

# Appraising Results Derived from a Maintenance Training Program

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•THE quantity of salt used by the Department of Highways, Ontario, for snow and ice control increased from 1956 to 1966 by an average of 11 percent annually. The quantity of treated sand used during the same period increased by 4.3 percent annually. Since the highway mileage serviced by the Department has been increasing annually by an average of 2.3 percent, it is evident that the increased use of salt is only partly due to the increased mileage. It is generally believed that the increased use of deicing materials has resulted in an improved level of service on highways throughout the Province.

The Department's organization for winter maintenance is shown in Figure 1. There are 18 districts. In each district there are approximately four patrol supervisors reporting to the maintenance supervisor, five patrolmen (front line supervisors) reporting to each patrol supervisor, and twelve winter maintenance employees (snowplow operators, etc.) directed by each patrolman or his counterpart night patrolman on the second and third work shifts. Most of the salt and treated sand used for snow and ice control is spread by hired truckers using Department spreaders mounted on their trucks. These personnel also work under the direction of the patrolman or his counterpart.

Late in the winter of 1965-66 a Province-wide survey was conducted during a major snowstorm and each district was required to submit data pertaining to salt usage during and immediately after the storm, i. e., quantity of salt used, number of applications, and total mileage treated. This information was correlated and it was found that the rate of application varied between 300 and 1200 lb per 2-lane mile. This divergence occurred not only among districts but also among characteristically similar patrols in the same district. There was evidence that poor control of the rate and frequency of application were prime factors in the increased use of salt for snow and ice control.

Inasmuch as the annual bill for bulk salt had reached \$4 million by 1966, it was obvious from the survey that effective control at the operations level, of the rate and frequency of application, would result in considerable savings. Accordingly, prior to the 1966-67 winter maintenance season, a uniform application rate was prescribed and all districts were instructed to calibrate their hydraulic spreaders to spread salt at this rate—450 lb per 2-lane mile. A truck speed of 20 mph was used in calibration. Simultaneously, a training program on the use of salt for snow and ice control was developed and presented in each district.

In 1965 the Department had retained the consulting firm of Roy Jorgensen and Associates to direct a research project to study its maintenance function. From this research a maintenance training group was organized to develop training materials aimed at field personnel. The first training program developed, "The Use of Salt for Snow and Ice Control," was conducted in the fall of 1966 and evaluated the following spring. This paper describes the manner in which this training program was developed and administered, and the conclusions drawn from its evaluation.

## THE TRAINING PROGRAM

It was suggested that an approach be adopted similar to the one effectively used by the Virginia Department of Highways in their program on snow and ice control. Initially,

it was necessary to determine the content and scope of the training program. Accordingly, a training committee was formed consisting of a district engineer, two district maintenance engineers, and two maintenance supervisors, all with considerable experience in maintenance operations. It was determined that the program, should cover the following five main subject areas:

1. Why salt is used for snow and ice control,
2. When it should be used,
3. How much should be used,
4. Where it should be placed on the road, and
5. How it should be placed there.

The next decision was who should be trained. It was determined arbitrarily that the training should be directed toward the following two groups: all field staff required to make decisions pertaining to winter maintenance operations, i. e., patrolmen and night patrolmen; and all hired truckers. Finally, decisions were necessary concerning the form the training program should take, and how and by whom it should be conducted. It was decided that—

1. The major part of the program was to consist of an illustrated training aid in the form of a flip chart, 24 by 18 in. in size.
2. The chart was to be prepared for district maintenance engineers and maintenance supervisors to use as a focal point of discussion at meetings attended by patrol supervisors and patrolmen.
3. The flip chart was to be issued to all patrolmen so that they could train their night patrolmen and hired truckers.

### Implementation

The flip chart was presented to the district maintenance engineers and maintenance supervisors at meetings held in each of the five Province regions to demonstrate its use as a training aid. Each district maintenance engineer was instructed to use the flip chart to train patrol supervisors and patrolmen; the patrolmen then trained their subordinate staff.

### Preliminary Evaluation

At the midpoint of the winter maintenance season a preliminary evaluation of the training program was made and each district was asked the following questions:

1. How many meetings were held at which the flip chart was used as a training aid by the district maintenance engineer or maintenance supervisor?
2. What were the minimum and maximum number of people in attendance at meetings?
3. How many people received this training firsthand?
4. Approximately how many patrol supervisors, patrolmen, equipment operators, manual workers, and hired truckers attended each meeting?
5. How do you rate the flip chart as a training aid? Did it afford any real assistance in making your presentation?
6. How did your staff react to this training program? To what degree did they exhibit interest or indifference?

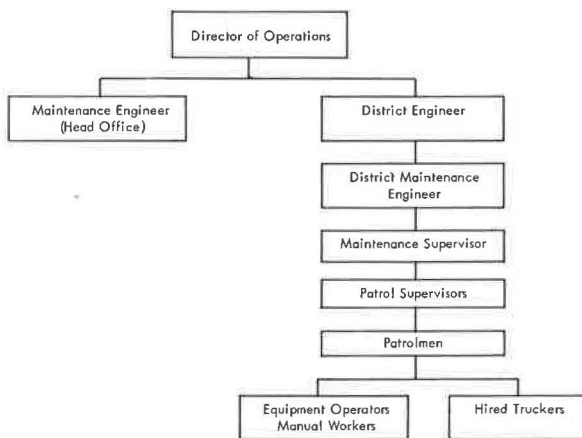


Figure 1. Winter maintenance organization.

TABLE 1  
SUMMARY OF INFORMATION PERTAINING TO TRAINING MEETINGS HELD IN EACH DISTRICT DURING FALL 1966

District	Total No. of Employees	Number of Meetings Held	Size of Meetings	Total Employees in Attendance	Classification of Those in Attendance						
					Patrol Supvrs.	Patrolmen	Night Patrolmen	Equipment Operators	Manual Workers	Hired Truckers	Others
1	197	3	14 to 21	50	3	19		5			
2	286	17	10 to 27	255		18		129	45	63	
3	397	14	10 to 36	321	5	25		219	24	42	6
4	554	11	8 to 50	278		-106				72	102
5	341	17	6 to 20	175-200		*	*	*		*	
6	467	NA	NA	NA							
7	351	3	25 to 30	82	3	17		58		4	
8	412	2	5 to 10	15	1	3	10				
9	301	9	14 to 32	185	4	26	88		22	17	
10	178	1	21	21	3	18					
11	217	7	5 to 18	94	4	15	18	32		25	
13	189	6	12 to 16	80	2	18	48			6	6
14	218	12	9 to 28	230	3	13		90	112	12	
16	127	4	9 to 28	62	2	9		34	5	5	7
17	289	2	27 to 44	71	4	16		36		15	
18	283	10	4 to 12	61	5	13		39		7	
19	232	13	7 to 27	171	3	21		77	58	12	
20	167	5	3 to 11	30	5	19	3				3

\*Numbers not available.

A summary of the replies to questions 1, 2, 3, and 4 is given in Table 1. It is apparent that while some district maintenance engineers left the training of patrol staff and hired truckers to their respective patrolmen, others trained considerable numbers of equipment operators, manual workers and hired truckers themselves. Responses to questions 5 and 6 indicate that the majority of district maintenance engineers and maintenance supervisors found the flip chart to be of considerable assistance in stimulating active discussion and maintaining interest at training sessions.

#### THE POST-TRAINING TEST

Toward the end of the winter maintenance season a post-training test (see Appendix) was given to a representative sample of field personnel to ascertain the current level of knowledge and to evaluate the training program, particularly the training aid. The post-training test was designed to cover almost the entire content of the illustrated training aid. A variety of techniques were used, e.g., true or false, multiple choice, and written answer, and in several cases questions were formulated so that the correct answer could come only from the training aid.

#### Implementation

All districts were instructed to test three people on each patrol who were using salt for snow and ice control, the patrolman, a night patrolman, and a hired trucker. The tests were given without forewarning and under supervision and only to those who had been exposed to the training program. To minimize "examination jitters" the testee was asked only to state his classification on the test paper—not his name.

When the testee handed in his test paper he was given a facsimile with correct answers, so that he could assess his own performance. It was believed that this would reinforce him in subject areas where he had responded correctly and alert him in those where he had responded either incompletely or incorrectly.

#### Marking

Before the test papers were marked each answer was given a value according to its relative importance. An attempt was made to mark with consistency, particularly where it was necessary to interpret partially-correct answers.

#### COMPILATION AND EVALUATION OF RESULTS

The results for each district were compiled in two ways:

1. The total mark obtained by each testee was tabulated and grouped according to job title. The results for a typical district are given in Table 2.

2. The average mark obtained by each of the three groups was, for each question and part question, tabulated under the appropriate heading as given in Table 3.

Following these analyses, the average mark obtained by each of the three groups, and the number in each, was tabulated for every district in the Province under the appropriate heading, as given in Table 4.

To evaluate the training program in detail it was necessary to analyze the responses to each question and part question as made by the patrolmen, night patrolmen, and hired truckers in each district, and in the Province as a whole. The degree of accuracy to which each group in each district answered was expressed as a percentage and tabulated as in Table 3. Similarly, information for each group at the Provincial level was tabulated (Table 5).

These data were considered indicative of the current level of knowledge in each district. The test score of 75 percent was arbitrarily selected as being indicative of a satisfactory level of knowledge. It was thought that this information shows the effectiveness of the training program in each district. Evaluation of the data in Table 4 shows that there was a spread of 30 percentage points between the lowest combined average mark of 61 percent in district 1 and the highest of 91 percent in district 6. The remaining districts were fairly evenly interspersed between these limits. There

TABLE 2  
SUMMARY OF TOTAL MARKS OBTAINED IN  
POST-TRAINING TEST BY  
TESTEES IN DISTRICT 1

Patrolmen (19)	Night Patrolmen (11)	Hired Truckers (14)
84	78	77
81	72	72
81	72	70
78	69	69
75	69	65
75	66	63
74	65	62
73	59	59
73	40	51
66	34	51
66	27	45
64		41
60		34
59		24
52		
50		
48		
47		
43		
66	59	56

TABLE 3  
SUMMARY OF AVERAGE MARKS OBTAINED BY TESTEES IN DISTRICT 1 FOR  
EACH QUESTION IN POST-TRAINING TEST

Question	Patrolmen (19)	Night Patrolmen (11)	Hired Truckers (14)	Combined Results (44)	Question	Patrolmen (19)	Night Patrolmen (11)	Hired Truckers (14)	Combined Results (44)
1	82	55	82	75	9	46	30	21	34
	58	55	50	55	10	95	100	86	93
2	63	73	64	66		79	27	36	52
	84	73	93	84		47	82	43	55
	58	64	64	61		100	100	79	93
3	84	82	79	82		21	55	29	30
4	55	27	29	40		37	36	29	34
5 (a) (i)	95	90	93	93		5	18	21	14
(ii)	68	60	79	70	11	100	90	86	91
(iii)	5	10	7	7		47	10	16	28
(iv)	63	70	93	74		84	70	79	79
(b)	47	25	29	36		84	70	36	65
6	84	70	79	79		100	100	86	95
	74	80	79	77		79	80	57	72
	82	85	64	77		58	90	93	77
	84	90	79	83		100	100	79	93
	74	65	57	66		89	90	93	91
	65	41	43	51		95	60	86	84
	61	50	50	55	12	70	50	21	49
	50	70	79	64	13	39	36	29	35
	82	75	71	77	14	86	59	71	74
	21	20	50	30	15 (a)	94	55	43	68
7	63	50	79	65	(b)	78	73	50	68
8	74	80	43	65					

TABLE 4  
SUMMARY OF AVERAGE MARKS OBTAINED IN POST-TRAINING TEST BY  
TESTEES IN EACH DISTRICT

District	Patrolmen		Night Patrolmen		Hired Truckers		Combined	
	No.	Mark	No.	Mark	No.	Mark	No.	Mark
1	19	66	11	59	14	56	44	61
2	15	78	38	77	24	75	73	77
3	26	78	33	78	20	77	79	78
4	34	71	9	70	77	61	120	65
5	19	77	19	70	25	71	63	73
6	12	91	9	91	0	—	21	91
7	17	78	36	77	4	76	57	77
8	4	89	9	83	0	—	13	85
9	18	75	26	67	7	67	51	70
10	18	75	15	72	21	68	54	72
11	13	82	11	85	7	79	31	82
13	18	88	19	86	6	89	43	87
14	11	81	9	80	10	81	30	81
16	9	80	7	77	0	—	16	79
17	16	91	29	89	5	88	50	90
18	13	69	15	64	9	65	37	66
19	15	80	8	74	9	75	32	77
20	26	74	2	78	0	—	28	74
Total	303	78	305	76	238	69	846	75

was a greater disparity in the average marks of patrolmen, night patrolmen, and hired truckers in those districts with combined average marks at the low end of the scale, than those at the high end. For example, district 1, with a combined average mark of 61 percent, recorded average marks of 66, 59, and 56 percent for patrolmen, night patrolmen and hired truckers, respectively, while district 17, with a combined average mark of 90 percent, recorded comparable average marks of 91, 89, and 88 percent.

The combined average mark in any district was generally assumed to reflect the relative effectiveness with which the training program had been conducted in that district.

TABLE 5  
SUMMARY OF AVERAGE MARKS OBTAINED IN POST-TRAINING TEST BY  
TESTEES IN THE PROVINCE AS A WHOLE

Question	Patrolmen (303)	Night Patrolmen (305)	Hired Truckers (238)	Combined Results (846)	Question	Patrolmen (303)	Night Patrolmen (305)	Hired Truckers (238)	Combined Results (846)
1	95	91	85	91	9	53	50	40	48
	81	79	72	78	10	95	97	85	93
2	84	84	72	80		57	56	36	51
	96	92	88	92		88	94	87	90
	83	82	73	80		96	97	89	94
3	93	93	92	92		70	72	61	68
4	73	66	58	66		45	46	35	42
5 (a) (i)	98	98	94	97		54	62	56	58
	(ii)	89	90	90	11	97	96	95	96
	(iii)	22	12	20		58	61	44	55
	(iv)	85	85	88		89	91	88	89
	(b)	52	43	50		91	87	79	86
6	87	92	83	87		99	99	93	97
	92	93	91	92		81	85	77	81
	96	95	90	94		76	80	86	80
	94	96	90	94		93	93	93	93
	76	75	69	74		90	90	87	89
	67	63	61	64		93	90	82	88
	71	70	64	68	12	67	63	38	57
	84	90	87	87	13	53	57	57	56
	91	90	82	89	14	89	84	77	84
	71	74	62	70	15 (a)	76	67	57	67
7	91	87	85	88		(b)	75	72	60
8	78	71	66	73					70

This assumption appeared even more valid after comparing the average marks obtained by the patrolmen, night patrolmen, and hired truckers in those same districts.

### CONCLUSIONS

1. The training program was considered successful in that almost 60 percent of the participants scored at least 75 percent on the post-training test. A summary of the total marks obtained by each testee is shown in the form of a frequency-distribution chart in Figure 2. It was felt that a greater degree of success would have been attained if more specific direction had been given to districts as to how the program was to be administered, by whom, and to whom; and if the program had included more follow-up.

2. The post-training test was not in all cases administered by the districts in the manner requested. This cast some doubt on the validity of some of the results. It is important that a post-training test be administered under strictly controlled conditions to a sufficiently large, representative sample of the population.

3. Evaluation of the training program would have been somewhat more meaningful had the level of knowledge prior to training been known. Administration of a pre-training test, similar in content to the post-training test, to a representative sample of the personnel to be trained would have provided a sound basis for measuring the effect of the training program.

4. Where questions contained in the post-training test had been poorly answered by a large percentage of the total testees, some difficulty was experienced in ascertaining whether the deficiency lay in the training program or in the specific test question. This emphasizes the necessity of field-testing the training (or testing) materials before distribution, to insure that the personnel to whom they are directed fully understand the content.

5. No attempt was made to determine the effect of the training program on field performance. However, the following observations were made: some districts were of the opinion that the training program resulted in the improved use of salt and an overall reduction in its use. Other districts felt that the emphasis placed on salt in the training program had encouraged some patrolmen to use salt where they had previously used treated sand. This resulted in increased salt consumption, but to what extent this was offset by a decrease in the use of treated sand is not known. In comparison with previous years there was a leveling-off in salt consumption even though the winter maintenance season in question was thought to be worse than usual.

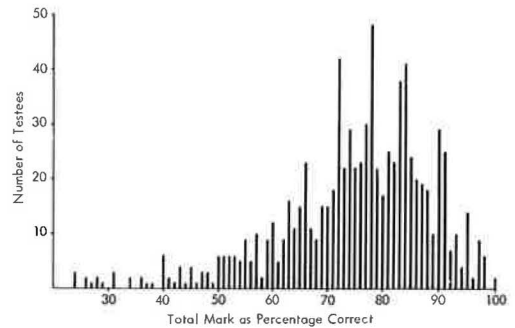


Figure 2. Summary of total marks obtained in post-training test.

## Appendix

POST-TRAINING TEST  
(See Following Sample Pages)

District \_\_\_\_\_

Patrolman

Night Patrolman

Trucker

1. Fill in the blanks.
- The standard rate of application for salt is 450 lb. per 2 lane mile of road.
- To salt 6 miles of 4 lane highway, you would expect to use 5400 lb. of salt, at the standard rate of application.

2. Fill in the blanks.
- A truck has been calibrated to spread salt on a 2 lane highway at the standard rate of application. The speed posted on the dashboard is 18 m. p. h.
- How much salt would it spread per mile of driving at the following speeds?

9 m. p. h. 900 lb. per mile  
 18 m. p. h. 450 lb. per mile  
 36 m. p. h. 225 lb. per mile.

3. Cross out the incorrect answers.
- Driving faster than the posted speed will mean -
- ~~more salt spread per mile~~  
~~no change in salt spread per mile~~  
 less salt spread per mile

4. Circle the correct answer.
- If you were given the choice of spreading salt in any of the following widths, which one would you choose?

4'    1'    7½'    12'    9'    2'     6'

5. a) Describe where on the pavement (right, left or centre) you would put salt on the following:
- 1) straight section of road                    CENTRE
- 2) curve to the left, super elevated (banked)                    RIGHT
- 3) curve to the right, super elevated                    CENTRE
- 4) curve to the right, not super elevated                    CENTRE
- b) State one rule to say where on the pavement salt should be spread, whether on a curve or on a straight section of road.

ON THE HIGHEST POINT OF THE PAYEMENT

6. . Against the temperatures listed, write down whether you feel the temperature is good, fair, or poor, for salting operations assuming all other conditions to be favourable.

150° F	<u>FAIR TO GOOD</u>	18° F	<u>GOOD</u>
-7° F	<u>POOR</u>	10° F	<u>FAIR</u>
29° F	<u>GOOD</u>	-12° F	<u>POOR</u>
0° F	<u>FAIR TO POOR</u>	23° F	<u>GOOD</u>
12° F	<u>FAIR</u>	-25° F	<u>POOR</u>

7. At 450 lb. per 2 lane mile, how many miles of 2 lane pavement would you expect to salt with a 5 ton load of salt?

22 MILES APPROX.

8. Why is it important to spread salt early in a storm?
- SO THAT BRINE WILL FORM UNDER THE SNOW AND PREVENT THE SNOW FROM STICKING TO THE PAVEMENT

9. Why is it important to spread salt early in the day?

**TO TAKE ADVANTAGE OF THE SUN, TRAFFIC AND HIGHER DAYTIME TEMPERATURES, WHICH MAKE SALT WORK BETTER**

10. Answer 'yes' or 'no' to indicate whether you would or would not use salt given the following conditions. If you are in doubt, or feel you would need more information, leave blank.

Weather	Time	Temperature	Forecast	Road Condition	Answer
Started Snowing	11 a. m.	23°	Continuous snow. Steady temp.	Lightly snow covered	<b>YES</b>
Clear	6 a. m.	0°	Clear	Ice patches	<b>YES</b>
Cloudy	4 p. m.	10°	Falling temperature	Ice and snow patches	<b>NO</b>
Sunny	10 a. m.	8°	Clear	Pavement dry Snow blowing across pavement	<b>NO</b>
Sunny	5 p. m.	10°	Clear	Icy	<b>NO</b>
Overcast	9 a. m.	25°	Snow	2" of snow	<b>NO</b>
Sunny	10 a. m.	20°	Clear	Snow pack covered	<b>NO</b>

11. Mark true or false.

True	False
<input checked="" type="checkbox"/>	<input type="checkbox"/>
Salt works better at higher temperatures.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>
Salt sometimes works at temperatures below 0°.	
<input type="checkbox"/>	<input checked="" type="checkbox"/>
Traffic has very little effect on how well salt works.	
<input type="checkbox"/>	<input checked="" type="checkbox"/>
The reason for salting early in the day is to take advantage of lower traffic volumes.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>
When snow is blowing off the road and is not sticking, the use of salt may cause the snow to stick to the pavement.	
<input type="checkbox"/>	<input checked="" type="checkbox"/>
Once salt has combined with the snow to form brine, it will not re-freeze even though the temperature goes down.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>
As long as the temperature is warm enough, the salt will work, no matter what the other weather conditions are like (sun, wind, etc.).	
<input checked="" type="checkbox"/>	<input type="checkbox"/>
You should never have a plow operating immediately behind a salt truck.	
<input type="checkbox"/>	<input checked="" type="checkbox"/>
You should never have a salt truck operating immediately behind a plow.	
<input type="checkbox"/>	<input checked="" type="checkbox"/>
After a snow storm has started, it is better to let snow accumulate to at least 1" before salting.	



12. Describe what is meant by "a brine sandwich".

BY SALTING EARLY IN THE STORM A LAYER OF  
BRINE IS FORMED BETWEEN THE SNOW AND THE  
PAVEMENT

13. At 25° F, how long do you think should be allowed between salting and plowing to allow the salt time to work?

A MINIMUM OF 1/2 HOUR

14. One of the three things that affects the rate per mile that salt is spread with a hydraulic sander is the speed of the truck. What are the other two?

1. GATE OPENING      2. HYDRAULIC SANDER  
MOTOR SPEED

15. a) Where would you set the gate opening on a hydraulic sander for salting operations?

AT THE PROPER SETTING FOR SALTING, MARKED ON  
TRUCK DASHBOARD OR ON THE SANDER BODY

- b) At what throttle setting do you run the motor on the hydraulic sander?

FULL THROTTLE