PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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1. **Scope**

This Practice provides design guidelines for typical OSHA-regulated fixed ladders, ladder safety systems/personal fall arrest systems and cages as specified and detailed for fabrication in *PIP STF05501* for open structures, miscellaneous platforms, and vessels for regular operational access and egress. Typical detail drawings for design are provided that describe ladder and cage details, platform access configurations, support and guide connections, ladder location details, and ladder clearances for side step and through ladder types.

The intention of this Practice is to inform structure/platform engineers of OSHA regulations regarding fixed ladders and discuss some practical issues that may arise. Interpretations of the OSHA regulations are the responsibilities of the owner and engineer of record.

2. **References**

Applicable parts of the following Practices, industry codes and standards, and government regulations shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 **Process Industry Practices (PIP)**

- PIP ADG009 - *Guideline for Increasing Global Application of Practices*
- PIP CVC01017 - *Plant Site Data Sheet*
- PIP CVC01018 - *Project Data Sheet*
- PIP STC01015 - *Structural Design Criteria*
- PIP STE05520 - *Guards and Handrails Design Guide*
- PIP STF05501 - *Fixed Ladders Fabrication Details*
- PIP STF05520 - *Pipe Guards and Handrails Fabrication Details*
- PIP STF05521 - *Angle Guards and Handrails Fabrication Details*
- PIP STF05535 - *Vessel Circular Platform Fabrication Details*
- PIP STI03310 - *Concrete Typical Details*
- PIP STS05120 - *Structural and Miscellaneous Steel Fabrication Specification*

2.2 **Industry Codes and Standards**

- American Institute of Steel Construction (AISC)
  - ANSI/AISC 303-16 - *Code of Standard Practice for Steel Buildings and Bridges*
- American National Standards Institute, Inc. (ANSI)
- American Society of Civil Engineers (ASCE)
  - ASCE/SEI 7-10 - *Minimum Design Loads for Buildings and Other Structures*
- National Fire Protection Association (NFPA)
  - NFPA 101-12 - *Life Safety Code*
Comment: In this Practice both versions of the code are referred to as “NFPA 101” or “NFPA” and are used in reference to provisions for guards for which both versions are virtually identical.

2.3 Government Regulations

The following government document has been used as a reference in the development of this Practice.

- U.S. Department of Labor (DOL) - Occupational Safety and Health Administration (OSHA)
  - Regulations 29 CFR 1910 Subpart D - Walking-Working Surfaces and Subpart I – Personal Protective Equipment (Amended) - Final Rule Published in Federal Register, Volume 81, No. 223, on November 18, 2016 (referred to as “OSHA” in this Practice)

3. Definitions

This Practice uses the same terminology as AISC, OSHA and NFPA. After each definition, the source document is indicated in parentheses. “(AISC)” refers to ANSI/AISC 303-16. “(OSHA)” refers to OSHA Regulations 29 CFR 1910 Subpart D and Subpart I. “(NFPA)” refers to NFPA 101-12 or NFPA 101-15 as applicable. “(PIP)” indicates PIP definitions not specifically provided by AISC, OSHA or NFPA.

anchoraged: A secure point of attachment for equipment such as lifelines, lanyards, deceleration devices, and rope descent systems (OSHA)

cage: An enclosure mounted on the side rails of a fixed ladder or fastened to a structure behind the fixed ladder that is designed to surround the climbing space of the ladder. A cage also is called a “cage guard” or “basket guard.” (OSHA)

carrier: The track of a ladder safety system that consists of a flexible cable or rigid rail attached to the fixed ladder or immediately adjacent to it (OSHA)

contract documents: Any and all documents, including codes, studies, design documents, specifications, sketches, Practices, and data sheets, that purchaser or engineer of record has transmitted or otherwise communicated, either by incorporation or reference, and made part of the legal contract agreement or purchase order between purchaser and structure/platform fabricator, ladder fabricator and/or vessel manufacturer (PIP)

design documents: The design drawings, or where the parties have agreed in the contract documents to provide digital model(s), the design model. A combination of drawings and digital models also may be provided. (AISC)

design drawings: The graphic and pictorial portions of the contract documents showing the design, location and dimensions of the work. These documents generally include, but are not necessarily limited to, plans, elevations, sections, details, schedules, diagrams and notes. (AISC)

design model: A dimensionally accurate 3D digital model of the structure that conveys the structural steel requirements given in Section 3.1 [of ANSI/AISC 303-16] for the building [or structure] (AISC)
engineer of record: Purchaser’s authorized representative with overall authority and responsibility for engineering design, quality, and performance of civil works, structure, foundations, materials, and appurtenances described in contract documents. Engineer of record shall be licensed as defined by laws of the locality in which the work is to be constructed, and be qualified to practice in the specialty discipline required for the work described in contract documents. *(PIP)*

fabricator shop drawings: Drawings produced by a fabricator that transfer information from design documents and other contract documents into accurate, detailed dimensional information to be used for fabrication of ladders and structural steel *(PIP)*

fixed ladder: A ladder with rails or individual rungs that is permanently attached to a structure, building, or equipment. Fixed ladders include individual-rung ladders, but not ship stairs, step bolts, or manhole steps. *(OSHA)*

guard: A vertical protective barrier erected along exposed edges of stairs, balconies, and similar areas *(NFPA)*

Comment: The term “guardrail system” used by ASCE and OSHA is considered by PIP to be equivalent to the term “guard” used by NFPA. The typical railing around the perimeter of platforms on open process structures, for example, is referred to in NFPA and this Practice as a “guard.”

guard fabricator: Party responsible for providing fabricated guards for platforms in accordance with contract documents. The term guard fabricator shall apply also to guard fabricator’s subcontractor(s) and/or vendor(s) *(see PIP STE05520, PIP)*

ladder fabricator: Party responsible for providing fabricated ladders in accordance with contract documents. The term ladder fabricator shall apply also to ladder fabricator’s subcontractor(s) and/or vendor(s). *(PIP)*

ladder safety system: A system designed to eliminate or reduce the possibility of falling from a ladder. A ladder safety system usually consists of a carrier, safety sleeve, lanyard, connectors, and body harness. Cages and wells are not ladder safety systems. *(OSHA)*

lower level: A surface or area to which an employee could fall. Such surfaces or areas include, but are not limited to, ground levels, floors, roofs, ramps, runways, excavations, pits, tanks, materials, water, equipment, and similar surfaces and structures, or portions thereof. *(OSHA)*

maximum intended load: The total load (weight and force) of all employees, equipment, vehicles, tools, materials, and other loads the employer reasonably anticipates being applied to a walking-working surface at any one time *(OSHA)*

owner: Party who has authority through ownership, lease, or other legal agreement over site, facility, structure, platform, vessel or project wherein ladders will be used *(PIP)*

personal fall arrest system: A system used to arrest an employee in a fall from a walking-working surface. It consists of a body harness, anchorage, and connector. The means of connection may include a lanyard, deceleration device, lifeline, or a suitable combination of these. *(OSHA)*

personal fall protection system: A system (including all components) an employer uses to provide protection from falling or to safely arrest an employee’s fall if one occurs. Examples of personal
fall protection systems include personal fall arrest systems, positioning systems, and travel restraint systems. *(OSHA)*

*purchaser:* Party who awards contract to structure/platform fabricator, ladder fabricator and/or vessel manufacturer. Purchaser may be owner or owner’s authorized agent. *(PIP)*

*side-step ladder:* A type of fixed ladder that requires an employee to step sideways from it in order to reach a walking-working surface, such as a landing *(OSHA)*

*structure/platform engineer:* Engineer that performs design of structures/platforms, including ladders that connect to structures/platforms. Structure/platform engineer may also perform design of ladders that connect to vessels if design of ladder support and guide connections is validated by a vessel engineer. *(PIP)*

*structure/platform fabricator:* Party responsible for providing fabricated structural and miscellaneous steel in accordance with contract documents. The term structure/platform fabricator shall apply also to structure/platform fabricator’s subcontractor(s) and/or vendor(s). *(PIP)*

*through ladder:* A type of fixed ladder that allows the employee to step through the side rails at the top of the ladder to reach a walking-working surface, such as a landing *(OSHA)*

*travel restraint system:* A combination of an anchorage, anchorage connector, lanyard (or other means of connection), and body support that an employer uses to eliminate the possibility of an employee going over the edge of a walking-working surface *(OSHA)*

*vessel engineer:* Engineer that performs design of vessels, including ladders that connect to vessels. Alternatively, vessel engineer may validate design of ladder support and guide connections to vessels for ladders that are designed by a structure/platform engineer. *(PIP)*

*vessel manufacturer:* Party responsible for providing manufactured vessels in accordance with contract documents. The term vessel manufacturer shall apply also to vessel manufacturer’s subcontractor(s) and/or vendor(s). *(PIP)*

*well:* A permanent, complete enclosure around a fixed ladder *(OSHA)*

## 4. Ladder Design

### 4.1 General

4.1.1 Fixed ladders should be designed in accordance with *(OSHA)* Regulations 29 CFR 1910 Subpart D. Revisions to the *(OSHA)* regulations which were published in the Federal Register Volume 81, No. 223 and took effect on January 17, 2017 impact many aspects of ladder design, installation and use. The impact of the revised *(OSHA)* regulations on ladder design is discussed in this section. The most significant impact is in the area of ladder fall protection which is discussed in Section 5 of this Practice.

4.1.2 This Practice provides guidelines for design of fixed ladders as mandated by *(OSHA)* regulations. *(ANSI-ASC A14.3-2008)*, which is a national standard, may also be used as a reference that provides guidelines for design of fixed ladders, however, *(OSHA)* regulations are mandated by the federal government and take precedence over *(ANSI-ASC A14.3-2008)*. Fixed ladder design and fabrication as represented in this Practice and *(PIP STF05501)* are based on *(OSHA)* regulations
and standard industry practice and do not necessarily address or adhere to any provisions of ANSI-ASC A14.3-2008.

4.1.3 The revised OSHA regulations have been written to be more performance-based and less prescriptive than previous OSHA regulations. As a result, many of the provisions are based on the intended use of the fixed ladder rather than specific prescriptive requirements. The revised OSHA regulations also provide more design options for employers to meet the regulations. PIP has intended for options in some cases to be left to the owner to decide and in other cases to be based on common industry practice established by details used in previous versions of PIP STE05501 and PIP STF05501.

4.1.4 Fixed ladders and ladder safety systems/personal fall arrest systems should be designed in accordance with criteria provided by owner in PIP CVC01017 and PIP CVC01018, as applicable.

4.1.5 Metric units provided in this Practice and PIP STF05501 are based on PIP ADG009. Units in centimeters referenced from OSHA have been converted to millimeters for consistency with units referenced from other sources and standard metric units as indicated in PIP ADG009.

4.2 Ladder Lengths

4.2.1 OSHA does not require fall protection on fixed ladders that extend 24 ft (7.3 m) or less above a lower level.

4.2.2 Ladders that extend more than 24 ft (7.3 m) above a lower level are required to meet OSHA fall protection requirements. Refer to Section 5.2.

4.2.3 Ladders equipped with a personal fall arrest system or ladder safety system are not limited in length, but the personal fall arrest system or ladder safety system is required to provide protection throughout the entire vertical length of the ladder including all ladder sections, and the ladder is required to have rest platforms provided at maximum intervals of 150 feet (45.7 m).

4.2.4 During the 20-year extended compliance period (see Sections 5.2.2 and 5.2.3), ladder sections with cages or wells are required to be offset from one another and to have landing platforms provided at maximum intervals of 50 feet (15.2 m). This provision no longer applies once the ladder is furnished with a ladder safety or personal fall arrest system.

4.2.5 Side rails for through or side-step ladders are required to extend 42 inches (1100 mm) minimum above top of access level or landing platform. PIP standardizes on a 48-inch (1200-mm) extension to allow for another rung to better facilitate attachment of ladder safety systems or personal fall arrest systems to multiple ladder rungs.

4.2.6 PIP recommends that ladders longer than 55 ft (16.8 m) in total length be fabricated in segments, with the maximum overall length of each segment approximately 55 ft (16.8 m) for practical reasons. Longer fabricated segments require special fabrication, galvanizing and shipping considerations. Fabricated segments may be left independent, with each segment independently supported and a gap provided between segments. Refer to details shown on drawing PIP STE05501-04. See Section 4.4.4 for segmented ladders with cages.
4.2.7 For ladders attached to vertical vessels or other applications where temperature variation is a concern, PIP recommends that continuous ladders be avoided and ladder sections be offset, with side-step access to landing platforms provided at 50-ft (15.2-m) maximum intervals. See Sections 4.5.2 and 4.10 for further discussion on this topic.

4.3 Platform Access

4.3.1 A ladder with side-step access at the top platform serviced by the ladder is the preferred configuration by common industry practice. Through ladders could create clearance issues with ladder safety systems and should be avoided if possible.

4.3.2 Side-step access between a continuous ladder and an intermediate platform along its length is not specifically prohibited by OSHA. The situation is not appreciably different from stepping onto or off of the top of a side-step ladder. Some owners, however, may prohibit intermediate access because of concerns about an employee stepping out onto the ladder from an intermediate platform and interfering with another employee climbing the ladder, and instead require a break in the ladder at each intermediate platform, with separate offset ladder sections to continue up or down.

4.3.3 Self-closing double-bar safety gates, in accordance with OSHA, are required to be provided at openings in platform guards for all platforms serviced by the ladder. OSHA requires safety gates to provide the same protection as a platform guard when the safety gate is in the closed position with the exception that a toe plate is not required at the opening at a ladder. See PIP STE05520 for further discussion.

4.3.4 Some owners may have a preferred manufacturer and type of safety gate to be used for their facility that should be specified in contract documents accordingly. Safety gates should be supplied by guard fabricator.

4.3.5 The location of the safety gate hinges relative to the ladder orientation as well as minimum required swing angle of the safety gate should be selected by structure/platform engineer to provide adequate accessibility between ladder and platform. At the top of side-step ladders, safety gate hinges should be located at the back of the person using the ladder, for ease of use. Direction of swing should be shown in design documents. Minimum required swing angle for safety gates should be 90 degrees. The minimum required swing angle of safety gate should be shown in design documents if greater than 90 degrees.

4.3.6 The mounting plate of most manufactured safety gates will extend into the clear opening between guard posts at the ladder access, thus reducing the effective clear opening in the guard system. This difference is required to be accounted for in establishing the required face-to-face dimension between the guard posts.

4.3.7 At the top of through ladders, the effective clear opening in the guard system should match the face-to-face dimension between the flared rails at the top of the ladder. In accordance with OSHA, the dimension between the flared rails at the top of a through ladder is required to be not less than 24 inches (610 mm) and not more than 30 inches (760 mm), except when a ladder safety system is provided on the ladder, the dimension must not exceed 36 inches (910 mm). If the safety gate mounting gate encroaches into the opening in the guard system, the dimension should be adjusted to provide an effective clear opening in the guard system of not less than 24 inches (610 mm).
4.3.8 At the top of side-step ladders, the effective clear opening in the guard system, including the encroachment of the safety gate mounting plate, should not be less than 18 inches (460 mm). PIP details provide for a 24-inch (610-mm) opening between guard posts at side-step ladders, which is believed to be sufficient for most manufactured safety gates, but this adequacy is required to be verified by the structure/platform engineer.

4.4 Ladder Cages

4.4.1 As discussed in Sections 5.1 and 5.2 below, for new fixed ladders (installed on or after November 19, 2018) extending more than 24 feet (7.3 m) above a lower level, cages are no longer considered by OSHA to provide effective fall protection and personal fall arrest system or ladder safety systems must be used instead. OSHA does not mention the use of cages for fixed ladders extending 24 feet (7.3 m) or less above a lower level.

4.4.2 Although cages are no longer required on fixed ladders, this does not mean that cages can no longer be provided, or that they no longer have any purpose. Cages may provide psychological comfort to some users of ladders, especially on longer climbs. In the event of emergency egress, it may not be practical for an employee to engage a personal fall arrest system or ladder safety system and having a cage may provide some protection to direct the fall of an employee to the base of a ladder for a fixed ladder on an elevated platform. Some owners may still elect to provide cages on longer fixed ladders or fixed ladders on elevated platforms in combination with a personal fall arrest system or ladder safety system for these reasons.

4.4.3 The current OSHA regulations provide fewer specific prescriptive requirements for cage construction than the previous OSHA regulations did. The details shown on drawings PIP STE05501-12 through PIP STE05501-17 are in accordance with previous OSHA regulations where current OSHA regulations do not provide specific requirements. PIP still recommends use of these details if cages are used. Some owners specify a larger inside radius for cages than shown in PIP details to accommodate employees wearing heavy clothing in cold climates and/or air packs in hazardous locations.

4.4.4 If cages are used on long ladders that are fabricated in segments, the cages should also be fabricated in segments with the ladder (See Section 4.2.6). A 3-inch (75-mm) hoop at the top of the lower cage segment and at the bottom of the upper cage segment should be provided. Similar to the ladder rails, a gap should be provided between cage segments. Refer to detail shown on drawing PIP STE05501-16.

4.4.5 If a cage is used in combination with a personal fall arrest system or ladder safety system (see Section 4.4.2 above), the cage is required by OSHA to not interfere with the operation of the system.

4.5 Ladder Supports and Guides

4.5.1 Ladders should be supported at top and guided at bottom and along the length as required based on the size and type of rails and unguided length criteria shown on drawings PIP STE05501-01 and PIP STE05501-06. Having the support located at top of ladder ensures that ladder rails will be loaded in tension and top rung will remain level with the walking surface of the platform.
4.5.2 Although OSHA permits continuous ladders of unlimited length provided they have a personal fall arrest system or ladder safety system, caution is required regarding ladders that attach to vertical vessels. It may not be practical to design slotted guides that can accommodate the movement caused by temperature differential between the vessel and ladder when the ladder is excessively long (See Section 4.2.7).

4.5.3 The ladder support details shown in this Practice and PIP STF05501 are capable of supporting a 150-ft (45.7-m) long ladder with cage, based on the load criteria provided in Section 4.9.7 using a live load provided in Section 4.9.1.

4.5.4 Ladder support members, support connectors, and guide connectors to structures/platforms should be located and designed by structure/platform engineer and shown in design documents.

4.5.5 Ladder support members, support connectors, and guide connectors to vessels should be located and designed by vessel engineer and shown in design documents. Refer to Section 4.10 for additional guidance regarding clips on vertical vessels with temperature variation.

4.6 Ladder Rails

4.6.1 OSHA does not provide prescriptive requirements for the shape or cross section of ladder rails. ANSI-ASC A14.3-2008 indicates that various shapes may be used for ladder rails that provide for a uniform gripping surface for the hands of persons using the ladder, as long as the shape provides a power grip throughout the length of climb. ANSI-ASC A14.3-2008 also recommends that ladder rails be have a minimum cross section of 2-1/2 inches by 3/8 inches. The ladder rail shapes and cross sections used by PIP are considered common industry practice that meet these recommendations.

4.6.2 Selection of ladder rails by fabricator should be based on guide locations shown in design documents and unguided length criteria shown on fabrication detail drawing PIP STF05501-01, unless otherwise specified in contract documents.

4.6.3 Guides for ladder rails should be located and designed by structure/platform engineer and/or vessel engineer based on using bar 2-1/2-inch by 3/8-inch ladder rails wherever feasible. If it is not feasible to provide sufficient guides for bar 2-1/2-inch by 3/8-inch ladder rails, bar 3-inch by 3/8-inch or C3x4.1 ladder rails should be used, in order of preference, based upon the feasibility of providing sufficient guides.

4.7 Ladder Rungs

4.7.1 Ladder rung length of 1 ft-6 inches (460 mm) as specified in PIP STF05501 is based on common industry practice and exceeds minimum required ladder rung length of 1 ft-4 inches (410 mm) specified in OSHA. Rung length may be reduced to minimum required by OSHA or increased at discretion of structure/platform engineer, vessel engineer and/or owner. Increased rung lengths may require a larger diameter rung based on design live load as prescribed in Section 4.9 of this Practice.

4.7.2 Ladder rung of 3/4-inch (20-mm) diameter smooth bar as specified in PIP STF05501 is based on common industry practice that was consistent with prescriptive requirements for rungs in the previous OSHA regulations. The
current OSHA regulations, which are performance-based, no longer have prescriptive requirements for the rung but rather require ladders to be designed to support the maximum intended load on the ladder. Ladder rungs specified in PIP STF05501 are designed based on the requirements given in Section 4.9.1 of this Practice, using a live load unit of 300 lb (1335 N). Assuming a 1 ft-6 inch (460 mm) simply-supported span, the rungs are each capable of supporting a maximum allowable live load unit of 315 lb (1400 N). See Section 4.9.3 for cases in which the maximum intended live load exceeds this value and will require a larger diameter rung.

4.7.3 Some owners specify the use of rungs that are corrugated, knurled, dimpled, or have coatings, caps or other types of treatments that are intended to provide additional slip resistance. Regardless of what is specified, it is important to provide uniformity in the slip resistance throughout entire length of ladder. Regular inspection of ladders and maintenance should be performed to ensure uniform slip resistance has not been compromised over time due to dirt, wear or damage.

4.7.4 Ladder rung spacing of 1 ft-0 inch (300 mm) center-to-center as specified in PIP STF05501 is based on common industry practice and within limits of 10 inches to 14 inches (250 mm to 360 mm) specified by OSHA. Rung spacing may be reduced or increased within limits specified by OSHA at discretion of structure/platform engineer, vessel engineer and/or owner but are required to be uniform throughout the length of ladder, however, consideration should be given to standardizing the rung spacing throughout the facility.

4.7.5 It is not specifically stated in OSHA whether spacing between bottom rung and base of ladder is also required to be uniform with rung spacing throughout length of the rest of ladder.

4.7.6 Ladder pads for ladder bases at grade are designed to have a full 1 ft-0 inch (300 mm) adjustability in height to accommodate uniform rung spacing of 1 ft-0 inch (300 mm) throughout length of the ladder including the bottom rung to base of ladder. See Section 4.11 of this Practice for more information about ladder pads.

4.7.7 For ladders with bases at elevated platforms, it is preferred to lay out platform elevations such that height between platforms serviced by ladders are in even 1 ft-0 inch (300 mm) increments to accommodate uniform rung spacing of 1 ft-0 inch (300 mm) throughout length of ladder including the dimension from the top of bottom rung to walking surface of platform. Where this is not feasible, the dimension from the top of bottom rung to walking surface of platform may be adjusted in accordance with common industry practice and criteria shown on drawings PIP STE05501-01 and PIP STE05501-06.

4.8 Ladder Pitch

4.8.1 Based on Figure D-10 in OSHA, ladders are defined as having a pitch within a range of 60 degrees and 90 degrees from horizontal. Fixed ladders having a pitch in excess of 90 degrees from horizontal are specifically prohibited by OSHA.

4.8.2 Previous OSHA regulations classified ladders having a pitch within a range of 75 to 90 degrees as “standard” and ladders having a pitch within a range of 60 to 75 degrees as “substandard.” The current OSHA regulations do not make these
distinctions but PIP still considers it good practice to limit the pitch of fixed ladders to within a range of 75 to 90 degrees from horizontal.

4.8.3 Details shown in drawings in this Practice and fabrication details shown in drawings in PIP STF05501 are intended only for ladders with a pitch of 90 degrees from horizontal. If a ladder is required with a different pitch, additional fabrication details should be provided in an addendum to PIP STF05501 or shown in design documents.

4.9 Design Loads

4.9.1 Current OSHA regulations no longer provide prescriptive load criteria for fixed ladders, stating instead that they be designed to support their maximum intended load. ASCE/SEI 7-10 provides prescriptive live load criteria for fixed ladders. Specifically, ASCE/SEI 7-10 requires that fixed ladders be designed for a minimum vertical concentrated live load of 300 lb (1330 N) applied at any point to produce the maximum load effect on the element being considered. For fixed ladders greater than 10 ft (3050 mm) in length, additional 300 lb (1330 N) concentrated live load units are required to be applied at a minimum of one unit for every additional 10 ft (3050 mm) of ladder length, in accordance with ASCE/SEI 7-10. The details shown in this Practice and the fabrication details shown in PIP STF05501 have been designed according to these live load criteria.

4.9.2 Structure/platform engineer should review ASCE/SEI 7-10 prescriptive live load criteria and determine if it adequately addresses the intended use of the ladder. If not, an adjusted concentrated live load unit should be determined and used to check the ladder design.

4.9.3 Individual rungs should be designed for the concentrated live load unit determined in Section 4.9.2 above, applied at any point along the rung.

4.9.4 Where ladder rails extend above a platform at top of the ladder, each rail extension is required to be designed for a concentrated live load of 100 lb (445 N) applied in any direction at any height up to top of the side rail extension, in accordance with ASCE/SEI 7-10.

4.9.5 Fixed ladders equipped with a ladder safety system mounted directly to ladder should be designed for an impact load determined by manufacturer of the safety system. At a minimum, this load should be the load resulting from an 18 inch (460 mm) drop of a 500-pound (227-kg) weight, in accordance with OSHA Subpart D Section 1910.29(i)(6). Typically ladder safety systems manufacturers’ literature shows a range of 1300 pounds (5.8 kN) to 1500 pounds (6.7 kN). OSHA limits the maximum arresting force on a person to 1800 pounds (8 kN). For a ladder safety system that attaches to rungs, the impact load would typically be distributed to several rungs or support system. Consult ladder safety system manufacturer for load distribution. Fixed ladders shown in drawings of this Practice have been validated for the loads above assuming that the ladder safety system has been attached to a minimum of three rungs. It is the structure/platform engineer’s responsibility to verify that all ladder details are adequate for the selected ladder safety system.

4.9.6 Fixed ladders equipped with a personal fall arrest system mounted directly to the ladder are required to be designed for the forces resulting from the 5000-pound (22.2-kN) ultimate prescriptive anchorage force specified in OSHA 29 CFR
1910.140(c) under Subpart I, or be designed for the anticipated load from the system, with a minimum factor-of-safety of 2 (performance-based alternative permitted by OSHA). Fixed ladders detailed in *PIP STF05501* have not been specifically designed for loads from an attached personal fall arrest system. Depending on the type of personal fall arrest system selected, modification may be required to the ladder details to accommodate the design loads of the system. Alternatively, personal fall arrest system can be supported separately from the ladder. It is the structure/platform engineer’s responsibility to verify that all ladder details or alternate supports are adequate for the selected personal fall arrest system.

4.9.7 Ladder support members and support connectors should be designed for the following loads:

a. Dead Load = actual estimated dead load of the ladder, including cage and ladder safety system/personal fall arrest system as applicable.

b. Live Load = total number of concentrated live load units multiplied by the value of the unit as determined according to Sections 4.9.1 and 4.9.2 above (e.g., Live Load = 900 lb [3990 N] for a 30 foot ladder with 3 live load units of 300 lb [1330 N])

c. For ladders equipped with a ladder safety system mounted directly to ladder, an impact load equal to the load specified in Section 4.9.5 above.

d. For ladders equipped with a personal fall arrest system mounted directly to ladder, a load determined according to Section 4.9.6 above.

4.9.8 Ladder supports and guides should be designed for ice, wind, and earthquake loads in accordance with *PIP STC01015*.

### 4.10 Allowances for Temperature Variation for Vertical Vessels

4.10.1 For ladders at vertical vessels, the dimensions shown with an asterisk in details on drawings *PIP STE05501-01, PIP STE05501-06*, and *PIP STE05501-10* are based on the vessel and ladder at ambient temperature.

4.10.2 If vertical vessel operates at a temperature above or below ambient temperature, allowance must be made for expansion or contraction of vessel in relation to position of ladder, since ladder will remain at ambient temperature. At base of ladder and at ladder guide connections, this will require slots that are long enough to accommodate the expected expansion or contraction of vessel at that point. The required lengths of slots depends on operating temperature of vessel, expansion coefficient of material from which vessel is fabricated, and location of slot in relation to anchor point (support point) at top of ladder.

4.10.3 Slot lengths shown in Type 2 ladder base detail on drawing *PIP STE05501-06* and guide connection detail on drawing *PIP STE05501-10* allow for approximately 3 inches (75 mm) of pin or bolt movement in slot. The engineer should review actual design conditions to check whether this allowance is sufficient for the particular application. Refer to Table 1 (U.S. Customary Units) and Table 1M (Metric Units) in this Practice for thermal expansion data to assist in determination.
4.10.4 If 3 inches (75 mm) allowable movement is insufficient at the ladder base, it is recommended that engineer specify Type 1 ladder base detail shown on fabrication detail drawing PIP STF05501-06 instead of Type 2 ladder base detail. If 3 inches (75 mm) allowable movement is insufficient at ladder guides, guide details shown on fabrication detail drawing PIP STF05501-10 will need to be modified with an addendum to PIP STF05501.

4.10.5 To allow for expansion of a vessel that operates at a temperature above ambient temperature (i.e., hot vessel), position of the pins or bolts in the slots should be as shown in the Type 2 ladder base detail on drawing PIP STE05501-06 and the guide connection detail on drawing PIP STE05501-10.

4.10.6 To allow for contraction of a vessel that operates at a temperature below ambient temperature (i.e., cold vessel), position of the pins or bolts in the slots shown in the Type 2 ladder base detail on drawing PIP STE05501-06 and the guide connection detail on drawing PIP STE05501-10 should be reversed.

4.10.7 If fabrication detail drawings included in PIP STF05501 are to be used for vessels operating below ambient temperature, an addendum to PIP STF05501 should be prepared to reverse the position of the pins or bolts in the slots shown in the appropriate details on fabrication detail drawings PIP STF05501-06 and PIP STF05501-10.

4.11 Ladder Pads

4.11.1 Ladders designed in accordance with this Practice that have connections at the base are intended to be used with ladder pad details in accordance with PIP STI03310.

4.11.2 Ladder pads detailed in PIP STI03310 are based on a ladder pad height between 0 inch (0 mm) minimum and 1 ft (300 mm) maximum.

4.12 Ladder Clearances

4.12.1 Fixed ladders that do not have cages or wells are required to have a clear width of 15 inches (380 mm) minimum on each side of the ladder centerline to the nearest permanent object; and a minimum perpendicular distance of 30 inches (760 mm) from the centerline of the steps or rungs to the nearest permanent object on the climbing side. When unavoidable obstructions are encountered, the minimum clearance at the obstruction may be reduced to 24 inches (610 mm), provided deflector plates are installed in accordance with OSHA requirements.

4.12.2 The minimum perpendicular distance from the centerline of rungs to the nearest permanent object in back of the ladder is 7 inches (180 mm).

5. Ladder Fall Protection

5.1 General

With the revised OSHA regulations, the basic philosophy for ladder fall protection is to phase out the use of cages and phase in the use of personal fall arrest or ladder safety systems to protect employees from falls. Per OSHA, it has been clearly determined from accident case studies that cages do not provide effective fall prevention/protection. OSHA studies show that injuries sustained while falling through caged ladders are typically more severe than falls from ladders without cages as body parts can be easily
entangled in the cage during a fall. OSHA emphasizes that personal fall arrest or ladder safety systems are inherently more effective for fall prevention/protection.

5.2 Fixed Ladders Extending more than 24 feet (7.3 m) above a Lower Level

5.2.1 According to OSHA regulations, fall protection is required for fixed ladders that extend more than 24 ft (7.3 m) above a lower level. Sections 5.2.2 through 5.2.7 address only those ladders. Fixed ladders can extend up to 24 ft (7.3 m) above a lower level without having any type of fall protection, cage or well. It is important to note that the definition of “lower level” is the level to which an employee could fall. This may be different than the level of the ladder base. See Appendix A for guidance on interpretation of the OSHA regulations relevant to this subject.

5.2.2 OSHA regulations provide for a gradual phase-in of ladder safety systems/personal fall arrest systems and phase-out of cages or wells over a 20-year extended compliance period. This 20-year period starts from the publication date of the revised OSHA regulations on November 18, 2016 and extends until November 18, 2036.

5.2.3 For existing fixed ladders (i.e., installed before November 19, 2018), employers have until November 18, 2036 to install personal fall arrest or ladder safety systems. During the 20-year extended compliance period, existing ladders must have personal fall arrest systems, ladder safety systems, cages or wells. This means that existing fixed ladders may continue to be used during the 20-year extended compliance period, even if they are equipped only with cages or wells.

5.2.4 New fixed ladders (i.e., installed on or after November 19, 2018) must be equipped with a personal fall arrest system or ladder safety system at time of installation. Note that, by OSHA definition, cages and wells are not ladder safety systems.

5.2.5 When a fixed ladder, cage or well, or any part thereof, is replaced, a personal fall arrest or ladder safety system must be installed on at least that section of the fixed ladder where the replacement is located.

5.2.6 By the end of the 20-year extended compliance period, all fixed ladders must be equipped with either personal fall arrest systems or ladder safety systems. Ladders may still be equipped with cages or wells, but these will not be considered a means of fall protection.

5.2.7 The fixed ladder fabrication details shown in PIP STF05501 for new ladders have been developed to allow for the installation of a ladder safety system (See Section 4.9.5). A personal fall arrest system may require support independent from the ladder. PIP ladder details are not specifically designed for attached personal fall arrest systems (See Section 4.9.6).

5.3 Considerations for Compliance with OSHA Fall Protection Regulations for Fixed Ladders

5.3.1 For fixed ladders that require fall protection, consultation between owner’s safety representative, facility operations and maintenance personnel, project engineering and management teams is necessary to determine the best options to meet OSHA regulations for specific applications.
5.3.2 The owner will need to decide where personal fall protection and/or ladder safety systems are required and which type to use. For each system, there are several types available. Ladder safety systems can be a rigid carrier type where the worker clips into a rail mounted on the ladder or a flexible carrier type where the worker attaches to a cable running up the ladder. Personal fall arrest systems can be an independent system supported from structure above the ladder or a davit type which mounts directly to the top of the ladder. Each option will require changes in facility protocols, training and Personal Protective Equipment (PPE) requirements.

5.3.3 Owners will need to establish appropriate safety protocols for using fixed ladders that have ladder safety systems or personal fall arrest systems. Ladder safety systems must include the ability to safely connect to and disconnect from the system at the top of the ladder. This requirement may require the installation and use of a separate personal fall arrest system at the top of each ladder equipped with a ladder safety system. If this step is necessary, it may be a better option to simply use the personal fall arrest system to provide the required fall protection for the ladder.

5.3.4 Owners will also need to develop specific strategies for meeting fall protection regulations for retrofitting existing fixed ladders to achieve compliance and consistency over the long term for safe, practical, functional and cost-effective use of all ladders in their facilities.

5.3.5 Owners may wish to avoid having to install personal fall arrest or ladder safety systems on any fixed ladders, because of concerns about maintenance, training and PPE requirements. With current OSHA regulations, the only way to do this is to limit the length of all ladders to 24 ft (7.3 m) above a lower level. This may be impractical in some applications, or it may require adding additional platform levels which are otherwise unnecessary for operations. Also, a ladder whose base is near the edge of an elevated platform will require fall protection if the potential fall height to a lower level below the elevated platform exceeds 24 ft (7.3 m), even if the climbing length of the ladder is less than 24 ft (7.3 m). For further discussion on this subject, refer to Appendix A of this Practice.

5.3.6 One significant concern with implementation of alternate compliance approaches (e.g., longer ladders with ladder safety systems with or without cages) is employee safety during an emergency evacuation situation. Many ladders in PIP member facilities are placed specifically for emergency evacuation purposes, during which employee use of a ladder safety system may be unlikely or even ill-advised. Longer ladders – even with cages – would result in a longer potential fall; use of a ladder safety system would result in delayed evacuation and greater exposure to the hazard (fire, toxic gas, etc.). The use of stairs is the best means of emergency egress and providing stairs rather than ladders in some circumstances should be considered. See also Section 4.4.2 for a discussion of the use cages in conjunction with ladders that have personal fall arrest or ladder safety systems.

5.3.7 When a ladder safety system or personal fall arrest system is used, consider establishing a single type of system for the facility to simplify maintenance issues, training, and harness hook-up requirements throughout the facility.
5.3.8 Consider signage for ladders with personal fall arrest or ladder safety systems, informing employees that training and harness hook-up are required to climb the ladder.

5.4 **Ladder Safety System Requirements**

5.4.1 Ladder safety system must allow employee to climb up and down without employee continuously holding, pushing or pulling any part of the system.

5.4.2 Connection between carrier and point of attachment to the body harness must not be greater than 9 inches (230 mm).

5.4.3 Mountings for rigid carriers must be attached at each end of the carrier, with intermediate mountings spaced, as necessary, along the entire length of carrier so the system has the strength to stop employee falls.

5.4.4 Mountings for flexible carriers must be attached at each end of carrier and cable guides must be installed at least 25 feet (7.6 m) apart but not more than 40 feet (12.2 m) apart along entire length of the carrier.

5.4.5 Design and installation of mountings and cable guides must not reduce design strength of the ladder.

5.4.6 Distance of the flare of the ladder rails at step through ladders may be increased to 36 inch (910 mm) maximum to accommodate access through the ladder rails where a ladder safety system is used.

5.5 **Personal Fall Arrest System Requirements**

All components of personal fall arrest systems (anchorage, connecting devices, body harnesses, etc.) must meet the requirements of the OSHA regulations for personal fall protection systems found in 29 CFR Part 1910 Subpart I, Section 1910.140.

6. **Inspection, Tagging, Use and Training Requirements**

6.1 *OSHA* provides ladder and personal fall protection systems inspection, tagging, use and training requirements that affect safety and PPE protocols within a facility.

6.2 Ladder inspection and tagging requirements are addressed in *OSHA* 29 CFR Part 1910 Subpart D, Sections 1910.23(b)(9) and (10).

6.3 Proper use of ladders by employees is addressed in *OSHA* 29 CFR Part 1910 Subpart D, Sections 1910.23(b)(11) through (13).

6.4 Training requirements related to fall hazards and procedures for minimizing those hazards with the proper use of personal fall protection systems are addressed in *OSHA* 29 CFR Part 1910 Subpart D, Sections 1910.30(a), (c), and (d).

6.5 Requirements for personal fall protection systems are comprehensively addressed in *OSHA* 29 CFR Part 1910 Subpart I, Section 1910.140.

7. **Contract Documents**

7.1 The following information should be shown in design documents or other contract documents by structure/platform engineer and/or vessel engineer as applicable:
a. Location and orientation of ladder and optional cage including centerline of rungs in the plane of the ladder and centerline of ladder perpendicular to plane of ladder
b. Location of safety gate hinges relative to orientation of ladder
c. Safety gate specifications, including approved manufacturer(s) and model number(s) (safety gates to be supplied by guard fabricator)
d. Selection of Type 1 ladder base (preferred – no connection at base) or Type 2 ladder base (with connection at base) for ladders at vertical vessels. See ladder base details on drawing PIP STE05501-06.
e. Top of bottom rung elevation for ladders at vertical vessels with Type 1 ladder base. See ladder base details on drawing PIP STE05501-06.
f. Bottom of ladder elevation for ladders at structures/platforms and horizontal vessels, and ladders at vertical vessels with Type 2 ladder base. See ladder base details on drawings PIP STE05501-05 and PIP STE05501-06.
g. Top of platform elevations (walking surface) for platforms serviced by ladder
h. Locations and details for ladder support members and support connectors to structures/platforms or vessels
i. Locations and details for ladder guide connectors to structures/platforms or vessels
j. Whether a cage is to be provided for ladder
k. Whether extended vertical bars are required for cage at an elevated platform
l. Bottom of cage elevation if a cage is used
m. Width of flare at top of rails for through ladders
n. Locations of gaps between ladder segments (for continuous ladders with multiple segments)
o. Ladder safety system and/or personal fall arrest system specifications, including approved manufacturer(s) and model number(s) (ladder safety systems and/or personal fall arrest systems to be supplied by ladder fabricator or by separate PO with supplier)

7.2 The following information should be included in an addendum to PIP STF05501 or specified elsewhere in the contract documents if applicable:
a. Alternate slotted ladder base and guide connection details for ladders on vertical vessels
b. Design loads for support members, support connectors, and guide connectors to structures/platforms if connection design is in the scope of services provided by structure/platform fabricator
c. Ladder rail selection criteria if different than specified in PIP STF05501
d. Rung length, diameter, and associated details, such as requirements for slip-resistant rungs, if different than 1 ft-6 inches (460 mm) long 3/4 inch (20 mm) diameter smooth bar
e. Ladder rung spacing if different than 1 ft-0 inch (300 mm)
f. Details for ladders with a pitch less than 90 degrees from horizontal
g. Structural steel material if different than specified in PIP STF05501

h. Metric equivalents for plates, bars, and structural shapes

i. Alternative or additional coatings for ladder assemblies (e.g., safety yellow paint) if different from requirements specified in PIP STF05501

j. Minimum required swing angle of safety gates if greater than 90 degrees

k. Any other requirements that are different or in addition to PIP STF05501

8. **Fabricator Shop Drawings Review**

Fabricator shop drawings should be reviewed by structure/platform engineer and/or vessel engineer as applicable to ensure drawings are in accordance with PIP STS05120, PIP STF05501, relevant design documents, and other contract documents as applicable. Drawing reviews should include the following checks:

a. Latest revisions of structure/platform and/or vessel design documents, and ladder design documents have been used as applicable

b. Fabricator shop drawings are in accordance with material specifications, dimensions, fabrication details, and other requirements as specified in PIP STS05120 and PIP STF05501

c. Ladder orientations and locations are correct

d. Top of bottom rung elevations for ladders at vertical vessels with Type 1 ladder base (no connection at base) are correct and ladder base is detailed in accordance with fabrication detail drawing PIP STF05501-06

e. Bottom of ladder elevations for ladders at structures/platforms and horizontal vessels, and ladders at vertical vessels with Type 2 ladder base (with connection at base) are correct and ladder base is detailed in accordance with fabrication detail drawings PIP STF05501-05 and PIP STF05501-06

f. Top of platform elevations are correct and even with top of ladder rungs at platforms

g. Ladder rail sizes are selected correctly in accordance with guide locations shown in design documents and unguided length criteria shown on fabrication detail drawing PIP STF05501-01

h. Plates connecting ladders to support connectors on structures/platforms and/or vessels at top of ladders are located and detailed correctly in accordance with design documents and fabrication detail drawings PIP STF05501-07 through PIP STF05501-09

i. Slotted plates connecting ladders to guide connectors on structures/platforms and/or vessels are located and detailed correctly in accordance with design documents and fabrication detail drawings PIP STF05501-10 and PIP STF05501-11

j. Support members, support connectors, and guide connectors to structures/platforms and/or vessels are located and detailed correctly in accordance with design documents

k. Support members, support connectors, and guide connectors to structures/platforms are designed correctly by structure/platform fabricator if connection design is in the scope of services provided by structure/platform fabricator

l. Cages are provided where specified
m. Bottom of cage elevations are correct
n. Vertical bars of cages are extended to top rail of railing on the platform if required for ladders at elevated platforms
o. Width of flare at top of the rails for through ladders is correct
p. Locations of centerlines of gap between ladder segments (for continuous ladders with multiple segments) are correct
q. Galvanizing requirements are shown correctly
r. Additional coating requirements, if required, are shown correctly
s. Sufficient quantities of specified bolts required for erection of ladder assemblies are indicated to be provided by ladder fabricator

9. **Typical Details**

Typical details for design of fixed ladders are shown in drawings appended to this Practice (i.e., Drawings PIP STE05501-01 through PIP STE05501-18). Some of the typical details show angle guards in relation to ladder details but pipe guards are equally applicable. See *PIP STF05501* for specific fabrication details for fixed ladders with angle guards and pipe guards.
Table 1 - Thermal Expansion Data (U.S. Customary Units)

Total linear expansion between 70°F and indicated temperature (inches/100 ft)

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<th>Temp. (°F)</th>
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<th>Austenitic Stainless Steels</th>
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Table 1 (continued)

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# Table 1M - Thermal Expansion Data (Metric Units)

Total linear expansion between 21°C and indicated temperature (mm/m)

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<td>14.07</td>
</tr>
<tr>
<td>816</td>
<td>15.39</td>
<td>14.38</td>
</tr>
</tbody>
</table>
APPENDIX A - Commentary on Interpretation of OSHA Regulations 29 CFR Part 1910 Subpart D, Section 1910.28(b)(9)

On November 18, 2016, OSHA published in the Federal Register Volume 81, No. 223, new and revised general industry standards on walking-working surfaces and personal protective equipment. These updates to 29 CFR Part 1910 Subparts D and I are referred to by OSHA as the “final rule.”

Paragraph 1910.28(b)(9) of the final rule requires employers to provide fall protection for fixed ladders that extend more than 24 feet (7.3 m) above a lower level. It is very important to understand that OSHA bases the fall protection requirements for a fixed ladder on the height that the ladder extends above a lower level and not the climb length of the ladder. In section 1910.21(b) of the final rule, the term “lower level” is defined by OSHA as follows:

“Lower level means a surface or area to which an employee could fall. Such surfaces or areas include, but are not limited to, ground levels, floors, roofs, ramps, runways, excavations, pits, tanks, materials, water, equipment, and similar surfaces and structures, or portions thereof.”

Based on this definition, the lower level associated with a fixed ladder is not necessarily the base of the ladder. It is the level to which an employee could fall.

Paragraph 1910.28(b)(9)(i)(A) of the final rule provides fixed ladder fall protection requirements for existing fixed ladders (defined as fixed ladders installed before November 19, 2018), and paragraph 1910.28(b)(9)(i)(B) of the final rule provides fall protection requirements for new fixed ladders (i.e. fixed ladders installed on or after November 19, 2018). Appendix A addresses an interpretation issue concerning the requirements for new fixed ladders according to 1910.28(b)(9)(i)(B).

Issue regarding how to interpret final paragraph 1910.28(b)(9)(i)(B) for certain ladders

Paragraph 1910.28(b)(9)(i)(B) of the final rule requires a ladder more than 24 feet (7.3 m) above a lower level to be equipped with a ladder safety or personal fall arrest system, but a question arises about how to interpret this rule for a new fixed ladder with a climb length of 24 feet (7.3 m) or less where the top of the ladder is more than 24 feet (7.3 m) above grade. What is required if an employer installs on this ladder a cage that is designed to direct a falling employee to the base of the ladder? Does adding a cage change the lower level associated with the ladder (i.e. the “surface or area to which an employee could fall”) such that it is now the base of the ladder, thereby eliminating the need for fall protection on this ladder? Is this an acceptable interpretation of the requirements of the final rule?

The argument for this interpretation

OSHA states in the preamble to the final rule that one of the objectives of the final rule is to give employers greater flexibility in complying with the regulations. One of the options when a workplace hazard exists is to use engineering controls to eliminate the hazard. By installing a cage on the ladder in the situation discussed above and designing it to contain a falling employee and direct the employee’s fall to the base of the ladder, the employee can no longer fall to a level below the base of the ladder. Thus, by using engineering, the employer has changed the lower level to which an employee could fall in this situation; it becomes the bottom of the ladder. Because the climb length of the ladder is not greater than 24 feet (7.3 m), the ladder no longer extends more than 24 feet (7.3 m) above a lower level. Thus, the ladder is outside the scope of paragraph 1910.28(b)(9) of the final rule, which according to its title applies...
only to ladders that extend more than 24 feet (7.3 m) above a lower level. Therefore, the entire paragraph 1910.28(b)(9) of the final rule, and all of the discussion in the preamble regarding this paragraph, does not apply to this ladder.

The effectiveness of cages at altering the potential landing of a fall is confirmed by language in the preamble to the final rule, which was published along with the final rule in the Federal Register, Vol. 81, No. 223, on November 18, 2016. On page 82521 of that publication, the preamble states that cages (and also wells) contain employees within the enclosure and direct their fall to a lower landing.

**The argument against this interpretation**

The argument against this interpretation relies on language found in the preamble to the final rule, which was published along with the final rule in the Federal Register, Vol. 81, No. 223, on November 18, 2016. On page 82604 of that publication, the preamble provides statements which make it clear that, even though cages and wells are not prohibited to be used in addition to ladder safety or personal fall arrest systems, they may not be used instead of providing ladder safety and personal fall arrest systems when they are required. The preamble cites two examples from ANSI/ASC A14.3-2008 that describe exactly the situation under discussion here. The first is for a one-section ladder and the second is for a multiple-section ladder. As stated in the preamble, ANSI/ASC A14.3-2008 allows the installation of ladders with only cages in those situations, but paragraph 1910.28(b)(9)(i)(B) of the final rule is “unlike ANSI/ASC A14.3-2008” in those situations. Also as stated in the preamble OSHA did not adopt the approach of ANSI/ASC A14.3-2008 because evidence shows that cages and wells do not prevent employees from falling off ladders or protect employees from injury if they fall. According to the preamble, OSHA believes the final rule is more protective to employees than ANSI/ASC A14.3-2008.

With the above language in the preamble, OSHA makes it clear that, regarding the situation under discussion here, the approach taken by ANSI/ASC A14.3-2008 (installing ladders with only cages) is not adopted by OSHA in paragraph 1910.28(b)(9)(i)(B) of the final rule. Thus, the idea that a cage can be added to a fixed ladder to eliminate the requirement to provide fall protection for that ladder is not in agreement with what OSHA intended to accomplish with the final rule.

**Conclusions**

As can be seen from the above discussion, there are compelling arguments on both sides of this issue. PIP has sent a letter to OSHA requesting an interpretation of paragraph 1910.28(b)(9) of the final rule as it applies to the situation under discussion. Up to the publication date of this Practice, OSHA has not yet responded to this request. Each PIP Member Company will need to make their own decision on how they will interpret the regulations to address this particular situation. The decision should consider employee safety, facility operations and safety protocols, and the potential risks and liabilities related to their interpretation.
FOR TOP DETAIL OF SIDE-STEP LADDER, SEE STE05501-02
FOR TOP DETAIL OF THROUGH LADDER, SEE STE05501-03

LOCATE SUPPORT CONNECTION AS CLOSE AS POSSIBLE TO TOP OF PLATFORM

1'-3" (380) MIN TO NEAREST OBSTRUCTION
7" (180) MIN TO NEAREST OBSTRUCTION
BEHIND LADDER

2'-6" (760) MIN TO NEAREST OBSTRUCTION
ON CLIMBING SIDE

SIDES CLEARANCE

NOTES:
1. SEE PIP STE05501 FOR LADDER DETAILS NOT SHOWN

2. LADDER SAFETY SYSTEM OR PERSONAL FALL ARREST SYSTEM IS REQUIRED FOR LADDERS THAT EXTEND MORE THAN 24 FEET ABOVE A LOWER LEVEL

BAR 2 1/2" x 3/8" UNGUIDED LENGTH
NOT TO EXCEED 10'-0" (3000)

BAR 3" x 3/8" UNGUIDED LENGTH
NOT TO EXCEED 18'-0" (5400)

C3x4.1 UNGUIDED LENGTH
NOT TO EXCEED 29'-6" (8850)

3/4" (20) DIA SMOOTH BAR RUNGS AT 1'-0" (300) SPACING 6/6

1'-6" (300) MAX (FOR LADDER BASE AT GRADE)

1'-2" (350) MAX (PREFERRED)
FOR LADDER BASE AT ELEVATED PLATFORM

1'-0" (300) MAX
FOR LADDER AT VERTICAL VESSELS

NOTE: FOR LADDERS AT VERTICAL VESSELS, SEE PIP STE05501 SECTION 4.10 FOR VESSEL OPERATING PARAMETERS THAT THESE DIMENSIONS ARE BASED ON

BOTTOM OF LADDER ELEVATION (TO BE SHOWN IN DESIGN DOCUMENTS)

SIDES ELEVATION

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
1. If any part of the structure extends beyond the edge of the platform walking surface, the minimum step-across distance will be superceded by the 1'-3" (380) minimum side clearance (see STE05501-01).

2. If the centerline of the ladder is greater than 1'-8" (510) from the edge of the platform support beam, the edge of the platform walking surface will need to be extended such that the step-across distance is no more than 1'-8" (510).

Dimensions are given in feet and/or inches. Metric dimensions in parentheses are in millimeters, unless otherwise noted.
NOTES:

1. If any part of the structure extends beyond the edge of platform walking surface, the minimum step-across distance will be superseded by the 7" (180) minimum back clearance (see STE05501-01).

2. If the centerline of the ladder is greater than 12" (300) from the edge of the platform support beam, the edge of the platform walking surface will need to be extended such that the step-across distance is no more than 12" (300).

3. Opening in guard matches flared opening in ladder rails (see plan). If safety gate mounting plate encroaches into guard opening, increase minimum flared opening in ladder rails, thereby increasing opening in guard, as required to provide effective 2'-0" (610) clear opening in guard.

4. Flared opening in ladder rails may be increased to 3'-0" (910) max when ladder safety system is provided, according to OSHA.

PLAN AT TOP
(THROUGH LADDER)

OPENING IN GUARD BETWEEN POSTS TO MATCH FLARED OPENING IN LADDER RAILS

SELF-CLOSING DOUBLE-BAR SAFETY GATE TO BE PROVIDED BY GUARD FABRICATOR

EDGE OF PLATFORM WALKING SURFACE

RUNGS

LOCATION TO BE SHOWN IN DESIGN DOCUMENTS

LADDER
LOCATION TO BE SHOWN IN DESIGN DOCUMENTS

FOR CONNECTION TO GUARD POSTS

SEE NOTE 3

SEE NOTE 4

TOP OF LADDER RAMS AND PLATFORM GUARD

SEE DETAIL THIS DRAWING FOR CHANNEL RAIL TRANSITION TO BAR RAIL

BAR 3"x3/8"

C3 RAIL

DETAIL

CHANNEL RAIL TRANSITION TO BAR RAIL

ELEVATION AT TOP
(THROUGH LADDER)

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
**Fixed Ladders Through Ladder Top Conn. Details**

**With Angle Guard Posts**
- **Conn Bar 3" x 1/4"**
- **Welded to Guard Post (By Guard Fabricator)**
- **3/8" Ladder Rail (Flared)**
- **11/16" (18) Dia Holes For 5/8" (16) Dia ASTM A307 Bolt At Centerline Of Conn Bars (Bolt By Ladder Fabricator)**

**With Pipe Guard Posts**
- **Conn Bar 3" x 1/4"**
- **Welded to Guard Post (By Guard Fabricator)**
- **3/8" Ladder Rail (Flared)**
- **11/16" (18) Dia Holes For 5/8" (16) Dia ASTM A307 Bolt At Centerline Of Conn Bars (Bolt By Ladder Fabricator)**

**Through Ladder Top Connection To Guard Post**
- **Provide Guide Connection On Upper Segment (Not Shown). Location To Be Shown In Design Documents. See STE05501-10 And STE05501-11 For Details.**
- **Gap Between Upper And Lower Segments (Location To Be Shown In Design Documents)**
- **Round Ends Of Bar Rails At Gap Radius = D/2**
- **Block Flanges And Round Ends Of Stem At Gap. Radius = 1 1/2". Chamfer Ends Of Blocked Flanges At 45 Degrees**

**Elevation View**
- **Gap Between Ladder Segments**

**Note:**
- Rounding, blocking and chamfering not required if ladder includes cage (see STE05501-16)

**Dimensions Are Given In Feet And/Or Inches. Metric Dimensions In Parentheses Are In Millimeters, Unless Otherwise Noted.**
LADDER BASE CONNECTION NOTES:

1. CONNECTION TO STEEL OR GRATING AT ELEVATED PLATFORM:
   LADDER FABRICATOR TO PROVIDE 2 CONNECTION BOLT ASSEMBLIES
   AT THE BASE OF EACH LADDER.
   EACH CONNECTION BOLT ASSEMBLY CONSISTS OF
   1 BOLT, 1 NUT, 1 WASHER, AND 1 PLATE 2 1/2" x 1/8" x 1/4".

2. CONNECTION TO CONCRETE AT GRADE:
   LADDER PAD INSTALLER TO PROVIDE LADDER PAD
   AND 5/8" (16) DIAMETER ADHESIVE ANCHORS.
   (SEE PIP ST05501 FOR LADDER PAD DETAILS)

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS
IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
PROCESS INDUSTRY PRACTICES
ENGINEERING GUIDE

FIXED LADDERS
LADDER BASE AT VERTICAL VESSEL

COORDINATE WITH DWG STF05501-01.
WITH TYPE 1 LADDER BASE DETAIL.
THE UNGUIDED LENGTH AT BOTTOM OF
LADDER MAY CONTROL THE RAIL SIZE.

GUIDE PLATE AT EACH LADDER
RAIL: SEE STF05501-10
2'-6" (750) MAX FOR
BAR 2-1/2" x 3/8" RAILS
4'-6" (1350) MAX
FOR BAR 3" x 3/8" RAILS
7'-6" (2250) MAX
FOR C3 x 4.1 RAILS

BOTTOM OF
LADDER RAILS

1'-2" (350) MAX *
1'-0" (300) MAX *(PREFERRED)

TOP OF BOTTOM
RUNG ELEVATION
(TO BE SHOWN IN
DESIGN DOCUMENTS)

WALKING SURFACE AT GRADE
(OR ELEVATED PLATFORM)

NOTE:
SEE PIP STF05501, SECTION 4.10
FOR VESSEL OPERATING
PARAMETERS THAT THESE
DIMENSIONS ARE BASED ON

STF STF05501-01 FOR
OTHER LADDER DETAILS

TYPE 1 (PREFERRED - NO CONNECTION AT BASE)
SIDE ELEVATION

BAR 3/8" (TYP)
3/16" WER (TYP)
2" (50) (TYP)
2" (50) (TYP)
1'-6" (460)

BOTTOM RUNG

ANGLE LENGTH TO MATCH CLEAR WIDTH BETWEEN CHANNEL FILLETS (TYP)

ANGLE LENGTH TO MATCH WIDTH OF BAR RAIL (TYP)
11/16" (18) DIA
HOLE IN RAIL FOR
3/8" (16) DIAMETER
SMOOTH ROD (TYP)

BOTTOM OF LADDER RAILS

ANGLE BASE PARially SHOWN
FOR CLARITY

AT BAR RAIL

LADDER BASE CONNECTION NOTES:
1. CONNECTION TO STEEL OR GRATING AT ELEVATED PLATFORM:
   LADDER FABRICATOR TO PROVIDE 2-CONNECTION BOLT ASSEMBLIES
   AT THE BASE OF EACH LADDER.
   EACH CONNECTION BOLT ASSEMBLY CONSISTS OF:
   - 1/2-13 UNEVENT 5/16" (8) DIAMETER BOLTS, 1-NEUT, 1-WASHER,
     AND 1-PLATE 2-1/2" x 2-1/2" x 1/4".

2. CONNECTION TO CONCRETE AT GRADE:
   LADDER PAD INSTALLER TO PROVIDE LADDER PAD
   AND 5/8" (16) DIAMETER ADHESIVE ANCHORS.
   (SEE PIP STF055310 FOR LADDER PAD DETAILS)

TYPE 2 (ALTERNATE - WITH CONNECTION AT BASE)
FRONT ELEVATION

LADDER BASE AT VERTICAL VESSEL

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS
IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
**FIXED LADDERS**

**SIDE-STEP LADDER SUPPORT**

**CONNECTION TO STRUCTURE/PLATFORM**

---

**PLAN**

**SIDE-STEP LADDER SUPPORT**

**CONNECTION TO STRUCTURE/PLATFORM**

- Support connectors to structure/platform to be designed by structure/platform engineer and shown in design documents (fabricated by structure/platform fabricator).
- Inside face of support connectors to structure/platform.
- Support connectors to structure/platform to be designed by structure/platform engineer and shown in design documents (fabricated by structure/platform fabricator).
- 7" (180) min to nearest construction behind ladder rungs (location to be shown in design documents).
- See detail this drawing for plate connection to channel rail.

---

**DETAIL**

**PLATE CONNECTION TO CHANNEL RAIL**

- 2-5/8" (16) Dia. ASTM A307 bolts (key ladder fabricator) (install with bolt head to inside of ladder).
- 3/8" (10) bolt.

---

**ELEVATION**

**SIDE-STEP LADDER SUPPORT**

**CONNECTION TO STRUCTURE/PLATFORM**

- 5" (130) unless otherwise noted in design documents.
- Outside each ladder rail for bar rail (key ladder fabricator).
- See detail this drawing for plate connection to channel rail.

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**DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.**

**ST05501-09**

**Fixed Ladders Through Ladder Support Connection to Structure/Platform**

**NOTE:**

Safety bar not shown for clarity

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**Inside Face of Support Connectors to Structure/Platform**

Support connectors to structure/platform to be designed by structure/platform engineer and shown in design documents (fabricated by structure/platform fabricator).

---

**Ladder Location to be Shown in Design Documents**

SEE DETAIL THIS DRAWING FOR PLATE CONNECTION TO CHANNEL RAIL

---

**Guard Post**

Structure/Platform

---

**Guard Rail**

Structure/Platform

---

**Legend Notes**

(A) Support Connectors to Structure/Platform to be designed by structure/platform engineer and shown in design documents (fabricated by structure/platform fabricator).

(B) 3/8" x 6" outside each ladder rail for bar rail (by ladder fabricator).

(C) Plate and support connector (location to be shown in design documents)

(D) 3-5/8" (16) dia. ASTM A307 bolts (by ladder fabricator)

---

**Elevation Through Ladder Support Connection to Structure/Platform**

(One set per ladder)

The support connectors from the structure/platform shown in the details above are examples only. Support connectors to be designed by structure/platform engineer for required loads, and arranged so as not to interfere with adjacent guard post supports. See PIP STF05520, PIP STF05531, or PIP STF05535 as applicable.

**Dimensions are given in feet and/or inches. Metric dimensions in parentheses are in millimeters, unless otherwise noted.
PROCESS INDUSTRY PRACTICES
ENGINEERING GUIDE

FIXED LADDERS
LADDER GUIDE
CONNECTION TO VERTICAL VESSEL

1'-7 1/2"
(500)

INSIDE FACE OF
GUIDE CONNECTORS
TO VESSEL

9 3/4"
(250)

GUIDE CONNECTORS TO VESSEL
(10 BE DESIGNED BY VESSEL ENGINEER
AND SHOWN IN DESIGN DOCUMENTS)
(FABRICATED BY VESSEL MANUFACTURER)

7" (180) MIN.
TO NEAREST OBSTRUCTION
BEHIND LADDER
(INCLUDING INSULATION)

6" (LOCATION TO
BE SHOWN IN
DESIGN DOCUMENTS)

INSIDE FACE OF
GUIDE CONNECTORS
TO VESSEL

LADDER
(LOCATION TO
BE SHOWN IN
DESIGN DOCUMENTS)

SEE DETAIL THIS
DRAWING FOR PLATE
CONNECTION TO
CHANNEL RAIL

PLATE CONNECTION
TO CHANNEL RAIL

PLAN
LADDER GUIDE
CONNECTION TO VERTICAL VESSEL

BOLT HOLE AND GUIDE CONNECTOR
(LOCATION TO BE SHOWN
IN DESIGN DOCUMENTS)

GUIDE CONNECTORS TO VESSEL TO
BE DESIGNED BY VESSEL ENGINEER
AND SHOWN IN DESIGN DOCUMENTS
(FABRICATED BY VESSEL
MANUFACTURER)

11/16" (18) DIA HOLE IN GUIDE CONNECTOR TO VESSEL AND
11/16" (18) DIA x 4" (100) LONG SLOTTED HOLE IN
LADDER CONNECTION PLATE FOR 3/8" (10) DIA
ASTM A307 BOLT WITH 2 NUTS (BY LADDER FABRICATOR)
(INSTALL WITH BOLT HEAD TO INSIDE OF LADDER)
NUTS SHALL BE HAND-TIGHTENED;
NUTS SHALL BE JAMMED TO PROVIDE A 1/16" (2) CLEARANCE
BETWEEN THE NUT AND THE GUIDE CONNECTOR MEMBER

VEssel

1 1/2" (35)

NOTE:
SEE PIP STE05501
SECTION 4.1.2 FOR
VESSEL OPERATING
PARAMETERS THAT
THIS DIMENSION IS
BASED ON

UNLESS OTHERWISE
NOTED IN
DESIGN DOCUMENTS

5" (130)

LADDER
RAIL

INSIDE EACH LADDER RAIL FOR BAR RAIL
(BY LADDER FABRICATOR) SEE DETAIL THIS
DRAWING FOR PLATE CONNECTION TO CHANNEL RAIL

ELEVATION
LADDER GUIDE
CONNECTION TO VERTICAL VESSEL

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES, METRIC DIMENSIONS
IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
NOTES:
1. SEE STE05501-01 FOR LADDER RAIL, RUNG SUPPORT AND GUARD INFORMATION.
2. PER OSHA REGULATIONS, CAGES ARE OPTIONAL. A CAGE MAY BE USED IN COMBINATION WITH A PERSONAL FALL ARREST SYSTEM OR LADDER SAFETY SYSTEM PROVIDED THAT THE CAGE DOES NOT INTERFERE WITH THE OPERATION OF THE SYSTEM.

SIDE ELEVATION

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
SIDE ELEVATION

OPTIONAL CAGE WITH INTERMEDIATE ACCESS TO SIDE-STEP LADDER

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
**Fixed Ladders**

**Optional Cage - Hoop Details**

**Top Hoop**
- Side-Step Ladder

**Intermediate Hoop**
- Side-Step and Through Ladder

**Bottom Hoop**
- Side-Step and Through Ladder

Dimensions are given in feet and/or inches. Metric dimensions in parentheses are in millimeters, unless otherwise noted.
**Fixed Ladders - Optional Cage - Top Hoop Connections to Guard Post**

**Angle Guard Post (Top Rail Not Shown)**
- **Conn Bar 3" x 1/4" Welded to Guard Post (by Guard Fabricator)**
- **Top Hoop Bar 3" x 1/4" Welded to Ladder Rail (by Ladder Fabricator)**
- **6" Rungs 3/8" Ladder Rail (Flared)**
- **Pipe Guard Post (Top Rail Not Shown)**
- ** INSIDE FACE OF FLARED LADDER RAIL AT THROUGH OPENING**
- **BY GUARD FABRICATOR**
- **INSIDE FACE OF FLARED LADDER RAIL AT THROUGH OPENING**
- **BY GUARD FABRICATOR**

**Through Ladder (w/ Cage)**
**Top Hoop Connection to Angle Guard Post**
- **Angle Guard Post (Top Rail Not Shown)**
- **Conn Bar 3" x 1/4" Welded to Guard Post (by Guard Fabricator)**
- **6" Rungs**
- **Top Hoop Bar 3" x 1/4" (by Ladder Fabricator)**
- **Pipe Guard Post (Top Rail Not Shown)**
- **Conn Bar 3" x 1/4" Welded to Guard Post (by Guard Fabricator)**
- **Top Hoop Bar 3" x 1/4" (by Ladder Fabricator)**
- **Pipe Guard Post (Top Rail Not Shown)**
- **Conn Bar 3" x 1/4" Welded to Guard Post (by Guard Fabricator)**
- **Top Hoop Bar 3" x 1/4" (by Ladder Fabricator)**

**Side-Step Ladder (w/ Cage)**
**Top Hoop Connection to Angle Guard Post**
- **Angle Guard Post (Top Rail Not Shown)**
- **Conn Bar 3" x 1/4" Welded to Guard Post (by Guard Fabricator)**
- **Top Hoop Bar 3" x 1/4" (by Ladder Fabricator)**
- **Pipe Guard Post (Top Rail Not Shown)**
- **Conn Bar 3" x 1/4" Welded to Guard Post (by Guard Fabricator)**
- **Top Hoop Bar 3" x 1/4" (by Ladder Fabricator)**

**Dimensions are given in feet and/or inches. Metric dimensions in parentheses are in millimeters, unless otherwise noted.**
DETAIL
HOOP CONNECTION TO PLATE AT LADDER GUIDE OR SUPPORT CONNECTOR

DETAIL
HOOP CONNECTION TO CHANNEL RAIL

INTERMEDIATE HOOP BAR 3" x 1/4" AT BOTTOM OF UPPER CAGE SEGMENT SEE STE05501-14

INTERMEDIATE HOOP BAR 3" x 1/4" AT TOP OF LOWER CAGE SEGMENT SEE STE05501-14

CAGE AT GAP BETWEEN LADDER SEGMENTS

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
ENGINER TO DESIGNATE IN DESIGN DOCUMENTS IF CASE IS REQUIRED
AND IF EXTENDED VERTICAL BARS AT THE BACK ARE TO BE PROVIDED
2'-7" (790) MIN UP TO 6'-0" (1800)
OVER 6'-0" (1800)

SLIDING RINGS (LOCATION TO BE SHOWN IN DESIGN DOCUMENTS)

ENGINER TO DESIGNATE IN DESIGN DOCUMENTS IF CASE IS REQUIRED

EXTENDED VERTICAL BARS CONNECTED TO PLATFORM GUARD

HORIZONTAL BARS
SEE SECTION A-A

ADDITIONAL VERTICAL BAR
1 1/2 x 1/4
CORNER CONDITION

1 0'-0" (300)
1 1/2'-0" (300)
7 1/2'-0" (190)

PLATEFORM GUARD (TOP RAIL)

PLAN

NOTE:
PER OSHA DEFINITION, A CAGE IS NOT A LADDER SAFETY SYSTEM. SEE DISCUSSION IN PIP STE05501 APPENDIX A REGARDING THE USE OF A CAGE AT AN ELEVATED PLATFORM.

3 ~ BARS 1 1/2" x 1/4" EQUALLY SPACED BETWEEN BOTTOM OF CAGE AND TOP OF GUARD

EXTENDED VERTICAL BARS

TOP OF PLATFORM GUARD (ANGLE OR PIPE, ANGLE-SHOWN)

SEE DETAIL 1 FOR THE CONNECTION OF VERTICAL BARS TO TOP RAIL OF GUARD

1 3/4'-0" (1070)

7 0'-0" (2140) MIN
7 6'-0" (2290) MAX
8'-6" (2590) MAX

SECTION A-A

INSIDE EDGE OF TOP RAIL (20) VERTICAL BAR 1 1/4" x 1/4" BY LADDER FABRICATOR
11/16" x 1 3/16" (1A x 30) SLOTTED HOLES (HORIZ-SLOT IN CONN BAR, VERT-SLOT IN VERT BAR) FOR 5/8" (16) DIA. ASTM A307 BOLT (BY LADDER FABRICATOR)

DETAIL 1

BOTTOM OF CAGE ELEVATION (TO BE SHOWN IN DESIGN DOCUMENTS)

ELEVATION OF TOP OF PLATFORM (WALKING SURFACE) (TO BE SHOWN IN DESIGN DOCUMENTS)

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
REST PLATFORM OR LANDING

TOP OF PLATFORM WALKING SURFACE

2'-6" (770) MIN (TYP)

GAP BETWEEN LADDER SEGMENTS

RECOMMENDED MAXIMUM LADDER SEGMENT LENGTH FOR FABRICATION, COATING, AND HANDLING CONSIDERATIONS (TYP)

SEE PIP STE55501 SECTION 4.2.E

EACH SEGMENT MUST BE SUPPORTED AT TOP AND GUIDED ALONG LENGTH AND AT OR NEAR BOTTOM AS REQUIRED.

LANDING (TYP)

TOP OF PLATFORM WALKING SURFACE

GAP BETWEEN LADDER SEGMENTS

RECOMMENDED MAXIMUM WHEN TEMPERATURE DIFFERENTIAL BETWEEN LADDER AND VERTICAL VESSEL IS A CONCERN (TYP)

SEE PIP STE55501 SECTION 4.2.E

DIMENSIONS ARE GIVEN IN FEET AND/OR INCHES. METRIC DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.