Energy Management

Introduction And Practical Applications

Presented to: WINGS Safety Seminars

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Federal Aviation Administration

Overview

- **What is Energy Management?**
- **Who uses Energy Management?**
- **Why GA community needs it**
- **Types of energy we manage in flight**
- **Practical applications:**
  - Power Table
  - Power-Off 180 planning
- **Airmen Certification Standards for E-M**
- **Accident case study**

Resource:

- **Airplane Flying Handbook (FAA-H-8083-3C)**
  - –Chapter 4: Energy Management
  - –Added as a handout in this seminar announcement!

Disclaimer

- **This presentation does not change current FAA policies or regulations, or published procedures where you train / teach**
- **Objectives are to:**
  - Introduce a new concept
  - Expand your thinking, generate discussion
  - Give you tools you can use immediately
  - Most importantly: Prevent accidents!

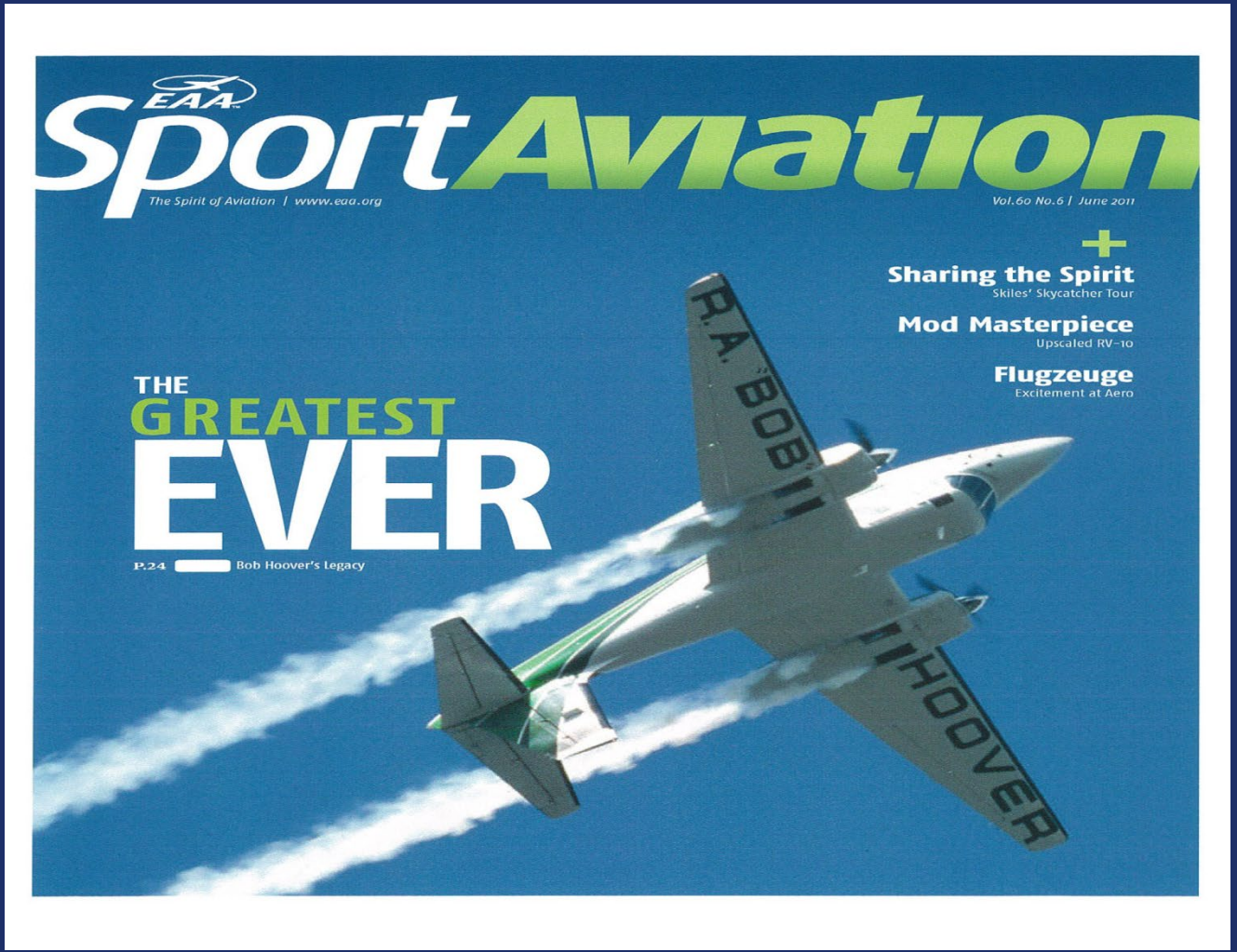
What is Energy Management?

(Not THIS kind!)

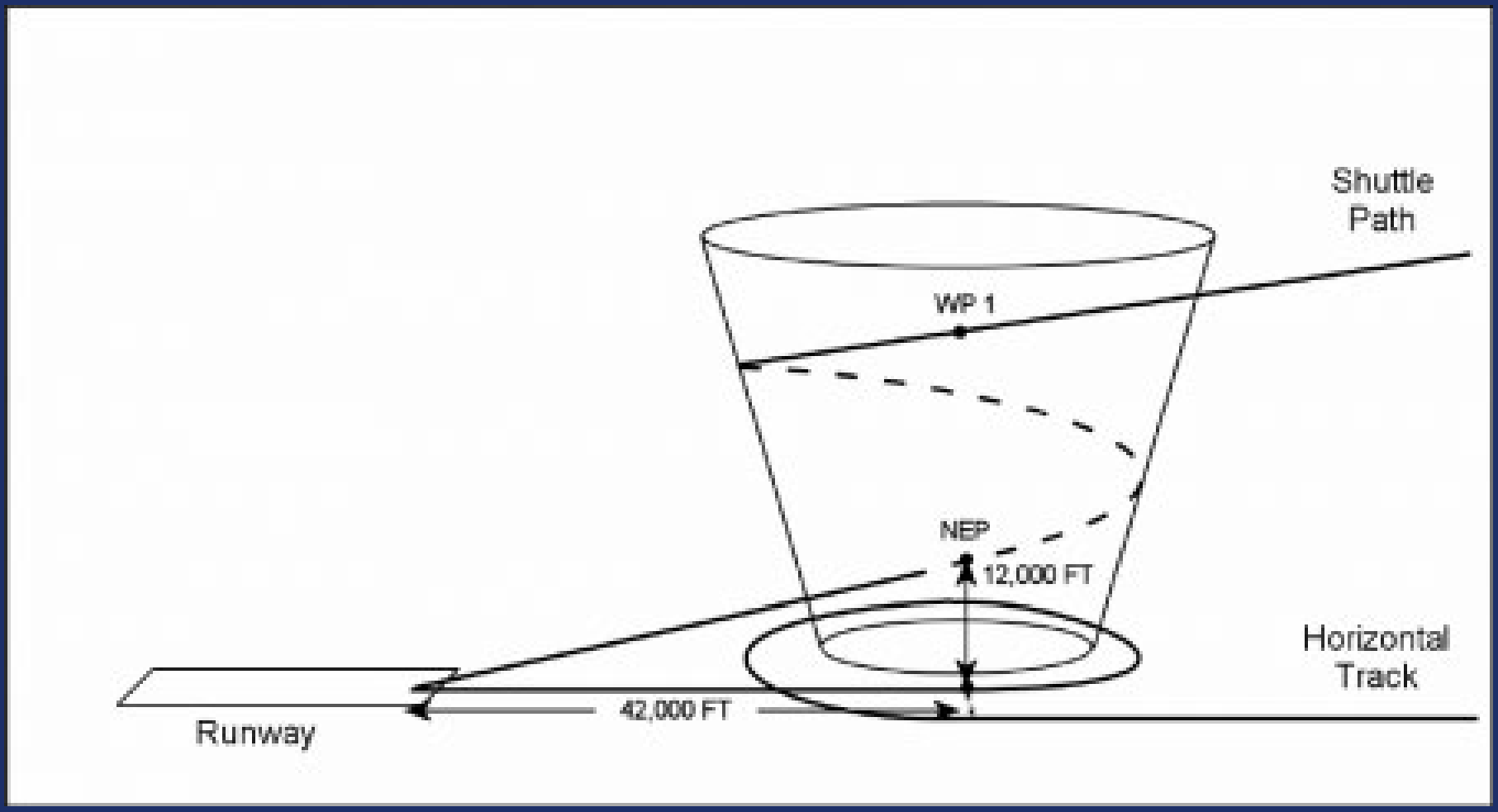
Who uses Energy Management?

Fighters use Energy Management!

Airshow performers use it!



NASA uses Energy Management!



Airliners use Energy Management!

Gliders use Energy Management!

GA is very late to this party!

Why GA needs Energy Management

- **Leading accident & incident cause (esp Flight Training):**
  - **Student loss of control on ldg (#1 overall)**
  - **Stall / Spin (#1 cause of fatal accidents)**

- **Many are due to mismanaged energy!**

Goals of Energy Management in GA

- **Efficient flying**
- **Develop kinesthetic sense in pilots**
- **Reduce accidents in leading areas of risk**

Most important types of energy:

- **Kinetic**
  - Airspeed!
- **Potential**
  - Altitude!

- **Total = Kinetic + Potential**

- **“Inverted Energy Bowl” concept**

“Inverted Energy Bowl” concept:

Garmin AOPA Pilot magazine ad c March 2023

Do you see the "Inverted Energy Bowls"?

Commercial Off-The-Shelf Tool

- **Garmin "Smart Glide" technology**
  - Calculates and assesses options
  - Recommends a route with alternatives
  - Can assist w/ flying a selected route
  - Can assist w/ certain em. tasks (CTAF, 7700)
  - Displays valuable relevant info (Glide range, etc.)
  - https://www.garmin.com/en-US/blog/aviation/five-reasons-your-aircraft-needs-garmin-smart-glide/

- **Others? Know your EFB!**

More Commercial O-T-S Tools!

Angle of Attack (AOA, or Alpha) indicators

Two practical E-M applications

- **Power Table**
- **Power-Off 180 planning**

Power Table

Power Table:

_____
(Model)

Profile	Pitch	Power	A/S	VSI	Remarks
Vy		**Full**			
Vx		**Full**			
Cruise Climb					
Cruise		**75%**		**0**	
		65%			
Holding				**0**	≤ 3 min til fix
-500 fpm; Clean				**-500**	Init Segm't; Vec. Final
S & L; Apch Flaps; **Gear up**				**0**	Intermed. Segment
ILS Final: Apch Flaps; **Gear down**					On GS

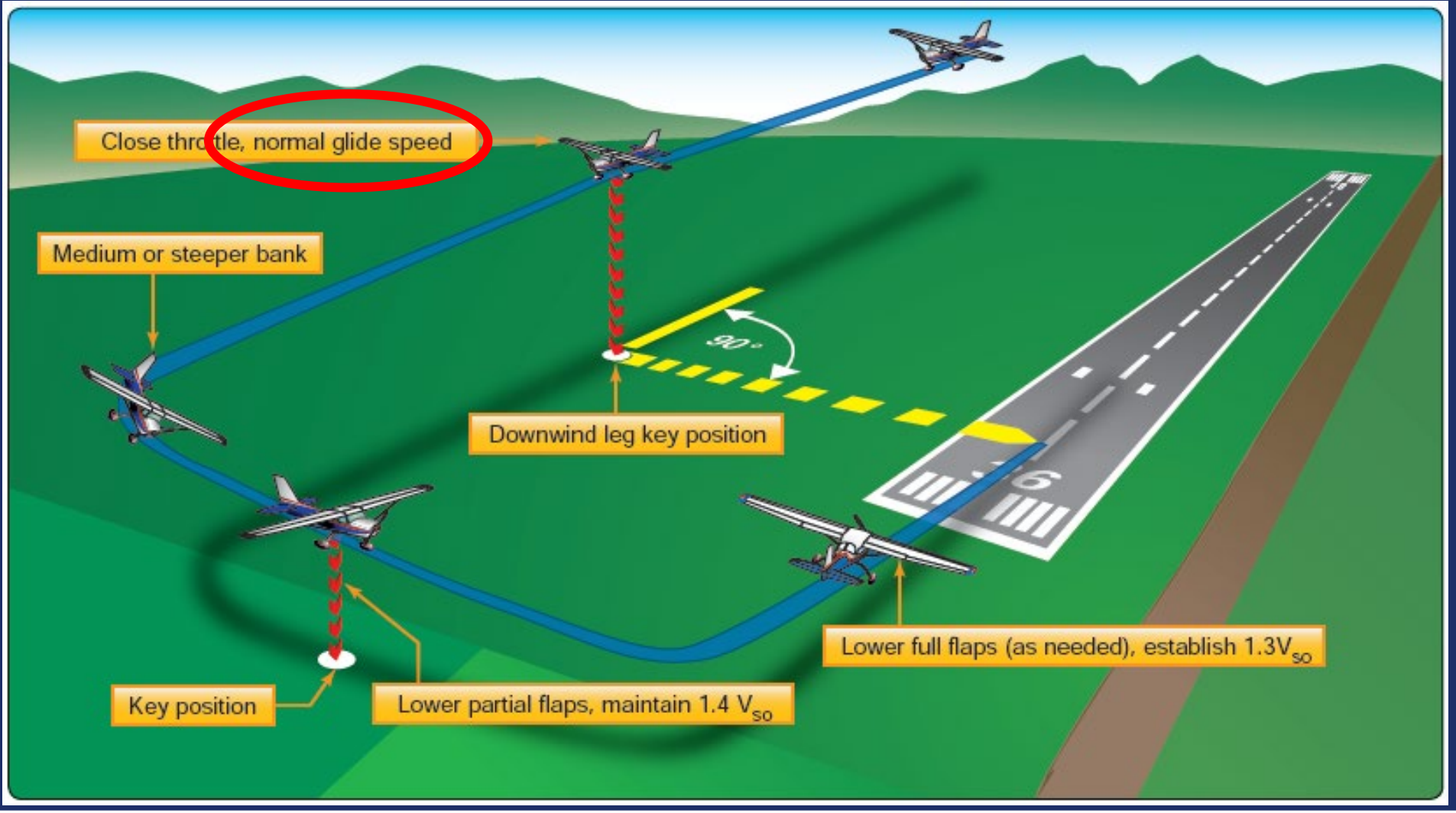
Re-trim as necessary after any profile change.

Notes:

Power-Off 180 Approach & Landing

- **Commercial ASE proficiency maneuver**
- **Typically flown in complex singles**
  - TAA may alternate for Complex airplane
- **Develops skills for engine-out approach**
- **Described in AFH, Chapter 8**

Extract from AFH, Chapter 8



Aero Review

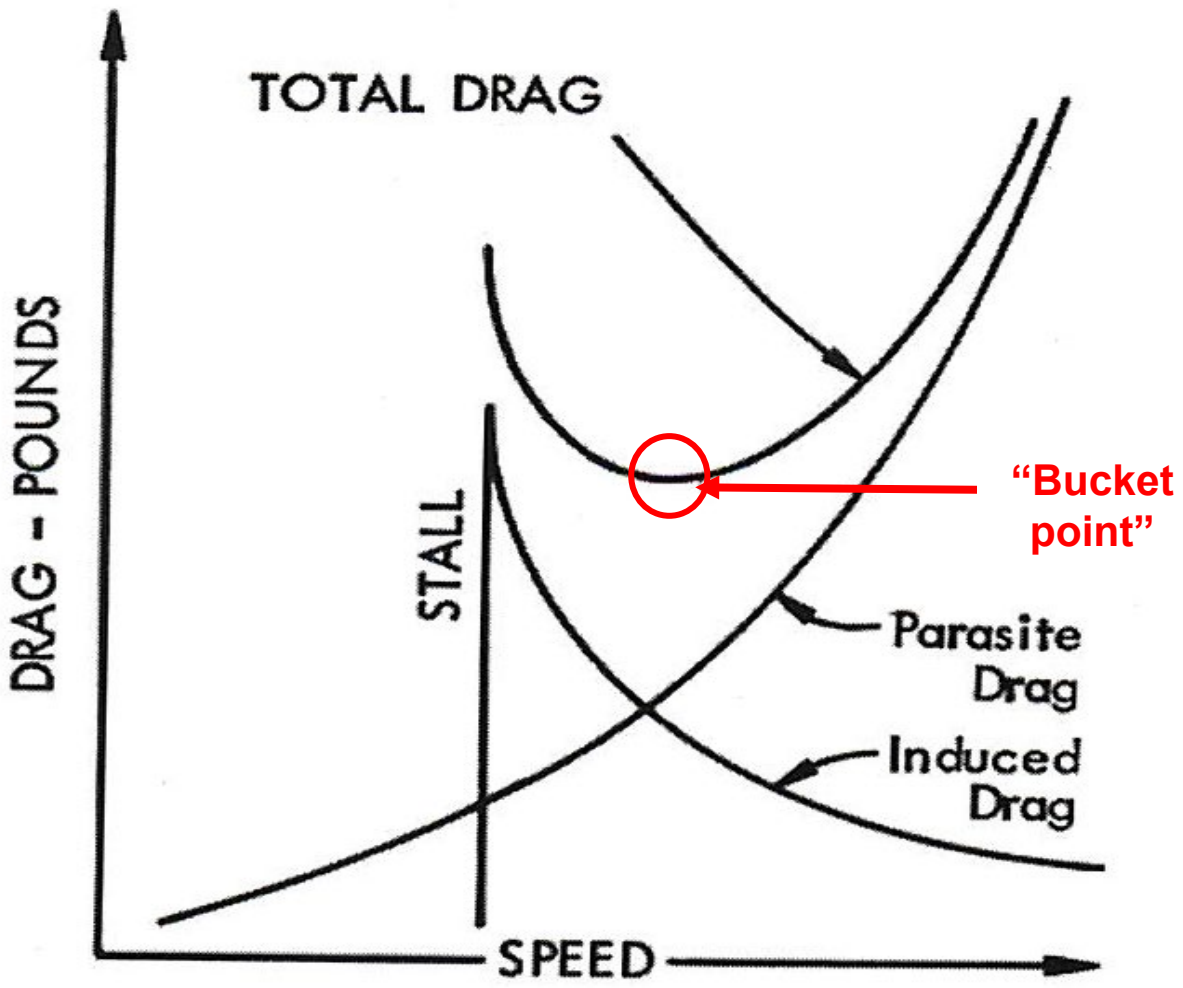
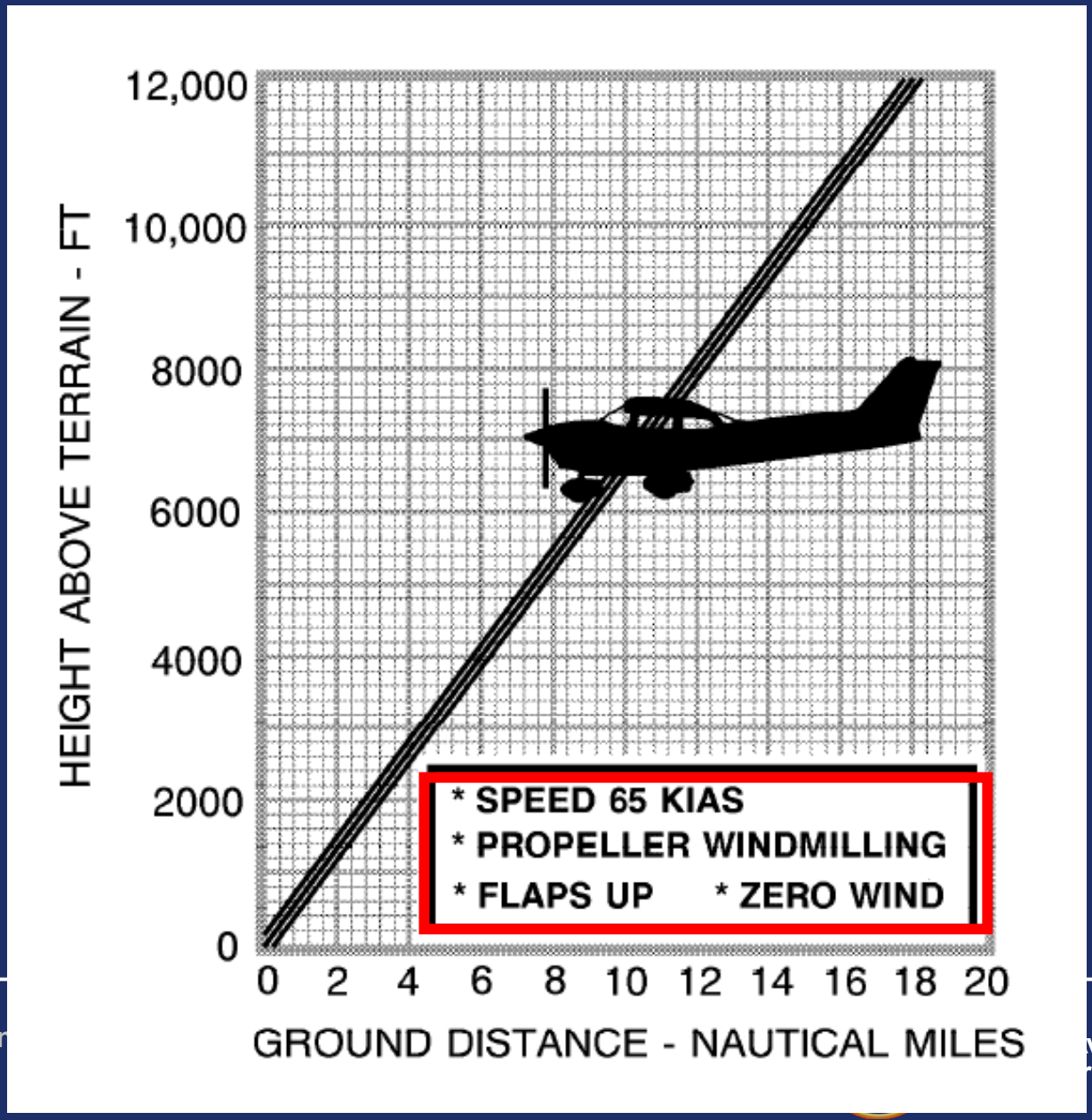
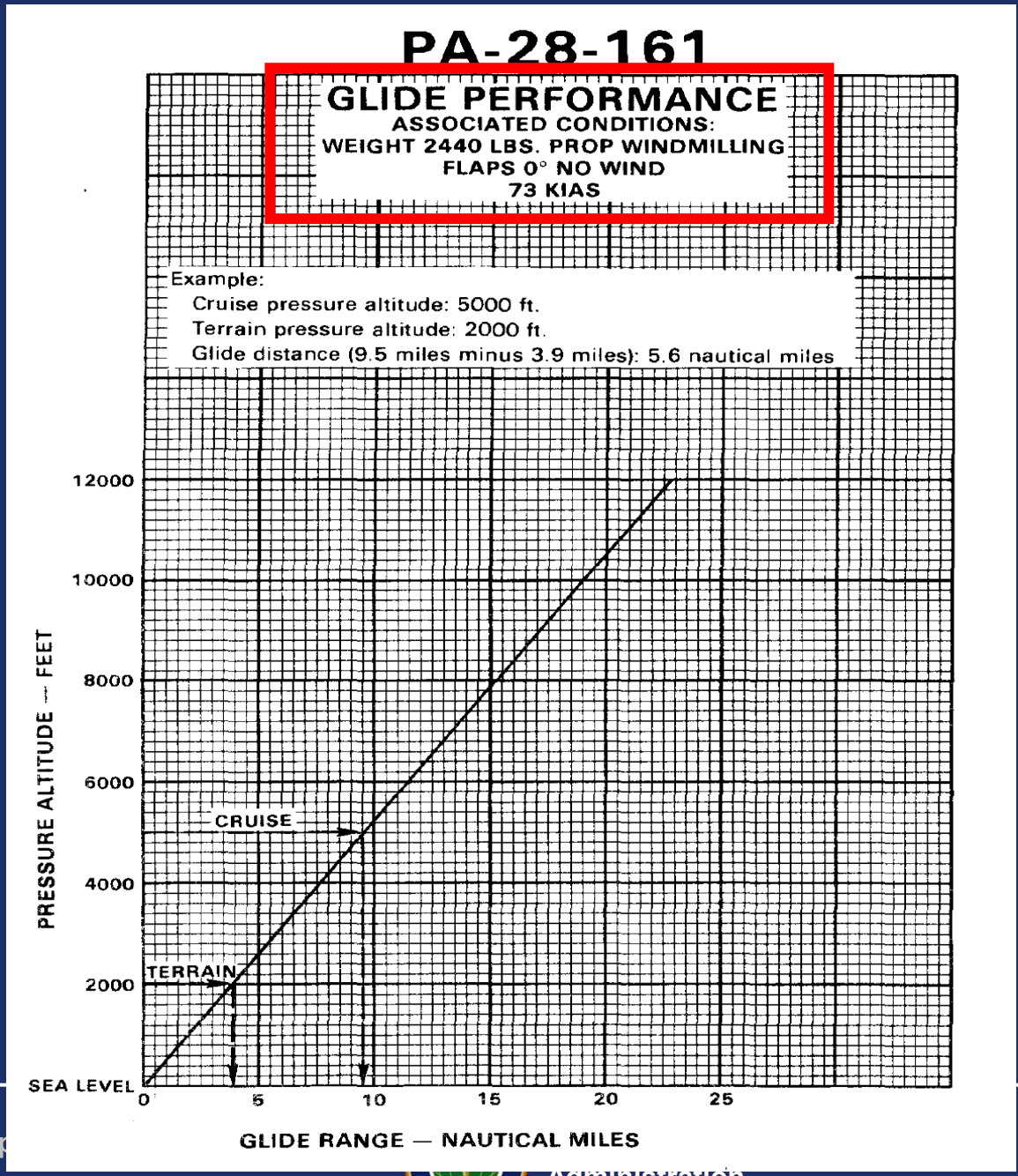


Figure 17–18 Drag Versus Speed

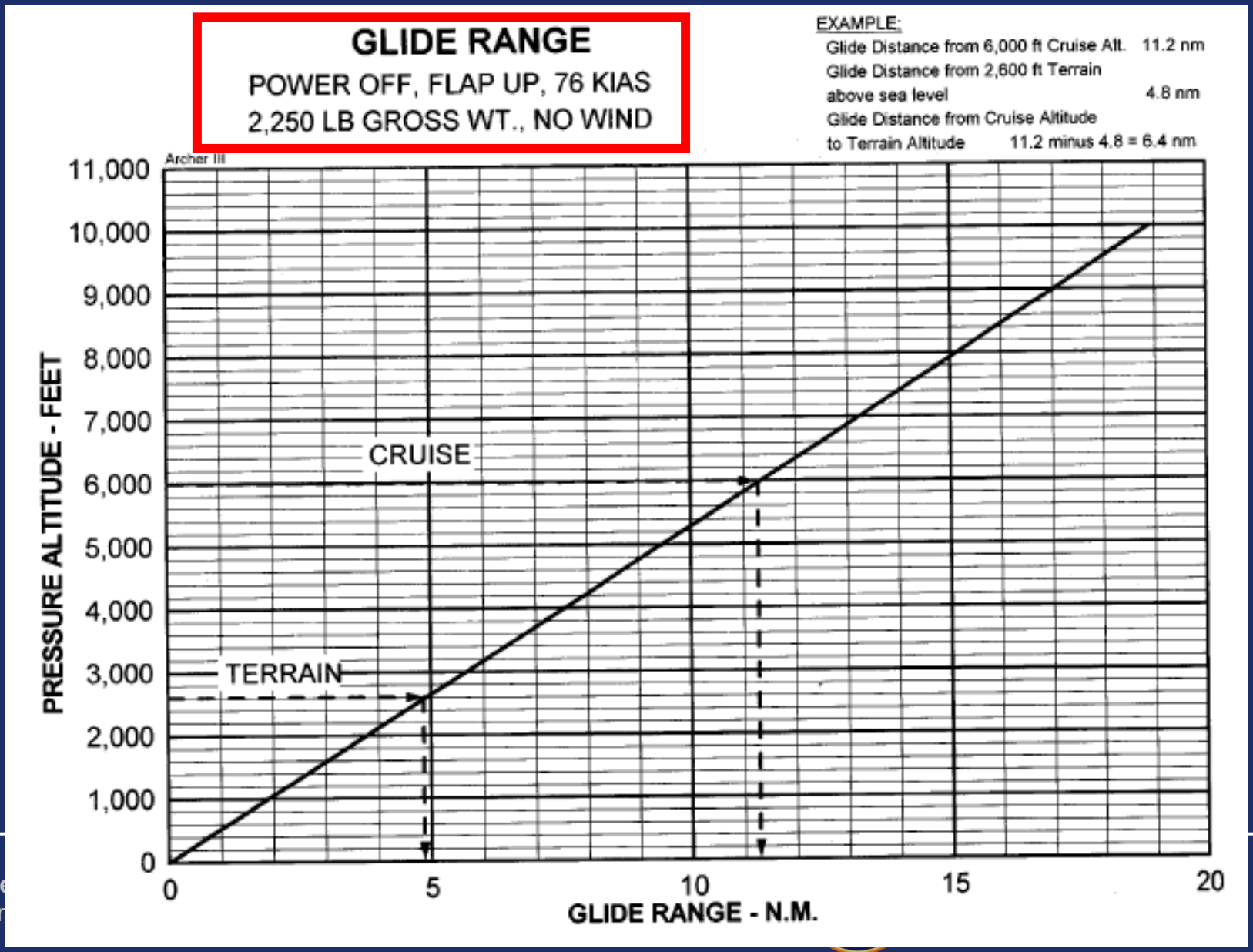
Glide Performance: C-172R



Glide Performance: PA-28-161



Glide Performance: Archer III



Glide Performance: Cirrus SR-20

Maximum Glide

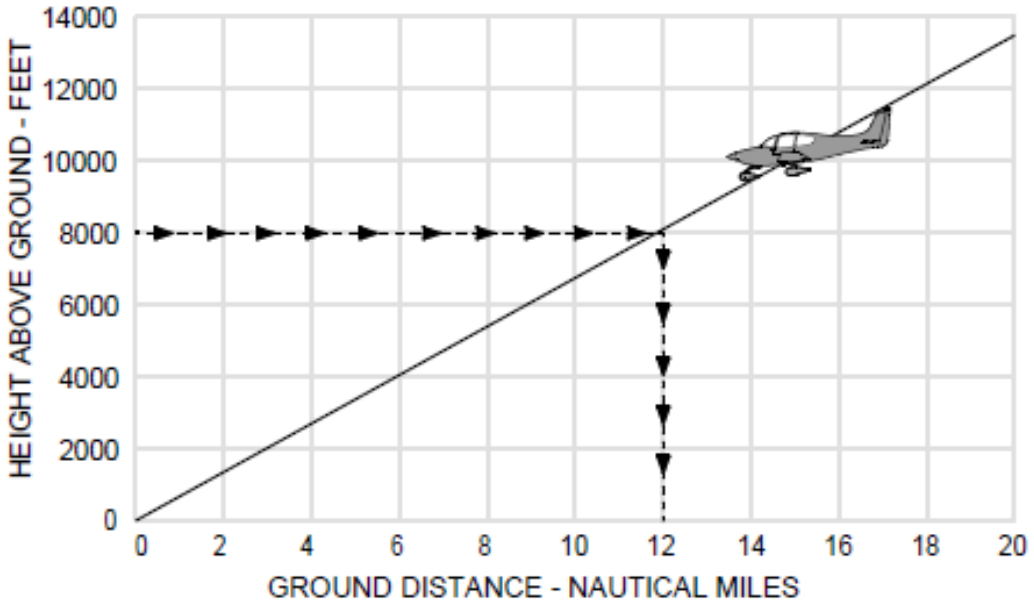
Conditions		Example:	
Power	OFF	Altitude	8,000 ft. AGL
Propeller	Windmilling	Airspeed	Best Glide
Flaps	0% (UP)	Glide Distance	12 NM
Wind	Zero		

Best Glide Speed

100 KIAS at 3150 lb

92 KIAS at 2600 lb

Maximum Glide Ratio ~ 9 : 1



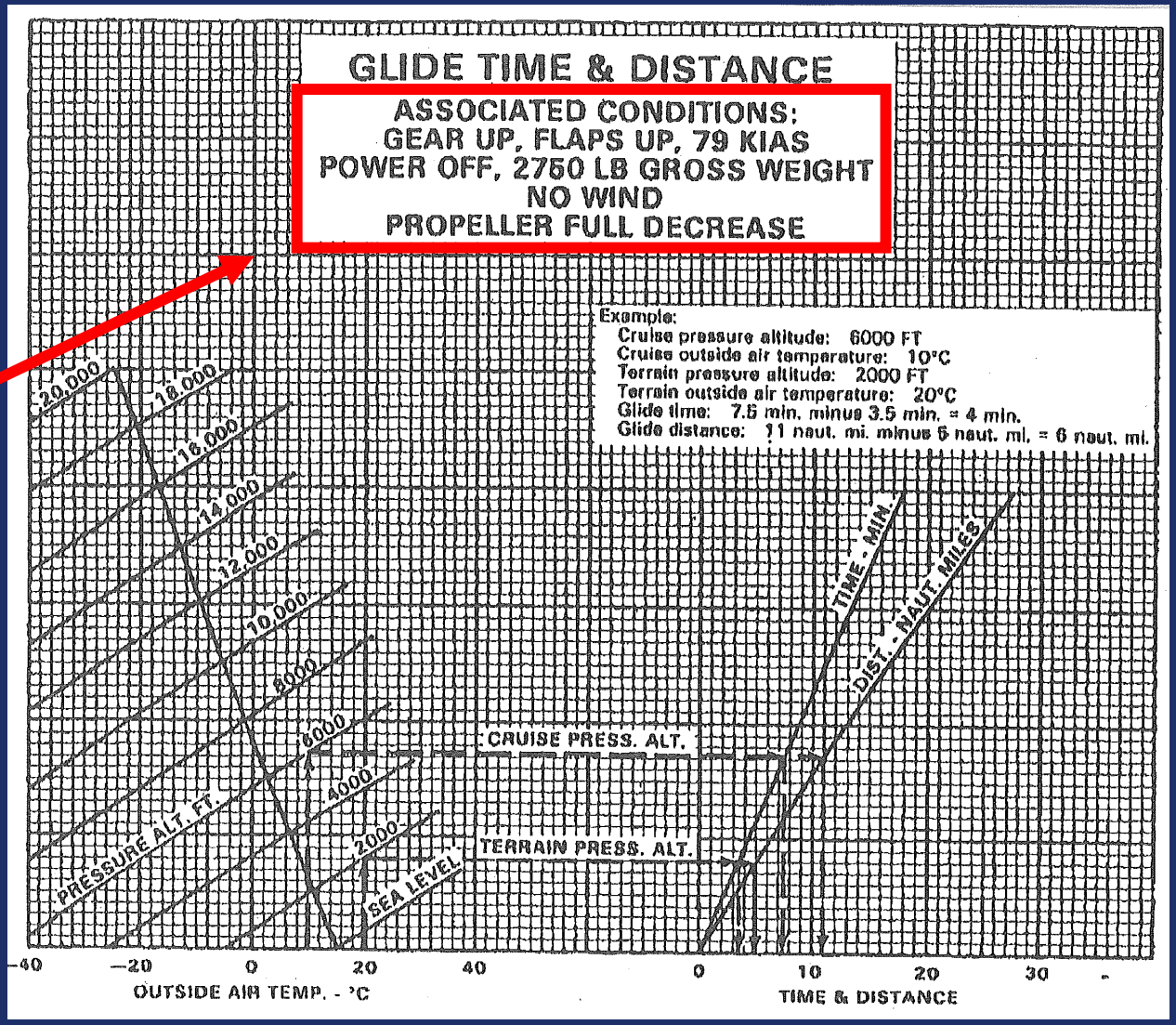
Glide Performance (PA 28R-201)

Always

Check

Assoc'd

Cond'ns

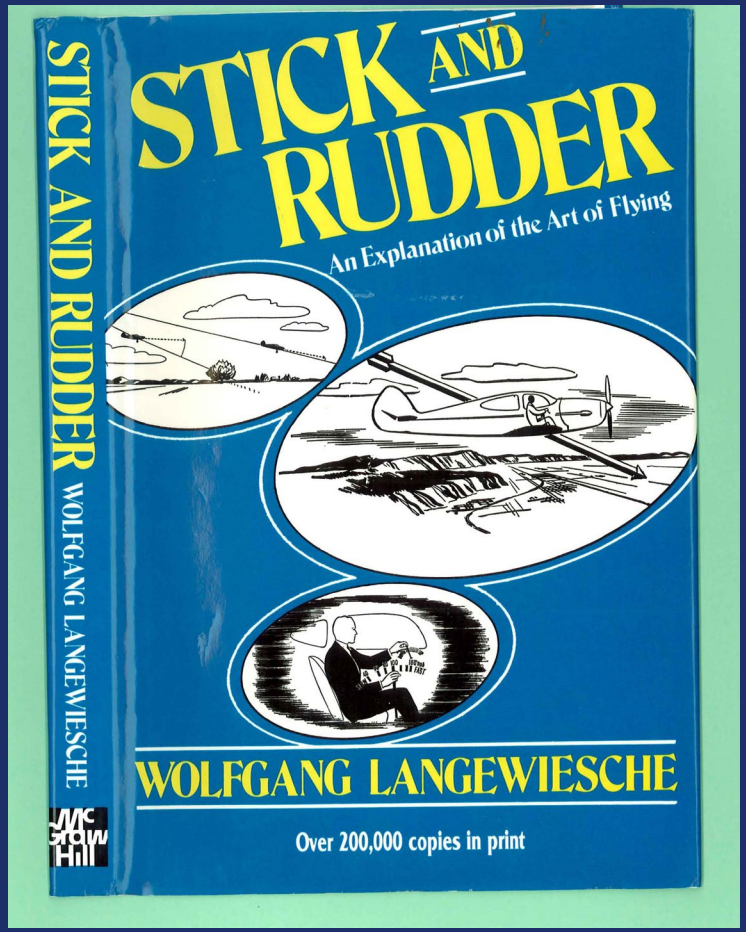


Excellent reference (since 1944)!

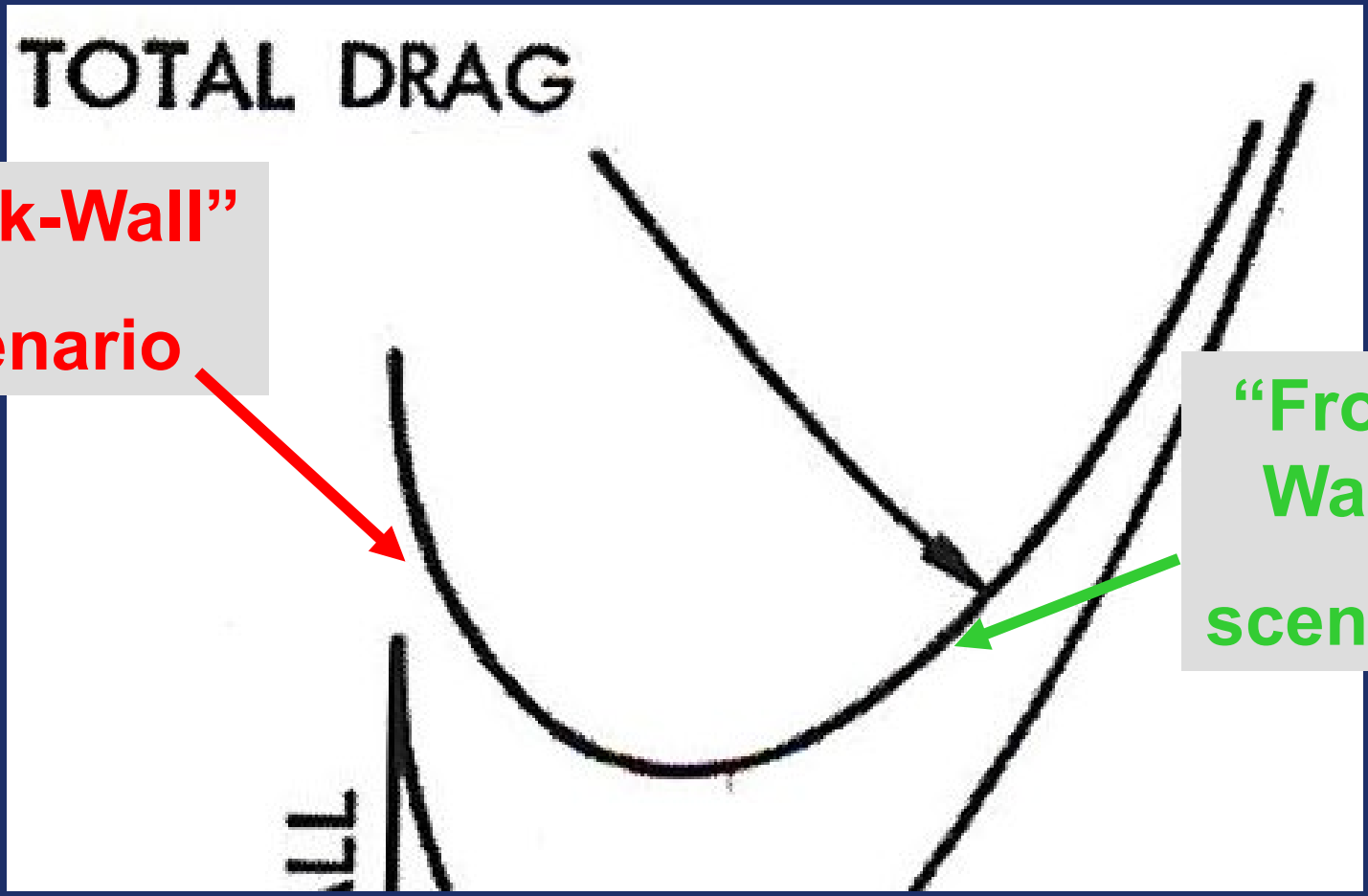
Check it out:

Chapter 14:

The Glide



Re-visit the drag curve -



Review of two key landing terms:

- Aiming point
- Specified Touchdown point
- They are not the same!

PTS (That was then!):

Task K: Power-Off 180° Accuracy Approach and Landing (ASEL and ASES)

Reference: FAA-H-8083-3.

Objective: To determine that the applicant:

1. Exhibits satisfactory knowledge of the elements related to a power-off 180° accuracy approach and landing.
2. Considers the wind conditions, landing surface, obstructions, and selects an appropriate touchdown point.
3. Positions airplane on downwind leg, parallel to landing runway, and not more than 1,000 feet AGL.
4. Completes final airplane configuration.
5. Touches down in a normal landing attitude, at or within 200 feet beyond the specified touchdown point.
6. Completes the appropriate checklist.

ACS, Task IV-M (Skills section):

The applicant demonstrates the ability to:
Complete the appropriate checklist.
Make radio calls as appropriate.
Plan and follow a flightpath to the selected landing area considering altitude, wind, terrain, and obstructions.
Select the most suitable touchdown point based on wind, landing surface, obstructions, and aircraft limitations.
Position airplane on downwind leg, parallel to landing runway.
Correctly configure the airplane.
As necessary, correlate crosswind with direction of forward slip and transition to side slip for landing.
Touch down at a proper pitch attitude, within 200 feet beyond or on the specified point with no side drift and with the airplane's longitudinal axis aligned with and over the runway centerline or landing path, as applicable.

ACS: Energy Mgmt. Tasks

- Normal Landing
- Soft Field Landing
- Short Field Landing
- Power-Off 180 Approach & Landing (Comm'l)
- Emergency Descent
- Emergency Approach & Landing

PP ACS Task IV-B: Normal Ldg

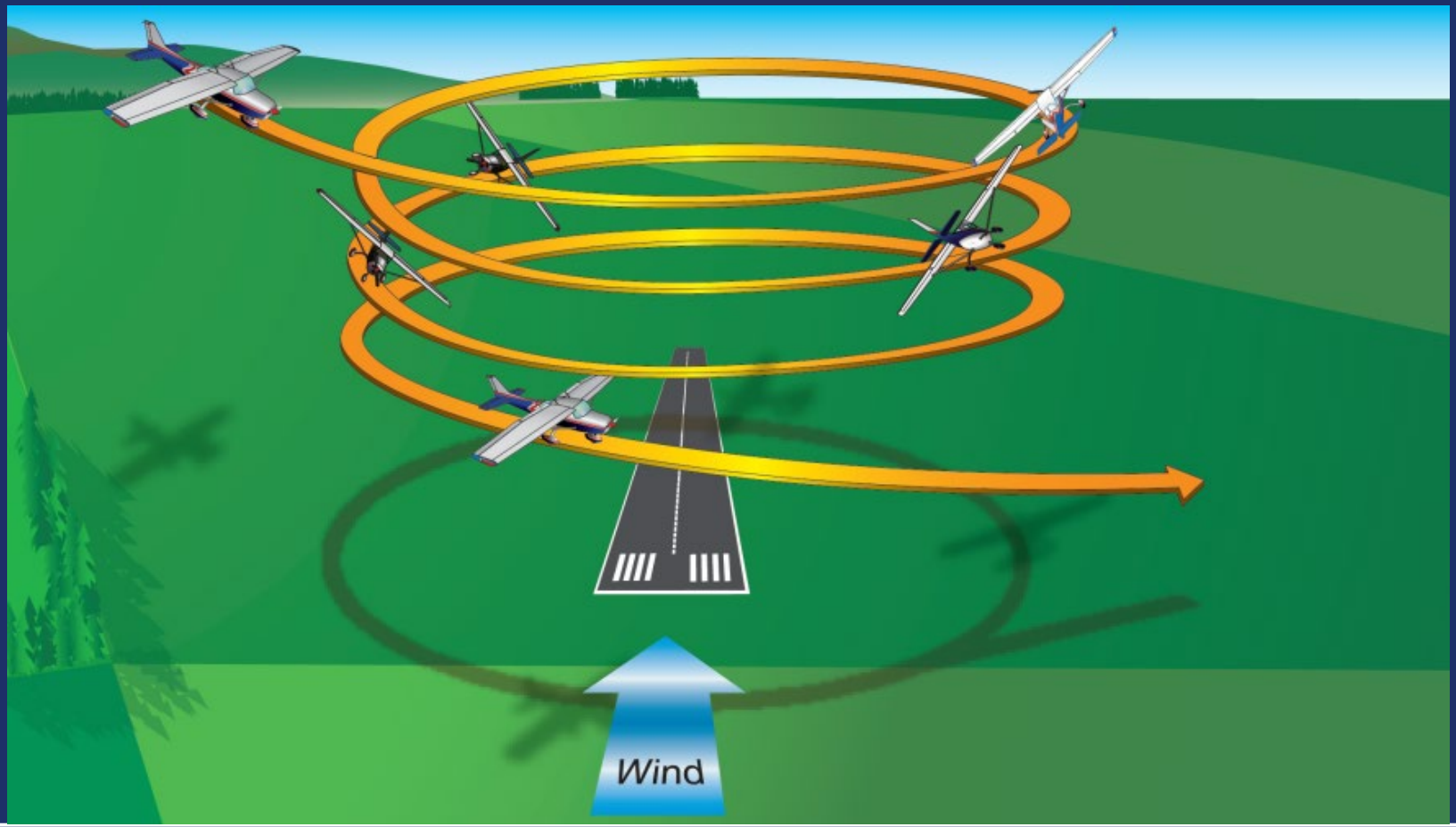
Task	***Task B. Normal Approach and Landing***
References	FAA-H-8083-2, FAA-H-8083-3, FAA-H-8083-23; POH/AFM
Objective	To determine that the applicant exhibits satisfactory knowledge, risk management, and skills associated with a normal approach and landing with emphasis on proper use and coordination of flight controls. ***Note:*** *If a crosswind condition does not exist, the applicant's knowledge of crosswind elements must be evaluated through oral testing.*
Knowledge	The applicant demonstrates understanding of:
PA.IV.B.K1	1. Available landing distance.
PA.IV.B.K2	2. Stabilized approach and interpretation and use of visual glide scope indicators.
PA.IV.B.K3	3. Energy management.
PA.IV.B.K4	4. Atmospheric conditions.
PA.IV.B.K5	5. Wind conditions and effects.
PA.IV.B.K6	6. Emergency procedures during approach and landing.
PA.IV.B.K7	7. Land and hold short operations (LAHSO) or option to refuse LAHSO restriction.
Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
PA.IV.B.R1	1. Failure to select the appropriate runway based on wind, pilot capability, and airplane limitations.

CP ACS: P-Off 180

IV. Takeoffs, Landings, and Go-Arounds

Task	*M. Power-Off 180° Accuracy Approach and Landing (ASEL, ASES)*
References	FAA-H-8083-2, FAA-H-8083-3; POH/AFM; AIM
Objective	To determine that the applicant exhibits satisfactory knowledge, risk management, and skills associated with a power-off 180° accuracy approach and landing. ***Note:*** *See Appendix 7: Aircraft, Equipment, and Operational Requirements & Limitations.*
Knowledge	The applicant demonstrates understanding of:
CA.IV.M.K1	A stabilized approach, to include energy management concepts.
CA.IV.M.K2	Effects of atmospheric conditions, including wind, on approach and landing.
CA.IV.M.K3	Wind correction techniques on approach and landing.
CA.IV.M.K4	Purpose of power-off accuracy approach.

Extract from AFH, Chapter 10 Steep Spiral:



Key Take-Aways:

- **Proper E-M could prevent many mishaps**
- **Power Table: Develop for YOUR aircraft**
- **For max-range glide, adjust Vg as needed**
  - Study glide range chart and associated conditions
  - Headwind: Increase your Vg
  - Lighter than MGW, stopped prop: Decrease your Vg
  - Don't dirty-up til landing assured
- **If range is not a factor, increase Vg**
  - P-Off 180: Range should not usually be a factor!
  - Adjust aiming point. Faster speed: Closer aiming pt.

Case Study in Energy Management:

Wx: 900 Bkn, winds NW 5-10,
3 SM, all available airports

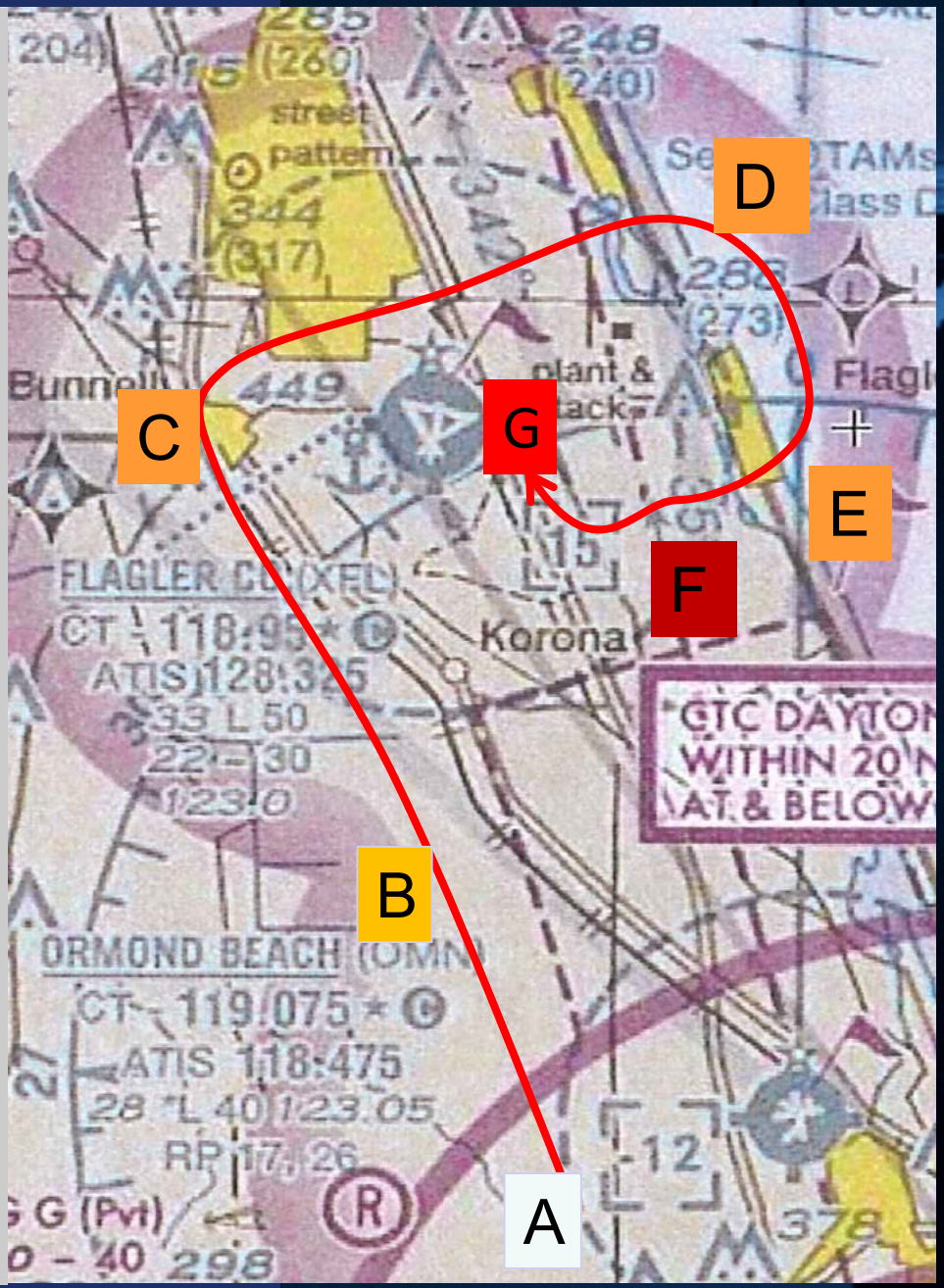
Situation: ASEL; VFR over the top;
Gradual, steady loss of power

SRM: ATC assist w/ vectors to final;
Flight path shown is an approximation

Outcome: A/C impacted off-airport,
All fatal; 1 ground injury.

NTSB ID: ERA13FA105

Lessons Learned…..?



Review: Energy Management

- Other communities already use it
- Leading accident cause; Now in ACS!
- Two main types of energy to manage
  - Kinetic
  - Potential
- Inverted "Energy Bowl"
- COTS tools now available!
- Power Table
- Power-Off 180 and Steep Spiral planning
- Keep a reserve, esp in Engine-Out emerg's

Questions?

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