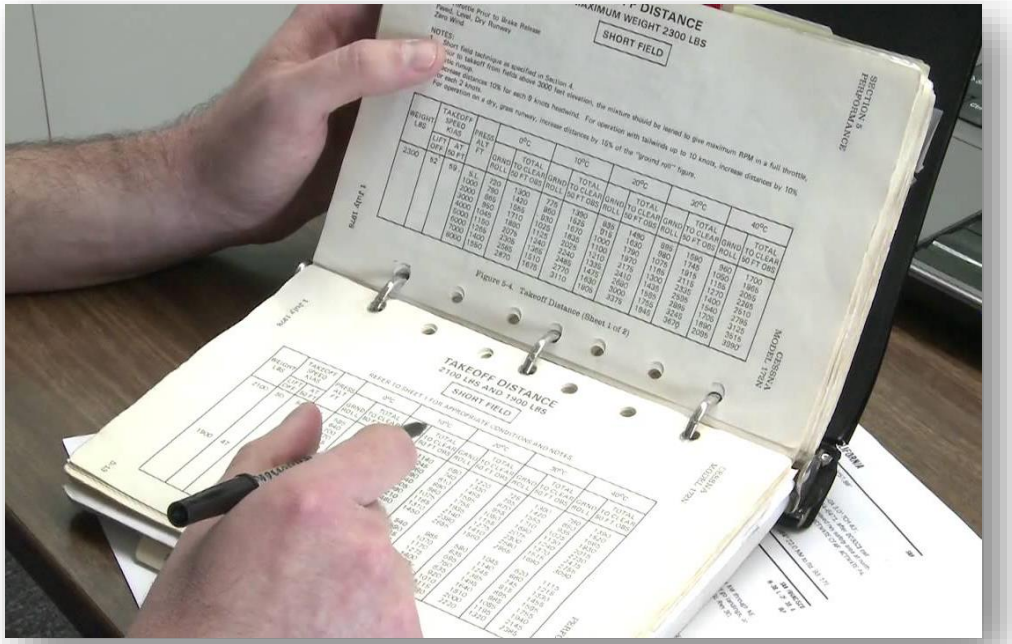
The National FAA Safety Team Presents

Federal Aviation Administration

Topic of the Month – December 2023

Making the Numbers



Presented to: Safety Minded Aviators, Everywhere…

By: Stephen Bateman, CFI, AOPA Flying Clubs

Date: Tuesday 19th December 2023

Produced by:
The National FAA Safety Team (FAASTeam)

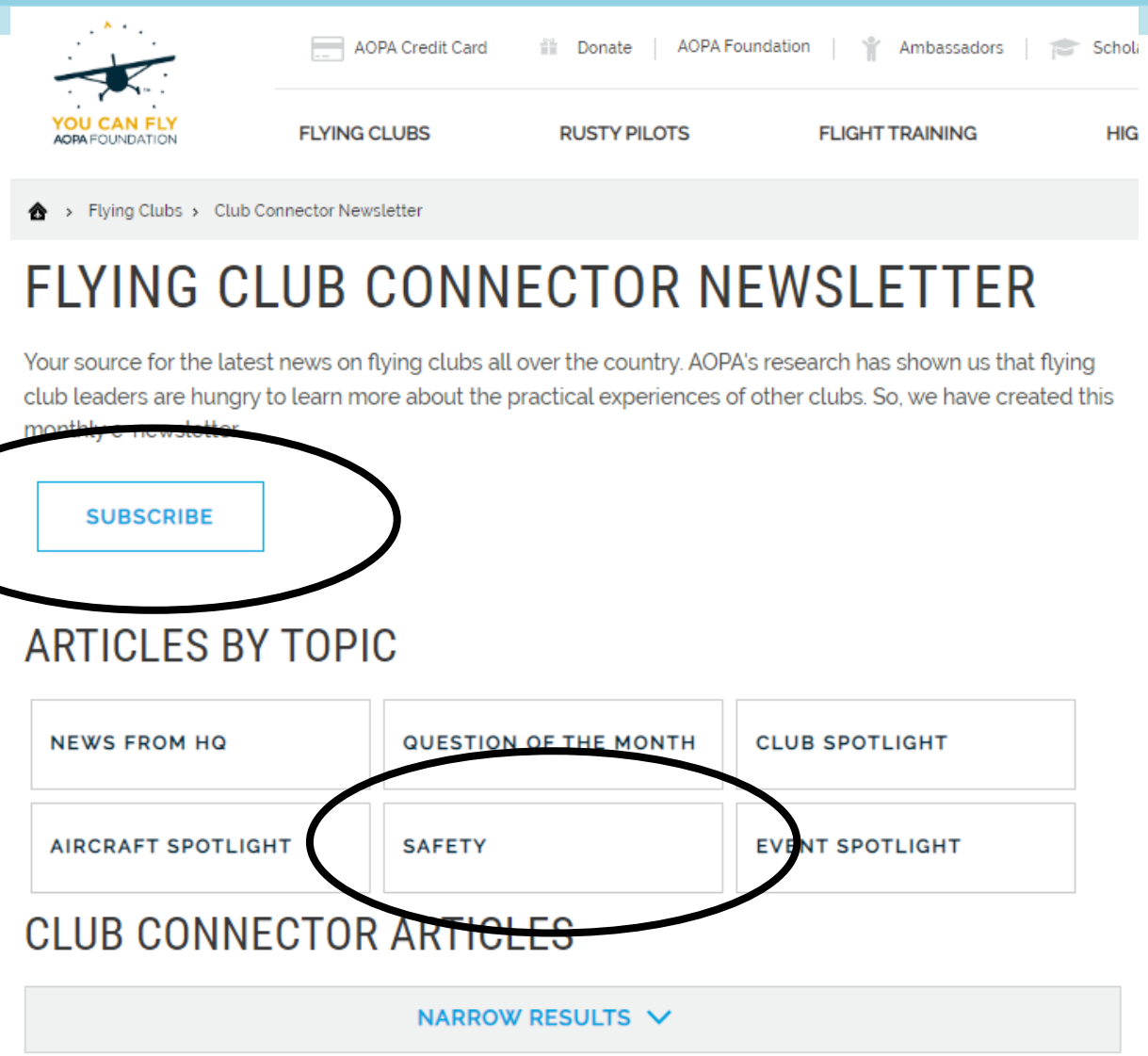
Welcome

- **Steve Bateman, CFI; AOPA Flying Clubs; Aviation Instructor Professional Pilot Program, COCC; FAASTeam Lead Rep Portland FSDO; *WINGS*Pro**
- **Your monthly 33-minute dose of aviation safety**
- ***WINGS* Credit: Yes…!**
- **No time for questions, but please send me email:**
  steve.bateman@aopa.org
  Tel: 301 695 2356
- ***Webinar email (ycfg2w2@aopa.org) is unmonitored—you will not get a reply!!!!***

So…

- **No recording…but even better…**
  - https://youcanfly.aopa.org/flying-clubs/flying-club-newsletter

- **You can download the presentation!**
  - This and earlier ToM presentations are available…
  - Sign-up now!
  - December edition 12/17/2023



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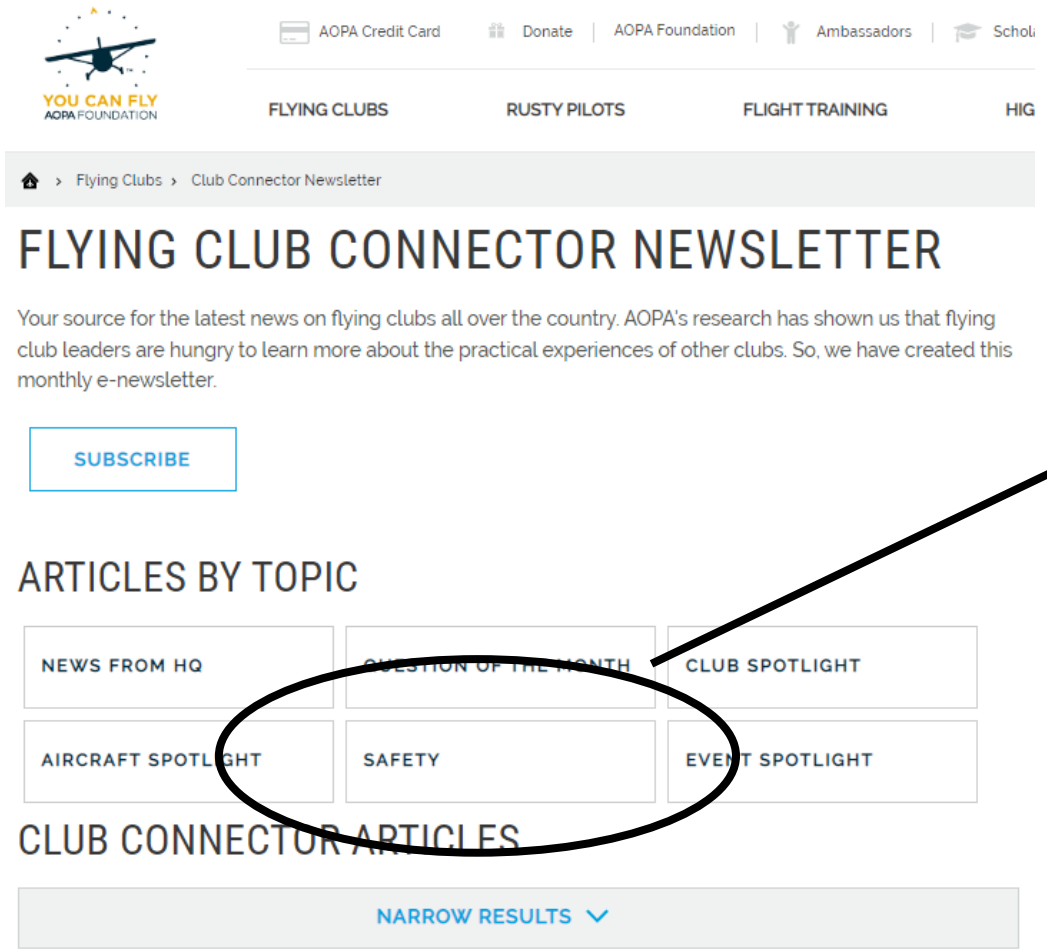
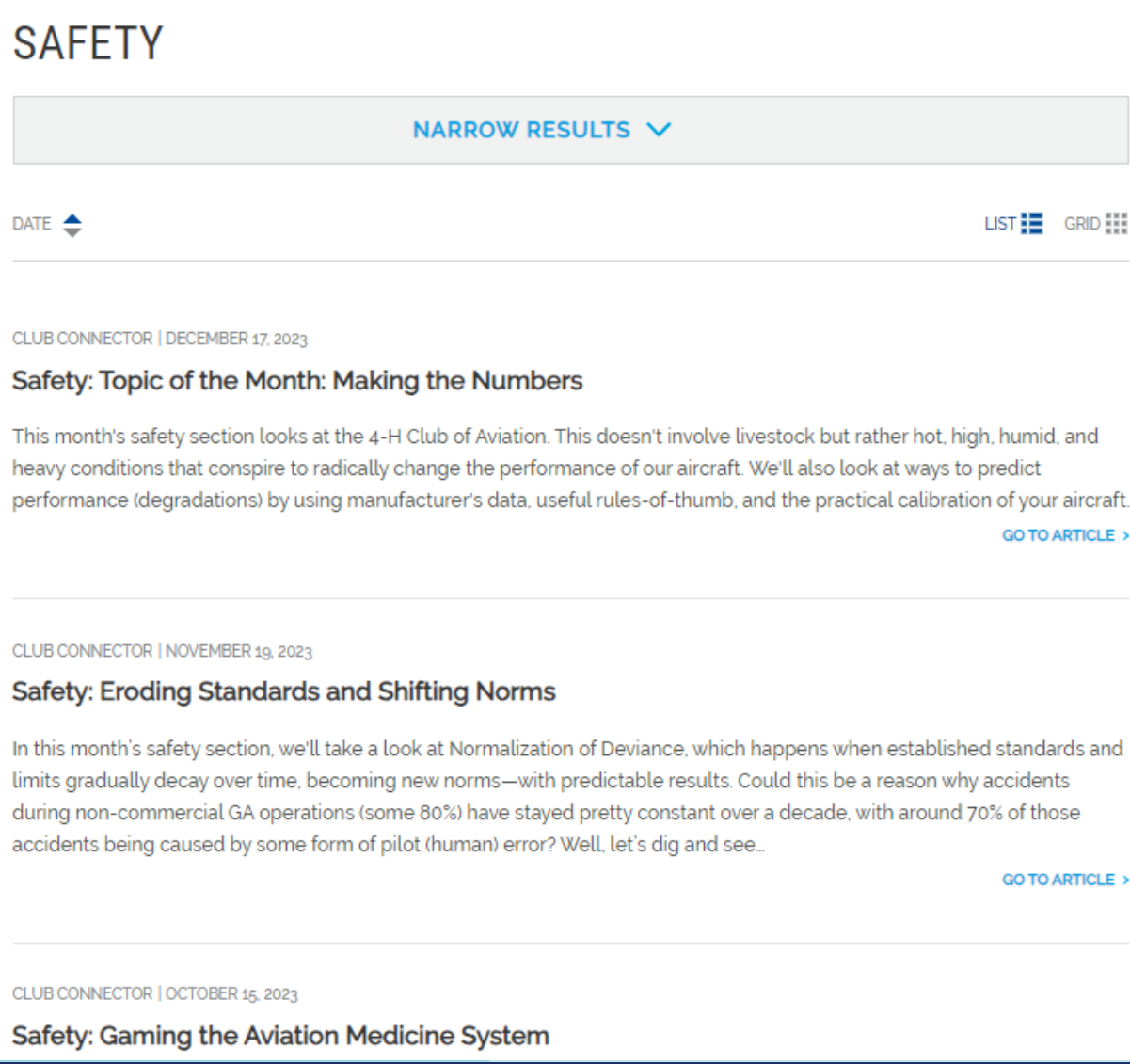





Check NOTAMS!

Overview : Aircraft Performance

- **Why**
  - Accidents are attributed to performance expectations vs. reality
- **What**
  - Determine how your aeroplane (and you) will perform in different conditions
- **How**
  - Book work and brain work for the numbers
  - Stick work for the understanding
  - Calibrate you and your aircraft

Why…

Accidents occurring hot, high, humid and heavy situations led The General Aviation Joint Safety Committee (GAJSC) to study this in more detail and concluded that many of these accidents were caused by inaccurate and/or unreasonable expectations about aircraft performance.

Classic example of human biases…it worked last time…

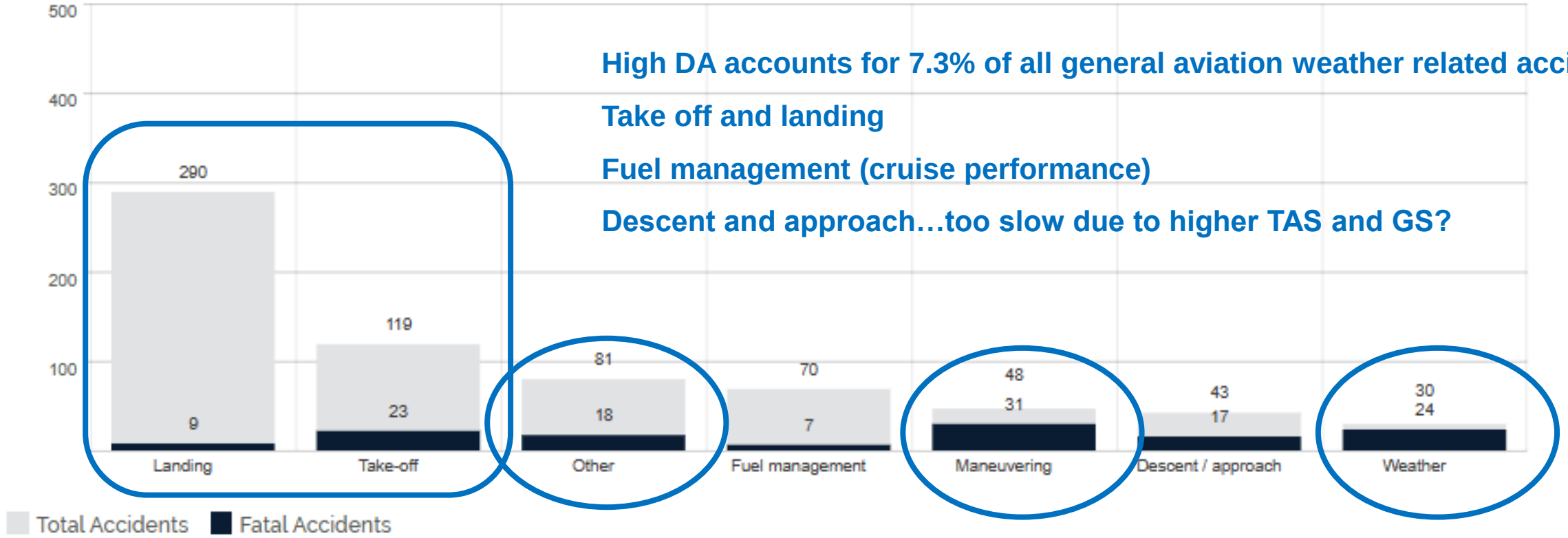
https://en.wikipedia.org/wiki/List_of_cognitive_biases

Accidents Involving Performance

Figure 1.11: Major types of accidents

2021 Non-commercial fixed-wing

THE RICHARD G. MCSPADDEN REPORT
33RD AOPA AIR SAFETY INSTITUTE ACCIDENT REPORT



High DA accounts for 7.3% of all general aviation weather related accidents

Take off and landing

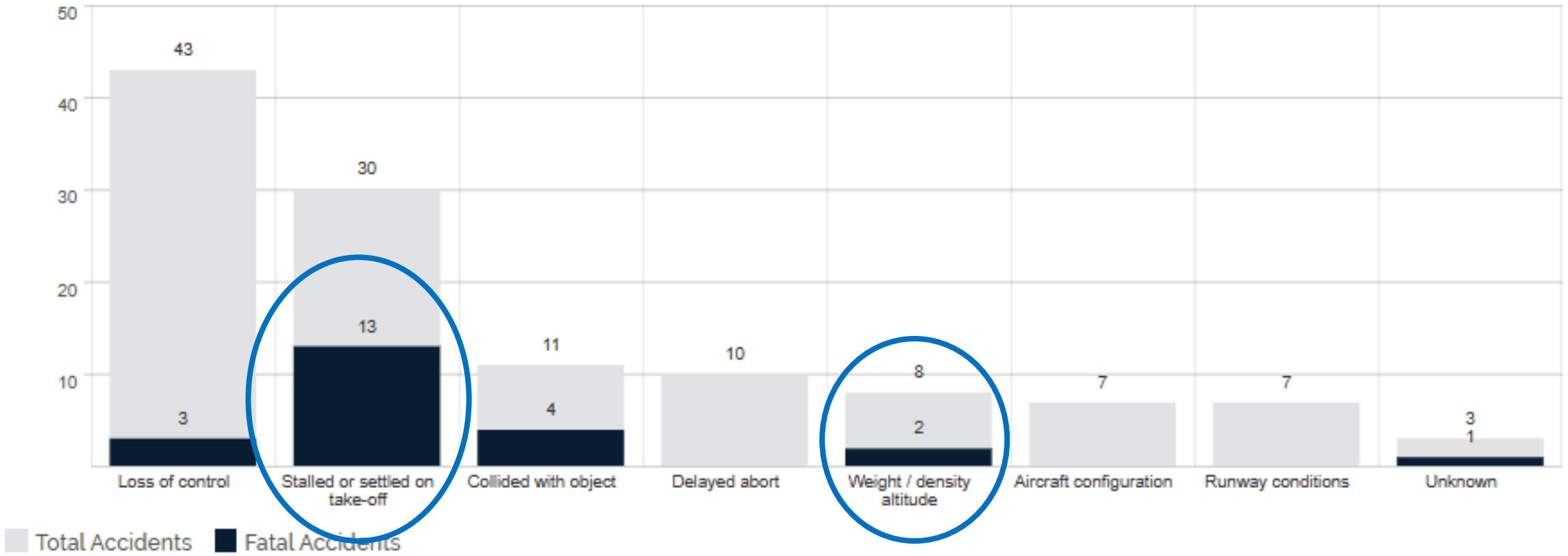
Fuel management (cruise performance)

Descent and approach…too slow due to higher TAS and GS?

Types of Take Off Accidents

Figure 1.3.2: Types of takeoff and climb accidents

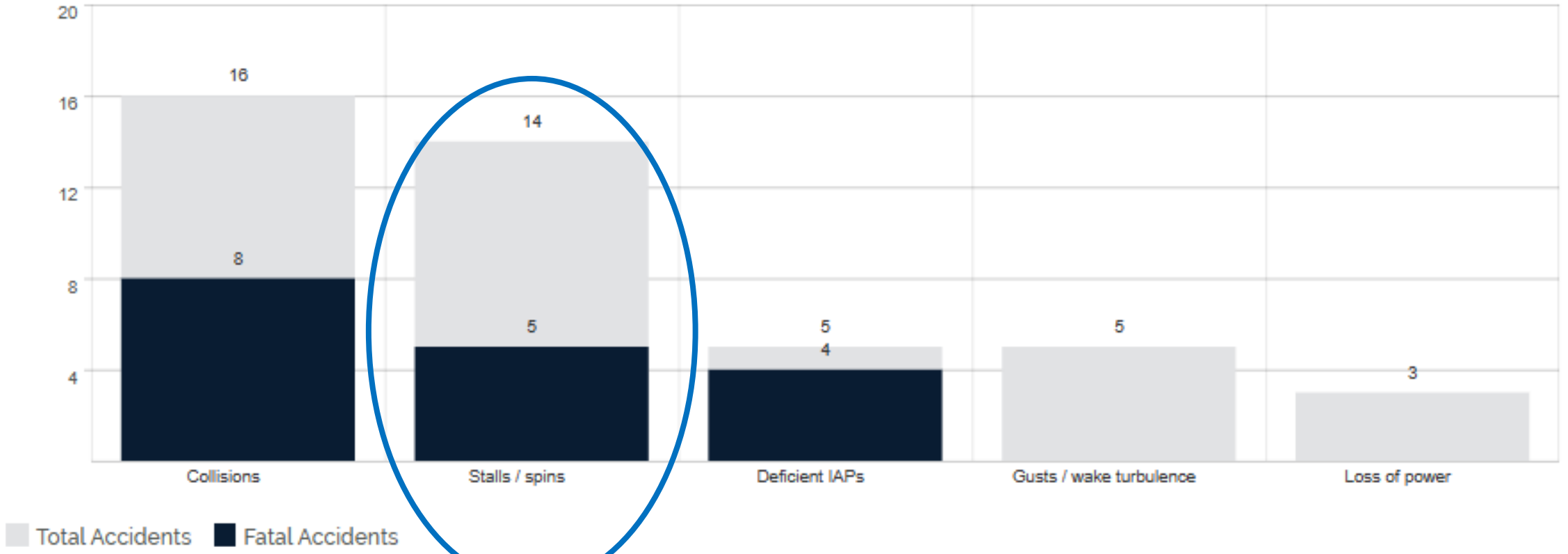
2021 Non-commercial fixed-wing



Types Descent and Approach Accidents

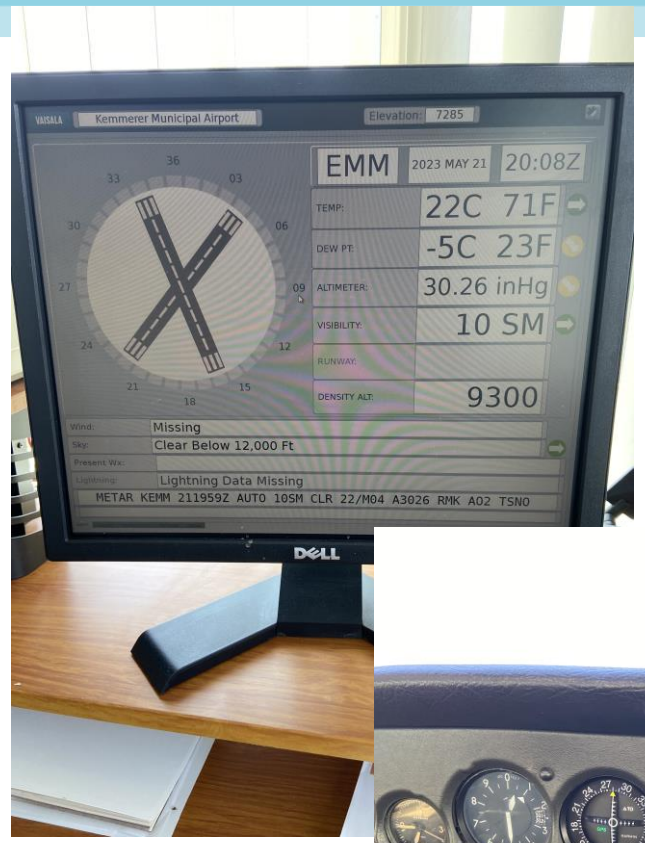
Figure 1.6.2: Types of descent and approach accidents

2021 Non-commercial fixed-wing



What: The (Aviation) 4-H Club

- **Hot**
  - Field temperature (take off and landing performance)
  - Temp at altitude (cruise performance)
- **High**
  - Altitude = lower air density
  - Low pressure day = lower air density
- **Humid**
  - Relative humidity
  - T & DP
  - Hot air can hold more water vapor = lower air density
- **Heavy**
  - More W requires more L to get up and stay airborne
  - Where does “more L” come from?
  - Lift comes from V^2 and/or C_L (airspeed and/or AoA)



It’s a regulation: (91.103) know all there is to know…

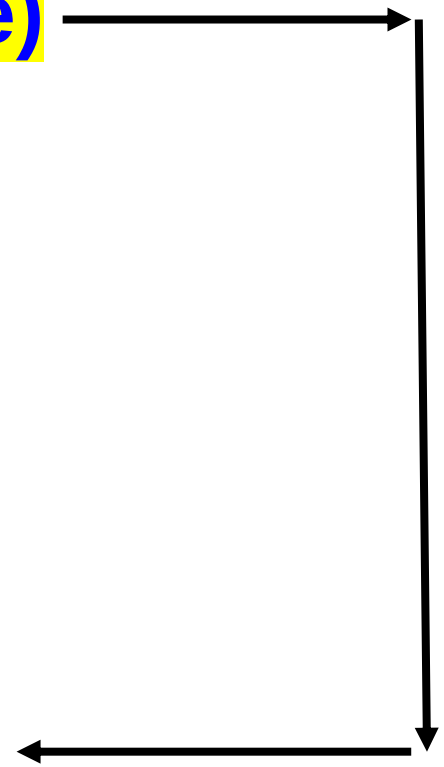
- **W** **Weather**
- **K** **Known issues: NOTAMs, TFRs**

- **R** **Runways of intended use**
- **A** **Alternatives**
- **F** **Fuel management**
- **T** **Take-off and landing performance**

It’s a regulation: (91.103) know all there is to know…

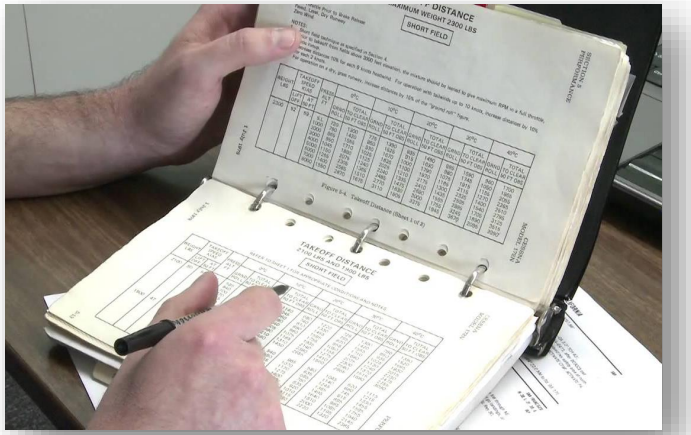
- **W** **Weather (including density altitude)**
- **K** **Known issues: NOTAMs, TFRs**

- **R** **Runways of intended use**
- **A** **Alternatives**
- **F** **Fuel management**
- **T** **Take-off and landing performance**



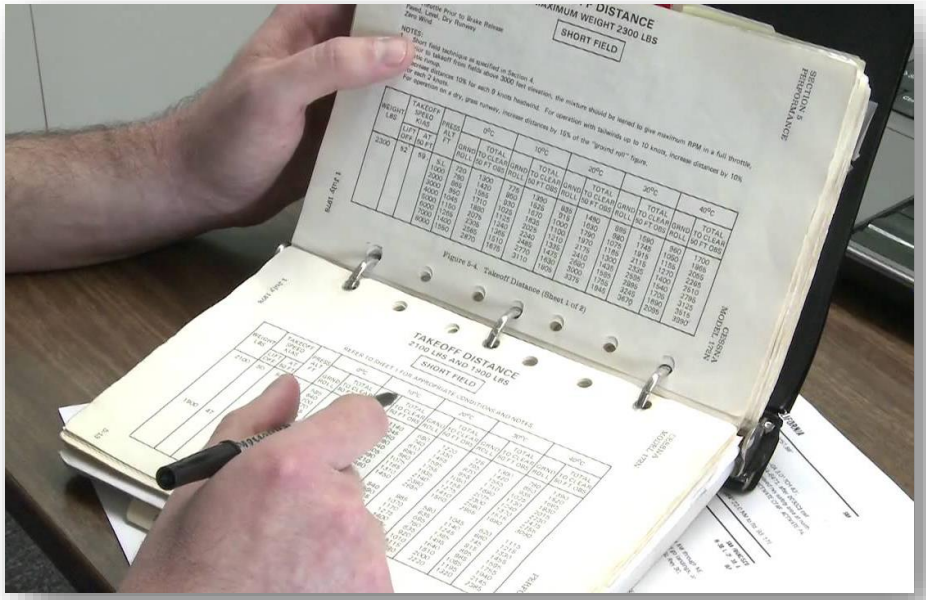
How often have you heard….

- **She'll haul anything you can fit in the door**
- **Relax…I flew it in here, I'll fly it out (umm, but when…)**
- **We've got plenty of fuel…(umm…perhaps too much?)**
  - Multi-dimensional trade-off. More fuel, but more weight…



Pilots need to understand and act on…

- **Takeoff and climb performance**
- **Cruise performance**
- **Approach and landing performance**
- **Emergency performance**
  - Aircraft weight
  - Wind
  - Runway composition, condition, length, slope
  - Obstacles



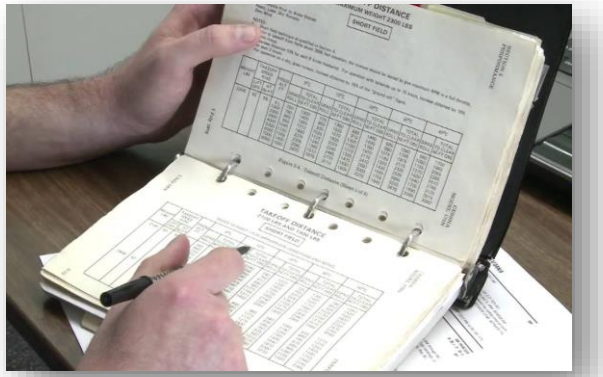
Pilots need to understand and act on…

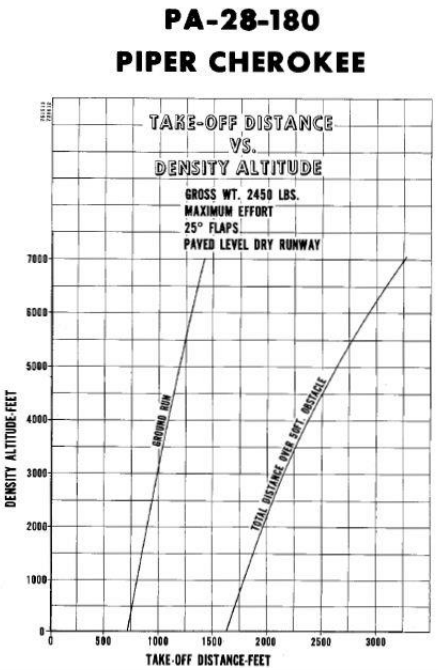
- **Weight and balance calculations**
  - Take off weight and CG location
    - Don’t guess—weigh it!
    - Location, location, location
    - Objects may shift in flight…
    - Document your work (e.g., EFB)

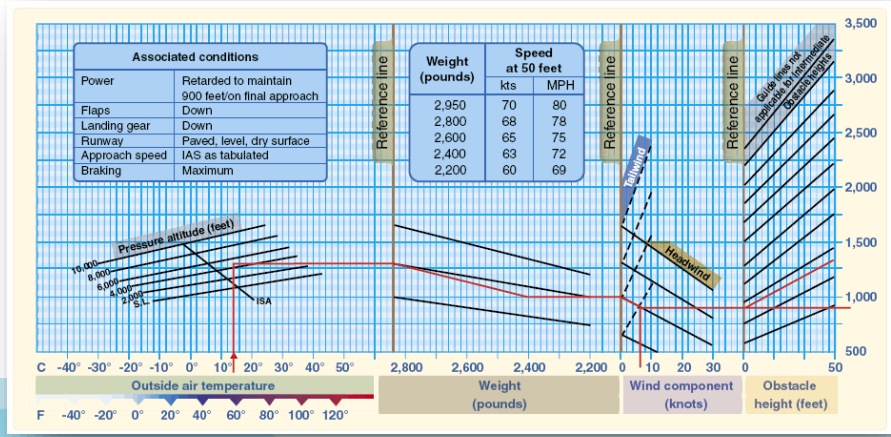
- **Experience it…**
  - At some stage, you will try to push it…
  - Fly the airplane, at or near max gross weight
  - Pick a long runway…
  - With a CFI (pick a CFI who has actually done it…)

Pilots need to know – performance calculations

- **DA and weight impacts:**
  - Take off distance
  - Landing distance
  - Climb performance & obstacle clearance
  - Cruise performance
- **Runway length, composition, condition and slope**
  - Impact on take off distance
  - Influence on landing distance
- **Aircraft configuration**
  - Normal, short field, soft field
  - Flap settings

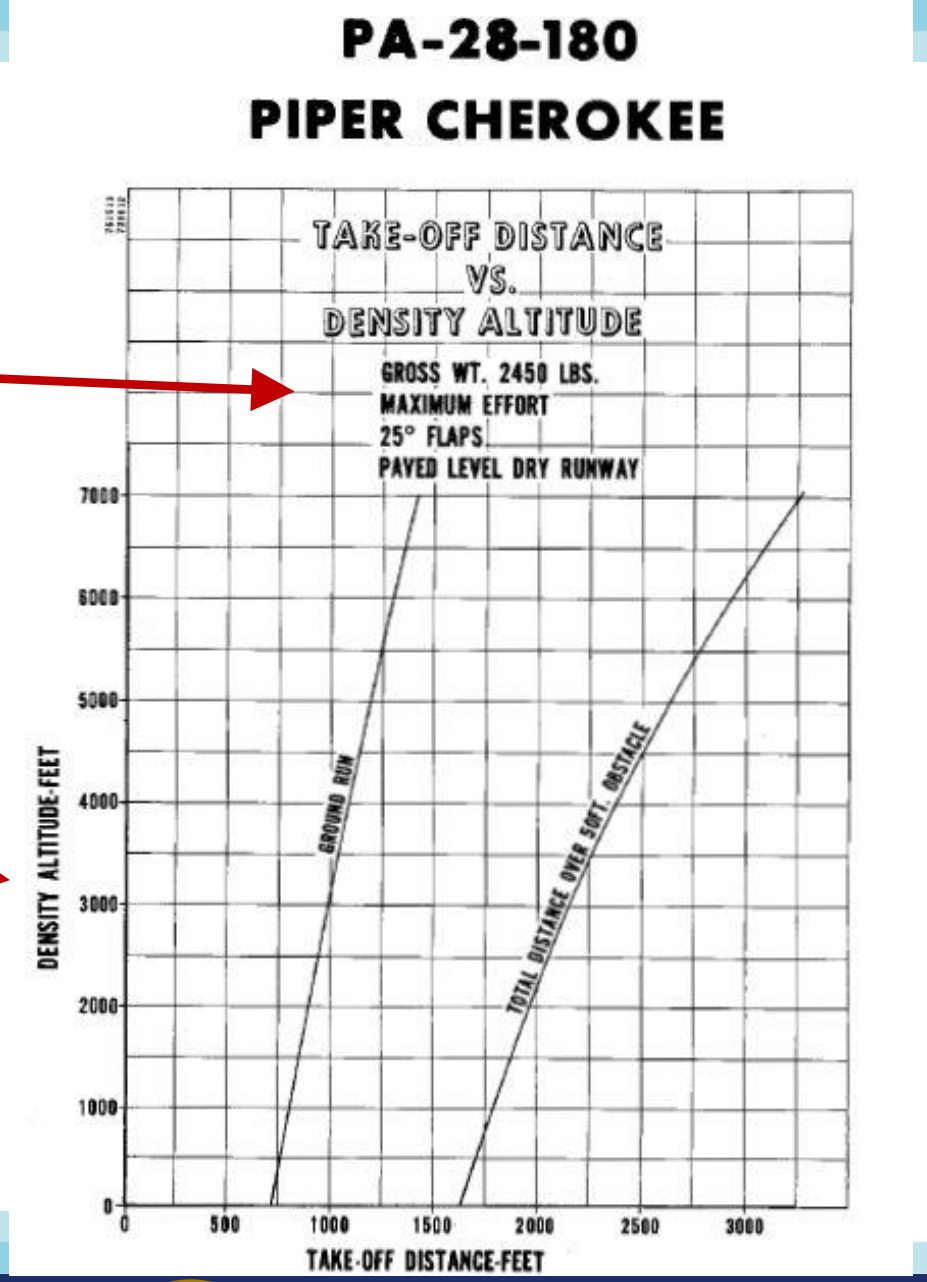






Take off calculations

- It's all about DA and weight
- Stated conditions…
- Need to know DA and weight for this Piper table



Take off calculations

- It's all about DA and weight
- Need to know PA, temp & weight for this Cessna table
- Read the conditions and notes!
- You, yeah you…Chuck, the test pilot

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

- But wait, there's more…

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 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:

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4. For operation on dry, grass runway, increase distances by 15% of the "ground roll" figure.

Figure 5-5. Short Field Takeoff Distance (Sheet 1 of 3)

Same aircraft…different conditions

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
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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.

Figure 5-5. Short Field Takeoff Distance (Sheet 1 of 3)

Impact of weight

Impact of DA

(PA and Temp)

But wait, there's more

SHORT FIELD TAKEOFF DISTANCE AT 2200 POUNDS

CONDITIONS:

Flaps 10°
Full Throttle Prior to Brake Release
Paved, level, dry runway
Zero Wind
Lift Off: 44 KIAS
Speed at 50 Ft: 50 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.	610	1055	655	1130	705	1205	760	1290	815	1380
1000	665	1145	720	1230	770	1315	830	1410	890	1505
2000	725	1250	785	1340	845	1435	905	1540	975	1650
3000	795	1365	860	1465	925	1570	995	1685	1065	1805
4000	870	1490	940	1605	1010	1725	1090	1855	1165	1975
5000	955	1635	1030	1765	1110	1900	1195	2035	1275	2175
6000	1050	1800	1130	1940	1220	2090	1310	2240	1400	2395
7000	1150	1985	1245	2145	1340	2305	1435	2475	1540	2650
8000	1270	2195	1370	2375	1475	2555	1580	2745	1695	2950

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.

Figure 5-5. Short Field Takeoff Distance (Sheet 3 of 3)

Take Off and Landing Data

- **Brief each takeoff, approach, and landing**
- **Take off and landing data (TOLD Card):**

My Short Field Takeoff and Landing Performance

Date		Pilot		Instructor	
Airport		Elevation		Temperature	
Density Altitude		Wind Dir./ Speed		X-Wind	
Runway		Runway Length		Runway Composition	
Aircraft		Gross Weight		Test Weight	
Takeoff Flap Setting		Rotation Speed X.07		Rotation Speed	
Vx/Vy		Takeoff Distance		50 Ft. Obstacle Dist.	
Landing Flap Setting		Approach Speed		Landing Distance	

Take-Off & Landing Distance Card - (See DA Graph)

Airplane Type: **Tail Number:** **Date:**

ATIS/WX Data:	Value:	Comments:
Date:		
Time:		
Airport:		
Info ID:		
Mag. Wind:		Headwind comp = WV*Cos(α)
Viz:		
Sky:		
Temp:		
Dew point:		
Altimeter:		
Expected runway:		
Runway length:		
Remarks:		
Calculated Data:	**Value:**	**Comments:**
Pressure Altitude.		
Density Altitude:		See DA table.
Take-off distances:		See PoH page: Take-off conditions:
a. Ground roll:		
b. To clear 50ft:		
c. TO speed IAS (V_R):		
d. Vx speed IAS (V_X):		
e. TO speed @ 50ft:		
f. Accel. stop distance: (2.5 x TO roll):		
Climb rate:		See PoH page:
a. Rate of Climb (FPM):		
b. Climb IAS (V_Y):		
Landing distances:		Conditions: See PoH page:
a. Ground roll:		
b. To clear 50ft:		
c. Landing speed @ 50ft:		
Hydroplane speed: SQRT(PSI)*9	50 40	At 30PSI. At 20PSI.

Note: Note: Take care with sign (+/-) of wind and field condition fiddle factors.

Pilots need to understand and act on…

- **Takeoff and departure calculations**
- **Rejected takeoff decision point**
  - 50/70 rule (be at 70% V_r by 50% distance)
    - 54 kts or mph rotation speed
      - 60 x 70% = 42
    - 1,420 ft. available
      - 1,420’ x 50% = 710‘

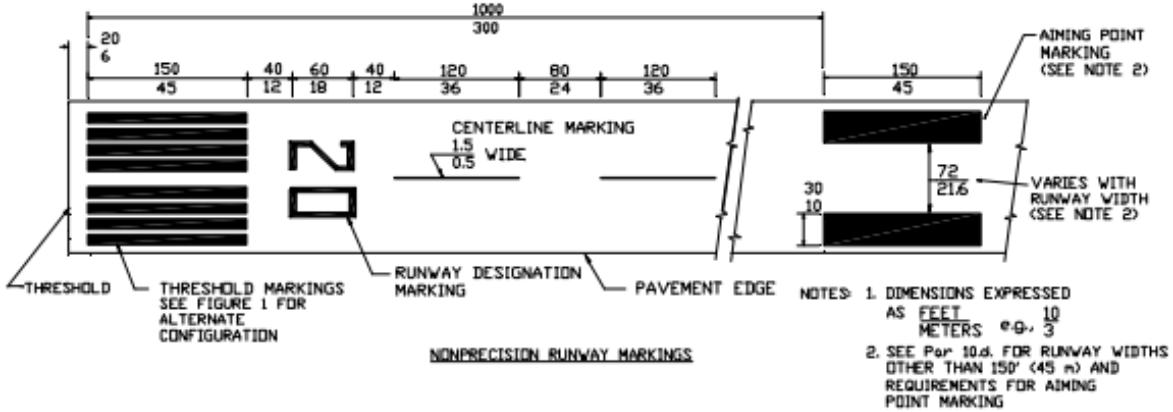
- **Terrain and obstructions**
  - Can you climb out without hitting anything?
- **Forced landing opportunities**
  - First time taking off from that field?
  - Where will you go?

Know your runway markings and distances

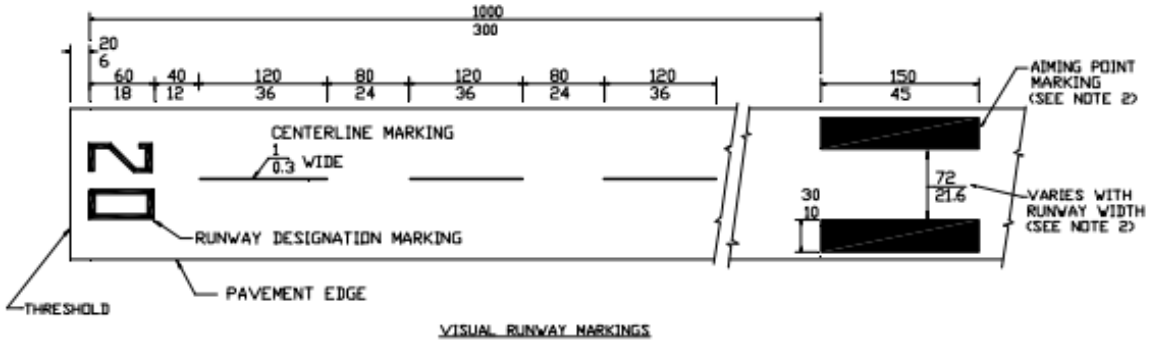
U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Standards for Airport Markings
Date: 12/23/2020
AC No: 150/5340-1M
Initiated By: AAS-100
Change: 1



NONPRECISION RUNWAY MARKINGS



VISUAL RUNWAY MARKINGS

- https://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5340-1M-Chg-1-Airport-Markings.pdf

Where is, say, 710 feet?

Threshold to first stripe = 310’

Each stripe = 120’

Each gap = 80’

Start of third stripe = 710’

Or…be reasonable…it’s between the 500’ and 1000’ markers!

Recommendations:

- **Brief each takeoff, approach, and landing**
  - Helps reduce impact of startle—get “it” in your head
  - Performance expectations vs data
  - Runway and available distance for takeoff or landing
    - Make every landing a precision landing
  - Aircraft configuration and target airspeeds
  - Rejected takeoff or landing decision point
  - Departure/approach path
  - Obstacles and terrain
  - Return to airport altitude
  - Forced landing prospects

} **Conundrum**

Pilots need to know

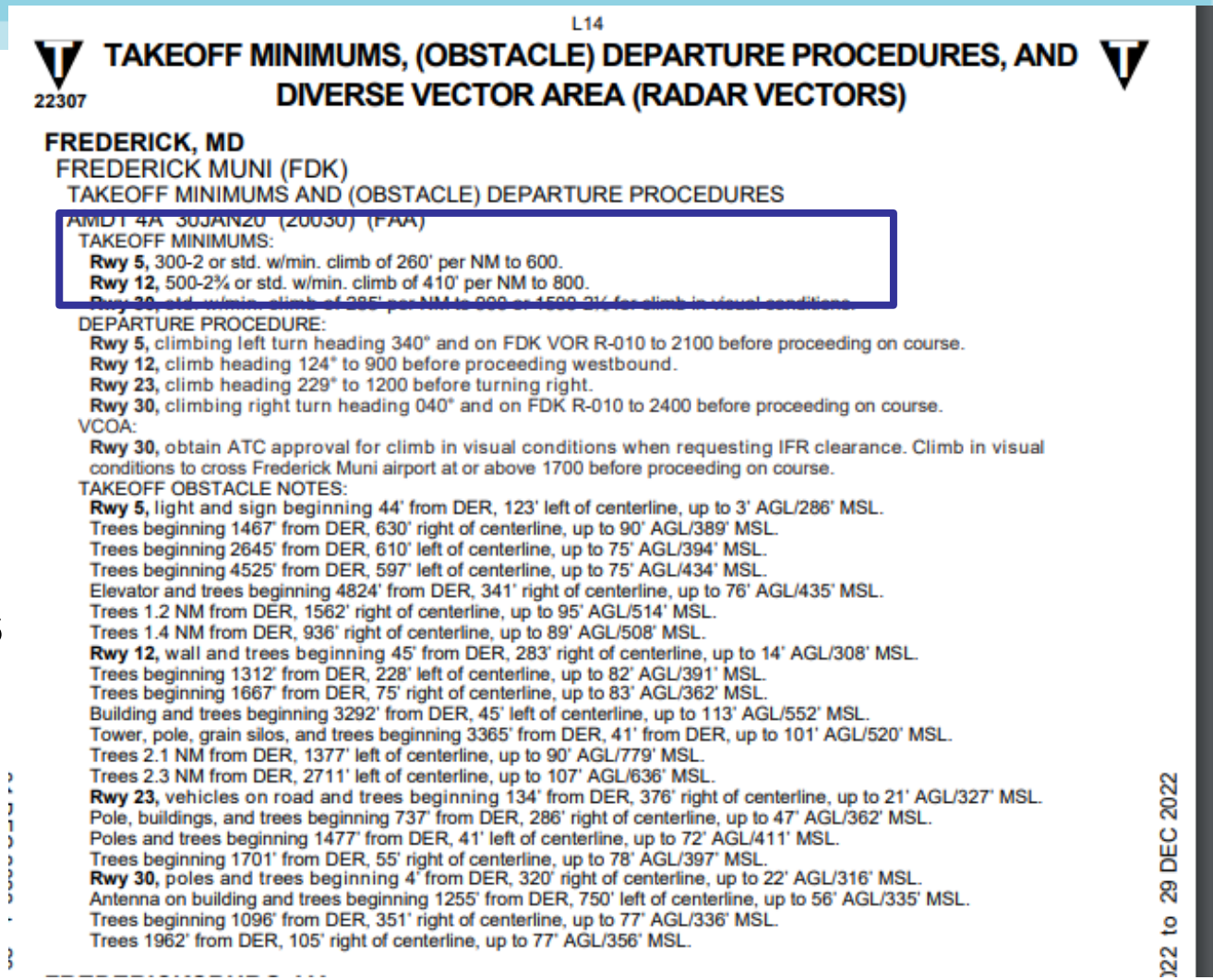
- **Terrain and obstructions**
- **Forced landing challenges and opportunities**
  - Consider this on the *approach* (to unknown airport)
  - Fly over, check wind, check for off-field landing spots
- **Even if VFR, know the ODPs…**

Take off and obstacle procedures are in the TPP

- **TPP: Terminal Procedures Publication**
- **Online**
  - Search for Digital TPP
  - https://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/dtpp/
- **PDF and paper version available**
- **A sort of Chart Supplement for instrument pilots**
- **Approach plates, approach and departure procedures…and more…**

Departure Procedures

- **Even if VFR, know the (IFR) *take off minimums***
- **Here, runway 12 requires a minimum climb of 410’ per NM to 800’**
- **Feet per NM?**
  - Yes - this is climb *gradient* (not rate)
- **We use this for instrument departures as we don’t want to hit things**
- **FPM = FPNM * GS/60**
- **At 90 knots, requires 615 FPM**
- **Can Gigi do it this, *today*?**
- **How do you know?**



L14

22307 **TAKEOFF MINIMUMS, (OBSTACLE) DEPARTURE PROCEDURES, AND DIVERSE VECTOR AREA (RADAR VECTORS)**

FREDERICK, MD

FREDERICK MUNI (FDK)

TAKEOFF MINIMUMS AND (OBSTACLE) DEPARTURE PROCEDURES

AMDT 4A 30JAN20 (20030) (FAA)

TAKEOFF MINIMUMS:

Rwy 5, 300-2 or std. w/min. climb of 260' per NM to 600.

Rwy 12, 500-2¾ or std. w/min. climb of 410' per NM to 800.

Rwy 30, std. w/min. climb of 385' per NM to 900 or 1500-3¼ for climb in visual conditions.

DEPARTURE PROCEDURE:

Rwy 5, climbing left turn heading 340° and on FDK VOR R-010 to 2100 before proceeding on course.

Rwy 12, climb heading 124° to 900 before proceeding westbound.

Rwy 23, climb heading 229° to 1200 before turning right.

Rwy 30, climbing right turn heading 040° and on FDK R-010 to 2400 before proceeding on course.

VCOA:

Rwy 30, obtain ATC approval for climb in visual conditions when requesting IFR clearance. Climb in visual conditions to cross Frederick Muni airport at or above 1700 before proceeding on course.

TAKEOFF OBSTACLE NOTES:

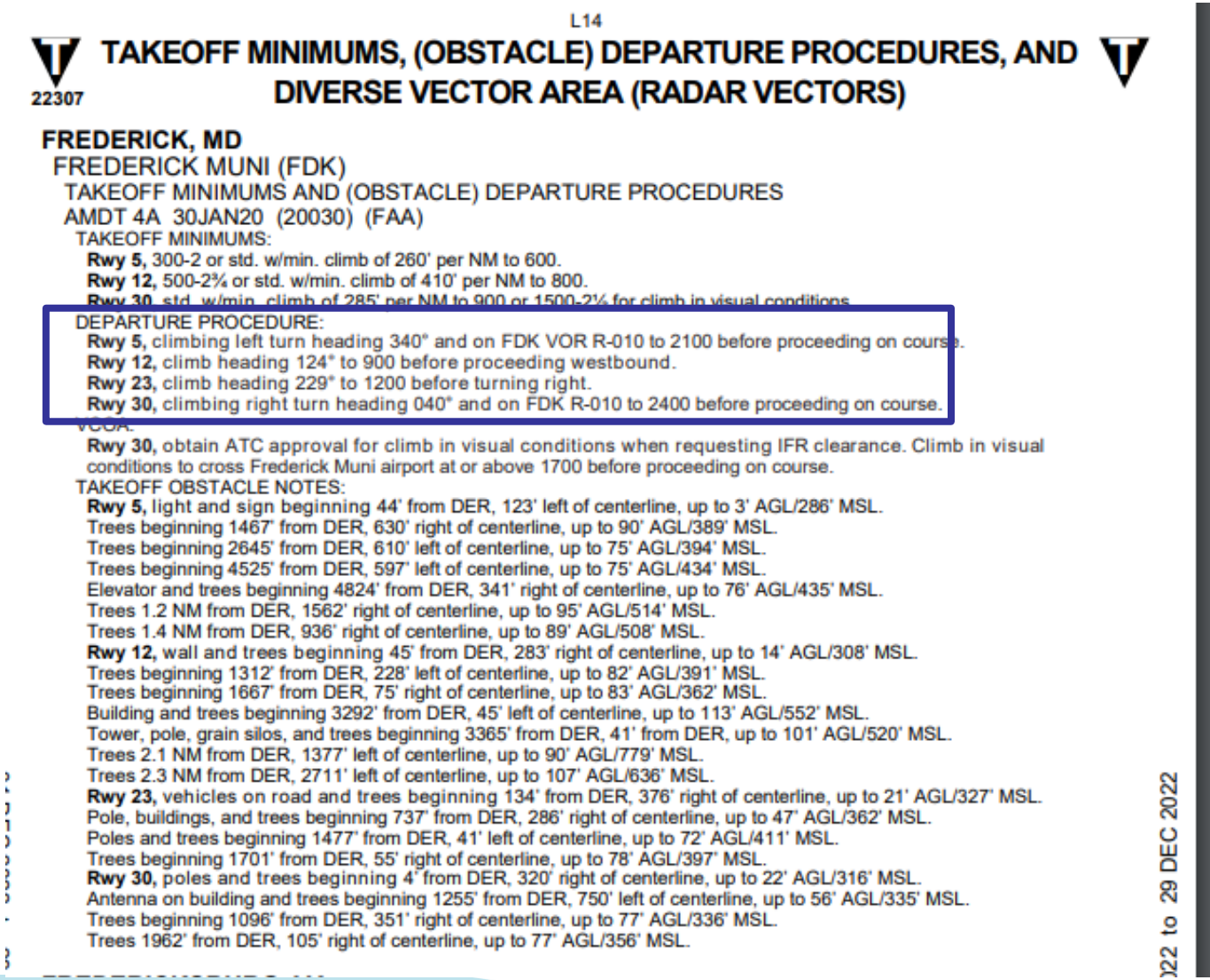
Rwy 5, light and sign beginning 44' from DER, 123' left of centerline, up to 3' AGL/286' MSL.
Trees beginning 1467' from DER, 630' right of centerline, up to 90' AGL/389' MSL.
Trees beginning 2645' from DER, 610' left of centerline, up to 75' AGL/394' MSL.
Trees beginning 4525' from DER, 597' left of centerline, up to 75' AGL/434' MSL.
Elevator and trees beginning 4824' from DER, 341' right of centerline, up to 76' AGL/435' MSL.
Trees 1.2 NM from DER, 1562' right of centerline, up to 95' AGL/514' MSL.
Trees 1.4 NM from DER, 936' right of centerline, up to 89' AGL/508' MSL.
Rwy 12, wall and trees beginning 45' from DER, 283' right of centerline, up to 14' AGL/308' MSL.
Trees beginning 1312' from DER, 228' left of centerline, up to 82' AGL/391' MSL.
Trees beginning 1667' from DER, 75' right of centerline, up to 83' AGL/362' MSL.
Building and trees beginning 3292' from DER, 45' left of centerline, up to 113' AGL/552' MSL.
Tower, pole, grain silos, and trees beginning 3365' from DER, 41' from DER, up to 101' AGL/520' MSL.
Trees 2.1 NM from DER, 1377' left of centerline, up to 90' AGL/779' MSL.
Trees 2.3 NM from DER, 2711' left of centerline, up to 107' AGL/636' MSL.
Rwy 23, vehicles on road and trees beginning 134' from DER, 376' right of centerline, up to 21' AGL/327' MSL.
Pole, buildings, and trees beginning 737' from DER, 286' right of centerline, up to 47' AGL/362' MSL.
Poles and trees beginning 1477' from DER, 41' left of centerline, up to 72' AGL/411' MSL.
Trees beginning 1701' from DER, 55' right of centerline, up to 78' AGL/397' MSL.
Rwy 30, poles and trees beginning 4' from DER, 320' right of centerline, up to 22' AGL/316' MSL.
Antenna on building and trees beginning 1255' from DER, 750' left of centerline, up to 56' AGL/335' MSL.
Trees beginning 1096' from DER, 351' right of centerline, up to 77' AGL/336' MSL.
Trees 1962' from DER, 105' right of centerline, up to 77' AGL/356' MSL.

022 to 29 DEC 2022

Departure Procedures

Departure Procedures

- **Even if VFR, know the *departure procedures and requirements***
- **Here, runway 12:**
  - Climb heading 124º to 900’ before proceeding westbound
  - Lots of notes to help you avoid hitting things…
- **So…we need to know take-off performance *AND* climb performance**



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22307 **TAKEOFF MINIMUMS, (OBSTACLE) DEPARTURE PROCEDURES, AND DIVERSE VECTOR AREA (RADAR VECTORS)**

FREDERICK, MD

FREDERICK MUNI (FDK)

TAKEOFF MINIMUMS AND (OBSTACLE) DEPARTURE PROCEDURES

AMDT 4A 30JAN20 (20030) (FAA)

TAKEOFF MINIMUMS:

Rwy 5, 300-2 or std. w/min. climb of 260' per NM to 600.

Rwy 12, 500-2¾ or std. w/min. climb of 410' per NM to 800.

Rwy 30, std. w/min. climb of 285' per NM to 900 or 1500-2¼ for climb in visual conditions.

DEPARTURE PROCEDURE:

Rwy 5, climbing left turn heading 340° and on FDK VOR R-010 to 2100 before proceeding on course.

Rwy 12, climb heading 124° to 900 before proceeding westbound.

Rwy 23, climb heading 229° to 1200 before turning right.

Rwy 30, climbing right turn heading 040° and on FDK R-010 to 2400 before proceeding on course.

VCOA:

Rwy 30, obtain ATC approval for climb in visual conditions when requesting IFR clearance. Climb in visual conditions to cross Frederick Muni airport at or above 1700 before proceeding on course.

TAKEOFF OBSTACLE NOTES:

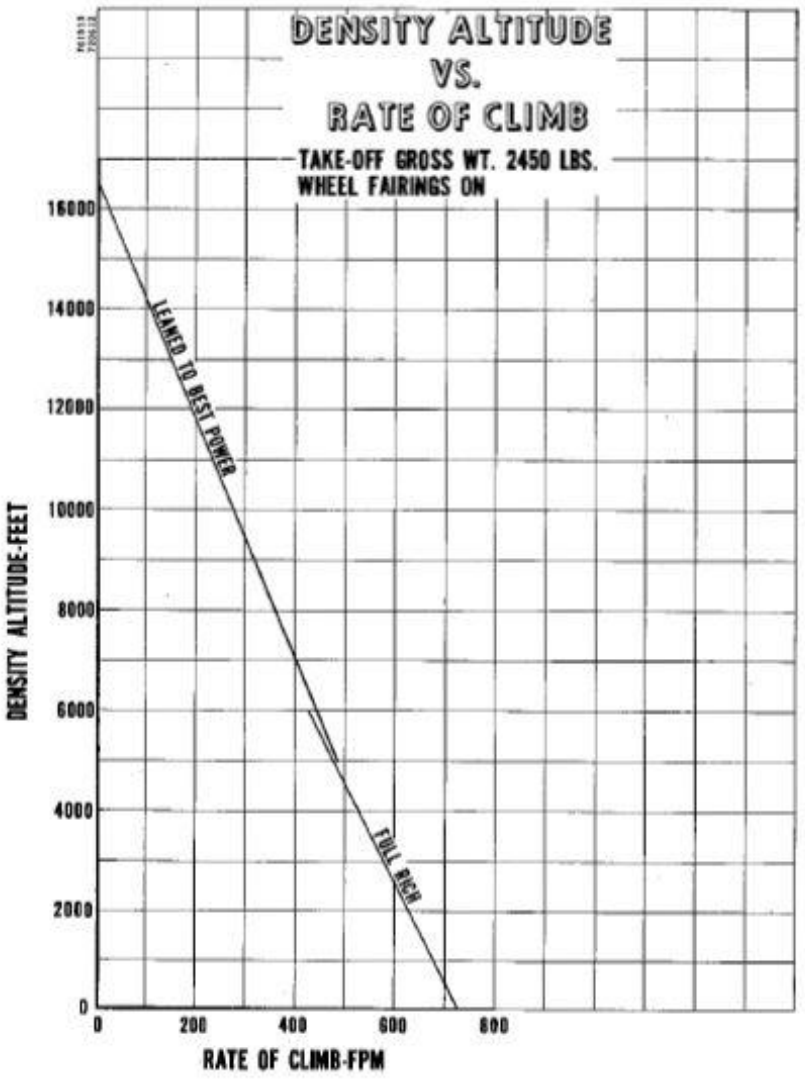
Rwy 5, light and sign beginning 44' from DER, 123' left of centerline, up to 3' AGL/286' MSL.
Trees beginning 1467' from DER, 630' right of centerline, up to 90' AGL/389' MSL.
Trees beginning 2645' from DER, 610' left of centerline, up to 75' AGL/394' MSL.
Trees beginning 4525' from DER, 597' left of centerline, up to 75' AGL/434' MSL.
Elevator and trees beginning 4824' from DER, 341' right of centerline, up to 76' AGL/435' MSL.
Trees 1.2 NM from DER, 1562' right of centerline, up to 95' AGL/514' MSL.
Trees 1.4 NM from DER, 936' right of centerline, up to 89' AGL/508' MSL.
Rwy 12, wall and trees beginning 45' from DER, 283' right of centerline, up to 14' AGL/308' MSL.
Trees beginning 1312' from DER, 228' left of centerline, up to 82' AGL/391' MSL.
Trees beginning 1667' from DER, 75' right of centerline, up to 83' AGL/362' MSL.
Building and trees beginning 3292' from DER, 45' left of centerline, up to 113' AGL/552' MSL.
Tower, pole, grain silos, and trees beginning 3365' from DER, 41' from DER, up to 101' AGL/520' MSL.
Trees 2.1 NM from DER, 1377' left of centerline, up to 90' AGL/779' MSL.
Trees 2.3 NM from DER, 2711' left of centerline, up to 107' AGL/636' MSL.
Rwy 23, vehicles on road and trees beginning 134' from DER, 376' right of centerline, up to 21' AGL/327' MSL.
Pole, buildings, and trees beginning 737' from DER, 286' right of centerline, up to 47' AGL/362' MSL.
Poles and trees beginning 1477' from DER, 41' left of centerline, up to 72' AGL/411' MSL.
Trees beginning 1701' from DER, 55' right of centerline, up to 78' AGL/397' MSL.
Rwy 30, poles and trees beginning 4' from DER, 320' right of centerline, up to 22' AGL/316' MSL.
Antenna on building and trees beginning 1255' from DER, 750' left of centerline, up to 56' AGL/335' MSL.
Trees beginning 1096' from DER, 351' right of centerline, up to 77' AGL/336' MSL.
Trees 1962' from DER, 105' right of centerline, up to 77' AGL/356' MSL.

)22 to 29 DEC 2022

Climb Performance – DA and Weight

PA-28-180

PIPER CHEROKEE



MAXIMUM RATE-OF-CLIMB AT 2550 POUNDS

CONDITIONS:

Flaps Up
Full Throttle

PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB - FPM			
		-20°C	0°C	20°C	40°C
S.L.	74	855	785	710	645
2000	73	760	695	625	560
4000	73	685	620	555	495
6000	73	575	515	450	390
8000	72	465	405	345	285
10,000	72	360	300	240	180
12,000	72	255	195	135	- - -

NOTE:

1. Mixture leaned above 3,000 feet for maximum RPM.

Figure 5-6. Maximum Rate of Climb

Notes:

- V_Y reduces with DA
- Rate of climb changes are significant

Climb Performance - Leaning

CESSNA
MODEL 172S

SECTION 5
PERFORMANCE

MAXIMUM RATE-OF-CLIMB AT 2550 POUNDS

CONDITIONS:

Flaps Up
Full Throttle

PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB - FPM			
		-20°C	0°C	20°C	40°C
S.L.	74	855	785	710	645
2000	73	760	695	625	560
4000	73	685	620	555	495
6000	73	575	515	450	390
8000	72	465	405	345	285
10,000	72	360	300	240	180
12,000	72	255	195	135	- - -

NOTE:

1. Mixture leaned above 3,000 feet for maximum RPM.

Figure 5-6. Maximum Rate of Climb

Note the note!

Lean above 3,000' (DA)

Some planes have a climb leaning table

RATE OF CLIMB

CONDITIONS:
Flaps Up
Gear Up
2700 RPM
Full Throttle
Mixture Set at Placard Fuel Flow
Cowl Flaps Open

MIXTURE SETTING	
PRESS ALT	GPH
S. L.	17
4000	15
8000	13
12,000	10

WEIGHT LBS	PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB – FPM			
			-20°C	0°C	20°C	40°C
2800	S.L.	82	1080	990	905	815
	2000	81	960	875	790	705
	4000	81	840	760	675	595
	6000	80	725	645	565	485
	8000	79	610	530	455	380
	10,000	79	495	420	350	- - -
	12,000	78	385	315	245	- - -

Weight, DA, Transition Training, Configuration

National Transportation Safety Board
Aviation Accident Final Report

Location:	Waterford, Michigan	**Accident Number:**	CEN13FA364
Date & Time:	June 21, 2013, 13:40 Local	**Registration:**	N9926Q
Aircraft:	Cessna 172M	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	4 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

Air traffic control tower personnel saw the airplane lift off the runway and attain an altitude of about 100 feet. A pilot approaching the runway for landing saw the airplane lift off and noticed it was not climbing. He saw the airplane "lagging" and "wallowing in the air with flaps extended." Shortly after, the accident pilot advised an air traffic controller that he was "a little overweight" and would need to return to the airport and land. The air traffic controller cleared the airplane to land on the parallel runway or the grass area surrounding the runways. The pilot did not respond. Several witnesses near the airport, including the pilot in the landing airplane, saw the accident airplane impact the ground and burst into flames. A postaccident examination revealed that the wing flaps were fully extended (40 degrees). Weight and balance calculations indicated the airplane was slightly under maximum gross weight. Postaccident examinations revealed no evidence of preimpact mechanical malfunctions or failures that would have precluded normal operation.

Field at 981', 28C, 30.17"
DA = 2,500'

Estimated gross weight 2,298.5 pounds
Maximum allowable gross weight 2,300 pounds

https://www.youtube.com/watch?v=eYqS-j3pUHY

Time, Fuel and Distance to Climb

TIME, FUEL, AND DISTANCE TO CLIMB

MAXIMUM RATE OF CLIMB

CONDITIONS:
Flaps Up
Gear Up
2700 RPM
Full Throttle
Mixture Set at Placard Fuel Flow
Cowl Flaps Open
Standard Temperature

MIXTURE SETTING	
PRESS ALT	GPH
S.L.	17
4000	15
8000	13
12,000	10

NOTES:
1. Add 1.5 gallons of fuel for engine start, taxi and takeoff allowance.
2. Increase time, fuel and distance by 10% for each 10°C above standard temperature.
3. Distances shown are based on zero wind.

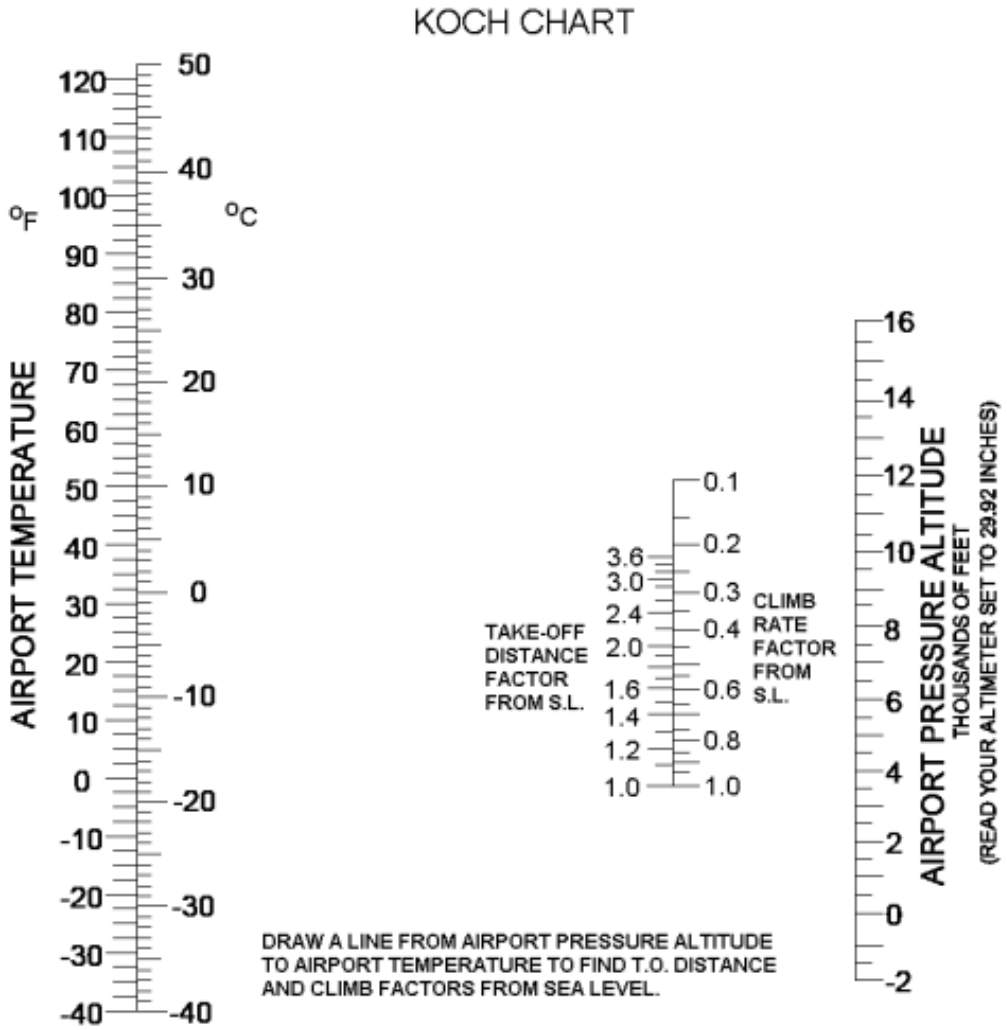
WEIGHT LBS	PRESSURE ALTITUDE FT	TEMP °C	CLIMB SPEED KIAS	RATE OF CLIMB FPM	FROM SEA LEVEL		
					TIME MIN	FUEL USED GALLONS	DISTANCE NM
2800	S.L.	15	82	925	0	0	0
	1000	13	82	875	1	0.3	2
	2000	11	81	830	2	0.6	3
	3000	9	81	780	4	1.0	5
	4000	7	81	730	5	1.3	7
	5000	5	80	685	6	1.6	9
	6000	3	80	635	8	2.0	11
	7000	1	80	585	10	2.4	14
	8000	-1	79	535	11	2.8	17
	9000	-3	79	490	13	3.2	20
	10,000	-5	79	440	16	3.6	23
	11,000	-7	78	390	18	4.1	27
	12,000	-9	78	345	21	4.6	31

- **Read the notes!**
- **To determine values when climbing from say 3,000’ to say 8,000’**
  - Get the 8,000’ values
  - Subtract the 3,000’ values

Example

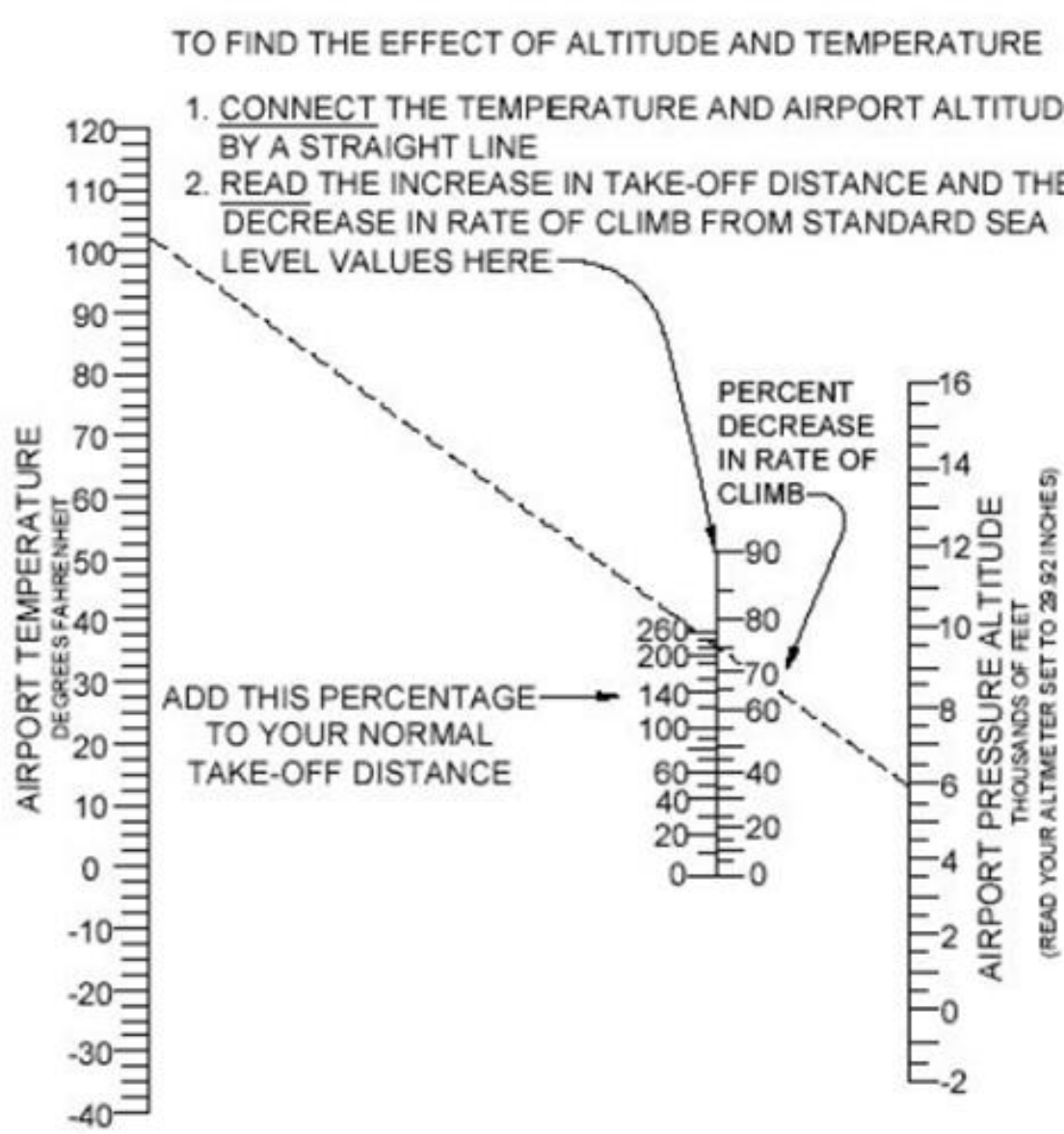
- **Climbing from an airport at 3,000’ to 8,000’ in standard conditions:**
  (2.8 – 1.0) + 1.5 = 3.3 gallons
  11-4 = 7 minutes
  17-5 = 12NM
  RoC ~ 650 FPM
  IAS ~ 80 knots

Koch Chart


KOCH CHART
AIRPORT TEMPERATURE
°F
°C
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
50
40
30
20
10
0
-10
-20
-30
-40
TAKE-OFF DISTANCE FACTOR FROM S.L.
3.6
3.0
2.4
2.0
1.6
1.4
1.2
1.0
0.1
0.2
0.3
0.4
0.6
0.8
1.0
CLIMB RATE FACTOR FROM S.L.
AIRPORT PRESSURE ALTITUDE
THOUSANDS OF FEET
(READ YOUR ALTIMETER SET TO 29.92 INCHES)
16
14
12
10
8
6
4
2
0
-2
DRAW A LINE FROM AIRPORT PRESSURE ALTITUDE TO AIRPORT TEMPERATURE TO FIND T.O. DISTANCE AND CLIMB FACTORS FROM SEA LEVEL.

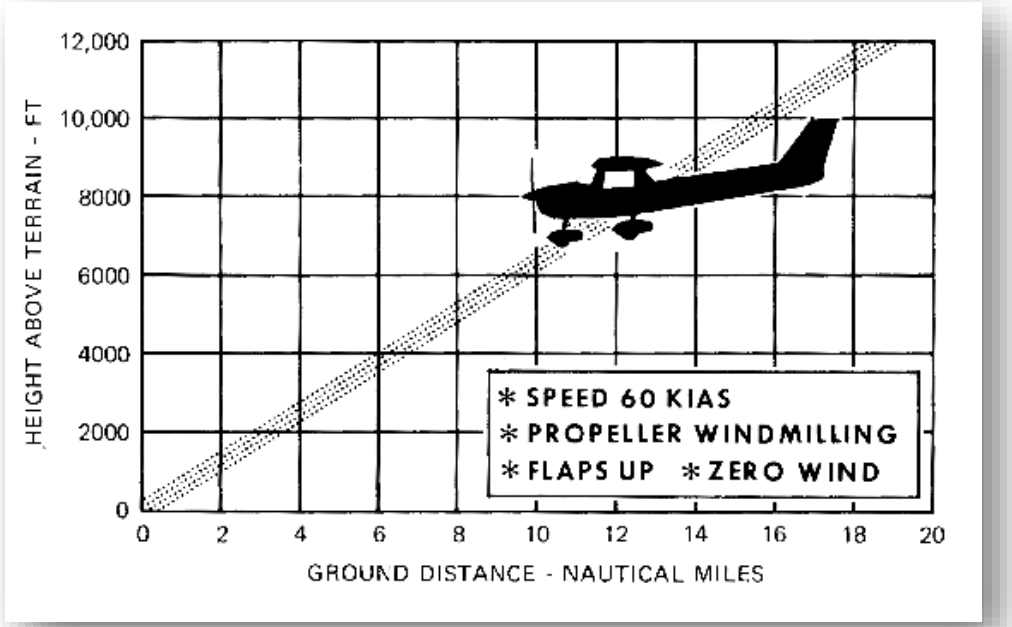
Example:

- For example, the diagonal line shows that 230 percent must be added to take off distance with temperature of 102F and a pressure altitude of 6,000 feet.
- Therefore, if your standard temperature sea level takeoff distance normally requires 1,000 feet of runway to climb to 50 feet, it would become 3,300 feet under the conditions shown in the chart.
- In addition, the rate of climb would be decreased by 76 percent. So, if normal sea level rate of climb is 500 FPM, it would become 120 FPM.



Forced landing tips & tricks

- **Know how far you can glide**
- **Think “per 1,000’ AGL”**



~ 2.0 NM per 1,000’ AGL

Know Before You Need—Information Sheet

- V speeds
- Quick checklists
- How far you can glide?

V-Speeds and Other Details	Cessna A152
Cessna A152	Fuel: 26-Galls total; 24.5 usable Oil: 6-Qrts Max, 5-Qrts Min
A152	Max Weight: 1670 lbs

V-Speed	IAS (Kts)
V_A @ 1670lbs	108
V_A @ 1500lbs	102
V_A @ 1350lbs	97
V_{FE}	85
V_{NE}	172
V_{LO} Gear up	NA
V_{NO}	125
V_R	50
V_S	48
V_{SO}	35
V_X Flaps Up	55
V_X Flap s+10	54
V_Y Flaps Up	67

Emergency Speeds	IAS (Kts)
Pwr-Off Ldg - no flap	65
Pwr-Off Ldg - 30 flap	60
Max. Glide	60
Glide Ratio:	9.7
AGL (feet)	Miles
2000	3.7
4000	7.3
5000	9.2
6000	11.0
8000	14.7
10000	18.4

Pattern Speeds:

Stall Speed (Kts)	Flaps = V_{S0} 35	Clean = V_{S1} 40	Actual Approach
Downwind	80	80	80
Mid-Field Downwind (*1.5)	53	60	70
Turning Base (*1.4)	49	56	65
Final (*1.3) = (V_{REF})	46	52	55-60
Over Numbers (*1.2)	42	48	55-60

Normal Operations:	
What:	IAS (Kts)
Max Crosswind Comp	12
Normal climb out	65-75
Short Field TO Flaps 10 Retract @ 100'	54
Climb - Flaps up:	
Best V_X @MSL	55
Best V_X @10,000'	55
Best V_Y @MSL	67
Best V_Y @10,000'	61
Approach to land:	
Normal - Flaps 0	65-70
Normal - Flaps 10	65-70
Normal - Flaps 20	65-70
Normal - Flaps 30	55-65
Short Field - Flaps 30	54

ASI Details:		
ARC		Kts
White Arc:		35 - 85
	V_{SO}	35
	V_{FE}	85
Green Arc:		40 - 125
	V_{S1}	40
	V_{NO}	125
Yellow Arc:		125-172
	V_{NO}	125
	V_{NE}	172

Landing Check -1:
• Fuel Gauges - CHECK
• Fuel - ON
• Thottle - AS NEEDED
• Light - LANDING ON
• Magnetos - BOTH
• Masters - ON
• Mixture - RICH
• Carb Heat - HOT
• Engine Gauges - GREEN
• Flaps - AS REQUIRED
• CLEARANCE/CTAF

Landing Check - 2:
BF-GUMPS
B: Boost Pump ON
F: Flaps & Feet
G: Gas - ON
U: Undercarriage - down
M: Mags, Masters, Mixture
P: Prop full high
S: Secure - belts, doors, etc

Pattern:
Take-Off:
• Rotate @ 50
• Climb out @ 67
• Level @ 80Kts - 2100 RPM
• Downwind TPA @ 80
• Downwind Checklist

Abeam Numbers:
• Power 1500 RPM - 70Kts
• Flaps 10
• Base @ 65-70
• Flaps 20
• Final @ 60-65
• Flaps 30 (if needed)
• BF-GUMPS
• X-Wind Control + Slip
• Touch down @ 42

Go Around:
• Full Power - Heat COLD
• Pitch down for 55 Kts
• Flaps back ONE notch
• Pitch for 67 Kts
• Flaps retract in increments

Know Before You Need—TAS at Various DAs

- **Use this chart to determine TAS based on DA**
- **Impact on TO and landing distance**
- **Impact on (ground speed) and illusions**
- **Example:**
  - CAS of 70 Kts
  - DA of 5,000’
  - TAS is 77 kts
  - Use wind HW comp to determine GS

TAS From CAS
At Various Density Altitudes

TAS from CAS at Various Density Altitudes (TAS = CAS*(1+0.2*DA/1000)												
CAS	40	50	60	70	80	90	100	110	120	130	140	150
DA (Feet)												
-5000	36	45	54	63	72	81	90	99	108	117	126	135
-4000	37	46	56	65	74	83	92	102	111	120	129	138
-3000	38	47	57	66	76	85	94	104	113	123	132	141
-2000	39	48	58	68	77	87	96	106	116	125	135	144
-1000	40	49	59	69	79	89	98	108	118	128	138	147
0	40	50	60	70	80	90	100	110	120	130	140	150
1000	41	51	62	72	82	92	102	113	123	133	143	153
2000	42	52	63	73	84	94	104	115	125	136	146	156
3000	43	53	64	75	85	96	106	117	128	138	149	159
4000	44	54	65	76	87	98	108	119	130	141	152	162
5000	44	55	66	77	88	99	110	121	132	143	154	165
6000	45	56	68	79	90	101	112	124	135	146	157	168
7000	46	57	69	80	92	103	114	126	137	149	160	171
8000	47	58	70	82	93	105	116	128	140	151	163	174
9000	48	59	71	83	95	107	118	130	142	154	166	177
10000	48	60	72	84	96	108	120	132	144	156	168	180
11000	49	61	74	86	98	110	122	135	147	159	171	183
12000	50	62	75	87	100	112	124	137	149	162	174	186
TAS = CAS*(1+0.2*DA)												
(With DA in 1,000s of feet)												

Forced landing tips & tricks

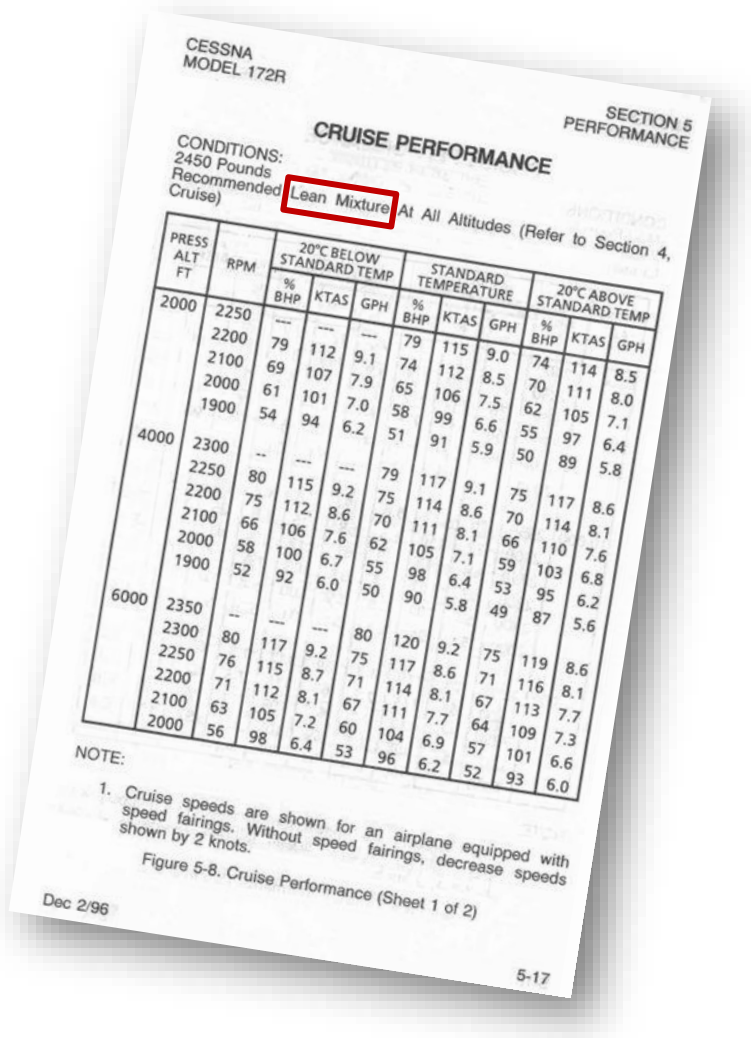
- **Frequent practice**
  - At typical mission weights
- **Flaps up approach to between 1st and 2nd third of runway of landing area**

Pilots need to know

- **Return to airport decision criteria**
  - Loss of control in this situation are usually fatal
  - No-go/Go – what's your number (altitude)?
  - Determine with a CFI, at altitude
    - In each airplane you fly
    - At operational weight
    - Consider startle response
      - 3-second delay
    - PUSH!!
  - Brief return to airport criteria for every takeoff
  - Return to airport should be last resort?

Takeoff and climb

- **Aircraft configuration**
  - Per POH for takeoff type
- **Power setting**
  - Takeoff, climb, cruise climb
  - Power setting & fuel consumption
  - Altitude, wind, & ground speed
  - En route fuel availability
- **Lean as per POH**



CESSNA
MODEL 172R

SECTION 5
PERFORMANCE

CRUISE PERFORMANCE

CONDITIONS:
2450 Pounds
Recommended Lean Mixture At All Altitudes (Refer to Section 4, Cruise)

PRESS ALT FT	RPM	20°C BELOW STANDARD TEMP			STANDARD TEMPERATURE			20°C ABOVE STANDARD TEMP		
		% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2000	2250	---	---	---	79	115	9.0	74	114	8.5
	2200	79	112	9.1	74	112	8.5	70	111	8.0
	2100	69	107	7.9	65	106	7.5	62	105	7.1
	2000	61	101	7.0	58	99	6.6	55	97	6.4
	1900	54	94	6.2	51	91	5.9	50	89	5.8
4000	2300	--	---	---	79	117	9.1	75	117	8.6
	2250	80	115	9.2	75	114	8.6	70	114	8.1
	2200	75	112	8.6	70	111	8.1	66	110	7.6
	2100	66	106	7.6	62	105	7.1	59	103	6.8
	2000	58	100	6.7	55	98	6.4	53	95	6.2
	1900	52	92	6.0	50	90	5.8	49	87	5.6
6000	2350	--	---	---	80	120	9.2	75	119	8.6
	2300	80	117	9.2	75	117	8.6	71	116	8.1
	2250	76	115	8.7	71	114	8.1	67	113	7.7
	2200	71	112	8.1	67	111	7.7	64	109	7.3
	2100	63	105	7.2	60	104	6.9	57	101	6.6
	2000	56	98	6.4	53	96	6.2	52	93	6.0

NOTE:

1. Cruise speeds are shown for an airplane equipped with speed fairings. Without speed fairings, decrease speeds shown by 2 knots.

Figure 5-8. Cruise Performance (Sheet 1 of 2)

Dec 2/96

5-17

Recommendations:

- **Brief each takeoff, approach, and landing**
  - Runway and available distance for takeoff or landing
  - Aircraft configuration and target airspeeds
  - Rejected takeoff or landing decision point
  - Departure/approach path
  - Return to airport altitude
  - Forced landing opportunities

Develop & adjust with your CFI

- **CFIs provide:**
  - Perspective
  - Consistency
  - Coaching
  - Experience
- **Non-judgmental (Choose your CFI wisely)**
  - Read "Death by Time Builder" for an illustration of bad behaviors
- **Regular Reassessment**
  - Required for professionals, including CFIs
  - Highly "recommended" for all pilots

Calibrate your airplane

- **Book number are…(ideal) book numbers**
- **Actual aircraft is older and probably very different from when it left the factory**
- **Okay…W&B *should* be up to date, but…**
- **Is it more or less draggy?**
- **Is the engine getting a bit tired (are you…?)**

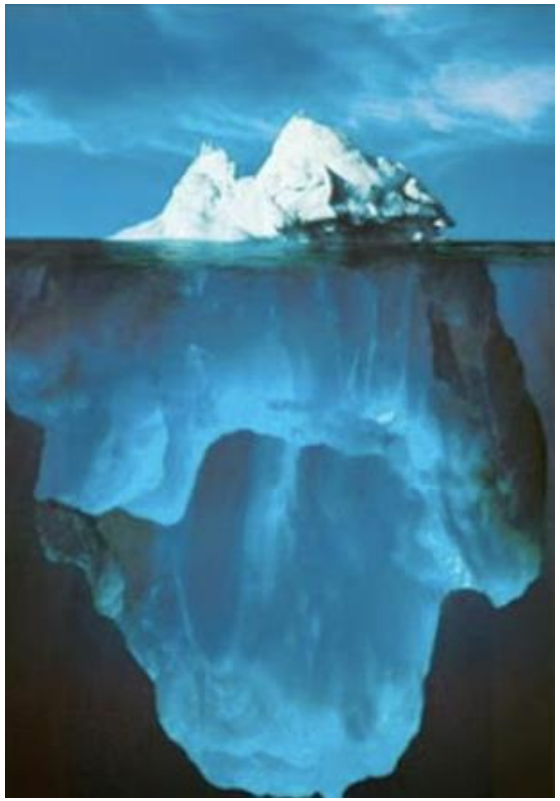
- **So, what is the actual capability of your aircraft?**
- **How does it compare to book numbers?**

Calibrate your airplane: Collect data

- **Prior to every take off, make a note of PA, temperature and hence DA. Use the TOLD card to capture this**
  - Estimate ground roll distance…count stripes
  - Maintain a table of ground roll at different DAs
  - Compare with book numbers – determine the multiplier
- **Calibrate climb performance at different DAs**
  - Can emulate different DA conditions by flying at different altitudes and noting PA and outside temperature
  - Create a table of climb performance at different DAs
  - Compare with book numbers – determine the multiplier
    - Hint: It is never going to be better, but will very likely be way worse

Proficiency and Peace of Mind

- **Regularly review WINGS courses and activities**
- **Fly regularly with your CFI—*WINGS* activities**
  - Do different things to become familiar
  - Do familiar things differently
- **“Revert to training”…only works if…?**
  a) You've seen it before
  b) You’ve done it recently
  c) Insist on scenario training during your flight review and/or *WINGS* flights. Dig into options, understand predispositions (biases)
- **Practice, practice…**
  - Get in your head
  - …and keep it there…for when you need it



Learning Points

- General aviation accidents continue to be associated with inaccurate or unreasonable expectations about aircraft performance
- Determination and use of aircraft performance information is essential for every flight and in all flight regimes
- Running the numbers isn't that difficult and a "take-off and landing card" should be part of every pre-flight action plan

- Go out and calibrate your actual aircraft

Homework-1: Review and learn from…

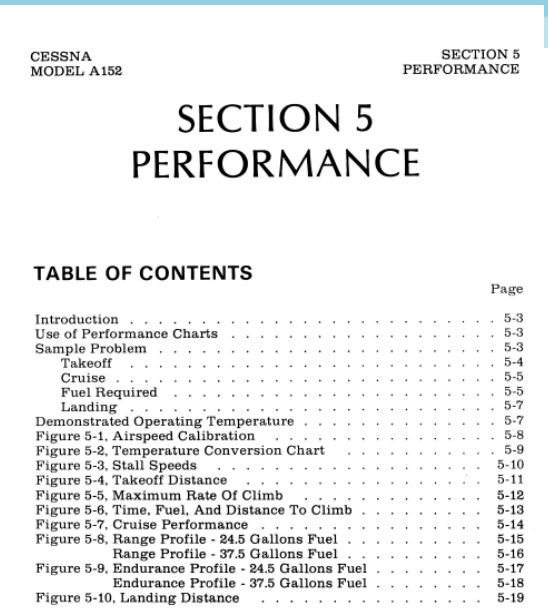
https://www.youtube.com/watch?v=eYqS-j3pUHY

https://www.youtube.com/watch?v=sTo4GGRExGE

https://www.aopa.org/training-and-safety/online-learning/accident-case-studies/into-thin-air

Homework-2: Dust off the POH…

- **Read section 5 – Performance**
  - Print out TO and landing tables and keep on your kneeboard
- **Read section 6 – Weight and Balance**
  - Run a few examples by hand to remember what it is all about
  - Check that the EFB W&B section is up to date for *YOUR* airplane!
  - Foreflight Workshops


CESSNA
MODEL A152

SECTION 5
PERFORMANCE

SECTION 5
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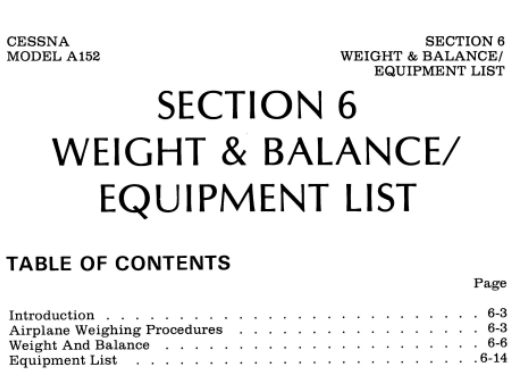
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SECTION 6
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EQUIPMENT LIST

SECTION 6
WEIGHT & BALANCE/
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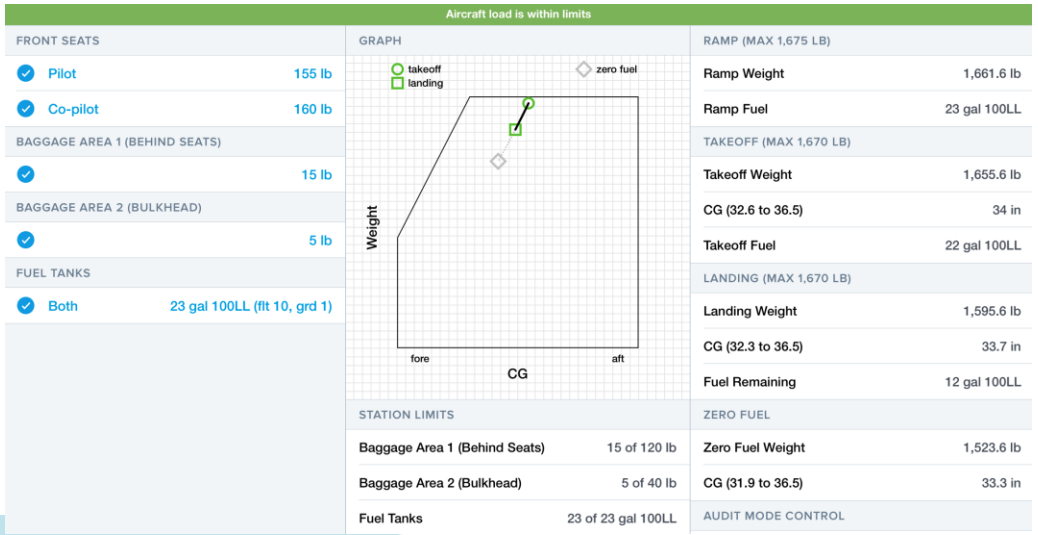

Aircraft load is within limits

FRONT SEATS
Pilot 155 lb
Co-pilot 160 lb
BAGGAGE AREA 1 (BEHIND SEATS)
15 lb
BAGGAGE AREA 2 (BULKHEAD)
5 lb
FUEL TANKS
Both 23 gal 100LL (flt 10, grd 1)

GRAPH
takeoff
landing
zero fuel
Weight
fore
aft
CG

STATION LIMITS
Baggage Area 1 (Behind Seats) 15 of 120 lb
Baggage Area 2 (Bulkhead) 5 of 40 lb
Fuel Tanks 23 of 23 gal 100LL

RAMP (MAX 1,675 LB)
Ramp Weight 1,661.6 lb
Ramp Fuel 23 gal 100LL
TAKEOFF (MAX 1,670 LB)
Takeoff Weight 1,655.6 lb
CG (32.6 to 36.5) 34 in
Takeoff Fuel 22 gal 100LL
LANDING (MAX 1,670 LB)
Landing Weight 1,595.6 lb
CG (32.3 to 36.5) 33.7 in
Fuel Remaining 12 gal 100LL
ZERO FUEL
Zero Fuel Weight 1,523.6 lb
CG (31.9 to 36.5) 33.3 in
AUDIT MODE CONTROL

Homework-3: Performance Specific Resources

- **Spend some quality time with these resources:**

[PHAK Chapter 10: Weight and Balance]

[PHAK Chapter 11: Performance]

https://www.aopa.org/training-and-safety/online-learning/reality-check/takeoff-and-landing-performance

[Density Altitude]

[Techniques: Density Altitude]

[Density Altitude Flying]

[Density Altitude]

[Tips & Techniques: Density Altitude - Safety considerations]

[Density Altitude—The Triple H Effect]

[FAA Density Altitude]

[The EXTREMELY helpful guide to Density Altitude]

Homework-4: Resources - General

- **Spend some quality time with these resources:**
- https://www.aopa.org/training-and-safety/air-safety-institute
- Safety to Go
- faasafety.gov
- Pilot Minute
- 57 Seconds To Safer Flying
- FAA Safety Briefing Magazine
- From the Flight Deck
  - https://www.youtube.com/playlist?list=PL5vHkqHi51DSNpsBC8nb8Q8gFcGVmWhGA
  - https://www.youtube.com/watch?v=303Pd_2UAmU

Subscribe to Aviation Safety

https://www.aviationsafetymagazine.com

Homework-5: Make a data sheet for your aircraft

V-Speeds and Other Details	Cessna C182T: N528MJ
Cessna C182T: N528MJ	Fuel: 92-Galls total; 87 usable Oil: 8-Qrts Max, 6-Qrts Min
Fuel Injected	Max TO Weight: 3100 lbs

V-Speed	IAS (Kts)
V_A @ 3100lbs	110
V_A @ 2600lbs	100
VA @ 2100lbs	91
V_{FE}	136/117/99
V_{NE}	175
V_{LO} Gear up	NA
V_{NO}	140
V_R	55
V_S	51
V_{SO}	41
V_X Flaps Up	62
V_Y Flaps Up	82

Emergency Speeds	IAS (Kts)
Pwr-Off Ldg - no flap	70
Pwr-Off Ldg - 30 flap	65
Max. Glide	70
Glide Ratio:	8.7
AGL (feet)	Miles
2000	3.3
4000	6.6
5000	8.2
6000	9.9
8000	13.2
10000	16.5

Pattern Speeds:

Stall Speed (Kts)	Flaps = V_{S0} 41	Clean = V_{S1} 51	Actual Approach
Downwind	80	80	80
Mid-Field Downwind (*1.5)	62	77	70
Turning Base (*1.4)	58	72	70
Final (*1.3) = (V_{REF})	54	67	65 - 70
Over Numbers (*1.2)	50	62	65

Normal Operations:	
What:	IAS (Kts)
Max Crosswind Comp	15
Normal climb out	70-80
Short Field TO Flaps 20 Retract @ 100'	60
Climb - Flaps up:	
Best V_X @MSL	62
Best V_X @10,000'	68
Best V_Y @MSL	82
Best V_Y @10,000'	77
Approach to land:	
Normal - Flaps 0	70-80
Normal - Flaps 10	
Normal - Flaps 20	
Normal - Flaps 30	60-70
Short Field - Flaps 30	60

ASI Details:		
ARC		Kts
White Arc:		41 - 100
	V_{SO}	41
	V_{FE}	100
Green Arc:		51 - 140
	V_{S1}	51
	V_{NO}	140
Yellow Arc:		140 - 175
	V_{NO}	140
Red Line	V_{NE}	175

Landing Check -1:
• Fuel Gauges - CHECK
• Fuel - ON
• Thottle - AS NEEDED
• Lights- LANDING ON
• Magnetos - BOTH
• Masters - ON
• Mixture - RICH
• Engine Gauges - GREEN
• Flaps - AS REQUIRED
• CLEARANCE/CTAF

Landing Check - 2:
BFC-GUMPS
B: Boost Pump - ON
F: Feet and Flaps
C: Cowl Flaps - Closed
G: Gas - ON
U: Undercarriage - down
M: Mags, Masters, Mixture
P: Prop full high
S: Secure - belts, doors, etc

Pattern:
Take-Off:
• Rotate @ 55
• Climb out @ V_{Y+82}
• Level @ 80Kts - 2100 RPM
• Downwind TPA @ 80
• Downwind Checklist

Abeam Numbers:
• Power 1500 RPM - 70Kts
• White Arc - Flaps 10
• Base @ 70
• Flaps 20
• Final @ 65
• Flaps 30 (if needed)
• BFC-GUMPS
• X-Wind Control + Slip
• Touch down @ 41

Go Around:
• Full Power
• Pitch down for 55 Kts
• Flaps back ONE notch
• Pitch for 62 then 82Kts
• Flaps retract in increments

Homework-6: SLAP

After every flight, *SLAP* yourself and create actions for the next flight:

S: **How were my *S*kills today?**

L: **What did I *L*earn today?**

A: **How was my *A*DM today?**

P: **How was my *P*lanning today?**

Homework-7: Determining DA

- **Slides at end of this presentation on ways to determine DA**

Next Month…

The National FAA Safety Team Presents

Federal Aviation Administration

Topic of the Month – January 2024
Human Performance and Safety Culture

Presented to: Safety Minded Aviators, Everywhere…

By: Stephen Bateman, CFI, AOPA Flying Clubs

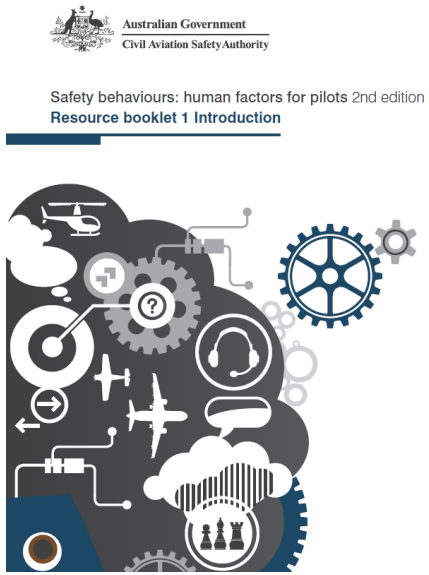
Date: Tuesday 16th January 2024

Produced by:
The National FAA Safety Team (FAASTeam)
The Australian Civil Aviation Safety Authority (CASA)

Preparations: (Overdue from previous months)

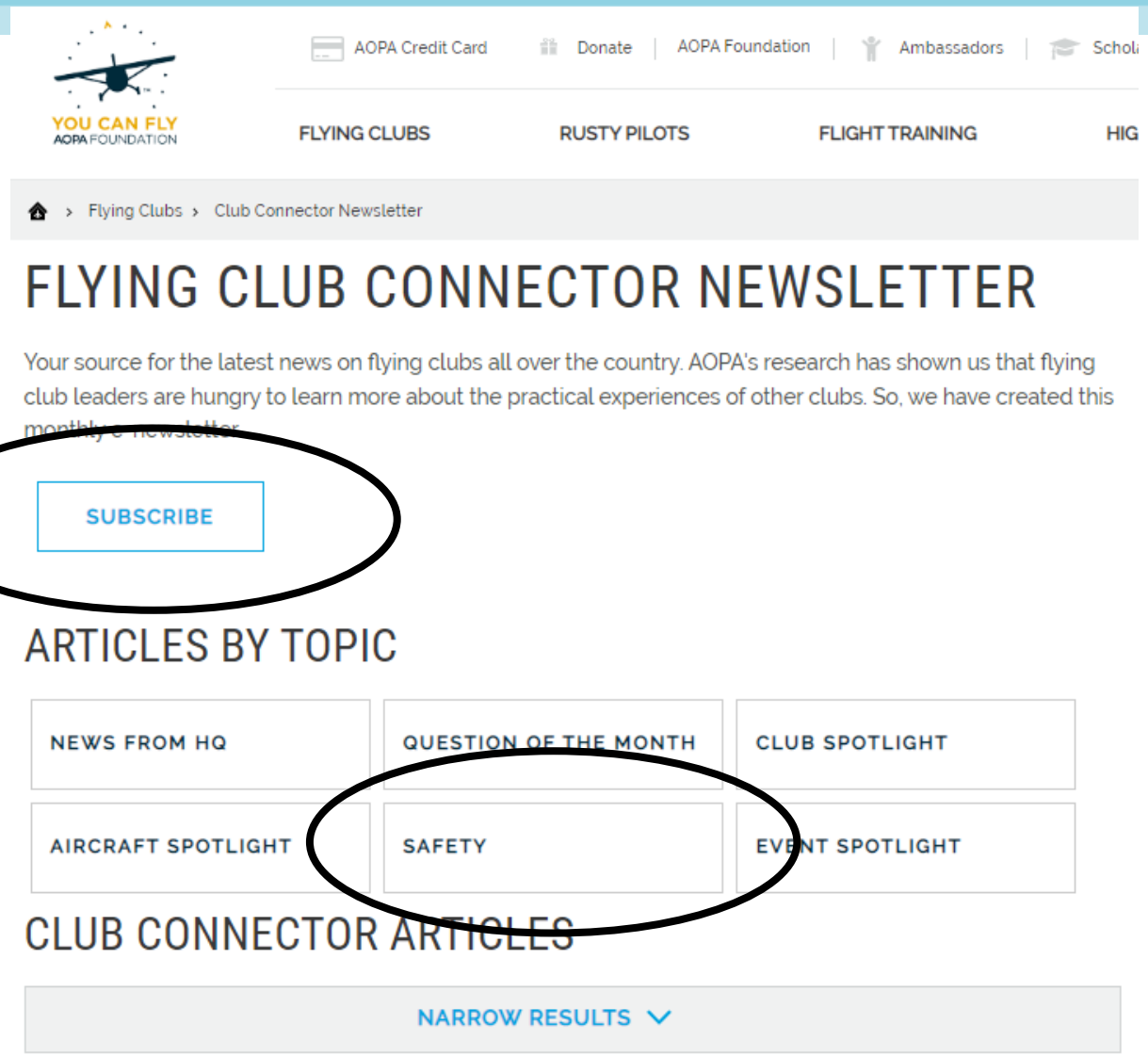
- **Ask a loved once if you should invest the time in this course…**

- **New Human Factors Course—Ten Modules**
  - Videos, quizzes, workbooks, tests.
- **Log into faasafety.gov:**
- **Go to activities-> courses-> all available courses**
  - Search for human factors
  - Then scroll to find these ALC codes:
    - 730, 731, 732, 825, 826, 827, 828, 829, 830
  - Here is a handy QR code to get you to 730 (modules 1 and 2):



So…

- **No recording…but even better…**
  - https://youcanfly.aopa.org/flying-clubs/flying-club-newsletter
- **You can download the presentation!**
  - This and earlier ToM presentations are available…
  - Sign-up now!
  - November edition 11/19/2023



Thank you for attending!

You are vital members of our GA safety community!

Bonus: Determining Density Altitude

Determining DA

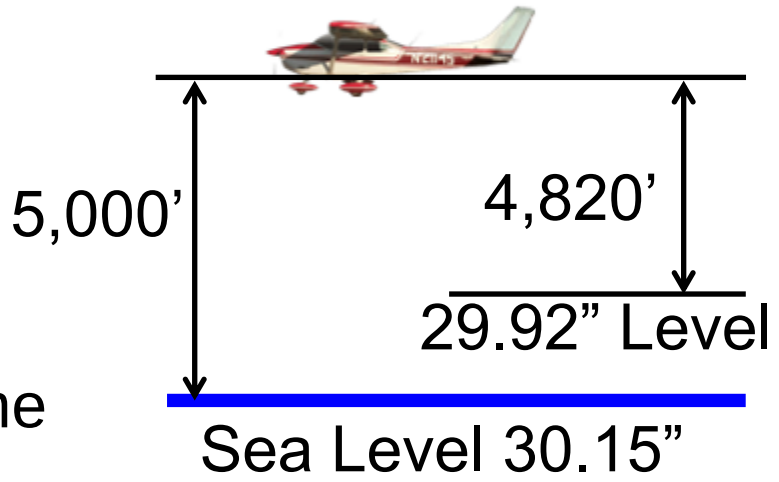
- **DA = PA corrected for non-standard temperature**
- **So, first find PA!**

Determining PA - 1

- **Find PA (altitude relative to pressure datum of 29.92”)**
  - Set “the knob” to 29.92”
  - PA = attitude reading
  - PA = 920’ here

Determining PA - 2

- **DA = PA corrected for non-standard temperature**
- **Use the approximate pressure lapse rate of 1,000’ per inch of Hg**
- **Say recorded altimeter setting is 30.1”**
  - This is the pressure at sea level at that place and time
- **You are flying at 5,000’ MSL**
- **PA = 5,000 + (29.92 - 30.1) * 1000 = 4,820’**



Determining PA - 3

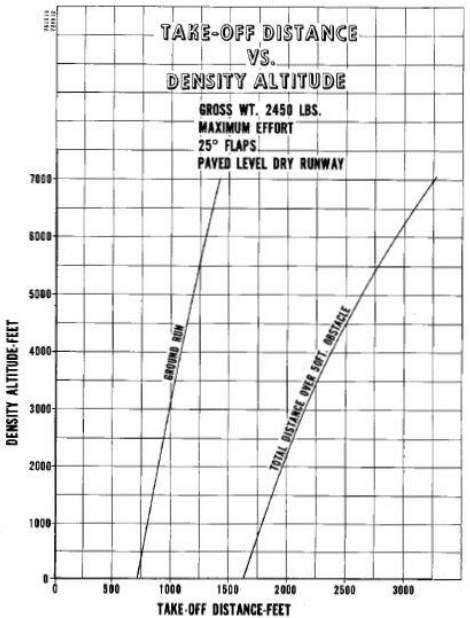
- DA = PA corrected for non-standard temperature
- Use a PA table
- Uses a more accurate lapse rate
- Add the correction factor to the known MSL
- At 5,000', when reported pressure is 30.1"
- PA = 5,000-165 = 4,835'
- At KFDK, when reported pressure is 28.9"
- PA = 320+975 = 1,295'
- Note that a low ambient pressure increases PA (and so DA)

Altimeter Setting (" Hg)	Pressure Altitude Conversion Factor
28.0	1,824
28.1	1,727
28.2	1,630
28.3	1,533
28.4	1,436
28.5	1,340
28.6	1,244
28.7	1,148
28.8	1,053
28.9	957
29.0	863
29.1	768
29.2	673
29.3	579
29.4	485
29.5	392
29.6	298
29.7	205
29.8	112
29.9	20
29.92	0
30.0	–73
30.1	–165
30.2	–257
30.3	–348
30.4	–440
30.5	–531
30.6	–622
30.7	–712

Either way…

- Some performance graphs require DA
- Some tables need PA and Temp
- Either way, we need to know DA for other things like TAS to CAS conversions
- So…we need to know how to determine DA!

PA-28-180
PIPER CHEROKEE



SECTION 5
PERFORMANCE

CESSNA
MODEL 172S

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:

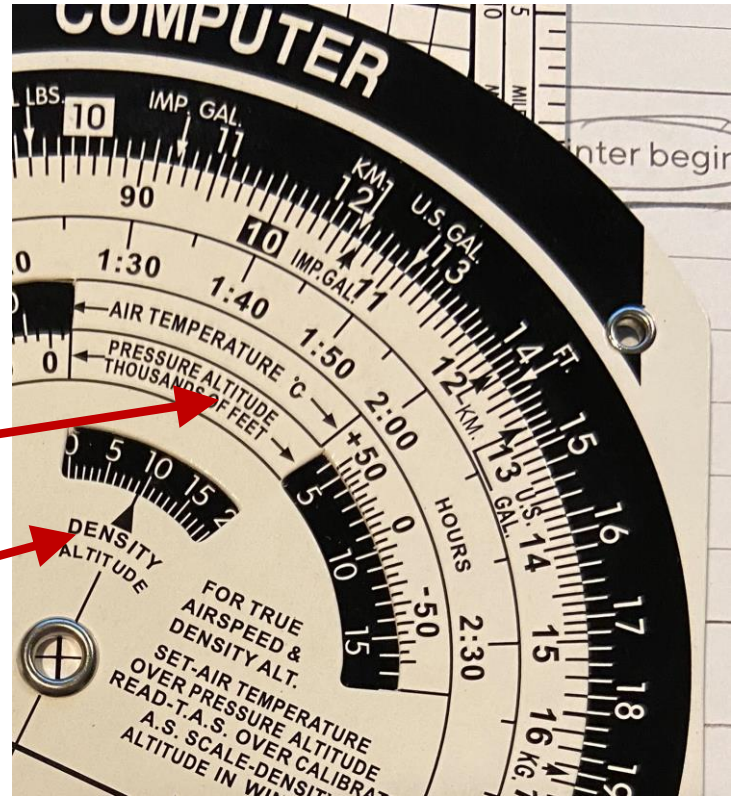
1. Short field technique as specified in Section 4.
2. Prior to takeoff from fields above 3000 feet elevation, the mixture should be leaned to give maximum RPM in a full throttle, static runup.
3. Decrease distances 10% for each 9 knots headwind. For operation with tail winds up to 10 knots, increase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

Figure 5-5. Short Field Takeoff Distance (Sheet 1 of 3)

Federal Aviation Administration

Determining DA-1

- **E6B (or another calculator)**
- **Get PA by setting 29.92” in the altimeter window (set it back after!)**
- **Get outside temperature = Temp**
- **Set PA and Temp on the small right-hand scale. Watch the pos(+) and neg(-) directions!**
- **Read DA**



Determining DA-2a

- **Use the PA-Temp chart**
- **Get PA**
  - Set “the knob” to 29.92” and read-off PA
  - Don’t forget to set it back to QNH
- **Knowing PA and Temp, find DA**

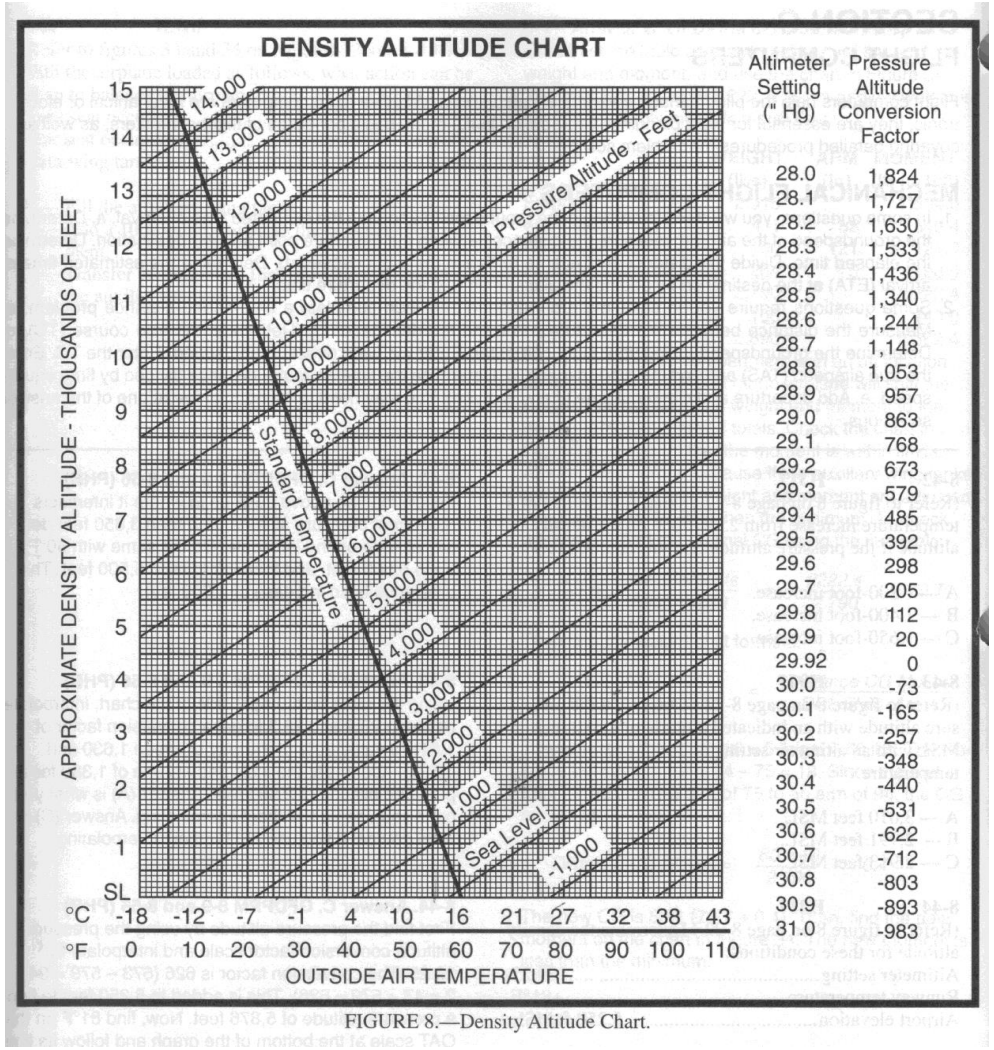


FIGURE 8.—Density Altitude Chart.

Determining DA-2b

- **Use the PA-Temp chart**
- **Get PA**
  - Use QNH (altimeter setting)
  - Determine the PA fiddle factor from the table
  - Add the fiddle factor to elevation or altitude
- **Knowing PA and Temp, find DA**

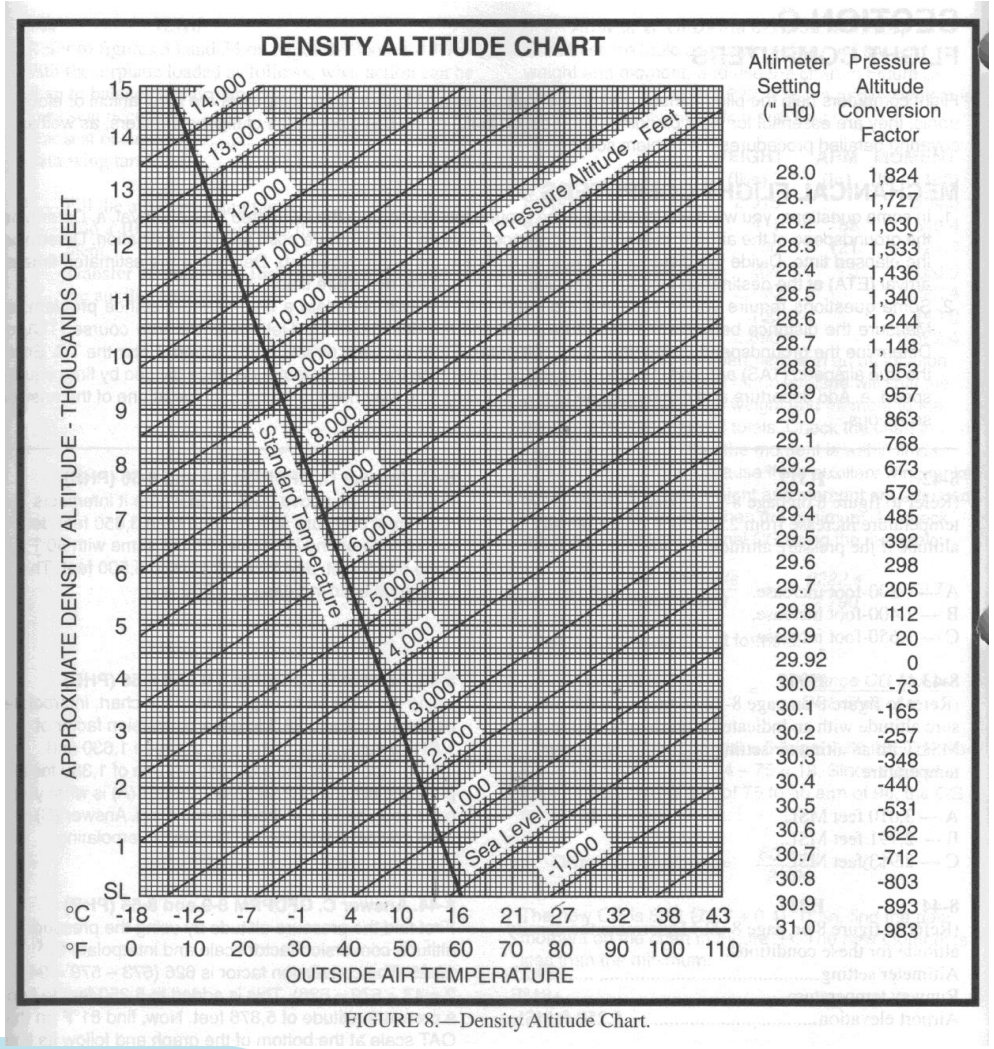


FIGURE 8.—Density Altitude Chart.

Example

- At FDK, elevation = 320’
- If QNH = 29.00”; fiddle factor is +893
- PA = 320 + 893 = 1,313’
- If T = 32°C
- DA = Approx. 3,600’

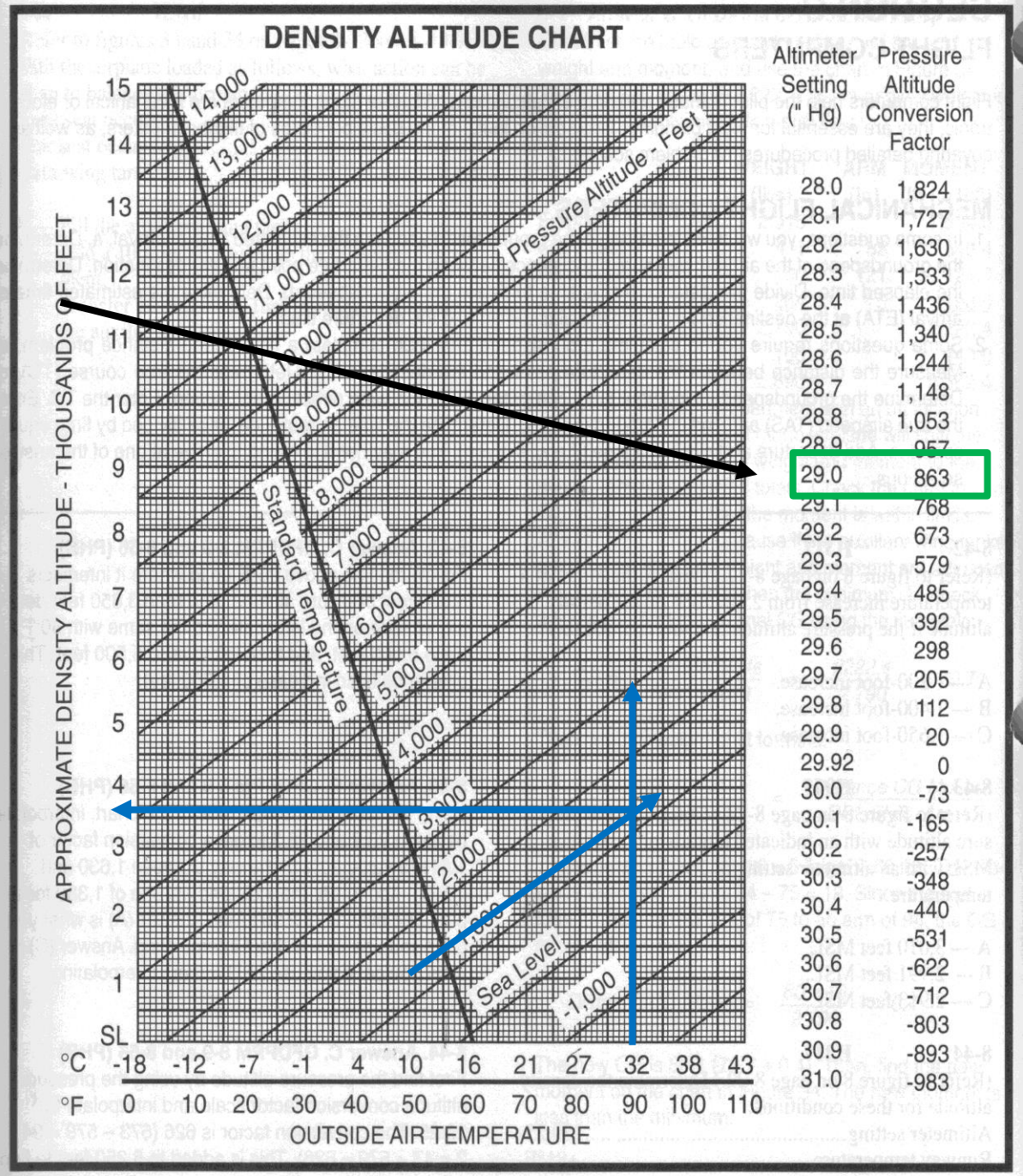
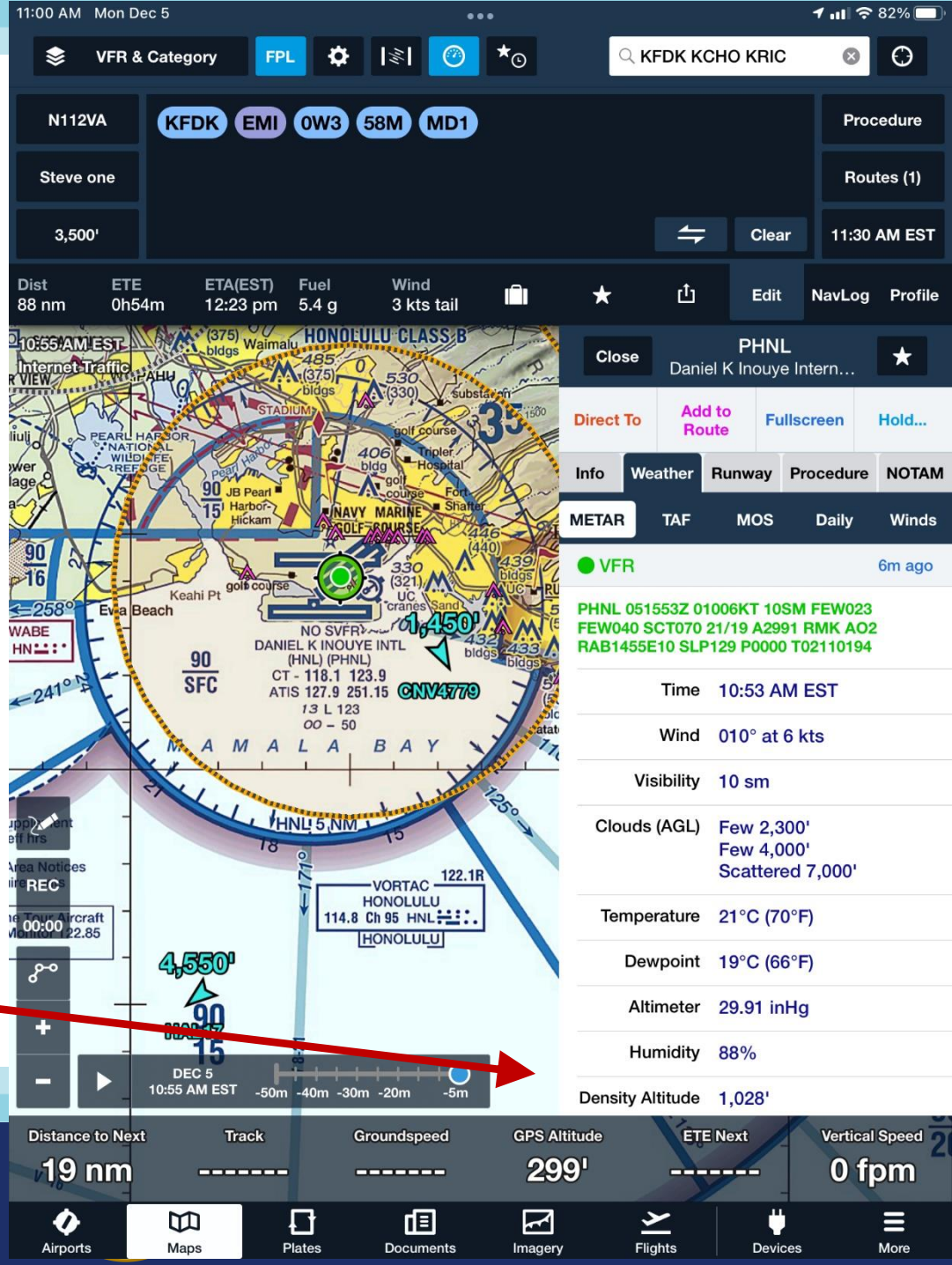


FIGURE 8.—Density Altitude Chart.

Determining DA-3

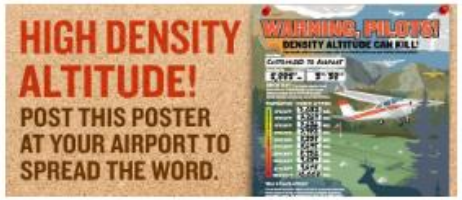
- Listen to the AWOS…!
- Use an online calculator
- Use your fav EFB

- Airport elevation = 13’
- Temp = 21C: DP = 19C
- Alt = 29.91”
- DA = 1,028’



DA Poster from AOPA

- https://www.aopa.org/training-and-safety/air-safety-institute/safety-publications/density-altitude



Density Altitude: Beware Of Thin Air

High altitude, high temperature, and high humidity create less dense or thinner air that contribute to high density altitude and impact aircraft and engine performance. Modify and use the AOPA Air Safety Institute's Density Altitude Poster to quickly know the density altitude values at your airport on a standard day.

READ THE ARTICLE AND GET THE POSTER