Tire-Pavement Noise Standards

An Update of the Tire-Pavement Noise Technical Working Group

U.S. Department of Transportation
Federal Highway Administration

AASHTO
American Association of State Highway and Transportation Officials
1914

National Pavement Evaluation Conference
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Roanoke, VA

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Tire-Pavement Noise Technical Working Group

- FHWA-sponsored
- First met in March 2005
- Regular meetings
  - Typically 2 times per year face-to-face
  - Typically 4 times per year via teleconference
- Primary objective
  - Develop drafts of AASHTO-ready standards
- Secondary objective
  - Provide FHWA, State DOTs, and the highway community at large with technical guidance on issues related to tire-pavement noise

Tire-Pavement Noise Technical Working Group

- Current Membership (26 people)
  - State DOT (CA, WA, FL, TX, MN, VA)
  - Academia (OH, KY)
  - Consultants (CA, TX, CO, TN, WI, MD)
  - Auto Industry
  - Tire Industry
  - Pavement Industry (PCC, HMA)
  - TRB/NCHRP
  - USDOT Volpe Center
  - FHWA (ex officio)
- Leads: Drs. Paul Donavan and Judy Rochat
- Secretary: Dr. Robert Rasmussen

Tire-Pavement Noise Technical Working Group

- Three draft standards developed to date
  1. On-Board sound intensity (OBSI)
  2. Statistical isolated pass-by method (SIP)
  3. Continuous-flow traffic time-integrated method (CTIM)

On-Board Sound Intensity (OBSI)

OBSI

Standard Method of Test for

Measurement of Tire/Pavement Noise Using the On-Board Sound Intensity (OBSI) Method

AASHTO Designation: TP 76-11 (proposed)

1. SCOPE

1.1. This test method describes the procedures for measuring tire/pavement noise using the on-board sound intensity (OBSI) method and the procedures for verification of the measurement system. The test method provides an objective measure of the acoustic power per unit area at points near the tire/pavement interface.

1.2. The on-board sound intensity measurement method described herein permits the tire/pavement noise to be measured directly and allows various pavements and textures to be directly compared.

1.3. This method is expected to be subject to revision as experience increases and research results are implemented.

1.4. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED DOCUMENTS

2.1. *ASTM Standards:*

- D 2240, Standard Test Method for Rubber Property – Durometer Hardness
- F 2493, Standard Specification for P225/60R16 97S Radial Standard Reference Test Tire

2.2. *ANSI Standards:*

- S1.9, Instruments for the Measurement of Sound Intensity
- S1.11, Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters
- S1.40, American National Standard Specifications and Verification Procedures for Sound Calibrators
- S1.42, American National Standard Design Response of Weighting Networks for Acoustical Measurements

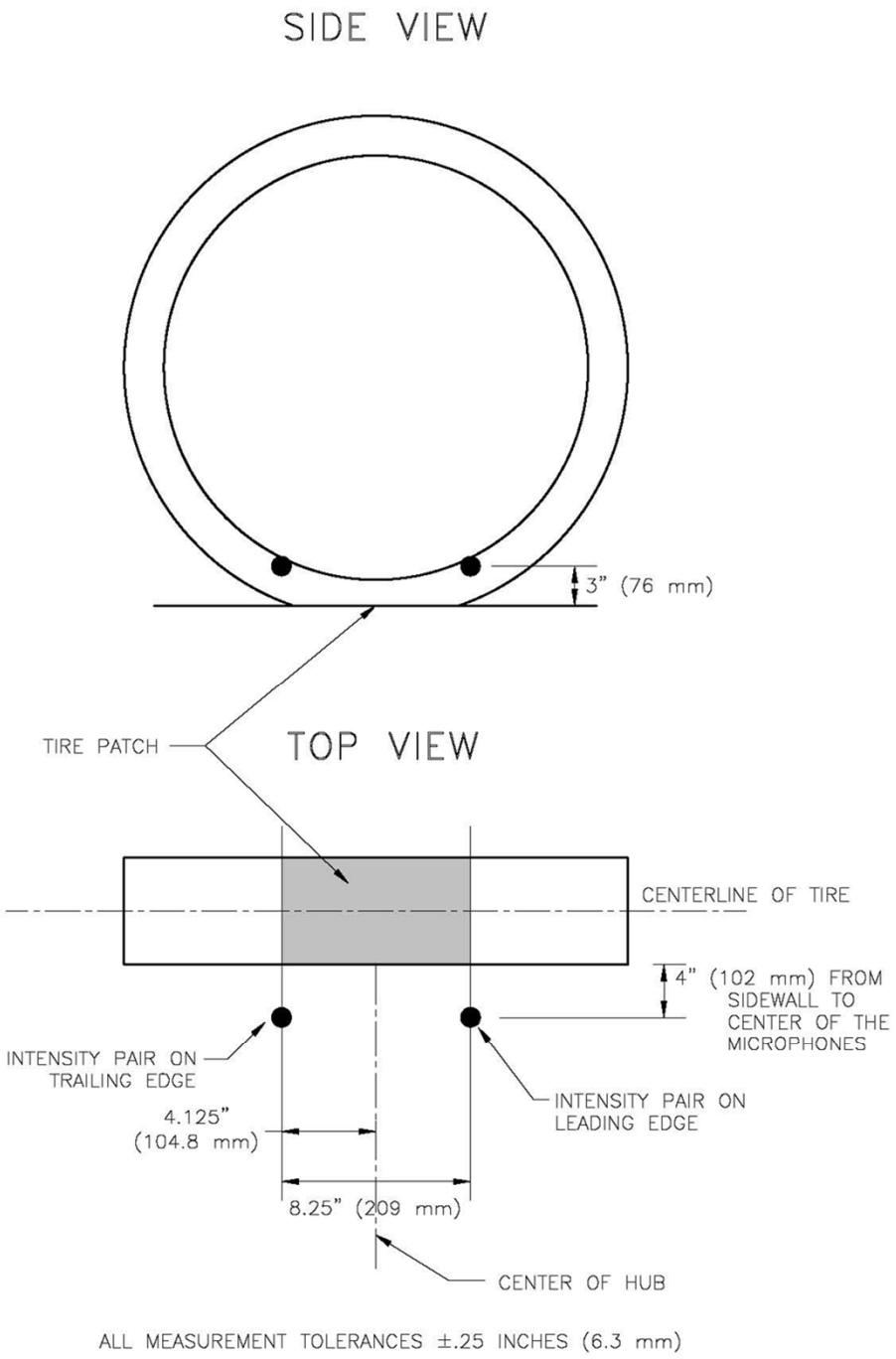
2.3. *IEC Standards:*

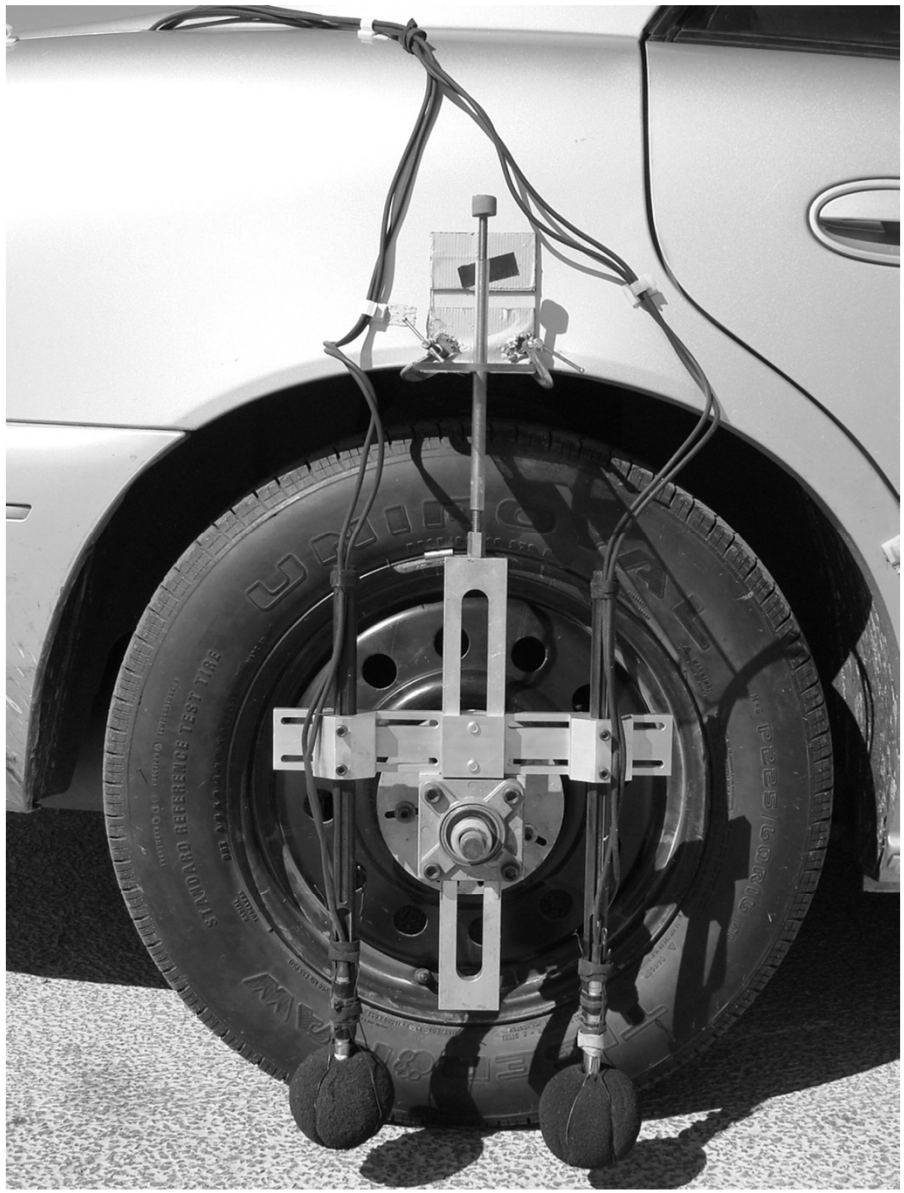
- 60942, Electroacoustics – Sound Calibrators
- 61043, Electroacoustics – Instruments for the Measurement of Sound Intensity – Measurement with Pairs of Pressure Sensing Microphones
- 61260, Electroacoustics – Octave-Band and Fractional-Octave-Band Filters
- 61672, Electroacoustics – Sound Level Meters

OBSI

- “A measurement procedure to evaluate the tire/pavement noise component resulting from the interaction of a ASTM F 2493 Standard Reference Test Tire (SRTT) on a pavement surface. Sound intensity measurements are taken at defined locations near the tire/pavement interface.”

OBSI


SIDE VIEW
3" (76 mm)
TIRE PATCH
TOP VIEW
CENTERLINE OF TIRE
4" (102 mm) FROM SIDEWALL TO CENTER OF THE MICROPHONES
INTENSITY PAIR ON TRAILING EDGE
INTENSITY PAIR ON LEADING EDGE
4.125" (104.8 mm)
8.25" (209 mm)
CENTER OF HUB
ALL MEASUREMENT TOLERANCES ±.25 INCHES (6.3 mm)

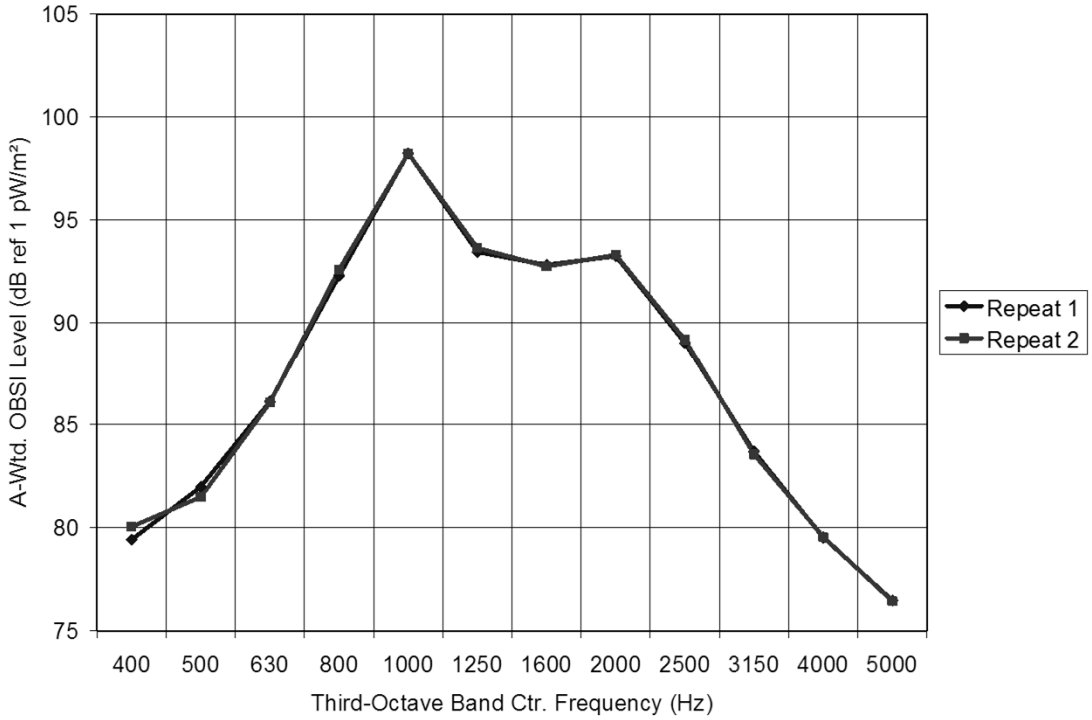


OBSI

- Test section is nominally 440 ft.
- Dry, straight, flat section
- Test speed is 60 mph (45, 35, 25 permitted, but must be CLEARLY shown)
- Tire controls: inflation (30 psi), and hardness/wear per the ASTM F 2493 standard

OBSI

- 2 test runs minimum
- Repeatability of overall level and third-octave band levels (400 to 5000 Hz)
- Other QC for coherence, PI-index



Statistical Isolated Pass-By (SIP)

SIP

Standard Method of Test for

Determining the Influence of Road Surfaces on Vehicle Noise Using the Statistical Isolated Pass-by (SIP) Method

AASHTO Designation: TP XX-11

1. SCOPE

1.1 This test method describes a procedure for measuring the influence of road surfaces on highway traffic noise. The Statistical Isolated Pass-by (SIP) Method test method provides a quantitative measure of the sound pressure level at locations adjacent to a roadway. The SIP method allows for the comparison of vehicle noise on roadways of varying surfaces and across studies by comparing measured sound levels to a reference noise curve.

1.2 Measurements capture the sound pressure level from isolated vehicles in existing traffic. The SIP method is to be applied on roadways where measuring sound levels from single vehicle pass-by events is possible without contamination from sound from other vehicles.

1.3 This document is intended for use by noise professionals. Competency with acoustical measurement and analysis techniques is assumed.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED DOCUMENTS

2.1 *AASHTO Standards*:

- TP 76, Measurement of Tire/Pavement Noise Using the On-Board Sound Intensity (OBSI) Method
- TP XX-11, Determining the Influence of Road Surfaces on Traffic Noise Using the Continuous-Flow Traffic Time-Integrated Method (CTIM)

2.2 *FHWA Reports*:

- FHWA-PD-96-008, Development of National Reference Energy Mean Emission Levels for the FHWA Traffic Noise Model (FHWA TNM®), Version 1.0
- FHWA-PD-96-009, FHWA Traffic Noise Model (FHWA TNM®): User's Guide, TNM® Version 2.5 Addendum, April 2004
- FHWA-PD-96-010, FHWA Traffic Noise Model (FHWA TNM®), Version 1.0: Technical Manual, 2004, update sheets available from FHWA
- FHWA-PD-96-046, *Measurement of Highway-Related Noise*, Section 4: Existing-Noise Measurements in the Vicinity of Highways

SIP

- “A procedure for measuring the influence of road surfaces on highway traffic noise.”
- “Measure of the sound pressure level at locations adjacent to a roadway.”
- “Comparison of vehicle noise on roadways of varying surfaces and across studies by comparing measured sound levels to a reference noise curve.”

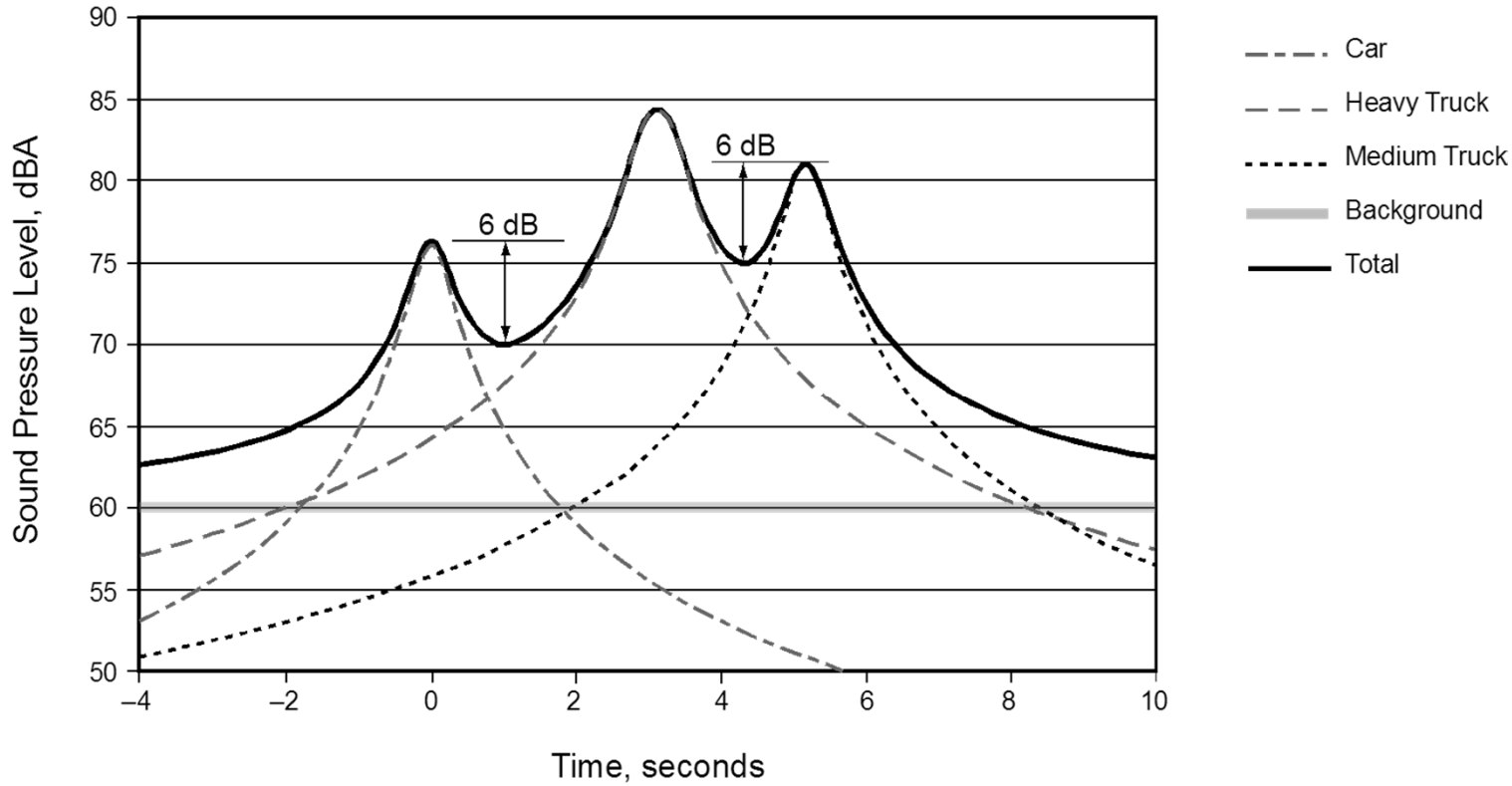
SIP

- Microphones can be 25 ft. from center of outside lane (5 ft. above lane), or 50 ft. from center of outside lane (12 ft. above lane)
- Optional 50 ft. / 5 ft. position would allow direct comparison to REMEL data (used to develop FHWA Traffic Noise Model)

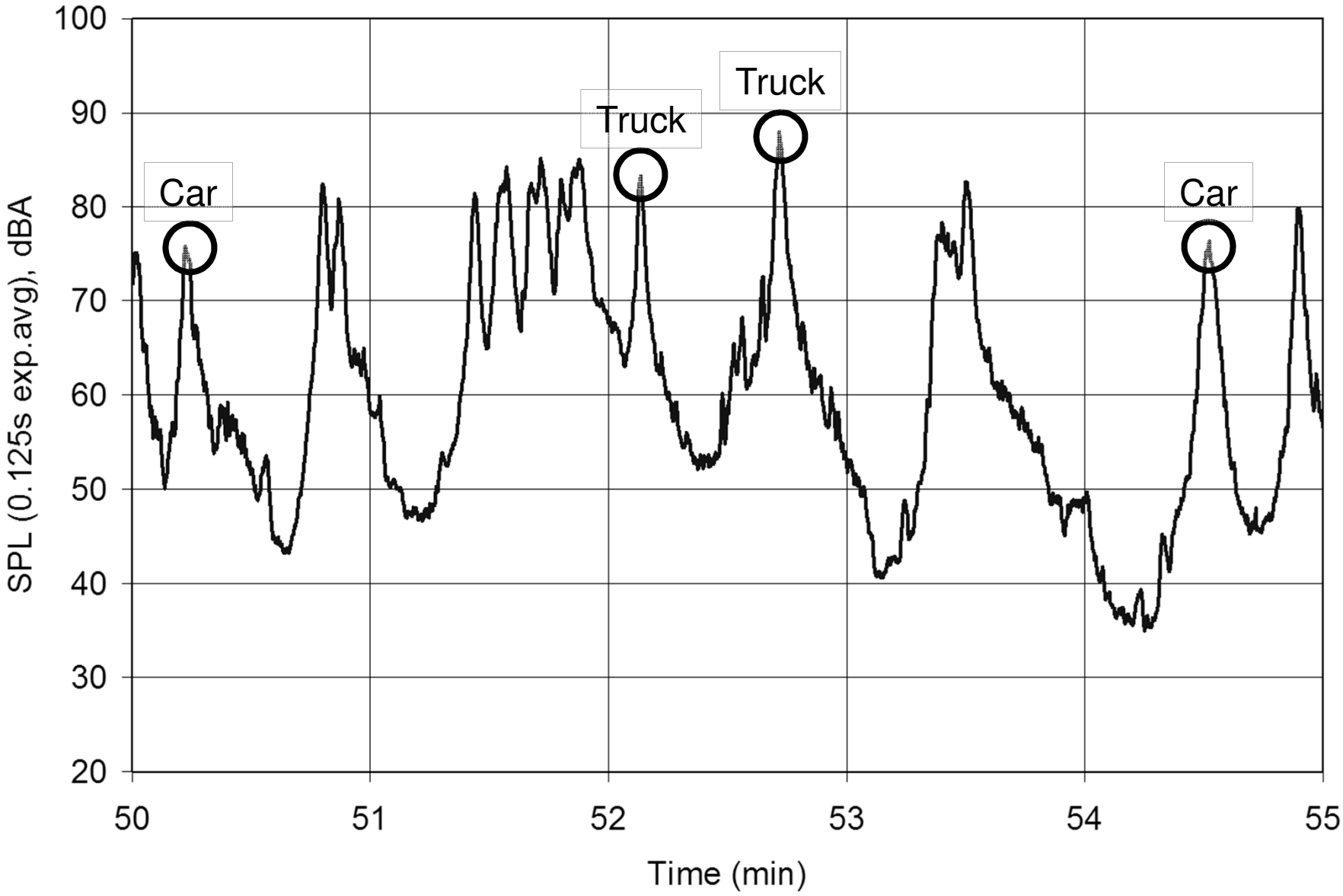
Photo: Bruce Rymer

SIP

- Pass-by levels are recorded and QC for contamination (other traffic, wind, etc.)
- Speed and vehicle classification noted

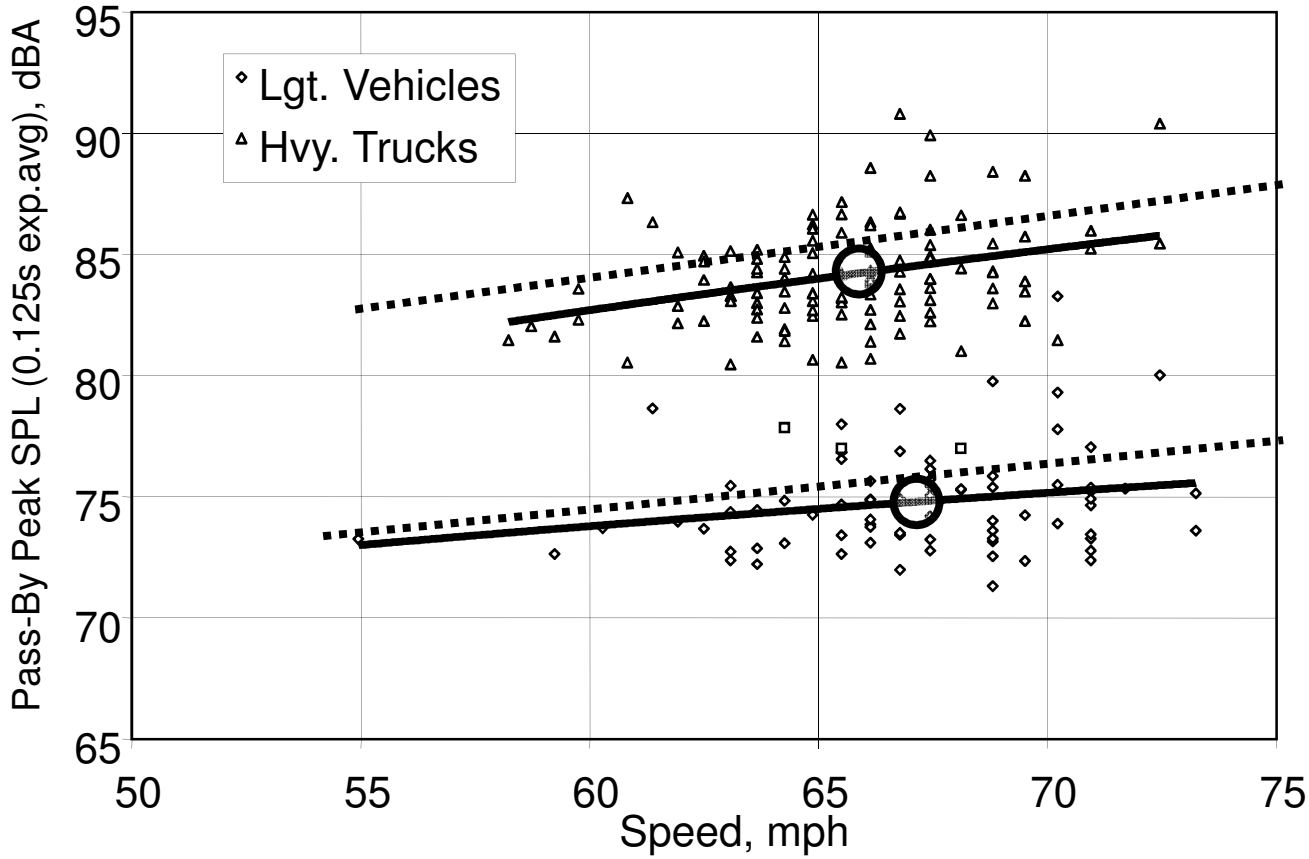


SIP


Car
Truck
Truck
Car
SPL (0.125s exp.avg), dBA
100
90
80
70
60
50
40
30
20
50
51
52
53
54
55
Time (min)

SIP

- Speed versus peak sound levels plotted
- SIP Index (SIPI) calculated by comparing to Reference Surface (REMEL average)



SIPI (heavy trucks) =
-2.0 dBA

SIPI (cars) =
-1.6 dBA

Continuous-Flow Traffic Time-Integrated Method (CTIM)

Photo: Ulf Sandberg

CTIM

Standard Method of Test for

Determining the Influence of Road Surfaces on Traffic Noise Using the Continuous-Flow Traffic Time-Integrated Method (CTIM)

AASHTO Designation: TP XX-11

1. SCOPE

1.1 The Continuous-Flow Traffic Time-Integrated Method (CTIM) test method describes the procedures for measuring the influence of road surfaces on highway traffic noise at a specific site. It provides a quantitative measure of the sound pressure level at locations adjacent to a roadway. Measurements capture the sound from existing traffic for all vehicles on all roadway lanes. Measurements also include propagation effects over the roadway pavement and adjacent terrain to the nearby measurement location.

1.2 CTIM is to be applied on roadways where measuring single vehicle pass-by events would be difficult due to continuously flowing, relatively dense traffic (sound levels from single vehicles cannot be properly captured due to contamination from sound from other vehicles).

1.3 This document is intended for use by noise professionals. Competency with acoustical measurement, modeling, and analysis techniques is assumed.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED DOCUMENTS

2.1 *AASHTO Standards*:

- TP 76, Measurement of Tire/Pavement Noise Using the On-Board Sound Intensity (OBSI) Method
- TP xxx, Determining the Influence of Road Surfaces on Vehicle Noise Using the Statistical Isolated Pass-by (SIP) Method

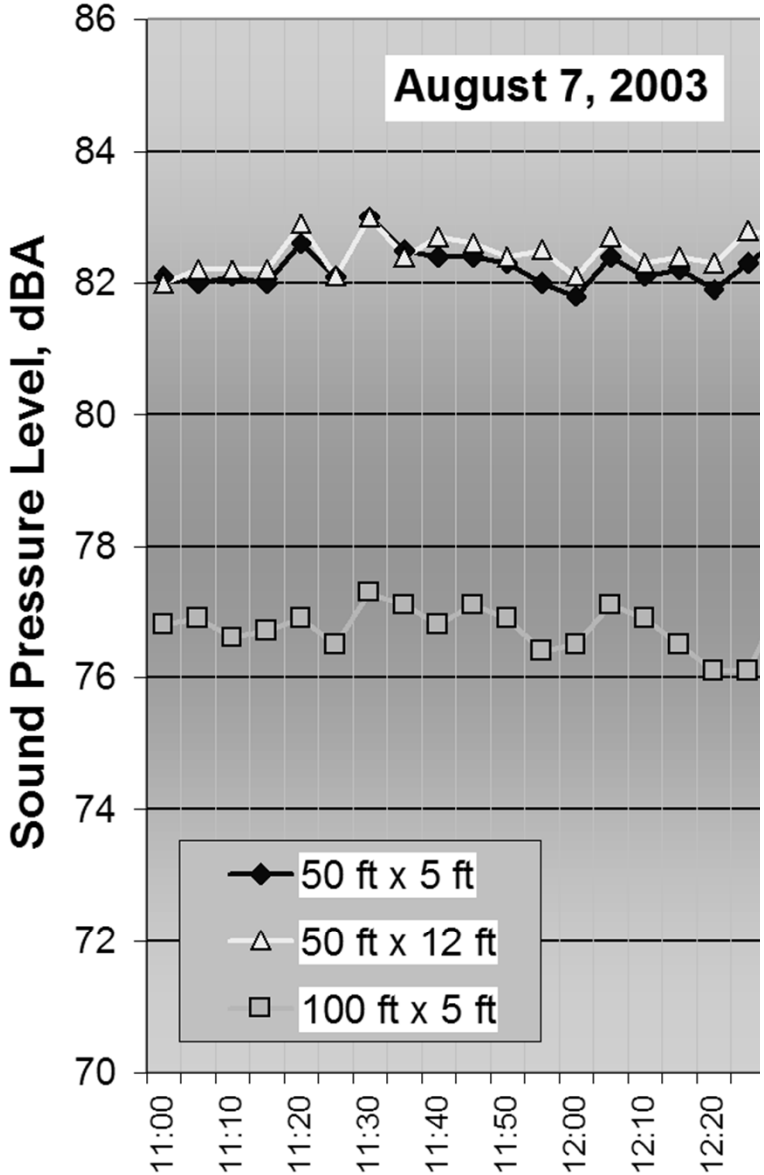
2.2 *FHWA Reports*:

- FHWA-PD-96-008, Development of National Reference Energy Mean Emission Levels for the FHWA Traffic Noise Model (FHWA TNM®), Version 1.0
- FHWA-PD-96-009, FHWA Traffic Noise Model (FHWA TNM®): User's Guide, TNM® Version 2.5 Addendum, April 2004
- FHWA-PD-96-010, FHWA Traffic Noise Model (FHWA TNM®), Version 1.0: Technical Manual, 2004, update sheets available from FHWA

CTIM

- "Sound from existing traffic for all vehicles on all roadway lanes."
- "Include propagation effects over the roadway pavement and adjacent terrain to the nearby measurement location."
- "Applied on roadways where measuring single vehicle pass-by events would be difficult due to continuously flowing, relatively dense traffic (sound levels from single vehicles cannot be properly captured due to contamination from sound from other vehicles)"

CTIM



- Traffic level (vph)
- Speed
- Mix (cars, trucks)

- Pavement effects

Figure: Paul Donavan