

(e) *Line-speed indicator.* The employers must:

(i) Equip the hoist machine with an operating line-speed indicator maintained in good working order; and

(ii) Ensure that the line-speed indicator is in clear view of the hoist operator during hoisting operations.

(f) *Braking systems.* The employers must equip the hoist machine with two (2) independent braking systems (*i.e.*, one automatic and one manual) located on the winding side of the clutch or couplings, with each braking system being capable of stopping and holding 150 percent of the maximum rated load.

(g) *Slack-rope switch.* The employers must equip the hoist machine with a slack-rope switch to prevent rotation of the winding drum under slack-rope conditions.

(h) *Frame.* The employers must ensure that the frame of the hoist machine is a self-supporting, rigid, welded-steel structure, and that holding brackets for anchor lines and legs for anchor bolts are integral components of the frame.

(i) *Stability.* The employers must secure hoist machines in position to prevent movement, shifting, or dislodgement.

(j) *Location.* The employers must:

(i) Locate the hoist machine far enough from the footblock to obtain the correct fleet angle for proper spooling of the cable on the drum; and

(ii) Ensure that the fleet angle remains between one-half degree ($1/2^\circ$) and one and one-half degrees ($1\frac{1}{2}^\circ$) for smooth drums, and between one-half degree ($1/2^\circ$) and two degrees (2°) for grooved drums, with the lead sheave centered on the drum.¹

(k) *Drum and flange diameter.* The employers must:

(i) Provide a winding drum for the hoist that is at least 30 times the diameter of the rope used for hoisting; and

(ii) Ensure that the winding drum has a flange diameter that is at least one and one-half ($1\frac{1}{2}$) times the winding-drum diameter.

(l) *Spooling of the rope.* The employers must *never* spool the rope closer than two (2) inches (5.1 cm) from the outer edge of the winding-drum flange.

(m) *Electrical system.* The employers must ensure that all electrical equipment is weatherproof.

(n) *Limit switches.* The employers must equip the hoist system with limit switches and related equipment that automatically prevent overtravel of a personnel cage, personnel platform, boatswains' chair, or material-transport device at the top of the supporting structure and at the bottom of the hoistway or lowest landing level.

5. *Methods of Operation*

(a) *Employee qualifications and training.* The employers must:

(i) Ensure that only trained and experienced employees, who are knowledgeable of hoist-system operations, control the hoist machine; and

(ii) Provide instruction, periodically and as necessary, on how to operate the hoist system, to each employee who uses a personnel cage for transportation.

(b) *Speed limitations.* The employers must *not* operate the hoist at a speed in excess of:

(i) Two hundred and fifty (250) feet (76.9 m) per minute when a personnel cage is being used to transport employees;

(ii) One hundred (100) feet (30.5 m) per minute when a personnel platform or boatswains' chair is being used to transport employees; or

(iii) A line speed that is consistent with the design limitations of the system when only material is being hoisted.

(c) *Communication.* The employers must:

(i) Use a voice-mediated intercommunication system to maintain communication between the hoist operator and the employees located in or on a moving personnel cage, personnel platform, or boatswains' chair;

(ii) Stop hoisting if, for any reason, the communication system fails to operate effectively; and

(iii) Resume hoisting only when the site superintendent determines that it is safe to do so.

6. *Hoist Rope*

(a) *Grade.* The employers must use a wire rope for the hoist system (*i.e.*, "hoist rope") that consists of extra-improved plow steel, an equivalent grade of non-rotating rope, or a regular lay rope with a suitable swivel mechanism.

(b) *Safety factor.* The employers must maintain a safety factor of at least eight (8) times the safe workload throughout the entire length of hoist rope.

(c) *Size.* The employers must use a hoist rope that is at least one-half ($1/2$) inch (1.3 cm) in diameter.

(d) *Inspection, removal, and replacement.* The employers must:

(i) Thoroughly inspect the hoist rope before the start of each job and on completing a new setup;

(ii) Maintain the proper diameter-to-diameter ratios between the hoist rope and the footblock and the sheave by inspecting the wire rope regularly (*see* Conditions 7(c) and 8(d) below); and

(iii) Remove and replace the wire rope with new wire rope when any of the conditions specified by §1926.552(a)(3) occurs.

(e) *Attachments.* The employers must attach the rope to a personnel cage, personnel platform, or boatswains' chair with a keyed-screwpin shackle or positive-locking link.

(f) *Wire-rope fastenings.* When the employers use clip fastenings (*e.g.*, U-bolt wire-rope clips) with wire ropes, they must:

(i) Use Table H-20 of §1926.251 to determine the number and spacing of clips;

(ii) Use at least three (3) drop-forged clips at each fastening;

(iii) Install the clips with the "U" of the clips on the dead end of the rope; and

(iv) Space the clips so that the distance between them is six (6) times the diameter of the rope.

7. *Footblock*

(a) *Type of block.* The employers must use a footblock:

(i) Consisting of construction-type blocks of solid single-piece bail with a safety factor that is at least four (4) times the safe workload, or an equivalent block with roller bearings;

(ii) Designed for the applied loading, size, and type of wire rope used for hoisting;

(iii) Designed with a guard that contains the wire rope within the sheave groove;

(iv) Bolted rigidly to the base; and

(v) Designed and installed so that it turns the moving wire rope to and from the horizontal or vertical as required by the direction of rope travel.

(b) *Directional change.* The employers must ensure that the angle of change in the hoist rope from the horizontal to the vertical direction at the footblock is approximately 90° .

(c) *Diameter.* The employers must ensure that the line diameter of the footblock is at least 24 times the diameter of the hoist rope.

8. *Cathead and Sheave*

(a) *Support.* The employers must use a cathead (*i.e.*, "overhead support") that consists of a wide-flange beam or two (2) steel-channel sections securely bolted back-to-back to prevent spreading.

¹ This variance adopts the definition of, fleet angle from *Cranes and Derricks*, H.I. Shapiro, *et al.* (eds.); New York: McGraw-Hill. Accordingly, the fleet angle is "[t]he angle the rope leading onto a [winding] drum makes with the line perpendicular to the drum rotating axis when the lead rope is making a wrap against the flange."