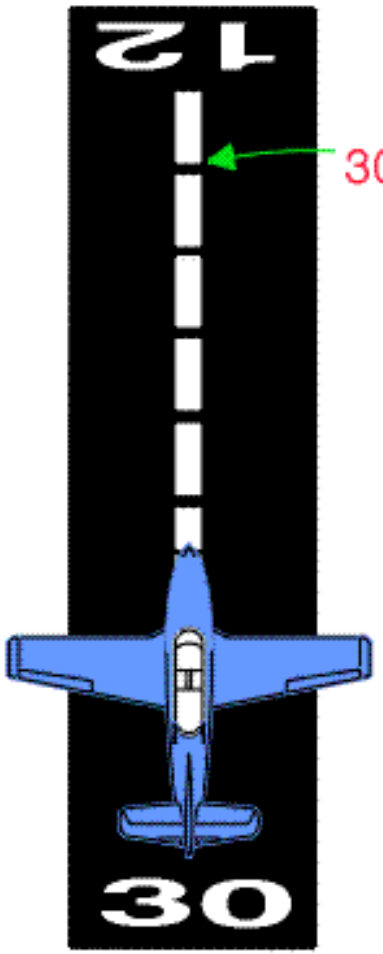
Aircraft Performance

Calculating Crosswinds

THE CROSSWIND COMPONENT CHART



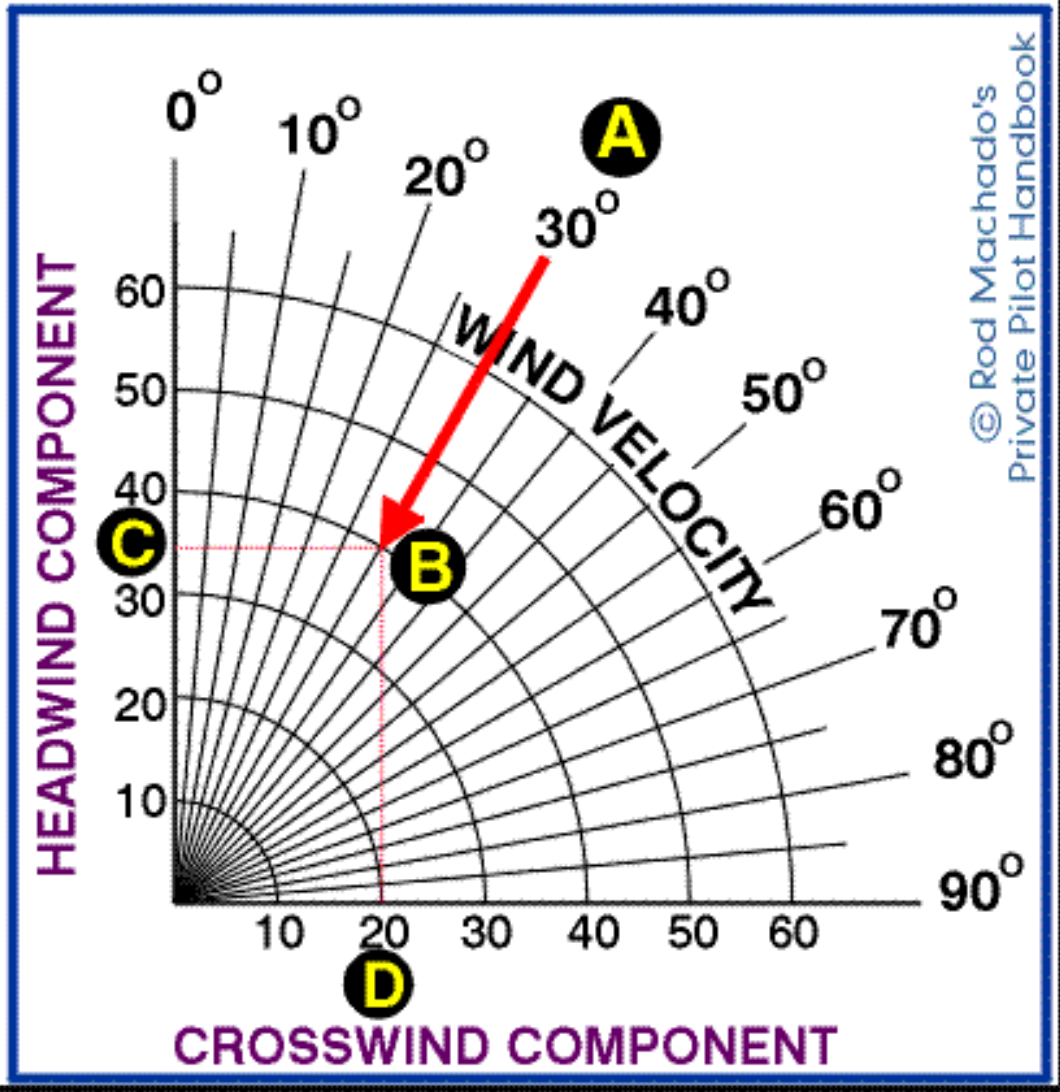
Wind
330° at 40 knots

30°

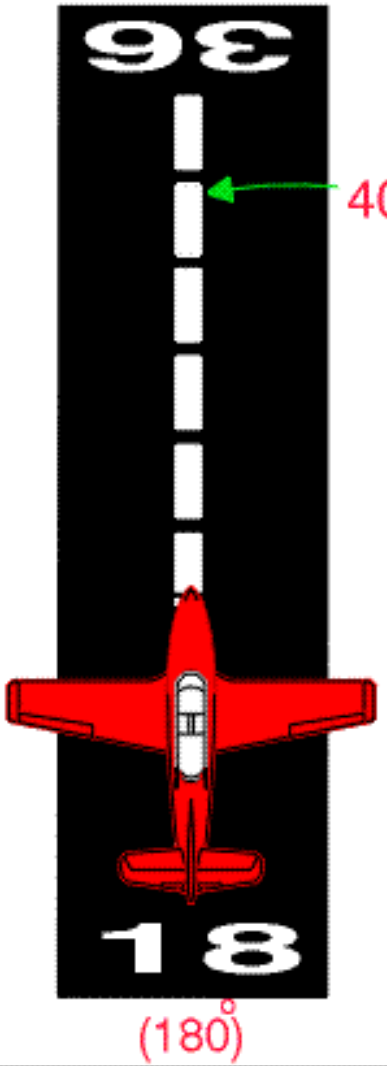
Headwind component
35 knots

Crosswind component
20 knots

15-30



THE CROSSWIND COMPONENT CHART

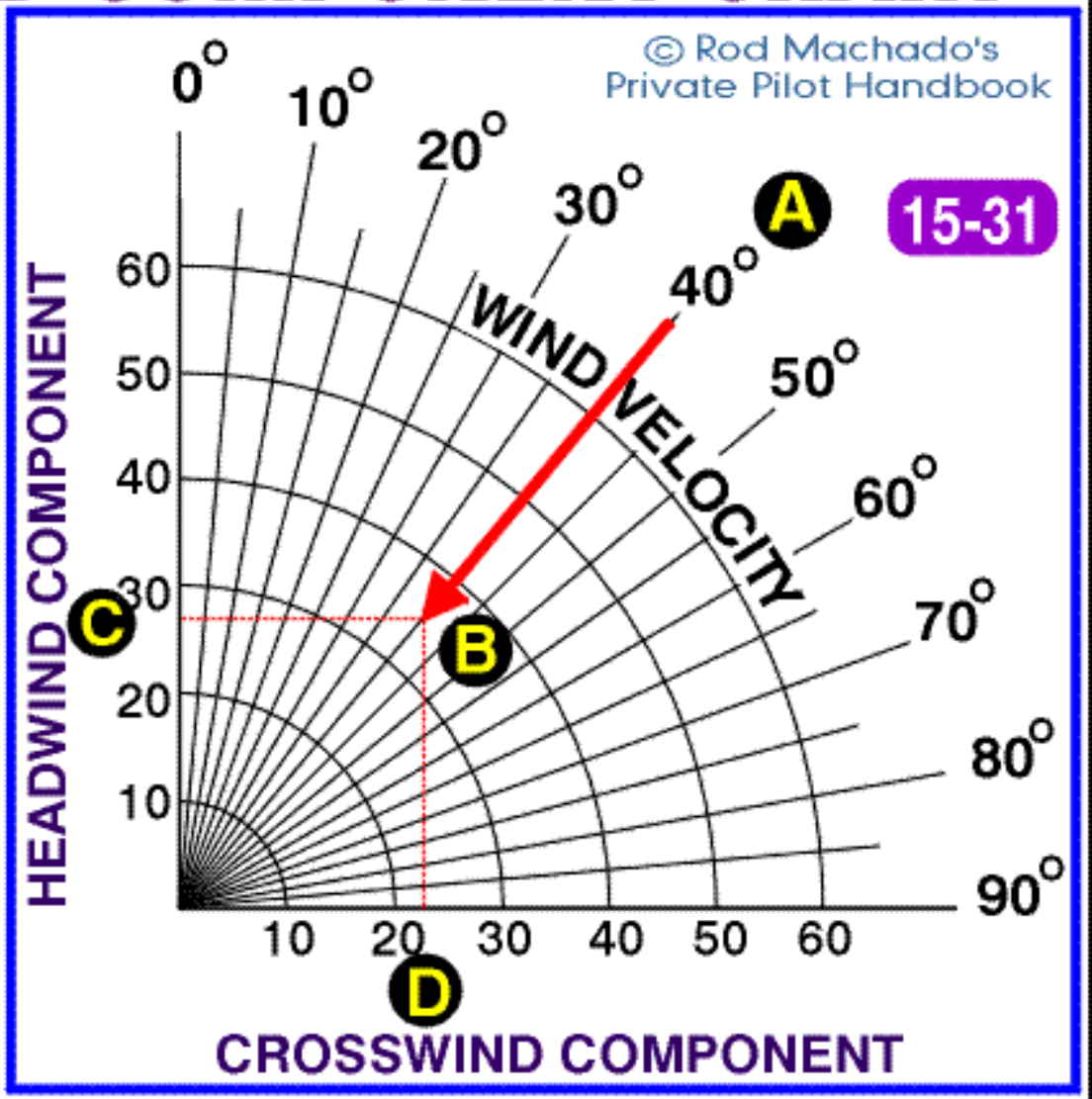


Wind
220° at 35 knots

40°

Headwind component
27 knots

Crosswind component
23 knots



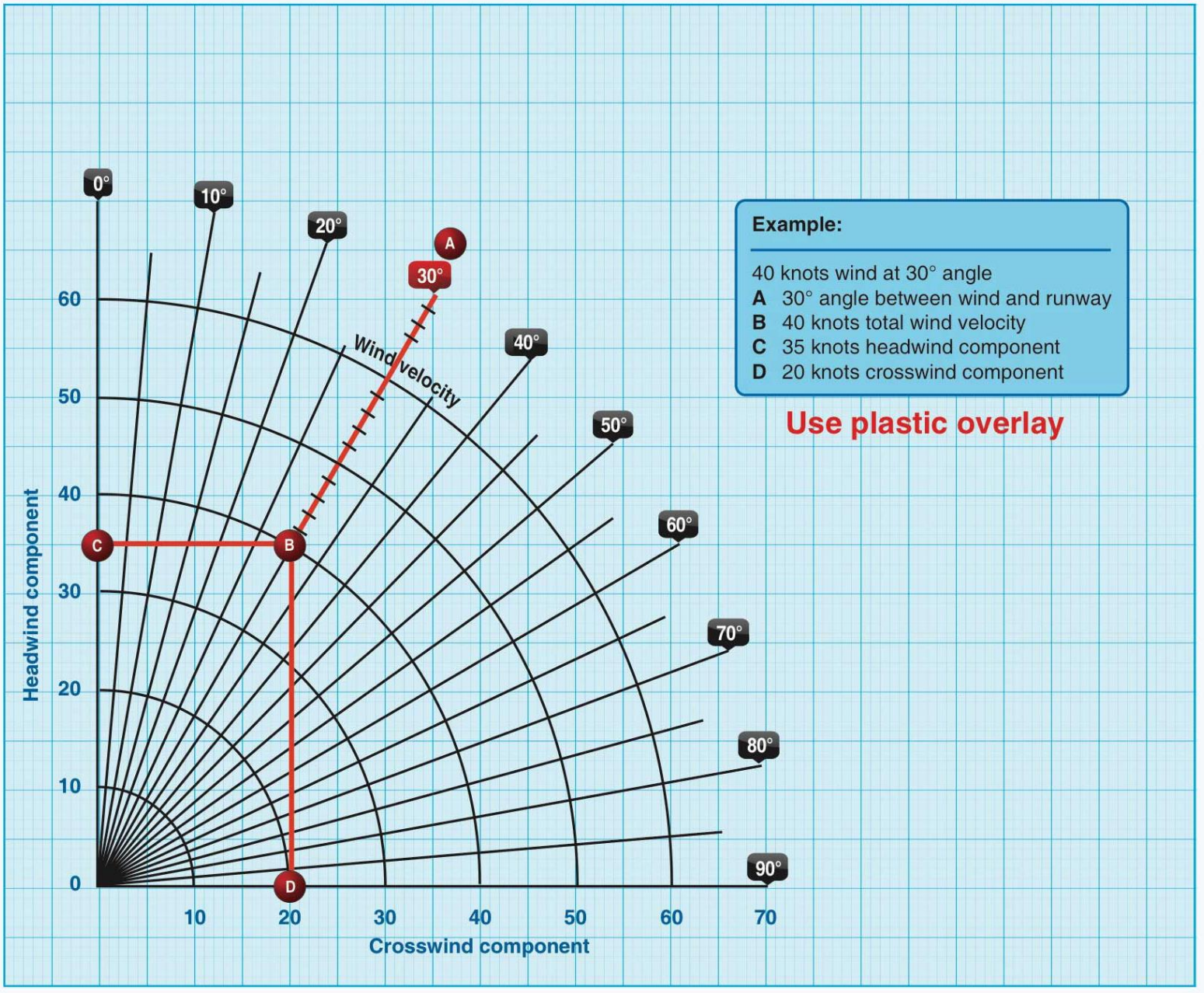
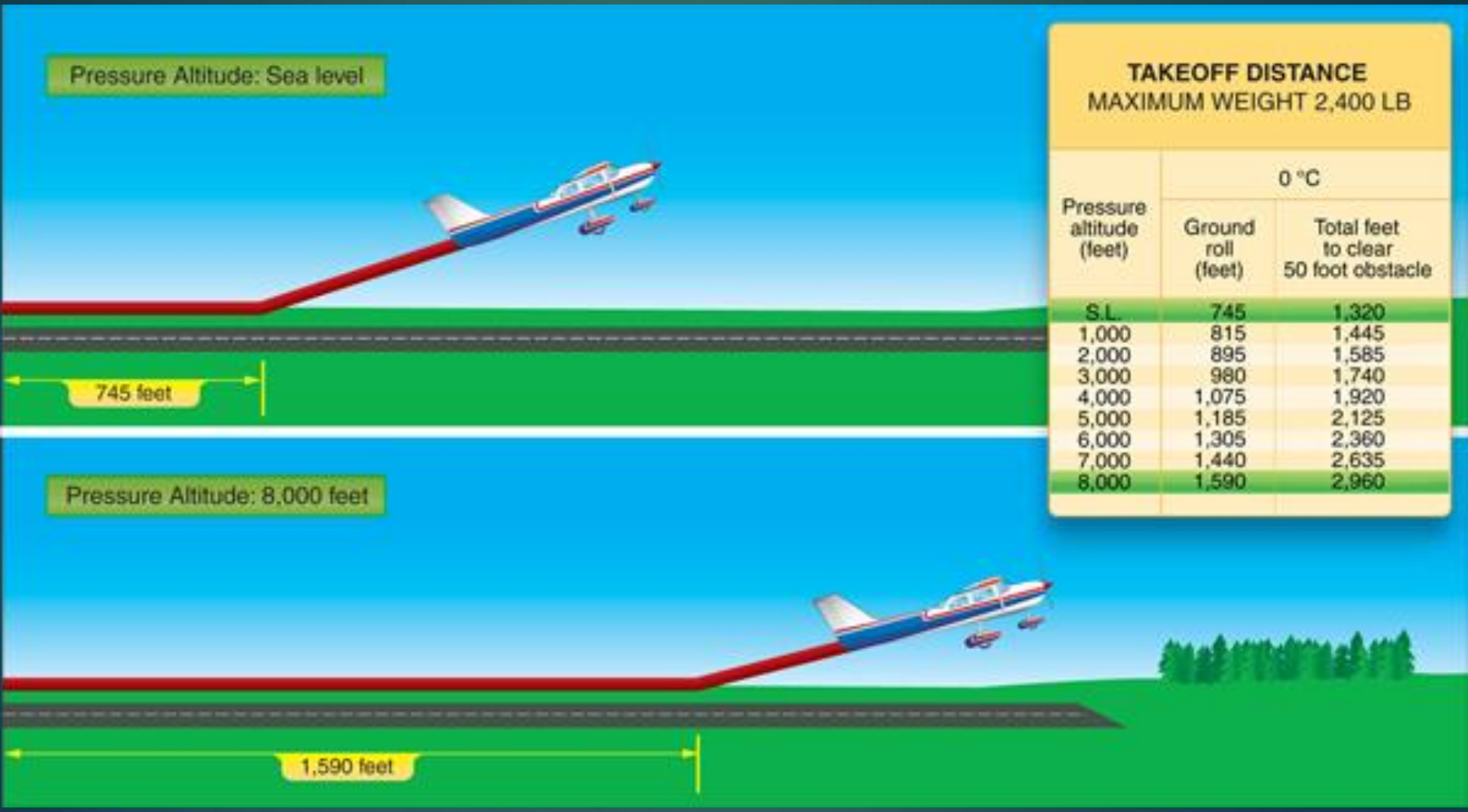


FIGURE 36.—Crosswind Component Graph.

Air Density & Aircraft Performance



TAKEOFF DISTANCE
MAXIMUM WEIGHT 2,400 LB

Pressure altitude (feet)	0 °C	
	Ground roll (feet)	Total feet to clear 50 foot obstacle
S.L.	745	1,320
1,000	815	1,445
2,000	895	1,585
3,000	980	1,740
4,000	1,075	1,920
5,000	1,185	2,125
6,000	1,305	2,360
7,000	1,440	2,635
8,000	1,590	2,960

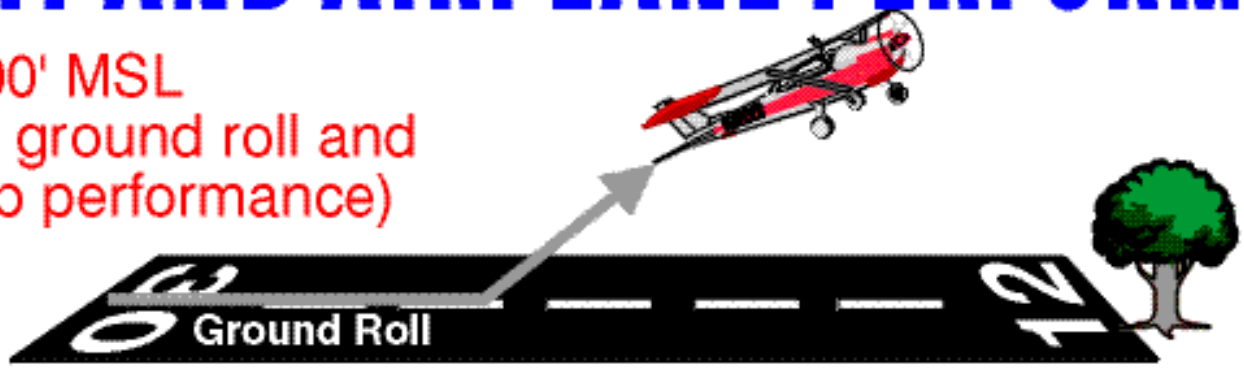
The Three "H"s and Air Density	
Height	The higher the altitude, the thinner the air – and consequently the fewer the particles to flow over the wing
Heat	Particles moving around more rapidly in heated air are farther apart
Humidity	Moist air is less dense than dry, because water vapor molecules are lighter than air molecules.

Effect of pressure and temperature on density altitude

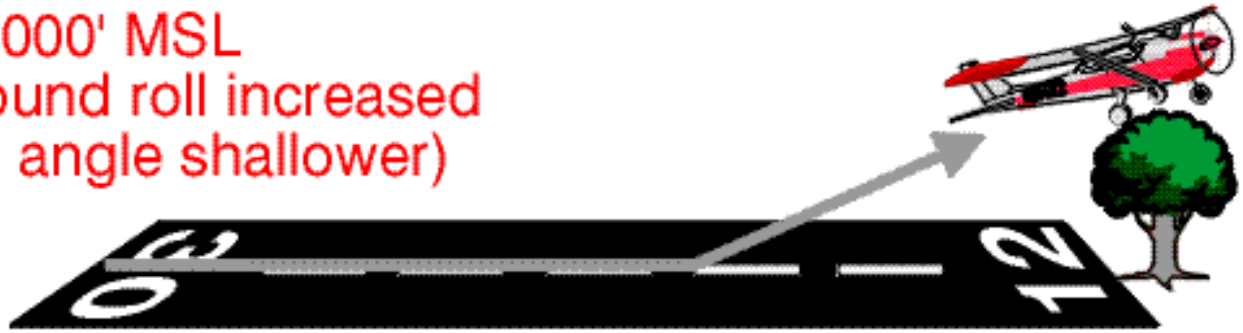
Field Elevation 0 msl	Pressure 29.65	Pressure 29.92	Pressure 30.50
Temperature 32° F	-1,512	-1,782	-2,362
Temperature 59° F	270	0	-580
Temperature 85° F	1,985	1,715	1,135

HEIGHT AND AIRPLANE PERFORMANCE

100' MSL
(fairly short ground roll and good climb performance)

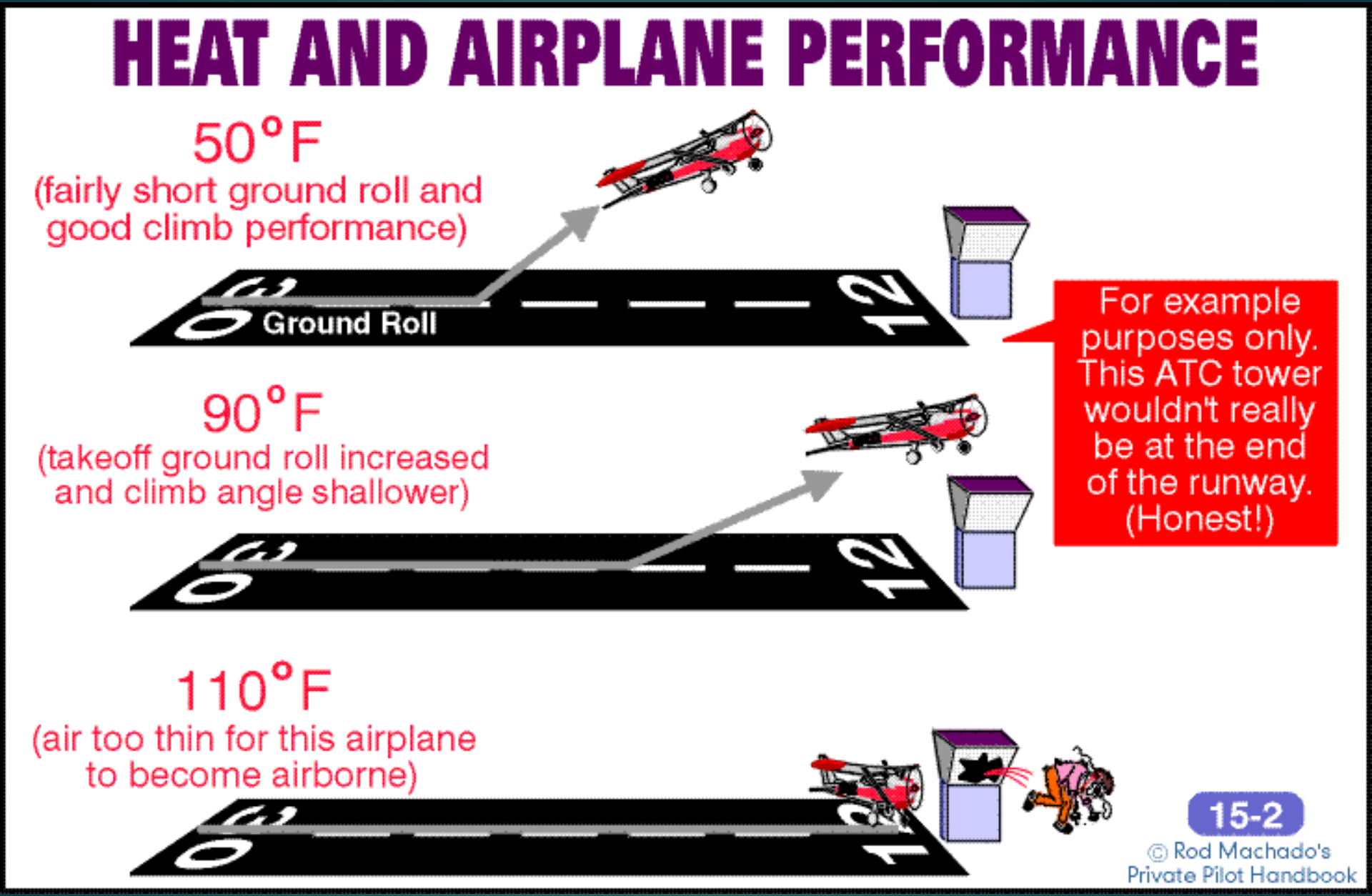


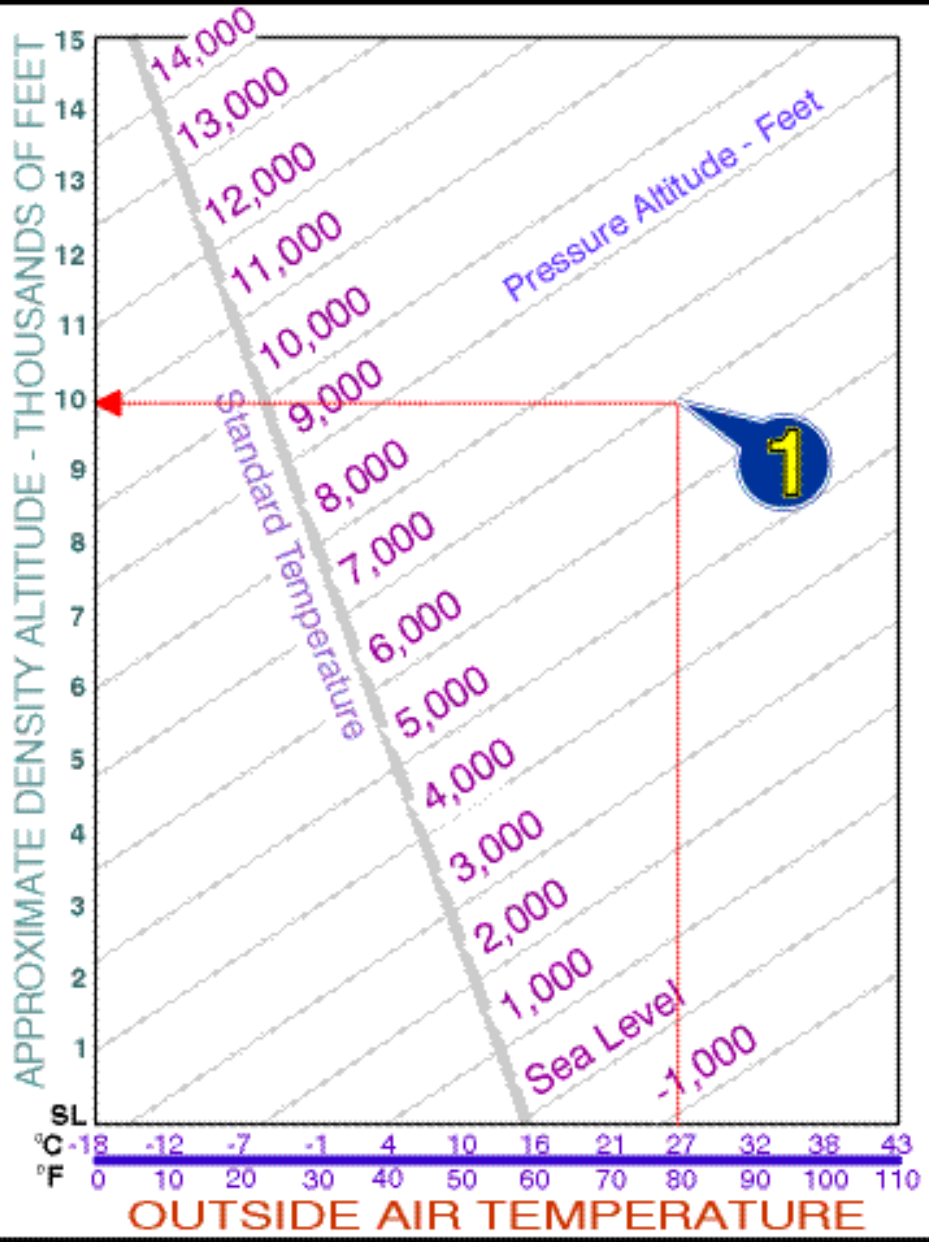
5,000' MSL
(takeoff ground roll increased and climb angle shallower)



15,000' MSL
(air too thin for this airplane to become airborne)

HEAT AND AIRPLANE PERFORMANCE





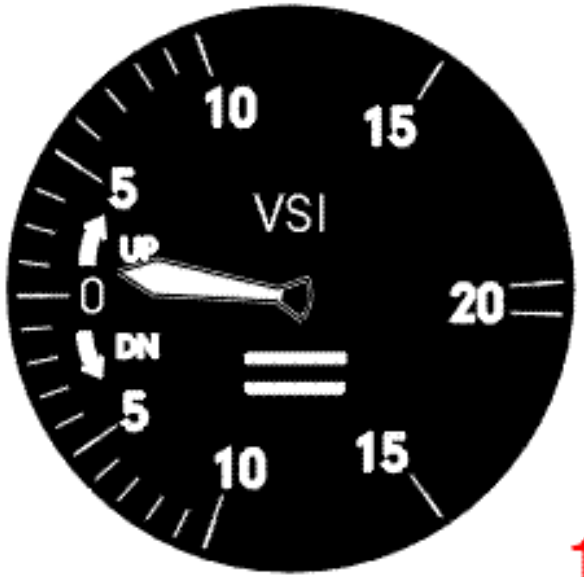
DENSITY ALTITUDE CHART

Altimeter Setting (" Hg)	Pressure Altitude Conversion Factor	Altimeter Setting (" Hg)	Pressure Altitude Conversion Factor
28.0	1,824	29.6	298
28.1	1,727	29.7	205
28.2	1,630	29.8	112
28.3	1,533	29.9	20
28.4	1,436	29.92	0
28.5	1,340	30.0	-73
28.6	1,244	30.1	-165
28.7	1,148	30.2	-257
28.8	1,053	30.3	-348
28.9	957	30.4	-440
29.0	863	30.5	-531
29.1	768	30.6	-622
29.2	673	30.7	-712
29.3	579	30.8	-803
29.4	485	30.9	-893
29.5	392	31.0	-983

THE SERVICE CEILING

An airplane reaches its service ceiling when its climb rate is reduced to 100 feet per minute or less.

14,700' MSL
(Service Ceiling)

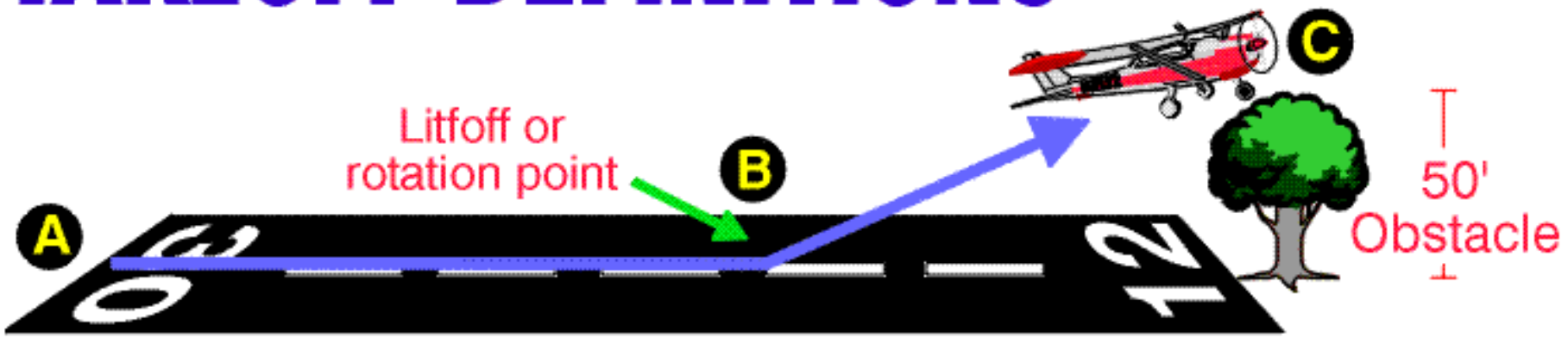


10,000' MSL

5,000' MSL

15-5

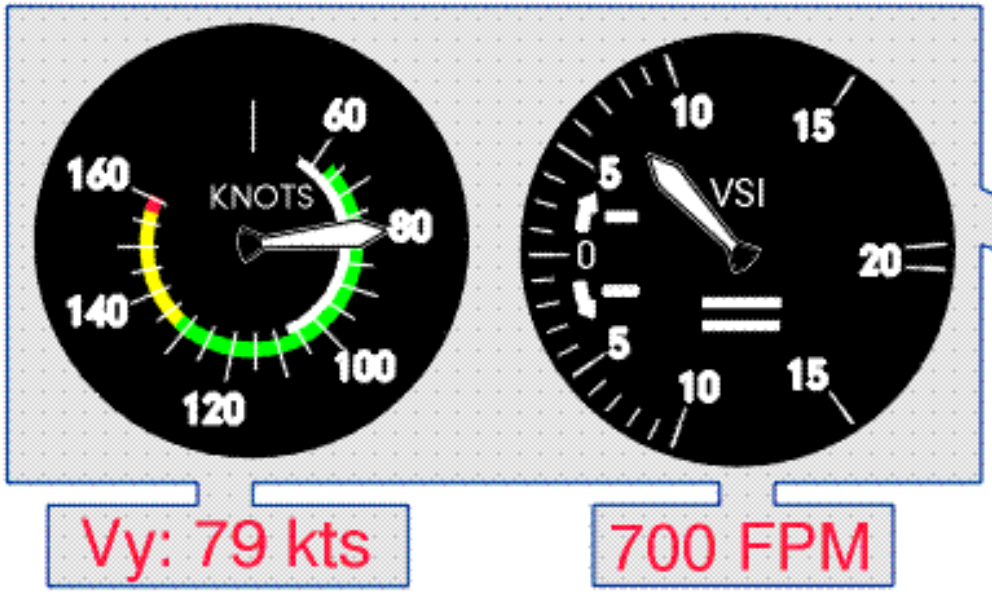
TAKEOFF DEFINITIONS



The ground roll is the total distance required for the airplane to become airborne. The point where the airplane reaches 50 feet above the runway is the total distance required for the airplane to clear a 50 foot obstacle (supposedly placed at this precise point).

Vy & Vx AIRSPEEDS

A



Vy: 79 kts

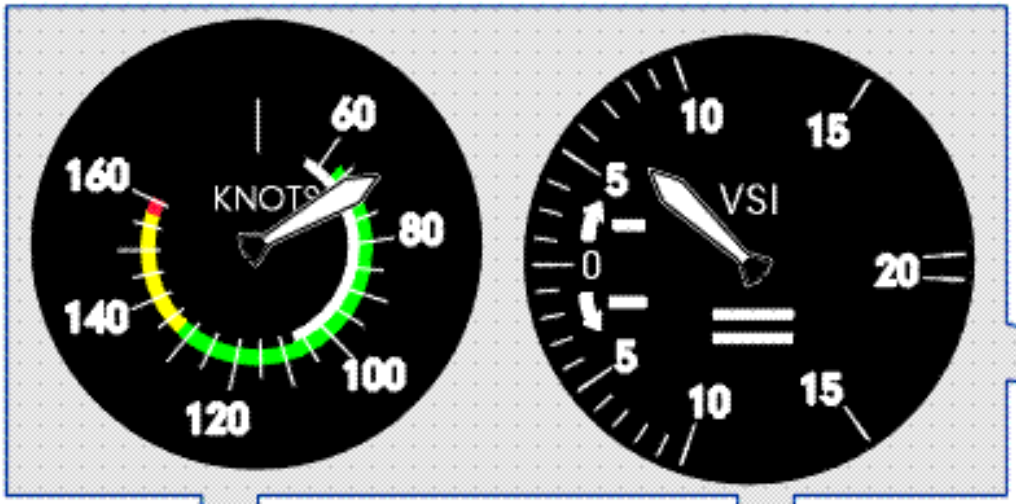
700 FPM

Climbing at the best rate of climb speed (Vy)

The best rate of climb speed (Vy) gives you the greatest altitude gain for a given amount of time. In other words, it gives you the largest deflection on your vertical speed indicator.

Vy & Vx AIRSPEEDS

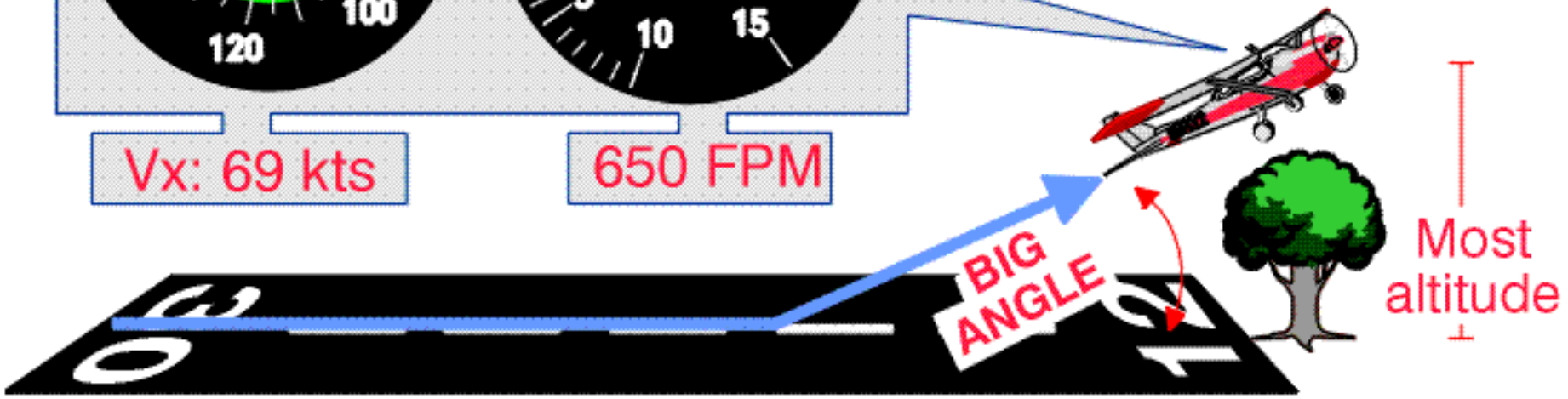
B



Vx: 69 kts

650 FPM

Climbing at the best angle of climb speed (Vx)



The best angle of climb speed (Vx) gives you the greatest altitude gain for a given distance over the ground. In other words, it gives you the largest climb angle possible.

Takeoff Distance Graphs and Charts

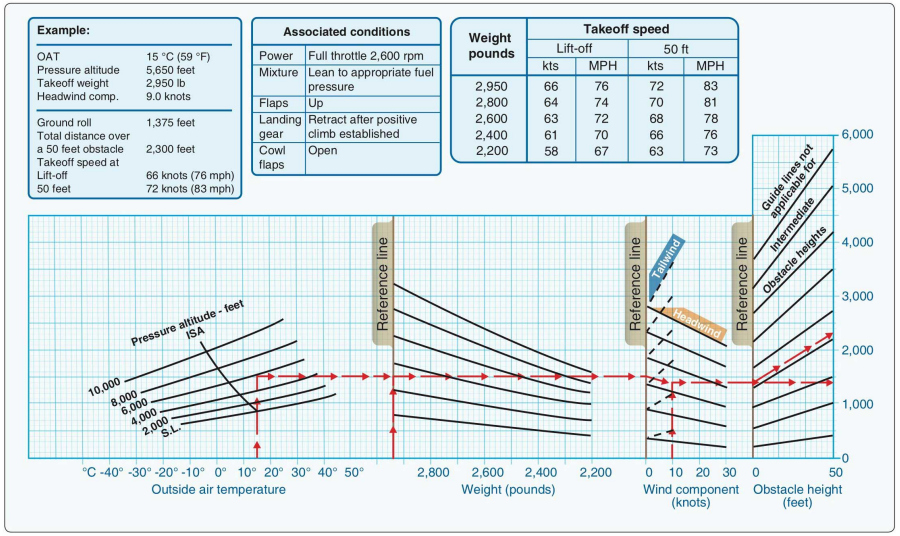


FIGURE 40.—Airplane Takeoff Distance Graph.

SHORT FIELD TAKEOFF DISTANCE AT 2400 POUNDS

CONDITIONS:

Flaps 10°
Full Throttle Prior to Brake Release
Paved, level, dry runway

Zero Wind
Lift Off: 48 KIAS
Speed at 50 Ft: 54 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.	745	1275	800	1370	860	1470	925	1570	995	1685
1000	810	1390	875	1495	940	1605	1010	1720	1085	1845
2000	885	1520	955	1635	1030	1760	1110	1890	1190	2030
3000	970	1665	1050	1795	1130	1930	1215	2080	1305	2230
4000	1065	1830	1150	1975	1240	2130	1335	2295	1430	2455
5000	1170	2015	1265	2180	1360	2355	1465	2530	1570	2715
6000	1285	2230	1390	2410	1500	2610	1610	2805	1725	3015
7000	1415	2470	1530	2685	1650	2900	1770	3125	1900	3370
8000	1560	2755	1690	3000	1815	3240	1950	3500	2095	3790

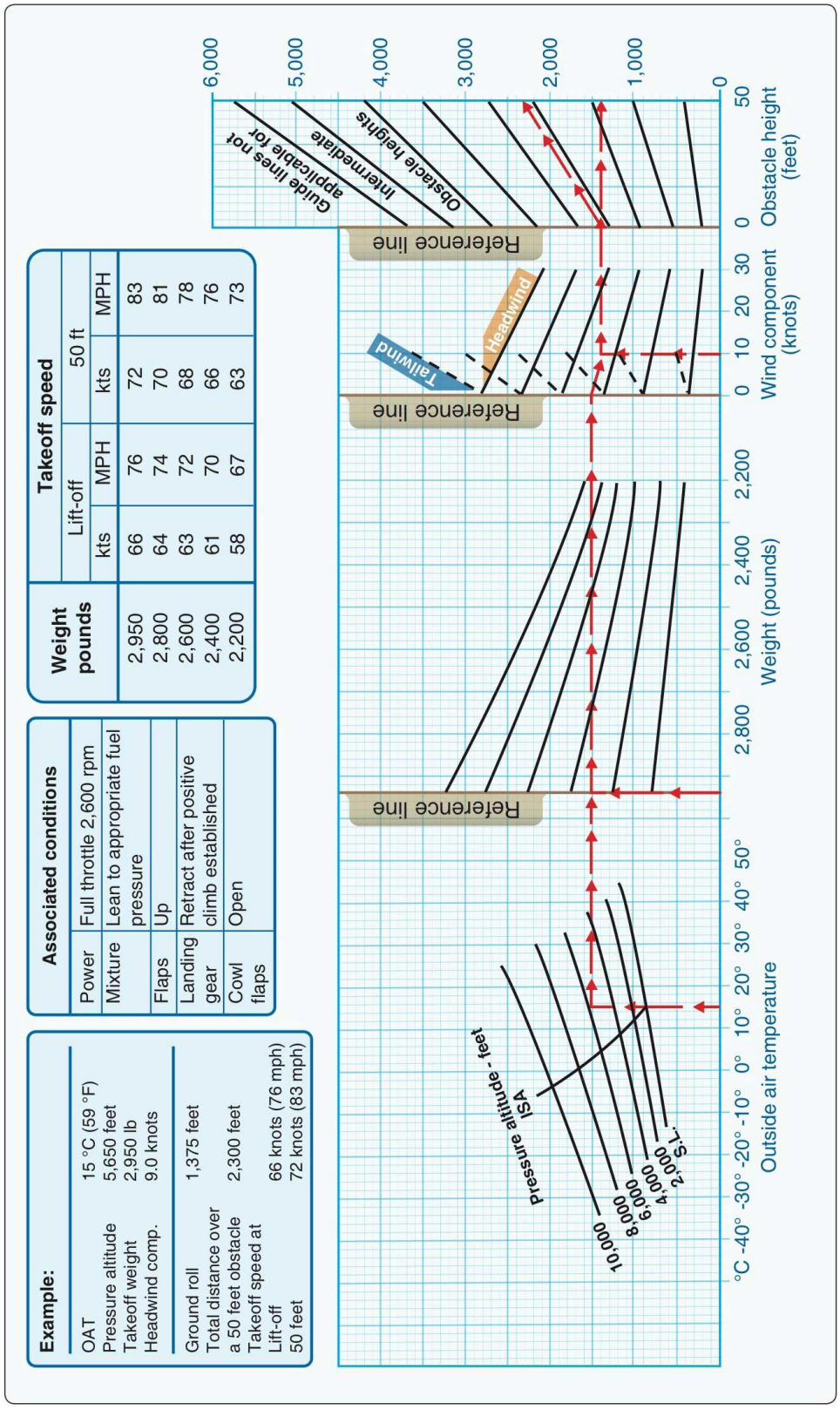
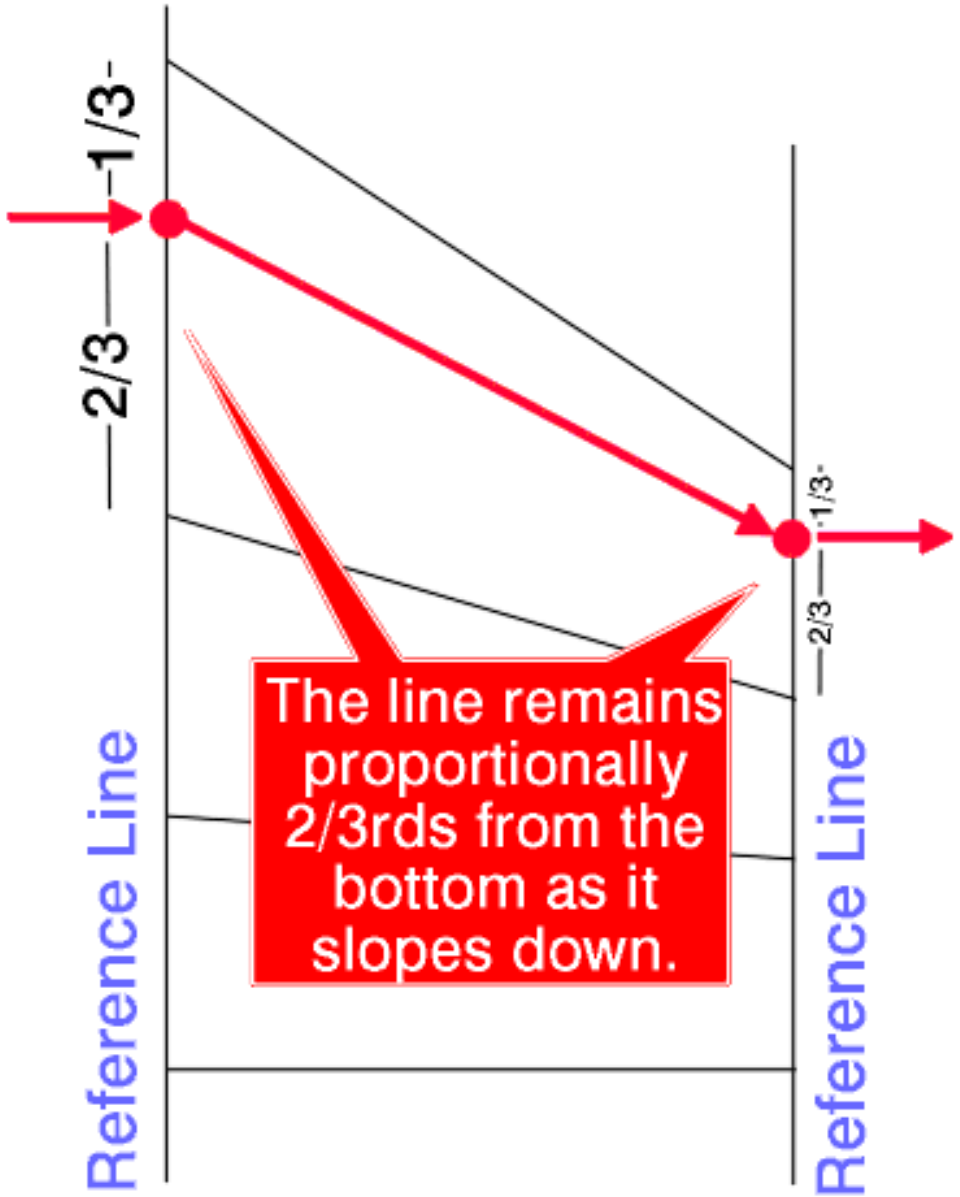


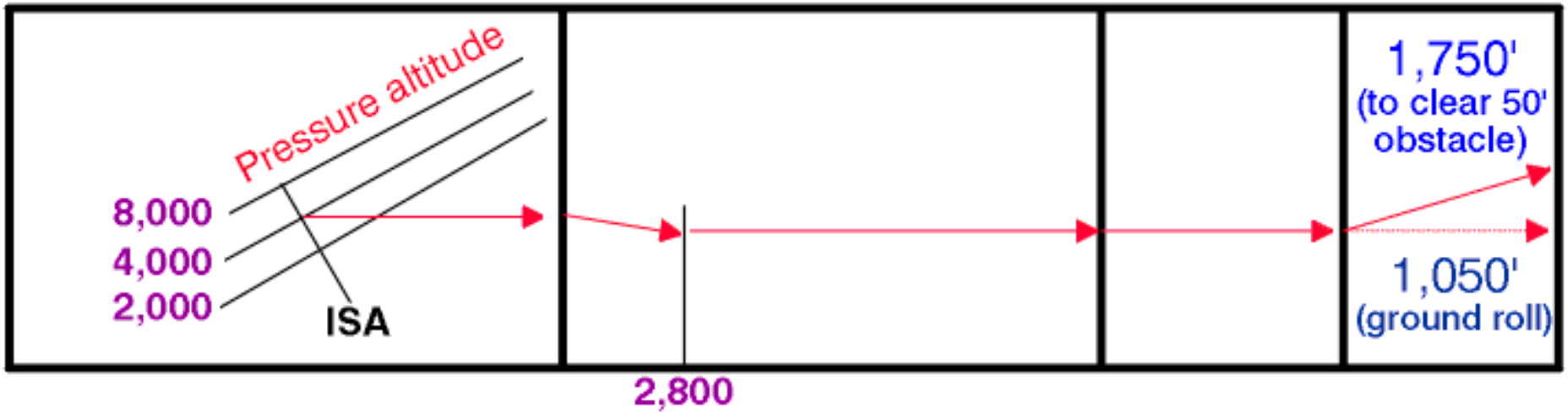
FIGURE 40.—Airplane Takeoff Distance Graph.

MOVING ALONG THE DIAGONAL LINES OF A CHART

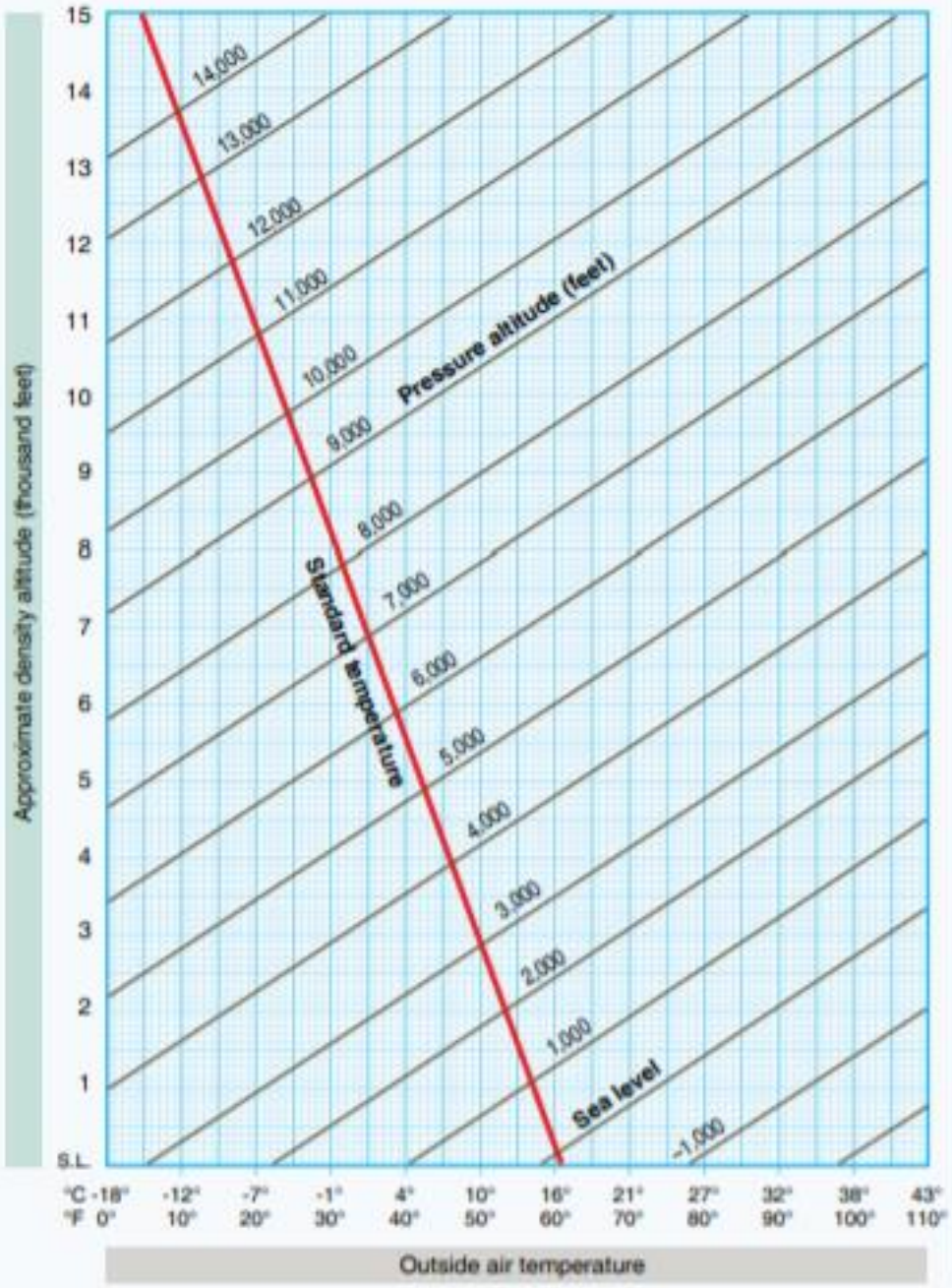
When moving along the sloping line of a performance graph, make sure you move proportionally (up or down) the line. In other words, don't parallel the nearest line as you move. Try to remain the same (proportional) distance between lines.



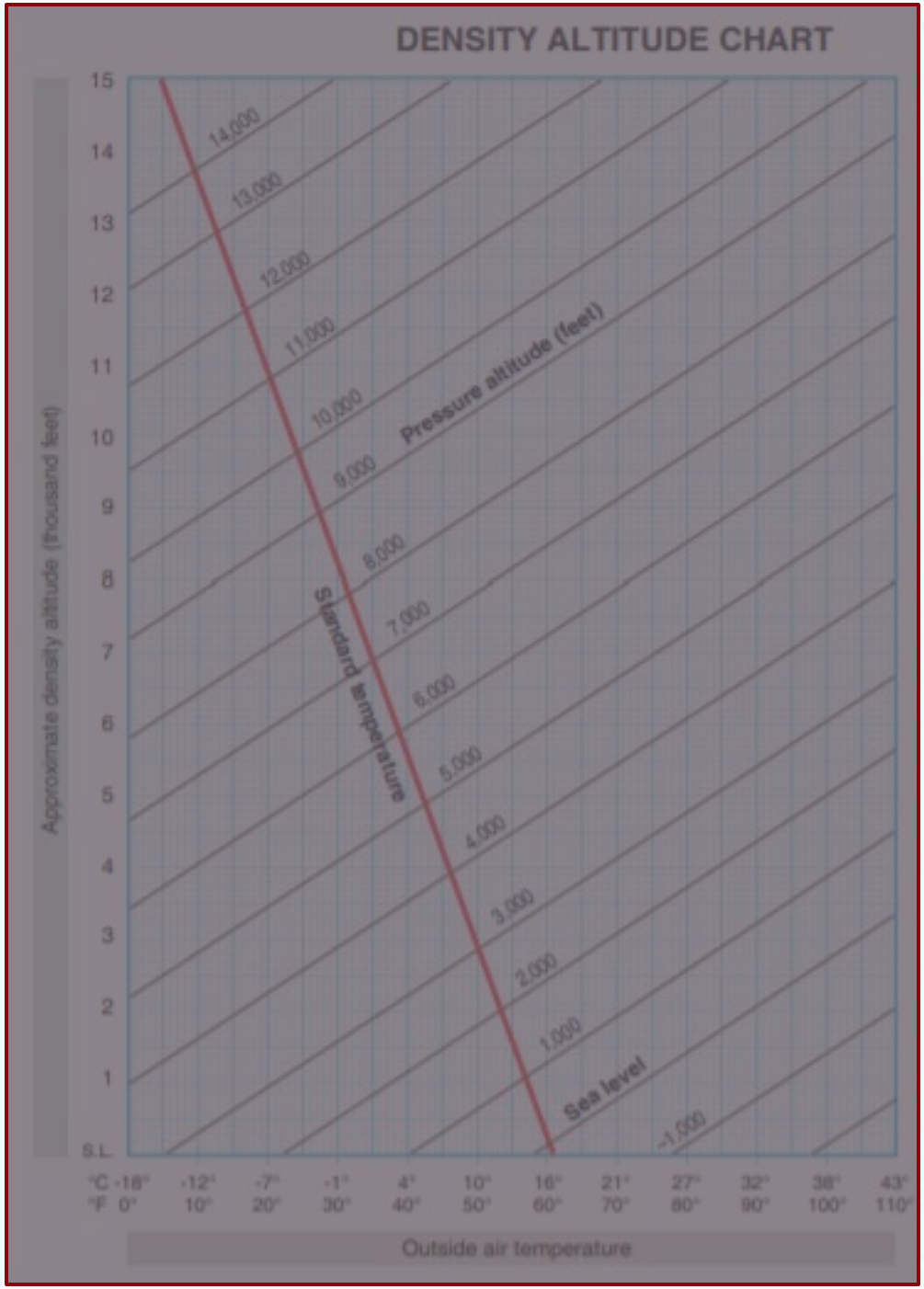
TAKEOFF DISTANCE COMPUTATION



DENSITY ALTITUDE CHART



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
30.8	–803
30.9	–893
31.0	–983



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
30.8	-803
30.9	-893
31.0	-983

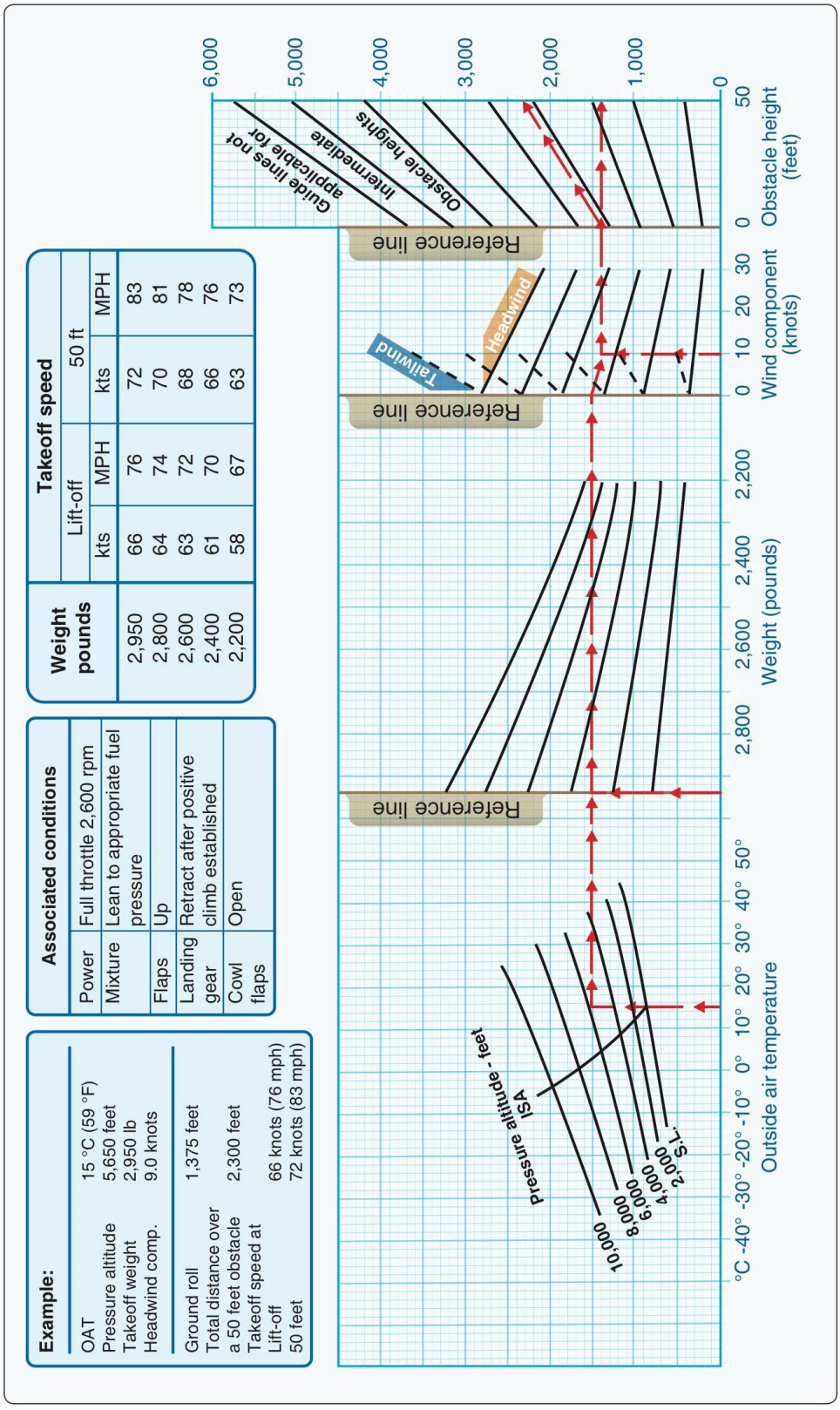


FIGURE 40.—Airplane Takeoff Distance Graph.

Revision:3 Date: 03/07/16

TAKE-OFF & CLIMB PERFORMANCE @ 1320lb

PRESS ALTITUDE (FT)	TEMP (°F)	TAKE-OFF DISTANCE (FT)		MAX RATE OF CLIMB (FT/MIN)
		GROUND ROLL	50 FT OBSTCL	
SEA LEVEL	0	589	1091	1156
	20	641	1188	1069
	40	696	1291	985
	60	750	1397	906
	80	812	1519	831
	100	873	1647	758
2000	0	681	1263	1007
	20	742	1380	921
	40	805	1505	839
	60	871	1642	761
	80	939	1790	687
	100	1010	1954	616
4000	0	790	1474	858
	20	860	1619	774
	40	933	1777	693
	60	1010	1952	617
	80	1089	2150	544
	100	1171	2379	474
6000	0	917	1742	710
	20	999	1927	627
	40	1084	2138	548
	60	1173	2384	473
	80	1265	2680	401
	100	1360	3060	333
8000	0	1068	2097	562
	20	1163	2355	481
	40	1262	2671	403
	60	1365	3082	330
	80	1472	3678	259
	100	1583	4720	192

Date: 03/07/16 Revision:3

TAKE-OFF & CLIMB PERFORMANCE @ 1050 lb

PRESS ALTITUDE (FT)	TEMP (°F)	TAKE-OFF DISTANCE (FT)		MAX RATE OF CLIMB (FT/MIN)
		GROUND ROLL	50 FT OBSTCL	
SEA LEVEL	0	471	951	1455
	20	513	1034	1345
	40	557	1122	1241
	60	600	1212	1141
	80	650	1314	1046
	100	699	1421	956
2000	0	545	1098	1268
	20	594	1197	1160
	40	644	1303	1057
	60	697	1416	959
	80	751	1539	865
	100	808	1673	776
4000	0	632	1277	1081
	20	688	1397	975
	40	747	1528	874
	60	808	1672	777
	80	871	1830	686
	100	937	2008	598
6000	0	734	1499	895
	20	799	1651	790
	40	867	1821	691
	60	938	2012	596
	80	1012	2233	506
	100	1088	2497	420
8000	0	854	1787	709
	20	930	1990	606
	40	1010	2226	509
	60	1092	2511	416
	80	1178	2877	327
	100	1267	3387	243

SHORT FIELD TAKEOFF DISTANCE
AT 2400 POUNDS

CONDITIONS:

Flaps 10°
Full Throttle Prior to Brake Release
Paved, level, dry runway

Zero Wind
Lift Off: 48 KIAS
Speed at 50 Ft: 54 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.	745	1275	800	1370	860	1470	925	1570	995	1685
1000	810	1390	875	1495	940	1605	1010	1720	1085	1845
2000	885	1520	955	1635	1030	1760	1110	1890	1190	2030
3000	970	1665	1050	1795	1130	1930	1215	2080	1305	2230
4000	1065	1830	1150	1975	1240	2130	1335	2295	1430	2455
5000	1170	2015	1265	2180	1360	2355	1465	2530	1570	2715
6000	1285	2230	1390	2410	1500	2610	1610	2805	1725	3015
7000	1415	2470	1530	2685	1650	2900	1770	3125	1900	3370
8000	1560	2755	1690	3000	1815	3240	1950	3500	2095	3790

Revision:3 Date: 03/07/16

LANDING PERFORMANCE – ZERO WIND

DENSITY ALTITUDE (FT)	APPROACH SPEED (KIAS)	LANDING DISTANCE (FT)	
		GROUND ROLL	50 FT OBSTCL
0	55	525	1550
2500	55	585	1615
5000	55	610	1695
7500	55	660	1770

NOTES:

1) Decrease the distances shown by 10% for each 5 kts of headwind.
2) The data given is with flaps fully extended

Cruise Performance

Cruise Power Setting Chart

Cruise power settings

65% Maximum continuous power (or full throttle 2,800 pounds)

Press ALT.	ISA −20 °C (−36 °F)								Standard day (ISA)								ISA +20 °C (+36 °F)							
	IOAT		Engine speed	MAN. press	Fuel flow per engine		TAS		IOAT		Engine speed	MAN. press	Fuel flow per engine		TAS		IOAT		Engine speed	MAN. press	Fuel flow per engine		TAS	
Feet	°F	°C	RPM	IN HG	PSI	GPH	KTS	MPH	°F	°C	RPM	IN HG	PSI	GPH	KTS	MPH	°F	°C	RPM	IN HG	PSI	GPH	KTS	MPH
SL	27	−3	2,450	20.7	6.6	11.5	147	169	63	17	2,450	21.2	6.6	11.5	150	173	99	37	2,450	21.8	6.6	11.5	153	176
2,000	19	−7	2,450	20.4	6.6	11.5	149	171	55	13	2,450	21.0	6.6	11.5	153	176	91	33	2,450	21.5	6.6	11.5	156	180
4,000	12	−11	2,450	20.1	6.6	11.5	152	175	48	9	2,450	20.7	6.6	11.5	156	180	84	29	2,450	21.3	6.6	11.5	159	183
6,000	5	−15	2,450	19.8	6.6	11.5	155	178	41	5	2,450	20.4	6.6	11.5	158	182	79	26	2,450	21.0	6.6	11.5	161	185
8,000	−2	−19	2,450	19.5	6.6	11.5	157	181	36	2	2,450	20.2	6.6	11.5	161	185	72	22	2,450	20.8	6.6	11.5	164	189
10,000	−8	−22	2,450	19.2	6.6	11.5	160	184	28	−2	2,450	19.9	6.6	11.5	163	188	64	18	2,450	20.3	6.5	11.4	166	191
12,000	−15	−26	2,450	18.8	6.4	11.5	162	186	21	−6	2,450	18.8	6.1	10.9	163	188	57	14	2,450	18.8	5.9	10.6	163	188
14,000	−22	−30	2,450	17.4	5.8	10.5	159	183	14	−10	2,450	17.4	5.6	10.1	160	184	50	10	2,450	17.4	5.4	9.8	160	184
16,000	−29	−34	2,450	16.1	5.3	9.7	156	180	7	−14	2,450	16.1	5.1	9.4	156	180	43	6	2,450	16.1	4.9	9.1	155	178

Note: 1. Full throttle manifold pressure settings are approximate.
2. Shaded area represents operation with full throttle.

Interpolation example:

PA = 15,000 feet
OAT = standard

fuel flow (gph)=

$$10.1 - \left[\frac{10.1 - 9.4}{2}\right] =$$

$$10.1 - \frac{0.7}{2} = 9.8$$

Type equation here.

Press ALT.	Standard day (ISA)							
	IOAT		Engine speed	MAN. press	Fuel flow per engine		TAS	
Feet	°F	°C	RPM	IN HG	PSI	GPH	KTS	MPH
SL	63	17	2,450	21.2	6.6	11.5	150	173
2,000	55	13	2,450	21.0	6.6	11.5	153	176
4,000	48	9	2,450	20.7	6.6	11.5	156	180
6,000	41	5	2,450	20.4	6.6	11.5	158	182
8,000	36	2	2,450	20.2	6.6	11.5	161	185
10,000	28	-2	2,450	19.9	6.6	11.5	163	188
12,000	21	-6	2,450	18.8	6.1	10.9	163	188
14,000	14	-10	2,450	17.4	5.6	10.1	160	184
16,000	7	-14	2,450	16.1	5.1	9.4	156	180

Interpolation example:

PA = 8,000 ft

OAT = standard – 10°C

TAS (mph)=

$$181 + \left[\frac{185-181}{2}\right] =$$

$$181 + \frac{4}{2} =$$

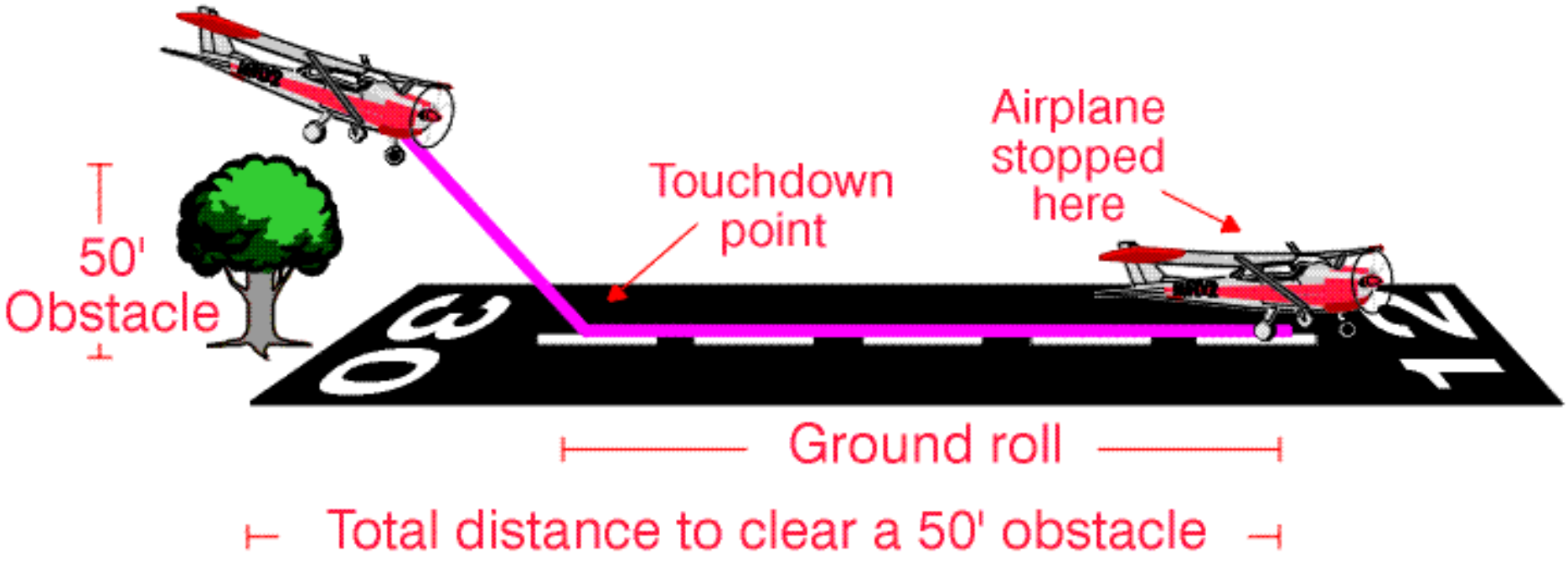
$$181 + 2 = 183$$

Press ALT.	ISA –20 °C (–36 °F)							
	IOAT		Engine speed	MAN. press	Fuel flow per engine		TAS	
Feet	°F	°C	RPM	IN HG	PSI	GPH	KTS	MPH
SL	27	–3	2,450	20.7	6.6	11.5	147	169
2,000	19	–7	2,450	20.4	6.6	11.5	149	171
4,000	12	–11	2,450	20.1	6.6	11.5	152	175
6,000	5	–15	2,450	19.8	6.6	11.5	155	178
8,000	–2	–19	2,450	19.5	6.6	11.5	157	181
10,000	–8	–22	2,450	19.2	6.6	11.5	160	184
12,000	–15	–26	2,450	18.8	6.4	11.5	162	186
14,000	–22	–30	2,450	17.4	5.8	10.5	159	183
16,000	–29	–34	2,450	16.1	5.3	9.7	156	180

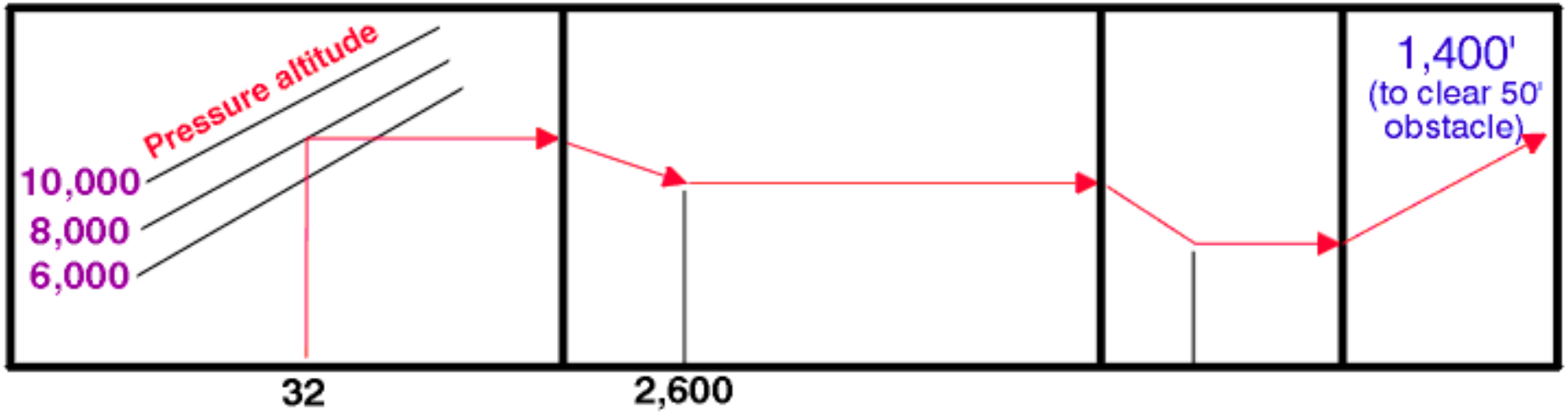
Press ALT.	Standard day (ISA)							
	IOAT		Engine speed	MAN. press	Fuel flow per engine		TAS	
Feet	°F	°C	RPM	IN HG	PSI	GPH	KTS	MPH
SL	63	17	2,450	21.2	6.6	11.5	150	173
2,000	55	13	2,450	21.0	6.6	11.5	153	176
4,000	48	9	2,450	20.7	6.6	11.5	156	180
6,000	41	5	2,450	20.4	6.6	11.5	158	182
8,000	36	2	2,450	20.2	6.6	11.5	161	185
10,000	28	–2	2,450	19.9	6.6	11.5	163	188
12,000	21	–6	2,450	18.8	6.1	10.9	163	188
14,000	14	–10	2,450	17.4	5.6	10.1	160	184
16,000	7	–14	2,450	16.1	5.1	9.4	156	180

Landing Distance & Other Considerations

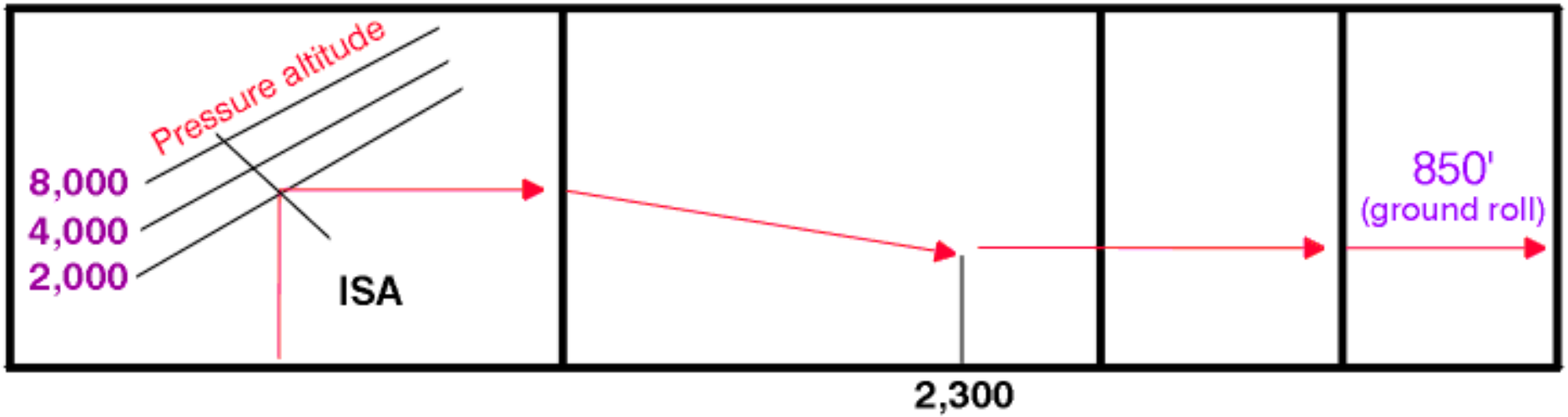
LANDING DEFINITIONS



LANDING DISTANCE COMPUTATION



LANDING DISTANCE COMPUTATION



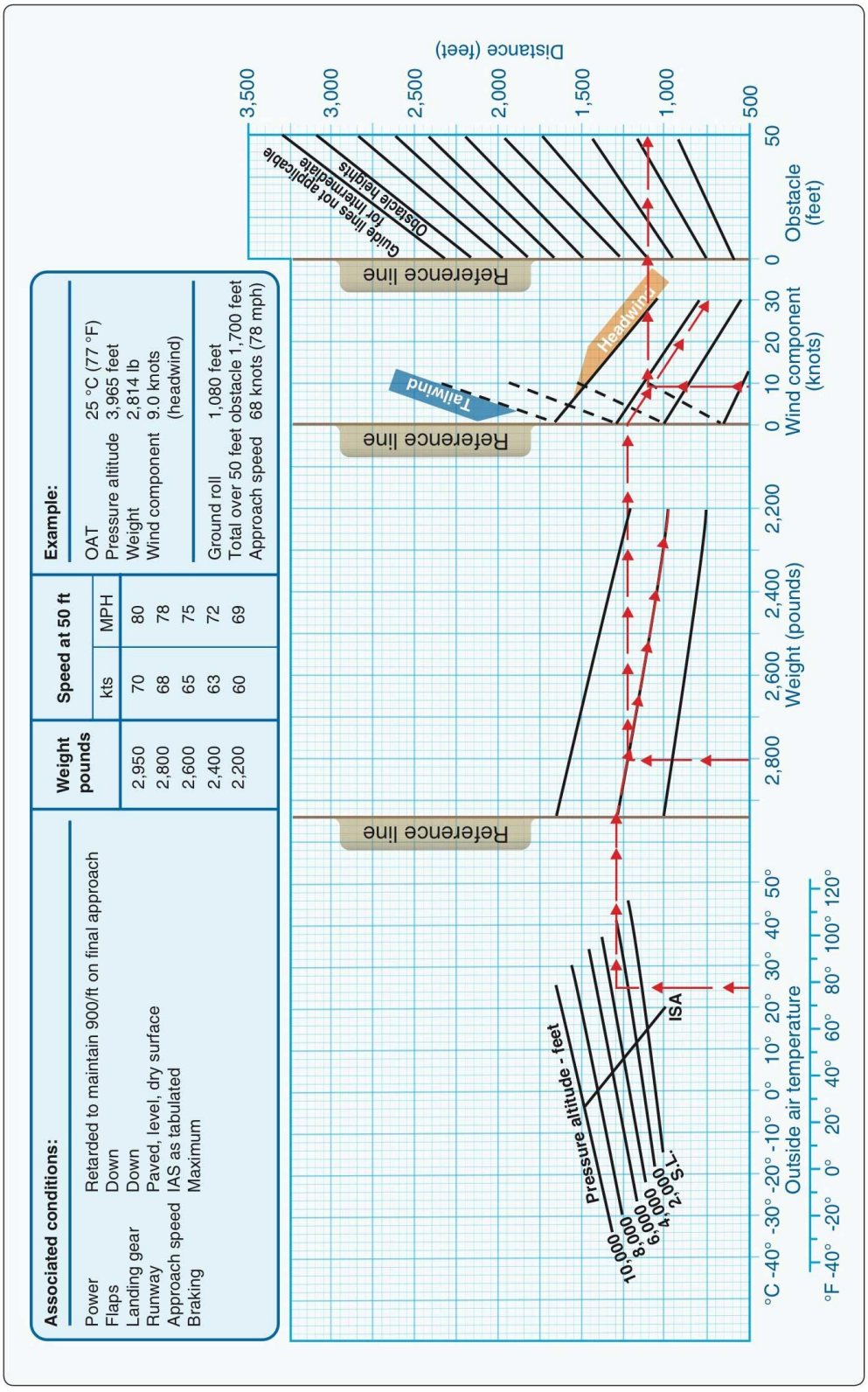


FIGURE 37.—Airplane Landing Distance Graph.

LANDING DISTANCE

FLAPS LOWERED TO 40 ° - POWER OFF
HARD SURFACE RUNWAY - ZERO WIND

GROSS WEIGHT LB	APPROACH SPEED, IAS, MPH	AT SEA LEVEL & 59 °F		AT 2500 FT & 50 °F		AT 5000 FT & 41 °F		AT 7500 FT & 32 °F	
		GROUND ROLL	TOTAL TO CLEAR 50 FT OBS	GROUND ROLL	TOTAL TO CLEAR 50 FT OBS	GROUND ROLL	TOTAL TO CLEAR 50 FT OBS	GROUND ROLL	TOTAL TO CLEAR 50 FT OBS
1600	60	445	1075	470	1135	495	1195	520	1255

NOTES:
1. Decrease the distances shown by 10% for each 4 knots of headwind.
2. Increase the distance by 10% for each 60 °F temperature increase above standard.
3. For operation on a dry, grass runway, increase distances (both "ground roll" and "total to clear 50 ft obstacle") by 20% of the "total to clear 50 ft obstacle" figure.

FIGURE 39.—Airplane Landing Distance Table.