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Minimum specifications for mass-produced portable platforms, ramps, stairs, and choral risers for live performance events

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Interest category codes:

CP = custom-market producer
DE = designer
DR = dealer rental company
G = general interest
MP = mass-market producer
U = user

Table of Contents

NOTICE AND DISCLAIMER.....	ii
Investors in Innovation.....	iv
Contact Information:.....	vi
Acknowledgments.....	vii
1 Scope (mandatory).....	1
2 Rationale for this standard (informative).....	1
3 US/SI conventions (mandatory).....	2
4 Definitions (mandatory).....	2
5 Referenced standards.....	2
6 Construction Requirements (mandatory).....	3
6.1 Fire behavior*.....	3
6.2 Surface finish*.....	3
6.3 Requirements for design.....	3
6.3.1 Minimum design loads.....	3
6.3.1.1 Uniformly distributed vertical load*.....	3
6.3.1.2 Vertical point load*.....	3
6.3.1.3 Horizontal loads.....	3
6.3.2 Deflection.....	4
6.3.2.1 Vertical deflection.....	4
6.3.2.2 Horizontal deflection.....	4
6.3.3 Design*.....	4
6.3.3.1 Design calculations or testing.....	4
6.3.3.2 Documentation of engineering practices.....	4
7 Additional conditions for access (mandatory).....	4
7.1 Stair units.....	4
7.1.1 Securing.....	4
7.1.2 Vertical point load for stairs*.....	4
7.1.3 Step rise, run, and width*.....	4
7.2 Ramps*.....	5
7.3 Handrails.....	5
8 Fall protection accessories (mandatory).....	5
8.1 General.....	5
8.2 Audience Railings.....	5
8.2.1 Audience Railing design load*.....	5
8.2.2 Audience Railing height and bar spacing*.....	5
8.3 Standard Guardrails*.....	5
8.3.1 Standard Guardrail design load.....	5
8.3.2 Standard Guardrail height and bar spacing.....	6
9 Labeling and user information (mandatory).....	6
9.1 Portable Unit labeling.....	6
9.2 User information.....	6
9.2.1 Operating instructions and user information.....	6
9.2.2 Maintenance instructions.....	6
9.2.3 Warnings and safety notices.....	7
Appendix A Explanatory information (informational, not mandatory).....	8
A.1 (2) Scope.....	8
A.6.1 Fire behavior.....	8
A.6.2 Surface finish.....	8
A.6.3.1.1 Uniformly distributed vertical load.....	8

A.6.3.1.2 Vertical point load..... 9
A.6.3.3 Design..... 9
A.7.1.2 Vertical point load for stairs..... 9
A.7.1.3 Step rise, run, and width..... 9
A.7.2 Ramps..... 9
A.8.2.1 Audience Railing design load..... 10
A.8.2.2 Audience Railing height and bar spacing..... 10
A.8.3 Standard Guardrails..... 10

Clauses that have an asterisk (*) have a corresponding informational entry in Appendix A. Appendix A contains no requirements and is informational only.

1 Scope (mandatory)

The standard covers mass-produced portable platforms, stair units and ramps used with those platforms, and choral risers, designed to be used for the presentation of music concerts, dramatic plays, fashion shows, and other entertainment and special events. The platforms, stairs, ramps, and choral riser modules covered by this standard are of a size and weight that allows them to be moved and erected by one or two people. Larger, heavier units that require three or more workers to move a module, or that need powered assistance to be moved, are outside the scope of this standard. The scope also covers the railings provided as fall protection accessories for the platforms, stair units, ramps, and choral risers within the scope of this standard.

This standard applies to the legging systems used with the mass-produced portable platforms, stair units and ramps used with those platforms, and choral risers. The legging systems may be integral to the units or separate, but they must be

- (1) designed, manufactured, and sold to be used with the units; or
- (2) supplied by the user or owner of the units in accordance with detailed, specific legging system specifications supplied by the platform manufacturer of the portable platform, stair unit, ramp, or choral riser. *

Custom platforms; complete stage systems; and platforms, ramps, and stairs used in the construction, maintenance, or repair of buildings are outside the scope of this standard.

2 Rationale for this standard (informative)

The products covered by this standard are mass produced and generally sold as equipment to assist in the staging of events. They often are set up for a short period of time in a particular configuration for an event, then are taken down, and stored for use on another event, probably in a different configuration, some time in the future. One or two platforms might be used to support a drummer and trap set for a rock band at a neighborhood bar, or scores of platforms might be used to provide tiered audience seating in a flexible-space, black-box theatre. These products are used and re-used in multiple configurations for a variety of entertainment and special events.

In the United States there are standards for these products when used in particular ways, but not for the products themselves. For example, if the platforms are arranged to provide tiered seating, the complete assembly can be considered a grandstand falling within the scope of NFPA 102, *Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures*. However, if they are not used for seating, they are outside the NFPA 102 scope. If platforms are set up as a drum riser for a rock band performing at a bar, the assemblage could be considered a “temporary platform” falling within Section 410 of the *International Building Code*. However, the extremely small size of this structure, the short time that is erected and used, and the venue in which it is being used will make it unlikely that anyone will consider a drum riser as something that should meet the requirements of the *IBC*. In any case, it is not easy to find the *IBC* requirements that might be applied to a drum riser. DIN 15921, *Veranstaltungstechnik – Podeste und Zargen aus Aluminium – Sicherheitstechnische Anforderungen und Prüfung*, applies to aluminum-framed products within the scope of this standard, but the standard is written in German and references EN standards not often used in North America.

The lack of product standards that clearly apply to mass-produced, portable platforms used in the United States complicates the US market for them. Manufacturers will sometimes contact ESTA's office to ask with what standards they will need to comply, and that results in an overly long conversation. Stage technicians and venue managers who use these platforms are sometimes asked by a supervisor what product standards the platforms meet, and the unsatisfactory answer is, “Well, it depends on how we use them.”

While there are no standards in North America for these portable platforms as products, there is significant congruence for the minimum performance specifications among the various standards and codes that can be applied to them when used in various ways. This standard attempts to incorporate those performance requirements into a product standard specification.

This document is a product specification. It is not a compliance testing document.

3 US/SI conventions (mandatory)

This Standard uses both United States customary units and the International System of Units in parenthesis for stating its requirements. The requirement statements are not exactly equivalent between US customary units and SI, but the difference is insignificant for the purposes of this Standard. A requirement shall be considered to be met if a product meets the requirement whether expressed in US customary units or SI.

4 Definitions (mandatory)

Audience Railing: A handrail or railing for fall protection in areas accessible to the general public.

Competent person: a person who is capable of identifying existing and predictable hazards in the workplace, and who is authorized to take prompt corrective measures to eliminate hazards.

Payload: The load that can be supported by a Portable Unit in addition to its own weight.

Portable Unit: A platform, stair unit, ramp, or choral riser that is within the scope of this standard.

Qualified Person: A person who by possession of a recognized degree, or certificate of professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

Shall: Indicates a mandatory requirement.

Should: Indicates a recommendation that is not a mandatory requirement.

Standard Guardrail: A railing for fall protection in areas not accessible to the general public.

5 Referenced standards

The following standards were referenced in the writing of this Standard. This Standard in general does not require compliance with these standards, except where specifically stated in a requirement of this Standard. However, the user of this standard is encouraged to consult these listed standards to gain an understanding of the context in which this Standard has been developed.

Note that compliance with these standards may be mandatory due to regulations or contractual obligations that might apply to users of this standard. That is, the lack of a compliance requirement in this Standard does not obviate the need to comply with a referenced standard if that compliance is required by a regulation.

- 29 CFR 1910.25, Stairways
- 29 CFR 1910.29, Fall protection systems and falling object protection-criteria and practices.
- 2010 ADA Standards for Accessible Design.
- 2015 Aluminum Design Manual
- 2018 International Building Code® (referred to in this Standard as “the 2018 IBC”)
- ANSI E1.34 – 2009 (R2019), Entertainment Technology – Measuring and Specifying the Slipperiness of Floors Used in Live Performance Venues

- ANSI Z535.4 - 2011 (R2017), Product Safety Signs and Labels
- ANSI Z535.6 - 2011 (R2017), Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials
- ASTM E84-18, Standard Test Method for Surface Burning Characteristics of Building Materials.
- DIN 15921:2015, Veranstaltungstechnik – Podeste und Zargen aus Aluminium – Sicherheitstechnische Anforderungen und Prüfung (Entertainment technology – Aluminium platforms and frames – Safety requirements and testing)
- ICC 300-2012, Standard for Bleachers, Folding and Telescopic Seating, and Grandstands
- National Design Specification for Wood Construction, 2018 edition
- NFPA 102, Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures, 2016 edition
- NFPA 5000, Building Construction and Safety Code, 2018 edition (NFPA 5000-2018)
- Steel Construction Manual, 13th Edition
- UL 723, Standard for Test for Surface Burning Characteristics of Building Materials, 2008 edition

6 Construction Requirements (mandatory)

6.1 Fire behavior*

The material used to construct Portable Units shall have flame spread and smoke-developed indices Class A or Class B as defined by UL 723, Standard for Test for Surface Burning Characteristics of Building Materials, or as defined by ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

6.2 Surface finish*

To avoid injury to persons, accessible edges, corners, and protruding parts must be burr-free. The grip areas for manual handling of the Portable Units should be designed according to ergonomic principles. As an alternative, the construction may allow for the use of accessories, such as ergonomically shaped carrying handles, to allow the safe manual handling of platforms, stair units, ramps, and choral risers.

Corrosion-prone parts of metal must be protected by paint or other coatings.

The walking surfaces of Portable Units shall be free from splinters, trip-hazards, and sharp edges. The walking and standing surfaces of Portable Units shall be slip-resistant.

6.3 Requirements for design

6.3.1 Minimum design loads

6.3.1.1 Uniformly distributed vertical load*

Walking surfaces of Portable Units shall be designed to support an evenly distributed vertical load of at least 100 pounds/square foot (4.8 kN/m²).

6.3.1.2 Vertical point load*

With the exception of stair units, walking surfaces of Portable Units shall be designed to be able to support a minimum point load of 300 pounds anywhere on the walking surface on an area 2 inches by 2 inches (1.3 kN on an area 51 mm X 51 mm). The point load shall not be required to be supported at the same time as the uniformly distributed load.

6.3.1.3 Horizontal loads

Portable Units shall support a horizontally directed load applied at the level of the upper walking surface with a force equal to 1/10 of the payload specified according to 6.3.1.1 or 1/10 the payload claimed for the

Portable Unit by the manufacturer, whichever is greater. Portable Units shall be able to support this horizontal load concurrently with the vertical loads specified in 6.3.1.1 and 6.3.1.2.

6.3.2 Deflection

6.3.2.1 Vertical deflection

In order to avoid creating a trip hazard, the difference in height between the surfaces of adjacent Portable Units sitting on a planar surface must not be more than 5/64" (2 mm) in an unloaded condition and not more than 5/32" (4 mm) with a 100 pound point load (4.8 kN) at the edge of one unit and no load on the adjacent one. This is to be assured by limiting the deflection under load or by providing a means of attaching platforms together or by a combination of both methods.

This maximum vertical deflection under load shall be determined and reported in the documentation available to the specifier or user of the Portable Unit.

6.3.2.2 Horizontal deflection

The maximum horizontal deflection with a horizontal load as specified in clause 6.3.1.3 shall be no more than 0.7% the height of the walking surface of the Portable Unit above the supporting floor or substrate.

6.3.3 Design*

6.3.3.1 Design calculations or testing

A Qualified Person shall design the Portable Unit to meet the specifications of this Standard, using established engineering practices. Those engineering practices may include Load and Resistance Factor Design, Allowable Stress Design, empirical testing, or other methods as determined by the Qualified Person.

6.3.3.2 Documentation of engineering practices

The Qualified Person doing the Portable Unit design shall document the design work, including any assumptions, material specifications, calculations, testing procedures, and testing results, in sufficient detail that a second Qualified Person, working independently of the first Qualified Person, can judge the efficacy of the design work in meeting the specifications of this Standard.

The design documentation shall be preserved on file for the expected life of the product, plus five years.

7 Additional conditions for access (mandatory)

7.1 Stair units

7.1.1 Securing

Stair units shall be fitted with devices to ensure that they do not shift away from any platform to which they provide access during use.

7.1.2 Vertical point load for stairs*

Stair units shall be able to support a minimum point load of 500 pounds anywhere on the walking surface on an area 4 inches by 4 inches (2.2 kN on an area 101 mm X 101 mm).

7.1.3 Step rise, run, and width*

The maximum riser height shall be 9.5 inches (24 cm). The minimum tread depth shall be 9.5 inches (24 cm). The minimum tread width shall be 22 inches (56 cm).

Multi-step units shall have a uniform tread depth and rise, varying less than 0.19 inches (5 mm) from step to step.

7.2 Ramps*

Ramps must be able to support the minimum design loads specified in 6.3.1 and should have the same load-bearing ability as the platform surfaces to which they are designed to lead. A slope of 1:8 (12.5%) must not be exceeded. A maximum inclination of 1:16.6 (6%) should not be exceeded for barrier-free access (e.g. for wheelchairs). The minimum width should be 36 inches (91 cm) for wheelchair access.

7.3 Handrails

Stair units and ramps having a rise of 8 inches (20 cm) or more shall have a provision for mounting at least one handrail. Multi-step stair units and ramps wider than 47 inches (1.2 meters) shall have a provision for mounting two handrails.

Handrails will need to meet the requirements for a Standard Guardrail at a minimum, and may need to meet the requirements for Audience Railings when the stair units are in public areas and there is a fall hazard. The handrail mounting must be designed to support either type of railing.

8 Fall protection accessories (mandatory)

8.1 General

Fall protection is generally provided by Audience Railings or Standard Guardrails. Other fall protection, such as nets and personal fall arrest systems, or work positioning systems to make falls impossible, could be used, but their use would be rare and these devices are outside the scope of this Standard.

For the purposes of this Standard, it should be assumed that any portable platform, stair unit, ramp, or choral riser that has or can have a walking or standing surface 8 inches (20 cm) or more above the supporting floor should have a means to attach Audience Railings or Standard Guardrails.

8.2 Audience Railings

8.2.1 Audience Railing design load*

Audience Railings shall be designed to support a concentrated load of at least 200 pounds (0.9 kN) applied in any direction on the top rail. They shall be able to support a uniformly distributed load of 50 pounds per linear foot of railing length (0.73 kN/m).

Intermediate rails (all those except the top rail) shall be designed to withstand a horizontal load of 50 pounds (0.22 kN) applied to an area of one foot square (30.5 cm x 30.5 cm). The application of the load shall not cause the intermediate structure to bend or tear to create an opening larger than allowed in 8.2.2.

8.2.2 Audience Railing height and bar spacing*

Audience Railings shall have a height of at least 42 inches (1.1 m). The bottom of the railing structure shall be designed to not be more than 0.8 inches (20 mm) above Portable Unit to which it would be fastened. The space between the top and bottom of the Audience Railing shall be filled with intermediate rails or a structure of bars, panels, or other elements spaced so that a 4-inch (100 mm) ball cannot be pushed through the structure.

8.3 Standard Guardrails*

8.3.1 Standard Guardrail design load

Standard Guardrails shall be designed to support a concentrated load of at least 200 pounds (0.9 kN) applied in any direction on the top rail. They shall be able to support a uniformly distributed load of 50 pounds per linear foot of railing length (0.73 kN/m).

Intermediate rails, bars, or panels shall be designed to withstand without failure a force of at least 150 pounds (0.7 kN) applied in any downward or outward direction at any point along the intermediate member.

8.3.2 Standard Guardrail height and bar spacing

Standard Guardrails shall have a height of at least 42 inches (1.1 m). The bottom of the railing structure shall be designed to not be more than 0.8 inches (20 mm) above Portable Unit to which it would be fastened. The space between the top and bottom of the Standard Guardrail shall be filled with intermediate rails or a structure of bars, panels, or other elements so there is no space larger than 19 inches (48 cm).

9 Labeling and user information (mandatory)

9.1 Portable Unit labeling

The Portable Unit shall have a durable label on it that specifies:

- 1) manufacturer with contact name;
- 2) manufacture year and month;
- 3) product name;
- 4) self-weight in kilograms or pounds;
- 5) the permissible payload as a function of the maximum permissible height, and the permissible leg positions;
- 6) the maximum permissible point loads;
- 7) the fire behavior classification (see clause 6.1)

9.2 User information

The following information should be provided to the user on the Portable Unit, in a hard-copy handbook, on a website, in a free app for portable devices, or via some other convenient medium.

9.2.1 Operating instructions and user information

The manufacturer, importer or distributor must provide a user manual with operating instructions and user information:

- a) description of the installation and use situation (e.g., fitness for outdoor use);
- b) the correct assembly of the Portable Unit;
- c) instructions for the correct positioning of the protective electrical bonding connection, if one exists;
- d) recommendations for preventive measures to be taken by the user (e.g., personal protective gear);
- e) instructions for assembly, dismantling, and operation, and the number of people required for manual handling indicated;
- f) information on the static load capacity and on variable or mobile loads (e.g., vehicles, wheelchairs);
- g) information on storage and transport;
- h) notes on maintenance (repair, maintenance, testing);
- i) criteria for decommissioning and disposal;
- j) information on spare parts procurement; and
- k) the maximum vertical or horizontal deflection under load.

9.2.2 Maintenance instructions

Maintenance instructions should include the following:

- a) advice about the nature and frequency of visual and functional checks, inspections, and maintenance;
- b) particular hazards during inspections and maintenance;
- c) qualification of the persons responsible for the inspection and maintenance;

- d) instructions for repairs and adjustments;
- e) cleaning and care methods;
- f) the scope of inspections and maintenance that may be carried out without the involvement of specialists;
- g) contact details of the manufacturer of the Portable Unit from which technical support is available.

9.2.3 Warnings and safety notices

Hazards shall be identified and reported to the user by appropriate labeling and safety notices per ANSI Z535.4 - 2011 (R2017), Product Safety Signs and Labels and ANSI Z535.6 - 2011 (R2017), Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials.

Appendix A

Explanatory information

(informational, not mandatory)

A.1 (2) Scope

A few platform systems are manufactured with sockets in the corners for user-supplied legs. The legs often are specified as needing to be of a particular type of pipe or tubing. Often the portable platform manufacturer will publish load performance specifications with the understanding that user will supply legs per the platform manufacturers instructions. The instructions should be detailed and specific, or the user-supplied legs will be an undefined element, and no meaningful statements can be made about the platform load-carrying capacity.

A.6.1 Fire behavior

The fire behavior specification is taken from clause 803.1.2, Interior wall and ceiling finish materials, of the 2018 International Building Code. That clause is about limiting flame and smoke spread, which, for the purposes of this standard, are considered the major fire hazards with portable platforms, not their contribution to the potential fuel load of a building. The frames of most mass-produced portable platforms, stair units, ramps, and choral risers are made of aluminum or steel, which are usually considered non-combustible, but the walking surfaces (decks) are often made of wood, plastic, or some combination of the two. In some situations, these might burn, but it is desirable to limit the rate of flame spread and smoke production.

DIN 15921 only addresses the flammability of the deck material and requires that it must at a minimum be out of normally flammable materials—not nonflammable, but not exceptionally flammable, either. (The phrase in German is “. . . müssen mindestens aus normalentflammbaren Materialien bestehen.”) However, for a North American audience, arguments about what constitutes “normal burning” are likely to be unsatisfying.

NFPA 102 cites sections of NFPA 5000 for grandstand construction requirements. Different maximum heights, maximum areas, and minimum distances from buildings are specified, depending on the construction type (i.e., Type I, Type II, Type III, Type IV, or Type V). That classification system does not work well for small, modular, Portable Units.

A.6.2 Surface finish

That walking surfaces be “slip-resistant” is a common requirement in standards for installations that might use the portable units within the scope of this Standard, but few specify a minimum coefficient of friction or a way to test for it. Never the less, it is recommended, but not required in this Standard, that the manufacturer determine an acceptable coefficient of friction for friction between the surface and footwear that is likely to be used on it, and to test to see that the portable unit meets that minimum specification. Common materials used in testing are stainless steel, to provide a specific generic material, and shoe sole leather or shoe sole rubber. The latter two materials are closer to real-world footwear but are highly variable. Common coefficients of friction for dry surfaces that are specified are 0.5, 0.6, and 0.8. ANSI E1.34, Entertainment Technology – Measuring and Specifying the Slipperiness of Floors Used in Live Performance Venues, offers a simple, low-cost drag-sled method for determining the coefficient of friction of a surface.

A.6.3.1.1 Uniformly distributed vertical load

The 2018 International Building Code specifies a minimum UDL for “Platforms (assembly),” “Other assembly areas,” and “Reviewing stands, grandstands and bleachers” in Table 1607.1 of 100 pounds per

square foot. DIN 15921 specifies 5 kN/m², which is about 104 pounds per square foot. This is a higher specification, but not so much as to suggest that the IBC is wrong.

NFPA 102 cites clauses in NFPA 5000 which cite clauses in ASCE 7. The 2005 edition of ASCE 7 specifies the same minimum loading as the 2018 IBC.

A.6.3.1.2 Vertical point load

This point load specification is taken from ICC 300. DIN 15921 specifies a higher minimum vertical point load of 1.5 kN on a square footprint 50 mm x 50 mm. (“Es ist eine vertikale Last von mindestens 1,5 kN mit einer quadratischen Aufstandsfläche mit einer Seitenlänge von 50 mm in ungünstigster Stellung anzusetzen.”) That is about 337 pounds-force on a square 1.97” on a side.

A.6.3.3 Design

Chapter 17, Special Inspections and Tests, of the *2018 International Building Code* lays out a procedure for empirical testing of “any material of questioned suitability proposed for use in the construction of a building or structure” by loading it to 2.5 times the design load or to failure.

The normative Anhang A, Verfahren zur Prüfung von Podesten und Zargen aus Aluminium, of DIN 15921:2015, *Veranstaltungstechnik – Podeste und Zargen aus Aluminium – Sicherheitstechnische Anforderungen und Prüfung*, has information about testing Portable Units.

This E1.62 Standard is not a testing document. Compliance is not required by this Standard with either DIN 15921 or the IBC. These two documents are noted for information only.

A.7.1.2 Vertical point load for stairs

This is more severe than the specification in DIN 15921:2015, clause 4.3.1, which requires stairways to withstand a point load of 1.5 kN (337 pounds) on a surface of 100 mm × 100 mm, but it is a specification met by products on the market in North America, and is closer to the 1000 pound load specification for permanent stairs required by OSHA's 29 CFR 1910.25(b)(6).

A.7.1.3 Step rise, run, and width

These rise, run, and width minimum specifications are taken from 29 CFR 1910.25(c)(2), 1910.25(c)(3), and 1910.25(c)(4). These OSHA regulations allow a higher rise and shorter tread depth than are allowed for assembly occupancy aisle stairs in NFPA 5000-2018.

The uniformity specification is based on ICC 300-2012, which defines nonuniformity as a variation of 0.188 inches (4.8 mm) or more. This Standard rounds the US customary unit specification to two significant digits and applies a similar rounding to the SI equivalent. A piece of 20-pound paper is about 0.00325 inches thick; taking the specification for step uniformity to a level of precision thinner than a piece of paper, as ICC 300 does, is unlikely to be helpful; two significant digits is precise enough.

A.7.2 Ramps

The slope specifications are copied from a translation of DIN 15921:2015, but the 1:8 (12.5%) maximum is consistent with clause 16.2.5.6.5.1 (2) in NFPA 5000-2018. Per that clause, any assembly occupancy aisle steeper than 1:8 is required to be a stairway. The 1:16 slope for wheelchair access is lower than the 1:12 stated in clause 405.2 in the Department of Justice's *2010 ADA Standards for Accessible Design*. However, that document also says, “Where possible, designers and operators are encouraged to provide ramps with a slope less than the 1:12 maximum.” (Advisory 240.2.1).

A.8.2.1 Audience Railing design load

These specifications are taken from ICC 300-2012. They are lower than what is required in DIN 15921:2015. That standard requires the design load at a 1m rail height to be 1 kN/m (69 pounds/foot), but at least 1 kN (225 pounds-force) in the direction of a possible fall, and 0.5 kN/m (34 pounds/foot), but at least 0.5 kN, in the direction away from the fall hazard, back toward the platform center.

A.8.2.2 Audience Railing height and bar spacing

These height and spacing requirements are broadly consistent across DIN 15921:2015, ICC 300-2012, and NFPA 102-2016. The DIN standard is more specific about the structure that fills the space between the top and bottom of the railing, requiring it to be made of vertical bars, but it also allows a wider spacing, 120 mm. The purpose of requiring vertical bars is to make climbing over the railing difficult.

A.8.3 Standard Guardrails

These requirements are essentially those found in 29 CFR 1910.29(b) with the addition of a uniformly distributed load requirement.