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CIVIL AERONAUTICS BOARD
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SPECIAL CIVIL AIR REGULATION

APPLICATION OF TRANSPORT CATEGORY PERFORMANCE REQUIREMENTS TO THE C-46 TYPE AIRPLANE

On January 31, 1952 the Civil Aeronautics Board issued an emergency Special Civil Air Regulation (SR-379) which limited to 45,000 pounds the maximum take-off and landing weight for all C-46 type airplanes used for the carriage of passengers for remuneration or hire. Concurrently the Board issued a notice of proposed rule making to inquire into the advisability and feasibility of applying performance requirements to C-46 type airplanes used for such purpose based on a modification of the transport category performance requirements set forth in Part 4b of the Civil Air Regulations. Previously, on July 6, 1951, the Board had issued a notice of proposed rule making which had proposed a somewhat different modification of the standards applicable to the C-46 when so used. It was at that time proposed that the maximum take-off weight should not be in excess of that which would allow a zero rate of climb at sea level in take-off configuration with the landing gear retracted and the critical engine inoperative and its propeller windmilling. Following the issuance of this proposed rule and after requests by various interested parties, the Board instituted and set down for hearing an inquiry into matters relating to the safe allowable operating weight of C-46 airplanes (Docket No. 5107). The examiner's report in this proceeding was issued on January 22, 1952. Oral argument with respect to issues in that proceeding and those raised by the January 31, 1952 notice of proposed rule making was heard by the Board on March 27, 1952.

These various steps with respect to the C-46 arose out of continuing Board concern with the safety operational aspects of the C-46. In August 1950, a committee composed of CAA and CAB staff members was formed to study C-46 safety problems. One of the recommendations of this committee was that flight tests using Part 4b test procedures be conducted to determine at what weight the C-46 would comply with the performance provisions of Part 4b.

Flight tests for this purpose were conducted by the CAA early in 1951. In addition to determining the weight at which the C-46 would meet the performance requirements of Part 4b, the CAA used the data thus developed to reevaluate the performance of the C-46 with respect to the requirements of Part 3 of the Civil Air Regulations under which it was originally certificated. Subsequently, on July 6, 1951 the Board proposed the application to the C-46 of a new standard of a zero rate of climb at sea level with the critical engine inoperative, to become effective after October 1, 1952. Data resulting from the flight tests conducted by the

CAA indicated that the weight at which such new standard would be met would not exceed 43,500 pounds for C-46 aircraft equipped with Pratt & Whitney R-2800 series engines. The Board also proposed to prescribe an interim maximum weight of 45,800 pounds for C-46 airplanes equipped with similar engines until the proposed new standard became effective.

During December 1951 and January 1952 it became increasingly apparent, as a result of additional accidents involving C-46 airplanes and investigations of operations conducted by certain air carriers, that some immediate action was necessary in order to give full protection to the traveling public. Therefore, Special Civil Air Regulation SR-379 was adopted by the Board as an emergency measure to limit the weight at which C-46 aircraft might be operated while carrying passengers for hire. The concurrent notice of proposed rule making proposed that the standard to be made applicable to the C-46 be that of the performance requirements of Part 4b modified to the extent that the second segment of the take-off climb should assume the landing gear to be retracted but with the propeller of the inoperative engine feathered rather than windmilling. The maximum emergency weight of 45,000 pounds, as set forth in Special Civil Air Regulation SR-379, was based on the standard proposed in the concurrent notice of proposed rule making and was chosen as a good approximation for the purposes of the emergency regulation.

The Civil Air Regulations provide at the present time that all large airplanes used for the carriage of passengers for hire after December 31, 1953 must comply with either the requirements of Part 4b or the transport category requirements of Part 4a, and further must be operated in accordance with transport category operating limitations. The Board has had under consideration for some time a proposal which would eliminate this requirement, thus making it inapplicable to the C-46, among other aircraft.

As a result of the developments outlined above, there are now pending before the Board two separate but related problems involving the C-46. These are:

First, there is the question of the permanent standards which should be made applicable to all aircraft used in air transport operations which do not comply with Part 4b or with the transport category requirements of Part 4a. While this question is one which will not be finally decided until the Board acts upon its rule-making proposal referred to above, our review of the C-46 performance capabilities has led us to the conclusion that there should be no general exemption from these requirements, particularly with respect to the take-off performance requirements at sea level. Therefore, on and after January 1, 1954, the C-46 will be required to comply in full with such take-off performance requirements, together with such additional standards of the transport category as the Board may decide are necessary in the interest of safety for non-transport category aircraft.

Second, we must decide the interim standards to be applicable to the C-46 during the period between now and January 1, 1954. Part 42 now authorizes the use of the C-46 in passenger-carrying transport operations pursuant to certification under Part 3 of the Civil Air Regulations. The applicable standards do not contain any requirements such as those found

in Part 4b relating to single-engine performance on take-off. Available data indicate that the take-off weight, without any engineering changes to increase its performance, at which the C-46 could comply with the performance standards of Part 4b would be approximately 36,000 pounds at sea level. Operation of the aircraft in passenger-carrying service during the interim period prior to January 1, 1954 without complying with any requirements as to performance on take-off would represent too great a departure from the standards of safety which will become fully applicable upon that date. Therefore, in order to provide a higher level of safety during the interim period, we believe that the C-46 when engaged in passenger-carrying operations, should conform to the sea level take-off performance standards of Part 4b to as great an extent as is now reasonable. We shall therefore make such standards applicable, with the exception that during the second segment of the take-off climb, the propeller of the inoperative engine shall be assumed to be feathered. This will provide a substantial step toward the protection accorded by Part 4b, while at the same time giving the operators of the C-46 a reasonable opportunity to adjust to the more comprehensive standards thereof.

A further problem which confronts the Board is what weight shall be applicable to the C-46 in passenger-carrying operations during the period until the Administrator establishes a precise weight under the modified Part 4b standards provided herein. The aircraft, as previously noted, is now operating at a take-off weight of 45,000 pounds in passenger operations pursuant to the emergency regulation of January 31, 1952. One alternative would be to continue that regulation in effect pending the necessary determinations by the Administrator. However, we believe that on further analysis of the data before us certain modifications should be made in the 45,000 pound figure as a temporary standard.

The only flight tests for climb performance of the C-46 which have been made in the configuration herein required -- that is, with wheels and flaps up, the critical engine inoperative and its propeller feathered, and the operating engine developing maximum take-off power -- have been performed by the Civil Aeronautics Administration. Data covering these tests were introduced in the proceeding hereinbefore referred to, but were challenged as to accuracy. The Board finds with respect to these specific tests that the techniques and instrumentation employed were not so at variance with accepted engineering practice as to impeach such data and make their use unreasonable. The Board further finds such data have been accurately adjusted to reflect climb performance under standard conditions. However, since the tests were conducted for the purpose of determining the performance capabilities of the C-46 under the transport category requirements, no tests were performed at weights which would be permitted under the less severe standards provided in this regulation for the interim period until January 1, 1954. Such provisional interim weight must therefore be determined by extrapolation. While the Board recognizes that extrapolation to the extent necessary for this purpose goes beyond conservative engineering practice, it is of the opinion that, in the absence of more direct test data, its use is reasonable for this purpose and that the result thus produced is neither arbitrary nor capricious. The only other alternative the Board has in fixing this provisional interim weight is to employ the test data, also on file in the aforementioned proceeding, developed in the Pan American C-46 certification tests conducted at 48,300 pounds and

at maximum continuous power instead of maximum rated take-off power. The Board believes that the extrapolation which use of these test data would require in order to arrive at the weight permitted under the more severe standard herein prescribed would not be as likely to produce an accurate result as would the extrapolation of the CAA climb test data.

In addition to the foregoing there must also be considered the question of the stalling speed of the C-46 in the wheels and flaps up, zero thrust configuration, since the standard herein prescribed is a function of the stalling speed. Two sets of data as to stalling speed are available to the Board, the first obtained in the Civil Aeronautics Administration tests; the second in the Pan American C-46 certification tests, both referred to above. After examination of both sets of data, the Board is unable to find that the CAA data were obtained under conditions more likely to insure accuracy than the Pan American data. Consequently, in order not to prejudice C-46 operators by prescribing a weight more limited than necessary to meet the standard hereby established, the Board will utilize the Pan American stall test data in arriving at the provisional interim weight.

Application of the foregoing principles will produce the following results: If CAA test data for both climb and stall are used the provisional interim allowable take-off weight would be 43,600 pounds. If Pan American climb and stall test data are used, the result would be 45,400 pounds. If CAA climb data and Pan American stall data are used, the result would be 44,300 pounds. For the reasons stated above, we prefer the use of the third alternative, and the provisional interim weight will be established at 44,300 pounds.

One of the recommendations made to the Board by the Council for C-46 Engineering is that a modification of the hydromatic propeller used on the C-46 by shortening the blades should be required by appropriate regulation and the effect of the modified propeller taken into account in determining the appropriate take-off weight for that aircraft. It is our understanding that this modification either already has been accomplished or is being planned by most operators of C-46 aircraft. Flight tests with this modified propeller indicate that an increased performance may be expected from its use which would result in an increased level of safety for C-46 aircraft. It is not now possible to translate precisely this increased performance into pounds of weight under the modified Part 4b performance standard prescribed for the C-46. However, the Administrator has advised us that the data before him as a result of tests comparing the performance of the clipped and unclipped propellers indicate that an allowance of an additional thousand pounds weight for the C-46 aircraft equipped with the modified propeller would be reasonable to reflect the increased performance to be expected therefrom, until some applicant demonstrates to the Administrator that a different allowance is proper. In view of the foregoing, the Board finds that allowance of 1,000 pounds additional weight for C-46 aircraft equipped with the clipped propeller will be reasonable during the temporary period provided in this regulation.

The promulgation of this Special Regulation makes moot the questions raised with respect to the July 6, 1951 notice of proposed rule making together with the proceeding in Docket No. 5107 since revised operating standards are hereby established.

Interested persons have been afforded an opportunity to participate in the making of this regulation and due consideration has been given to all relevant matter presented.

Accordingly, the Civil Aeronautics Board hereby promulgates a Special Civil Air Regulation, effective April 1, 1953, to read as follows:

1. Prior to January 1, 1954, C-46 type airplanes when used for the carriage of passengers for remuneration or hire shall not be operated at weights exceeding those which it is demonstrated to the Administrator will allow compliance with the performance requirements of Part 4b except that in determining the maximum take-off weight, such weight shall be limited only to a value at which the airplane has a rate of climb equal to 0.035 V_{s1}^2 in the take-off configuration at sea level with the landing gear retracted but with the propeller of the inoperative engine feathered rather than windmilling.

2. Provisionally, pending a determination by the Administrator of the weights at which C-46 aircraft will meet the standards prescribed by paragraph 1 of this regulation, the maximum take-off weight of such aircraft, when used in the manner herein referred to, shall not exceed 44,300 pounds; Provided that, in the case of such aircraft equipped with Hamilton Standard propellers with blades serial number 6491A-9 or approved equivalent which have been clipped in accordance with specifications approved by the Administrator, such provisional maximum weight shall be increased by 1000 pounds until such time as the Administrator shall have determined by suitable tests another value to correspond to the additional efficiency obtainable by the use of such propellers, and thereafter by such other value.

3. This regulation shall be effective until superseded or rescinded by the Board. Special Civil Air Regulation SR-379 is hereby suspended and shall remain suspended so long as this regulation shall continue in effect, or until the further order of the Board.

(Sec. 205(a), 52 Stat. 984; 49 U.S.C. 425(a). Interpret or apply secs. 601, 604, 1005, 52 Stat. 1007, 1010, 1023; 49 U.S.C. 551, 554, 645; 62 Stat. 1216.)

By the Civil Aeronautics Board:

/s/ M. C. Mulligan

M. C. Mulligan
Secretary

(SEAL)

Member Adams did not participate in this decision.