

## C172S (SP) Skyhawk orientation

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The Cessna 172 is the most popular general aviation training airplane. This document is a summary of technical information about the SP model of the aircraft.

**Warning: For training purpose only! This document is in no way an alternative to reading the actual POH!**

### **General**

- ✚ All metal **airframe**
- ✚ Four place
- ✚ High wing
- ✚ Single engine airplane
- ✚ Tricycle gear (Nose gear + two main gears; as opposed to a tail wheel airplane)
- ✚ Semi-monocoque structure (That means the skin is attached to the stringers, bulkheads, and other structural devices and carries part of the load).
- ✚ One door on each side of front seats.
- ✚ Rear baggage compartment door on left side of the fuselage.

## Airspeed limitations

Symbol	Description	Indicated airspeed (Knots)	Marking on A/S indicator
<b>V<sub>so</sub></b>	Stall speed at landing configuration	40 KIAS	<b>Beginning of white arc.</b>
<b>V<sub>s</sub></b>	Stall speed at clean configuration	48 KIAS	<b>Beginning of green arc.</b>
<b>V<sub>R</sub></b>	Rotation speed	55 KIAS	<b>Not marked.</b>
<b>V<sub>x</sub></b>	Best angle-of-climb speed	62 KIAS at sea level  67 KIAS at 10,000'	<b>Not marked.</b>
<b>V<sub>y</sub></b>	Best rate-of-climb speed	74 KIAS at sea level  72 KIAS at 10,000'	<b>Not marked.</b>
<b>V<sub>FE</sub></b>	Max. flap extended speed	10° flaps 110 KIAS  10°-30° 85 KIAS	<b>White arc ends at 85 KIAS.</b>
<b>V<sub>A</sub></b>	Maneuvering speed. Do not make full or abrupt control maneuvers above this speed.	105 KIAS at max takeoff weight  98 KIAS @ 2200 lb  90 KIAS @ 1900 lb	<b>Not marked.</b>
<b>V<sub>NO</sub></b>	Max. structural cruising speed. Do not exceed except in smooth air and than only with caution.	129 KIAS	<b>End of green arc. Beginning of yellow arc.</b>
<b>V<sub>NE</sub></b>	<b>Never Exceed speed.</b>	<b>163 KIAS</b>	<b>Red line.</b>

## Weights

- ✚ The aircraft is certified as both normal and utility categories depending on the weight and balance of the specific flight.
- ✚ Max. Ramp weight: Normal category 2558 lb; Utility category 2208 lb.
- ✚ Max. takeoff and landing weights: Normal cat. 2550; Utility cat. 2200
- ✚ Max weight baggage area 1: 120 lb.
- ✚ Max weight baggage area 2: 50 lb.
- ✚ Max weight in baggage areas 1+2 combined: 120 lb.
- ✚ To operate under utility category, baggage compartments should be empty and back seat not occupied.
- ✚ Limit load factors:
  - Normal category
    - Flaps up: +3.8g, -1.52g
    - Flaps down: +3.0g
  - Utility category
    - Flaps up: +4.4g, -1.76g
    - Flaps down: +3.0g

## Engine

- ✚ **Textron-Lycoming IO-360-L2A** (I = fuel Injected; O = Opposed cylinders; 360 cu. Inch displacement)
- ✚ **180 rated Brakes Horse Power (BHP) at 2700 RPM.**
- ✚ **Reciprocating** engine.
- ✚ **Four Cylinders.**
- ✚ **Normally aspirated** – The air intake is **not** boosted with devices such as turbo or super chargers.
- ✚ **Direct drive** – No gear reduction box is used. Direct connection from the crank shaft to the prop.
- ✚ **Air cooled** (Engine has cooling fins on it but no liquid cooling - no radiator)
- ✚ **Horizontally opposed cylinders.**
- ✚ **Engine accessories** (devices driven by the engine):
  - 2 vacuum pumps – supply suction to both heading and attitude indicators.
  - Alternator
  - 2 magnetos – powers two separate ignition systems.
  - Engine-driven oil pump with oil filter.

## Engine instruments

- ✚ **Oil pressure indicator**
  - The pressure in a pressure line from the upper front of the engine case is translated to an electrical signal displayed on the oil pressure gauge.
  - Minimum pressure (lower red line): **20 PSI.**
  - Normal operating range (green arc): **50 – 90 PSI.**
  - Maximum pressure: (upper red line) **115 PSI.**
- ✚ **Oil temperature indicator**
  - Resistance type probe located in the accessory case of the engine. An electrical signal from the probe is translated to a temperature reading.
  - Normal operation range (green arc): **100°-245° F.**
  - Maximum temperature (red line): **245° F.**
- ✚ **Low oil pressure annunciator** – illuminates when oil pressure drops below 20 PSI. Activated by an automatic pressure switch located on the rear of the engine accessory case.
- ✚ **Tachometer** – indicates engine/prop speed in Revolutions Per Minute (RPM).
  - Mechanically driven by the engine.
  - Includes an hour meter.
  - Normal operation range (green arc): **2100 – 2700 RPM.**
  - Max RPM: red line at **2700 RPM.**
  - Multiple widths of the green arc indicate recommended power settings at sea level, 5,000 feet and 10,000 feet respectively.
- ✚ **Exhaust Gas Temperature indicator (EGT)** – used for leaning of the mixture
  - Recommended lean: Adjust the mixture to 50° F cooler (richer mixture) than peak EGT
  - Best economy lean: lean the mixture to peak EGT (engine roughness may occur in some conditions).

## Engine Lubrication system

- ✚ **Wet Sump** type.
- ✚ Oil **lubricates** the internal engine parts reducing metal to metal friction.
- ✚ Assists in **cooling** of the internal engine parts.
- ✚ Oil dipstick is located at the right rear of the engine.
- ✚ **Oil quantity in sump: 5-8 quarts** on the dipstick.
- ✚ **Approved oil types:**

- Aviation grade **straight mineral oil**: first 50 hours break-in of a new engine. Does not include detergent additives.
- Aviation grade **Ashless Dispersant oil**: must be used after first 50 hours. This oil includes detergents that help clean the engine.
- SAE oil grade depends on outside temperature. Refer to POH.
- ✚ **The engine will not run without oil!** Check oil level (at least 5 qt.) and look for oil leaks on preflight. During flight, check the engine gauges periodically, a low oil pressure and high oil temperature combination indicates that you have a problem; the engine will not run for much long. Refer to emergency procedures section in POH.
- ✚ **Oil routing:**
  - Sump -> oil suction strainer screen-> Engine driven oil pump -> bypass valve.
  - If oil is cold, the bypass valve allows the oil to bypass the oil cooler and go directly to the full flow oil filter;
  - If the oil is hot, the bypass valve will route the oil to the oil cooler on the right rear engine baffle -> oil from the oil cooler goes to the full flow oil filter ->oil pressure relief valve, which regulates oil pressure by sending excessive oil back to the sump while the rest of the oil is circulated through various engine parts. Residual oil returns to the sump by gravity flow.

## **Propeller**

- ✚ **Manufacturer: McCauley Propeller Systems**
- ✚ Model: 1A170E/JHA7660
- ✚ **2 blades**
- ✚ **Diameter: 76 inches**
- ✚ **Fixed pitch**
- ✚ One pieced forged aluminum alloy
- ✚ Anodized to prevent corrosion

## **Fuel System**

- ✚ **Approved fuel grades:**
  - 100LL aviation Fuel (Blue) (100 octane Low Lead AVGAS)
  - 100 Grade aviation fuel (green) (also known as 100/130 AVGAS)
- ✚ **2 integral fuel tanks.** One in each wing.
- ✚ **Fuel venting** allows fuel to flow to the engine. A fuel tank air vent is located on the left wing and must not be blocked. Both tanks are interconnected by a vent line. Both fuel caps are also vented as a backup to the left tank fuel vent.

- ✚ **Total fuel** capacity: 56 U.S. Gallons (Each tank:28 U.S. Gallons)
- ✚ **Total usable fuel:** 53 U.S. Gallons (26.5 each tank)
- ✚ **Total unusable fuel:** 3 U.S. Gallons.
- ✚ Fuel filled up to **the bottom of the filler caps indicates 17.5 gallons** usable in that tank.
- ✚ **13 Fuel drains** (5 each wing; 3 below the cowling for fuel reservoir tank, fuel selector and fuel strainer)
- ✚ **All drain sumps should be drained** on preflight to eliminate any water/other contaminants in the fuel and to check fuel grade (by color).
- ✚ **Three position fuel selector** (LEFT, BOTH and RIGHT)
- ✚ **Fuel shutoff valve.** Cuts the supply of fuel from the fuel tanks. (in case of an engine fire, for example. Refer to emergency section in POH)
- ✚ **Fuel reservoir tank.**
- ✚ **Engine driven fuel pump**
- ✚ **Auxiliary fuel pump-** used as a back up if the engine driven fuel pump fails. Also aids in priming the engine before starting. Do not over-prime engine before startup, this may lead to fuel spillage and fire on engine start.
- ✚ **Fuel/air control unit** – regulates the air / fuel mixture by metering the fuel.
- ✚ **Fuel distribution valve (manifold).**
- ✚ **Fuel injection nozzles** – one to each cylinder in the engine
- ✚ Two **float type fuel quantity transmitters** (one in each main fuel tank) measure amount of fuel.
- ✚ **Fuel quantity gauge for each tank** on left side of the instrument panel receives signal from the fuel quantity transmitters. Never trust their accuracy, always visually check fuel in tanks before flight!
- ✚ **Fuel flow gauge** – Electrically connected to a transducer in the fuel manifold. Indicates gallons per hour.
- ✚ **Low fuel warnings on annunciator panel:**
  - 'L LOW FUEL' – illuminates when quantity in left tank less than 5 gallons for more than 60 seconds.
  - 'LOW FUEL R' – illuminates when quantity in right tank less than 5 gallons for more than 60 seconds.
  - 'L LOW FUEL R' – illuminates when both tanks are low on fuel.
  - Low fuel quantity will also illuminate if the quantity transmitter has failed.

### **Fuel distribution:**

Fuel tank -> Fuel selector valve -> Aux fuel pump -> Fuel shutoff valve->Fuel strainer->Engine driven fuel pump -> Fuel/air control

unit-> Fuel distribution valve (manifold) -> Fuel injection nozzles inject the fuel to each cylinders, where it is finally mixed with the air from the air ducts.

✚ **Advantages** of a **fuel injection** system (as the one in the 172S) over a carburetor (like the system in most older models of 172):

- Reduction in evaporation icing (No carburetor ice).
- Better fuel flow and distribution to all cylinders.
- Faster throttle response.
- Precise control of mixture.
- Easier cold weather start.

✚ **Disadvantages** of a **fuel injection** system:

- Difficulty in starting a hot engine due to vapor lock.
- Vapor lock during low RPM operations on hot days.
- Problems in restarting an engine that quits due to fuel starvation.

## Engine Ignition System

✚ **Two engine-driven magnetos.**

✚ **Two spark plugs in each cylinder.**

✚ Right magneto fires the lower right and upper left spark plugs

✚ Left magneto fires the upper right and lower left spark plugs

✚ **Normal operations are conducted with both magnetos** to allow more efficient burning of the mixture in each cylinder; and redundancy.

✚ Rotary type **ignition switch** with 5 positions:

- Off
- R – Only the right magneto and its ignition system are selected.
- L – Only the left magneto and its ignition system are selected.
- BOTH – Both magnetos are on.
- START – Activates the starter. A spring will return the switch to BOTH when releasing it from the START position.

✚ The **starter is powered by the battery.**

✚ Other than for start up, the **engine does not rely on the airplane's electrical system** to run, since the ignition is provided by the engine-driven magnetos and not by the battery.

## Engine air induction system

✚ **Engine air intake** is located on the lower front of the engine cowling covered by a filter.

- ✚ **Air is ducted** to the engine **cylinders** through intake manifold tubes.
- ✚ The **air intake** may be **blocked** for different reasons. Most commonly by **induction ice**.
- ✚ If the air intake is blocked, an **alternate air intake** door is automatically opened by engine suction.
- ✚ Alternate air is unfiltered and when used will cause about 10% power loss at full throttle.

### **Exhaust system**

- ✚ Exhaust gas from each cylinder is directed to a muffler and then to the tailpipe.
- ✚ Outside air is pulled in around shrouds constructed around the outside of the muffler and supply heated air to the cabin.
- ✚ **A crack in the exhaust system may lead to carbon monoxide (CO) poisoning.**

### **Flight Controls**

- ✚ Dual flight controls.
- ✚ Conventional ailerons, rudder and elevator control surfaces.
- ✚ Manually operated through cables and mechanical linkage.
- ✚ Ailerons and elevator controlled by the control wheel ("yoke").
- ✚ Rudder controlled by the lower pedals.
- ✚ Design of the ailerons reduces adverse yaw by having the forward side of the up-positioned aileron to stick a little below the lower camber of the wing. This creates more drag on that wing and reduces the amount of rudder pressure needed to coordinate the turn. (This is called a Frise aileron but the Cessna POH does not refer to that name).
- ✚ Differential ailerons. (The aileron can deflect up more than it can deflect down, reducing amount of drag on the upper wing and the rudder pressure required for compensation for adverse yaw). The Cessna POH does not mention these are differential ailerons.
- ✚ Manually operated elevator trim.
- ✚ Elevator trim tab located on right side of the elevator.

### **Wing Flap System**

- ✚ Single-slot type wing flaps.
- ✚ Electrically actuated.
- ✚ Flaps position switch provides mechanical stops at 4 positions: 0°, 10°, 20° and 30°.
- ✚ A flap position indicator left to the flaps selector switch.

- ✚ 10-ampere circuit breaker labeled "FLAP"
- ✚ **Maximum allowed flaps position for takeoff: 10°.**

## **Landing Gear System**

- ✚ Tricycle type
- ✚ Nose wheel steering
- ✚ Two main wheels (left and right)
- ✚ Shock absorption
  - Tabular spring steel main gear struts.
  - Air/oil nose gear shock strut.
  - Right/left nose wheel vibrations reduced by a shimmy damper on the nose gear.
- ✚ 2 separate hydraulically actuated disc brakes (one for each main gear).
- ✚ Nose gear steering by using lower rudder pedals.
- ✚ Main gear brakes actuated by upper pedals.
- ✚ Parking brakes applied by pressing the main brakes (top of the pedals) and then pulling the parking brake lever, located just below the left side of the panel, and rotating it 90 degrees down.
- ✚ Release parking brakes by rotating the lever 90° to the right and pushing it forward.

## **Electrical system**

- ✚ **28 volt system**
- ✚ **Direct current** (DC).
- ✚ Engine-driven **60-amp alternator**
- ✚ **24 volt battery**
- ✚ **Circuit breakers.**
  - Protect the various electrical equipment from over-voltage conditions and power surges.
  - Push-to-reset and switch/breaker types.
  - Do not reset a circuit breaker after it tripped twice.
- ✚ **Fuses**
  - Spade type (automotive style) fuses used for the power distribution module.
  - Spare fuses are located inside the power distribution module.
  - One glass type fuse for the clock.
  - Not accessible to the pilot in flight
- ✚ 1 essential bus.
- ✚ 2 Primary electrical busses.
- ✚ 2 avionics busses. Avionic master switches should be off when turning the main master switch on or off, when connecting an

external power source or when starting the engine to prevent damage to the avionics.

- ✚ Split rocker type master switch
  - Right half controls battery power to the airplane.
  - Left half controls the alternator.
- ✚ The battery, alternator and starter are connected to the cockpit switches via contactors. This allows keeping the high voltage cables behind the firewall and away from the cockpit.
- ✚ If ALT side of the master switch is placed in the OFF position for too long, there may not be enough power left in the battery to reconnect the alternator contactor when turning the switch back on.
- ✚ **Ammeter.** Indicates current from/to the battery.
  - In the event the alternator is not functioning the ammeter will indicate a discharge. (-)
  - Ammeter needle should indicate less than two needle widths of charging current (+) after about 30 minutes of cruising flight. If the charging rate were to remain above this value, the battery would overheat.
- ✚ The **Alternator Control Unit** (ACU) will automatically disconnect the alternator by tripping the "ALT FLD" circuit breaker in case of an over-voltage condition. If the over-voltage sensor malfunctions, the alternator should be turned off manually when over charging is observed on the ammeter.
- ✚ **Voltmeter** is provided on a combined voltmeter/clock/outside air temperature indicator on the top left side of the panel.
- ✚ **Low voltage** is annunciated by the red annunciation "**VOLTS**" on the annunciator panel when voltage falls below 24.5V.
- ✚ **Ground service plug receptacle.** Located left side of the airplane near the firewall; it allows to connect an external power source.