U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: EMERGENCY EVACUATION DEMONSTRATIONS
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Change:

1. PURPOSE. This advisory circular (AC) provides guidance on a means, but not the only means, of compliance with the Federal Aviation Regulations (FAR) concerning: (1) conduct of full-scale emergency evacuation demonstrations, and (2) use of analysis and tests for emergency evacuation demonstrations in lieu of conducting an actual demonstration.

2. RELATED FAR SECTIONS.

a. Section 25.803, Emergency evacuation, as amended through Amendment 25-46.

b. Section 121.291, Demonstration and emergency evacuation procedures, as amended through Amendment 121-149.

3. BACKGROUND.

a. The requirements for emergency evacuation demonstrations were first established in Part 121 (§ 121.291) of the FAR by Amendment 121-2, effective March 3, 1965. Operators were required to conduct full-scale evacuation demonstrations with a time limit of two minutes using 50 percent of the exits. The purpose of the test was to demonstrate the crewmembers' ability to execute the established emergency evacuation procedures and to ensure realistic assignment of functions to the crew. A full-scale demonstration was required on initial introduction of a type and model of airplane into passenger-carrying operation, a five percent or greater increase in passenger seating capacity, or a major change in the cabin interior that would affect emergency evacuation.

b. The requirement for the airplane manufacturer to conduct an evacuation demonstration for airplanes having a seating capacity of more than 44 passengers was established in Part 25 (§ 25.803) by Amendment 25-15, effective October 24, 1967. The time limit for the manufacturer's demonstration was established at 90 seconds, and the Part 121 time limit was reduced to 90 seconds. It was considered that the manufacturer's demonstration would show the basic capability of a new airplane and, as before, the Part 121 demonstration was intended to account for crew training and adequate crew procedures. Therefore, the test conditions were somewhat different.

With the addition of the requirement for a full-scale demonstration in Part 25, § 25.803(d) gave conditions for analysis in lieu of demonstration. Section 25.803(d) stated that the demonstration need not be repeated for a change in the interior arrangement or a passenger capacity change of not more than five percent, or both, if it could be substantiated by analysis that the passengers could be evacuated in 90 seconds. At that time analysis was used for decreases in passenger capacity when an airplane was reduced in size. Generally, the analysis was based on a full-scale demonstration for the larger airplane. Analysis was also used for increases of less than five percent.

c. Since Amendment 25-15, numerous full-scale demonstrations have been conducted by the manufacturers for both type certification and operational requirements. These tests provided data on evacuation rates, escape system performance, and the behavior of evacuees during the demonstration.

d. By Amendments 25-46 and 121-149, effective December 1, 1978, § 25.803 was revised to allow a means other than actual demonstration to show the evacuation capability of the airplane and to replace the existing Part 25 demonstration conditions with conditions that would satisfy both Part 25 and Part 121 so one demonstration would serve both requirements. Part 25 was changed to match the conditions in Part 121.

Amendment 25-46 removed the five percent limitation on analysis from § 25.803(d). It was proposed in Notice 75-26, that analysis or a combination of analysis and tests be used to show evacuation capability. Amendment 25-46 dropped the provision which allowed analysis alone and required a combination of analysis and tests to assure approvals would be based on sufficient test data. It was considered that sufficient data may not be available in the case of a completely new airplane model or a model which had major changes or a considerably larger passenger capacity than a previously approved model. Thus, the requirement that the Administrator find the data used in the analysis acceptable was intended to preclude approvals which might be based on insufficient test data.

e. Amendment 121-176, effective January 18, 1982, allowed a Part 121 certificate holder to use the results of a Part 25 demonstration or the Part 121 demonstration of another operator to show compliance with § 121.291. This amendment also eliminated the five percent limit from Part 121 because the manufacturer would have already shown compliance with § 25.803 and the partial demonstration required by § 121.291 would show that the carrier's procedures, training program and maintenance program are adequate.

The preamble to Amendment 121-176 referred to the results of an FAA study of evacuation demonstrations. The preamble stated that the study concluded "that with rare exceptions, the rates of passenger egress are not significantly different for the same type of exit and that changes in the passenger cabin configuration, seat pitch, and aisle width have no significant bearing on the egress rates if the airplane type certification requirements for minimum aisle width and exit accessibility are met."

f. The conduct of emergency evacuation demonstrations and the use of analysis in lieu of a full-scale demonstration were discussed at the Public Technical Conference held by the FAA in September 1985, in Seattle, Washington.

These items were later discussed in detail at working group meetings. As a result of a paragraph by paragraph review of § 25.803(c), the FAA concluded that it was necessary to formalize policy on conduct of an evacuation demonstration and to clarify items of concern expressed by the group members. Most of the guidance presented in this AC is consolidated from existing FAA policy or the consensus of the working group. In those areas where no consensus could be reached, for example the use of analysis in lieu of full-scale demonstration, the FAA has decided how best to implement the regulations.

4. OBJECTIVE OF THE RULE.

a. A full-scale demonstration is conducted to assess the evacuation capability of the airplane and, when compliance with § 25.803(c)(7)(i) is requested, to also demonstrate the effectiveness of crew training and emergency procedures. Section 25.803(c) specifies the conditions for conduct of the evacuation demonstration.

b. The objective of the analysis allowed by § 25.803(d) is to show that the airplane can be evacuated within 90 seconds under the conditions specified in § 25.803(c). The use of analysis will reduce the number of injuries to passengers used in actual demonstrations and eliminate conducting demonstrations that would not provide additional knowledge.

5. DETERMINATION OF WHETHER ANALYSIS OR A DEMONSTRATION IS REQUIRED FOR A NEW CONFIGURATION.

a. Each change in airplane design that may have an effect on the emergency evacuation capability of the airplane should be evaluated for compliance with § 25.803, either by full-scale demonstration or by analysis if appropriate.

b. The following are examples of design changes that should be evaluated for their effect on evaluation capability.

(1) A change in type, number or location of exits.

(2) An increase in passenger capacity above that listed on the type certificate data sheet.

(3) Changes in passenger distribution within the cabin area that would increase the number of passengers expected to use an exit pair to a number greater than the exit rating of the exit pair.

(4) Classifying an exit as an "excess" exit in accordance with the requirements of § 25.807(c)(6).

(5) Installation of escape slides or other assist means not previously approved for that model airplane.

(6) Changes to the interior that adversly affect the passengers access to any emergency exit when the full-scale demonstration was conducted with significantly greater than minimum access. For example, partitions, galleys, etc., that restrict the flow of passengers merging from an aisle and

cross aisle, that restrict the crew's ability to determine which exits are operable, or restrict the crew's ability to balance the passenger flow to a Type A exit or among the operating exits.

c. Changes in passenger cabin configuration, seat pitch, aisle width and passageway configuration generally have no significant effect on evacuation if the minimum type certification requirements are met.

d. A full-scale demonstration should be conducted when one or more of the following conditions occur:

(1) Insufficient test data exist for an analysis, as discussed in paragraph 6.o.

(2) The type and number of exits is not identical to a previous approval (a new exit arrangement) and the passenger capacity requested is at or near the limit permitted by § 25.807(c). "Near" in this context is considered within five percent of the maximum allowable, not to exceed an increase of five percent from previously demonstrated arrangement.

NOTE: This would permit installation of additional exits if no increase in passenger capacity was requested; or a new exit arrangement at a reduced capacity, i.e., a passenger capacity less than that permitted by § 25.807(c), where the capacity is not substantially greater than that previously approved for the model in question. In any case, each exit's evacuation performance would have to be verified by test.

(3) The analysis indicates that the number of evacuees expected to use an exit is higher than has been previously demonstrated for that type exit.

(4) Crew duties are more complicated or physically demanding than previously demonstrated, i.e., the crew complement is changed or flight attendant seats are drastically relocated such that the crew performance as originally demonstrated is invalidated.

(5) The proposed passenger seating configuration is an increase of more than five percent above that which has been previously demonstrated on an airplane (which need not be the same model as the airplane being reviewed) with an identical (with respect to type and number of exits) exit configuration.

e. The determination that a demonstration or formal analysis is required is made by the FAA. The applicant can participate in this decision process by preparing a proposal for either running a demonstration or preparing an analysis. If the proposal is to do an analysis, the applicant should indicate which previous evacuation demonstrations will be used as the database for the analysis.

6. GUIDANCE FOR DEMONSTRATING COMPLIANCE WITH § 25.803.

a. Section 25.803(c). The following is intended to provide uniform standards for test conduct to make test results as directly comparable as is practical.

(1) Upon determination that an actual demonstration will be required, the applicant should prepare a test plan that outlines such details as time and place for the demonstration, test vehicle configuration, and flightcrew training program. This plan should be submitted to the FAA as soon as possible to allow the FAA time to review the plan and to arrange for participation of the appropriate FAA organizations.

(2) The phrase "The maximum capacity... for which certification is requested," refers to the airplane model presented for certification.

(3) To constitute a successful test, all passengers and crewmembers used in the demonstration must be evacuated to the ground or to an off-wing stand or ramp, if used, within 90 seconds. Use only the number of passengers for which approved seating is provided, not to exceed the limits of § 25.807(c) or (d). No credit is given for the number of evacuees on the ground at 90 seconds if all persons have not been evacuated.

(4) Federal Aviation Administration observers should be stationed inside the airplane at expected critical locations, and outside the airplane at each exit to be used. Small airplanes which do not have space for an onboard observer should provide extra interior video coverage to compensate for the absence of an official witness.

(5) The airplane should be configured with the minimum aisle and passage clearance expected to be type certificated. This may require combining features of more than one model. The airplane interior need not be representative of a specific configuration for the purposes of the test. For example, galleys and other furnishings may be simulated by mockups; seats need not have a Technical Standard Order (TSO) authorization, etc. The interior configuration should be FAA-approved, as a test configuration, prior to the test, and should be described in sufficient detail to allow a conformity inspection.

(6) The phrase "including the number of crewmembers required by the operating rule" refers to the minimum number of flight crewmembers listed in the Airplane Flight Manual (AFM) and the minimum number of flight attendants required by § 121.391 for the passenger capacity to be demonstrated. The observer seats need not be occupied.

(7) If the demonstration fails due to mechanical problems such as failure of a door or slide, the demonstration may be repeated after corrective action is identified to the FAA. A different group of passengers and crewmembers should be used in the repeat demonstration.

b. Section 25.803(c)(3).

(1) If the airplane is equipped with an off-wing assist means, it should be used during the demonstration in lieu of any stands or ramps.

(2) Safety personnel stationed outside the airplane to prevent injury to the participants, should not aid participants (until they have cleared the descent means), interfere with the evacuation process, or position the assist means following its deployment.

c. Section 25.803(c)(5). The emergency descent devices used in the demonstration should be those intended to be in the airplane type design. The slide certification program should have progressed to the point where the system is reliable and can be expected to perform safely during the demonstration.

d. Section 25.803(c)(7).

(1) Evacuation demonstrations using crewmembers meeting the requirements of § 25.803(c)(7)(ii) are conducted to demonstrate the evacuation capability of the airplane. Therefore, there are no specific crew training requirements for the demonstration.

(2) Evacuation demonstrations intended to meet the requirements of § 25.803(c) and § 121.291(a)(1) should use crewmembers who meet the requirements of § 25.803(c)(7)(i). These demonstrations are conducted to demonstrate the evacuation capability of the airplane and to demonstrate the effectiveness of the crewmembers' emergency training program and evacuation procedures.

(3) Flight attendants should be positioned at the most critical (with respect to executing their evacuation duties) cabin locations consistent with § 121.391. The flight attendants should be seated near operative and inoperative exits.

(4) Following the test start signal, the flightcrew should simulate the time required for normal pilot compartment procedures prior to commencing evacuation.

(5) Crewmembers in excess of the number required for the demonstration should be available. The FAA will select the crew that will participate in the test from this group. Subsequent tests, if required, may use crewmembers from the group remaining.

e. Section 25.803(c)(7)(i). In order to be considered a "regularly scheduled line crew," the crew should meet the following requirements:

(1) The crew should be trained in specific duties related to an emergency evacuation in accordance with an FAA-approved training program (for evacuation demonstration purposes). This training program need not be a complete flight attendant training program but should be an emergency evacuation training program similar in content and duration to the emergency evacuation portion of training programs approved under Part 121 and FAA-approved, for evacuation demonstration purposes, prior to the demonstration. Reference § 25.803(c)(19).

(2) If the crew to be used for the demonstration has been previously trained under an operator's FAA-approved program, additional training may be given when the airplane model or layout to be demonstrated differs from the one used by that operator. Training in exit operation and passenger management is especially important for a demonstration of a new model airplane; however, the crew should not be trained specifically in the conduct of a demonstration, or receive special training or be assigned duties not

normally associated with a Part 121 crew training program. This training should be similar in content and duration to the training received by a flight attendant when an operator adds a new model airplane to their operating certificate.

(3) If extensive training is required (or provided) for successful conduct of a demonstration, this additional information or training should be added to the training program of all operators utilizing that demonstration for compliance with § 121.291(a)(1).

(4) If the demonstration is not successful and crew procedures are changed in order to successfully conduct a repeat demonstration, the changes in procedures should be fully documented.

(5) The crew to be used in the demonstration should participate as required crewmembers on a regular basis and should not be instructors, supervisory personnel, worker-organization safety representatives, or anyone else expected to have knowledge above that of an average crewmember, with respect to evacuation demonstrations.

(6) Crewmembers from more than one operator may be used.

f. Section 25.803(c)(8). The following two age-sex distributions have been found to be equivalent under the provisions of § 21.21(b)(1) to that stipulated in this section:

	Age	Percent of Total	Percent of Female
(1)	21-50	80	30
	51-59	15	40
	60+	5	30
(2)	18-50	75	30
	51-60	25	40

g. Section 25.803(8)(iv). The life size dolls should be of appropriate size and weight to simulate an infant two years old or younger.

h. Section 25.803(c)(8)(v). In addition to those persons prohibited by the regulation, persons involved in the design or type certification of escape systems, development of emergency evacuation crew training, or those who have previously conducted evacuation demonstrations should not be used as passengers for the demonstration.

i. Section 25.803(c)(9). Passenger seating for the demonstration should be random. It is preferred that passengers be allowed to select their own seats except as specifically required by § 25.803(c)(9) and (c)(12). Federal Aviation Administration observers may subsequently reseat passengers at their discretion.

j. Section 25.803(c)(11). Simulated carry-on luggage in the form of small suitcases, gym bags, airplane flight bags, briefcases, etc., filled with old clothes or newspaper, that will fit under a passenger seat should be placed in the main aisle(s) with approximately one bag per seat row for each aisle. Also, some bags should be placed in the cross aisles and passageways and pillows and blankets should be scattered in the main aisle(s).

k. Section 25.803(c)(13).

(1) Neither the crew nor passengers should hear or otherwise receive any indication that the demonstration is about to begin. The first indication to persons on board the airplane should be the test start signal.

(2) If safety pillows or other equipment unique to the active exits are employed, passengers and crew should enter the airplane through a tunnel or other means that prevents them from viewing the airplane exterior.

(3) Video cameras used to record activity inside the airplane should be positioned so as not to reveal the exits used in this demonstration. This may require the installation of cameras at inoperative exits.

(4) If exit deactivation is by an external indication (e.g., red light outside exit), this indication should not be visible from inside the airplane until after the demonstration has begun. Mechanical deactivation of exits in a manner not perceptible to crew or passengers prior to attempting to operate them is preferred.

(5) For those airplanes equipped with emergency descent means, the means should be installed at inactive exits as well as active exits.

l. Section 25.803(c)(14). The following are guidelines for the applicant to obtain informed consent from participants in the demonstration and still comply with the intent of § 25.803(c)(14). These guidelines are not intended to be a complete list nor meet any legal requirements. The applicant is responsible to obtain informed consent and to comply with all local, state and federal laws and regulations concerning the use of people in tests of this nature.

(1) The applicant should seek consent under circumstances that provide the prospective participants sufficient opportunity to consider whether or not to participate in the demonstration. This will minimize the possibility of coercion or undue influence.

(2) The prospective participants should be informed of the purpose of the demonstration and the expected duration of their participation. They should also be given a description of any logistic procedures to be followed before and after the demonstration. Details of the test parameters should not be disclosed.

(3) The participants should be given a description of any reasonably foreseeable risks or discomforts such as the type or probability of injury that could be encountered when using an emergency escape slide.

(4) A description of any benefits of the testing should be given.

(5) An explanation should be given as to whether any compensation and/or medical treatments are available if injury occurs and, if so, what they consist of or where further information may be obtained.

(6) Information on whom to contact for answers to questions should be given.

(7) A statement should be given that participation is voluntary, refusal to participate will involve no penalty and that the subject may discontinue participation at any time without penalty or loss of benefits to which the subject is otherwise entitled.

(8) The consequences of a person's decision to withdraw from the demonstration at any given time and procedures for orderly termination of participation should be explained. This should include the consequences of the subject attempting to withdraw after the demonstration has started, such as the possibility of being pushed out of the airplane if the subject stops at the exit.

(9) The approximate number of participants involved in the demonstration may be disclosed.

(10) The participants may be told that they are evacuating an airplane via the escape slides and to follow the instructions of the crew, but a description of the location or operation of the exits, the conduct of the demonstration, or additional information not in the normal passenger briefing should not be given. The prospective passengers may not have the benefit of prior practice in exit or escape-slide operation or knowledge of the airplane configuration, since only crewmembers are required to be properly trained. Neither crewmembers nor passengers should have participated in a demonstration within the preceding six months.

m. Section 25.803(c)(17). In order for the operable exits to be representative of all of the required emergency exits on the airplane, one exit from each pair should be used. Flightcrew exits, ventral exits, tail-cone exits, and exits in the side of the fuselage that are not part of a pair should not be used for the demonstration (even if additional passenger capacity has been granted), except for ventral and tail-cone exits used in conjunction with an exit on the side that has been determined to be equivalent to an exit pair, such as the aft exits on the MD-81 and 82. (The MD-81 and MD-82 have a tail-cone exit and a Type I exit which is located on the left-hand side of the fuselage, aft of the wing. The FAA has determined that these two exits form an exit pair.)

n. Section 25.803(c)(20).

(1) The "acceptance rate" of the stand or ramp refers to the width of the passage to the stand or ramp.

(2) The test is complete when the last evacuee (passenger or crew) has cleared the assist means and has both feet on the ground or ramp (if provided at the off-wing exit).

o. Section 25.803(d).

(1) The preamble to Amendment 25-46 makes it clear that adequate test data are a prerequisite for considering substantiation of airplane evacuation capability using analysis instead of conducting a full-scale demonstration. It is intended that the analysis be a conservative prediction of the results that would be achieved if a full-scale demonstration were conducted. As such, the assumptions used should be conservative.

(2) Full-scale demonstrations should be required whenever one of the conditions specified in paragraph 5.b. cannot be substantiated by analysis.

(3) There are many factors that should be evaluated to determine the adequacy of data used to support an evacuation analysis. The data used in an evacuation analysis should be based on actual demonstrations used to show compliance with § 25.803(c) or § 121.291 or other appropriate tests such as demonstrations of portions of an airplane cabin conducted under the conditions of § 25.803(c). It should not include data from mini-evacuations conducted under § 121.291(b), escape-slide evacuation rate tests conducted under the Technical Standard Order (TSO), or "Latin-square" (see FAA Order FS8110-12, dated May 21, 1964) tests that do not meet all the requirements of § 25.803(c).

(4) Test data to be used as a basis for analysis should be derived from demonstrations which are consistent with the type demonstration that would be conducted for the model in question. That is, tests which would be currently unacceptable as showing compliance with § 25.803(c) should not be used as a basis for analysis.

(5) In order to preclude extending an analysis to a completely new airplane exit arrangement and passenger capacity, a comparative analysis should be made with a full-scale demonstration of an airplane that has identical type and number of exits. As noted in paragraph 5.d.(2), it would be possible to analyze a modified exit arrangement at a reduced passenger capacity. The reduced capacity should be approved on the airplane used for comparison as desribed above. The airplane under consideration should also be compared to previous approvals of similar airplanes and should consider passenger capacity, passenger distribution, aisles, cross aisles, crew stations, crew duties, exit locations, and exit distribution. Any differences should be examined for their effect on evacuation capability. It may be necessary to conduct partial evacuation demonstrations to substantiate particular aspects of the airplane design for which insufficient data exist.

(6) Evacuation data from previous full-scale demonstrations on the same model airplane should be used as the primary source for an analysis. Data from different model airplanes may be conservatively applied for the same exit types if it can be shown that the exits on the airplane being analyzed will produce equivalent evacuation rates considering all the elements noted below. Different series of the same airplane are considered to be the same model. For example, the 737-100 and 737-200 are the same model, and since the exits are identical, demonstrations on one of these airplanes are the best source of data for analysis on the second.

(7) Each exit should be evaluated considering the time for the crew to reach their assigned evacuation station, time to fully open the exit, slide inflation time, evacuee hesitation, time for an evacuee to traverse the slide, evacuation rate, passenger distribution within the cabin, and the passenger management duties of the crew.

(8) Evacuation rate data should include average passenger flow rates for each type of exit, considering the internal constraints as well as the escape slide being analyzed. This average should include as many demonstrations as possible, but no less than five individual exit rates for each type (A, I, III, etc.) of exit being analyzed for data applied to a different model. Data from the same model airplane should include three exit rates per exit type or should otherwise be applied conservatively. Conversely, a derivative model whose only difference from a demonstrated model is a shortened fuselage (door/slide mechanisms identical) could be analyzed in a simplified fashion.

(9) The passenger distribution within the airplane with respect to the exits should be evaluated to determine the number of persons likely to use each exit. The highest passenger seating density expected in each area of the cabin should be considered. Critical points such as aisles, passageways, and points where aisles and cross aisles meet should be evaluated for factors that may limit evacuation rate versus the arrangements actually demonstrated.

(10) The analysis should also include an evaluation of the duties the crewmembers are expected to perform to assure that those duties are no more difficult than those performed during a successful full-scale demonstration. This is of particular importance when considering the performance of the crew in directing passengers to usable exits and redirection of passengers during a demonstration in an attempt to balance the number of passengers using each exit.

(11) As a general guideline, evacuation analyses should be at least informally coordinated with the certificating office for a given model to ensure that all factors that may have been significant in the original approval have been addressed.

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