

- Arm** Arm is the horizontal distance from the reference datum to the center of gravity (C.G.) of an item.
- Moment** Moment is the product of the weight of an item multiplied by its arm. (Moment divided by the constant 1000 is used in this handbook to simplify balance calculations by reducing the number of digits.)
- Center of Gravity (C.G.)** Center of Gravity is the point at which an airplane, or equipment, would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane.
- C. G. Arm** Center of Gravity Arm is the arm obtained by adding the airplane's individual moments and dividing the sum by the total weight.
- C. G. Limits** Center of Gravity Limits are the extreme center of gravity locations within which the airplane must be operated at a given weight.
- Standard Empty Weight** Standard Empty Weight is the weight of a standard airplane, including unusable fuel, full operating fluids and full engine oil.
- Basic Empty Weight** Basic Empty Weight is the standard empty weight plus the weight of optional equipment.
- Useful Load** Useful Load is the difference between takeoff weight and the basic empty weight.
- Gross (Loaded) Weight** Gross (Loaded) Weight is the loaded weight of the airplane.
- Maximum Takeoff Weight** Maximum Takeoff Weight is the maximum weight approved for the start of the takeoff run.
- Maximum Landing Weight** Maximum Landing Weight is the maximum weight approved for the landing touchdown.
- Tare** Tare is the weight of chocks, blocks, stands, etc. used when weighing an airplane, and is included in the scale readings. Tare is deducted from the scale reading to obtain the actual (net) airplane weight.

SECTION 2  
LIMITATIONS

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## INTRODUCTION

Section 2 includes operating limitations, instrument markings, and basic placards necessary for the safe operation of the airplane, its engine, standard systems and standard equipment. The limitations included in this section have been approved by the Federal Aviation Administration. When applicable, limitations associated with optional systems or equipment are included in Section 9.

### NOTE

The airspeeds listed in the Airspeed Limitations chart (figure 2-1) and the Airspeed Indicator Markings chart (figure 2-2) are based on Airspeed Calibration data shown in Section 5 with the normal static source. If the alternate static source is being used, ample margins should be observed to allow for the airspeed calibration variations between the normal and alternate static sources as shown in Section 5.

Your Cessna is certificated under FAA Type Certificate No. 3A12 as Cessna Model No. 172M.

## AIRSPEED LIMITATIONS

Airspeed limitations and their operational significance are shown in figure 2-1.

	SPEED	KCAS	KIAS	REMARKS
V <sub>NE</sub>	Never Exceed Speed	158	160	Do not exceed this speed in any operation.
V <sub>NO</sub>	Maximum Structural Cruising Speed	126	128	Do not exceed this speed except in smooth air, and then only with caution.
V <sub>A</sub>	Maneuvering Speed: 2300 Pounds 1950 Pounds 1600 Pounds	96 88 80	97 89 80	Do not make full or abrupt control movements above this speed.
V <sub>FE</sub>	Maximum Flap Extended Speed	86	85	Do not exceed this speed with flaps down.
	Maximum Window Open Speed	158	160	Do not exceed this speed with windows open.

Figure 2-1. Airspeed Limitations

## AIRSPEED INDICATOR MARKINGS

Airspeed indicator markings and their color code significance are shown in figure 2-2.

MARKING	KIAS VALUE OR RANGE	SIGNIFICANCE
White Arc	41 - 85	Full Flap Operating Range. Lower limit is maximum weight V <sub>SO</sub> in landing configuration. Upper limit is maximum speed permissible with flaps extended. V <sub>FE</sub>
Green Arc	47 - 128	Normal Operating Range. Lower limit is maximum weight V <sub>SI</sub> with flaps retracted. Upper limit is maximum structural cruising speed. V <sub>NO</sub>
Yellow Arc	128 - 160	Operations must be conducted with caution and only in smooth air.
Red Line	160	Maximum speed for all operations.

Figure 2-2. Airspeed Indicator Markings

## POWER PLANT LIMITATIONS

Engine Manufacturer: Avco Lycoming.

Engine Model Number: O-320-E2D.

Engine Operating Limits for Takeoff and Continuous Operations:

Maximum Power: 150 BHP.

Maximum Engine Speed: 2700 RPM.

## NOTE

The static RPM range at full throttle (carburetor heat off) is 2300 to 2420 RPM.

Maximum Oil Temperature: 118°C (245°F).

Oil Pressure, Minimum: 25 psi.

Maximum: 100 psi.

Propeller Manufacturer: McCauley Accessory Division.

Propeller Model Number: 1C160/DTM7553.

Propeller Diameter, Maximum: 75 inches.

Minimum: 74 inches.

**POWER PLANT INSTRUMENT MARKINGS**

Power plant instrument markings and their color code significance are shown in figure 2-3.

INSTRUMENT	RED LINE	GREEN ARC	YELLOW ARC	RED LINE
	MINIMUM LIMIT	NORMAL OPERATING	CAUTION RANGE	MAXIMUM LIMIT
Tachometer At Sea Level	---	2200 - 2500 RPM	---	2700 RPM
At 5000 Ft.	---	2200 - 2600 RPM	---	2700 RPM
At 10,000 Ft.	---	2200 - 2700 RPM	---	2700 RPM
Oil Temperature	---	100°-245°F	---	245°F
Oil Pressure	25 psi	60-90 psi	---	100 psi
Carburetor Air Temperature	---	---	-15° to 5°C	---

Figure 2-3. Power Plant Instrument Markings

**WEIGHT LIMITS****NORMAL CATEGORY**

Maximum Takeoff Weight: 2300 lbs.

Maximum Landing Weight: 2300 lbs.

Maximum Weight in Baggage Compartment:

Baggage Area 1 (or passenger on child's seat)-Station 82 to 108:  
120 lbs. See note below.

Baggage Area 2 -Station 108 to 142: 50 lbs. See note below.

**NOTE**

The maximum combined weight capacity for baggage areas 1 and 2 is 120 lbs.

**UTILITY CATEGORY**

Maximum Takeoff Weight: 2000 lbs.

Maximum Landing Weight: 2000 lbs.

Maximum Weight in Baggage Compartment: In the utility category, the baggage compartment and rear seat must not be occupied.

**CENTER OF GRAVITY LIMITS****NORMAL CATEGORY**

Center of Gravity Range:

Forward: 35.0 inches aft of datum at 1950 lbs. or less, with straight line variation to 38.5 inches aft of datum at 2300 lbs.

Aft: 47.3 inches aft of datum at all weights.

Reference Datum: Front face of firewall.

**UTILITY CATEGORY**

Center of Gravity Range:

Forward: 35.0 inches aft of datum at 1950 lbs. or less, with straight line variation to 35.5 inches aft of datum at 2000 lbs.

Aft: 40.5 inches aft of datum at all weights.

Reference Datum: Front face of firewall.

**MANEUVER LIMITS****NORMAL CATEGORY**

This airplane is certificated in both the normal and utility category. The normal category is applicable to aircraft intended for non-aerobatic operations. These include any maneuvers incidental to normal flying, stalls (except whip stalls) and turns in which the angle of bank is not more than 60°.

**UTILITY CATEGORY**

This airplane is not designed for purely aerobatic flight. However, in the acquisition of various certificates such as commercial pilot, instrument pilot and flight instructor, certain maneuvers are required by the FAA. All of these maneuvers are permitted in this airplane when operated in the utility category.

In the utility category, the baggage compartment and rear seat must

not be occupied. No aerobatic maneuvers are approved except those listed below:

MANEUVER	RECOMMENDED ENTRY SPEED*
Chandelles . . . . .	105 knots
Lazy Eights . . . . .	105 knots
Steep Turns . . . . .	95 knots
Spins . . . . .	Slow Deceleration
Stalls (Except Whip Stalls) . . . . .	Slow Deceleration

\*Abrupt use of the controls is prohibited above 97 knots.

Aerobatics that may impose high loads should not be attempted. The important thing to bear in mind in flight maneuvers is that the airplane is clean in aerodynamic design and will build up speed quickly with the nose down. Proper speed control is an essential requirement for execution of any maneuver, and care should always be exercised to avoid excessive speed which in turn can impose excessive loads. In the execution of all maneuvers, avoid abrupt use of controls. Intentional spins with flaps extended are prohibited.

## FLIGHT LOAD FACTOR LIMITS

### NORMAL CATEGORY

Flight Load Factors (Gross Weight - 2300 lbs.)

*Flaps Up . . . . .	+3.8g, -1.52g
*Flaps Down . . . . .	+3.0g

\*The design load factors are 150% of the above, and in all cases, the structure meets or exceeds design loads.

### UTILITY CATEGORY

Flight Load Factors (Gross Weight - 2000 lbs.)

*Flaps Up . . . . .	+4.4g, -1.76g
*Flaps Down . . . . .	+3.0g

\*The design load factors are 150% of the above, and in all cases, the structure meets or exceeds design loads.

## KINDS OF OPERATION LIMITS

The airplane is equipped for day VFR and may be equipped for night VFR and/or IFR operations. FAR Part 91 establishes the minimum required instrumentation and equipment for these operations. The reference to types of flight operations on the operating limitations placard reflects equipment installed at the time of Airworthiness Certificate issuance.

Flight into known icing conditions is prohibited.

## FUEL LIMITATIONS

- 2 Standard Tanks: 21 U.S. gallons each.  
Total Fuel: 42 U.S. gallons.  
Usable Fuel (all flight conditions): 38 U.S. gallons.  
Unusable Fuel: 4.0 U.S. gallons.
- 2 Long Range Tanks: 26 U.S. gallons each.  
Total Fuel: 52 U.S. gallons.  
Usable Fuel (all flight conditions): 48 U.S. gallons.  
Unusable Fuel: 4.0 U.S. gallons.

### NOTE

To ensure maximum fuel capacity when refueling, place the fuel selector valve in either LEFT or RIGHT position to prevent cross-feeding.

### NOTE

Takeoff and land with the fuel selector valve handle in the BOTH position.

- Fuel Grade (and Color): 80/87 Minimum Grade Aviation Fuel (red).  
Alternate fuels which are also approved are:  
100/130 Low Lead AVGAS (green). (Maximum lead content of 2 cc per gallon.)  
100/130 Aviation Grade Fuel (green). (Maximum lead content of 4.6 cc per gallon.)

### NOTE

When substituting a higher octane fuel, low lead AVGAS 100 should be used whenever possible since it will result in less lead contamination of the engine.

**PLACARDS**

The following information is displayed in the form of composite or individual placards.

(1) In full view of the pilot: (The "DAY-NIGHT-VFR-IFR" entry, shown on the example below, will vary as the airplane is equipped.)

This airplane must be operated in compliance with the operating limitations as stated in the form of placards, markings, and manuals.

—————MAXIMUMS—————

	Normal Category	Utility Category
MANEUVERING SPEED (IAS) . . . . .	97 knots . . . . .	97 knots
GROSS WEIGHT . . . . .	2300 lbs. . . . .	2000 lbs.
FLIGHT LOAD FACTOR		
Flaps Up . . . . .	+3.8, -1.52 . . . . .	+4.4, -1.76
Flaps Down . . . . .	+3.0 . . . . .	+3.0

Normal Category - No acrobatic maneuvers including spins approved.  
Utility Category - Baggage compartment and rear seat must not be occupied.

—————NO ACROBATIC MANEUVERS APPROVED—————  
EXCEPT THOSE LISTED BELOW

Maneuver	Recm. Entry Speed	Maneuver	Recm. Entry Speed
Chandelles . . . . .	105 knots	Spins . . . . .	Slow Deceleration
Lazy Eights . . . . .	105 knots	Stalls (except	
Steep Turns . . . . .	95 knots	whip stalls)	Slow Deceleration

Altitude loss in stall recovery -- 180 feet.  
Abrupt use of controls prohibited above 97 knots.  
Spin Recovery: opposite rudder - forward elevator - neutralize controls. Intentional spins with flaps extended are prohibited.  
Flight into known icing conditions prohibited. This airplane is certified for the following flight operations as of date of original airworthiness certificate:

DAY - NIGHT - VFR - IFR

(2) Forward of fuel selector valve:

BOTH TANKS ON FOR  
TAKEOFF & LANDING

(3) On the fuel selector valve (standard tanks):

BOTH - 38 GAL. ALL FLIGHT ATTITUDES  
LEFT - 19 GAL. LEVEL FLIGHT ONLY  
RIGHT - 19 GAL. LEVEL FLIGHT ONLY  
OFF

On the fuel selector valve (long range tanks):

BOTH - 48 GAL. ALL FLIGHT ATTITUDES  
LEFT - 24 GAL. LEVEL FLIGHT ONLY  
RIGHT - 24 GAL. LEVEL FLIGHT ONLY  
OFF

(4) Near fuel tank filler cap (standard tanks):

FUEL  
80/87 MIN. GRADE AVIATION GASOLINE  
CAP. 21 U.S. GAL.

Near fuel tank filler cap (long range tanks):

FUEL  
80/87 MIN. GRADE AVIATION GASOLINE  
CAP. 26 U.S. GAL.

(5) Near flap indicator:

AVOID SLIPS WITH FLAPS EXTENDED

(6) In baggage compartment:

120 POUNDS MAXIMUM  
BAGGAGE AND/OR AUXILIARY PASSENGER  
FORWARD OF BAGGAGE DOOR LATCH  
  
50 POUNDS MAXIMUM  
BAGGAGE AFT OF BAGGAGE DOOR LATCH  
  
MAXIMUM 120 POUNDS COMBINED  
  
FOR ADDITIONAL LOADING INSTRUCTIONS  
SEE WEIGHT AND BALANCE DATA

(7) On the instrument panel near over-voltage light:

HIGH VOLTAGE

# SECTION 3 EMERGENCY PROCEDURES

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