WEST VIRGINIA

SECRETARY OF STATE

KEN HECHLER

ADMINISTRATIVE LAW DIVISION

Form #1

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NOTICE OF PUBLIC HEARING ON A PROPOSED RULE

AGENCY: Board of Coal Mine Health and Safety TITLE NUMBER: 36

RULE TYPE: Legislative ; CITE AUTHORITY 22-6-4

AMENDMENT TO AN EXISTING RULE: YES x NO ___

IF YES, SERIES NUMBER OF RULE BEING AMENDED: 27

TITLE OF RULE BEING AMENDED:

Surface areas of underground mines

IF NO, SERIES NUMBER OF NEW RULE BEING PROPOSED: ___

TITLE OF RULE BEING PROPOSED: ___

DATE OF PUBLIC HEARING: February 29, 2000 TIME: 9:00 a.m.

LOCATION OF PUBLIC HEARING: Board of Coal Mine Health and Safety
1591 Washington St.,E.
Charleston, WV 25311

COMMENTS LIMITED TO: ORAL ___, WRITTEN ___, BOTH x

COMMENTS MAY ALSO BE MAILED TO THE FOLLOWING ADDRESS: Vic Green, Administrator
1591 Washington St.,E.
Charleston, WV 25311

The Department requests that persons wishing to make comments at the hearing make an effort to submit written comments in order to facilitate the review of these comments.

The issues to be heard shall be limited to the proposed rule.

ATTACH A **BRIEF** SUMMARY OF YOUR PROPOSAL

Vic Green

36-20

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TITLE 36
LEGISLATIVE RULE
BOARD OF COAL MINE HEALTH AND SAFETY

SERIES 27
RULES AND REGULATIONS GOVERNING SURFACE AREAS

§36-27-1. General.

1.1. Scope. -- Rules and Regulations Governing Surface Areas

1.2. Authority. -- W. Va. Code §22-6-4.

1.3. Filing Date. -- August 15, 1995.

1.4. Effective Date. -- October 1, 1995.

1.5. These rules and regulations shall have the effect of law and violations shall be deemed a violation of law and so cited with the same effect as law. All provisions of Article 1, Chapter 22 of the Code, relative to enforcement, are applicable to the enforcement of these rules and regulations.

§36-27-2. Definitions.

2.1. "High voltage powerline" means any uninsulated suspended power conductor carrying high voltage.

2.2. "Lanyard" means a rope, suitable for supporting one person. One end is fastened to a safety belt or harness and the other end is secured to a substantial object or a safety line.

2.3. "Lifeline" means a rope, suitable for supporting one person, to which a lanyard or safety belt (or harness) is attached.

2.4. "Safety belt" means a device, usually worn around the waist, which, by reason of its attachment to a lanyard and lifeline for a structure, will prevent a worker from falling.

2.5. All other terms used in these rules and regulations, not defined herein, shall have the means set forth in W. Va. Code §22-1-1.

§36-27-3. Operating Equipment With Suspended Material.

3.1. All persons remain a safe distance from any supplies or materials while being raised, lowered or in transit, by a forklift, crane, or other equipment: Provided, that whenever it is necessary to have persons other than the equipment operator in the immediate vicinity of any such supplies, the loads shall be securely fastened by a chain or other device to the equipment handling the load in order to prevent the load from slipping or falling off the equipment.

§36-27-4. Protection From Falls From Elevated Areas.

4.1. Safety protection such as safety belts, lifelines, or lanyards to prevent a person from falling shall be provided at all times where the potential fall distance exceeds fifteen (15) feet, except that safety belts shall not be used where they are impractical or would pose a greater hazard.

4.2. Safety nets shall be provided when work places are more than twenty-five (25) feet above the ground where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts are impractical.

§36-27-5. Safety Precautions on Coal Stockpiles.

5.1. The following requirements shall apply to all surface coal stockpiles with draw-off tunnel feeders underneath the coal storage area of the stockpile which discharge onto a conveyor belt:

(a) No person shall travel on foot or operate equipment on a coal stockpile or coal storage area directly over areas where underlying coal feeders are in place without a plan approving such activity by the Director, or his authorized representative. The Plan shall be submitted by the operator or the independent contractor performing the work, and shall be

reviewed with all persons prior to work being done, and a record kept of such review.

(b) The Plan shall outline procedures to protect the health and safety of those who may have to travel on foot or operate equipment on a coal stockpile or coal storage area directly over areas where underlying coal feeders are in place. The minimum criteria for approval of the plan shall include:

(1) The equipment shall be equipped with an enclosed cab.

(2) The equipment shall have two-way communications and a back up communication system.

(3) The equipment operator shall be provided with a two self-contained self-rescuers.

(4) Warning signs shall be posted at the entrances to all coal stockpiles with underlying coal feeders.

(5) No person shall travel on foot, except on an emergency basis, and only under direct supervision; they shall be secured by an overhead lifeline; and feeders shall be locked and tagged out.

(6) A remote control device capable of stopping the flow from the feeder and stop the coal coming onto the stockpile.

(7) A means of providing emergency lighting to the mobile equipment operator.

(c) The operator shall establish rules for the safe procedures for breaking through cavities and for marking the feeder areas on the surface. A copy of the rules shall be submitted to the Director, Office of Miners' Health, Safety and Training for approval. A copy of the approved rules shall be posted at the mine site, and all persons to perform such work shall be instructed in these procedures.

(d) Telephone or equivalent two-way communications shall be established between equipment operators working on stockpiles and those persons who are operating conveyors, feeders, and hoppers at storage piles (where more than one person performs these duties), in order to keep such equipment operators advised of the possibility of bridged material over a cavity in the stockpile.

(e) Within six months of the effective date of this regulation, all mobile equipment manually operated on stockpiles with underlying draw-off feeders shall be provided with a fully-enclosed cab capable of withstanding a pressure of at least 20 pounds per square inch, with a factor safety of 2 as certified by a registered professional engineer.

§36-27-6. Working Around High-Voltage Powerlines.

6.1. Location of high-voltage powerlines. High-voltage powerlines located above surface work areas, driveways, haulageways, and railroad tracks shall be installed no less than fifteen (15) feet above ground.

6.2. Operation of equipment, minimum distance from high voltage lines.

(1) Equipment or machinery operated on the surface of any coal mine shall not be operated within ten (10) feet of an overhead powerline unless the line is deenergized and visibly grounded at the point of work, or unless insulating barriers not part of or an attachment to, the equipment have been erected to prevent physical contact with the lines. Where the voltage of overhead powerlines is sixty-nine thousand (69,000) volts or more, the minimum clearance between the lines and part of the equipment or load shall be: (Please see Table 36-27a).

(2) A person shall be designated to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means.

6.3. Movement of equipment; minimum distance for high voltage lines. When any part of any equipment operated on the surface of any coal mine is required to pass under or by any energized high-voltage powerline and the clearance between such equipment and powerline is less than that specified above, such powerlines shall be deenergized or other

precautions shall be taken to prevent contact with the powerlines.

6.4. Deenergization of powerlines. Any overhead wire shall be considered to be an energized line unless and until the person owning such line or electrical utility authorities verifies that it is not an energized line and it has been visibly grounded.

§36-27-7. Tires and Repairs.

7.1 A safety tire rack, cage or equivalent protection shall be provided when inflating tires during installation on split rings or rims equipped with locking rings or similar devices. Tires shall be deflated before repairs on them are started, and means shall be provided to prevent wheel locking rims from creating a hazard during tire inflation. Different types and sizes of wheel rims in the same location shall be stored separate from each other.

§36-27-8. Crushers, Feeders, and Rotary Breakers.

8.1. No person shall be permitted to perform any work within the confines of the cargo space of a crusher, feeder, or rotary breaker unless such equipment has been deenergized and locked out.

§36-27-9. Machines with Movable Parts.

9.1. Ninety (90) days after the effective date of this section, machines with movable parts used at surface mines or surface areas of underground mines, which are capable of coming into contact with its operating controls or is capable of pinning the operator between the movable part and its controls, shall be equipped with a panic bar or suitable mechanical means to prevent such contact, or pinning of the operator.

§36-27-10. Seat Belts.

10.1. Each employee working in a surface coal mine or in the surface areas of an underground coal mine shall be required to wear seat belts in a vehicle where there is a danger of overturning and where roll protection is provided.

10.2. Seat belts shall be worn by all drivers of trucks, 5-ton or greater, while operating their trucks on surface mines and surface areas of underground mines.

§36-27-11. Transporting Compressed Gas Cylinders.

11.1. When tanks and cylinders are not used and they are being transported, they shall be securely mounted with regulators removed, cylinder valves closed and protective valve caps replaced, except in conformance with the following requirements:

(a) Cylinders shall remain in a substantially constructed compartment while the gauges are attached and shall be secured against movement.

(b) The substantially constructed compartment shall be designed specifically for the mine maintenance vehicles carrying it; the cylinders shall be secured against movement and be placed at no greater than a 45 degree angle.

(c) The cylinder regulators, if not in enclosed compartments, shall be adequately covered to provide protection when regulators are left attached to cylinders.

(d) The substantially constructed compartments shall be secured to the mine maintenance vehicle in such a manner to prevent the entire compartment from overturning at any time.

(e) If the cylinders are being transported in closed compartments, the compartments shall be adequately ventilated, and all doors on the substantially constructed compartments shall be closed and secured when not in use.

(f) Cylinders, gauges, hoses, connectors, valve stems, and torches shall be checked for damage and proper fit by a qualified person immediately following transportation and prior to use.

(g) The cylinder valves shall be in a shut-off position, and the hoses relieved of pressure when not in use and when being transported.

(h) All substantially constructed

compartments shall be approved by the Director or his authorized representative prior to initial use.

§36-27-12. Mirrors on Surface Operated Equipment.

12.1. When required by an authorized representative of the Director to enhance safe operation, adequate mirror(s) will be provided on surface mine equipment that operates at surface mines, surface areas of underground mines, preparation plants and loadouts.

Mirror(s) provided on equipment by manufacturers of said equipment shall be deemed adequate and in compliance with the regulations.

WEST VIRGINIA BOARD OF COAL MINE HEALTH AND SAFETY

1591 Washington Street, E.• Charleston, WV 25311 • (304) 558-3721•FAX: 558-3729

TO: All Persons Interested in Rules and Regulations Constructed by the Board of Coal Mine Health and Safety

FROM: Vic Green, Health and Safety Administrator

SUBJECT: Rules and Regulations Governing Mobile Equipment operating on Coal Stockpiles

DATE: December 28, 1999

Action: Draft Proposed Rule - Title 36, Series 27 (Section 5.(b)(1-7); Section 5.1(e)

Comment Period: 60-day written comment period

Public Hearing: February 29, 2000, 9:00 a.m.
1591 Washington Street, E.
Charleston, WV 25311

Authority: WV Code §22-6-4

The Board of Coal Mine Health and Safety is created pursuant to WV Code § 22-6-1.

Background:

A fatality occurred April 11, 1999 when a dozer operator was working above an underground coal stockpile feeder, and the dozer was engulfed, above a cavity directly above the feeder, thus trapping the operator.

The Board of Coal Mine Health and Safety recognizes that several fatalities have occurred over the years from this type of accident, and accordingly the Board has constructed and is hereby proposing the enclosed proposed draft regulation to help prevent future accidents of the nature. However, the Board also recognizes there may be alternatives or different approaches to achieve this objective.

The Board of Coal Mine Health and Safety voted November 30, 1999 to submit a draft proposed rule, and the Board is interested in your views and comments regarding its proposal, as well as your views and comments on alternative approaches.

Accompanying this draft proposed rule are three reports that have been added to the Findings of Fact and Conclusion of Law by the Board's vote on November 30, 1999. They are as follows:

- Stockpile Dozer Submarine Kit
- Status report on stronger dozer cab windows
- PPG Industries, Inc. test report

Hopefully these reports will provide alternative methods to achieve a fully enclosed cab capable of withstanding a pressure of at least 20 pounds per square inch with a factor safety of 2.

Summary:

This rule only applies to mobile equipment operating on coal stockpiles where there is a chance of the equipment being submerged in a cavity caused by an underground feeder. The intent of this proposal is to provide window/cab protection as configured that will withstand the pressure if such equipment is submerged in a coal stockpile. Glass of adequate strength alone or glass used in conjunction with window reinforcement should collectively be capable of withstanding pressure of 40 psi.

The BCMH&S has granted a sixty (60) day written comment period ending on February 29, 2000 with a public hearing being held beginning at 9:00 a.m. at 1591 Washington Street, E., Charleston, WV 25311

A completed copy of the Draft Proposed Rule in its entirety can be reviewed at the Secretary of State's office or contact the Board office.

VTG:lgh

Attachments

DRAFT PROPOSED REGULATION

Title 36-27.5

Within six months of the effective date of this regulation, all mobile equipment manually operated on stockpiles with underlying draw-off feeders shall be provided with a fully-enclosed cab capable of withstanding a pressure of at least 20 pounds per square inch with a factor safety of 2 as certified by a registered professional engineer. In addition, the cab shall be equipped with the following:

(1) two self-contained self-rescuers, which are rated for providing 1-hour service each;
(2) back-up communication system;
(3) remote control device capable of stopping the flow from the feeder and stop the coal coming onto the stockpile;
(4) means of providing emergency lighting to the mobile equipment operator.

Sections of law affected

Title 36, Series 27, Section 5. Safety Precautions on Coal Stockpiles.

Section 5.1(b)(2) The equipment shall have two-way communications and a back-up communication system.

Section 5.1(b)(3) The equipment operator shall be provided with a two self-contained self-rescuers.

Section 5.1(b)(6) A Remote control device capable of stopping the flow from the feeder and stop the coal coming onto the stockpile.

Section 5.1(b)(7) A Means of providing emergency lighting to the mobile equipment operator.

Section 5.1(e) Within six months of the effective date of this regulation, all mobile equipment manually operated on stockpiles with underlying draw-off feeders shall be provided with a fully-enclosed cab capable of withstanding a pressure of at least 20 pounds per square inch, with a factor safety of 2 as certified by a registered professional engineer.

STOCKPILE DOZER SUBMARINE PACKAGE

NO. 1 REPORT

1. All dozers working on a coal stockpile with an underground feeder shall be equipped with the Submarine Package. That package is as follows:
   a.) All dozers will be equipped with chemtem glass in all windows. The chemtem glass shall not be cut on site. No sliding windows in stockpile equipment will be permitted.
   b.) Two rescuers shall be mounted in top of the environmental cab on each side of the operator. Use a caterpillar seat belt to buckle all rescuers into their storage compartment. Storage compartments must have a notch cut out to allow for visual examination of the moisture dot. You must also have a hole drilled into the back of the storage box to allow for the rescuers to be fastened to the box, by zip ties, in the event the seat belt becomes unbuckled. Rescuers must be mounted in pouches.
   c.) Three chemical light sticks mounted in a 1 ½" (inside diameter) PVC pipe shall be attached to one of the rescuer storage boxes. These lights must give a total of at least 12 hours of light.
   d.) All windows except the back window will use 1½" X 1½" X ¼" angle iron frame. Back window will be 1½" X 2½" X ¼" angle iron.
   e.) All cross bars are made of 1" X 3/8" flat bar.
   f.) Door bars are made from 2" X ¾" aluminum bars.
   g.) The sides of all angle iron shall have ½" key stock to decrease the distance from the glass to the internal frame where the frame extends over the glass.
   h.) All metal that can come into contact with any glass will have a thin silicone layer painted on them.
   i.) All internal frames and bars will be painted OEM.
   j.) Each dozer should be measured to allow for any air conditioning vents or cab inconsistencies.
   k.) Flat bars should have rubber tubing placed around them where they fit into the window slots to prevent vibration.
   l.) All pins shall be 3/8" snapper pins, as short as possible.
   m.) Back outside window guard will be made of ¾" metal with a 1" wire mesh cover that is painted black.
   n.) Mounting brackets for the back screen will be made of ½" angle iron. This will be mounted to the roll over protection.
   o.) A squeegee window will be left in one of the side mounting brackets for the back screen.
   p.) A side platform will be installed or a stationary platform will be constructed to allow for access to the squeegee window.
   q.) Additional lights should be mounted to the back of the dozer to give more lighting when looking to the rear.
   r.) All dozers operating on coal stockpiles will have a procedure in place to allow for radio communication with the operator, in the event the dozer electrical system fails. This can be accomplished by a back-up battery for the radio, or the operator can have a hand held portable radio in the cab.
   s.) The following companies have installed the submarine packages in dozers:

Tramco	Dynasty Welding	H&H Welding
Mitch Hager	Roger Ryan	Mike Hinkle
304-235-6479	304-934-7986	304-872-5176

Stronger Dozer Cab Windows: A Way to Improve Surge-Pile Safety

A Status Report

December 1, 1999

John Fredland
Civil Engineer

Pittsburgh Safety and Health Technology Center
Mine Safety and Health Administration

Background

Since November, 1998, two bulldozers operators have died in separate coal surge-pile accidents. One accident occurred in Virginia, the other in West Virginia. In both cases the bulldozer fell into a hidden cavity above a feeder. In each case, coal filled the cab when the windows of the bulldozer broke, or were pushed out of their gaskets. With these two accidents, 19 fatalities have now occurred at coal surge piles since 1980.

Recognizing that fatalities from this type of accident are preventable, the Mine Safety and Health Administration set out, following the Virginia accident, to determine whether it was feasible to provide bulldozers cab windows strong enough to resist surge-pile burial pressures. MSHA's Pittsburgh Technical Support Center explored possible solutions to the problem. These included installing stronger glass, or material such as polycarbonate, and/or providing supports to decrease the unsupported area of the glass in the windows.

This report summarizes the status of the option of strengthening the windows by installing high-strength glass - without additional supports. If feasible, this approach is considered preferable since adding supports would at least partially obstruct the operator's field of vision from the cab. The use of remotely-controlled equipment to remove the bulldozer operator from the from the potential danger also appears to be a feasible alternative and is being tried by at least two coal companies.

The purpose of strengthening the cab windows is to provide a "safe refuge" for the operator in the event of an accident, but this is just one element in an overall surge-pile-safety program. The overall focus of a such a safety program has to be to minimize the development of hidden cavities and to ensure that equipment operators will not be exposed to the danger should a cavity develop.

Surge Pile Survey Results

For background information, MSHA conducted a surge pile survey in February, 1999. The purpose was to determine the number of surge piles at coal operations and the number and type of mobile equipment used to move coal on the piles. The total number of surge piles reported at coal mines was 337, with at least one surge pile at 238 different operations. Approximately 600 pieces of mobile equipment were identified as being used on piles. Roughly 78% of the equipment was found to be Caterpillar bulldozers. The most common models were D9s (232 machines) and D8s (113 machines).

Burial Pressures

To determine the burial pressure that surge-pile-equipment cabs should be able to withstand, the surge pile accidents that have occurred over the last 20 years were examined. It appeared that when a bulldozer had fallen into a hidden cavity, the amount of coal that came in on top of it varied from about 10 to 25 feet. It was also recognized that additional coal can come in on the dozer from two sources. While digging out the buried dozer, additional coal may be disturbed and slide onto the dozer. Also, before it is discovered that an accident has occurred, additional coal may

discharge from the stacker tube and accumulate on the dozer. A further consideration is that the rescue equipment itself can impose additional stress as it is used to dig-out the buried piece of equipment.

Considering these factors, it appears prudent to provide a cab which will safely withstand being buried to a pressure equivalent to a depth of at least 35 feet of coal. With a cab capable of withstanding this amount of pressure, it appears that all of the accident victims who died as a result of coal breaking into the cab would have had the opportunity to have been rescued.

The pressure created by a burial depth of 35 feet depends on the unit weight of the coal. Coal weights can vary from a low of approximately 60 pounds per cubic feet (pcf) for clean coal, to a high of about 80 pcf for raw coal. Using the higher unit weight value, the burial depth of 35 feet correlates to a pressure of about 20 pounds per square inch (psi). This is proposed as the burial pressure that the cabs of the equipment used on coal surge piles should be able to withstand.

Factor of Safety

From a burial-pressure standpoint, the windows represent the weakest area of a cab enclosure. To protect the equipment operator, the window glazing and mounts need to be designed to withstand the 20 psi burial pressure with an adequate factor of safety. The factor of safety allows for uncertainty in the conditions involved, and provides a measure of protection against factors that are difficult to quantify, such as the possibility of impact-type loading, stress concentrations from larger pieces of coal or rock, and pressure from the weight of rescue equipment. In the glass industry, a minimum factor of safety of at least 2 is considered prudent in this type of application. Therefore, a prudent design for the equipment used on coal surge piles would be to provide a cab which is capable of preventing coal from entering the cab under a burial pressure of at least 20 psi, with a factor of safety of 2.

Window Materials

Various glass and plastic manufacturers were contacted to attempt to identify a window material strong enough to resist a burial pressure of 20 psi with an adequate factor of safety. To support this level of pressure with a material of reasonable thickness, and without additional supports, it was found that chemically-strengthened glass, or a material like polycarbonate, would be required. A chemically-strengthened glass called Herculite II, which is manufactured by PPG Industries, was identified as a product with high bending strength. This material was developed by PPG for F-111 cockpit windows. To produce Herculite II, a special base glass containing lithium is cut to the required shape and then immersed in a bath of molten sodium nitrate. The glass is strengthened when the larger sodium ions displace the lithium ions, putting the surface of the glass into compression. Once treated, this glass has a modulus of rupture (unabraded) of over 60,000 psi, making it about 4 times stronger in bending than heat-tempered glass and about twice as strong as some other chemically-strengthened glass products.

The use of polycarbonate was not explored further at this time for two reasons. One was concern that the scratch resistance of polycarbonate may present a problem in a surge-pile environment. The other was concern that, because it undergoes large deflections under loading, a polycarbonate

window would have to be either rigidly held around the edges or a significant amount of edge overlap would need to be provided.

Window Mounting

In addition to having sufficient bending strength, the window material must also be adequately supported around the edge of the window opening. If a gasket is used, it must be designed to allow the glass to overlap the edge of the cab opening by an adequate amount. The overlap must be sufficient to prevent the development of high enough stresses to cause the glass to crack along its edge, and the overlap must ensure that the glass will not pull through the opening when the glass deflects. Currently available gaskets only allow a minimal overlap of the glass - on the order of 1/8 of an inch - and will not accommodate glass thicker than 5/16 inch.

An alternative method of mounting the glass may be to use an adhesive bonding material, such as the material used to install automotive windshields. This method is currently being used by Caterpillar on some front-end-loaders cab windows.

Testing of High-strength Glass at PPG's Laboratory

To demonstrate and verify that the high-strength glass would support the burial pressure with an adequate factor of safety, laboratory testing was conducted at PPG's Aircraft and Specialty Products manufacturing plant in Huntsville, Alabama. The most critical condition was examined by testing the largest available dozer cab window, which is the rear window in a Caterpillar model D9R. The window is about 29 inches high and varies in width from about 43 inches across the top to about 45 inches across the bottom. A fixture was fabricated which duplicated the size of the opening in the cab and permitted the glass to be subjected to a uniform pressure using water and air pressure.

PPG engineers had recommended that a two-layer laminated glass be used. The strength of the full glass thickness would be designed to support the 20 psi pressure with a factor of safety of two. Futhermore, the inner ply of the window would be designed such that if the outer layer became damaged, the inner layer could still support the 20 psi loading. Thus the outer layer would provide a measure of protection against impact loadings.

A test was conducted on a window consisting of two 6 millimeter (mm) thick layers of Herculite II with a 1-mm thick polyvinyl butyral (PVB) interlayer. To represent worst case conditions, the glass was "simply-supported" around the edge of the test fixture, that is, it was simply resting on strips of rubber and a putty-type sealant. The glass overlapped the edge of the window opening by ½ -inch, which was the minimum overlap recommended by PPG.

The test was conducted in an environmental chamber with the temperature raised to 120 degrees Fahrenheit. This was done to simulate the conditions of operating the equipment on a pile on a hot, sunny day. The temperature of the glass itself was over 105 degrees. A strain-gage was installed to monitor the strain in the glass. The glass was loaded to a pressure of 40 psi and this pressure was held for two hours. The center of the glass deflected by about 1½ inches. No breakage of the glass occurred.

Testing on other glass samples had shown the importance of maintaining a cushion between the glass and the edge of the steel around the window opening. In a test where the glass was supported only on a bead of putty, the test sample eventually failed when the pressure on the glass squeezed the putty out allowing a high stress concentration in the glass where it contacted the uneven edge of the steel.

This testing demonstrated that Herculite II glass consisting to two 6-mm thick laminated layers can withstand a 40 psi pressure in the size windows found in bulldozers. Note that the largest window was tested and the results indicate that thinner glass could be used on the smaller dozer windows.

MSHA Field Burial Demonstration

To demonstrate the use of the high-strength glass in a surge-pile bulldozer, a Caterpillar D9N was fitted with the glass and a full-scale burial test was conducted at the Federal No. 2 Mine in West Virginia. The dozer was prepared for the test in cooperation with representatives of PPG Industries and Caterpillar. The windows used in the demonstration were laminated, consisting of two 6-mm thick layers of Herculite II chemically-strengthened glass. The glass had been sized to provide a ½ -inch of overlap around the edge of the cab opening.

Caterpillar had the windows installed by Imperial Glass, a local glass installer. The glass was bonded to the cab using Betaseal U-216, a two-component urethane adhesive used to install automobile windshields. Spacers or "buttons" were used within the adhesive to attempt to obtain a uniform adhesive thickness of about 5 mm. The adhesive was used because there wasn't a gasket available that could accommodate glass of this thickness. Since the glass was not held in place by a gasket, four layers of electrical tape were applied to protect the edges of the glass.

In the burial demonstration, the test dozer was positioned on the side of a pile of clean coal with the blade facing up the slope. The slope of the pile was about 35 degrees. A D11 was then used to push coal over the edge of the pile and accumulate it on top of the test dozer. The test dozer ended up being buried under a 30-foot high pile of coal. When the dozer was dug out, the windows were undamaged. Instrumentation on the windows showed that for this burial condition the glass was subjected to stresses well below the level that it would take to break the glass.

Summary

Pushing coal on a surge pile is a potentially dangerous job. The danger comes from the changing conditions, the time pressures, and the need to push coal at night and in adverse weather. While safety measures should be in place to minimize the formation of hidden cavities and to prevent equipment from being exposed to the danger of such cavities, as a back-up safety measure either the cabs of surge-pile equipment should be made strong enough to resist burial pressures, or remote-control equipment should be used. Coal companies are encouraged to implement one of these options to provide protection to their surge pile equipment operators.

For the option of strengthening the cab windows, as described in this report, chemically-strengthened glass with a modulus of rupture of over 60,000 psi has been demonstrated to be capable of withstanding the pressure of 35 feet of coal, with a factor of safety of more than two.

Other glass or polycarbonate products, capable of withstanding this amount of pressure, may also be available. Before a window product is installed in a piece of surge pile equipment, it should be demonstrated by testing that the material will withstand an ultimate pressure of 40 psi. The testing should also demonstrate that the method specified for mounting the window to the cab, whether it be by a gasket, an adhesive, or some other means, will provide adequate overlap and strength.

Coal companies are encouraged to work with glass manufacturers, and equipment manufacturers, in upgrading existing surge-pile equipment and in purchasing new equipment that may be used on surge piles.

Contacts

For additional information on the testing and products described in this report, the following individuals can be contacted:

MSHA

- Mark Skiles, Director, Technical Support, Arlington, VA 703-235-1570
- John Fredland, Civil Engineer, Technical Support, Pittsburgh, PA 412-386-6910

PPG Industries, Inc.

- Arthur Scott, Manager Securitect Products, Huntsville, AL 256-851-1023

Caterpillar Inc.

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QUALIFICATION TEST REPORT
QTR-187205

For

Mine Safety and Health Administration
Caterpillar model D9R

PPG Industries Inc.
Aircraft Products
Huntsville, Alabama

Prepared by: _____ _____
Jorge Flores Date

1.0 TEST OBJECTIVE

The objective of this test program was to satisfy the requirements of the QTP-187205. The following test report describes the testing conducted and presents the test data gathered in the completion of this task.

2.0 TEST PROCEDURE SUMMARY

2.1 Ultimate Pressure Test

The sample window will be loaded into the test fixture. The fixture will be placed in an environmental chamber and heated to 120 degrees F. Pressure will be applied to the fixture until 40 psig has been achieved. This pressure will be maintained for four hours, or until the readings of the deflection and strain gauges stabilize, but a two hour minimum will be imposed.

To be considered a successful pass of the test, no delamination, breakage or other structural degradation shall be observed as a consequence of this test.

2.2 Failsafe Pressure Test

The windshield shall be instrumented with a three-element strain gauges on the exterior glass surface, which is representative of the inner ply in reference to the vehicle cab. The gauge will be located at the approximate windshield center.

The windshield shall be installed in the pressure test fixture and pressurized to 20 psig at 120 degrees F. The pressure shall be maintained for 2 hours without windshield failure, such as damage to the core structural glass ply. Surface stresses and deflections will be recorded at one minute intervals. This test must be completed without failure of the structural glass ply.

3.0 TEST SETUP

3.1 Test Article

The pressure test article was fabricated per PPG drawing number 22-17-6586. The fixture was built to conform to the rear windshield opening of a Caterpillar D9R tractor. Window opening sizes for this vehicle were provided by Caterpillar, Incorporated. All test samples were tested in this fixture.

3.2 Test Conditions

Unless otherwise stated herein, all measurements were performed at the following standard ambient conditions.

Relative Humidity	90% or less
Barometric Pressure	Local ambient
Input Voltage	27 VDC

3.3 Test Apparatus

The PPG calibration system controls all instruments as required and guarantees that all instruments were in calibration during the actual testing procedures. The data acquisition instrumentation and equipment used along with calibration information is included as follows: (also see Table 1.0 in Appendix A)

Environmental Chamber
Russells Technical Products
Thermotron Chamber
No calibration required

Ashcroft Pressure Gauges
PG-866349
0-30 psig .1 psi increments
last calibration 7/30/1998
house calibration due date 6/99

Watlow Temperature Controller
-100° F.to 200° F TR-866465
last calibration 10/99

Sensotec Pressure Transducer
TJE-703-04 0-25 psig
S/N 1453372
certified by manufacturer/verified in

Deflection Transducer
Type GCD-121-500
± 0.500 inches
S/N 9465
calibrated prior to test with gage blocks

Miscellaneous
Strain Gages
Voltage and Ohm Sensor

3.4 Test Witness

The various phases of the testing were witnessed by Mr. Charles Madewell, Test engineer, and Mr. William Newberry, Senior Development specialist, Mr. Jorge Flores Senior Design engineer, Mr. James Hartmann, Staff engineer for Sales and Service, all from PPG Industries, Mr. E. Larry Checca, Mr. John Fredland, and Mr. Stephen Gigliotti, from the Mine Safety and Health administration, and Mr. C. Calvin Camp from Caterpillar.

4.0 TEST RESULTS DISCUSSION

4.1 Ultimate Pressure Test

The ultimate pressure test began on November 3, 1999 according to test plan. The 6mm/3mm cross section laminate with a .04 inch PVB interlayer was loaded into the test fixture and water pressure was turned on into the system. The test setup is shown in figures 1 and 2. The goal was to reach 40 psig. As the fixture reached about 35 psig, the sample failed. Examination of the broken sample did not provide any clues to the method of failure. Below the glass sample and on the topside of the holding cart were steel cross members. As the sample burst, the window smashed into these support railings causing extreme damage to the window. It could not be determined if the glass failed due to failure to carry the 40 psig or for other extraneous circumstances. The strains measured by the strain gauge were in the 1500 to 1600 micron range, which equates to a stress of 17.5 to 18.5 ksi. The glass used in this sample has an abraded modulus of rupture near 62 ksi. The broken sample is shown in figures 3, 4 and 5.

A second sample was loaded into the fixture on November 4, 19999. This was a 6mm/6mm cross section laminate with a .04 inch PVB interlayer. A few leaks were observed in the system. The leaks were sealed and the test was rerun on November 5, 1999 on this same 6mm/6mm sample.

The test sample was again placed in a chamber where the temperature was set to 120 degrees F. The pressure was raised to 40 psig and held constant. The readings on the strain gauges leveled off in approximately 70 minutes. The readings on the LVDT leveled off in about 45 minutes. However, the constant pressure was maintained for the two hour minimum. After two hours, the glass had not failed, and the test was stopped.

4.2 Fail Safe Pressure Test

A spring loaded center punch was then used to break the outer ply of the test sample. Note that the outer ply of the test sample was on the interior of the fixture. This ply would be the equivalent of the outer ply on a vehicle Once the outer ply was broken, the pressure chamber was again heated to 120 degrees F, and the pressure turned on. The fixture sprung many leaks and could not hold any pressure. Due to the deflection of the previous test, the sealing of the glass into the test fixture had been stretched out of place. Figure 6 shows the sample with a broken outer ply, with the seal plane violated.

5.0 TEST CONCLUSION

It is the technical opinion of PPG Industries that the requirements of the test plan, QTP-187205, have been successfully met through the testing conducted and the data presented in this report. The 6mm/6mm glass laminate maintained twice the design load of 20 psig for a period of two hours, simulating the load carrying capability that may be necessary in a coal mining mishap.

6.0 REFERENCES

All documents are the latest revision unless otherwise stated.

DOCUMENTS

PPG	"Procedures Manual, Aircraft and Specialty Products"
PPG	"Qualification Test Procedure", QTP-187205

DRAWINGS

PPG	22-17-6586