

## RIDE – PAVEMENT MANAGEMENT VANS

### General Description

A Digital Inspection Vehicle (DIV) is driven to collect digital images, pavement roughness, and pavement distress. The data is then used to compare the performance of different roadways, pavement designs, and for project planning and programming. The DIV is driven on the entire MnDOT Trunk Highway system every year to monitor the performance of the system, to help in the selection of projects, and identify pavements that need future maintenance and/or rehabilitation. The Pavement Management unit also surveys MnROAD in the fall and spring of each year.



Digital Inspection Vehicle

### Equipment

The first vans used by Pavement Management at MnROAD were made by Pavetech. More recently, two versions of a van made by Pathways have recorded pavement conditions. A new Pathways van with improved visual inspection technologies will be used in 2011. Each of these vans perform similar functions, as described below.

Lasers are mounted across the front bumper to measure roughness and faulting of pavement test sections. The lasers measure the pavement's longitudinal profile, and vertical deviations from a flat surface are indicative of roughness. They take a measurement approximately every 1/8-inch as the van travels down the roadway at highway speed. The faulting measurements made by the DIV have not been independently verified and are therefore not included in the data product. There are additional lasers used for rut depth measurements mounted at the rear of the vehicle. There are also four digital cameras mounted on top of the van to record pavement distress (cracking, patching, etc), right-of-way images, and help assess the overall condition of the shoulder.

More information on the digital inspection vehicles can be found on the MnDOT Pavement Management website at <http://www.dot.state.mn.us/materials/pvmtgmt.html>.



## Pavement Condition Indices and Measures

MnDOT uses three indices to report and quantify pavement condition. These indices, listed in the table below, are used to quantify the present condition of the pavement and predict future condition, both of which are needed for project planning and programming. For each index, a higher value means better pavement condition.

Index Name	Pavement Attribute Measured	Rating Scale
Ride Quality Index (RQI)	Pavement Roughness	0.0 - 5.0
Surface Rating (SR)	Pavement Distress	0.0 - 4.0
Pavement Quality Index (PQI)	Overall Pavement Quality	0.0 - 4.5

The PQI is calculated from the RQI and SR as follows:  $PQI = \overline{RQI} \cdot \overline{SR}$

## Pavement Roughness

The serviceability of a pavement is expressed in terms of the Present Serviceability Rating, or PSR. The PSR is a reflection of the “seat-of-the-pants” feeling the average citizen gets as he or she travels down the roadway. MnDOT now refers to the present serviceability rating as the Ride Quality Index, or RQI.

The RQI is determined by first calculating the International Roughness Index, or IRI, from the pavement profile measured by the front lasers on the van. This international standard simulates a reference vehicle traveling down the roadway and is equal to the total anticipated vertical movement of this vehicle accumulated over the length of the section (reported in units of m/km). The IRI is then converted to RQI by the following equations, which are correlated to the ride quality experienced by a formal rating panel as shown in the table below.

Bituminous Pavement:  $RQI = 5.697 - 2.104 \cdot \overline{IRI}$

Concrete Pavement:  $RQI = 6.634 - 2.183 \cdot \overline{IRI}$

Numerical Rating	Verbal Rating
4.1 - 5.0	Very Good
3.1 - 4.0	Good
2.1 - 3.0	Fair
1.1 - 2.0	Poor
0.0 - 1.0	Very Poor



## Pavement Distress

Pavement distresses are those defects visible on the pavement surface. They are symptoms, indicating some problem or phenomenon of pavement deterioration such as cracks, patches and ruts. The type and severity of distress a pavement has can provide great insight into what its future maintenance and/or rehabilitation needs will be.

MnDOT uses the Surface Rating, or SR, to quantify pavement distress. The task is done by technicians using computer workstations. The workstations allow the operators to view and analyze the digital images captured by the van. Software assists in the calculation of the quantity of distress. The defects monitored by MnDOT and included in the calculation of SR are shown in the table below.

Bituminous Pavement	Jointed Concrete Pavement	Continuously Reinforced Concrete Pavement (CRCP)
Transverse Cracking	Transverse Joint Spalling	Patch Deterioration
Longitudinal Cracking	Longitudinal Joint Spalling	Localized Distress
Longitudinal Joint Distress	Faulted Joints	D-Cracking
Multiple Cracking	Cracked Panels	Transverse Cracking
Alligator Cracking	Broken Panels	
Rutting	Faulted Panels	
Raveling & Weathering	Overlaid Panels	
Patching	Patched Panels	
	D-Cracked Panels	

The percentage of each distress in the 500-foot sample is determined and multiplied by a weighting factor to give a weighted percentage. The weighting factors are higher for higher severity levels of the same distress and higher for distress types that indicate more serious problems exist in the roadway such as alligator cracking and broken panels. Once all of the weighted percentages are calculated, they are summed to give the Total Weighted Distress or TWD. The SR is calculated from the TWD by the equation:

$$SR = e^{1.386 - 0.045 \cdot TWD}$$



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## Data Collection and Processing

Ride quality is typically measured twice per year at MnROAD with the Pavement Management van. The data is collected and processed as described above. The table below shows the columns that are in the Data Product table entitled RIDE\_PATHWAYS and RIDE\_PAVETECH.

RIDE_PATHWAYS
CELL
LANE
TEST_LENGTH_FT
DAY
TIME
RUN
IRI_LWP
IRI_RWP
IRI_AVG
RUT_LWP
RUT_CEN
RUT_RWP
RUT_AVG
PSR
SR
COMMENTS
RQI
DESIGN

RIDE_PAVETECH
DAY
CELL
LANE
TIME
IRI_M_PER_KM
RUT_IN
DESIGN

**Note that table column definitions and units can be found in Section J of the Data Product.**

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MnROAD is a state of the art cold weather pavement and transportation testing facility located in Minnesota