Cessna Skyhawk II / 100

Performance Assessment

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Cessna Skyhawk II/100 (172) Performance Assessment

1. Introduction

This document outlines the information and procedures used to determine the approximate performance of the Cessna 172 aircraft. As much aerodynamic and dimensional information as possible was first obtained from several sources and that data is presented in the following section.

While the Cessna 172 model was the target aircraft, it was necessary to obtain some data from other related models where data specifically for a model 172 was not available. Additionally there are several sub-models of the 172, so where possible data was obtained for a Cessna Skyhawk II/100, this being a later version of the generic model 172.

Tail data was obtained for a model 177, as 172 data was not available. In this case the 177 has a slightly smaller tail, but the general design features should be equivalent to the 172.

A computer program was then used to obtain a range of performance data based on specific input data derived from the various reference sources. The computer program could output performance over a range of speeds and altitudes, allowing iteration of the input data, so it was possible to obtain a data set which would closely equate to the defined aircraft performance. A copy of the final program output is included here.

2. Reference Data

As much data as possible was obtained by reference to a number of text books. The key reference was taken to be **Jane's All the World's Aircraft**, with more detailed data sourced from other books. The complete set of data which was obtained is presented here.

2.1. Jane's All the World's Aircraft 1977-78

For the Cessna Skyhawk II/100 the following data was presented;

NACA 2412 wing section	1 degree 44 minutes dihedral
	1 degree 30 minutes incidence at wing root
	-1 degree 30 minutes incidence at tip
	Modified Frise ailerons
	Single slotted flaps

Vertical Tail:	35 degrees quarter chord sweep
Engine:	160 hp Lycoming O-320-H (max power at 2700 rpm)
Propellor:	Two bladed fixed pitch metal propellor
Fuel Capacity:	43 US gallons (38 US gallons usable)
Baggage Capacity:	120 pounds

Principle Dimensions

Wing span:	35 feet 10 inches
Wing root chord:	5 feet 4 inches
Wing tip chord:	3 feet 8.5 inches
Wing aspect ratio:	7.52
Length overall:	26 feet 11 inches
Height overall:	8 feet 9.5 inches
Tailplane span:	11 feet 4 inches
Propellor diameter:	6 feet 3 inches
Wing area:	174 square feet (gross)
Aileron Area:	18.3 square feet
Flap Area:	21.2 square feet
Vertical Tail Area:	11.24 square feet
Rudder Area:	7.43 square feet
Horizontal Tail Area:	21.56 square feet
Elevator Area:	14.53 square feet

Weight Data

Weight - Empty Equipped:	1403 pounds
Max Takeoff Weight:	2300 pounds
Max Wing Loading:	13.2 pounds per square feet
Max Power Loading:	14.4 pounds per horsepower

Performance Data

Never Exceed Speed:	174 mph
Max Level Speed:	144 mph (at SL)
Max Cruising Speed:	140 mph (75% power at 8000 feet)
Stalling Speed:	57 mph CAS (flaps up)
Stalling Speed:	51 mph CAS (flaps down)

Max Rate of Climb:	770 feet per minute (at SL)
Service Ceiling:	14,200 feet

Range Performance

558 miles range at 8,000 feet cruise
662 miles range at 10,000 feet cruies

(using standard fuel, with allowance for engine start, taxi, takeoff, climb, and 45 minutes reserve at 45% power)

2.2. Fluid Dynamic Drag by Hoerner

This book includes a very basic drag analysis of a Cessna 172, based on the following information.

Span:	36 feet
Wing Area:	175 square feet
Weight:	2200 pounds
Power:	140 horsepower

At a velocity of 122 knots and sea level the aircraft was calculated to have a total drag coefficient of 0.032, a profile drag coefficient of 0.029 and a drag coefficient based on wetted surface area of 0.009.

This is basic data for a Cessna 170, which is not the aircraft being analysed here. As it is a similar design, this data can be used to approximately verify any drag data we may be able to calculate for the Cessna 172.

2.3. Synthesis of Subsonic Airplane Design by Torenbeek

This book provides many general rules for preliminary aircraft design calculations. The key performance data which is relevant here is that a typical small, single engine aircraft, with a fixed undercarriage, will have a profile drag coefficient somewhere between 0.025 and 0.040. The Oswald spanwise efficiency factor will lie between 0.65 and 0.75.

The book also provides a number of tables of representative data for various aircraft, for wing, horizontal and vertical tail parameters, and also weight data.

Wing data for a Cessna 172

Prototype first flight:	1956
Aspect Ratio:	7.52
Taper Ratio:	0.672
Quarter Chord Sweep Angle:	0 degrees
Geometric Twist:	-3.0 degrees
Dihedral:	1 degree 44 minutes
Section Profile - Root:	NACA 2412
Section Profile - Tip:	NACA 2412 to symmetric
Thickness/Chord Ratio:	12 percent
Vmo:	224 kmh (EAS) Maximum Operating Limit
Vd:	280 kmh (EAS) Design Dive
Flap Type:	single slotted
Cf/C Streamwise:	32.9 percent (flap chord ratio)
Bf/B:	46.1 percent (flap span ratio)
Flap Angle - Takeoff:	20 degrees
Flap Angle - Landing:	40 degrees
Clmax - Landing:	2.10 (from flight test)

Weight Data for Cessna 172B

MTOW:	2200 pounds
Wing Group:	236 pounds
Tail Group:	61 pounds
Fuselage Group:	253 pounds
Landing Gear:	122 pounds
Surface Controls:	31 pounds
Nacelle Group:	31 pounds
Propulsion Group:	427 pounds
Engine Installation:	312 pounds
Fuel System:	30 pounds
Exhaust:	38 pounds
Other Items:	47 pounds
Services/Equipment Group:	154 pounds
Nav Instruments:	7 pounds
Hydraulic/Pneumatic:	3 pounds
Electrical:	41 pounds

Furnishing: 99 pounds
Aircond/Anti-ice: 4 pounds

Payload Group
Pilot: 165 pounds
Passenger: 165 pounds
Fuel: 252 pounds (43 US gallons at 5.85 pounds per US gallon)

Other: 303 pounds (cargo, oil, etc)

Weight and CG Data for Cessna 172 (normal category FAR 23)
(CG positions are in percent of mean aerodynamic chord)

Forward CG Limit - Takeoff/Landing: 15.6
Forward CG Limit - Flight: 15.6

Rear CG Limit - Takeoff/Landing: 36.5
Rear CG Limit - Flight: 36.5

CG Range - Takeoff/Landing: 20.9
CG Range - Flight: 20.9

Payload: 64.3 (percent OEW)
Tail Volume: 0.59
Horizontal Tail Type: Fixed Stabiliser
Clmax: 2.14 (flap angle for landing)

Horizontal Tail Data for Cessna 177

Sh/S: 0.202
Aspect Ratio: 4.00
Taper Ratio: 1.0
Sweep: 0.0 degrees
Airfoil Section: NACA 0012/0009
Average T/C: 10.5 percent
Tail Type: All Flying
Horizontal Tail Volume: 0.600
Hinge Position: 25 percent Elevator Chord
Servo Tabs fitted

Vertical Tail Data for Cessna 177

Max Crosswind:	20 knots
Sv/S:	0.107
Aspect Ratio:	1.41
Sweep:	35 degrees (quarter chord)
Airfoil Section:	NACA 0009/0006
Average T/C:	7.5 percent
Vertical Tail Volume:	0.0411
Sr/Sv:	0.368
Hinge Position:	60 percent Cv (root/tip)

Note: The Cessna 177 has a slightly smaller tail than the Cessna 172

Tail Areas

Fin:	11.24 sq.ft (Cessna 172)	11.02 sq.ft (Cessna 177)
Rudder:	7.43 sq.ft (Cessna 172)	6.41 sq.ft (Cessna 177)
Tailplane:	21.56 sq.ft (Cessna 172)	
Elevators:	14.53 sq.ft (Cessna 172)	
Horizontal Tail:		35.01 sq.ft (Cessna 177)

3. Computer Analysis

A computer program was then used to iterate to a suitable set of data values which would be representative of the Cessna 172. This program is a simple aircraft performance program, written about 20 years ago, for operation on Personal Computers running MS DOS. Its most useful feature is that, based on very basic input data, it can produce data for any altitude, for a range of air speeds. This facility allows for rapid checking of estimated performance data against published values.

From the reference data obtained the following values were used as input to the computer performance program.

Stall speed without flaps	57.0 mph
Maximum lift coefficient	1.60 (no flaps)
Maximum lift coefficient	2.10 (with flaps)
Maximum take-off weight	2300 lb
Empty weight	1403 lb + pilot at 165 lbs
Wing span	35.83 ft
Airplane efficiency factor	0.77
Engine brake horsepower	160 hp
Maximum level speed	144.0 mph
Propellor diameter	75.0 inches
Propellor speed	2700 rpm

The engine is not supercharged
Fixed-pitch propellor fitted to aircraft
Number of propellors: 1

Average range propulsive efficiency	0.700
Average endurance propulsive efficiency	0.700
Aircraft propulsive efficiency	0.850

The above data is that used for the final computer analysis. Earlier runs used slightly different data, which was slowly adjusted until this dataset gave what were considered as acceptable results. The final output from the program is included here as Appendix A.

4. Drag Summary

The total aircraft drag coefficient, based on a gross wing area of 174 square feet, was 0.0341, giving a drag area (CdS) of 5.9334 square feet. This value of 0.0341 corresponds acceptably with the value determined by **Hoerner** for the Cessna 170 of 0.032.

Breaking the drag down into its component parts, for wing, tail and fuselage, we know the total aircraft drag value, and can also obtain estimates of the drag coefficient from NACA graphs for the particular wing sections used. Using **Theory of Wing Sections by Abbott and Von Doenhoff** to obtain the section drag data (assumed to be "standard roughness" rather than values for laminar flow),

Wing (NACA 2412)	Cd = 0.0100	S = 174.0 sq ft	CdS = 1.74 sq ft
Tail (NACA 0012)	Cd = 0.0098	S = 21.56 sq ft	CdS = 0.21 sq ft
Fin (NACA 0009)	Cd = 0.0092	S = 11.24 sq ft	CdS = 0.10 sq ft
Total Aircraft	Cd = 0.0341	S = 174.0 sq ft	CdS = 5.93 sq ft

Subtracting the wing and tail/fin values from the total aircraft gives us the drag of the fuselage and any other miscellaneous items (undercarriage, struts, etc), which is,

5.93 - 0.10 - 0.21 - 1.74 = 3.88 square feet

This then becomes 3.88 / 174 = 0.0223, being the drag coefficient for the fuselage based on gross wing area.

We can also estimate the wetted surface area based on the **Hoerner** analysis, where the areas will be in inverse ration to the drag coefficients. Using his drag coefficients,

Cd = 0.009 based on wetted surface area (to be found)
Cd = 0.032 based on wing area (174.0)

So wetted surface area = (0.032 / 0.009) x 174.0 = 618.7 square feet approximately.

5. Program Validation

The output from the computer program is only approximate in its modelling of the Cessna 172 performance, but does agree with the published performance data for the aircraft in most areas.

At seal level the predicted speed range is from slightly less than 57 mph to nearly 140 mph, compared to the published data of 57 mph to 144 mph.

The service ceiling is defined as the altitude where the rate of climb of the aircraft declines to 100 feet per minute, and is quoted for the Cessna as 14,200 feet. At 14,200 feet from the program output the indicated maximum climb rate is 111 feet per minute.

The quoted maximum rate of climb at sea level of 770 feet per minute compares with a program prediction of 689 feet per minute.

The quoted maximum cruising speed of 140 mph, at 75 percent power at 8,000 feet, is not achievable according to the program, indicating the drag estimate is possibly a little too high. Alternatively this could indicate that the actual engine power decreases with altitude at a slower rate than that predicted by the program. In practice this discrepancy is probably partly due to both causes.

Although the range calculations of the program are only very approximate, at 8,000 feet it predicts a range of 584 miles compared to the published figure of 558 miles, while at 10,000 feet it predicts a figure of 539 miles, compared to 662 miles for the published data. This analysis is necessarily only approximate as no specific data has been provided for the engine fuel consumption or power variation with altitude, so the program can only make very general assumptions for these values.

Appendix A: Program Output

Input Parameters :

Stall speed without flaps	VS1 =	57.0	mph
Maximum lift coefficient	CLmax =	1.60	
Maximum lift coeff with flaps	CLmaxf =	2.10	
Maximum take-off weight	W =	2300.	lb
Empty weight	We =	1568.	lb
Wing span	B =	35.83	ft
Airplane efficiency factor	E =	0.700	
Engine brake horsepower	BHP =	160.	HP
Maximum level speed	Vmax =	144.0	mph
Propellor diameter	Dp =	75.0	inches
Propellor rpm	RPM =	2700.	rpm

The engine is normally aspirated
Fixed-pitch propellor fitted to aircraft
Number of propellors = 1

Average range propulsive efficiency = 0.700
Average endurance propulsive efficiency = 0.700
Aircraft propulsive efficiency = 0.750

Output Quantities :

Wing loading	W/S =	13.3	lb/ft2
Stall speed with flaps	Vs0 =	49.8	mph
Wing area	S =	173.0	ft2
Aspect ratio	AR =	7.42	
Chord	C =	4.83	ft
Effective aspect ratio	ARe =	5.20	
Effective span	Be =	29.98	ft
Effective chord	Ce =	5.77	ft
Effective span loading	W/Be =	76.72	lb/ft
Drag area	AD =	5.89	ft2
Zero-lift drag coefficient	Cd0 =	0.0341	

Airspeed for minimum sink	Vmins =	63.5	mph
Minimum power required for level flight	THPm =	41.06	HP
Minimum drag	Dmin =	210.1	lb
Minimum sink rate	RSmin =	589.1	fpm
Maximum lift-to-drag ratio	LDmax =	10.94	
Lift coefficient at minimum sink	CLmins =	1.29	
Maximum ideal climb rate	RCstar =	2295.7	fpm
Reference prop airspeed for .74 eff	Vprop =	67.0	mph
Idealized static thrust	Ts =	1041.0	lb
Propellor tip Mach number	Mp =	0.7915	

********** Cessna Skyhawk II/100 (172) Performance Check **********

Altitude : 0. feet

Ambient temperature = 288.15 deg.K
Ambient pressure = 2116.2 psf
Density ratio = 1.0000
Speed of sound = 1116.4 fps

Airspeed V(mph)	Rate-of-Climb RC(fpm)	Sink Rate RS(fpm)	Reynolds No	THP (hp)	Thrust (lb)	Drag (lb)	L/D	SEP (ft/sec)	Mach No.
57.0	441.	574.	2.6 million	68.	446.	253.	8.6	7.4	0.075
60.0	490.	570.	2.7 million	71.	442.	238.	9.2	8.2	0.079
70.0	613.	585.	3.2 million	80.	427.	209.	10.5	10.2	0.092
80.0	678.	640.	3.6 million	88.	411.	200.	10.9	11.3	0.105
90.0	689.	733.	4.1 million	95.	394.	204.	10.7	11.5	0.118
100.0	647.	866.	4.5 million	101.	378.	217.	10.1	10.8	0.131
110.0	551.	1040.	5.0 million	106.	362.	237.	9.2	9.2	0.145
120.0	401.	1256.	5.4 million	111.	346.	263.	8.3	6.7	0.158
130.0	195.	1516.	5.9 million	115.	331.	294.	7.4	3.2	0.171
140.0	-68.	1823.	6.3 million	118.	317.	329.	6.6	-1.1	0.184
150.0	-391.	2177.	6.8 million	122.	304.	369.	5.9	-6.5	0.197
154.0	-537.	2332.	6.9 million	123.	299.	385.	5.7	-8.9	0.202

Maximum estimated aircraft range is 760. miles
Maximum estimated endurance is 4.5 hours

Taxi/Take-off fuel used = 5.88 lbs
Climb fuel used = 0.12 lbs
Descent fuel used = 0.15 lbs
Landing/Taxi fuel used = 4.20 lbs
Reserve fuel available = 56.70 lbs
Total fuel for climb and descent = 67.05 lbs
Fuel available for cruise = 156.01 lbs

Range attained during climb = 0.1 miles
Range attained during descent = 0.1 miles

Time taken during climb = 0.1 minutes
Time taken during descent = 0.1 minutes

********** Cessna Skyhawk II/100 (172) Performance Check **********

Altitude : 5000. feet

Ambient temperature = 278.24 deg.K
Ambient pressure = 1760.8 psf
Density ratio = 0.8617
Speed of sound = 1097.0 fps

Airspeed V(mph)	Rate-of-Climb RC(fpm)	Sink Rate RS(fpm)	Reynolds No	THP (hp)	Thrust (lb)	Drag (lb)	L/D	SEP (ft/sec)	Mach No.
57.0	222.	632.	2.2 million	57.	376.	279.	7.8	3.7	0.076
60.0	270.	622.	2.3 million	60.	373.	261.	8.4	4.5	0.080
70.0	392.	617.	2.7 million	67.	360.	221.	9.9	6.5	0.094
80.0	460.	650.	3.1 million	74.	346.	203.	10.8	7.7	0.107
90.0	479.	720.	3.5 million	80.	333.	200.	10.9	8.0	0.120
100.0	450.	826.	3.9 million	85.	319.	207.	10.6	7.5	0.134
110.0	373.	969.	4.3 million	89.	305.	221.	9.9	6.2	0.147
120.0	248.	1150.	4.7 million	93.	292.	240.	9.1	4.1	0.160
130.0	75.	1370.	5.0 million	97.	279.	265.	8.3	1.3	0.174
140.0	-148.	1632.	5.4 million	100.	267.	294.	7.4	-2.5	0.187
150.0	-423.	1937.	5.8 million	102.	256.	326.	6.7	-7.1	0.201
154.0	-548.	2071.	6.0 million	103.	252.	340.	6.4	-9.1	0.206

Maximum estimated aircraft range is 651. miles
Maximum estimated endurance is 4.1 hours

Taxi/Take-off fuel used = 5.88 lbs
Climb fuel used = 12.20 lbs
Descent fuel used = 15.04 lbs
Landing/Taxi fuel used = 4.20 lbs
Reserve fuel available = 56.70 lbs
Total fuel for climb and descent = 94.01 lbs
Fuel available for cruise = 129.05 lbs

Range attained during climb = 8.9 miles
Range attained during descent = 9.5 miles

Time taken during climb = 7.3 minutes
Time taken during descent = 9.0 minutes

********** Cessna Skyhawk II/100 (172) Performance Check **********

Altitude : 8000. feet

Ambient temperature = 272.30 deg.K
Ambient pressure = 1571.9 psf
Density ratio = 0.7861
Speed of sound = 1085.3 fps

Airspeed V(mph)	Rate-of-Climb RC(fpm)	Sink Rate RS(fpm)	Reynolds No	THP (hp)	Thrust (lb)	Drag (lb)	L/D	SEP (ft/sec)	Mach No.
57.0	91.	674.	2.0 million	51.	338.	298.	7.3	1.5	0.077
60.0	139.	660.	2.1 million	54.	335.	277.	7.9	2.3	0.081
70.0	262.	643.	2.5 million	60.	323.	230.	9.5	4.4	0.095
80.0	333.	663.	2.8 million	66.	311.	208.	10.5	5.6	0.108
90.0	357.	720.	3.2 million	72.	299.	200.	10.9	6.0	0.122
100.0	336.	810.	3.5 million	76.	286.	203.	10.8	5.6	0.135
110.0	270.	936.	3.9 million	80.	274.	213.	10.3	4.5	0.149
120.0	160.	1097.	4.2 million	84.	262.	229.	9.5	2.7	0.162
130.0	5.	1295.	4.6 million	87.	251.	250.	8.7	0.1	0.176
140.0	-197.	1531.	5.0 million	90.	240.	275.	8.0	-3.3	0.189
150.0	-445.	1808.	5.3 million	92.	230.	304.	7.2	-7.4	0.203
154.0	-558.	1930.	5.4 million	93.	226.	317.	6.9	-9.3	0.208

Maximum estimated aircraft range is 584. miles
Maximum estimated endurance is 3.8 hours

Taxi/Take-off fuel used = 5.88 lbs
Climb fuel used = 19.51 lbs
Descent fuel used = 24.06 lbs
Landing/Taxi fuel used = 4.20 lbs
Reserve fuel available = 56.70 lbs
Total fuel for climb and descent = 110.36 lbs
Fuel available for cruise = 112.70 lbs

Range attained during climb = 14.2 miles
Range attained during descent = 15.2 miles

Time taken during climb = 11.6 minutes
Time taken during descent = 14.3 minutes

********** Cessna Skyhawk II/100 (172) Performance Check **********

Altitude : 10000. feet

Ambient temperature = 268.34 deg.K
Ambient pressure = 1455.3 psf
Density ratio = 0.7386
Speed of sound = 1077.3 fps

Airspeed V(mph)	Rate-of-Climb RC(fpm)	Sink Rate RS(fpm)	Reynolds No	THP (hp)	Thrust (lb)	Drag (lb)	L/D	SEP (ft/sec)	Mach No.
57.0	3.	706.	1.9 million	48.	314.	313.	7.0	0.0	0.078
60.0	52.	689.	2.0 million	50.	311.	289.	7.6	0.9	0.082
70.0	177.	663.	2.3 million	56.	301.	238.	9.2	2.9	0.095
80.0	250.	676.	2.7 million	62.	289.	212.	10.3	4.2	0.109
90.0	277.	723.	3.0 million	67.	278.	201.	10.9	4.6	0.123
100.0	261.	804.	3.3 million	71.	266.	201.	10.9	4.4	0.136
110.0	202.	918.	3.7 million	75.	255.	209.	10.5	3.4	0.150
120.0	102.	1066.	4.0 million	78.	244.	223.	9.8	1.7	0.163
130.0	-42.	1250.	4.3 million	81.	233.	241.	9.1	-0.7	0.177
140.0	-229.	1470.	4.7 million	83.	223.	264.	8.3	-3.8	0.191
150.0	-461.	1729.	5.0 million	86.	214.	290.	7.5	-7.7	0.204
154.0	-567.	1843.	5.1 million	86.	210.	302.	7.3	-9.4	0.210

Maximum estimated aircraft range is 539. miles
Maximum estimated endurance is 3.6 hours

Taxi/Take-off fuel used = 5.88 lbs
Climb fuel used = 24.39 lbs
Descent fuel used = 30.08 lbs
Landing/Taxi fuel used = 4.20 lbs
Reserve fuel available = 56.70 lbs
Total fuel for climb and descent = 121.25 lbs
Fuel available for cruise = 101.81 lbs

Range attained during climb = 17.7 miles
Range attained during descent = 18.9 miles

Time taken during climb = 14.5 minutes
Time taken during descent = 17.9 minutes

********** Cessna Skyhawk II/100 (172) Performance Check **********

Altitude : 12000. feet

Ambient temperature = 264.38 deg.K
Ambient pressure = 1345.9 psf
Density ratio = 0.6933
Speed of sound = 1069.4 fps

Airspeed V(mph)	Rate-of-Climb RC(fpm)	Sink Rate RS(fpm)	Reynolds No	THP (hp)	Thrust (lb)	Drag (lb)	L/D	SEP (ft/sec)	Mach No.
57.0	-86.	740.	1.8 million	44.	291.	328.	6.7	-1.4	0.078
60.0	-36.	721.	1.9 million	46.	288.	303.	7.2	-0.6	0.082
70.0	91.	687.	2.2 million	52.	279.	246.	8.9	1.5	0.096
80.0	167.	691.	2.5 million	57.	268.	216.	10.1	2.8	0.110
90.0	198.	729.	2.8 million	62.	257.	203.	10.8	3.3	0.123
100.0	187.	800.	3.1 million	66.	247.	200.	10.9	3.1	0.137
110.0	136.	903.	3.4 million	69.	236.	205.	10.7	2.3	0.151
120.0	44.	1039.	3.7 million	72.	226.	217.	10.1	0.7	0.165
130.0	-89.	1209.	4.1 million	75.	216.	233.	9.4	-1.5	0.178
140.0	-262.	1413.	4.4 million	77.	207.	254.	8.6	-4.4	0.192
150.0	-478.	1654.	4.7 million	79.	198.	278.	7.9	-8.0	0.206
154.0	-577.	1761.	4.8 million	80.	195.	288.	7.6	-9.6	0.211

Maximum estimated aircraft range is 494. miles
Maximum estimated endurance is 3.4 hours

Taxi/Take-off fuel used = 5.88 lbs
Climb fuel used = 29.27 lbs
Descent fuel used = 36.09 lbs
Landing/Taxi fuel used = 4.20 lbs
Reserve fuel available = 56.70 lbs
Total fuel for climb and descent = 132.14 lbs
Fuel available for cruise = 90.92 lbs

Range attained during climb = 21.3 miles
Range attained during descent = 22.7 miles

Time taken during climb = 17.4 minutes
Time taken during descent = 21.5 minutes

********** Cessna Skyhawk II/100 (172) Performance Check **********

Altitude : 14200. feet

Ambient temperature = 260.02 deg.K
Ambient pressure = 1233.2 psf
Density ratio = 0.6460
Speed of sound = 1060.5 fps

Airspeed V(mph)	Rate-of-Climb RC(fpm)	Sink Rate RS(fpm)	Reynolds No	THP (hp)	Thrust (lb)	Drag (lb)	L/D	SEP (ft/sec)	Mach No.
57.0	-185.	782.	1.7 million	41.	267.	348.	6.3	-3.1	0.079
60.0	-134.	760.	1.7 million	42.	265.	320.	6.8	-2.2	0.083
70.0	-4.	717.	2.0 million	48.	256.	257.	8.5	-0.1	0.097
80.0	75.	711.	2.3 million	53.	246.	223.	9.8	1.3	0.111
90.0	111.	739.	2.6 million	57.	236.	206.	10.6	1.8	0.124
100.0	106.	799.	2.9 million	60.	226.	200.	10.9	1.8	0.138
110.0	62.	891.	3.2 million	64.	217.	203.	10.8	1.0	0.152
120.0	-20.	1013.	3.5 million	66.	207.	211.	10.3	-0.3	0.166
130.0	-140.	1168.	3.8 million	69.	198.	225.	9.7	-2.3	0.180
140.0	-299.	1357.	4.1 million	71.	190.	243.	9.0	-5.0	0.194
150.0	-498.	1579.	4.4 million	73.	182.	265.	8.3	-8.3	0.207
154.0	-589.	1678.	4.5 million	74.	179.	274.	8.0	-9.8	0.213

Maximum estimated aircraft range is 444. miles
Maximum estimated endurance is 3.1 hours

Taxi/Take-off fuel used = 5.88 lbs
Climb fuel used = 34.63 lbs
Descent fuel used = 42.71 lbs
Landing/Taxi fuel used = 4.20 lbs
Reserve fuel available = 56.70 lbs
Total fuel for climb and descent = 144.13 lbs
Fuel available for cruise = 78.93 lbs

Range attained during climb = 25.2 miles
Range attained during descent = 26.9 miles

Time taken during climb = 20.6 minutes
Time taken during descent = 25.4 minutes

Weight Data :

Payload	=	732. lbs
Fuel load	=	223. lbs
Maximum take-off weight	=	2300. lbs
Empty weight	=	1345. lbs
Mean weight	=	2188. lbs

Maximum dynamic pressure Qmax = 53.0 psf