

of the stair rail also serves as a handrail. The following are examples of the acceptable heights of each component installed on or after (insert date 60 days after the effective date of the final rule in the **Federal Register**):

Guardrail: Minimum 39 inches (1 m). (Optimum height: 42 inches (1.11 m)). Stair rail: Minimum 36 inches (91 cm). (Optimum height: 42 inches (1.1 m)).

Handrail: 30 inches (76 cm) to 37 inches (94 cm) (Optimum height: 33 inches (84 cm)). Combination stair rail/handrail: 36 inches (91 cm) to 37 inches (94 cm).

Ideally (but not required by this standard) an open-sided stairway should have a 42 inch (1.1 m) stair rail, with a 33 inch (84 cm) handrail mounted on it.

2. *Examples of acceptable guardrail components.* The guardrail criteria contained in § 1910.28 is performance-oriented, and provides the employer with many options in materials to use in designing and installing a guardrail system. The following are several examples of guardrail systems considered acceptable by OSHA:

A. *For wood railings:* The posts should be of at least two-inch by four-inch (5.1 cm by 10.2 cm) lumber spaced not to exceed eight feet (2.4 m); the top and intermediate rails should be at least two-inch by four-inch (5.1 cm by 10.2 cm) lumber. If the top rail is made of two one-inch by four-inch (5.1 cm by 10.2 cm) pieces of lumber nailed at right angles to one another, the posts should be spaced on eight-foot (2.4 m) centers, with a two-inch by four-inch (5.1 cm by 10.2 cm) intermediate rail. Selected wood components should be minimum 1500 lb-f/in² (1.03 kN/cm²) fiber stress construction grade lumber. All dimensions refer to nominal sizes as provided by the American Softwood Lumber Standards.

B. *For pipe railings:* Posts, top rails and intermediate railings should have at least a one and one-half inch (3.8 cm) outside diameter. Posts should be spaced no more than eight feet (2.4 m) on centers.

C. *For structural steel railings:* Posts, top rails and intermediate rails should be of two inch by two inch by three-eighth inch (5.1 cm by 5.1 cm by 0.95 cm) angle iron or of other

metal shapes with equivalent bending strength. Posts should be spaced not more than eight feet (2.4 m) on centers. Structural steel systems may also have posts of two inch by two inch by one-eighth inch (5.1 cm by 5.1 cm by 0.3 cm) angle iron spaced five foot (1.52 m) or less on center with 1-3/4 inch by 1-3/4 inch by 3/16 inch (4.4 cm by 4.4 cm by 0.5 cm) top rail and 1/4 inch by one inch (0.64 cm by 2.54 cm) bar stock midrails.

Note: Railings subject to receiving heavy impacts from material-handling equipment or large numbers of employees should be provided with additional strength by using heavier stock, closer spacing of posts, additional bracing or the equivalent.

4. *Guardrails less than 39 inches (1.0 m).* The following are examples of acceptable guardrail systems where the height of the top edge of the guardrail may be reduced to as low as 30 inches (76 cm). Such alternatives could be used in hot-dip galvanizing operations or similar situations where employees need to work with hand tools over the guardrail system.

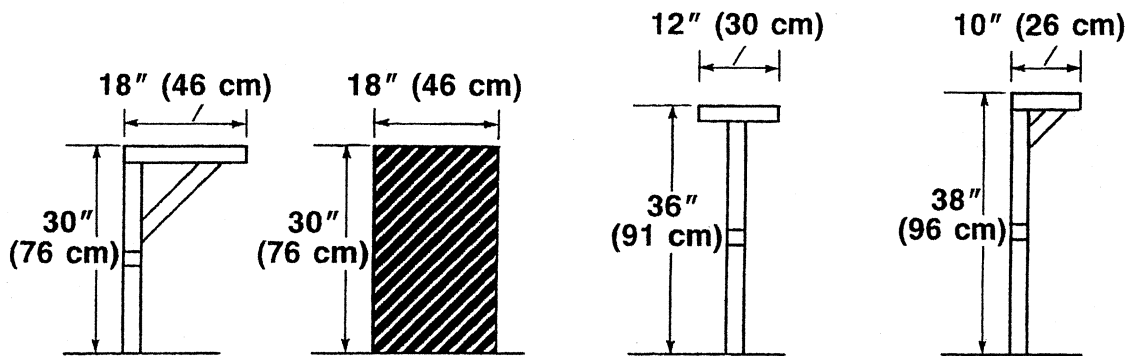


FIGURE D-5

5. *Openings in guardrails.* Openings in guardrails should be small enough to limit the spacing between guardrail members in any one direction to 19 inches (48 cm) or less. A 19 inch (48 cm) diameter ball or sphere can be used to measure spacing of irregularly shaped openings.

In the case of non-rigid guardrail systems, the opening criteria is considered met if the dimensions are proper while the system is not under load. If the size of the openings needs to be reduced, higher toeboards, wider midrails, multiple intermediate rails, perpendicular bars, x-bracing, panels, screen mesh, etc., can be used if they meet the strength, deflection, and permanent deformation requirements. This standard

does not require midrails, provided the 19 inch (48 cm) requirement is met by some other way such as solid barriers, pickets, screening, etc. It should be noted that smaller openings may be required in areas used by the general public, and local building codes may require lesser dimensions.

6. *Surfaces of guardrails.* An acceptable top rail would be a smooth surface such as a pipe, with normal pipe fittings or a smoothly surfaced lumber component. Examples of unacceptable top rails would be rough surfaced lumber, small diameter wire, steel or plastic banding, and guardrails with protruding objects such as splinters, nails, or bolts—all of which could injure an employee's hand.

7. *Testing of guardrail and handrail systems.* In developing and performing tests for guardrail and handrail systems, it is recommended that the test force be applied to the top rail or midrail over an area not to exceed four inches (10.1 cm) by four inches (10.1 cm). In addition, the center of the applied force must be within two inches (5.1 cm) of the top edge of the top rail. The employer should exercise care in determining the most critical locations and directions in which to apply the force (such as a horizontal force at the midpoint of the top rail between supporting posts).

8. *Handrail height requirements.* (a) A diagram of how to measure the height of a handrail is as follows: