

FEDERAL AVIATION AGENCY

Washington 25, D. C.

TECHNICAL STANDARD ORDER

Regulations of the Administrator

Part 514

SUBJECT: EMERGENCY EVACUATION SLIDES

TSO-C69

Technical Standard Orders for Aircraft Materials,
Parts, Processes, and Appliances

Part 514 contains minimum performance standards and specifications of materials, parts, processes, and appliances used in aircraft and implements the provisions of sections 3.18, 4a.31, 4b.18, 6.18 and 7.18 of the Civil Air Regulations. The regulation uses the Technical Standard Order system which, in brief, provides for FAA-industry cooperation in the development of performance standards and specifications which are adopted by the Administrator as Technical Standard Orders, and a form of self-regulation by industry in demonstrating compliance with these orders.

Part 514 consists of two subparts. Subpart A contains the general requirements applicable to all Technical Standard Orders. These provisions are summarized below for the convenient reference of the public. Subpart B contains the technical standards and specifications to which a particular product must conform, and each Technical Standard Order is set forth in the appropriate section of Subpart B. The subject Technical Standard Order is printed below. ANY TECHNICAL STANDARD ORDER MAY BE OBTAINED BY SENDING A REQUEST TO FAA, WASHINGTON 25, D. C.

SUBPART A--GENERAL

This subpart provides, in part, that a manufacturer of an aircraft material, part, process, or appliance for which standards are established in Subpart B, prior to its distribution for use on a civil aircraft of the United States, shall furnish a written statement of conformance certifying that the material, part, process, or appliance meets the applicable performance standards established in this part. The statement of conformance must be signed by a person duly authorized by the manufacturer, and furnished to the Chief, Engineering and Manufacturing Division, Bureau of Flight Standards, Federal Aviation Agency, Washington 25, D. C.

Subpart A also requires appropriate marking of materials, parts, processes, and appliances as follows:

- (a) Name and address of the manufacturer responsible for compliance,
- (b) Equipment name, or type or model designation,
- (c) Weight to the nearest pound and fraction thereof,
- (d) Serial number and/or date of manufacture, and
- (e) Applicable Technical Standard Order (TSO) number.

In addition, Subpart A provides that no deviation will be granted from the performance standards established in Subpart B, and that the Administrator may take appropriate action in the event of noncompliance with Part 514.

SUBPART B

§ 514.75 Emergency evacuation slides - TSO-C69--(a) Applicability -
(1) Minimum performance standards. Minimum performance standards are hereby established for emergency evacuation slides which are required to be of an approved type to be eligible for use on civil aircraft of the United States. New models of emergency evacuation slides manufactured on or after August 15, 1961, shall meet the standards set forth in FAA standard "Emergency Evacuation Slides".^{1/} Emergency evacuation slides approved by the Administrator prior to August 15, 1961, may continue to be manufactured under the provisions of their original approval.

(b) Marking. The slide shall be permanently marked in accordance with the marking provisions of Subpart A, except that (1) a part number which shall vary with length or any other change in the slide, (2) serial number, and (3) date of manufacture shall be included.

(c) Data requirements. (1) One copy each of the following shall be furnished to the Chief, Engineering and Manufacturing Division, Bureau of Flight Standards, Federal Aviation Agency, Washington 25, D. C.

(i) Packing instructions.

(ii) Operation instructions.

(iii) Assembly drawing.

(iv) Applicable limitations pertaining to installation of slides on aircraft. These limitations shall include the minimum and maximum stowage area temperatures and any other limitations which will prevent the slide from performing its intended function and from complying with the minimum performance standards under all reasonable foreseeable emergency conditions. The slide manufacturer shall also provide the purchaser with such limitations.

(2) The manufacturer shall maintain a current file of complete design data.

(3) The manufacturer shall maintain a current file of complete data describing the inspection and test procedures applicable to his evacuation slide. (See paragraph (d) of this section.)

(d) Quality control. Emergency evacuation slides shall be produced under a quality control system, established by the manufacturer, which will assure that each slide is in conformity with the requirements of this section and is in a condition for safe operation. This system shall be described in the data required under paragraph (c)(3) of this section. A representative of the Administrator shall be permitted to make such inspections and tests at the manufacturer's facility as may be necessary to determine compliance with the requirements of this section.

(e) Effective date. August 15, 1961.

^{1/}Copies may be obtained upon request addressed to: Aeronautical Reference Branch, Correspondence Inquiry Section, MS-126, Federal Aviation Agency, Washington 25, D. C.

June 15, 1961

FAA STANDARD - TSO EMERGENCY EVACUATION SLIDES

Part I: Inflatable Type

- 1.0 Purpose. To establish minimum requirements for inflatable emergency evacuation slides.
- 2.0 Scope. This standard covers inflatable evacuation slides suitable for use to assist occupants in descending to the ground from floor-level aircraft exits.
- 3.0 Materials and Workmanship.
- 3.1 Non-Metallic Materials.
- 3.1.1 The finished slide shall be clean and free from any defects that might affect its function.
- 3.1.2 All coated fabrics and other items, such as webbing, subject to deterioration used in the manufacture of evacuation slides, shall have been manufactured not more than 18 months prior to the date of delivery of the finished product.
- 3.1.2.1 Coated Fabrics, General. All coated fabrics used in the manufacture of inflatable emergency evacuation slides shall possess at least 90% of the physical properties called for under their applicable specifications after these coated fabrics have been subjected to the accelerated aging test specified in Paragraph 5.1 of this standard.
- 3.1.2.1.1 Inflation Chambers. Coated fabrics used for this application shall conform to the following minimum test specifications:
- Tensile Strength. (Grab Test) Warp 190 lbs./in. (min)
Fill 190 lbs./in. (min)
- Tear Strength. (Trapezoidal Method) 13 x 13 lbs./in.
(min)
- Permeability. Permeability to helium of not more than 10 liters per square meter per 24 hours, at +77°F (max)
- Ply and Coat Adhesion. 5 lbs. per inch width, at normal room temperature (approx. 70°F) at 2 in./min.
(Refer to Part II, Paragraph 5.2 of this standard)

3.1.2.1.2 The material shall be free of nutrients for fungus growth.

3.1.2.1.3 Flame Resistance. The material shall be flame resistant, as determined in accordance with specifications given in Part II, Paragraph 5.3 of this standard.

3.1.2.1.4 Determination of Quality. Each lot of material shall be tested by the manufacturer to determine that it meets the above specifications.

3.1.3 Seam Strength and Adhesives. Seams and adhesives used in the manufacture of inflatable evacuation slides shall develop the following minimum strength:

Load Test. Seam Strength (3/4 in. overlap, maximum;
2 in. test specimen width, maximum)

At 75°F 350 lbs. @ 12 in./min.

At 140°F 80 lbs. @ 12 in./min.

Peel Test. Seam Strength - The seam shall have a peel strength of 5 lbs. per inch width at normal room temperature (approx. 70°F) at 2 in./min.

Samples of seams shall retain at least 90% of the above values after having been subjected to an accelerated aging test in accordance with specifications given under Part II, Paragraph 5.1 of this standard.

3.1.4 Molded Non-Metallic Fittings. Materials used for this purpose shall retain their operational characteristics when subjected to temperatures of -40°F to +160°F.

3.2 Metallic Parts. All metallic parts shall be corrosion resistant or suitably protected against corrosion.

3.2.1 Protection. All inflation chambers shall be protected in such a manner that nonfabric parts shall not cause chafing or abrasion of the chamber material in either the packed or inflated condition.

3.3 Air Reservoirs. Air reservoirs used for inflation of slides shall conform to ICC (3AA, 3HT) or military (MIL-R-8573A(ASG)) specifications.

4.0 General Operational Requirements.

4.1 The operation of the slide shall be simple enough that

brief, easily understood instructions can be posted and followed by the passengers.

Note. Some of the new aircraft have as many as four floor-level exits. In an emergency it is entirely possible that a crew member may not be available at each one to prepare the slide for use.

- 4.2 The slide assembly, including its inflation system, shall be capable of functioning when subjected to temperatures of -40° F. to $+160^{\circ}$ F.
- 4.2.1 Strength. The slide shall be designed and fabricated so that when installed for use, it will safely handle the weight of three (170 lbs.) evacuees assumed to have jumped in such rapid succession that they occupy the slide simultaneously. If the strength is substantiated by an actual test, the use of single 510 lbs. weight is satisfactory.
- 4.2.2 Elimination of Static. The slide and its fastenings shall be so constructed that static electricity will not be generated in sufficient quantity to cause a spark, thereby creating a hazard if there is any gasoline spillage nearby.
- 4.2.3 Use As Noninflatable Slide. The slide shall be so constructed as to permit its use as a noninflatable slide in the event of puncture, or other cause which may render the slide incapable of inflation.
- 4.2.4 Length. The length of the slide, for a given application shall be such that when the slide is in position its angle with the ground will be safe and useable by an evacuee regardless of whether any one or any two landing gear legs may have collapsed.
- 4.2.5 Elimination of Encumbrances. Encumbrances which might be grabbed by an evacuee shall be kept to a minimum consistent with good design for maximum operational efficiency.
- 4.2.6 Hardware Strength. The hardware used in attaching the slide to the aircraft shall have a strength equal to 1.15 times the highest load imposed by the operating conditions.
- 4.2.7 Webbing and Handle Strength. Webbing and straps used in attaching the slide to the aircraft as well as ground handling straps or grips shall have a strength equal to 1.5 times the highest load imposed by the operating conditions.

- 4.2.8 Use As a Re-entry Device. Should the evacuation slide be designed with additional provisions so that the slide may also be used as a means of re-entering the aircraft, these additional provisions shall in no way interfere with the use of the slide for its intended purpose.
- 4.2.9 Use As a Flotation Device. Should the evacuation slide be designed with additional provisions so that the slide may also be used as a flotation device to augment the required flotation equipment, these additional provisions shall in no way interfere with the use of the slide for its intended purpose.
- 4.2.10 Inflation Hose Connection. The slide and its inflation means shall be designed to remain connected and ready for instant use.
- 4.2.11 Activation Time. The design of the slide and its operation shall be such that when installed in its normally stowed position in an aircraft, and after the door has been opened, it shall be possible to make the slide ready to receive its first evacuee in not more than 25 seconds.
- 4.2.12 Evacuation Rate. The wet or dry slide shall be so designed as to be capable of handling evacuees at a rate of at least 30 persons per minute.

Part II Noninflatable Type.

1.0 Purpose. To establish minimum requirements for noninflatable emergency evacuation slides.

2.0 Scope. This standard covers noninflatable evacuation slides suitable for use to assist occupants in descending to the ground from floor-level aircraft exits.

3.0 Materials and Workmanship.

3.1 Non-Metallic Materials.

3.1.1 The finished slide shall be clean and free from any defects that might affect its function.

3.1.2 All coated fabrics and other items, such as webbing, subject to deterioration, used in the manufacture of evacuation slides, shall have been manufactured not more than 18 months prior to the date of delivery of the finished product.

3.1.2.1 Coated Fabrics, General. All coated fabrics used in the manufacture of noninflatable emergency evacuation slides, shall possess at least 90% of the physical properties called for under their applicable specifications after these coated fabrics have been subjected to the accelerated aging test specified in Paragraph 5.1 of this standard.

3.1.2.1.1 These fabrics shall conform to the following minimum test specifications:

Tensile Strength. (Grab Test) Warp 190 lbs./in. (min)
Fill 190 lbs./in. (min)

Tear Strength. (Trapezoidal Method) 13 x 13 lbs./in. (min) Refer to Paragraph 5.2 of this standard.

3.1.2.1.2 The material shall be free of nutrients for fungus growth.

3.1.2.1.3 Flame Resistance. The material shall be flame resistant as determined in accordance with specifications given in Paragraph 5.3 of this standard.

3.1.2.1.4 Determination of Quality. Each lot of material shall be tested by the manufacturer to determine that it meets the requirements of Section 3.1.2.1.1.

4.0 General Operational Requirements.

4.1 The operation of the slide shall be simple enough that brief, easily understood instructions can be posted and followed by the passengers.

4.1.1 Elimination of Static. The slide and its fastenings shall be so constructed that electricity will not be generated in sufficient quantity to cause a spark thereby creating a hazard if there is any gasoline spillage nearby.

4.1.2 Length. The length of the slide, for a given application, shall be such that when the slide is in position its angle with the ground will be safe and usable by an evacuee regardless of whether any one, or any two, landing gear legs may have collapsed.

4.1.3 Strength of Slide. The slide shall be so constructed as to preclude tearing in any direction to an extent which would render it un-serviceable. If seams are stitched they shall be of the French fell type. (See Fig. 3-1(E) in CAM 18) If cemented, they shall meet the minimum strength requirements set forth in Part I, Paragraph 3.1.3 of this standard.

The complete slide assembly shall be capable of withstanding the impact of a bag loaded so as to weigh 250 lbs. dropped into it in the manner of an evacuee leaving the aircraft with the slide in the 45° installed position.

Note. The test bag shall be suspended so that no part of it is less than three feet above the simulated aircraft floor, and located outboard so that when released it will hit the slide at approximately the location contacted by the evacuee, and its area of contact will approximate that of an evacuee.

4.1.4 Elimination of Encumbrances. Encumbrances which might be grabbed by an evacuee shall be kept to a minimum consistent with good design for maximum operational efficiency.

4.1.5 Hardware Strength. The hardware used in attaching the slide to the aircraft shall have a strength equal to 1.15 times the highest load imposed by the operating conditions.

4.1.6 Webbing and Handle Strength. Webbing and straps used in attaching the slide to the aircraft as well as ground handling straps or grips

shall have a strength equal to 1.5 times the highest load imposed by the operating conditions.

- 4.1.7 Use As a Re-entry Device. Should the evacuation slide be designed with additional provisions so that the slide may also be used as a means of re-entering the aircraft, these additional provisions shall in no way interfere with the use of the slide for its intended purpose.
- 4.1.8 Time to Make Ready for Use. The design of the slide and its operation shall be such that when installed in its normally stowed position in an aircraft, and after the door has been opened, it shall be possible to make the slide ready to receive its first evacuee in not more than 40 seconds.
- 4.1.9 Evacuation Rate. The wet or dry slide shall be so designed as to be capable of handling evacuees at a rate of at least 20 persons per minute.

Note. The following sections are applicable to both Part I and Part II of the foregoing.

5.0 Tests.

- 5.1 Accelerated Age Test for Coated Fabrics. Samples of coated cloth used in the slide shall be suspended in an air circulating oven and exposed to a temperature of 158 ± 4 °F for a period of 168 hours. After aging, the samples shall be allowed to cool to room temperature for not less than 16 nor more than 96 hours before determining their physical properties in accordance with Paragraph 3.1.2.1 of Parts I and II of this standard.
- 5.2 Tests for Strength of Coated Fabrics. Coated fabrics shall be tested when in moisture equilibrium in a standard atmosphere having a relative humidity of 65% at 70°F (21°C). A relative humidity tolerance of $\pm 2\%$ and a temperature tolerance of ± 2 °F (1.1°C) are permitted.

Note. It shall be considered that moisture equilibrium is reached when, after free exposure to air in motion, the change in weight of the fabric in successive weighings made at intervals of one hour is no greater than .25%. Certain coatings may greatly retard moisture penetration into the fabric and, therefore, fabrics coated on both sides may require 24 hours or more to reach equilibrium.

- 5.2.1 Testing Machine. A machine shall be used wherein the specimen is held between two clamps and strained by a uniform movement of the pulling clamp.

The design of each clamp shall be such that one gripping surface or jaw shall be an integral part of the rigid frame of the clamp while the other shall be on a part hinged or swiveled to the movable member of the clamp. The gripping surfaces of the clamp shall be metallic and shall be sufficiently flat and parallel to prevent slipping of the specimen during the test. All edges which might cause a cutting action shall be rounded to a radius of not over 1/64". The indicator which is used to determine the applied tension shall remain at the point of maximum load after rupture of the specimen occurs. The error of the machine at any reading within its loading range shall not exceed 2% up to and including a 50 lb. load or 1% over a 50 lb. load. The machine shall be of such capacity that the maximum load required to break the specimen is not greater than 85% of the machine's rated capacity.

5.2.2 Grab Method. The fabric test specimens shall have dimensions of at least 4 x 6 inches. The long dimension shall be parallel to the warp for warp tests and parallel to the fill for fill tests. The fabric test specimens shall be taken no nearer the selvage than 1/10 the width of the coated fabric and no two specimens to be tested in one direction shall be woven from the same thread or yarn. One gripping surface of each clamp shall be one inch by one inch. The other gripping surfaces shall measure one inch by 1 1/2 or more inches with the longer dimension perpendicular to the direction of application of the load. The specimen shall be placed symmetrically in the clamps of the machine with the long dimension parallel and short dimension perpendicular to the direction of application of the load. The distance between clamps shall be at least 3 inches at the start of the test and the force shall be applied to the specimen at such a rate that the pulling clamp will travel at a uniform speed of $12 \pm .5$ inches/min. The recorded breaking strength (tensile strength) shall be the average of the results obtained from at least 5 specimens tested in each of the warp and fill directions.

5.2.3 Trapezoidal Method. The test specimens shall be 3 x 6 inches. The longer dimension shall be parallel to the lengthwise direction of the coated fabric to test for longitudinal tearing strength. The longer dimension shall be parallel to the crosswise direction of the coated fabric to test for transverse tearing strength. An isosceles trapezoid having an altitude of three inches and bases of one and four inches respectively shall be marked on each specimen. A cut 1/4 to 3/8 of an inch in length shall be made in the center of the one inch edge and perpendicular to it. The gripping surfaces of each clamp shall be one inch by 3 inches with the longer dimension perpendicular to the direction

of application of the load. The specimen shall be clamped in the machine along the nonparallel sides of the trapezoid so that the cut is halfway between the clamps. The distance between clamps at the start of the test shall be one inch and the force shall be applied to the specimen at such a rate that the pulling clamp will travel at a uniform speed of $12 \pm .5$ inches per minute. The average of the results of at least 5 individual tests in each direction shall be recorded as the longitudinal and transverse tearing strengths respectively.

5.3 Test for Flame Resistant Materials.

Test Specimens. Three specimens, approximately 4 inches wide and 14 inches long, should be tested. Each specimen should be clamped in a metal frame so that the two long edges and one end are held securely. The frame should be made of rectangular sections approximately one inch in width and 1/4 inch in thickness with overall dimensions such that the exposed area of the specimen is at least 2 inches wide and 13 inches long, with the free end at least 1/2 inch from the end of frame for ignition purposes. In the case of fabrics, the specimens should be cut so that the 14 inch length is parallel to the direction of the warp. It has been found that the pattern of some cloth may cause the cloth to be more hazardous in one direction than in the other, in which case the 14 inch dimension of the specimen should be parallel to the more hazardous direction.

A minimum of 10 inches of the specimen should be used for timing purposes, and approximately 1 1/2 inches should burn before the burning front reaches the timing zone. The timing should be stopped at least one inch before the burning front reaches the metal frame across the specimen, since dissipation of the heat by the metal frame may appreciably effect the burning progress at the end.

Test Procedure. The specimens should be supported horizontally and tested in a draft-free room or under a draft-free hood. The surface that will be exposed should face down for the test. The specimens should be ignited by a Bunsen or a Tirrell burner. To be acceptable, the average burn rate of the three specimens must not exceed 4 inches per minute. In addition, if the specimens do not support combustion after the ignition flame is applied for 15 seconds, or if the flame extinguishes itself and subsequent burning without a flame does not extend into the undamaged areas, the material is also acceptable. (Federal Specification CCC T191-b, Method 5906 may also be used for testing materials of this type. The material to be acceptable should meet the burn rate criteria of this section.)