ASME A90.1-2003
(Revision of ASME A90.1-1997)

SAFETY STANDARD FOR BELT MANLIFTS

AN AMERICAN NATIONAL STANDARD

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FOREWORD

This is a revision of A90.1, Safety Code for Manlifts, which was originally drawn up and approved in 1949 and reaffirmed in 1956. The original Sectional Committee consisted of 19 members representing manufacturers, users, insurance groups, enforcement officials, and independent specialists.

Work was started in 1966 on a revision of this Standard. Each provision of the original code was carefully evaluated in the light of considerable practical field experience. A draft revision was completed in 1967 and approved by letter ballot in 1968. The USA Standards Institute (now called the American National Standards Institute, Inc.) approved the revised standard on February 7, 1969.

Prompted by several serious manlift accidents, the Committee, through correspondence in 1970, considered additional changes to the 1969 standard. Subsequently, in 1972, the Committee issued ANSI A90.1a-1972, a supplement to ANSI Standard A90.1-1969.

In 1972, new Committee officers were appointed and Committee membership was expanded to include new members, many of whom have since made significant contributions to the work of the A90 Committee.

Due to changes in technology and the desire to maximize manlift safety, the Committee set about the task of totally revising the A90.1 Standard. This was accomplished only with a great deal of individual member research and study, coupled with numerous meetings of the entire committee. After three years of concentrated work, the Committee approved by ballot, in 1976, a completely revised draft of the A90.1 Standard. Subsequently, this draft was approved by the American National Standards Institute, Inc., for issuance as American National Standard A90.1-1976.

In 1981, the A90 Committee was converted from an American National Standards Committee to an ASME Accredited Organization Committee, operating under procedures developed by the ASME and accredited by ANSI. Several new members were added to the Committee in this process. After several years of work, a revision to ANSI A90.1-1976 was approved by the A90 Committee and the sponsor organization, and was designated an American National Standard by the American National Standards Institute, Inc., on September 10, 1985.

This revision was approved by the American National Standards Institute on August 14, 2003.

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Safety Standards for Belt Manlifts

(The following is the roster of the Committee at the time of approval of this Standard.)

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Secretary, A90 Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016

Proposed Revisions. Revisions are made periodically to the standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible: citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Interpretations. On request, the A90 Committee will render an interpretation of any requirement of the standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the Standards Committee.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and provide a concise description.
Edition:	Cite the applicable edition of the standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation.

Requests that are not in this format may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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ASME A90.1-2003
SUMMARY OF CHANGES

Following approval by the ASME A90 Committee and ASME, and after public review, ASME A90.1-2003 was approved by the American National Standards Institute on August 14, 2003.

ASME A90.1-2003, which has been editorially revised in its entirety, includes editorial changes, revisions, and corrections made in A90.1a-1999 and A90.1b-2001, as well as the following changes identified by a margin note, **(03)**.

Page	*Location*	*Change*
1	1.5	Added
2	Table 1	(1) Second and third entries in second column revised (2) General Note revised
	4.1.1	Revised
8	4.6.1	Note added
13, 14	5.1.2(b)	Revised
	5.2.4	Revised in its entirety
	5.2.5	Revised
17	Fig. 12	Added
18	5.5.9	Added
	5.6.5	Revised
	5.7.2	Last paragraph added
20	8.1.10	Added

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SAFETY STANDARD FOR BELT MANLIFTS

1 GENERAL

1.1 Scope

This Standard applies to the manufacture, installation, maintenance, inspection, and operation of manlifts. Manlifts covered by this scope consist of steps (platforms) and accompanying handholds mounted on, or attached to, an endless belt operating vertically in one direction only and being supported by, and driven through, pulleys at the top and bottom. These manlifts are intended for conveyance of persons only. It is not intended that this scope cover moving stairways, elevators with enclosed platforms (Paternoster elevators), gravity lifts, or conveyors used only for conveying materials.

1.2 Purpose

The purpose of this Standard is to establish safety requirements for manlifts. It is intended for use as a standard reference for manlift safety requirements by manufacturers, architects, plant designers, installers, and consulting engineers, and for users of manlifts through voluntary application and for governmental authorities.

1.3 Application

(a) This Standard applies to manlifts used to carry only authorized personnel trained in their use. Manlifts shall not be available to the general public.

(b) Because of the difficulty in enforcing paras. 4.2 and 7.1(a), manlifts are not recommended for use on construction sites.

(c) One year after the date of issuance, all provisions of this Standard shall apply to both new and existing installations, except as noted in individual sections.

1.4 Exceptions

In case of practical difficulty or unnecessary hardship, the enforcing authority may grant exceptions from the literal requirements of this Standard or permit the use of alternate methods, but only when it is clearly evident that equal safety is thereby secured.

NOTE: It is suggested that in cases where exceptions are asked for, the enforcing authority consult with The American Society of Mechanical Engineers, Secretary, A90 Standards Committee, Three Park Avenue, New York, NY 10016-5990.

1.5 Units of Measurement (03)

This Standard contains SI (metric) units as well as Customary units. The SI units have been directly (softly) converted from the Customary units.

2 REFERENCES

This Standard is intended for use in conjunction with the following American National Standards.

ANSI A12.1-1973, Safety Requirements for Floor and Wall Openings, Railings, and Toeboards

ANSI A14.3-1984, Safety Requirements for Fixed Ladders

Publisher: American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036

ASME B15.1-2000, Safety Standard for Mechanical Power Transmission Apparatus

ASME B18.5-1990, Round Head Bolts

Publisher: The American Society of Mechanical Engineers (ASME International), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300

NFPA 70-1984, National Electrical Code

Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101

3 DEFINITIONS

belt-breaking strength: the amount of tensile load [pounds (Newtons)] applied to a belt causing its fracture.

belt travel: the distance between the centers of the top and bottom pulleys when the bottom pulley is at its highest position.

debris deflector: a protective shield positioned to deflect falling objects away from the bottom pulley.

elevator bolt: a flathead countersunk elevator bolt as defined by ASME B18.5-1990, Table 9.

factor of safety: the ratio of the tensile strength of the material to the allowable stress when a part is subjected to full-load operation.

handhold (handgrip): a cup-shaped device securely attached to the belt, which can be grasped by the passenger to provide a means for maintaining balance.

manlift: a power-driven endless belt that moves in one direction only, and is provided with steps (platforms)

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(03) **Table 1 Allowable Size for Floor Openings**

Belt Width, in. (mm)	Minimum Floor Opening Width, in. (mm)	Maximum Floor Opening Width, in. (mm)
12 (305)	28 (710)	36 (915)
14 (355)	30 (760)	38 (965)
16 (405)	30 (760)	40 (1 015)

GENERAL NOTE: The minimum and maximum distance from face of belt to edge of floor openings as shown in Fig. 1 is applicable to 12 in. (305 mm) and 16 in. (405 mm) belts.

and handholds for the transportation of personnel from floor to floor.

rated speed: the speed of the belt at which the manlift is designed to run (refer to para. 5.4).

safety stop device: any electrical or electromechanical device (such as a limit switch, photoelectric eye, or proximity probe) that shall cause the electric power to be removed from the driving machine motor and brake, stopping the manlift.

severe belt damage: the protective outer cover of a belt that becomes cut, cracked, or separated, exposing damaged inner fabric, and such damage that extends across the full width of the belt or spans between adjacent bolt holes. A torn belt is also considered severe.

split-rail safety stop: an electric limit switch operated mechanically by the rollers on the manlift steps.

step (platform): a passenger carrying unit.

superficial belt cover damage: the protective outer cover of a belt that becomes scratched, cut, or cracked, exposing the inner fabric. Such damage is not continuous across the full width of the belt.

torn: a severence of any length or width that goes through the entire thickness of the belt.

4 GENERAL REQUIREMENTS

4.1 Floor Openings

(03) **4.1.1 Allowable Size.** New installations shall have minimum floor openings of 30 in. (760 mm) and maximum floor openings of 36 in. (915 mm). Floor opening widths for both the up- and down-runs for existing installations shall be in accordance with Table 1 and Fig. 1.

4.1.2 Uniformity. All floor openings for a given manlift shall be uniform in size and shall be approximately circular, and each shall be located vertically above the opening below it.

4.2 Riding Clearance

(a) There shall be no encroachment of any kind within the cylindrical space defined by the outer edges of the floor openings for the entire run of the manlift.

(b) Should maintenance or construction work be planned for in close proximity to the manlift causing an encroachment on the space defined in para. 4.2(a), the manlift shall be shut down during such work.

4.3 Landings

4.3.1 Vertical Clearance. The clearance between the floor or mounting platform and the lower edge for the underfloor hood above it required by para. 4.4 shall be not less than 7 ft 6 in. (2 285 mm). Where this clearance cannot be obtained, no access to the manlift shall be provided, and the manlift runway shall be enclosed where it passes through such floor. The enclosure shall be equipped with an emergency exit.

4.3.2 Clear Landing Space. The landing space adjacent to the floor openings shall be free from obstruction and kept clear at all times. The landing space shall be at least 2 ft (610 mm) in width from the edge of the floor opening used for mounting and dismounting (see Figs. 2 and 3).

4.3.3 Lighting of Landings. Adequate lighting, not less than 5 fc (54 lx), shall be provided at each floor landing at all times when the lift is in operation.

4.3.4 Landing Surface. The landing surface at the entrances and exits to the manlift shall be constructed and maintained to provide safe footing at all times.

4.3.5 Emergency Landings. Where there is a travel of 50 ft (15 m) or more between floor landings, one or more emergency landing(s) shall be provided so that there is a landing (either floor or emergency) for every 25 ft (7.5 m) or less of manlift travel.

(a) Emergency landings shall be accessible from both the up- and down-runs of the manlift and shall give access to the ladder as required in para. 4.8.

(b) Emergency landings shall be provided with standard railings and toeboards.

(c) Platforms constructed to give access to bucket elevators or other equipment for the purpose of inspection, lubrication, and repair may also serve as emergency landings under this paragraph. All such platforms shall then be considered part of the emergency landing and provided with standard railings and toeboards.

4.4 Hoods on Underside of Floor Openings

4.4.1 Fixed Type. On the up-side of the manlift floor, openings shall be provided with an underfloor hood meeting the following requirements (see Fig. 4).

(a) Slope. The underfloor hood shall make an angle of not less than 45 deg with the horizontal.

(b) Extent. The lower edge of this hood shall extend at least 44 in. (1 118 mm) outward from the face of the belt. It shall not extend beyond the upper surface of the floor above.

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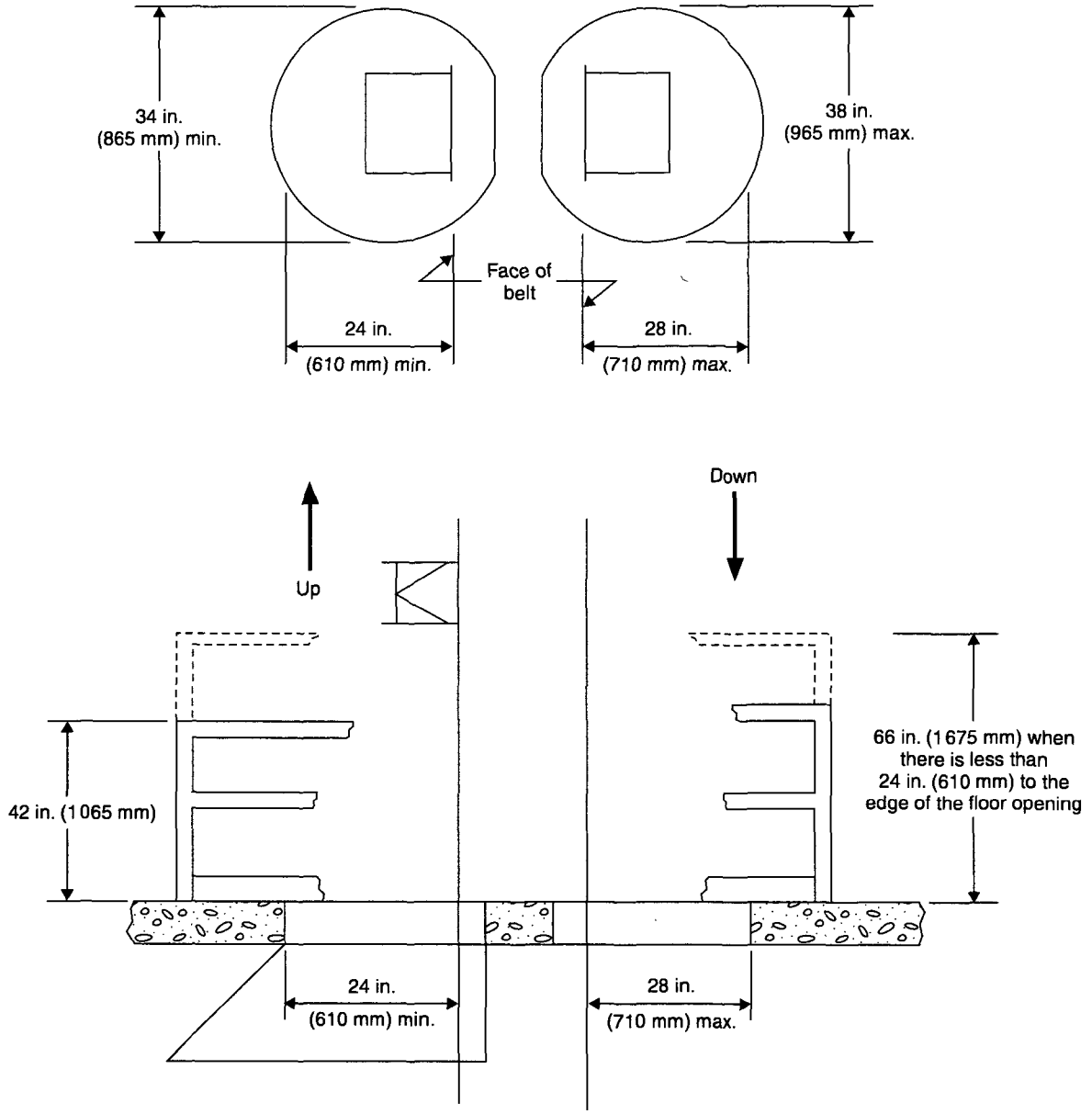


Fig. 1 Typical Floor Openings [for 14 in. (355 mm) Belts]

(c) Material and Construction. The hood shall be made of not less than No. 18 U.S. gage sheet steel or material of equivalent strength or stiffness. The lower edge shall have a minimum diameter of ½ in. (13 mm) and the interior shall be smooth, with no protruding rivets, bolts, or screws.

4.4.2 Floating Type. Where the fixed hood specified in para. 4.4.1 is not used, a floating-type hood may be used; such floating hoods shall be mounted on hinges a maximum of 6 in. (150 mm) below the underside of the floor, and so constructed as to actuate a safety switch that shuts off the manlift should a force of 2 lb (9 N) be applied on the edge of the hood closest to the hinge. The depth of this floating hood need not exceed 12 in. (305 mm).

4.5 Protection of Entrances and Exits

4.5.1 Guardrail Requirement. The entrances and exits at all floor landings affording access to the manlift shall be guarded by a maze (staggered railing) or handrail equipped with self-closing gates (see Figs. 2, 3, and 5). The guardrails should be located a minimum of 2 ft (610 mm) from the edge of the floor opening on those sides used as landings.

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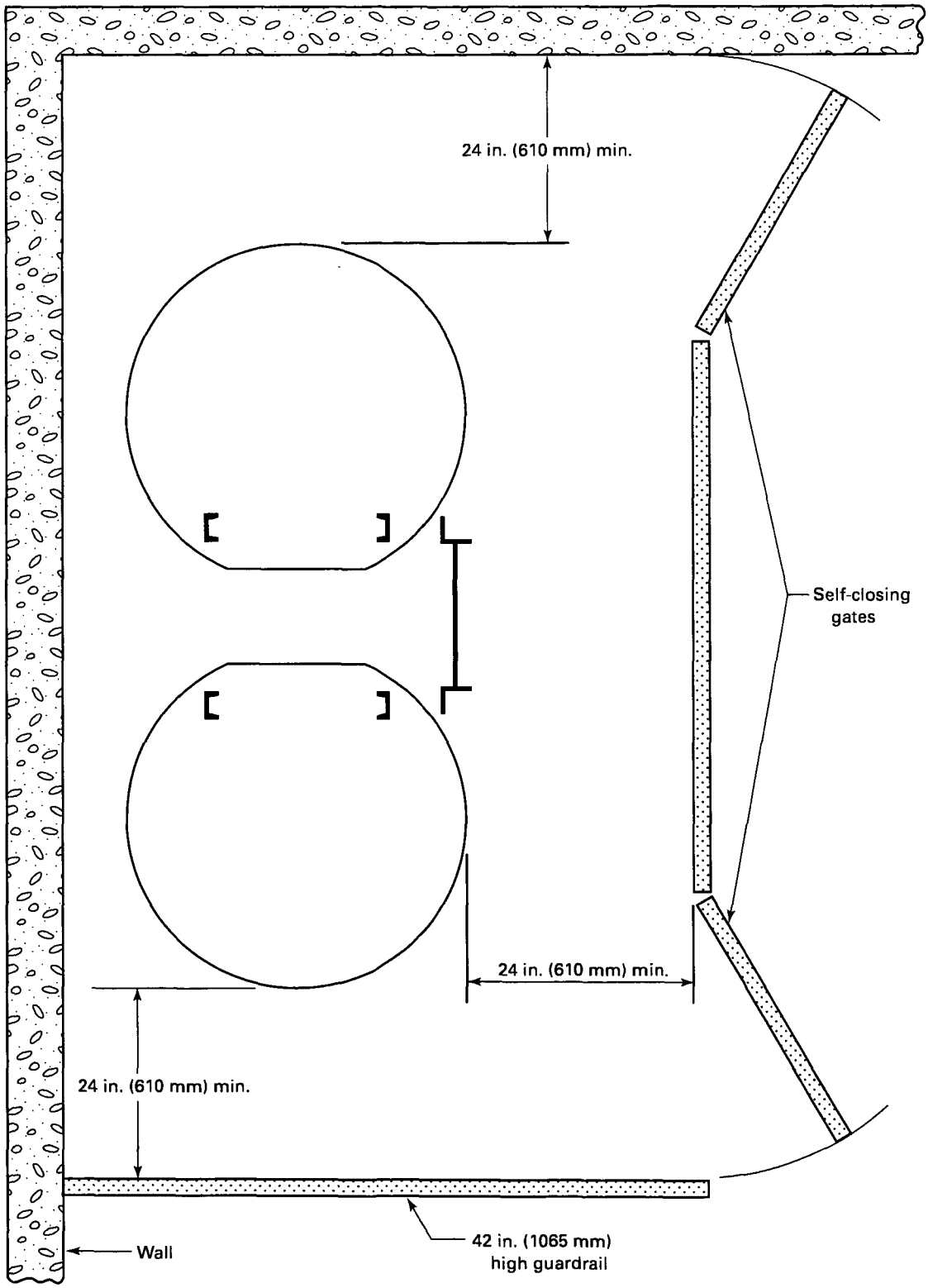


Fig. 2 Guardrail and Wall

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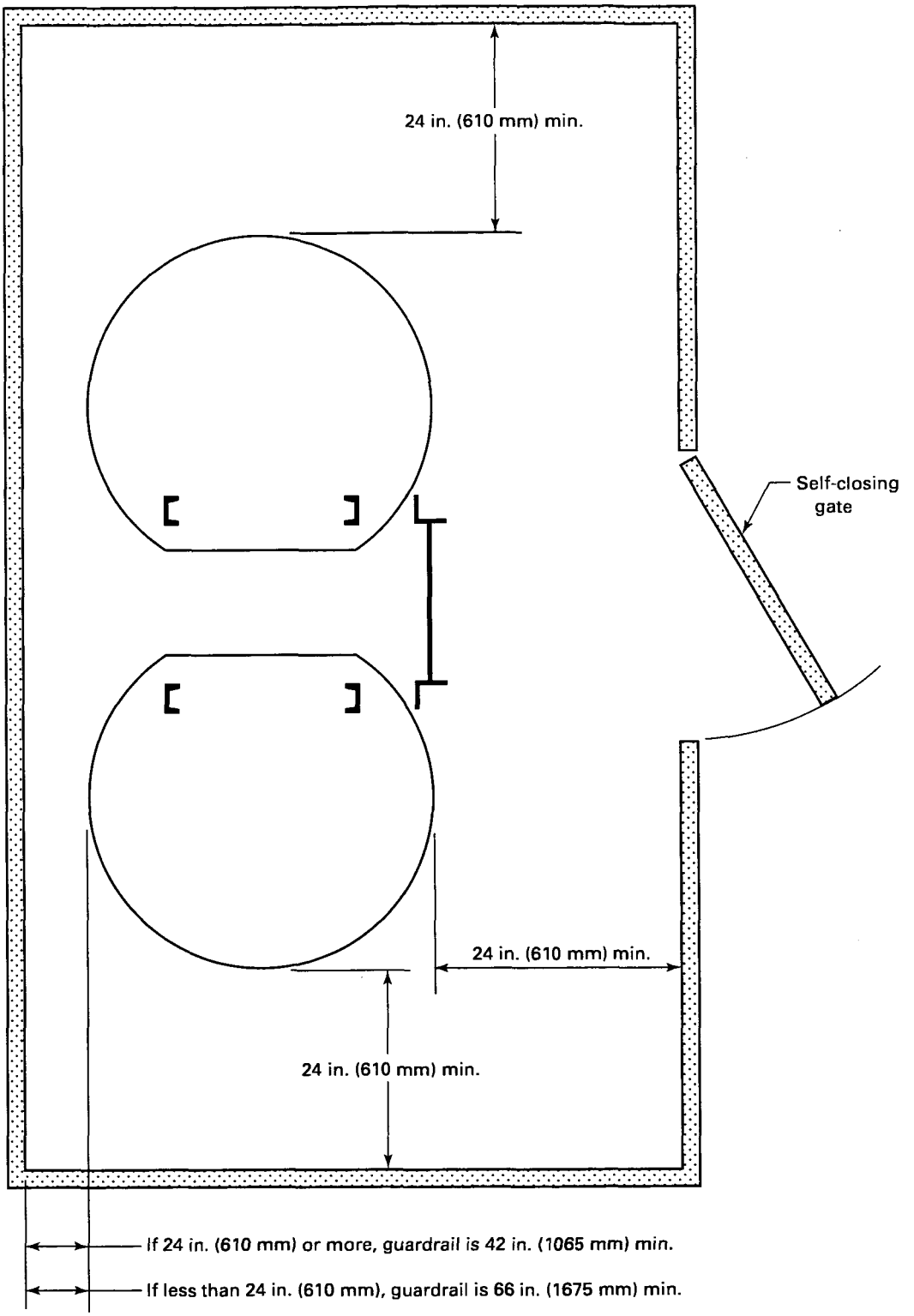


Fig. 3 Guardrail or Screened Enclosure

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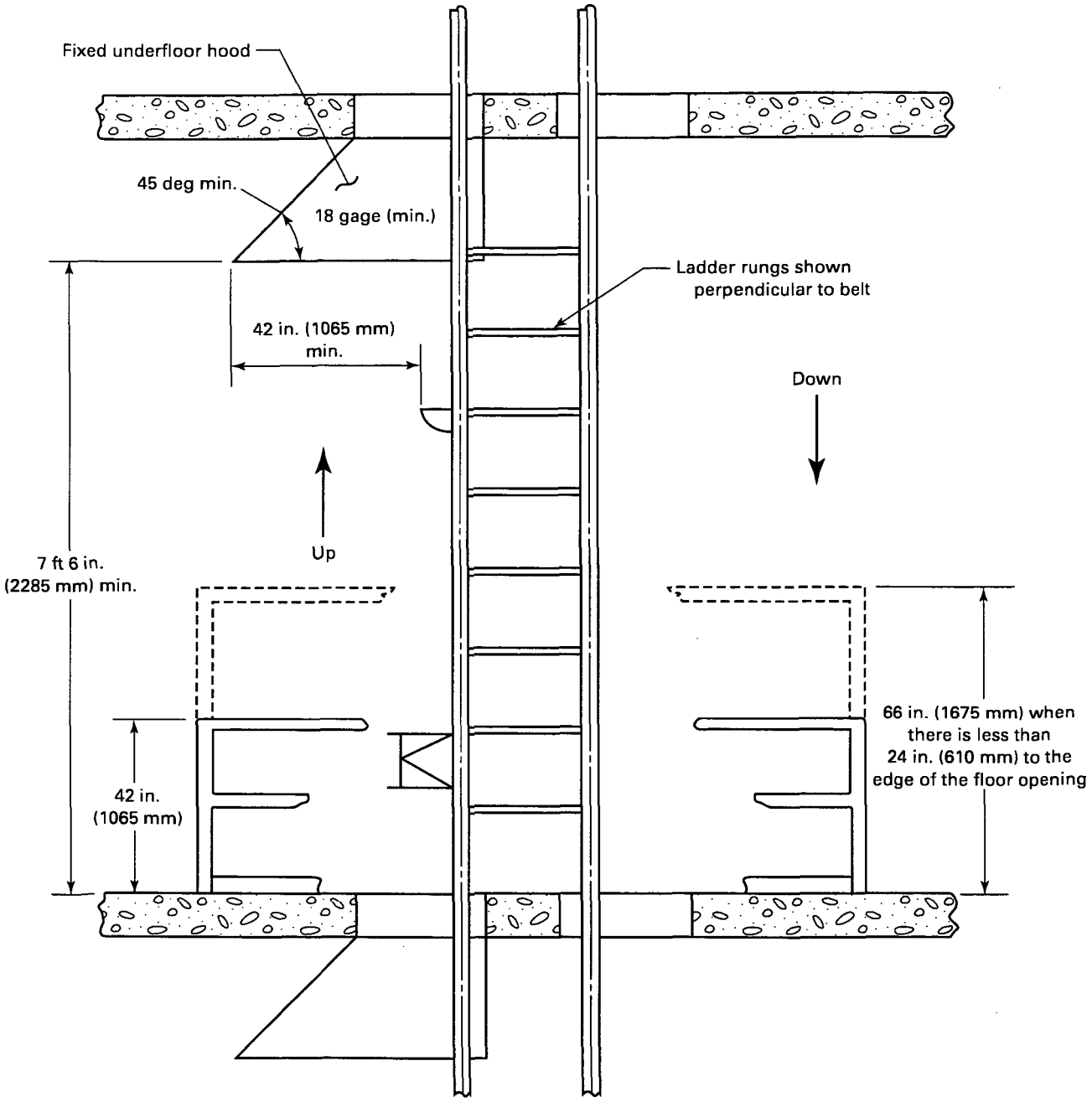


Fig. 4 Fixed Type Underfloor Hoods and Guardrail

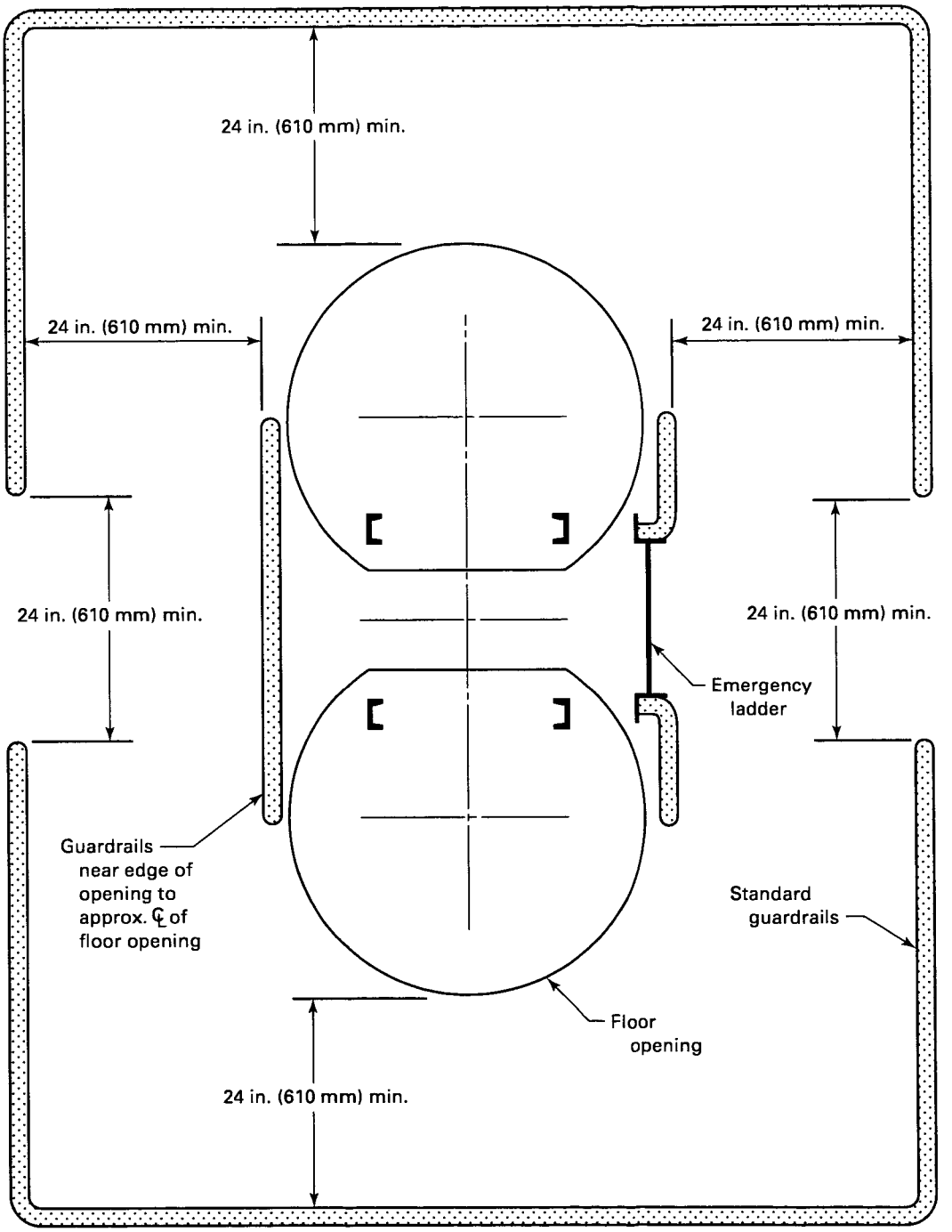
4.5.2 Construction. The rails shall be standard guardrails with toeboards meeting the provisions of ANSI A12.1. On those sides *not* used as a landing, the guardrails shall be extended to a minimum height of 66 in. (1 675 mm) when less than 24 in. (610 mm) away from the edge of the floor opening. In lieu of the 66 in. (1 675 mm) high guardrail, a wall, wire mesh, expanded metal, or solid panels may be used. This minimum 66 in. (1 675 mm) high guardrail is intended to prevent personnel alongside the manlift from being able to lean over the guardrails and into the floor opening area.

4.5.3 Gates. Gates, if used, shall open outward and shall be self-closing. Corners of gates shall be rounded.

4.5.4 Maze. Maze or staggered openings shall offer NO DIRECT PASSAGE between enclosure and outer floor space (see Fig. 5).

4.5.5 Entrance Position. Entrances at all landings shall be in the same relative position.

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GENERAL NOTE: Entry shown on two sides; entry on one side is adequate.

Fig. 5 Maze Entrance to Manlift

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4.5.6 Security. Manlifts shall not be available to the general public. If located in buildings to which the public has access, manlifts shall be located in an enclosure protected by self-closing, spring-locked doors. Keys to such doors shall be limited to authorized personnel.

4.6 Bottom Arrangement

(03) **4.6.1 Bottom Landing.** At the bottom landing, the clear area shall be a minimum of 30 in. (750 mm) wide directly in front of the belt on both the up- and down-sides. A side landing area is not required at the bottom landing. Any wall in front of the down-running side of the belt shall be not less than 48 in. (1 220 mm) from the face of the belt. This space shall not be encroached upon by stairs or ladders (see Fig. 6).

If a dismounting platform is used, the edge of this platform should be in line with the outer edge of the openings at the upper floors.

NOTE: Where a difficulty of dismount at the bottom landing is present, a riser may be used if it does not exceed 10 in. (254 mm) in height.

4.6.2 Location of Bottom Pulley. The bottom pulley shall be installed so that it is supported by the lowest floor served; or, where it is necessary to gain required clearance (see para. 4.3.1), it may be located in a pit below the lowest floor served. Where a pit is used or a dismounting platform is provided, two safety stops shall be installed on the down-run to stop the manlift in case the step is ridden past the dismounting level (refer to para. 5.7.2). Where no pit is used, a dismounting platform on the down-side is not required (see Fig. 7). When a pit is used or a dismounting platform is provided, the dismounting level shall be at or above the point at which the upper surface of the descending step is in the horizontal position and the step has not contacted the bottom safety stops prior to beginning its turn. Pit opening or floor plate, if used, shall conform with para. 4.1.1.

4.6.3 Mounting Platform. A mounting platform shall be provided in front of the up-run at the lowest landing, unless the floor level is such that the following requirement can be met: the floor or platform shall be at or above the point at which the upper surface of the ascending step completes its turn and assumes a horizontal position.

4.6.4 Guardrails. To guard against persons walking under a descending step, the area on the down-side of the manlift shall be guarded in accordance with para. 4.5. To guard against a person getting between the mounting platform and an ascending step, the area on the up-side of the manlift shall be guarded in accordance with para. 4.5 as well.

4.7 Top Arrangement

4.7.1 Clearance From Floor. A top clearance shall be provided of at least 11 ft (3.4 m) above the top landing (see Fig. 8). This clearance shall be maintained from a plane through each face of the belt to a vertical cylindrical plane having a diameter 2 ft (610 mm) greater than the diameter of the floor opening, extending upward from the top floor to the ceiling on the up-running side of the belt. No encroachment of structural or machine supporting members within this space shall be permitted.

4.7.2 Pulley Clearance

(a) There shall be a clearance of at least 5 ft (1.5 m) between the center of the top pulley shaft and any ceiling obstruction.

(b) The center of the top pulley shaft shall be not less than 6 ft (1.8 m) above the top landing.

4.8 Emergency Exit Ladder

A fixed metal ladder accessible from both the up- and down-run of the manlift shall be provided for the entire travel of the manlift (see Fig. 9). Such a ladder may be built into the supporting structure of the manlift and may be parallel to the plane of the manlift or perpendicular to the plane of the manlift (see Figs. 4, 6, and 7), and shall be in accordance with provisions of ANSI A14.3. The purpose of this rule is to provide a means of exit from a manlift step to the floor or platform below it should a mechanical or power failure strand passengers between floors. No ladder passage through a floor or platform is required.

4.9 Superstructure Bracing

Manlift guide rails shall be secured in such a manner as to avoid spreading, vibration, and misalignment.

4.10 Illumination

4.10.1 General. Both runs of the manlift shall be illuminated at all times when the lift is in operation. An intensity of not less than 1 fc (10.7 lx) shall be maintained at all points. (However, see para. 4.3.3 for illumination requirements at landings.)

4.10.2 Control of Illumination. Lighting of manlift runways shall be by means of circuits permanently tied into the building circuits (no switches), or lighting shall be controlled by switches at each landing. Where separate switches are provided at each landing, any one switch shall turn on all lights necessary to illuminate the entire runway.

4.11 Weather Protection

The manlift and driving mechanism shall be protected from adverse effects of the weather so that the other

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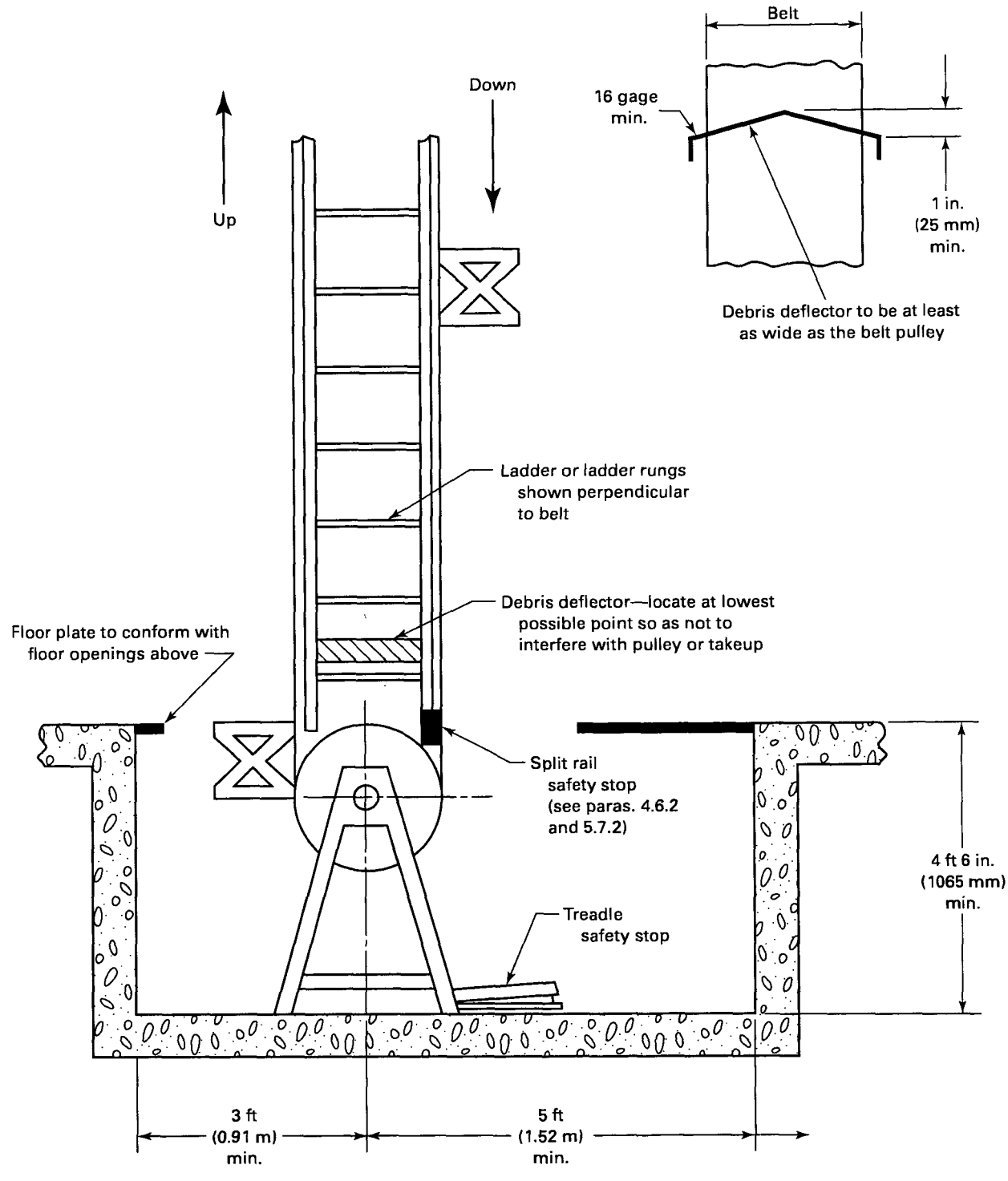
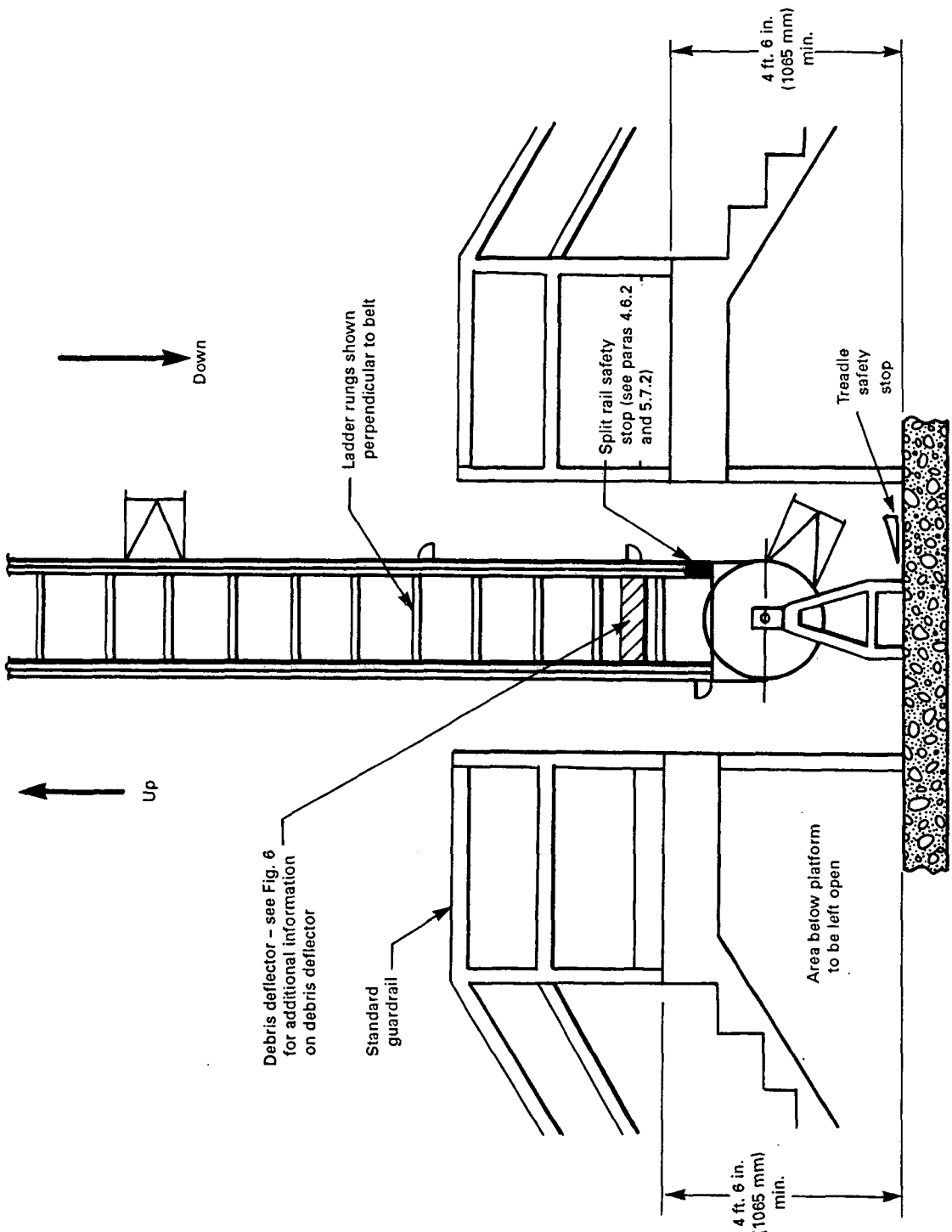


Fig. 6 Typical Pit Location Detail (for New Installations)

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GENERAL NOTE: Refer to paras. 4.5 and 4.6.4 for guardrail arrangement on down side.

Fig. 7 Typical Lower Landing Detail

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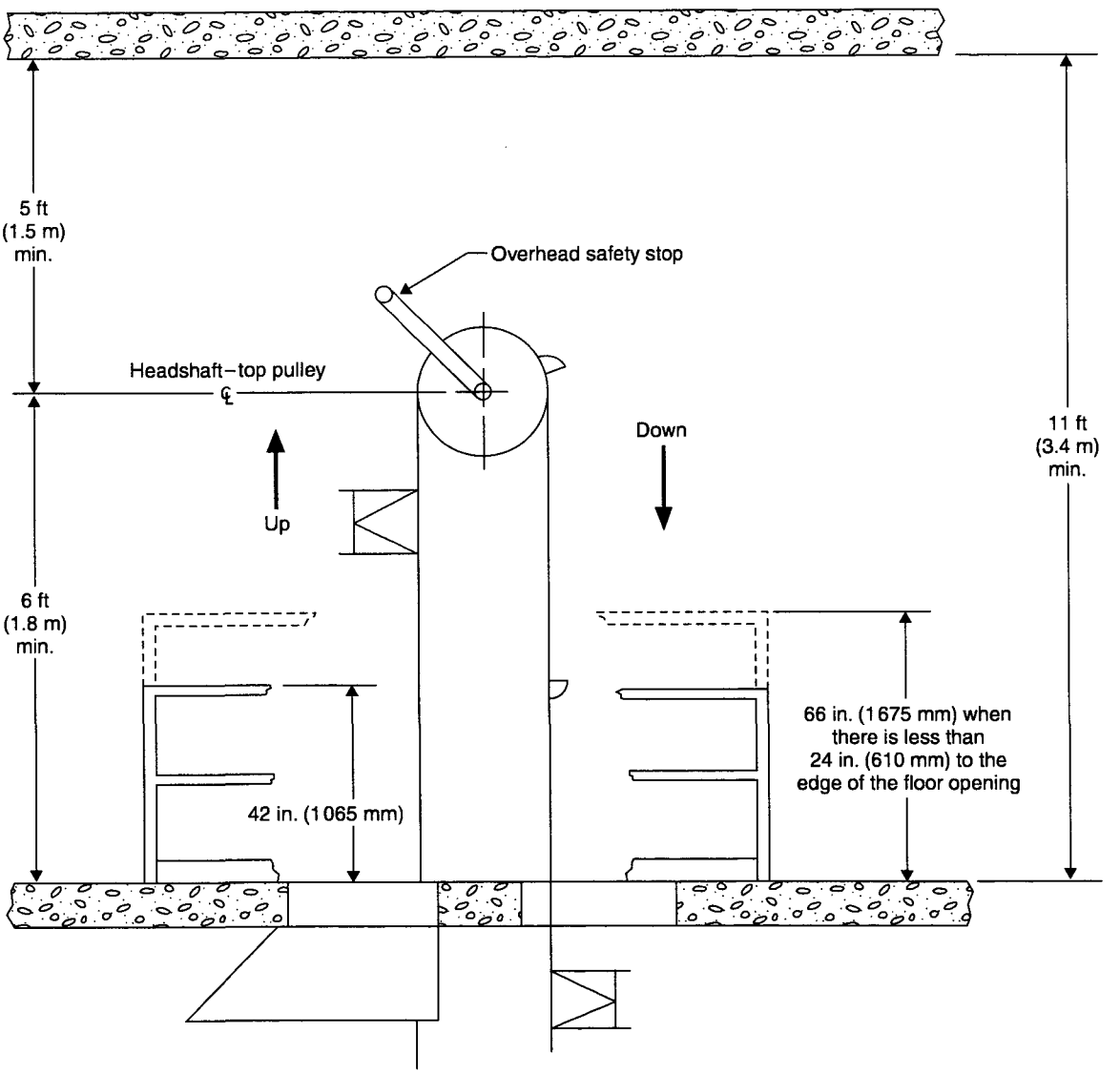


Fig. 8 Head Shaft Dimensions — Top Landing

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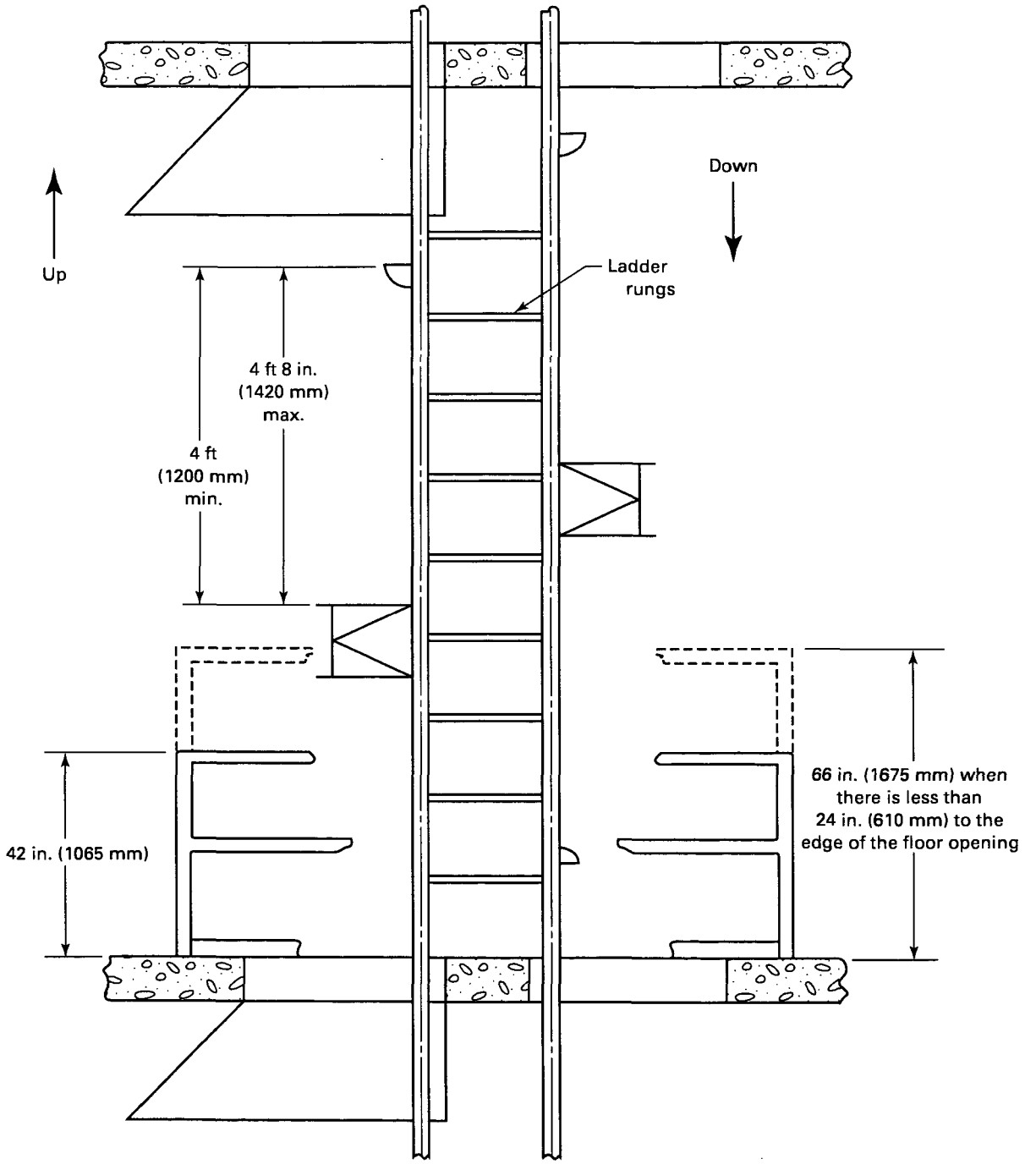


Fig. 9 Distance Between Handhold and Step

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Table 2 Rubber Manufacturers Association Tolerances for Width of Belting

Type of Belting (All Belt Widths)	Width Tolerance, Plus or Minus, in.			Maximum Width Variation in Any One Belt, in.		
	Fraction	Decimal	mm	Fraction	Decimal	mm
Molded edge	1/4	0.250	6.35	1/4	0.250	6.35
Slit edge	1/8	0.125	3.17	1/8	0.125	3.17

provisions of this Standard can be met. It is not the intent of this requirement to provide total enclosure.

5 MECHANICAL REQUIREMENTS

5.1 Machines

5.1.1 Types. Machines shall be the direct-connected type. Cast-iron gears shall not be used. There shall be no 90 deg shoulders machined onto any shaft in manlift machines or pulleys.

EXCEPTION: Existing multiple V-belt drive systems are permissible. All new installations shall be the direct-connected type. When one V-belt is replaced, all belts shall be replaced.

5.1.2 Brake

(a) A mechanically applied, electrically released brake shall be provided. The brake shall be capable of stopping and holding the manlift when the down-side is loaded with 200 lb (90 kg) on each step.

(03) *(b)* All new belt manlifts and complete drive assemblies shall be equipped with a mechanically-applied, manually-released brake that will prevent free-wheeling of the head pulley and/or head pulley shaft due to couple, shafting, or reducer failure. This brake when applied shall cut off the power to the manlift motor and prevent rotation of the head pulley and/or head pulley shaft.

5.2 Belt

5.2.1 Material. The material shall be laminated belting, solid-woven PVC belting, or other belting meeting the strength requirements of para. 5.2.3.It shall have a coefficient of friction such that when used in conjunction with an adequate tension device, it will meet the brake test specified in para. 5.1.2.

5.2.2 Width. Belts shall meet Rubber Manufacturers Association (RMA) tolerances for width. The minimum tolerances shall be as follows (see Table 2).

(a) New Installations. The width of the belt shall be not less than 14 in. (355 mm) for a travel not exceeding 150 ft (46 m), and 16 in. (405 mm) for a travel exceeding 150 ft (46 m) for new manlift installations.

(b) Existing Installations. The width of the belt may be less than those dimensions specified in para. 5.2.2(a), but never less than 12 in. (305 mm) nor less than that of the original belt. If a belt of at least 12 in. (305 mm) in width is to be used for a travel that exceeds 100 ft (30 m), the total tensile strength of the belt (its tensile strength rating per inch of width multiplied by its width) must meet the total tensile strength of the belt as called for by the strength requirements and safety factor specifications in para. 5.2.3.

5.2.3 Strength. The breaking strength of the manlift belt shall be not less than 30,600 lb (136 000 N) minimum tensile strength for belts with 100 ft (30 m) of travel or less; 44,100 lb (196 200 N) minimum tensile strength for belts with 101 to 150 ft (31 to 46 m) of travel; and 72,000 lb (320 300 N) minimum tensile strength for belts with 151 to 250 ft (46 to 76 m) of travel. No manlift shall have a travel in excess of 250 ft (76 m). (See Table 3 for breakdown by belt width.)

5.2.4 Belt Fastenings. Belts shall be fastened by one of the following methods: (03)

(a) Butt Splice, With a Strap of Equal Strength on the Side Away From the Pulleys. The strap must extend not less than 3 ft (0.9 m) on each side of the butt for manlift travel not in excess of 100 ft (30 m), and not less than 4 ft (1.2 m) on each side of the butt if the travel exceeds 100 ft (30 m). (See Fig. 10 for correct method and Table 4 for minimum number of bolts.)

(b) Lap Splice, With the Leading Edge of the Belt Away From the Pulleys. The overlap of the belt at the splice shall be not less than 3 ft (0.9 m) when the travel of the manlift does not exceed 100 ft (30 m), and not less than 4 ft (1.2 m) if the travel exceeds 100 ft (30 m). (See Fig. 11 for correct method and Table 4 for minimum number of bolts.)

NOTE: When replacing old belts with new belts meeting tensile strength requirements for 12 in. (305 mm) and 14 in. (355 mm) manlift belts exceeding maximum height limitations, belts with lap or butt splices, due to increased thickness, may lose flexibility at the splice when passing over the top pulley. The resulting stress on the splice may cause a premature elongation of bolt holes and fracture or tearing of the belt. It is recommended that this potential problem be reviewed with the belt supplier prior to installation. Further, it is recommended that more frequent checks be made during the first few months of operation to detect if such conditions are developing.

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Table 3 Belt Breaking Strength

Belt Travel Pulley Centers		Belt Width		Minimum Belt Breaking Strength of Belt Width		Minimum Belt Breaking Strength per Full Belt Width	
ft	m	in.	mm	lb/in.	N/mm	lb	N
0–100	0–30	12	305	2,550	445	30,600	136 100
		14	355	2,250	395	31,500	140 100
		16	405	2,000	350	32,000	142 300
100–150	30–46	12	305	3,675	645	44,100	196 200
		14	355	3,200	560	44,800	199 300
		16	405	2,850	500	45,600	202 800
150–250	46–76	12	305	6,000	1 050	72,000	320 300
		14	355	5,225	915	73,150	325 400
		16	405	4,625	810	74,000	329 200

(c) Mechanical Splice, Using Cast Fasteners Approved by Their Manufacturer for Manlift Applications

(1) Fastener installation shall be in accordance with the manufacturer's recommendations, as clamp bolt torque is critical. (See Fig. 12 for correct method and for minimum number of fasteners.)

(2) Mechanical splices shall only be used on new belting.

(03) **5.2.5 Repairs Prohibited.** A belt that has evidence of severe belt damage while in use on a manlift shall not be repaired and/or returned to service. The conversion of a lap splice to a butt splice, or a mechanical splice to a butt splice, does not constitute a repair.

5.2.6 Steps Prohibited. Steps or handholds are prohibited on the belt splice.

5.2.7 Elevator Bolts. All elevator bolts used for joining the belt or securing handholds or steps to the belt shall be installed and maintained so that the heads do not project beyond the inner surface of the belt (see Table 4).

5.2.8 Splice. Only one splice per manlift belt shall be permitted.

NOTE: A lap splice that has become cracked or damaged may be converted to a butt splice and returned to service, provided that the damaged area to the splice is completely removed.

5.2.9 Belt Location. Manlift belts shall be centered in the floor openings.

5.3 Pulleys

5.3.1 Dimensions. Top pulleys and bottom pulleys shall have a diameter of not less than 20 in. (505 mm).

5.3.2 Pulley Lagging. All head pulleys shall be lagged (i.e., covered with nonslip material and securely fastened in place). The fasteners shall be below the surface of the lagging. Head-pulley lagging shall be changed in conjunction with belt replacement.

5.3.3 Pulley Protection. The manlift drive machine shall be designed and constructed so that the main drive supporting members are located directly beneath the head pulley and between the up- and down-sides of the belt. These main drive supporting members shall be designed to support the entire combined loads of the pulley, belt, steps [200 lb (90 kg) on each step], handholds, all of the drive machinery, plus the bottom pulley and related bottom pulley components that contribute to the load on the head pulley. Appropriate design safety factors shall be used when designing the main drive supporting members.

5.3.4 Bottom Pulley Protection. The bottom pulley shall be provided with a debris deflector (see Figs. 6 and 7).

5.4 Speed

5.4.1 Maximum Speed. No manlift with a belt speed in excess of 80 ft/min (0.4 m/sec) shall be installed.

5.4.2 All manlifts in a given location should run at approximately the same speed.

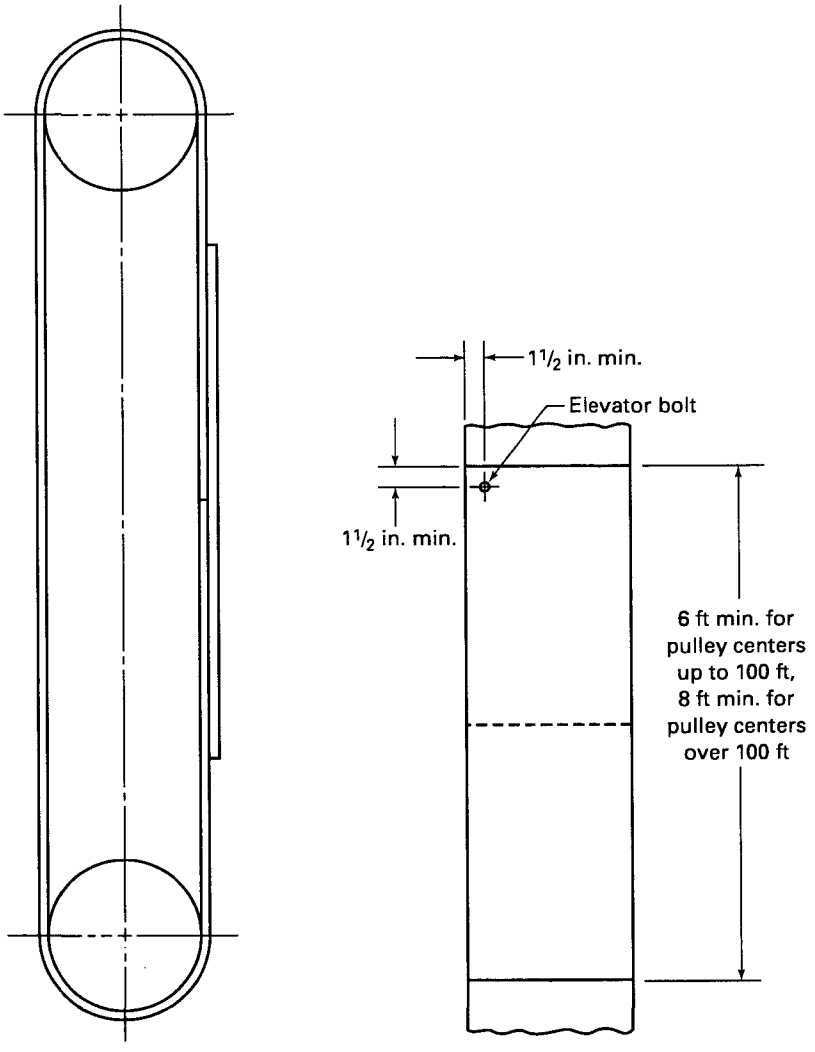
NOTE: To take care of variations in voltage, etc., the actual free running speed of the belt (no load) may exceed rated speed by not more than 10%.

5.5 Platforms or Steps

5.5.1 Minimum Depth. Steps or platforms shall be not less than 12 in. (305 mm) nor more than 14 in. (355 mm) deep, measured from the belt to the edge of the step or platform.

5.5.2 Width. The width of the step or platform shall be not less than the width of the belt to which it is attached.

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Metric Conversion

5/16 in. = 7.9 mm	6 ft = 1.8 m
1½ in. = 40 mm	8 ft = 2.4 m
12 in. = 305 mm	100 ft = 30 m
14 in. = 355 mm	
16 in. = 405 mm	

Minimum No. of Bolts

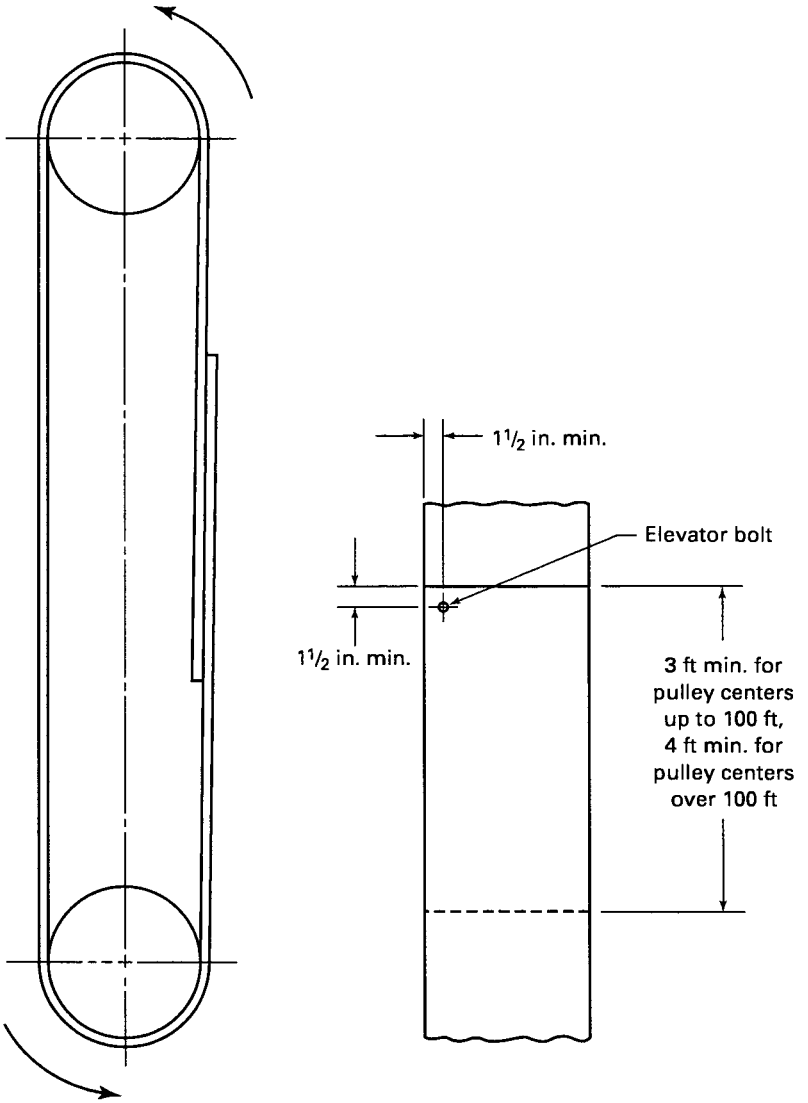
12 in. Belt	14. in. Belt	16 in. Belt
40	46	54

Minimum bolt size of 5/16 in. with lock nut or lock washer backed with flat washer

GENERAL NOTE: Follow manlift manufacturer's recommended bolt pattern.

Fig. 10 Typical Butt Splice Detail

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Metric Conversion

5/16 in. = 7.9 mm	3 ft = 0.9 m
1½ in. = 40 mm	4 ft = 1.2 m
12 in. = 305 mm	100 ft = 30 m
14 in. = 355 mm	
16 in. = 405 mm	

Minimum No. of Bolts

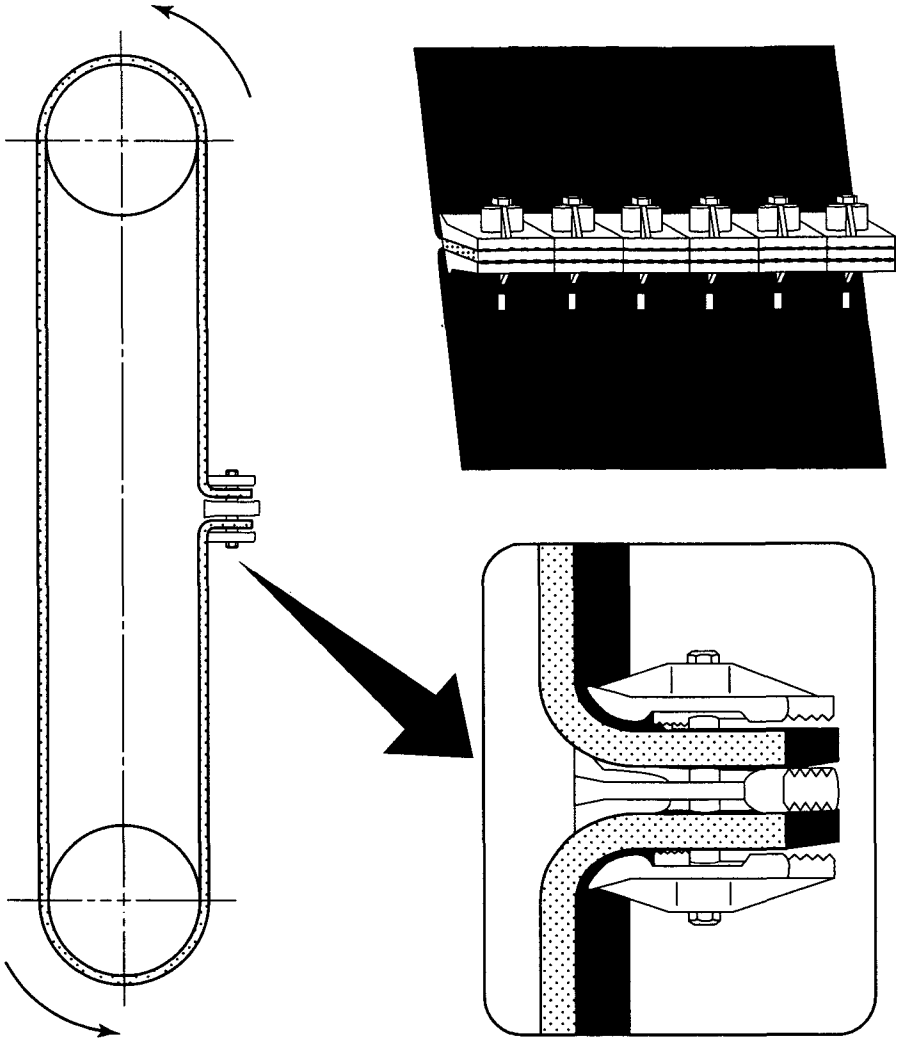
12 in. Belt	14. in. Belt	16 in. Belt
20	23	27

Minimum bolt size of 5/16 in. with lock nut or lock washer backed with flat washer

GENERAL NOTE: Follow manlift manufacturer's recommended bolt pattern.

Fig. 11 Typical Lap Splice Detail

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Belt Width, in. (mm)	No. of Splice Sets
12 (305)	6
14 (355)	7
16 (406)	8

Minimum Grade 5, ½ in. (13 mm) Bolt Size with Locknut

GENERAL NOTE: Follow fastener manufacturer's installation instructions and recommendations.

Fig. 12 Typical Manual Splice Detail (03)

5.5.3 Distance Between Steps. The distance between steps shall be equally spaced and not less than 16 ft (4.8 m), measured from the upper surface of one step to the upper surface of the next step above it.

5.5.4 Angle of Step. The surface of the step shall make approximately a right angle with the up- and down-runs of the belt and shall travel in the approximate horizontal position with the up- and down-runs of the belt.

5.5.5 Surfaces. Each step shall be protected with a nonslip tread or surface.

5.5.6 Strength of Step Supports. When subjected to a load of 400 lb (180 kg mass) applied at the approximate center of the step, step frames, or supports and their guides shall be of adequate strength to:

(a) prevent the disengagement of any step roller

(b) prevent any appreciable misalignment

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Table 4 Minimum Number of Bolts

Type of Splice	Width of Belt, in.	Width of Belt, mm	Minimum Number of Bolts
Butt	12	305	40
	14	355	46
	16	405	54
Lap	12	305	20
	14	355	23
	16	405	27

(c) prevent any visible deformation of the steps or their supports

5.5.7 Steps. Steps shall be attached using elevator bolts with locking washers and nuts or locking nuts.

5.5.8 Prohibition of Steps Without Handholds. No step shall be provided unless there is a corresponding handhold above and below it meeting the requirements of para. 5.6. If a step is removed for any reason, the handholds immediately above and below it shall be removed before the manlift is again placed in service.

(03) **5.5.9 Color.** Each step or step surface shall be in high contrast color with the belt.

5.6 Handholds

5.6.1 Location. Handholds attached to the belt shall be provided and so installed that they are not less than 4 ft (1.2 m) nor more than 4 ft 8 in. (1 420 mm) above the step tread and centered on the belt (see Fig. 9). These handholds shall be so located as to be available on both the up- and down-runs of the belt. All handholds on any given manlift should be located the same distance above the step treads.

5.6.2 Size. The grab surface of the handhold shall be not less than $4\frac{1}{2}$ in. (115 mm) in width or less than 3 in. (75 mm) in depth, and shall provide 2 in. (50 mm) of clearance from the belt. Fastenings for handholds shall be located at least 1 in. (25 mm) from the edge of the belt.

5.6.3 Strength. The handhold shall be capable of withstanding, without damage, a load of 300 lb (135 kg mass) applied parallel to the run of the belt and attached to the belt with elevator bolts.

5.6.4 Prohibition of Handhold Without Steps. No handhold shall be provided without a corresponding step. If a handhold is removed permanently or temporarily, the corresponding step and handhold for the opposite direction of travel shall be removed before the manlift is again placed in service.

(03) **5.6.5 Surfaces.** All handholds shall be the closed type and in high contrast color with the belt.

5.7 Safety Stops

5.7.1 Upper Limit Safety Stops. Three separate automatic safety stops shall be provided to shut off the power and apply the brake when a loaded step passes the top landing. Two of these shall consist of split-rail safety stops or in-track equivalent safety stops located on opposite guide rails, mechanically operated by the step. These two safety stops shall function so that the manlift will be stopped before the loaded step has reached a point 24 in. (610 mm) above the top landing. The third automatic stop device shall consist of one of the following:

(a) an electronic device

NOTE: A time delay switch may be required as part of an electronic device installation to permit passage of empty steps.

(b) a switch actuated by a lever, bar, or plate to be placed at the top pulley on the up-side, and shall be at a 45 deg angle with a maximum of 1 in. (25.4 mm) clearance from a passing step. The actuating bar shall be hinged or of a breakaway type so as not to create a hazard.

5.7.2 Lower Limit Safety Stops. Two separate automatic safety stops shall be provided to shut off the electric power and apply the brake when a loaded step passes the bottom landing (refer to para. 4.6.2). One of these devices shall activate while the step is still in the horizontal position. The automatic safety stop may consist of one of the following:

(a) a split-rail or equivalent safety stop located on the opposite guide rail

(b) an electronic devicer

(c) a treadle safety stop

No lower limit safety stops are required for a permanently installed riser, provided that it is 10 in. (254 mm) in height or less from the floor.

5.7.3 Manual Reset Location. After the manlift has been stopped by an automatic safety stop, it shall be necessary to reset the electrical control circuit manually. A manual reset shall always be located at the top landing. When safety stops are provided at the bottom landing, a reset button shall also be included (at the bottom landing). The reset shall be so located that a person resetting it shall have a clear view of both the up- and down-runs of the manlift. It shall not be possible to reset the electrical control circuit from any step. Manual resets are permissible at top and bottom landings only.

5.7.4 Electrical Requirements

(a) Where switches open the main motor circuit directly, they shall be of the multiple type, i.e., all conductors entering the switch must be opened.

(b) Where electronic devices are used, they shall be so designed and installed that failure will result in cutting off the power to the drive motor.

(c) All electrical installations shall be classified in accordance with the requirements of NFPA 70-1984.

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(d) Contacts carrying the main motor current shall be broken at two or more points simultaneously in each phase of the circuit. One point of each phase may be the motor starter contacts and the other point should be an auxiliary contact with load carrying capacity equal to or greater than the motor starter contacts. If copper to carbon contacts are used, then only one break in each phase is required.

(e) Reverse phase relay and phase failure protection are required on all manlift installations.

NOTE: It is recommended that all electrical motor control apparatus and safety relays be placed in a locked enclosure so as to prevent tampering by unauthorized persons.

5.8 Start/Stop Control Rope

5.8.1 Location and Requirements. A start/stop control rope shall be provided within easy reach of the up- and down-runs of the belt, incorporating rope guides and pulley arrangements to restrict lateral movement.

5.8.2 Operation. This control rope shall be so connected to a control lever or operating mechanism that it will cut off the electric power and apply the brake when pulled in the direction of travel. When pulled in the opposite direction of travel, the power will be restored and the brake released, without having to reset motor controls.

5.8.3 Control Rope. The control rope shall consist of a wire-center rope with a minimum diameter of $\frac{3}{8}$ in. (9.5 mm). Wire rope shall not be used.

5.9 Factor of Safety

All parts of the machine shall have a factor of safety of 6, based on a load of 200 lb (90 kg mass) on each horizontal step on the up- and down-runs.

NOTE: Any stresses set up during acceleration or stopping are to be included in the above factor of safety. This paragraph does not apply to belts. See para. 5.2.3.

6 INSTRUCTION AND WARNING SIGNS

6.1 Instruction Signs at Landings and on Belt

Signs of a conspicuous and easily-read style giving instructions for the use of the manlift shall be posted at each landing and on the belt at each handhold.

6.1.1 Size and Legibility. Such signs shall be of letters not less than 1 in. (25 mm) in height and of a color having high contrast with the surface on which it is stenciled or painted.

6.1.2 Inscription. The instructions shall read approximately as follows:

Face the Belt
Use the Handhold
To Stop, Pull Rope in Direction of Travel

6.1.3 Directional Arrows. Arrows pointing in the direction of belt travel shall be marked on the belt below or above each handhold.

6.2 Top Floor Warning Sign and Light

6.2.1 Requirements. Immediately below the top floor an illuminated sign shall display the following wording:

TOP FLOOR — GET OFF

The sign shall be in block letters not less than 2 in. (50 mm) in height and shall be located within easy view of an ascending passenger, not more than 2 ft (610 mm) below the top landing.

6.2.2 Additional Warning Light. In addition to the sign required by para. 6.2.1, a red warning light of not less than 40 W rating shall be provided immediately below the top landing and so located as to shine in the passenger's face.

6.3 Bottom Floor Warning Sign

A sign within easy view of descending passengers shall display the following wording:

BOTTOM FLOOR — GET OFF

The sign shall be in block letters not less than 2 in. (50 mm) in height.

NOTE: It may be useful to have all floors and landings numbered or identified by name to eliminate confusion by riders.

6.4 Visitor Warning Sign

A conspicuous sign shall display the following wording at each landing:

AUTHORIZED PERSONNEL ONLY

The sign shall be of block letters not less than 2 in. (50 mm) in height and shall be a color offering high contrast with the background color.

NOTE: See para. 1.3(a) for definition of *authorized personnel.*

7 OPERATING RULES

7.1 Proper Use of Manlifts

(a) Only authorized personnel trained in their use shall be permitted to use manlifts. See Mandatory Appendix I for recommended training guide and program.

(b) Unsafe conditions on manlifts must be reported immediately, and the manlift is to be taken out of service until the condition is corrected.

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(c) When riding a manlift, the rider shall stand squarely on the top surface of the step, in an upright position, and face the belt while grasping the handhold securely with both hands. Jumping on the step, yanking on the handhold, or horseplay of any kind is prohibited. Only one rider per step is permitted.

(d) No freight, packaged goods, pipe, lumber, or materials of any kind shall be carried or transported on any manlift.

(e) No tools, except those fitting entirely within a pocket, tool pouch, or holster designed specifically for small hand tools and attached to an employee's belt or body harness (the kind from which no tools are able to protrude) shall be carried on any manlift.

(f) Before starting or restarting a manlift, it shall be necessary to alert all riders on the manlift and all others in its vicinity.

8 TESTS AND INSPECTIONS

8.1 Acceptance and Annual Tests

NOTE: On completion of the manlift installation, there should be an acceptance test performed by the installer in the presence of the owner, owner's representative, and/or the representative of the enforcement department. Under no circumstances shall humans be used as weights for testing.

The same series of tests as outlined in this paragraph shall be performed by the owners on an annual basis.

8.1.1 Up Capacity. The manlift with 200 lb (90 kg mass) on each horizontal step of the up-run shall show no appreciable slip of the belt when standing or running at rated speed.

8.1.2 Down Capacity — Brake. The manlift with 200 lb (90 kg mass) on each horizontal step of the down-run shall show no appreciable slip of the belt when standing or running at rated speed. The brake shall stop and hold the belt with test load within a maximum of 24 in. (610 mm) of travel.

8.1.3 Loaded Step Deflection. Each step shall be subjected to a 400 lb (180 kg mass) load applied to its center while the machine is stationary. The guide rails shall not be displaced and there shall be no visible deformation, deflection, or misalignment of the step or its support during the test.

8.1.4 Strength of Handhold. Each handhold shall support a load of 300 lb (135 kg mass) without appreciable deformation or injury to its fastenings. The test shall be performed while the machine is stationary.

8.1.5 Safety Stops. The split-rail safety stops or in-track equivalent safety stops shall be tested by placing a weight of 50 lb (25 kg) on the approximate center of the step or platform and running the manlift in the appropriate direction until the manlift is stopped by the safety stop. Each safety stop shall be tested individually. All other safety stops shall be manually tested.

8.1.6 Start/Stop Control Rope. The manlift shall be started and stopped on both the up- and down-runs by means of the start/stop control rope.

8.1.7 Movable Cone Guards. If such guards are installed, each one shall be tested by applying a force of not more than 2 lb (9 N) on the edge of guard nearest the hinge.

8.1.8 Speed Tests. Speed tests shall be taken and checked against specified (rated) speed. The rated speed shall not be exceeded by more than 10% when the manlift is running empty.

NOTE: Speed may be determined by a revolution counter on the top (head) pulley, where the revolutions per minute are multiplied by D, where D is the diameter in feet, or may be determined with a tachometer with a 6 in. (150 mm) or 12 in. (305 mm) circumference wheel running in contact with the belt. Readings taken with a 6 in. (150 mm) wheel circumference should be divided by 2. For speed values in meters per second, the following conversion factor may be useful:

$$1\ ft/mm = 0.00508\ m/sec$$

8.1.9 Emergency Brake. The emergency brake, if installed, shall be tested per manufacturer's procedure.

8.1.10 Mechanical Splice. Verify proper bolt torque on mechanical splice. (03)

8.2 Periodic Inspection

8.2.1 Frequency. All manlifts shall be inspected by a competent, designated person at intervals of not more than 30 days. Safety stops and rope control shall be checked weekly. Manlifts found to be unsafe shall not be operated until properly repaired.

8.2.2 Items Covered. This periodic inspection shall cover, but is not limited to, the following items:

(a) bearings

(b) belt and belt splice [cuts, damage, tracking (top and bottom)]

(c) bottom pulley and clearance

(d) bottom pulley takeup

(e) brake

(f) drive coupling

(g) driving mechanism

(h) electrical switches

(i) floor braces

(j) floor landings — slippery conditions

(k) guide rail supports and fastenings

(l) guide rail/track

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(m) guardrails
(n) hoods
(o) handhold and handhold fastenings
(p) illumination
(q) lubrication
(r) motor
(s) motor coupling
(t) pulley lagging
(u) pulley supports
(v) rollers and slides
(w) safety stops
(x) skip on up- or down-run when mounting step (check drive train)
(y) start/stop control rope
(z) steps
(aa) step clearance at top and bottom landings
(bb) step fastenings
(cc) top pulley
(dd) vibration and misalignment
(ee) warning signs and lights

8.2.3 Unsafe Use. The individual making the inspection shall also make a special point to observe which persons are using the manlift and whether they are complying with the operating rules listed in para. 7. The inspecting individual shall immediately report any unsafe acts or unauthorized use to proper personnel.

8.2.4 Inspection Log. A written inspection log shall be kept of findings at each inspection and be signed and dated. Records of inspection shall be made available to duly authorized agencies. See Mandatory Appendix II for a sample inspection form.

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MANDATORY APPENDIX I
RECOMMENDED TRAINING PROGRAM FOR MANLIFT PASSENGERS

I-1 LECTURE

(a) Using a chart, describe in general terms how a manlift is constructed, operation of the start/stop control rope, step mounting, safety stops, etc.

(b) Discuss the operating rules of para. 7. Explain the "why" of each rule. Answer questions.

(c) Explain the operation of safety stops and method of resetting them.

I-2 DEMONSTRATION

(This requires a trainer and an assistant — never leave trainees alone at a manlift.)

(a) Walk trainees to the lowest landing of the manlift and review start-up procedures.

(1) Check to see that everyone is clear of the belt and steps.

(2) Wait for up handhold to appear at waist level and grasp it.

(3) Step on the next step as it levels with the landing.

(4) Face the belt and grasp handhold with both hands.

(5) Place both feet securely on step.

(b) Stop manlift almost immediately by pulling or grasping rope.

(1) Explain operation of start/stop control rope.

(2) Ride to first landing and return to trainees on down belt.

(3) Explain all steps you have taken in dismounting. Answer questions on how to get on and off manlift.

I-3 PRACTICE

(a) Station an assistant or an experienced manlift rider on first landing above the lowest landing.

(1) Standing alongside of step at lowest level, encourage each trainee to mount the manlift for a one-floor ride. Be ready to pull rope in case of a misstep.

(2) Have an assistant or experienced rider watch each trainee as he/she arrives at the next floor, watching carefully as each trainee steps off the manlift. Be ready to pull the rope, if necessary. Continue to watch and comment, as pertinent, as each trainee practices riding the up belt.

(b) Repeat the process on the down-side of the belt from an upper landing, this time stationing the assistant or experienced rider at the lowest floor served.

(1) Explain the technique of watching for the correct handhold to come level with the chest and simultaneously grasping it while stepping on descending step.

(2) Have each trainee, in turn, ride down one floor.

(c) Send an assistant or experienced rider to the top floor served and have each trainee, in turn, ride the belt its full length. Enroute to the top, have each trainee stop and start the manlift at one or more floors (with the required warning at startup) to become familar with rope control. If, at any time, a trainee expresses fear of riding a manlift, he/she should not use the manlift and training should be suspended.

(d) Go to the top and bottom landings and show any and all safety stops, and demonstrate reset procedures.

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MANDATORY APPENDIX II
BELT MANLIFT INSPECTION REPORT (WEEKLY AND MONTHLY)

Belt Manlift Inspection Report (Weekly and Monthly)

Location _____ Date _____

Manlift Make and Serial No. _____ Code _____

	Period			Period	
	Weekly	Monthly		Weekly	Monthly
1. Observe manlift in operation for visible defects	( )	( )	18. Lower safety stops	( )	( )
2. Steps and rollers		( )	19. Upper safety stops	( )	( )
3. Handholds		( )	20. Photo eye — sonic safety (if applicable)	( )	( )
4. Belt Splice		( )	21. On-off switch and control rope (test up- and down-run)	( )	( )
5. Belt (look for cuts or damage)		( )	22. Step clearance at drive		( )
6. Belt takeup at bottom pulley		( )	23. Belt tracking at drive pulley		( )
7. Step clearance at bottom pulley		( )	24. Motor		( )
8. Belt tracking at bottom pulley		( )	25. Motor brake		( )
9. Bottom bearing lubrication and support		( )	26. Gear reducer and check oil level and change per manual		( )
10. Guide rails, proper alignment, fastenings, and support		( )	27. Head shaft, couplings, collars, and keys		( )
11. Floor braces for guide rails		( )	28. Head shaft bearings and lubrication		( )
12. Floor hoods and openings		( )	29. Top pulley and lagging		( )
13. Safety switches on movable hoods	( )	( )	30. Overall drive assembly and support structure		( )
14. Guardrails and gate operation		( )	31. Skipping when mounting step (check drive train)		( )
15. Floor landings (clear of obstruction)		( )	32. Vibration or misalignment in drive		( )
16. Illumination of manlifts and floor landings		( )	33. Lubrication per maintenance manual		( )
17. Top and bottom floor warning signs and lights		( )	34. Guide rail free of foreign material and lubricant		( )

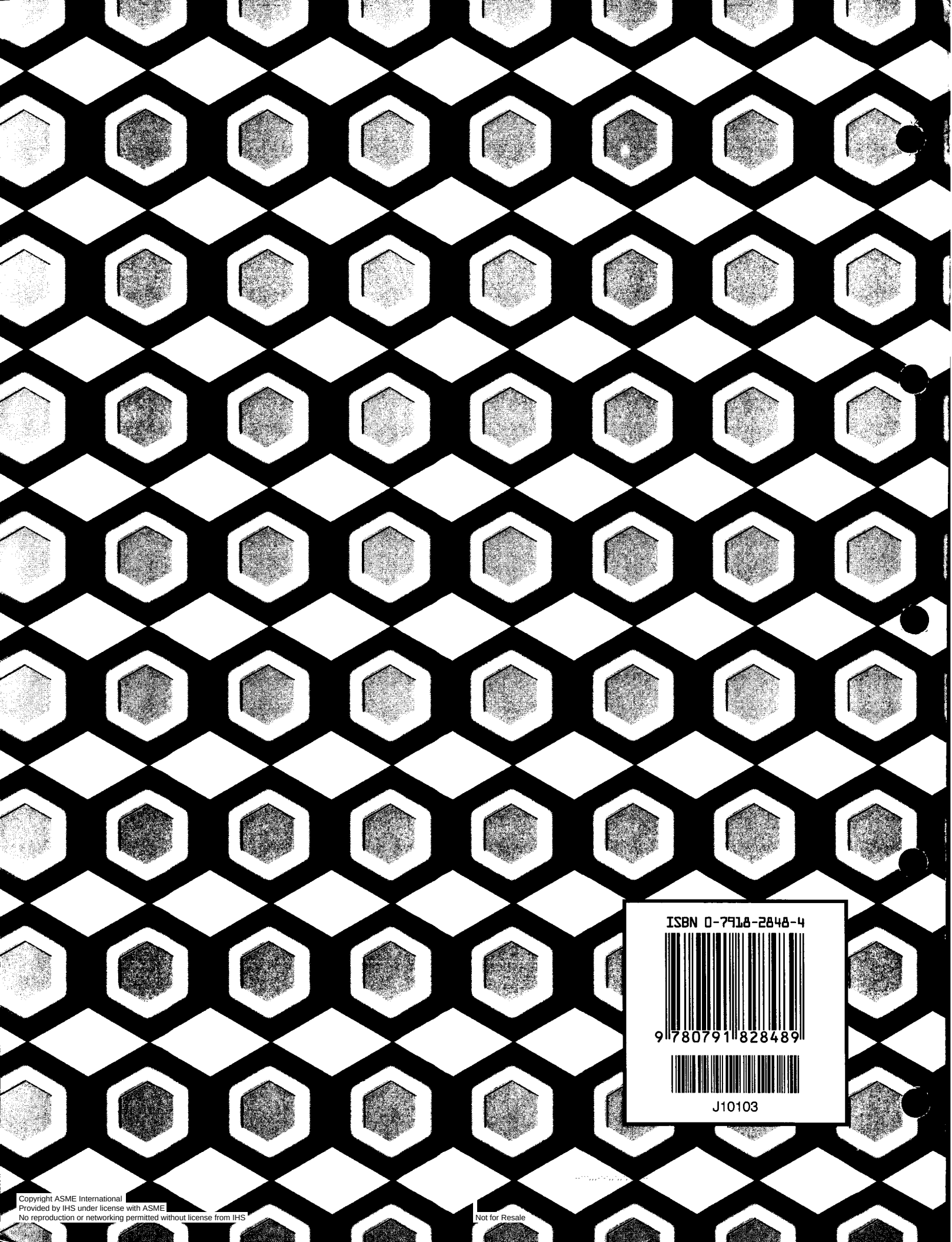
Is manlift being properly used? _____ By authorized personnel? _____

Item numbers above that were corrected or are in need of such — give complete description on back side of this form.

Inspected by: _____ Date: _____

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