

SECTION V

PERFORMANCE

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INTRODUCTION TO PERFORMANCE AND FLIGHT PLANNING

All airspeeds quoted in this section are indicated airspeeds (IAS) except as noted and assume zero instrument error.

The graphs and tables in this section present performance information for flight planning at various parameters of weight, power, altitude and temperature. Examples have been presented on some performance charts. Calculations for flight time, block speed and fuel required for a sample VFR trip from Denver to Wichita are detailed below. All examples and calculations assume the following conditions:

CONDITIONS

At Denver:

Outside Air Temperature 15°C (59°F)
Field Elevation 5330 ft
Altimeter Setting 29.60 in. Hg
Wind 270° at 10 kts
Runway 26L length 10,010 ft

Route of Trip

*DEN-V4-GLD-V132-HUT-V73-ICT

For VFR Cruise at 9,500 feet

ROUTE SEGMENT	MAGNETIC COURSE	DIST NM	WIND 9500 FEET DIR/KTS	OAT 9500 FEET °C	ALT SETTING IN.HG
DEN-TXC	090°	78	010/30	-5	29.60
TXC-GLD	092°	73	010/30	-5	29.60
GLD-HUT	102°	195	220/10	0	29.56
HUT-ICT	116°	28	220/10	9	29.56

*REFERENCE: Enroute Low Altitude Chart L-6

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At Wichita:

Outside Air Temperature 25°C (77°F)
Field Elevation 1332 ft
Altimeter Setting 29.56 in. Hg
Wind 180° at 10 kts
Runway 19 Length 7301 ft

To determine pressure altitude at origin and destination airports, add 100 feet to field elevation for each .1 in. Hg below 29.92, and subtract 100 feet from field elevation for each .1 in. Hg above 29.92.

Pressure Altitude at DEN:

$$29.92 - 29.60 = .32 \text{ in. Hg}$$

The pressure altitude at DEN is 320 feet above the field elevation.

$$5330 + 320 = 5650 \text{ ft}$$

Pressure Altitude at ICT:

$$29.92 - 29.56 = .36 \text{ in. Hg}$$

The pressure altitude at ICT is 360 feet above the field elevation.

$$1332 + 360 = 1692 \text{ ft}$$

NOTE

For flight planning, the difference between cruise altitude and cruise pressure altitude has been ignored.

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Enter the CRUISE PERFORMANCE table for 73 percent maximum continuous power (or full throttle) at 9500 feet:

ALTITUDE FEET	THROTTLE SETTING RPM	FUEL FLOW GPH	TAS KNOTS
9500	2600	8.3	110

Time and fuel used were calculated as follows:

$$\text{Time} = \frac{\text{Distance}}{\text{Ground Speed}}$$

$$\text{Fuel Used} = (\text{Time}) (\text{Fuel Flow})$$

Results are:

ROUTE SEGMENT	DISTANCE NM	EST GROUND SPEED KNOTS	TIME AT CRUISE ALTITUDE HRS: MIN	FUEL USED FOR CRUISE GAL
DEN-TXC	78	107	0:44	6.1
TXC-GLD	73	108	0:41	5.6
GLD-HUT	195	113	1:44	14.3
HUT-ICT	28	112	0:15	2.1

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TIME - FUEL - DISTANCE

ITEM	TIME HRS: MINS	FUEL GAL	DISTANCE NM
Start, Runup, Taxi and Take- off acceleration	0:00	0.9	0
Cruise	3:24	28.1	374
Total	3:24	29.0	374

Total Flight Time: 3 hours, 24 minutes

Block Speed: $374 \text{ NM} \div 3 \text{ hours, 24 minutes} = 110 \text{ knots}$

Reserve Fuel (45 minutes at 51% Maximum Continuous Power)

Enter the CRUISE POWER SETTINGS table for 51% MCP at 2300 RPM. The fuel flow at 51% MCP is 6.2 gallons per hour.

Reserve fuel = (45 min) (6.2 GPH) = 4.7 gallons

Total Fuel = $29.0 + 4.7 = 33.7$ gallons

The estimated landing weight is determined by subtracting the fuel required for the trip from the ramp weight:

Assumed ramp weight = 2300 lbs

Estimated fuel from DEN to ICT = (29.0 gal) (6 lbs/gal) = 174 lbs

Estimated landing weight = $2300 - 174 = 2126 \text{ lbs}$

**COMMENTS PERTINENT TO THE USE OF
PERFORMANCE GRAPHS**

1. Indicated airspeeds (IAS) were obtained by using the AIRSPEED CALIBRATION NORMAL SYSTEM Table.
2. The associated conditions define the specific conditions from which performance parameters have been determined. They are not intended to be used as instructions, however, performance values determined from charts can only be achieved if specified conditions exist.
3. The full amount of usable fuel is available for all approved flight conditions.
4. Engine and component cooling has been demonstrated for temperatures up to 100°F at sea level with a 3.57°F per 1000 ft lapse rate. (ISA + 41°F)

AIRSPEED CALIBRATION - NORMAL SYSTEM

INDICATED AIRSPEED		CALIBRATED AIRSPEED			
KNOTS	MPH	FLAPS UP		FLAPS DOWN	
		KNOTS	MPH	KNOTS	MPH
50	58	54	62	52	60
55	63	57	65	56	64
60	69	61	70	60	69
65	75	65	75	64	74
70	81	70	80	69	79
75	86	74	85	73	84
80	92	79	91	77	89
85	98	84	97	83	95
90	104	90	103	88	101
95	109	94	108	92	106
100	115	99	114	98	113
105	121	104	120		
110	127	110	126		
115	132	115	132		
120	138	120	134		
125	144	125	144		
130	150	130	150		
135	155				
140	161				

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AIRSPEED CALIBRATION - ALTERNATE SYSTEM

IAS (MPH)	STORM WINDOW CLOSED		STORM WINDOW OPEN	
	FLAPS UP	FLAPS DOWN	FLAPS UP	FLAPS DOWN
	IAS (MPH)	IAS (MPH)	IAS (MPH)	IAS (MPH)
70	75	74	80	79
80	86	84	90	89
90	96	94	111	99
100	107	105	121	109
110	117	115	132	119
120	127		142	
130	138		152	
140	148		162	
150	158			

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ALTIMETER CORRECTION - NORMAL SYSTEM

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INDICATED AIRSPEED		ALTIMETER CORRECTION TO BE ADDED ~ FEET			
KNOTS	MPH	FLAPS UP		FLAPS DOWN	
		SL	10000 FT	SL	10000 FT
50	58	12	16	12	15
55	63	11	14	8	10
60	69	9	13	5	6
65	75	8	11	1	1
70	81	6	9	-2	-3
75	86	5	7	-5	-7
80	92	4	5	-9	-13
85	98	3	4	-13	-18
90	104	1	2	-17	-24
95	109	0	0	-21	-29
100	115	-2	-2		
105	121	-3	-4		
110	127	-4	-6		
115	132	-5	-7		
120	138	-7	-9		
125	144	-9	-12		

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ALTIMETER CORRECTION - ALTERNATE SYSTEM

IAS (MPH)	STORM WINDOW - CLOSED		STORM WINDOW - OPEN	
	FLAPS UP (FEET)	FLAPS DOWN (FEET)	FLAPS UP (FEET)	FLAPS DOWN (FEET)
70	20	20	45	40
80	30	25	60	50
90	40	30	70	60
100	50	35	85	70
110	60	40	95	80
120	70		110	
130	75		120	
140	85		135	
150			150	

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POWER OFF STALL SPEEDS

(WEIGHT 2300 LBS)

Maximum altitude loss during a normal stall recovery is approximately 300 ft.

ANGLE OF BANK			
LEVEL	30°	45°	60°
FLAPS-UP			
70 mph 61 kts	77 mph 67 kts	84 mph 73 kts	100 mph 87 kts
FLAPS - DOWN (30°)			
62 mph 54 kts	70 mph 61 kts	76 mph 66 kts	88 mph 77 kts

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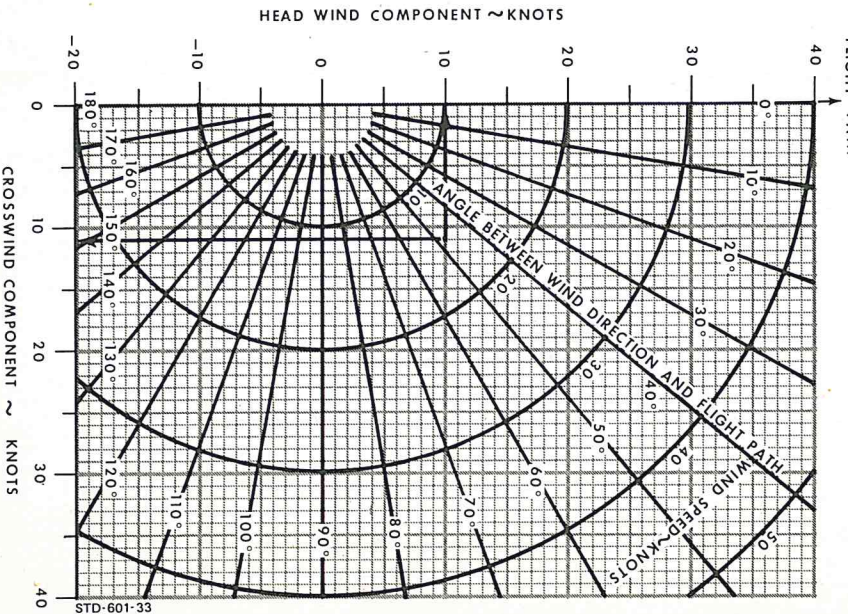
WIND COMPONENTS

Demonstrated Crosswind is 13KTS/15MPH

EXAMPLE:

WIND SPEED	15 KTS
ANGLE BETWEEN WIND DIRECTION AND FLIGHT PATH	50°
HEADWIND COMPONENT	10 KTS
CROSSWIND COMPONENT	11 KTS

FLIGHT PATH



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TAKE-OFF DISTANCE – HARD SURFACE

ASSOCIATED CONDITIONS:

POWER FULL THROTTLE
MIXTURE LEAN TO MAXIMUM RPM, THEN ENRICH SLIGHTLY
FLAPS UP
RUNWAY LEVEL, DRY, HARD SURFACE
WEIGHT 2300 LBS

TAKE OFF SPEEDS:

LIFT OFF 75 MPH/65 KTS
AT 50 FT 84 MPH/73 KTS

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WIND COMPONENT DOWN RUNWAY KNOTS	SEA LEVEL				2000 FT				4000 FT				6000 FT				8000 FT			
	OAT °F	°C	GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET	OAT °F	°C	GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET	OAT °F	°C	GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET	OAT °F	°C	GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET	OAT °F	°C	GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET
0	23	-5	893	1587	16	-9	1045	1844	9	-13	1225	2148	2	-17	1441	2509	-6	-21	1699	2938
	41	5	966	1706	34	1	1131	1984	27	-3	1329	2314	20	-7	1565	2707	13	-11	1847	3173
	59	15	1042	1829	52	11	1222	2130	45	7	1437	2487	38	3	1694	2912	31	-1	2002	3418
	77	25	1121	1957	70	21	1316	2281	63	17	1549	2666	56	13	1829	3125	49	9	2164	3672
	95	35	1204	2089	88	31	1415	2438	81	27	1666	2851	74	23	1969	3345	67	19	2332	3934
15	23	-5	757	1365	16	-9	889	1592	9	-13	1047	1861	2	-17	1236	2182	-6	-21	1464	2564
	41	5	820	1470	34	1	964	1716	27	-3	1138	2009	20	-7	1345	2358	13	-11	1595	2773
	59	15	887	1579	52	11	1044	1845	45	7	1233	2163	38	3	1460	2540	31	-1	1732	2981
	77	25	956	1692	70	21	1127	1979	63	17	1331	2322	56	13	1579	2730	49	9	1875	3219
	95	35	1028	1809	88	31	1213	2119	81	27	1435	2486	74	23	1703	2926	67	19	2025	3453
30	23	-5	620	1143	16	-9	734	1340	9	-13	868	1575	2	-17	1032	1855	-6	-21	1242	2189
	41	5	675	1234	34	1	798	1484	27	-3	947	1703	20	-7	1126	2009	13	-11	1342	2382
	59	15	731	1328	52	11	866	1561	45	7	1029	1838	38	3	1225	2169	31	-1	1462	2564
	77	25	790	1427	70	21	937	1678	63	17	1114	1977	56	13	1328	2335	49	9	1587	2765
	95	35	853	1529	88	31	1012	1800	81	27	1203	2121	74	23	1436	2507	67	19	1717	2973

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NORMAL CLIMB

ASSOCIATED CONDITIONS:

POWER FULL THROTTLE
FLAPS UP

EXAMPLE:

WEIGHT 2300 POUNDS
PRESSURE ALT 4000 FT
OAT 7°C
CLIMB SPEED 74 KTS/85 MPH
RATE OF CLIMB 530 FT/MIN

WEIGHT POUNDS	SEA LEVEL				4000 FEET				8000 FEET				12000 FEET			
	OAT		R/C FT/MIN	CLIMB SPEED KTS/MPH	OAT		R/C FT/MIN	CLIMB SPEED KTS/MPH	OAT		R/C FT/MIN	CLIMB SPEED KTS/MPH	OAT		R/C FT/MIN	CLIMB SPEED KTS/MPH
	°F	°C			°F	°C			°F	°C			°F	°C		
2300	59	15	710	75/86	45	7	530	74/85	30	-1	345	73/84	16	-9	165	71/82
2100	59	15	900	73/84	45	7	715	72/83	30	-1	525	71/82	16	-9	340	69/80
1900	59	15	1125	71/82	45	7	930	70/81	30	-1	735	69/80	16	-9	540	68/78

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CRUISE PERFORMANCE

STANDARD DAY – 38.8 GALLONS

ALT.	RPM	% BPH	FF GPH	TAS KTS/MPH	ENDURANCE HOURS	RANGE NM/SM
2500	2500 2350 2200	75 63 53	9.0 7.6 6.4	109/125 100/115 90/104	3.7 4.4 5.2	405/466 442/508 473/544
3500	2525 2400 2250	75 65 55	9.0 7.8 6.7	110/126 103/118 93/107	3.7 4.3 5.0	406/467 438/504 462/531
4500	2550 2400 2250	75 63 53	9.0 7.6 6.4	110/127 101/116 91/105	3.7 4.4 5.2	408/469 442/508 473/544
5500	2600 2450 2300	77 65 55	9.2 7.8 6.7	113/130 103/119 94/108	3.7 4.3 5.0	405/466 439/505 463/532
6500	2600 2450 2300	75 63 54	9.0 7.6 6.5	113/130 102/118 94/108	3.7 4.4 5.1	414/476 444/511 471/542
7500	2600 2450 2300	73 62 53	8.8 7.5 6.4	112/129 102/117 93/107	3.8 4.4 5.1	418/481 444/511 473/544
8500	2600 2450 2300	71 60 52	8.5 7.2 6.3	111/128 101/116 92/106	4.0 4.6 5.2	425/489 451/519 473/544
9500	2600 2450 2300	69 59 51	8.3 7.1 6.2	110/127 101/116 92/106	4.1 4.7 5.3	436/501 463/533 484/557
10,500	2550 2450 2300	63 57 50	7.6 6.9 6.1	106/122 99/114 91/105	4.4 4.8 5.3	454/522 467/537 485/558

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CRUISE PERFORMANCE

STANDARD DAY — 58.8 GALLONS

ALT.	RPM	% BPH	FF GPH	TAS KTS/MPH	ENDURANCE HOURS	RANGE NM/SM
2500	2500 2350 2200	75 63 53	9.0 7.6 6.4	109/125 100/115 90/104	6.0 7.1 8.4	647/744 706/812 756/869
3500	2525 2400 2250	75 65 55	9.0 7.8 6.7	110/126 103/118 93/107	6.0 6.9 8.0	650/747 701/806 740/851
4500	2550 2400 2250	75 63 53	9.0 7.6 6.4	110/127 101/116 91/105	6.0 7.0 8.3	653/751 708/814 758/872
5500	2600 2450 2300	77 65 55	9.2 7.8 6.7	113/130 103/119 94/108	5.8 6.8 8.0	650/747 704/810 743/855
6500	2600 2450 2300	75 63 54	9.0 7.6 6.5	113/130 102/118 94/108	5.9 7.0 8.1	665/765 716/823 759/873
7500	2600 2450 2300	73 62 53	8.8 7.5 6.4	112/129 102/117 93/107	6.1 7.1 8.3	675/776 717/824 764/879
8500	2600 2450 2300	71 60 52	8.5 7.2 6.3	111/128 101/116 92/106	6.3 7.3 8.4	688/791 730/839 766/881
9500	2600 2450 2300	69 59 51	8.3 7.1 6.2	110/127 101/116 92/106	6.5 7.5 8.5	702/807 748/860 782/899
10,500	2550 2450 2300	63 57 50	7.6 6.9 6.1	106/122 99/114 91/105	6.7 7.7 8.6	734/844 754/867 784/902

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LANDING DISTANCE – HARD SURFACE

ASSOCIATED CONDITIONS:

POWER IDLE
MIXTURE RICH
FLAPS 30°
RUNWAY LEVEL, DRY, HARD SURFACE
WEIGHT 2300 LBS

LANDING SPEEDS:

AT 50 FT 79 MPH/69 KTS
TOUCHDOWN 69 MPH/60 KTS

WIND COMPONENT DOWN RUNWAY KNOTS	SEA LEVEL				2000 FT				4000 FT				6000 FT				8000 FT			
	OAT		GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET	OAT		GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET	OAT		GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET	OAT		GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET	OAT		GROUND ROLL FEET	TOTAL OVER 50 FT OBSTACLE FEET
	°F	°C			°F	°C			°F	°C			°F	°C			°F	°C		
0	23	-5	836	1526	16	-9	924	1659	9	-13	1026	1832	2	-17	1141	2018	-6	-21	1274	2230
	41	5	891	1615	34	1	987	1770	27	-3	1097	1947	20	-7	1224	2149	13	-11	1369	2381
	59	15	948	1706	52	11	1052	1875	45	7	1172	2067	38	3	1310	2286	31	-1	1468	2538
	77	25	1007	1802	70	21	1120	1983	63	17	1250	2191	56	13	1399	2428	49	9	1572	2701
	95	35	1068	1900	88	31	1190	2095	81	27	1330	2319	74	23	1492	2575	67	19	1679	2869
15	23	-5	690	1260	16	-9	767	1385	9	-13	856	1528	2	-17	957	1692	-6	-21	1073	1879
	41	5	738	1338	34	1	822	1474	27	-3	918	1629	20	-7	1029	1807	13	-11	1157	2012
	59	15	787	1417	52	11	879	1566	45	7	984	1735	38	3	1105	1928	31	-1	1244	2151
	77	25	839	1501	70	21	938	1661	63	17	1052	1844	56	13	1184	2054	49	9	1336	2296
	95	35	893	1588	88	31	999	1759	81	27	1122	1957	74	23	1265	2184	67	19	1431	2445
30	23	-5	544	993	16	-9	610	1101	9	-13	685	1224	2	-17	772	1365	-6	-21	872	1527
	41	5	585	1060	34	1	656	1177	27	-3	739	1311	20	-7	834	1465	13	-11	945	1643
	59	15	627	1128	52	11	705	1256	45	7	795	1402	38	3	900	1570	31	-1	1020	1764
	77	25	671	1201	70	21	756	1338	63	17	854	1497	56	13	967	1679	49	9	1100	1890
	95	35	717	1275	88	31	809	1424	81	27	915	1595	74	23	1039	1793	67	19	1183	2021

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