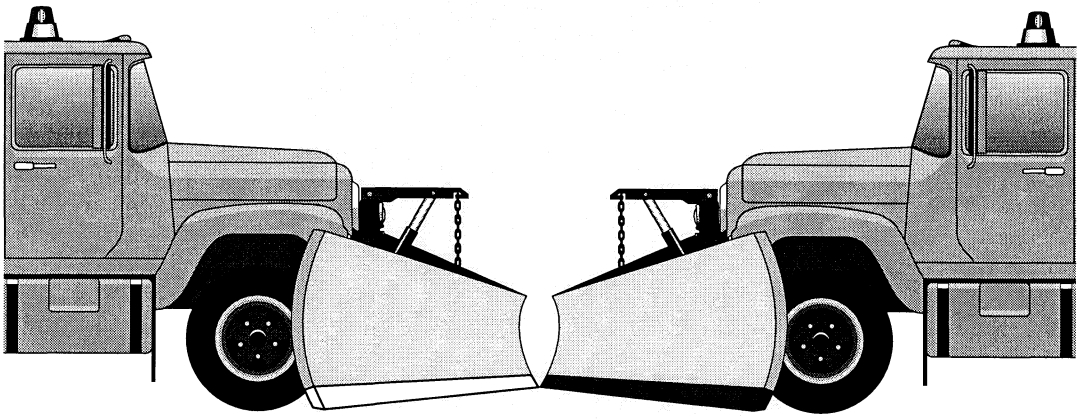
FINAL REPORT

EVALUATION OF URETHANE SNOW PLOW BLADES AS AN ALTERNATIVE TO RUBBER BLADES



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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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ABSTRACT

The purpose of this study was to determine if urethane blades are a suitable alternative to rubber blades for use on snow plows. The importance of finding a suitable alternative is due to the anticipated increased need to protect the new, longer lasting, and expensive preformed tape now being introduced as pavement markings in Virginia. Two sites were selected to test urethane blades, and six sites were selected to test rubber blades. The study reviewed the cost and quality of snow removal for each type of blade.

The study found that urethane blades cleaned the roadway surface better than rubber blades but were subject to the same problem of low durability. The Virginia Department of Transportation (VDOT) uses a plowing method that places the full weight of the plow on the blade. This method results in high friction between the blade and the road surface, which causes the blades to wear quickly. The rapid disintegration of the blades within a single snow event makes life-cycle cost a moot point. Limited data, however, indicated that the life-cycle cost of urethane blades was 6.5 times greater than that of rubber blades.

Many airports extend the blade life of urethane blades on their plows by removing the weight of the plow from the blade through the installation of wheels on the plow. Since the conditions under which VDOT currently uses rubber blades is similar to airport conditions, the study recommends that VDOT plows be modified to take the plow's weight off the blade and that urethane blades be substituted for rubber blades.

The study was unable to determine if the use of wheel-supported plows equipped with urethane blades would sharply reduce damage to pavement markings. The study recommends that an additional study be conducted in the coming winter season to determine the effect of properly supported urethane blades on pavement markings and the suitability of urethane blades for snow removal under a wider range of conditions.

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INTRODUCTION

In 1993, Virginia Governor George Allen established the Governor's Commission on Government Reform (GCGR) to investigate and recommend changes in state government that would streamline its operation and improve its efficiency and service. The GCGR reviewed the Virginia Department of Transportation's (VDOT) snow removal operation as a part of its investigation. This review resulted in three recommendations[1] for further study by VDOT:

> TR44—VDOT should test urethane blade use. This blade has not been previously used in Virginia but is touted as an alternative to rubber-tipped blades that avoids some of the problems associated with rubber-tipped blades (no durability, relatively higher cost than carbide-tipped blades).
>
> TR45—VDOT should obtain more accurate data concerning the damage caused exclusively by carbide-tipped blades. Various test sections of roadway should have a "before and after" snowstorm pavement marking assessment performed.
>
> TR46—VDOT should explore new technologies (including enhanced use of chemical applications to roadways) that might help in preventing ice/pavement bonding. This bonding contributes an unknown amount to the pavement damage resulting from clearing the roads of ice and snow.

Recommendations TR44 and TR45 resulted from the GCGR's concern that VDOT's current method of snow removal is damaging pavement markings. These markings include the new, more durable, but expensive, preformed tape now being used on Virginia's highways as well as the paint and thermoplastic material that has been in use for many years. In part, the current snow removal method involves plowing road surfaces with snow plows equipped with carbide-tipped blades. The full weight of the plow rests on the road. Currently, the only alternative to the carbide-tipped blade used by VDOT is a rubber blade. A carbide-tipped blade normally lasts a complete snow removal season, whereas a rubber blade wears rapidly and must be changed or adjusted frequently, often more than once during a single storm. The GCGR's concern about pavement marking damage leads to an anticipated increased use of rubber blades. The investigation, then, to determine if urethane blades are an acceptable substitute for rubber blades with regard to cost, durability, and snow removal (TR44) has a larger application than merely finding a substitute for a little-used snow plow blade.

PURPOSE AND SCOPE

The purpose of this study was to evaluate the use of urethane snow plow blades as an alternative to the use of rubber blades under current plowing conditions. Rubber and urethane blades were used in snow removal operations at eight locations. Their use was evaluated to compare the durability, snow removal ability, and cost of the two types of blades.

METHODOLOGY

The methods involved conducting a literature review, conducting a survey of other users and manufacturers of snow plow blades, and field experimentation. Some VDOT field locations had ordered rubber and urethane blades independent of, and prior to, this study. These locations were used as test sites to obtain data on the durability of the rubber and urethane blades and their ability to remove snow from roadway pavements. Other states, some localities within Virginia, and many airports use rubber and/or urethane blades. Their experience was determined through a survey and telephone contacts. Finally, a cost analysis was conducted to compare the costs associated with the use of rubber blades and those associated with the use of urethane blades.

Literature Review

The recently published NCHRP synthesis entitled *Managing Roadway Snow and Ice Operations*[2] was reviewed. It summarizes the snow removal practices of 34 states, 6 Canadian provinces, and 11 cities and counties. In addition, the Transportation Research Information Service was accessed using DIALOG.

Agency Survey

A questionnaire (see Appendix A) was sent to each of the 33 states and 6 Canadian provinces that traditionally remove heavy accumulations of snow from their roadways. The questionnaire was designed to solicit information for the three snow removal studies undertaken at the request of the GCGR. Questions 2 through 12 applied directly to this study.

Industry Survey

Airports use urethane snow plow blades extensively. Because most runways have in-ground light fixtures that protrude above the surface of the runway, plowing the runway with steel or carbide-tipped blades damages the light fixtures and/or chips the blade. Both rubber and urethane blades absorb the shock and ride over the fixture. Airports have chosen urethane over rubber blades because they remove more snow and work better in freezing temperatures. To

determine the experience of airports, maintenance superintendents and foremen at National Airport in Northern Virginia and Hancock International Airport in Syracuse, New York, were contacted.

Sherwin Industries supplies blades to 144 commercial airports and more than 50 military airports. John J. Carini, National Sales Manager for Airport Runway Support, Sherwin Industries, Milwaukee, Wisconsin, was contacted for his industry experience.

The City of Charlottesville uses rubber blades on most of its snow plows and supports the weight of the moldboard through the use of caster wheels. Contact was made with their maintenance operations personnel to discuss their experience, and their operations were observed in the field.

Field Investigation

In 1993 and 1994, residencies in four VDOT districts purchased rubber and urethane blades for use on sections of roadway where preformed tape was in place. The blade types and locations to which they were assigned were as follows:

Residency	Area HQ	Route	Blade Type
Abingdon	Fort Chiswell	I-81/77	Rubber
Abingdon	Wytheville	I-81/77	Rubber
Appomattox	Rustburg	460	Rubber
Chatham	Mt. Airy	29	Rubber
Edinburg	Stevens City	I-81	Rubber
Edinburg	Tom's Brook	I-81	Rubber
Edinburg	Tom's Brook	I-81	Urethane
Christiansburg	Christiansburg	I-81	Urethane

The experience of the Charlottesville Residency (Yancey Mills Area HQ), which, for many years, has used rubber blades on the area of I-64 that has in-pavement fog lights was also determined.

Cost Analysis

The costs associated with the use of rubber blades were compared with those associated with the use of urethane blades.

RESULTS

Literature Review

According to the NCHRP synthesis, 23 agencies use carbide-tipped blades, 16 use high-carbon steel blades, 15 use steel blades, and 5 use rubber blades. None uses urethane blades.

In 1969, the Washington State Department of Highways[3] studied the use of rubber and polyurethane snow plow blades in their snow removal operation. Their plowing method is similar to that of Virginia's in that they plow with the full weight of the plow on the blade. They found that urethane blades remove nearly 100% of slushy snow but only about 85% of dry, compacted snow, which was an improvement over rubber blades. The urethane blades did not wear as well as the rubber blades. The researcher estimated that the higher materials and labor costs involved made the cost of urethane blades 10 times that of rubber blades. The Washington State response to the questionnaire indicated that they continue to operate with the full weight of the plow on the blade and do not use urethane blades in any of their snow removal operations. No other published studies concerning the use of urethane snow plow blades on highways were found.

Agency Survey

Of the 39 surveys sent, 21 states and 2 Canadian provinces responded. All of them use carbide-tipped or steel blades as their primary snow plow blade, and 7 use rubber blades on a limited basis. Only one state, Illinois, has used urethane blades, but only on an experimental basis.

The 7 states using rubber blades are experiencing results similar to those experienced in Virginia. They noted a shorter life and a reduced ability to clear snow from the pavement for rubber blades than for carbide-tipped or steel blades. Most use rubber blades only at locations with raised pavement markers. They find the rubber blade to be ineffective at below freezing temperatures. Oregon uses skids to hold the weight of the plow off the blade. Even under that condition, the wear is much faster than with steel blades, which is their primary blade.

Illinois experimented with the use of urethane blades on a few trucks in the Chicago area. Chemicals had been applied to the roads to prevent a bond forming between the snow and the pavement. The full weight of the plow rested on the blade. The urethane blades removed snow as well as the carbide-tipped blades usually used. However, they wore quickly and, due to their high material cost, their use was prohibitively expensive.[4]

Industry Survey

Airports

Airports use urethane snow plow blades extensively. Because most runways have in-ground light fixtures that protrude above the surface of the runway, plowing the runway with steel or carbide-tipped blades damages the light fixtures and/or chips the blades. Both rubber and urethane blades absorb the shock and ride over the fixture. Airports have chosen urethane over rubber blades because they remove more snow and work better in freezing temperatures.

Sherwin Industries supplies urethane blades to almost 200 airports for runway snow removal operations and has studied this topic extensively. They found that the following conditions are necessary to use urethane blades successfully:[5]

1. *The weight of the plow must be taken off the blade.* Failure to do so will cause rapid wear to the blade. They strongly recommend using high-pressure rubber tired wheels attached to the back of the plow to support the weight of the plow.

2. *The plow should not have a trip mechanism or the trip mechanism should be locked out.* Tripping and untripping the plow places stresses on the blade, which will cause it to crack or shear.

3. *The ideal angle for the blade is a 5 to 15 degree tilt back from the vertical.* This allows the blade to scrape snow from the surface and be flexible enough to ride over obstructions, such as runway light fixtures. Angles greater that 15 degrees cause the urethane blade to chip on impact with in-pavement obstructions.

Discussions with maintenance personnel at Hancock International[6] and National Airports[7] confirmed these findings. They also reported that their blades normally last through the entire winter season when these conditions are met. Both support their plows with wheels and use plows without trip mechanisms. Both indicated that they plow with the blade just in contact with the pavement. This process usually leaves a skim of snow, which is probably not critical for motor vehicles but is a problem for aircraft. Both airports follow each plow with a tractor sweeper to remove the skim before the runway is opened to aircraft. In addition, airports use anti-icing chemicals to keep a bond from forming between the snow and the pavement. The chemicals of choice are calcium magnesium acetate and urea. Sodium chloride and calcium chloride are never used since they cause rapid corrosion of aircraft.

Earl Crouse, Superintendent of Maintenance at National Airport, also discussed his previous experience with highway maintenance with the State of Maryland. He stated that the urethane blades remove snow as well as the carbide-tipped blades as long as no bond has formed between the snow and the pavement. If ice is present, the urethane blades tend to ride over the ice without removing it whereas the carbide-tipped blades cut into the ice in some cases.

Airports have little experience with the effect of plowing on pavement markings of the type used on Virginia highways. Glass beads reduce the coefficient of friction between aircraft tires and the runway surface and are not used in runway pavement markings. For this reason, most airports use regular roadway paint, without beads, and repaint their runways annually. At National Airport, a single unit is responsible for snow removal on both roads and runways. Although they do not use preformed tape on their roadways, they do use thermoplastic pavement markings at many locations. They have noted no physical damage to the paint or thermoplastic by urethane blades used on plows with their weight supported by wheels. They have no knowledge of damage to the reflectivity of these markings.

City of Charlottesville

The City of Charlottesville equips most of its plows with rubber blades and supports the weight of all its plows with adjustable, metal caster wheels. Discussions with the Chief of Street Maintenance[8] and the Shop Foreman[9] indicated that the city has few problems with the wheels malfunctioning during snow removal operations. Limited observation of Charlottesville and VDOT snow removal operations during a single storm indicated that VDOT's procedure of plowing with carbide-tipped blades resting on the pavement removes a higher percentage of the snow than Charlottesville's method on surfaces that have been treated with chemicals. On untreated surfaces, the difference is not as pronounced, as both methods tend to leave streaks of packed snow on the surface.

Field Investigation

The winter of 1994-95 was mild compared to recent winters. Those locations chosen to test rubber and urethane blades had no more than three snowstorms, and most were light accumulations with relatively high temperatures. For this reason, the researcher did not observe the snow removal operations. The experiences of the field personnel involved were recorded through written reports and verbal contacts.

The rubber and urethane blades were used as a part of VDOTs normal plowing plan. The blades were mounted on plows similar to those used at all maintenance headquarters in the state. The blade was allowed to rest on the pavement and supported the full weight of the plow. A summary of the comments from the individual sites can be found in Appendix B.

The rubber blades were used at six locations. Temperatures ranged from -15 to 2 C (5 to 35 F), and snow accumulation ranged from 2.5 to 13 cm (1 to 5 in) at the test sites. Reports from all six sites indicated that the blades wore rapidly when compared to carbide-tipped blades. Those estimating kilometers traveled indicated that the blades needed to be replaced every 72 to 96 km (45 to 60 mi). Those reporting hours used indicated that the blades needed to be replaced about every 3 hours. In addition to the wear, all sites reported that the plow bounced and

vibrated if the plow blade lost contact with the ground. This condition occurs often during plowing, especially at higher speeds and when snow accumulation is light. Rubber blades also tend to "roll back" under the plow if more than 4 cm (1.5 in) of blade are exposed. This effect causes the blade to slide over snow that has been compacted by traffic.

Urethane blades were used at two sites. Temperatures ranged from 0 to -5 C (20s F), and accumulation never exceeded 10 cm (4 in). Reports from both sites indicated that the blades wore rapidly and had to be replaced after 2 to 4 hour of use. Both sites reported tthat he urethane blade removed the snow as well as the carbide-tipped blade as long as the pavement was completely snow covered. Tom's Brook AHQ reported some bouncing and vibration when the blade was used on bare pavement during cleanup operations. Christiansburg encountered no such problem.

At Yancey Mills, where rubber blades have been used for many years, steps have been taken to minimize the locations where rubber blades are used. Three trucks are equipped with plows mounted with rubber blades. These trucks are assigned to the section of I-64 from milepost 100 to milepost 107, which includes the lights set in the pavement on the east side of Afton Mountain. Once operations on that section are completed, the trucks are assigned to other routes and the plows equipped with rubber blades are replaced with plows equipped with carbide-tipped blades. Yancey Mills' experience with rubber-tipped blades is that they wear rapidly as compared to carbide-tipped blades and must be adjusted often. At higher speeds, the plow tends to bounce and vibrate, making it necessary for the operator to stop or slow down to bring the truck under control. The blade tends to roll back and ride over the ice or snow packed on the pavement. That, combined with the bouncing, often leaves snow-covered spots on the surface.

Cost Analysis

Although the lack of durability makes the cost of rubber and urethane blades of secondary importance, a cost comparison was made. The rubber blades observed in this study were used for 72 to 96 km (45 to 60 mi) before they needed to be replaced. The urethane blades were used for no more than 128 km (80 mi) before they were replaced. A carbide-tipped blade usually lasts throughout the snow season, although an unknown, but small, number of them fracture due to impact with in-pavement obstructions.

The material cost estimates for a 3.3-m (11-ft) blade were $100 for carbide, $26 for rubber, and $296 for urethane blades. Labor costs were considered to be the same for all three types and were estimated to be 1.5 staff hours at $15 per hour. Cost estimates for three and five blade changes per winter were developed for rubber and urethane blades. One in four carbide-tipped blades were assumed to be damaged and changed during the winter season.

The cost estimates given here are the blade cost per plow over a single winter season:

Labor cost/blade change: 1.5 hr x $15/hr = $22.50

Carbide-tipped blade:

Labor	$ 22.50
Materials	100.00
Total	122.50 x 1.25 changes/year = $153.13

Rubber blade:

Labor	$22.50
Materials	26.00
Total	48.50 x 3 changes/year = $145.50
	x 5 changes/year = $242.50

Urethane blade:

Labor	$ 22.50
Materials	296.00
Total	318.50 x 3 changes/year = $955.50
	x 5 changes/year = $1,592.50

Based on the assumptions made from the limited field data collected, the cost per plow to remove snow over a winter season is about 6.5 times greater for urethane blades than for rubber blades. When compared to the cost of carbide-tipped blades, however, urethane blades are 6 to 10 times more expensive if they are changed only three to five times over the normal life of a carbide-tipped blade.

The experience of airports indicated that the frequency of rubber and urethane blade changes could be greatly reduced if the weight of the plow was taken off the blade through the use of skids or wheels. The skids purchased by the Northern Virginia District in 1994 cost $990 per pair, and a pair was needed for each plow modified. An additional labor cost of $150 was incurred for installation. Valk Manufacturing, a plow manufacturer and supplier of the skids, indicated that if the plows were purchased with the skids already in place, the price for their current plows would increase by approximately $900.[10] VDOT currently has about 4,000 plows that could be modified to use skids or wheels. At $1,050 per plow, the cost to modify all of them would be approximately $4,200,000.

Based on discussions with airport personnel, the use of wheels on plows could result in a single urethane blade lasting the entire winter. If this were the case, the cost to modify a plow and equip it with a urethane blade would be $1,368 (plow supports, $1,050; blades, $318) as compared to $153.13 for plows equipped with carbide-tipped blades: a difference of $1,215 per plow.

DISCUSSION

VDOT's current method of plowing began with the advent of the carbide-tipped blade. Its development solved the problems of rapid blade wear and time-consuming blade replacement during snow removal operations, which had plagued road maintenance crews since modern winter road maintenance began. An added benefit of the carbide-tipped blades was that they allowed castors and skids to be eliminated from snow plows. This removed another equipment part that was a high maintenance item during snow removal operations. The effect of the full weight of the plow resting on the blade cleared packed snow from the pavement better than the skid-supported plows of the past.

The limited use of longer lasting pavement paints, tape, and markers in the past made damage to these items and the pavement in general a secondary consideration. The recent increased use of sophisticated, more expensive markings and markers has emphasized an already growing concern for their protection and the cost to replace them. Often, this replacement occurs earlier that anticipated because the markings and markers are damaged by road maintenance equipment, especially during snow removal. A VTRC study[11] estimated that damage to pavement markings that required replacement due to snow removal operations over the winter of 1994-95 cost approximately $220,000. Almost all of the damage was to preformed tape markings. Damage to the reflectivity of the pavement markings, which at present do not require replacement, is estimated to cost nearly $3 million eventually. This loss of reflectivity is a problem common to all types of pavement markings used in Virginia.

Although the use of preformed tape for pavement markings is expanding, it is limited to interstate and arterial primary roads. The number of plows that need to be modified to protect these markings is considerably less than the approximately 4,000 plows in VDOT's fleet. At a cost of $1,215 per plow to modify and equip it with a urethane blade, more than 180 plows could have been converted with the funds that will need to be spent annually to replace the markings. Although the replacement this year was, for the most part, covered by a manufacturer's warranty, with an anticipated life of 6 years and the future cost of replacement being borne by VDOT, the potential savings could be $1,100,000 over the life of the markings. The number of plows that would need conversion is unknown at this time, but with estimated dollar costs for pavement marking damage in the million dollar range, the funding to cover the actual conversion costs should be available if an acceptable modified plowing system that does not damage pavement markings can be found.

CONCLUSIONS

Under current VDOT snow removal procedures, the use of urethane blades in place of rubber blades on a limited basis at locations where carbide blades cannot be used appears to be a feasible option. Although urethane blades are more expensive, their ability to clear snow is greater than that of rubber blades. Although VDOT's experience with urethane blades is limited,

and unsatisfactory, the experience of almost 200 airports supports urethane blades as an effective snow removal tool when used properly.

The larger question concerning the increased use of alternate blades in place of carbide-tipped blades was not clearly answered by this research. Urethane blades have snow plowing qualities that surpass those of rubber blades. Under conditions where no bond has formed between the snow and the pavement, urethane blades appear to clear snow as well as carbide-tipped blades. Under current plowing procedures, urethane blades are not cost competitive or labor efficient as a substitute for carbide-tipped blades. To make them so, the plows on which they are used would have to be modified to take the weight of the plow off the blade.

Airports have had good success with snow plows equipped with urethane blades. Their use, however, has been limited to pavements that are hard surfaced and, for the most part, smooth. In all cases, the pavements are treated with chemicals to retard or eliminate the bond between the snow and the pavement. Their effect on untreated pavements, rough roads, and gravel roads is unknown. Although airports report little problem with the wheels supporting their plows, the effect of rough surfaces and gravel roads on them is unknown. Airports have no experience with preformed tape. The effect on the tape of using urethane blades and taking the weight of the plow off the blade is uncertain, but it is expected to result in less damage than is caused by the carbide-tipped blades under VDOTs current practice.

RECOMMENDATIONS

1. *Snow plows with rubber blades that are currently used at locations having in-pavement lights or markers should be modified.* Specifically, wheels should be added to support the plow's weight, and the plows should be equipped with urethane blades.

2. *The $220,000 direct damage to pavement markings by carbide-tipped blades warrants further study into expanding the use of urethane blades on wheel- or skid-supported snow plows.* Test sections shuold be established to test such plows during the winter of 1995-96. The study should include operations on other roads to determine the ability of snow plows equipped with urethane blades to remove snow on roads not chemically treated and to determine the effect of such roads on the blade and plow support mechanism. The research should also involve a control section where VDOT standard procedures are used and should investigate the use of carbide-tipped blades on plows equipped with wheels as an alternative.

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7. Earl Crouse, Superintendent of Maintenance, National Airport, Arlington, Virginia. Conversation with author, May 30, 1995.

8. Mike Woolfrey, Chief of Street Maintenance, City of Charlottesville, Virginia. Conversation with author, April 5, 1995.

9. John Miranda, Shop Foreman, City of Charlottesville, Virginia. Conversation with author, January 31, 1995.

10. Floyd Canard, Interstate Maintenance Operations Manager, VDOT Northern Virginia District. Conversation with author, June 1, 1995.

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Appendix A

SNOW REMOVAL QUESTIONNAIRE

SNOW REMOVAL QUESTIONNAIRE

1. Briefly describe your snow removal policy or enclose a copy (e.g., VDOT's snow removal policy is to keep its interstate and major primary routes free of snow and ice so that traffic can proceed in safety without the use of chains, except during periods of heavy falling snow or drifting).

_____

_____

_____

PART I: SNOW PLOWING

2. Do you use any of these types of blades for snow removal?

carbide-tipped___

rubber___

urethane___

steel___

other___(Please specify)

3. Under what conditions do you use each type of blade? (e.g., rubber blades used at locations with raised markers.)

_____

_____

_____

_____

_____

4. For each type of blade, what has been your experience with blade wear, vehicle and plow control, and performance in removal of snow from the pavement?

_____

_____

_____

5. Do you keep the blade from riding directly on the pavement?____Yes ___No. If yes, please answer questions 6 through 10.

6. What method do you use to lift or hold the blade off the pavement?

7. Under what conditions do you use each type of lift?

skids/shoes____ _____

castor (metal) wheels____ _____

rubber tired wheels____ _____

other____(Please specify) _____

8. For each type of lift, what has been your experience with wear on the skid/shoe or wheel?

_____

_____

_____

9. How high off the pavement does the blade ride?_____inches or mm.

10. Why do you plow with the blade raised off the pavement?

_____

_____

_____

11. What is your experience with pavement marking damage resulting from snow plowing? Generally, the damage is ___ substantial, ___ moderate, ___ minor, ___ practically nonexistent. Please enclose any documentation related to pavement marking damage.

12. Are any actions taken to minimize pavement marking damage? ___ yes ___ no
If yes, please list the actions taken.

_____

_____

_____

PART I I: ANTI-ICING and DE-ICING

13. Do you have a computerized weather system used to acquire:

Regional weather data:	Yes___	No___
Local weather data:	Yes___	No___
Pavement condition data:	Yes___	No___

14. Do you practice:

Anti-icing (applying chemicals prior to a storm event)
Yes___ No___

De-icing (applying chemicals after a storm event has started)
Yes___ No___

15. What rate of application and chemicals do you use for:

	Anti-icing	(#/lane mile)	De-icing	(#/lane mile)
Sodium chloride (NaCl)	____	_____	____	_____
Calcium chloride (CaCl)	____	_____	____	_____
Calcium magnesium acetate (CMA)	____	_____	____	_____

Sodium formate (NaFO)	____	_____	____	_____
Urea	____	_____	____	_____
Other (please list)_____	____	_____	____	_____
_____	____	_____	____	_____

16. Do you apply any chemicals listed above as a liquid?
Yes___ No___

17. If yes, please list which chemicals, when they are applied, the rate of application, and any other pertinent information.

_____

_____

_____

18. Do you use any specialized equipment other than a conventional snow plow or V-plow?
Yes___ No___

If yes, please list the other equipment.

_____

_____

_____

19. Do you use any other technologies to prevent ice from bonding to a pavement surface? (e.g., heated pavement or bridge deck) ___Yes ___No. If yes, please list them below.

_____

_____

_____

If you have any other information or publications you can provide us on these topics, please send us one copy or information on how we can acquire the publication.

_____

_____

Your name_____

State/Province_____

Address_____

_____

_____

Phone _____

THANK YOU!!

Please return by March 31, 1995, to:

D. S. Roosevelt
Research Scientist
VTRC
530 Edgemont Road
Charlottesville, VA 22903

or FAX (804) 293-1990

If you have any questions, call Dan Roosevelt at (804) 293-1924 or Dave Wyant at (804) 293-1964.

Appendix B

REPORTS AND COMMENTS RECEIVED FROM INDIVIDUAL TEST LOCATIONS

Fort Chiswell and Wytheville Area HQs used rubber blades on five plows during snow removal operations in January 1995. The amount of snow and temperature were not recorded. After an average of only 3 hr of use, the blades had to be replaced. Rather than reverse the rubber blades or replace them with other rubber blades, carbide-tipped blades were installed. The residency estimated that 1.5 hr were spent replacing the blades (replacement and travel time) for every 3 hr spent plowing. The rubber blade rides over packed snow that a carbide-tipped blade usually removes from the pavement.

In a second test, rubber blades were installed on five plows at Fort Chiswell and Wytheville Area HQs in February 1995. Snow depths ranged from 2.5 to 13 cm (1 to 5 in), and the temperature ranged from -15 to 2 C (5 to 35 F). After an average use of 3 hr, the blades had to be replaced. The blades worked fairly well when the temperature was above -4 C (25 F). Below that temperature, the blade tended to ride over the snow when the snow was packed down. Carbide-tipped blades worked efficiently regardless of the temperature.

Rustburg Area HQ used a rubber blade during the storm of January 25-27, 1995. The snow averaged 8 cm (3 in) and the temperature ranged from -3.3 to 0.5 C (26 to 33 F). The blade was mounted with 4 cm (1.5 in) exposed below the moldboard with a carbide-tipped blade mounted on top. The blade was used for approximately 96 km (60 mi) and wore down to the carbide-tipped blade. When used on snow- and ice-covered roads, the rubber blade left a skim of ice and snow. When used at locations where bare pavement existed, the rubber blade tended to bounce and shake the vehicle.

Mt. Airy Area HQ used rubber blades on three plows during a storm on January 29-30, 1995. The snow was light, averaging from 2.5 to 8 cm (1 to 3 in), with most areas receiving closer to 2.5 cm (1 in). Temperatures ranged from -3 to 0 C (27 to 32 F). The rubber blades were mounted against the plow moldboard with a carbide-tipped blade on top. About 5 cm (2 in) of rubber blade extended below the carbide-tipped blade. The average distance each blade was used was 72 to 80 km (45 to 50 mi). Each rubber blade folded back under the plow during use, and as much as 3 cm (1.5 in) of wear occurred, but not enough to cause the carbide-tipped blade to come in contact with the pavement. Most of the wear occurred on the primary road, where chemicals created a considerable amount of bare pavement. On the routes where no chemicals were used, the rubber blade tended to ride on top of the snow without removing it.

Tom's Brook and Stevens City used rubber blades during the winter of 1994-95. Both found blade wear to be rapid during periods when sections of the pavement were bare. Tom's Brook indicated that the rubber blade they tested had to be replaced three times during the winter and adjusted "several times" during that period. Both headquarters reported that the rubber blade caused excessive vibration to the plow and the truck. This occurred when the blade was lifted off the pavement due to riding over packed snow or ice. Often, the driver had to stop the truck to stop the vibration.

At Tom's Brook, urethane blades were used during snow removal operations in January 1995. The urethane blade was installed as a sandwich between a carbide-tipped blade next to the plow and with a strip of metal on top. Their experience was that the blade wore quickly if used in situations where it came in contact with the surface. If more than 2.5 cm (1 in) of the urethane blade was left exposed, the blade tended to roll back and delaminate. The urethane blade cleaned as well as the carbide-tipped blades in heavy snows. During cleanup, however, when considerable bare pavement was encountered, the plow would bounce and the blade would leave streaks of snow on the pavement.

Christiansburg Area HQ used urethane blades during snow storms on January 6 and 7, 1995, and on January 27 and 28, 1995. During the first storm, accumulation was light and plowing occurred on surfaces that had numerous bare spots. The blade was attached directly to the plow without any metal covering. Wear and failure of the blades was rapid. After 2 hr of use, the blade became damaged. Pieces of urethane peeled off the back side of the blade, and bolt holes in the blade began to strip, causing the blade to separate from the plow. After 4 hr, the damage to the blade was so great that the blade was considered unusable and was replaced. During the second storm, accumulation was, again, light, but the pavement was snow covered during most of the snow removal operation. The blade was sandwiched between two metal strips and bolted to the snow plow. The problems of bolt hole stripping and peeling experienced during the first storm were corrected; however, the rate of wear on the urethane blade was not improved. After 4 hr of use, 6 of 18 cm (2.5 of 7 in) of the original depth had worn away. The metal plates used to stabilize the urethane blade had also worn, and the entire assembly was replaced.

Christiansburg reported good results with the quality of snow removal provided by the urethane blades. They seemed to remove the snow exactly as the carbide-tipped blades did once the metal plate was added to stabilize the blade. No bouncing or vibration, as experienced with rubber blades at other locations, was noted. The snow accumulation was light, and no conclusion should be drawn as to how the blade would operate with heavier accumulations.