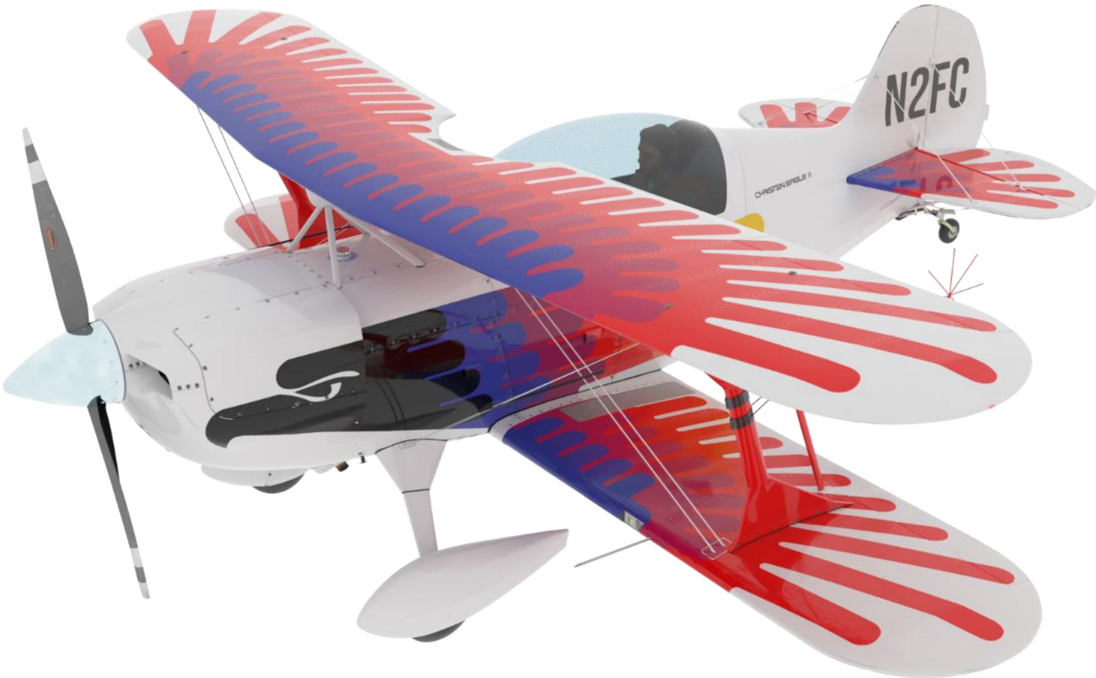
CHRISTEN EAGLE II
Back in the saddle

LEATHERNECK SIMULATIONS

MAGNITUDE 3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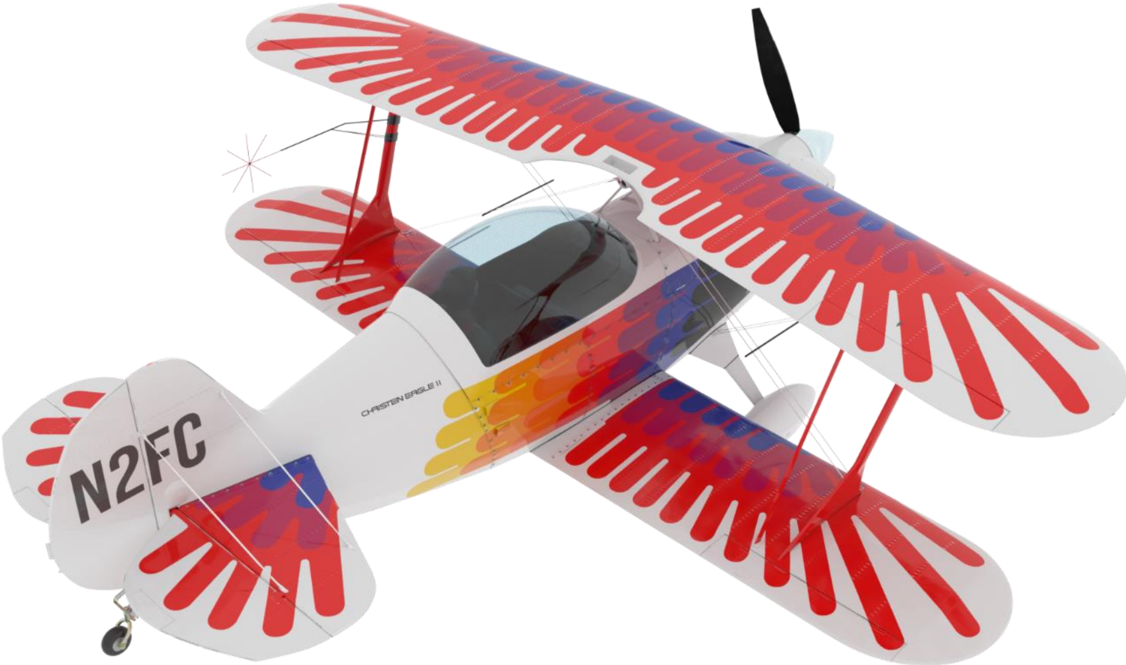
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About the Christen Eagle II by Magnitude 3 LLC

The Christen Eagle II by Magnitude 3 LLC is a flight simulation software module which integrates into Digital Combat Simulator World (DCS World) made by Eagle Dynamics. To use this module, **DCS World needs to be installed on the PC. DCS World is free to download and use; it can be downloaded from** www.digitalcombatsimulator.com

Minimum system requirements for DCS World changes as the DCS World evolves. Please check current system requirements on the DCS World download page.
This manual contains most of the information needed to successfully master the DCS Christen Eagle II. However, for the general DCS environment understanding and usage, refer to the **DCS User Manual** which can be found in the DCS World installation folder ("Doc" folder) and in corresponding module folder.

End User License Agreement for DCS World automatically applies for this module too.

Useful Links:

MAGNITUDE 3 ED Forum Link

MAGNITUDE 3 YouTube Channel

MAGNITUDE 3 Facebook Page

MAGNITUDE 3 Support Mail

MAGNITUDE 3 Mantis Bug Tracker

For newcomer pilots not familiar with DCS World or even flying, it is strongly recommend joining some of DCS's "virtual squadrons" – a group of like-minded people with great collective experience, playing DCS World and in different DCS modular aircraft. They can help get on the right track quickly, since this manual does not contain general DCS World user instructions nor basic flying instructions.
Here are some useful links of known virtual squadrons:

ED Wiki – Virtual Squadrons and Regiments

ED Forum – Squadron Directory

SECTION 1

GENERAL INFORMATION: HERE WE GO!

Section 1: GENERAL INFORMATION

Introduction

The Christen Eagle II, which later became the Aviat Eagle II in the mid-1990s, is an aerobatic sporting biplane aircraft that has been produced in the United States since February 1977.

Frank Christensen, a veteran WW2 P-51D pilot, originally of Salt Lake City, Utah, developed the Eagle II, designed to compete with the Pitts Special. It is a small aircraft of conventional configuration of a single-bay, with equal-span staggered bi-wings. Each wing set is braced for streamlined flying with tension cables and I-struts to form a box truss. The pilot and a single passenger sit in tandem underneath a large bubble canopy. The tail wheel is attached to a leaf spring affixed to the undercarriage, with the main wheels mounted on flexible solid aluminum legs. The main wheels are also housed in streamlined fairings. The fuselage and tail are constructed of chromium-molybdenum steel welded tubes, with the forward fuselage skinned in aluminum and the rear fuselage and tail covered in fabric. The wing structure is formed by Sitka spruce wood and is also fabric covered. The engine cowling is made of fiberglass.

It is unknown how many aircraft were built so far, but by 2011 over 350 aircraft were in flying condition.

The Christen Eagle II celebrated its 40th anniversary in 2017.

Specifications

The Christen Eagle II is a light aerobatic aircraft, equipped with a set of instruments that allow for day visual flight rules (day VFR) application only. Aircraft attitude is determined by visual references by observing the ground and horizon. In case of fog, clouds, or during the night-time, it might be impossible to determine aircraft attitude, which leads to disorientation with very high probability of a catastrophic outcome.

Type of operation	Day VFR
Engine	AVCO Lycoming AEIO-360—A1D, 200 hp
Propeller	Hartzell HC-C2YK-4/C7666A-2, constant speed
Fuel capacity	25 gal. (24 usable), 150 lb
Fuel type	(100/130 octane min) 100 octane aviation gasoline, color green 100 octane low-lead aviation gasoline (100LL), color blue
Oil capacity	8 qt, 15 lb
Oil type	straight mineral
Empty weight (typical)	1050 lb with electrical, radio, and canopy
Gross weight	**Normal** 1600 lb **Acrobatic** 1520 lb **Useful load** (typical) 550 lb **Baggage allowance** 30 lb
Length	18 ft 6 in.
Wing span	19 ft 11 in.
Height	6 ft 6 in.
Wing area	125 sq ft
Wing loading (at gross weight)	12.80 lb/sq ft
Structural limits at acrobatic weight	+7g, -5g
Limits of travel of control surfaces	**Elevator** (relative to horizontal stabilizer): Up = +26° Down = -28° **Rudder**: 30° side-to-side deflection from the neutral position (60° total movement arc). **Ailerons** (measured at lower aileron relative to neutral reference; upper and lower ailerons are parallel): Up = +26° Down = -22°

Selected Design Airspeeds

	mph	knots
Maximum speed, VH	184	160
Stall speed, VS	58	50
Cruise speed, VC	173	150
Maneuvering speed, VA	155*	135*
Never exceed speed, VNE	210	182*

*Theoretical VA at 1520 lb is 159 mph or 138 knots, at 1600 lb VA it is 163 mph or 142 knots.

► *Performance Data*

Max rate of climb	2120 fpm
Best angle of climb speed, VX	78 mph
Best rate of climb speed, VY	94 mph
Recommended climb speed	100 mph
Recommended engine-out glide speed	90 mph
Service ceiling	22,200 ft
Take-off distance (over 50 ft obstacle at sea level and 75°F, zero wind)	900 ft
Landing distance (over 50 ft obstacle at sea level and 75°F, zero wind)	1,375 ft
Roll rate	187°/sec
Vertical penetration (entry at 180 mph)	1500 ft
Knife-edge endurance (180 mph)	approx. 6000 ft
Inverted flight endurance	unlimited

► *Engine Data Summary*

Power	**RPM**	**M.P. (in. Hg)**	**Fuel cons. (gph)**
Full	2700	28.6	15.8
75%	2450	25.0	12.0
65%	2350	23.5	10.5
50%	2000	22.7	8.1

► *Cruise Speed Summary*

Power	TAS, Sea level (mph)	TAS, 5000 ft (mph)
75%	152	162
65%	146	151
50%	125	133

► *Cruise Range Summary (30 Min. Reserve)*

Power	Max Power Cruise (mi)	Economy Cruise (mi)
75%	243	-
65%	270	328
50%	328	390

► *Aerobatic Entry Speed Summary (in mph)*

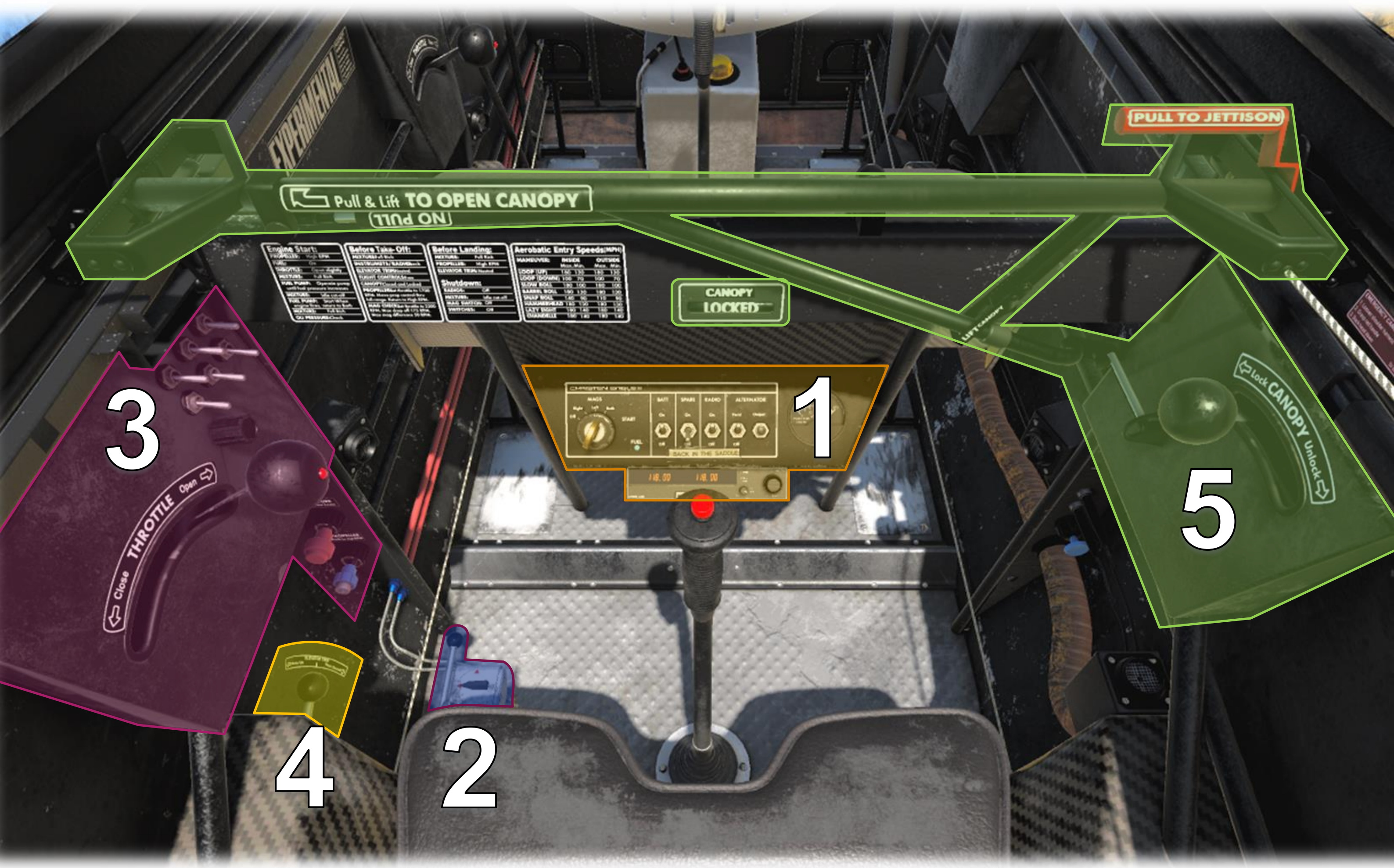
	Inside		Outside	
Maneuver	**Max.**	**Min.**	**Max.**	**Min.**
Loop (up)	180	130	180	130
Loop (down)	100	70	100	70
Slow roll	180	100	180	100
Barrel roll	180	130	180	130
Snap roll	140	90	110	90
Hammerhead	180	130	180	130
Lazy eight	180	140	180	140
Chandelle	180	140	180	140

Cockpit

The Christen Eagle II can be flown with either one or two persons on board. The main seat ("pilot's seat" or "instructor's seat") is in back cockpit area. This seat must be occupied to assure a safe center of gravity position. The front seat is reserved for either the passenger or a student pilot. This seat can be empty.

The aircraft cannot be fully utilized from the front seat since only the back-cockpit area holds all engine and avionics controls. The front cockpit area holds only the stick, throttle, rudder pedals, and a radio transmit button.

► *Back Cockpit Area*



1. Main control panel with the radio
2. Manual fuel pump
3. Engine controls and lights panel
4. Trim pitch lever
5. Canopy control area

Main Control Panel

The main control panel is in the back cockpit only. It holds the electric system controls, the magnetos/starter switch and the radio.

MAGS – Engine magnets and starter switch with 5 positions:

- Off – Magnets off, engine off
- Right – Right magnet is ON only
- Left – Left magnet is ON only
- Both – Both right and left magnets are ON
- START – Engine starter ON

FUEL – A push-button used to select the digital fuel display operation mode.

The digital fuel display is located on the instrument panel in the front cockpit.

BATT – Aircraft onboard battery output, either ON (up) or OFF (down).

SPARE – Spare switch, used to activate smoke system if the aircraft is equipped with smoke oil.

RADIO – Switch not in use. See "*RADIO King/Bendix KY-196B*" description.

ALTERNATOR – Aircraft onboard alternator controls. Press **"Output"** circuit breaker to enable the alternator feed to the aircraft's electrical system, pull to disable it. The **"OFF"** and **"Field"** switch positions disable/enable the alternator electrical feed.

VA Meter – Indicates either Volts or Amps a.k.a. battery load. It normally indicates Amps. For Volts, press-and-hold the button on the instrument. Nominal values are 24V / 50A.

RADIO King/Bendix KY-196B

The radio is in the back cockpit, therefore radio set-up (ON/OFF, frequency tuning, volume control, etc.) can be performed from the back cockpit only. The pilot in the front cockpit can use the radio only to communicate on the current frequency.

1. **"USE" window**
2. **Transfer switch**
3. **"STBY" (stand-by) window**
4. **"CHAN" channel button**
5. **ON / OFF / Volume knob**
6. **Frequency selection knob**

- ***Power Up***

When the ON/OFF/Volume knob is turned clockwise to the **"ON"** position, the unit will display the frequencies last used in the **"USE"** and **"STBY"** (standby) windows.

To override the automatic squelch, pull the ON/OFF/Volume knob out and, judging by static noise, rotate it to the desired volume level. Push the knob back in to activate the automatic squelch.

NOTE: As with all avionics, the KY-196B should only be turned on after engine startup. This simple precaution will help protect the solid-state circuitry and extend the operating life of the equipment.

- ***Frequency Mode (Normal Operation)***

1. Select a new frequency in the **"STBY"** window, using the frequency selection knobs. The larger knob controls change in increments of 1MHz. The smaller knob controls change in increments of 50kHz when pushed in, and 25kHz when pulled out.

   At the outside limits of the band, the display will "wrap around" to the other end of the band, going from 118MHz to 136MHz.

2. Press the transfer button to activate the new frequency. The newly entered frequency in the **"STBY"** window flipflops with the frequency in the **"USE"** window. This new frequency is now available for use.

- ***Program Mode***

The Program Mode is used to program frequencies for use in the Channel Mode.

1. Press the channel **(CHAN)** button for more than two seconds, until the channel number (to the right of the standby frequency) begins flashing. The most recently used active frequency will remain displayed in the **"USE"** window.

2. Turning either frequency selection knob will change the channel.

3. Once the desired channel number is selected, a new frequency may be programed by pressing the transfer button. This will cause the frequency in the **"STBY"** window to flash. The tuning knobs are now used to enter desired frequency.

4. To program additional channels, push the transfer button again to make the channel number flash, and repeat step three above.

5. If fewer than nine channels are needed, while skipping certain channel numbers, rotate the MHz frequency knob left or right beyond 136MHz or 118MHz. Dashes (- - -) will appear within the **"STBY"** window, indicating that the channel will be skipped when the system is operating in Channel Mode.

6. To exit the Program Mode, momentarily press the channel button. The unit will also automatically exit the Program Mode if programming does not occur within approximately 20 seconds.

- ***The Program-Secure Mode***

The Program Secure Mode may be used to lock a desired frequency to a specific channel number, prohibiting program changes from the front of the unit. The KY-196A should be taken to an authorized Bendix/King dealer for programming in this mode.

- ***Channel Mode***

The Channel Mode is used to recall preset frequencies stored in memory.

1. To momentarily enter the Channel Mode, push the channel button while in the Frequency Mode. The active frequency remains displayed in the **“USE”** window, and the last used channel number and its associated frequency are displayed in the **“CHAN”** and **“STBY**” windows.

   If no channels have been programmed, channel 1 automatically disappears and dashes are displayed in the **“STBY”** window.

2. Turn either frequency selection knob to change the channel number and the channel’s corresponding frequency in the **“STBY”** window.
3. If there is no activity for five seconds, the radio will exit the Channel Mode and return to the Frequency Mode, with the channel frequency remaining in the **“STBY”** window.

4. You can also return to the Frequency Mode by either:

   a. Pressing the channel button before the five-second delay, in which case the radio recalls the **“USE”** and **“STBY”** frequencies prior to entering the Channel Mode, or

   b. Pressing the transfer button so that the channel frequency becomes the active frequency and the last **“USE”** frequency becomes the new **“STBY”** frequency.

- ***Direct Tune Mode***

The Direct Tune Mode is entered by pressing and holding the transfer button for longer than two seconds. The **“STBY”** frequency will disappear and the frequency in the active window can be changed with the frequency selection knobs.

Momentarily pushing the transfer button will return the unit to the Frequency Mode (normal operation).

The **“STBY”** frequency displayed prior to entering the Direct Tune Mode will return unchanged.

- ***Default Mode***

Turning on the KY-196B while pressing the transfer button will bring the unit up in the Direct Tune Mode and install 120.00MHz as the active frequency. This will aid the pilot in blind tuning the radio in an unlikely event of display failure.

- ***Display Adjust Modes***

To enter the Display Adjust Mode, press and hold the channel button until the Program Mode is entered. Continue holding the channel button while simultaneously pressing and holding the frequency transfer button until **“dA1”** replaces the frequency in the **“USE”** window.

The frequency selector knobs are used to change the value in the **“STBY”** window. Momentarily pressing the channel button steps the unit through the Display Adjust Modes, **“dA1”** through **“dA3”**. Press the frequency transfer button to exit the Display Adjust Mode

- **dA1** is used to vary the dim/brightness response time to changes in ambient light on the display's photocell. The range of values for dA 1 is 1-8, with 1 representing normal.

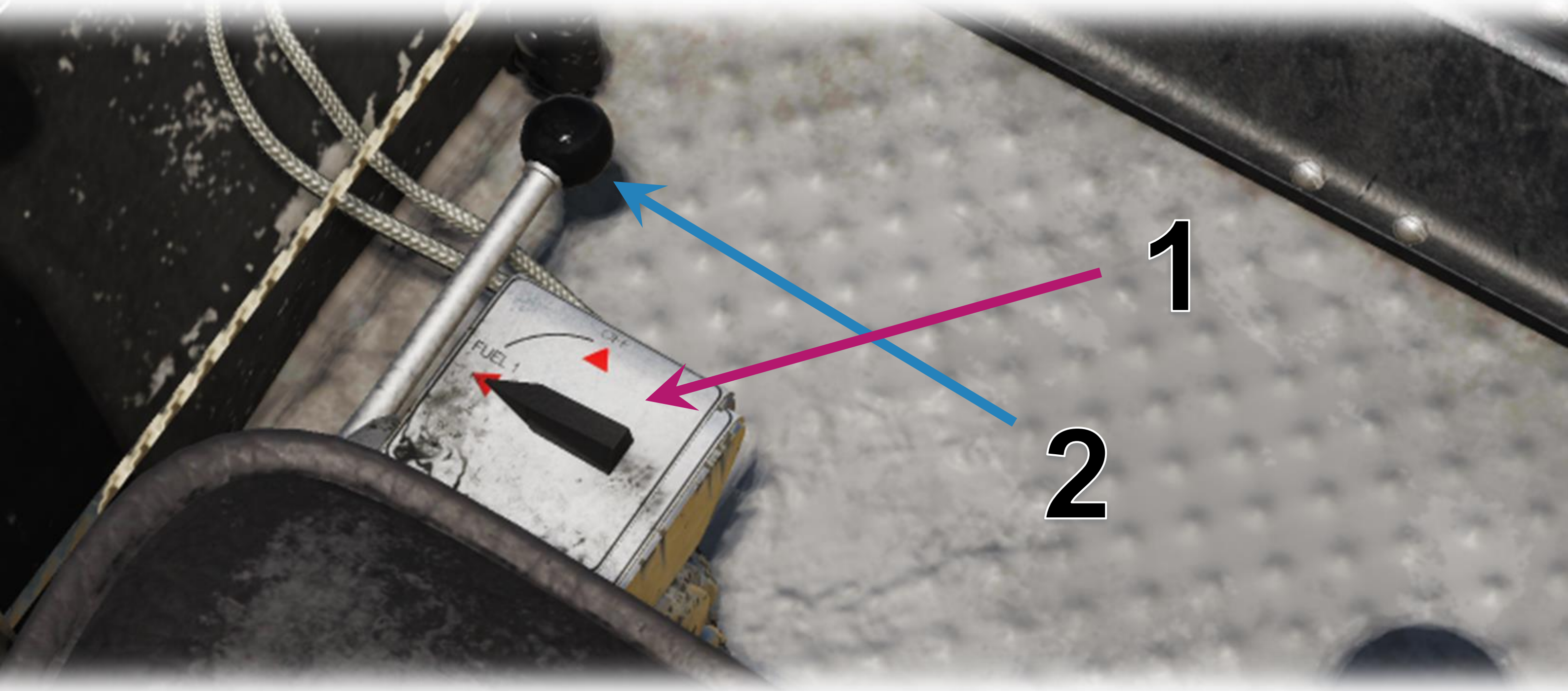
  The normal setting, 1, provides immediate display brightness changes when there are changes in the light falling on the photocell. With dA 1 set to a value of 8, the response time is approximately eight seconds. dA 1 values of 2 through 7 provide intermediate response times.

- **dA2** is used to vary the display brightness when ambient light conditions are less than direct sunlight, such as in a dark cockpit. dA 2 values range from 0-64, with 0 being the dimmest and 64 being the brightest; the normal dA 2 setting is 20.

- **dA3** values range from 0 to 255, with 0 being the dimmest and 255 being the brightest. This adjustment varies the amount of ambient light required for the display to reach its full dim and brightness levels. Normal dA3 values for a new display range from 0 to 30. A common use of dA3 is to adjust the KY-196A display brightness to match the brightness of other radios' displays. Another use is to provide display brightness compensation as the display ages.

Manual Fuel Pump

The manual fuel pump is located in the back cockpit, below the left side of the pilot's seat. It is used to pull the fuel from the tank during the initial engine start-up. This is often called engine priming. Once the engine is started and heated up, it is not necessary to use the pump during hot engine starts, because the fuel line is well established and the mixture for the start-up does not need to be further enriched.



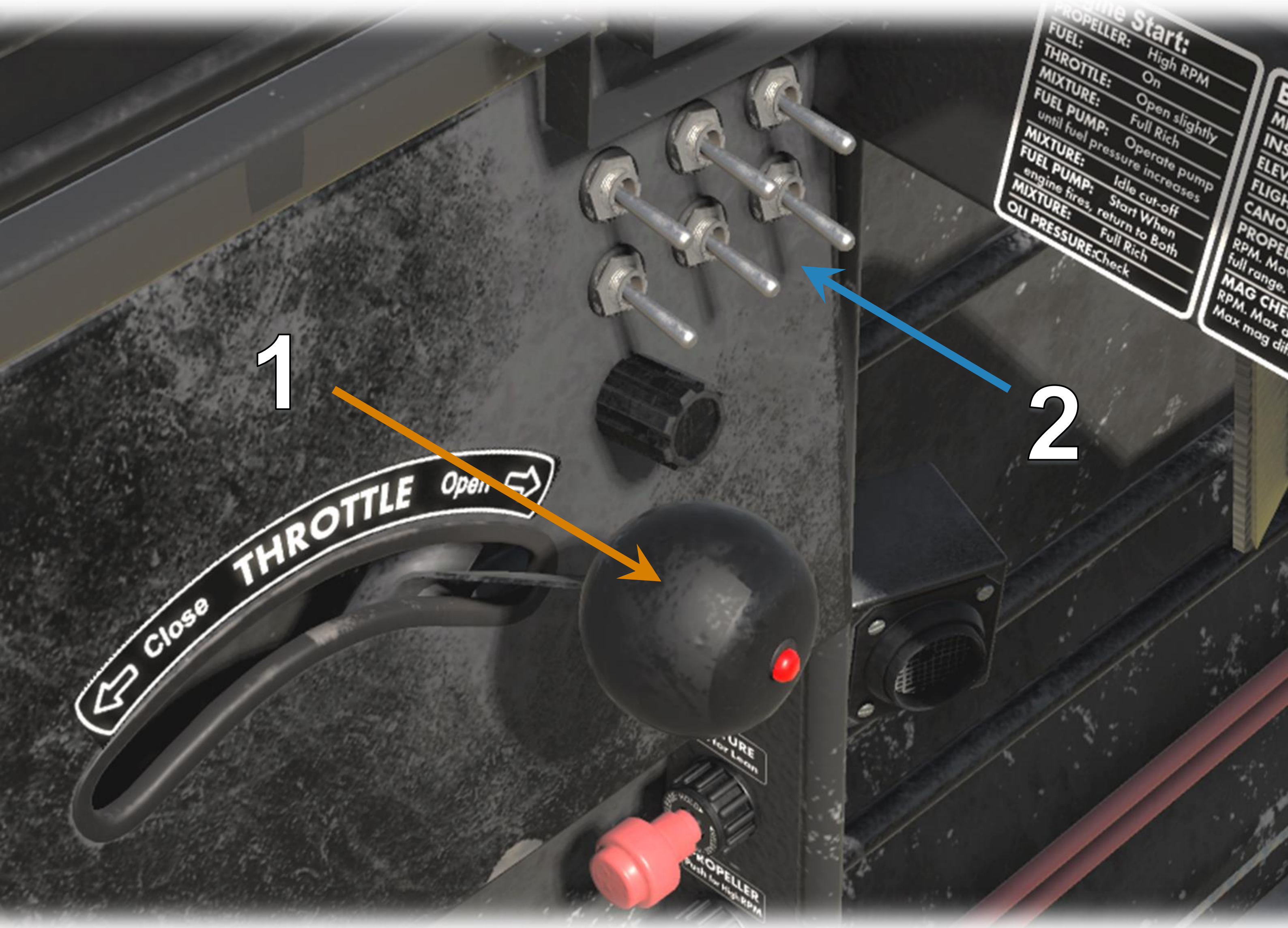
1. **Fuel valve: OFF – fuel cutoff, FULL ON – fuel flow enabled.**
2. **Fuel pump lever. Used to prime the engine on cold start.**

NOTE: The fuel pump body with the valve is hardly visible from the pilot's viewpoint. Move forward to see the pump. Although the fuel lever is visible, it is practical to map the FUEL ON/OFF commands to keyboard inputs: this will eliminate the need to look at the pump.

Engine & Lights Control Panel

The throttle lever with lights controls is on the left vertical panel. The throttle moves back and forth: although inscription for the back position reads “Close”, the throttle is never actually closed, and the engine can’t turn off by pulling the throttle control all the way back. The “Close” position refers to idling engine throttle setup.

Light control can only be done from the back cockpit.



1. **Throttle control with a radio transmit button**
2. **Light switch area:**

- Top row, from left:
    - NAV lights, cockpit RED light, cockpit YELLOW light

- Bottom row, from left:
    - Landing & taxi lights, not used, not used

- The knob below the light switches controls the instrument panel’s light intensity.

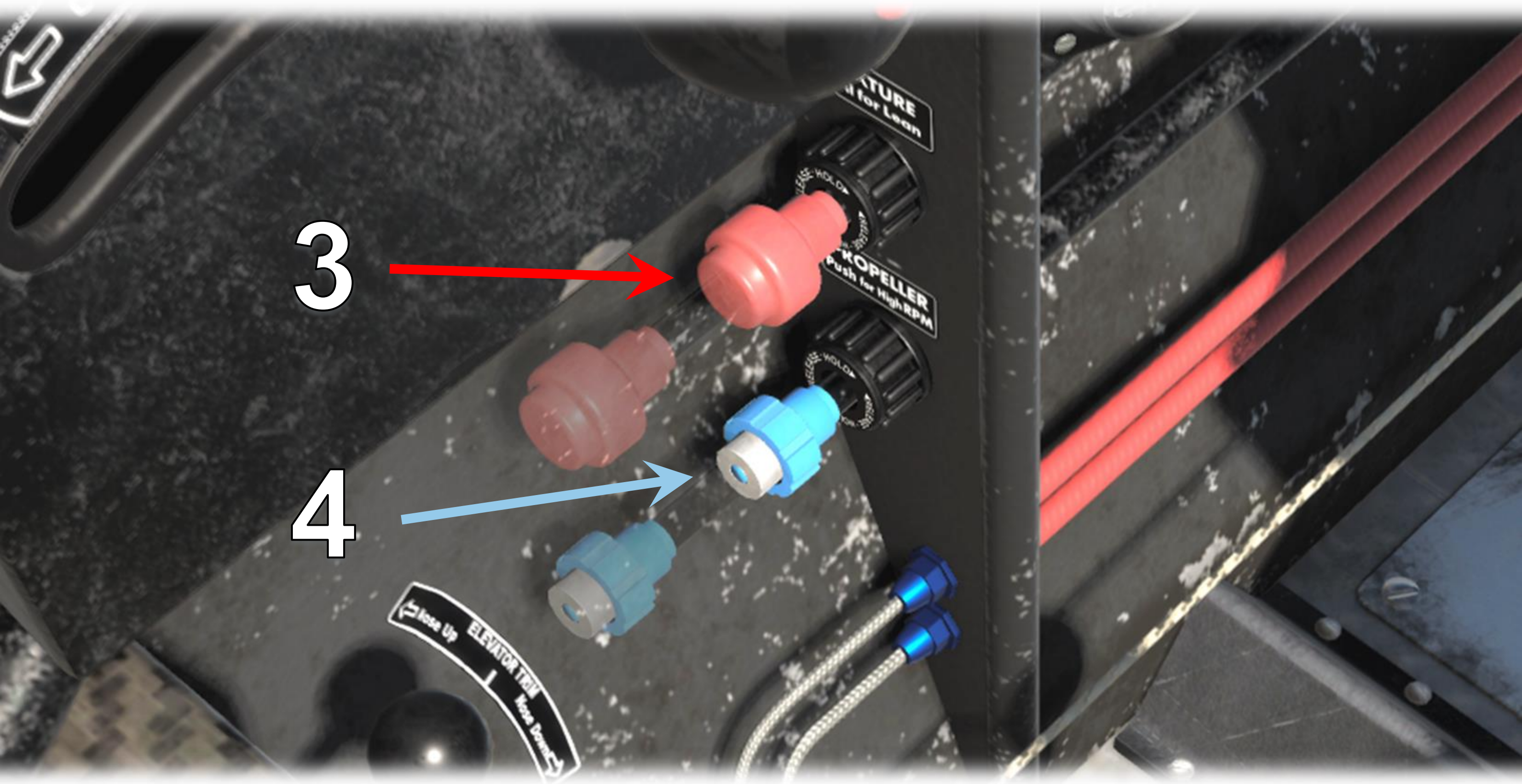
Mixture & RPM Levers

The Mixture and RPM levers are located below the throttle/lights panel. These are not available in the front cockpit.

The mixture lever is used to control fuel and air mixture supplied to the engine. Leaning the mixture during the cruise can save a lot of fuel (flight economy). In most cases during the flight, this lever should be pushed into the front position (“full rich”).

The RPM lever is used to control the engine RPM along with the throttle. The throttle controls the engine energy, while the RPM lever controls how that energy should be used. In most cases, this lever should be also be pushed into the front position (“high RPM”); for economic engine operations, this lever is pulled back to certain positions in accordance with the throttle. This can save a lot of fuel when the aircraft is cruising, while combined with the mixture leaning it can save even more, providing longer range and more time in the air. However, for aerobatic aircraft use, both mixture and RPM levers should be pushed into the front position, giving the engine maximum available power.

More details on engine economy management can be found in the “Cruise Procedure” section, page 38.



1. Mixture lever, painted in red.

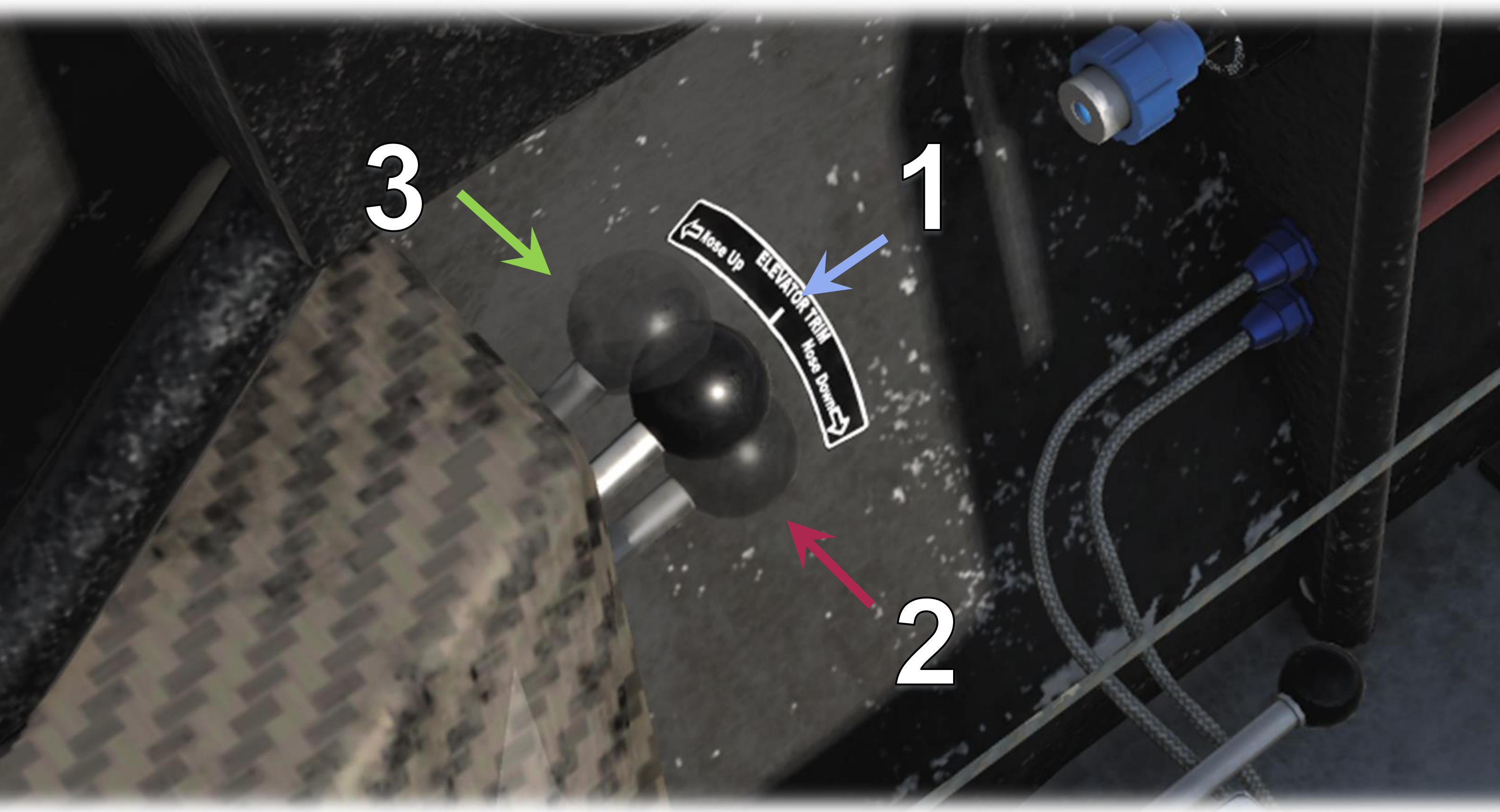
a. Front position is “full rich”, back position is “full lean”.

2. RPM setting lever.

a. Front position is “high RPM”, back position is “low RPM”

Elevator Trim Lever

The Christen Eagle II has elevator (pitch) trim only. The trim lever is placed in the back-cockpit area, on the left vertical side of the pilot's seat. Although the Christen Eagle II does not need a lot of trim, it is recommended to trim on a cruising speed, which is usually around 140-150 mph. For aerobatics, it is best to trim at 150 mph, but this depends on personal preference.



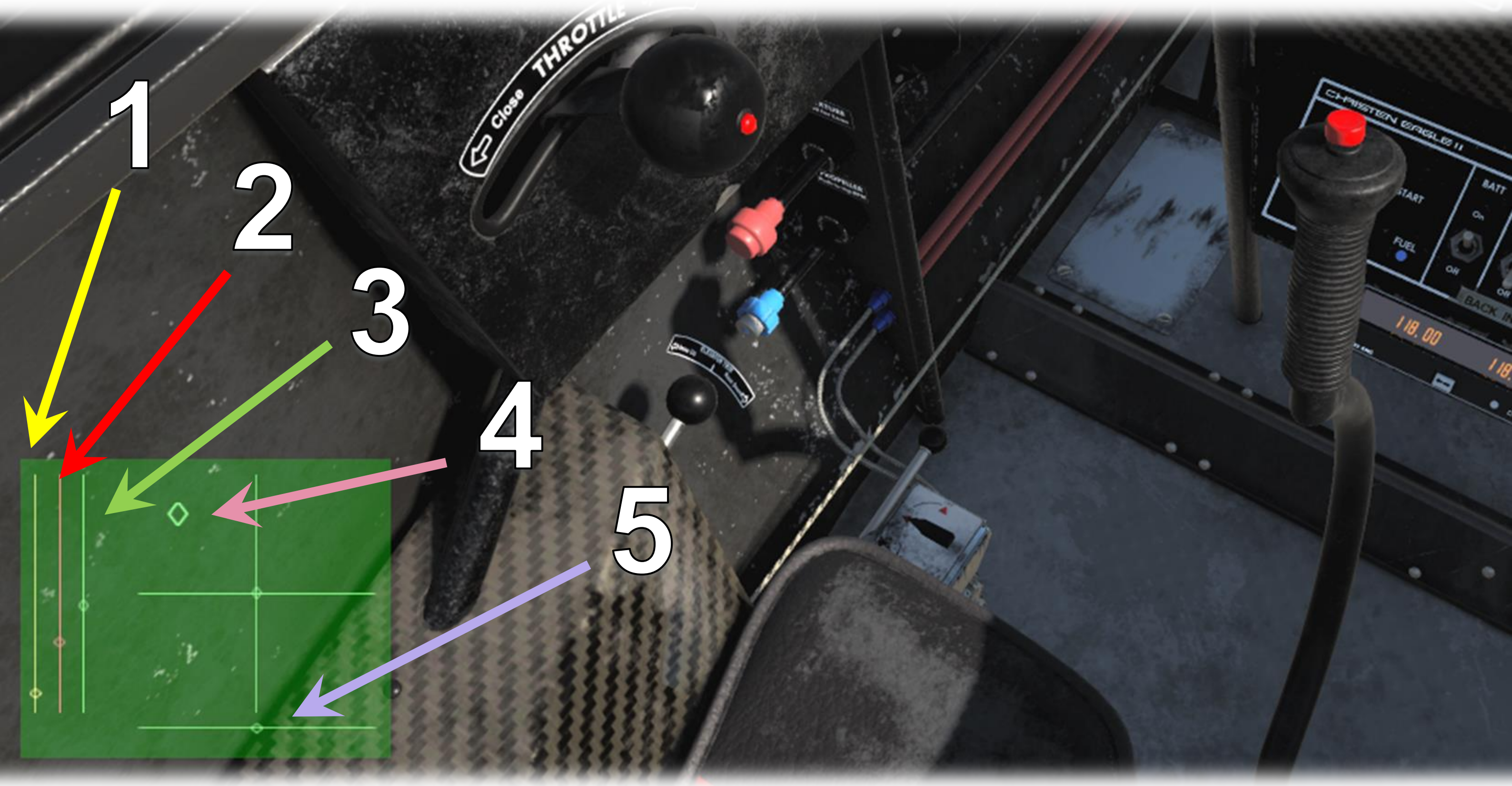
The lever moves up and down:

- **Position 1 – Neutral trim**
- **Position 2 – Nose down trim**
- **Position 3 – Nose up trim**

The lever can be placed in any position between 2 and 3.

Controls Indicator

The controls indicator is an on-screen graphic representation of the user's control inputs sent to simulator. This feature is not visible by default. It can be activated/deactivated by using RCTRL + ENTER default keyboard combo. The indicator is visible only in the cockpit view (F1). When activated, it becomes visible in the lower left corner of the screen.



1. **RPM lever position (yellow)**
2. **Mixture lever position (red)**
3. **Throttle lever position (green)**
4. **Stick position**
5. **Rudder position**

Canopy Control Area

The canopy is controlled by three levers: close, open and lock/unlock. Indicating whether the canopy is locked or unlocked is provided by a mechanical info plate that shows the canopy lock status. The canopy closing and opening procedures are described below.

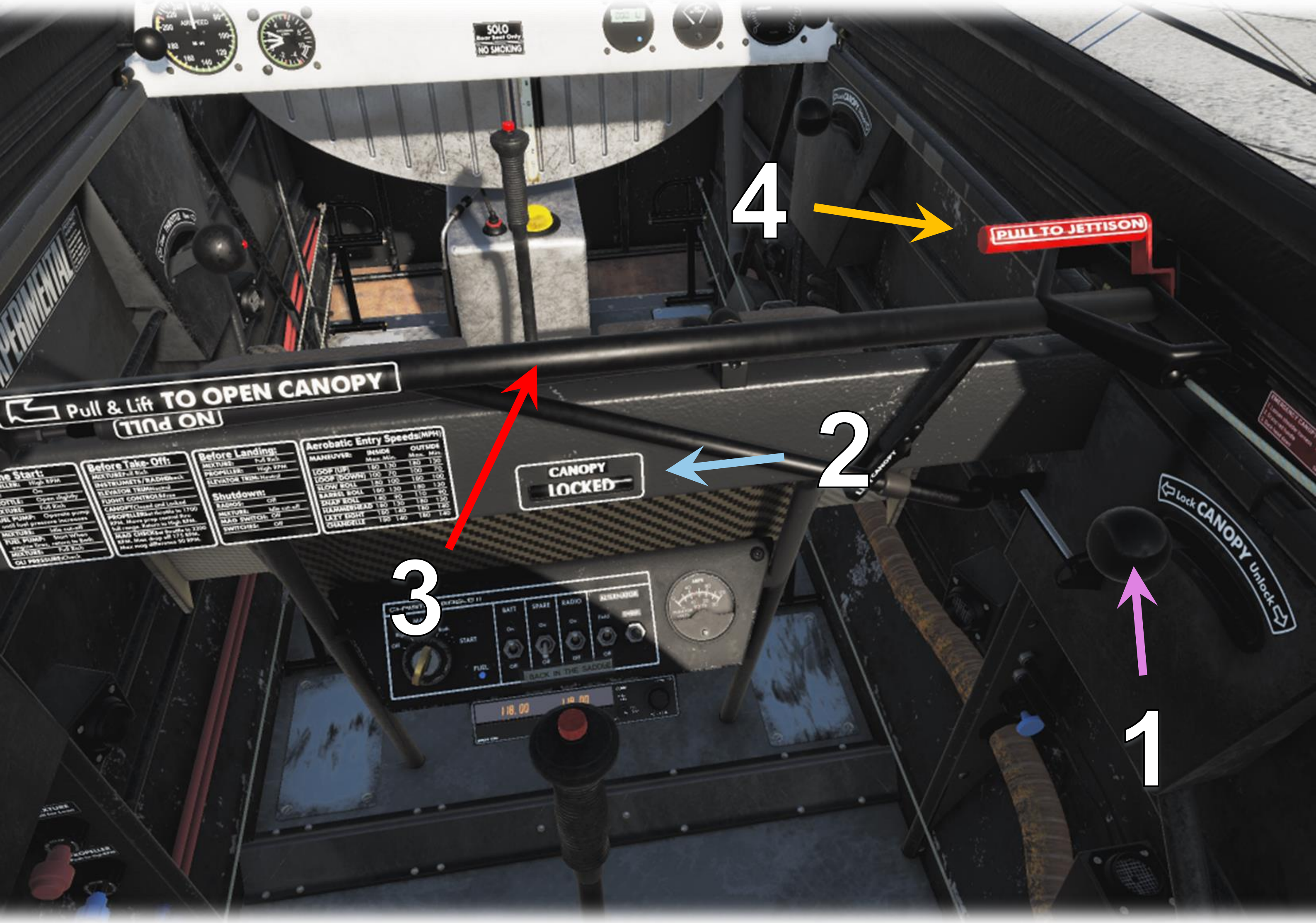
The canopy could be jettisoned at any time if it is closed, by pulling the red-colored “JETTISON” lever.

The Image above shows the canopy in an OPEN position. Follow the procedure to close and lock the canopy below.

1. **Canopy CLOSE lever. Click to close the canopy.**
2. **Canopy LOCK / UNLOCK lever. Push FORWARD to LOCK.**
3. **Canopy LOCKED / UNLOCKED info plate, it should show “LOCKED”.**

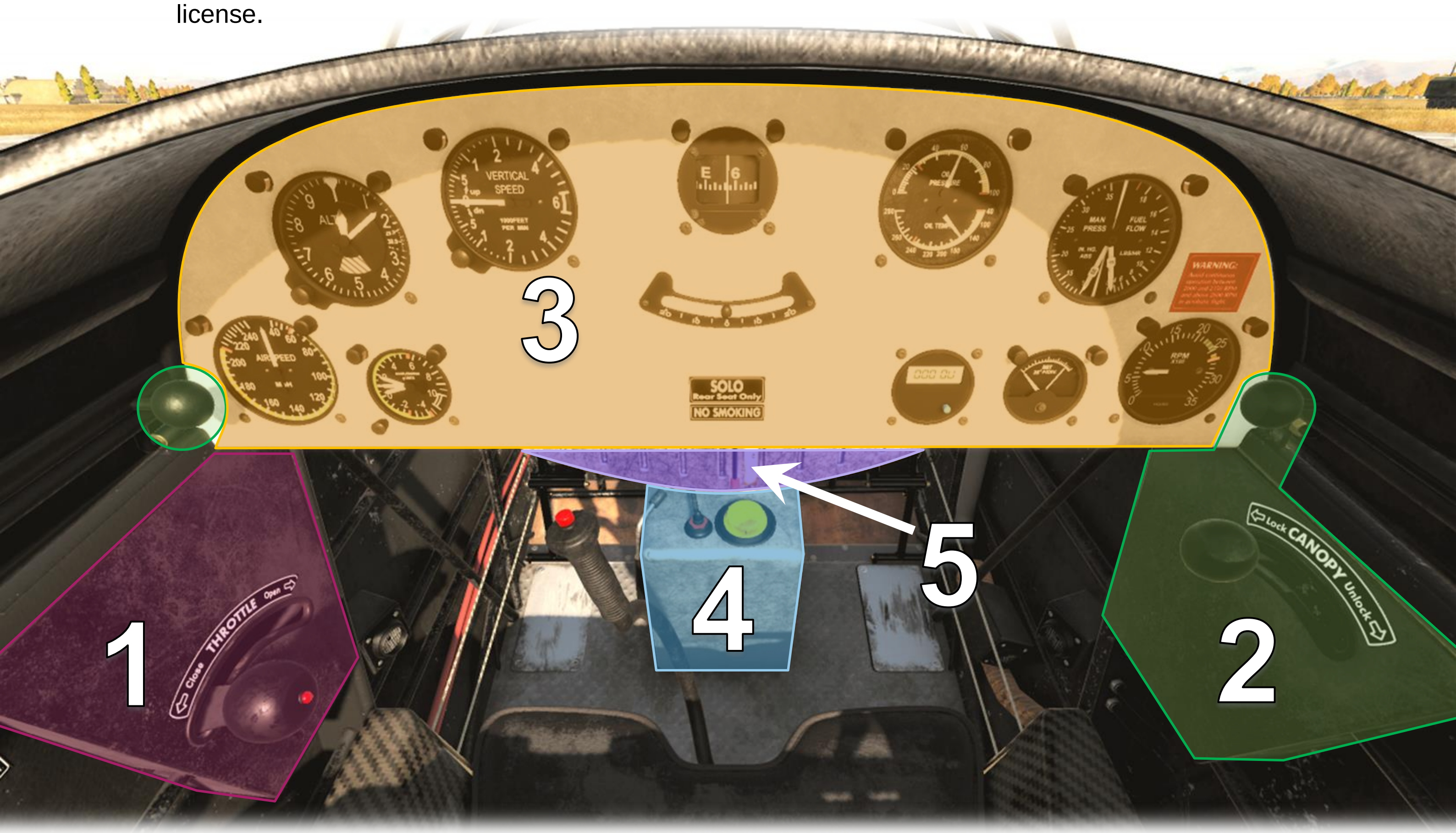
The image below shows the canopy in a CLOSED position. Follow the procedure to unlock and open the canopy below:

1. **Canopy LOCK/UNLOCK lever. Pull to UNLOCK.**
2. **Canopy LOCKED / UNLOCKED info plate, it should show “UNLOCKED”.**
3. **Click canopy crossbar to OPEN unlocked canopy.**
4. **Canopy JETTISON lever. Pull to jettison in flight or on ground when canopy is closed and locked.**



► *Front Cockpit Area*

The front cockpit area holds all the instruments except the VA meter, but has limited aircraft controls. Most importantly, the mixture and RPM levers are not installed here, along with the radio. This area is usually occupied by either a student pilot, a passenger, or the instructor controlling the student preparing for the solo flight from the back seat or receiving instructions for the instructor's license.



1. **Throttle control panel**
2. **Canopy control area**
3. **Instrument panel**
4. **Smoke oil canister**
5. **Fuel tank**

The throttle panel only holds the throttle control. The RPM and mixture controls are in the back cockpit only. The canopy control area contains a canopy lock control and canopy slider. The person in the front cockpit can lock or unlock the canopy and slide it back to open it. It's impossible to close the canopy from the front cockpit.

The instrument panel holds instruments visible from both cockpits. The instruments are arranged in such way that the person in the back cockpit can see most of them even if there is a person in the front cockpit. If the front cockpit is empty, all the instruments are clearly visible.

Summary of Instrument Color Marks

Airspeed Indicator

Redline, 58 mph: Stall speed

Green arc, 58-155 mph: Normal speed range below maneuvering speed

Yellow arc, 155-210 mph: Caution speed range above maneuvering speed

Redline, 210 mph (never exceed speed)

Oil Pressure

Redline, 25 psi: Minimum safe limit

Yellow arc, 25-60 psi: Precautionary range

Green arc, 60-85 psi: Normal range

Yellow arc, 85-100 psi: Precautionary range

Redline, 100 psi: Maximum safe limit

Oil Temperature

Redline, 40°F: Minimum safe limit

Yellow arc, 40°-120°F: Precautionary range

Green arc, 120°-245°F: Normal range

Redline, 245°F: Maximum safe limit

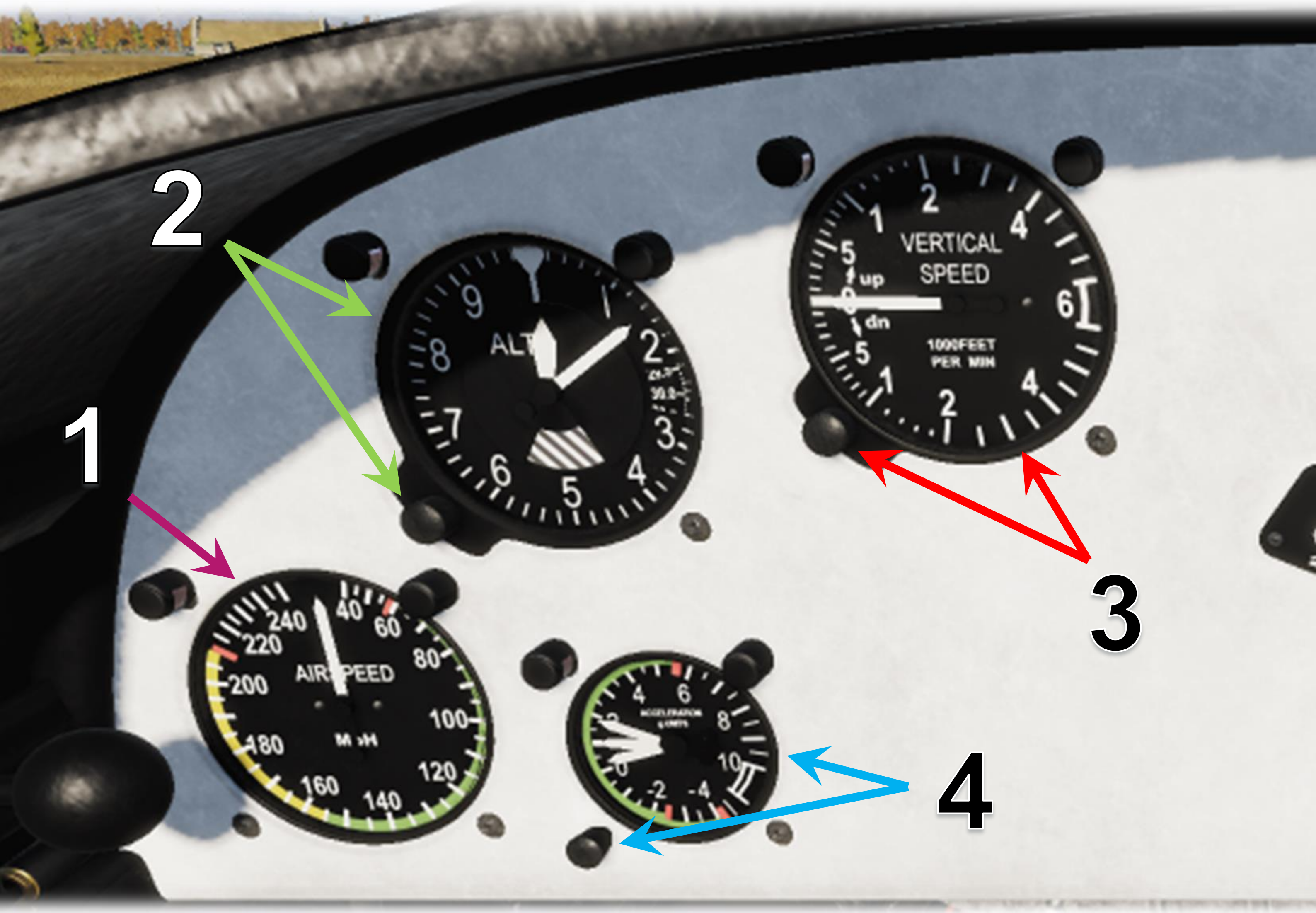
Tachometer

Green arc, 2000-2700 rpm: Normal engine speed range; however, propeller restrictions prohibit continuous operation between 2000 and 2350 rpm.

Redline, 2700 rpm: Maximum safe limit

Instrument Panel, Left Section

This section contains aircraft speeds, altitude and g-load instruments essential for aircraft flight handling.



1. **AIRSPEED INDICATOR**, indicates speed in miles per hour (mph)

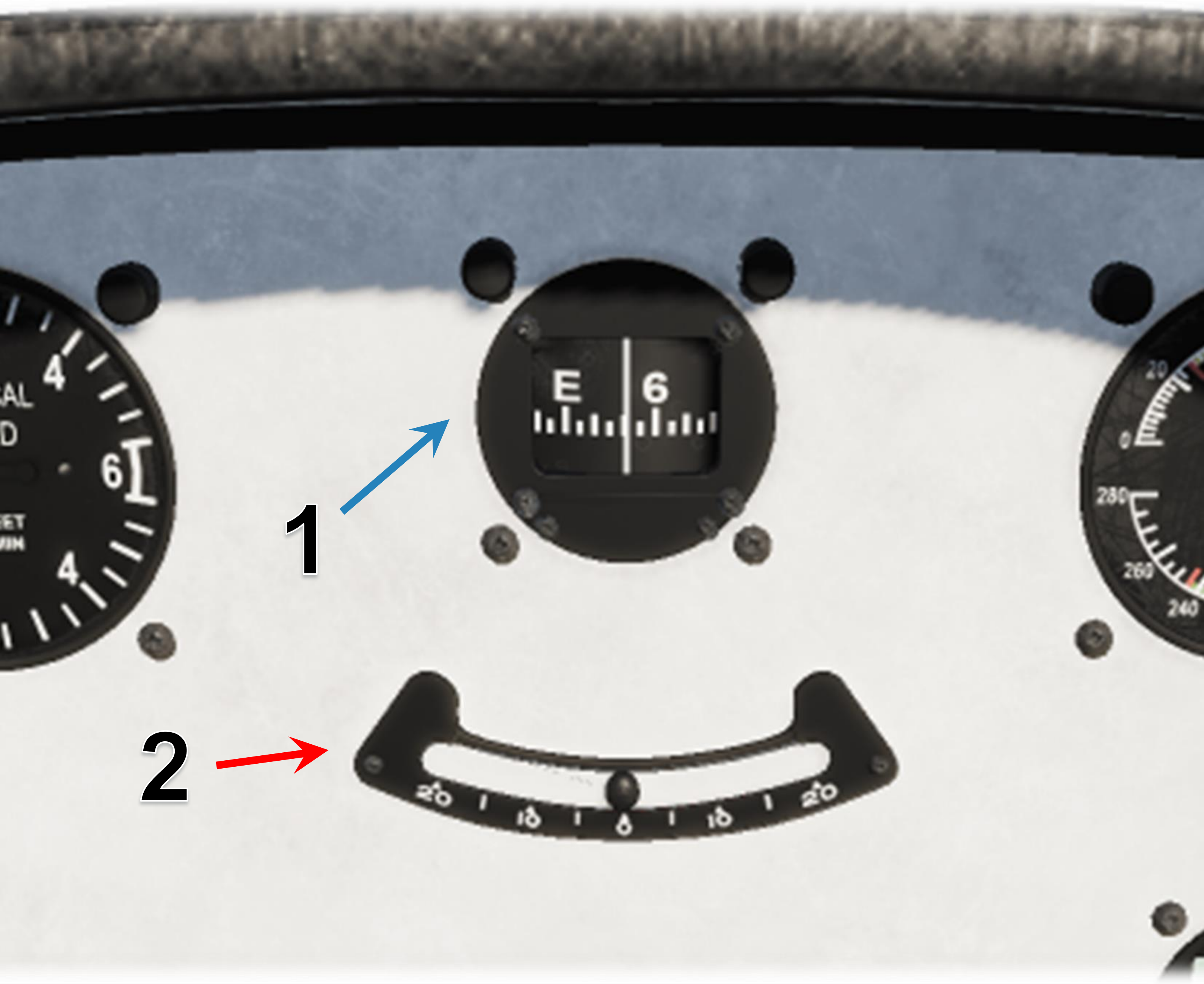
2. **ALTIMETER**, indicates altitude in feet. Small needle indicates thousands of feet, big needle indicates hundreds of feet, while outer triangular needle indicates tens of thousands of feet. Altimeter knob is used to set the pressure scale to desired atmosphere pressure in inches of Mercury (inHg).

3. **VERTICAL SPEED INDICATOR**, indicates vertical speed in feet per minute. Big numbers are n x 1000 ft/min. Small number "5" represents 500 ft/min. The push-button is pressed to zero out the needles.

4. **ACCELEROMETER**, indicates vertical g-load. Upper scale are positive values, lower scale is negative. Min and max g-loads achieved in flight are indicated by two needles that will remain in min/max positions unless reset to "1" with **"RESET"** button.

Instrument Panel, Central Section

The central section of the instrument panel is mostly empty. The reason is that this section is hidden behind the pilot sitting in the front cockpit, therefore it does not contain important instruments.



1. **MAGNETIC COMPASS**, indicates magnetic course.
2. **SLIP INDICATOR,** indicates slip angles up to +/- 20 degrees.

Instruments panel, right section

This section contains engine and fuel instruments, essential for safe engine operations.

1. **OIL PRESSURE** and **OIL TEMPERATURE** indicator. Upper scale shows engine oil pressure in pounds per square inch (psi), while lower scale shows engine oil temperature in degrees of Fahrenheit (F).

2. **MANIFOLD PRESSURE** and analogue **FUEL FLOW** indicator. Left scale shows manifold absolute pressure (MAP) in inches of Mercury (inHg), while the right scale shows fuel flow in gallons per hour (gph).

3. **RPM INDICATOR** indicates engine crankshaft revolutions per minute (RPM). Since the propeller drive ratio is 1:1, this complies with propeller RPM. The window below the scale indicates engine working hours used for engine maintenance in the real world. Operation of this counter is not simulated in the game.

4. **EGT INDICATOR** indicates exhaust temperature in degrees of Fahrenheit (F). Fixed needle shows max EGT allowed for safe engine operation.

5. **FUEL DISPLAY 911-FD**. Indicates either fuel flow ("F") or used fuel since last reset ("U"). The push-button allows instrument setup, reset, and indication selection. If the instrument is set to show the fuel flow, it practically doubles the operation of the analogue fuel flow indicator (2).

Fuel Display Kit

The 911-FD Fuel Display indicator is mounted in the instrument panel. It includes all electrical circuits for computing fuel flow and total usage, as well as a liquid-crystal display (LCD) for visual display of fuel usage and flow rate.

A push-button switch on the fuel display indicator permits selection of several modes of operation. The functions of this switch are duplicated by a FUEL METER push-button switch which is mounted in the electrical panel in the back cockpit.

During normal in-flight operation, the indicator displays either total gallons of fuel used (display suffixed "U") or current rate of fuel flow in gallons per hour (display suffixed "F").

For example, if the display reads "14.6U", the total fuel consumed since the last refueling is 14.6 gallons.

If the display reads "12.1F", the current rate of fuel flow is 12.1 gph.

- ***Startup Blinking***

At startup, after turning on the ACC or SPARE circuit breaker, the indicator will display the fuel used in blinking mode. If the aircraft has not been refueled, press the FUEL METER button momentarily. The startup blinking will stop, and fuel usage determination will continue from the previous reading.

- ***Zeroing After Refueling***

If the aircraft has been refueled (fuel tank full), press and hold the FUEL METER push-button for 3 seconds to reset the indicator to zero. The startup blinking will stop, and fuel usage determination will start from zero.

- ***Accidental Zeroing***

If the FUEL METER push-button is accidentally held for 3 seconds, but the aircraft has not been refueled, the indicator will be zeroed. To correct for unwanted zeroing, press and hold the FUEL METER push-button for 15 seconds to return the indicator to read the last fuel used.

- ***Switching "U" to "F"***

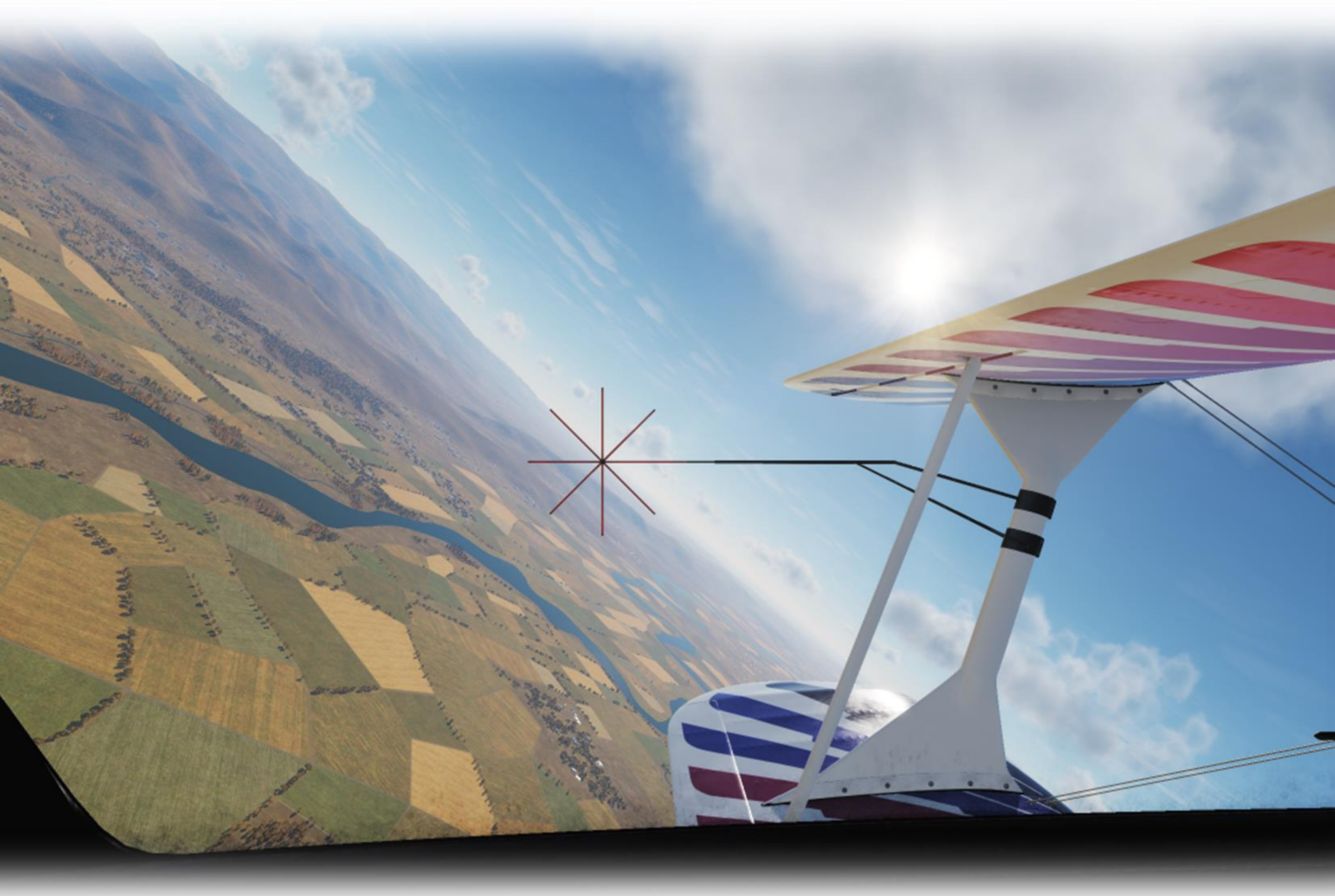
After startup, the display shows quantity of fuel used (suffix "U"). To switch the display to fuel flow, press the FUEL METER switch momentarily, and the display will indicate fuel flow (suffix "F"). To return to quantity of fuel used (suffix "U") again, press the push-button momentarily.

Aerobatic Sight Device

Since the Christen Eagle II is not equipped with an attitude indicator (also known as gyro horizon or artificial horizon), the aerobatic sight device is an important tool that helps pilots determine aircraft attitude during the flight. It’s particularly useful in aerobatics, where aircraft attitude changes significantly, and when the aircraft should assume certain pitch or bank angles to satisfy aerobatic figures requirements. Therefore, this tool is broadly called “aerobatic sight device”.

The aerobatic sight device is a visual tool located on the left wing support I-strut, extending backwards. It has a “star” usually made of four metallic rods, welded in the center, assuming 45 degrees angles between the rods. Since it is firmly attached to the wing support I-strut, it does not change position relative to the aircraft, thus enabling pilots to determine aircraft pitch and to some extent the bank and yaw.

NOTE: The aerobatic sight device is intended to be used from the back seat only.

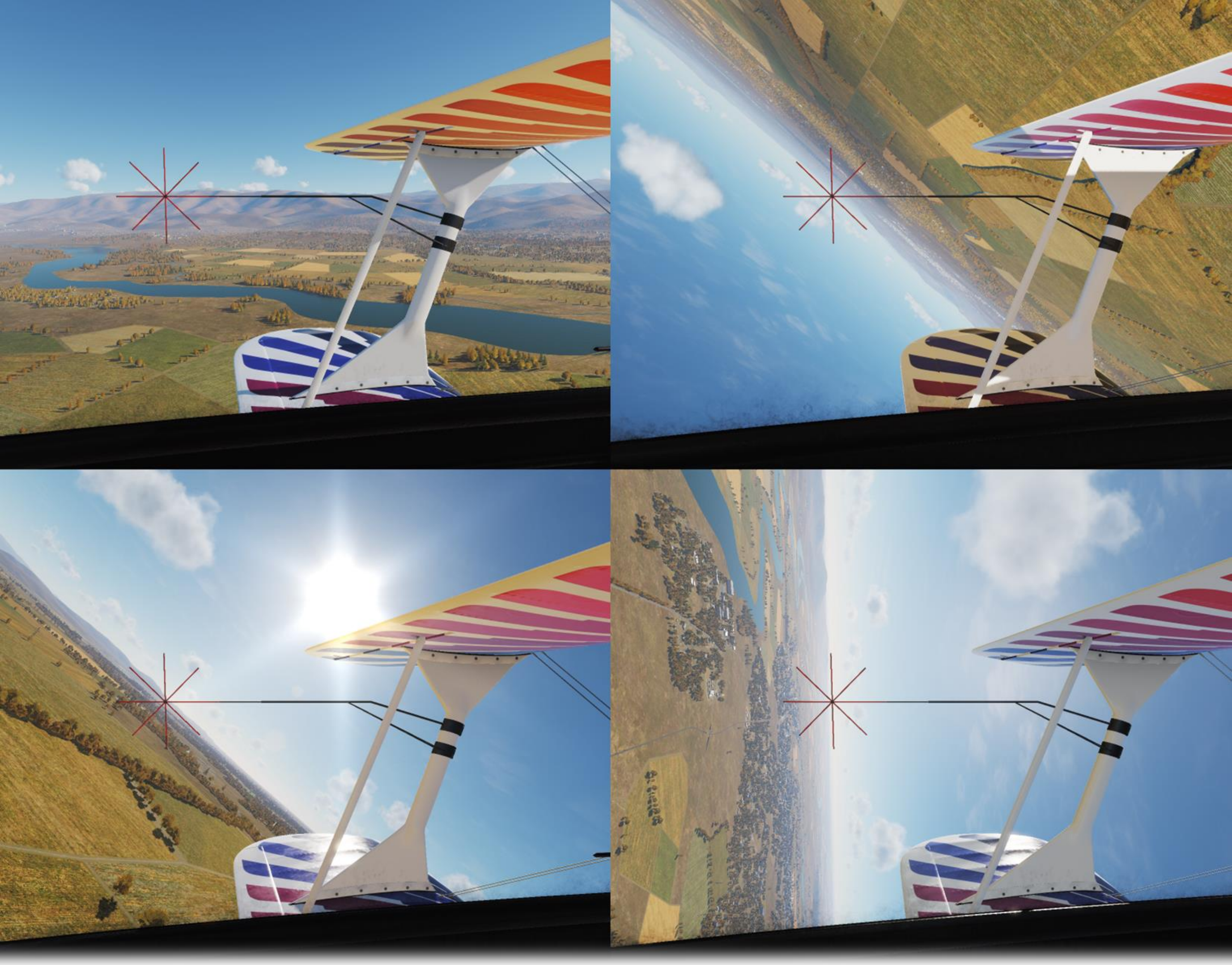


For maximum precision, the sighting device must be aligned horizontally with the natural horizon, and vertically with the location of the pilot’s head. Four control inputs allow it to be set-up according to the role in the aircraft (back or front cockpit pilot) and seating (higher/lower viewpoint and back/front leaning).

The image above shows the movement area of the device: depending on the needs, it can be moved up/down and back/forth to precisely match the pilot's field-of-view in the aircraft.

Since most aerobatic maneuvers are performed either in a horizontal or vertical plane, the pilot determines the aircraft pitch by looking at the device and comparing the device rods' position with the natural horizon line. This gives the pitch references of 0, 45, 90, 135, 180, 225 (or -135), 270 (or -90) and 315 (or -45) degrees.

The bank and yaw visual references are more complex to understand since they are affected by aircraft pitch: bank references are valid up to +-45 degrees of pitch measured from either 0 or 180 degrees of pitch, while yaw references are valid at greater pitch values. If the center of the star is below or above the horizon line, either the bank or yaw or both are present.



The image above shows examples of visual attitude references:

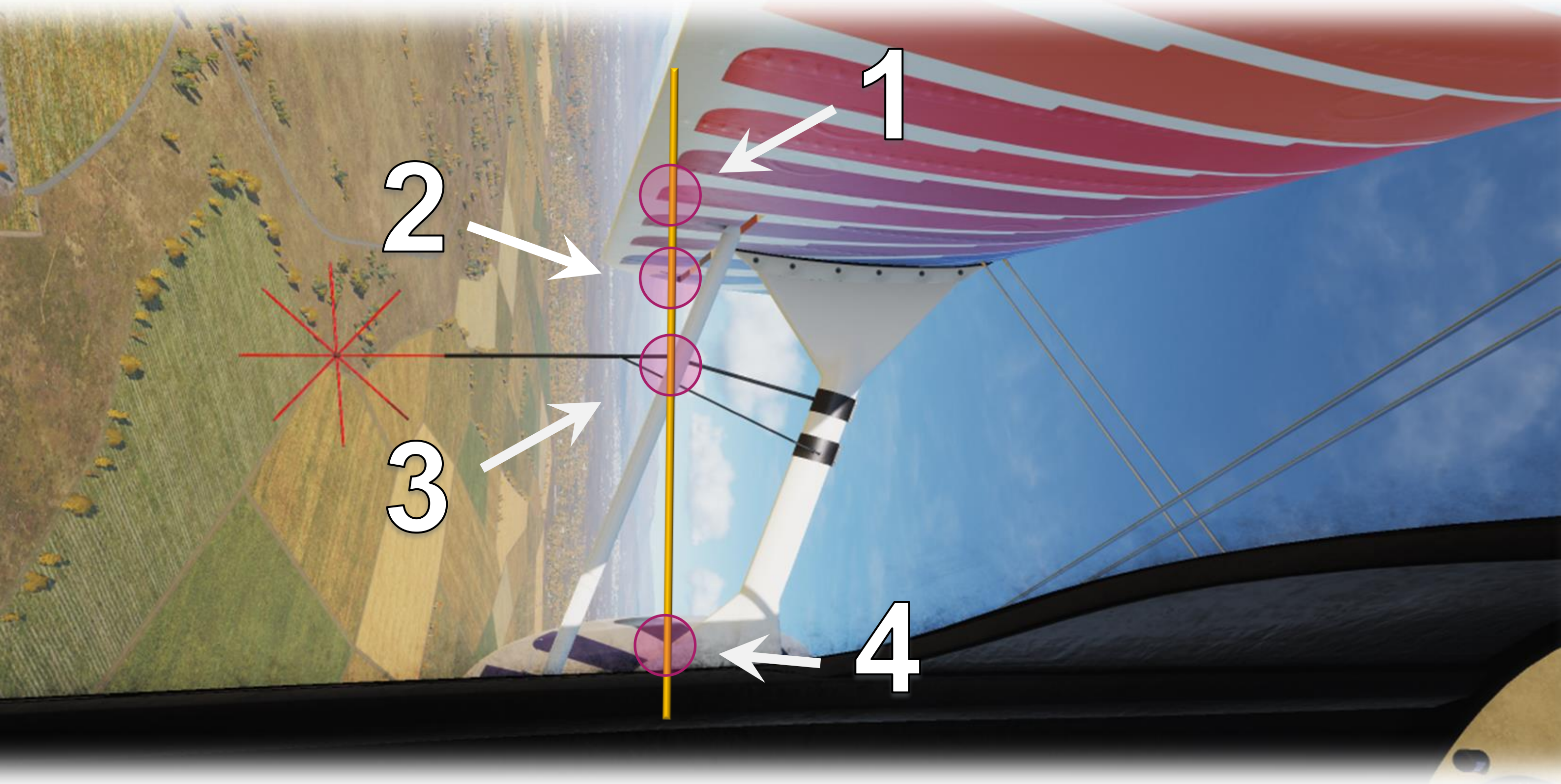
- **Top left** – Aircraft is in horizontal upright position.
- **Top right** – Aircraft is pitched down 45 degrees inverted, without significant bank or yaw.
- **Bottom left** – Aircraft is pitched up at 45 degrees, climbing in upright position. Since the “star” is on horizon, aircraft does not have significant bank or yaw.
- **Bottom right** – Aircraft is pitched up 90 degrees, climbing vertically, without significant yaw (note that “the bank” would appear as the aircraft rotation).

► *Visual Clues for Front Seat Pilots*

The aerobatic sight device is intended to be used from the back cockpit area only (back seat); if used from the front cockpit area (front seat) it will provide wrong clues about the aircraft bank/direction if the aircraft is pitched anywhere outside, around the horizontal attitude. When aerobatics maneuvers are performed from the front seat, the pilot must use different visual clues for correct aircraft attitude.

The aerobatic sight device star could be used to roughly determine aircraft pitch, provided awareness that the star should be below the horizon line for 0 bank if positive pitch is present (nose up), and above the horizon line if negative pitch is present (nose down).

Each pilot should establish their own visual clues when flying from the front seat.
The following image shows a set of visual clues to determine a 90 degree upright attitude.



Yellow line – Horizon line projection.

1. Horizon line intersecting the middle of the inner end of the left aileron.
2. Horizon line intersecting the beginning of the outer end of the left aileron.
3. Horizon line intersecting the aerobatic sight gauge arms and ailerons rod.
4. Horizon line intersecting the middle of the left wing i-strut base.

The most important clues here are 3 and 4: if the aircraft is aligned so that the horizon line passes through positions 3 and 4, the aircraft is certainly very close to a 90 degree upright position.

The other two clues (1 and 2) can serve for fine tuning if necessary, or as a main clue if the pilot is sitting too low in the cockpit.

SECTION 2

FLIGHT PROCEDURES: TURN IT ON!

Section 2: FLIGHT PROCEDURES

NOTE: parts of the text in this section are borrowed from original Christen Eagle II flight manual, conveniently adjusted for the aircraft implementation for the DCS environment.

Pilot Qualifications

The Christen Eagle II is a short-wheelbase conventional gear (taildragger) high-performance aircraft intended for aerobatic competition. Visibility ahead of the aircraft is limited when the aircraft is in the three-point attitude. The aircraft is very stable and controllable, but control forces are extremely light, and the aircraft is highly responsive to small control inputs.

Each prospective pilot must be certain that they can control an aircraft of this type.

WARNING: Most aircraft - including military trainers - do not approach the control responsiveness of the Eagle II. Pilots who are unacquainted with the sensitivity of the controls on an aircraft of this type are very likely to over-control.

Most highly experienced pilots build their flight time in routine flying, frequently in large, highly stable aircraft. The confidence produced by thousands of hours of flying can create unwarranted overconfidence in aerobatic flying, which can lead to fatal spin accidents. In this respect, **HIGH-TIME PILOTS WITH FLIGHT TIME MOSTLY IN HEAVY AIRCRAFT MUST CONSIDER THEMSELVES BEGINNERS AT AEROBATICS.**

Aircraft Characteristics

Performance of the Christen Eagle II is characterized by several performance features that enhance aerobatic capabilities:

1. The aircraft is highly responsive in all axes to slight changes in control position and required control pressures are very light. This reduces the effort required for maneuvering the aircraft but increases the need for extra caution on the part of a pilot whose previous experience is with aircraft types having limited capabilities.

2. Because of low control pressures and high rates of response in all axes, the aircraft can enter stall maneuvers (for example, spins and snap rolls) with high initial rates in any axis. Pilots with limited experience in highly responsive aircraft must use extra caution to avoid accidental snap rolls which can be caused by inadvertent application of sudden or excessive control inputs.

3. The high power-to-weight ratio of the aircraft permits high maneuvering capability and relatively low entry speeds for many maneuvers. For example, a loop can be performed with an entry speed of 100 mph, whereas many aircraft types require relatively high-speed entry for looping maneuvers.

4. The aircraft uses a constant-speed propeller, thus reducing the need for continuous attention to engine speed. Throttle position is therefore not particularly critical and engine rpm is automatically kept in a safe range.

5. Aircraft performance during inverted or negative-g flight is very similar to performance during upright or positive-g flight. This results because (a) symmetrical airfoils are used on both upper and lower wings, (b) the angle-of-incidence of both upper and lower wings is 0°, (c) dihedral on the upper wing is 0°, and (d) dihedral on the lower wings is only 1.5°. Aircraft attitudes during inverted flight and upright flight are nearly identical.

6. In the Christen Eagle II, the longitudinal axis of the aircraft (and the flight path) is approximately horizontal whenever the horizon passes around the middle of the triangular space formed by the cowling and cabane struts, regardless of roll position. To maintain an approximately level flight path during steeply banked turns and during inverted flight, simply keep the horizon framed by the cabane strut triangle.

Horizon line in horizontal upright flight at cruise speed (150-160 mph).

Horizon line in horizontal inverted flight at cruise speed (150-160 mph).

Horizon line in horizontal 30 degrees bank turn at cruise speed (150-160 mph).

Horizon line in horizontal 45 degrees bank turn at cruise speed (150-160 mph).

Horizon line in horizontal 60 degrees bank turn at cruise speed (150-160 mph).

Engine Starting Procedure

WARNING: before any engine starting procedure – cold or hot – make sure you pressed both brakes and always hold the stick aft during engine start or run-up to eliminate any possibility of tail-lifting. If it happens that the throttle is open too much during the engine start or run-up, the aircraft will start to move quickly: in that case, most pilots hit the brakes before they cut the throttle. This is an instinctive reaction that can lead to the aircraft flipping forward. If that happens, the propeller will suffer the damage and there is no way to get back in a normal three-point position unless you call "repairs" or restart the mission.

For basic cold-engine start, proceed as follows:

1. Turn on **BATT** (battery) switch.
2. Press **ALTERNATOR OUTPUT** circuit breaker.
3. Turn on **ALTERNATOR FIELD** switch.
4. Set **PROPELLER CONTROL** to **HIGH** rpm (push full forward).
5. Set **FUEL SELECTOR** to FUEL ON.
6. Set **THROTTLE** open slightly (if you are uncertain how much, you can leave it in the "CLOSE" position).
7. Set **MIXTURE** control to **FULL RICH** (push full forward).
8. Operate manual **fuel pump** until fuel pressure increases as displayed on FUEL FLOW gauge.
9. Set **MIXTURE** control to idle cutoff (pull full aft.)
10. Turn **MAGS** switch to **START** position (full clockwise) to crank engine. When engine fires, return ignition switch to **BOTH** position.
11. Set **MIXTURE** control to **FULL RICH** (push full forward).
12. Check **OIL PRESSURE**. Verify that pressure rises to 60 to 85 psi (green arc) within 30 seconds; if proper pressure does not develop, shut the engine off immediately and determine the cause before proceeding.
13. Warm up engine at 1000 – 1200 rpm.

For hot-engine start, repeat the above procedure, but omit steps 5 through 8.

Takeoff Procedure

Takeoff with the Christen Eagle II in DCS is probably the most complex procedure compared to non-aerobatic aircraft:

- Aircraft acceleration is high, takeoff run is short and happens fast.

- Aircraft is nose-high on the runway, visibility is poor, and takeoff could happen near the stall angle of attack, therefore it is necessary to lower the nose, move the wings down out of the near-stall region, stabilize the aircraft and takeoff.

Increasing the engine RPM creates left-yaw momentum while pushing the nose down during takeoff. Gentle right rudder input is required during the takeoff run to compensate for this.

Pushing the nose down too much will create reactive forces on front legs' suspension, which will destabilize the aircraft both in pitch and yaw first, then in bank.

For all mentioned reasons, the most important thing for safe takeoff is to **be gentle on inputs and reactions**, until you familiarize with the aircraft handling.

For basic checks immediately prior to takeoff and for takeoff and climb, proceed as follows:

1. Set **MIXTURE** to **FULL RICH** (push full forward).
2. Check all instruments for normal indications; check radio and transponder.
3. Set **ELEVATOR TRIM** to **NEUTRAL**.
4. Check all flight controls for free movement (ailerons, elevators and rudder).
5. Verify that the canopy is closed and **LOCKED**.

WARNING: Verify that the canopy is secure by (a) checking the status placard at the back of the front seat and (b) making a final positive check by pulling aft firmly on the canopy crossmember.

6. Set engine speed to 1700 rpm using the **THROTTLE**. Check propeller operation by moving **PROPELLER** control through full range. Return **PROPELLER** control to **HIGH RPM** (push full forward).
7. Perform magneto checks:
   a. Set engine speed to 2200 rpm using **THROTTLE.**

CAUTION: Light-weight pilots may experience a tail-lifting tendency at 2300 rpm. Always hold the stick aft during engine run-up to eliminate any possibility of tail-lifting. Do not intentionally set the throttle above 2200 RPM until ready for takeoff.

   b. Set **MAGS** switch to **LEFT** and note new tachometer **RPM**.
   c. Set **MAGS** switch to **RIGHT** and note new tachometer **RPM**.

d. Magnetos are acceptable if lowest tachometer reading on either **LEFT or RIGHT** is at least 2025 rpm (175 rpm maximum allowable reduction) and the difference between **LEFT** and **RIGHT** magnetos (steps b and c above) does not exceed **50 RPM**.

8. Sit up straight in the seat while looking straight forward; observe the edges of the runway and the runway surface in front of each lower wing using peripheral vision. Do not lean to one side or the other to increase view of the runway since this will cause disorientation and turning of the aircraft.

9. Apply full power smoothly but briskly. Note that aircraft acceleration is high and that the speed increases fast. As speed increases beyond 45 mph IAS, hold the stick a bit forward to raise the tail slightly (about 8 inches) as speed increases. As soon as the tail starts to rise, gently place the stick back around neutral position. For lift-off, slightly pull the stick. After lift-off, allow the aircraft to accelerate to 90 to 100 mph IAS before climbing.

10. Climb at 90 to 100 mph IAS with full throttle and full rpm. Observe all aircraft instruments to verify normal engine operation.

Cruise Procedure

1. Adjust **THROTTLE** to provide the required manifold pressure.

   For cruise at 75% power, manifold pressure should be as high as possible, but not above 25 in. Hg.
   For cruise at 65% power, manifold pressure should be as high as possible, but not above 23.5 in. Hg.
   For cruise at 50% power, manifold pressure should be as high as possible, but not above 22.7 in. Hg.

2. Adjust **PROPELLER** control to provide the required engine **RPM**.

   For cruise at 75% power, set engine speed to 2450 rpm.
   For cruise at 65% power, set engine speed to 2350 rpm.
   For cruise at 50% power, set engine speed to 2000 rpm.

3. **WARNING:** Propeller restrictions prohibit continuous operation between 2000 and 2350 rpm.

4. Set **ELEVATOR TRIM** for straight and level flight, "hands off".

5. Adjust **MIXTURE** control to offset the **EGT** reading the desired temperature difference from peak EGT.

   For maximum power cruise (recommended), set EGT 150° toward the rich side of peak EGT. (Slowly pull MIXTURE lever while observing the EGT gage, note the MIXTURE position that produces the maximum EGT reading, then slowly push MIXTURE back until the EGT indication is reduced by 5 scale divisions.)

   For best economy cruise (65% or 50% power only), set EGT at peak EGT or up to 50°F toward the lean side of peak EGT. (Slowly pull MIXTURE lever while observing the EGT gage, then set MIXTURE at the position that produces maximum EGT indication or slowly push the MIXTURE lever until the EGT indication is reduced by 1 or 2 scale divisions.)

6. Verify correct cruise settings (steps 1 to 4) every 15 minutes.

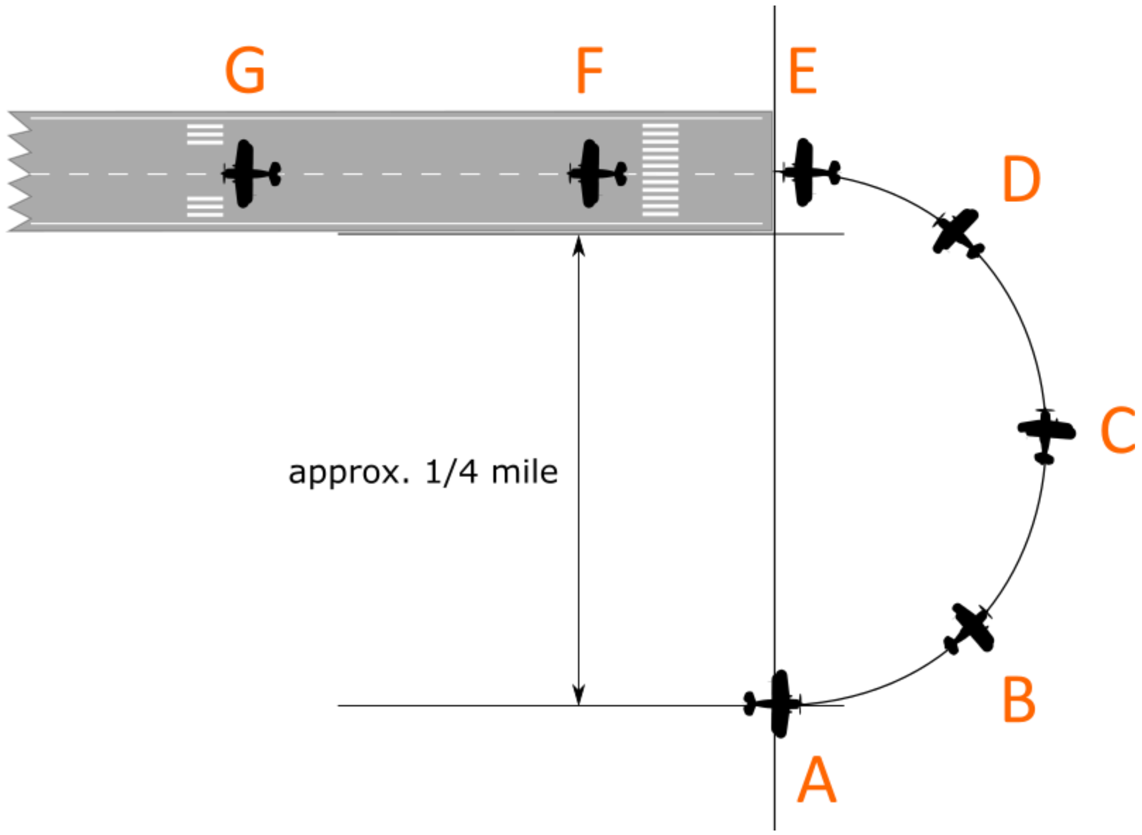
WARNING: In case of any engine operating problem, immediately readjust MIXTURE control to FULL RICH (push knob full forward), then attempt corrective action. In case of an emergency requiring engine shut down, a glide speed of 85 to 90 mph IAS is recommended.

Landing Procedure

The following basic checks should be made before landing:

1. Set **MIXTURE** control to **FULL RICH** (push full forward).
2. Set **PROPELLER** control to **HIGH RPM** (push full forward).
3. Set **ELEVATOR TRIM** to **NEUTRAL**.

For landing, fly a close-in pattern at 90 to 100 mph IAS and 400 to 500 feet AGL, as shown in the following image.



A – Aircraft is no closer than ¼ of a mile from the runway edge. Altitude is 400-500 ft AGL, speed 100 mph. When the aircraft reaches the runway threshold traverse, cut the engine power to neutral thrust and start descending turn towards the runway. In normal conditions, vertical speed should be around -500 ft/min.

B – At this point, a descending turn is established, speed is 90 mph or slightly greater. Look at the runway and estimate turn and altitude corrections. Keep the end of the runway in sight during descent all the way to flare by adjusting the length of the base leg and final turn so that the aircraft is turning continuously until just before the flare.

C – At this point, altitude should be no less than 200 ft, speed 90 mph and slowly dropping.

D – Speed is 85 mph, make final directional corrections to align with the runway centerline. Decrease engine power if needed.

E – Turn is complete, speed is 85-80 mph, aircraft is very close or above the runway threshold. Once over the runway, reduce the power to idle, gently compensate yaw, and flare the aircraft.

F – Hold the aircraft in three-point attitude close to the runway surface and await stall and touchdown. Be patient and careful with the control inputs. The stick will be slightly aft of neutral at stall, not full aft as with some aircraft.

G – Once on the ground, pull the stick back and maintain direction with gentle rudder inputs. Abrupt rudder or brakes inputs can cause aircraft instability. Use both brakes at the same time in short impulses: If the brakes are applied and not released on time, the aircraft may flip forward or diagonally over the nose. Careful rudder and brakes use are especially important if there is wind present in the mission.

CAUTION: Cross-wind landings are hazardous and must not be attempted in winds above 20 knots (9 m/s) at 45° to the runway, unless the pilot is very experienced.

Shutdown Procedure

The following basic checks should be made when the aircraft is stopped, and the engine is to be shut down.

1. Turn off the radio.
2. Set **MIXTURE** to idle cutoff (pull full aft) and wait for the engine to stop.
3. Set **MAG** switch to **OFF**.
4. Set all breakers to **OFF** on the electrical panel.
5. Set **FUEL SELECTOR** to **OFF** on the manual fuel pump.

SECTION 3

AEROBATICS: YAHOOOO!

Section 3: AEROBATICS

The Christen Eagle II is built for aerobatics. The aircraft is capable to perform many official and unofficial aerobatic figures, which can take many flight hours to master. In this manual we will focus on a few of the most commonly executed figures often seen at airshows: parts of these figures are often used in more complex figures. For detailed explanations and figure execution examples please check our video instructions on our YouTube channel.

For an aerobatic pilot, it's important to realize the necessity to frequently observe the aerobatic sight device located on the left wing. The more aerobatics are practiced, the more the aerobatic sight device will be used.

Another important thing that will help in aerobatics training is the smoke trail. A smoke system is implemented that can be equipped to the aircraft during the mission design in Mission Editor, or later in the mission itself by calling the ground crew to rearm your aircraft.

Finally, since aerobatic figures require a lot of engine power and aircraft speed, the best aircraft performances are achieved if flown solo: A mission with a single pilot can be created by going to the special options tab in the Mission Editor.

Loops

Although a basic aerobatic figure, the loop is important since it teaches the pilot how to control the aircraft during vertical movement and what happens with the aircraft as it loses and then gathers the speed.

Loops can be normal (upright) or inverted. Normal loops are performed in an upright position at entry. The aircraft will be inverted on top of the loop. Inverted loops are performed in an inverted position at entry while the aircraft will be in an upright position on the top of the loop.
Loops can start either at the bottom or the top, but a complete circle-like movement must be executed.

If performed separately, the climbing part of the loop with a semi-roll on the top is called an Immelmann, while the diving part of the loop with an initial semi-roll on top is called a Split-S.

To execute a normal loop:

1. Accelerate to 150 mph with full throttle, then pull 4Gs to start the loop. Check the aircraft bank and pitch by observing the aerobatic sight device.

2. At 90 degrees pitch up, the speed should be around 110 mph. As the aircraft moves toward the upper part of the loop, start easing the stick to avoid stalling. The aircraft should be at least 60 mph at the top of the loop (optimally 80 mph), but the more speed it has, the better since this will be useful later if a roll is executed at the top of the loop.

3. After passing the loop top, the throttle can be decreased and continue gently pulling the stick or start pulling the stick harder as the aircraft quickly gathers speed with full throttle.

4. As the aircraft reaches a 90 degree dive, it should be around 130 mph; start estimating the exit altitude and try to match it precisely – it should be the same or as close as the entry altitude.

Note that if at full throttle, the entry altitude will most likely be undershot.

For initial attempts in an inverted loop, it's recommended to enter from the bottom loop point. This is because if the top point entry is attempted, misjudgment in altitude and looping tempo can occur, eventually leading to overspeed, a slowly executed bottom part of the loop, a high negative overload and possible crash.

Note that the aircraft in an inverted loop is a bit slower than a normal loop due to elevator down deflection and aircraft shape effects on the aerodynamics: expect a bit lower speeds and more careful aircraft handling at the top of the inverted loop. On the other side, since the aircraft has increased positive acceleration near the top of the loop (forward stick plus Earth gravity), and the engine has maximum available power, the aircraft accelerates quickly and quickly passes the stall region.

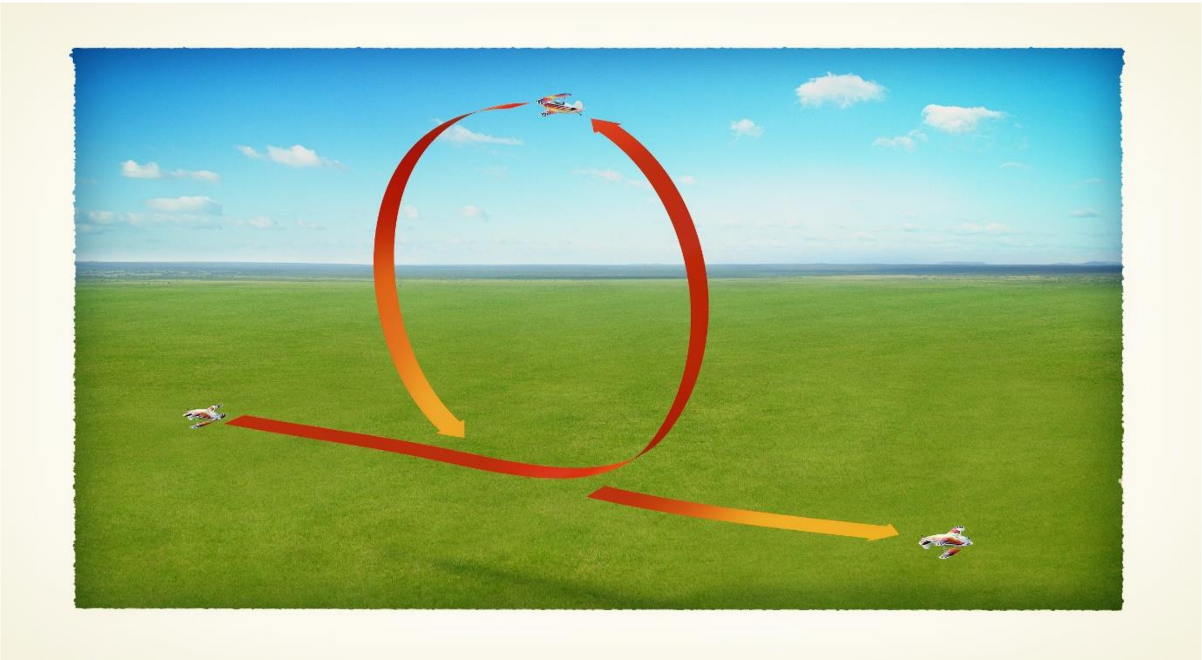
To enter an inverted loop:

1. Accelerate to at least 150 mph with full throttle, level and invert the aircraft with a left or right aileron semi-roll. Quickly adjust the bank angle to 0 degree and push the stick so that there is a negative 3G overload. Control the aircraft bank and pitch angle by observing the aerobatic sight device.

2. At 90 degrees up, the aircraft should be around 100 mph. Continue pushing until the aircraft is close to 30 degrees pitch near the top, then ease the push and observe the speed: it should be around 80 mph, further falling towards 60 mph.

Note that it's better not to push too much at low speed than to try to quickly pass over the top to accelerate. If the aircraft's wings are not loaded, they will not stall regardless of speed, thus enabling the engine to pull and accelerate the aircraft. In the second part of the loop, past the top, the most important thing is to avoid over-speed: since the aircraft will accelerate quickly, it's recommended to decrease the throttle until the horizon starts appearing near the bottom point of the loop.

3. Exit the loop inverted in horizontal flight at full throttle, then perform aileron semi-roll to get the aircraft in normal attitude.



Square loop

The square loop is best executed if the entry speed is at least 180 mph: the more speed there is at entry, the longer the climbing part will be, giving the figure a nice squared shape when observed from the ground.

To execute a square loop:

1. Accelerate to at least 180 mph at full throttle and level the aircraft. Enter the climbing part with a 4G overload, checking the aircraft pitch and bank with the aerobatic sight device until the aircraft reaches a 90 degree climb. Continue at 90 degrees and frequently check the speed.

2. As the speed reaches around 120-100 mph, gently pull to the horizon.

Note that the aircraft will be close to stall at the top of the loop, so the stick must be gently pulled.

3. When the horizon can be seen, start slowing down the aircraft pitch so that the aircraft becomes inverted without losing altitude. This is a difficult maneuver and takes some time and practice to do it right.

4. While inverted, keep the bank angle at 0 degree, vertical speed as close to 0 as possible, and let the engine accelerate the aircraft.

Note that this part of the figure requires some time since the aircraft is accelerating from 60 or 80 mph and the pilot must be patient until the aircraft travels distance approximately equal to the distance at the entry so that the top side of the "square" has approximately the same length as the bottom or climbing part. However, this should not take too long, since the speed will rise and the diving part of the figure will be difficult to perform.

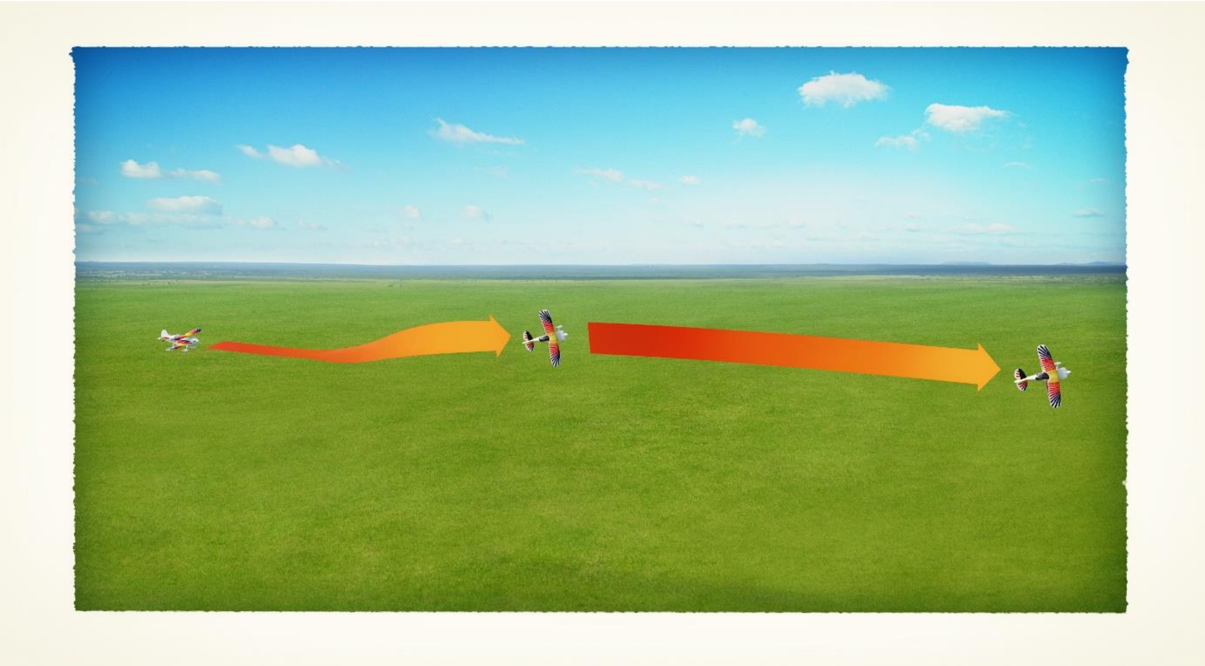
5. When the aircraft's speed is above 120 mph, start reducing the throttle and pull the aircraft into a 90 degree dive. During the dive, the aircraft will accelerate quickly, and the exit altitude must be observed to start the exit pull in a timely manner.

6. During the exit pull, apply full power to keep the speed high for the next figure. Try not to overload the airframe by pulling more than 7Gs.

Knife edge

The knife edge is an aerobatic figure in which the aircraft flies horizontally in a straight line banked to either side around 90 degrees. In this figure, speed tends to drop for many reasons. Since this figure demands a large thrust-to-weight ratio and high speed, many pilots execute this figure by banking the aircraft less than 90 degrees.

For example, a bank of 60 degrees will allow flying the "knife-edge like" figure at much lower speeds and weaker engine than what's required for a true knife edge. On the other hand, this has practical use: if the figure is flown at higher altitudes, a heavier loaded aircraft or at high outside temperatures or lower pressure, it might be impossible to execute a true knife edge, but decreasing the bank angle to around 70 degrees will enable the execution and it will look good observed from the ground.



To execute the knife edge:

1. Accelerate to at least 180 mph at full throttle, level the aircraft and perform a 90 degree roll to either side simultaneously pushing the opposite rudder pedal to keep the nose above the horizon. A roll will require a slight stick push to maintain straight direction, since the aircraft tends to follow the stick during the roll, thus diverting from the original straight path.

2. Once banked around 90 degrees, concentrate on direction, bank, and check the variometer. Don't allow significant bank changes and use the rudder pedals to keep the

nose high so that altitude is neither gained nor lost. Since the speed will drop, observe it occasionally.

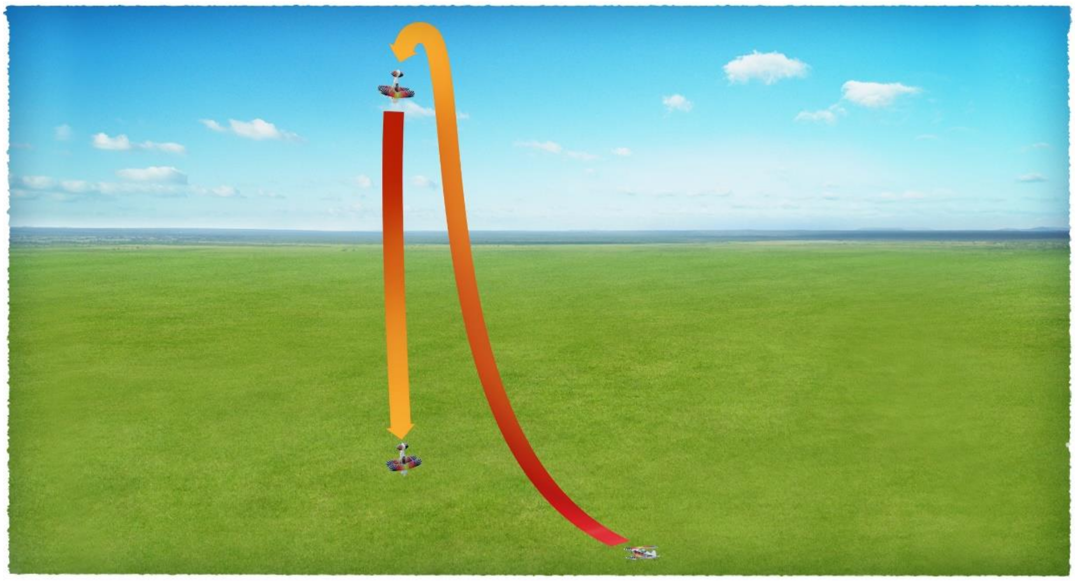
3. Apply full rudder to keep the aircraft in horizontal flight while starting to roll back to normal flight. A back roll requires input coordination to maintain a straight and level path.

The best practice is to learn this figure by attempting to perform it along linear ground objects such as runways, coasts, rivers, roads or railroads, and similar markers.

Hammerhead

The hammerhead is a figure in which the aircraft climbs vertically, bleeding speed until it’s close to stop, then it yaws 180 degrees around the left wing and continues into a vertical dive quickly gathering speed.

Because of gyroscopic moments that act on the aircraft's body, it can be only performed correctly as a left hammerhead.



To execute the hammerhead:

1. Accelerate to at least 150 mph in horizontal flight with full throttle, and then pull through a 4G vertical climb. Check the aircraft's elevation and bank angle by observing the aerobatic sight device on the left wing during the climb.

2. After pulling into a vertical trajectory, maintain pitch and bank using small stick and rudder pedal inputs. In this position, the aircraft is less stable than in a horizontal flight trajectory, mostly due to significant lower wing lifting forces (almost 0).

Note as the speed bleeds, compensate torque tendency (left roll) with a bit of a right stick, and left yaw with a bit of a right rudder pedal.

3. Observe the speed drop: as the speed approaches 50-40 mph, push the left rudder pedal fully while simultaneously applying the right stick. Once the aircraft starts yawing, it will tend to lift the nose, so a bit of a forward stick press is needed.

4. When the aircraft surpasses a 90 degree yaw, counter the further left yawing tendencies by gradually pushing the right rudder pedal so that the aircraft stops in a vertical dive. During this stop, all input commands should be timely placed in their neutral position, as the aircraft begins to accelerate.

A clean vertical dive that lasts a few seconds will give this figure a nice shape when observed from the ground.

Tumble

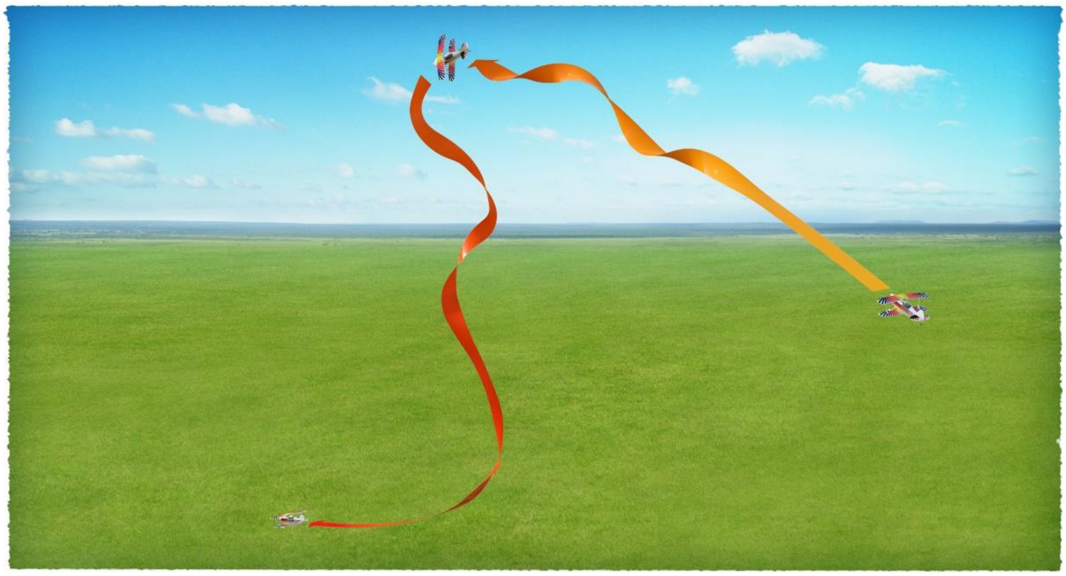
The tumble is a very dynamic figure that is usually performed in combination with other figures in a vertical plane. In this figure, the aircraft yaws, rolls and pitches nose-down simultaneously.

To execute a clean tumble, not combined with other figures:

1. Accelerate the aircraft at full throttle until it reaches at least 150 mph, then pull into a 45 degree climb. Use the aerobatic sight to check the 45 degree climb and maintain it, keeping the engine at full throttle.

2. When the speed drops to 130 mph, start an aileron roll to the left: once the bank is at 90 degrees, simultaneously push the right rudder pedal and push the stick forward while keeping it banked to the left.

The aircraft might make one spiraling roll until it loses speed and then it will start to tumble. It usually has enough energy for 2 tumbles.



It is a good practice to stop the tumble after the second one so that the aircraft doesn't get into a deep stall/spin situation, while there is still enough control to precisely exit the figure in the direction flown.

Note that since the aircraft is stalled with the engine at full throttle and positioning of the input controls can easily promote an inverted flat spin condition. Unless intended, care should be taken to avoid this situation.

This figure looks very nice when the aircraft is equipped with a smoke system. It can be performed even in the vertical climb with the tumble starting at speeds of 120 to 60 mph. At lower speeds, the aircraft doesn’t have enough energy to tumble properly, but it will enter a complex rotational movement pattern until it gathers the speed in a dive when stability forces have overcome destabilizing moments.

Torque roll

The torque roll is an aerobatic figure in which the aircraft starts rolling left (stick to the left) in a vertical climb, slowly losing progressive and rolling speed until it reaches the top of a climb; in that moment the aircraft is still slowly rolling to the left thanks to the propeller's torque. The pilot then reverses banking input (stick to the right) to further support the left roll as the aircraft starts a tail slide. Since the powered tail slide is very unstable, as soon as the tail offsets a neutral position the aircraft will exit the roll.

The torque roll is difficult to perform correctly because it requires exceptional situational awareness and input coordination.

To execute a torque roll:

1. Enter a vertical powered climb as you would for a hammerhead.

2. While the aircraft is in a 90 degree climb, start a left aileron roll: constantly looking at the aerobatic sight to notice pitch and bank angle deviation.

Note that corrections need combined stick and pedal input, since pitch and bank change every 90 degrees of rotation (in fact they change with every degree of rotation, but it’s easier to correct inputs every 90 degrees since the rotation could be fast). The closer the aircraft maintains 90 degrees pitch, the better the torque roll will be.

3. Notice how the aircraft loses rotational speed as it loses progressive speed, and once the aircraft stops climbing, move the stick to the right.

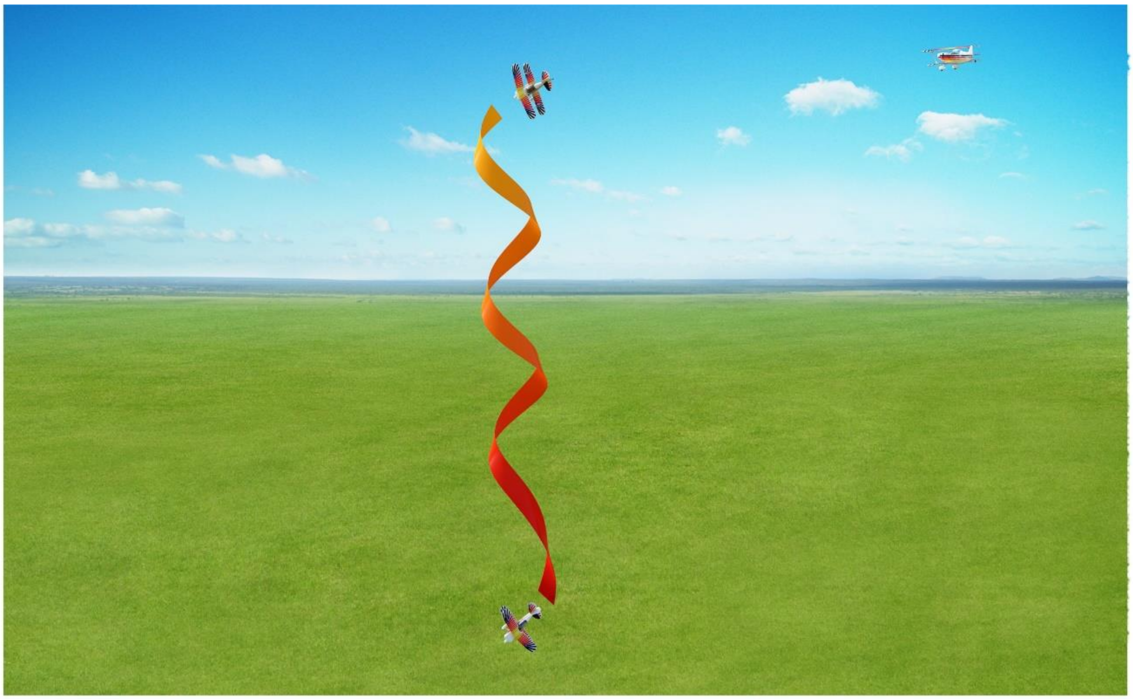
As the back slide starts, the stick pitch and pedals inputs are the same as in normal flight, but not for as long: the aircraft will accelerate backwards, and the local air stream will reverse effects of normal pedal and stick pitch input as it previously happened for the bank input.

With that in combination with the fact that the aircraft has an unstable aerodynamic configuration during the backward air flow, this makes maintaining the roll difficult.

The only thing that helps, is the fact that the aircraft accelerates the roll, thus improving directional and pitching stability to some extent. However, sooner or later the aircraft will dislocate from an ideal position and fall to a certain side, or the pilot can initiate dislocation using either the pitch or yaw inputs.

Other figures

Along with the previously mentioned figures, the Christen Eagle II is capable performing many other maneuvers: Humpty-Bump, Cuban 8 (all variations), Chandelle, barrel rolls, slow rolls, snap rolls, rolling turns, tail-slides and spins.



SECTION 4
SPINS: YES YOU CAN!

Section 4: SPINS

NOTE: Parts of the text in this section are borrowed from original Christen Eagle II flight manual, conveniently adjusted for the aircraft implementation for the DCS environment.

Although the general principles involved in spin recovery are similar for all aerobatic aircraft, specific procedures in this manual apply only to the Christen Eagle II.

Introduction

The Eagle II has docile and controllable stall characteristics with no tendency to spin; however, the aircraft will spin immediately and smoothly, if the proper control inputs are made following a stall. It has normal spin recovery characteristics in all four basic spin types. Because both intentional and unintentional spins will be encountered in aerobatic flying, it is essential that pilots understand the simplified emergency-action procedures as well as the four basic spin types as well as the correct recovery procedure for each spin type.

WARNING: Never attempt low-altitude aerobatic maneuvers. The safe maneuvering altitude for beginners: 5,000 feet AGL. After competence in basic aerobatic maneuvers and spin recovery: 3,000 to 5,000 feet AGL.

Terminology

Throughout the following text, relative directions are given from the pilot's viewpoint. For example, an inverted spin to the right is toward the pilot's right, even though an exterior observer might think of the spin as being a "left-hand spiral" or "toward the left".

Spin direction is always considered to be the direction of yaw, so a spin to the right can also be described as a right-rudder spin, and a spin to the left can be described as a left-rudder spin. Rudder input which tends to stop the yaw during a spin is called "opposite rudder". For example, during a spin to the right, opposite rudder would be a left-rudder input.

Aileron and elevator positions are described in terms of control stick position, such as "stick forward", "stick back", "stick right", or "stick left".

The relative direction toward the spin axis is referred to as "inside", and the relative direction away from the spin axis is referred to as "outside". For example, in a normal upright spin to the left, the left wing (which is toward the spin axis) is referred to as the "inside" wing, and the right wing (which is away from the spin axis) is referred to as the "outside" wing.

Spin Recovery, General

By making use of inherent aerodynamic stability, the Christen Eagle II will recover from all spins by using the simplified emergency recovery procedure, which requires only (a) cutting engine power, (b) release of the control stick, and (c) pressing on the rudder pedal opposite to yaw (or placed in neutral if uncertain).

The recovery techniques described here are standard procedures which provide faster, controlled recovery with minimum altitude loss when the spin type is known. Note that experienced aerobatic pilots will recover the aircraft faster, often without the need to cut the throttle completely.

To appreciate the fundamental principles that are involved, three main points must be understood:

POINT 1. Application of power increases the difficulty of spin recovery. During an inverted right-rudder spin or an upright left-rudder spin, gyroscopic precession tends to lift the aircraft nose, flattening the spin; continued application of full power may hold the nose of the aircraft up, making a normal diving recovery difficult.

In a normal unflattened spin, excess power always increases descent rate, thus increasing the hazards of pull-out near the ground.

- The first basic requirement for spin recovery is this: **CUT THE THROTTLE.**

POINT 2. The spin is a yaw maneuver. Yaw-producing forces must be neutralized or reversed to stop the spin. Since the rudder controls yaw, it must be neutralized or reversed ("opposite rudder") to stop aircraft yaw. As soon as the yaw stops, the rudder must be neutralized to prevent reversed yaw and entry into a new spin type.

- The second basic requirement for spin recovery is this: **STOP THE YAW.**

POINT 3. In all spins, the wings are stalled or partially stalled. Stall-producing forces must be neutralized or reversed to stop the spin. Since the elevator controls angle-of-attack and thus the stall condition of the wings, the elevator must be either released or neutralized or reversed to reduce the angle-of-attack and eliminate the stall condition. As soon as the stall stops, a reversed elevator must be neutralized to prevent a reversed stall (from upright to inverted or inverted to upright) followed by entry into a new spin type.

- The third basic requirement for spin recovery is this: **STOP THE STALL.**

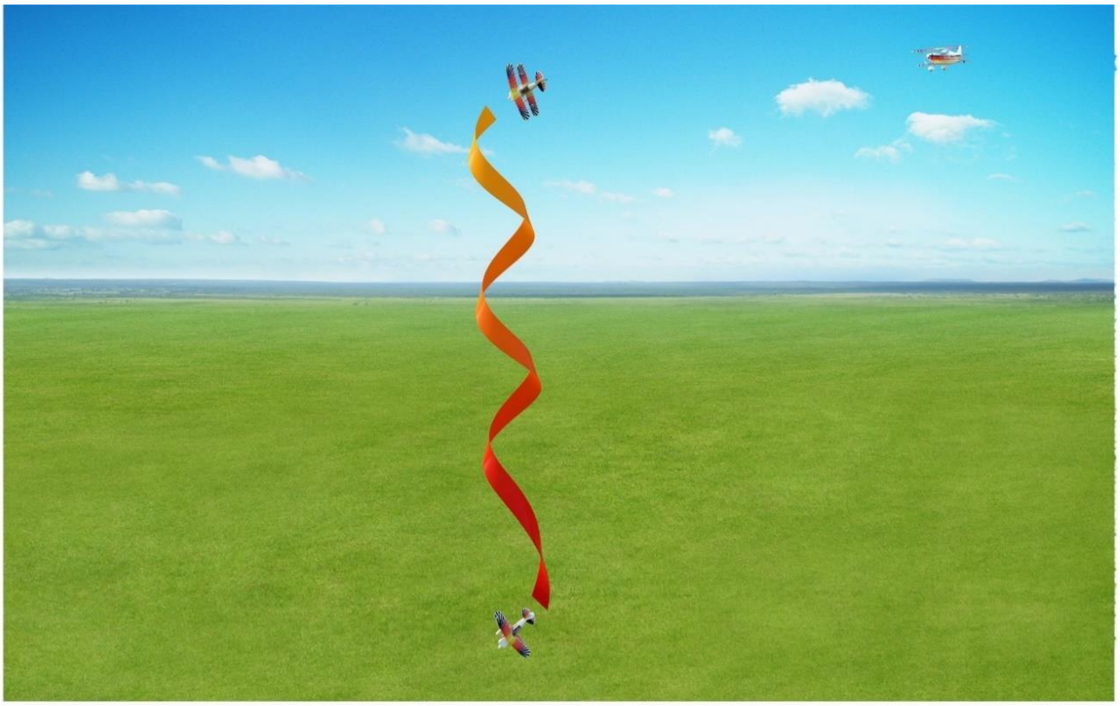
The traditional standard recovery procedure from a known spin type is this:

1. Pull the throttle aft to cut power.
2. Push the rudder pedal opposite to the spin yaw direction to stop the yaw (that is, push the left rudder pedal if spin yaw is to the right, or push the right rudder pedal if spin yaw is to the left). Neutralize the rudder when yaw stops.
3. Push the control stick in the direction opposite to that which produced the original stall to unstall the wings (that is, push the control stick forward in an upright spin, or pull the control stick aft for an inverted spin). Neutralize the elevator when the stall stops.
4. When airspeed is sufficient, pull up normal flight attitude.
5. Push the throttle forward to reapply power.

Normal Upright Spins

In a normal upright spin (a) the aircraft is nose down, yawing toward the spin axis, rotating with the inside wing lower than the outside wing and (b) the axis of rotation near the aircraft is above the aircraft centerline (that is, on the canopy-side). The aircraft rolls around the spin axis, with roll in the same direction as yaw. Usually, this type of spin is entered from an upright flight attitude, stalling with stick back while applying firm rudder input. The aircraft can rotate either to the right or left.

The spin axis intersects the ground below the aircraft (that is, belly-side). All visual cues permit accurate determination of yaw direction during any upright spin. Safe practice, however, requires that yaw direction be determined only by observation of ground reference cues between the engine and the upper wing.



If the spin is known to be a normal upright spin, the standard recovery procedure, which places the aircraft into a steep dive, is as follows:

1. Pull the throttle full aft to cut engine power.
2. Push the rudder pedal gently but firmly in the direction opposite the spin to stop yaw.
3. Push the control stick gently but firmly forward to unstall the wings.
4. When the spin stops (rapid build-up of airspeed), complete the recovery by pulling out of the dive, correcting aircraft attitude as required, and reapplying power.

To prevent stalling during pullout, the pullout must be initiated using gentle elevator input until adequate airspeed develops.

NOTE: Moderate aileron in the direction of yaw will steepen the spin and will usually speed up spin recovery.

Image above shows the cockpit view and control inputs in a normal upright spin to the left.

Flat Upright Spins

In a flat upright spin (a) the aircraft rotates with the wings approximately level (that is, zero roll), usually with the aircraft nearly horizontal in pitch or slightly nose up and (b) the aircraft is upright.

This type of spin is entered from a normal left-rudder upright spin by applying full power and right stick (that is, stick away from the spin axis). Gyroscopic precession lifts the nose only during left yaw; in an upright spin to the right, gyroscopic forces are in the wrong direction to lift the nose.

The spin axis intersects the ground under the aircraft (that is, belly-side). All visual cues permit accurate determination of yaw direction during any upright spin.

Safe practice, however, requires that yaw direction be determined only by observation of ground reference cues between the engine and the upper wing.

If the spin is known to be a flat upright spin to the left, the standard recovery procedure, which basically places the aircraft into a normal upright spin, is as follows:

1. Pull the throttle full aft to cut engine power.

2. Move the stick full left (that is, toward the spin axis and in the yaw direction), to force the inside wing down.

3. Hold the controls until a normal upright spin has developed (1/2 to 3 turns, typically less than 1 turn), and then recover from a normal upright spin using moderate forward stick and moderate right rudder. These control inputs are typically introduced at the same time as aileron deflection, producing a smooth single-motion recovery.

WARNING: Recovery from flat spins must be initiated no lower than 2500 feet AGL to allow for altitude loss during the pull-out phase of recovery.

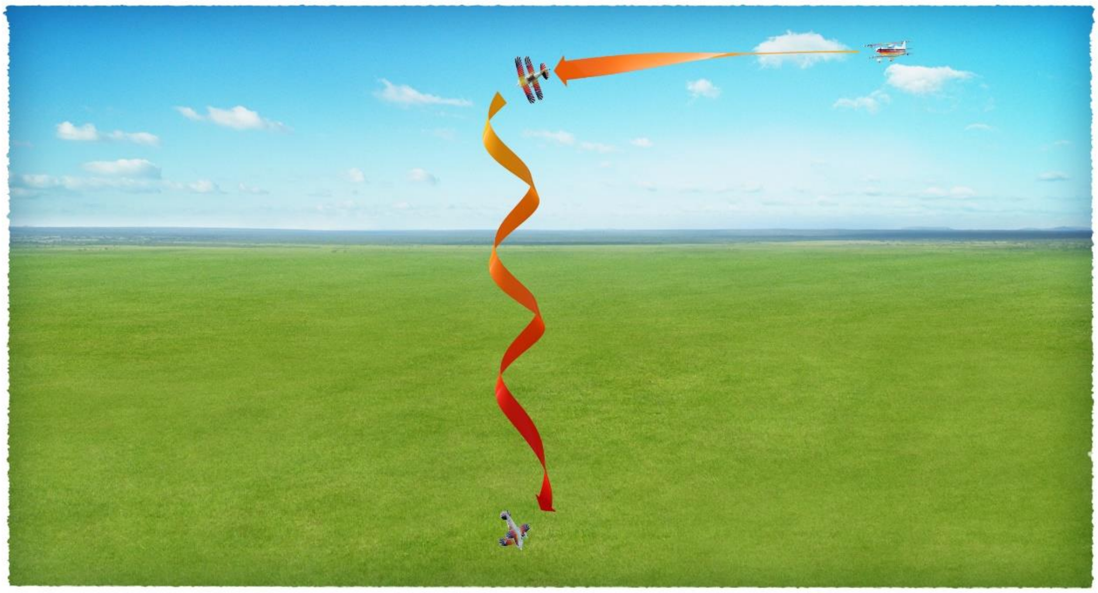
Image above shows the cockpit view and control inputs in developed flat upright spin to the left.

Normal Inverted Spins

In a normal inverted spin, (a) the aircraft is nose down, yawing toward the spin axis, rotating with the inside wing distinctly lower than the outside wing and (b) the axis of rotation near the aircraft is below the centerline of the aircraft (that is, on the belly-side).The aircraft rolls around the spin axis with the roll direction opposite to yaw direction. Usually, this type of spin is entered from an inverted flight attitude, stalling with the stick forward while holding firm rudder input. The aircraft can rotate either to the right or left.

The spin axis intersects the ground above the aircraft (that is, canopy-side). Usually the point of intersection is behind or slightly over the upper wing. Visual cues between the engine and the upper wing always permit accurate determination of yaw direction.

WARNING: Visual cues above the upper wing (that is, canopy-side) are misleading. Because the ground reference cues are behind the spin axis. Such miscues produce an illusion that can lead to the erroneous conclusion that the spin direction is opposite to the true direction. Always observe ground reference cues between the engine and the upper wing to provide unambiguous determination of yaw direction.



If the spin is known to be a normal inverted spin, the standard recovery procedure, which basically places the aircraft into an inverted dive, is as follows:

1. Pull the throttle full aft to cut engine power.

2. Push the rudder pedal gently but firmly in the direction opposite the spin.

3. Pull the control stick gently but firmly aft.

4. When the spin stops (rapid build-up of airspeed), complete the recovery by pulling out of the dive, correcting aircraft attitude as required, and reapplying power. To prevent stalling during pullout, the pullout must be initiated using gentle elevator input until adequate airspeed develops (which can be sensed through control pressures).

NOTE: Moderate aileron opposite to the direction of yaw usually hastens spin recovery.

The tendency for a pilot to look up (canopy side) to maintain ground reference during many inverted maneuvers can produce a dangerous psychological trap that must be avoided during any spin.

The relative movement of the ground behind the spin axis will be easily misinterpreted as yaw reference ahead of the spin axis, and the pilot will erroneously conclude that the spin yaw direction is the reverse of the true yaw direction.

The resulting misapplication of rudder input will then hold the aircraft in the original spin, and recovery will be impossible.

Yaw cues must therefore always be taken ahead of the spin axis; this can be assured during all spin types only if ground reference for yaw determination is always made between the wings.

NEVER LOOK ABOVE THE UPPER WING (CANOPY SIDE) FOR GROUND REFERENCE DURING SPINS.

Image above shows the cockpit view and control inputs in a normal inverted spin to the right.

Flat Inverted Spins

In a flat inverted spin (a) the aircraft rotates with the wings approximately level (that is, zero roll), usually with the aircraft nearly horizontal in pitch or slightly nose up and (b) the aircraft is inverted.

This type of spin is entered from a normal right-rudder inverted spin by applying full power while holding right stick (that is, stick toward the spin axis). Gyroscopic precession lifts the nose only during right yaw; in an inverted spin to the left, gyroscopic forces are in the wrong direction to lift the nose.

The spin axis intersects the ground well above the aircraft (that is, canopy-side). The point of intersection is normally beyond the pilot's visual scan during the flattened portion of the spin. However, the point of intersection moves to its normal position behind or near the upper wing during the recovery procedure, as the spin transitions to a normal inverted spin. This may create the illusion that the spin has reversed direction if ground reference cues are taken above the upper wing. Visual cues between the engine and the upper wing always permit accurate determination of yaw direction.

WARNING: Always observe ground reference cues between the engine and the upper wing to provide unambiguous determination of yaw direction.

If the spin is known to be a flat inverted spin to the right, the standard recovery procedure, which basically places the aircraft into a normal inverted spin, is as follows:

1. Pull the throttle full aft to cut engine power.

2. Move the stick full left (that is, toward the outside of the spin, away from the spin axis and opposite to yaw direction), to force the inside wing down.

3. Hold the controls until a normal inverted spin has developed (1/2 to 3 turns, typically less than 1 turn), and then recover from a normal inverted spin using moderate back stick and moderate left rudder. These control inputs are typically introduced at the same time as aileron deflection, producing a smooth single-motion recovery.

WARNING: Recovery from flat spins must be initiated no lower than 2500 feet AGL to allow for altitude loss during the pull-out phase of recovery.

Image above shows the cockpit view and control inputs in a developed flat inverted spin to the right.

SECTION 5
FAILURES: OH NO!

Section 5: SYSTEMS FAILURES

Introduction

DCS Christen Eagle II implements five systems failures:

- Electrical system failure
- Engine failure
- Radio failure
- Light failure
- Pitot system failure

If any of the mentioned systems fail during the flight except a radio failure, there is no action a pilot can take to recover the system, therefore an emergency landing must be attempted. The only way to repair the failures is to land, park the aircraft, call the ground crew and ask for repairs.

Electrical System Failure

Electrical system failures will prevent an alternator electric feed, meaning the internal battery will start to drain. The only way to observe this failure is to check the VA gauge: if the Amp output is low or the Volt output is 0V, while both battery and alternator are ON and engine is running, it indicates an electrical failure.

Note that unloaded alternator and battery outputs should be around 24V / 50A.

Engine Failure

Engine failure is implemented as a disruption of fuel supply to the engine. If the engine failure occurs, the engine will continue to work for brief period and then stop. Since the fuel is not reaching the engine, there is no action a pilot can take to restart it. At this point, the pilot has two options: Attempt an emergency landing or to bail out.

► *Restarting the Engine in Flight*

If the failure is not set to occur in the mission, the only way the engine can stop is if the user stops the engine intentionally. If the aircraft is in flight with a stopping or stopped engine, and all requirements for the engine operation are met, the engine will restart if it has sufficient RPM (propeller rotating). Otherwise the pilot can restart it (propeller either rotating or stopped).

Restarting with the Electrical Starter

In-flight restarting is the same as on-ground starting. Because in-flight engine failure is likely caused by ignition or fuel problems, be sure to verify that controls are handled properly for optimum quick-start:

1. **FUEL SELECTOR** set to **ON**
2. **THROTTLE** open (forward)
3. **MIXTURE** to **FULL RICH** (forward)
4. Manually stroke **fuel pump**
5. **MAGS** set to **BOTH** if propeller is spinning or switch to **START** (full clockwise) if propeller is not spinning.

Restarting without the Electrical Starter

If the starter fails to crank the engine for any reason (such as discharged battery), verify that all controls are properly set, as listed in the “Engine Starting Procedure” section to attempt starting.

If the propeller has stopped because of low airspeed, dive the aircraft to spin the propeller.

If the engine cannot be restarted at a safe altitude, prepare for a forced landing; do not continue restarting efforts unless a safe landing area is assured.

► *Emergency Landing*

In case of an emergency landing, pilots should maintain speed around 90-95 mph for the best glide and avoid accelerating the aircraft to avoid spinning the propeller.

When the engine is not working, a spinning propeller acts as an air-brake, slowing down the aircraft and slightly worsening the gliding conditions.

If the runway or landing surface is within reach during the glide, the landing procedure does not differ much compared to normal landings: the aircraft will lose speed a bit more rapidly during the flare, but it will touch down at the same speed and pitch angle as during a normal landing.

► *Bail Out*

Before bailing out, the aircraft should assume a normal (upright) position, while the speed should be above the stall speed.

Note that only the pilot in the back cockpit can initiate a bailing procedure.

To bail out, the canopy must be dropped first, which is done by pulling the **“PULL TO JETTISON”** red lever located in the back cockpit. The rest of the bail out procedure is automatic.

Radio Failure

There are two possible radio failures, a common total electric failure and a rare radio display failure.

When a radio failure is detected, the pilot should first check if it's only a display failure by turning the radio into Direct Tuning Mode. Turn it on while pressing the transfer button. This will automatically tune the radio to 120.00MHz and the pilot can attempt to blindly re-tune it to the desired frequency.

If the radio doesn't respond to tuning with the display turned OFF, it means that the radio circuitry is broken (total electric failure).

Light Failure

DCS Christen Eagle II is equipped with an internal and external lighting system. In case of a lighting system failure, internal lights will fail while the external landing and navigational lights will remain operational to allow other players to spot the aircraft.

If the internal lighting system fails, pilots should use the implemented flashlight to illuminate the instrument panel in the front cockpit or the main panel with the radio. The default command to toggle the flashlight is **LALT + L.**

Pitot System Failure

Instruments dependent on the Pitot will occasionally freeze and won't react to speed and altitude changes. Those instruments are the IAS indicator, variometer and altimeter.

To maintain a safe speed during approach to the runway for emergency landing attempt, pilots should set up the engine to known engine settings for 50-60% power cruise during horizontal flight or descent. For climbing maneuvers, maximum power should be used.

Estimating the altitude is the most difficult operation during approach to the runway, but once in the vicinity, pilots have more difficulty estimating the speed. Therefore, it is good practice to learn how much engine power is needed for certain runways. This depends on runway altitude in the first place, then the altitude of the surrounding terrain, the atmosphere pressure and temperature, and finally the aircraft weight, to a lesser extent.

Special Thanks

Igor Tishin
For believing in us and supporting our efforts to further extend our common dream.
We miss you Igor…

Frank Christensen
For designing this wonderful aircraft back in 1977. What an amazing achievement Frank!

Lynn O'Jala
Owner of two Christen Eagles II, for providing an abundance of information, to include measurements, images and advice. Thank you for your support Lynn: we could not have made it without you! Clear skies!

Joshua Pemberton
For painting many of the beautiful Christen Eagle II liveries and providing valuable information about the aircraft's function, shape and flight model.
"Give me dihedral or else!"

Piotr Forkasiewicz & Antonis "Roen911" Karldis
For rendering the awesome cover and chapter illustrations seen throughout this manual.

Frantz Raia
Author of the Tacview flight data analysis software. For friendship and software support during and after development.

Virtual Horsemen & Virtual Vultures Jet Team
For superior flight skill while developing our video.

Thomas Dye, Joe Grinnelli, Brandon Murrer
For your undying motivation to help our module come to fruition!

Our Supporters
Finally, our supporters. This was all made possible by people like you!

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Thomas Dye
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Brandon Murrer
Joshua Pemberton
Corey Prefontaine
Frank Pullano Jr.
James Read
Jared Sebesta
Gerrit Van Wyngaard

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