

## DEPARTMENT OF LABOR

## Occupational Safety and Health Administration

## 29 CFR Part 1926

[Docket No. S-007]

## Guarding of Low-Pitched-Roof Perimeters During the Performance of Built-Up Roofing Work

**AGENCY:** Occupational Safety and Health Administration (OSHA), U.S. Department of Labor.

**ACTION:** Final standard.

**SUMMARY:** This notice amends Subpart M of 29 CFR Part 1926, by adding a standard for the guarding of low-pitched-roof perimeters during the performance of built-up roofing work. This final standard is being issued after appropriate consultation with the Advisory Committee on Construction Safety and Health and public comment. It provides for the use of motion-stopping safety systems, warning lines, and safety monitoring systems in certain specified situations, requires the use of safety belt or guardrail systems at hoisting and storage areas, prohibits the use of mechanical equipment near unprotected roof sides or edges, and requires training for all employees engaged in built-up-roofing work. In addition, it clarifies the application of the existing standards on perimeter guarding contained in Subpart M.

**EFFECTIVE DATE:** This standard will become effective January 13, 1981.

**FOR FURTHER INFORMATION CONTACT:**

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**SUPPLEMENTARY INFORMATION:****I. History of the Regulation**

Subpart M of Part 1926, entitled "Floor and Wall Openings, and Stairways", was promulgated in 1971, under section

6(a) of the Occupational Safety and Health Act of 1970. It contains the following provision pertaining to the guarding of perimeters:

§ 1926.500(d). *Guarding of open-sided floors, platforms, and runways.* (1)

Every open-sided floor or platform 6 feet or more above adjacent floor or ground level shall be guarded by a standard railing, or the equivalent, as specified in paragraph (f)(1) of this section, on all open sides, except where there is entrance to a ramp, stairway, or fixed ladder.

Because no other specific standards in Subpart M address the guarding of low-pitched-roof perimeters (sides and edges), OSHA interpreted § 1926.500(d)(1) as being applicable to such roofs. However, two circuit courts of appeals have ruled that the language of 29 CFR 1926.500(d)(1) is not amendable to such an interpretation because the word "roof" is not in the language of the standard (*Langer Roofing and Sheet Metal, Inc. vs. Secretary of Labor*, 524 F. 2d 1337 (7th Cir. 1975); *Diamond Roofing Co., Inc. vs. Occupational Safety and Health Review Commission*, 528 F. 2d 645 (5th Cir. 1976)).

As a result, OSHA reviewed the available data and information, together with the *Langer* and *Diamond* decisions, and determined that a new provision should be proposed specifically to cover the guarding of low-pitched-roof perimeters during roofing work in order to supplement the existing provisions of § 1926.500. (Roof openings and holes are already required to be guarded by the provisions of Subpart M since "floor holes" and "floor openings" are defined in § 1926.502 as including holes and openings in roofs. In addition, protection for other roof level work operations is provided under provisions such as §§ 1926.28(a), 1926.104, 1926.105, 1926.451 as well as Section 5(a)(1) of the Occupational Safety and Health Act of 1970.)

Prior to issuing the proposal, OSHA consulted with the Advisory Committee on Construction Safety and Health in 1977 and 1978 as to the substance of the draft proposal. The Committee's recommendations are discussed in more detail below. After evaluating these recommendations, OSHA published its proposed standard for the guarding of low-pitched-roof perimeters during roofing work on August 17, 1979 (44 FR 48275). The proposal contained requirements for the guarding of low-pitched-roof perimeters, including hoist and storage areas, restrictions on the use of mechanical equipment near roof edges, and requirements for employee

training. A period for receipt of written comments on the proposed standard and issues raised therein and for the filing of objections was established through October 12, 1979.

To assist participants in preparing their written comments and to give interested persons an opportunity to obtain clarification of the proposal, OSHA scheduled a public meeting for September 28, 1979. A transcript of the meeting was prepared and is part of the record of this rulemaking. Subsequently, on October 16, 1979, the comment period was extended through November 26, 1979 (44 FR 59561).

Over 200 written comments were received by the end of the comment period. Most of the comments favored the adoption of the proposed standard in principle. A number of comments offered recommendations for minor modification of certain provisions of the proposal. There were no requests for a hearing under section 6(b)(3) of the OSH Act.

A Regulatory Assessment (Ex. 3:3) was prepared in accordance with Executive Order 12044 (43 FR 12661, March 24, 1978), and was made available to the public, as noted in the preamble to the proposed standard (44 FR 48279). Opportunity was given to interested persons to comment on the subject matter and contents of that report. (See Section VI, Regulatory Assessment, below.)

The final standard on the guarding of low-pitched-roof perimeters during the performance of built-up-roofing work is based on a full consideration of the entire record of the rulemaking proceeding including the materials relied on in the proposal, the transcript of the public meeting, and all written comments and exhibits received. All materials in the record are available for public review and copying at the OSHA Docket Office, Room S6212, U.S. Department of Labor, 3rd Street and Constitution Avenue, NW, Washington, D.C. 20210, Telephone (202) 523-7894.

**II. Roof Perimeter Guarding**

The National Bureau of Standards (NBS) reports that the roofing and sheet metal industry has had, in recent years, a lost-time-injury-accident rate of 56 injuries per million man-hours of work. According to NBS and a report issued by the National Institute for Occupational Safety and Health (NIOSH) (Ex. 3:5) the roofing industry has one of the highest lost-time-injury-accident rates of any industry in the United States, exceeding even that for the coal mining industry.

As shown in a report by the Bureau of Labor Statistics (BLS) (Ex. 3:2), there are over 133,000 employees in the Standard

Industrial Classification (SIC) 176-Roofing and Sheet Metal Workers. The Regulatory Assessment (Ex. 3:3) concludes that of these employees, approximately 40,000 are exposed to the hazard of falling off low-pitched-roofs and that, on an annual basis, approximately 82 of these employees will fall, resulting in one to three fatalities, six to eleven permanent disabilities, and the loss of 3,600 workdays.

However, based on the data in the record, it appears that neither the Bureau of Labor Statistics, most state agencies, nor the insurance industry compile job-related injury data in the precise format or detail necessary to determine the exact causes of accidents. Of the data that are available, the NIOSH report cites a 1970 State of California report that shows "falling off roofs", both low and high pitched, to comprise 17.7 percent of all roofing accidents. The NIOSH report also cites a similar State of New York report that shows "falling to a different level" to be the most serious of all types of roofing accidents. Further, in a 1976 report issued for the State of Wisconsin, falls from roofs comprised 5.1 percent of all roofing accidents and 26 percent of all accidents in the category "falls to a different level." In addition, NIOSH concludes there are, undoubtedly, many more workers injured in falls from roofs than are reported under these headings because, although the roofing and sheet metal industry does most of the commercial roofing work performed, employers whose business is less than 50 percent roofing work have their roofer employment and injury data placed under other classifications such as residential or nonresidential building construction.

Based on the information in the record, OSHA concludes that employees working on roofs are confronted with a significant risk of serious injury or death. None of the participants in the proceeding seriously contested the hazards faced by employees or the need for protection from these hazards.

The record shows that falls from low-pitched roofs occur frequently, often result in severe injuries, and involve roofing workers with varying degrees of roofing experience (Ex. 3:5). It is the intent of this standard to significantly reduce such injuries.

Guardrails are often used to provide fall protection and are required for open-sided floors and platforms by § 1926.500(d)(1). However, although guardrails can be used during construction of a roof deck, they must be removed prior to the application of roof waterproofing membranes and related

sheet metal work at the roof edge. According to a report by the engineering firm of Simpson, Gumpertz and Heger (Ex. 3:6), the reason guardrails must be removed is that, unless mounted on a parapet wall, guardrails are normally mounted on the roof deck and impede the application of the roof membrane. The use of freestanding guardrail systems as an alternative is limited since such guardrails must also be moved out of the way when the membrane is applied near roof edges and thus they are not a solution to the problem of providing fall protection. Other potential concerns include the increase in cost and time required to erect guardrails and the question of whether guardrails are needed when the work to be performed is not near the roof edge. These problems exist whether the work being done is a reroofing operation on an existing building or the application of a new roof on new construction.

Unique difficulties with conventional guarding systems are encountered on low-pitched roofs during the performance of "built-up" roofing work which involves the application of waterproofing membranes (usually felt and tar) and related insulation and sheet metal work. The proposal was directed toward providing fall protection in these circumstances. While the scope of the proposal was not explicitly limited to built-up roofing, OSHA intends that this final standard cover only built-up roofing work performed on low-pitched roofs. Accordingly, as will be discussed below in the summary and explanation section of this preamble, the term "built-up roofing work" is used throughout this preamble and in the final standard in order to clarify the standard's coverage.

The record establishes that fall protection during built-up roofing work presents unique problems. As will be shown, the provisions of this standard are directed at these special circumstances.

The Simpson, Gumpertz, and Heger report prepared for the National Roofing Contractors Association (NRCA), concluded that guardrails make orderly built-up roofing work impossible and do not offer the protection desired since they must be removed prior to the completion of roof side and edge finishing work. In addition, the report concluded that some free-standing guardrail systems may seriously overstress the roof support system because the roof deck is normally not designed to hold the weight necessary to keep the guardrail upright. And, as noted earlier, freestanding guardrail systems which do not overstress the

roof, still have to be moved out of the way prior to the application of waterproofing membranes (and related sheet metal work) close to roof edges, where protection is most needed.

The Simpson, Gumpertz, and Heger report concluded that other conventional guarding systems also pose serious feasibility problems during built-up roofing operations on low-pitched roofs. Catch platforms, for example, cannot be used on a majority of building types because of the presence of high windows, lightweight wall panels, or unknown masonry structural details which make it very difficult to safely anchor the platform to the building. Safety belt systems, according to the report, are difficult or impossible to anchor safely and result in chaos when used during built-up roofing work. When safety belts are used during such work, the lines drag in the hot tar, pose tripping hazards to employees working in hot tar areas and tend to become tangled during the normal rapid movement of employees doing built-up roofing work.

OSHA believes that the difficulties with conventional guarding systems (referred to in the standard as "motion-stopping-safety (MSS) systems") during the performance of built-up roofing work, will be avoided by allowing the use of a warning line and/or safety monitoring system (referred to in the proposal as "direct supervision") as alternatives to MSS systems in specified circumstances. Simply described, a warning line is a rope, chain, or wire, supported by a series of stanchions set back from the side or edge of the roof. It serves to delineate the area where mechanical equipment may be used. It also serves to warn and remind employees that they are approaching or working near a fall hazard by providing a direct physical contact with the employee. The contact attracts the employee's attention, enabling the employee to stop in time to avoid falling off the roof. The safety monitoring system is a verbal warning system and requires that a competent person be designated to monitor the safety of all employees in a roofing crew and warn them when it appears that they are unaware of the hazard or are acting in an unsafe manner. These systems are not intended to serve as positive fall restraints, but only as warning systems. These alternative systems of fall protection are discussed in detail in Section III of this preamble.

The concepts of the warning line and safety monitoring systems were first suggested by the NRCA in a September 1977 letter to OSHA (Ex. 6). These

concepts have also received support from the United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association (AFL-CIO) (Ex. 2:191). The warning line concept has also been endorsed by the Simpson, Gumpertz and Heger report which calls it a "practical solution" to the problem of roof-perimeter protection. In addition, several contractors have used the warning line and support the use of the warning line as an effective safety system (cf. Ex. 2:8, 31, 43).

As has been noted, the MSS system, warning line, and direct supervision proposals were reviewed prior to their publication by the Advisory Committee on Construction Safety and Health (Ex. 3:1). At a meeting held on November 29, 1977, the proposals were first submitted by OSHA to the committee for review. Action was postponed until the following meeting so that the committee would have time to evaluate them. During the February 1978 committee meeting, the proposals were discussed, modified, and determined by the Committee to be acceptable procedures for use during roof level repair or construction.

The proposals were resubmitted to the Committee at the December 5, 1978 meeting to show the Committee how its recommendations had been incorporated into the proposal language (Ex. 3:1). The Committee, which had just had a significant membership change, voted at this meeting to recommend the adoption of a standard that would require the use of MSS systems around low-pitched roof perimeters, and would not allow warning lines or direct supervision as alternatives.

The Committee's suggested approach at the December 5, 1978 meeting was not included in the proposal and is not included in this final standard, which is limited to built-up roofing work only. As noted, serious questions exist as to the feasibility and benefits of the Committee's recommended approach for the operations involved. These questions are discussed more thoroughly both in the Economic Impact Statement/Assessment (Ex. 3:3) performed for OSHA by Centaur Associates, Inc. (See Section VI, Regulatory Assessment), and in the Simpson, Gumpertz, and Heger report discussed earlier.

OSHA concludes from the record that warning line and safety monitoring systems, as detailed in the following section, are effective safety systems for employees working on roofs which have a slope less than or equal to four in twelve, during the performance of built-up roofing work. These requirements are necessary and appropriate to provide

protection for employees from the significant risks of falling from such roofs during the performance of built-up roofing work.

### III. Summary and Explanation of the Standard and Major Issues

The following section discusses the individual requirements of the standard, including analysis of the major issues raised during the proceeding, the record evidence, and the policy considerations underlying the various provisions of the standard.

The language of the standard closely follows that of the proposal except for revisions based on OSHA's review of the entire rulemaking record, including written comments and testimony submitted at the public meeting.

The format of the final standard differs in several respects from that of the proposal. The discussion in the preamble will refer primarily to the paragraph numbers contained in the final standard. However, in order to clarify the format changes, the following table sets forth the paragraph numbers of the final standard § 1926.500(g) which differ from the paragraph numbers as proposed:

Proposed paragraph	Final paragraph
1926.500	1926.500
Exceptions to (g)(1)	(g)(2)
(g)(2)(iii)	(g)(4)(ii)
(g)(2)(iv)	(g)(4)(i)
(g)(2)(v)(a)	(g)(3)(iii)(a)
(g)(2)(v)(b)	(g)(3)(iii)(b)
(g)(3)	Deleted
(g)(3)(i)	(g)(1)(ii)
(g)(3)(ii)	(g)(1)(iii)

In general, the proposal provided three alternative means to provide the required perimeter protection on low-pitched roofs during the performance of roofing work: motion-stopping-safety (MSS) systems, warning lines, and direct supervision. MSS systems may be used in all circumstances, whereas warning lines and safety monitoring systems may be used only in certain situations. Most of the comments expressed agreement with the intent of the proposal.

The standard applies to low-pitched roofs, defined as roofs with a slope no greater than four in twelve. While the proposal made a distinction between slopes of three in twelve and four in twelve for some purposes, this distinction does not apply in the final standard, as discussed more fully below.

The record shows there was some confusion as to the exact nature of the work covered by the proposal (cf. Ex. 2:49, 50, 52). The proposal was intended to apply only to built-up roofing operations. This was due to the problems encountered with conventional guardrail and other MSS

systems which are unique to these operations. In order to make this clear, the words "built-up" are added to the title of the standard and throughout the text of the standard wherever the term "roofing work" is used. To further clarify the scope, a definition of built-up roofing is added to the standard as follows:

"(p) 'Built-up roofing'—a weatherproofing cover, applied over decks, consisting of either a liquid-applied system, a single-ply system or a multiple-ply system. Liquid-applied systems generally consist of silicone rubber, plastics, or similar material applied by spray or roller equipment. Single-ply systems generally consist of a single layer of synthetic rubber, plastic, or similar material, and a layer of adhesive. Multiple-ply systems generally consist of layers of felt and bitumen, and may be covered with a layer of mineral aggregate."

The standard does not apply to other types of roofing work such as shingle application and removal. This limitation of scope is based on the extent of available data in this record and does not reflect a conclusion that hazards do not exist in other types of roofing work. The recommendation of the Advisory Committee on Construction Safety and Health that MSS systems be required for all other employees on roofs is being evaluated for future rulemaking.

*Section 1926.500(g)(1)—General provisions.* The general provisions of the standard, paragraph (g)(1), require that, during the performance of built-up roofing work on low-pitched roofs, with a ground to eave height greater than 16 feet, employees engaged in such work be protected from the hazard of falling from sides and edges by the use of one or more of the following: motion-stopping-safety systems (MSS systems), and, in specific situations, warning lines and/or safety monitoring systems. This is the same requirement as proposed except the term "safety monitoring system" replaces the term "direct supervision." This change is made because it was suggested, that "direct supervision" implies that a management level person is required to provide this supervision (Ex. 2:191). Since any individual, supervisory or non-supervisory, may be designated to be the safety monitor, the term "direct supervision" was determined to be inappropriate.

The definition of "low-pitched roof" is the same as in the proposal. It is defined as any roof with a pitch (slope) equal to or less than the ratio four in twelve (i.e. four inches vertical to twelve inches horizontal). This limit, together with the minimum roof height of greater than sixteen feet, was selected so that the new provisions would complement the provisions of § 1926.451(u)(3) (catch

platforms) contained in Subpart L, which apply to roofs having a slope greater than four in twelve and a minimum ground to eave height greater than sixteen feet.

The proposal created somewhat different requirements for protection of roofing employees depending on the pitch of the roof on which they are working. The proposal required that only MSS systems be used on low-pitched roofs with a slope greater than three in twelve. On roofs less than or equal to three in twelve, the employer was not limited to MSS systems, but could use MSS systems, warning lines, and/or direct supervision as described in the proposal. This distinction in the proposal between slopes of three in twelve and four in twelve was based on the view that slopes greater than three in twelve constituted a significantly greater hazard to employees due to the increased difficulty for employees to stop their momentum on such roofs and because of a greater likelihood of slipping on hot tar. Although these factors do increase as the roof slope increases, there is not enough information in the record to warrant the proposed prohibition on the use of warning lines on slopes between three in twelve and four in twelve. In addition, several comments indicated that confusion could possibly result from the distinction between slopes of three in twelve and four in twelve, particularly since low-pitched roofs were defined only in terms of four in twelve (cf. Ex. 2:27, 28, 31). Consequently, references to roofs with slopes of three in twelve are deleted and the final standard provides similar requirements for all roofs with slopes less than or equal to four in twelve.

The standard indicates when MSS, warning line, and safety monitoring systems are to be used, either alone or in combination. Paragraphs (g)(1)(i) and (ii) require that on roofs with a ground to eave height greater than 16 feet, employers must protect their employees by the use of an MSS system, warning line and MSS system combination, or warning line and safety monitoring system combination. Paragraph (g)(1)(iii) provides that on roofs 50 feet or less in width (where mechanical equipment is not used or stored), the employer may protect employees by a safety monitoring system alone. MSS systems are defined to include guardrails, platforms or scaffolds with guardrails, safety nets, and safety belt systems. As noted earlier, warning lines and safety monitoring systems are being permitted as alternatives to MSS systems only

because of the nature of the problems encountered in built-up roofing work.

Comments were made that MSS systems should not be allowed as alternative safety protection during built-up roofing work and that only warning lines and safety monitoring systems should be allowed (cf. Ex. 2:6, 9, 12). However, there is little, if any, dispute that MSS systems are more effective at preventing fall injuries than are warning lines and safety monitoring systems. Indeed, OSHA believes that MSS systems are, in general, the best available means of fall-injury protection. It is only due to the unique problems presented by built-up roofing work on low-pitched roofs that OSHA has decided not to require the use of MSS systems in all such work. It is evident, therefore, that OSHA does not intend to prohibit or discourage the use of MSS systems as alternatives to the other systems in situations where they are appropriate. Similarly, where a guardrail or other MSS system is already in place from previous work on the roof deck, this standard will not require the roofer to remove it, or to supplement it with other protection.

On roofs 50 feet or less in width, the workers are never more than 25 feet from an edge and are therefore, aware of the proximity of the fall hazard. In addition, a warning line on such roofs creates a very narrow protected work area inside the line. In these situations the warning line may not be practical. Therefore, paragraph (g)(1)(iii) allows safety monitoring to be used on roofs 50 feet or less in width where mechanical equipment is not used or stored. This does not, of course, preclude the employer from using mechanical equipment on roofs 50 feet or less in width if he uses an MSS system or warning line for protection (provided that the equipment is kept inside the warning line). As noted above, a safety monitoring system is a verbal warning system and requires that a competent person be designated to monitor the safety of all employees in a roofing crew and warn them when it appears that they are unaware of the hazard or are acting in an unsafe manner. The monitor may have supervisory or non-supervisory responsibilities as there are no restrictions on the performance of other duties. (It is obvious, however, that the monitor must not be so busy with other responsibilities that the monitoring function is encumbered.) The monitor must be on the same roof as and within visual sighting distance of the employees, and must be close enough to verbally communicate with the employees.

The record indicates there is confusion as to which dimension of a building should be considered to be the width of a roof (Ex. 2:147). In all cases the building must first be viewed in plain view (i.e., viewed from above, looking down). The width of the roof is then determined to be the narrower of the two primary dimensions which define the roof area.

Appendix A is provided to serve as a guide in determining the widths of roofs which are not simple rectangles in shape. Although the appendix does not show all possible roof configurations, it does give some common arrangements. This appendix does not create any additional obligations or detract from any obligations otherwise contained in the final standard. It is intended to provide useful, explanatory material and information to employers and employees to aid in understanding and complying with the standard.

*Paragraph (g)(2)—Exception.* The requirements of paragraph (g)(1) do not apply at points of access such as stairways, ladders, and ramps. In addition, employers are not subject to the requirements of paragraph (g)(1) if their employees are on the roof solely for the purpose of investigating, inspecting, or estimating roof level conditions. This is because of the relatively short time, if any, spent near a roof edge during such work.

It was requested that an additional exception be made for the emergency repair of roofs (Ex. 2:82). Such an exception is not appropriate because the nature and hazards presented by such repair work do not differ significantly from the general kinds of built-up roofing work covered by the standard. The exception for estimating, inspecting, and investigating is provided because these operations are normally conducted in good weather, require little time, if any, near the roof edge, do not require the employees to be on the roof for long periods of time, and involve work of a nature such that the employee is more likely to be aware of his proximity to the roof edge. On the other hand, emergency repairs may be necessary in inclement weather, may require a significant amount of time to complete, and involve use of the same type of equipment used in regular built-up roofing work. In addition, such repairs may require the employee to work close to a roof edge. As is the case with built-up roofing work in general, the employee doing the repairs will be concentrating on his task, and not necessarily on the falling hazard. Moreover, it should be noted that some "emergency repairs" may

even involve the complete reroofing of a structure.

*Paragraph (g)(3)—Warning lines.* This paragraph sets forth the specific requirements and limitations for the use of warning lines. As noted above, a warning line is a rope, chain, or wire, supported by a series of stanchions. The warning line is set back from the side or edge of the roof. It serves to warn and remind employees that they are approaching or working near a fall hazard. Warning lines function by providing a direct physical contact with the employee. The contact attracts the employee's attention, enabling the employee to stop in time to avoid falling off the roof. The system is not intended to serve as a positive restraint, but only as a warning system.

Some comments suggested that the standard not apply when the scheduled work activity is to take place exclusively at the roof edge (cf. Ex 2:31, 42, 98), or exclusively away from the edge (Ex. 2:77, 82). While the "warning" benefits of the line may not be as critical at these points, other features still contribute to the safety of the employees both inside and outside the warning line. The warning line delineates the work area outside which employees' safety must either be monitored or provided for by the use of an MSS system. It prevents employees inside the warning line from inadvertently moving out of their work area and into the more hazardous area at the roof edge. The line designates the area within which they may perform work without special concern about falling. In addition, the warning line also clearly delineates the boundary outside which mechanical equipment may not be used, as discussed below.

The proposal stated that warning lines could only be used where the work area is free of ice and snow. The reason for this requirement was the assumption that the setback distances of six and ten feet (discussed below) for the warning line would not be sufficient for slippery roof conditions. The records indicate that built-up roofs cannot be and, therefore, are not applied over roof decks covered with ice and snow (cf. Ex 2:12, 20, 120). Therefore, this provision is deleted. Snow removal for maintenance purposes is not intended to be covered by this standard.

Paragraph (g)(3)(i)(a) of the standard requires that the warning line be set back from the roof edge at least six feet when no mechanical equipment is being used. When mechanical equipment is being used, paragraph (g)(3)(i)(b) requires that the warning line be at least ten feet from the roof edge which is *perpendicular* to the direction of mechanical equipment operation and at

least six feet from the roof edge which is *parallel* to the direction of mechanical equipment operation. This is a change from the proposal which required a distance of at least ten feet from all edges when mechanical equipment is being used. The change recognizes that the greatest hazards with mechanical equipment operation are at the points of turn-around (perpendicular to the direction of equipment movement) where an employee's attention is no longer on the edge hazard, but rather is on the effort required to turn the equipment around (cf. Ex 2:82, 120, 191). At these points, employees are in danger of losing their balance because of the sometimes awkward motions necessary to turn the mechanical equipment, and because of the need to step backward toward the edge, as they try to line the machine up for the next run. These unique problems do not exist along the parallel edge. Therefore, the ten foot requirement is reduced to six feet along such edges.

The six and ten foot distances were selected to allow a worker time to react to the warning line before getting close to a roof edge. This is especially important in the roofing trade where a worker may be moving backwards during the application of roofing materials.

The six-foot distance is sufficient to allow an employee to stop moving after being alerted by the line as to the proximity of the roof edge. When mechanical equipment is being used, the distance of ten feet from the edge perpendicular to the direction of equipment movement allows for the added momentum of the equipment which makes it harder for an employee to stop.

The six and ten foot distances from the roof edge are minimums for those jobs which are located away from the roof edge. However, there is no upper limit on the distance that a warning line may be erected away from a roof edge provided that the entire work area is enclosed. The warning line erected around the work area need not be placed as close to the roof perimeter as six or ten feet. Obviously, it is advantageous to have the warning line surround as much of the work area as possible since paragraph (g)(4) (discussed below) prohibits the use or storage of mechanical equipment outside the warning line.

According to a report by the University of Michigan (Ex. 3:8), a warning line must be highly visible to be effective. Accordingly, paragraph (g)(3)(i)(a) requires that the line be flagged with high-visibility material at no more than six foot intervals.

However, since visibility is primarily dependent on the brightness of the visual device to its environment and not on the color of the flagging material, no specific color is specified for use.

Paragraph (g)(3)(ii)(b) requires the line to be positioned between 34 and 39 inches from the roof surface. As recommended by the University of Michigan report, the height is low enough to warn a short worker stooped over, while, at the same time, it is high enough not to be a tripping hazard. The limits also allow for the sag which is present in any non-rigid system.

Paragraph (g)(3)(ii)(c) requires that the stanchions supporting the warning line be capable of resisting, without tipping over, a force of at least 16 pounds applied horizontally against the stanchion, at a point 30 inches above the roof surface, perpendicular to the warning line, and in the direction of the roof edge.

A minimum force is specified because a worker may approach the line while moving backwards or may otherwise have his attention diverted, and the line must offer sufficient resistance to attract a worker's attention when the worker touches it. The proposal contained the same requirements as the final standard except that a force of 25 pounds was specified and the force was to be applied at the top of the stanchion.

Comments were received expressing concern that the proposed 25 pound requirement would necessitate a stanchion weighting 75-80 pounds (assuming a two-foot-diameter base) (Ex. 2:82, 152). The stanchions would thus be awkward and heavy to move. It was recommended that the minimum force be lowered to 10 to 15 pounds (Ex. 2:152, 154, 204).

The proposed 25 pound requirement was based on the University of Michigan study (Ex. 3:8) which recommended that the minimum force-resistance capacity (righting moment) of the stanchions be 25 pounds. However, although it did state that the 25 pound force is more than adequate to make a worker aware of the warning line's presence, the Michigan study provided no supporting data for this figure. The study also indicated that a force of as little as one pound would produce sufficient pressure to be felt by the average person wearing no shirt.

It is clear to OSHA, based on the comments and the University of Michigan report, that the appropriate resistance for stanchions will be significantly greater than one pound in order to allow for heavy clothing often worn by roofing employees. However, the resistance may also be less than the 25 pounds proposed in order to allow

the use of reasonably sized stanchions which are manageable by employees.

There is little hard data on which to rely in making a determination as to the proper minimum force resistance capacity for warning line stanchions. OSHA believes that a 40-pound stanchion will be a reasonable weight for use on roofs. A stanchion of this size will sustain a 16-pound force applied 30 inches above the base before tipping over (assuming a two-foot diameter base). Stanchions meeting these requirements are available from suppliers (Ex. 2:204). In addition, such stanchions may be easily fabricated by employers in their own workshops or at the construction site. Therefore, based on this reasoning, paragraph (g)(3)(ii)(c) requires the stanchion, after being erected and the warning line attached, to withstand such a force, applied horizontally against the stanchion, without its tipping over.

The standard requires that this force be applied to the stanchion at a point 30 inches from the roof surface. The proposal required the force to be applied to the "top" of the stanchion. Since stanchions may be constructed to any height, the proposal's force requirement would have varied with the height of the stanchion. The new requirement specifies the height for testing the resistance to overturning forces and will assure uniform application of the standard.

Paragraph (g)(3)(ii)(d) requires the warning line rope, wire, or chain to have a minimum tensile strength capable of supporting the 16 pound test load applied to the stanchion without breaking. In no case shall the tensile strength be less than 500 pounds. This performance requirement simply assures that the line is capable of functioning as intended, regardless of how far apart the stanchions are placed. In addition, the minimum tensile strength of 500 pounds assures that the line is made of materials more substantial than string, such as wire, chain, rope, or heavy cord.

A new requirement of the standard, paragraph (g)(3)(ii)(e), provides that the rope, wire, or chain be securely attached to each stanchion and not simply passed through an eye bolt. Eyebolts may be used but the line must be attached to them in such a way that the stanchion will start to tip over before slack in either adjacent section of line is taken up. This will assure that when the warning line is contacted, it will provide sufficient resistance to the employee.

Paragraph (g)(3)(iii) requires that points of access, materials handling areas, and storage areas be connected to the work area by a path formed by warning lines. The proposal required

that "roof edge points of access, materials handling and storage areas" be so connected. The words "roof edge" were deleted since points of access, materials handling areas and storage areas can be at locations other than at roof edges. The revised requirement assures that workers being protected by a warning line have the benefit of that protection at all times.

*Paragraph (g)(4)—Mechanical Equipment.* Paragraph (g)(4) of the standard limits the use and storage of mechanical equipment to areas where employees are protected by MSS or warning line systems. The proposal required that mechanical equipment not be stored or used between a warning line and roof edge unless the employees are protected by an MSS system. In addition, the proposal prohibited the use of mechanical equipment in areas where direct supervision is used to protect employees. There is no substantive difference between the provisions of the proposal and the final language; however, the language was changed to make the requirement clearer.

As noted above, the warning line serves to designate those areas of low-pitched roofs where mechanical equipment may and may not be used or stored. Wherever employees are being protected by safety monitoring systems, whether they be outside the warning line or on a roof 50 feet or less in width, mechanical equipment may not be used or stored. (This does not, of course, preclude the employer from using mechanical equipment on roofs 50 feet or less in width if an MSS system or warning line for protection is being used.)

In connection with this requirement, the proposed definition of mechanical equipment is changed. The definition in § 1926.502(p)(4) now reads as follows: "Mechanical equipment—all motor or human propelled, wheeled equipment except for wheelbarrows and mopcars". The definition in the proposal did not make any exception for wheelbarrows or mopcars. These two pieces of equipment are excluded from the definition because their use does not require employees to move backward. In addition, they are light in weight and, therefore, develop little momentum. Wheelbarrows and mopcars do not present the same degree of risk to roofing employees as do such machines as felt layers and gravelbuggies (cf. Ex. 2:36, 120, 152). Mopcars and wheelbarrows do not require employees to divide their attention between the equipment they are using and the roof edge, as they would have to do with heavier, more awkward machinery. In

addition, excluding mopcars and wheelbarrows from outside the warning line would require employees to transport hot tar, gravel, and related materials by hand. This could result in increased burn injuries and employee fatigue, both of which may be very hazardous when working near the roof edge (cf. Ex. 2:36, 42, 56).

*Paragraph (g)(5)—Roof edge materials handling areas and material storage.* These provisions are essentially the same as those contained in the proposed standard, except as noted.

Paragraphs (g)(5) (i) thru (v) require the use of MSS systems at all roof edge materials handling areas. These are particularly hazardous areas because employees often lean out over the roof edge in order to observe the hoisting operations. Warning lines and safety monitoring systems are not allowed as alternatives to guardrails or safety belt systems in these areas. The feasibility question discussed earlier involving the dragging and tangling of safety lines during built-up roofing work does not arise during materials handling operations at the roof edge. No comments were received on these provisions.

Paragraph (g)(5)(vi) prohibits the storage of materials within six feet of the roof edge unless a guardrail is erected. Paragraph (g)(5)(vii) requires that all stacked materials be arranged in a stable and self-supporting manner. The proposal required that materials not be stacked higher than the guardrails unless stacked more than six feet from the roof edge. However, this would not prevent materials from sliding under a guardrail in the event the stacked materials shifted (Ex. 2:147). The requirement was changed to address this problem of stability. The new requirement is in addition to any relevant materials storage requirements contained in § 1926.250—General Requirements for Storage.

*Paragraph (g)(6)—Training.* This paragraph requires that all employees engaged in built-up roofing work be trained in the proper techniques and practices applicable to the use of MSS, warning line, and safety monitoring systems. These systems must be fully understood if they are to be used properly. For example, employees must be instructed that a warning line will only warn them of the nearness of a roof edge and will not function as a positive restraint.

The standard does not specify the details of the training program. Instead, it requires that employees be fully informed about the hazards of working near roof edges and that they be instructed in the proper use and

maintenance of the safety systems prescribed in the standard. In this way, the standard provides flexibility for the employer in designing the training program.

The proposal required that training be given to all new employees and to all employees before they start on each new jobsite. This provision was widely criticized as requiring an excessive amount of training (cf. Ex. 2:3, 12, 27). Many roofing jobs take only a day or so to complete and many of the employees working on one job are the same people who will work on the next job. Therefore, the final standard requires that training be provided for each newly-hired employee, and for all other employees as necessary to insure that they maintain proficiency in the listed subjects. This allows flexibility in the scheduling of training while still requiring that employees be properly trained. The initial training for new hires is essential to assure that protection is maintained regardless of the turnover rate for roofing employees.

*Section 1926.502(p) (1) to (9)—*  
*Definitions.* Paragraph (p) of § 1926.502 provides definitions for key words used in § 1926.500(g). The definitions as proposed have been modified to reflect the changes in the substantive provisions of the proposal. In addition to these changes, which have already been discussed, the following modifications are made: the words "insulation" and "vapor barrier" are added to the definition of "Built-up-roofing work" to further clarify the exact nature of the work intended to be covered by the standard; the definition of "warning line" is deleted as being unnecessary.

#### IV. Metric Conversion Policy

English measurement values given in this standard are followed by an equivalent International System (SI) metric measurement value, usually in parentheses. The first stated value is the requirement; the second value may only be an approximation. The SI units as employed are in accordance with the American National Standard for Metric Practice, ANSI/ASTM E380.

It is OSHA's policy to use this method, known as "soft conversion" to facilitate metrication activities under guidelines published by the Federal Interagency Committee on Metric Policy. These guidelines were published in the Federal Register at 45 FR 1840 on January 8, 1980. OSHA's metrication policy was established through a memorandum to the Assistant Secretary of Labor for Policy, Evaluation and Research from the Assistant Secretary of Labor for Occupational Safety and Health dated January 19, 1977.

#### V. References

Materials in the record of this rulemaking, including the public comments, the transcript of the public meeting, the regulatory assessment, and the reports referred to in this preamble are available for public inspection and copying at the OSHA Docket Office, Room S6212, New Department of Labor Building, 200 Constitution Avenue, N.W., Washington, D.C. 20210 Telephone (202) 523-7894.

#### VI. Regulatory Assessment

In accordance with Executive Order No. 12044 (43 FR 12661, March 24, 1978), OSHA has assessed the potential economic impact of this standard. Based on the economic identification guidelines of the Department of Labor (44 FR 5570, January 26, 1979), OSHA has concluded that the subject matter of this proposal is not a "major" action which would necessitate further economic impact evaluation and the preparation of a Regulatory Analysis.

Centaur Associates, Inc., has prepared for OSHA an economic assessment entitled "Economic Impact Statement/Assessment for the Proposed Amendments for the Guarding of Low-Pitched-Roof Perimeters" (Ex.3:3). The study includes estimates of the benefits as well as the costs of compliance associated with the proposed amendments. The effects of the proposed regulation on productivity and market structure are also considered.

According to the study, compliance costs are not expected to reach the threshold for determining that a proposed regulation will have a major economic impact. Total first year cost of the standard is estimated to be \$21.3 million. The proposed amendments to Subpart M are also not expected to have any other economic impact that might be considered major. No significant market structure effects are projected nor is it expected that employment will be affected.

The report briefly discusses the feasibility of the MSS and the warning line systems. While warning lines are found to be feasible and easily fabricated and assembled by relatively unskilled employees, the MSS systems are found to have feasibility problems.

The report notes that guardrails, whether fixed or portable, must be removed prior to the completion of roof edge work. Thus, they cannot be in place at the time when they are needed most. Catch platforms may have anchorage problems because of high windows, lightweight panels, or unknown masonry details. Safety belts reduce necessary mobility, pose tripping

hazards, and may not be possible to anchor safely. While these systems can work on some roofs, and, therefore, would not be prohibited from use by the standard, the report indicates that the warning line is adaptable to any low-pitched roof situation.

The study concludes that compliance with the standard is both technically and economically feasible.

Opportunity was given to interested persons to comment on and testify concerning the contents of the report and related issues. No contentions were made that the standard, with its limited scope, would be economically burdensome. Since OSHA received no comments regarding the regulatory assessment, the determination that the standard is not a "major" action in terms of economic impact remains unchanged. Based on its review of the Centaur report and the entire rulemaking record, OSHA also concludes that the standard is both economically and technologically feasible and that it contains provisions reasonably necessary and appropriate to reduce the significant risk faced by employees, at very limited cost.

In addition, OSHA certifies that this standard is not "major" under Executive Order 12044 and the Secretary's guidelines (44 FR 5570).

#### VII. Effective Date

Based on the information in the regulatory assessment, and in the absence of any contentions to the contrary, it is anticipated that employers will have little difficulty in obtaining or constructing the safety systems required by this standard. There should be no need for extended delay for employers to implement the provisions of the standard. Therefore, the effective date of this standard is January 13, 1981, 60 days from publication.

#### VIII. Authority

This document was prepared under the direction of Eula Bingham, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, Third Street and Constitution Avenue, N.W., Washington, D.C. 20210.

Accordingly, pursuant to section 6(b) of the Occupational Safety and Health Act of 1970 (84 Stat. 1593; 29 U.S.C. 655), section 107 of the Contract Work Hours and Safety Standards Act (83 Stat. 96; 40 U.S.C. 333), Secretary of Labor's Order No. 8-76 (41 FR 25059), and 29 CFR Part 1911, Part 1926 of Title 29, Code of Federal Regulations is amended by adding a new paragraph (g) to § 1926.500, by adding a new paragraph (p) to § 1925.502, and by adding an

Appendix A to Subpart M, as set forth below.

Signed at Washington, D.C. this 6th day of November 1980.

Eula Bingham,

Assistant Secretary of Labor.

1. Section 1926.500 of 29 CFR Part 1926 is amended by adding a new paragraph (g) to read as follows:

**§ 1926.500 Guardrails, handrails and covers.**

(g) *Guarding of low-pitched roof perimeters during the performance of built-up roofing work.*—(1) *General provisions.* During the performance of built-up roofing work on low-pitched roofs with a ground to eave height greater than 16 feet (4.9 meters), employees engaged in such work shall be protected from falling from all unprotected sides and edges of the roof as follows:

(i) By the use of a motion-stopping-safety system (MSS system); or  
(ii) By the use of a warning line system erected and maintained as provided in paragraph (g)(3) of this section and supplemented for employees working between the warning line and the roof edge by the use of either an MSS system or, where mechanical equipment is not being used or stored, by the use of a safety monitoring system; or

(iii) By the use of a safety monitoring system on roofs fifty feet (15.25 meters) or less in width (see Appendix A), where mechanical equipment is not being used or stored.

(2) *Exception.* The provisions of paragraph (g)(1) of this section do not apply at points of access such as stairways, ladders, and ramps, or when employees are on the roof only to inspect, investigate, or estimate roof level conditions. Roof edge materials handling areas and materials storage areas shall be guarded as provided in paragraph (g)(5) of this section.

(3) *Warning lines.*

(i) Warning lines shall be erected around all sides of the work area.

(a) When mechanical equipment is not being used, the warning line shall be erected not less than six feet (1.8 meters) from the roof edge.

(b) When mechanical equipment is being used, the warning line shall be erected not less than six feet (1.8 meters) from the roof edge which is parallel to the direction of mechanical equipment operation, and not less than 10 feet (3.1 meters) from the roof edge which is perpendicular to the direction of mechanical equipment operation.

(ii) The warning line shall consist of a rope, wire, or chain, and supporting stanchions erected as follows:

(a) The rope, wire, or chain shall be flagged at not more than six foot (1.8 meters) intervals with high-visibility material;

(b) The rope, wire, or chain shall be rigged and supported in such a way that its lowest point (including sag) is no less than 34 inches (.86 meters) from the roof surface and its highest point is no more than 39 inches (1 meter) from the roof surface;

(c) After being erected, with the rope, wire, or chain attached, stanchions shall be capable of resisting, without tipping over, a force of at least 16 pounds (71 Newtons) applied horizontally against the stanchion, 30 inches (0.76 meters) above the roof surface, perpendicular to the warning line, and in the direction of the roof edge;

(d) The rope, wire, or chain shall have a minimum tensile strength of 500 pounds (227 Kilograms), and after being attached to the stanchions, shall be capable of supporting, without breaking, the loads applied to the stanchions as prescribed in paragraph (g)(3)(ii)(c) of this section; and

(e) The line shall be attached at each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in adjacent sections before the stanchion tips over.

(iii) Access paths shall be erected as follows:

(a) Points of access, materials handling areas and storage areas shall be connected to the work area by a clear access path formed by two warning lines.

(b) When the path to a point of access is not in use, a rope, wire, or chain, equal in strength and height to the warning line, shall be placed across the path at the point where the path intersects the warning line erected around the work area.

(4) *Mechanical equipment.* Mechanical equipment may be used or stored only in areas where employees are being protected by either a warning line or an MSS system. Mechanical equipment may not be used or stored between the warning line and the roof edge unless the employees are being protected by an MSS system. Mechanical equipment may not be used or stored where the only protection provided is by a safety monitoring system.

(5) *Roof edge materials handling areas and materials storage.* Employees working in a roof edge materials handling or materials storage area located on a low-pitched roof with a

ground to eave height greater than 16 feet (4.9 meters) shall be protected from falling by the use of an MSS system along all unprotected roof sides and edges of the area.

(i) When guardrails are used at hoisting areas, a minimum of four feet of guardrail shall be erected on each side of the access point through which materials are hoisted.

(ii) A chain or gate shall be placed across the opening between the guardrail sections when hoisting operations are not taking place.

(iii) When guardrails are used at bitumen pipe outlets, a minimum of four feet of guardrail shall be erected on each side of the pipe.

(iv) When safety belt systems are used, they shall not be attached to the hoist.

(v) When safety belt systems are used they shall be rigged to allow the movement of employees only as far as the roof edge.

(vi) Materials may not be stored within six feet of the roof edge unless guardrails are erected at the roof edge.

(vii) Materials which are piled, grouped, or stacked shall be stable and self-supporting.

(6) *Training.* (i) The employer shall provide a training program for all employees engaged in built-up roofing work so that they are able to recognize and deal with the hazards of falling associated with working near a roof perimeter. The employees shall also be trained in the safety procedures to be followed in order to prevent such falls.

(ii) The employer shall assure that employees engaged in built-up roofing work have been trained and instructed in the following areas:

(a) The nature of fall hazards in the work area near a roof edge;

(b) The function, use, and operation of the MSS system, warning line, and safety monitoring systems to be used;

(c) The correct procedures for erecting, maintaining, and disassembling the systems to be used;

(d) The role of each employee in the safety monitoring system when this system is used;

(e) The limitations on the use of mechanical equipment; and

(f) The correct procedures for the handling and storage of equipment and materials.

(iii) Training shall be provided for each newly hired employee, and for all other employees as necessary, to assure that employees maintain proficiency in the areas listed in paragraph (g)(6)(ii) of this section.

2. Section 1926.502 of 29 CFR Part 1926 is amended by adding a new paragraph (p) to read as follows:



§ 1926.502 Definitions applicable to this subpart.

(p) For the purposes of paragraph (g) of § 1926.500, the following definitions shall apply:

(1) "Built-up-roofing"—a weatherproofing cover, applied over roof decks, consisting of either a liquid-applied system, a single-ply system, or a multiple-ply system. Liquid-applied systems generally consist of silicone rubber, plastics, or similar material applied by spray or roller equipment. Single-ply systems generally consist of a single layer of synthetic rubber, plastic, or similar material, and a layer of adhesive. Multiple-ply systems generally consist of layers of felt and bitumen, and may be covered with a layer of mineral aggregate.

(2) "Built-up-roofing work"—the hoisting, storage, application, and removal of built-up roofing materials and equipment, including related insulation, sheet metal, and vapor barrier work, but not including the construction of the roof deck.

(3) "Low-pitched roof"—a roof having a slope less than or equal to four in twelve.

(4) "Mechanical equipment"—all motor or human propelled wheeled equipment except for wheelbarrows and mopcars.

(5) "MSS Systems" (motion-stopping-safety systems)—fall protection using the following equipment singly or in combination: standard railings (guardrails) as described in § 1926.500(f); scaffolds or platforms with guardrails as described in § 1926.451; safety nets as described in § 1926.105; and safety belt systems as described in § 1926.104.

(6) "Roof"—the exterior surface on the top of a building. This does not include floors which, because a building has not been completely built, temporarily become the top surface of a building.

(7) "Safety-monitoring system"—a safety system in which a competent person monitors the safety of all employees in a roofing crew, and warns them when it appears to the monitor that they are unaware of the hazard or are acting in an unsafe manner. The competent person must be on the same roof as and within visual sighting distance of the employees, and must be close enough to verbally communicate with the employees.

(8) "Unprotected side or edge"—any side or edge of a roof perimeter where there is no wall three feet (.9 meters) or more in height.

(9) "Work area"—that portion of a roof where built-up roofing work is being performed.

3. Subpart M of Part 1926 is amended by adding the following Appendix at the end of the Subpart:

**Appendix A to Subpart M for § 1926.500(g)(1)—Roof Widths**

This appendix serves as a guideline to assist employers in complying with the appropriate requirements of Subpart M, § 1926.500(g)(1). Each example shows a roof plan or plans and indicates where each roof or roof area is to be measured to determine its width. Section views or elevation views are shown where appropriate. Some examples show "correct" and "incorrect" subdivisions of irregularly shaped roofs into smaller regularly shaped areas. In all examples, the dimension selected to be the width of an area is the lesser of the two primary dimensions of the area. Example A shows that on a simple rectangular roof, width is the lesser of the two primary overall dimensions. This is also the case with roofs which are sloped toward or away from the roof center, as shown in Example B.

Many roofs are not simple rectangles. Such roofs may be broken down into subareas as shown in Example C. The process of dividing a roof area can produce many different configurations. Example C gives the general rule of using dividing lines of minimum length to minimize the size and number of the areas which are potentially less than 50 feet wide. The intent is to minimize the number of roof areas where § 1926.500(g)(1)(iii) can be applied.

Roofs which are comprised of several separate, non-contiguous roof areas, as in Example D, may be considered as a series of individual roofs. Some roofs have penthouses, additional floors, courtyard openings, or similar architectural features; Example E shows how the rule for dividing roofs into subareas is applied to such configurations. Irregular, non-rectangular roofs must be considered on an individual basis, as shown in Example F.

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