Cessna Skyhawk II / 100

Performance Assessment

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Temporal Images

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http://www.temporal.com.au
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)
Propeller: 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 cruise

(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
Di hedra: 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
Cl max - 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),

\[
\begin{align*}
\text{Wing (NACA 2412)} & : C_d = 0.0100 \quad S = 174.0 \text{ sq ft} \quad C_dS = 1.74 \text{ sq ft} \\
\text{Tail (NACA 0012)} & : C_d = 0.0098 \quad S = 21.56 \text{ sq ft} \quad C_dS = 0.21 \text{ sq ft} \\
\text{Fin (NACA 0009)} & : C_d = 0.0092 \quad S = 11.24 \text{ sq ft} \quad C_dS = 0.10 \text{ sq ft} \\
\text{Total Aircraft} & : C_d = 0.0341 \quad S = 174.0 \text{ sq ft} \quad C_dS = 5.93 \text{ sq ft}
\end{align*}
\]

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,

\[
5.93 - 0.10 - 0.21 - 1.74 = 3.88 \text{ square feet}
\]

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,

\[
\begin{align*}
C_d &= 0.009 \text{ based on wetted surface area (to be found)} \\
C_d &= 0.032 \text{ based on wing area (174.0)}
\end{align*}
\]

So wetted surface area = (0.032 / 0.009) \times 174.0 = 618.7 \text{ 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.
Input Parameters:

Stall speed without flaps \( V_{S1} = 57.0 \) mph
Maximum lift coefficient \( C_{L_{max}} = 1.60 \)
Maximum lift coeff with flaps \( C_{L_{maxf}} = 2.10 \)
Maximum take-off weight \( W = 2300. \) lb
Empty weight \( W_{e} = 1568. \) lb
Wing span \( B = 35.83 \) ft
Airplane efficiency factor \( E = 0.700 \)
Engine brake horsepower \( BHP = 160. \) HP
Maximum level speed \( V_{max} = 144.0 \) mph
Propeller diameter \( D_p = 75.0 \) inches
Propeller rpm \( RPM = 2700. \) rpm

The engine is normally aspirated
Fixed-pitch propeller fitted to aircraft
Number of propellers = 1

Average range propulsive efficiency = 0.700
Average endurance propulsive efficiency = 0.700
Aircraft propulsive efficiency = 0.750
Output Quantities:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wing loading</td>
<td>13.3 lb/ft²</td>
</tr>
<tr>
<td>Stall speed with flaps</td>
<td>49.8 mph</td>
</tr>
<tr>
<td>Wing area</td>
<td>173.0 ft²</td>
</tr>
<tr>
<td>Aspect ratio</td>
<td>7.42</td>
</tr>
<tr>
<td>Chord</td>
<td>4.83 ft</td>
</tr>
<tr>
<td>Effective aspect ratio</td>
<td>5.20</td>
</tr>
<tr>
<td>Effective span</td>
<td>29.98 ft</td>
</tr>
<tr>
<td>Effective chord</td>
<td>5.77 ft</td>
</tr>
<tr>
<td>Effective span loading</td>
<td>76.72 lb/ft</td>
</tr>
<tr>
<td>Drag area</td>
<td>5.89 ft²</td>
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<tr>
<td>Zero-lift drag coefficient</td>
<td>0.0341</td>
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<tr>
<td>Airspeed for minimum sink</td>
<td>63.5 mph</td>
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<td>Minimum power required for level flight</td>
<td>41.06 HP</td>
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<tr>
<td>Minimum drag</td>
<td>210.1 lb</td>
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<tr>
<td>Minimum sink rate</td>
<td>589.1 fpm</td>
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<tr>
<td>Maximum lift-to-drag ratio</td>
<td>10.94</td>
</tr>
<tr>
<td>Lift coefficient at minimum sink</td>
<td>1.29</td>
</tr>
<tr>
<td>Maximum ideal climb rate</td>
<td>2295.7 fpm</td>
</tr>
<tr>
<td>Reference prop airspeed for .74 eff</td>
<td>67.0 mph</td>
</tr>
<tr>
<td>Idealized static thrust</td>
<td>1041.0 lb</td>
</tr>
<tr>
<td>Propeller tip Mach number</td>
<td>0.7915</td>
</tr>
</tbody>
</table>

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### 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

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

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

<table>
<thead>
<tr>
<th>Airspeed (mph)</th>
<th>Rate-of-Climb (RC fpm)</th>
<th>Sink Rate (RS fpm)</th>
<th>Reynolds No</th>
<th>Thrust (hp)</th>
<th>Thrust (lb)</th>
<th>Drag (lb)</th>
<th>L/D</th>
<th>SEP (ft/sec)</th>
<th>Mach No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>57.0</td>
<td>222.</td>
<td>632.</td>
<td>2.2 million</td>
<td>57.</td>
<td>376.</td>
<td>279.</td>
<td>7.8</td>
<td>3.7</td>
<td>0.076</td>
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<tr>
<td>60.0</td>
<td>270.</td>
<td>622.</td>
<td>2.3 million</td>
<td>60.</td>
<td>373.</td>
<td>261.</td>
<td>8.4</td>
<td>4.5</td>
<td>0.080</td>
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<tr>
<td>70.0</td>
<td>392.</td>
<td>617.</td>
<td>2.7 million</td>
<td>67.</td>
<td>360.</td>
<td>221.</td>
<td>9.9</td>
<td>6.5</td>
<td>0.094</td>
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<tr>
<td>80.0</td>
<td>460.</td>
<td>650.</td>
<td>3.1 million</td>
<td>74.</td>
<td>346.</td>
<td>203.</td>
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<td>0.107</td>
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<tr>
<td>90.0</td>
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<td>0.120</td>
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<td>319.</td>
<td>207.</td>
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<td>0.134</td>
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<tr>
<td>110.0</td>
<td>373.</td>
<td>969.</td>
<td>4.3 million</td>
<td>89.</td>
<td>305.</td>
<td>221.</td>
<td>9.9</td>
<td>6.2</td>
<td>0.147</td>
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<td>248.</td>
<td>1150.</td>
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<td>292.</td>
<td>240.</td>
<td>9.1</td>
<td>4.1</td>
<td>0.160</td>
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<tr>
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<td>1370</td>
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<td>97.</td>
<td>279.</td>
<td>265.</td>
<td>8.3</td>
<td>1.3</td>
<td>0.174</td>
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<tr>
<td>140.0</td>
<td>-148.</td>
<td>1632</td>
<td>5.4 million</td>
<td>100.</td>
<td>267.</td>
<td>294.</td>
<td>7.4</td>
<td>-2.5</td>
<td>0.187</td>
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<td>-423.</td>
<td>1937</td>
<td>5.8 million</td>
<td>102.</td>
<td>256.</td>
<td>326.</td>
<td>6.7</td>
<td>-7.1</td>
<td>0.201</td>
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<tr>
<td>154.0</td>
<td>-548.</td>
<td>2071</td>
<td>6.0 million</td>
<td>103.</td>
<td>252.</td>
<td>340.</td>
<td>6.4</td>
<td>-9.1</td>
<td>0.206</td>
</tr>
</tbody>
</table>

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**
Altitude: 8000 feet
Ambient temperature = 272.30 deg. K
Ambient pressure = 1571.9 psf
Density ratio = 0.7861
Speed of sound = 1085.3 fps

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Rate-of-Climb (fpm)</th>
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<th>Thrust (hp)</th>
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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**: 10,000 feet
- **Ambient temperature**: 268.34 °C
- **Ambient pressure**: 1455.3 psf
- **Density ratio**: 0.7386
- **Speed of sound**: 1077.3 fps

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<th>Sink Rate (RS fpm)</th>
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- Maximum estimated aircraft range is 539 miles
- Maximum estimated endurance is 3.6 hours

**Fuel Usage**
- **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

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<th>Airspeed (V)</th>
<th>Rate-of-Climb (RC)</th>
<th>Sink Rate (RS)</th>
<th>Reynolds No</th>
<th>THP (hp)</th>
<th>Thrust (lb)</th>
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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
Altitude: 14200. feet
Ambient temperature = 260.02 deg. K
Ambient pressure = 1233.2 psf
Density ratio = 0.6460
Speed of sound = 1060.5 fps

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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: $Q_{max} = 53.0$ psf