

Amendment to the Human Factors Design Standard

Chapter 10: Exhibit 10.4.8.3.1 (B) Tread depth and (G) Handrail height

June 2006

SUMMARY

The Federal Aviation Administration Human Factors Group received a comment pertaining to handrail height and tread depth. The comment suggested that the Human Factors Design Standard design criteria be updated so as to be consistent with the current building codes and international standards, reflecting more recent research on stair safety.

The commenter stated that the current minimum tread depth in the HFDS of 24 cm (9.5”) is not safe and that building codes currently require a handrail height of 34-38”, not the 30- 34” currently cited in the HFDS.

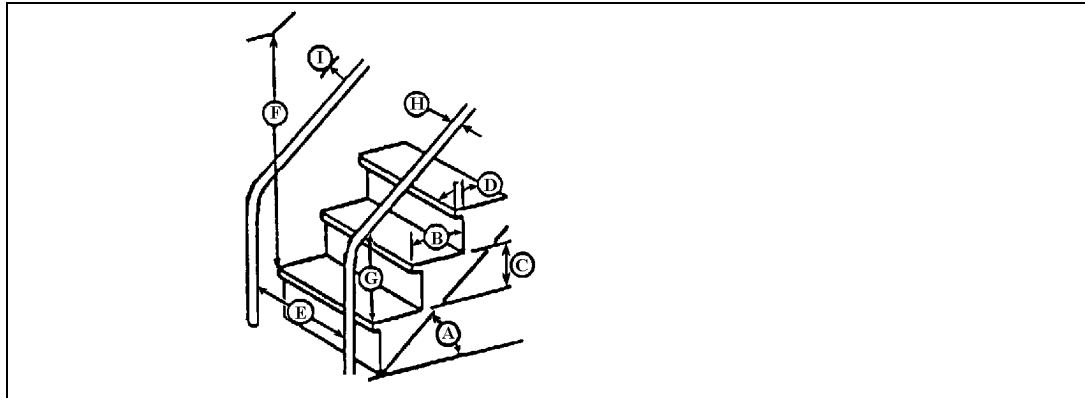
In response to the comment, we reviewed multiple sources of information on stair design including OSHA, ADAAG, ANSI, and international building codes. Upon reviewing the sources cited by the commenter and current established codes, we agree with the commenter that the section is outdated and should be amended.

SPECIFIC PURPOSE AND ACTUAL BASIS OF AMENDMENT

Exhibit 10.4.8.3.1 (B) and (G) should be amended to bring the requirements for handrail height and stair tread depth in accordance with other federal and international standards. The amendment is necessary to facilitate the safety of people at FAA facilities, protecting them from potential workplace hazards.

Previous HFDS Exhibit 10.4.8.3.1

Exhibit 10.4.8.3.1 Design requirements for stair dimensions. [Source: UCRL-15673, 1985; MIL-STD-1472D, 1989; MIL-HDBK-759B, 1992; MIL-STD-1800A, 1990]



		Minimum	Maximum	Best
A	Angle of rise	30°	50°	--
B	Tread depth	24 cm (9.5 in)	30 cm (12 in)	28-30 cm (11-12 in)
C	Riser height	13 cm (5 in)	20 cm (8 in)	17-18 cm (6.5-7 in)
D	Depth of nosing	2 cm (.75 in)	4 cm (1.5 in)	3 cm (1 in)
E	Width (handrail to handrail)			
	One-way stairs	56 cm (22 in)	--	56 cm (22 in)
	Two-way stairs	122 cm (48 in)	--	130 cm (51 in)
F	Minimum overhead clearance	2.1 m (7 ft)	--	2.1 m (7 ft)
G	Height of handrail	76 cm (30 in)	86 cm (34 in)	84 cm (33 in)
H	Diameter of handrail	4 cm (1.5 in)	8 cm (3 in)	4 cm (1.5 in)
I	Hand clearance	8 cm (3 in)	--	8 cm (3 in)

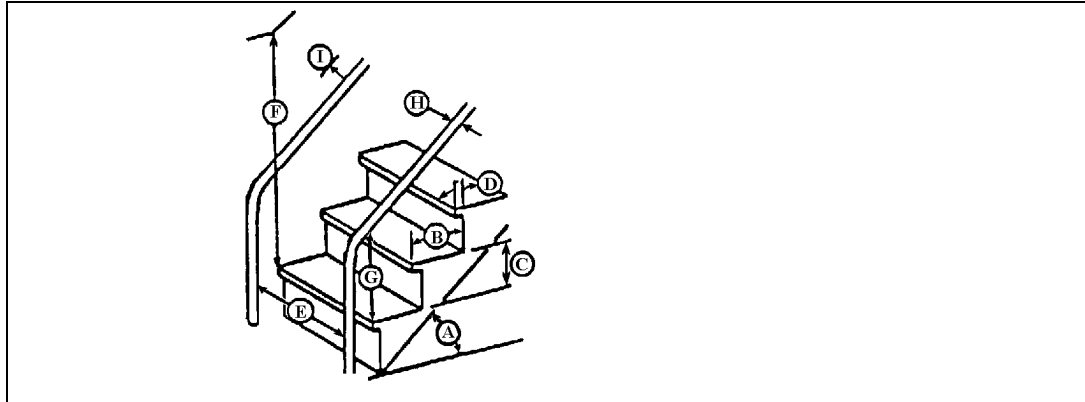
Exhibit 10.4.8.1 B recommends a minimum tread depth of 9.5 inches, a maximum of 12 inches and “best” of 11-12 inches. Appendix A to this document provides a side-by-side comparison of current codes and standards related to tread depth. Based on the consensus of the documents reviewed, we recommend changing the minimum tread depth dimension to 11 inches, with no maximum.

Exhibit 10.4.8.1 G recommends a minimum handrail height of 30 inches, a maximum handrail height of 34 inches and a “best” height of 33 inches. Appendix B of this document shows a side-by-side comparison of current codes and standards related to handrail height. Based on the consensus of documents reviewed, we recommend changing the current 30-34 inch handrail height to 34-37 inches consistent with current codes and standards.

Both of the proposed revisions are within the OSHA values, although more restrictive than OSHA values, so as not to conflict with OSHA recommendations.

These revisions are necessary so that the users are not faced with conflicting information from differing regulations and standards. The handrail and tread depth information must be consistent with a design that provides for the maximum safety of the users, avoiding falls and potential personnel injury.

Recommended revision to HFDS Exhibit 10.4.8.3.1:



		Minimum	Maximum	Best
A	Angle of rise	30°	50°	--
B	Tread depth	28 cm (11 in)		28-30 cm (11-12 in)
C	Riser height	13 cm (5 in)	20 cm (8 in)	17-18 cm (6.5-7 in)
D	Depth of nosing	2 cm (.75 in)	4 cm (1.5 in)	3 cm (1 in)
E	Width (handrail to handrail)			
	One-way stairs	56 cm (22 in)	--	56 cm (22 in)
	Two-way stairs	122 cm (48 in)	--	130 cm (51 in)
F	Minimum overhead clearance	2.1 m (7 ft)	--	2.1 m (7 ft)
G	Height of handrail	86 cm (34 in)	94 cm (37 in)	--
H	Diameter of handrail	4 cm (1.5 in)	8 cm (3 in)	4 cm (1.5 in)
I	Hand clearance	8 cm (3 in)	--	8 cm (3 in)

References

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- Roys, M. (2001). *Serious stair injuries can be prevented by improved stair design*. *Applied Ergonomics*. 32: 135-139.
- The United States Architectural and Transportation Barriers Compliance Board (2004 update). *Accessibility Guidelines for Buildings and Facilities (ADAAG)*.
- Title 29. *Occupational health and safety standards* (OSHA 29 C.F.R.). Rehabilitation Act of 1973, 29 U.S.C. § 794 et seq. (amended 1974). Part 1910. Occupational Health and Safety Standards (29 CFR 1910). Washington, DC.
- Uniform Federal Accessibility Standard (UFAS). (1988). 41 CFR Ch101 subpart 101-19.6 Appendix A. Available online from www.access-board.gov
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Appendix A: Tread depth side-by-side comparison

HFDS	OSHA/MIL-STD 1472F	ADAAG/UFAS	DOJ 28 CFR part 36	International Building Code
<p>Dimensions for stairs. Stair dimensions shall be within the minimum and maximum values shown in the Exhibit 10.4.8.3.1. [Source: UCRL-15673, 1985] B. Tread depth Min = 24 cm (9.5 in) Max = 30 cm (12 in) Best = 28- 30 cm (11-12 in)</p>	<p>OSHA 1917.120(b)(1) ...tread depth a minimum of 12+/- 2 inches (30.48 +/- 5.08cm)</p>	<p>ADAAG 504.2 Treads and Risers. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Risers shall be 4 inches (100 mm) high minimum and 7 inches (180 mm) high maximum. Treads shall be 11 inches (280 mm) deep minimum.</p>	<p>4.9.2 Treads and Risers. On any given flight of stairs, all steps shall have uniform riser heights and uniform tread widths. Stair treads shall be no less than 11 in (280 mm) wide, measured from riser to riser (see Fig. 18(a)).</p>	<p>IBC 1009.3 Stair treads and risers. Stair tread depths shall be 11 inches (279 mm) minimum. The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at right angle to the tread's leading edge. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than 0.375 inch (9.5 mm). Winder treads shall have a minimum tread depth of 11 inches (279 mm) measured at a right angle to the tread's leading edge at a point 12 inches (305 mm) from the side where the treads are narrower and a minimum tread depth of 10 inches (254 mm). The greatest winder tread depth at the 12-inch (305 mm) walk line within any flight of stairs shall not exceed the smallest by more than 0.375 inch (9.5 mm).</p>
	<p>MIL-STD-1472F Figure 30 A Tread depth (including nosing) Min = 240mm (9.5 in.) Max = 300 mm (12 in.) Preferred = 280-300 mm (11-12 in.)</p>	<p>UFAS 4.9.2 Tread and risers. ...Stair treads shall be no less than 11 in (280 mm) wide, measured from riser to riser.</p>		

Appendix B: Side-by-side comparison of handrail height recommendations

HFDS	OSHA/MIL-STD-1472F	ADAAG/UFAS	DOJ 28CFR part 36/Maki et al	ANSI/International Building Code
<p>Dimensions for stairs. Stair dimensions shall be within the minimum and maximum values shown in the Exhibit 10.4.8.3.1. [Source: UCRL-15673, 1985] G Height of handrail Min = 76 cm (30 in) Max = 86 cm (34 in) Best = 84 cm (33 in)</p>	<p>OSHA 1926.1052(c)(6) The height of handrails shall be not more than 37 inches (94 cm) nor less than 30 inches (76 cm) from the upper surface of the handrail to the surface of the tread, in line with the face of the riser at the forward edge of the tread.</p>	<p>ADAAG 505.4 Height. Top of gripping surfaces of handrails shall be 34 inches (865 mm) minimum and 38 inches (965 mm) maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above walking surfaces, stair nosings, and ramp surfaces.</p>	<p>4.8.5(5) Top of [ramp] handrail gripping surfaces shall be mounted between 34 in and 38 in (865 mm and 965 mm) above ramp surfaces. 4.9.4(5) Top of [stair] handrail gripping surface shall be mounted between 34 in and 38 in (865 mm and 965 mm) above stair nosings.</p>	<p>ANSI 505.4 Height. Top of gripping surfaces of handrails shall be 34 inches (865 mm) minimum and 38 inches (965 mm) maximum vertically above stair nosings, ramp surfaces and walking surfaces. Handrails shall be at a consistent height above stair nosings, ramp surfaces and walking surfaces.</p>
	<p>MIL-STD-1472F Figure 30 F Height of handrail (from leading edge of tread) 840 mm (33 in.) 940 mm (37 in.) 840 mm (33 in.)</p>	<p>UFAS 4.9.4 Handrails. (5) Top of handrail gripping surface shall be mounted between 30 in and 34 in (760 mm and 865 mm) above stair nosings.</p>	<p>Maki et al (1984) Estimates the optimal range of handrail height as .91-1.20 m. For young subject > .91 m is acceptable, for elderly (>59 years), .86 -1.02 m. Mean preferred height is .91 m overall.</p>	<p>IBC 1009.11.1 Height. Handrail height, measured above stair tread nosings, or finish surface of ramp slope, shall be uniform, not less than 34 inches (864 mm) and not more than 38 inches (965 mm).</p>