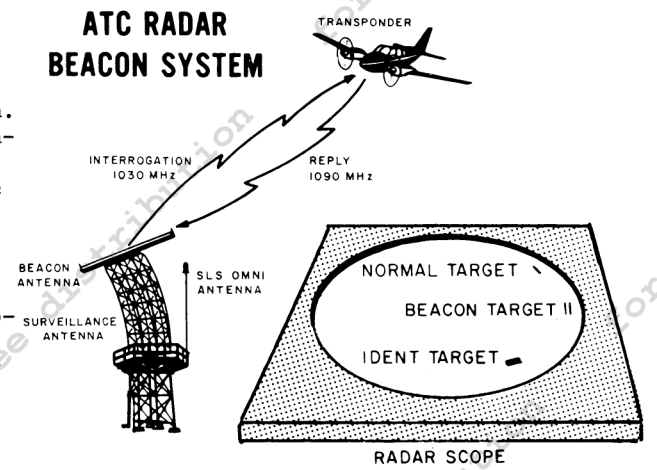
DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration

IFR PILOT EXAM-O-GRAM* NO. 25

THE ATC TRANSPONDER

Written tests for the Instrument Pilot and Airline Transport Pilot ratings include questions pertaining to transponders and the operation of "Secondary" radar. Test analyses and responses to oral questions by instrument pilot examiners show that many applicants lack essential knowledge in this area. The installation of transponders in many aircraft has been a great help to ATC in safely handling the constantly increasing VFR and IFR traffic load. This Exam-O-Gram briefly explains the principles and functions of this valuable flight aid.

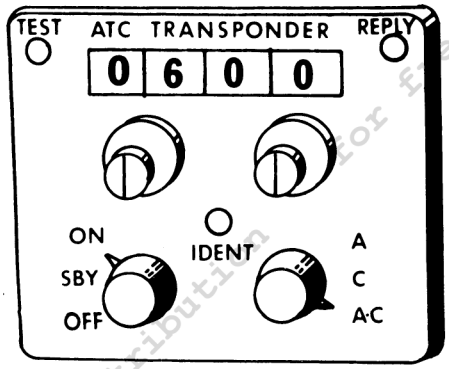
WHAT IS ATCRBS? This is an abbreviation referring to the Air Traffic Control Radar Beacon System, also known as Secondary Surveillance Radar. "Secondary" radar relies on the exchange of electronic signals between a ground radar beacon antenna (interrogator) and an aircraft transponder. A "Primary" radar system depends on "skin paint" or echo return from the aircraft structure, on a radar scope for identification. Secondary radar has these advantages: it reinforces the radar target, allows rapid target identification, and extends the radar coverage area. Secondary radar is usually slaved with the primary surveillance radars, a common pedestal supporting both antennae.



HOW DOES A TRANSPONDER WORK? The ground equipment transmits an ultra high frequency pulsed signal on 1030 MHz to the aircraft transponder which receives the signal, interprets it and replies by transmitting a coded signal on 1090 MHz to the ground receiver. This unit, in turn, decodes the signal and causes it to appear on the radar scope in a distinct pattern, normally two short parallel lines. The interrogator transmits only on 1030 MHz and the transponder replies only on 1090 MHz. Mode and code changes are made by varying the time interval between pulsed signals, not by frequency change. The transponder operates on "line of sight," therefore, range can be increased by climbing to a higher altitude. Another factor bearing on transponder operation is the attitude of the aircraft. In a bank, part of the aircraft structure may block signals from the interrogator.

WHAT BASIC "MODES" ARE AVAILABLE? Presently, there are six. Modes 1 and 2 are used exclusively by the military services. Mode A in the civil system is the same as military Mode 3 and is used exclusively for air traffic control. It is commonly designated Mode A/3. Modes B and D are still unassigned. Mode C is used for automatic altitude reporting in the NAS Stage A (enroute) and the ARTS III (terminal) systems. The radar scope displays for NAS Stage A and ARTS III are, of course, much more complex than the diagram shown above.

WHAT "CODES" ARE UTILIZED IN MODE A/3? The first Mode A/3 system utilized 64 codes, however, equipment utilizing 4096 codes is being rapidly phased into the system. As there are no 8's or 9's used, the numerical value of the codes range from 0000 to 7777 (from 00 to 77 in the 64 code system). Pilots of civil aircraft should never operate a transponder on code 0000. This is reserved for North American Air Defense (NORAD) use. When making code changes, you should avoid inadvertent selection of codes 7500, 7600, or 7700, thereby causing momentary false alarms at the automated ground facilities. These codes are designated as follows: 7500 - hijack code; 7600 - loss of communications code; 7700 - emergency or MAYDAY code. When filing an IFR flight plan, be sure to file the maximum transponder/navigation capability of your aircraft in the equipment suffix, so ATC can assign proper codes. Only codes with the last two digits as zeros will be assigned to 64 code capability aircraft, while 4096 code capability aircraft may be assigned discrete four digit codes; e.g., 0123. If your aircraft has only 64 code capability and ATC assigns you such a code, you should advise them of your transponder limitations and request an appropriate code.



WHAT IS THE PURPOSE OF THE "IDENT" BUTTON? You will be instructed to "Ident" whenever the controller wishes to

positively identify your aircraft. Press, then immediately release, the "Ident" button, thereby transmitting a Special Position Identification pulse (SPI). The space between the parallel lines of your target on the radar scope will then fill in, identifying you unmistakably. Transmit this signal only when so instructed by the controller to avoid mistaken identification with another aircraft.

WHAT IS THE PURPOSE OF THE "STANDBY" FUNCTION? You may be asked to "Squawk Standby" if the controller wishes to have your transponder to stop replying to interrogation. By this means the radar scope can be selectively cleared.

WHAT IS THE NORMAL SEQUENCE OF STEPS IN OPERATING A TRANSPONDER? At a specified point on the aircraft checklist, the transponder is turned to the "Standby" position, and the internal circuitry of the set is checked by operating the "Test" switch. On a VFR flight, unless otherwise instructed by ATC, set in code 1200 regardless of altitude. On an IFR flight, set in the code specified by ATC. If your transponder is the 64 code type, disregard the last two zeros; e.g., if the code assigned is 2100, set in code 21. Just prior to takeoff, on either a VFR or an IFR flight, switch from "Standby" to "On." When under Approach Control's jurisdiction, the controller may tell you to "Stop Squawk" or switch off the transponder. If you are not so instructed, turn the transponder off as soon as practicable after landing.

WHEN IS A TRANSPONDER REQUIRED BY REGULATIONS? With certain exceptions, FAR 91.24 requires an aircraft operating in Group I, II, and III Terminal Control Areas and in all controlled airspace of the 48 contiguous states and the District of Columbia above 12,500 feet MSL, excluding the airspace at or below 2,500 feet AGL, to be equipped with a transponder having a Mode A/3 4096 code capability and be equipped with automatic pressure altitude reporting equipment having Mode C capability.

REFERENCES:
Airman's Information Manual, Part I
FAR, Part 91

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