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# **Recommended Practice for Guarding of Pumping Units**

API RECOMMENDED PRACTICE 11ER  
FOURTH EDITION, XXXXXXXX 20XX

BALLOT DRAFT

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## **Foreword**

To be populated prior to publication.

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## Recommended Practice for Guarding of Pumping Units

### 1 Scope

This recommended practice (RP) provides a reference or guide for the design, manufacture, and installation of guards for moving parts on pumping units. It is based on knowledge and experience gained through the application of guards for pumping units by the production segment of the petroleum industry.

### 2 Normative References

There are no referenced documents that are indispensable for the application of this document.

### 3 Terms and Definitions

There are no terms or definitions for this document.

### 4 General

This RP is intended to provide safeguards for all persons who are required to work around or on oil well pumping units.

These safeguards should prevent bodily injury from contact with moving parts by anyone inadvertently walking into, falling, slipping, tripping, or similar action. The safeguards should also prevent injury from reasonable or predictable breakage of any of the component parts.

Where unattended locations present close exposure to a community of people, safety barriers, such as provided by a totally enclosed and locked perimeter, may be required (see 7.3.4).

Pumping unit manufacturers shall provide instructions for identifying and isolating all energy sources and preventing any movement of the unit while maintenance activities are being performed.

It is the responsibility of the end user to identify and ensure that all local, state, and federal regulations specific to the pumping unit installation site are met. When there is conflict between requirements, the stricter of the two shall apply.

## **5 Types of Guarding to be Used on Pumping Unit**

### **5.1 General**

The general types of guards include those listed as follows or combinations thereof.

### **5.2 Enclosures and Guardrails**

Enclosures usually provide the greatest degree of protection against moving parts of mechanical equipment. Guardrails sometimes offer less effective protection than enclosures of proper dimension and the use of guardrails shall be confined to protecting against slow moving equipment such as cranks, counterweights, air counterbalance tanks, and horseheads. Both enclosures and guardrails should be strong enough to withstand the impacts and loadings imposed upon them without collapsing against the moving mechanism they protect against, and their dimensions should be within the limits prescribed in Section 7.

### **5.3 Location**

This refers to equipment which, because of its location, is not accessible to employees performing normal operating or maintenance procedures. Where a hazard would exist during maintenance, the equipment should be shut down and all power locked out or the equipment guarded in accordance with 7.2 or 7.3.

## **6 Items to be Guarded**

### **6.1 General**

The following parts of a pumping unit should be guarded (components except sheaves and belts may be considered to be guarded by location if they are not easily accessible during operation of the unit due to the presence of other guards or moving components).

### **6.2 Sheaves and Belts**

Sheaves and belts on pumping units should be guarded by removable enclosures. An example of a typical enclosure is shown in Figure A.1.

### **6.3 Cranks, Counterweights, and Air Counterbalance Tanks**

Cranks, counterweights, and air counterbalance tanks should be guarded either by enclosures or guardrails. The use of guardrails for this application has proven adequate because cranks, counterweights, and air balance tanks are slow moving pieces of equipment and because there is no reason for an employee to perform maintenance or do other types of work on this equipment while the unit is in operation. Either enclosures or guardrails should be far enough from the moving parts to protect the employee from inadvertent contact but not so far that the employee might be tempted to use the space as a passageway. An example of a guardrail is shown in Figure A.2.

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## **6.4 Flywheels**

Flywheels on gas engine prime movers for pumping units should be guarded by enclosures. The design of this enclosure should permit temporary access to the flywheel when necessary for engine starting. An example flywheel enclosure is shown in Figure A.3.

## **6.5 Horsehead and Carrier Bar**

In those instances where the horsehead or carrier bar descends to less than 84 in. from the ground or work platform, a securely fastened single or standard guardrail shall be installed. Examples of horsehead guards are shown in Figure A.4.

The need for guarding the carrier bar and the polished rod stuffing box shear point is not deemed necessary if the following practice is observed: the carrier bar, polished rod clamps, and polished rod liner clamps shall not travel within six inches of the top of the stuffing box on the down stroke.

# **7 Requirements for Guarding**

## **7.1 Enclosures**

**7.1.1** The enclosure prevents inadvertent placing of any part of the body in, on or over edges of the enclosure where it might contact a moving part.

**7.1.2** The enclosure shall be constructed of expanded metal, perforated or solid sheet metal, wire mesh, plastic or other material of equivalent or greater strength to meet requirements of 7.1.3 and 7.1.4. Such material shall be free from burrs or sharp edges. Enclosure guards shall be securely attached to the base or framework of the pumping unit, engine, gear case, motor, etc., or securely affixed to ground or foundation.

**7.1.3** The enclosure and its supports shall be designed with sufficient rigidity so that an adult person leaning on or falling against the enclosure will not sustain an injury from the moving part.

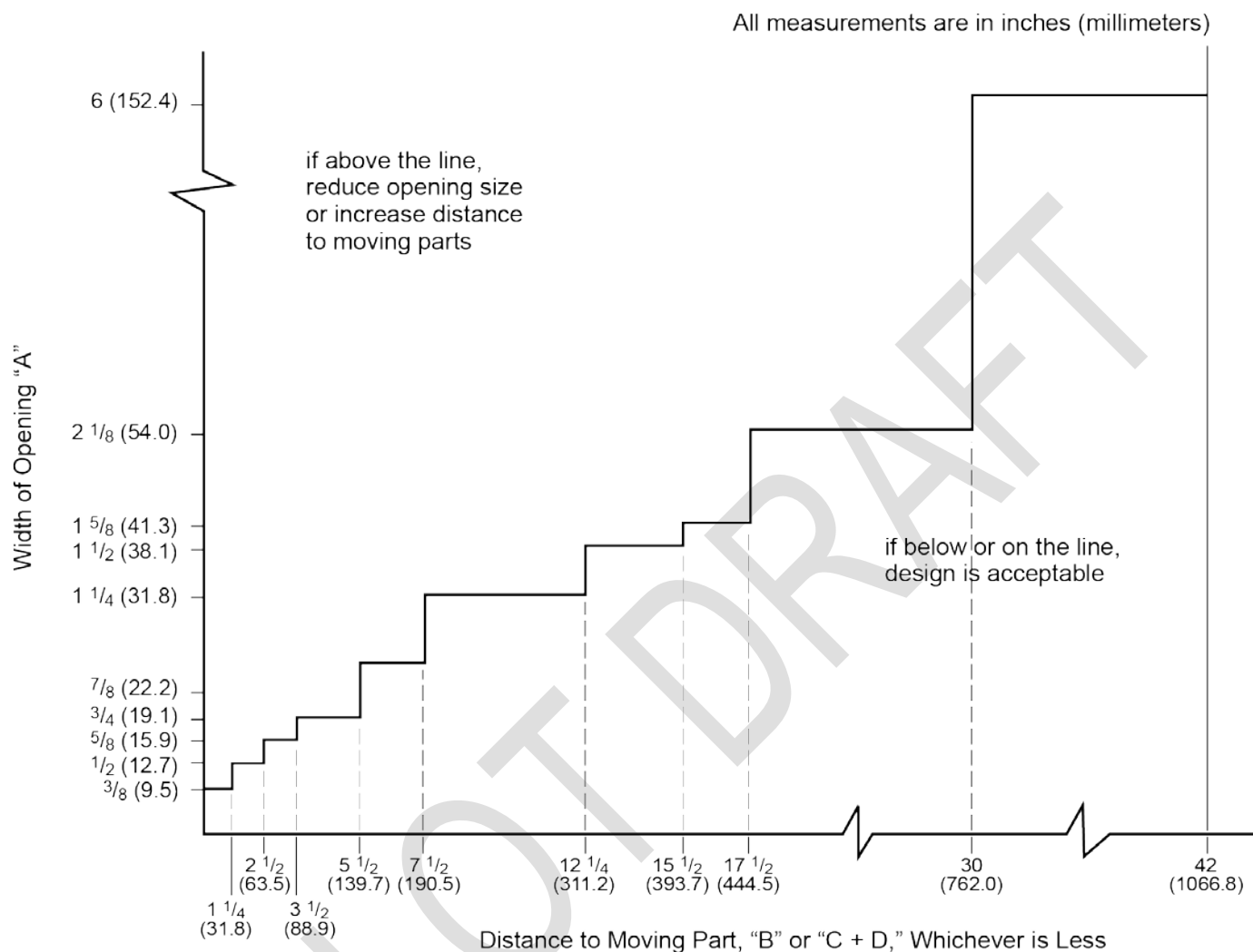
**7.1.4** Enclosure openings should conform to the requirements of Figure 1, shown graphically in Figure 2 and Figure 3.

**7.1.4.1** Figure 1 shows the relationship, to provide reasonable safety, between the maximum size opening permitted in a guard and the distance from the moving part. Thus, up to  $\frac{3}{8}$  in. (9.5 mm) openings are permitted below  $1\frac{1}{4}$  in. (31.8 mm) from a moving part, up to  $\frac{1}{2}$  in. (12.7 mm) openings at distances  $1\frac{1}{4}$  in. (31.8 mm) and above,  $\frac{5}{8}$  in. (15.9 mm) openings at distances of  $3\frac{1}{2}$  in. (88.9 mm) and above, etc.

**7.1.4.2** When the enclosure is partially open on the machine side as shown in Figure 2, the distance to the moving part is a variable based on the opening A and should be the lesser of either the distance B or the distance C + D (the sum of the depth of the guard lip and the distance from the edge of the lip to the moving part).

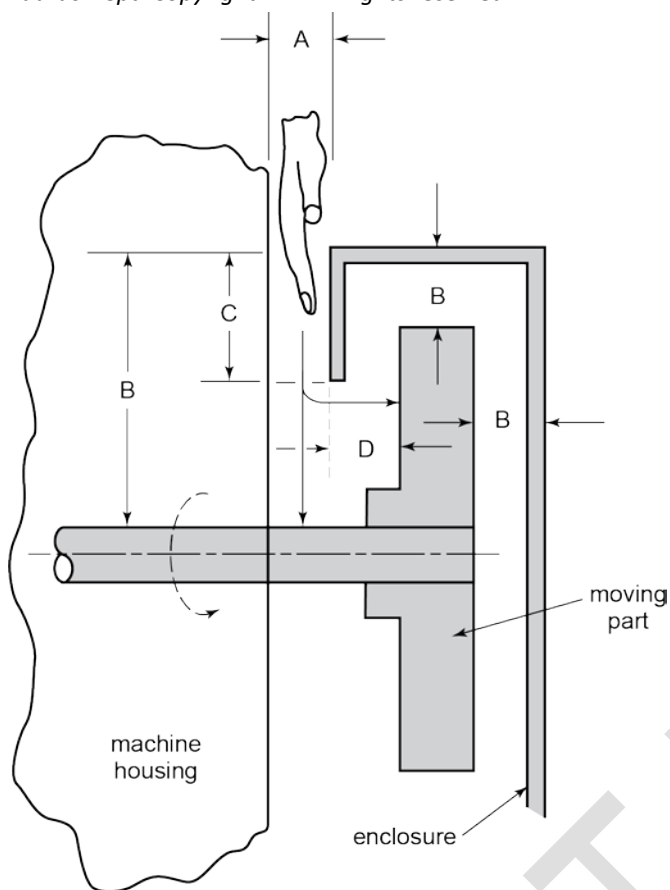
**7.1.5** Openings to permit lubrication, adjustment or inspection should be equipped with hinged, sliding, or bolted cover plates of a design that will stay closed while the opening is not in use.

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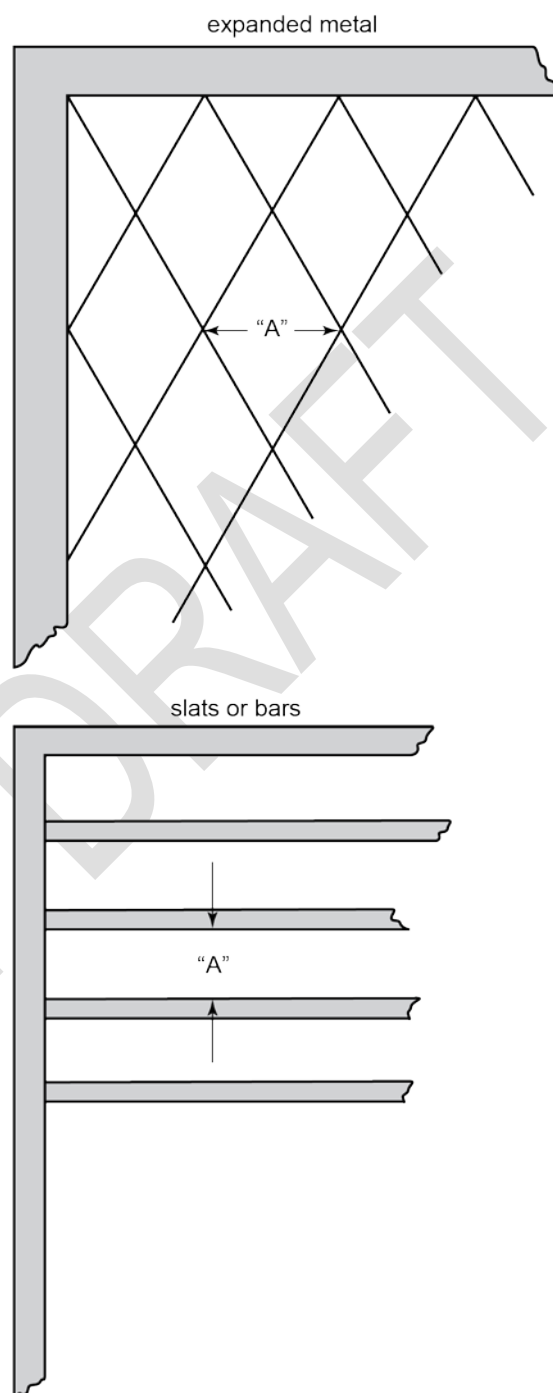


**Figure 1—Distance to Moving Part Requirements for Enclosures**

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**Figure 2—Measurement of Distance Requirements for Enclosures Listed in Figure 1**



**Figure 3—Method of Measuring Opening "A" in Figure 1**

## 7.2 Guardrails

**7.2.1** A guard railing consists of top rail, intermediate rail or equivalent protection, and posts, with a vertical height within the range of 36 in. (914.4 mm) to 48 in. (1219.2 mm) nominal from upper surface of top rail to floor, platform,

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runway, or work level. The top rail should be smooth-surfaced throughout the length of the railing. The intermediate rail should be installed approximately halfway between the top rail and the floor, platform, runway, or work level. Mesh, crossbars, or other designs may also be used. The ends of the rails should not overhang the terminal posts, except where such overhang does not constitute a projection hazard. Many units are elevated above grade. If the guardrail is attached to the unit frame the lower rail may be too high above grade. Guardrails may require field modification to accommodate this condition.

## **7.2.2** Minimum requirements for guard railings are as follows.

**NOTE** The following loads are not additive.

**7.2.2.1** The railing shall be designed and constructed to withstand a load of 25 pounds per linear foot (37.20 kg/m) applied in any direction at the top of the railing.

**7.2.2.2** The intermediate rail shall be capable of withstanding a horizontal load of 20 pounds per linear foot (29.76 kg/m).

**7.2.2.3** The end terminal posts shall be capable of withstanding a load of 200 lb (90.72 kg) applied in any direction at the top of the post.

**7.2.3** Guardrails shall have a minimum horizontal clear distance between the rail and the face of the moving part of 15 in. (381.0 mm) and a maximum horizontal clearance of 42 in. (1066.8 mm). Guardrail height at minimum horizontal clearance shall be 48 in. (1219.2 mm). Proportional decrease in rail height to a minimum of 36 in. (914.4 mm) is permitted with increasing horizontal clearance providing that the 36-in. (914.4-mm) minimum rail height is not effected with less than 36 in. (914.4 mm) horizontal clearance from the face of the moving part. When the guardrail horizontal clearance exceeds 20 in. (508.0 mm), signs should be posted to warn against the use of the space between as a passageway while the machinery is operating.

## **7.3 Guarding by Location**

**7.3.1** Equipment may be considered to be guarded by location if the remoteness of the working area removes the foreseeable risk of contact by persons.

**7.3.2** To be guarded by location or position, any moving part should be at least 84 in. (2133.6 mm) above the walkway, platform or walking level.

**7.3.3** Where conformance to 7.3.1 and 7.3.2 is not possible, the guarding shall be in accordance with 7.1 or 7.2.

**7.3.4** Equipment may be considered to be guarded by location when in an enclosed area with a locked entrance. The area should have either walls or a fence of a minimum height of 96 in. (2438.4 mm). Mechanical power transmission components should be individually guarded in conformance with 7.1 and 7.2 unless the source of power to or within all prime movers is automatically shut down when the entrance is opened. Manual restart will be required.



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## **8 Equivalent Safety**

Where specific devices or methods are mentioned in this RP, other devices or methods which will provide equivalent safety may be substituted.

## **9 Caution Signs and Color Coding**

### **9.1 General**

At the option of the operator, signs and color coding for marking physical hazards may be used to extend and augment the protection afforded by enclosures and guards.

### **9.2 Signs**

Signs should conform to the current ANSI Z535.2 and ANSI Z535.4 standards for safety signs.

### **9.3 Color Coding**

A bright, contrasting color such as orange or yellow should be used for designating dangerous parts of machines or energized equipment, which may cut, crush, shock or otherwise injure, and to emphasize such hazards. An example of areas of the pumping unit components to be color coded is shown in Figure A.5.

## **10 Pumping Unit Brake**

### **10.1 Accessibility**

For operational purposes the pumping unit brake and engine clutch handles should extend or be accessible outside the pumping unit counterbalance guard.

### **10.2 Brake Use**

The pumping unit brake is not intended as a safety stop but is intended for operational stops only.

### **10.3 Securing**

When operations or maintenance are to be conducted on or around the pumping unit, the position of the crank arms and counterweights should be securely fixed in a stationary position by chaining or other acceptable means.

A common means for securing the crank arms and counterweights is to loop a chain through the brake hub or attach a chain and load binder (or "come-a-long") to the cranks themselves. These chains or other supplemental constraint components should be of appropriate strength to withstand the load that would be imparted on them in the event of a brake system failure or other load-altering action such as decoupling from the well.

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**NOTE** Determination of the required strength of the chain or supplemental constraint involves variables that differ from one pumping unit design to another and as such are beyond the scope of this RP. Operators can consult their pumping unit operator's manual or contact the manufacturer for additional assistance.

## **11 Ladders and Platforms**

### **11.1 General**

**11.1.1** Ladders may be provided to give access to the walking beam and/or some of the structural bearings to help in the erection of the unit and for maintenance purposes. The lower flange of the walking beam is considered to be the landing level.

**11.1.2** Ladders are not intended to be used during the operation of the unit.

**11.1.3** Care should be taken to locate ladders such as not to create a hazardous condition. A person should not be required to enter the crank swing area to use a ladder.

**11.1.4** Clearance on the climbing side of the ladder shall be 30 in. (762 mm) minimum for a pitch of 90° and 36 in. (914 mm) for a pitch of 76° with minimum clearances for intermediate pitches varying between these two limits in proportion to the slope (see Figure A.6). Side clearance on ladders without cages shall be 15 in. (381 mm) minimum each way of the centerline of the ladder.

**11.1.5** Toe clearance on the back side of the ladder shall be 7 in. (177.8 mm) minimum (see Figure A.6). For unavoidable obstructions, see Figure A.7.

### **11.2 Design Requirements**

#### **11.2.1 General**

All ladders, attachments, and fastenings shall be designed of steel to meet the following.

#### **11.2.2 Load Requirements**

**11.2.2.1** The minimum design live load shall be a single concentrated load of 250 lb (114 kg).

**11.2.2.2** The number and position of additional concentrated live-load units of 250 lb (114 kg) each as determined from anticipated usage shall be considered in the design.

**11.2.2.3** Where applicable, the loads of a uniform coating of ice on all parts of the ladder as well as the weight of rigging attached to the ladder should be considered in the ladder design.

**11.2.2.4** The live loads imposed by persons occupying the ladder shall be considered to be concentrated at such points as will cause the maximum stress in the structural member being considered.

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**11.2.2.5** The weight of the ladder and attachments together with the live load(s) shall be considered in the design of rails and fastenings. Additionally, anticipated impact loads associated with use of the ladder safety systems and other live loads must be factored into the overall ladder design.

### **11.2.3 Configuration**

All rungs or cleats shall have a minimum diameter of  $\frac{3}{4}$  in. (19 mm) or be made of other suitable section with at least the same strength. The center-to-center distance between rungs shall not exceed 12 in. (304.8 mm) and shall be uniform throughout the length of the ladder. The minimum clear length of rungs shall be 16 in. (406.4 mm). Side rails shall be of such cross section as to afford adequate gripping surface.

### **11.2.4 Quality of Finish**

All parts of the ladder shall be free of burrs, sharp edges, or projections. Any splices in side rails shall have a smooth transition with original members and with no sharp or extended projections.

### **11.2.5 Inclination**

Ladders should always be securely attached on a pitch of 75° to 90° from the horizontal.

## **11.3 Cages**

### **11.3.1 General**

Cages, fall arrest systems, and/or ladder safety systems shall be used on ladders of more than 24 ft (7315 mm) to a maximum unbroken length of 30 ft (9144 mm).

### **11.3.2 Length**

The length of a ladder, not its height, determines the requirement for a cage. The bottom of a ladder is considered to be the top of the bottom rung or cleat, not the ground or landing elevation. Thus, the ladder length is measured from the top of the bottom rung to the top of the top rung or landing level. Ladder extensions which provide safe access to a landing are not considered part of the ladder when determining the ladder length.

### **11.3.3 Size**

The cage shall extend a minimum of 42 in. (1066.8 mm) above the top of the landing and shall extend down the ladder to a point not less than 7 ft (2133.6 mm) nor more than 8 ft (2438.4 mm) above the bottom of the ladder. The bottom portion of the cage shall be flared not less than 4 in. (101.6 mm). Cages shall not extend less than 27 in. (685.8 mm) or more than 28 in. (711.2 mm) from the centerline of the rungs of the ladder. The cage shall not be less than 27 in. (685.8 mm) in width. The inside shall be clear of projections.

Vertical bars shall be located at a maximum spacing of 40° around the circumference of the cage; this will give a maximum spacing of approximately 9  $\frac{1}{2}$  in. (241.3 mm), center to center. Caged ladders shall be built as shown in Figure A.9.

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## **11.4 Fall Arrest Systems**

The fall arrest systems on ladders shall ensure that the fall arrest system is designed according to the applicable local, state, or federal requirements (e.g. OSHA 1910)

## **11.5 Landing Platforms**

### **11.5.1 General**

Landing platforms are commonly used on larger structures. The maximum distance from the bottom of the ladder to the top of the landing floor shall be 20 ft (6096 mm) or 30 ft (9144 mm) if the ladder is caged.

### **11.5.2 Size**

The ladders (or grab bars on step-through types) shall extend a minimum of 42 in. (1066.8 mm) above the landing. For sidestep or offset fixed ladder sections at landings, the side rails or rungs shall be extended to the next regular rung above 42 in. (1066.8 mm) (see Figure A.8). One of the rungs shall be level with the landing.

### **11.5.3 Railings**

All landing platforms shall be equipped with railings and toeboards arranged in such a manner as to give safe access to the ladder. Minimum width of platforms shall be 30 in. (762 mm) and minimum length shall be 30 in. (762 mm).

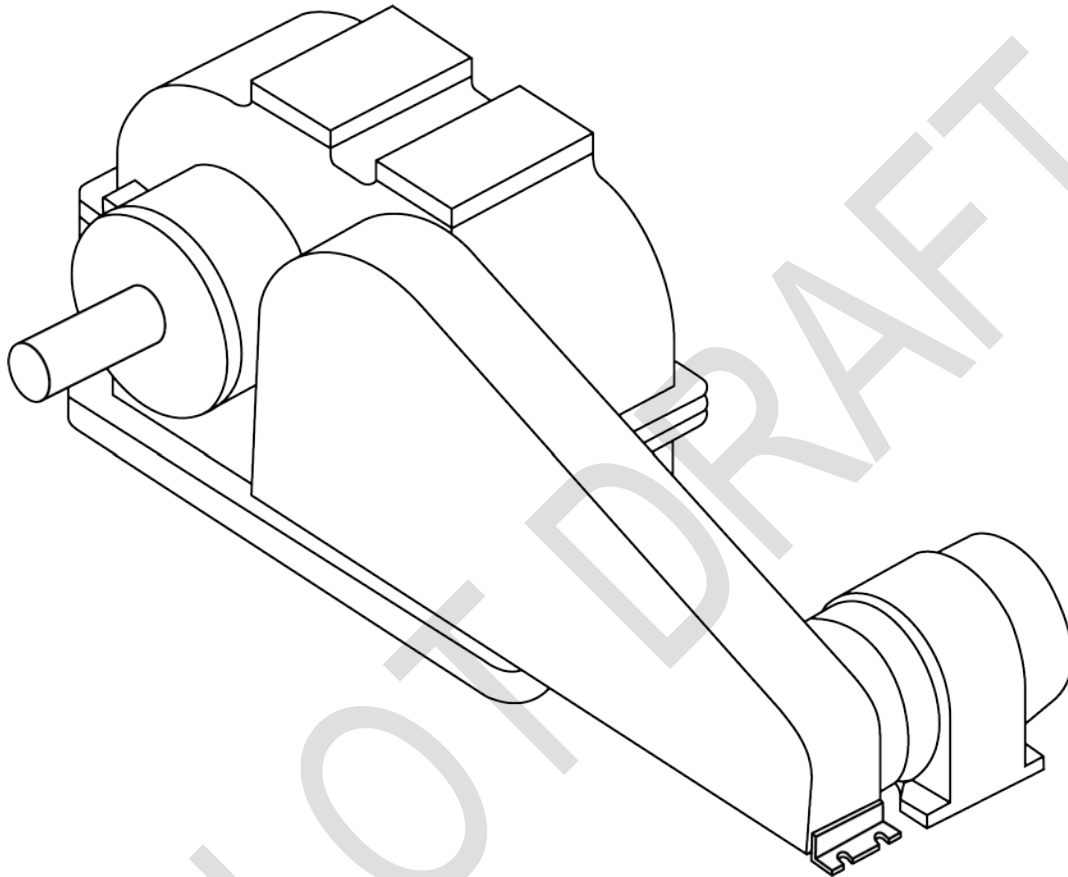
### **11.5.4 Load**

Platforms shall be designed to a uniform minimum live load of 100 lb/ft<sup>2</sup> (488.2 kg/m<sup>2</sup>).

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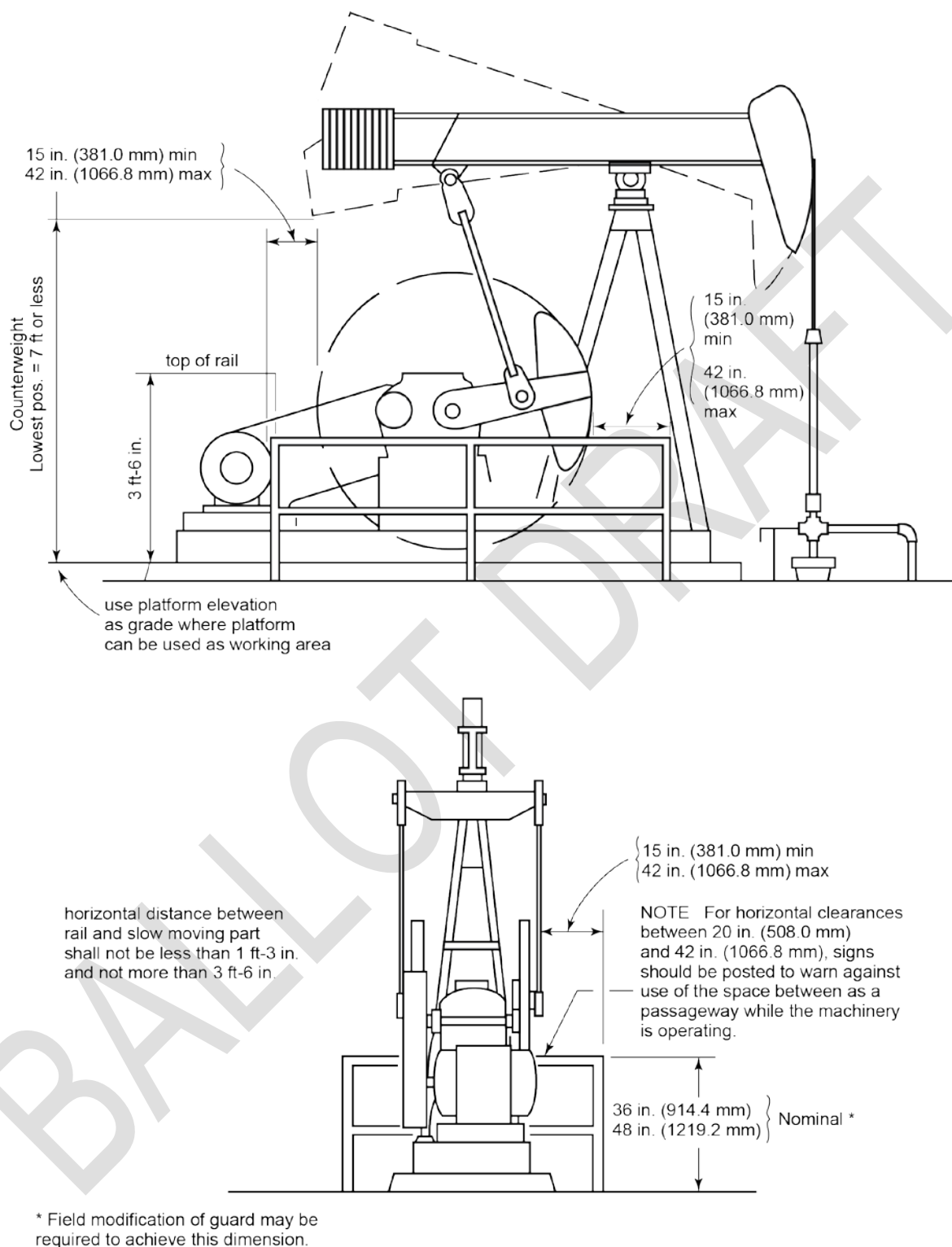
## **Annex A** **(informative)**

### **Examples of Guarding Equipment**



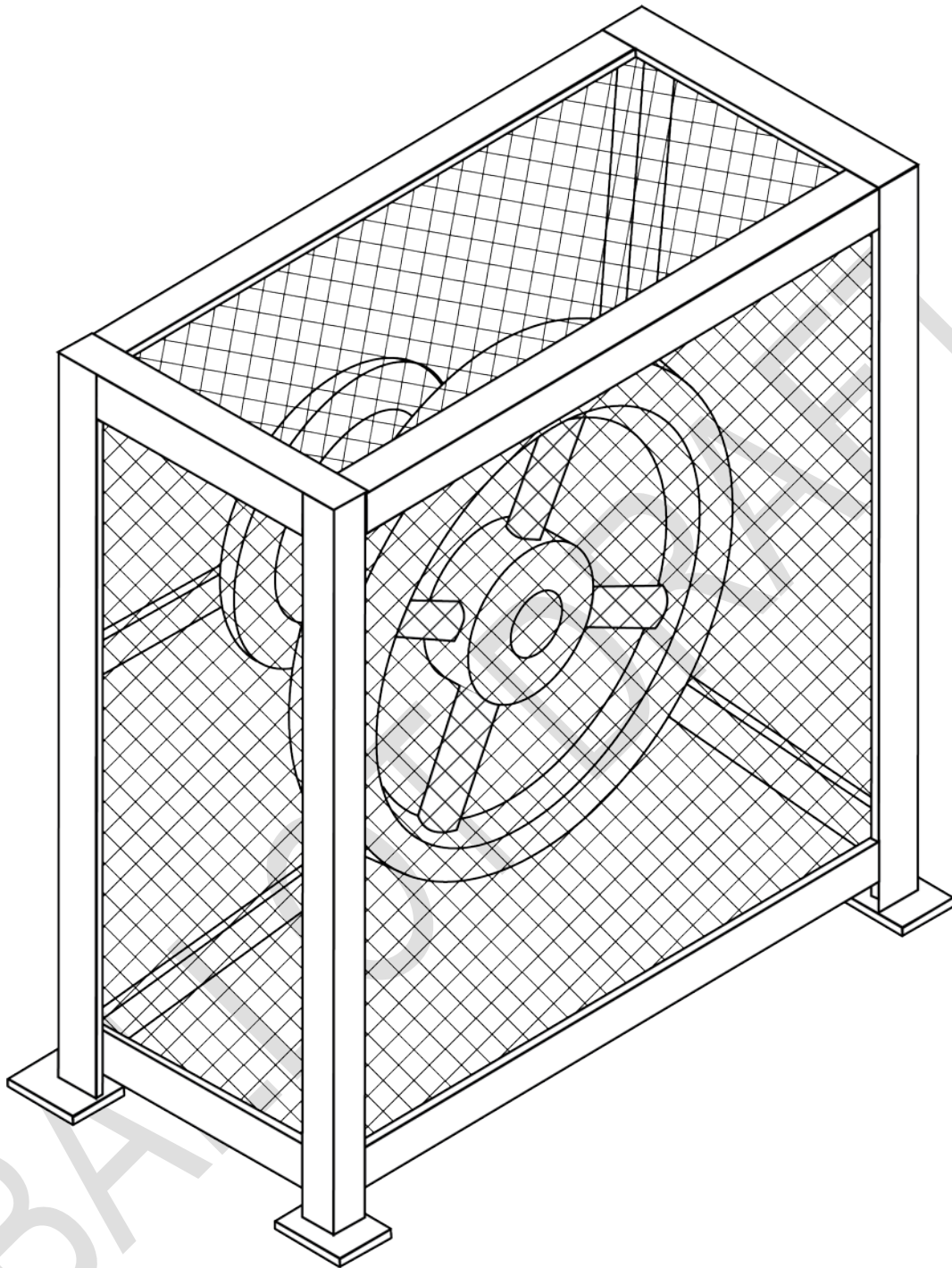
**Figure A.1—Example of Belt Guard**

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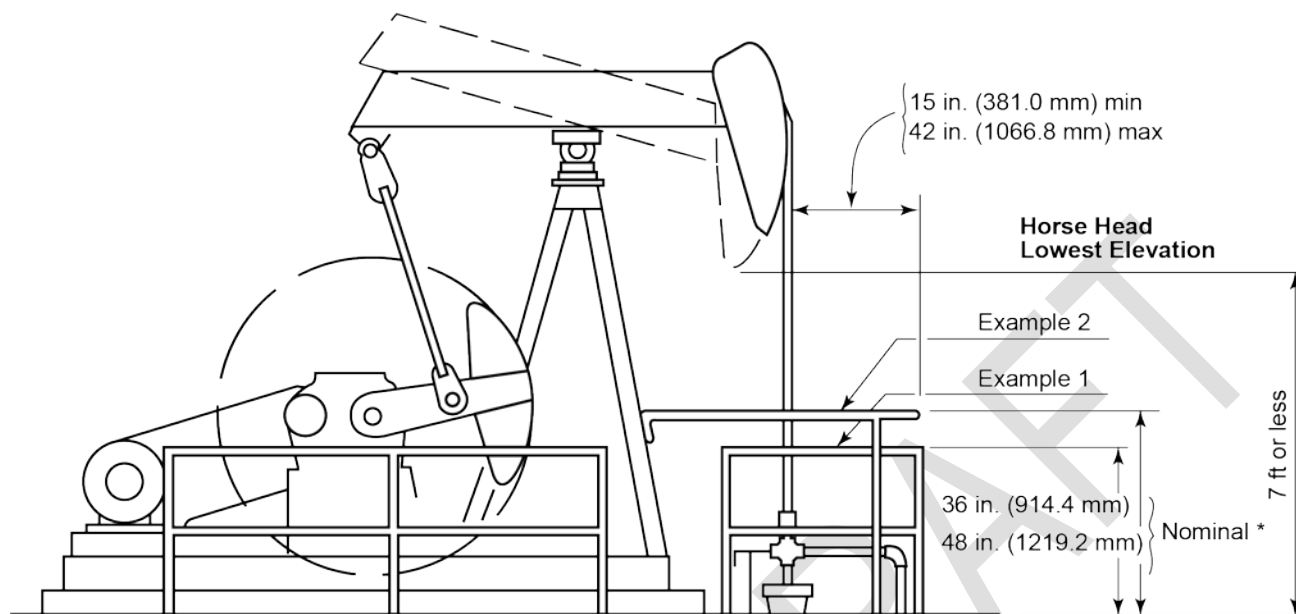
**Figure A.2—Example of Counterbalance Guard**

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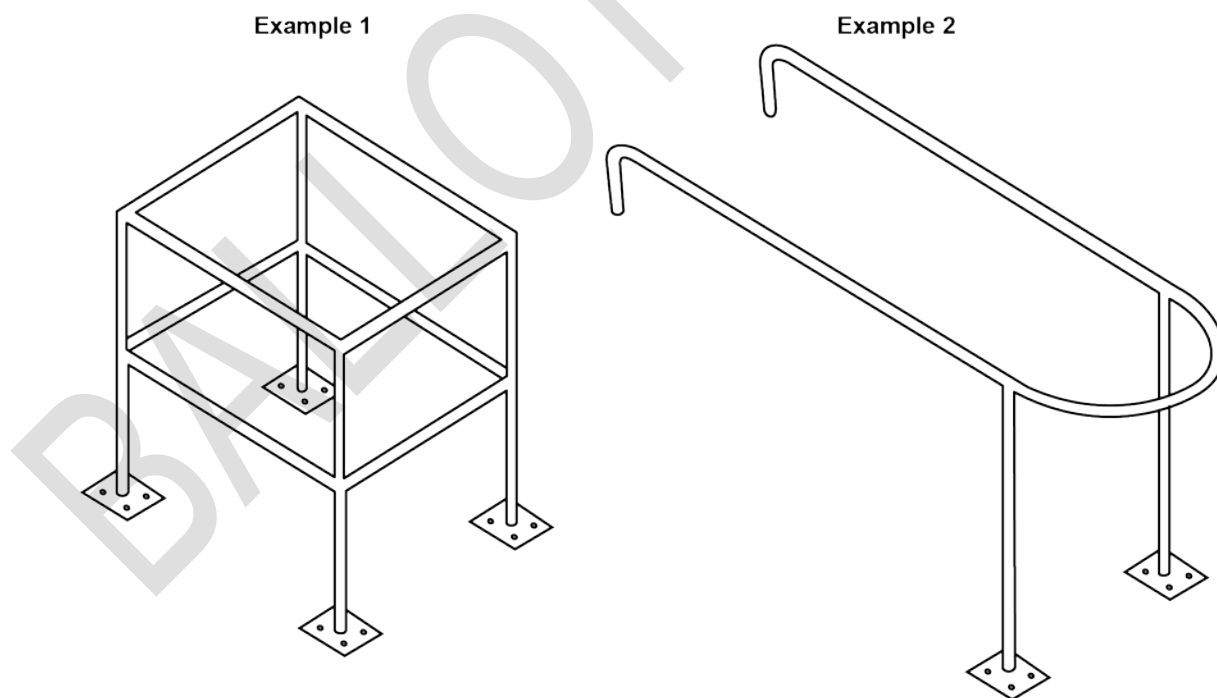
**Figure A.3—Example of Flywheel Enclosure**

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\* Field modification of guard may be required to achieve this dimension.

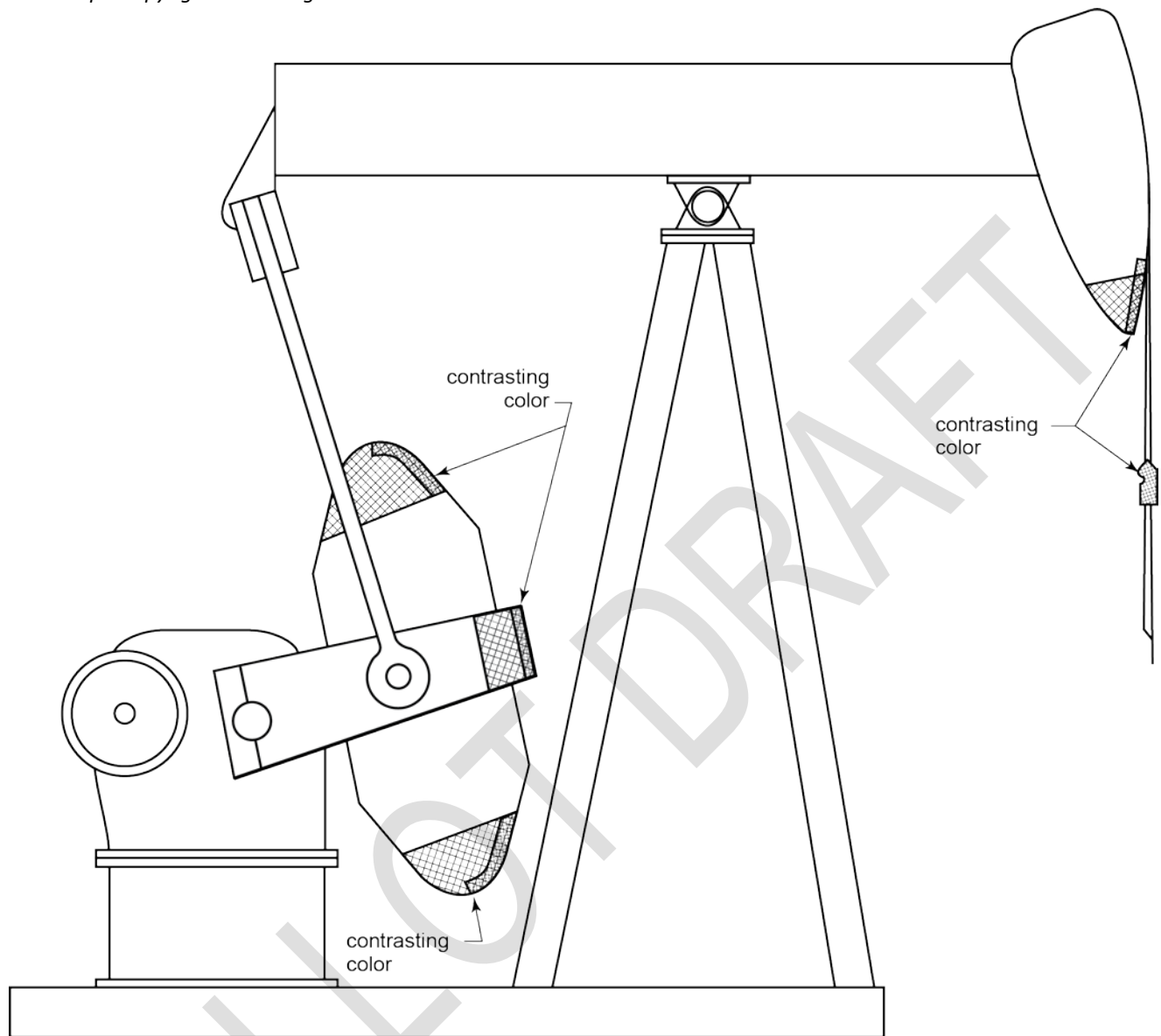
Where lowest elevation of counterweight or Horse head is 7 ft or less, rail shall be provided to maintain horizontal clearance of 1 ft-3 in. to 3 ft-6 in.



**Figure A.4—Examples of Horsehead Guards**



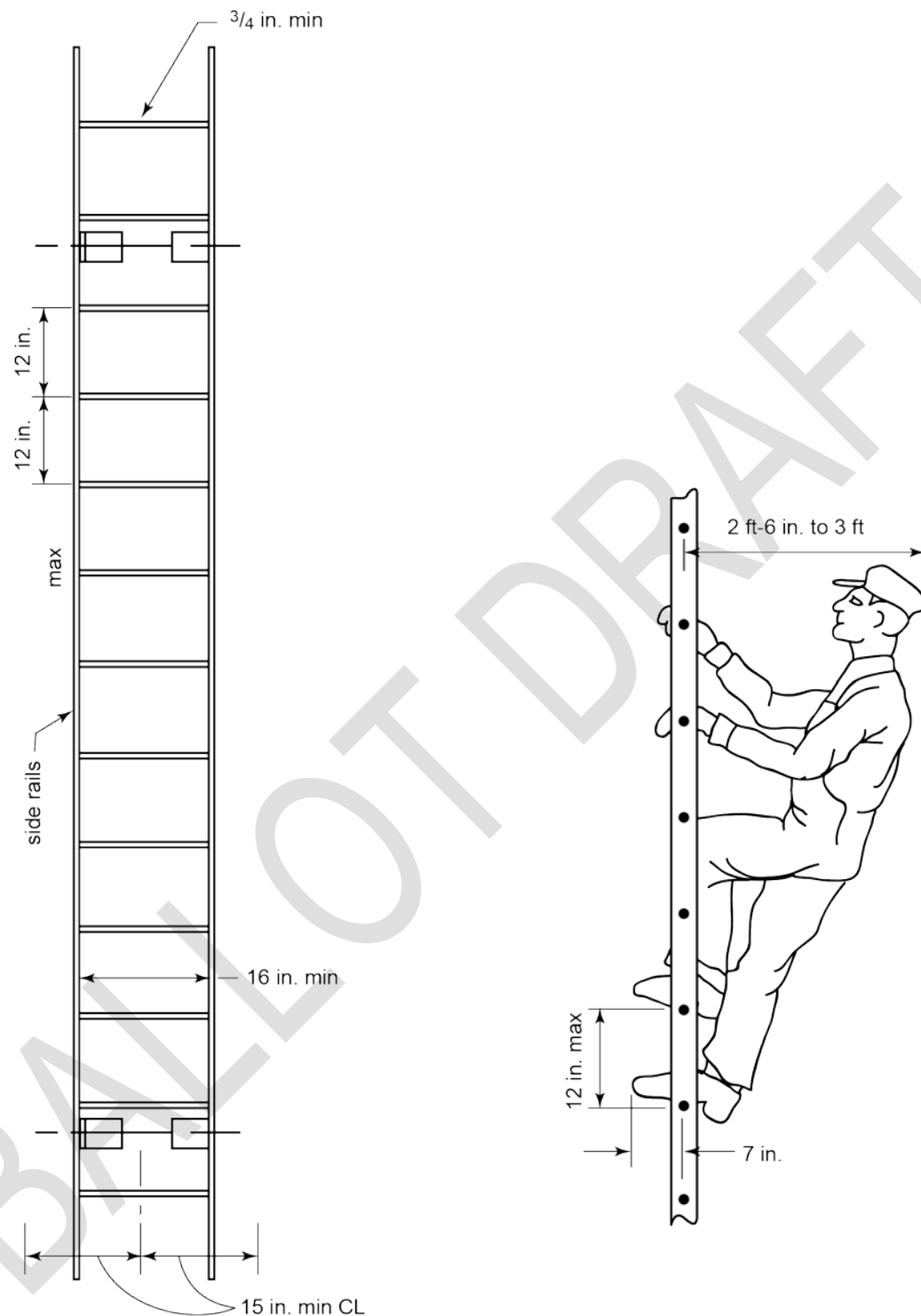
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Areas indicated to be painted with contrasting color are to be considered minimums.  
Actual pattern of painted areas is left to the discretion of the manufacturer or operator.

**Figure A.5—Example of Color Code Application**

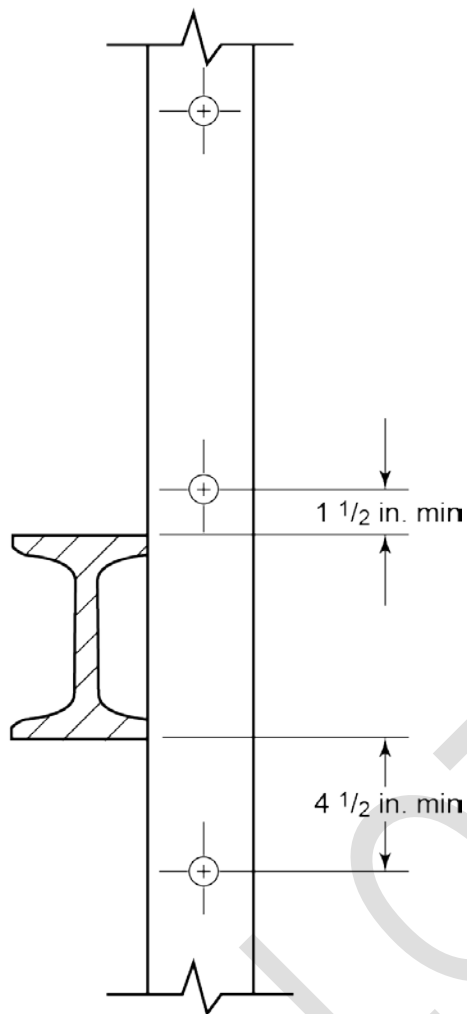
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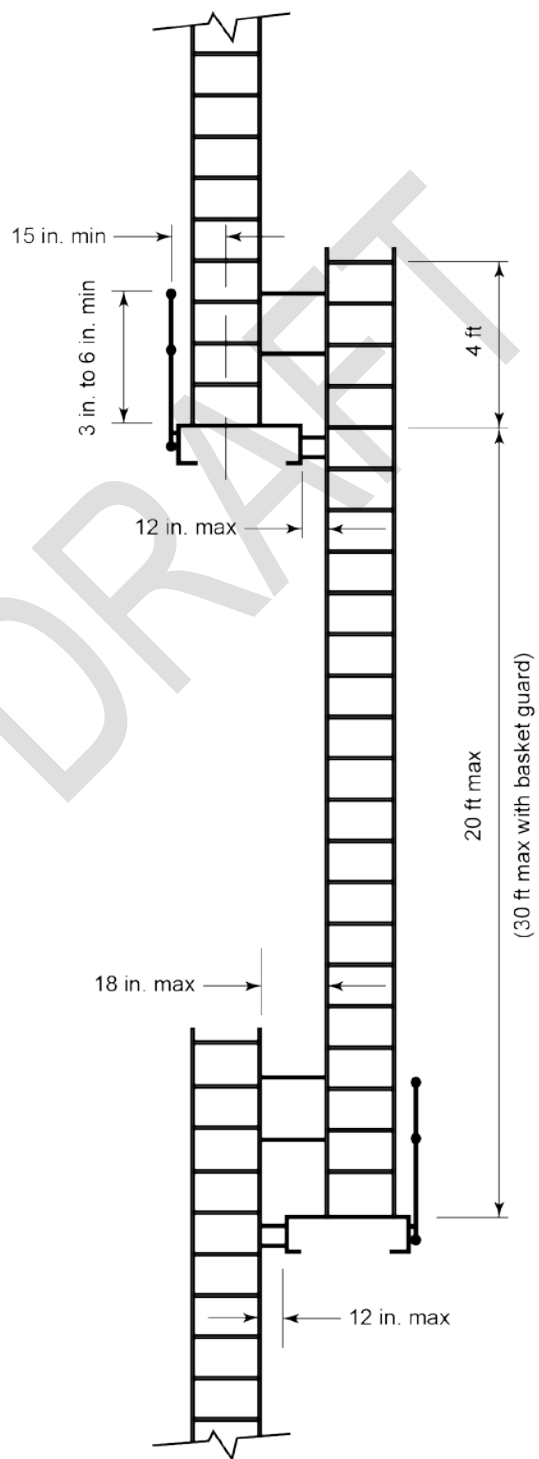
**Figure A.6—Rail Ladder with Bar Steel Rails and Round Steel Rungs**

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### Minimum Ladder Clearances

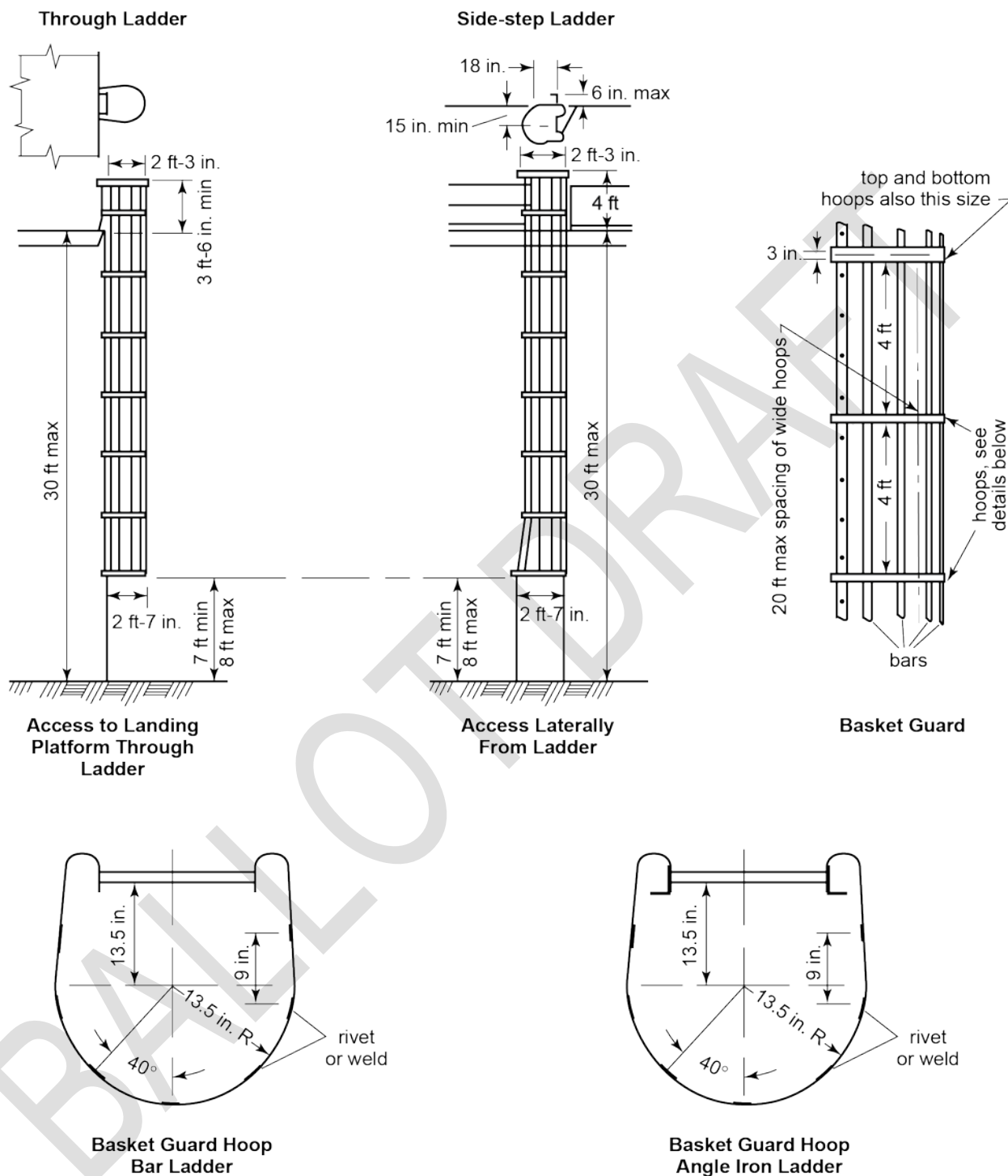


**Figure A.7—Clearance for Unavoidable Obstruction at Rear of Fixed Ladder**



**Figure A.8—Offset Fixed Ladder Sections**

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**Figure A.9—Basket Guard Specifications**

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## **Bibliography**

- [1] ASSE A1264.1:2007 <sup>1</sup>, *Safety Requirements for Workplace Walking/Working Surfaces and Their Access; Workplace, Floor, Wall and Roof Openings; Stairs and Guardrails Systems*
- [2] ASME B15.1:2000, *Safety Standard for Mechanical Power Transmission Apparatus*
- [3] ANSI Z535.2, *Environmental and Facility Safety Signs*
- [4] ANSI Z535.4, *Product Safety Signs and Labels*

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