Flight Test Performance Calculation Package - Beech BE76 Duchess

You must prepare a full set of planning documents for your flight test and can use this package for that purpose.

These flight planning documents must include:

- weight and balance
- flight plan
- performance predictions
  - Accelerate-Stop Distance Required
  - Accelerate-Go Distance Required
  - Take-Off Distance Required
  - Etc.

Performance predictions should cover all phases of flight for which charts are available in the POH. We suggest that you prepare these in a package in advance of your flight test using an estimate of the examiner's weight, the forecast weather conditions applicable to the time of your flight test and of course the actual aerodrome data.

The charts and performance information provided in this package are based on a 1978 model Beech BE76 Duchess. You should check to confirm that the information given in this package is applicable for the year or model aircraft that you will use on your flight test. If the information differs then you should use the charts provided by your flight school or the actual POH information when preparing for your flight test, or any other flight.

Often the examiner will give you a questionnaire ahead of time so that you can have this information determined before the examiner arrives. You should of course be capable of explaining how you determined it during the pre-flight oral briefing.

Your documentation should be put together in a package or binder so that it is neat, clear and professional. This will make a good impression with the examiner and will set you up for success.

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Using information for your specific aircraft, airfield and the latest weather information, fill in the information below for use in the weight & balance and performance calculations:

Aeroplane and loading information:

- **Aeroplane empty weight:** _______ lbs
- **Aeroplane empty moment:** _______ in-lbs
- **Pilot weight:** _______ lbs
- **Examiner weight:** _______ lbs
- **Baggage weight:** _______ lbs
  (Mostly flight bags, jackets and documentation, normally located in the aft baggage area)
- **Fuel quantity:** _______ USG, and **Fuel weight:** _______ lbs
  (Sufficient fuel for at least a two hour flight test plus day VFR reserves)

Aerodrome and Weather information:

- **Aerodrome elevation:** _______ feet
- **Altimeter setting:** _______ " Hg
- **Runway in use:** _______, length of runway: _______ feet
- **OAT:** _______ °C
- **Wind:** _____/___ by ATIS
- **Flight test altitude:** _______' (sufficient to allow recovery at least 2,000' AGL)
- **Temperature at flight-test altitude:** ___°C from FD

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Most aeroplane charts require one to input the pressure altitude and the aeroplane weight so the first steps are to calculate these.

Use the information for the airfield where you will be conducting your flight test and the latest weather information information

Pressure Altitude at take-off = (airfield elevation) + ((altimeter setting) – 29.92) x 1,000'
= _______ ft

Select an altitude for the flight test that will allow at recovery at least 2,000' AGL.

Pressure Altitude at test altitude = (test altitude) + ((altimeter setting) – 29.92) x 1,000'
=_______ ft

The second step in pre-flight planning is to estimate the aeroplane weight at take-off. To do this we must estimate the weight of fuel that will be carried.

For a typical flight test, sufficient fuel must be carried for about 2 hours of flying plus VFR reserves which correspond to 30 minutes of fuel at normal cruise power. Of course there will have to be fuel for taxi, take-off, climb, descent and landing so we can estimate the fuel using a total flight time of 3 hours at normal cruise power. We can verify that this will be sufficient and then make any adjustments necessary at the end.

Refer to the "Recommended Cruise Power" chart. By interpolation at flight test altitude, the fuel flow is ___ GPH per engine or ___ GPH total

Estimated fuel required is 3 hours x ____ GPH = _____ USG = _____ lbs

Actual fuel on board = ____ USG = _____ lbs

Using this information, we can now calculate the weight and balance for the flight test

Use the weight and balance chart to determine your take-off and landing weights and center of gravity positions

Take-off weight: _____ lbs, **Center of Gravity:** Within Limits / Outside Limits

Landing weight: _____ lbs, **Center of Gravity:** Within Limits / Outside Limits

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Accelerate-Stop Distance Required (ASDR)

The total distance needed to accelerate to the maximum abort speed (sometimes called the decision speed) and then stop on the remaining runway. This is the distance that will be required if you had an engine failure at the abort speed and decided to abort the take-off.

It is not a legal requirement that the accelerate-stop distance available exceed the accelerate-stop distance required by the aeroplane. However you should calculate the distance required, compare it to the distance available and be aware of the implications of the result should an engine fail just prior to lift off.

Knowing that you do or don't have enough distance available to stop on the runway following an engine failure just before lift off can be used to help in your decision making. Be sure to include this as part of your pre-takeoff briefing; for example, if you brief that there is not distance available to stop on the runway then you can mentally prepare for running off the end of the runway (and for performing the critical action items to secure the aircraft) if you have an engine failure just before lift off.

Refer to the "Accelerate-Stop Distance Required" graph and the local aerodrome information

Accelerate-Stop Distance Required: _____ ft

Accelerate-Stop Distance Available: _____ ft

Accelerate – Go Distance Required (AGDR)

The total distance required to accelerate with both engines running, experience an engine failure at 71 knots, rotate, lift off and climb to 50 ft above the runway elevation.

It is not a legal requirement to calculate the Accelerate-Go Distance Required or that it should exceed the Accelerate-Go Distance Available. In fact, very few light twins other than the Beech Duchess publish this information in their handbooks. In many cases this class of aircraft is simply not able to continue accelerating, lift-off and climb away due to the very small performance margin when on one engine.

Again, determine the required and available distances and use this to guide your decision making. Knowing for certain that you cannot clear obstacles is a good reason to abort the takeoff rather than attempting to continue if the engine fails before lift off. Don't forget to include this information in your pre-takeoff briefing.

Refer to the "Accelerate-Go Distance Required" graph and the local aerodrome information

Accelerate-Go Distance Required: _____ ft

Accelerate-Go Distance Available: _____ ft

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Take-off Distance Required (TODR)

The total take-off distance needed to clear a 50 ft tall obstacle. Where there are existing obstacles at your departure airport you should determine the distance required to clear these obstacles.

Refer to the "Take-off Distance Required" chart and the local aerodrome data

Take-off Distance Required: _____ ft

Take-off Distance Available: _____ ft

Time, Fuel and Distance to Climb

This is the time, fuel and distance needed to climb from an initial altitude up to a specified altitude, usually the cruising altitude. For the flight test the initial altitude is usually the elevation of the departure airport and the final altitude is the altitude that you will use when manoeuvring or demonstrating your engine failure procedures.

The chart is read by finding the time, fuel and distance to climb from sea level to the departure aerodrome altitude and then subtracting these from the time, fuel and distance to climb from sea level to the flight test altitude.

Refer to the "Time, Fuel and Distance to Climb" chart

Climb from sea level to flight test altitude	
Time	__ minutes
Fuel	__ USG
Distance	__ nm

\-

Climb from sea level to aerodrome elevation	
Time	__ minutes
Fuel	__ USG
Distance	__ nm

=

Climb from aerodrome to flight test altitude	
Time	__ minutes
Fuel	__ USG
Distance	__ nm

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Single Engine Climb Rate

The single engine rate of climb is usually determined for two situations – firstly following an engine failure after take-off and secondly at your cruising altitude.

Refer to the "Climb – One Engine Inoperative" chart

After liftoff

Single engine rate of climb: _____ fpm (_____% gradient)

At flight test altitude

Single engine rate of climb: _____ fpm (_____% gradient)

Single Engine Cruise Performance

If you are above your single engine absolute ceiling when an engine fails then you will be unable to maintain altitude. You will gradually descend down to the single engine absolute ceiling even if you are at full power on the operating engine and are maintaining the best single engine rate of climb speed (blue line, V_{YSE}). You need to check that you still will be able to maintain an altitude above terrain. This is particularly important during instrument conditions when you can't see the terrain, so you should always check that your single engine absolute ceiling is above the Minimum Obstacle Clearance Altitude (MOCA) if you are flying IFR.

Refer to the "Service Ceiling – One Engine Inoperative" chart

Single Engine Service Ceiling: _____ ft

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Time, Fuel and Distance to Descend

This chart enables you to determine the time, fuel and distance needed to descend from an initial altitude to some final altitude. The chart is similar in its form and usage to the one used to determine fuel, time and distance to climb. For the flight test the initial altitude is usually the altitude that you will use when manoeuvring or demonstrating your engine failure procedures and the final altitude is the altitude of the aerodrome that you will be landing at.

The chart is used by finding the time, fuel and distance to descend from aerodrome elevation to sea level and then subtracting these from the time, fuel and distance to descend from flight test maneuvering altitude to sea level.

Refer to the "Time, Fuel and Distance to Descend" chart

Descend from flight test altitude to sea level	
Time	__ minutes
Fuel	__ USG
Distance	__ nm

\-

Descend from aerodrome elevation to sea level	
Time	__ minutes
Fuel	__ USG
Distance	__ nm

=

Descend from flight test altitude to aerodrome elevation	
Time	__ minutes
Fuel	__ USG
Distance	__ nm

Landing Distance Required

The total landing distance needed to clear a 50 ft tall obstacle situated at the threshold. Where there are existing obstacles at your arrival airport you should determine the distance required to clear these obstacles and land.

The landing distance chart requires the pressure altitude and temperature (to take into account the effects of density altitude) and the wind component to calculate landing distance but do not usually take into account the effect of weight on landing distance.

Refer to the "Landing Distance – Flaps Down" chart and the local aerodrome information

Landing Distance Required: _____ ft

Landing Distance Available: _____ ft

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PERFORMANCE CALCULATIONS SUMMARY

WEIGHT AND BALANCE

Estimated fuel required: ____ USG = _____ lbs

Actual fuel on board: _____ USG = _____ lbs

Take-off weight: _____ lbs, **Center of Gravity:** Within Limits / Outside Limits

Landing weight: _____ lbs, **Center of Gravity:** Within Limits / Outside Limits

TAKE OFF

Pressure Altitude: _____ ft **Take-off Decision Speed:** _____ KIAS

Accelerate-Stop Distance Required: _____ ft, **Distance Available:** _____ ft

Accelerate-Go Distance Required: _____ ft, **Distance Available:** _____ ft

Take-off Distance Required: _____ ft, **Distance Available:** _____ ft

CLIMB

NORMAL

Airspeed: _____ KIAS

Time: _____ minutes

Fuel: _____ USG

Distance: _____ nm

ONE ENGINE INOPERATIVE

Airspeed: _____ KIAS

After Liftoff:

Single Engine Rate of Climb: _____ fpm (_____% gradient)

At Flight Test Altitude:

Single Engine Rate of Climb: _____ fpm (_____% gradient)

CRUISE

Pressure Altitude: _____ ft **Single Engine Service Ceiling:** _____ ft

Power Setting: _____ in. Hg, _____ RPM

Performance: _____ KIAS, _____ KTAS, _____ GPH per Engine

DESCENT

Airspeed: _____ KIAS **Time:** _____ minutes

Fuel: _____ USG **Distance:** _____ nm

LANDING

Approach Airspeed: _____ KIAS

Landing Distance Required: _____ ft, **Distance Available:** _____ ft

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RECOMMENDED CRUISE POWER – 20.0 IN. HG @ 2300 RPM (OR FULL THROTTLE) (Chart extract)

PRESS ALT.	STANDARD DAY (ISA)							ISA +20°C (+36°F)						
	OAT		MAN. PRESS.	FUEL FLOW/ ENGINE		IAS	TAS	OAT		MAN. PRESS.	FUEL FLOW/ ENGINE		IAS	TAS
FEET	°C	°F	IN. HG	PPH	GPH	KTS	KTS	°C	°F	IN. HG	PPH	GPH	KTS	KTS
SL	16	61	20.0	40	6.7	123	123	36	97	20.0	38	6.3	119	123
1000	14	57	20.0	41	6.8	124	126	34	93	20.0	39	6.5	120	126
2000	13	55	20.0	42	7.0	125	129	33	91	20.0	40	6.7	121	129
3000	11	52	20.0	42	7.0	126	132	31	88	20.0	41	6.8	122	132
4000	9	48	20.0	43	7.2	127	135	29	84	20.0	42	7.0	122	135
5000	7	45	20.0	44	7.3	127	137	27	81	20.0	43	7.2	123	137
6000	5	41	20.0	45	7.5	128	140	25	77	20.0	44	7.3	124	140
7000	3	37	20.0	46	7.7	128	143	23	73	20.0	45	7.5	124	143
8000	1	34	20.0	47	7.8	129	145	21	70	20.0	46	7.7	125	146
9000	-1	30	20.0	48	8.0	129	148	19	66	20.0	47	7.8	125	149
10000	-3	27	20.0	49	8.2	130	151	17	63	20.0	48	8.0	125	151
11000	-6	23	19.5	49	8.2	129	152	15	59	19.5	47	7.8	124	152
12000	-7	19	18.8	47	7.8	125	151	13	55	18.8	46	7.7	121	151
13000	-9	16	18.0	46	7.7	122	149	11	52	18.0	44	7.3	117	149
14000	-11	12	17.3	44	7.3	119	147	9	48	17.3	42	7.0	114	147
15000	-13	9	16.7	42	7.0	115	145	7	45	16.7	41	6.8	110	144
16000	-15	5	16.0	40	6.7	111	143	5	41	16.0	39	6.5	106	142

NOTES:
1. FULL THROTTLE MANIFOLD PRESSURE SETTINGS ARE APPROXIMATE
2. SHADED AREA REPRESENTS OPERATION WITH FULL THROTTLE
3. LEAN TO 25°F – 50°F ON RICH SIDE OF PEAK EGT
4. CRUISE SPEEDS ARE PRESENTED AT AN AVERAGE WEIGHT OF 3600 LBS

NOTE:
Mark up these charts in red so that it is easy for the examiner to see how you came up with your performance figures

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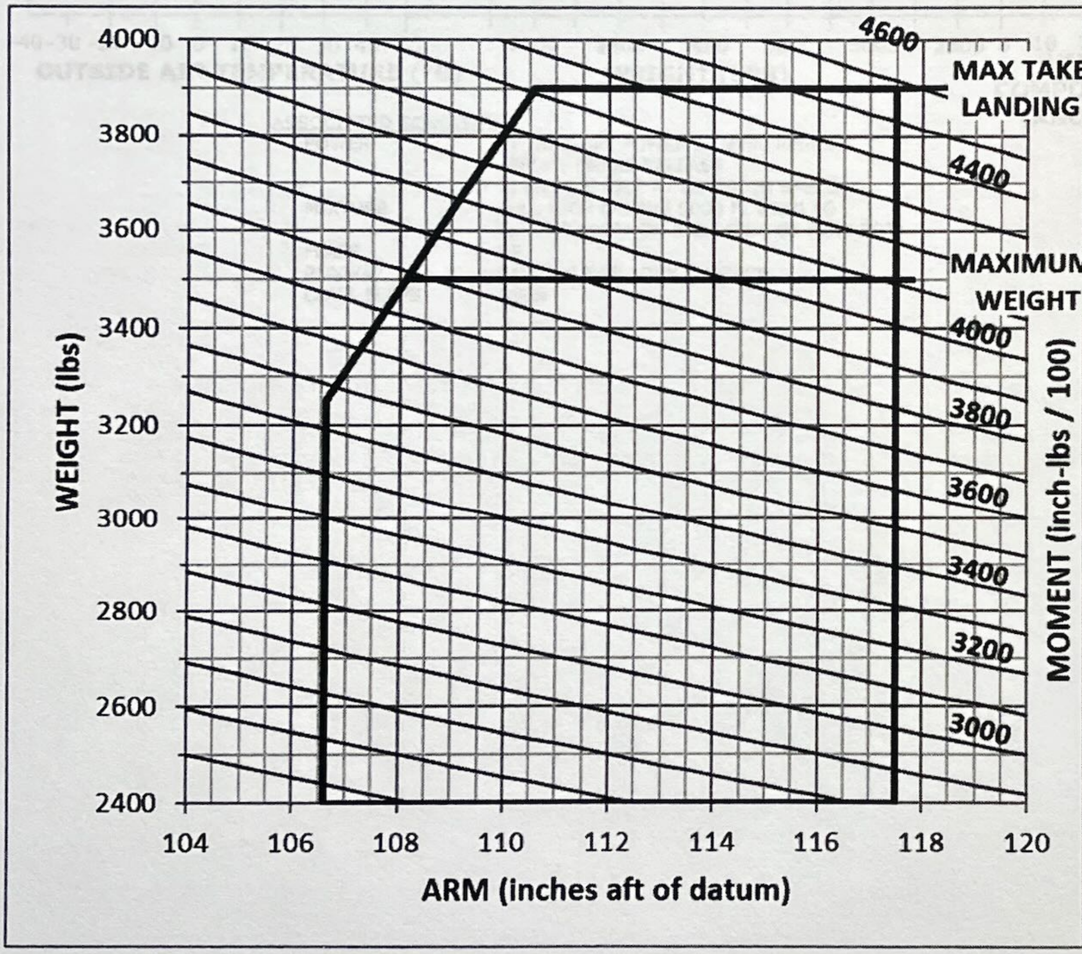
	Weight (lbs)	Arm (inches)	Moment (inch-lbs / 100)
Basic Empty Weight			
Pilot & Co-Pilot		108.0	
Rear Passengers		144.0	
Baggage (Max 200lb)		167.0	
Zero Fuel Total (Max 3500lb)			
Fuel (6lb / USG)		117.0	
Ramp Weight (Max 3916lb)			
Start & Taxi Fuel	16	117.0	1872
Take-Off Weight (Max 3900lb)			
Trip Fuel (6lb / USG)		117.0	
Landing Weight (Max 3900lb)			

NOTE:
Weight and CG location must be within limitations at all times during the flight. It is not sufficient to simply calculate the weight and balance at take-off



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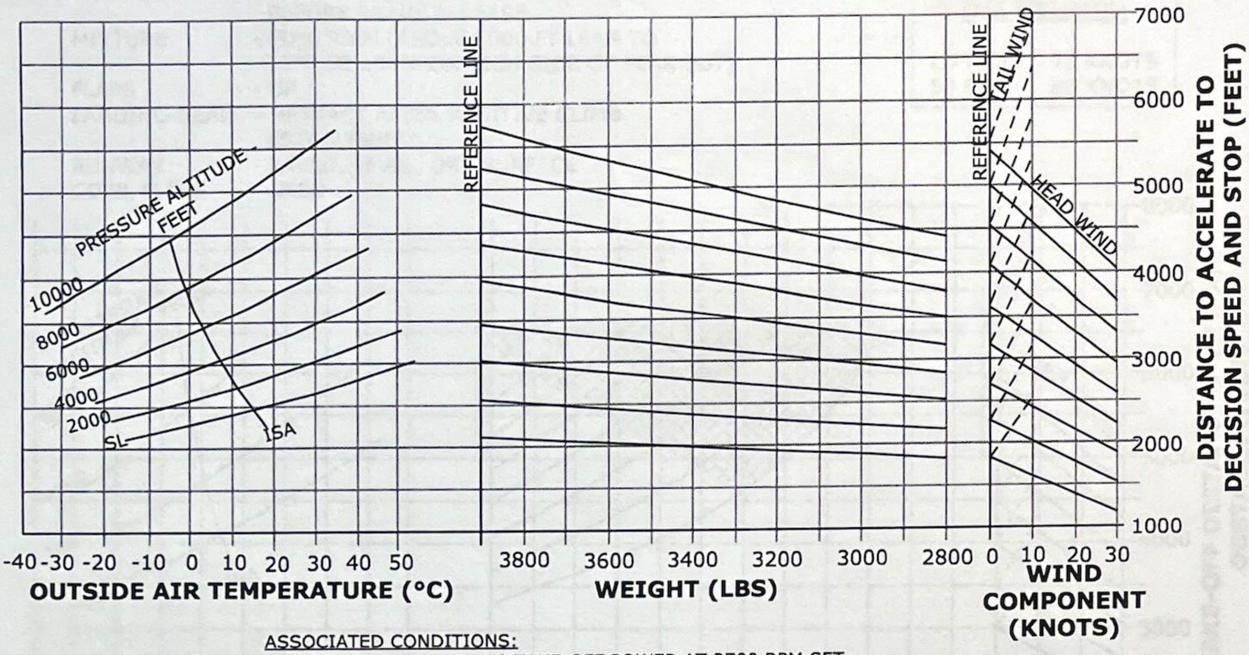
ACCELERATE – STOP DISTANCE REQUIRED

DECISION SPEED (ALL WEIGHTS) 71 KNOTS



ASSOCIATED CONDITIONS:

POWER	- 1) TAKE-OFF POWER AT 2700 RPM SET BEFORE BRAKE RELEASE
	- 2) ENGINE IDLE AT DECISION SPEED
MIXTURE	- FULL RICH (ABOVE 5000 FT LEAN TO 75°F TO 100°F ON RICH SIDE OF PEAK EGT)
FLAPS	- UP
RUNWAY	- PAVED, LEVEL, DRY SURFACE
COWL FLAPS	- OPEN

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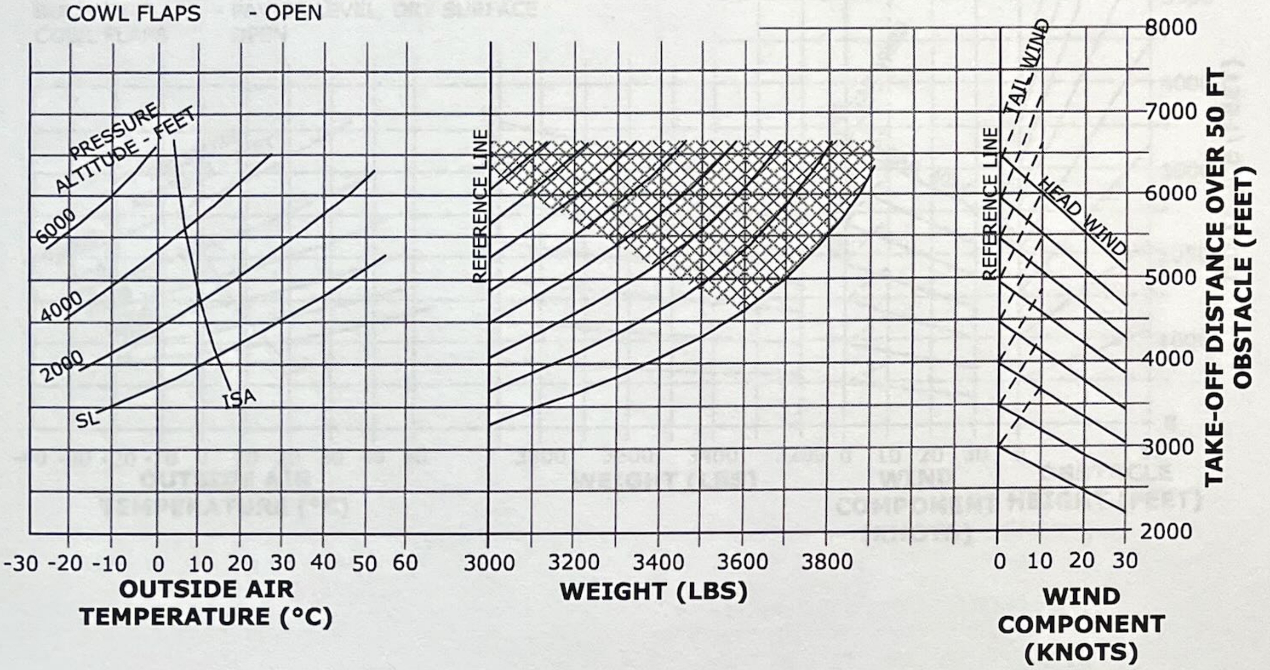
ACCELERATE – GO DISTANCE REQUIRED

ASSOCIATED CONDITIONS:

POWER	- TAKE-OFF POWER AT 2700 RPM SET BEFORE BRAKE RELEASE
MIXTURE	- FULL RICH (ABOVE 5000 FT LEAN TO 75°F TO 100°F ON RICH SIDE OF PEAK EGT)
FLAPS	- UP
LANDING GEAR	- RETRACT AFTER POSITIVE CLIMB ESTABLISHED
RUNWAY	- PAVED, LEVEL, DRY SURFACE
COWL FLAPS	- OPEN

TAKE-OFF SPEEDS (ALL WEIGHTS)

LIFT-OFF	71 KNOTS
50 FEET	80 KNOTS



NOTES:

1. GROUND ROLL DISTANCE IS 20% OF TAKE-OFF DISTANCE OVER 50 FT OBSTACLE.
2. DISTANCES ASSUME AN ENGINE FAILURE AT LIFT-OFF AND PROPELLER IMMEDIATELY FEATHERED.
3. WEIGHTS IN SHADED AREA MAY NOT PROVIDE POSITIVE ONE-ENGINE INOPERATIVE CLIMB. REFER TO TAKE-OFF WEIGHT GRAPH FOR MAXIMUM WEIGHT AT WHICH THE ACCELERATE-GO PROCEDURE SHOULD BE ATTEMPTED.

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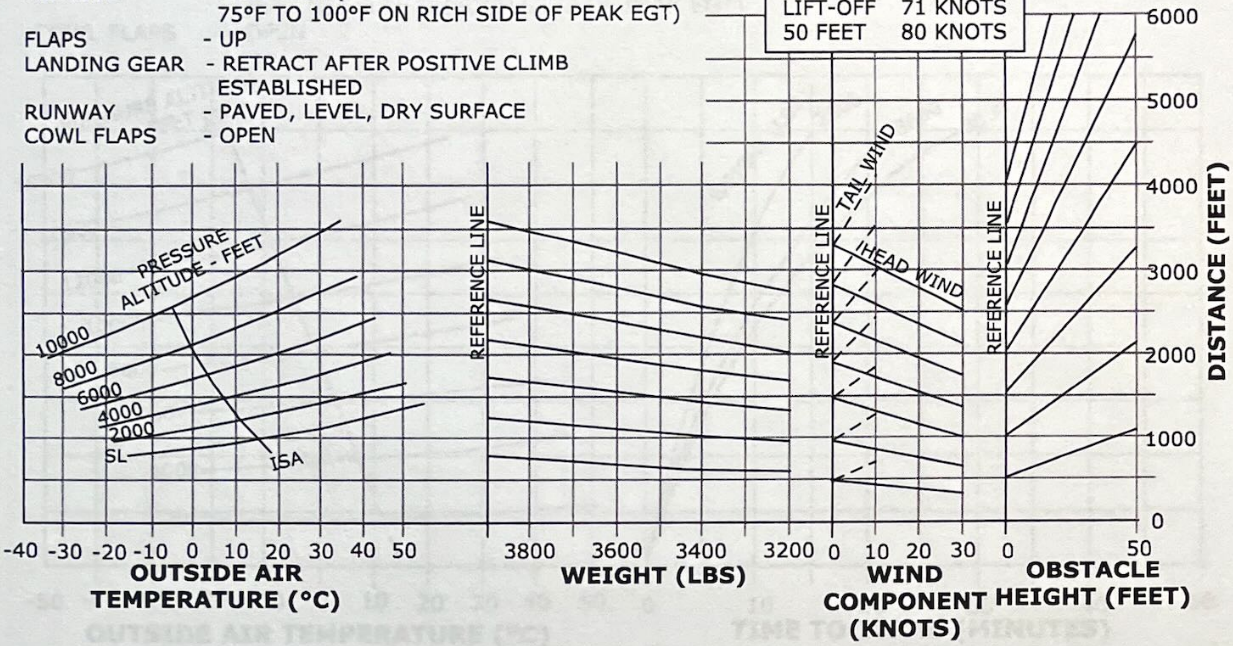
TAKE-OFF DISTANCE REQUIRED

ASSOCIATED CONDITIONS:

POWER	- TAKE-OFF POWER AT 2700 RPM SET BEFORE BRAKE RELEASE
MIXTURE	- FULL RICH (ABOVE 5000 FT LEAN TO 75°F TO 100°F ON RICH SIDE OF PEAK EGT)
FLAPS	- UP
LANDING GEAR	- RETRACT AFTER POSITIVE CLIMB ESTABLISHED
RUNWAY	- PAVED, LEVEL, DRY SURFACE
COWL FLAPS	- OPEN

TAKE-OFF SPEEDS (ALL WEIGHTS)

LIFT-OFF	71 KNOTS
50 FEET	80 KNOTS



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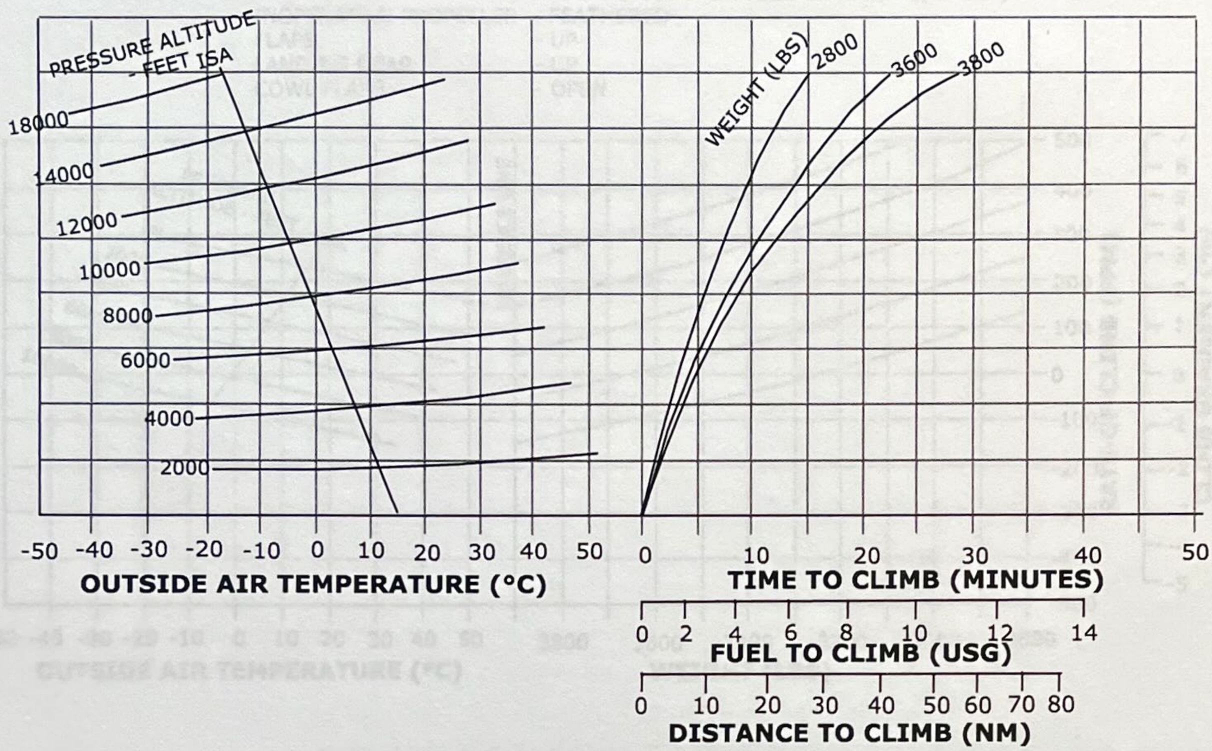
TIME, FUEL AND DISTANCE TO CLIMB

CLIMB SPEED 100 KNOTS

ASSOCIATED CONDITIONS:

POWER	- FULL THROTTLE AT 2600 RPM
MIXTURE	- FULL RICH (ABOVE 5000 FT LEAN TO 75°F TO 100°F ON RICH SIDE OF PEAK EGT)
COWL FLAPS	- OPEN



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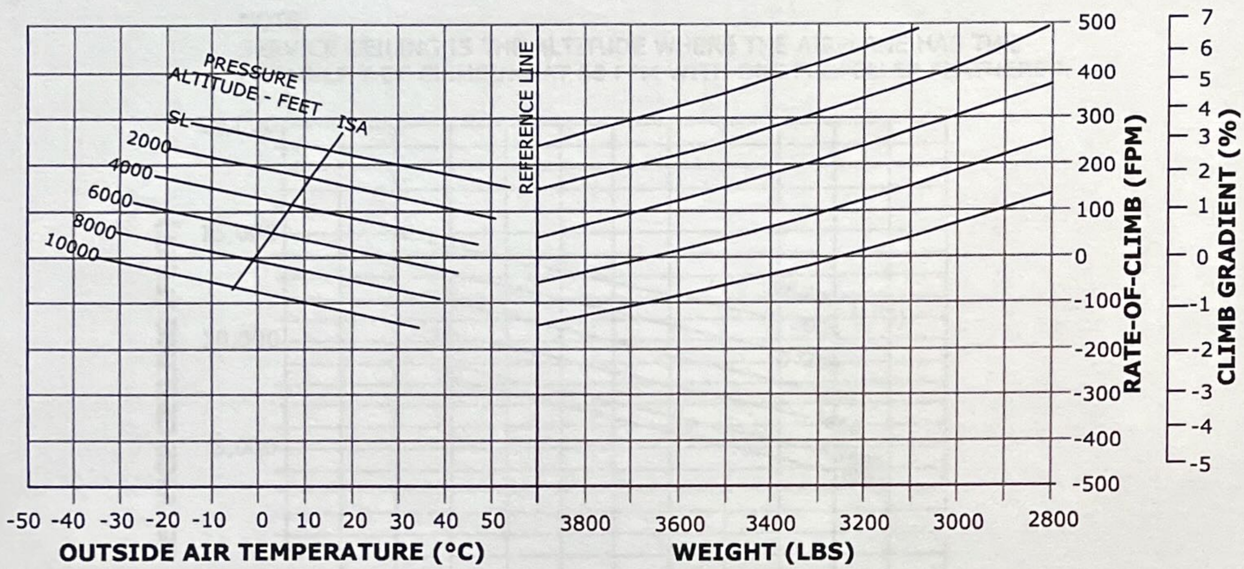
CLIMB – ONE ENGINE INOPERATIVE

CLIMB SPEED 85 KNOTS (ALL WEIGHTS)

ASSOCIATED CONDITIONS:

POWER	- TAKE-OFF POWER AT 2700 RPM
MIXTURE	- FULL RICH (ABOVE 5000 FT LEAN TO 75°F TO 100°F ON RICH SIDE OF PEAK EGT)
INOPERATIVE PROPELLER	- FEATHERED
FLAPS	- UP
LANDING GEAR	- UP
COWL FLAPS	- OPEN



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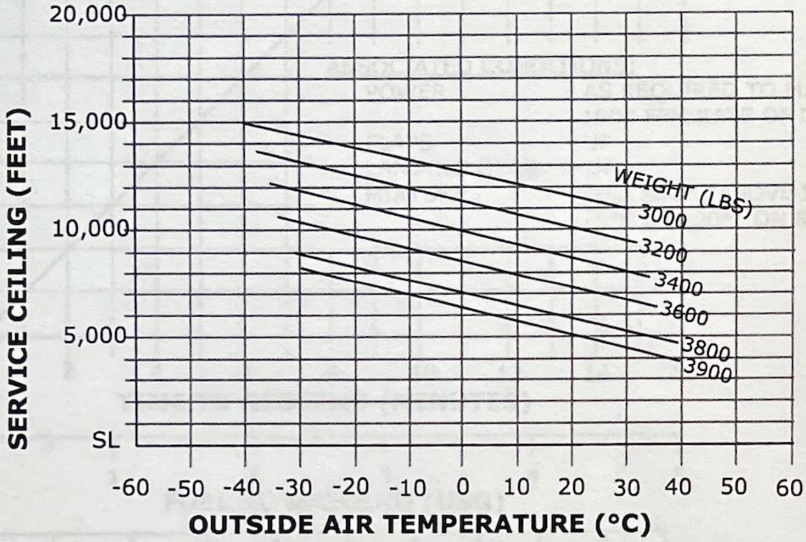
SERVICE CEILING – ONE ENGINE INOPERATIVE

CLIMB SPEED 85 KNOTS (ALL WEIGHTS)

ASSOCIATED CONDITIONS:

POWER	- MAXIMUM CONTINUOUS AT 2700 RPM
INOPERATIVE PROPELLER	- FEATHERED
FLAPS	- UP
LANDING GEAR	- UP
COWL FLAPS	- OPEN

NOTE:
SERVICE CEILING IS THE ALTITUDE WHERE THE AIRPLANE HAS THE CAPABILITY OF CLIMBING AT 50 FPM WITH ONE PROPELLER FEATHERED.



NOTE:

To use this chart, you have to estimate what the temperature will be at your single engine service ceiling before you have determined what that ceiling is. You will have to do this by trial and error but do not try to be too accurate because the graph itself is only an approximation of real world performance

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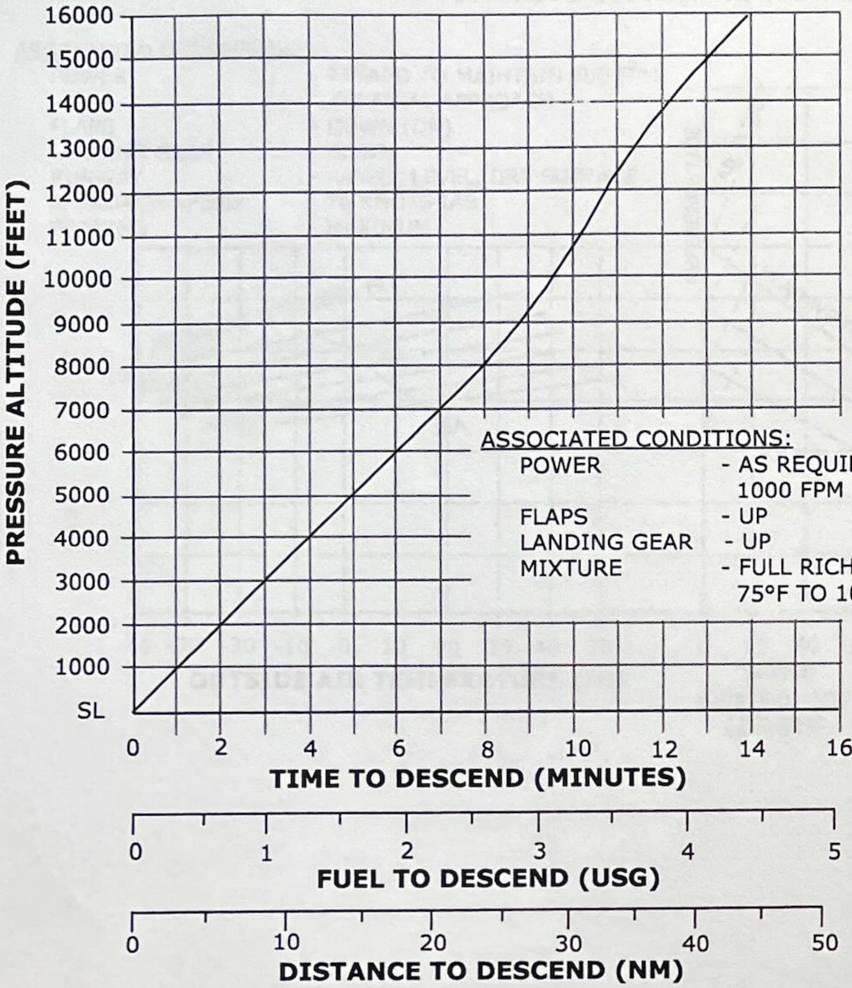
TIME, FUEL AND DISTANCE TO DESCEND

DESCENT SPEED – 170 KNOTS



ASSOCIATED CONDITIONS:

POWER	- AS REQUIRED TO MAINTAIN 1000 FPM RATE OF DESCENT
FLAPS	- UP
LANDING GEAR	- UP
MIXTURE	- FULL RICH (ABOVE 5000 FT LEAN TO 75°F TO 100°F ON RICH SIDE OF PEAK EGT)

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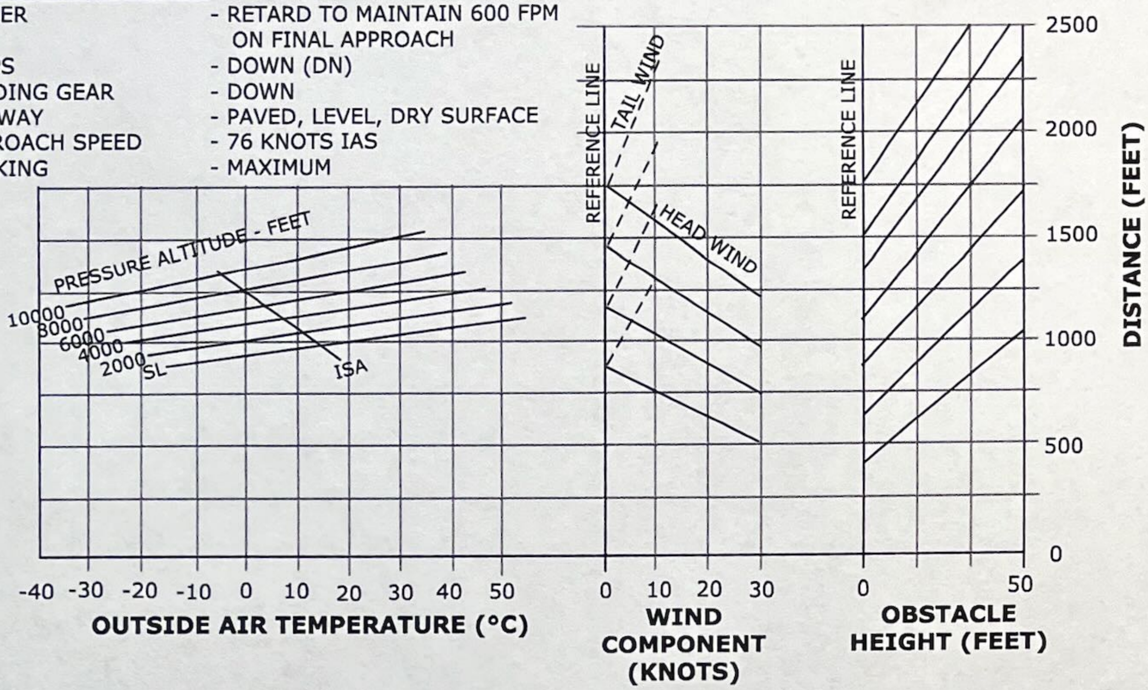
LANDING DISTANCE – FLAPS DOWN

APPROACH SPEED 76 KNOTS (ALL WEIGHTS)

ASSOCIATED CONDITIONS:

POWER	- RETARD TO MAINTAIN 600 FPM ON FINAL APPROACH
FLAPS	- DOWN (DN)
LANDING GEAR	- DOWN
RUNWAY	- PAVED, LEVEL, DRY SURFACE
APPROACH SPEED	- 76 KNOTS IAS
BRAKING	- MAXIMUM



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