

Best Practices for Road Weather Management

Version 3.0

Alaska DOT&PF Temperature Data Probe Program

The Alaska Department of Transportation and Public Facilities (ADOT&PF) has developed an effective seasonal weight restriction program that uses temperature data probe (TDP) profiles as one tool to issue fact-based weight restriction notices. TDP sensors deployed at strategic locations provide a vertical temperature profile in the six foot layer below the pavement surface. The TDP sites are polled periodically, data are collected and loaded into an Oracle relational database, and then are available under *Alaska's Road Weather (RWIS) and Temperature Data Profiles TDPs for M&O* on the ADOT&PF internal web page <web.dot.state.ak.us> and the Road Weather Information System (RWIS) public web site <<http://roadweather.alaska.gov>>.

Weight limitations during the spring thaw restrict the Maximum Allowable Axle or Axle Group Weights to less than the typical summer/winter loads. These restrictions help prevent pavement damage, avoid higher road maintenance costs, and limit vehicle wear and tear. Additionally, timely weight restriction notices allow commercial trucking the opportunity to plan their work schedules and minimize the impacts of hauling less than full loads.

The regional maintenance engineers base these temporary weight restrictions on the downward thaw progression; inputs to their decision process include:

- Past weather – includes the past week and conditions from the previous fall such as amount of rainfall
- National Weather Service forecasts – solar insolation, temperatures, precipitation
- Local maintenance and operations staff experience – including local TDP measurements
- Roadway pavement structure – roadbed materials, soil characteristics, pavement age, and drainage capabilities
- Site observations – standing water, water seepage through pavement cracks, precipitation, and remaining snow cover

The weight restriction decision-making process involves multiple ADOT&PF work centers. Communication among state, local government, and commercial trucking agencies provide for an effective restriction notice distribution process.

System Components: The temperature probe program started with the Northern Region Fairbanks Research Section more that 20 years ago. In 1990 there was a coordinated effort to install statewide permanent data recorders and collect telemetry. The TDP program continues with new installations as construction projects and funding allows. There are over 75 sites around the state where TDP are installed in the road section.



Figure AK-1. Thermistor string and temperature probe casing.



Figure AK-2. Boring hole for temperature probe.

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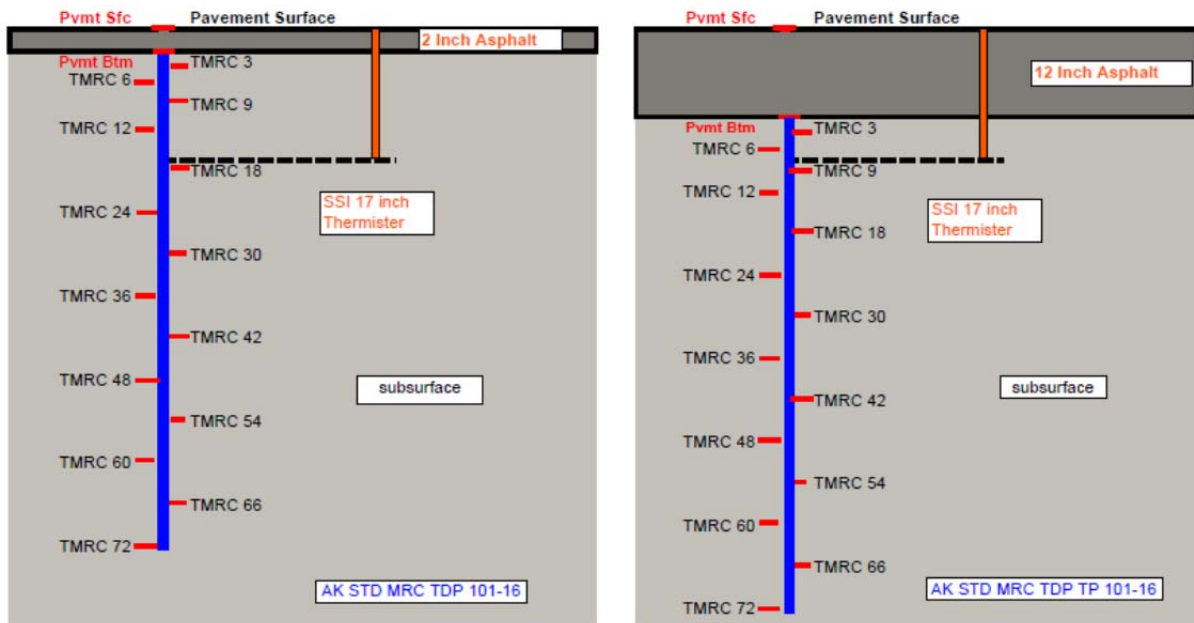
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The probes have been manufactured by Measurement Research Corporation (MRC). MRC is only providing a limited number of TDP units, so ADOT&PF is diligently searching for another supplier for future years. Each probe has a lead-in data cable and a 6-foot thermistor string, one-inch diameter, encased in an epoxy resin. Figure AK-1 shows the 6-foot thermistor string with the top “pig-tail” thermistor featured in the inset. The MRC probe is installed vertically through the pavement in a hole, which is normally drilled through the shoulder of the road, as shown in Figure AK-2. The hole is back-filled with sand and capped with asphalt pavement.



Figure AK-3. Top sensor on a wire lead.

There are 16 thermistors in the MRC probe. The top sensor is on a wire lead and is placed within 1 inch of the pavement surface (Figure AK-3). The second sensor is positioned at the bottom of the pavement, no matter the depth. Sensors #3 through #6 are spaced 3 inches apart, sensors #7 through #16 are spaced 6 inches apart, so sensor #16 is positioned 72 inches below the bottom of the pavement. Figure AK-4 diagrams the vertical thermistor spacing. The older MRC probes co-located with a RWIS site do not have the pavement surface thermistor. In these cases, the RWIS pavement sensor (Vaisala’s FP 2000, ThermoScan1000, or DST 111) temperature is used for this top reading and is reported in the online TDP profiles.



The graph shows the contrast of different pavement thickness and levels of temperature measured by the MRC probe (installed at the bottom of pavement) vs. the SSI 17 inch probe (installed from pavement surface). **Note:** Drawing is not to scale.

Figure AK-4. Diagram of the vertical thermistor spacing.

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System Operations: Regional maintenance engineers try to issue weight restrictions three days prior to altering existing weight restrictions to allow truck operators to plan their work schedules and to minimize the impacts. The regional Maintenance and Operations staff e-mails the restriction notices to a pre-determined list of parties, which includes ADOT&PF regions and districts, trucking firms, ADOT&PF Measurement Standards and Commercial Vehicle Enforcement (MS/CVE), the military, Alaska State Troopers, local law enforcement, and local transportation authorities. The local Maintenance and Operations staff post the restriction signs along the roadway.

Weight Restrictions - Ketchikan Area

Category: Public Notices Sub-Category: Weight Restrictions Publish Date: 03/21/2006	Department: Transportation & Public Facilities Location: Ketchikan Coastal District: N/A
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Body of Notice:

Effective 03/21/06, 10:00 a.m. and until further notice the following emergency weight restrictions are in effect for listed state maintained highways and roads in Ketchikan area.

This weight restriction applies to trucks of 10,000 lbs. or more.

State roads listed: 50% of legal load
D-2 Loop, D1-Loop, No. Point Higgins Spur, Potter, South Point Higgins, Wood Road, Powerhouse, North Tongass (end of pavement to Waterfall II), Shoup Street, Revilla Road, Cranberry, Knudsen Cove, North Point Higgins, Pond Reef, Shoreline, Sunset, Roosevelt Drive.

State roads listed: 75% of legal load
North and South Tongass from City Limits to end of road.
North City Limits start at mile 4418 N. Tongass.
South City Limits start at mile 1 S. Tongass.

Legal axle loads are:
Single Axles 20,000 lbs. 50%=10,000
2-axle tandem 38,000 lbs. 50%=19,000
3-axle group 42,000 lbs. 50%=21,000

For specific information, call Nick Farstad, Ketchikan Maintenance Station at (907) 225-2513.

Figure AK-5. Example of a posted weight restriction.

Local transportation authorities use the State restrictions to help develop local restrictions. In many cases, they adopt the ADOT&PF restrictions for adjacent roads in their service areas. Local Maintenance and Operations staff may also issue weight restrictions on State roads in their local area.

MS/CVE posts the weight restrictions on the State of Alaska Online Public Notice web site <<http://notes4.state.ak.us/pn>> and maintains the commercial weight restrictions on the MSCVE web site:

Figure AK-6. Areas and corridors of Alaska with TDP sites.

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<<http://dot.alaska.gov/mscve/main.cfm?go=weightrestrictions>>. Figure AK-5 shows an example of a posted weight restriction. MS/CVE Commercial Vehicles Customer Service Center posts the weight restrictions on FAX-On-Demand (907-348-9876). Stakeholders can also sign up for email and text message notification. MSCVE and the Alaska State Troopers enforce the posted weight restrictions.

TDP data are available on the internal ADOT&PF home page at <<http://web.dot.state.ak.us/>> under *Alaska's Road Weather (RWIS) and Temperature Data Profiles TDP's for M&O* and on the Road Weather Information System (RWIS) public web site <<http://roadweather.alaska.gov>>. Both web applications also include road weather and camera information. On the internal application, Vaisala's proprietary ScanWeb application presents the most recent TDP for each site. There is also an area summary for TDP sites within a given travel corridor.

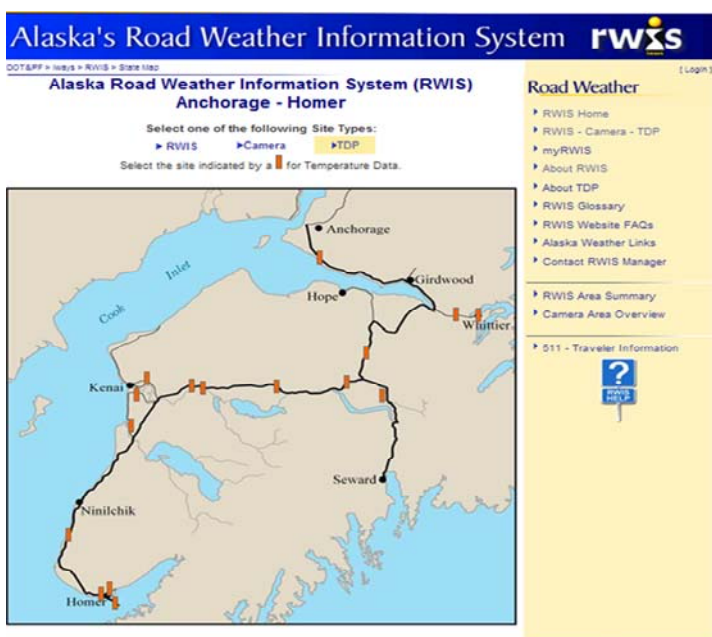


Figure AK-7. Anchorage-Homer corridor with available TDP sites.

Both web sites offer access to TDP through corridor maps. Figure AK-6 shows the four areas and six corridors that have TDP sites. Passing the cursor over an area/corridor area will highlight the area/corridor on the state map. Clicking on the area/corridor text will display the area/corridor with the available TDP sites. Figure AK-7 shows the Anchorage – Homer corridor with the available TDP sites. Hovering over the TDP site displays the name of the site.

The RWIS web site <<http://roadweather.alaska.gov>> provides Road Weather, Camera, and TDP information on a single base map. Simply click on TDP at the top of the corridor map to show the available TDP sites for this map

area. Select the appropriate TDP site to get to the TDP setup screen. Output formats include both an on-line graphical report and a delimited export file. A pull-down menu also provides an alpha list of available TDP sites. Three time periods are available: 24 hours, 7 days, and 31 days. A calendar function provides an easy date range selection; the earliest data availability is included in the site metadata. TDP data are sorted into three-degree temperature bins for graphical display.

Transportation Outcome(s): A progressive series of roadway weight restrictions become necessary each spring when Alaska's road embankments thaw as temperatures rise from south to north across the state. These spring weight restrictions are necessary to help protect highways from unnecessary damage, help avoid higher road maintenance costs, and limit vehicle wear and tear.

Per the Alaska Regulations, at 17 AAC 25.100 (a), "The Department of Transportation and Public Facilities may prohibit the operation of vehicles upon any highway or may impose restrictions on any aspect of vehicle operation on any highway whenever the highway, in the judgment of the commissioner, may be seriously damaged or destroyed by such operation."

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Limitations are therefore imposed from March through June, area by area, and road by road, by restricting the Maximum Allowable Axle or Axle Group Weights to less than typical summer or winter loads. Where a value of “100%” represents the normal legal maximum allowable weight, key paved and unpaved roads are temporarily constrained by public legal notice to restrictions of 85%, 75%, or even 50% of the statutorily defined weights.

Once the thaw process starts at the pavement surface and progresses downward slowly, over a period of days and weeks, moisture content rises and a water-saturated layer of soil generally develops between the uppermost (thawed) zone of pavement and structural fill, and the still-frozen mass of sub grade beneath the thawed layer.

- Trucks and trailers moving heavy cargoes press down atop this constrained system, dramatically increasing the thaw zone’s pore pressure. This potentially can cause “quick” foundation conditions, a loss of strength within the granular soil matrix, and can trigger pavement flexure and rutting (soil displacement), constituting significant road damage. The real-time TDP temperature data at various depths, times of day, and dates provides a clear indication of when certain roads across the state are likely to be incapable of supporting heavy wheel loads because of the progressing thaw depth. This is when load limits, restricting vehicle loads to viable non-damaging levels, are posted.

Reasonable thaw progression estimates are possible by observing site-specific conditions reported by experienced maintenance station foremen. Considerations such as a road’s drainage and soil characteristic, variable pavement age and structural condition, remaining snow cover, and weather forecasts are all important at each TDP location. The maintenance engineer uses the previous years’ archived TDP thaw data and the relative loss of strength from shallow thaw depths to impose load limits. With the return of load-carrying ability within the granular embankment structure in place below the paved (or unpaved) road surface as the thaw gets deeper, load limits are then carefully lifted. Depending on the quality of the roadway’s structural regime and moisture content circumstances, load restrictions are usually completely lifted as the thaw depth exceeds 48 inches.

DOT&PF’s TDP sensors play an important role in selecting which roads to include in road restriction notices and to what level of restriction to apply at various dates. Alaska’s cost-effective TDP system plays a useful and desirable role in providing real-time temperature data for year-round uses, but its spring applications are particularly critical and unparalleled in protecting the state’s \$10 billion highway infrastructure, while realistically balancing the competing needs of surface transportation, commerce and industrial livelihoods. TDP data are also used for road design and arctic research.

Implementation Issues: The TDP program incorporates two statewide networks, one for TDPs co-located with RWIS sites and one that is comprised of stand-alone installations. The co-located sites are polled hourly by the RWIS servers in Anchorage and Juneau and packaged into a 24 hour TDP data file. The stand-alone sites are polled periodically by the Central Region Highway Data Section (CR/HDS). TDP data are transferred to Juneau where they are loaded to an Oracle relational database at 5:00am, noon, and 5:00pm each day.

Campbell Scientific data loggers (model CR-10X) installed in adjacent roadside cabinets collect the CR/HDS TDP data. The CR/HDS polls the TDP sites via modem periodically, more often in the spring, forwards hourly data files to Juneau for loading into an Oracle relational database. Manual readings can be taken from the remaining older MRC thermistor probes on-site when connected to a hand-held display. Most of the stand-alone TDP sites also have other temperature sensors installed such as ambient air temperature and the reference temperature

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inside the control cabinet. These additional data elements are also available in the Oracle database.

The MRC probes co-located with RWIS sites are connected to the RWIS remote-processing unit (RPU) computer in adjacent roadside cabinets. Vaisala, the Department's RWIS contractor, maintains the RWIS sites. These sites are equipped with telemetry that ties into the Internet or the State of Alaska wide area network (WAN). At remote locations, wireless radios provide a connection from the RWIS sites to the Internet or WAN. The RWIS servers in Anchorage and Juneau poll these sites at least three times an hour. The RWIS server forwards the daily TDP files to Juneau for loading into the Oracle relational database.

ADOT&PF has several ongoing initiatives to upgrade the RWIS web site and TDP program. These initiatives include moving to a GIS-enabled, Google-like web interface, improving the communications to the CR/HDS TDP data loggers, automate the CR/HDS TDP data polling, and introduce standard TDP profile reports that can be distributed to interested stakeholders automatically.

Contact(s):

- Howard Helkenn, Central Region Traffic Data Manager, 907-269-0876, howard.helkenn@alaska.gov
- Jack Stickel, Transportation Information Group – Division of Program Development, 907-465-6998, jack.stickel@alaska.gov

Reference(s):

- Road Weather Information System (RWIS) public web site <<http://roadweather.alaska.gov>>
- State of Alaska Online Public Notice web site <<http://notes4.state.ak.us/pn>>

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