

Michigan Snow and Ice Control

Field Handbook for Snowplow Operators

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Acknowledgments

This field handbook is dedicated to the plow operators who keep our roads safe all winter long. It is based on the *Manual of Practice for an Effective Anti-icing Program*, produced by the Utah LTAP Center.

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Purpose of this Handbook

The purpose of this field handbook is to help promote the understanding of the tools, best practices, and limitations for snow and ice control. The handbook will also help you understand when to use and when not to use these tools and practices. In addition, it encourages progressive changes in snow and ice control practices that will help you reduce salt/sand use and environmental impacts while meeting the safety and mobility needs of roadway users.

Improved practices such as anti-icing, prewetting, and pretreating are emphasized in this field handbook. Also included are standard best practices expected in a quality snow and ice control program.

Throughout the field handbook you will find environmental tips shown with this fish symbol . These tips are provided to help you reduce environmental impacts from snow and ice control operations.

A blanket approach will not work for the broad range of conditions Michigan experiences; different strategies are needed for different regions and different conditions. We encourage you to continue to test, document, and refine the practices from this field handbook.

Less material on roads means less material in lakes and streams.

Basic Concepts

WEATHER

Knowing existing and potential weather conditions is very important for a successful snow and ice control operation. Six pieces of information are especially valuable:

1. Start of precipitation
2. Type of precipitation
3. Total precipitation expected
4. Expected event length
5. Wind conditions (speed, gusts, directions)
6. Temperature trend

Monitor the weather closely so that you are available and prepared to act early in storm situations.

Weather information sources

- Check DTN or web-based weather sources
- Talk to neighboring agencies and share information on conditions.
- Subscribe to a value-added meteorological service (VAMS). These are useful for viewing weather forecasts.
- Check the National Weather Service.

PAVEMENT TEMPERATURE

Most weather stations measure temperature and other conditions 30 feet above ground, which means these conditions can differ substantially from pavement temperatures. Thus, use the pavement temperature - not the air temperature - to determine your application rate.

You'll notice changes in pavement temperature first on bridge decks; pavement temperatures will also be lower in shady areas.

Measuring with sensors or RWIS

There are two ways to measure pavement temperatures: with sensors or with the Road Weather Information System (RWIS) if available.

Pavement temperatures can be substantially lower or higher than air temperatures.

Basic Concepts

Sensors can be hand-held or truck-mounted. Hand-held infrared laser sensors are pointed at the pavement to get a pavement or surface temperature while your vehicle is stopped or moving slowly.

Truck-mounted temperature sensors measure pavement or surface temperatures while your truck is moving. Ideally, every agency should own at least one truck-mounted unit.

If you do not have road sensors in your truck, look up the road temperature from the closest state highway on RWIS (Not available in every Region). This will give you an idea of the local road temperatures.

DILUTION: THE CAUSE OF REFREEZE

An ice control product will work until product dilution causes the freeze point of the brine to equal the pavement temperature. At this point, the material will stop melting and you may experience refreeze if pavement temperatures are dropping. This process is *Dilution of Solution*.

How long an application will last depends on five factors: pavement temperature, application rate, precipitation, beginning concentration, and chemical type. These factors explain why one application rate will not fit all storm events.

Before the Winter

Take some time before the season to plan your routes and learn the plowing policies. A little planning up-front can help you do a more efficient job in keeping the roads safe.

POLICIES

- Make sure you have a plowing policy and meet to discuss it.
- Your level of service may be based on average daily traffic, environmental concerns, safety, mobility, economics, and other factors.
- Inform your citizens of policies.
- Learn to record what and how much you apply on each shift. Be prepared to analyze and make adjustments to your process based on what you learn.

PLAN YOUR ROUTES

- During the fall, inspect and make sure ditches, culverts, and surfaces are free from obstructions and ready for the spring melt.
- Remove potential snow traps, such as tall grasses, that will catch and accumulate snow.
- Drive the assigned routes prior to winter to identify critical areas and find the most efficient way to cover the routes.
- Inventory all the areas prone to drifting and have a plan to manage them.
- Know your routes. Plan which way you will start.
- Be flexible. Conditions could change the way you plow your route.



Using less salt doesn't have to reduce safety, but it does protect our lakes.

CALIBRATE YOUR EQUIPMENT

Calibration is an essential procedure to measure the pounds of salt and sand applied to the roadway at various auger settings in relation to truck speed. No matter how sophisticated or simplified your operations, always calibrate yearly.

- Because spreaders vary, calibrate each truck. Re-calibration is required if changes are made to the hydraulic system, if the augers have extensive wear or are resurfaced or replaced, or a different material is used.
- Follow the manufacturer’s guidelines for calibration, and contact the manufacturer for training. For manual sander controls, refer to instructions at Division of Operations website in the *Memos, Manuals, Maps and More* section.
- Calibrate separately for salt/sand mix vs. salt or sand only. Remember: The auger plate must be in place during calibration. You are not calibrating the truck properly if the material is gravity-flowing.
- Place the chart in your truck (if applicable) and check it to see how much material will be applied at each setting, or ask your supervisor.
- Additional information on truck calibration can be found online in a Clear Roads pooled fund study report titled “Calibration Guide for Material Spreaders” at: http://www.clearroads.org/research-projects/05-02calibration_files/Final-Calibration-Guide-02-09.pdf

All good programs include calibration.
If you don’t calibrate your spreader, the application rates will not be accurate.

ANTI-ICING

Anti-icing is often the most cost-effective and environmentally safe practice in certain winter road maintenance situations. You should consider heading in this direction.

Anti-icing – a proactive approach – should be first in a series of strategies for most winter storms. By applying chemical freeze-point-depressant materials before a storm, you can prevent snow and ice from bonding to the pavement.

Anti-icing requires about ¼ the material of deicing at 1/10 the overall cost, making it the least expensive option for improving traffic safety. Anti-icing is effective and cost-efficient when used correctly and approached with realistic expectations.

Guidelines for anti-icing

- Anti-icing is often effective for heavy frosts.
- Anti-icing works best when combined with accurate road weather information.
- Early application is particularly important for frost or light freezing drizzle.
- Liquids are the most efficient and may be applied days in advance of an event.
- Pretreated salts will work at lower applications (lowest possible setting, less than 100 lbs/two-lane mile) closer to the expected event.
- See the Application Rate Guidelines on page 17 of this field handbook.

What to do

- Apply only with stream nozzles to maintain some bare pavement between sprayed areas to reduce slipperiness. Fan spray is not recommended.
- Schedule applications on bridge decks and critical areas if temperature and conditions could produce frost or black ice.
- Consider spot-applications on hills, curves, and intersections if predicted conditions warrant.
- Use appropriate chemical for your pavement temperature range. See the chart on page 18 of this field handbook.

What to do (cont.)

- Apply an anti-ice product during non-rush-hour traffic periods.
- When frost on the shoulder starts to move into the travel lanes, reapply anti-icing product.

What not to do

- Don't anti-ice under blowing conditions, in areas prone to drifting, and anywhere else you would refrain from using salt. Be aware of areas that are prone to wind issues.
- Reapplication isn't always necessary if there is still a residual. The residual effect can remain for up to five days after application if precipitation or traffic wear-off does not dilute the initial application.
- Remember that the surface can refreeze when precipitation or moisture in the air dilutes the chemical.
- Don't apply MgCl₂ or CaCl₂ to a warm road (above 28°F pavement temperature). It can become slippery causing crashes!
- Don't apply before predicted rain.
- For the first application or after a prolonged dry spell, apply liquids at half the rate (not half the concentration). On dry roads, liquids tend to mix with oil from vehicles and cause slippery conditions.
- Don't apply too much or the roadway may become slippery. Less is better. Always follow application recommendations.

Equipment

- Anti-icing unit, i.e., transport vehicle with tank.
- Fan spray is not recommended.



Anti-icing can reduce airborne dust and salt particulates.

Use wisely. Chlorides can increase the salinity of soil, which can lead to compaction and erosion.

PRETREATING AND PREWETTING SALT AND SAND

Dry material bounces or blows off the road, so everyone should be either pretreating or prewetting dry material. Liquids also increase salt's effectiveness by jump-starting the melting process. Depending on the liquid used, it can lower salt's effective working temperature.

Because pretreating and prewetting cause material to stick to the road, 20 to 30 percent less material is used – saving money and reducing environmental impacts.

Guidelines for pretreating

Pretreating is mixing a liquid into the stockpile of salt or sand before it is applied. Unlike prewetting, it does not require equipment changes and requires no new capital investment for equipment. You can also switch from dry application to wet application immediately – just remember less material is needed if it is pretreated.

Salt stockpile

- Treat the salt stockpile with liquid deicing chemical. It may be purchased pretreated or mixed on site by the vendor.
- When treating the stockpile at the shop, apply at 6 to 8 gallons/ton.
- Because leach risk at a stockpile is increased, store it covered on an impervious pad.

Sand stockpile

- Pretreat the stockpile to keep it flowable.
- Apply to stockpile at 4 to 6 gallons of salt brine/ton sand.
- Store the stockpile under cover.

If you must use dry material, follow best practices to reduce bounce and scatter.

Before the Storm

Guidelines for prewetting

Prewetting is adding a liquid to the salt as it is being applied – either at the spinner or through a soaker pipe in the auger box – to help it stick to the road better. Although prewetting requires some equipment changes, it provides flexibility to switch the chemical makeup depending on conditions.

- Salt brine, chlorides, and acetates may be used as prewetting agents.
- The optimal application rate is 8 to 10 gallons/ton for salt brine.
- Prewetting with other chemicals at the spinner can help reduce the application rate.
- Below 15°F, salt brine is less effective than other liquids and may freeze hoses and valves.
- Salt brine should be mixed at 23.3%.



Apply wisely. We will never have a chance to recover the chlorides applied.

During the Storm

DEICING

Deicing is a reactive operation in which a deicer is applied to the top of an accumulation of snow, ice, or frost that is already bonded to the pavement surface. Deicing generally costs more than anti-icing in materials, time, equipment, and environmental damage.

Removing ice that has already bonded to the pavement can be difficult, and removing it mechanically can damage equipment and roads. Generally, enough ice must be melted chemically to break the bond between the ice and the pavement, which requires larger quantities of chemical than anti-icing.

- Use an appropriate amount of salt. Most oversalting can be prevented by using calibrated, speed-synchronized spreaders and good judgment in selecting application rates and truck speed.
- It is not necessary to melt all the snow or ice on the road with salt. This is an overuse of materials. Apply just enough to loosen the bond between the road and the ice so it can be bladed off.
- See the Application Rate Guidelines on pages 17-18 of this handbook.
- Dilution of Solution (see page 2) also applies to deicing.

The goal is not to melt everything. The goal is to penetrate through the ice and snow and break the bond so that pavement can be bladed.

USING ABRASIVES

Use winter sand and other abrasives when temperatures are too cold for deicing chemicals to be effective. But be aware that sand does not melt anything. It provides temporary traction, and only when it is on top. Sand also clogs sewers, ditches, and streams. As a result, avoid sand use as much as possible.



Winter abrasives use has been documented as an air pollution concern.

A salt/sand mix is generally not recommended. Salt reduces the effectiveness of sand, and sand reduces the effectiveness of salt. However, a salt/sand mix may be helpful in limited situations such as a long freezing rain event where the salt is washed away quickly. A 25 to 50 percent sand/salt mix has been documented as effective in increasing friction by sticking the sand to the surface, like sandpaper.

- Use abrasives in slow-moving traffic areas such as intersections and curves.
- If your purpose is melting, use salt only.
- Salt is ineffective in cold weather, so use sand or an alternative chemical.
- Sand is not cheap when you consider the handling, clean-up and disposal costs.
- Sweep up sand frequently, after each event if feasible.

If you use a 50/50 salt/sand mix, you're generally either half right or half wrong. Using a salt/sand mix leads to over application of both materials.

STANDARD PRACTICES

- Know the pavement temperatures and trends to help you use the right application at the right time. Generally use less chemical when temperatures are rising and more when they are falling.

- Don't apply dry salt (sodium chloride) at pavement temperatures below 20°F. It will not melt fast enough to help and it will blow off the road into the ditch.
- Below 20°F, switch to other tools like prewetting with CaCl₂ and MgCl₂ at curves, hills, and intersections to obtain maximum melting. If unavailable, use sand for traction.
- Adjust your spinner speed to the lowest setting possible, except at intersections.
- Drive at the slowest possible speed, not to exceed 35 mph.
- Don't let the traffic dictate your speed. Keep it slow to keep material on the road.
- Apply deicers in the center of the road or high side of the curve.
- Set spinners lower to the ground to reduce bounce and scatter.
- If your truck is not equipped with a ground-speed control system, turn off the auger when stopped, even briefly.



Sand that washes into a stream or lake may smother some small aquatic organisms.

Never use calcium chloride to open drains – it is extremely toxic to aquatic systems.

Loading/hauling

- Set up and load on a level surface wherever possible.
- Maintain loading area. Keep it clear and smooth.
- Don't overload. Avoid spilling on units.
- Remove loose material from the exterior of the dump body.
- Watch for co-workers/pedestrians in or near the loading area.

Effective use of underbody blades

Blade to remove snow and loose ice before deicing applications. If snow accumulates before or after applications, blading directly before your next application will minimize product dilution.

- Blade first before applying deicers to avoid dilution of the salt.

- Coordinate blading activities to eliminate windrows at intersections and prevent blading off another operator's material.
- Never blade or blow snow over a bridge into the water or onto traffic below.
- Remove snow from roads as quickly as possible to reduce compaction; use of underbody blades helps remove compacted or slushy snow.
- Make use of carbide blade edges.
- Adjust blade angle to maximize cutting efficiency or snow throwing capabilities.

When slush begins to stiffen and kicks to the rear from vehicle tires, it's time to blade and then reapply chemical.

Public safety/operator safety

- Perform your required CDL pre- and post-trip inspections.
- Make sure you're mentally and physically prepared to drive.
- Obey traffic laws. Use the seat belt. Clean lights and windows frequently.
- Flow with traffic as much as possible. Avoid sudden moves. Be alert to all surroundings.
- Demonstrate courtesy toward other drivers and pedestrians.
- Be aware of spinner discharge at all times.
- Avoid pushing snow over bridge rails and onto road below.
- Be alert to hazards such as downed power poles, stop lights, overhead structures, power lines, etc.
- Know the height of your truck box.
- Be aware of changing braking abilities from a loaded box to an empty one.
- Keep others informed of changing conditions.
-

Snow cloud

Be aware of wind conditions and potential problems. Snow clouds can form during any plowing operation. A very slight snow cloud can temporarily block out any lighting configuration and increase chances of being hit from the rear.

- Reduce your speed to minimize snow clouds.
- Don't plow just to plow. If plowing (shoulder) isn't necessary when the wind is blowing, don't do it.

After the Storm

After the storm, when snow and ice control operations have ended, evaluate what was done, how well it worked, and what could be changed to improve operations.

- Accurately record your material use at the end of your shift (see below).
- Attend a post-storm meeting in the shop to evaluate your operations.
- Look for opportunities to try new and improved practices.
- Clean and check all equipment.
- Report any hazards such as low-hanging branches, raised utilities, snow accumulation on bridges, or other potential problems.
- At the end of the season, clean and maintain the truck, tanks, brine-making systems, and pumps according to manufacturer specifications.
- Place all piles on an impervious pad and cover them, if not stored indoors. This includes salt and salt/sand mixes.

STANDARD PRACTICES

Documenting and charting

Good documentation helps you use less material, reduce costs and environmental impacts, and run a more effective snow and ice control program. Unless you document and chart, you can't measure what you are doing.

- Track your material use.
- Understand the storm conditions and the target level of service for each route.
- Refine your procedures and material use based on observations.
- Share observations to improve operations and learn from each other.
- Use forms like those shown in the appendix of this field handbook to record and track your work and observations.
- Complete forms at the end of your shift.
- Turn in documentation forms to your supervisor.

You can't manage what you don't measure.

After the Storm

Fine-tuning your program

Calibrate Yearly



Use Application Rate Guidelines (pages 17–18)
And
Best Practices



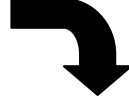
Check Weather
And
Pavement Conditions



Track & Evaluate



Adjust Rates
And
Methods



Treat

Application Rate Guidelines

Develop your own application rates using the guidelines on pages 16-18 as a starting point and modify them incrementally over time to fit your needs. You can summarize information gathered from your truck logs into application rates for your area. Be aware, though, that sample rate charts vary greatly from one area to another, and most are very high. Make it a goal to reduce application rates while keeping our roads safe. You can reduce rates by following anti-icing and other strategies covered in this field handbook.

GUIDELINES FOR DETERMINING APPLICATION RATES

- Sand/salt mix isn't advised but may help in some situations such as freezing rain.
- Always blade before applying chemical. For reapplication, start with the lowest rate in the range.
- High traffic volume will work salt into the snow and aid in melting – so use a lower rate.
- Higher traffic speeds will blow salt off the road and hinder melting – so increase use of prewetted materials.
- Use sand for short-term traction only. It will never melt anything.
- For application on a single lane, cut rates in half. For an 18-foot-wide road, use $\frac{3}{4}$ of the listed rate (i.e., multiply rate by 0.75).
- It is usually not cost-efficient to apply salt (sodium chloride) at pavement temperatures below 20°F.

Application Rate Guidelines

Anti-icing Application Rate Guidelines

These guidelines are a starting point. Reduce or increase rates incrementally based on your experience.

Condition	Gallons/Lane Mile Salt Brine		Other Products
	MgCl ₂		
1. Regularly scheduled application	15 - 25	20 - 40	Follow Manufacturers' recommendation
2. Prior to frost or black ice event	15 - 25	20 - 40	
3. Prior to light or moderate snow	15 - 25	20 - 50	

Pounds of Ice Melted Per Pound of Salt

Pavement Temp. °F	One Pound of Salt (NaCl) melts	Melt Times
30	46.3 lbs. of ice	5 min.
25	14.4 lbs of ice	10 min.
20	8.6 lbs of ice	20 min.
15	6.3 lbs of ice	1 hour
10	4.9 lbs of ice	Dry salt is ineffective and will blow away before it melts anything.
5	4.1 lbs of ice	
0	3.7 lbs of ice	
-6	3.2 lbs of ice	

It is not cost-efficient to apply salt (sodium chloride) at pavement temperatures less than 20°F.

Application Rate Guidelines

Application Rate Guidelines

Deicing Application Rate Guidelines

24' of pavement (typical two-lane road)

These rates are not fixed values, but rather the middle of a range to be selected and adjusted by an agency according to its local conditions and experience.

Pavement Temp. (°F) and Trend (↑↓↔)	Weather Condition	Maintenance Actions	Lbs/two-lane mile				Winter Sand (abrasives)
			Salt Pretreated with Salt Brine	Salt Pretreated/ Pretreated with Other Blends	Dry Salt*		
>30° ↑	Snow	Blade, treat intersections only	80	70	100*	Not Recommended	
	Frz. Rain	Apply Chemical	80-160	70-140	100-200*		
30° ↓	Snow	Blade & apply chemical	80-160	70-140	100-200*	Not Recommended	
	Frz. Rain	Apply Chemical	150-200	130-180	180-240*		
25-30° ↑	Snow	Blade & apply chemical	120-160	100-140	150-200*	Not Recommended	
	Frz. Rain	Apply Chemical	150-200	130-180	180-240*		
25-30° ↓	Snow	Blade & apply chemical	120-160	100-140	150-200*	Not Recommended	
	Frz. Rain	Apply Chemical	160-240	140-210	200-300*	400	
20-25° ↑	Snow or Frz. Rain	Blade & apply chemical	160-240	140-210	200-300*	400	
	Snow	Blade & apply chemical	200-280	175-250	250-350*	Not Recommended	
20-25° ↓	Frz. Rain	Apply Chemical	240-320	210-280	300-400*	400	
	Snow	Blade & apply chemical	200-280	175-250	250-350*	Not Recommended	
15-20° ↑	Frz. Rain	Apply Chemical	240-320	210-280	300-400*	400	
	Snow	Blade & apply chemical	200-280	175-250	250-350*	Not Recommended	
15-20° ↓	Snow or Frz. Rain	Blade & apply chemical	240-320	210-280	300-400*	500 for frs. Rain	
	Snow	Blade, treat with blends, sand hazardous areas	Not Recommended	300-400	Not Recommended	500-7050 spot treat as needed	
<0°	Snow	Blade, treat with blends, sand hazardous areas	Not Recommended	400-600**	Not Recommended	500-7050 spot treat as needed	

*Dry salt is not recommended. It is likely to blow off the road before it melts ice.

**A blend of 6-8 gal/ton MgCl₂ or CaCl₂ added to NaCl can melt ice as low as -10°

How to use the table on page 18:

- Select the row with the appropriate pavement temperature, temperature trend, and weather conditions.
- Select the column that has the type of material you are using.
- Find the box where the row and columns intersect to find the application rate. These rates are not fixed values, but rather the middle of a range to be selected and adjusted by your agency according to your local conditions and experience.
- Dial the correct setting for the rate indicated on the Application Rate Guidelines.
- If you are not treating a 24-foot-wide road (typical two-lane road), adjust the rate as follows: for application on a single lane, cut rates in half. For an 18-foot-wide road, use ¾ of the listed rate (i.e., multiply rate by 0.75).

Materials and Quality Control

Chemical Melting Temperatures

Multiple products can be used in a snow and ice control program. This chart helps you choose the correct product and apply it at the correct times.

Chemical	Lowest Practical Melting Temperature	Concentration
* NaCl (Sodium Chloride) - Delivered as solid rock salt; also can be made into a brine. The basis of most deicing materials. Very corrosive. Inexpensive.	20°F	23.3%
* MgCl ₂ (Magnesium Chloride) – Delivered as flakes, pellets, or liquid. Often used to wet NaCl crystals to increase adherence to road and reduce melting points. Corrosive. Higher cost.	-10°F	27 to 30%
* CaCl ₂ (Calcium Chloride) – Delivered as flakes, pellets, or liquid. Powerful deicer but extremely corrosive. Sometimes used incorrectly to open storm drains. Higher cost.	-20°F	30%
CMA (Calcium Magnesium Acetate) – Delivered as a powder, crystals, pellets, or liquid. Liquid CMA is used mainly on automated bridge deicing systems. Non-corrosive, biodegradable. Sometimes added to sodium chloride as a corrosion inhibitor. Alternative for areas where chloride use must be limited. Higher cost.	20°F	32%
KAc (Potassium Acetate) – Delivered as a liquid. Used on automated bridge deicing systems. Use for anti-icing, deicing, and prewetting. Non-corrosive, biodegradable. Alternative for areas where chloride use must be limited. Higher cost.	-15°F	50%
Winter Sand/Abrasives – Winter sand is sand treated with brine or another blend. It is often used as an abrasive for low-temperature conditions when chemicals are not effective. Sand provides temporary traction and only works when it is on top of the ice.	Never melts – traction only	

* Liquid chlorides are available with corrosion inhibitors.

Materials and Quality Control

Material Conversions

The following quick reference table and the formulas below will help you convert between tons and cubic yards. Weights will vary depending upon moisture content.

Sand		Salt	
Yards	Tons	Yards	Tons
1	1.4	1	1.1
2	2.8	2	2.2
3	4.2	3	3.2
4	4.6	4	4.3
5	7.0	5	5.4
6	8.4	6	6.5
7	9.8	7	7.6
8	11.2	8	8.6
9	12.6	9	9.7
10	14.0	10	10.8
11	15.4	11	11.9
12	16.8	12	13.0
13	18.2	13	14.0
14	19.6	14	15.1
15	21.0	15	16.2
16	22.4	16	17.3
17	23.8	17	18.4
18	25.2	18	19.4
19	26.6	19	20.5
20	28.0	20	21.6

- To convert tons of clean sand to cubic yards:
tons divided by 1.4 = cubic yards
- To convert cubic yards of clean sand to tons:
cubic yards multiplied by 1.4 = tons
- To convert tons of winter sand to cubic yards:
tons divided by 1.37 = cubic yards
- To convert cubic yards of winter sand to tons:
cubic yards multiplied by 1.37 = tons
- To convert tons of straight salt to cubic yards:
tons divided by 1.08 = cubic yards
- To convert cubic yards of straight salt to tons:
cubic yards multiplied by 1.08 = tons

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- University of New Hampshire Technology Transfer Center. *Manual of Practice*. www.t2.unh.edu/pubs/manofpractice_1.pdf

Utah LTAP Center. *Manual of Practice for an Effective Anti-icing Program: A Guide for Highway Winter Maintenance*. www.utaht2.usu.edu

TRAINING AND TECHNICAL ASSISTANCE

- The Circuit Training and Assistance program (CTAP), a joint program of Mn/DOT and the Minnesota Local Technical Assistance Program (LTAP), brings training to your doorstep. For workshop registration, call 651-282-2160 or visit www.mnltap.umn.edu/ctap
- Minnesota LTAP offers a series of workshops around the state on a variety of topics. Visit www.mnltap.umn.edu or call 612-626-1077.
- Mn/DOT Winter Maintenance Coordinator: 651-284-3606

OTHER WEB RESOURCES

- Iowa Department of Transportation. *Anti-icing Equipment Manual* (with drawings for shop-made equipment). www.dot.state.ia.us/maintenance/manuals/equip/intro.htm
- Minnesota Department of Transportation. *Guide to Field-Testing Deicing and Anti-icing Chemicals*. www.dot.state.mn.us/maint/research/chemical/chem_evaluation_guide.pdf
- Pacific Northwest Snowfighters. www.wsdot.wa.gov/partners/pns/default.htm
- Salt Institute
 - *Practical Guide for Storing and Handling Deicing Salt*. www.saltinstitute.org/snowfighting
 - Calibration Instructions (with downloadable Excel worksheet) www.saltinstitute.org/snowfighting/6-calib.html
 - Snow and Ice electronic mailing list: www.sicop.net