COCKPIT CONTROLS

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INTRODUCTION

This Technical Leaflet is intended to give aircraft builders (and those modifying their aircraft) advice and guidance on how to arrange cockpit controls. At issue 1, this document is limited in scope to only a few areas, but it is intended to add further subjects in time.

Builders should bear in mind that in due course the aircraft might be flown by pilots other than themselves (syndicate members or a new owner for instance) and it mustn't be assumed that they'll be there to brief them: controls should therefore always be obvious to anyone getting in the aircraft.

In this Leaflet, where 'must' is used, this reflects LAA policy and it is expected that the associated guidance will be incorporated on an aircraft unless advised by LAA Engineering to the contrary, e.g. by means of a modification approval. 'Should' represents best practice and should be followed where possible.

GENERAL

As a starting point, it's worth distilling the wisdom of the airworthiness codes, as these have been formulated over the years from bitter experience:

The cockpit of an aircraft must be designed to allow the pilot to perform their duties without unreasonable concentration or fatigue. In other words, the pilot needs to be sufficiently comfortable and have all the necessary controls readily to hand so that they can concentrate on the important things: flying the aircraft.

Each cockpit control (flight controls or system controls) must be located to provide convenient operation and to prevent confusion and inadvertent operation: it's no use lowering your flaps if you meant to lower your undercarriage! They also need to be reachable when firmly strapped in.

Controls must maintain any desired position without requiring constant attention by the pilot and must not tend to creep under loads or vibration. Clearly, this doesn't apply to flying controls, but when a control is meant to stay in a particular position, it mustn't creep towards an unintended position. Similarly, controls need to be strong enough and not need too much force to operate them (conversely, they shouldn't require too little force, either). They also need to operate in a conventional direction, to avoid the control being moved in the wrong sense, particularly under the pressure of an emergency situation. The standard senses of operation are:

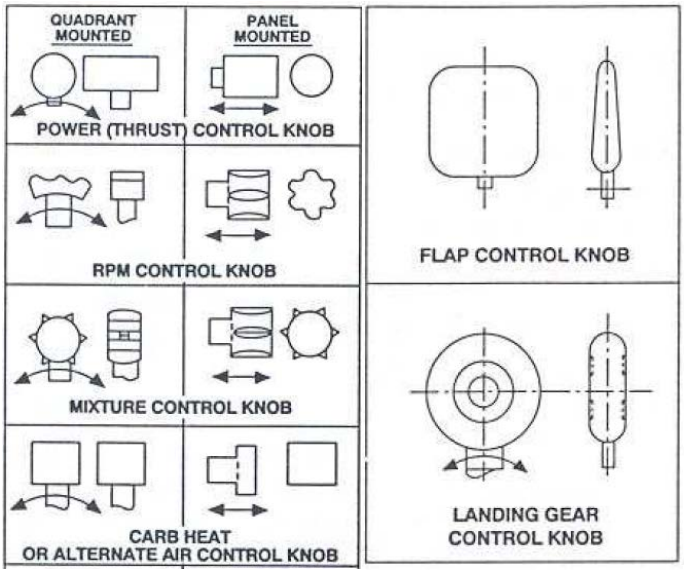
Trim	Corresponding to motion of controls, i.e. if stick is forward for nose down, nose down pitch trim should also be in a forward direction.
Flaps	Pull/move aft or down for flaps down/extended.
Throttle	Forward to increase power.
Propeller pitch	Forward to increase rpm.
Carburettor/hot air/alternate air	Forward or up for cold.
Mixture	Forward or up for rich.
Switches	Down for off.
Rotary controls	Clockwise from off to full on.
Landing gear	Down to extend.
Speed brakes	Aft to extend.

Emergency controls must be coloured red. These would include things like fuel shut-off valves, cockpit jettison handles and perhaps battery master switches. As a general rule, if a control is not an emergency control, it should *not* be coloured red. It should be noted that mixture

controls are usually coloured red, and this is acceptable. Throttles are usually black and propeller speed controls are usually blue.

Flap controls must be located far enough away from the undercarriage control to avoid confusion.

Where confusion of controls might occur, it would be handy to use the conventional shapes. CS-VLA gives these as:



Conventionally, the engine controls are in the order (from left to right): throttle, propeller speed and mixture.

CONTROL COLUMN SWITCHES

Despite the availability of stick grips laden with switches, the general advice is that a control column grip should contain, at the most, a press-to-talk (PTT) switch, an autopilot disengage switch and a pitch and/or roll trim switch. Unless there is specific LAA or aircraft manufacturer's guidance to the contrary, we would expect a mod application to be submitted for an installation with more switches.

Caution needs to be taken for the following reasons:

- More switches and wiring in the moving stick increases the chances of fretting/fatigue of wires and insulation with the potential risk of short circuit or uncommanded effects.
- More wires might also increase the friction in the control system.
- It is difficult to placard grip switches so that unfamiliar or out of practice pilots might struggle to operate the correct switch at the correct moment.
- In an emergency, the wrong switch might easily be operated, resulting in an undesired and/or unnoticed effect on the aircraft, with the intended operation not being completed.
- Switches might inadvertently be operated by, for example, resting a map on the control column. Where this is a possibility, we would recommend that the buttons are recessed or a bump added between switches so that a map is unlikely to activate them.
- Aircraft often have a flap speed significantly lower than their cruise speed and so inadvertent operation of the flaps might cause significant structural damage.

Consideration should be given on including a 'trim disable' switch on the panel for aerobatic aircraft, so that unexpected trim input can't accidentally be dialled in from the stick during aerobatics.

INSTRUMENT PANEL SWITCHES

Switches are an inevitable part of an instrument panel, but care in selecting the correct type and positioning should enhance safety.

Switches should always be orientated 'up' for on and 'down' for off, and be placarded with their sense of operation and function. They also need to be reachable by a tightly strapped in pilot.

Think about what might happen in an accident: sharp toggle switches would be unforgiving if a head were to hit them (and don't forget that harnesses stretch under load). Recessing switches into a padded panel might be a solution, although you'd need to think about the padding and covering material: those that give off toxic fumes when alight should be avoided.

Switches that might need fine adjustments, such as trim switches, might be better positioned on a central control console, if available, so that the pilot can rest his wrist and make delicate inputs even in turbulent air. Alternatively, some sort of finger rest might be used to the same effect on a vertical panel face.

The type of switch used for flaps should reflect the flap system. For instance, an on-off-on switch (latching at each position) could be used to adjust the flap position, but this would only be appropriate if the system incorporated switches at the extremes of travel to cut out the motor. If the system didn't have this feature, then a momentary (sprung to 'off') switch would be appropriate. More advanced systems use a 'pre-select' system whereby the pilot moves the selector to the required flap position (e.g. 10° down) and is able to take his hand off the control while the system motors the flaps to that position. If set up correctly, this type of system can reduce pilot workload in the circuit.

Some switches need guarding against inadvertent operation. Ignition switches in particular should be protected so that they're not accidentally switched off. In addition, ignition switches mustn't be used as the master switch for other electrical circuits.

Critical systems generally shouldn't incorporate 'arming' switches. Essential controls such as flap and trim switches and stall warning devices should operate when the pilot needs them to, without having to remember to operate another switch first.

FUEL VALVES

Each fuel cock must have positive stops or detents in the 'on' and 'off' position so that a pilot knows for certain when they've selected the desired valve position and the valve isn't only partially open.

A classic 'gotcha' on some types of fuel cock is where there is a handle section and a pointer section. The cause of a number of accidents over the years has been found to be that the pilot had thought he'd selected the 'on' position, but actually it was the handle of the fuel cock pointing to the 'on' position and the indicator was actually pointing to the 'off' position. In this case, the pointer should be ground off and the handle used to both select and indicate the valve position.

For similar reasons, a fuel valve should not pass through the 'off' position when changing from one tank to another, to reduce the chances of you switching off the fuel altogether instead of changing tanks.

ENGINE CONTROLS

In order to facilitate engine starting, particularly in-flight, it is sensible to group all of the engine controls together, so that one hand can be kept on the stick and the other hand can move rapidly between the throttle, choke/mixture, starter button, etc. Care should be taken to avoid

controls that might be confused from being too near each other, e.g. carb heat and mixture control, or carb heat and cabin heat.

Some carburettors are set up such that the throttle lever is sprung open. It is recommended that the throttle system is balanced to neutral bias at the cockpit end of the arrangement, so the tendency is for the throttle to stay in position when it's let go. We would also recommend that the throttle is gently sprung to open at the carburettor end, so that should the cable break it would tend to provide full power.

It's often useful if the ignition switch(es) are separate from the start switch: some engine manufacturers recommend that the engine is turned over with the ignition off, so that oil can start to circulate prior to engine start. On the other hand, mag switches are less likely to be accidentally left in the 'on' position with a key-type switch.

The requirement for a starter warning light has been tended to be misreported in recent times. The danger is that if a starter relay sticks 'on', then the starter can continue to draw high currents from the electrical system and overheat, with the ensuing fire risk. The requirement for a warning light used to be contained in a CAA Airworthiness Notice, but was dropped from there as part of a re-write of their information publications. The intent of this requirement is now contained within the design codes, and so it is LAA policy to require a starter warning light on larger engines such as Lycomings and Continentals, and to strongly recommend them on smaller engines.

PARK BRAKES

To avoid accidental operation and landing with the brakes applied or disabled, this control should be visible to the pilot so that they can tell what position it's in. It should also be positioned so that it can't be accidentally set and arranged so that it needs a positive action to set it.