Cessna 172

Training Manual

Oleg Roud and Danielle Bruckert

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TRAINING MANUAL

by
Oleg Roud
and
Danielle Bruckert

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Contact the Authors:

We appreciate your feedback.

D Bruckert
danielle@redskyventures.org
PO Box 11288 Windhoek, Namibia
Red Sky Ventures

O Roud
roudoleg@yahoo.com
PO Box 30421 Windhoek, Namibia
Memel CATS

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Introduction

This training manual provides a technical and operational description for most models of the Cessna 172 series aeroplane, from the C172 and C172A to the C172SP, and includes systems descriptions for common variants, including the C172RG, P172D, and R172/FR172.

The information is intended for ground reference and as an instructional aid to assist with practical training for type transition or ab-initio training, provided by an approved training organisation.

The book is laid out according to a typical training syllabus progression for ease of use. This material does not supersede, nor is it meant to substitute any of the manufacturer's operation manuals. The material presented has been prepared from the information provided in the pilots operating handbook for the model series, Cessna maintenance manuals and from operational experience.

History

The Cessna aircraft company has a long and rich history. Founder Clyde Cessna built his first aeroplane in 1911, and taught himself to fly it! He went on to build a number of innovative aeroplanes, including several race and award winning designs. The Cessna Aircraft company was formally established by Clyde in 1927, in the state of Kansas.

In 1934, Clyde's nephew, Dwane Wallace, fresh out of college, took over as head of the company. During the depression years Dwane acted as everything from floor sweeper to CEO, even personally flying company planes in air races (several of which he won!). Under Wallace's leadership, the Cessna Aircraft Company eventually became the most successful general aviation company of all time.

Cessna first began production of two-seat light planes in 1946 with the model 120 which had an all aluminium fuselage and fabric covered wings. This was followed by a nearly identical model the 140, with aluminium clad wings. More than 7,000 model 120-140's were sold over four years when Cessna stopped production in order to focus on four-seat aircraft.

At the time of publication, Cessna continues to produce a range of aircraft, from their signature piston engine range, largely unchanged since first appearance, to the PT6 turbine powered Caravans, and the Citation Jet.

Development of the C172

The Cessna 172 is probably the most popular flight training aircraft in the world. The aircraft made her first flight in November 1955, the first production models

were delivered in 1957, and became an overnight sales success and over 1400 aircraft were built in its first full year of production. It is still in production in 2005, more than 35 000 have been built.

The Cessna 172 started as a relatively simple tricycle undercarriage development of the tail-dragger Cessna 170B. The airframe was basically a 170B, including the "fastback" or colloquially called the straight-back fuselage and effective 40º Fowler flaps. The maximum gross weight was identical although the useful load went down 45 pounds.
Later versions incorporated a swept back tail, revised landing gear, a lowered rear deck, and an aft window. Cessna advertised this added rear visibility as "Omni-vision".
The airframe has remained almost unchanged since then, with updates mainly affecting avionics and engine fittings, including the most recent the Garmin 1000 glass cockpit option. Production ended in the mid-1980s, but was resumed in 1996 and
continues at the time of writing.

In 1966 Cessna began assembly of US airframes at Reims Aviation in France. The Cessna F172 was built by Reims Cessna through to 1971. Cessna also produced a retractable version and most models are available as a seaplane version with floats.

Illustration 1a Cessna 172

Terminology

Airspeed		
KIAS	**Knots Indicated Airspeed**	Speed in knots as indicated on the airspeed indicator.
KCAS	**Knots Calibrated Airspeed**	KIAS corrected for instrument error. Note this error is often negligible and CAS may be omitted from calculations.
KTAS	**Knots True Airspeed**	KCAS corrected for density (altitude and temperature) error.
Va	**Max Manoeuvring Speed**	The maximum speed for full or abrupt control inputs.
Vfe	**Maximum Flap Extended Speed**	The highest speed permitted with flap extended. Indicated by the top of the white arc.
Vno	**Maximum Structural Cruising Speed**	Sometimes referred to as "normal operating range". Should not be exceeded except in smooth conditions and only with caution. Indicated by the green arc.
Vne	**Never Exceed speed**	Maximum speed permitted, exceeding will cause structural damage. Indicated by the upper red line.
Vs	**Stall Speed**	The minimum speed before loss of control in the normal cruise configuration. Indicated by the bottom of the green arc. Sometimes referred to as minimum 'steady flight' speed.
Vso	**Stall Speed Landing Configuration**	The minimum speed before loss of control in the landing configuration, at the most forward C of G*. Indicated by the bottom of the white arc.
*forward centre of gravity gives a higher stall speed and so is used for certification		
Vx	**Best Angle of Climb Speed**	The speed which results in the maximum gain in altitude for a given horizontal distance.
Vy	**Best Rate of Climb Speed**	The speed which results in the maximum gain in altitude for a given time, indicated by the maximum rate of climb for the conditions on the VSI.
Vref	**Reference Speed**	The minimum safe approach speed, calculated as 1.3 x Vso.
Vbug	**Nominated Speed**	The speed nominated as indicated by the speed bug, for approach this is Vref plus a safety margin for conditions.
Vr	**Rotation Speed**	The speed which rotation should be initiated.

Vat	**Barrier Speed**	The speed to maintain at the 50ft barrier or on reaching 50ft above the runway.
	Maximum Demonstrated Crosswind	The maximum demonstrated crosswind during testing.
Meteorological Terms		
OAT	**Outside Air Temperature**	Free outside air temperature, or indicated outside air temperature corrected for gauge, position and ram air errors.
IOAT	**Indicated Outside Air Temperature**	Temperature indicated on the outside air temperature gauge.
ISA	**International Standard Atmosphere**	The ICAO international atmosphere, as defined in document 7488. Approximate conditions are a sea level temperature of 15 degrees with a lapse rate of 1.98 degrees per 1000ft, and a sea level pressure of 1013mb with a lapse rate of 1mb per 30ft.
	Standard Temperature	The temperature in the International Standard atmosphere for the associated level, and is 15 degrees Celsius at sea level decreased by two degrees every 1000ft.
	Pressure Altitude	The altitude in the International Standard Atmosphere with a sea level pressure of 1013 and a standard reduction of 1mb per 30ft. Pressure Altitude would be observed with the altimeter subscale set to 1013.
	Density Altitude	The altitude that the prevailing density would occur in the International Standard Atmosphere, and can be found by correcting Pressure Altitude for temperature deviations.
	IMC	Conditions of cloud base and visibility that are below the legal minimum required for VFR flight.
	VMC	Conditions of cloud base and visibility that are at or above the legal minimum required for VFR flight.
	IFR	The set of operating rules required for instrument flight, IFR is a flight status rather than a meteorological term. IFR flights may operate in VMC, or IMC, (visual or instrument meteorological conditions), as defined by and in accordance with the applicable IFR legislation.

	VFR	The set of operating rules required for visual flight, VFR is a flight status rather than a meteorological term. All VFR flights must maintain VMC, (visual meteorological conditions), as defined by the applicable VFR legislation.
Engine Terms		
BHP	**Brake Horse Power**	The power developed by the engine (actual power available will have some transmission losses).
RPM	**Revolutions per Minute**	Engine drive and propeller speed.
	Static RPM	The maximum RPM obtained during stationery full throttle operation
Weight* and Balance Terms		
	Moment Arm	The horizontal distance in inches from reference datum line to the centre of gravity of the item concerned, or from the datum to the item 'station'.
C of G	**Centre of Gravity**	The point about which an aeroplane would balance if it were possible to suspend it at that point. It is the mass centre of the aeroplane, or the theoretical point at which entire weight of the aeroplane is assumed to be concentrated. It may be expressed in percent of MAC (mean aerodynamic chord) or in inches from the reference datum.
	Centre of Gravity Limit	The specified forward and aft points beyond which the CG must not be located. Typically, the forward limit primarily effects the controllability of aircraft and aft limits stability of the aircraft.
	Datum (reference datum)	A n imaginary vertical plane or line from which all measurements of arm are taken. The datum is established by the manufacturer.
	Moment	The product of the weight of an item multiplied by its arm and expressed in inch-pounds. The total moment is the weight of the aeroplane multiplied by distance between the datum and the CG.
**In reference to loading, the correct technical term is 'mass' instead of 'weight' in all of the terms in this section, however in everyday language and in current Cessna manuals the term weight remains in use. In this context there is no difference in meaning between mass and weight, and the terms may be interchanged.*		
MZFW	**Maximum Zero Fuel Weight**	The maximum permissible weight to prevent exceeding the wing bending limits. This limit is not always applicable for aircraft with small fuel loads.

BEW	**Basic Empty Weight**	The weight of an empty aeroplane, including permanently installed equipment, fixed ballast, full oil and unusable fuel, and is that specified on the aircraft mass and balance documentation for each individual aircraft.
SEW	**Standard Empty Weight**	The basic empty weight of a standard aeroplane, specified in the POH, and is an average weight given for performance considerations and calculations.
OEW	**Operating Empty Weight**	The weight of the aircraft with crew, unusable fuel, and operational items (galley etc.).
	Payload	The weight the aircraft can carry with the pilot and fuel on board.
MRW	**Maximum Ramp Weight**	The maximum weight for ramp manoeuvring, the maximum takeoff weight plus additional fuel for start taxi and run-up.
MTOW	**Maximum Takeoff Weight**	The maximum permissible takeoff weight and sometimes called the maximum all up weight, landing weight is normally lower as allows for burn off and carries shock loads on touchdown.
MLW	**Maximum Landing Weight**	Maximum permissible weight for landing. Sometimes this is the same as the takeoff weight for smaller aircraft.
Other		
AFM	**Aircraft Flight Manual**	These terms are inter-changeable and refer to the approved manufacturer's handbook. General Aviation manufacturers from 1976 began using the term 'Pilot's Operating Handbook', early handbooks were called Owner's Manual, most legal texts use the term AFM.
POH	**Pilot's Operating Handbook**	
PIM	**Pilot Information Manual**	A Pilot Information Manual is a new term, coined to refer to a POH or AFM which is not issued to a specific aircraft.

Useful Factors and Formulas

Conversion Factors			
Lbs to kg	1kg =2.204lbs	kgs to lbs	1lb = .454kgs
USG to Lt	1USG = 3.785Lt	lt to USG	1lt = 0.264USG
Lt to Imp Gal	1lt = 0.22 Imp G	Imp.Gal to lt	1Imp G = 4.55lt
NM to KM	1nm = 1.852km	km to nm	1km = 0.54nm
NM to StM to ft	1nm = 1.15stm 1nm = 6080ft	Stm to nm to ft	1 stm = 0.87nm 5280ft
FT to Meters	1 FT = 0.3048 m	meters to ft	1 m = 3.281 FT
Inches to Cm	1 inch = 2.54cm	cm to inches	1cm = 0.394”
Hpa (mb) to “Hg	1mb = .029536”	“ Hg to Hpa (mb)	1” = 33.8mb

AVGAS FUEL Volume / Weight SG = 0.72					
Litres	Lt/kg	kgs	Litres	lbs/lts	Lbs
1.39	1	0.72	0.631	1	1.58

Crosswind Component per 10kts of Wind								
Deg	10	20	30	40	50	60	70	80
Kts	2	3	5	6	8	9	9	10

Formulas

Celsius (C) to Fahrenheit (F)	C = 5/9 x(F-32), F = Cx9/5+32
Pressure altitude (PA)	PA = Altitude AMSL + 30 x (1013-QNH) Memory aid – Subscale up/down altitude up/down
Standard Temperature (ST)	ST = 15 – 2 x PA/1000 i.e. 2 degrees cooler per 1000ft altitude
Density altitude (DA)	DA = PA +(-) 120ft/deg above (below) ST i.e. 120ft higher for every degree hotter than standard
Specific Gravity	SG x volume in litres = weight in kgs
One in 60 rule	1 degree of arc ≈ 1nm at a radius of 60nm i.e degrees of arc approximately equal length of arc at a radius of 60nm
Rate 1 Turn Radius	R = TAS per hour/60/π or TAS per minute/π R ≈ TAS per hour/180 (Where π (pi) ≈3.14)
Radius of Turn Rule of Thumb	Radius of Turn lead allowance ≈ 1% of ground speed (This rule can be used for turning on to an arc – e.g. at 100kts GS, start turn 1nm before the arc limit)
Rate 1 Turn Bank Angle Rule of Thumb	degrees of bank in a rate one turn ≈ GS/10+7

Pilot's Operating Handbook Information

The approved manufacturer's operating handbook, which may be commonly referred to as a Pilot's Operating Handbook (POH), an Aircraft Flight Manual (AFM), or an Owners Manual, is issued for the specific model and serial number, and includes all applicable supplements and modifications. It is legally required to be on board the aircraft during flight, and is the master document for all flight information.

In 1975, the US General Aviation Manufacturer's Association introduced the 'GAMA Specification No. 1' format for the 'Pilot's Operating Handbook' (POH). This format was later adopted by ICAO in their Guidance Document 9516 in 1991, and is now required for all newly certified aircraft by ICAO member states. Most light aircraft listed as built in 1976 or later, have provided Pilot's Operating Handbooks (POHs) in this format.

GAMMA standardised the term 'Pilot's Operating Handbook' as the preferred term for a manufacturer's handbook on light aircraft, however some manufacturers still use different terms (see further explanation above under definitions).This format aimed to enhance safety by not only standardising layouts but also by creating an ergonomic format for use in flight. For this reason the emergency and normal operating sections are found at the front of the manual, while reference and ground planning sections are at the rear.

It is recommended that pilots become familiar with the order and contents of each section, as summarised in the table below.

Section 1	General	Definitions and abbreviations
Section 2	Limitations	Specific operating limits, placards and specifications
Section 3	Emergencies	Complete descriptions of action in the event of any emergency or non-normal situation
Section 4	Normal Operations	Complete descriptions of required actions for all normal situations
Section 5	Performance	Performance graphs, typically for stall speeds, airspeed calibration, cross wind calculation, takeoff, climb, cruise, and landing
Section 6	Weight and Balance	Loading specifications, limitations and loading graphs or tables
Section 7	Systems Descriptions	Technical descriptions of aircraft systems, airframe, controls, fuel, engine, instruments, avionics and lights etc.
Section 8	Servicing and maintenance	Maintenance requirements, inspections, stowing, oil requirements etc.

Section 9	Supplements	Supplement sections follow the format above for additional equipment or modification.
Section 10	Safety Information	General safety information and helpful operational recommendations which the manufacturer feels are pertinent to the operation of the aircraft

For use in ground training, or reference prior to flight, this text should be read in conjunction with the POH from on board the aircraft you are going to be flying. Even if you have a copy of a POH for the same model C172, the aircraft you are flying may have supplements for modifications and optional equipment which affect the operational performance.

AIRCRAFT TECHNICAL INFORMATION

The Cessna 172 aircraft is an all-metal, single engine, four-seat, high-wing monoplane aircraft, equipped with tricycle landing gear and designed for general utility purposes.

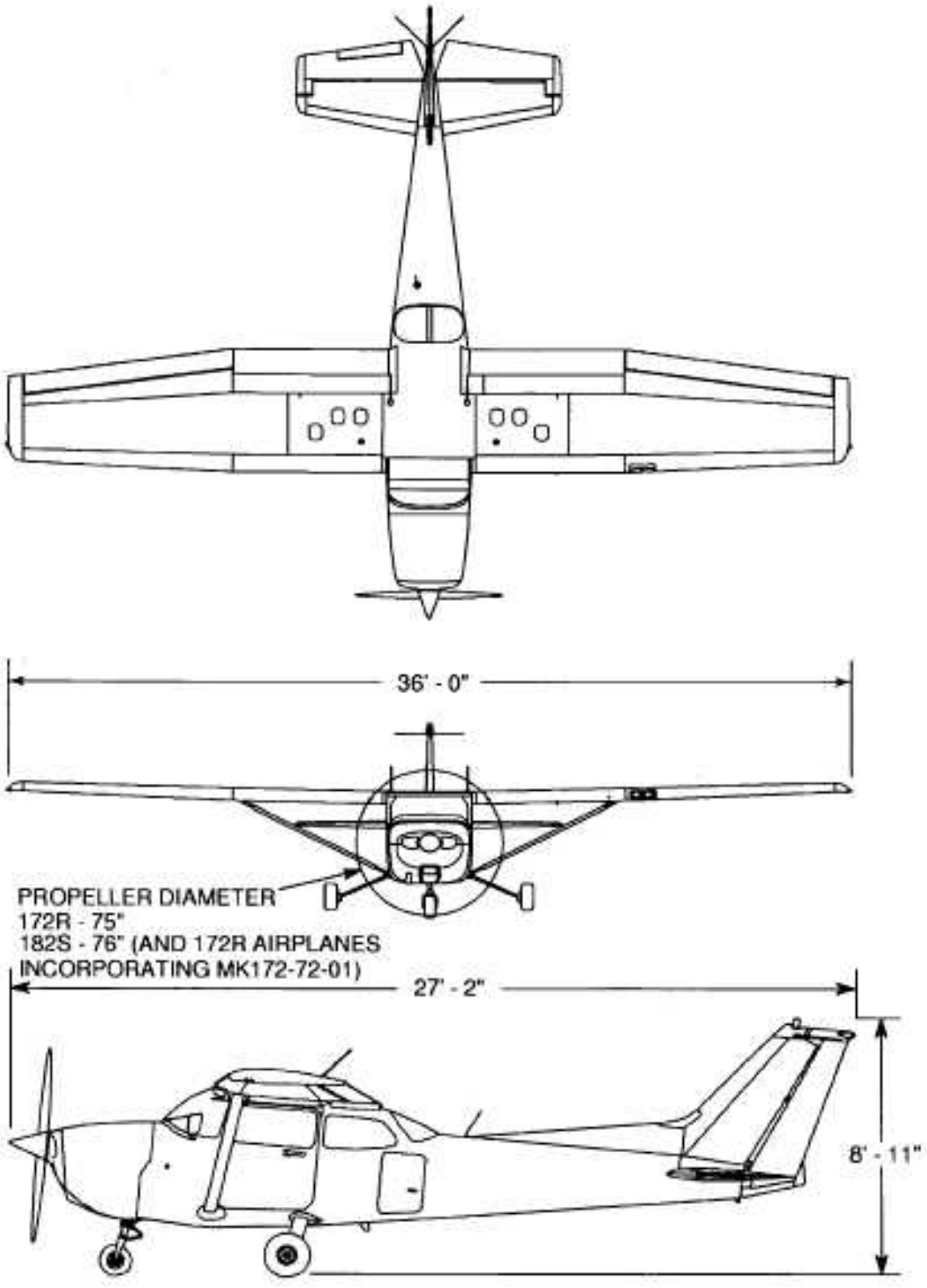

Illustration 1b Cessna 172 Plan and Profile Views