Federal Aviation Administration

Memorandum

Date: APR 1 1 2008

From: Manager, Chicago Aircraft Certification Office, ACE-115C

To: Manager, Small Airplane Directorate, ACE-100

Prepared by: Mike Downs, ACE-118C

Subject: Equivalent Level of Safety to 14 Code of Federal Regulations (CFR) Part 23, § 23.777(d), Cockpit controls, and § 23.781(b), Cockpit control knob shape, for Cirrus Model SR22 Airplanes with Full Authority Digital Engine Control (FADEC)]; ACE-08-05

This memorandum documents concurrence for the subject finding of an Equivalent Level of Safety (ELOS). We request that your office review and concur with the proposed ELOS finding to 14 CFR part 23, § 23.777(d), Cockpit controls, and § 23.781(b), Cockpit control knob shape. The proposed ELOS will allow for the use of one power lever in place of conventional throttle (power), propeller and mixture controls, as the SR22 airplanes will incorporate the use of Full Authority Digital Electronic Control (FADEC) to schedule the thrust command to the engine.

BACKGROUND:

The Cirrus SR22 is a 3,400 pound single-engine, four-place, fixed-gear airplane powered by a 310 hp reciprocating engine. It has a conventional tractor configuration and utilizes composites for the structure. Some unique features of the SR22 include sidestick controls and a ballistic recovery system. The FADEC installation will eliminate the standard controls and install one control for power.

APPLICABLE REGULATIONS:

The applicable regulations are 14 CFR part 23, §§ 23.777(d) and 23.779(b), which state:

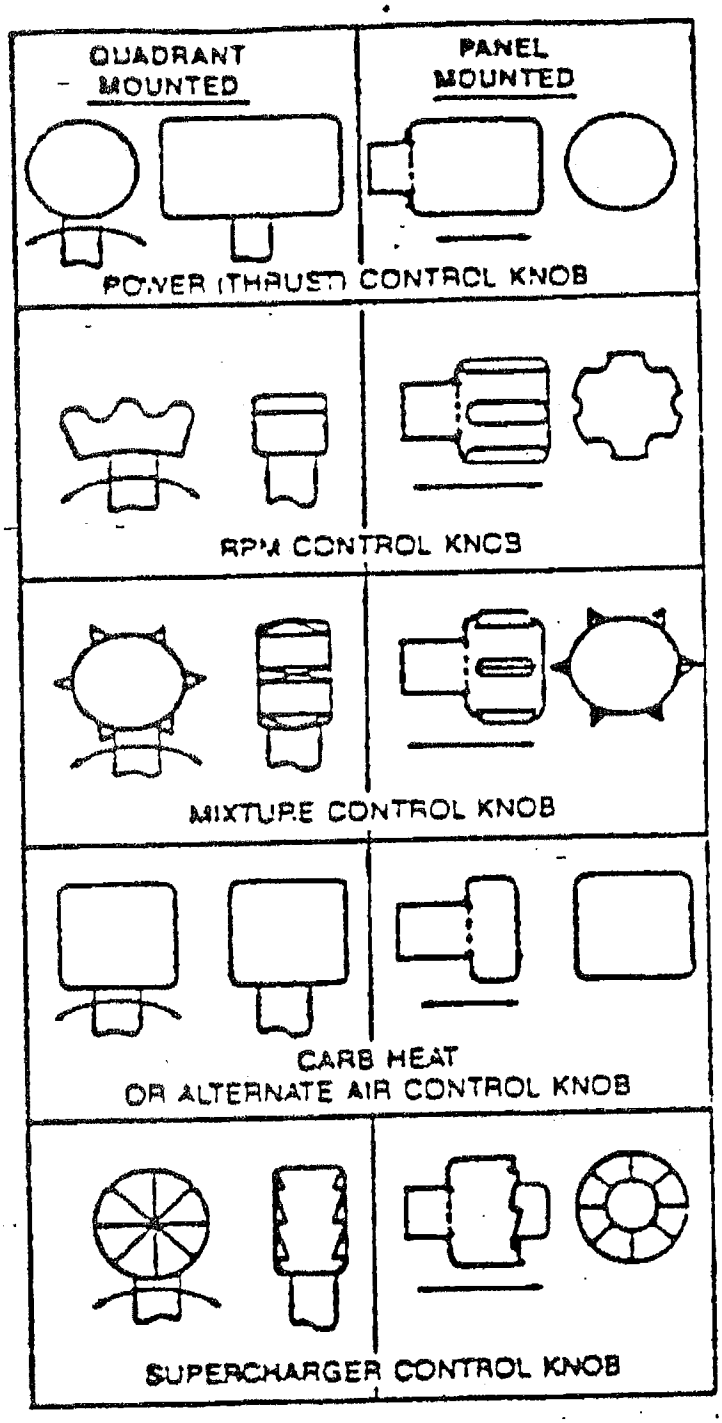
Sec. 23.777 - Cockpit controls.

(d) The control location order from left to right must be power (thrust) lever, propeller (rpm control), and mixture control (condition lever and fuel cut-off for turbine-powered airplanes). Power (thrust) levers must be at least one inch higher or longer to make them more prominent than propeller (rpm control) or mixture controls. Carburetor heat or alternate air control must be to the left of the throttle or at least eight inches from the mixture control when located other than on a pedestal. Carburetor heat or alternate air control, when located on a pedestal must be aft or below the power (thrust) lever. Supercharger controls must be located below or aft of the propeller controls. Airplanes with tandem seating or single-place airplanes may utilize control locations on the left side

of the cabin compartment; however, location order from left to right must be power (thrust) lever, propeller (rpm control) and mixture control.

Sec. 23.781 - Cockpit control knob shape

[(b) Powerplant control knobs must conform to the general shapes (but not necessarily the exact sizes or specific proportions) in the following figure:



COMPENSATING FEATURES:

The primary engine control system consists of the throttle, propeller, and, except on the FADEC equipped SR22, mixture controls. Each control utilizes a conventional steel push-pull cable encased in a protective housing.

The engine controls (throttle, propeller, and mixture, where applicable) are terminated at each end with spherical bearing rod ends fastened with castellated nuts and cotter pins.

The cabin termination of the control cables are connected to a "quadrant" style cluster mounted on the engine control panel between the front crew seats (see Figure 1). This control assembly incorporates a friction lock that can be adjusted to retain the throttle and mixture control levers.

The propeller control cable is terminated in the cabin on a cam plate, which is mounted to the throttle control, as depicted in Figure 1. This connection automatically adjusts the propeller speed to the throttle setting. Under this arrangement the propeller is set to 2700 RPM for full throttle takeoff, 2500 RPM for mid to full throttle cruise, and approximately 1900 RPM at lower power.

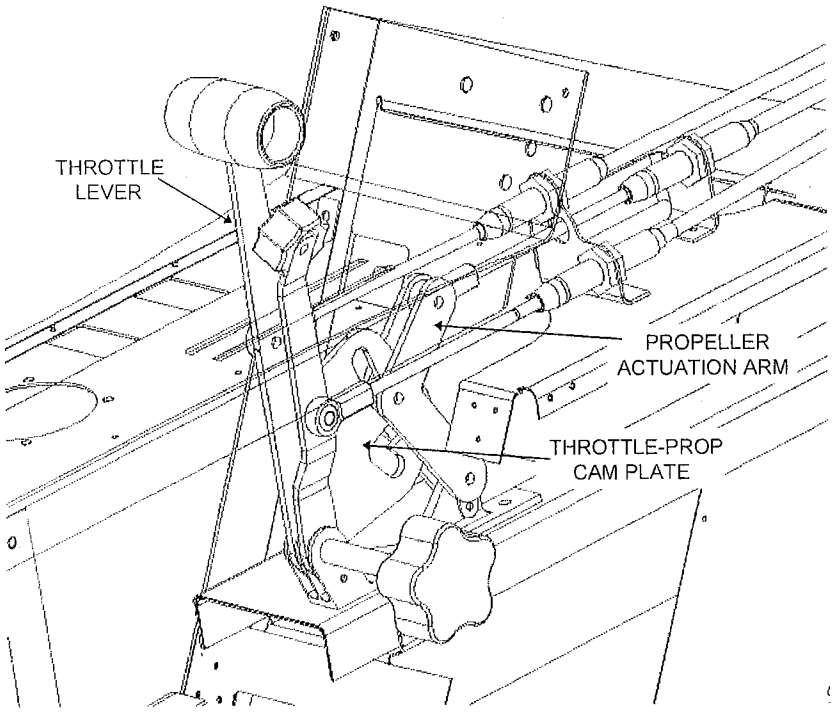


Figure 1: Existing throttle quadrant

Substantiation for an ELOS:

The throttle and propeller speed controls are combined into one control to be operated by the pilot, and cannot be separated by having the throttle control one inch longer or more prominent than the propeller control. This design makes it impossible to inadvertently operate the incorrect control, which is the intent of this regulation. Also, this design was selected to reduce pilot workload. The gearing in this design provides the appropriate propeller pitch for the throttle position selected. Therefore, the Cirrus power lever design provides an equivalent level of safety for meeting the requirements of 14 CFR part 23, § 23.777(d) while providing reduced pilot workload. The CDC power lever is, however, at least one inch longer than the mixture control to

its right and, therefore, meets the § 23.777(d) requirements for those aircraft equipped with manual mixture control.

See Figure 2 for a comparison of the existing and proposed throttle levers showing consistency in the height separation between the throttle knob and the mixture knob for non-FADEC equipped aircraft.

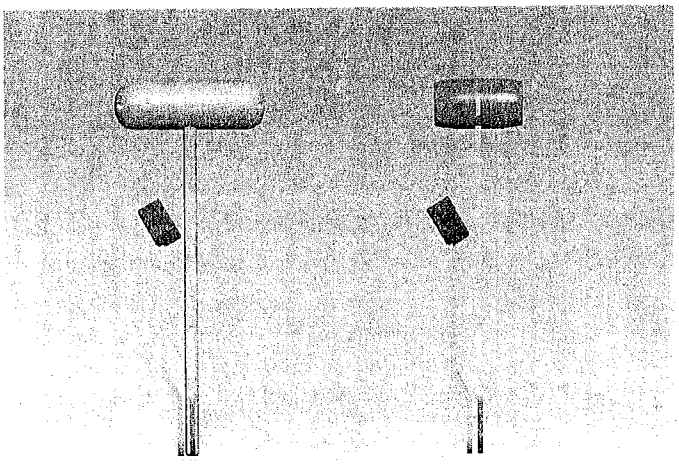


Figure 2: Comparison of proposed (left) and existing (right) throttle lever/mixture lever combination for non-FADEC equipped aircraft (view looking aft)

The control knobs must meet the general shapes outlined in 14 CFR part 23, § 23.781(b) to allow the pilot to identify each control by feel. The Cirrus power lever control knob is egg shaped in cross section and has rounded ends as shown in Figure 3a and Figure 3b. This round shape could be interpreted to meet the "general" shape as displayed for power levers in § 23.781(b) in that it is round and smooth without protrusions. Its cross-sectional shape is not far enough from round to confuse anyone as to its intended function.

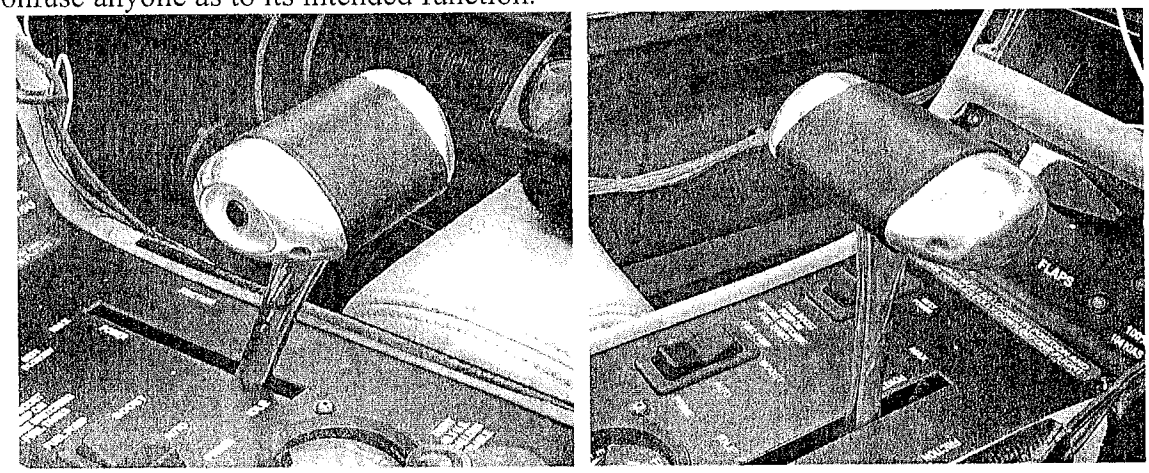


Figure 3a: Proposed power control knob shape (shown without mixture control in FADEC configuration)

Since the Cirrus SR20 and SR22 aircraft are single engine aircraft, the power "quadrant" has only the two engine controls (power and mixture). The mixture control knob shape is the shape required by 14 CFR part 23, § 23.781(b). The "egg" shape of the remaining powerplant control knob (combination throttle/propeller) provides an equivalent level of safety to the required round shape of 14 CFR part 23, § 23.781(b) since there are no other round control levers on the "quadrant" to provide confusion as to which control to operate to change engine power. The

power lever is placarded MAX – POWER – IDLE to further indicate its operation and function. See Figure 3b for the non-FADEC control configuration.

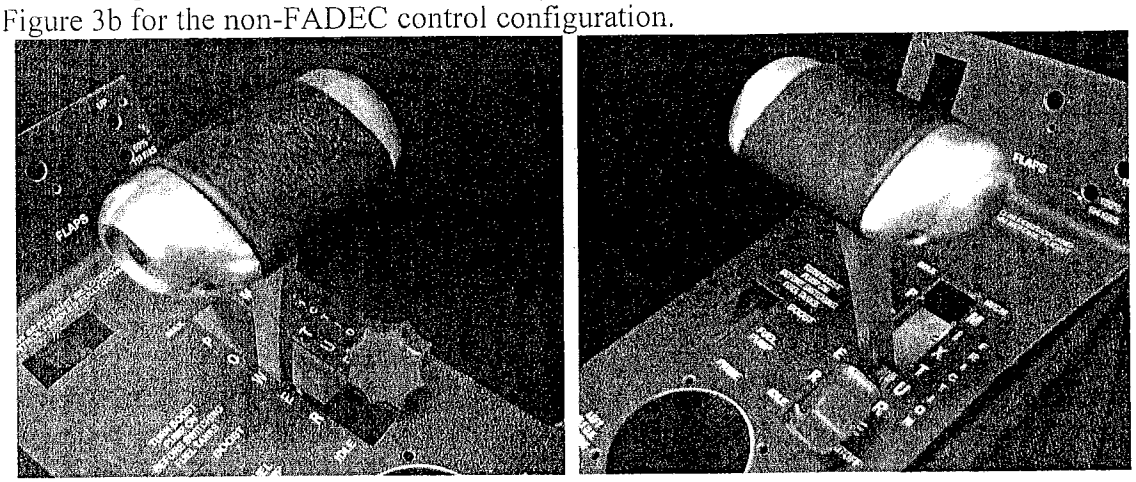


Figure 3b: Conceptual power control knob configuration with mixture knob for non-FADEC aircraft

FADEC equipped aircraft do not have a manual mixture control. The only lever available to manually control the engine power is the single power lever on the console "quadrant" making the shape of the power lever control somewhat immaterial as long as it meets the remaining powerplant control requirements of 14 CFR part 23. The power lever control knob shape, therefore, provides an equivalent level of safety to the requirements of 14 CFR part 23, § 23.781(b).

The SR2X combined throttle/propeller control lever negates the probability for inadvertent operation of the incorrect control. Further, adequate separation has been provided between the throttle and mixture knobs so as to allow the pilot access to the mixture knob regardless of throttle lever position. FADEC equipped aircraft also include mixture control in the single power lever, completely removing the probability for incorrect control operation. Also, pilot workload is reduced by not requiring multiple control operation while still providing correct throttle versus propeller pitch settings. Pilot workload is further reduced on FADEC equipped aircraft, only requiring a single lever control for the engine. Cirrus believes an ELOS should be granted for 14 CFR part 23, § 23.777(d) for both the SR20 and SR22 aircraft.

The SR2X throttle knob shape is distinctive compared to the only other knob on the throttle quadrant (mixture control) and is the only knob on FADEC equipped aircraft. Therefore, the potential for pilot confusion as to lever function due to "knob feel" has been minimized. Cirrus believes an ELOS should be granted for 14 CFR part 23, § 23.781(b) for both the SR20 and SR22 aircraft.

RECOMMENDATION:

Cirrus believes an ELOS should be granted for 14 CFR part 23, §§ 23.777(d) and 23.781(b).

We concur that Cirrus Design's substitution of one power lever in place of the traditional levers for power, propeller and mixture controls provides an equivalent level of safety to the regulatory requirements of 14 CFR part 23, § 23.777(d), Cockpit controls, and 14 CFR part 23, § 23.781(b), Cockpit control knob shape.

Concurred by:

Mary Ellen A. Schutte 26 JAN 07

for Manager, Aircraft Certification Office, ACE-115C — Date

4/10/08

for Manager, Standards Office, ACE-110 — Date

James E. Jackson 4-11-2008

for Manager, Small Airplane Directorate, ACE-100 — Date