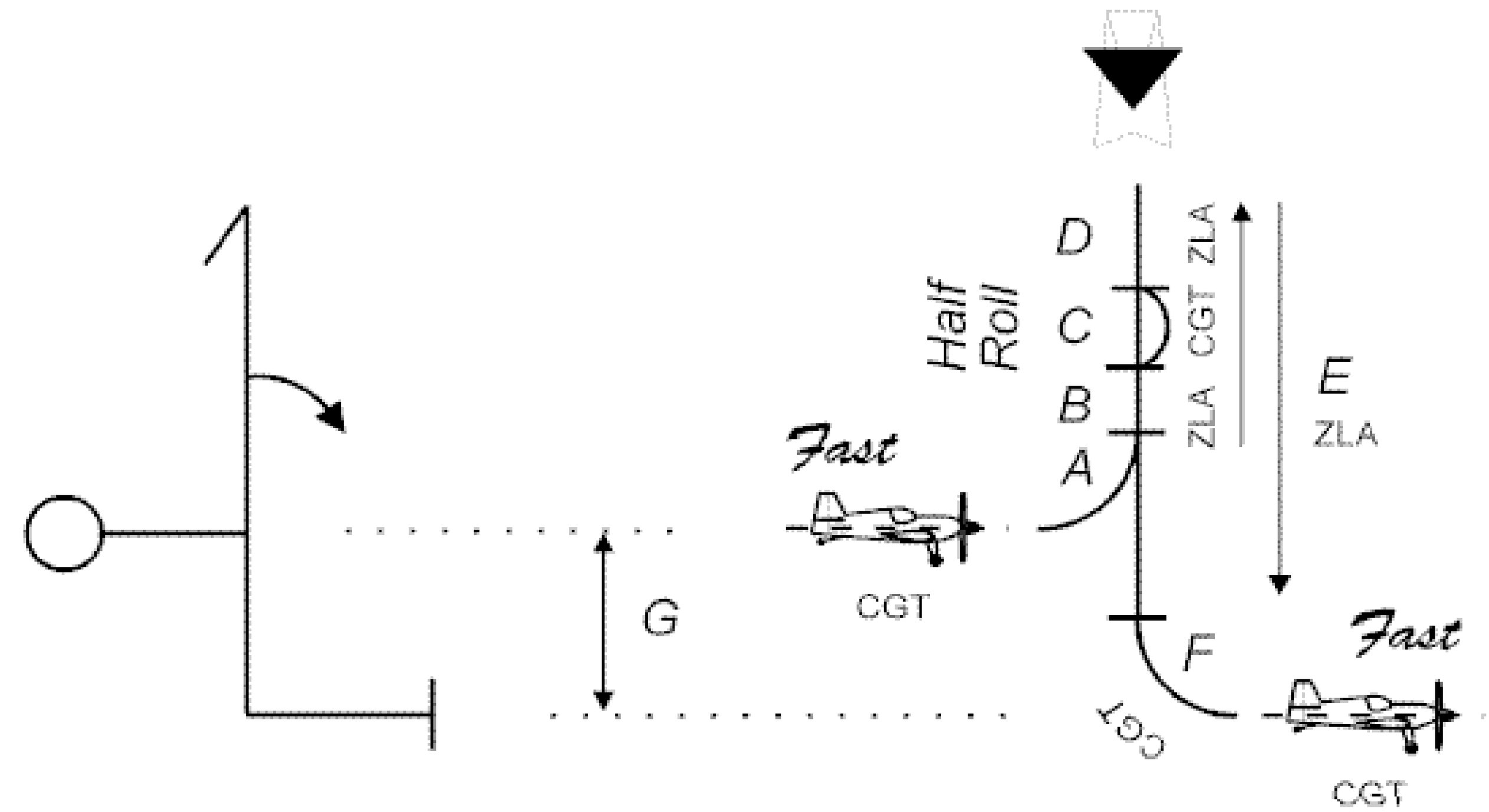

Slow
ZLA
CGT
CGT
Fast
Fast
CGT
CGT
Loops must be round, but
45° flight paths made
shallower or steeper by wind

Spins

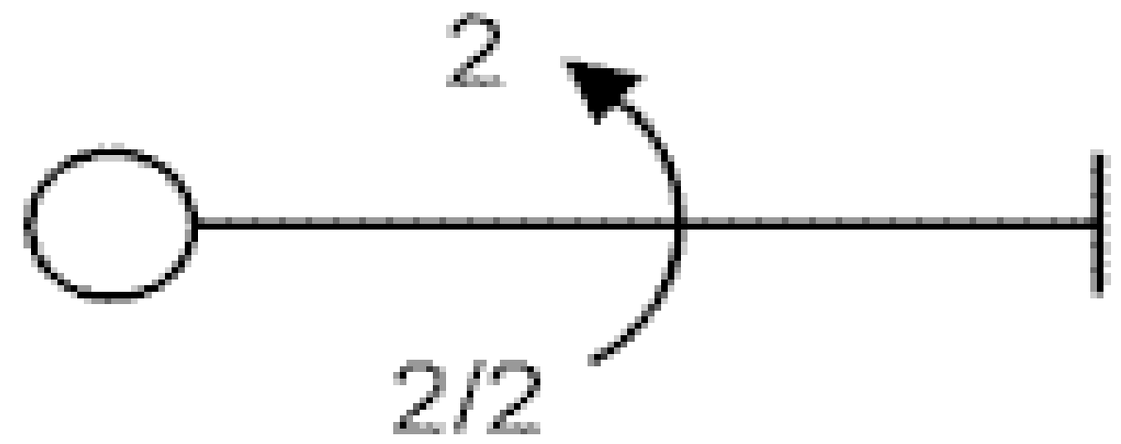




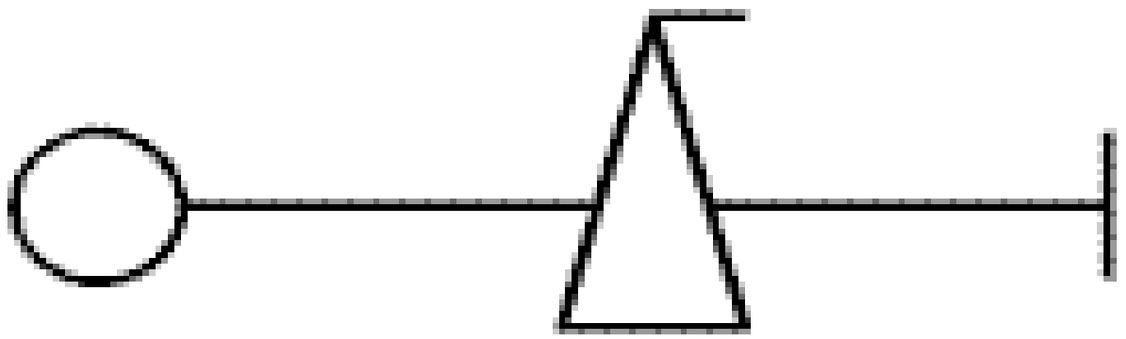
Stall Turns

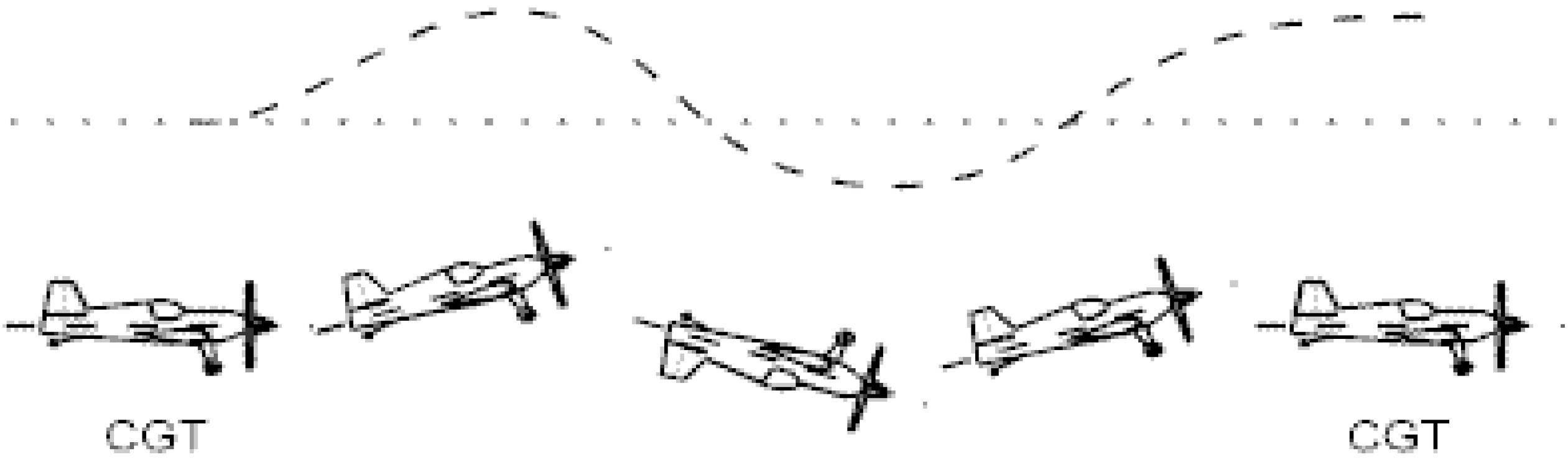


Slow Rolls

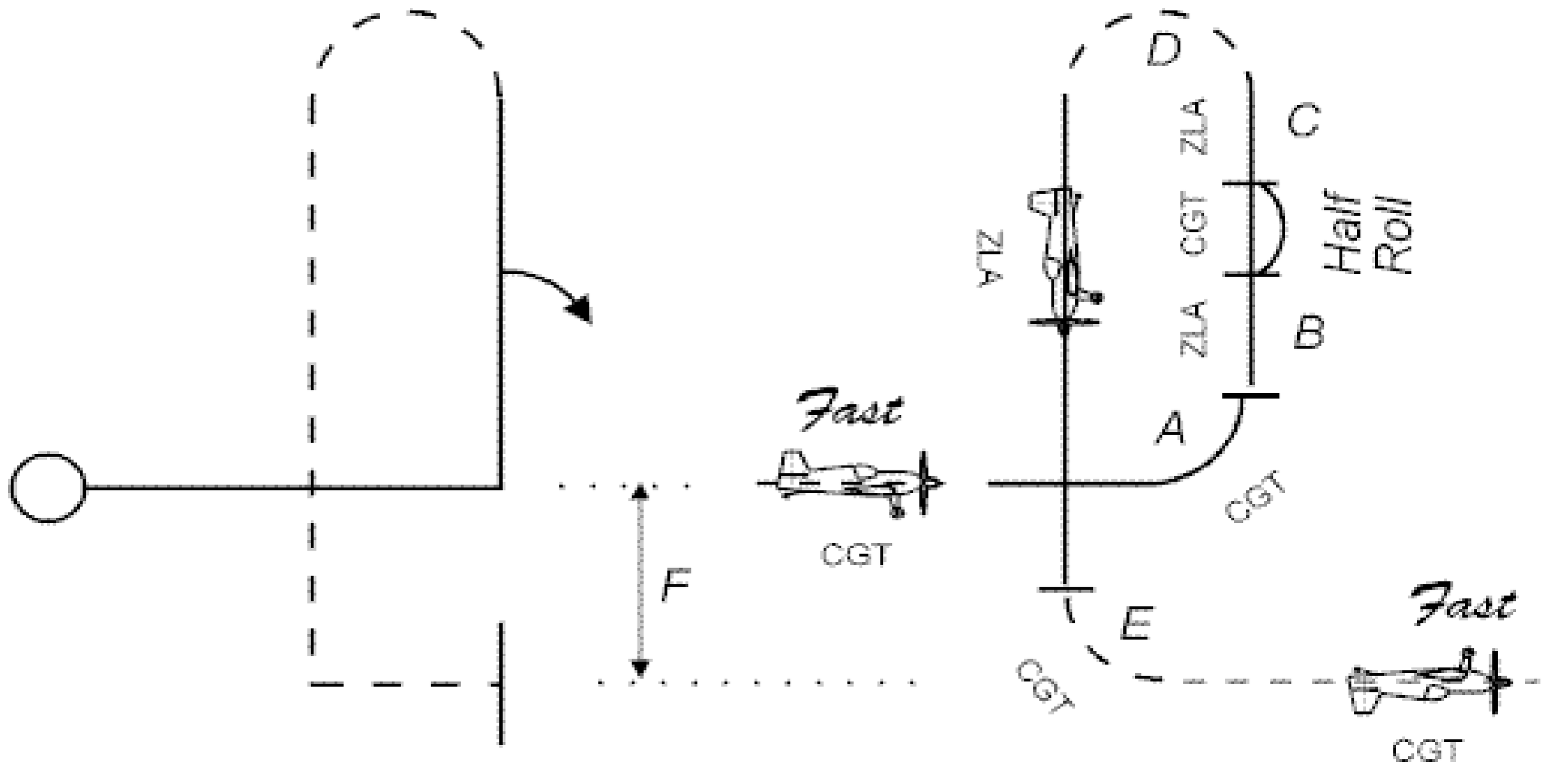


Flick Rolls





Humpty Bumps



Positioning

- % of figures placed per flow chart

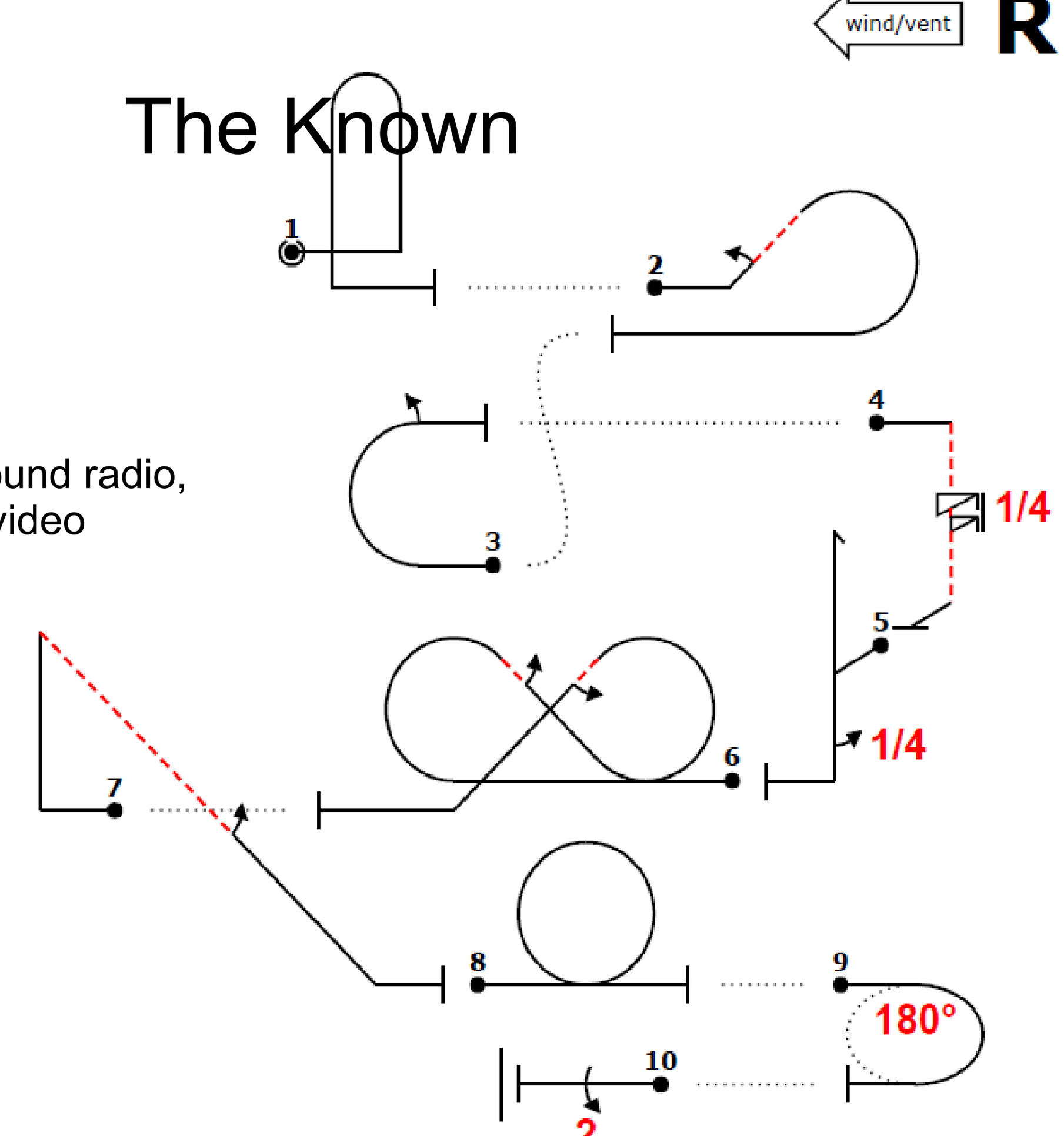
Three Flights

1. The Known – practice it
2. The Free (or repeat the Known) – design a free and do 10% better
3. The Unknown – look at common figures and practice

Get coaching from the ground. Video.

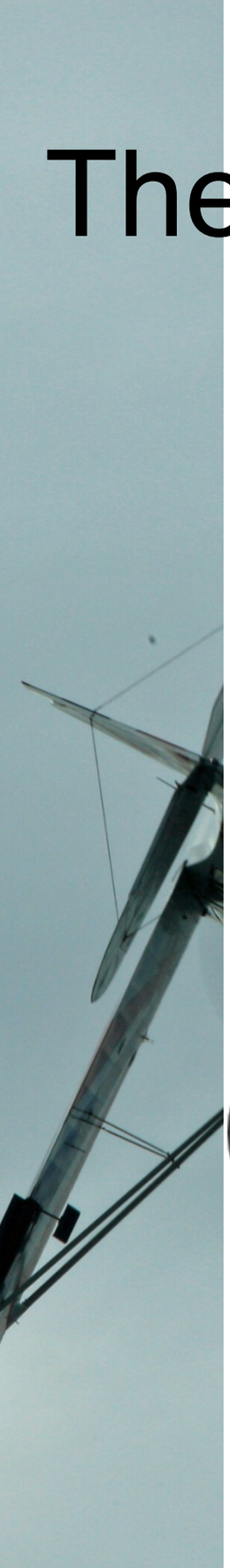
The Known

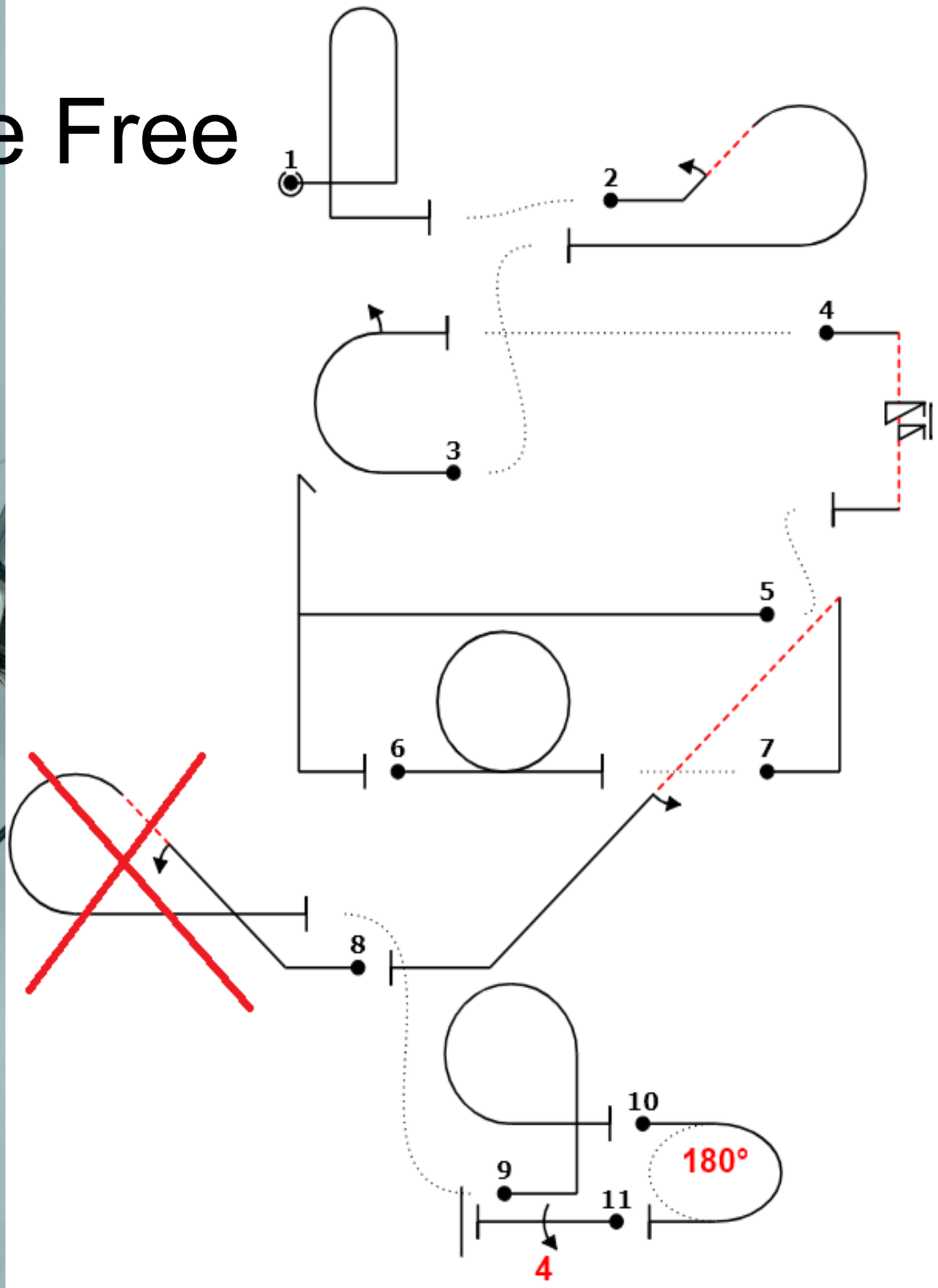
- Practice!
- Coaching – ground radio, recording and video



The Free

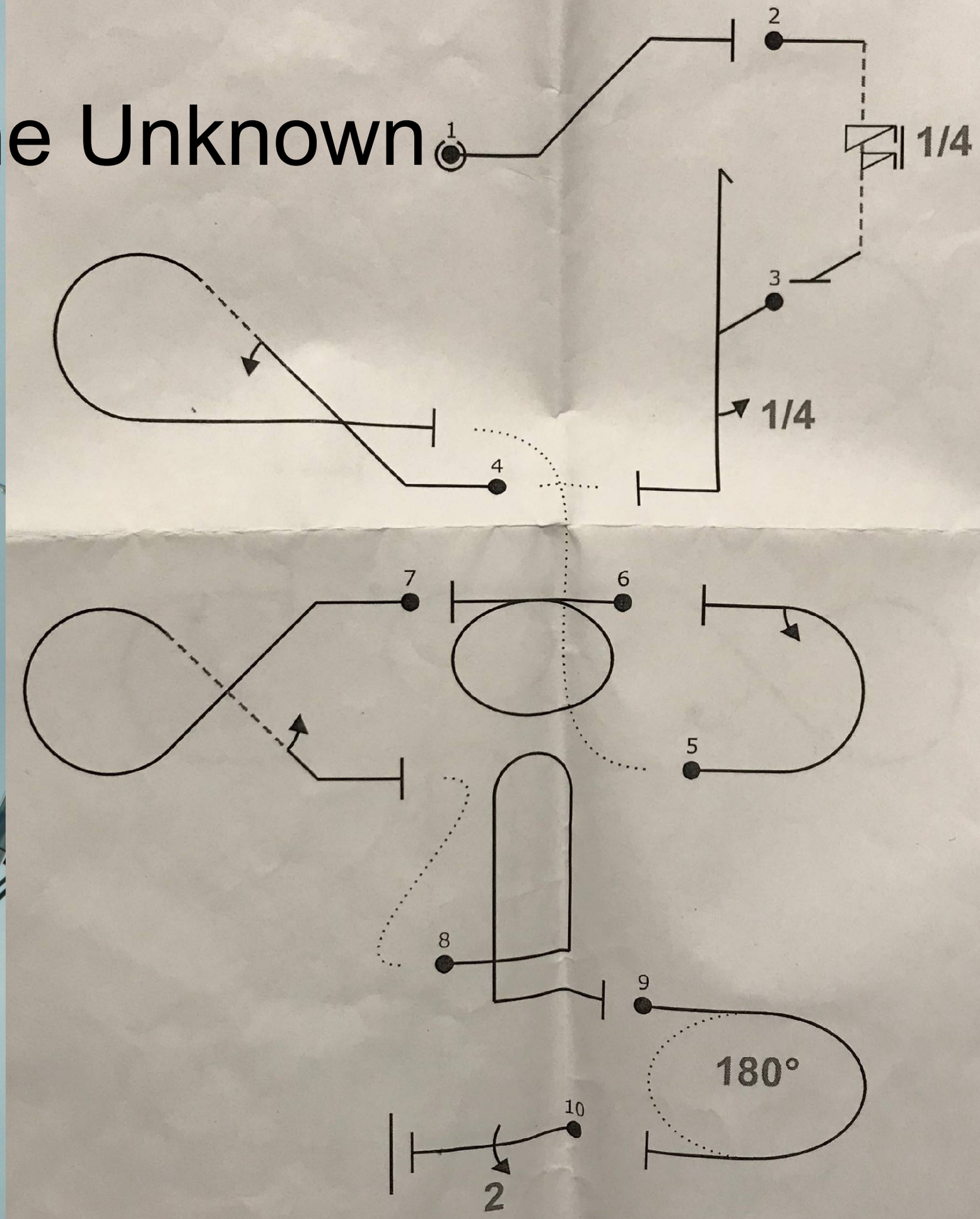
- California Free!
- Contest rules
- Practice
- Coaching
- Modify





The Unknown

- Look at samples
- Read the rules
- Practice figures
- Practice some samples



The Rules

- Briefing
- Entering and exiting the box
- Safety check manoeuvres
- Breaks – buy them cheaply; may be free
- Weather – wind and cloud

Before the Contest

- Safety – undisciplined flying and arrivals
- Practice – overhead or away
- Watch the competitors – check wind
- Replan for known wind
- Walk through the flights prior
- Don’t forget pre-aerobatic checks

Post Flight

- Listen to recording from coach
- Review judges' comments on score sheets

WHAT NEXT?

1500 SYLLABUS

Lesson 1	Dual • Basic aerobatic revision • Upright spin revision • Unusual attitude recovery revision	1.0 hours
Lessons 2	Dual • Half Cuban Eight • Half Reverse Cuban • Humpty bump • 4 Point Hesitation Roll • Stall turn with ¼ roll down	1.0 hours
Lesson 3-5	Solo • Known Sequence Practice	3.0 hours
Lesson 6-8	Solo • Free Sequence Practice	3.0 hours
Lesson 9	Dual • Sequence Assessment	1.0 hours
Lesson 10-14	Solo under supervision below 3000 ft • Known Sequence • Free Sequence	5.0 hours
Lesson 15	Solo under supervision below 3000 ft • Unknown Sequence	1.0 hours
Lesson 16	Dual – Endorsement Assessment • Known or Free Sequence	1.0 hours
Total		16.0 hours