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Pavement roughness testing is performed on approximately 30,000 miles of roadway annually in Pennsylvania. Historically, pavement roughness data was collected for the Interstate system and one half of the other routes every year. That way, data was collected for the entire system every two years. Beginning in 1996, the entire National Highway System (NHS) was tested every year; non-NHS routes followed the same biennial cycle.

IRI data is also collected for recently repaved, new or rebuilt roads, this varies from year to year, but in 2007 this was an additional 3000 miles of testing.

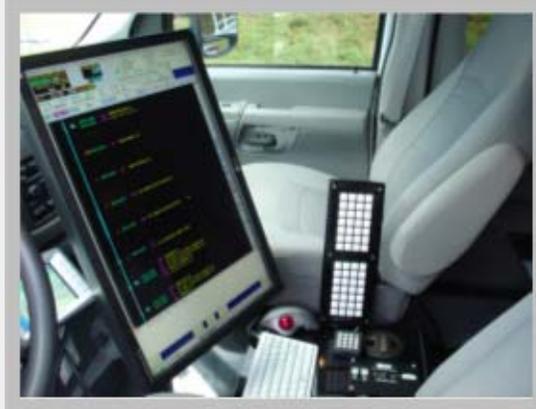
RITS currently owns three full sized highway speed Mobile Data Recorders model (MDR) 4185-L2, manufactured by International Cybernetics Corporation, of Clearwater, Florida. These devices, called Road Profilers, are vans equipped with an on-board computer that is interfaced to lasers and accelerometers which are mounted along the front bumper. The system hardware consists of an IBM-PC compatible computer System Unit with associated Super VGA monitor, compact keyboard, printer and RS-232C Serial Interface. A Data Measurement Subsystem installed in the System Unit provides interfaces to a transmission mounted distance transducer and a custom designed Event keyboard.

The system accepts a downloaded RMS file containing all roadway information as an input database for test data. Vehicle location and roadway features are displayed on the computer screen in a Straight Line Diagram (SLD) format, and the software accepts operator inputs verifying segment locations, known as "events." Routes can be tested in increasing or decreasing segment order, and test sections may begin on a segment beginning, ending, or any permanent landmark feature.

There are two laser height sensors and two accelerometers. One height sensor and one accelerometer is located over each wheelpath; they function together to allow road profile and surface height data to be collected independent of the travel speed and vehicle characteristics.

An additional laser height sensor is located between the wheelpaths; this sensor along with the height sensors located at the wheelpaths measure pavement rutting information.

The test method and equipment used for pavement roughness data collection are defined in ASTM E 950.



Operator's Control Unit

Two persons are needed to perform testing, a driver and an operator. Typically, the operator is a permanent Roadway Programs Technician 2, and the driver is a temporary Roadway Programs Technician 1. Testing is typically performed during the months of March through November, but can vary depending on weather conditions. During the winter months, test results may misleadingly indicate rougher roadways due to the pavement surface characteristics caused by colder pavement temperatures.

Roughness testing is typically performed while traveling at normal highway speed continuously along a route within a county from the beginning of the route to the end. The operator signals the beginning of each segment as the vehicle travels along the route. The laser sensors make measurements at the rate of 32,000 per second, and a profile value is recorded for each traveled distance of six inches. Average IRI values are determined for each tenth mile and for each segment.

The results of pavement roughness testing are International Roughness Index (IRI) values, expressed in terms of slope, typically inches per mile.



(Profile Bumper Containing Lasers)

The following table defines standard adjectival categories and nomenclature for the evaluation of IRI for various classes of roads. The IRI ranges were originally based on the groupings in the Federal Highway Administration's "Highway Statistics Manual." These ranges have been modified to reflect ride quality in terms of customer satisfaction based on results of a study by Dr. Theodore H. Poister titled "Quality Thresholds from the Motorists perspective."

IRI Categories	Interstate Routes	IHS Non-Interstate Routes	Non-IHS Routes with ADT \geq 2000	Non-IHS Routes with ADT $<$ 2000
\leq 70	Excellent	Excellent	Excellent	Excellent
71-75	Good	Good	Good	Good
76-100				
101-120	Fair	Fair	Fair	Fair
121-150				
151-170	Poor	Poor	Poor	Poor
171-195				
196-220				
$>$ 220				

(IRI Ranking Categories)

INTERNATIONAL ROUGHNESS INDEX (IRI) - BACKGROUND

The International Roughness Index is:

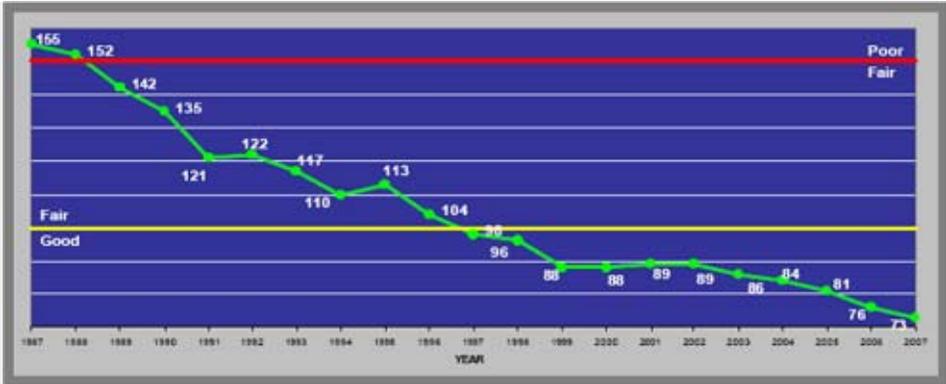
- an internationally accepted scale for roughness
- a computer-based "virtual response-type system," determined by obtaining a suitably accurate measurement of the profile of the road, processing it through an algorithm that simulates the way a reference vehicle would respond to the roughness inputs, and accumulating the suspension travel
- defined as a property of the true profile, and therefore can be measured with any valid profiler
- correlated to three vehicle response variables: road meter response, vertical passenger acceleration, tire load
- different from Profile Index (PI)

PI is the measurement of vertical deviation, or profile, of the pavement surface, in inches per mile. IRI is expressed in the same units, but it is the calculated (not measured) response of a vehicle to the road's profile. (Not an actual vehicle, but a computer-based model, so as to ensure that all IRI values are repeatable, comparable, and do not vary from one test vehicle to another.) The PI value reflects the vertical movement of the wheel as it traverses a pavement. The IRI reflects movement of the chassis and considers the effects of the vehicle's suspension, which may dampen the wheel's vertical movement or, in some cases, actually amplify the movement.

The following is a simplified analogy:

Temperature is a measurement. Processing a Temperature value through a specific mathematical algorithm results in Wind Chill Factor, which is meant to describe (in the same units as Temperature) what "it actually feels like." Likewise, Profile Index is a measurement. Processing a Profile value through a specific mathematical algorithm results in a Roughness Index, which is meant to describe (in the same units as Profile Index) what "it actually feels like."

The median IRI value for Pennsylvania's Interstate system has improved by seventy-nine inches per mile since 1987. That is to say, the improvements we have made results in what feels like a difference of seventy-nine inches per mile. (The actual profile has not decreased by seventy-nine inches per mile).



(Median Interstate IRI values 1987-2007)

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