**ASAE S412.1 MAR1990 (R2014)**
**Ladders, Cages, Walkways and Stairs**

## American Society of Agricultural and Biological Engineers

STANDARD

ASABE is a professional and technical organization, of members worldwide, who are dedicated to advancement of engineering applicable to agricultural, food, and biological systems. ASABE Standards are consensus documents developed and adopted by the American Society of Agricultural and Biological Engineers to meet standardization needs within the scope of the Society; principally agricultural field equipment, farmstead equipment, structures, soil and water resource management, turf and landscape equipment, forest engineering, food and process engineering, electric power applications, plant and animal environment, and waste management.

**NOTE:** ASABE Standards, Engineering Practices, and Data are informational and advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. The ASABE assumes no responsibility for results attributable to the application of ASABE Standards, Engineering Practices, and Data. Conformity does not ensure compliance with applicable ordinances, laws and regulations. Prospective users are responsible for protecting themselves against liability for infringement of patents.

ASABE Standards, Engineering Practices, and Data initially approved prior to the society name change in July of 2005 are designated as "ASAE", regardless of the revision approval date. Newly developed Standards, Engineering Practices and Data approved after July of 2005 are designated as "ASABE".

Standards designated as "ANSI" are American National Standards as are all ISO adoptions published by ASABE. Adoption as an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by ASABE.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

**CAUTION NOTICE**: ASABE and ANSI standards may be revised or withdrawn at any time. Additionally, procedures of ASABE require that action be taken periodically to reaffirm, revise, or withdraw each standard.

Copyright American Society of Agricultural and Biological Engineers. All rights reserved.

ASABE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA, phone 269-429-0300, fax 269-429-3852, hq@asabe.org

Documents
Document Sharing Hub

Copyright American Society of Agricultural and Biological Engineers
Provided by IHS Markit under license with ASABE
No reproduction or networking permitted without license from IHS
Full document details: ASAE S412.1 2014

Licensee=/, User=,
Not for Resale,

# Ladders, Cages, Walkways and Stairs

*Proposed initially by the Grain Bin Manufacturers Council of the Farm and Industrial Equipment Institute; approved by the ASAE Structures Group; approved by the ASAE Structures and Environment Division Standards Committee; adopted by ASAE, December 1981; reconfirmed December 1982, December 1984, December 1985, December 1986, withdrawn as ASAE publication June 1988; S412.1 developed by the Grain Bin Ladders, Cages and Walkways Subcommittee of the ASAE Structures Group; approved by the Structures and Environment Division Standards Committee; adopted by ASAE March 1990; revised editorially January 1991; reaffirmed December 1994, December 1995, December 1996, December 1997, February 2003, February 2008; periodic review extended for two years October 2012; reaffirmed December 2014.*

**Keywords:** Bins, Cages, Ladders, Safety, Silos, Stairs, Structures, Walkways

## 1 Purpose and Scope

**1.1** The purpose of this Standard is to promote personal safety to owners or operators who use ladders and stairs that are attached to agricultural structures.

## 2 Definitions

**2.1 agricultural structure:** A shelter for farm animals or crops; or when incidental to agricultural production, a shelter for processing or storing products of farm animals or crops, or for storing or repairing agricultural equipment. An agricultural building is not for use by the public, or for human habitation.

**2.2 cage:** An enclosure mounted on the side rails of a fixed ladder or fastened to the structure wall to enclose the climbing space in order to safeguard persons climbing the ladder.

**2.3 catwalk:** A raised walkway which may be positioned horizontally or at an incline up to 15 deg.

**2.4 silo chute:** A multipurpose enclosure mounted on the exterior wall of tower silos used for the discharge of stored materials, access into the structure for adjustment and maintenance of silo filling and discharge equipment, and/or various functions appurtenant to proper utilization of the structure.

**2.4.1 chute ladder:** A series of uniformly spaced individual steps or rungs, which may or may not have a side rail relationship, incorporated into a silo door assembly, serving the purpose of hinging and/or latching and/or removing said silo door(s) assembly.

**2.5 eave line:** The intersection of the roof and the structure wall.

**2.6 external ladder:** A ladder attached to the outside of a structure.

**2.7 fastening:** Attaching a ladder, cage or other component to a structure.

**2.8 grain bin:** A structure for the storage of grain.

**2.9 handrail:** A single bar or pipe supported on brackets from a wall, partition, or vertical supports to provide a continuous handhold for persons using a stair or catwalk.

**2.10 internal bin wall ladder:** A ladder attached to the interior surface of a grain bin wall.

**2.11 ladder:** A device incorporating or employing steps, rungs or cleats on which a person can ascend or descend.



Documents Document Sharing Hub

Copyright American Society of Agricultural and Biological Engineers
Provided by IHS Markit under license with ASABE
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: ASAE S412.1 2014

**2.12 landing platform:** An elevated horizontal surface area that provides access/egress for a fixed ladder.

**2.13 railing:** A vertical barrier erected along exposed sides of stairs and platforms to prevent falls of persons. The top member of a railing usually serves as a handrail.

**2.14 roof cleats:** A member fastened to the roof of a structure for ascent or descent.

**2.15 roof slope:** Degree of deviation of the roof from the horizontal.

**2.16 rungs:** Ladder cross members used for ascent or descent.

**2.17 safety devices:** A ladder safety device is any device, other than a cage or well, designed to eliminate or reduce the possibility of accidental falls and which may incorporate such features as life belts, friction brakes and sliding attachments.

**2.18 siderails:** Members that support ladder rungs.

**2.19 silo:** A cylindrical structure used for storage of high moisture forage, silage and grain.

**2.20 silo door:** Generally a rectangularly shaped door mounted flush to interior wall and opening inwardly, which as a unit consists of a dual rung and/or hinge assembly and latching device(s), and specifically designed to perform the purposes as specified in paragraph 2.4.1.

**2.21 splice:** A device for connecting adjoining members.

**2.22 stairs:** A series of steps leading from one level or floor to another, or leading to platforms, pits, crossovers, or around machinery, tanks and other equipment. A series of steps and landings having three or more risers constitutes stairs or stairway.

**2.23 toeboard:** A barrier erected along the exposed edges of a landing platform or catwalk to prevent falls of materials or tools that would present a hazard to persons below.

**2.24 tread:** The walking surface of a stair.

**2.25 vertical entry and exit platform:** An elevated horizontal surface area specifically designed to allow access/egress through a hinged door.

## 3 Fixed Wall Ladder Requirements

### 3.1 Performance requirements

**3.1.1** The ladder rung shall be capable of sustaining a minimum 1100 N (250 lb) concentrated live load applied to cause maximum stress on the member.

**3.1.2** The siderails and fastenings shall be capable of sustaining two live loads of 1100 N (250 lbf) each concentrated between any two consecutive fastenings plus the weight of the ladder and attachments and each applied to cause maximum stress in the members.

**3.1.3** Ladder splice connections shall be capable of resisting a minimum total live load of 2200 N (500 lbf) at each individual splice plus the weight of the ladder and attachments applied to cause maximum stress in the members.

### 3.2 Rungs

**3.2.1** Distance between rungs of wall ladders shall be a maximum of 300 mm (12 in.). Rung spacing shall be uniform throughout the length of the ladder (see Figure 1).



Documents
Document Sharing Hub
Copyright American Society of Agricultural and Biological Engineers
Provided by IHS Markit under license with ASABE
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: ASAE S412.1 2014

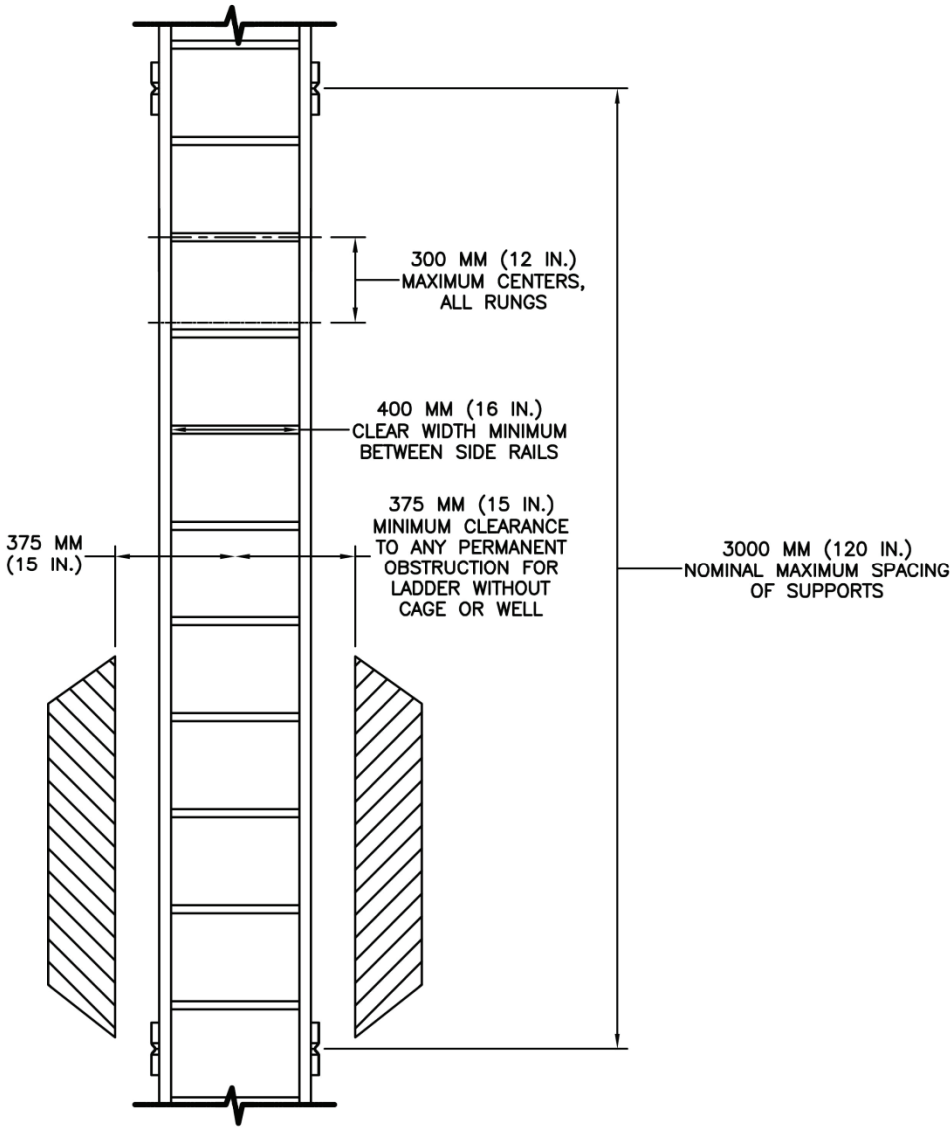


**Figure 1 – Wall ladder design details**

**3.2.2** The minimum clear length of rungs shall be 400 mm (16 in.) (see Figure 1).

**3.2.3** The minimum size (cross section) requirements of rungs are based on section properties adequate to support the design loads specified in paragraph 3.1.1 and on the minimum clear length specified in paragraph 3.2.2. In no case shall the cross-sectional dimension of rungs be less than 20 mm (0.75 in.).

**3.2.4** Rungs shall be bolted, riveted, welded or otherwise securely attached to the ladder siderails or to the structure.

**3.2.5** Rungs shall be free of burrs and shall be of a configuration that permits a handhold.

### 3.3 Siderails

**3.3.1** Siderails shall be free of burrs and be of uniform cross section for all ladders in the same length of climb.

**3.3.2** The minimum size (cross section) of siderails is based on section properties adequate to support the design loads specified in paragraph 3.1.2 and on the maximum spacing of supports specified in paragraph 3.3.3.



Documents
Document Sharing Hub
Copyright American Society of Agricultural and Biological Engineers
Provided by IHS Markit under license with ASABE
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: ASAE S412.1 2014

**3.3.3** The maximum spacing of supports for fastening siderails to the structure or equipment shall be 3000 mm (10 ft) (see Figure 1). Care should be taken in penetrating wall surfaces when fastening side rails to structure so as not to produce a source for leaks.

**3.3.4** Fastenings for siderails to the structure should occur at points where structural members occur.

### 3.4 Splices

**3.4.1** All splices and fastenings shall be free of burrs and shall provide a smooth transition with original members.

### 3.5 Clearances

**3.5.1** The wall ladder rungs shall be positioned to allow a minimum of 175 mm (7 in.) of toe space measured from the centerline of the rung to the nearest permanent object in back of the ladder (see Figure 2). When unavoidable obstructions are encountered, minimum clearances as shown in Figure 3 shall be provided.

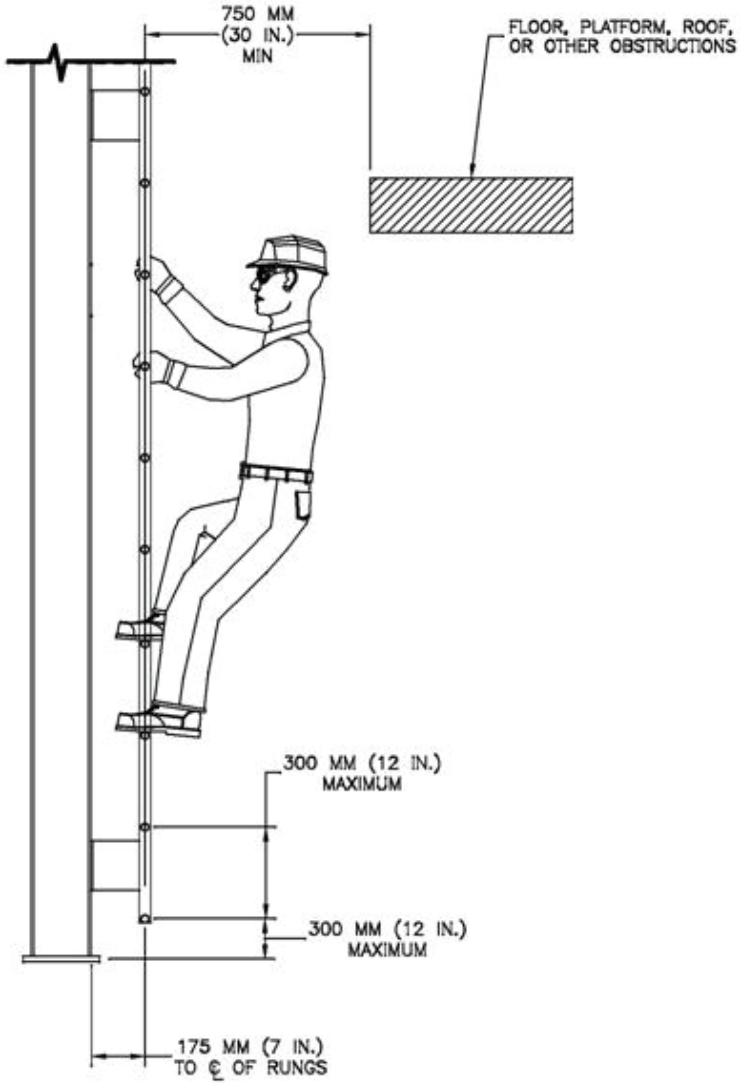


**Figure 2 – Wall ladder clearances**



Documents
Document Sharing Hub
Copyright American Society of Agricultural and Biological Engineers
Provided by IHS Markit under license with ASABE
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: ASAE S412.1 2014