CIVIL AERONAUTICS MANUAL 8 (CAM 8)

A Brief Synopsis

Introduction

CAM 8 was the policies and interpretations of the Administrator of Civil Aeronautics to Part 8 of the regulations of the Civil Aeronautics Board, and became effective on October 11, 1950. At that time Part 8 was new, and a significant departure from previous restricted category airworthiness requirements. Part 8 was the regulation governing the issue of type certificates and airworthiness certificates in the restricted category.

This new Part 8 departed from the previous requirements that were requiring an equivalent level of safety as a passenger-carrying aircraft. The Administrator accepted that for special purposes, in this case agricultural, compliance with restricted category requirements was simplified, and the operating limitations would be tailored to the purpose of the operation. Although that simplification eased the requirement to provide engineering data and so on, there was still a requirement that good engineering practice was maintained, and that no feature of the design or modification would render the aircraft unsafe. The idea behind Part 8 was to provide the greatest flexibility and minimum burden on the operator consistent with public safety.

Part 8

Applicability

Established standards for the issuance of type and airworthiness certificates for aircraft in the restricted category. It also established operating limitations applicable to such aircraft.

Eligibility for type certificate

Addressed aircraft that were type certificated in another category, military aircraft, and modifications. Required conformance to good aeronautical practice and that no feature or characteristic of the aircraft rendered it unsafe when operated in accordance with the limitations prescribed for its intended use.

8.10(a)(1) addressed aircraft that had not been type certified in another category, and referred to Appendix B to CAM 8 as guidance for showing compliance with the applicable airworthiness requirements (eg CAR 3).

8.10-3 dealt with aircraft modified from a previously approved type. It contained requirements such as who could perform the modification, flight checking, hazards to avoid, and approval of the modification which included the Administrator's agent or designee prescribing operating limitations.

8.10-4 dealt with agricultural aircraft modifications (to aircraft previously type certified in another category) and applied to aircraft where operations were normally conducted over open areas. It referred to the guidance contained in Appendix A to CAM 8.

8.20 dealt with the issue of airworthiness certificates where the aircraft has been type certified or modified per section 8.10, inspected by the Administrator, and the Administrator has prescribed operating limitations. This section was administrative and covered aircraft inspection, airworthiness directives, aircraft marking, repairs and alterations and their data, maintenance and maintenance facilities, and approval of major repairs and alterations.

8.30 dealt with operating limitations that the Administrator must prescribe, in addition to those required in this section, as he finds necessary for safe operation and protection of the public.

8.30-1 required that the special purpose operations and operating limitations would be listed, along with the limitations in sections 8.31 through 8.34.

For agricultural operations, examples of operating limitations were –

1. The aircraft shall not be operatied in any manner which will endanger public life and property. The operator shall adjust the take-off weight to provide a safe margin of performance for the existing operating conditions, considering the take-off area, altitude, temperature, and terrain. For maximum capacities of hoppers and spray tanks see placards.
2. Maneuvers shall be limited to those normally performed in agricultural operations.
3. Agricultural and pest control operations shall not be conducted over densely populated areas, in congested air lanes, or in the vicinity of busy airports where passenger transport operations are being conducted, unless the Administrator finds it in the public interest to authorise such operation and has issued a Certificate of Waiver or Authorisation.
4. Persons and cargo shall not be carried for compensation or hire.
5. Persons other than the minimum crew necessary for the agricultural operations shall not be carried during these operations.
6. No person shall be carried in the aircraft unless a seat and safety belt, installed in accordance with good aeronautical practice is provided for his use.

Examples of additional limitations were –

1. A prohibition against sulphur dusting, unless special fire previention measures have been incorporated in the aircraft.
2. A statement in the area operating limitations that the aircaraft is not eligible for a waiver to operate over congested area because of uncertificated poerplant components.
3. Restricted engine speed (rpm) ranges, if a metal propeller stress survey indicates the need for such a restriction.

8.31 dealt with area operating limitations. This was regarding waivers to operate in congested areas, and was largely administrative.

8.32 dealt with economic operating limitations. This was regarding the ability to carry another person in transit (loader driver) and associated equipment without it being regarded as being for hire or compensation.

8.33 prohibited the carriage of passengers during special purpose operations.

8.34 dealt with separate operating limitations for multiple airworthiness certification, converting from one category to the other, the instructions, and the owner's responsibility.

Appendix A – Restricted Category Aircraft Modifications

1 – Structural Changes

Stated that is a practical guide in the structural considerations when modifying an aircraft for agricultural use. This section discussed the effects of alterations from structural and

aerodynamic perspectives, conversion of personal aircraft types to agricultural use, general rules for proper alteration of the aircraft structure, attachment of hopper or tank to primary structure, boom installations, and corrosion protection.

2 – Dispensing Equipment Design Criteria

This section dealt with sources of information regarding equipment design, hopper materials, seams, doors, volume calculations, agitators, spray tank design, venting, baffles, spray booms, nozzles, cockpit draining, etc.

3 – Powerplant Changes

This section dealt primarily the structural issues regarding the installation of a different engine type such as engine mounts with the associated change in weight.

4 – Pilot Safety Items

This section dealt with the issues such as visibility, location of instruments, seat belts and harnesses, ventilation, and crash protection.

5 – Electrical Systems

This section dealt with possible changes to the electrics and addressed generators, environmental conditions, cable selection, terminals, lights, switches. It also covered the installation regarding cable runs, bonding, etc.

6 – Fire Protection

This section dealt with the fire hazards that could be encountered from the materials being dispensed such as sulphur. Areas covered were exhaust sparks, static electricity, and spraying of combustible liquid.

7 – Weight and Balance

7.0 General This section stressed the importance of weight to the structure, of weight control and balance, and that if approved limits are exceeded then flight tests should be made

7.1 General Effects of Gross Weight Changes This section begins a discussion on the relationship between the design load factor and gross weight. It made the point that gross weights chosen should permit safe operation under all normal and emergency conditions. The chart that is currently reproduced in CAR Part 137 Appendix B is mentioned as a guide to determining gross weight provided the aircraft is flown in a restricted manner.

7.10 Effects of Gross Weight Changes on Aircraft Structure This section noted that the aircraft landing gear and supporting structure are particularly critical if the aircraft is landed overweight; and taxiing is very likely to be unfavourably affected by increased gross weights. With the increase in gross weight there must be a proportionate decrease in the load factor that can be reached in flight. It again notes that caution should be exercised in all flights at overload weights whether or not they are below the possible maximum. There was some discussion on the distribution of load with respect to the structural strain on the fuselage

7.11 Effects of Gross Weight Changes on Maneuvers This section notes that to prevent excessive loading the aircraft must be maneuvered cautiously, and that the stalling speeds are increased and stalls in turns are more easily encountered. A lower allowable load factor means restricting bank angle. Another factor is gust loads; the level flight and never exceed speeds should be reduced by the ratio of specification weight to overload weight but not below maneuvering speed. Again it advised caution in all flight conditions. There was discussion about pull-up speeds and the use of full deflection of control surfaces.

7.2 Weight and Balance Computations This provided guidance on aircraft weighing.

7.3 Effect of c. g. Position on Structural Strength This section discussed the effect of increased gross weight operation on structural strength, and in particular around the landing gear.

8 – Powerplant Installation

The manual provided considerable guidance on design factors for the powerplant installation including the engine, cowling, firewall, propeller, fuel and oil systems, cooling system, induction and exhaust system. In addition the supply and control systems aft of the firewall, and instrumentation, are covered. This section was directed at the airworthiness evaluation of the powerplant installation, and ensuring satisfactory powerplant operation was achieved under the atmospheric conditions, altitudes, and maneuvers to be encountered.

It advised the use of type certified engines and propellers. It also covered engine/prop vibration characteristics with respect to blade stress, and some performance aspects associated with differing propellers.

9 – Flight Test

This section addressed flight testing and began by stating that "There are certain principles in the field of aeronautical engineering wheich do not enter directly ino piloting but which are well for a pilot or an operator engaged in agricultural operations to understand in order to know what claims may reasonably be made for an airplane of known weight and power. These principles relate to performance which includes climb, distances required to take-off and land, etc."

It made the point that aircraft used for agricultural operations have sufficient climb performance to avoid obstacles, and minimise stall/spin possibilities. The manual then went on to discuss the factors affecting climb performance, and used examples from aircraft of the time (Aeronca 7AC, Boeing 75, Navy N3N, Piper PA11, etc), and included a rate-of-climb correction chart for temperature and pressure.

Appendix B – Airworthiness Criteria for Agricultural and Similar Special Purpose Aircraft

.0 – Basis and Purpose

These criteria were derived from CAR 3 and apply to single engine aircraft intended for low speed dusting or spraying or similar. Following subsections described the procedure for showing compliance, inspections and tests, changes, definitions, etc.

.1 – Flight

Flight tests should be made to demonstrate the existence of satisfactory flight and ground handling characteristics.

Weight and centre of gravity ranges should be established. Maximum weight should not exceed the weight selected by the applicant, the design weight for the structure, or the maximum weight at which compliance with the flight standards is demonstrated.

Performance was dealt with for – stalling speed (stalling speed limit at maximum weight 70 mph; recommended less than 55 mph at max weight), and normal climb (at least 8 times stalling speed or 300 feet per minute which ever is the greater, at max weight).

Flight characteristics was dealt with regarding controllability in a variety of conditions. Topics covered were longitudinal control, trim, stability, static longitudinal stability in climb, static directional and lateral stability, dynamic stability, stalling (level and turning flight)

Ground characteristics dealt with longitudinal and directional stability as well as shock absorption and flutter/vibration.

.2 – Strength Criteria

This section contained an extensive list of load criteria (both limit loads and ultimate loads), safety factor, flight loads, design airspeeds, flight load factors, wing loadings under varying conditions, landing loads, structural criteria such as fuselage to wing attach points, dead weight items, control system design conditions, engine mount loads, landing loads, landing weight, landing gear loads and drop tests.

.3 – Design and Construction Standards

This section contained criteria applicable to various design tasks such as control systems, crew protection, cockpit hazards, cargo provisions, toxic materials, corrosion protection, dispensing installations, and aircraft structure covering.

.4 – Powerplant Installation

This section dealt with powerplant and propeller installation standards, and associated components and systems, such as fuel and oil tanks, and powerplant controls.

.5 – Equipment

This section listed the required and recommended instruments and equipment.

.6 – Design and Operating Limitations and Information

Design limitations were established and submitted to the (then) CAA for inclusion in the aircraft specification. They were airspeeds (V_{ne}, V_m, V_{fe}), powerplant (rpm, manifold pressure, octane rating), maximum weight, and centre of gravity.

This section also covered markings and placards.

.7 – Identification Data

Required an ID plate to be attached to the aircraft.