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Aircraft — Self-propelled passenger stairs for large capacity aircraft — Functional requirements

Aéronefs — Escaliers passagers autotractés pour aéronefs gros porteurs — Exigences fonctionnelles

Reference number
ISO 12056:1996(E)

Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12056 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 9, *Air cargo and ground equipment*.

Annex A forms an integral part of this International Standard. Annex B is for information only.

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Introduction

Throughout this International Standard, the minimum essential criteria are identified by the use of the key word "shall". Recommended criteria are identified by the use of the key word "should", and while not mandatory are considered to be of primary importance in providing serviceable, economical, and practical passenger stairs. Deviation from the recommended criteria should occur only after careful consideration, extensive testing and thorough service evaluation have shown alternate methods to be satisfactory.

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Aircraft — Self-propelled passenger stairs for large capacity aircraft — Functional requirements

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1 Scope

1.1 This International Standard specifies the functional, performance and safety requirements for self-propelled passenger boarding stairs intended for access to the cabin of all aircraft types commonly in service in international civil air transport with a cabin door sill height equal to or exceeding 2,54 m (100 in) over the ground.

1.2 The intent of this International Standard is not to specify equipment design, but rather to define minimum functional and performance requirements and highlight those criteria which are recognized as essential in the environment of international airports by aircraft and vehicle manufacturers as well as airlines and handling agencies.

1.3 This International Standard shall be applied with due reference to national governmental regulations of the country where the vehicle is to be operated. The main though not exclusive areas in which such national regulations may apply are:

— regulations concerning equipment for use by the public;

— stability and other safety requirements applicable to elevating equipment.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6966:1993, *Aircraft — Basic requirements for aircraft loading equipment.*

ISO 7000:1989, *Graphical symbols for use on equipment — Index and synopsis.*

ISO 7718:1984, *Aircraft — Connection of passenger loading bridge or transfer vehicle — Interface requirements in the vicinity of main deck passenger doors.*

ISO 11995:1996, *Aircraft — Stability requirements for loading and servicing equipment.*

3 Structure and overall dimensions

3.1 The stairs should preferably be constructed on a standard automotive chassis of appropriate gross weight rating.

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3.2 The stairs should consist of telescopic sections with an upper (main) platform and an intermediate platform, and provide a straight ascent/descent to/from the aircraft door.

3.3 The height of the upper platform shall be adjustable by increments of one full step within a range from 2,54 m (100 in) to 5,6 m (220 in).

3.4 The dimensions, laden weight and other characteristics of the vehicle should meet all applicable government regulations for vehicles to be driven on public roadways, when in the fully retracted position.

3.5 The overall height in the fully retracted position shall not exceed 4 m (158 in).

NOTE 1 This requires that the optional canopy described in clause 10 d) be removable, if provided.

3.6 The overall width of the vehicle, with stabilizers retracted, shall not exceed 2,5 m (98 in), or less if so required by locally applicable regulations.

NOTE 2 Overall height and width of the vehicle may be further restricted by public road regulations in certain countries.

3.7 The lowest point of the vehicle's structure shall not be less than 200 mm (8 in) above a horizontal ground. In addition, the vehicle's underclearance shall allow without interference the transversing of two surfaces intersecting at an angle of 3° (5 %) either in bridging or in cresting.

3.8 The overall swept turning radius of the vehicle in the fully extended position shall be less than 12,2 m (40 ft).

3.9 The cab or driver's position shall not project forward of the leading edge of the upper platform when in its fully retracted position.

3.10 The equipment shall meet the appropriate requirements of ISO 6966.

4 Stairs flight

4.1 The stairs flight shall consist of fixed risers and treads. The treads cover material shall

— be of non-skid/anti-slip quality, including when wet;

— permit easy elimination of water and snow;

— resist the catching of women's shoes heels.

4.2 The angle of incline, tread-riser ratio and riser dimensions of the stairs flight should meet the geometry criteria defined in annex A.

4.3 The stairs flight internal usable clear width shall be 1 m (40 in) min.

4.4 The stairs flight should include an intermediate platform of a minimum length equal to 3 treads. Any longer platform should have a length equal to that of the tread multiplied by an integer.

4.5 The design load capacity shall be 2 200 N (500 lbf) per step and 6 600 N (1 500 lbf) for the intermediate platform. A safety factor of 3:1 should be applied to the design load in order to obtain the minimum required yield strength, unless a higher safety factor is required by local government regulations concerning equipment for use by the public (see 1.3).

4.6 Any hinged step that may be fitted at the bottom of the stair in order to meet the requirements of 3.7 shall have a riser of the same dimensions as those of the stairway. This step shall be counterbalanced for ease of handling. A self-engaging latch shall be provided to secure the step in the up position.

4.7 The stairs flight and intermediate platform shall have complete illumination, of non-glare quality and permitting no deep shadows which could present a hazard.

5 Platform

5.1 The upper (main) platform shall have minimum usable dimensions of 1,5 m (60 in) width and 1,2 m (48 in) length.

5.2 The platform cover material shall

— be of non-skid/anti-slip quality, including when wet;

— permit easy elimination of water and snow;

— resist the catching of women's shoes heels.

5.3 The platform incline in any position should not be in excess of ± 2° (3,5 %), and shall not be in excess of ± 3° (5 %) from the horizontal plane, while the vehicle is stabilized on a horizontal surface.

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5.4 Both sides of the platform shall be fitted with full panels supporting the handrails specified in 6.1. The forward end of each side panel shall be covered by protective padding and have a geometry such that it can suit the fuselage contour of all aircraft types intended to be handled, while leaving a minimum gap.

5.5 In addition, unless the platform internal usable width is at least 2,3 m (90 in), the left-hand side panel together with its handrail shall be sliding or folding in order to allow opening and closing of the aircraft doors without obstruction. A positive and reliable means of latching the sliding or folding side panel at a variety of intermediate positions shall be provided.

5.6 In order to avoid any risk of damage to the aircraft while being serviced, the following precautions shall be taken.

a) The leading edge of the platform shall be entirely covered by protective padding and compatible with ISO 7718.

b) The area directly below the platform shall be free from all components and/or obstructions within at least 300 mm (12 in) of the aircraft interface area. The platform thickness in this area shall be kept to a minimum.

5.7 The design load capacity of the platform shall be 6 600 N/m^2 evenly distributed, and under any condition not less than 9 000 N (2 000 lbf). A safety factor of 3:1 should be applied to the design load in order to obtain the minimum required yield strength, unless a higher safety factor is required by local government regulations concerning equipment for use by the public (see 1.3).

5.8 The platform forward left-hand corner shall include a provision allowing for an unobstructed up and down movement of the open aircraft door while the stairs are in position.

5.9 The platform shall have complete illumination, of non-glare quality and permitting no deep shadows which could present a hazard.

6 Handrails

6.1 Handrails shall be provided on both sides of the stairway, the intermediate platform and the upper platform.

6.2 Maximum continuity shall be maintained at all points between handrail segments.

6.3 The handrails shall include no projection or corners that could cause injury, and shall be easily replaceable and suitably finished to preclude the possibility of damaging or soiling passenger clothing.

6.4 The handrails should preferably be supported by a full panel, and shall include at least a 100 mm (4 in) high footguard at all points and a mid-height guardrail (see 5.4 for upper platform side panels).

6.5 The total heights of the handrails shall be as given in table 1.

Table 1

Location	Total height			
	min.		max.	
	m	in	m	in
Stairs flight (measured at nose of steps)	0,76	30	0,91	36
Intermediate platform (measured at nose of step)	0,86	34	0,91	36
Upper (main) platform (measured all around)	0,91	36	1	40

6.6 The design horizontal side load at any point on the upper edge of the handrails shall be 1 780 N (400 lbf). Under this side load, the maximum allowable deflection as a function of the local height of the handrail shall be 20 mm per m (0,25 in per ft) of handrail height. A safety factor of 3:1 should be applied to the design load in order to obtain the minimum required yield strength, unless a higher safety factor is required by local government regulations concerning equipment for use by the public (see 1.3).

7 Elevation and stability

7.1 Each height adjustment shall be performed by increments of one full step. Adjustment to intermediate heights should be provided by either controllable platform incline (see 5.3) or stair flight incline.

7.2 Reliance on the height adjustment mechanism shall not be considered acceptable. In order to provide a fail-safe operation, a minimum of one mechanical safety lock shall be incorporated to ensure that the adjusted elevation is maintained at each step when the stairs are subjected to maximum design loads.

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Preferably, two separate and distinct safety locks (one of which may be hydraulic) should be incorporated for this purpose.

7.3 Power-operated stabilizers shall be installed in order to provide the stability required for passenger boarding and disembarkation.

7.4 The stabilizers in the retracted position shall not protrude from the vehicle's overall width as specified in 3.6. The stabilizers in the extended position should preferably not protrude from the overall width.

7.5 When supported by the fully extended stabilizers, the fully extended stairs in both the maximum design loads and empty conditions shall meet the static and wind stability criteria of ISO 11995.

7.6 It shall not be possible for the stabilizers to collapse in case of a system failure.

7.7 The suitability of the safety devices defined in 7.2 and 7.3 shall be demonstrated by testing with the stairs loaded to their maximum design loads, prior to acceptance for passenger boarding and disembarkation service.

7.8 The stairs shall be fitted with a placard indicating the maximum load capability as demonstrated in 7.7 and the maximum number of passengers to be allowed at any time.

8 Controls

8.1 Controls for extending and retracting the stairs, as well as the upper platform and the stabilizers, shall be located in the vehicle cabin or driver's position.

8.2 Controls shall be protected against any inadvertent activation. Positive confirmation by a warning light or equivalent device shall be provided next to the controls, indicating that the stabilizers are either fully retracted or fully extended and supporting the vehicle's weight against a supporting surface.

8.3 An emergency stop button which kills the engine shall be provided at the control panel.

8.4 Unless the unit is electrically operated, the engine shall be equipped with a demand throttle providing high idle whenever one of the hydraulic functions is actuated.

8.5 For the final safe positioning to the aircraft door, a positive non-jerking slow speed shall be provided.

8.6 An indicator showing the height of the aircraft door sill in relation to that of the stairs shall be situated on the underside of the stairway and shall be observable from the operator's position.

8.7 A spotlight controllable from the operator's position shall be provided for positioning the stairway to the aircraft door area during night operation.

8.8 All controls shall be identified by the appropriate pictographic symbols as described in ISO 7000.

8.9 The control panel layout should insofar as practical meet the requirements of the IATA AHM 915, section 2.

9 Emergency

9.1 The vehicle shall be fitted with an emergency auxiliary system allowing

a) the platform and the stairs flight to be lowered;

b) the stabilizers to be retracted;

c) the vehicle to be towed away,

in the event of primary power loss, in order to allow removal of the vehicle from the aircraft.

9.2 The emergency auxiliary system may either be manual (hand pump) or, as an option, have an independent power source. Its controls shall be located at ground level and protected by a cover or equivalent device.

10 Options

The following optional additional features may be considered.

a) Additional facilities provided for the loading of incapacitated passengers.

b) A swivel section fitted along the full length, provided at the forward end of the bridge in order to align the bridge with the aircraft door threshold. The swivel limits shall be 10° to either side of the centered position.

c) The top platform capable of limited forward and backward movement to allow for varying door sill to platform relationship during operation, without the need for repositioning the entire vehicle.

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Control for this should be located on the top platform.

d) An all-weather canopy provided over the top platform and the entire stairway, the forward portion of the canopy to fit the contour of the passenger entry door. The canopy may be made up of individual sections which telescope together.

e) Duplicate controls for step operation on the top platform. These controls should override the controls at the operator's position.

f) An emergency auxiliary system with an independent power source (see 9.2).

g) A sliding or folding right-hand platform side panel in accordance with 5.5.

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Annex A
(normative)

Geometry criteria for stair flight design

NOTES

3 This annex is based on the standard ARP 836A, of which certain values have been adapted to the requirements of this International Standard.

4 In order to conform with aircraft stairs industry practice, stair dimensions throughout this annex are expressed in inches (1 in = 25,4 mm) and feet (1 ft = 305 mm).

A.1 Definitions

For the purposes of this annex, the following definitions apply.

A.1.1 (theoretical) tread depth, T: Dimension from one stair nosing to the adjacent stair nosing.

A.1.2 effective tread depth, T_1: Effective dimension from one stair nosing to the adjacent stair vertical riser.

A.1.3 riser height, R: Distance between the surface of the tread of one step and the surface of the tread of a step above or below when measured perpendicularly between the tread surfaces.

A.1.4 riser to tread ratio, R/T: Arithmetical ratio of the height of one of the risers to the theoretical tread depth, which ratio is equal to the tangent of the angle of inclination of the stairway.

A.1.5 step width, W: Width of the step surface as measured along the nose of the step.

A.1.6 handrail height, H: Distance to the centre of the handrail as measured at the nose of the step and perpendicular to the tread surface.

A.1.7 fixed-riser stairway: Flight of stairs wherein the riser to tread ratio (R/T) is a constant which will result in a fixed angle of inclination.

NOTE 5 This is the case in this International Standard.

A.1.8 variable-riser stairway: Flight of stairs designed to allow variation of the riser to tread ratio and therefore variation of the angle of inclination to suit varying elevations.

NOTE 6 Not within the scope of this International Standard.

A.1.9 stair length: Distance measured horizontally and parallel to the tread surfaces between the face of the nose of the lowermost tread and the face of the nose of the uppermost tread.

NOTE 7 This is a geometric dimension only and does not include allowance for approach at the lower end, intermediate platforms in excess of the normal tread length, or length of the upper platform.

A.2 Basic stair design dimensions

A.2.1 Table A.1 lists the minimum and maximum limits of basic stair dimensions generally accepted for stair design.

Table A.1

Parameter	Dimension		
	min.	max.	preferred
Angle of incline	20° [1]	40° [1]	32° to 38°
Tread depth, T (in)	11	15	(see A.2.4)
Riser height, R (in)	5,5	8	(see A.2.4)
Platform angle of incline	0°	3°	0° to 2°

1) Critical angle.

A.2.2 A properly designed stairway requires the proportioning of certain basic dimensions, i.e. for every selected tread depth (T) between the maximum and the minimum, there is a best riser height (R) for best proportion. The proper proportion for best riser-to-tread ratio for any selected riser can be determined from the formula:

$$R/T = \tan[(R - 3) \times 8]^\circ$$

A tabulation of risers and treads within the limits of table A.1 is given in table A.2.

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Table A.2

Riser height, R in	**Tread depth,** T in	tan θ	**Angle,** θ
5,5	15,1	0,364	20°
5,75	14,2	0,405	22°
6	13,5	0,444	24°
6,25	12,8	0,488	26°
6,5	12,2	0,532	28°
6,75	11,7	0,577	30°
7	11,2	0,625	32°
7,25	10,7	0,677	34°
7,5	10,3	0,728	36°
7,75	9,9	0,783	38°
8	9,5	0,839	40°

A.2.3 Figure A.1 may be employed to determine quickly the characteristics of an acceptable stair, for any given elevation difference within the limits of figure A.1. As an example: assume a stair of proper proportion is desired for an elevation difference of 11 ft. Enter the chart at elevation 11 ft and follow the 11 ft elevation to its intersection with horizontal lines of "Number of risers". Note that the 11 ft elevation difference curve intersects all horizontal "Number of risers" lines beginning at a maximum number of 24 down to a minimum number of 17. Note that these two limits represent the maxima and minima that would define a stair within the limits of table A.2 with 24 risers of 5,5 in down to 17 risers of 7,75 in, respectively.

Projecting horizontally from the point of intersection of the 11 ft elevation difference curve with the selected number of risers, the number of treads in the stair becomes immediately evident, i.e. 23 treads for 24 risers and 16 treads for 17 risers for the two limits cited above.

A.2.4 Table A.2 lists the preferred tread depth, T, for given riser heights. The preferred tread depth for a 5,5 in riser is 15,1 in. The preferred tread depth for 7,75 in is 9,9 in. Figure A.1 will allow the determination of these preferred relationships directly, by reference to the tie lines labelled "Table A.2 proportions".

Using these preferred tread depths, T, for the risers, the length of the stair for these limits is readily determined. The tread depth, T, for the properly proportioned stair of 24 risers of height 5,5 in is 15,1 in. Enter figure A.1 on the "Tread depth" scale at 15,1 in and project vertically to the intersection with the diagonal line extending from point 23 on the "Number of treads" vertical line. Project horizontally and read the value on the "Length of stairs" scale at 28,75 ft. By the same procedure a 9,9 in tread depth, T, for 16 treads at a riser height of 7,75 in results in a stair length of approximately 13,3 ft. These lengths conform to the definition given in A.1.8. It becomes evident that a stairway for 11 ft elevation difference has maximum and minimum limits with respect to riser and tread depth and corresponding stair lengths. It becomes further evident that the limiting factor on the design of the ideal stairway at 30° to 35° angle of inclination becomes the length or space allowable for use of the stairway.

A.2.5 As a second example, consider the characteristics of a stairway for this elevation difference as close as possible to the recommended tread and riser limits as shown in table A.3. Projecting vertically from the "Riser height" base line a 7,75 in riser intersects the 11 ft difference curve at 17 risers; a 7 in riser intersects at 19 risers. The corresponding number of treads is therefore 16 and 18, respectively. The proper tread depths are 9,9 in and 11,2 in respectively. The stair lengths are approximately 13,25 ft and 16,75 ft, respectively. A stairway should have characteristics within these limits. In analysing elevation differences for which curves are not shown in figure A.1, interpolation must be employed.

A.2.6 Associated design dimensional data such as step width, W, handrail height, H, etc., require no dimensional analysis, and are shown as recommended limits in A.3.

A.3 Recommendations

Table A.3 gives basic design data recommended for the design of passenger boarding stairways.

Tolerances where noted are considered critical on a given stairway to maintain the design dimensions within limits such that the lack of dimensional control could not create additional hazards to the safe usage of the stairway. Where tolerances are not noted, commercial tolerances relevant to the type of equipment are considered acceptable.

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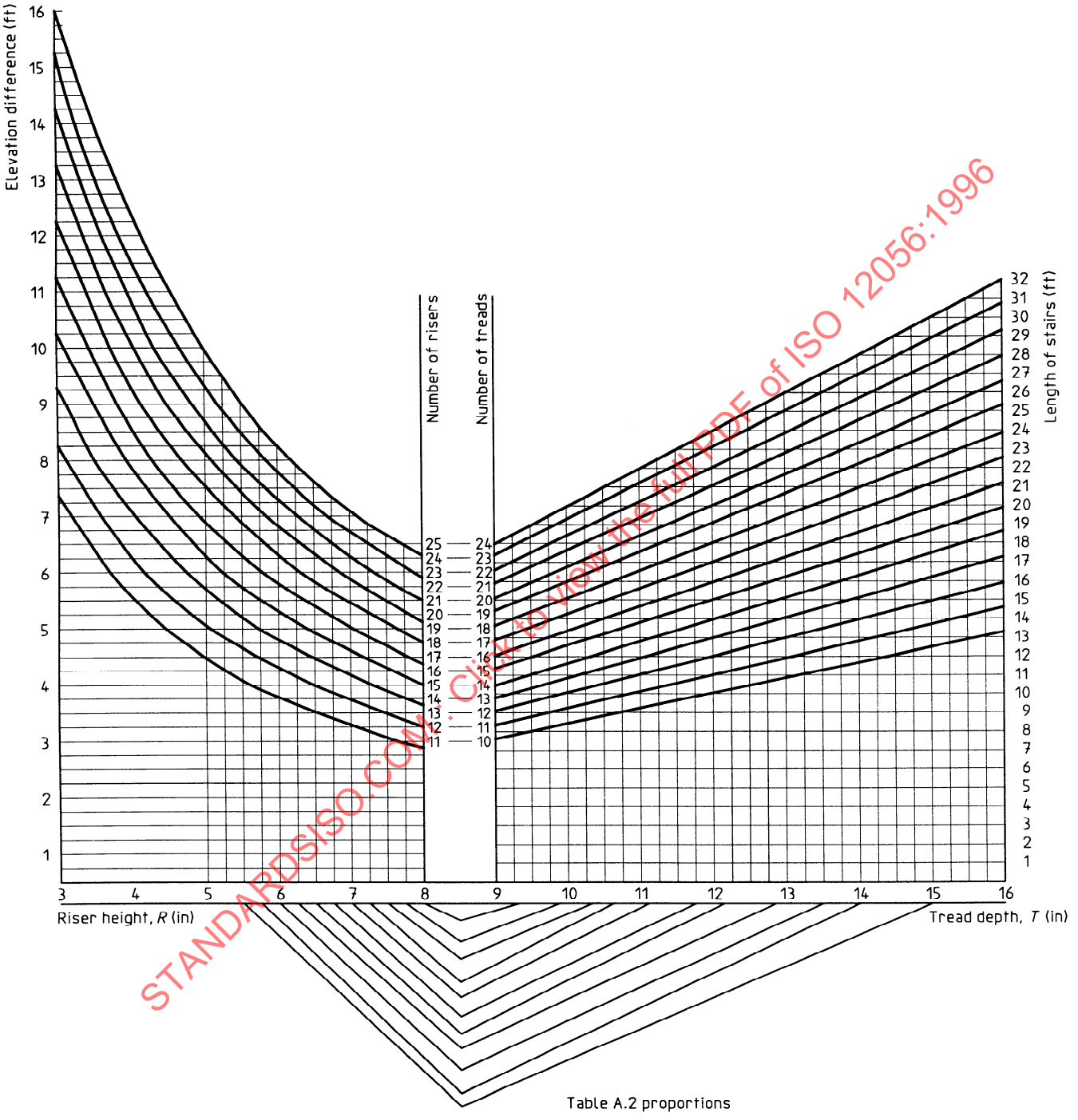

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Figure A.1 — Stair design data chart