

Field Guide for Testing Deicing Chemicals

Overview:

Field testing of deicing chemicals can range from a very simple test done near the maintenance garage to a full-scale, side-by-side comparison using sensors, cameras and other instrumentation to measure differences in how the deicers react on the roadway. The following are three types of field testing that can be performed to determine the effectiveness of a deicing chemical:

- 1) **Simple Garage Test**- test and evaluate deicers in the parking lot or on a sidewalk away from traffic to observe how the deicers work. Testing can be a comparison of two or more deicers or a simple observation of one deicer.
- 2) **Single Roadway Test**- test and evaluate a deicer under normal traffic conditions during a winter storm with one deicing chemical. This test is typically done to determine how changes in application rates of existing deicers or new deicers will work.
- 3) **Side-by-Side Test**- This is typically a test where a known deicer (control) is compared to a different deicer (test) in a side-by-side evaluation.

This guide was developed to walk someone through the different testing levels, give examples of the types of testing that can be done at each testing level and then provide guidance on what data should be collected with each test.

Under each test type you will find the following subgroups to help users design the deicing test procedures:

- **Roadway Environment**- Determine where to conduct a deicing chemical test.
- **Weather**- Determine how weather can influence a field test and also discusses what weather information should be collected.
- **Truck and spreading equipment**- Determine what trucks and spreading equipment is needed for deicing chemical testing and then how to use the spreaders during the tests.
- **Testing material**- Determine how to stockpile and use the deicing chemicals involved in the tests.
- **Data collection tools**- Determine what information should be collected during the testing period, how often the tests need to be done and what tools are needed to get quality results.

Before You Start:

One of the most important things to remember when conducting a field test with deicing chemicals is to try to make sure the deicing chemical is the only variable that changes during the evaluation period. What this means is that it's important to minimize as many of the other variables at a test locations that might change the results of the tests. Let's say you test one deicing chemical on an asphalt roadway and another deicing chemical on a concrete roadway. The type of roadway will probably make more of a difference in the results than the different deicers. The same may happen if you have two trucks testing different deicing chemicals. If one of the trucks used in the tests is not properly calibrated, it could be applying more deicing chemical than the other test truck. There's a good chance the test will show the deicing chemical being spread by the un-calibrated truck performed better than the other deicing chemical but the results would be based on the over application of deicing chemical from one truck rather than the improved performance of one deicing chemical over another.

Eliminating variables that influence test results is very important in field testing of deicing chemicals. The more of these you can eliminate or minimize, the more accurate the test results. Hopefully this guide will help you identify these variables and eliminate as many as possible before testing begins. If you can't eliminate the variables that could affect the outcome of the tests, the variable should be noted in the final report. The person making the final decision on whether to use the new deicing product will then have all the facts to determine whether additional tests are needed or whether the variables didn't contribute that much to the difference in results.

Simple Garage Test

This is a simple test conducted near the garage or other location that can be easily monitored. This is not a true scientific test but it does allow the observer to see general trends of deicing chemicals during a winter storm and can also gauge how the deicing chemical might react on different surfaces and over time. If the tests from this simple test are encouraging, a test on a roadway under traffic may be warranted.

Roadway Environment:

- The roadway or test location selected for the testing should be in good physical condition and representative of other roadways in the area. A sidewalk can also be used for this test but the user should be aware of the thermal property differences between a sidewalk and a roadway. Make sure to mark the test area with paint or other markings so it's easy to find when making observations or reapplying deicing chemicals. The test locations should be at least a 3-foot by 3-foot square to make it easy to observe changes.



Figure 1. Grid painted on the concrete near a garage for testing multiple deicers

Weather:

- Don't select a location that is exposed to strong winds, shaded, sheltered or has foot traffic as these may adversely affect the test results.
- Use a handheld radiometer to collect the temperature of the sidewalk and air temperature. Just remember that if you point the radiometer at the snow or ice on the sidewalk that's what you're measuring. If you want to know the pavement temperature of the area being treated you will need to remove the snow or ice from the sidewalk. If a weather station is nearby, use the data from that station to record air and pavement temperatures.

Spreading Equipment:

- The best approach is to use a fertilizer spreader or other device that can spread material uniformly in the test area. Make sure to adjust the amount of material being spread for the size of the test area. If you typically apply 250# of material per lane mile on the roadway the application rate on a 3 x 3 test area has to be reduced significantly to replicate what would be used on a roadway.



Figure 2. Different liquid deicers were applied to the grid in smaller amounts to replicate how a 50 gallon per lane mile application would look on the roadway

Test Material:

- Make sure to have an adequate supply of the test material on-hand from the same source to use for all testing expected for the year.
- Make sure the product is clean and of uniform consistency
- Make sure the area where the test material is being stored has been thoroughly cleaned. This helps avoid contamination by other products.
- Take a sample of the product before testing and have it analyzed by a materials laboratory and set it aside. It's best to keep the sample throughout the testing period just in case it is needed to verify the properties of the product at the start of the testing period. After all testing has been concluded the sample can be returned to the stockpile.
- Review the Material Safety Data Sheet for the product being tested with anyone that might be exposed to the product

Data Collection Tools

- Handheld Cameras or videos are excellent tools to help document the performance of deicing chemicals. Make sure the camera is set to capture dates and times. It's also a good practice to take photos or videos from the same physical location and angle so it's easy for the reviewer to see differences over time.



Figure 3. Images collected after a snowfall to show differences between different deicers

- RWIS sites with atmospheric and pavement sensors will provide the best data for a comprehensive review of deicing chemicals performance. If an RWIS site is not nearby a handheld radiometer should be used to collect air and pavement temperatures throughout the test period. Make sure the radiometer is calibrated before each use.

A data collection form should be prepared that gathers the following information at a minimum:

General information (recorded once per day)

- Date and time of the tests
- Location of the test
- Roadway type (asphalt-concrete-other)
- Traffic volume (none-low-medium-high)
- Road conditions (snow covered, ice covered, etc.)
- Type of precipitation (light snow, medium snow, etc.)
- Material(s) tested
- Material applicator used (Truck, fertilizer spreader, hand applied)
- Tester's name

Specific information (data that should be recorded with each application)

- Application time
- Application rate
- Pavement temperature
- Observation (Describe what you see every 10-15 minutes)
- Any variances or abnormalities in the test
- “Scuff” test- The tester may do a simple test of slipperiness with their shoe to determine the condition of the roadway after treatments.

A sample data collection form with instructions on how to complete the form is included at the end of this document to use as a reference.

Single Roadway Test

This level of field testing is used when testing one deicing chemical on a roadway to see how it performs under actual weather and traffic conditions or to determine how that deicing chemical may perform at different application rates. If a garage is comfortable with a new deicing chemical after doing the simple garage test the next step might be to apply the deicing chemical on a roadway where it can be observed during an actual winter storm with normal traffic. This level of field testing requires more data collection and observations than the simple garage test but can provide more detailed results.

Roadway Environment:

- The roadway selected for the testing should be in good physical condition and is representative of other roadways in the area.
- Traffic in the test areas should have normal traffic flow. Don't select a busy commuter roadway or roadways with high truck traffic. These traffic characteristics make data collection difficult and can skew deicer performance. The tests can also be run on a closed roadway if you are only interested in seeing how the deicer works without traffic.
- It's best to make sure the terrain is fairly level and straight. Avoid steep grades, intersections, ramps, significant elevation changes or shaded areas.
- Find a test location near a weather reporting site, if possible.



Figure 4. Testing on one lane may allow the evaluator to see how the deicer works with traffic. Note the roadway is fairly representative of roadways in the area and doesn't have roadway or weather variables that might influence the results of the testing.



Figure 5. A two lane road might be used to test two different deicers, one in each direction or testing in only one lane.

Weather:

- Select a test location that receives a reasonable number of winter events each year (ideally no less than 15-20 events) so you can guarantee that you will have sufficient opportunities to test new products in a winter.
- Don't select a location that has extreme weather conditions, such as strong wind areas, shaded roadways or sheltered areas. These areas are usually isolated areas and most agencies don't select a deicer for their trouble spots (If you want to test for a deicer that performs well in windy conditions or on bridges, then you should select a test area with high winds or on a bridge deck for the testing) For most deicer testing the test location should experience winter weather that is representative of the area.
- Select a location that is near a weather reporting station that collects pavement temperature, air temperature, relative humidity and wind speeds. If a weather station is not nearby, use a truck or handheld

infrared thermometer to record pavement and air temperatures.

Truck and Spreading Equipment:

- Make sure the truck spreader is calibrated before the test for the type of material (liquid or solid) being tested
- Use the same truck and operator for all tests to provide consistency in the tests.
- Make a couple practice runs in the area to make sure the spreader is operating properly and spreading material evenly.
- Make sure the applications are done at the same speed and same rate each pass

Test Material:

- Make sure to have an adequate supply of the test material on-hand from the same source to use for all testing expected for the year.
- Make sure the product is clean and of uniform consistency
- Make sure the area where the test material is being stored has been thoroughly cleaned. This helps avoid contamination by other products.
- Take a sample of the product before testing and have it analyzed by a materials laboratory and set it aside. It's best to keep the sample throughout the testing period just in case it is needed to verify the properties of the product at the start of the testing period. After all testing has been conclude the sample can be returned to the stockpile.
- Review the Material Safety Data Sheet for the product with anyone that might be exposed to the product



Figure 6. Taking a salt sample from the stockpile for testing at a laboratory

Data Collection Tools

- To describe the location of the test area in the final report an aerial photo, map or drawing of the test site will be helpful.
- Handheld Cameras or videos are excellent tools to document the performance of the deicing chemicals. Make sure the camera is set to capture dates and times so it will be easier to match later with the data collection form. It's also a good practice to take photos or videos from the same physical location and angle so it's easy to see any differences over time.
- RWIS sites with atmospheric and pavement sensors will provide the best data for a comprehensive review of deicing chemicals performance. If an RWIS site is not nearby a handheld radiometer should be used to collect air and pavement temperatures throughout the test period. Make sure the radiometer is calibrated before each use.

A data collection form should be prepared that gathers the following information at a minimum:

General information (recorded once per day)

- Date and time of the test
- Location of the test
- Roadway type (asphalt-concrete-other)
- Traffic volume (none-low-medium-high)
- Road conditions (snow covered, ice covered, etc.)
- Type of precipitation (light snow, medium snow, etc.)
- Material(s) tested
- Truck(s) involved with test
- Operator name
- Tester's name

Specific information (data that should be recorded with each application)

- Application time
- Application rate
- Pavement temperature
- Sky conditions
- Observation (Describe what you see every 10-15 minutes)
- Any variances or abnormalities in the test

A sample data collection form with instructions on how to complete the form is included in this document.

Side-by-Side Test

This is a much more complex testing procedure where a standard application rate, type or brand of deicer or a method, referred to as, “control section” is compared with a new application rate, type of deicer or method of application, called a, “test section” to determine differences between the two. More preparation and coordination is required with a side-by-side test but it provides a much better method to compare a new product, application or method against a standard deicer, application or method.

Roadway Environment:

- The roadway selected for the test and control sections should be in good physical condition and representative of other roadways in the area.
- The test and control sections should be made of the same material (asphalt, concrete, etc.)
- It's best to make sure the terrain is fairly level and straight. Avoid steep grades, intersections, ramps, significant elevation changes or shaded areas.
- Find a test location near a weather reporting site, if possible
- Four-lane divided highways are the best option for test and control evaluations because the observer can monitor both test areas with minimal effort.
- Two-lane highways can be used for test and control evaluations with treatments in each direction but care should be taken to avoid cross contamination of deicing products across each test area.
- One direction of travel on a two-lane roadway can also be used for test and control evaluations but care must be taken to allow plenty of room between the test sections. The space is needed to avoid cross-contamination of deicing products. It's fairly common for deicing chemicals to track for more than a ½ mile from the test area.
- Traffic in both the test and control areas should have normal traffic flow. Don't select a busy commuter roadway or roadways with high truck traffic. These traffic characteristics make data collection difficult and can skew deicer performance. Don't select the driving lane for one test and the passing lane for the other test. Traffic differences between the driving and passing lanes can make a difference in test results plus there is a risk that the deicing chemicals will move between the lanes, eliminating any true comparison.



Figure 7. Side by side testing in parking lot



**Figure 8. Side by side comparison of two different liquid deicers
Weather:**

- Select a test location that receives a reasonable number of winter events each year (ideally, no less than 15-20 events) so you can guarantee that you will have sufficient opportunities to test new products in a winter.
- Don't select a location that has extreme weather conditions, such as strong wind areas, shaded roadways or sheltered areas. The test and control sections should experience winter weather that is representative of the area.
- Select a location that is near a weather reporting station that collects pavement temperature, air temperature, relative humidity and wind speeds. If a weather station is not nearby, use a truck or handheld infrared thermometer to record pavement and air temperatures.

Truck and Spreading Equipment:

- Two trucks are required in most test and control evaluations. If just testing application rate differences one truck can be used. It's best to have trucks that are the same age, same type of application spreader and similarly equipped.
- Make sure the truck spreader(s) are calibrated before the test for the type of material (liquid or solid) being tested. This is a very important step in preparing to test two deicing chemicals. Differences in application rates will make a big difference in the results.
- Use the same trucks and operators, if possible, for all tests to provide consistency in the testing procedures.
- Make a couple practice runs in the area to make sure the spreader is operating properly and spreading material evenly.
- Make sure all applications are done at the same speed.

Test Material:

- Make sure to have an adequate supply of the test material on-hand from the same source to use for all testing expected for the year.
- Make sure the product is clean and of uniform consistency
- Make sure the area where the test material is being stored has been thoroughly cleaned. This helps avoid contamination by other products.
- Take a sample of the product before testing and have it analyzed by a materials laboratory and set it aside. It's best to keep the sample

throughout the testing period just in case it is needed to verify the properties of the product at the start of the testing period. After all testing has been concluded the sample can be returned to the stockpile.

- Review the Material Safety Data Sheet for the product with anyone that might be exposed to the product

Data Collection Tools

- To describe the location of the test area in the final report an aerial photo, map or drawing of the test site will be helpful.



Figure 9. Aerial photo of test location

- Handheld Cameras or videos are excellent tools to document the performance of deicing chemicals. Make sure the camera is set to capture dates and times. It's also a good practice to take photos or videos from the same physical location and angle so it's easy for the reviewer to see differences over time.

- RWIS sites with atmospheric and pavement sensors will provide the best data for a comprehensive review of deicing chemicals performance. If an RWIS site is not nearby a handheld radiometer should be used to collect air and pavement temperatures throughout the test period. Make sure the radiometer is calibrated before each use.

Change End Date:

Date/Time (CST)	Surface				Air			Wind			Precip	
	Status	Sfc	Pvt	Sub	Air	RH	Dew	Avg	Gust	Dir	Type	Intens
11/04/2009 23:57	Dry	35.6F	-	-	34F	78%	28F	Calm	Calm	SW	None	None
11/04/2009 23:52	Dry	35.8F	-	-	34F	78%	28F	Calm	Calm	SW	None	None
11/04/2009 23:47	Dry	35.8F	-	-	34F	77%	28F	Calm	Calm	SW	None	None
11/04/2009 23:43	Dry	35.8F	-	-	34F	77%	28F	Calm	Calm	SW	None	None
11/04/2009 23:37	Dry	36.0F	-	-	34F	77%	28F	Calm	Calm	SW	None	None
11/04/2009 23:32	Dry	36.1F	-	-	34F	76%	27F	Calm	Calm	SW	None	None
11/04/2009 23:27	Dry	36.1F	-	-	34F	76%	28F	Calm	4 mph	SW	None	None
11/04/2009 23:23	Dry	36.3F	-	-	34F	76%	28F	Calm	4 mph	SW	None	None
11/04/2009 23:17	Dry	36.3F	-	-	34F	75%	27F	4 mph	4 mph	SW	None	None
11/04/2009 23:12	Dry	36.7F	-	-	33F	74%	26F	Calm	Calm	SW	None	None
11/04/2009 23:07	Dry	36.7F	-	-	33F	74%	26F	Calm	Calm	SW	None	None
11/04/2009 23:02	Dry	36.9F	-	-	34F	73%	26F	Calm	Calm	SW	None	None
11/04/2009 22:57	Dry	37.0F	-	-	34F	73%	26F	Calm	Calm	S	None	None
11/04/2009 22:52	Dry	37.2F	-	-	34F	72%	26F	Calm	Calm	S	None	None
11/04/2009 22:47	Dry	37.4F	-	-	34F	72%	26F	Calm	Calm	SW	None	None
Date/Time (CST)	Surface				Air			Wind			Precip	
Status	Sfc	Pvt	Sub	Air	RH	Dew	Avg	Gust	Dir	Type	Intens	
11/04/2009 22:42	Dry	37.4F	-	-	33F	71%	24F	Calm	Calm	N	None	None
11/04/2009 22:37	Dry	37.6F	-	-	34F	70%	25F	Calm	Calm	SW	None	None
11/04/2009 22:32	Dry	37.8F	-	-	35F	70%	26F	Calm	Calm	SW	None	None
11/04/2009 22:26	Dry	37.9F	-	-	35F	70%	26F	Calm	Calm	N	None	None
11/04/2009 22:22	Dry	38.1F	-	-	36F	69%	27F	Calm	Calm	N	None	None
11/04/2009 22:16	Dry	38.1F	-	-	36F	69%	27F	Calm	Calm	N	None	None
11/04/2009 22:12	Dry	38.1F	-	-	37F	68%	27F	Calm	Calm	NW	None	None

Figure 10. RWIS site historical data showing pavement and atmospheric conditions

A data collection form should be prepared that gathers the following information at a minimum:

General information (recorded once per day)

- Date and time of the tests
- Location of the test
- Roadway type (asphalt-concrete-other)
- Traffic volume (none-low-medium-high)
- Road conditions (snow covered, ice covered, etc.)
- Type of precipitation (light snow, medium snow, etc.)
- Material(s) tested
- Truck(s) involved with test
- Operator name
- Tester's name

Specific information (data that should be recorded with each application)

- Application time
- Application rate
- Pavement temperature
- Observation (Describe what you see every 10-15 minutes)
- Any variances or abnormalities in the test

A sample data collection form with instructions on how to complete the form is attached at the end for reference.