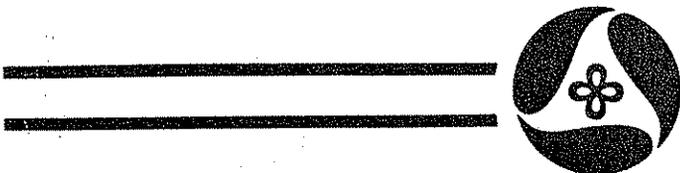


SNOW REMOVAL ON IOWA'S SECONDARY ROADS

**FINAL REPORT
IOWA HIGHWAY RESEARCH BOARD
PROJECT HR-267**

Highway Division



**Iowa Department
of Transportation**

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SNOW REMOVAL ON IOWA'S SECONDARY ROADS

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ABSTRACT

Snow removal on the 90,000 mile Iowa secondary road system is a major concern of county engineers. Rural residents rely almost entirely on motor vehicles for travel. They have come to expect passable roads during all types of weather and as most county engineers know, the public is less tolerant of problems in snow removal than in any other highway department function.

To avoid snow removal problems, maintenance personnel begin preparation before the winter maintenance season. The slide tape presentation, "Snow Removal on Iowa's Secondary Roads", was developed to assist in training and retraining maintenance personnel each year prior to winter. The program covers preparation for winter, snow and ice removal, and after storm care of equipment.

ACKNOWLEDGEMENTS

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1. Blank
2. Scenic Secondary Road
3. Farm Truck
4. School Bus
5. Mail Carrier
6. Main Street
7. School Bus in Ditch
8. Severely Drifted Road
9. Title - "Snow Removed on Iowa's Secondary Roads"
10. Traffic on Road During Snow
11. State Map with Snowfall Amount

2.
* Rural Iowans living along secondary roads regard these roads as a very important part of their lives. These highways provide a means of ³ * transporting ⁴ their commodities to market, * their ⁵ children to school, * mail to their homes, and act as links ⁶ * to nearby cities and ⁷ towns.*

Roads easily traveled during summer and fall may become difficult to drive ⁸ several days * during the winter. The public is not very tolerant of delays in clearing snow and ice from the roadways.* ⁹

This presentation was developed to help prepare maintenance personnel for the winter maintenance season. The presentation is a guide for basic snow removal procedures and is not intended as ¹⁰ a standard, specification or regulation.*

Generally, Iowa's significant snowfall appears in the months of December, January, February and March. In fact the greatest average of inches of monthly snowfall during ¹¹ the year occurs in March.*

12. Blowing and Drifting Snow

The average seasonal snowfall accumulation in Iowa ranges from 40 inches in the northeast to 25 inches in the southeast.*¹² More important than the amount of snowfall is the problem of blowing and drifting snow. Prevailing winter winds from the north and west create by far the most severe drifting.*¹³

13. Early Day Construction

In the early days, roads were constructed with little consideration for the effects of winter storms.*¹⁴ Today modern highway design has provided for drifting snow by using wider, deeper ditches, flatter foreslopes and back-slopes, and wider right-of-way.*¹⁵

14. High Type Road

15. Narrow ROW in Cut

However, the county road system still has many miles of roadway that are subject to severe snow drifting. Narrow rights-of-way, vegetation and debris, and buildings *¹⁶ and trees cause snow drifting and are all common features on the secondary road system.*¹⁷

16. Snow Drift

17. List of Topics

Winter maintenance activities consist of: preparation for winter, snow and ice removal, and after storm care of equipment.

18. Patrol Blading

18

* Preparation for winter involves:

19. Person Checking Motor Patrol

19

* preparing the roadway, preparing equipment and supplies, and preparing the maintenance personnel.

20. Artwork - Cross Section

In the fall, before the snow season, preparation of the roadway should begin.*²⁰

A good crown, 1/2 to 3/4-inch per foot of width, should be obtained and maintained by the motor grader operator

21. Motor Grader Working

on granular surfaced roads. *²¹ Shoulders should also have a slope equal to or greater than the road surface and have no secondary ditches. Snow removal and traffic through the winter will tend to destroy some of the slope, but enough crown should remain to

22. High Grass on Paved Road

allow snow melt to drain to the foreslope.*²²

23. Mowing

Weeds and high grass, hay, or equipment in the right-of-way may cause snow to drift onto the roadway.*²³ Grass and weeds along

24. Hay in Right-of-Way

the shoulder should be mowed when possible.*²⁴

25. Snow Fence

If equipment or hay is being stored in the right-of-way, inform the engineer so that appropriate action may be taken against the violator.*²⁵

An effective way of reducing snow from drifting on the road is to cause the snow drifts to form in the adjacent field. Snow fences are the most common way of minimizing large snow drifts forming on the roadway. Snow fence is usually placed on either the north or west side, parallel to the roadway where drifting is expected. In most cases, the fence should be placed 75 to 100 feet back from the right-of-way line.²⁶ The posts are driven about 10 to 12 feet apart. Research has shown that the drift caused by a snow fence will extend to 27 times the height of the fence. Two other effective techniques are: placing hay bales in the adjacent field or after the first significant snow fall, creating a windrow of snow in the field. Obviously, these methods require the approval and cooperation of the land owner.²⁷

26. Posts in Place

27. Headwall Above Road Surface

Obstructions such as fire hydrants and culvert headwalls should be marked. These items can become hidden by snow and can damage the plow or wing if hit accidentally.²⁸

28. Flag, Pins, Etc.

Preparation of equipment and supplies should be completed before the first week in November. All snow removal equipment should be checked to verify that it is complete with pins, cables, sheaves, etc. This will allow time to get the small parts needed.

29. Installing Blade

A "dry run" with all snow removal equipment attached should be made.*²⁹

The dry run should be made by actually installing complete equipment such as wings, straight blades, "V" plows and spreaders *³⁰

30. Patrol with "V" Plow and Wing

on the motor graders and trucks and driving around the yard to see that all equipment

31. Replacing Flag

is ready for operation.*³¹

Faded or missing flags and broken or missing reflectors should be replaced.

Cover new flags or remove them when

32. Placing Spreader on Truck

plows are in storage to help prevent fading.*³²

33. Calibrating Spreader

The spreader boxes should be mounted and hooked up mechanically or hydraulically and actually operated to make sure that they function properly.*³³ Those spreaders used for the application of salt and sand-salt mixtures should be calibrated. Calibration is done to verify the spreader control setting is delivering the desired application rate of material. The engineer should be consulted as to the proper calibration

34. Checking Blade

procedure for the type of truck and spreader.*³⁴

35. Installing Tire Chains

Check all hydraulic systems. Check all
³⁵ plow blades for needed replacement.*

Check tire chains for wear and make
 needed repairs.

36. Stockpile of Sand

When chains become a necessity, they
 should be used on all drive wheels of both
 trucks and motor graders if clearance allows.*³⁶

37. Sand with Salt

By November, materials such as salt and
 abrasives should be on hand for use during icy
³⁷ conditions.* It is common to treat a stock
 pile of abrasives with 26 to 30 pounds of solid
 calcium chloride per ton of abrasive. This
 will keep the stockpile from freezing during
 the winter. County policies for mixtures of salt
³⁸ vary from county to county.* For mix-

38. Small Pile of Sand/Salt

tures, the abrasive is taken from the stockpile
 and mixed with additional salt as the mixture
 is needed. The Iowa DOT generally will use
 a mixture of 50 percent salt and 50 percent
³⁹ abrasives.*

39. P & P Sheet

All employees should be familiar
 with the county's policies and procedures
 for snow removal. They should be reviewed
⁴⁰ each year prior to winter.*

40. Fire Department Or Dispatcher

Such things as emergencies during
 a storm, if not handled properly, can
 result in tragedy or at least public
 embarrassment for your department.

Every operator should know what to do if asked to assist police, firemen, doctors,⁴¹ or others during an emergency situation.*

41. Stalled Car in Storm

During severe snow storms, the operator should assist occupants of stalled vehicles to reach the nearest shelter. Assistance should also be rendered at the scene of an accident.⁴²*

42. Abandoned Car

Temporarily abandoned vehicles may block the roadway and obstruct maintenance operations. Moving these vehicles with snow removal equipment may damage the abandoned vehicle and result in a damage claim. Some counties do not allow towing of abandoned vehicles. In this case, inform the supervisor so he may inform the Sheriff's Department.⁴³*

43. Plow with Traffic

Safety is a prime concern during snow removal operations. Slick roads and reduced visibility make driving more difficult. The snow removal equipment is constantly exposed to traffic and is furnished with safety equipment

44. Vehicle with All Safety Equipment

⁴⁴ for high visibility.* Flags, reflectors and beacons should be in place, clean and in

45. Truck at Intersection

⁴⁵ working order.* Special care should be taken

46. Traffic Following Truck

⁴⁶ when backing or plowing an intersection.*

47. County Map of Priority
1 Routes

Snow plows operate at a relatively low speed and traffic may bunch-up behind. The operator may want to occasionally pull over far enough to let following traffic pass safely.*⁴⁷

Well planned snow and ice removal operations are scheduled on a priority basis. The paved roads, about 5 to 30 percent of a county road system, are generally the first priority for snow removal. Trucks with straight-blade plows are most often used for clearing these roads. After very heavy snows with drifting, heavy-duty trucks with V-plows or motor graders may be used on the paved roads.*⁴⁸

48. County with Operator-
Territories

The second priority routes are the bulk of the granular surfaced roads. Specific areas are assigned to each operator. Varying the route is a common practice, so that no residence is always last to be plowed out. Motor graders almost exclusively are used to clear the granular surfaced roads. Heavy-duty trucks equipped with "V" plows are used in some counties to assist the motor graders in clearing operations after the paved roads have been cleared.

After heavy snows, it may be the county's policy to plow the roads one lane wide initially. This will provide access to the residents quicker than plowing all the roads completely.*⁴⁹

49. Level "B" Road with Sign

The lowest priority roads are low volume roads with no residences along them, such as the level "B" roads. In many cases these roads may not be cleared at all during the winter season.*⁵⁰

50. Snow

When the storm arrives and snow begins to accumulate on the road,*⁵¹ the engineer or maintenance superintendent is responsible for notifying the men needed and ordering out the proper equipment and materials. Operators should arrive prepared with warm clothing, food and water in case of emergencies while working. Weather forecast information is received by the county and should be relayed to the operators.*⁵²

51. Engineer on Telephone

52. Operator Checking Oil

Before the trucks and motor graders are started, oil and coolant levels should be checked.*⁵³ Check and clean lights, reflectors, and beacons. During operations, lights and reflectors may occasionally need to be cleaned of snow and ice. The two-way radio should be tested to ensure it is working properly.*⁵⁴

53. Operator Cleaning Lights

54. Plow Adjustment

Before leaving, the straight blade adjustment on the trucks should be checked for the proper setting for the type of plowing to be performed-

55. Changing Plow Adjustment

55

* And if found to be incorrect, it should be properly adjusted.*

56

56. View of Plow Angle

Adjusting the top part of the plow back toward the truck allows the blade to slide over the surface. The plow has less tendency to trip in this position - the plow has a tendency to knife under the snow lifting it into the blade which causes a rolling action of the snow in the plow. Normally a greater amount of snow can be moved by using this setting. This setting is used when removing dry snow or removing snow from the shoulder area.*

57

57. Truck Plowing Packed Snow

When using straight blade plows to clear the road of packed snow or ice, the plow adjustment should be changed so the cutting edge of the plow is in a more upright position.

58

58. View of Plow Angle

* When in this position the blade will dig in and have more of a scraping action. * Additional force is placed on the trip mechanism causing it to trip more often.*

59

59. Trip Mechanism

60

60. Straight Blade Plow

When operating straight blade plows, the speed should not normally exceed 20 miles per hour. Side draft caused by snow being pushed to the shoulder affects the truck steering. When pushing patches of intermittent heavy snow, slow down so the effect of side draft will not cause loss of control of the vehicle.*⁶¹

61. Loader with Sand

During snow and ice removal, some ballast is required in the truck to provide good traction.*⁶² The amount of ballast should be only the amount needed to provide traction for the operation being performed. Too much ballast or load in the truck will use power needed for the plowing operation.*⁶³

62. Loading Truck with Ballast

63. Truck with spreader

On snow plow runs where abrasives or salt are likely to be needed, the load of course will be larger, but the load should not exceed the truck's capacity.

64. Rock Scraped from Surface

When using a motor grader on granular surfaced roads, the blade should be positioned 1-inch above the surface.*⁶⁴ This prevents scalping of stone from the surface.*⁶⁵

65. Motor Patrol at Blade

66. Tip Control Lever

On motor patrols, blade angle is established in a similar manner as with the truck plow.*⁶⁶ The adjustment is easily made by using the blade tip control. The angle of the moldboard should be set between 30° and 45°. Lean the wheels to the right to overcome side draft when casting snow toward the ditch.

67. Large Windrow of Snow on 1-Side ⁶⁷
 * When plowing snow, a good operator will avoid pushing up large piles of snow along the north and west sides of roads when possible. Large piles of snow are sure to create large drifts across the road during the next storm.* ⁶⁸
68. Intersection with Main Highway
 At intersections with previously plowed roads, avoid pushing windrows of snow into the intersection.* ⁶⁹ With a reversible straight blade plow, the plow can be adjusted * and snow can be pushed across the road and deposited in a downwind ditch.* ⁷⁰ For fixed blade plows, it may be best to carry the snow around the corner. Again remember, avoid pushing up large piles of snow on the north and west sides of the intersection. Intersections are notorious for drifting, and pushing up large piles of snow will only make things worse during the next storm.* ⁷¹ At drifted intersections it may be best to work away from the intersection, pushing most of the snow to the downwind side of the road.* ⁷²
69. Graphic - Pushing Snow Across Road
70. Graphic - Pushing Snow Across Road
71. Graphic - Pushing Snow Around Return
72. Graphic - Pushing Snow Away from Intersection
73. Overpass Over Interstate ⁷³
 road.*

Special attention should be given to bridges over other roadways. Snow should not be thrown onto the road below as this may result in an accident. When approaching these bridges, the operator should slow down to a speed that the plow will not cast snow over the bridge rail.*⁷⁴

74. Flange Way of R.R.

Operators should not leave any foreign material in the flange ways of railroad tracks.*⁷⁵ In most operations the blade can be lifted before passing over the crossing so no material will be deposited in the flange way.

75. Truck Passing R.R.

76. Truck with Underbody Blade

⁷⁶ * Freezing rain or packed snow can cause slippery conditions. Motor patrols or underbody blades are commonly used to thin down

77. Truck Sanding

⁷⁷ packed snow and ice.* It is common to apply abrasives or salt, or a mixture of the two to locations such as intersections, curves and approaches to railroad tracks. Salt or salt mixtures are best applied to the inside wheel path. The application rate generally should be a maximum of 100 pounds per lane mile for salt and 200 pounds per lane mile for a 50 percent salt and 50 percent abrasive mixture.

When the temperature is below 20 degrees and falling, salt or salt mixture is relatively ineffective and is generally not recommended. Treated abrasives can be applied for traction except during very windy conditions.

78. Blowing Snow

⁷⁸

* When the snow storm becomes intense and

blowing snow creates drifts too large for a

⁷⁹

79. Truck with "V" Plow

* straight blade plow to negotiate,

the "V" plows will be needed.

⁸⁰

80. Truck & Blowing Snow

* If visibility becomes so poor as to

make it unsafe to continue plowing operations,

the operator should radio the supervisor or

engineer to inform them of the conditions.

The supervisor may advise the operator to dis-

⁸¹

continue operation until conditions improve.*

81. Large Snow Drift

Opening blocked roadways with a "V" plow

requires a higher degree of skill than normal

⁸²

snow removal with a straight blade plow.*

82. Snow Board-Proper Location
for Thrust

The operator should evaluate the drifted area

⁸³

83. Snow Board-Thrust into
Drift

as to where to make the initial thrust *- always

try to split the drift to plow most of the snow

⁸⁴

84. Snow Board-Patrol Proceeding
Through Drift

toward the shallower side of the drifted area.*

- The operator may proceed through the drift if the drift is not too heavy.*⁸⁵ The drift can be widened out by using only one side*⁸⁶ of the V-Plow or it can be worked back with the plow and wing combination.*⁸⁷
- All "V" plows should be equipped with shoes. These shoes should be adjusted to hold the blade at least 1-inch above the road surface.⁸⁸
- * Larger drifts such as this require more effort to remove. The recommended sequence of thrusts is as follows.*⁸⁹ Again evaluate the drifted area as to where to make the initial thrust*⁹⁰ and make the thrust.⁹¹
- (Pause 2 seconds)*.⁹¹
- Now make the second thrust preferably to the strong side of the drift.*⁹² Always keeping in mind to plow as much snow as possible to the weak side of the drift.*⁹³
- Make the third thrust in line with the first thrust. Care should be taken to not make the thrust too strong into the drift as this could cause the vehicle to rideup into the drift, possibly resulting in the vehicle becoming stuck.*⁹⁴ Now make the fourth thrust to the weaker side of the drift.
85. Snow Board-Patrol Widening
Out Drift
86. Snow Board-Patrol Widening
Out Drift
87. "V" Plow with Shoes
88. Large Drift
89. Snow Board-Patrol
at Drift
90. Snow Board - First Thrust
91. Snow Board-Ready for
Second Thrust
92. Snow Board - Second Thrust
93. Snow Board - Third Thrust
94. Snow Board - Fourth Thrust

95. Snow Board - First Thrust ⁹⁵ Repeat these thrusts as * needed -
96. Snow Board - Second Thrust ⁹⁶ (Pause 3 seconds)*
97. Snow Board - Third Thrust ⁹⁷ (Pause 3 seconds)*
98. Huge Drift - No Storage ⁹⁸ always maintaining a wide path to the rear and continue through the drift. Remember to check for traffic behind before backing up.*
99. Rotary Snow Blower ⁹⁹ When confronted with huge drifts and no available storage space,* it is best to use a rotary plow. End loaders or bulldozers may be used for this operation if a rotary plow is not available. When using an end loader or bulldozer to remove drifts, care should be taken ¹⁰⁰ to avoid damaging fences.*
100. Clear County Road ¹⁰⁰ Removing the accumulated snow or ice is only the first step in the road clearing process. Keeping the roads clear is a continuing process during and after the ¹⁰¹ storm.* Often times the road has been normal for several days when, all of a sudden, the wind may cause snow to begin drifting onto the roadway in isolated locations. The remainder of the road may remain normal. At times, this blowing snow can become severe, covering the entire road requiring much effort in restoring the road to a normal condition.
101. Snow Drifting onto Road ¹⁰¹

102. Road in Normal Condition

102

* After the road has been cleared and is in a normal condition, clean up operations consisting of cleaning shoulders, winging operations and cleaning snow from bridges and guardrails are appropriate. These operations are performed during normal working

103. Patrol Winging Snow

103
hours.*

During the storm and while the road surface is being cleaned, some snow accumulates on the shoulder. This snow should be cleaned off to make room for the next snow - also so melting snow will not soften the shoulder. Excessive snow on the shoulders may also cause snow to drift onto the roadway. Shoulders may be cleaned by using either a truck or motor grader.

104. Gouged Shoulder

When cleaning shoulders, be sure to first adjust the wheels or shoes on the plows and wings so that the cutting blade will come no closer than 1-inch to the shoulder surface.*¹⁰⁴

This is done to avoid scalping of shoulders. The speed for this operation should not exceed 10 miles per hour for blades or 15 miles

105. Patrol Winging

105
per hour for wings.*

- Winging is done to help prevent future drifting and to make room for the next snow.*¹⁰⁶
106. Wing with Good Shoe
Make sure all wings are equipped with a good shoe or have a wing stop mechanism to help reduce the chances of the wing digging in and scalping the shoulder or foreslope which could result in damage to the wing or the vehicle.*¹⁰⁷ Winging snow far down the foreslope is unnecessary.*¹⁰⁸ The wing should normally be operated level with the shoulder edge. In some situations the wing may be operated below the shoulder line to define the shoulder edge on narrow roads. When doing this downwinging be careful. It is a major cause of damaged wings.*¹⁰⁹ Winging can be done at the same time the surface is being cleaned during periods of relatively light snow.*¹¹⁰
107. Snow Far Down Foreslope
108. Proper Operation of Wing
109. Light Snow, Both Wing and Blade Being Used
110. Patrol Winging
Care should be taken when winging to avoid hitting mail boxes or signs.*¹¹¹
111. Winging Working Back Large Drift
When working back large drifts and benching snow, a motor patrol or heavy-duty truck with a wing is used.*¹¹² Wing push arms should be adjusted to a horizontal position.*¹¹³
112. Wing Push Arm Horizontal
113. High Ridge of Snow Left by Winging
When winging and benching snow avoid pushing up high ridges of snow if possible as they will only contribute to future drifting.

114. Wing Chained to Patrol ¹¹⁴
 * When wings are not being used and are in the raised position, it is best to secure them to prevent accidental lowering.* ¹¹⁵
115. Clean-up of Truck
 After clean-up operations, all equipment used during the storm clearing operations should be washed and serviced. This is done to prolong the life the equipment.* ¹¹⁶
116. Washing Spreader Box
 Begin by thoroughly washing trucks and spreader boxes as soon after use as time permits.* ¹¹⁷
117. Dump Box Raised
 When washing spreaders mounted in dump boxes, the dump box may be raised slightly to facilitate the washing and for better access to hard-to-get-to locations. When this is done, be sure to block the dump box for safety.* ¹¹⁸
118. Unloaded Spreader Box
 In most cases the spreader box should be unloaded from the dump box and the underneath side thoroughly washed.* ¹¹⁹
119. Drag Chain Oiled
 After the spreader has been washed and allowed to dry, the drag chain should then be oiled with Type A transmission oil.* ¹²⁰
120. Truck Being Serviced

The next step is to service the equipment. Equipment service records should now be checked and equipment scheduled for servicing should be serviced to ensure that it is ready for the next storm. At this time, equipment should also be checked for needed

121. Servicing Spreader

¹²¹ repairs.* Service the hopper spreader and check the drag chain for proper tension.

122. Painting Plow

The final step is to wax the plows, wings and spreader boxes.¹²² Graphite paint is used on plows and wings in many counties. The paint or wax will cause snow to slide off the blade better and help prevent snow from sticking on the blade.

123. Waxing Spreader Box

¹²³ * Wax on the inside of the hopper spreader will reduce the corrosion by salt and make the spreader easier to clean.

124. Motor Patrol Plowing

¹²⁴ (Pause 2 seconds)*

The snow removal operation is one of the most important maintenance functions of the county highway department.

With our increasingly mobile society, it is very important for residents to get out to work, to school, and to stores. Operators must be aware of this need. Good performance by the operators during snow conditions will contribute greatly to public satisfaction and public support for your department.*

125

125. Historical Shot

Snow removal procedures and operations vary across the state to accommodate the public demand and the various conditions and terrains. This presentation covers the basic snow removal operations and equipment. For the new operator, this presentation should answer many questions and raise many more questions on specific department procedures. For the experienced operator, this presentation should serve to reinforce proper procedures and techniques.*

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126. Credit Slide

Iowa Highway Research Board

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127. Credit Slide

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129. Black Slide

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