**DEPARTMENT OF TRANSPORTATION**

**Federal Railroad Administration**

**49 CFR Part 224**

**[Docket No. FRA–1999–6689, Notice No. 3]**

**RIN 2130–AB41**

## Reflectorization of Rail Freight Rolling Stock

**AGENCY:** Federal Railroad Administration (FRA), Department of Transportation (DOT).

**ACTION:** Notice of proposed rulemaking.

**SUMMARY:** FRA is proposing to require retroreflective material on the sides of freight rolling stock (freight cars and locomotives) to enhance the visibility of trains in order to reduce the number of accidents at highway-rail grade crossings in which train visibility is a contributing factor. This document proposes a rule establishing a schedule for the application of retroreflective material and prescribing standards for the application, inspection, and maintenance of the material.

**DATES:** *Written Comments:* Comments must be received by March 5, 2004. Comments received after that date will be considered to the extent possible without incurring additional expense or delay.

*Public Hearing:* FRA is planning to conduct a public hearing in Washington, DC, on Tuesday, January 27, 2004, at 9:30 a.m., in order to provide all interested parties the opportunity to comment on the provisions contained in this notice. Any person wishing to participate in the public hearing should notify the Docket Clerk by telephone (202–493–6030) or by mail at the address provided below at least five working days prior to the date of the hearing. The notification should identify the party the person represents, and the particular subject(s) the person plans to address. FRA reserves the right to limit participation in the hearing of persons who fail to provide such notification.

**ADDRESSES:** You may submit comments identified by DOT DMS Docket Number FRA–1999–6689 by any of the following methods:

- Web site: *http://dms.dot.gov.* Follow the instructions for submitted comments on the DOT electronic docket site.
- Fax: 1–202–493–2251.
- Mail: Docket Management Facility; U.S. Department of Transportation, 400 Seventh Street, SW., Nassif Building, Room PL–401, Washington, DC 20590–001.
- Hand Delivery: Room PL–401 on the plaza level of the Nassif Building, 400 Seventh Street, SW., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal Holidays.
- Federal e-Rulemaking Portal: Go to *http://www.regulations.gov.* Follow the online instructions for submitting comments.

*Instructions:* All submissions must include the agency name and docket name and docket number or Regulatory Identification Number (RIN) for this rulemaking. For detailed instructions on submitting comments and additional information on the rulemaking process, see the Public Participation heading of the Supplementary Information section of this document. Note that all comments received will be posted without change to *http://dms.dot.gov,* including any personal information provided. Please see the Privacy Act heading under Regulatory Notices.

*Docket:* For access to the docket to read background documents or comments received, go to *http://dms.dot.gov* at any time or to Room PL–401 on the plaza level of the Nassif Building, 400 Seventh Street, SW., Washington, DC, between 9 am and 5 pm, Monday through Friday, except Federal Holidays.

*Public Hearing:* The public hearing will be held at the Washington Plaza Hotel, 10 Thomas Circle, NW., Massachusetts Avenue at Fourteenth Street, Washington, DC 20005 (202–842–1300). Written notification of a party's intended participation should identify the docket number and must be submitted to Ms. Ivornette Lynch, Docket Clerk, Office of Chief Counsel, Federal Railroad Administration, RCC–10, 1120 Vermont Ave., NW., Stop 10, Washington, DC 20590.

**FOR FURTHER INFORMATION CONTACT:** Dr. Tom Blankenship, Mechanical Engineer, Office of Safety, FRA, 1120 Vermont Ave., NW., Mailstop 25, Washington, DC 20590 (telephone: 202–493–6446); Mary Plache, Industry Economist, Office of Safety, FRA, 1120 Vermont Ave., NW., Mailstop 21.1, Washington, DC 20590 (telephone: 202–493–6297); or Lucinda Henriksen, Trial Attorney, Office of Chief Counsel, FRA, 1120 Vermont Ave., NW., Mailstop 10, Washington, DC 20590 (telephone: 202–493–6038).

**SUPPLEMENTARY INFORMATION:**

### Background

This proposed rule represents a partial solution to a safety problem that has long concerned FRA—the need to reduce the incidence and severity of collisions between motor vehicles and trains at highway-rail grade crossings throughout the United States. Approximately 4,000 times each year, a train and a highway vehicle collide at one of this country's 262,000 public and private highway-rail grade crossings. Approximately 23% of all highway-rail grade crossing accidents involve motor vehicles running into trains occupying grade crossings (''RIT'' accidents).[1] Almost 80% of these RIT accidents occur during nighttime conditions (dawn, dusk, and darkness) and involve a highway vehicle striking a train after the first two units of the consist. These statistics suggest that a contributing factor to many RIT accidents is the difficulty motorists have in seeing a train consist at a crossing in time to stop their vehicles before reaching the crossing, particularly during periods of limited visibility, such as dawn, dusk, darkness, or during adverse weather conditions.

The physical characteristics of trains, in combination with the characteristics of grade crossings (*e.g.*, grade crossing configuration, type of warning devices at a crossing, rural background environment with low level ambient light, or visually complex urban background environment, etc.), and the inherent limitations of human eyesight, make it difficult for motorists to detect a train's presence on highway-rail grade crossings, particularly during periods of limited visibility. Freight trains lack conspicuity (*i.e.*, the ability to be seen) in some of their different environmental settings. For example, trains are typically painted a dark color and are covered with dirt and grime which are inherent in the rail environment. With the exception of locomotives, trains are usually unlighted and are not equipped with reflective devices. Similarly, a large percentage of crossings are not lighted. Consequently, much of the light from a motor vehicle's headlights is absorbed by the freight cars, instead of being reflected back toward the motorist. The large size of freight cars, which are out of scale relative to a motorist's expectations, also make them difficult to detect. For instance, even if a motorist is looking for a train, if the locomotive has already passed, it is difficult to detect the freight cars because the cars often encompass the motorist's entire field of view and have the tendency to ''blend'' into the background environment, especially at night. In addition, because most drivers involved in grade crossing accidents are familiar with the crossings and with roadway features at the crossings, the

[1] Based on available data from 1992 through 2001.

drivers become habituated (or pre-conditioned) to the crossings. In other words, based on previous driving experiences and conditioning, a driver may not expect a train to be occupying a crossing, and without a clear auditory signal (because the locomotive has already cleared the crossing) or visual stimuli alerting the driver to a train traveling through the crossing, the driver may fail to perceive the train in time to stop. This condition is further exacerbated when a train is stopped on a crossing.

There is currently no requirement for lighting or reflective markings on freight rolling stock. However, in recognition that the transportation of people and goods is not restricted to daytime hours and pristine weather conditions, reflectorization has become an indispensable tool for enhancing visibility in virtually all other modes of transportation, including air, highway, maritime, and pedestrian travel. For example, airplanes and motor vehicles are equipped with high brightness retroreflective material at key locations on the exterior surfaces to increase their conspicuity. Mircoprismatic corner cube retroreflectors (which have the ability to direct light rays back to the light source) are typically used on roadway signs that warn of construction or other hazardous conditions. Federal regulations require retroreflective materials on the sides and rear of large trucks to increase their conspicuity and to aid motorists in judging their proximity to these vehicles. Even regulations addressing bicycle safety have specific requirements on the use of reflective materials. Lifesaving marine equipment, such as life vests and rafts, require reflectorization; and to enhance the conspicuity of pedestrians, especially at night, retroreflective material has been incorporated into clothing and similar items.

The everyday use of reflectors indicates their acceptance to delineate potential hazards and obstructions to a vehicle's path of travel. Research specific to the railroad industry has demonstrated that reflective materials can increase the conspicuity of freight cars, thereby enhancing motorists' ability to detect the presence of trains in highway-rail grade crossings. This greater visibility can help drivers avoid some accidents and reduce the severity of other accidents that are unavoidable. Accordingly, FRA, as the Federal agency responsible for ensuring that America's railroads are safe for the traveling public, and in direct response to a Congressional mandate, proposes to require use of reflective material on the sides of certain rail cars and locomotives to enhance the visibility of trains in order to reduce the number of accidents at highway-rail grade crossings where train visibility is a contributing factor.

*A. History of Railroad Car Conspicuity Issue and Congressional Mandate*

As applied to rail car visibility, the term ''conspicuity'' refers to the characteristic of a rail car in its roadway setting to command the attention of approaching motorists and be recognizable to reasonably prudent motorists at sufficient distance to allow the motorists to reduce their vehicles' speed and take action to avoid collisions. Research relating to the conspicuity of rail cars is not a new concept. Research dating back to the early 1950s has noted the potential viability of rail car conspicuity materials such as luminous sources (lights on rail cars), self-luminous sources (phosphorescent), and reflective sources. In the mid 1950's, researchers concluded that reflective material along the side sill of boxcars increased the visibility of the cars and aided in the perception of the cars' motion. The same study also found that the amount and distribution of reflectorized material proportionally affected the level of visibility and accuracy of perception of rail cars' motion. In other words, by using material with high coefficients of reflectivity (*i.e.*, high levels of reflected light) against a high contrast background (*e.g.*, dark and dirty rail cars), the amount of illumination was increased, and the motorists' ability to discriminate the movement of the rail cars across their line of vision was enhanced. In the early 1970's, a study concentrating on the conspicuity of trains at night found that although luminous and reflective sources both proved effective in enhancing the visibility of trains, reflectors provided conspicuity at a greater distance and field of vision than the other sources which were studied.

The general consensus of historical research was that reflective materials can increase the conspicuity of objects to which they are attached, but previous generations of reflective materials did not reflect enough light to be effective in the railroad environment and lacked the durability to survive the harsh railroad operating environment. For example, in 1959 a Canadian freight car reflectorization program was begun. In this program, high-intensity retroreflective sheeting in the shapes of circular discs and squares were applied to the sides of rail cars for the purpose of assessing their long term durability and performance. Reflective intensity measurements on the Canadian cars after six months, one year, and two years of service indicated rapid deterioration of the retroreflective material. Only 23% of the material's original reflectivity remained at the end of six months. This declined to 14% after one year and to 5% at the end of two years of service. Tests of similar high intensity retroreflective sheeting conducted by the Boston and Maine Railroad in 1981 yielded substantially the same results as the earlier Canadian tests.

FRA first evaluated the use of reflective material on rail rolling stock in the early 1980s, and supported a study completed in 1982 on the potential use of reflectorization to reduce nighttime accidents at highway-rail intersections. The study concluded that although the use of reflective material enhanced the visibility of trains, the reflective material was not durable enough to withstand the harsh railroad environment. It was decided that rulemaking action was not warranted at that time.

Since 1982, however, improvements in the brightness, durability, and adhesive properties of reflective materials have been achieved and a new material, microprismatic retroreflective material, is now available. Because of the technological advances in reflective materials and the creation of microprismatic retroreflective material, beginning in the early 1990's FRA funded renewed research through the John A. Volpe National Transportation Systems Center in Cambridge, Massachusetts (''Volpe'') to reexamine the issue of using reflective material to enhance railcar conspicuity.

In July 1999, FRA announced the results of its renewed research efforts with the release of the report *Safety of Highway-Railroad Grade Crossings: Freight Car Reflectorization* (DOT/FRA/ORD–98/11) (''1999 Volpe Report''). The 1999 Volpe Report provided significant information, including cost estimates and data on the performance of equipped rail car fleets in an actual service environment. Similar to earlier research, the 1999 Volpe Report concluded that reflective materials enhanced motorists' ability to detect the presence of a train in a highway-rail grade crossing and could therefore prevent collisions involving highway vehicles. Unlike earlier studies which utilized previous generations of reflective material, the 1999 Volpe Report concluded that the durability and adhesive properties of the new microprismatic retroreflective material could provide adequate luminance intensity levels which can be sustained for up to 10 years with minimum maintenance. A copy of the complete 1999 Volpe Report is in the docket of this proceeding (Document No. FRA–1999–6689–17).

Building upon the research detailed in the 1999 Volpe Report, and recognizing that the study's human factors tests did not provide a realistic environment in which to evaluate the detectability and recognition of freight cars equipped with microprismatic retroreflective material in a real-world environment, FRA subsequently investigated whether motorists, under real world driving conditions, would likely confuse reflectorized trains with other roadway hazards, particularly trucks which were already required by federal regulations to be equipped with retroreflective material. It is important for motorists to be able to distinguish rail cars from trucks because motorists' interaction with trains is different from trucks. Because trucks are shorter in length and pass through an intersection more quickly than the average train, a motorist approaching a truck in an intersection may only need to slow his or her vehicle to avoid a collision, while a motorist approaching a grade crossing occupied by a train more likely will need to stop at the crossing to avoid a collision. In July 2001, FRA released the results of this research in the report *Safety of Highway-Railroad Grade Crossings: Recognition of Rail Car Retroreflective Patterns for Improving Nighttime Conspicuity* (DOT/FRA/ORD–00/07) (''2001 Volpe Report''). The 2001 Volpe Report concluded that motorists had difficulty discriminating unreflectorized rail cars from trucks as illuminance levels declined, but motorists could discriminate between reflectorized freight cars and truck trailers for each of the four reflective patterns tested. In addition, the report concluded that vertically oriented patterns, as opposed to outline or horizontally oriented patterns, were preferable because they were less likely to be confused with the horizontally oriented truck reflectorization patterns. A copy of the complete 2001 Volpe Report is in the docket of this proceeding (Document No. FRA–1999–6689–48).

Meanwhile, in 1994 Congress passed the Federal Railroad Safety Authorization Act of 1994, Pub. L. 103–440 (''Act''). The Act added § 20148 to title 49 of the United States Code. Section 20148 required FRA to conduct a review of the Department of Transportation's (''Department'') rules with respect to the visibility of railroad cars and mandated that if the review established that enhanced railroad car visibility would likely improve safety in a cost-effective manner, the Secretary of Transportation (''Secretary'') must initiate a rulemaking proceeding to prescribe regulations requiring enhanced visibility standards for railroad cars. Section 20148 specifically directs the Secretary to examine the use of reflectors. Section 20148 of title 49 of the United States Code states as follows:

(a) REVIEW OF RULES.—The Secretary of Transportation shall conduct a review of the Department of Transportation's rules with respect to railroad car visibility. As part of this review, the Secretary shall collect relevant data from operational experience by railroads having enhanced visibility measures in service.

(b) REGULATIONS.—If the review conducted under subsection (a) establishes that enhanced railroad car visibility would likely improve safety in a cost-effective manner, the Secretary shall initiate a rulemaking proceeding to prescribe regulations requiring enhanced visibility standards for newly manufactured and remanufactured railroad cars. In such proceeding the Secretary shall consider, at a minimum—

(1) visibility of railroad cars from the perspective of nonrailroad traffic;

(2) whether certain railroad car paint colors should be prohibited or required;

(3) the use of reflective materials;

(4) the visibility of lettering on railroad cars;

(5) the effect of any enhanced visibility measures on the health and safety of train crew members; and

(6) the cost/benefit ratio of any new regulations.

(c) EXCLUSIONS.—In prescribing regulations under subsection (b), the Secretary may exclude from any specific visibility requirement any category of trains or railroad operations if the Secretary determines that such an exclusion is in the public interest and is consistent with railroad safety.

On July 28, 1999, FRA hosted a workshop on reflectorization of rail rolling stock. Attendees included representatives from the railroad industry, reflector manufacturing and supply companies, as well as representatives from the National Transportation Safety Board and the National Highway Traffic Safety Administration (NHTSA) and other interested parties. The workshop provided an opportunity for FRA and all interested parties to review and discuss the issue of rail car conspicuity and specifically, rail car reflectorization. During the workshop, representatives from Volpe provided a briefing on the 1999 Volpe Report and a representative of NHTSA provided a briefing on that agency's rule requiring the reflectorization of large truck trailers. The workshop also provided an opportunity for all interested parties to share their views, concerns, and experiences with regard to rail car reflectorization. Discussion during the workshop focused on the potential effectiveness of rail car reflectorization under a variety of circumstances (*e.g.*, at nighttime versus daytime, at passively protected crossings versus actively protected crossings, or when drivers are under the influence of alcohol or otherwise impaired), as well as more practical aspects of any rail car reflectorization program (*e.g.*, maintenance and cleaning requirements, when and where reflector installation would occur, and the costs involved in installing and maintaining the reflectors). Throughout the workshop FRA representatives acknowledged participants' concerns regarding reflectorization and invited interested parties to share further comments and relevant data as FRA continued its investigation into whether a rulemaking mandating reflectorization of rail cars was warranted. A copy of the transcript of this workshop is included in the docket of this proceeding. (Document No. FRA–1999–6689–7).

Recognizing that part of the review mandated by Congress included collecting relevant data from operational experience by railroads having enhanced visibility measures in service, on January 14, 2000, FRA established a public docket (Docket No. FRA–1999–6689) to provide all interested parties with a central location to both send and review relevant information concerning railroad car conspicuity and to provide a venue to gather and disseminate information and views on the issues. The docket contains several submissions from FRA (*e.g.*, transcript of the July 28, 1999 workshop, an analysis of signal detection theory, FRA's preliminary cost-benefit analysis on railcar reflectorization, and technical reports from the NHTSA and Volpe), as well as comments from numerous members of the public and the regulated community, which will be discussed in more detail below.

FRA regards the 1999 and 2001 Volpe Reports, as well as the 1999 workshop and establishment of the public docket as responsive to section 20148's directive to review the Department's rules with respect to rail car visibility. Further, because the 1999 and 2001 Volpe Reports concluded that reflectorization could enhance rail car visibility, FRA conducted a preliminary cost-benefit analysis (''Preliminary Analysis'') to determine whether reflectorization would provide a cost effective method of reducing the number of collisions at highway-rail grade crossings and the casualties and property damages which result from those collisions. FRA's Preliminary Analysis concluded that the benefits of a uniform, nationwide freight car reflectorization program would far outweigh the costs of such a program.

In the Preliminary Analysis, FRA identified the primary source of benefits to be gained from freight car reflectorization as the avoidance of a portion of the fatalities, injuries, and property damage that result from collisions between motor vehicles and freight trains at grade crossings. Statistics show that collisions between trains and motor vehicles often result in fatal or very serious injuries to the occupants of the motor vehicle involved, and the vehicle may be completely destroyed. In addition, collisions between trains and motor vehicles often result in damage to the rail equipment and significant delays and disruptions to rail operations. For example, FRA's Railroad Safety Advisory Committee estimates that collisions cause an average of a two-hour train delay at $250 per hour for freight trains. This estimate does not include the ripple effect of delays incurred by other trains, including passenger trains, awaiting use of the track where service has been interrupted.

FRA calculated the expected safety benefits of reflectorization in terms of the decline in the probability of RIT accidents. Recognizing that the effectiveness of retroreflectors (and therefore the benefits to be gained from their use) will vary by circumstance (*e.g.*, nighttime versus daytime conditions, clear versus cloudy weather conditions, presence of other warning devices at a crossing, train speed and length, etc.), FRA's Preliminary Analysis recognized that forecasting the benefits which would likely result from reflectorization necessitated a certain amount of subjective analysis and the exercise of judgment. Accordingly, based on the manufacturers' 10-year guaranteed useful life of retroreflective sheeting, FRA employed four different approaches to the estimation of benefits. Benefit estimates were based on varying effectiveness rates derived from (1) two previous studies analyzing the effectiveness of reflective material on large trucks, (2) subjective estimates of reflector effectiveness by internal FRA grade crossing experts, and (3) a signal detection model consisting of an analysis of the statistical probability of different potential severities of hazard or injury, based on laboratory experiments and accident/incident data from FRA's Rail Accident/Incident Reporting System database. FRA estimated the ten-year discounted benefits of a reflectorization program, in terms of avoided casualties and property damage, to be in the range of $57 million, $70 million, $100 million, or $105 million, depending on the methodology employed.

Taking into consideration material, installation and maintenance costs, FRA's Preliminary Analysis concluded that over a ten-year period (the estimated useful life of the retroreflective material), the discounted cost to reflectorize the entire freight railroad fleet would be approximately $40 million. Accordingly, FRA concluded that the reflectorization of railroad freight equipment is a viable and cost-effective method of reducing the number of collisions at highway-rail grade crossings and the casualties and property damages which result from those collisions. FRA published the results of its Preliminary Analysis on October 26, 2001. *See* 66 FR 54326. A copy of the Preliminary Analysis is in the docket of this proceeding. (Document No. FRA–1999–6689–25).

Because of the rail industry's continued interest in the issue of rail car reflectorization, FRA met with members of the regulated community on March 24, 2003, to again listen to their comments and concerns regarding reflectorization. During this meeting, the participating railroads and car owners reiterated their concerns regarding a potential rail car reflectorization rulemaking. Specifically, participants expressed concern that a federal rulemaking mandating reflectorization could have the effect of increasing their liability for grade crossing accidents. Participating railroads and car owners also raised important considerations regarding many practical aspects of a potential reflectorization program (*e.g.*, a feasible schedule for the application of reflectors to rail cars, what types of reflective material would be required, reflector cleaning and maintenance responsibilities, and when and where reflectors would be applied to cars).

### *B. Fundamentals of Reflectivity and Human Eyesight*

Materials that have reflective properties can be classified into three general categories: direct reflectors, diffuse reflectors, and retroreflectors. Direct reflectors, such as mirrors, bounce light off the reflective material at an angle equal and opposite to the direction of the light source. Diffuse reflectors, such as license plates, bounce light off the reflective material at an angular spread of up to 180 degrees. Retroreflectors, however, direct the reflected light in the direction of the light source. As applied to motorists approaching grade crossings, retroreflective material on the sides of rail cars will reflect light from an approaching vehicle's headlights back to the motorist in a concentrated beam. If either a direct or diffuse reflective material was applied to the sides of rail cars, light from an approaching vehicle's headlights would be reflected in several different directions, thereby lessening the amount of light reflected back to the motorist.

Retroreflective material is rated in terms of the reflected light per unit area as contrasted with the light striking it (''specific intensity per unit area'' or SIA). The amount of reflected light reaching the driver's eyes will determine how bright that object appears to the driver. Therefore, retroreflective materials that are efficient in returning light to a driver's eyes may appear brighter to the driver than materials that are not as efficient. The newest, most durable, and most efficient retroreflective material available today, the prismatic type retroreflector, is made of microscopic prisms or corner cubes. Each of these prisms or corner cubes contains three surfaces oriented at 90 degrees to each other. The entering rays of light are reflected from each of the surfaces and are returned to the observer in a more concentrated and focused beam than direct or diffuse reflectors or even other types of retroreflective material.

The amount of light received by an observer from a retroreflector is affected by six factors: (1) Reflective intensity of the material (the SIA), (2) size of the retroreflector, (3) intensity of the light source (in the case of grade crossings, the intensity of approaching motor vehicles' headlights and the efficiency of those headlights), (4) atmospheric transmissivity (*e.g.,* clear, foggy, or hazy weather conditions), (5) windshield transmittance, and (6) the distance of the observer from the retroreflector. The relationship among these factors and the illuminance received by an observer is based on *Allard's Law* and is represented by the following equation:

$$E_e = \frac{I_s * A * B * t^{2d} * W * H}{d^4}$$

in which

$E_e$ = Illuminance received by the observer (measured in footcandles (fc))

$I_s$ = Intensity of the light beamed toward the reflector (measured in candela (cd))

A = Area of the reflector (measured in square feet)

B = Reflective intensity of reflector (*i.e.,* SIA, measured in candela/footcandle/square foot (cd/fc/ft$^2$))
t = Transmissivity of the atmosphere (per foot)
d = Distance between the observer and the reflector (measured in feet)
W = Windshield transmittance (percentage)
H = Headlight efficiency (percentage)

The above relationship assumes that the incident light from the light source is normal to (*i.e.,* perpendicular to) the surface of the retroreflector. At highway-rail crossings, however, light will often strike retroreflectors on rail cars at an angle other than 90 degrees, and as a result, the reflected light received by an approaching motorist will be reduced. This reduction is a function of three factors: the incidence (or entrance) angle, the divergence (or observation) angle, and the properties of the retroreflective material. The incidence angle is the angle formed between a line from the light source (*e.g.,* headlights of approaching motor vehicle) to the reflective surface and a line perpendicular to the reflective surface. The divergence angle is the angle between the line of sight of the observer to the reflective surface and the path of the light from the source to the reflective surface. A retroreflector's effectiveness is affected primarily by the divergence angle and secondarily by the incidence angle. The divergence angle is a function of the distance between the driver's eyes and the light source and the distance between the reflector and the light source. In the scenario of a motor vehicle approaching a highway-rail grade crossing, since the distance between the light source (*i.e.,* vehicle's headlights) and the motorist's eyes is a constant, the divergence angle decreases as the distance between the vehicle and the reflector increases. The retroreflector will produce maximum reflectivity for the motorist when both the incidence and divergence angles equal zero. This maximum reflectivity will not be achieved for highway-rail grade crossings, however, due to the fact that the divergence angle increases as the vehicle approaches the reflective material on the train. In other words, the reflective intensity of retroreflectors on the sides of rail cars will increase with distance since both the observation and entrance angles vary inversely with the distance between the reflector and the vehicle. Similarly, as a vehicle gets closer to a rail car, the entrance and observation angles get larger, and the retroreflective material's performance drops (*i.e.,* the intensity of the reflected light drops). Because illuminance is inversely proportional to the square of the distance, however, as a motorist gets closer, less performance is needed. In addition, the reduction in the material's reflectivity as a vehicle approaches a train can be partly compensated for by using reflective materials with the highest level of performance (*e.g.,* microprismatic retroreflective material).

In evaluating the performance of reflective materials in the railroad operating environment, the inherent limitations of human eyesight must also be taken into account. In general, an individual's visual attention orients toward areas that contain a great deal of information (such as concentrations of signs, lights, people, *etc.*) and toward objects that differ greatly from their background (such as contrasting color or brightness, or moving objects against a still background). Accordingly, although reflectorization will increase the visibility of trains in normal daytime conditions, it is expected that reflectorization will be most effective in reducing RIT accidents at nighttime or during other times of limited visibility when the reflective material contrasts the most with the background environment.

For human beings to see in darkness and other low-light conditions, sufficient light must illuminate their retinas. Two types of light sources affect a human's ability to see. The primary light source is one that is self-luminous (*e.g.*, a vehicle's headlights or crossing illumination). Secondary light sources (*e.g.*, reflective material) are not self-luminous and can be detected in darkness only if light is reflected from their surface. Non-luminous and non-reflecting objects are also visible under low light conditions based on available contrast with a lighter background against which they stand out. As applied to railroad crossings during periods of darkness or otherwise limited visibility, a motor vehicle's headlights and retroreflection can be used to partially compensate for the daylight that is not present.

The light that illuminates the retina stimulates two types of photoreceptor cells—cones and rods. The cones are sensitive to normal daylight conditions (photopic vision). Photopic vision requires higher levels of illumination and allows color perception and high visual acuity. The rods are sensitive to lower levels of illumination, do not allow color perception, and do not provide as high a level of visual acuity as the cones. This is called scotopic vision. At dusk and dawn both types of receptors are activated (mesopic vision). Mesopic vision is characterized by diminished color vision and reduced detail discrimination relative to photopic vision.

During normal daylight conditions, the human visual system operates at its highest level of visual acuity and has the greatest capability of distinguishing differences between objects in the visual field (good detail discrimination). At night, and in other conditions of low ambient light, contrast sensitivity is greatly diminished, colors cannot be discriminated, and details are not easily discernible. Thus, in order to be seen at night, objects must be sufficiently brighter (or darker) than their backgrounds. The perceived brightness of an object, including an object with reflective properties, is, at least in part, dependent on its color.

The visible spectrum of light, which lies between the nonvisible ultraviolet and infra-red radiation, contains all colors. Color is the property of an object reflecting the light of a particular wavelength. The colors range from the longest wavelength, red, to the shortest wavelength, violet. The various cones (red, green, and blue) of the human visual system are selectively sensitive to different wavelengths of light, resulting in the perception of color. The unaided human eye is able to detect light (visible radiation) within a narrow band of the electronmagnetic spectrum between approximately 400 nanometers (nm) (violet end) and 780 nm (red end). The eye is most sensitive, however, to light in the wavelengths that stimulate both the red and green cones (approximately 500 nm to 650 nm, with peak sensitivity at approximately 550 nm, the wavelength corresponding to the color yellow-green). The eye is least sensitive to red or violet light at either extreme of the spectrum. Wavelengths between 500 nm and 650 nm, and particularly at about 550 nm (yellow-green), contribute most to the perception of color, as well as the definition of visual detail. As such, reflective materials with a color falling within the range of yellow-green peak sensitivity would provide the most visible contrast with the normally dark and dirty background of freight cars.

### *C. FRA's Studies of Freight Car Reflectorization*

FRA's study resulting in the 1999 Volpe Report consisted of a four-phase research program to determine the feasibility of reflectorization as a train conspicuity device. Specifically, the goals of the research were to: (1) Determine whether the new generation of reflective material (microprismatic retroreflective material) would provide adequate brightness in the railroad environment; (2) determine whether the new material could withstand the harsh environmental conditions of railroad operations; (3) establish the minimum intensity level required to attract a motorist's attention; and (4) assess the effectiveness of pattern placement on freight car detectability. After reviewing past and current transportation experiences with the use of reflectors, Volpe conducted a demonstration test to establish the durability of the newly developed microprismatic material, and to create a test pattern. Next, a nationwide in-service test was conducted to measure the microprismatic retroreflectors' performance, accident reduction potential, and costs. Finally, a human factors test was conducted to evaluate the detectability and recognition of several retroreflective designs.

First, Volpe reviewed past and current reflectorization experiences in the railroad environment. Specifically, Volpe surveyed the rail industry and identified several railroads and other industry participants, including the Burlington Northern Santa Fe (''BNSF''), the Soo Line, the Georgia Power Company, and Southern Company, that had already begun using retroreflective markings on at least some portion of their fleets. BNSF reported using a rail car marking system having retroreflective material on each end of freight cars and eleven 5x8 inch rectangular white diamond grade markings along the side sill of each side of its freight cars. Smaller 3x8 inch markings were reportedly used on car sides where surface space is limited, such as under boxcar doors. The Soo Line reported applying retroreflective material to its cars for advertisement purposes and to improve the safety of nighttime yard operations. The Georgia Power Company reported using twelve 3x12 inch yellow prismatic retroreflectors located at 42 inches above the top of the rail (''TOR'') on its coal hoppers since 1981, while the Southern Company reported using high intensity yellow retroreflective material on its open top hopper cars. Although none of railroads which responded to Volpe's survey conducted any formal evaluations of their marking systems, the Soo Line reported satisfaction with their program and that some of the retroreflective materials applied to cars in the mid 1960s still performed adequately.

Using information gleaned from previous studies of reflectorization, Volpe next established a minimum threshhold for reflector brightness (minimum SIA) to be used as a basis for evaluating reflector performance. For reflectorization to be effective in reducing RIT accidents, reflectors must be sufficiently bright to attract the attention of approaching motorists early enough in the approach path of the vehicles so that the drivers have time to react to avoid collisions. Accordingly, Volpe defined the minimum threshold of intensity as the lowest luminous value that allows a motorist to detect the presence of a retroreflector (and therefore a freight car equipped with a retroreflector) in a crossing, even if the motorist is not actively looking for a train. In developing this minimum threshold, Volpe took into account the effects of the harsh railroad operating environment, including the inherent dirt and grime that accumulates on rail cars and the effects of often severe weather conditions, as well as the aging of the retroreflective material and the orientation and configuration of rail cars. Utilizing visibility assumptions established by previous reflectorization studies (*i.e.*, a level approach grade, a 2.5 second driver reaction time, wet pavement, and a vehicle speed of 50 miles per hour), Volpe first concluded that a motorist must become aware of a train's presence when the vehicle is 500 feet from the crossing so that the vehicle can be brought to a safe stop.

Next, using the ''point source method'' upon which many guidelines for reflector intensity are built, Volpe determined that the minimum threshold illuminance level of $2.3 \times 10^{-6}$ footcandles would be sufficient to make a reflector detectable to most drivers. The ''point source method'' is based on the fact that astronomical observations have determined that a star producing an luminance of $2.3 \times 10^{-9}$ footcandles at the eye of an observer against an overcast moon sky illuminance, equal to $9.9 \times 10^{-4}$ footlamberts, can be detected with a 98% probability when the observer is actively looking for the light and knows precisely where to look for it. This level must be increased five to ten times if the light is to be easily found. (The FAA detection level for pilots is almost eight times this minimum threshold). If the light signal is to attract the attention of an observer who is not actively looking for it, then increases of 100 to 1,000 times the threshold level are needed—which is equivalent to $2.3 \times 10^{-6}$ footcandles. Accordingly, Volpe determined that an illumination level of $2.3 \times 10^{-6}$ footcandles should be sufficient to make the reflector detectable to all but the few drivers who are completely oblivious to their driving environment.

Finally, using several additional visibility assumptions established by previous research, Volpe used *Allard's Law* to determine the minimum reflector intensity (SIA) required to enable approaching motorists to detect and recognize a train's presence in a crossing from a distance of 500 feet. These assumptions include:

$E_e$= Required level of illuminance to be received by an observer sufficient for detectability & recognition—$2.3 \times 10^{-6}$ fc
W = Windshield Transmittance—0.70
H = Headlight Efficiency—0.85
$I_s$= Headlight Intensity—3,000 cd (per headlight)
$t^{2d}$ = Atmospheric Transmittance—0.945

Using these known assumptions and rearranging *Allard's Law* to solve for A, the area of the reflector, and B, the reflector's SIA (*i.e.*, $A*B = E_e*d^4/I_s*t^{2d}*W*H$), a range of values was determined. Specifically, assuming a vehicle is traveling 50 miles per hour on wet pavement, a 4x8 inch reflector (0.22 $ft^2$) must have a minimum reflector brightness (SIA) of 200 cd/fc/$ft^2$ for detection to occur in time for motorists to stop before entering the highway-rail grade crossing. A 4x36 inch (one square foot) reflector, however, must have an SIA of only approximately 45 cd/fc/$ft^2$ for detection to occur in time for motorists to stop before entering the crossing. These results demonstrate that for the same amount of illumination to attract the driver's attention, the smaller the area of the reflector (*e.g.*, 0.22 $ft^2$) the larger the required SIA of the reflector (*e.g.*, 200 cf/fc/$ft^2$). The same holds true for the opposite scenario, the larger the reflector area (*e.g.*, one square foot), the smaller the required SIA of the refector (*e.g.*, 45 cd/fc/$ft^2$).

The demonstration test was designed to evaluate the degradation in reflectivity of different reflective materials applied to freight cars under controlled conditions and to develop a test pattern. Three types of reflective materials (enclosed lens, bonded, and microprismatic retroreflective material) were tested. For the tests, nine open top hopper cars were treated with groups of three 4x4 inch diamond shaped markings placed near the side sill (at approximately 42 inches TOR). Each group of markings was comprised of the three types of materials being evaluated. Five more hopper cars had groups of two or three 4x2 inch rectangular markings attached to the wheels at 90, 120, or 180 degrees of separation. Only microprismatic material was used on the wheel application. One car had a 4x96 inch vertical strip applied to the corner post at each end of the car. All of the marking systems evaluated were either all white, all red, or a combination pattern of red and white.

Results of the demonstration test indicated that the white microprismatic material performed satisfactorily, while the enclosed lens and bonded materials did not. The microprismatic material had a much higher initial SIA value than the other two materials and was found to be ten times brighter than the material tested in 1982. In addition, after one year of service, the microprismatic retroreflective material maintained an SIA value that was 87% of the original measurement, which was well above the established minimum conspicuity threshold. The enclosed lens material lost approximately the same percentage of reflectivity as the microprismatic material, but due to its lower original SIA value, this loss was sufficient for it to fall below the minimum reflectivity required. The red microprismatic material degraded approximately the same as the white. However, none of the all red markings evaluated in the study met the minimum reflectivity requirements after one year. In addition, all of the materials placed on the wheels degraded very quickly and became ineffective in only a few months. Of the markings that were comprised of both red and white materials, only the performance of the vertical 4x96 inch strips of microprismatic material (applied to the corner posts of one car) was reported. The reflectivity of these markings decreased to about 67% of their initial value after one year. Because of the relatively large size of the markings, however, this amount of reflectivity was well above the conspicuity threshold level.

Based on the preliminary results of the demonstration test, larger scale trials, spanning approximately two years, were initiated in collaboration with Norfolk Southern Corporation and the Alaska Railroad Corporation. This in-service test allowed data collection of the retroreflective material's durability, performance, and accident reduction potential under in-service conditions. For these trials, two color combinations of microprismatic retroreflective material were selected based on the demonstration test and input from the railroads: A pattern of all white material and a pattern of alternating red and white material. The marking configuration selected consisted of three 4x8 inch white rectangular markings applied horizontally every nine feet just above the side sill (at approximately 42 inches TOR in most instances), and a 4x36 inch strip of red/white material applied vertically at the side sill on both ends of the cars. In 1991, the markings were applied to 29 tank cars carrying various petroleum products on the Alaska Railroad. Because of the curvature of the tank body, the markings were placed at 72 inches TOR. In January 1992, the markings were applied to 149 Norfolk Southern double-stack intermodal flat cars. Because of the limited surface area of these flat cars, the 4x8 inch markings were placed at 42 inches TOR, while the 4x36 inch markings were placed at 30 inches TOR. This was followed in March and April 1992 with 336 captive Norfolk Southern open top hopper cars and 74 boxcars in clay service, respectively, receiving the marking system.

Although the results of the in-service test showed that the harsh railroad operating environment could have a severe effect on the performance of the retroreflectors, Volpe identified a general correlation between reflector performance and height above TOR. Specifically, reflectors mounted highest on test cars performed the best, while reflectors mounted lower, and particularly below the side sill, did not perform as well. Finding little change in reflector performance due to dirt and grime accumulation above the side sill level (approximately 42 inches TOR), Volpe identified a minimum placement height as 42 inches TOR to allow maximum efficiency of reflector performance. The average performance of the vertical 4x36 inch reflective strips at the ends of the cars remained above the minimum threshold level for all car types for the entire testing period. The average performance of all 4x8 inch reflectors degraded more quickly, especially when mounted under the side sill or in mid-car locations where loading operations occur. Accordingly, Volpe concluded that any reflectorization pattern should minimize reflectors' location under the side sill and at loading points, and should utilize larger reflectors. Larger-size reflectors would lower the acceptable SIA level and would also degrade at a slower rate than the 4x8 inch reflectors.

Although the in-service test did not provide statistically valid results regarding the reflectors' accident reduction potential, the test did show a reduction in RIT accidents. During the three year period before the installation of the reflectors on the captive Norfolk Southern hopper cars, there were six accidents in which the motorist hit the side of the train after the first unit had passed through the crossing (*i.e.*, referred to as Category 1 RIT accidents). These accidents occurred during the hours of dawn, dusk, and darkness. During the three year period after the cars were reflectorized, no RIT accidents occurred.

The primary concern of the fourth phase of the research program, the human factors evaluation, was to develop a retroreflective pattern that is detectable in time for the motorist to recognize a train in the grade crossing and respond in time to avoid an accident. Specifically, the test was designed to determine the detection characteristics of the new microprismatic retroreflective material in various color and mounting configurations. Several potential placement patterns and color combinations were developed and analyzed to determine the most effective reflectorization configuration. Based on the outcome of both subjective and objective evaluation techniques, reflectorized freight cars were found to be significantly more detectable than non-reflectorized cars. Even the worst performing pattern and color configuration tested was several orders of magnitude better than an unreflectorized car. Generally, the results indicated that a uniform pattern of reflectorized material would facilitate motorists' detection of a hazard in his or her path and recognition of that hazard as a freight car. The results specifically indicated that a uniform vertical reflector pattern yielded the highest levels of detection and recognition and that a red/white color combination was preferable in order to facilitate motorists' recognition of a train as a hazard in the motorists' path and convey a sense of danger. In addition, distribution patterns that outlined the shape or that spaced the retroreflective material over a relatively large area of the rail car side were found to be superior to a distribution that concentrated the material along the bottom of the car. Accordingly, Volpe recommended the development of a standard pattern that: (1) Either outlined the shape of the freight car, or otherwise spaced the material over a large area of the rail car side; (2) could fit on all types of rail cars; and (3) would not likely be confused with other roadway hazards, particularly reflectorized trucks and trailers.

FRA addressed the issue of motorist confusion with the issuance of the 2001 Volpe Report. This study recognized that the previous study did not provide a realistic environment in which to evaluate the detectability and recognition of freight cars reflectorized with microprismatic retroreflective material. For example, in the 1999 study, observers did not see anything else in the scene that might be encountered in an actual driving environment (*e.g.*, signs, other vehicles, lights, foliage, buildings, *etc.*). In the real world, foliage, buildings, or other obstructions may block a motorist's view, or lights, signs, and other visual clutter may compete for a motorist's attention. In addition, with reflective materials in comon use on the nation's highways, the opportunity exists for motorists to confuse freight cars with other roadway hazards, particularly reflectorized truck trailers and respond inappropriately. NHTSA regulations require trucks more than 80 inches wide and weighing more than 10,000 pounds to be reflectorized (49 CFR 571.108). Specifically, the regulation requires the use of a strip (two to four inches wide) in alternating colors (red and white) and covering at least 50% of the length of the trailer. Because trucks are shorter in length and pass through an intersection more quickly than the average train, an approaching motorist may only need to slow the vehicle to avoid a collision instead of stopping prior to reaching the intersection. Conversely, because the average train is longer than the average truck, it spends a greater amount of time in the intersection. For motorists approaching a grade crossing, the greater amount of time the train spends in the intersection means it is more likely that the motorists will need to stop at the intersection. Accordingly, the 2001 study was designed to determine whether, at night when relying upon retroreflective patterns for identification, motorists are likely to confuse reflectorized trains with reflectorized trucks.

In the 2001 study, four patterns, each utilizing 144 square inches of reflective material, were evaluated: An outline, a horizontal strip, a vertical strip, and a variable height vertical strip. The outline pattern outlined the shape of the freight car. The horizontal strip pattern concentrated the retroreflective material along the side sill of the car. The vertical strip pattern (also known as the ''fence'' pattern), distributed the material in six equally-sized vertical strips over a relatively large area of the car sides. The variable height vertical strip pattern distributed the material in six varying-sized vertical strips over a relatively large area of the freight car sides. The patterns were placed on two types of freight cars, hopper cars and flat cars. The study measured the degree to which drivers recognized reflectorized freight cars in the grade crossing when both the motor vehicle and the train were in motion, and the driver's ability to discriminate reflectorized freight cars from other objects in the intersection.

The 2001 Volpe Report concluded that motorists could, at least to a certain extent, discriminate between reflectorized freight cars and reflectorized truck trailers for all of the patterns tested. The most effective patterns, in terms of detectability distance and recognition of the object as a freight car, however, were the fence pattern and the variable height vertical strip patterns. The report also concluded that using a vertically oriented pattern clearly distinguishable from the horizontally oriented patterns founds on truck trailers will minimize the likelihood that motorists will confuse a train in a grade crossing with a truck trailer.

*D. Accident Reduction Potential of Reflective Markings and Alternative Approaches to Reducing Grade Crossing Accidents*

FRA recognizes that the effectiveness of rail car reflectorization will, to a certain extent, vary by circumstance. As discussed earlier, various factors will influence the degree of effectiveness of reflectors and in turn, the resulting accident reduction and mitigation achieved. While all RIT accidents are potentially affected by reflectorization, those RIT accidents that result from a highway vehicle striking the train after the lead unit has entered the crossing (Category 1 RIT accidents) are the accidents most likely preventable by reflectorization. In particular, reflectorization is expected to be most effective in reducing nighttime Category 1 RIT accidents, which currently make up almost 70% of all Category 1 RIT accidents, despite the generally lower volume of highway traffic at night as compared to the daytime.

Although reflectorization of rail cars is expected to be most effective at nighttime, some daytime RIT accidents are also expected to be prevented, or at least mitigated, by reflectorization. Under conditions of reduced daytime visibility (*e.g.*, inclement weather), reflectors enhance the visibility of freight cars by providing an increased visible contrast with the freight car side wall, especially when an approaching motor vehicle's headlights are turned on. During the day, other light sources (*e.g.*, the sun), may be at an appropriate orientation to cause reflected light to be seen by the motorist.

The type of warning device at the crossing can also influence the effectiveness of reflectorization. Crossings with only passive devices, where almost 50% of all Category 1 RIT accidents occur, will benefit the most from reflectorization. Passive warning devices include signs (*e.g.*, crossbucks, stop signs, etc.) and other statically displayed information (*e.g.*, pavement markings) that warn motorists of the potential of a train at a crossing. Passive devices warn motorists that tracks are present; these devices do not indicate if a train is actually approaching or in the crossing. Reflectorization of rail cars improves the visual detection of the train by making its distance and relative state of motion more quickly and accurately gauged by drivers of other vehicles.

Crossings with active warning devices (*e.g.*, flashing lights, gates, etc.) will also receive some benefit from reflectorization. Each year over 200 accidents occur when motorists drive around lowered gates or past flashing lights and strike trains at highway-rail grade crossings. Under conditions of limited visibility, such as darkness or inclement weather, the added, unique visual signal offered by reflectors will augment the visual warning of flashing lights. The same rationale, although to a lesser extent, applies to crossings with gates. In many instances, a train standing in or passing through a crossing encompasses the motorist's entire field of view because of its size and proximity. The motorist may not see the train in the crossing because there is no contrast between the train and the surrounding environment. The motorist can look both ways, but because there is no detectable train movement, may still attempt to cross the track. Crossing warning devices, active or passive, only provide a warning to the motorist. The signal delivered by reflective material on the sides of rail cars is clear and indicates to approaching motorists the actual presence and current movement of a train in or through a crossing.

FRA also recognizes the existence of numerous other methods for reducing the occurrences of RIT accidents (*e.g.*, the elimination of highway-rail grade crossings, installation and upgrading of crossing warning devices, crossing illumination, etc.). FRA believes that a number of these alternatives used alone and in combination, are viable methods for mitigating collision risk at highway-rail grade crossings. However, FRA also believes that reflectorization of freight rolling stock is a feasible and cost-effective method of reducing and mitigating grade crossing accidents that provides unique safety benefits not obtainable with the other grade crossing warning devices and safety measures. Obviously, the most effective way to reduce highway-rail grade crossing accidents, RIT accidents or otherwise, is to eliminate highway-rail grade crossings. Closing access to highway-rail crossings where redundant or unnecessary crossings exist or constructing grade separating overpasses where necessary is an effective safety improvement. However, local opposition to closing crossings and the associated expenses with constructing grade separations or other alternatives to the crossings, often render these methods impractical, if not impossible. Efforts have also been underway in recent years to illuminate crossings with street lamps. It is generally believed that crossing illumination reduces the likelihood of RIT accidents (by enabling motorists to recognize a train in a crossing earlier), at a lower cost than that required to install active warning systems. To date, however, limited cost information is available and no specific effectiveness or accident reduction statistics have been developed. In addition, an obvious limit to crossing illumination is the unavailability of commercial power sources at some crossings, particularly rural, passively protected crossings. Without a commercial power source, a crossing illumination system may require its own energy generating and storage device and train detection equipment, often making it a cost-prohibitive measure.

*E. Discussion of Comments*

The public docket in this proceeding contains approximately 55 comments from interested parties, including members of the railroad industry, trade organizations, local governments, public interest organizations, reflective material manufacturing and supply companies, as well as members of the general public. Specifically, comments were received from the following organizations: The American Trucking Association (ATA), the Texas Motor Transportation Association, Niagara Bulk Service Limited, the Port of Woodland, the Conway Scenic Railroad, the Brotherhood of Maintenance of Way Employees (BMWE), the American Automobile Association (AAA), the City of Hudsonville in Michigan, Reidler Decal Corporation, 3M, Reflexite, the American Highway Users Alliance, the Tourist Railroad Association, the Association of American Railroads (AAR), Avery Dennison, Great Lakes Transportation LLC, the Railway Progress Institute (now known as the Railway Supply Institute (RSI)), the American Short Line and Regional Railroad Association (ASLRRA), the North American Freight Car Association (NAFCA), the National Industrial Transportation League, as well as TTX. Although the majority of comments submitted were in favor of reflectorization, some members of the railroad industry raised important considerations related to the implementation of a nationwide rail car reflectorization program.

Several individual members of the public and organizations of concerned citizens (including the Angels on the Track Foundation and Active People Against Railroad Tragedies), voiced strong support for a nationwide rail car reflectorization program. These commenters related stories of personal tragedy in which friends or loved ones were injured or killed as a result of grade crossing accidents—specifically, grade crossing collisions in which the motor-vehicle drivers apparently did not see a train in the path of their vehicles in time to react to avoid collisions. FRA has the greatest sympathy for the losses suffered by these commenters. The goal of this rulemaking is to reduce the number of RIT accidents, but rules must be based on consideration of evidence and data. Accordingly, this preamble focuses on the technical and economic aspects of rail car reflectorization. FRA, however, has not ignored the advice of those whose tragic personal experiences has led them to support this proposal addressing rail car conspicuity.

Other commenters expressing support for a nationwide freight car reflectorization program include municipalities, trade organizations such as the ATA and the Texas Motor Transportation Association, and other organizations concerned with safe and efficient highway transportation (including AAA and the American Highway Users Alliance). These commenters expressed the view that the issue of highway-rail grade crossing safety is an issue that affects not only the railroad industry, but the entire motoring public as well, including individual motorists and commercial motor carriers which traverse grade crossings on a daily basis. Specifically, the ATA expressed support for the December 1999 petition for rulemaking filed by the South Dakota Trucking Association, the Wyoming Farm Bureau Federation, the Wyoming Trucking Association, and the Mississippi Trucking Association which sought to require railcars to bear retroreflective sheeting. These commenters also pointed out the prevalence of unlighted, passively protected highway-rail grade crossings in rural communities and the particular vulnerability of these types of crossings to RIT accidents.

The BMWE, a rail labor organization, also submitted comments in support of rail car reflectorization. The BMWE cited the federal highway rule requiring reflectorization of large trucks as evidence of the benefits which could be derived from rail car reflectorization (*e.g.*, reduced property damage and reductions in injuries and deaths associated with RIT accidents). The BMWE also expressed its agreement with FRA's conclusion that reflectorization represents a cost-effective approach to mitigating the problem of RIT accidents. Another commenter, although acknowledging some of the inherent difficulties in implementing a nationwide reflectorization program (*e.g.*, catching up with specific rail cars to apply reflective material, reflector maintenance and cleanliness issues), expressed support for rail car reflectorization and suggested that FRA adopt NHTSA's standards for reflective material on commercial vehicles.

Railroad industry participants, such as the AAR, Great Lakes Transportation LLC (which submitted comments on behalf of two class II carriers, Bessemer and Lake Erie Railroad Company and the Duluth, Missabe and Iron Range Railway Company), RSI, the ASLRRA, as well as NAFCA, raised important considerations related to implementation of a nationwide rail car reflectorization program (*e.g.*, a feasible schedule for the application of reflectors to rail cars, reflector cleaning and maintenance requirements, the treatment of rail cars already equipped with reflective material pursuant to one of the many voluntary reflectorization programs already underway throughout the industry). These commenters also expressed the opinion that a federal regulation mandating reflectorization would not be a cost-effective safety measure given the costs railroads and car owners would incur implementing such a program (*e.g.*, the costs of initially installing the material, periodically inspecting, cleaning, and maintaining the material, and the potential for increased litigation exposure).

The ASLRRA and Great Lakes Transportation LLC (which submitted comments on behalf of two class II carriers, Bessemer and Lake Erie Railroad Company and the Duluth, Missabe and Iron Range Railway Company), additionally expressed the opinion that a Federal regulation mandating rail car reflectorization would be unduly burdensome and costly on small railroads. One commenting railroad, however, recognized that adopting a high visibility, common color scheme on rail equipment could reduce accidents at highway-rail grade crossings. A representative of another small railroad, the Conway Scenic Railroad in New Hampshire, suggested that railroads should make their locomotives and cars more visible and that reflectorization could be a practical method of doing so. This commenter, however, recognized the limits of any program designed to enhance the visibility of trains, including reflectorization, and explained that ''[t]he most visible train is only as safe as the motor vehicle operator who encounters it.'' FRA strongly agrees with this statement and recognizes that reflectorization will provide only a partial solution to the safety issues surrounding highway-rail grade crossings. FRA recognizes, and feels it worthy of emphasis, that nothing in this rule relieves motorists from the responsibility to be alert at highway-rail crossings and use due diligence in operating motor vehicles safely, even during times of limited visibility.

*F. The Proposed Rule*

Based upon the information currently available, FRA believes that reflectorization of rail freight rolling stock is a feasible method of enhancing rail car visibility that would likely improve safety in a cost-effective manner. Accordingly, as the Federal agency responsible for ensuring that America's railroads are safe for the traveling public and in direct response to the Congressional directive of 49 U.S.C. 20148, FRA is proposing to require the use of reflective material on the sides of certain rail cars and locomotives.

Generally, this rule proposes that all freight cars and locomotives that operate over a public or private highway-rail grade crossing in the United States in revenue or work train service be equipped with retroreflective sheeting on both sides. This rule contemplates that conforming retroreflective sheeting will be applied to freight cars on a fleet basis so that each segment of the freight car fleet is brought into compliance within ten years, and each segment of the locomotive fleet is brought into compliance within five years. To ensure the most efficient and cost-effective implementation of the rule, FRA proposes that retroreflective sheeting be applied to new freight rolling stock at the time of construction, and to existing stock when such stock is being repainted, rebuilt, or is undergoing other periodic maintenance.

This rule proposes specific color, construction, placement, and performance requirements for the required retroreflective sheeting and also sets forth a schedule for the application, inspection, and maintenance of the sheeting. The performance requirements set forth in this proposal are based on the material as it is initially applied. In other words, FRA has chosen to impose color, type, size, and placement requirements that ensure sufficient reflectivity will be retained over time, despite the harsh railroad operating environment. The amount and placement of retroreflective sheeting required to be applied to freight rolling stock pursuant to this part depends on the size of the freight car or locomotive, as well as the car type. Generally, however, this rule proposes a vertical pattern of retroreflective material along the entire side of freight rolling stock, as the physical configuration of various equipment types allows.

In drafting this rule, FRA has carefully considered the comments submitted to the docket of this proceeding and has attempted to devise a rule which will ensure the most efficient and cost-effective implementation of a nationwide reflectorization program which will provide valuable safety benefits to both the railroad industry and the motoring public. FRA anticipates that many constructive comments will result from public analysis of this proposal and that the proposed rule may be changed as a result of the public input. As such, FRA invites public comments on all aspects of this proposed rule.

Section-by-Section Analysis

*Section 224.1 Purpose and Scope*

This section contains a formal statement of the proposed rule's purpose and scope. FRA intends that the rule cover all aspects of reflectorization of freight rolling stock, including but not limited to, the size, color, placement, and performance standards of the reflective material, as well as the schedule for the application, inspection, and maintenance of the material.

Paragraph (a) states that the proposed rule is intended to reduce highway-rail grade crossing accidents, deaths, injuries, and property damage resulting from those accidents by enhancing the conspicuity of rail freight rolling stock as to increase its detectability by motor vehicle operators at night and under conditions of poor visibility. Paragraph (b) explains that the proposed rule establishes the duties of freight rolling stock owners and railroads to progressively apply retroreflective material to freight rolling stock, and to periodically inspect and maintain that material in order to achieve cost-effective mitigation of collision risk at highway-rail grade crossings. Paragraph (c) explains that the proposed rule establishes a schedule for the application of retroreflective material to rail freight rolling stock and prescribes standards for the application, inspection, and maintenance of retroreflective material to rail freight rolling stock for the purpose of enhancing its detectability at highway-rail grade crossings. This rule will not restrict freight rolling stock owners from applying retroreflective material to freight rolling stock on an accelerated schedule, nor will this rule restrict freight rolling stock owners from applying additional reflective material as long as any such additional material does not interfere with the recognizable pattern contemplated in proposed § 224.105. Freight rolling stock owners, however, are under no duty to install, maintain, or repair reflective material except as specified in this rule.

*Section 224.3 Applicability*

This section proposes that this rule apply to all freight cars and locomotives used for revenue or work train service that operate over a public or private highway-rail grade crossing and are used for revenue or work train service. FRA is aware that cars with Canadian reporting marks are used extensively within the United States. Transport Canada has previously administered a reflectorization program for Canadian cars, and FRA expects that Transport Canada will take actions in parallel with this proposal to handle the North American fleet.

This part will not apply to (1) freight railroads that operate only on track inside an installation that is not part of the general railroad system of transportation, (2) rapid transit operations within an urban area that are not connected to the general system of transportation, or (3) locomotives or passenger cars used exclusively in passenger service. Although FRA recognizes that both public and private grade crossings may be found on plant railroads and freight railroads that are not part of the general railroad system of transportation, these operations typically involve low speed vehicular traffic and FRA has not determined that reflectorization would be helpful in these areas. These reasons, together with the historical basis for not asserting jurisdiction over insular rail operations, leads FRA to propose not to exercise jurisdiction over public and private crossings at such plant and private railroads. FRA does, of course, retain the statutory right to assert jurisdiction in this area and will do so if circumstances warrant.

Paragraph (c) provides that this rule will not apply to locomotives and passenger cars used exclusively in passenger service. FRA proposes to exclude locomotives and passenger cars used exclusively in passenger service from this rule because the conspicuity issues attendant to passenger service are significantly different from those of freight service. For example, particularly in commuter service, the highway-rail grade crossings through which passenger trains operate are typically better protected than crossings used exclusively in freight service. Also, many passenger cars have bright stainless steel exteriors or are painted contrasting light colors and are maintained in a much cleaner condition than freight cars. Passenger cars typically have inside lights which are visible through side windows that run the entire length of the cars. Although FRA does not at this time propose to require the application of reflective material to locomotives and passenger cars used exclusively in passenger service, FRA may do so in a future rulemaking if it proves a cost-effective method of mitigating collision risk at highway-rail grade crossings.

As in all aspects of this proposed rule, FRA invites comments on the jurisdictional determinations proposed in this notice.

*Section 224.5 Definitions*

This proposed rule uses various terms, which for purposes of this rulemaking, have very specific meanings. FRA intends these definitions to clarify the meaning of important terms as they are used in the text of the proposed rule and several of these definitions warrant further discussion.

''*Freight rolling stock*'' includes any locomotive subject to 49 CFR part 229 used to haul or switch freight cars in revenue or work train service and any railroad freight car subject to 49 CFR part 215, including a car stenciled MW pursuant to § 215.305. Although FRA proposes to limit the definition of ''freight rolling stock'' to locomotives and freight cars, FRA requests comments on the potential utility and practicability of reflectorizing other rail equipment, such as specialized maintenance of way vehicles (particularly maintenance of way vehicles not falling within the purview of subpart D to 49 CFR part 214) or any other rail equipment used to haul freight cars. FRA specifically requests data demonstrating what, if any, other types of rail equipment (other than locomotives subject to 49 CFR part 229) are used to haul freight cars and the potential feasibility of reflectorizing such equipment and any data and/or relevant comments related to the conspicuity of maintenance of way equipment which is not subject to 49 CFR part 214 (*e.g.*, how often is this equipment involved in grade crossing accidents, what, if any, conspicuity devices are already utilized on this equipment, would it be practicable to equip these vehicles with retroreflective material, *etc.*).

*''Freight rolling stock owner''* is defined to include any person who owns freight rolling stock, leases freight rolling stock, manages the maintenance or use of freight rolling stock on behalf of an owner or one or more lessors or lessees, or who otherwise controls the maintenance or use of freight rolling stock. This definition recognizes the practicalities of freight car ownership in the industry today. It is estimated that over one-half of all freight cars are privately owned. This number continues to increase. Because private freight car owners often contract with others to maintain their cars and may not even see their cars on a regular basis, this definition contemplates that those who control the maintenance or use of freight cars by contractual agreements or otherwise, will also be responsible for compliance with this part in conjunction with the actual owners of the cars.

''*Obscured*'' means, for purposes of this part, concealed or hidden. Specifically excluded from this definition are ordinary accumulations of dirt, grime, or ice resulting from the normal railroad operating environment. FRA recognizes that the harsh railroad operating environment inevitably results in dirt accumulating on the sides of freight rolling stock. The standards for retroreflective material set forth in this part take into account this ordinary accumulation. The term ''obscured,'' however, is intended to refer to situations where reflective material is covered by paint, a dense chemical residue, or any other foreign substance, such that the material no longer reflects light. For example, FRA understands that the sides of coal cars will accumulate coal dust and other dirt over time due to the nature of normal railroad operations. An accumulation of coal dust or other dirt, even if it significantly darkens and dirties the retroreflective material, will not cause the material to be ''obscured'' for purposes of this rule. The standards proposed in this rule account for the effects of accumulations of dirt and grime inherent in the railroad operating environment, the aging of the reflective material, and other adverse effects of the operating environment (*e.g.*, harsh weather conditions). FRA believes that reflective material meeting the requirements of this rule when initially applied will still provide adequate reflectivity throughout the manufacturers' stated useful life despite inevitable accumulations of dirt. If, however, retroreflective material is covered with paint (*e.g.*, graffiti), a dense chemical residue (*e.g.*, product spilled from a tank car), or any other foreign substance, other than dirt or grime, which effectively blocks all incoming light, that material would be considered ''obscured'' under this part.

In order to ensure that the requirements of this part would be practicable for each type of freight car to which they apply, FRA has included definitions for railroad freight car, flat car, and tank car. The proposed requirements for each type of car differ based on configurational differences between the vehicles in those groups. FRA believes that almost 99% of the freight car fleet that would be subject to this rule falls within one of these three definitions. The remaining 1% of the fleet that does not fall within one of these definitions is provided for in § 224.105(a)(4) addressing ''cars of special construction.'' FRA requests comments on the use of these definitions, specifically, whether these definitions are adequate to identify car types for purposes of this rule or whether commenters have other definitions that they would prefer.

*Section 224.7 Waivers*

This section explains the process for requesting a waiver from a provision of this rule. FRA has historically entertained waiver petitions from parties affected by an FRA regulation. In reviewing such requests, FRA conducts investigations to determine if a deviation from the general regulatory criteria can be made without compromising or diminishing safety.

The rules governing the FRA waiver process are found in 49 CFR part 211. In summary, after a petition for a waiver is received by FRA, a notice of the waiver request is published in the **Federal Register**, an opportunity for public comment is provided, and an opportunity for a hearing is afforded the petitioning or other interested party. FRA, after reviewing information from the petitioning party and others, will grant or deny the petition. In certain circumstances, conditions may be imposed on the grant of a waiver if FRA concludes that the conditions are necessary to assure safety or if they are in the public interest.

*Section 224.9 Responsibility for Compliance*

General compliance requirements are proposed in this section. Paragraph (a) states that freight rolling stock owners (as defined in § 224.5), railroads, and (with respect to certification of material) manufacturers of retroreflective material, are primarily responsible for compliance with the rule. The responsibility of manufacturers is discussed in more detail in the analysis of proposed § 224.103(a) below.

Paragraph (a) also clarifies FRA's position that the requirements contained in the rule are applicable to any ''person'' (as defined in the rule) that performs any function or task required by the proposed rule. Although various sections of the rule address the duties of freight rolling stock owners, railroads, and manufacturers of retroreflective material, FRA intends that any person who performs any action on behalf of any of these parties or any person who performs any action covered by the rule is required to perform that action in the same manner as required of the freight rolling stock owner, railroad, or manufacturer, or be subject to FRA enforcement action. For example, employees or agents of freight rolling stock owners, or railroad contractors that perform duties covered by these regulations would be required to perform those duties in the same manner as required of a freight rolling stock owner or railroad. Likewise, employees or agents of manufacturers of retroreflective sheeting being manufactured pursuant to this part, would be required to perform those duties in the same manner as the manufacturer.

Paragraph (b) states that any person performing any function or task required by this part will be deemed to have consented to FRA inspection of the person's facilities and records to the extent necessary to ensure that the function or task is being performed in accordance with the requirements of this part. This provision is intended to put freight rolling stock owners, railroads, manufacturers, and contractors performing functions or tasks required by this part on notice that they are consenting to FRA's inspection for rail safety purposes of that portion of their facilities and records relevant to the function or task required by this part. Pursuant to 49 U.S.C. 20107, FRA has the statutory authority to inspect any facilities and relevant records pertaining to the performance of functions or tasks required under this part, and this provision is merely intended to make that authority clear to all persons performing such tasks or functions.

*Section 224.11 Civil Penalties*

This section identifies the civil penalties that FRA may impose upon any person that violates any requirement of this part. These penalties are authorized by 49 U.S.C. 21301, 21302, and 21304. The penalty provision parallels penalty provisions included in numerous other safety regulations issued by FRA. Essentially, any person who violates any requirement of this part or causes the violation of any such requirement will be subject to a civil penalty of at least $500 and not more than $11,000 per violation. Civil penalties may be assessed against individuals only for willful violations, and where a grossly negligent violation or a pattern of repeated violations creates an imminent hazard of death or injury to persons, or causes death or injury, a penalty not to exceed $22,000 per violation may be assessed. In addition, each day a violation continues will constitute a separate offense. Maximum penalties of $11,000 and $22,000 are required by the Federal Civil Penalties Inflation Adjustment Act of 1990 (Pub. L. 101–410) (28 U.S.C. 2461 note), as amended by the Debt Collection Improvement Act of 1996 (Pub. L. 104–134, 110 Stat. 1321–373) which requires each agency to regularly adjust certain civil monetary penalties in an effort to maintain their remedial impact and promote compliance with the law.

*Section 224.13 Preemptive Effect*

This section informs the public as to FRA's intention regarding the preemptive effect of the final rule. While the presence or absence of such a section does not conclusively establish the preemptive effect of a final rule, it informs the public concerning the statutory provisions which govern the preemptive effect of the rule.

This section points out that the preemptive effect of this rule is governed by 49 U.S.C. 20106 (''section 20106''). Section 20106 provides that all regulations prescribed by the Secretary relating to railroad safety preempt any State law, regulation, or order covering the same subject matter, except a provision necessary to eliminate or reduce an essentially local safety hazard that is not incompatible with a Federal law, regulation, or order, and that does not unreasonably burden interstate commerce. With the exception of a provision directed at an essentially local safety hazard that is not inconsistent with a Federal law, regulation, or order, and that does not unreasonably burden interstate commerce, section 20106 will preempt any State or local law or regulatory agency rule covering the same subject matter as the regulation proposed today when issued as a final rule.

The Supreme Court has consistently interpreted section 20106 to confer on the Secretary the power to preempt not only State statutes, but State common law as well. *See CSX Transp.* v. *Easterwood,* 507 U.S. 658, 664 (1993) (''(L)egal duties imposed on railroads by the common law fall within the scope of (the) broad phrases' of section 20106.). *See also Norfolk Southern Ry. Co.* v. *Shanklin,* 529 U.S. 344 (2000). The Court has further held that Federal regulations under the Federal Railroad Safety Act will preempt common law where the regulations ''substantially subsume'' the subject matter of the relevant State law. *Easterwood,* 507 U.S. at 664.

As is evident in the language of proposed § 224.1, FRA intends to cover the subject matter of standards for the use of retroreflective materials on freight rolling stock and the specific duties of freight rolling stock owners in this regard. FRA intends this part to preempt any State law, rule, or regulation, or common law theory of liability that might attempt to impose a duty on freight rolling stock owners pertaining to the reflectorization of freight rolling stock that is not specifically set forth in this part. For example, FRA intends to preempt any State law or common law theory of liability which might attempt to impose a duty on freight rolling stock owners to apply additional retroreflective material other than that specified in this part, to apply retroreflective material on a different schedule than that specified in this part, or to inspect, or maintain retroreflective material on a more frequent basis than that specified in this part. Inference of any duties not specifically set forth in this part may cause the costs of the proposed rule to outweigh the safety benefits of the rule in direct conflict with the Congressional mandate of 49 U.S.C. 20148 (requiring that FRA initiate a rulemaking proceeding prescribing regulations requiring enhanced visibility standards for railroad cars if such regulations would likely improve safety in a cost-effective manner).

*Section 224.15 Special Approval Procedures*

This section contains the procedures to be followed when seeking to obtain FRA approval of alternative standards under proposed § 224.103(e). FRA anticipates continued technological improvements and product advances in the field of reflective materials. Accordingly, this section is intended to provide a relatively quick approval process to allow the incorporation of new technology into the standards of this part, thereby making the technology available to all car owners and railroads, while maintaining the same level of safety originally contemplated. FRA believes this proposed procedure will speed the process for taking advantage of new technologies over that which is currently available through the waiver process. However, in order to provide an opportunity for all interested parties to provide input for use by FRA in its decision making process, as required by the Administrative Procedure Act, 5 U.S.C. 553 *et seq.*, (APA), FRA believes that any special approval provision must, at a minimum, provide proper notice to the public of any significant change or action being considered by the agency with regard to the existing regulations.

Paragraph (b) sets forth the substantive and procedural requirements for petitions for special approval of alternative standards. For example, paragraph (b) states that each petition must contain (1) relevant identification and contact information of the primary person to be contacted with regard to the petition, (2) a detailed description of the alternative proposed, and (3) sufficient data and analysis establishing that the alternative will provide at least an equivalent level of safety and meet the requirements of § 224.103(e). Paragraphs (c) and (d) provide opportunity for notice and public comment on any petition for special approval of an alternative standard received by FRA, and paragraph (e) describes the process FRA will follow in acting on any such petitions.

Subpart B—Application, Inspection, and Maintenance of Retroreflective Material

*Section 224.101 General Requirements*

This section contains the general requirement that all rail freight rolling stock subject to this part be equipped with retroreflective sheeting conforming to the requirements of this rule and that the sheeting be applied, inspected, and maintained in accordance with subpart B or in accordance with an alternative standard approved under § 224.15. This general requirement reflects FRA's understanding that motorists need to be given as much visual information as possible to correctly decide whether a roadway hazard (*e.g.*, a train) exists in a vehicle's path. Specifically, devices intended to make a train conspicuous should: (1) Tell the motorist that something is there, (2) tell the motorist that what he or she sees is a train, (3) tell the motorist if the train is on or about to cross a road in the vehicle's path, (4) aid the motorist in estimating the distance he or she is from the train, and (5) aid the motorist in estimating the speed and direction of the train's motion. FRA believes that the retroreflective sheeting contemplated in this subpart B, applied and inspected in conformance with this part, effectively achieves these objectives.

*Section 224.103 Characteristics of Retroreflective Sheeting*

This section sets forth the proposed construction, color, and performance standards for the retroreflective sheeting required by § 224.101. Paragraph (a) states that retroreflective sheeting must be constructed of a smooth, flat, transparent exterior film with microprismatic elements embedded or suspended beneath the film so as to form a non-exposed retroreflective optical system. Paragraph (a) also provides that air encapsulated sheeting must be sealed around all edges. FRA understands that air encapsulated sheeting that is not sealed on all edges will allow water to seep between the layers of the product. Over time, due to the normal railroad operating environment, this water will freeze and expand, causing layers of the sheeting to peel.

Paragraphs (b) and (c) propose to require that the retroreflective sheeting meet the color and performance requirements, except for the photometric requirements, of the American Society of Testing and Measurements' (ASTM) standard D 4956–01, *Standard Specification for Retroreflective Sheeting for Traffic Control.* ASTM D 4956–01 has been chosen as the basis for the FRA specification because FRA understands it to be the specification that manufacturers of retroreflective sheeting are following in their current manufacturing process. NHTSA's rule requiring reflectorization of large truck trailers (49 CFR 571.108) is also based on this ASTM standard. Information provided by several retroreflective sheeting manufacturers indicates that the products of most manufacturers currently meet the performance requirements of this proposed rule, and FRA has no reason to believe that other manufacturers could not meet the performance standards if there was a market for the product. In addition, because FRA is requiring that retroreflective sheeting meet the requirements of ASTM D 4956–01 only as initially applied and does not propose to require specific minimum reflectivity for vehicles in service, FRA believes that highly durable sheeting meeting the performance tests of the ASTM standard is required. It is less costly to install durable material than it would be to install less durable material but be required to regularly test its performance relative to a performance standard.

Specifically, paragraph (b) requires that the retroreflective sheeting be yellow as specified by the chromaticity coordinates of ASTM D 4956–01. As explained above, the human eye is more sensitive to some colors than others. This color sensitivity can vary in different lighting situations, making some colors more noticeable at different times of the day. Although the 1999 Volpe Report concluded that a pattern of red-and-white reflectors was preferred to facilitate motorists' recognition of a hazard as a train and convey a sense of danger, FRA proposes to require yellow retroreflective material as specified by the chromaticity coordinates of ASTM D 4956–01. FRA proposes to require yellow retroreflective material because the spectral measurement of the color (approximately 550 nm) is within the peak sensitivity range of the human visual system and accordingly, it is one of the most easily detectable colors under varying ambient light and other environmental conditions (*e.g.*, darkness, fog, haze, etc.). In addition, the color yellow minimizes the risk of motorist confusion with the colors of other roadway hazards (*e.g.*, red and white reflectors on trucks) and is not a color prevalent in most background environments.

In comments submitted to the docket, 3M, a manufacturer of retroreflective materials, recommended the use of a high contrast colored corner cube retroreflective material with a spectral measurement within the peak sensitivty range of the human visual system (*e.g.*, yellow/green) and fluorescent properties. 3M explained that the efficient corner cube retroreflective material would aid nighttime visibility and the fluorescent properties would provide additional daytime luminance. Although FRA's own research found that fluorescent yellow retroreflective material had the highest SIA value of all materials tested and could be detected from a further distance than any of the other materials, because the duration of fluorescent pigments is substantially less than the ten-year reflector product guarantee, FRA is not proposing to require the use of fluorescent-colored retroreflective material at this time. However, if a fluorescent retroreflective material meets all of the requirements of this part, its use is acceptable.

Paragraph (c) requires that retroreflective sheeting applied in accordance with the rule meet all the performance requirements, except for the minimum photometric performance requirements, of ASTM D 4956–01. The minimum photometric performance requirements (*i.e.*, minimum SIA) of the FRA standard are set forth in Table 1 of the proposed rule. The proposed values were developed to perform above the minimum detection threshold of 45 cd/fc/ft$^2$ identified in the 1999 Volpe Report as necessary to enable most motorists to detect a train in time to avoid a collision. Recognizing that in the real world railroad operating environment, the effective SIA of retroreflective materials depends on various factors (*e.g.*, grade crossing configurations and angles, ambient light conditions, vehicle headlight type and lens cleanliness, weather, and the presence and working condition of illumination and other warning devices) and may be reduced because of accumulated dirt and grime, the proposed minimum photometric performance requirements take into account these varying factors. Specifically, extrapolating the test data detailed in the Volpe Report out ten years, the manufacturers' stated useful life of the material, FRA found that the forecasted SIA levels remained well above the minimum detection level established in the 1999 Volpe Report. In addition, although the primary degradation in the SIA of the material occurs during the first two years as a result of ultraviolet light exposure, after which the material maintains a relatively consistent intensity throughout its useful life, FRA forecasted SIA degradation of the material due to dirt and grime accumulation exponentially. As a result, FRA's analysis substantially overestimates the degradation rate of the material and even with this overestimation, the expected SIA values remain well above the minimum detection level identified in the 1999 Volpe Report.

Table 1 specifies the minimum photometric performance requirement (*i.e.*, minimum required SIA) for yellow retroreflective material at observation angles of 0.2° and 0.5° and light entrance angles of −4° and 30° based on ASTM D 4956–01. FRA's Grade Crossing Inventory identifies crossings into three categories of crossing angles: 60–90°, 30–59°, and 0–29°. Approximately 80% of all crossings have crossing angles between 60 and 90°, almost 17% have crossing angles between 30 and 59°, and only 4% have crossing angles less than 30°. Accordingly, the requirements of Table 1 ensures that the retroreflectors will perform above the minimum detection threshold for the average motor vehicle at approximately 97% of all crossings.

Although the minimum photometric performance requirements set forth in the proposal are specific to yellow microprismatic retroreflective material, FRA recognizes that many car owners who currently reflectorize their cars have used white microprismatic retroreflective material. If FRA alternatively required the use of white retroreflective material, the minimum photometric performance requirements (based on a required detection distance of 500 feet) for the retroreflective material would be as follows:

| Entrance angle | Observation angle | |
|---|---|---|
| | 0.2° | 0.53° |
| −4° | 600 | 160 |
| 30° | 350 | 75 |

Minimum Photometric Performance (Coefficient of Retroreflection ($R_A$) in Candela/Lux/Meter$^2$) Requirement for White Retroreflective Sheeting.

FRA requests commenters' views as to the desirability of using white versus yellow retroreflective material and further solicits comments and alternative suggestions to the proposed construction, color, and performance requirements of this section.

The responsibility for compliance with the construction, color, and performance requirements of the retroreflective sheeting used to comply with this rule would rest upon the manufacturers of the sheeting. Thus, manufacturers who are providing retroreflective sheeting to the railroad industry would have to certify compliance with § 224.103. Paragraph (d) sets forth this certification requirement and would require that the characters ''FRA–224'' be permanently stamped, etched, molded, or printed, in characters at least 3 mm high, with each set of characters spaced no more than four inches apart, on each piece of retroreflective sheeting manufactured.

Although, the proposed rule generally requires application of retroreflective sheeting meeting the specific construction, color, and performance requirements of § 224.103(a) through (c), paragraph (e) of this section recognizes that under § 224.15, freight rolling stock owners and railroads may request FRA approval to use alternative standards. As discussed in the analysis of § 224.15 above, any alternative standard utilized must result in an equivalent level of safety as the sheeting described in 224.103(a) through (c) applied in accordance with the rule.

*Section 224.105 Size and Location*

This section proposes to make the amount and placement of retroreflective sheeting required to be applied to freight rolling stock pursuant to this part dependent on the size of the car or locomotive, as well as the car type. A primary concern in developing the proposed standards of this part was developing a retroreflective pattern that is detectable in time for an approaching motorist to recognize a train in the grade crossing and respond appropriately in time to avoid an accident. Another concern was the potential for motorist confusion as more potential roadway hazards (particularly truck trailers) benefit from the addition of reflectorization. Accordingly, recognizing that a unique, uniform pattern of application is necessary to facilitate recognition of rail cars and that the placement of retroreflectors affects their performance, this section proposes a specific pattern of application, striving to achieve as uniform a pattern as possible throughout the relevant fleet, while taking into consideration the configurational differences between various types of freight rolling stock. Although a vertical pattern of retroreflective material along the entire side of freight cars is proposed, FRA recognizes that the physical configuration of locomotives and the conspicuity issues surrounding locomotives are different. Accordingly, in paragraph (b) of this section, FRA proposes a more flexible approach to the reflectorization of locomotives.

As discussed earlier in the preamble, the general consensus of research pertaining to retroreflective materials is that retroreflective materials can increase the conspicuity of objects to which they are attached. FRA, however, found little existing research that suggested how retroreflective materials should be displayed on rail cars to maximize the conspicuity of the cars for approaching motorists. Early studies suggested that massed applications (concentrating retroreflective material in one or two locations) were more effective than those applications that were distributed over a wider area. More recent studies assessing the effectiveness of retroreflective markings on trucks used the newer prismatic materials and concluded that providing a design that outlined the shape of the vehicle increases conspicuity.

The recommendation to use an outline shape was based in part on the need of a motorist to estimate closing distance when following behind a truck. However, motorists' interaction with trains is different from trucks. Because trucks are shorter in length and pass through an intersection more quickly than the average train, the motorist may only need to slow his or her vehicle to avoid a collision instead of stopping prior to reaching the intersection. Conversely, because the average train is longer than the average truck, it spends a greater amount of time in the intersection. For a motorist approaching a grade crossing, the greater amount of time the train spends in the intersection means the more likely the motorist will need to stop at the intersection in order to avoid a collision.

FRA's own research concluded that either a pattern that outlined the shape of the railroad equipment, or a vertically-oriented pattern that spaced retroreflective material uniformly over a large area of the equipments' side, was most effective. Based on the results of studies investigating truck reflectorization, the specific findings of FRA's targeted research, as well as input from the railroad industry and manufacturers of retroreflective material, FRA is proposing in this section what it believes to be the optimum placement patterns of retroreflective material on freight rolling stock. The proposed placement patterns in this section are designed to maximize the effectiveness of the material, allow retroreflectorization of a variety of freight car types with the same generally recognizable pattern, and also minimize the degradation rate of the material. In addition, other practical advantages to a standardized reflectorization pattern include the potential for volume discounts on the costs of materials and minimizing labor costs by standardizing the repair and installation of the material.

This section proposes a vertical pattern of retroreflective sheeting on the sides of freight cars, where the physical configuration of the car allows, with strips of sheeting to be located as close to each end of the car as practicable and at equidistant intervals of not more than 10 feet. This pattern is intended to alert an approaching motorist to the approximate dimensions of the hazard (the freight car) in his or her path. In addition, because roadway lanes in the United States are typically 10 to 12 feet wide, applying strips of retroreflective sheeting at least every ten feet along the sides of freight cars, increases the likelihood of at least one reflector being in the sight path of an approaching motorist.

A vertically oriented pattern, as opposed to an outline pattern, is proposed because it contrasts with the horizontally oriented pattern of the retroreflective pattern required for truck trailers, thereby reducing the likelihood that motorists will confuse a train in a grade crossing with a truck trailer. In addition, because not all approaches to grade crossings are level, to the extent that a motor vehicle's headlights are aimed away from the retroreflective material, less light will reach the retroreflective material if it is applied horizontally and therefore less light will be returned to the driver and a train in a crossing will be more difficult to detect. Orienting the retroreflective material vertically increases the likelihood that the maximum available light from vehicle headlights will enter the retroreflective material and be returned to the motorist when the road grade is not level.

This section also proposes to require four square feet of retroreflective material on each side of the typical 50-foot freight car and provides that freight cars longer than 50 feet would require one additional foot of material for each additional ten feet in length. Although the optimum configuration of retroreflectors identified in the 1999 Volpe Report, required slightly less retroreflective material, this configuration assumed that the material would be periodically washed. Volpe found that periodic washing of the retroreflectors could recover the intensity of the prismatic material to nearly original levels. However, because of practical concerns expressed by many members of the railroad industry (*e.g.*, increased labor costs, environmental wastewater and water usage issues), FRA does not propose to require the periodic cleaning of the retroreflective sheeting. Instead, in order to compensate for the lack of cleaning, FRA is proposing to require approximately one additional square foot of material on each side of freight rolling stock, thereby lowering the level of luminance needed.

Paragraph (a) of this section generally explains that the amount of retroreflective sheeting required to be applied to freight cars under this part is dependent on the length of the car, measured from endsill to endsill, exclusive of the draft gear. Paragraph (a)(1) proposes to require that on freight cars other than tank cars and flat cars, retroreflective sheeting be applied vertically in 4x36 inch and 4x18 inch strips along the car sides, with the bottom edge of each strip no lower than 42 inches above the top of the rail. Further, this paragraph proposes to require that either a minimum of one 4x36 inch (one square foot) strip of retroreflective material or two 4x18 inch strips, directly above each other, be applied vertically as close to each end of the car as practicable and that a minimum of one 4x18 inch strip be applied vertically at intervals of no more than every 10 feet between each end (*i.e.*, for a typical 60 foot freight car, at 10 feet, 20 feet, 30 feet, 40 feet, and 50 feet). *See* Figure 1.

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**Retroreflective Sheeting Pattern for Typical 60 Foot Freight Car**

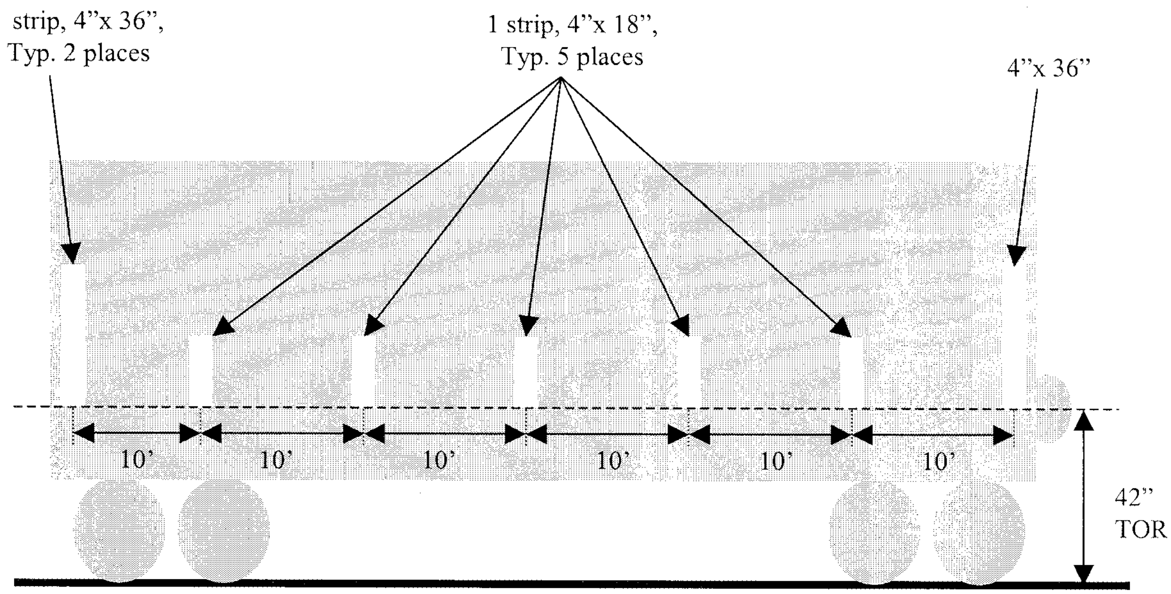


Figure 1

BILLING CODE 4910–06–C

Although paragraphs (a)(2) and (3) follow this same basic pattern, FRA has attempted to account for the configurational differences between various types of freight cars. Paragraph (a)(2) addresses tank cars specifically, while paragraph (a)(3) addresses flat cars. Paragraph (a)(2) proposes to require that on tank cars, retroreflective sheeting be applied vertically along the car sides and centered on the horizontal centerline of the tank, or as near as practicable. *See* Figure 2. If it is not practicable to safely apply the sheeting centered on the horizontal centerline of the tank, the sheeting may be applied vertically with its top edge no lower than 70″ above the top of the rail. *See* Figure 2(a). Similar to the pattern proposed in paragraph (a)(1), paragraph (a)(2) requires a minimum of one 4x36 inch (one square foot) strip of retroreflective material or two 4x18 inch strips, directly above each other, be applied vertically as close to each end of the tank as practicable and that a minimum of one 4x18 inch strip be applied vertically at intervals of no more than every 10 feet between each end of the tank. The intent of this configuration is that the retroreflective sheeting will be centered, as practicable, on the outermost curved area of the tank, thereby reflecting the most light. FRA recognizes that the material applied underneath the centerline of the tank may reflect a certain amount of light downward and not directly back to the motorist and that illumination from a vehicle's headlights may not even reach some of the material applied above the centerline.

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**Retroreflective Sheeting Pattern for Typical 60 Foot Tank Car**

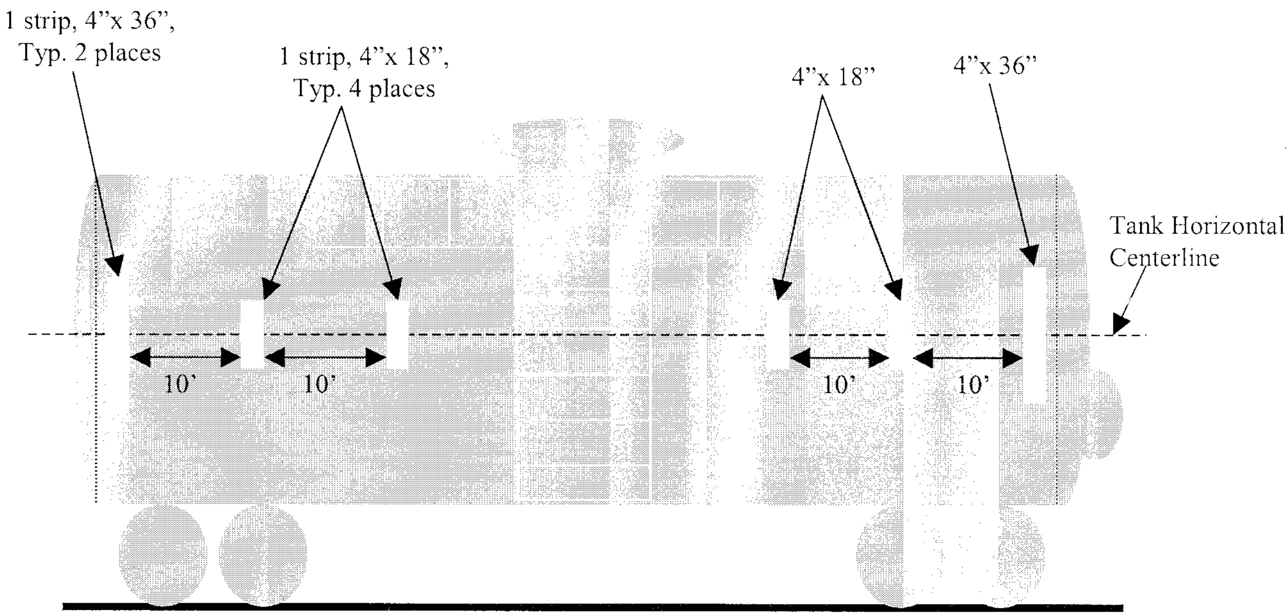


Figure 2

**Alternative Retroreflective Sheeting Pattern for Typical 60 Foot Tank Car**

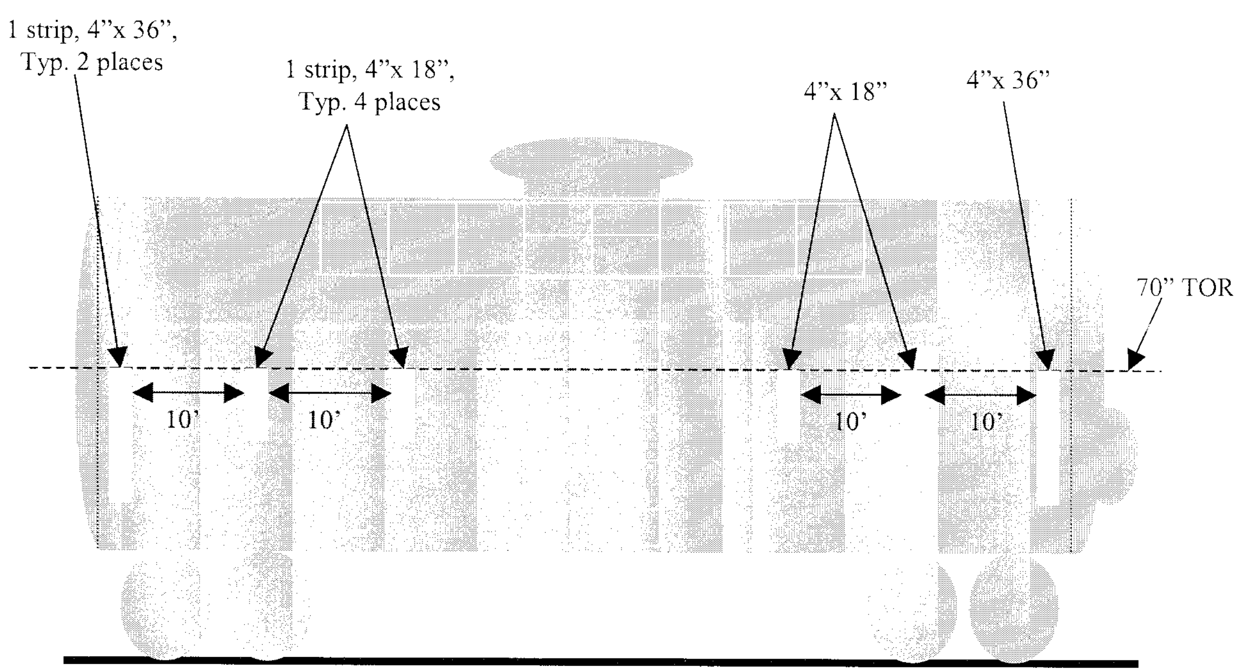


Figure 2(a)

BILLING CODE 4910–06–C

Recognizing the limited surface area of the sides of a typical flat car, paragraph (a)(3) proposes to require a minimum of two 4x18 inch strips, one next to the other, be applied vertically as close to each end of the car as practicable, with the bottom edge of each strip no lower than 30 inches above the top of the rail, as practicable. Consistent with the application pattern for other freight cars, paragraph (a)(3) requires that a minimum of one 4x18 inch strip be applied to the sides of flat cars vertically at intervals of no more than every ten feet (*i.e.*, at 10 feet, 20 feet, 30 feet, 40 feet, *etc.*), with the bottom edges of each strip no lower than 42 inches above the top of the rail, as practicable. *See* Figure 3. Because the surface area of a typical flat car is between 4 and 18 inches in height, if vertical application of 4x18 inch strips is not feasible, paragraph (a)(3) allows retroreflective sheeting on flat cars to be applied vertically in three 4x6 inch strips placed directly next to each other, or placed horizontally along the side sills of the cars.

BILLING CODE 4910–06–P

**Retroreflective Sheeting Pattern for Typical 60 Foot Flat Car**

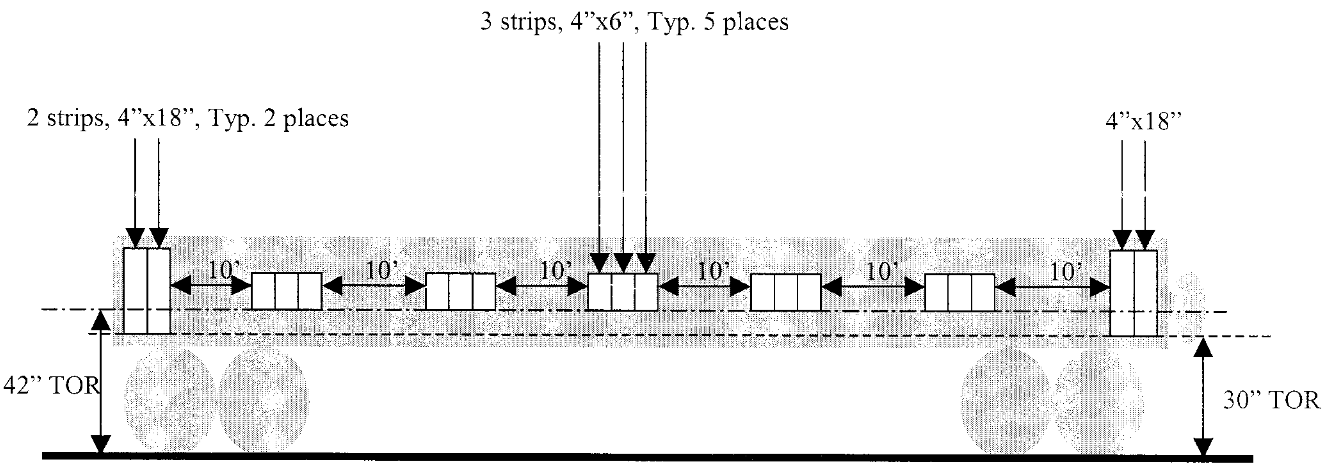


Figure 3

BILLING CODE 4910–06–C

Paragraph (a)(4) recognizes that not all freight cars will fit the standard configuration contemplated in paragraphs (a)(1) through (a)(3). FRA estimates that the patterns proposed for typical freight cars, tank cars, and flat cars would be impractical to apply to approximately 1% of the fleet (*e.g.*, schnabel cars, *etc.*) due to their unique physical configurations. Accordingly, this paragraph proposes a more flexible application pattern for these ''cars of special construction.'' Specifically, based on the length of a ''car of special construction,'' this paragraph specifies the required amount of retroreflective material and requires that the pattern of application for these cars conform as close as practicable to the standard patterns proposed in paragraphs (a)(1) through (a)(3).

Paragraph (b) contains the proposed requirements for the reflectorization of locomotives. The conspicuity issues surrounding locomotives differ from the issues surrounding freight cars in many respects. First, the physical configuration of locomotives is obviously quite different from the configuration of most freight cars. In some cases, locomotives are painted brighter colors than freight cars; and locomotives owned by major railroads and used in road service are cleaned on a more frequent basis. Often, company logos are displayed on the sides of locomotives in fluorescent or reflective materials and locomotives have a light source attached at the front and sides. However, in other cases, locomotives are painted in dark colors or are not repainted for several years, resulting in a very dark appearance.

FRA believes that some pattern of retroreflective material recognizable to motorists is necessary to facilitate motorists' recognition of locomotives in grade crossings. Most major railroads have already instituted programs to accomplish this. Application of retroreflective material to locomotives will enhance conspicuity under the following scenarios:

- Several locomotives are coupled in a multiple-unit consist pulling a train and the motorists' first view of the crossing occurs when the first locomotive is already on the crossing.
- The train is stopped with one or more locomotives on the crossing.
- A locomotive is embedded in the consist providing ''distributed power'' or is in ''helper service'' pushing from the rear.
- During switching operations, the locomotive is pushing the train.

Inclusion of locomotives in this program is further warranted by their high utilization. While many freight cars sit idle for days or weeks at a time, locomotives are generally used on a daily basis. Investments in improved conspicuity of locomotives should be amortized through safety benefits even more quickly than would be the case with freight cars.

Although requiring the same amount of retroreflective material on locomotives as comparably sized freight cars, paragraph (b) does not propose to mandate a specific pattern. Instead, this paragraph proposes to allow any pattern that divides the amount of retroreflective sheeting equally between both sides of a locomotive and is applied in a ''pattern recognizable to motorists,'' even a horizontal pattern along the sill or side walkway of a locomotive.

Although FRA believes that the patterns of application proposed in this

§ 224.105 represent the optimum configuration of retroreflective material on freight rolling stock, FRA solicits comments as to the feasibility and efficiency of these patterns and any recommendations for alternative patterns of application.

*Section 224.107 Application of Retroreflective Sheeting*

This section proposes to require that all freight cars subject to this part be equipped with retroreflective sheeting conforming to this part within ten years of the effective date of the final rule, and similarly, that all locomotives subject to this part be equipped within five years. Recognizing the voluntary efforts by many freight rolling stock owners who have already begun reflectorizing their fleets and the practical differences involved in applying reflective materials to freight rolling stock already in use versus newly manufactured stock, FRA has attempted to devise a schedule for the application of retroreflective material which assures the most efficient and cost-effective implementation of the rule. Generally, FRA proposes that retroreflective sheeting be applied to new freight rolling stock at the time of construction and to existing stock when such stock is being repainted, rebuilt, or undergoing other periodic maintenance. As an alternative to this schedule, FRA is also proposing the more flexible approach of allowing freight car owners to designate, in individualized reflectorization implementation plans, a schedule for the reflectorization of their freight car fleets.

Railroad Freight Cars

*Newly constructed cars:* Paragraph (a)(1) requires that retroreflective sheeting conforming to the rule be applied to cars manufactured after the effective date of the final rule at the time of construction.

*Existing cars without retroreflective sheeting:* As applied to cars that, as of the date of publication of the final rule, are not equipped with at least one square foot of retroreflective sheeting on each side, paragraph (a)(2) generally requires the application of retroreflective sheeting to the cars as they are repainted, rebuilt, or taken out of service for other scheduled maintenance and/or inspections. Specifically, paragraph (a)(2)(i) requires that conforming retroreflective sheeting be applied to existing freight cars when, after the effective date of the final rule, either (1) the car is repainted or rebuilt, or (2) the car first undergoes a single car air brake test required under 49 CFR 232.305, whichever occurs first. Paragraph (a)(2)(i)(B) also provides that the application of retroreflective sheeting to a freight car may be deferred until the second single car air brake test, if it is more practicable to apply the sheeting at that time. By allowing the flexibilty to defer application of the sheeting until the second single car air brake test, FRA recognizes that conditions at the time of the first single car air brake test may make it impractical to apply retroreflective sheeting at that time.

FRA understands that most rail cars are repainted, on average, every seven years and undergo a major overhaul or rebuild every ten years, depending upon mileage and condition. Similarly, the single car air brake test is required every eight years for new cars and every five years for other cars. *See* 49 CFR 232.305(c), (d). Accordingly, FRA believes that the schedule set forth in paragraph (a)(2)(i), providing for application of the retroreflective sheeting when cars are out of service for regularly scheduled maintenance, will allow the entire U.S. fleet of freight cars to be reflectorized well within the ten year implementation period and will not require cars to incur any additional downtime outside of the normal maintenance cycle for the purpose of reflectorization.

Although FRA believes the schedule set forth in § 224.107(a)(2)(i) is the most cost-effective and efficient method of reflectorizing freight cars, paragraph (a)(2)(ii) recognizes that some freight car owners may prefer to develop their own schedule for reflectorization. Paragraph (a)(2)(ii) provides that a freight car owner may elect not to follow paragraph (a)(2)(i)'s schedule, if within 60 days of the effective date of the final rule, the owner submits to FRA a Fleet Reflectorization Implementation Plan. This plan must set forth the car numbers constituting the fleet subject to this part and indicate when the identified cars will be reflectorized. The plan must also contain an affirmation that at least 20% of the total fleet will be equipped with retroreflective sheeting conforming to this part within 24 months after the effective date of the final rule and that not less than an additional ten percent of the total fleet will be completed each 12-month period thereafter for the duration of the 10-year implementation period. Absent identification of a car in a Fleet Reflectorization Implementation Plan, retroreflective sheeting conforming to this part will be applied to that car at the time of its first single car air brake test after the effective date of the final rule. *See* Appendix B for the standard form Fleet Reflectorization Implementation Plan anticipated by this section.

If a freight car owner elects the procedures of paragraph (a)(2)(ii) and submits a Fleet Reflectorization Implementation Plan to FRA, the owner is thereafter responsible for compliance with the plan. In keeping with the requirements of the Paperwork Reduction Act and the Government Paperwork Elimination Act, FRA anticipates providing car owners with the option of submitting this plan (and any required updates) to FRA electronically. If upon completion of the initial 24-month period an owner fails to reflectorize at least 20% of the freight car fleet, or if after any subsequent 12-month period an owner fails to reflectorize at least an additional 10% of the total fleet, the owner must notify FRA's Associate Administrator of such a failure. Thereafter, the owner will be required to comply with the schedule set forth in paragraph (a)(2)(i), the percentage requirements of paragraph (a)(2)(ii) will continue to apply, and the fleet owner must take any additional action necessary to bring cars under his ownership or control into compliance.

*Existing cars already equipped with retroreflective sheeting as of publication date of final rule:* Recognizing the voluntary efforts already underway by many railroads and car owners to reflectorize their freight car fleets, paragraph (a)(3) of this section addresses existing freight cars that, as of the publication date of the final rule, are already equipped with retroreflective material. FRA understands that approximately 25% of the domestically-owned freight car fleet is already equipped with some type of reflective material. However, many of the color schemes, the levels of reflectivity of the material, and the per car amount of material in use, differ from the standards proposed in this rule. If car owners are required to replace the retroreflective materials that they voluntarily installed to improve safety, it would have the effect of penalizing owners that demonstrated an extra level of safety consciousness. This would have the unintended effect of discouraging car owners from exploring innovative approaches to improving safety. With this in mind, FRA is proposing that freight cars equipped with at least one square foot of retroreflective material, uniformly distributed over the length of each car side, will be considered in compliance with this part for ten years from the effective date of the final rule, provided that the sheeting is not engineering grade, super engineering grade (enclosed lens), or glass bead encapsulated type sheeting. FRA intends to exclude all engineering grade and glass bead encapsulated type retroreflective sheeting because such sheeting does not meet the minimum photometric performance requirements of § 224.103. Accordingly, freight cars already equipped with engineering grade, super engineering grade, or glass bead encapsulated type retroreflective sheeting, or any other reflective material that is not retroreflective, must be brought into compliance with this part in accordance with § 224.107(a)(2). FRA proposes a minimum requirement of one square foot of retroreflective sheeting per car side under this section because based on the information provided to FRA to date, it appears that one square foot per side is the minimum amount currently utilized in existing voluntary reflectorization programs.

In order for previously equipped cars to be considered in compliance pursuant to this section, a car owner must, within 60 days of the effective date of the final rule, file a Fleet Reflectorization Implementation Plan with FRA identifying by car numbers the freight cars in the fleet already equipped with complying retroreflective sheeting and providing a description of the technical specifications of the retroreflective material already applied (*e.g.*, color of material, type of material, amount and placement pattern of material on each side of car). *See* Appendix B.

Locomotives

*Newly constructed locomotives:* Paragraph (b)(1) requires that retroreflective sheeting conforming to the rule be applied to locomotives manufactured after the effective date of the final rule at the time of construction.

*Existing locomotives without retroreflective sheeting:* As applied to locomotives that, as of the date of publication of the final rule, are not equipped with at least one square foot of retroreflective sheeting on each side, paragraph (b)(2) generally requires the application of retroreflective sheeting to the locomotives not later than the first biennial inspection performed pursuant to 49 CFR 229.29 occurring after the effective date of the final rule. Again, FRA's proposal to install the retroreflective sheeting on a locomotive while the locomotive is already out of service for the required biennial inspection ensures that reflectorization of the entire locomotive fleet can be completed well within the 5 years contemplated by this proposal without incurring any additional out of service time for the locomotives.

*Existing locomotives already equipped with retroreflective sheeting as of publication date of final rule:* Again, recognizing the voluntary reflectorization efforts already underway by many freight rolling stock owners, paragraph (b)(3) addresses existing locomotives that, as of the publication date of the final rule, are already equipped with retroreflective material. Specifically, paragraph (b)(3) provides that locomotives equipped with at least one square foot of retroreflective sheeting, uniformly distributed over the length of each side, will be considered in compliance with this part for a period of 5 years from the effective date of the final rule, provided that the sheeting is not engineering grade, super engineering grade (enclosed lens), or glass bead encapsulated type sheeting. Again, FRA proposes to exclude all engineering grade and glass bead encapsulated type retroreflective sheeting because such materials do not meet the minimum photometric requirements of the rule. Locomotives already equipped with engineering grade, super engineering grade, or glass bead encapsulated type retroreflective sheeting, or any other reflective material that is not retroreflective, must be brought into compliance with this part in accordance with § 224.107(b)(2). Similar to § 224.107(a)(3) addressing freight cars, in order for previously equipped locomotives to be considered in compliance pursuant to this part, the locomotive owner must, within 60 days of the effective date of the final rule, file with FRA a Fleet Reflectorization Implementation Plan identifying by locomotive reporting marks the locomotives in the fleet already equipped with complying retroreflective sheeting and providing a description of the technical specifications of the retroreflective material already applied (*e.g.*, color of material, type of material, amount and placement pattern of material on each side of locomotives). *See* Appendix B.

For ease in understanding the requirements of this section, the following table summarizes the schedules of application proposed in this section.

| New | Freight Cars: At time of construction | Locomotives: At time of construction |
|---|---|---|
| Existing stock without retroreflective sheeting. | Earliest of: (a) when car is repainted, or rebuilt, or (b) when car first undergoes single car air brake test under 49 CFR 232.305, OR<br>In accordance with Individual Reflectorization Plan filed with FRA per § 224.107(a)(2)(ii). | No later than first biennial inspection performed per 49 CFR 229.29. |
| Existing stock with retroreflective sheeting (not ASTM D 4956–01 Types I, II, or III). | 10 years from date of final rule's publication. | 5 years from date of final rule's publication. |

*Section 224.109 Inspection and Replacement*

This section sets forth the proposed requirements for the periodic inspection and replacement of damaged retroreflective material on freight rolling stock. Although FRA is not proposing any specific maintenance requirements, paragraph (a) requires that retroreflective sheeting on freight cars subject to this part be visually inspected for presence and condition whenever a car undergoes a single car air brake test required under 49 CFR 232.305. Likewise, paragraph (b) requires that retroreflective sheeting on locomotives subject to this part be visually inspected for presence and condition whenever the locomotive receives the annual inspection required under 49 CFR 229.27. Upon inspection, if more than 20 percent of the amount of sheeting required on either side of the car or locomotive under § 224.105 is damaged, obscured, or missing, that damaged, obscured, or missing sheeting must be replaced. In other words, if a 4x36 inch end strip (or two 4x18 inch strips) of retroreflective sheeting is missing from one side of a typical 50 or 60 foot freight car, that sheeting must be replaced.

*Section 224.111 Renewal*

This section proposes to require that all retroreflective sheeting required under this part be replaced with new conforming sheeting, regardless of its condition, no later than ten years after the date of initial installation. This section is based on the manufacturers' stated useful life of retroreflective material. FRA, however, will monitor the retroreflective qualities of various fleet segments over time and may extend the ten year interval if warranted.

*Appendix A—Schedule of Civil Penalties*

This appendix is being reserved until the final rule. At that time it will include a schedule of civil penalties to be used in connection with this part. Because such penalty schedules are statements of policy, notice and comment are not required prior to their issuance. *See* 5 U.S.C. 553(b)(3)(A). Nevertheless, commenters are invited to submit suggestions to FRA describing the types of actions or omissions under each regulatory section that would subject a person to the assessment of a civil penalty. Commenters are also invited to recommend what penalties may be appropriate, based upon the relative seriousness of each type of violation.

*G. Public Participation*

When conducting a rulemaking, FRA must follow the APA. The APA generally requires that FRA allow all interested parties to review and comment on any proposed rule. Thus, by this notice, FRA is providing the public an opportunity to study the proposed rule and comment on it. Based on comments provided in response to this notice, FRA will, after the close of the comment period, determine what action to take.

The Docket Management Facility maintains the public docket for this rulemaking. Comments and documents as indicated in this preamble will become a part of this docket and will be available for inspection or copying at Room PL–401 on the Plaza Level of the Nassif Building at the same address during regular business hours. You may also obtain access to this docket on the Internet at *http://dms.dot.gov.*

Regulatory Impact and Notices

*A. Executive Order 12866 and DOT Regulatory Policies and Procedures*

This proposed rule has been evaluated in accordance with existing policies and procedures, and determined to be non-significant under both Executive Order 12866 and DOT policies and procedures (44 FR 11034; Feb. 26, 1979). FRA has prepared and placed in the docket a regulatory evaluation addressing the economic impact of this rule. Document inspection and copying facilities are available at 1120 Vermont Avenue, NW., 7th Floor, Washington, DC 20590. Photocopies may also be obtained by submitting a written request to the FRA Docket Clerk at the Office of Chief Counsel, Federal Railroad Administration, 1120 Vermont Avenue, NW., Washington, DC 20590. Access to the docket may also be obtained electronically through the Web site for the DOT Docket Management System at *http://dms.dot.gov.* FRA invites comments on this regulatory evaluation.

The life expectancy of the proposed reflective material is 10 years, therefore, the potential costs and benefits are calculated for a ten-year period. Because most of the costs of the rule for a single car occur in the year material is applied while benefits are spread over subsequent years, and because the benefits are discounted to present value, use of this limitation on the study period is a very conservative approach. If a twenty-year period were used, the benefits would substantially increase relative to the costs. The total cost of reflectorizing locomotives, $194,512.08 (NPV), added to the cost of reflectorizing rail cars, $48,671,710.63 (NPV) equals the total costs of $48,866,222.71 (NPV).

Benefits of increased rail car visibility are measured in terms of grade crossing accidents averted. Safety benefits were calculated in terms of the decline in the probability of accidents. The magnitude of the reduction in the probability of accidents as a result of rail car reflectorization depends on the effectiveness of reflectors and the number of accidents expected absent reflectorization. The FRA employed three completely separate approaches to the estimation of benefits utilizing data from FRA's highway-rail grade crossing accident/incident reports (Form F 6180.57) from 1998–2001. In each method of benefits estimation, in order to ensure a realistic estimate, FRA took into account various factors that could influence the effectiveness of the retroreflective material (*e.g.*, active versus passive grade crossings, clear versus cloudy weather conditions, dark versus illuminated crossings). FRA accounted for these factors by developing ''effectiveness rates'' which varied depending on the circumstances of reported Category 1 RIT accidents. For example, the highest effectiveness rate employed was 60% for accidents where motor vehicles ran into the sides of trains at night at unlighted, passive crossings, while the lowest effectiveness rate employed was 15% for accidents where motor vehicles ran into the sides of trains at night at lighted crossings equipped with active warning devices (*i.e.*, flashing lights or gates).

Each approach appears to be reasonable, and the FRA suggests that together they provide a good idea of the order of magnitude of benefits likely to result from a rule requiring the reflectorization of rail freight equipment. The first approach employed the Delphi methodology based on the opinions of FRA's grade crossing experts. The discounted total ten-year benefit equals $87,517,527.50. Using the signal detection model, which is based on signal detection theory, the accident reduction potential of placing reflectors on rail cars is estimated, once discounted, to equal a total ten-year benefit of $69,304,986.61. Using results from a NHTSA report evaluating truck reflector effectiveness, the average benefit estimates are approximately $101 million. The following chart summarizes the three different benefit estimation techniques, unique subsets of the accident pool utilized, resulting values of collisions, and the resulting net present value of estimated benefits.

REFLECTORIZATION BENEFIT ESTIMATION TECHNIQUES

| | | | |
|---|---|---|---|
| Alternative Approaches | Grade Crossing Experts | Signal Detection Model | NHTSA Technical Report.[2] |
| Methodology | Delphi Method | Risk and Uncertainty Analysis | Truck Reflector Effectiveness Rates. |
| Subset of RIT accident pool (1998–2001 data: 768 accidents, 84 fatalities, 347 injuries). | 67.89 accidents (271.55 accidents/4 years × various scenario effectiveness rates). | 53.76 accidents (768 accidents/4 years × effectiveness rate of 28%). | 93.68, 76, 47.72 accidents (707 accidents/4 years. (176.75) × various effectiveness rates of 53%, 43%, and 27%). |
| Value of accident | $412,829 | $412,829 | $442,738. |

REFLECTORIZATION BENEFIT ESTIMATION TECHNIQUES—Continued

| | | | |
|---|---|---|---|
| Total Benefits (NPV) | $87,517,527.50 | $69,304,986.61 | $101,411,947.44 (AVG). |

[2] "The Effectiveness of Retroreflective Tape on Heavy Trailers," National Highway Traffic Safety Administration (NHTSA) Technical Report, DOT HS 809 22, March 2001.

Estimated ten-year discounted benefits range from a low of $69 million based on the Signal Detection Model, to a high of more than $101 million (NHTSA's truck reflectorization follow-up study), with FRA subjective analysis coming in between at $87 million. While there is certainly a broad range in these estimates, the fact that they are as close as they are, given the vastly different approaches taken, gives FRA confidence that together they represent a reasonable indicator of the magnitude of benefits achievable for the reflectorization of railroad freight equipment. FRA believes that reflectorization of rail freight rolling stock is a feasible method of enhancing rail car visibility, that will likely improve safety in a cost effective manner. FRA expects that the measures called for in this proposal would prevent or mitigate the severity of casualties greater in value than the costs of complying with the proposed requirements.

*B. Regulatory Flexibility Act of 1980 and Executive Order 13272*

The Regulatory Flexibility Act of 1980 (5 U.S.C. 601–612) requires an assessment of the impacts of proposed rules on small entities. FRA has conducted a regulatory flexibility assessment of this rule's impact on small entities, and the assessment has been placed in the public docket for this rulemaking. This proposed rule affects railroad freight car and locomotive owners and may affect other entities as well.

Entities impacted by the proposed rule are companies and railroads that own freight cars and locomotives. Many companies that own freight cars are subsidiaries of larger companies that are not considered small businesses. FRA does not expect that smaller railroads will be affected disproportionately. The level of costs incurred by each organization should vary in proportion to car ownership.

Passenger railroads are excepted from the proposed rule. Visibility conditions for passenger rail cars are different than freight rail cars. FRA solicits comments to identify the impacts of these provisions to the extent that those affected by such provisions are small entities.

*C. Paperwork Reduction Act of 1995*

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 *et seq.* The sections that contain the new information collection requirements and the estimated time to fulfill each requirement are as follows:

| CFR section—49 CFR | Respondent universe | Total annual responses | Average time per response | Total annual burden hours | Total annual burden cost |
|---|---|---|---|---|---|
| 224.7—Waivers | 289 Car Owners | 20 petitions | 1 hour | 20 hours | $700 |
| 224.15—Special Approval Procedures: | | | | | |
| —Petitions For Special Approval. | 289 Car Owners | 10 petitions | 40 hours | 400 hours | $19,040 |
| —Public Comments | Public/Railroads | None | NA | NA | NA |
| —Written Request For Hearing. | Interested Parties | None | N/A | N/A | N/A |
| 224.103—Characteristics of Retroreflective Sheeting: | | | | | |
| —Certification | 4 Manufacturer | NA | NA | NA | NA |
| —Alternative Standards | 289 Car Owners | Cov. Under 224.15 | Cov. Under 224.15 | Cov. Under 224.15 | Cov. Under 224.15 |
| 224.107—Application of Retroreflective Sheeting: | 289 Car Owners | 140 plans/forms | 28 hours | 3,920 hours | $137,200 |
| —Reports of Failure Meet Percentage requirements. | 289 Car Owners | 15 reports | 16 Hours | 240 hours | $8,400 |
| —Existing Cars with Retroreflective Sheeting—Forms. | 289 Car Owners | Cov. Above | Cov. Above | Cov. Above | Cov. Above. |
| 224.109—Inspection and Replacements: Locomotives—Records of Restriction. | 289 Car Owners | 2 records | 3 minutes | .10 hour | $5 |

All estimates include the time for reviewing instructions; searching existing data sources; gathering or maintaining the needed data; and reviewing the information. Pursuant to 44 U.S.C. 3506(c)(2)(B), FRA solicits comments concerning: whether these information collection requirements are necessary for the proper performance of the functions of FRA, including whether the information has practical utility; the accuracy of FRA's estimates of the burden of the information collection requirements; the quality, utility, and clarity of the information to be collected; and whether the burden of collection of information on those who are to respond, including through the use of automated collection techniques or other forms of information technology, may be minimized. For information or a copy of the paperwork package submitted to OMB, contact Mr. Robert Brogan, Information Clearance Officer, at 202–493–6292.

Organizations and individuals desiring to submit comments on the collection of information requirements should direct them to Mr. Robert Brogan, Federal Railroad Administration, 1120 Vermont Avenue, NW, Mail Stop 17, Washington, DC 20590. Comments may also be submitted via e-mail to Mr. Brogan at the following address: *robert.brogan@fra.dot.gov.*

OMB is required to make a decision concerning the collection of information requirements contained in this proposed rule between 30 and 60 days after publication of this document in the **Federal Register**. Therefore, a comment to OMB is best assured of having its full effect if OMB receives it within 30 days of publication. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

FRA is not authorized to impose a penalty on persons for violating information collection requirements which do not display a current OMB control number, if required. FRA intends to obtain current OMB control numbers for any new information collection requirements resulting from this rulemaking action prior to the effective date of a final rule. The OMB control number, when assigned, will be announced by separate notice in the **Federal Register**.

*D. Federalism Implications*

Executive Order 13132, entitled ''Federalism,'' issued on August 4, 1999, requires that each agency ''in a separately identified portion of the preamble to the regulation as it is to be issued in the **Federal Register**, provide to the Director of the Office of Management and Budget a federalism summary impact statement, which consists of a description of the extent of the agency's prior consultation with State and local officials, a summary of the nature of their concerns and the agency's position supporting the need to issue the regulation, and a statement of the extent to which the concerns of State and local officials have been met.'' FRA will adhere to Executive Order 13132 when issuing a final rule in this proceeding.

*E. Environmental Impact*

FRA has evaluated this rule in accordance with its ''Procedures for Considering Environmental Impacts'' (FRA's Procedures) (64 FR 28545, May 26, 1999) as required by the National Environmental Policy Act (42 U.S.C. 4321 *et seq.*), other environmental statutes, Executive Orders, and related regulatory requirements. FRA has determined that this regulation is not a major FRA action (requiring the preparation of an environmental impact statement or environmental assessment) because it is categorically excluded from detailed environmental review pursuant to section 4(c)(20) of FRA's Procedures. 64 FR 28547, May 26, 1999. Section 4(c)(20) reads as follows:

(c) Actions categorically excluded. Certain classes of FRA actions have been determined to be categorically excluded from the requirements of these Procedures as they do not individually or cumulatively have a significant effect on the human environment. * * * The following classes of FRA actions are categorically excluded:

* * * * *

(20) Promulgation of railroad safety rules and policy statements that do not result in significantly increased emissions of air or water pollutants or noise or increased traffic congestion in any mode of transportation.

In accordance with section 4(c) and (e) of FRA's Procedures, the agency has further concluded that no extraordinary circumstances exist with respect to this regulation that might trigger the need for a more detailed environmental review. As a result, FRA finds that this regulation is not a major Federal action significantly affecting the quality of the human environment.

*F. Unfunded Mandates Reform Act of 1995*

Pursuant to Section 201 of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4, 2 U.S.C. 1531), each Federal agency ''shall, unless otherwise prohibited by law, assess the effects of Federal regulatory actions on State, local, and tribal governments, and the private sector (other than to the extent that such regulations incorporate requirements specifically set forth in law).'' Section 202 of the Act (2 U.S.C. 1532) further requires that ''before promulgating any general notice of proposed rulemaking that is likely to result in the promulgation of any rule that includes any Federal mandate that may result in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of $100,000,000 or more (adjusted annually for inflation) in any 1 year, and before promulgating any final rule for which a general notice of proposed rulemaking was published, the agency shall prepare a written statement'' detailing the effect on State, local, and tribal governments and the private sector. This proposed rule will not result in the expenditure, in the aggregate, of $100,000,000 or more in any one year, and thus preparation of such a statement is not required.

*G. Energy Impact*

Executive Order 13211 requires Federal agencies to prepare a Statement of Energy Effects for any ''significant energy action.'' 66 FR 28355, May 22, 2001. Under the Executive Order, a ''significant energy action'' is defined as any action by an agency (normally published in the **Federal Register**) that promulgates or is expected to lead to the promulgation of a final rule or regulation, including notices of inquiry, advance notices of proposed rulemaking, and notices of proposed rulemaking: (1)(i) That is a significant regulatory action under Executive Order 12866 or any successor order, and (ii) that is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (2) that is designated by the Administrator of the Office of Information and Regulatory Affairs as a significant energy action. FRA has evaluated this NPRM in accordance with Executive Order 13211. FRA has determined that this NPRM is not likely to have a significant adverse effect on the supply, distribution, or use of energy. Consequently, FRA has determined that this regulatory action is not a ''significant energy action'' within the meaning of Executive Order 13211.

*H. Privacy Act*

Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (Volume 65, Number 70; Pages 19477–78) or you may visit *http://dms.dot.gov.*

**List of Subjects**

Incorporation by reference, Penalties, Railroad locomotive safety, Railroad safety, and Reporting and recordkeeping requirements.

**The Proposed Rule**

In consideration of the foregoing, FRA proposes to amend chapter II, Subtitle B, of title 49, Code of Federal Regulations to add part 224 as follows:

## PART 224—REFLECTORIZATION OF RAIL FREIGHT ROLLING STOCK

### Subpart A—General

Sec.



### Subpart B—Application, Inspection, and Maintenance of Retroreflective Material

**Authority:** 49 U.S.C. 20103, 20107 and 20148; 28 U.S.C. 2461; and 49 CFR 1.49.

## Subpart A—General

### § 224.1 Purpose and scope.

(a) The purpose of this part is to reduce highway-rail grade crossing accidents and deaths, injuries, and property damage resulting from those accidents, by enhancing the conspicuity of rail freight rolling stock so as to increase its detectability by motor vehicle operators at night and under conditions of poor visibility.

(b) In order to achieve cost-effective mitigation of collision risk at highway-rail grade crossings, this part establishes the duties of freight rolling stock owners (including those who manage maintenance of freight rolling stock, supply freight rolling stock for transportation, or offer freight rolling stock in transportation) and railroads to progressively apply retroreflective material to freight rolling stock, and to periodically inspect and maintain that material. Freight rolling stock owners, however, are under no duty to install, maintain, or repair reflective material except as specified in this part.

(c) This part establishes a schedule for the application of retroreflective material to rail freight rolling stock and prescribes standards for the application, inspection, and maintenance of retroreflective material to rail freight rolling stock for the purpose of enhancing its detectability at highway-rail grade crossings. This part does not restrict a freight rolling stock owner or railroad from applying retroreflective material to freight rolling stock for other purposes if not inconsistent with the recognizable pattern required by this part.

### § 224.3 Applicability.

This part applies to all railroad freight cars and locomotives that operate over a public or private highway-rail grade crossing and are used for revenue or work train service, except:

(a) Freight rolling stock that operates only on track inside an installation that is not part of the general railroad system of transportation;

(b) Rapid transit operations in an urban area that are not connected to the general railroad system of transportation; or

(c) Locomotives and passenger cars used exclusively in passenger service.

### § 224.5 Definitions.

As used in this part—

*Administrator* means the Administrator of the Federal Railroad Administration or the Administrator's delegate.

*Associate Administrator* means the Associate Administrator for Safety, Federal Railroad Administration, or the Associate Administrator's delegate.

*Flat car* means a car having a flat floor or deck on the underframe with no sides, ends or roof.

*Freight rolling stock* means:

(1) Any locomotive subject to part 229 of this chapter used to haul or switch freight cars (whether in revenue or work train service), and

(2) Any railroad freight car subject to part 215 of this chapter (including a car stenciled MW pursuant to § 215.305).

*Freight rolling stock owner* means any person who owns freight rolling stock, leases freight rolling stock, manages the maintenance or use of freight rolling stock on behalf of an owner or one or more lessors or lessees, or otherwise controls the maintenance or use of freight rolling stock.

*Locomotive* has the meaning assigned by § 229.5 of this chapter, but for purposes of this part applies only to a locomotive used in the transportation of freight or the operation of a work train.

*Obscured* means concealed or hidden (*i.e.*, covered up, as where a layer of paint or dense chemical residue blocks incoming light); this term does not refer to ordinary accumulations of dirt, grime, or ice resulting from the normal railroad operating environment.

*Person* means an entity of any type covered under 1 U.S.C. 1, including but not limited to the following: a railroad; a manager, supervisor, official, or other employee or agent of a railroad; any owner, manufacturer, lessor, or lessee of railroad equipment, track or facilities; any independent contractor providing goods or services to a railroad; and any employee of such an owner, manufacturer, lessor, lessee, or independent contractor.

*Railroad* means all forms of non-highway ground transportation that run on rails or electromagnetic guideways, including high speed ground transportation systems that connect metropolitan areas, without regard to whether they use new technologies not associated with traditional railroads.

*Railroad freight car* has the meaning assigned by § 215.5 of this chapter.

*Tank car* means a rail car, the body of which consists of a tank for transporting liquids.

*Work train* means a non-revenue service train used for the administration and upkeep service of the railroad.

### § 224.7 Waivers.

(a) Any person subject to a requirement of this part may petition the Administrator for a waiver of compliance with such requirement. The filing of such a petition does not affect that person's responsibility for compliance with that requirement while the petition is being considered.

(b) Each petition for waiver under this section shall be filed in the manner and contain the information required by part 211 of this chapter.

(c) If the Administrator finds that a waiver of compliance is in the public interest and is consistent with railroad safety, the Administrator may grant the waiver subject to any conditions that the Administrator deems necessary.

### § 224.9 Responsibility for compliance.

(a) Freight rolling stock owners, railroads, and (with respect to certification of material) manufacturers of retroreflective material, are primarily responsible for compliance with this part. However, any person that performs any function or task required by this part (including any employee, agent, or contractor of the aforementioned), must perform that function in accordance with this part.

(b) Any person performing any function or task required by this part shall be deemed to have consented to FRA inspection of the person's facilities and records to the extent necessary to determine whether the function or task is being performed in accordance with the requirements of this part.

### § 224.11 Civil penalties.

Any person (including but not limited to a railroad; any manager, supervisor, official, or other employee or agent of a railroad; any owner, manufacturer, lessor, or lessee of railroad equipment, track, or facilities; any employee of such owner, manufacturer, lessor, lessee, or independent contractor) who violates any requirement of this part or causes the violation of any such requirement is subject to a civil penalty of at least $500, but not more than $11,000 per violation, except that: Penalties may be assessed against individuals only for willful violations, and, where a grossly negligent violation or a pattern of repeated violations has created an imminent hazard of death or injury to persons, or has caused death or injury, a penalty not to exceed $22,000 per violation may be assessed. Each day a violation continues shall constitute a separate offense. Appendix A to this part contains a schedule of civil penalty amounts used in connection with this part.

**§ 224.13 Preemptive effect.**

Under 49 U.S.C. 20106, issuance of this part preempts any State law, rule, regulation, or order covering the same subject matter, except an additional or more stringent law, rule, regulation, or order that is necessary to eliminate or reduce an essentially local safety hazard; that is not incompatible with a law, rule, regulation, or order of the United States Government; and that does not unreasonably burden interstate commerce.

**§ 224.15 Special approval procedures.**

(a) *General.* The following procedures govern consideration and action upon requests for special approval of alternative standards under § 224.103(e).

(b) *Petitions.*

(1) Each petition for special approval of an alternative standard shall contain—

(i) The name, title, address, and telephone number of the primary person to be contacted with regard to the petition;

(ii) The alternative proposed, in detail, to be substituted for the particular requirements of this part; and

(iii) Appropriate data and analysis establishing that the alternative will provide at least an equivalent level of safety and meet the requirements of § 224.103(e).

(2) Three copies of each petition for special approval of an alternative standard shall be submitted to the Associate Administrator for Safety, Federal Railroad Administration, 1120 Vermont Ave., NW., Mail Stop 25, Washington, DC 20590.

(c) *Notice.* FRA will publish a notice in the **Federal Register** concerning each petition under paragraph (b) of this section.

(d) *Public comment.* FRA will provide a period of not less than 30 days from the date of publication of the notice in the **Federal Register** during which any person may comment on the petition.

(1) Each comment shall set forth specifically the basis upon which it is made, and contain a concise statement of the interest of the commenter in the proceeding.

(2) Each comment shall be submitted to the DOT Central Docket Management System, Nassif Building, Room Pl-401, 400 Seventh Street, SW., Washington, DC 20590, and shall contain the assigned docket number which appears in the **Federal Register** for that proceeding. The form of such submission may be in written or electronic form consistent with the standards and requirements established by the Central Docket Management System and posted on its Web site at *http://dms.dot.gov.*

(3) Upon written request of an interested party, or in the event FRA requires additional information to appropriately consider the petition, FRA will conduct a hearing on the petition in accordance with the procedures provided in § 211.25 of this chapter.

(e) *Disposition of petitions.*

(1) If FRA finds that the petition complies with the requirements of this section and that the proposed alternative standard is acceptable or changes are justified, or both, the petition will be granted, normally within 90 days of its receipt. The Associate Administrator may determine the applicability of other technical requirements of this part when rendering a decision on the petition. If the petition is neither granted nor denied within 90 days, the petition remains pending for decision. FRA may attach special conditions to the approval of the petition. Following the approval of a petition, FRA may reopen consideration of the petition for cause stated.

(2) If FRA finds that the petition does not comply with the requirements of this section, or that the proposed alternative standard is not acceptable or that the proposed changes are not justified, or both, the petition will be denied, normally within 90 days of its receipt.

(3) When FRA grants or denies a petition, or reopens consideration of a petition, written notice is sent to the petitioner and other interested parties and a copy of the notice is placed in the electronic docket of the proceeding.

## Subpart B—Application, Inspection, and Maintenance of Retroreflective Material

**§ 224.101 General requirements.**

All rail freight rolling stock shall be equipped with retroreflective sheeting that conforms to the requirements of this part. Notwithstanding any other provision of this chapter, the application, inspection, and maintenance of that sheeting shall be conducted in accordance with this subpart or in accordance with an alternative standard providing at least an equivalent level of safety after special approval of FRA under § 224.15.

**§ 224.103 Characteristics of retroreflective sheeting.**

(a) *Construction.* Retroreflective sheeting shall consist of a smooth, flat, transparent exterior film with microprismatic retroreflective elements embedded in or suspended beneath the film so as to form a non-exposed retroreflective optical system. Retroreflective sheeting construction that entraps air between laminations shall be sealed around all edges in the final application sufficiently to prevent water from penetrating the sheeting.

(b) *Color.* Retroreflective sheeting applied under this part must be yellow as specified by the chromaticity coordinates of the American Society for Testing and Materials' (ASTM) Standard D 4956–01, ''Standard Specification for Retroreflective Sheeting for Traffic Control.''

(c) *Performance.* Retroreflective sheeting applied pursuant to this part shall meet the requirements of ASTM D 4956–01, except for the photometric requirements, and shall, as initially applied, meet the minimum photometric performance requirements specified in Table 1 of this section.

TABLE 1.—MINIMUM PHOTOMETRIC PERFORMANCE (COEFFICIENT OF RETROREFLECTION ($R_A$) IN CANDELA/LUX/METER [2]) REQUIREMENT FOR YELLOW RETROREFLECTIVE SHEETING.

| Entrance angle | Observation angle | |
|---|---|---|
| | 0.2° | 0.5° |
| –4° | 400 | 100 |
| 30° | 220 | 45 |

(d) *Certification.* The characters ''FRA–224'', constituting the manufacturer's certification that the retroreflective sheeting conforms to the requirements of paragraphs (a) through (c) of this section, shall appear at least once on the exposed surface of each sheeting in the final application. The characters shall be a minimum of 3 mm high, and shall be permanently stamped, etched, molded, or printed within the product and each certification shall be spaced no more than four inches apart.

(e) *Alternative standards.* Upon petition by a freight rolling stock owner or railroad under § 224.15, the Associate Administrator may qualify an alternative technology as providing equivalent safety. Any such petition shall provide data and analysis sufficient to establish that the technology will result in conspicuity and durability at least equal to sheeting described in paragraphs (a) through (c) of this section applied in accordance with this part and will present a recognizable visual target that is suitably consistent with freight rolling stock equipped with retroreflective sheeting meeting the technical requirements of this part.

**§ 224.105 Size and location.**

(a) *Railroad freight cars.* The amount of retroreflective sheeting to be applied to each car is dependent on the length of the car. For purposes of this part, the length of a car is measured from endsill to endsill, exclusive of the draft gear.

(1) *General rule.* On railroad freight cars other than tank cars, flat cars, and cars of special construction (as defined in paragraph (a)(4) of this section), retroreflective sheeting shall be applied vertically to each car side, with its bottom edge as close as practicable to 42 inches above the top of the rail. Either a minimum of one 4x36 inch strip or a minimum of two 4x18 inch strips, one above the other, shall be applied as close to each end of the car as practicable. Between the ends of the car, a minimum of one 4x18 inch strip shall be applied at equal intervals that shall not exceed 10 feet.

(2) *Tank cars.* On tank cars, retroreflective sheeting shall be applied vertically to each car side and centered on the horizontal centerline of the tank, or as near as practicable. If it is not practicable to safely apply the sheeting centered on the horizontal centerline of the tank, the sheeting may be applied vertically with its top edge no lower than 70 inches above the top of the rail, as practicable. A minimum of either one 4x36 inch strip or two 4x18 inch strips, one above the other, shall be applied as close to each end of the car as practicable. Between the ends of the car a minimum of one 4x18 inch strip shall be applied at equal intervals that shall not exceed 10 feet.

(3) *Flat cars.* On flat cars, a minimum of two 4x18 inch strips, one next to the other, shall be applied vertically to each car side as close to each end of the car as practicable. The bottom edges of these 4x18 inch strips shall be no lower than 30 inches above the top of the rail, as practicable. A minimum of one 4x18 inch strip shall be applied vertically as can be best fit at equidistant intervals between each end, with the bottom edge of each strip no lower than 42 inches from the top of the rail, as practicable. Between the ends of the car, a minimum of one 4x18 inch strip shall be applied at equal intervals that shall not exceed 10 feet. When vertical application of a 4x18 inch strip is not feasible, the sheeting may be applied vertically in three 4x6 inch strips placed directly next to each other or as close as practicable, or placed horizontally along the sill of the car.

(4) *Cars of special construction.* This paragraph applies to any car the design of which is not compatible with the patterns of application otherwise provided in this section. Retroreflective sheeting shall conform as close as practicable to the requirements of paragraphs (a)(1) through (a)(3) of this section and shall have the following amount of sheeting equally distributed between both sides of the car:

(i) For cars less than 50 feet long, a minimum of seven square feet of sheeting;

(ii) For cars that are 50 to 60 feet long, a minimum of eight square feet of sheeting; and

(iii) For cars greater than 60 feet long, one additional square foot of sheeting for every additional 10 feet of length.

(b) *Locomotives:*

(1) For locomotives that are less than 50 feet long, a minimum of seven square feet of sheeting must be equally distributed between both sides of the locomotive in a pattern recognizable to motorists.

(2) For locomotives 50 feet long or greater, an additional square foot of sheeting must be equally distributed between both sides of the locomotive for every additional 10 feet of length. The sheeting must be distributed in a pattern recognizable to motorists.

(3) For any locomotive, application of material horizontally along the sill or side walkway of the locomotive shall be considered a pattern recognizable to motorists.

**§ 224.107 Application of retroreflective sheeting.**

(a) *Railroad freight cars.* All railroad freight cars subject to this part must be equipped with retroreflective sheeting conforming to this part by 10 years after the effective date of the final rule. If a car already has reflective material applied that does not meet the standards of this part, it is not necessary to remove the material unless its placement interferes with the placement of the sheeting required by this part.

(1) *New cars.* Retroreflective sheeting conforming to this part must be applied to all new cars at the time of construction.

(2) *Existing cars without retroreflective sheeting.*

(i) If as of the date of publication of the final rule a car subject to this part is not equipped on each side with at least one square foot of retroreflective sheeting as specified in paragraph (a)(3) of this section, retroreflective sheeting conforming to this part must be applied to the car at the earliest of the following occasions occurring after the effective date of the rule or in accordance with paragraph (a)(2)(ii) of this section:

(A) When the car is repainted or rebuilt; or

(B) When the car first undergoes a single car air brake test as prescribed by 49 CFR 232.305. Application may be deferred until the second such test if it is more practicable to do so and the test will be made before 10 years after the effective date of the final rule.

(ii) A freight rolling stock owner may elect not to follow the schedule in paragraph (a)(2)(i) of this section if, not later than 60 days after the effective date of the final rule, the freight rolling stock owner submits to FRA a Fleet Reflectorization Implementation Plan designating the car numbers constituting the fleet subject to this part and affirming that the cars will be equipped with retroreflective sheeting as required by this part such that not less than 20 percent of the total fleet subject to this part shall be equipped within 24 months following the effective date of the final rule and not less than an additional 10 percent of the total fleet shall be completed each 12-month period thereafter for the duration of the 10-year period. *See* Appendix B of this part. Thereafter,

(A) The designated fleet shall be equipped with retroreflective sheeting according to the requirements of this paragraph (a)(2)(ii); and

(B) If, following the conclusion of the initial 24-month period or any 12-month period thereafter, the percentage requirements of this section have not been met—

(*1*) The freight rolling stock owner shall be considered in violation of this part;

(*2*) The freight rolling stock owner shall, within 60 days of the close of the period, report the failure to the Associate Administrator;

(*3*) The requirements of paragraph (a)(2)(i) of this section shall apply to all railroad freight cars subject to this part in the fleet;

(*4*) The percentage requirements of this paragraph (a)(2)(ii) shall continue to apply; and

(*5*) The fleet owner shall take such additional action as may be necessary to achieve future compliance.

(C) Cars to be retired shall be included in the fleet total until they are retired.

(3) *Existing cars with retroreflective sheeting.* If as of the date of publication of the final rule a car is equipped on each side with at least one square foot of retroreflective sheeting, uniformly distributed over the length of each side, that car shall be considered in compliance with this part for a period of 10 years from the effective date of the final rule, provided the sheeting is not engineering grade, super engineering grade (enclosed lens), or glass bead encapsulated type sheeting, and

provided the freight rolling stock owner files a Fleet Reflectorization Implementation Plan with FRA no later than 60 days after the effective date of the final rule identifying the cars already so equipped. *See* Appendix B of this part.

(b) *Locomotives.* All locomotives subject to this part must be equipped with conforming retroreflective sheeting by five years after the effective date of the final rule. If a locomotive already has reflective material applied that does not meet the standards of this part, it is not necessary to remove the material unless its placement interferes with the placement of the sheeting required by this part.

(1) *New locomotives.* Retroreflective sheeting conforming to this part must be applied to all new locomotives at the time of construction.

(2) *Existing locomotives without retroreflective sheeting.* If as of the date of publication of the final rule a locomotive subject to this part is not equipped on each side with at least one square foot of retroreflective sheeting as specified in paragraph (b)(3) of this section, retroreflective sheeting conforming to this part must be applied to the locomotive not later than the first biennial inspection performed pursuant to 49 CFR 229.29 occurring after the effective date of the final rule.

(3) *Existing locomotives with retroreflective sheeting.* If as of the date of publication of the final rule a locomotive is equipped on each side with at least one square foot of retroreflective sheeting, uniformly distributed over the length of the locomotive side, that locomotive shall be considered in compliance with this part for a period of 5 years from the effective date of the final rule, provided the existing material is not engineering grade, super engineering grade (enclosed lens), or glass bead encapsulated type sheeting, and provided the freight rolling stock owner files a Fleet Reflectorization Implementation Plan with FRA no later than 60 days after the effective date of the final rule identifying the cars already so equipped. *See* Appendix B of this part.

(4) Each railroad that has fewer than 400,000 annual employee work hours, and does not share locomotive power with a railroad with 400,000 or more annual employee work hours, may bring its locomotive fleet into compliance according to the following schedule: fifty percent of the railroad's locomotives must be retrofitted pursuant to § 224.105(b) within five years of the effective date of this part and one hundred percent must be retrofitted pursuant to § 224.105(b) within 10 years of the effective date of this part. If a railroad with fewer than 400,000 annual employee work hours shares locomotive power with a railroad with 400,000 or more annual employee work hours, the smaller railroad must comply with the requirements of paragraphs (b)(2) and (3) of this section.

**§ 224.109 Inspection and replacement.**

(a) *Railroad freight cars.* Retroreflective sheeting on railroad freight cars subject to this part must be visually inspected for presence and condition whenever a car undergoes a single car air brake test required under 49 CFR 232.305. If at the time of inspection more than 20 percent of the amount of sheeting required under § 224.105 on either side of a car is damaged, obscured, or missing, that damaged, obscured, or missing sheeting must be replaced. If conditions at the time of inspection are such that replacement material can not be applied, such application may be completed not later than the earliest of the following events: when the car next receives a required single car air brake test or when the car is taken out of service for repairs or other maintenance.

(b) *Locomotives.* Retroreflective sheeting must be visually inspected for presence and condition when the locomotive receives the annual inspection required under 49 CFR 229.27. If more than 20 percent of the amount of sheeting required under § 224.105 on either side of a locomotive is damaged, obscured, or missing, that damaged, obscured, or missing sheeting must be replaced. If conditions at the time of inspection are such that replacement material can not be applied or if sufficient replacement material is not available, such application can be completed at the next forward location where conditions permit, provided a record of the restriction is maintained in the locomotive cab or in a secure and accessible electronic database to which FRA is provided access on request.

**§ 224.111 Renewal.**

Regardless of condition, retroreflective sheeting required under this part must be replaced with new sheeting no later than 10 years after the date of initial installation.

**Appendix A to Part 224—Schedule of Civil Penalties [Reserved]**

**Appendix B to Part 224—Form Fleet Reflectorization Implementation Plan**

This appendix contains the standard form Fleet Reflectorization Implementation Plan referenced in §§ 224.107(a)(2) and (a)(3). Freight rolling stock owners electing not to follow the reflectorization schedule of § 224.107(a)(2)(i) and freight rolling stock owners seeking compliance with this part under § 224.107(a)(3) must file this form no later than 60 days after the effective date of the final rule.

Fleet Reflectorization Implementation Plan

Railroad or Car Owner Name

Prepared and Submitted By:

Name:
Title:
Address:

Phone:
Fax:
E-mail:

Instructions for completing form:

Report in this plan only the freight cars in your fleet subject to 49 CFR part 224 that will be reflectorized on a schedule other than that specified in 49 CFR 224.107(a)(2(i), and those cars that are already equipped with retroreflective material meeting the requirements of 49 CFR 224.107(a)(3).

I. *Column (a):* Insert the car number(s) identifying each freight car in fleet subject to 49 CFR part 224. A range(s) of car numbers may be inserted. Note: exclusions from range(s) may be listed in *column (b).*

II. *Column (b):* List the car number of each car subject to 49 CFR part 224 not included in range (a). (Such as cars sold, retired, or permanently removed from fleet as of the date of filing.)

III. *Column (c):* Indicate the status of each car identified in column (a) as follows:

1. Enter REFL 20XX (year) if the car(s) is scheduled to be reflectorized by owner or other authorized party at a time other than that specified in 49 CFR 224.107(a)(2)(i). REFL indicates that reflective material meeting the requirements of 49 CFR part 224 will be installed on the car specified in *column (a)* at a time other than when that car is being repainted, rebuilt, or undergoing the first single car air brake test pursuant to 49 CFR 232.305 after the effective date of the final rule. 20XX indicates the year that reflective material will be applied to that car. Example: REFL 2005 indicates that the car owner will reflectorize the car specified in *column (a)* by the end of the 2005 calendar year.

2. Enter RET XXXX (year) if the car indentified in column(a) is scheduled to be retired from service during the initial 10-year implementation period. RET indicates that the car will be retired, and 20XX indicates the year that the car is scheduled to be retired. Example: RET 2006 indicates that the car owner will retire the car specified in *column (a)* by the end of the 2006 calendar year.

3. Enter COM if the car indentified in *column (a)* is, as of the date of publication of the final rule, already equipped with retroreflective material meeting the requirements of 49 CFR 224.107(a)(3).

4. Enter REPT XXXX (year) if the car identified in *column (a)* is to be repainted or rebuilt during the initial 10-year implementation period of 49 CFR part 224, and not to be reflectorized during the first single car air-brake test (49 CFR 232.305) after the effective date of the final rule. 20XX

indicates the year that the car will be rebuilt or repainted. Example: REPT 2008 indicates that the car owner will repaint the car specified in *column (a)* by the end of the 2006 calendar year.

IV. If for any car listed in *column (a),* COM is entered in *column (c),* please describe the technical specifications of the retroreflective material with which the cars are presently equipped (*e.g.*, color of material, type of material, amount and placement pattern of material on each side of car).

| (a) Car no. and identification no. (or range) | (b) Subtractions from range | (c) Status (REFL XXXX, RET XXXX, COM, REPT XXXX) |
| --- | --- | --- |
| | | |
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| | | |

By filing this FLEET REFLECTORIZATION IMPLEMENTATION PLAN and any accompanying documents or electronic files with FRA, the Railroad or Car Owner agrees to equip the cars identified in column (a) with retroreflective material conforming to 49 CFR part 224 in accordance with this plan. By filing this plan, the Railroad or Car Owner also agrees to update, at least annually, the American Association of Railroad's UMLER file to reflect the current reflectorization status of each freight car in its fleet subject to Part 224. If the Railroad or Car Owner is not able, or chooses not to update UMLER at least annually, the Railroad or Car Owner shall annually file an updated FLEET REFLECTORIZATION IMPLEMENTATION PLAN with FRA.

*(signature of Corporate Officer/Car Owner)*

Name:

Title:

Date

Issued in Washington, DC on October 29, 2003.

**Allan Rutter,**

*Federal Railroad Administrator.*

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