U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: UNIFORM DISTRIBUTION OF EXITS **Date:** 8/13/90 **AC No:** 25.807-1
Initiated by: ANM-110 **Change:**

1. PURPOSE. This advisory circular (AC), applicable to transport airplanes, provides guidance material defining acceptable means, but not the only means, of demonstrating compliance with the requirements for distributing required passenger emergency exits uniformly. This AC addresses only those passenger-carrying airplanes, including mixed passenger/cargo ("combi") configurations, which are required to comply with § 25.807, Amendment 25-15 or later. This AC does not address airplanes with only one pair of required exits. There is no intent to impact existing certificated passenger/exit configurations or new models added to existing type certificates which have identical, or improved, passenger/exit configurations even if these configurations do not strictly meet the guidance material presented herein. The intent is to provide guidance for application to new airplane models, to prevent changes to derivative airplanes which would worsen already marginal configurations, and to prevent changes to existing airplanes that could result in undesirable passenger/exit configurations. Such changes could include, but not be limited to, the addition of fuselage sections between existing exits, and the addition of passenger seats in areas of the cabin beyond previously approved numbers.

2. REFERENCE REGULATION. Section 25.807(c) of the Federal Aviation Regulations (FAR).

3. BACKGROUND.

a. Amendment 25-15 introduced the requirement in § 25.807(c) that passenger emergency exits "be distributed as uniformly as practicable taking into account passenger distribution." Additionally, the preamble to Notice of Proposed Rulemaking (NPRM) 66-26 stated that the FAA was proposing to "require that emergency exits be distributed as uniformly as possible throughout the passenger compartment." The intent of the regulation change was to maintain a passenger-to-exit proximity which would provide the passenger reasonable access to an exit in case of an emergency. Therefore, when considering the exit distribution, both passenger distribution and the placement of exits along the length of the passenger compartment should be considered. Other factors such as types of exits installed and maintenance of reasonable separation between adjacent exits should also be considered.

b. In September 1985, the Federal Aviation Administration (FAA) held a Public Technical Conference on Emergency Evacuation of Transport Airplanes, in

Seattle, Washington. As a result of the conference, a number of recommendations were given to the FAA. One of the recommendations was for the FAA to develop an AC to provide guidance in demonstrating compliance with § 25.807(c), Amendment 25-15, which requires that the prescribed exits be uniformly distributed.

c. The FAA confirmed that there was a lack of existing guidance regarding uniform distribution of exits.

d. Another recommendation was for the FAA to adopt a regulation to specify a maximum distance between adjacent exits. Amendments 25-67 and 121-205 were adopted June 13, 1989, effective July 24, 1989, specifying a maximum distance of no more than 60 feet between adjacent exits. This new requirement must be complied with as well as the requirement for uniformly distributed exits when developing exit configurations.

4. DEFINITIONS.

a. Passenger zone (or zone). A section of the passenger cabin which is bounded longitudinally by a pair of exits on both ends or, in instances where there are passenger seats installed beyond the most forward or most aft pair of exits, a section of the passenger cabin bounded by the start or end of the passenger cabin and the nearest pair of exits. Airplanes with ventral or tail cone exits which allow for an increase in passenger seating beyond Tables 1 and/or 2 (see paragraph 5a for explanation of tables) can have this unpaired exit be the aft bound of the last zone. Exit centerlines or the centerline of the front tie-down of the passenger seat furthest from the exit, for the second type of zone discussed above, should be used for determining the actual start or finish of a zone.

NOTE: The front tie-down is determined with respect to the leading edge of the seat bottom cushion and not the orientation of the seat in the airplane, i.e., forward or aft facing.

b. Exit rating (or rating). The increase in passenger seating configuration allowed by the installation of a pair of that type of exit, as listed in § 25.807(c)(2), Amendment 25-39. For example, the exit rating for a pair of Type A exits is 110. For airplanes whose maximum capacity is determined by Table 1 (see paragraph 5a), the rating of the Type I exits varies (see paragraph 6a(1) for method of determining rating). Ratings for the generally unpaired ventral or tail cone exits are as determined by § 25.807(c)(4).

c. Maximum passenger seating configuration (or maximum passenger capacity). The theoretical maximum number of passenger seats that can be installed in an airplane based upon the exit configuration and the exit ratings of § 25.807(c).

NOTE: Not all airplanes are approved for installation of the theoretical maximum passenger seating configuration. Refer to the appropriate type certificate data sheet for the maximum FAA approved seating configuration, if necessary.

d. Passenger cabin length. Usually the distance from the centerline of the forward most exit to the centerline of the aft most exit in the airplane. (Section 25.807(c) requires that for non-combi airplanes without ventral or tail cone exits with more than one pair of floor level exits, one pair be located near each end of the cabin. Most current airplanes that fit this description have the exit at the ends of the cabin.) If there are four or more rows of passenger seats located beyond the most forward or most aft exits, then the cabin starts or ends at the centerline of the front stud of the most forward and/or most aft passenger seat. For airplanes with tail cone or ventral exits, for which additional passenger capacity has been given or is being sought, the end of the cabin should be considered to be the bulkhead through which the passengers must pass in order to gain access to the tail cone opening or ventral stairs.

e. Exit unit. A dimensionless number that is related to the exit rating of a pair of exits of the same type and uses the rating of the Type III exit (35) as the baseline. The exit unit value of a pair of exits is determined by dividing the rating of the exit by 35 and rounding the value down to the next quarter of a unit. Typical values for exits (rating shown in parentheses) are as follows:

(1) Type III (35) and Type II (40) - 1.0;

(2) Two pairs of Type III exits which are located within three rows of each other (70) - 2.0;

(3) Type I (45) - 1.25;

(4) Oversized Type I with dual slide, so-called Type "B" (80) - 2.25 or (75) - 2.0;

(5) Type A (110) - 3.0.

f. Fuselage length factor (or length factor). A length determined by dividing the length of the passenger cabin by the sum of the exit units in each zone in the airplane.

g. Exit offset. The distance between the proposed exit centerline and the calculated exit centerline using paragraph 6b(2).

h. Individual zone passenger capacity. The maximum number of passengers which may be seated in an individual zone. That number is the sum of the ratings of the exits which bound the zone.

NOTE: For airplanes with more than one zone, the sum of all the individual zone passenger capacities will exceed the allowable maximum passenger seating configuration. This is because non-end-of-cabin exit ratings will be double counted.

i. Sequential zone passenger capacity. The maximum number of passengers which may be seated in two or more adjacent zones. That number is the sum of the ratings of the exits which either bound or are included within the adjacent zones.

5. DISCUSSION.

a. Section 25.807 contains two tables which specify the types and quantities of exits required for passenger seating configurations no greater than 299. The first table (henceforth referred to as Table 1) specifies the exit types and quantities of exits required for each side of the fuselage for passenger seating configurations up to and including 179. The second table (henceforth referred to as Table 2) lists the increases in passenger configuration over 179 that are allowed when various additional types of exits are provided. For passenger seating configurations greater than 179 but not greater than 299, the exit types and quantities specified in Table 1 for each side of the fuselage for a passenger seating configuration of 179 must be supplemented with additional exits as specified in Table 2. The ratings shown in Table 2 for various types of exits cannot be used to obtain the allowed passenger capacities contained in Table 1.

b. For passenger seating configurations in excess of 299, § 25.807(c)(3) specifies that each exit must be either a Type A or Type I exit. For such configurations, § 25.807 (see Table 2) further specifies that a passenger seating configuration of 110 is allowed for each pair of Type A exits (one on each side of the fuselage) and a passenger seating configuration of 45 is allowed for each pair of Type I exits.

c. Ventral and tail cone exits are not installed in pairs; however, § 25.807(c)(4) provides for their use in certain circumstances in lieu of those specified for each side of the fuselage.

d. For airplanes whose type certification basis is Part 25, including Amendments 25-15 through 25-31, § 25.807(c)(3)(i) and (ii) allows up to 10 additional passenger seats to be installed if slides meeting the requirements of § 25.809(f)(1) are installed at floor level exits.

e. An acceptable method of meeting the requirement for uniform distribution of exits is described in paragraph 6. It considers the two aspects of uniform distribution of exits.

(1) The first is the number and location of passengers throughout the passenger cabin with respect to the exits. The guidelines were based on criteria which should provide a reasonable evacuation flow. Under the criteria, passengers should not be required to bypass an exit in order to minimize evacuation time. This was achieved by limiting the passenger capacity of a passenger zone to the sum of the ratings of the exits bordering the zone. This limitation still allows considerable flexibility for the airplane designer, e.g., on an airplane with three pairs of Type A exits, each of the two passenger zones could have passenger capacities ranging from 110 to 220 passengers and still allow for the maximum capacity of 330 passengers. For a zone with exits on only one end (so-called "dead-end zone"), a maximum capacity equal to 75 percent of the rating of the pair of exits is recommended. This capacity was determined by reviewing exemptions from § 4b.362(c)(1) of the Civil Air Regulations (CAR) (recodified as § 25.807(c)(1) of the FAR), and § 25.807(c) of the FAR, which were granted to combi configurations in which only one pair of exits were available to the passengers. Exemption Nos. 420 (relating to the 707-300C) and 2463 (relating to the DC-10) allowed a passenger capacity of 33 for a passenger cabin with a

pair of Type I exits equipped with slides, 50 for a cabin with a pair of improved Type 1 exits (Type "B"), and 70 for a cabin with a pair of Type A exits. Those passenger capacities were 73.3 percent, 62.5 percent, and 63.6 percent, respectively, of the ratings in Table 2 for the Type I and Type A exits and the rating of 80 for the improved Type I granted by Exemption No. 1573. Since the exits in this case would not be the only exits available, the recommended percentage is the highest one granted by the exemptions rounded up to the next 5-percent level. On most airplanes with two or more pairs of floor level exits, except for combis, the capacities of dead-end zones will be quite low since § 25.807(c) also requires that floor level exits be near each end of the cabin.

(2) The second is the proximity of the exits to each other along the length of the passenger cabin taking into account the ratings (as determined by exit type) of the exits. This results in an arrangement where passenger cabin zones are sized according to the type of exits which bound the zone. The ± 15-percent tolerance from the nominal location, as allowed in paragraph 6b(2)(vi), was developed by analyzing current transport airplane configurations and selecting a tolerance band which encompassed the majority of the airplanes. Airplanes which fell outside the tolerance band ranged from 15.9 percent to over 25 percent beyond the nominal location for at least one exit.

f. The method is based on providing uniformly distributed exits for a typical single class, maximum passenger seating configuration in the airplane.

(1) Care, therefore, should be taken when reviewing seating configurations which include first and/or business class seating. This may result in overloading the economy class zones while still keeping the total seating configuration at or below the maximum for the entire airplane.

(2) Consideration may be given to airplane configurations which, by virtue of the number and types of exits installed in the airplane, have a theoretical maximum passenger seating configuration well beyond the practical maximum seating capacity. For example, for a twin-aisle airplane having four pairs of Type A exits, the theoretical maximum passenger seating capacity would be 440. If, however, the airplane were only big enough to seat 370 passengers at the highest density seating, then only three pairs of Type A exits and one pair of Type I exits would be required, by Table 2, for that number of passengers. It would then be permissible to evaluate the airplane as if one of the Type A exit pairs had been derated to Type I exits (thereby limiting the maximum passenger capacity to 375), or, alternatively, to derate two of the Type A exit pairs to Type "B" exits (thereby limiting the maximum passenger capacity to 380 or 370, depending on the Type "B" rating). This could be useful to the applicant, particularly when one of the three passenger zones is significantly smaller than the other two. The same derating of exits, for purposes of the analysis, would be acceptable if the applicant proposed to purposefully limit the passenger seating capacity of the airplane to a lesser number than theoretically allowable. (When exits are derated for purposes of analyzing their proximity to each other, their full rating may still be used for calculating passenger zone capacities. See Example 3 in Appendix 1.)

6. ACCEPTABLE METHOD.

a. General considerations.

(1) In completing the calculations specified under the method of analysis (paragraphs 6b(1), (2), (3)), the exit ratings of Table 2 should be used for all exit types with the following exceptions:

(i) For airplanes whose maximum passenger seating configuration is established by Table 1 and is greater than 39, including those airplanes whose type certification basis allows extra seats for installing slides, the rating for Type I exits should be determined for each airplane separately. Development of the rating for Type I exits may also be required for airplanes whose exit configuration is approved by the granting of a petition for exemption or by a finding of an equivalent level of safety, e.g., the BAe-146 and the 757. The rating is determined by subtracting the ratings for the non-Type I exits, as found in Table 2, from the maximum of the range in which the maximum capacity falls in Table 1 (which may be increased by 10 for certain airplanes as described in paragraph 5d) and then dividing the remainder by the number of pairs of Type I exits. For example, for an airplane with a space-limited seating capacity of 145, Table 1 requires that it have two pairs of Type I exits and two pairs of Type III exits. With such an exit configuration, however, the airplane would be eligible for a maximum passenger seating configuration of 179. Therefore, the rating for the Type I exits for this airplane, for analytical purposes, would be (179 - 2(35)) / 2 = 54.5 which is rounded up to 55.

(ii) For airplanes with one pair each of Type II and Type III exits with a maximum passenger seating configuration between 20 and 39, assign a rating of 20 to the Type II exits and a rating of 19 to the Type III exits.

(2) For airplanes which have two pairs of adjacent Type III exits, these may be considered in the analysis in paragraph 6b to be one exit pair with a rating of 70 passengers, provided that the exits are no more than three seat rows apart. Since this "double III" exit does consist of two separate exits, however, care should be taken to ensure that passenger flow to the "double III" comes from both directions. A "double III" should never be located, for example, at the end of a passenger cabin. For purposes of defining the start or end of a zone bounded by two pairs of Type III exits, establish a new centerline midway between the two exits. Seats whose front studs are forward of the new centerline will be considered to be in the forward zone, seats aft of the centerline in the aft zone. If the exits are more than three rows apart, they should be considered as separate exits with a passenger zone between them.

(3) If a ventral or tail-cone exit or any other unpaired exit is installed, but no increase in passenger seating is allowed, the exit is not to be considered in the analysis. Exit pairs which are installed, but which have been determined to be excess exits, as noted in § 25.807(c)(6), Amendment 25-32, should normally not be considered in the analysis. If, however, the excess exits are needed in order to meet the criteria specified in this AC, then those exits should no longer be considered as excess exits.

(4) When the exits in an exit pair are not directly opposite each other, the analysis should consider the exit distribution on each side of the

airplane separately. For example, if the forward exits of an airplane are staggered such that the centerline of the left hand exit is at fuselage station (FS) 100 and the right hand exit is at FS 130, the airplane should be analyzed as if the forward exits were at FS 100 and then the airplane should be analyzed again as if the forward exits were at FS 130. Both analyses should be acceptable in order for the airplane to be acceptable.

b. The method of analysis for determining compliance with the uniform distribution requirement.

(1) An evaluation should be made to determine passenger distribution throughout the passenger cabin with respect to exits. In making this determination, the following steps should be taken:

(i) The passenger seating within any zone should not exceed the sum of the ratings of the two pairs of exits bounding the zone. For example, the passenger capacity in a zone bounded by two pairs of Type A exits should not exceed 220 (2 x 110). For airplanes which have passengers seated forward of the first exit or aft of the last exit in the passenger cabin, the first or last zone in the airplane would be from the start or end of the passenger cabin to the closest pair of exits. For these zones, the capacity should not exceed 75 percent of the rating of the single pair of exits bounding the zone.

(ii) In addition to the maximum capacities per individual zone, while traversing the airplane from nose to tail and also from tail to nose, the passenger capacity should not exceed the sum of the ratings of the exits included in the consecutive zones being analyzed.

(iii) The maximum seating capacity should be determined by referring to Tables 1 and/or 2 or, as necessary, the type certificate data sheet for the specific airplane.

(2) An evaluation should be made to determine the distribution of the exits with respect to the fuselage and to each other, taking into account the type of each exit. In making this determination, the following steps should be taken:

(i) Determine the passenger cabin length. An adjustment is required when there is a zone beyond the first and/or last pair of exits. If the zone consists of three or less rows of seats, ignore the cabin beyond the exit and start or end the cabin at the exit centerline. If there are four or more rows, the cabin starts or ends at the location of the front stud of the most remote seat row;

(ii) Determine the exit unit value of each exit in the airplane. Then determine the number of exit units in each zone of the airplane by adding the exit unit values of the exits bounding the zone. When a zone beyond the first and last pair of exits is three rows or less, do not give that zone an exit unit rating. In addition, determine the total number of exit units in the airplane by adding the total of each zone (this results in non-end-of-cabin exit units being counted twice);

(iii) Divide the cabin length by the total number of exit units to determine the value of the fuselage length factor;

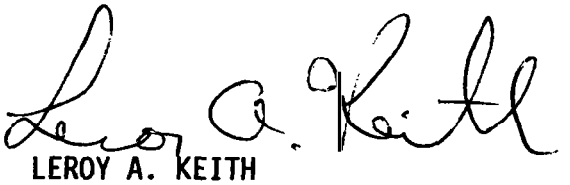
(iv) Starting at the beginning of the passenger cabin (which will be either the centerline of the first exit or the centerline of the front stud of the most forward pair of seats), determine the nominal location of the centerline of the next (or first) pair of emergency exits by multiplying the fuselage length factor by the number of exit units in Zone A and adding the result to the fuselage station at the start of the cabin. The nominal location of the centerline of the next pair of exits is determined by multiplying the fuselage length factor by the number of exit units in Zone B and adding that number to the previous nominal location. This procedure is repeated until all the nominal exit locations are determined. The starting and end points are fixed by the configuration and need not be calculated;

(v) At each nominal exit location, determine the offset of the proposed/actual exit from the nominal location. With the exception of two pairs of Type III exits within three rows of each other, however, two adjacent pairs of exits should not be closer than the distance of the fuselage length factor.

(vi) Calculate the offset as a percent of the length of the cabin. No proposed/actual exit should be more than ± 15 percent from the nominal exit location.

(3) The nominal exit location, and the allowed ± 15 percent deviation from that location, is not applicable when it would position the exit in an area that could be hazardous to passengers during an emergency evacuation. Such areas are in the vicinity of propeller planes, engine intakes or pylons, landing gear, and the wing leading and trailing edges.

7. EXAMPLES. See Appendix 1 for four examples using this method of analysis.



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APPENDIX 1

EXAMPLE 1

Airplane 1 has five pairs of exits, listed by exit type, in this order: I, A, A, I, and I, with no passenger seats located beyond the forward and aft exits. The centerlines of exits 1 through 5 are FS 200, FS 750, FS 1200, FS 1875, and FS 2200, respectively. Zone A is bounded by a pair of I's and a pair of A's, Zone B by two pairs of A's, Zone C by a pair of A's and a pair of I's, and Zone D by two pairs of I's.

The maximum seating configurations of the four zones and sequential combinations of these zones are as follows:

(a) Individual zone passenger capacities:
Zone A: 155 (45 + 110);
Zone B: 220 (110 + 110);
Zone C: 155 (110 + 45);
Zone D: 90 (45 + 45).

(b) Sequential zone passenger capacities - nose to tail:
Zones A + B: 265 (45 + 110 + 110);
Zones A + B + C: 310 (45 + 110 + 110 + 45).

Sequential zone passenger capacities - tail to nose:
Zones D + C: 200 (45 + 45 + 110);
Zones D + C + B: 310 (45 + 45 + 110 + 110).

(c) Maximum passenger seating configuration:
Zones A + B + C + D: 355 (The exit limit per Table 2).

Exit distribution with respect to fuselage is as follows:

(a) The length of the cabin is 2000 inches (FS 2200 - FS 200).

(b) The number of exit units in each zone is as follows:
Zone A: 4.25 (1.25 + 3.0);
Zone B: 6.0 (3.0 + 3.0);
Zone C: 4.25 (3.0 + 1.25);
Zone D: 2.5 (1.25 + 1.25);
Airplane total: 17.0.

(c) Fuselage length factor = 117.6 inches (2000"/17).

(d) Nominal exit location:
Exit 1: FS 200 (by definition, as it is at the start of the passenger cabin);
Exit 2: FS 699.8 (200 + (117.6 x 4.25));
Exit 3: FS 1405.4 (699.8 + (117.6 x 6.0));
Exit 4: FS 1905.2 (1405.4 + (117.6 x 4.25));
Exit 5: FS 2200 (by definition, as it is at the end of the passenger cabin).

(e) Exit offsets:

Exits 1 and 5: Offset = 0;
Exit 2: Offset = 50.2" (750 - 699.8);
Exit 3: Offset = 205.4" (1405.4 - 1200);
Exit 4: Offset = 25.4" (1905.2 - 1875).

(f) Percent of exit offset:
Exits 1 and 5: 0%;
Exit 2: 2.5% (50.2/2000 x 100%);
Exit 3: 10.3% (205.4/2000 x 100%);
Exit 4: 1.3% (25.4/2000 x 100%);
All exits are offset less than 15 percent from the nominal locations and are acceptable.

(g) By inspection, no two exits are closer together than the fuselage length factor of 117.6 inches (see 6b(2)(v)).

EXAMPLE 2

Airplane 2 has a passenger cabin with four pairs of exits: a Type I, III, III, and I, in that order, and a tail-cone exit which has been determined to allow an increase in seating configuration of 25. There are also 12 passengers (two rows of seats) seated forward of the first pair of exits. The centerlines of exits 1 through 4 are at FS 200, FS 600, FS 640, and FS 945, respectively. The tail-cone exit floor-level opening in the passenger cabin is at FS 1200. The first seat in the airplane is at FS 110. Since there are only 40 inches between the two pairs of Type III exits, there must be less than three rows of seats between them. Therefore, for purposes of the analysis, they can be considered to be one double Type III exit with centerline at FS 620. Therefore, Zone A is bounded by the start of the passenger cabin and a I, Zone B by a I and the double III, zone C by the double III and a I, and Zone D by a I and the tail-cone exit.

This configuration is defined in Table 1 with the addition of the tail-cone rating of 25 for a total of 204 passengers. The calculated rating for Type I exits for this airplane is 55 ((204 - (25 + (2 x 35))) / 2).

The maximum seating configurations of the three zones and sequential combinations of these zones are as follows:

(a) Individual zone passenger capacities:
Zone A: 41 (.75 of 55, rounded down);
Zone B: 125 (55 + (2 x 35));
Zone C: 125 ((2 x 35) + 55);
Zone D: 80 (55 + 25).

(b) Sequential zone passenger capacities - nose to tail:
Zones A + B: 125 (55 + (2 x 35));
Zones A + B + C: 180 (55 + (2 X 35) + 55).

Sequential zone passenger capacities - tail to nose:
Zones D + C: 150 (25 + 55 + (2 x 35));
Zones D + C + B: 204 (the limit per Table 1 plus 25 for the tail cone).

(c) Maximum passenger seating configuration:
Zones A + B + C + D: 204 (the limit per Table 1 plus 25 for the tail cone).

Exit distribution with respect to fuselage is as follows:

(a) The length of the passenger cabin is 1000 inches (FS 1200 - FS 200). Note that the passenger cabin was deemed to start at the centerline of the forward exits rather than at the front stud of the first row of seats. This is because Zone A is too small, i.e., three rows or less, to warrant an exit unit rating.

(b) The number of exit units in each zone and in the airplane is as follows:
Calculate the exit unit value for the Type I exits: 55/35 = 1.57 rounded down to 1.5;
Calculate the exit unit value for the tail-cone exit: 12/35 = .34 rounded down to .25.
Zone A: 0;
Zone B: 3.5 (1.5 + 2);
Zone C: 3.5 (2 + 1.5);
Zone D: 1.75 (1.5 + .25);
Airplane total: 8.75.

(c) Fuselage length factor = 114.3 inches (1000"/8.75).

(d) Nominal exit locations:
Exit 1: FS 200 (by definition, as it is at the start of the passenger cabin);
Exit 2: FS 600 (200 + (114.3 x 3.5));
Exit 3: FS 1000 (600 + (114.3 x 3.5));
Exit 4: FS 1200 (by definition, as it is at the end of the passenger cabin).

(e) Exit offsets:
Exits 1 and 4: Offset = 0;
Exit 2: Offset = 20 (620 - 600);
Exit 3: Offset = 55 (1000 - 945).

(f) Percent of exit offset:
Exit 1 and 4: 0%;
Exit 2: 2.0% (20/1000 x 100%);
Exit 3: 5.5% (55/1000 x 100%);
All exits are offset less than 15 percent from the nominal locations and are acceptable.

(g) By inspection, no two exits, the two Type III exits excluded, are closer together than the fuselage factor of 114.3 inches.

EXAMPLE 3

Airplane 3 has a dual-aisle passenger cabin with four pairs of exits: Type A, A, I, and A, in that order. The centerline of the exits are at FS 160, FS 600, FS 900, and FS 1600, respectively. Zone A is bounded by two pairs of

A's, Zones B and C by a pair of A's and a pair of I's. Because of the size of the airplane, the passenger seating capacity is effectively space-limited to 304 passengers.

The maximum seating configurations of the three zones and sequential combinations of these zones are as follows:

(a) Individual zone passenger capacities:
Zone A: 220 (110 + 110);
Zone B: 155 (110 + 45);
Zone C: 155 (45 + 110).

(b) Sequential zone passenger capacities - nose to tail:
Zones A + B: 265 (110 + 110 + 45).

Sequential zone passenger capacities - tail to nose:
Zones C + B: 265 (110 + 45 + 110).

(c) Maximum passenger seating configuration:
Zones A + B + C: 375. This is the exit limit of the airplane using Table 2.

Exit distribution with respect to fuselage is as follows:

(a) The length of the cabin is 1440 inches (FS 1600 - FS 160).

(b) The number of exit units in each zone is as follows:
Zone A: 6.0 (3.0 + 3.0);
Zone B: 4.25 (3.0 + 1.25);
Zone C: 4.25 (1.25 + 3.0);
Airplane total: 14.5.

(c) Fuselage length factor = 99.3 inches (1440"/14.5).

(d) Nominal exit location:
Exit 1: FS 160 (by definition, as it is at the start of the passenger cabin);
Exit 2: FS 755.8 (160 + (99.3 x 6));
Exit 3: FS 1177.8 (755.8 + (99.3 x 4.25));
Exit 4: FS 1600 (by definition, as it is at the end of the passenger cabin).

(e) Exit offsets:
Exits 1 and 4: Offset = 0;
Exit 2: Offset = 155.8" (755.8 - 600);
Exit 3: Offset = 277.8" (1177.8 - 900).

(f) Percent of exit offset:
Exits 1 and 4: 0%;
Exit 2: 10.8% (155.8/1440 x 100%);
Exit 3: 19.3% (277.8/1440 x 100%);
Exit 3 is offset by more than 15 percent and therefore falls outside the acceptable tolerance bounds for locating that exit.

The configuration does not meet this guidance for uniform distribution of exits.

(g) By inspection, no two exits are closer together than the fuselage length factor of 99.3 inches.

Because the airplane is space-limited to a maximum of 304 passengers, the airplane can be reanalyzed, since the maximum seating capacity would require only two pairs of Type A and two pairs of Type I exits be installed (per Table 2). Since Zone B is the smallest zone, designate exit number 2 as being derated to a Type I exit for purposes of the exit distribution analysis.

The maximum seating configurations of the three zones and sequential combinations of these zones are as follows:

(a) Individual zone passenger capacities:
Zone A: 220 (110 + 110);
Zone B: 155 (110 + 45);
Zone C: 155 (45 + 110).

(b) Sequential zone passenger capacities - nose to tail:
Zones A + B: 265 (110 + 110 + 45).

Sequential zone passenger capacities - tail to nose:
Zones C + B: 265 (110 + 110 + 45).

(c) Maximum passenger seating configuration:
Zones A + B + C: 375 (the limit per Table 2).

Exit distribution with respect to fuselage is as follows:

(a) The length of the passenger cabin is 1440 inches (FS 1600 - FS 160).

(b) The number of exit units in each zone and in the airplane is as follows:
Zone A: 4.25 (3.0 + 1.25);
Zone B: 2.5 (1.25 + 1.25);
Zone C: 4.25 (1.25 + 3.0);
Airplane total: 11.0.

(c) Fuselage length factor = 130.9 inches (1440"/11).

(d) Nominal exit locations:
Exit 1: FS 160 (by definition, as it is the start of the passenger cabin);
Exit 2: FS 716.3 (160 + (4.25 x 130.9));
Exit 3: FS 1043.6 (716.3 + (2.5 x 130.9));
Exit 4: FS 1600 (by definition, as it is at the end of the passenger cabin).

(e) Exit Offsets:
Exits 1 and 4: Offset = 0;

Exit 2: Offset = 116.3" (716.3 - 600);
Exit 3: Offset = 143.6" (1043.6 - 900).

(f) Percent of exit offset:
Exits 1 and 4: 0%;
Exit 2: 8.1% (116.3/1440 x 100%);
Exit 3: 10.0% (143.6/1440 x 100%);
All exits are offset less than 15 percent from the nominal locations and are acceptable. The reanalysis based on the actual passenger maximum capacity shows that this configuration is acceptable. (Note that the lower passenger capacity could also have been self-imposed by the manufacturer.)

(g) By inspection, no two exits are closer together than the fuselage length factor of 130.9 inches.

EXAMPLE 4

Airplane 4 has three pairs of exits in this order: Type I, III, and I, with four rows of seats aft of the most aft exit and with the forward pair of exits offset from one another. The centerlines of the exits are as follows: L1 - FS 100, R1 - FS 220, L2 and R2 - FS 500, L3 and R3 - 850. The seats in the first row in the airplane have their front studs at FS 120 on the left side and FS 90 on the right side (there are four rows of seats forward of the R1 exit) and the seats in the last row in the airplane have their front studs at FS 970.

This configuration is defined in Table 1 for a total of 139 passengers. The calculated rating for Type I exits for this airplane is 52 ((139-35)/2).

Analysis of left-hand side:

The maximum seating configurations of the three zones and sequential combinations of these zones are as follows:

(a) Individual zone passenger capacities:
Zone A: 87 (52 + 35);
Zone B: 87 (35 + 52);
Zone C: 39 (.75 x 52).

(b) Sequential zone passenger capacities - nose to tail:
Zones A + B: 139 (52 + 35 + 52).

Sequential zone passenger capacities - tail to nose:
Zones C + B: 87 (52 + 35).

(c) Maximum passenger seating configuration:
Zones A + B + C: 139. This is the exit limit of the airplane using Table 1.

Exit distribution with respect to fuselage is as follows:

(a) The length of the cabin is 870 inches (FS 970 - FS 100).

(b) The number of exit units in each zone is as follows:
Zone A: 2.25 (1.25 + 1.0);
Zone B: 2.25 (1.0 + 1.25);
Zone C: 1.25;
Airplane total: 5.75.

(c) Fuselage length factor = 151.3 inches (870"/5.75).

(d) Nominal exit location:
Exit 1: FS 100 (by definition, as it is at the start of the passenger cabin);
Exit 2: FS 440.4 (100 + (151.3 x 2.25));
Exit 3: FS 780.8 (440.4 + (151.3 x 2.25)).

(e) Exit offsets, proposed versus nominal:
Exit 1: Offset = 0;
Exit 2: Offset = 59.6" (500 - 440.4);
Exit 3: Offset = 69.2" (850 - 780.8).

(f) Percent of exit offset:
Exit 1: 0%;
Exit 2: 6.9% (59.6/870 x 100%);
Exit 3: 8.0% (69.2/870 x 100%);
All exits are offset less than 15 percent from the nominal locations and are acceptable.

(g) By inspection, no two exits are closer together than the fuselage length factor of 151.3 inches.

Analysis of right-hand side:

The maximum seating configurations of the four zones and sequential combinations of these zones are as follows:

(a) Individual zone passenger capacities:
Zone A: 39 (.75 x 52);
Zone B: 87 (52 + 35);
Zone C: 87 (35 + 52);
Zone D: 39 (.75 x 52).

(b) Sequential zone passenger capacities - nose to tail:
Zones A + B: 87 (52 + 35);
Zones A + B + C: 139 (52 + 35 + 52).

Sequential zone passenger capacities - tail to nose:
Zones D + C: 87 (52 + 35);
Zones D + C + B: 139 (52 + 35 + 52).

(c) Maximum passenger seating configuration:
Zones A + B + C + D: 139. This is the exit limit of the airplane using Table 1.

Exit distribution with respect to fuselage is as follows:

(a) The length of the cabin is 880 inches (FS 970 - FS 90).

(b) The number of exit units in each zone is as follows:
Zone A: 1.25;
Zone B: 2.25 (1.25 + 1.0);
Zone C: 2.25 (1.0 + 1.25);
Zone D: 1.25;
Airplane total: 7.0.

(c) Fuselage length factor = 125.8 inches (880"/7.0).

(d) Nominal exit location:
Exit 1: FS 277.2 (120 + (125.8 x 1.25));
Exit 2: FS 565.2 (277.2 + (125.8 x 2.25));
Exit 3: FS 843.3 (565.2 + (125.8 x 2.25)).

(e) Exit offsets, proposed versus nominal:
Exit 1: Offset = 57.2" (277.2 - 220);
Exit 2: Offset = 60.2" (560.2 - 500);
Exit 3: Offset = 6.7" (850 - 843.3).

(f) Percent of exit offset:
Exit 1: 6.5% (57.2/880 x 100%);
Exit 2: 6.8% (60.2/880 x 100%);
Exit 3: 0.8% (6.7/880 x 100%);
All exits are offset less than 15 percent from the nominal locations and are acceptable.

(g) By inspection, no two exits are closer together than the fuselage length factor of 121.4 inches.

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