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ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

SUBJECT: RADAR TRANSPONDER REQUIREMENTS

1. **PURPOSE.** This circular describes certain aspects of the planned operation of the Air Traffic Control Radar Beacon System (ATCRBS) which will be of interest to aircraft operators who expect to use radar transponders in their aircraft.
 2. **BACKGROUND.** During past years, FAA planning for the employment of radar transponders in the National Airspace System has been made known to the public by various means. Among these have been the issuance of the following:
 - a. On 27 December 1963 the United States Standard for the ATCRBS was amended to provide for Mode C automatic altitude transmission and for 4096 Mode 3/A codes. The latest revised U. S. National Standard for ATCRBS is contained in Advisory Circular 00-27 dated 27 January 1969.
 - b. On 28 April 1965 FAA issued an Advance Notice of Proposed Rule Making which indicated, among other things, that aircraft operating in positive control area would be required to carry transponders having 4096 selective Mode 3/A codes and Mode C altitude reporting capability at some time in the 1965 - 1975 period.
 - c. On 10 February 1967 Federal Aviation Regulations Section 37-180 was amended to include in Technical Standard Order C74a a requirement for 4096 Mode 3/A codes and automatic altitude reporting in the manufacture of airborne radar transponders.
 - d. On 5 March 1969 a Notice of Proposed Rule Making was issued inviting comment on a proposed rule to require airborne equipment with 4096 Mode 3/A codes and Mode C altitude reporting in aircraft operating in positive control area and certain other controlled airspace beginning 1 January 1973.
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- e. In March 1970, FAA published the document "The National Aviation System Policy Summary," containing description of the agency's plans for ATCRBS facilities.

3. THE NEED FOR GREATER ATCRBS CAPABILITY.

- a. The spectacular growth of air traffic has made automation of some air traffic control operations a necessity. In no area is this more applicable than in the processing and display of secondary radar data for the air traffic controller. The number of transponder codes for VFR flight was recently increased (1 January 1970). For flight in positive control area and at several high density traffic airports, the number of codes (64) now in use is becoming inadequate to meet traffic loads. At the same time the number of aircraft is increasing, more codes are needed to enable the controller to display aircraft targets in such a way that he can quickly analyze the traffic situation. And, as more codes are put into use to accommodate more traffic, the controller becomes less able to employ secondary radar data effectively without some form of computer assistance.
- b. The trend of traffic growth and increasing difficulty on the part of the controller to manually identify, track and separate aircraft targets was anticipated in the design of the National Airspace System. The actions mentioned in Paragraph 2 above reflect the FAA program to solve the problem by providing greater ATCRBS capability and computer processing of the additional secondary radar data which become available.

4. ADVANTAGES OF INCREASED ATCRBS CAPABILITY. What are the benefits in safety and efficiency which will accrue to airspace users and air traffic control from improved radar transponders in aircraft and automatic secondary radar processing equipment on the ground?

- a. It is an accepted fact that the radar capability to detect and display aircraft targets does not in itself ensure safety from collision. In any traffic situation involving more than a few aircraft, the identity and intent of the aircraft, together with the ability to communicate with them, are required by the controller. Neither the present system nor the planned National Airspace System includes the huge numbers of ground personnel and amounts of equipment which would be necessary to process flight plans for, communicate with, track and separate large numbers of aircraft using a single code, or a limited number of codes, in a given area. Further, it is doubtful that any ground system, manual or automatic, which could be devised in the future could ensure separation between flights, IFR or VFR, in heavy traffic areas under such conditions.

- b. The automation equipment now being installed in many air traffic control facilities will permit automatic processing of multi-coded secondary radar returns from aircraft. The 4096 discrete identity and automatic altitude code transponders, together with the computer processing capacity of the ground equipment of the National Airspace System, will enable the controller to select areas, altitude strata, conditions of flight (VFR and IFR) or particular aircraft (e.g., climbing or descending) for automatic display.
- c. Aircraft operators will be afforded greater safety, as the improved airborne and ground equipment will identify and track aircraft targets automatically, thereby virtually eliminating the possibility of misidentification of targets or transposition of target tracks and enable the controller to concentrate his attention on aircraft separation problems.
- d. The Mode C altitude reporting feature of the improved transponders will enable the controller to display the altitude of all equipped aircraft, obviating the need for oral altitude reports and thereby reducing the volume of pilot-controller communications. Likewise, it will not be necessary to issue as many advisories and traffic avoidance vectors because the actual altitude of each aircraft will be known. These benefits of automatic altitude reporting and processing will make for greater safety, as well as reduce pilot and controller workload.

5. FUTURE OUTLOOK FOR SINGLE AND LIMITED-CODE TRANSPONDERS.

- a. All radar-equipped air traffic control facilities, including those which will have automatic processing of secondary radar data, eventually will be capable of accepting replies from single code, 64 code or 4096 code transponders. It will not be necessary to eliminate limited-code transponders from the National Airspace System after 1 January 1973. However, for reasons outlined in Paragraph 3 above and set forth in previous FAA releases, air traffic loads in certain airspace, on heavily traveled airways and in busy terminal areas will necessitate the use of automation equipment on the ground and 4096 codes and Mode C altitude reporting capability in aircraft operating in these areas.
- b. Although it is not expected that the use of single or limited-code radar transponder equipment will be ruled out in areas of low traffic density, users should consider the limitations placed on their operation into or out of areas where 4096 codes and Mode C altitude reporting capability will be necessary. As air traffic increases, which it is expected to do in future years, the number of places where full transponder capability will be needed will increase in order to meet requisite standards of safety and efficiency of aircraft movement.

- c. While FAA believes that future requirements will develop in the manner outlined above, the possibility exists of a breakthrough in achieving a satisfactory proximity warning instrument or collision avoidance system. The agency is active in development programs for the design of such systems, but at this point in time they appear to present certain weight, complexity and cost problems which make wide acceptance and use a long-term proposition. In any event, the need for sophisticated ATCRBS equipment is expected to remain valid well into the future.

6. SUMMARY.

- a. The need for greater ATCRBS capability will increase as air traffic increases.
- b. Computer processing of secondary radar data will be required in the provision of air traffic control services in many areas.
- c. Single-code and limited-code transponders will not be adequate to meet anticipated traffic loads in positive control area, in certain other airspace, heavily-traveled routes and at busy airports. Federal Aviation Regulations can be expected which will not permit their use in these areas.
- d. Aircraft operators should bear in mind that the useful life of single-code and limited-code transponders will be short in many areas and should prepare to equip their aircraft with 4096 codes and Mode C altitude reporting capability if they intend to operate in these areas.



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