# CHAPTER 2. ALL-WEATHER TERMINAL AREA OPERATIONS

## SECTION 1. INTRODUCTION TO AND EVOLUTION OF ALL-WEATHER TERMINAL AREA OPERATIONS

**401. GENERAL BACKGROUND.** All-weather terminal area operations (AWTA) include all-terminal area operations conducted under instrument flight rules, including certain operations conducted in visual conditions. This chapter discusses concepts and national direction and guidance to be used by FAA inspectors when evaluating, approving, or denying requests for an authorization to conduct AWTA operations. Also covered in this chapter are operations not previously approved for an operator, proposed operations using aircraft and/or AWTA operating systems new to an operator, and proposed operations using previously approved aircraft and AWTA operating systems using operating minimums new to an operator.

A. Due to the complexity of AWTA operations in domestic and international operations, and wide variations in equipment, procedures and standards used, inspectors must evaluate proposed AWTA operations with consideration for the capabilities of the following:

- The operator's aircraft
- Type of AWTA operations equipment
- Type of AWTA operations proposed
- Airports being used
- Operating minimums
- Operator's experience with other aircraft and equipment in the type of operation proposed
- Operator's experience with the same aircraft and equipment in other AWTA operations

B. Specific standards are provided in this chapter for evaluating operations using aircraft and equipment which have well understood operational characteristics and limitations in specific AWTA operations. When an operator requests approval to conduct operations not covered in these standards, or when an operator requests to use lower operating minimums than the ones provided in these standards, the request must be forwarded through the Regional Flight Standards Division to AFS-400. AFS-400 will develop the necessary AWTA operational concepts and will provide national policy and direction to be used in evaluating these proposals.

**403. EVOLUTION OF AWTA OPERATIONS.** In the early years of aviation, all flight operations were conducted in visual flight conditions. During those early years, electronic ground-based navigation aids were not available and cockpit instrumentation could not support flight in instrument meteorological conditions. The capability of AWTA operations slowly evolved as flight instrumentation, airborne navigation equipment, and ground-based electronic navigation aids were developed and improved. The development of a gyro, providing reliable attitude information, was the technological advance which established the foundation for instrument flight as we know it today. The essential information provided by this device permitted pilots to safely control aircraft during instrument flight conditions. Operating minimums were gradually reduced as overall capability for instrument flight improved. The introduction of turbojets for commercial service in 1958 provided the stimulus for further and more rapid refinement of equipment, operating procedures, and standards. When turbojets were introduced, the concept of operating minimums was based on ceiling and visibility. For the first 3 1/2 years, the turbojet operating minimums for precision approaches were specified as a ceiling of 300 ft. and a meteorological visibility of 3/4 statute miles. These early minimums have been modified and are presently known as the "basic turbojet minimums." The basic turbojet minimums are currently specified as a decision height (DH) of 200 ft. and a visibility of 3/4 statute miles (RVR 4000). Included as part of the initial concept of operating minimums was an increase in the operating minimums for all PIC's until 100 hours of flight experience in a particular aircraft was obtained. This was determined by adding 100 feet to the published ceiling and 1/2 statute mile to the published visibility for each approach. This aspect of the concept of operating minimums is still in use today. The high minimum PIC requirement is currently specified in Parts 121 and 135 (with RVR landing minimum equivalents in the operations specifications). The lowest minimums for high minimum PIC's is a DH of 300 feet and a visibility

of 1 statute mile (RVR 4500).

**405. CURRENT CATEGORY I (CAT I) OPERATIONS.**

A. The initial steps toward achieving the current CAT I operating minimums were taken on September 28, 1961. The first air carrier operations with minimums of a ceiling of 200 ft. and a visibility of 1/2 statute miles (RVR 2600) were authorized on May 11, 1962. The concepts developed to permit this reduction in operating minimums established the foundation for a "building block" approach. With this approach AWTA operations evolved in an orderly manner as airborne and ground-based capabilities improved. The 1961 reduction in minimums to a ceiling of 200 ft. and 1/2 statute mile visibility (RVR 2600) was based on further improvements of airborne equipment, electronic ground-based navigation aids (NAVAID's), ground-based visual aids and enhanced pilot training and qualifications. This 1961 reduction was authorized when the following conditions were met:

(1) Ground-based navigational aids included:

- A complete, operational ILS
- A maximum glideslope angle of 3 degrees

(2) Ground-based visual aids included:

- High intensity runway lights
- Full configuration approach lights with sequenced flashing lights
- All-weather runway marking or runway centerline lights

(3) Airborne equipment included:

- A flight director system or an automatic approach coupler (autopilot)
- An instrument failure warning system or cockpit procedures for assuring the immediate detection of instrument failures or malfunctions

(4) Pilot-in-command experience, training, and qualification requirements included:

- 100 hours of experience as pilot-in-command in the particular type of turbojet airplane
- Raw data approach to 200 ft.
- Flight director and/or autopilot approach to 100 ft.
- ILS approach (flight director and/or autopilot as appropriate) to 100 ft. followed by a landing
- Engine-out ILS approach to a landing or missed approach

(5) Additional runway field length and crosswind component limitations included:

- 15 percent or 1000 ft. of additional field length (whichever is greater) over normal regulatory requirements
- A maximum crosswind component of 10 knots

B. A major change in the method of specifying the operating minimums for precision approaches evolved with the introduction of the decision height concept and the RVR concept. These changes were finalized by the publication of U.S. TERPS criteria in 1966. This conceptual change eliminated the ceiling requirement by introducing a decision height (DH) (see section 2, paragraph 489) and based landing minimums on runway visual range (RVR) reports, when available, instead of ground or flight visibility reports. This conceptual change was necessary because of the limitations in the methods used to observe or measure ceiling and visibility (see section 2, paragraph 495). Often ceiling and visibility observations were taken several miles from the approach end of a runway, and as a result were frequently not representative of the seeing-conditions encountered during the final stages of an approach and landing, especially in rapidly changing or marginal weather conditions. Operational use of RVR reports began in 1955 but they were not available at most major airports until the early 1960's. Currently (1989), all operations using minimums below 1/2 statute mile visibility must be based on RVR reports.

C. In 1963, operating minimums were reduced further to DH 200/RVR 1800 for two- and three-engine airplanes (usually Category B or C) and DH 200/RVR 2000 for four-engine airplanes (usually Category D). These reductions were based on the "building block" approach estab-

lished in 1961 and the added requirement for enhanced in-runway lighting systems such as high-intensity touchdown zone and runway centerline lighting. In 1964, the minimums for runways not equipped with a high-intensity touchdown zone and runway centerline lights were reduced to DH 200/RVR 2400. Improvement in visual aids were, and still are, a critical element in reducing landing minimums. These aids provide pilots with the necessary external visual references for manually controlling and maneuvering the aircraft during the final approach, flare, landing, and taxiing. The requirement for improvements in the overall airborne and ground-based capabilities combined with a cautious incremental reduction in operating minimums assured that a high level of safety was maintained. Currently CAT I operations are still conducted in accordance with these concepts and criteria.

D. In 1988, CAT I operating minimums for Category D airplanes were reduced to DH 200/RVR 1800. This change established common CAT I minimums for all airplanes. The 1988 reduction was based on more than 20 years of successful experience with Category B and Category C turbojet aircraft operating to DH 200/RVR 1800, as well as research and analysis. This research has shown that the handling characteristics and seeing-conditions in existing turbojet Category D airplanes were equivalent to other turbojets.

**407. EVOLUTION OF CURRENT CATEGORY II (CAT II) OPERATIONS.** It is essential to understand that the concepts and criteria established in the early 1960's are the "building block" foundations for all CAT II and III operations. The initial criteria for CAT II operations were issued in October 1964. These criteria resulted in a requirement for further improvements in ground-based navigation aids, RVR reporting capabilities, airborne equipment, maintenance standards, and pilot training and qualification. Current CAT II criteria are essentially the same as those issued in 1964, except for enhancements to provide additional flexibility and operational credit for modern flight control systems.

A. During CAT II operations, greater reliance must be placed on the guidance provided by the ground-based navigation aids. Therefore, design and maintenance criteria for airborne and ground-based equipment must assure that better performance and higher reliability is achieved by the total system. For example, before an airport can qualify for CAT II minimums, it must be equipped with a Type II ILS which has greater signal quality, reliability, and integrity than the Type I ILS equipment. It is also necessary for CAT II runways to have more than one RVR reporting system to provide more accurate information concerning seeing-conditions on the runway. A purpose of these requirements is to supplement the high-intensity touchdown zone and runway centerline lighting required for CAT I operations below RVR 2400. Additional airborne equipment is also required. This equipment includes the following:

- Dual ILS localizer and glideslope receivers
- An autocoupler (autopilot) and a flight director system, or two independent flight director systems
- Equipment to identify the DH (such as a radar altimeter)
- Rain removal equipment
- Go-around guidance
- An autothrottle system (for certain aircraft to reduce pilot workload)

B. The initial CAT II criteria was established to provide flexibility to operators in the selection of various combinations of airborne equipment to meet CAT II requirements. An operator had to prove (demonstrate), however, that the performance and reliability of the airborne system selected performed at the level of precision and reliability required for CAT II operations. The operator also had to demonstrate that its maintenance program was one of sufficient quality to assure that the equipment continued to perform at the demonstrated level of precision and reliability. The pilot training and qualification program, through enhanced ground and flight training, had to provide the pilot proficiency required. This program had to address factors such as the availability and limitations of visual cues in the CAT II environment as well as the procedures and techniques for transitioning from nonvisual to visual flight at low altitude during landing.

C. CAT II type design approval standards had not been established during the initial phase of CAT II operations. As a result the following methods of obtaining airborne equipment approval were established.

(1) *Operational Demonstration.* When the operator's airborne equipment had not been certificated (type design approved) for CAT II operations, the operator was permitted to establish an extensive operational demonstration program. The purpose of this program was to show that the required levels of performance and reliability were

attained and maintained. This program consisted of numerous approaches (approximately 300). The operator was also required to show that the methods for failure and/or malfunction detection were acceptable to the Administrator.

(2) *Type Design Approval.* When the operator could show that the airborne equipment had been previously tested and expressly approved for CAT II operations during FAA type certification or supplemental type certification, the operator was not required to conduct an extensive operational demonstration before receiving initial CAT II approval.

D. When an operator had demonstrated that all of the initial criteria had been met, initial operations to DH 150/RVR 1600 were authorized. This authorization was known as an "operational approval." Operational approvals were accomplished by the issuance of standard operations specifications. Following this initial operational approval, the operator was required to demonstrate the ability to maintain the required levels of reliability and performance on a continuing basis in CAT II line operations. After 6 months, assuming continued satisfactory maintenance and performance of the airborne systems, the operator was issued an operational approval to operate with minimums of DH 100/RVR 1200. These basic CAT II criteria for approval are still applicable today.

**409. EVOLUTION OF CURRENT CATEGORY III (CAT III) OPERATIONS.** The initial step toward introducing CAT III operations occurred in 1966 when the requirements for ILS equipment to support CAT IIIa operations were established at an ICAO COM/OPS divisional meeting. These requirements established international standards for CAT III ground-based NAVAID's that were essential to the development of airborne equipment and operating concepts.

A. *Initial U.S. CAT IIIa Criteria.* The initial U.S. CAT IIIa criteria (AC 120-28) were issued on September 5, 1969 to assist industry in developing a CAT IIIa capability. These criteria were based on the CAT I and CAT II "building blocks" and further improvements were required in ground-based NAVAID's, RVR reporting capabilities, airborne equipment (such as a requirement for autoland), maintenance standards, and pilot training and qualification. These initial criteria did not include definitive operational approval requirements for ground support systems, maintenance, training, and operational procedures and limitations. However, the basic concepts and the minimum airborne equipment type design requirements considered necessary for CAT IIIa operations were clearly delineated in AC 120-28. These basic concepts and equipment requirements included the following:

- Alert height concept
- Fail-passive flight control system concept
- Fail-operational CAT IIIa system concept
- Autoland concept
- Dual radio (radar) altimeter requirements
- Redundant flight control system requirements
- Enhanced missed approach instrumentation
- Autothrottle control system requirements
- Enhanced failure detection and warning capability
- Type design approval criteria

*FYI: "Fail-operational" means an airborne system with redundant operational capability down to touchdown and, if applicable, through rollout. The redundant operational systems must have no common failure modes. If one of the required systems fails below alert height (AH), the flare, touchdown, and rollout, if applicable, can be accomplished using the remaining operational system or systems. "Fail-passive" means an automatic flight control system which, upon occurrence of any single failure, should not cause: significant displacement from the approach path; altitude loss below the nominal glidepath; or upon disconnection, involve any significant out-of trim condition. In addition, any single failure should not cause any action of the flight control system that is not readily apparent to the pilot. See Advisory Circular 120-28.*

B. *Initial CAT IIIa Approvals.* The publication of initial CAT IIIa criteria (AC 120-28) led to the rapid development of CAT IIIa airborne and ground-based capabilities. In February 1971, the B-747 was granted the first U.S. type design approval for CAT IIIa. This type design approval was based on the use of fail-operational automatic landing systems. CAT IIIa criteria were significantly improved in December 1971 by publication of AC 120-28A. This revision enhanced the type design (airworthiness certification) approval criteria and established initial operational approval criteria. Washington-Dulles Airport received the

first U.S. CAT IIIa ILS facility approval in January 1972. The type design for the L-1011 was certificated for CAT IIIa using fail-operational autoland systems in April 1972. The first U.S. CAT IIIa operational approval was issued to Trans World Airlines on September 15, 1972 for fail-operational CAT IIIa operations using the L-1011. All initial CAT IIIa operations were restricted to Type III ILS equipped runways and fail-operational CAT IIIa airborne equipment.

C. *Type II ILS Equipped Runways and Fail-Passive Airborne Equipment.* The criteria initially established for CAT IIIa (AC 120-28A) were based on a conservative approach for reducing operating minimums. However, as operational experience was gained, it was determined that the initial criteria were unnecessarily stringent. After a thorough review of the Type II ILS equipment, the FAA determined that some Type II installations could be upgraded, through minor modification, to support CAT IIIa operations. Furthermore, the operational experience of Air Inter in France, during extensive CAT III operations (RVR 500) and using fail-passive autoland systems, indicated that under tightly controlled conditions fail-passive CAT III operations could be safely conducted. Research efforts in the U.S. and Europe also supported this conclusion. In October 1976, Notice 8400.18 was issued to establish approval criteria for fail-passive CAT IIIa autoland operations using DH 50/RVR 700. In December 1976, the B-727 became the first airplane certificated by the U.S. for fail-passive CAT IIIa operations. AC 120-28B, issued in December 1977, permitted CAT IIIa operations at runways equipped with suitably modified Type II ILS equipment. It also permitted fail-passive autoland operations with aircraft which had handling characteristics, physical characteristics, and seeing-conditions equivalent to the B-727 and DC-9 airplanes. A flight standards policy decision, expressed in a letter dated June 22, 1978, authorized CAT IIIa operations to 32 runways equipped with Type II ILS equipment at 31 airports. FAA Order 8400.8 was initially issued on September 10, 1980 to enhance the criteria and procedures for approving CAT III operation using U.S. Type II ILS facilities. These changes significantly increased the number of facilities which could support CAT IIIa operations and the number of aircraft which could potentially use these facilities.

D. *Initial CAT IIIb Criteria.* As operational experience and capability of airborne equipment increased in CAT IIIa operations, the need for CAT IIIb criteria was gradually realized. The initial U.S. CAT IIIb criteria were issued in March 1984 (AC 120-28C). This revision permitted operations with minimums as low as RVR 300. The B-767 became the first aircraft certificated (type design approval) for CAT IIIb by the U.S. The B-767 was approved under a final draft version of this AC. The initial CAT IIIb criteria were based on the CAT I, CAT II, and CAT IIIa "building blocks." Further enhancements were required in the CAT IIIb criteria, particularly in ground-based NAVAID's, lighting systems, RVR reporting systems, airborne equipment, training and qualification programs. These revisions further clarified CAT III operational concepts, system requirements, and the visual references necessary for the various CAT III operations. Another conceptual change was implemented by establishing concepts for CAT III operations with the "pilot in the active control loop." These new concepts permitted manually-flown CAT III operations using special flight guidance and control systems such as "heads-up displays" (HUD). The first U.S. CAT IIIb operational approvals were granted to Trans World Airlines (L-1011) and Eastern Airlines (L-1011 and A300) using minimums of RVR 600. RVR 600 was the lowest minimum supported by U.S. facilities due to RVR reporting system limitations. The first CAT IIIb RVR 300 minimum approvals were granted to Delta and Eastern Airlines in September 1984 for L-1011 aircraft. Initial RVR 300 approvals were restricted to those airports equipped with CAT III taxiway centerline lights and the capability to report RVR's as low as RVR 300. The first U.S. CAT IIIb RVR 300 ILS facility approval was granted for runway 16R at Seattle Tacoma International Airport (SEATAC) in 1987.

**411. FUTURE REDUCTIONS TO LANDING MINIMUMS.** The lowest landing minimum currently (1989) authorized for CAT III operations by U.S. operators at any airport and by foreign flag operators in the U.S. is RVR 300. This restriction is related primarily to problems associated with aircraft taxi operations and the difficulty of providing adequate safety services (such as crash, fire, rescue, and collision prevention) when operating in seeing-conditions less than RVR 300. The lowest minimum currently (1989) authorized for foreign flag operators outside the U.S. is 75m (RVR 250) and is based on an operational determination similar to the U.S. RVR 300 decision. Future reductions in landing minimums are unlikely unless technology permits the development of economically viable capabilities to adequately resolve these limitations. Presently potential solutions appear to be enhancements in airborne equipment such as forward-looking infrared or millimeter-wave radar technologies.

**413. AUTHORITY AND RESPONSIBILITY FOR APPROVAL OF AWTA OPERATIONS.** The complex nature of AWTA operations in domestic and international environments, the wide variation of airborne and ground-

based equipment, and the variation in procedures and standards used in these operations, require a broad-based evaluation and approval process. An evaluation and approval process has been established to assure that AWTA operations are conducted at facilities which have the capabilities necessary for safe operation. This process is necessary for safely accommodating the varying levels of standardization and capabilities of the ground-based facilities that can be used to conduct the various categories of AWTA operations. The process must take into consideration wide variations in the capabilities of the airborne equipment options available to air carriers. The operational concepts and procedures, flightcrew training programs, and aircraft maintenance programs vary widely from one operator to another. All of these factors require a special review and approval process to ensure that proposed operations are compatible with the intent of established AWTA operational concepts, procedures, and safe operating practices. Due to these operational and technical complexities, it is essential for this evaluation and approval process to use a "systems approach" (big picture approach). This systems approach must involve many personnel who are knowledgeable in their respective areas. When the safety of a proposed operation is being evaluated, personnel knowledgeable in such areas as aircraft certification, ILS/MLS ground equipment design and maintenance, visual aid concepts and criteria, instrument approach procedure design criteria, airport design criteria, flight inspection, ATC procedures, flight operational programs, and aircraft maintenance programs must be involved. This broad-based systems approach process is particularly important in the evaluation and approval of CAT II and CAT III approach and landing operations. Although approval of CAT I operations is relatively straightforward due to the high level of CAT I operational experience and international standardization, CAT II and CAT III operations must be examined and approved on a runway-by-runway and an operator-by-operator basis.

A. *AFS-1 Authority and Responsibility.* The Director of Flight Standards Service is assigned the overall responsibility for management of the ILS/MLS program and the establishment of all AWTA operational policies, concepts, and criteria. The Director also has the final approval authority for all CAT II and CAT III operations, including approval of the ground-based facilities which can be used by U.S. operators in the conduct of CAT II and CAT III operations (see the appropriate sections of this chapter).

B. *AWTA Operational Policy and Criteria.* The Director of Flight Standards Service establishes policy, criteria, and procedures which are used by other elements of the FAA to install (site), inspect, commission (approve), and maintain the ground-based facilities necessary to support the various categories of AWTA operations. The Director also establishes policy, criteria, and procedures which assure that air traffic terminal area control procedures and techniques are compatible with the equipment (airborne and ground-based) and the operational concepts and procedures used in these operations. FAA Orders 6750.7, 6750.16A, 6750.24, 6750.39, 6850.5A, 6850.9, 6850.25, 7110.65, 8240.45, 8400.8, 8260.6B, 8260.34, and the various advisory circulars used to approve AWTA operations are examples of documents where these criteria and procedures are specified. Figure 4.2.1.1. contains a more complete listing of the references applicable to the approval and conduct of CAT I, CAT II, and CAT III AWTA operations.

**414-. 440. RESERVED.**

**FIGURE 4.2.1.1.**
**REFERENCES FOR AWTA OPERATIONS**

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