road manager

by Thomas J. Martinelli

Seeing Clearly Through Snowplow Windshields

Strategies clear ice and fog to help plow drivers keep their eyes on the road.

It's a familiar sight for a snowplow driver: ice and snow creeping in from the outside edges of the windshield, progressively obstructing the view. Add a little ice buildup on the windshield wipers and a coating of fog on the inside of the glass, and these minor annoyances can turn into a serious safety problem.

Photo courtesy of the Wisconsin DOT.

Blowing snow presents a visibility challenge for plow drivers.

Windshield icing and fogging are issues that just about every snowplow driver has dealt with, but they tend to be perceived as minor problems, and typically receive less attention from equipment manufacturers and state departments of transportation than concerns about how to plow more efficiently.

"It's a problem that's plagued everybody, and it's a big safety issue," says Jim Dowd, a winter operations research analyst with the Iowa DOT. "It really never gets much airtime, but it's pretty imperative that the windshield and side window be totally clear."

A recent research project sponsored by the Clear Roads winter maintenance research program investigated strategies for keeping snowplow windshields, windows, and side mirrors clear. Clear Roads (*www.clearroads.org*), a pooled fund project led by the Wisconsin DOT, focuses on testing winter maintenance materials, equipment, and methods for use by highway maintenance crews.

As part of the research project, over 200 winter maintenance professionals participated in a survey about which methods they find most effective at eliminating icing and fogging on their trucks. These survey respondents identified and

Photo courtesy of the Iowa DOT.

Snow and ice can become stuck to wipers, lifting the blade off the windshield and creating streaks and smears.

rated several strategies for each problem — some long-term solutions and some less-expensive aftermarket fixes.

"This type of research is really important, because it lets DOTs know how other agencies handle problems that we're all facing," says Dennis Belter, maintenance administration manager at the Indiana DOT and a Clear Roads technical advisory committee member. "It helps DOTs avoid spending time and money independently researching a problem that another agency may have found a solution for."

The survey yielded hundreds of comments from maintenance supervisors, fleet managers, and others at DOTs across the country and internationally. Their perspectives on their experience with icing and fogging, and which solutions they've found most effective, helped the researchers compile a comprehensive list of strategies that other DOTs may want to try. This article details several of the solutions that survey respondents mentioned.

Obstructed view

One of the most common problems plow drivers face is ice and snow buildup on windshields. Snow blowing over the top of the plow contributes to the problem, as does falling, blowing, and drifting snow. Depending on the design of the truck's hood, windshield, and wipers, ice and snow may accumulate along the cowling at the base of the windshield, or along the sides, beyond the reach of the wipers.

"We have problems with snow buildup on the cowl to the point that the wiper arms can come off of the wiper motor," says Matt Ladenburg, a shop superintendent at the Montana DOT.

Plow deflectors and plow flaps are two devices that work to trap plowed snow and prevent it from moving upward and over the plow.

Traditionally, snowplow drivers have relied on the truck's defrost system and windshield wipers to remove most snow and ice, and if the buildup becomes too great for the wipers to handle, a driver may have to stop the truck to clear the windshield with an ice scraper — a less than ideal solution.

One way to address the problem is by preventing plow blow-over. Plow deflectors and plow flaps are two devices that work to trap plowed snow and prevent it from moving upward and over the plow.

A plow deflector is a strip of stiff rubber, metal, or plastic that is bolted to the top of the plow to create a horizontal barrier over the plow. In contrast, plow flaps are typically attached to the underside of the top edge of the plow and hang vertically down the front. Plow flaps are often made of stiff rubber or belting material.

"A stiff flap mounted on the front of the plow curl helps reduce blow-over — stiff so it doesn't sail or cave into the curl," says C. Ray Stocks, also a shop superintendent at Montana DOT.

Choosing the right plow design can also help minimize blow-over, including using a plow with sufficient moldboard height. Some agencies have had success using plows with a greater curvature or deeper funnel. Adjusting the angle between the plow and the road can help as well.

"MoDOT has gone with a greater angle on the moldboard to eliminate bulldozing," says Tim Houdyshell, a maintenance superintendent in the Missouri DOT's District 7. "With the increased

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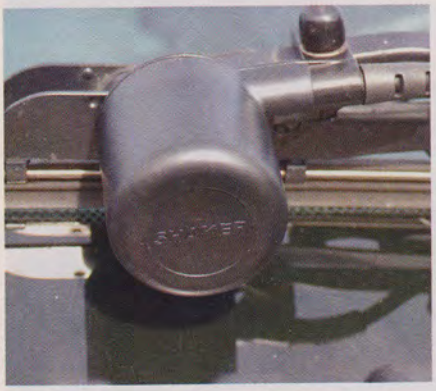

Photo courtesy of Wiper Shaker Technology.

The Shaker attaches to an existing wiper arm and blade assembly. When activated, it causes the wiper blade to rapidly and repeatedly lift and return to the windshield, clearing trapped snow and ice. "With the press of a button in the cab of the truck, the vibrator is activated, and the snow and ice usually come off," says Kevin Mitchell, a fleet manager with the Nova Scotia Department of Transportation and Public Works.

angle, we are turning the snow over fewer times, which helps eliminate the wind getting under it and blowing it up on the truck."

Especially at higher speeds, a hood-mounted wind deflector may also afford some protection, preventing snow that blows over the plow from hitting the windshield.

"A wind deflector works best when the truck is moving fast, providing a high velocity of air over the hood," says Bob Lannert, a technical support engineer at the Missouri DOT.

Other methods of combating blow-over that can be used when practical include plowing at a lower speed, and using underbody plows, which discharge snow away from the driver's field of vision.

Hot or cold

Since some snow will inevitably reach the windshield, other strategies focus on melting the snow, or preventing it from sticking to the glass. Using the truck's heater/defroster to keep the windshield warm and melt the snow is a common first step. Newer trucks may have more powerful blowers and more effective heating systems than older trucks.

"Sometimes our drivers run the defroster on full heat and then crack the window down a bit so it doesn't get too hot," Dowd says.

Building on this concept, some truck manufacturers are beginning to offer heated windshields. Mack offers heated windshields on its Granite line of trucks and snowplows, and plans to offer them on other lines in 2007, according to Dan Wickline, director of government and municipal sales at Mack.

Similar to rear-window defrosters that use wires embedded in the glass, Mack's heated windshields use a 12-volt heating element around the outside 4 inches of the glass. "It works extremely well, and is now a standard option for many customers," Wickline says.

While heating the windshield can be a very effective approach, keeping the windshield cold to prevent snow from sticking and accumulating on the glass can work well in very cold weather. Drivers may turn off the heating system in the cab, or drive with the side windows open.

Chemical glass treatments such as Rain-X may also help prevent snow from sticking, especially in combination with one of the other strategies mentioned above.

At high speeds, a hood deflector can also help prevent snow that blows over the plow from reaching the windshield.

Photos courtesy of the Wisconsin DOT.

Plow flaps attach to the top edge of the plow and hang down the front, trapping plowed snow and preventing it from blowing over the plow.

A plow deflector is attached to the top of a plow to prevent plowed snow from blowing over the top of the plow and hitting the windshield.

Photo courtesy of Kenworth Truck Company.

Vertical wipers like those on this Kenworth truck reduce snow and ice buildup at the base of the windshield. Their upright design provides less surface for snow to collect on, and the arc of the wipers minimizes packing of snow and ice.

"We have noticed that when you wipe on a product that leaves a non-stick surface barrier, it helps with removal in the corners and lower center of the windshield, where snow tends to build up," says Lonnie Ford, a highway maintenance supervisor with the Iowa DOT.

Some agencies have had success using systems that heat the truck's windshield washer fluid to melt accumulated ice and snow. Others add deicing additives to standard washer fluid to help melt ice buildup.

"The additives burn the frost off the windshield," Lannert says. "It's better than using standard washer fluids alone."

Wipers take on winter

In addition to windshield accumulation, ice and snow can build up on windshield wipers as they work to clear precipitation. Wet snow can build up at the bottom of the windshield under the wipers, which can strain the wiper motors, sometimes causing the motor to fail or the wiper arm to break. In addition, ice can become stuck to the wiper blades, lifting parts of the wipers off the windshield and causing streaks and smears that obscure the driver's vision.

"In heavy snowstorms, we often see snow piling up below the wipers," Lannert says. "Then the wipers pound on the pile of ice and snow, which can bend the wiper arms or fail the wiper motor.

"The failure of a simple wiper system can cause a $100,000 snowplow truck to be out of service," he adds.

To prevent ice buildup, many agencies use winter-grade wipers, which have covers over the wiper blades. Often made of rubber, these sleeves or boots encase the brackets and joints of the wiper assembly where snow can become trapped.

The placement of wipers on the truck can also minimize buildup. Vertical wipers, such as those available on some Kenworth trucks, rest in an upright, vertical position and sweep horizontally across the windshield. Other truck manufacturers, such as Oshkosh, offer wipers mounted at the top of the windshield. The upright design of both types of wipers provides less surface for snow to collect on, and the arc of the wipers minimizes packing of snow and ice at the base of the windshield. Oshkosh also offers reverse-slope windshields to minimize buildup and side window wipers on some trucks.

Two companies offer aftermarket wiper attachments that mechanically remove ice buildup from wiper blades. Slap Wipers use air pressure to raise the wipers about 8 inches off the windshield and slap them back in place, causing accumulated snow and ice on the wiper to break off.

"We used to have to reach out through the side window and slap the wiper to get ice and snow off," says Alan Lightfoot, a transportation operations supervisor with the Minnesota DOT. "Now, you just push an air button and the wiper lifts off the windshield and slaps back down, clearing the blade."

Similar to rear-window defrosters that use wires embedded in the glass, Mack's heated windshields use a 12-volt heating element around the outside 4 inches of the glass.

Photo courtesy of Mack Trucks.

A second product is the Shaker, an attachment that clamps onto an existing wiper arm and blade assembly. When activated, the Shaker rapidly and repeatedly lifts the wiper arm 0.0625 inch off the glass to clear trapped snow, ice, and debris.

"The operators find it very helpful to clear the windshield without having to stop and get out to clear the wipers by hand," says Doug Peveril, fleet service coordinator for the Nova Scotia Department of Transportation and Public Works. "By staying inside the cab, this decreases the chance of other vehicles hitting our parked trucks or the operators."

Fogging the windows

In addition to buildup on the outside of the windshield, snowplow drivers must contend with fogging on the inside of the windshield, a problem that is most common when temperatures are near freezing or in humid conditions.

Two approaches to combating interior fogging, which may be used simultaneously, are to increase airflow over the windshield and to reduce the moisture content in the air. Some agencies mount small fans inside the cab to direct air over sections of the windshield or windows that do not receive adequate airflow from the truck's ventilation system. To dry the air, agencies may use an air conditioner, alone or as part of the system's defrost setting.

"We have added air conditioning to help with the problem, and it seems to have made a difference in how much fog we get on the inside of the truck," said one respondent to the Clear Roads survey.

Another strategy for eliminating fogging is to reduce the temperature difference between the inside of the cab and the outside air, which also minimizes the humidity difference and the opportunity for condensation to form on the windshield.

The operators find it very helpful to clear the windshield without having to stop and get out to do it by hand.

"Some of the drivers don't put any heat on the windshield," Dowd says. "Sometimes they blow it down onto their feet to keep them warm, and some will try to lay gloves and rags over the vents to keep the heat from going on the windshield."

Two approaches to combating interior fogging are to increase airflow over the windshield and to reduce the moisture content in the air.

Lannert agrees. "It's an old trick of the trade," he says. "Most operators will tend to try to clear their windows and then they'll run a cold cab. They'll leave a window cracked, so the humidity exits the cab and doesn't fog up the inside of the glass."

Since each problem has a range of potential solutions, each DOT can try the strategies that are most appropriate for its climate, equipment, and budget. Replacing older trucks with newer models that may have more efficient heaters or air conditioning requires time and money, but there are less expensive aftermarket solutions that can provide relief from the problems as well.

"We try to look at it from a life-cycle costing perspective," Lannert says. "We consider a strategy's initial cost together with the maintenance costs throughout the life of the truck.

"Our operators being able to see is a safety issue," he continues. "A feature that costs a couple hundred dollars is nothing when it can prevent one accident." **BR**

Thomas J. Martinelli, P.E, is the state winter operations engineer at the Wisconsin DOT, and the technical advisory committee chair for the Clear Roads winter maintenance research program. Consulting firm CTC & Associates LLC performed the Clear Roads project described in this article. The final report is available online at www.clearroads.org/surveyproject.htm.