# Correlation of OBSI, CPB, and SPB:

## NCHRP 1-44

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TRB ADC40 Noise & Vibration
Key West '08

# Measurements

- Passby
  - 25 & 50 ft, 5 ft above roadway
  - Statistical – light vehicles & heavy trucks
  - Controlled – defined speeds & tires

Dunlop
SP
Winter
Sport
M3

ASTM
SRTT

- On-Board Sound Intensity

# On-Board Sound Intensity Measurement

**Caltrans & Draft AASHTO Procedures**

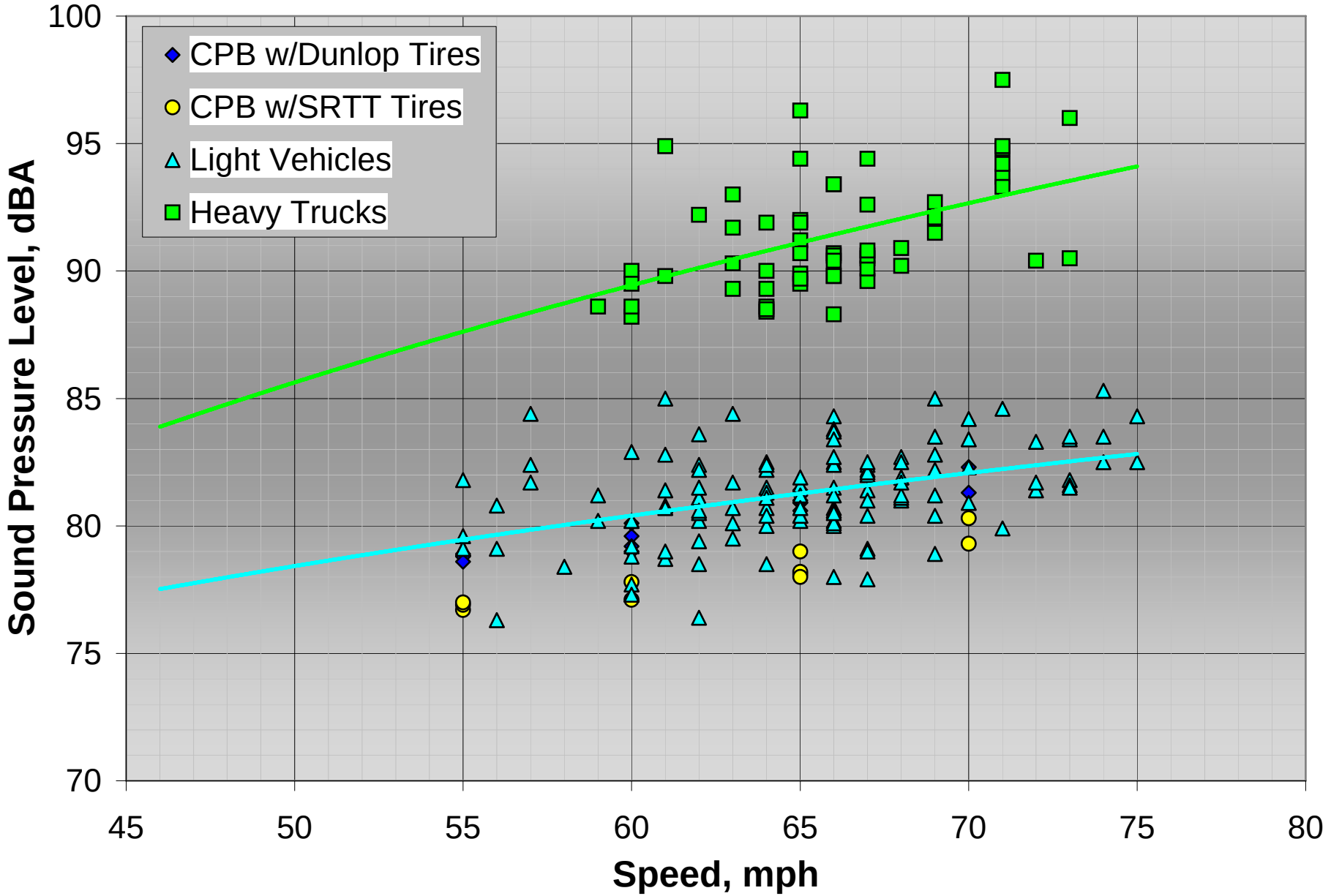
# Test Sites

- 2 States
- 6 Portland Cement Concrete (PCC)
- 6 Asphalt Concrete (AC)

| Site Description | | | | CPB & OBSI Test Speeds |
|---|---|---|---|---|
| # | Location | Roadway | Pavement | |
| 1 | Iowa | US 30 | Burlap Drag PCC | 50, 55, 60, 65 mph |
| 2 | Iowa | US 30 | Random Transverse Tine PCC | 50, 55, 60, 65 mph |
| 3 | Iowa | US 30 | Uniform Transverse Tine PCC | 55, 60, 65, 70 mph |
| 4 | Iowa | US 30 | Dense Graded Asphalt (DGAC) | 50, 55, 60 mph |
| 5 | Iowa | US 30 | Longitudinal Tine PCC | 55, 60, 65, 70 mph |
| 6 | Lancaster, CA | LA 138 | Dense Graded Asphalt (DGAC) | 50, 55, 60, 65 mph |
| 7 | Lancaster, CA | LA 138 | Open Graded Asphalt (OGAC) | 50, 55, 60, 65 mph |
| 8 | Lancaster, CA | LA 138 | Open Graded Rubberized Asphalt | 50, 55, 60, 65 mph |
| 9 | Lancaster, CA | LA 138 | Bonded Wearing Course | 50, 55, 60, 65 mph |
| 10 | Mojave, CA | KN 58 | Grooved Burlap Drag PCC | 60, 65, 70 mph |
| 11 | Mojave, CA | KN 58 | Ground PCC | 60, 65, 70 mph |
| 12 | Redding, CA | Shasta 299 | Open Graded Rubberized Asphalt | 55, 60, 65, 70 mph |

# Typical Test Sites

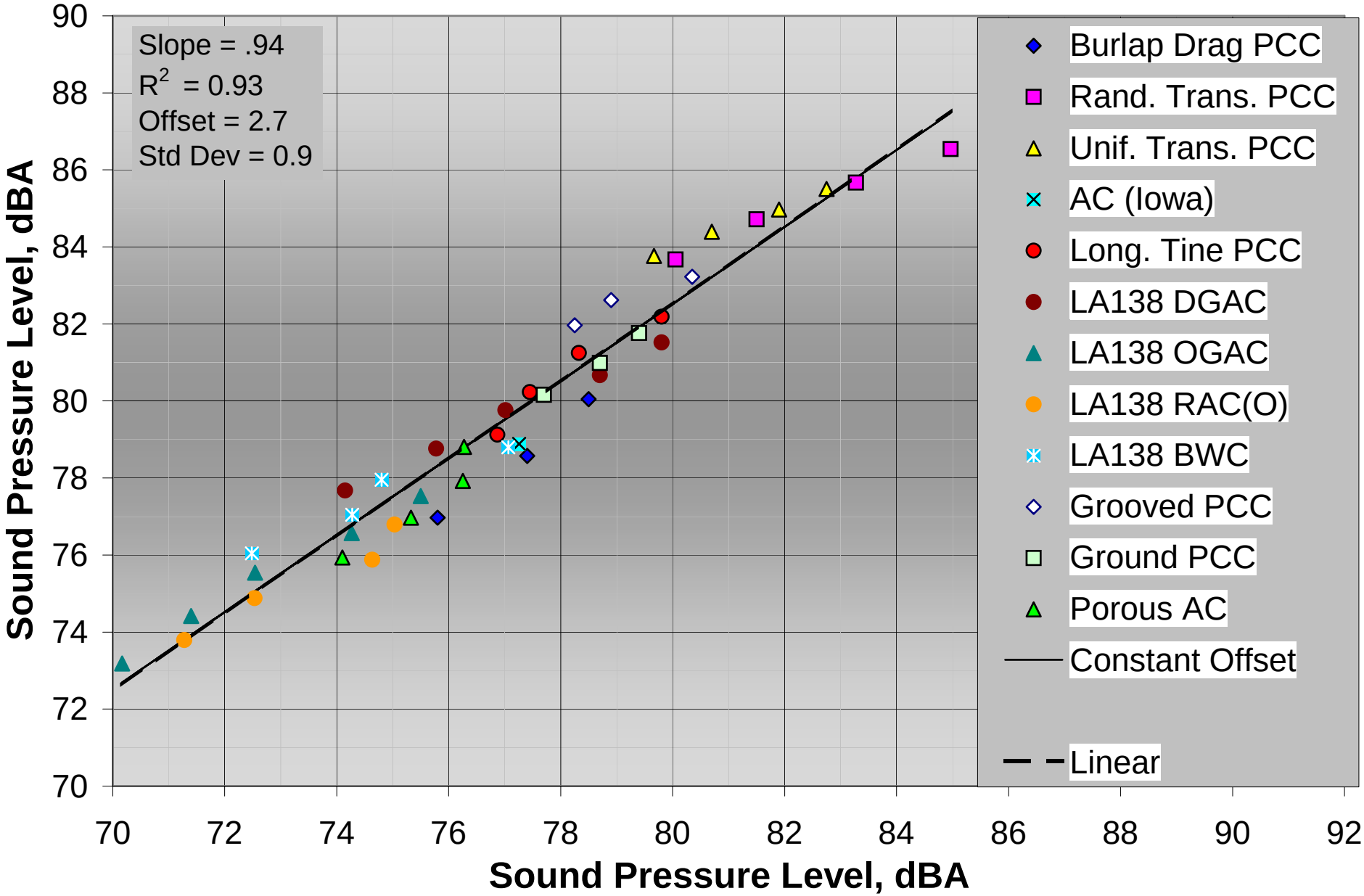
# Passby Data – 25 ft Iowa Long. Tine



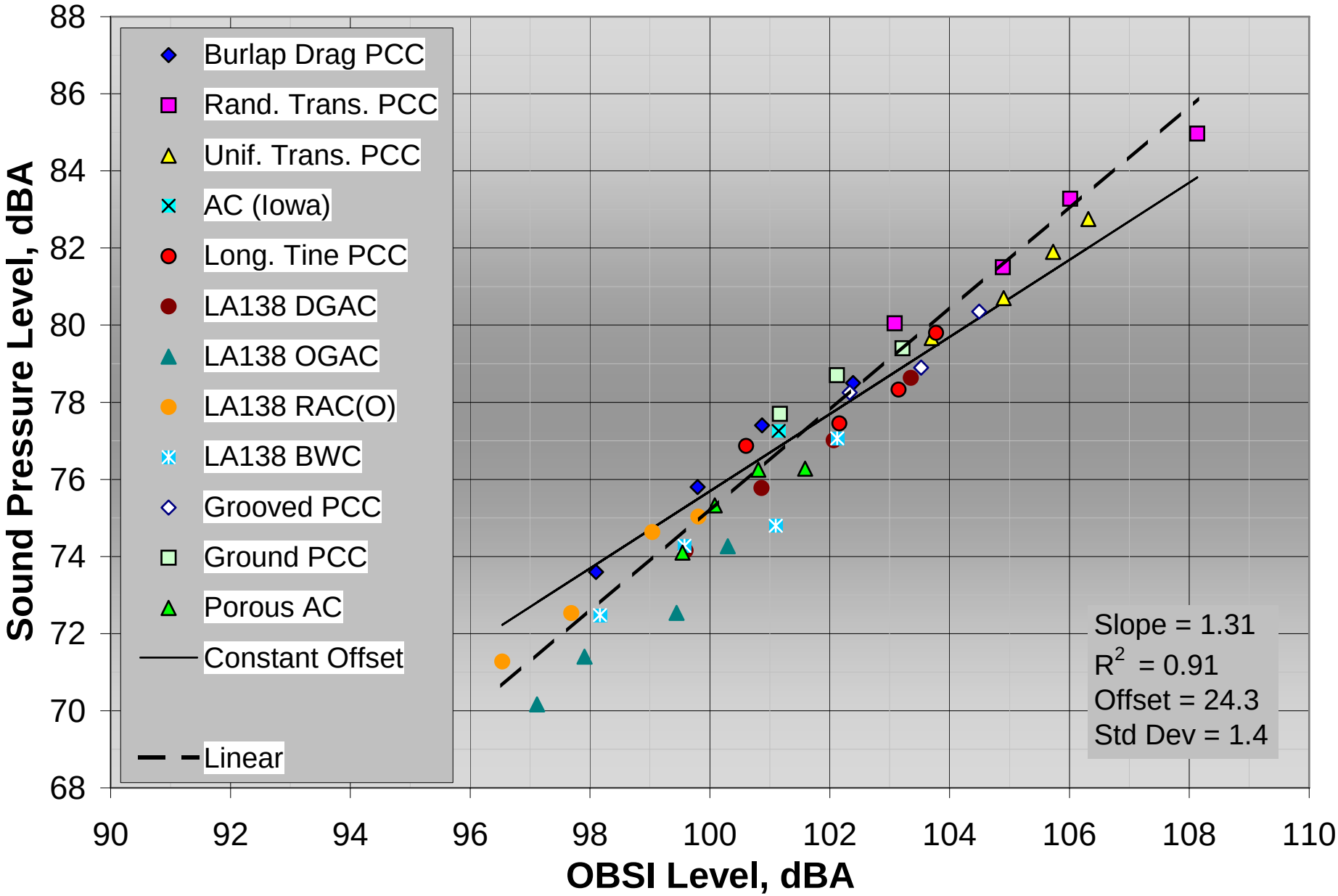
# Data Reduction

- Review time histories for clean passby events
- Eliminate events with unusual sounds & levels
- SPB data fit with logarithm curve
- Values at 50, 55, 60, 65, & 70 mph determined as appropriate
- CPB levels averaged at each test speed covering those of the SPB results
- OBSI time histories reviewed to check 5 second average vs. pavement variation at passby site

# Lt Vehicle SPB vs. SRTT CPB

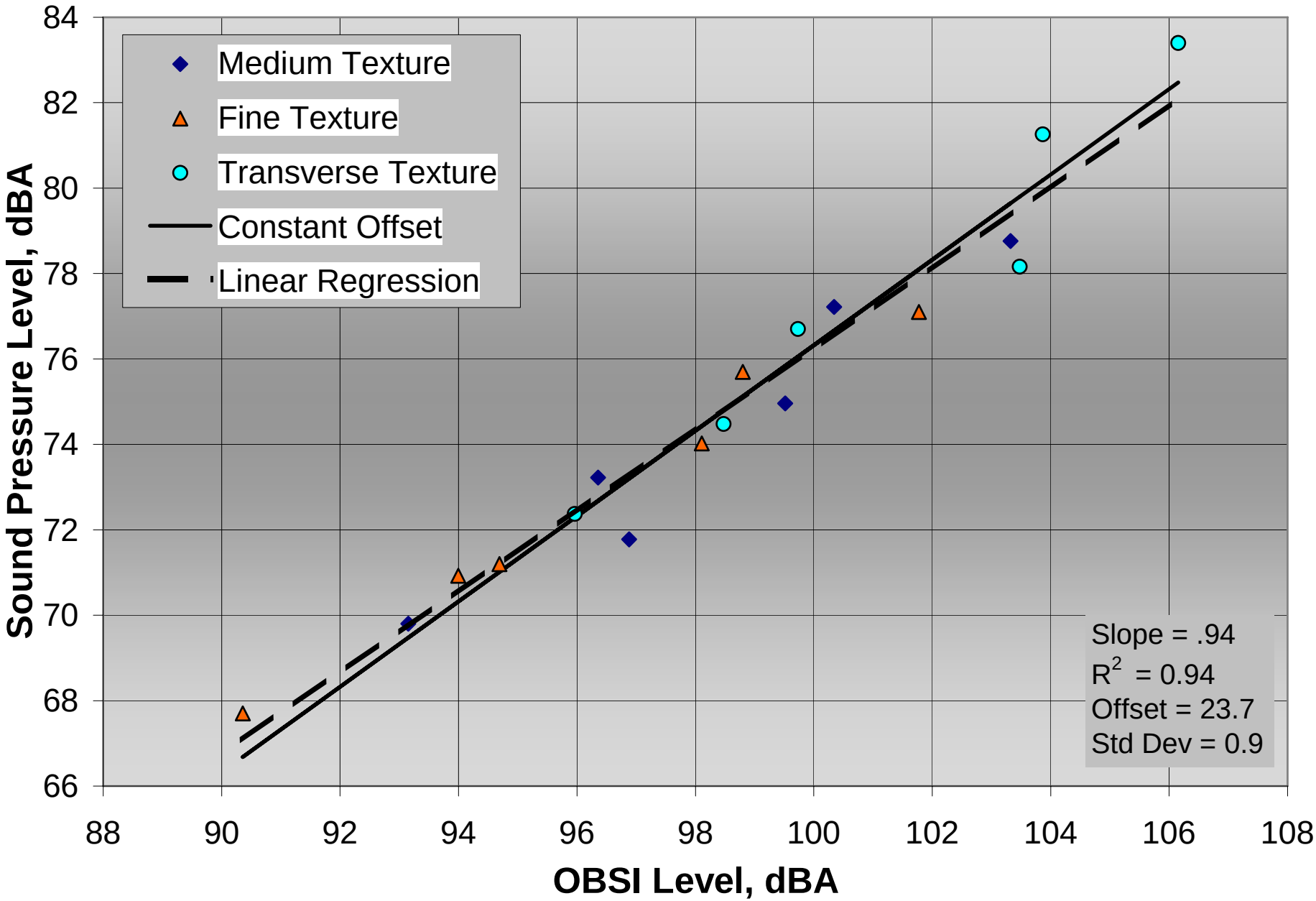


# Lt Vehicles CPB vs. SRTT OBSI – All Sites,

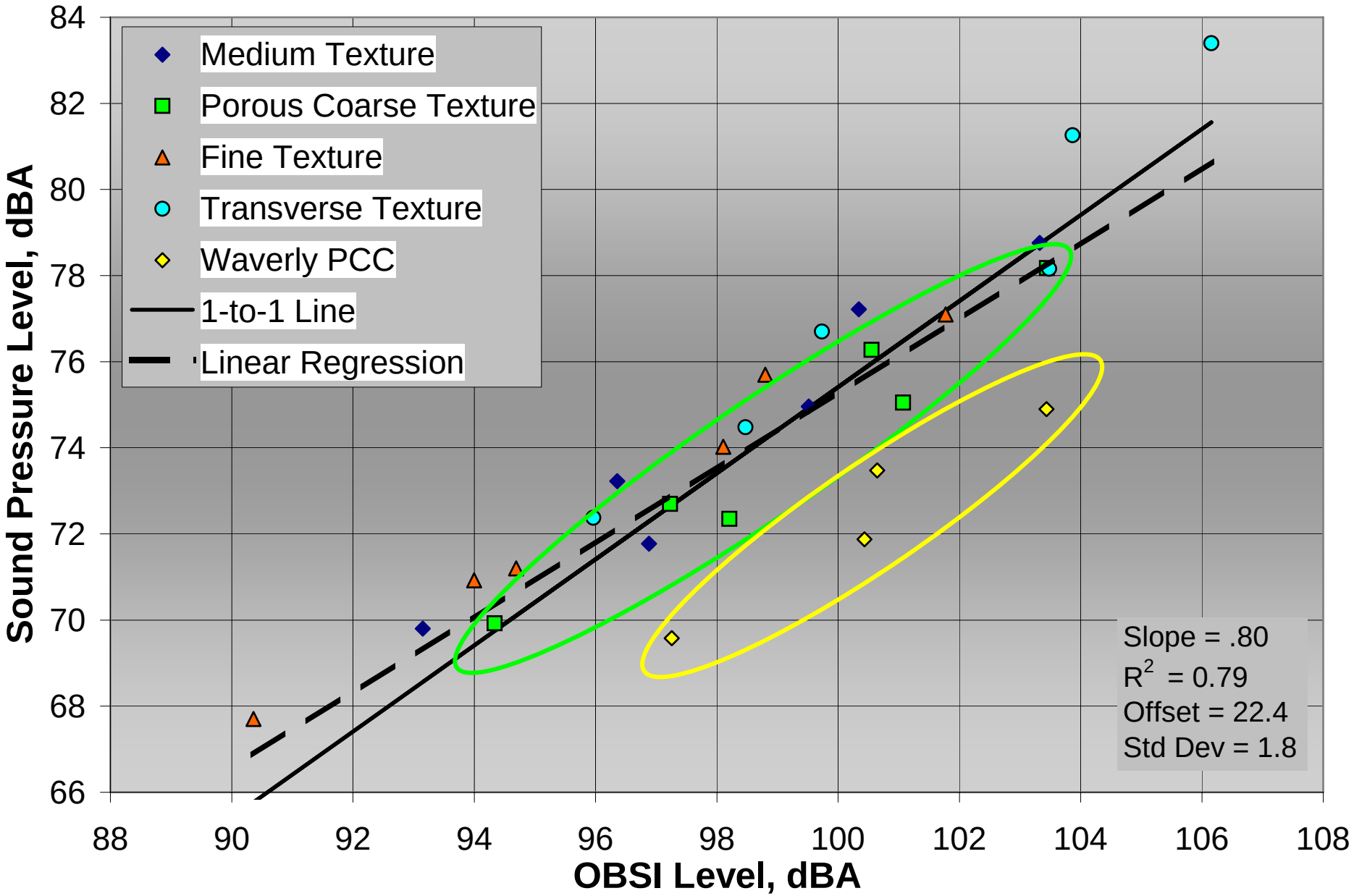


Controlled Passbys
NCAT Test Track

# CPB vs. OBSI – Ideal Sites, Non-Porous AC

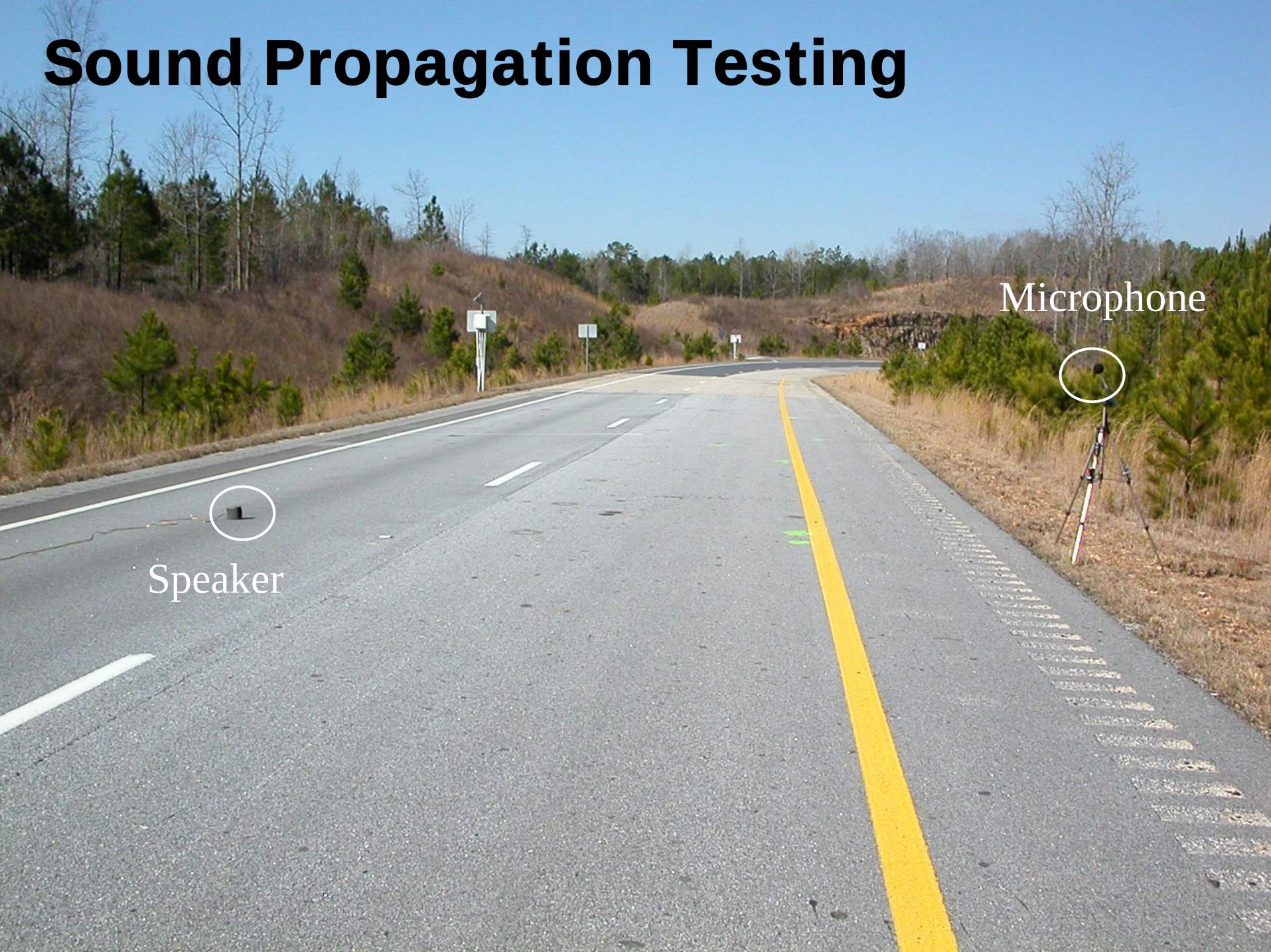


# CPB vs. OBSI w/Porous AC & Soft Site

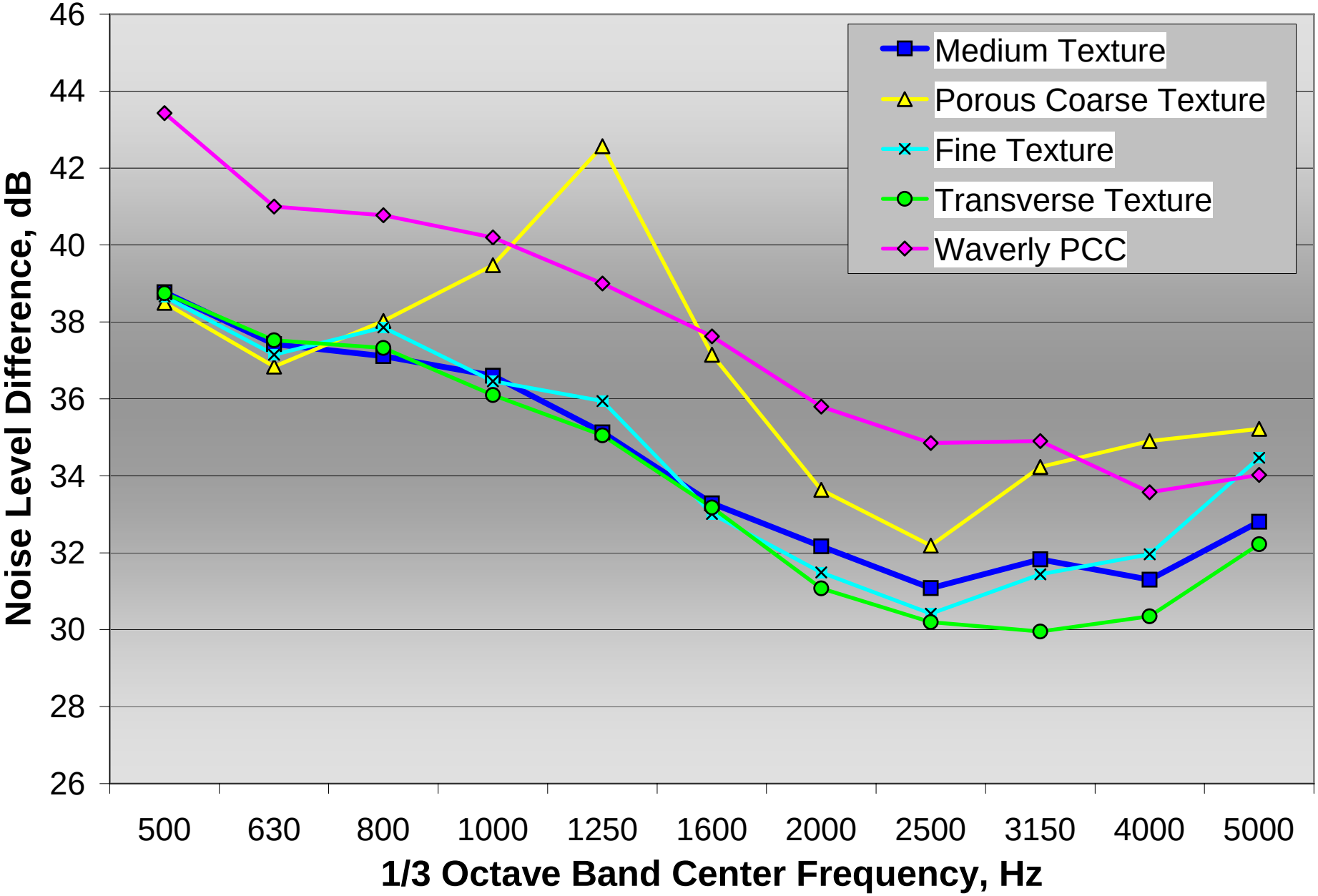


Waverly PCC Test Site

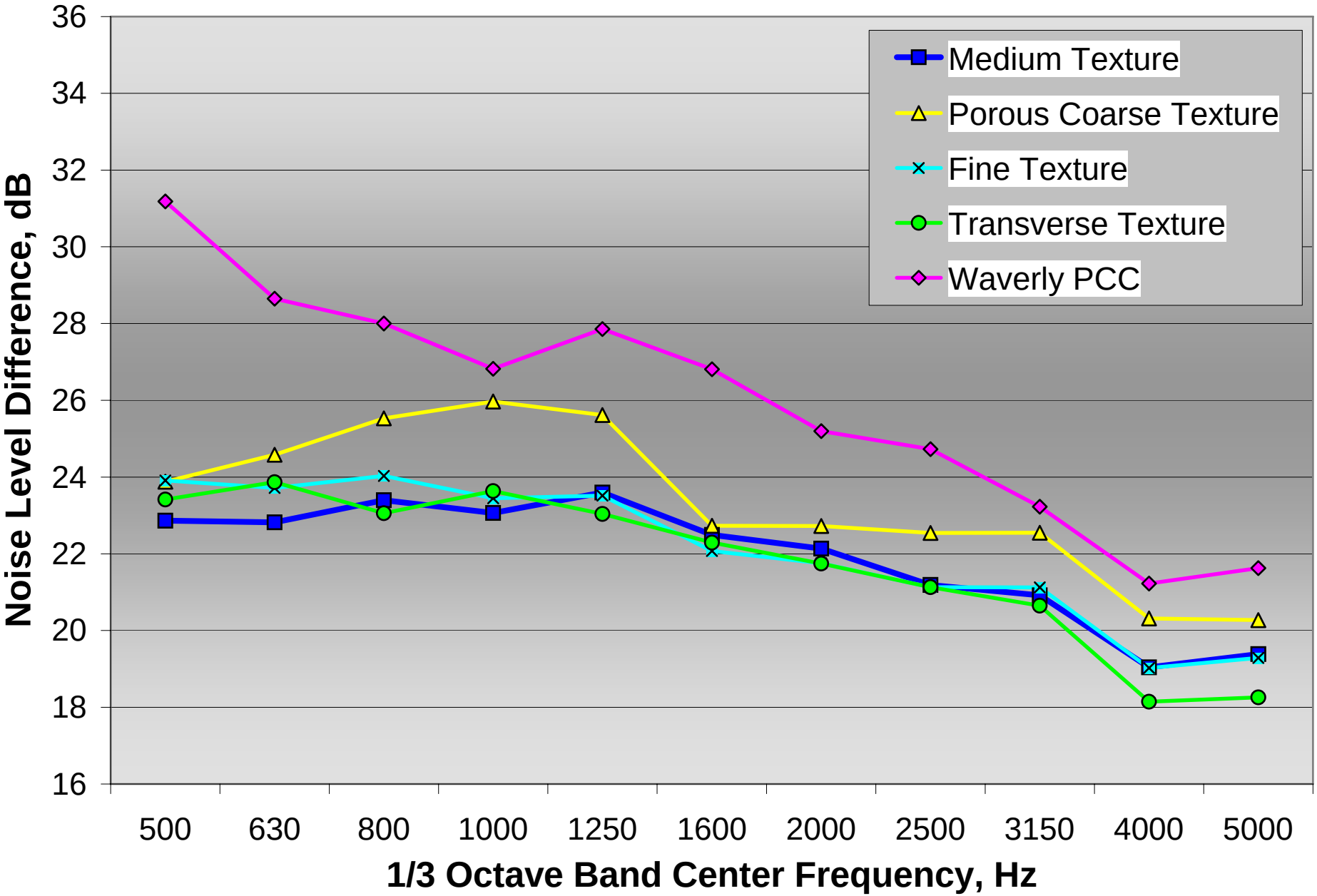
# Sound Propagation Testing



# Noise Reduction – Speaker to PB Mic



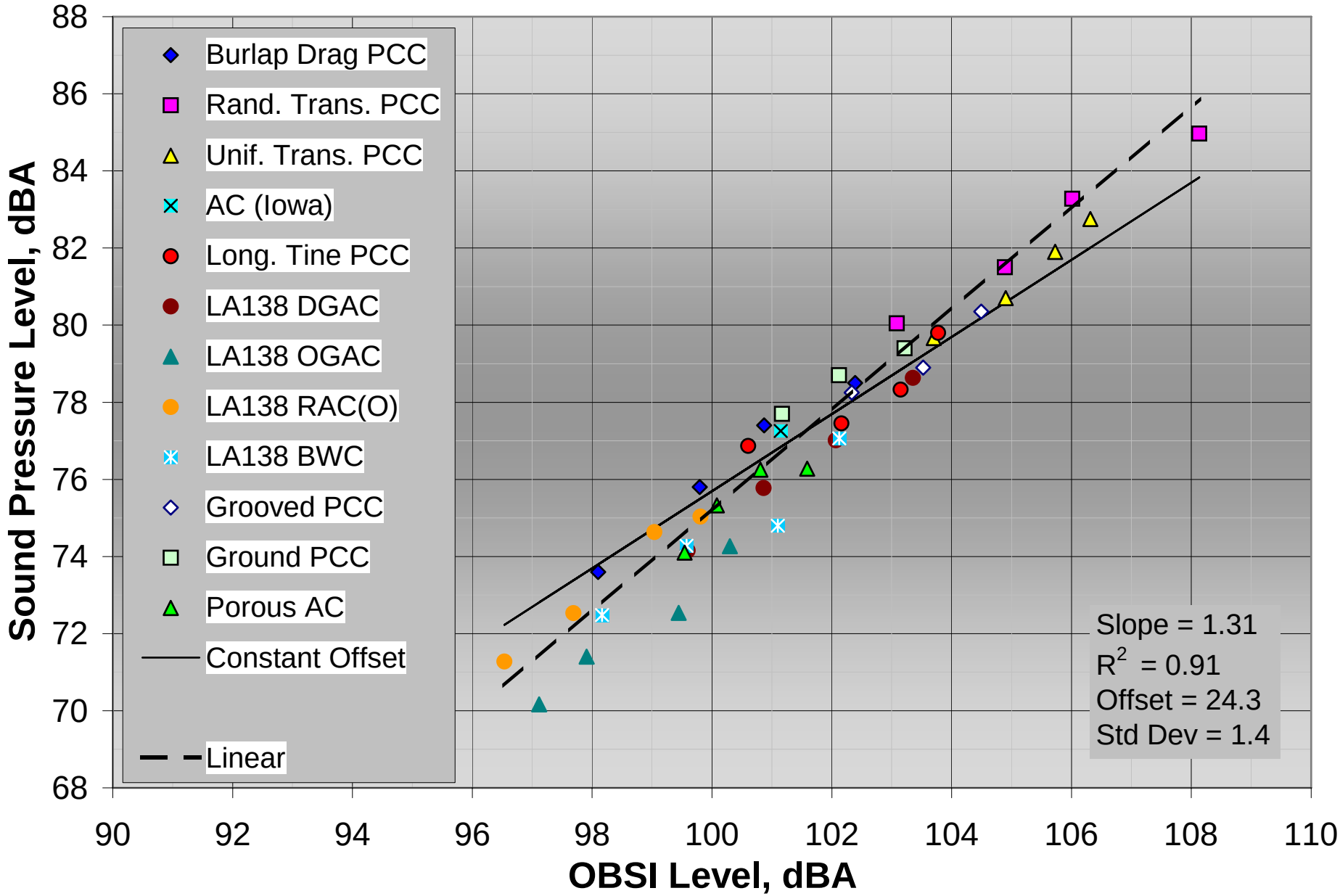
# Level Difference - OBSI Minus CPB



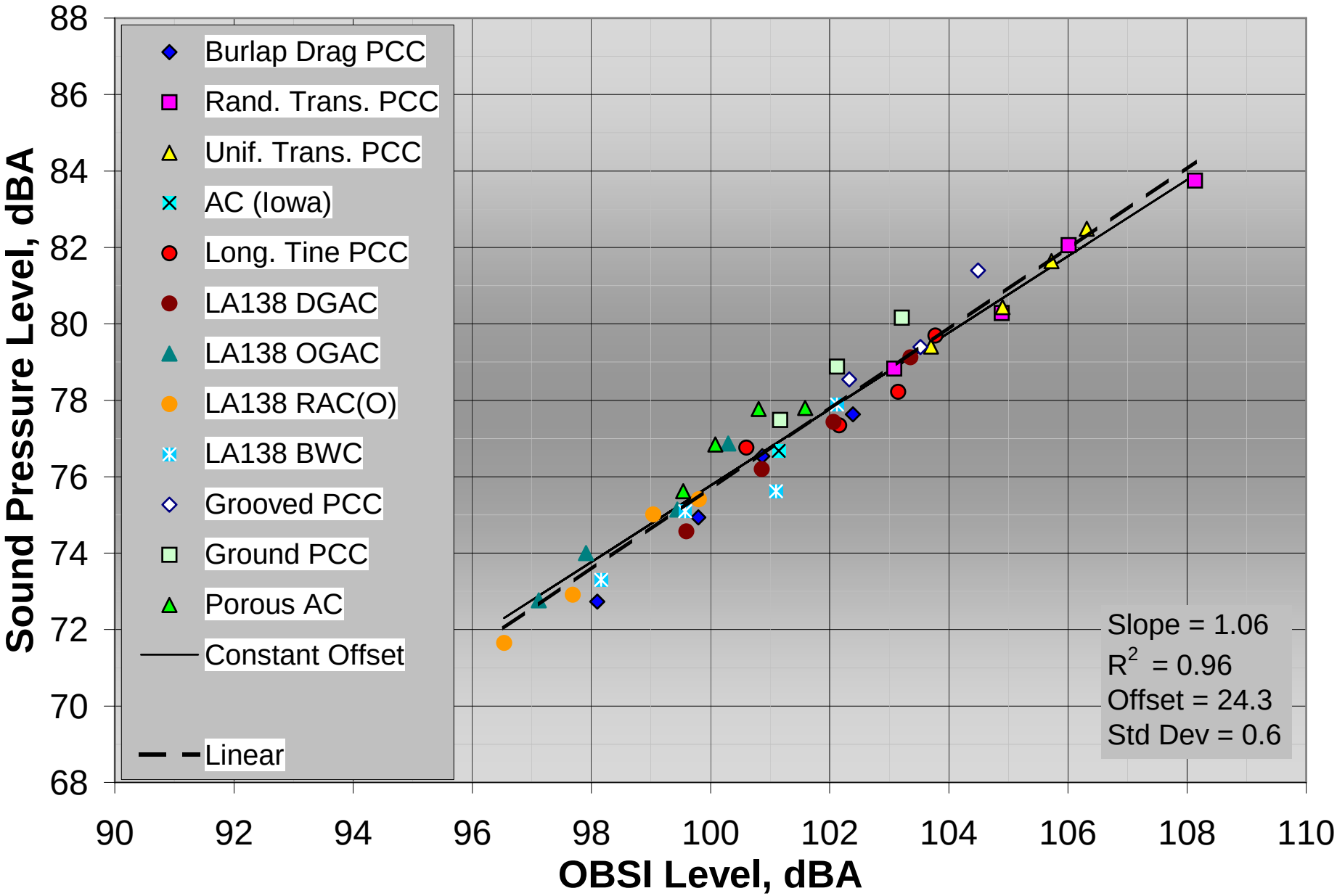
# Site-to-Site Normalization

- Average OBSI minus CPB levels over test speeds for each site
- Average OBSI/CPB difference over all sites – define “average test site”
- Determine normalization coefficients for each site – difference of average & site specific values
- Coefficients:
  - For 25 ft – range = -1.6 to 2.6 dB, std dev = 1.3 dB
  - For 50 ft – range = -2.8 to 3.1 dB, std dev = 2.1 dB

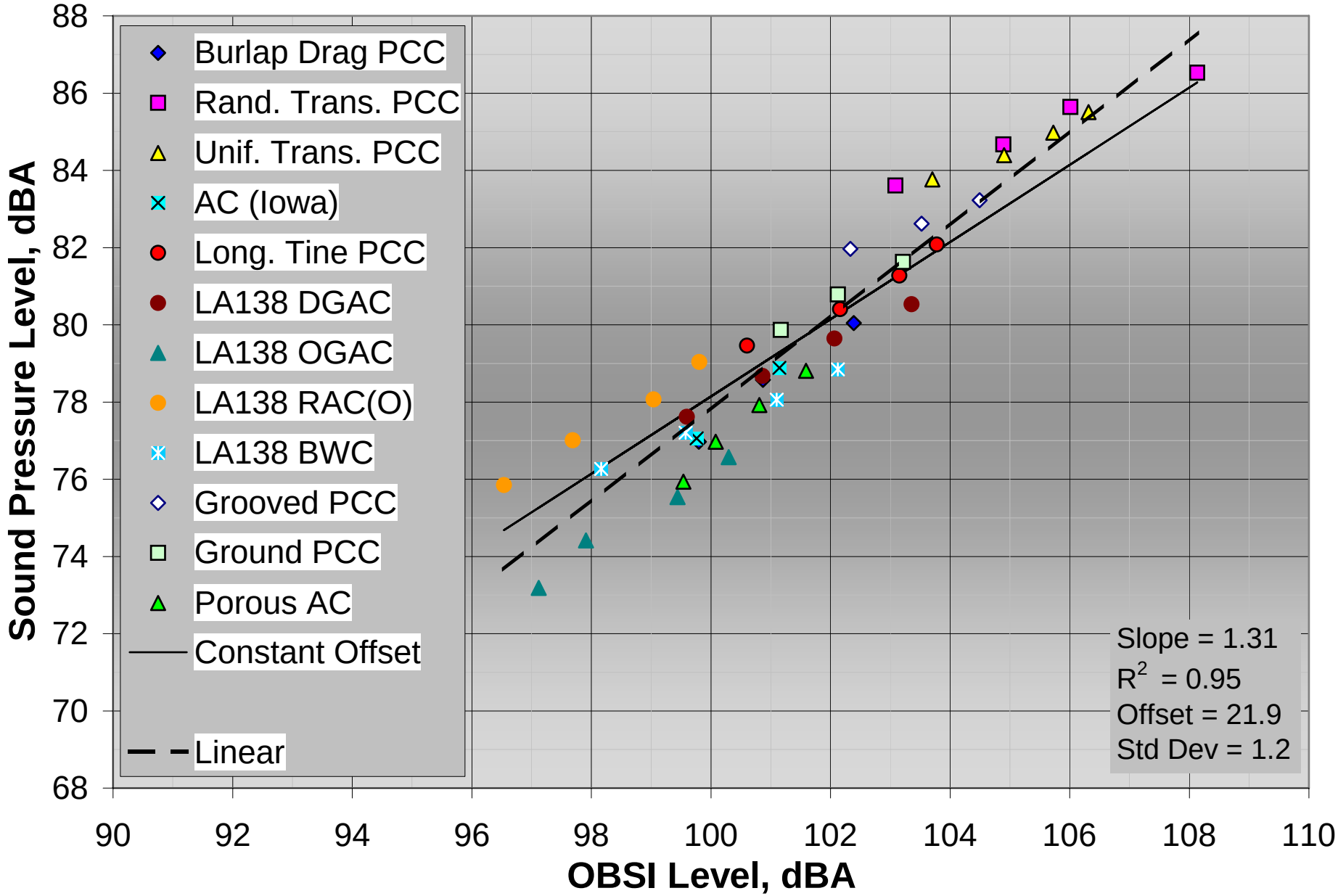
# Lt Vehicles CPB vs. SRTT OBSI – All Sites,



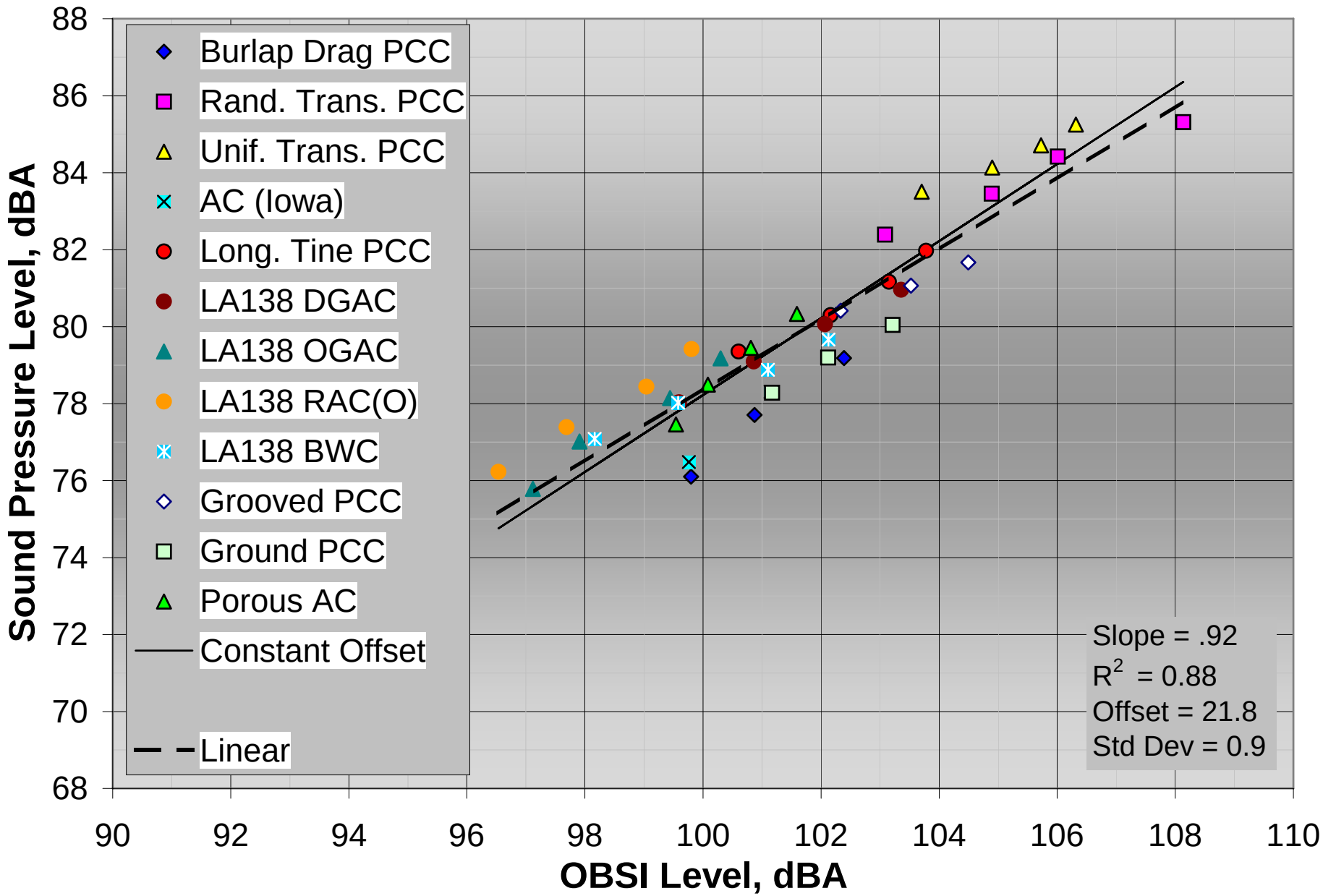
# Normalized Lt Vehicle CPB vs. SRTT OBSI



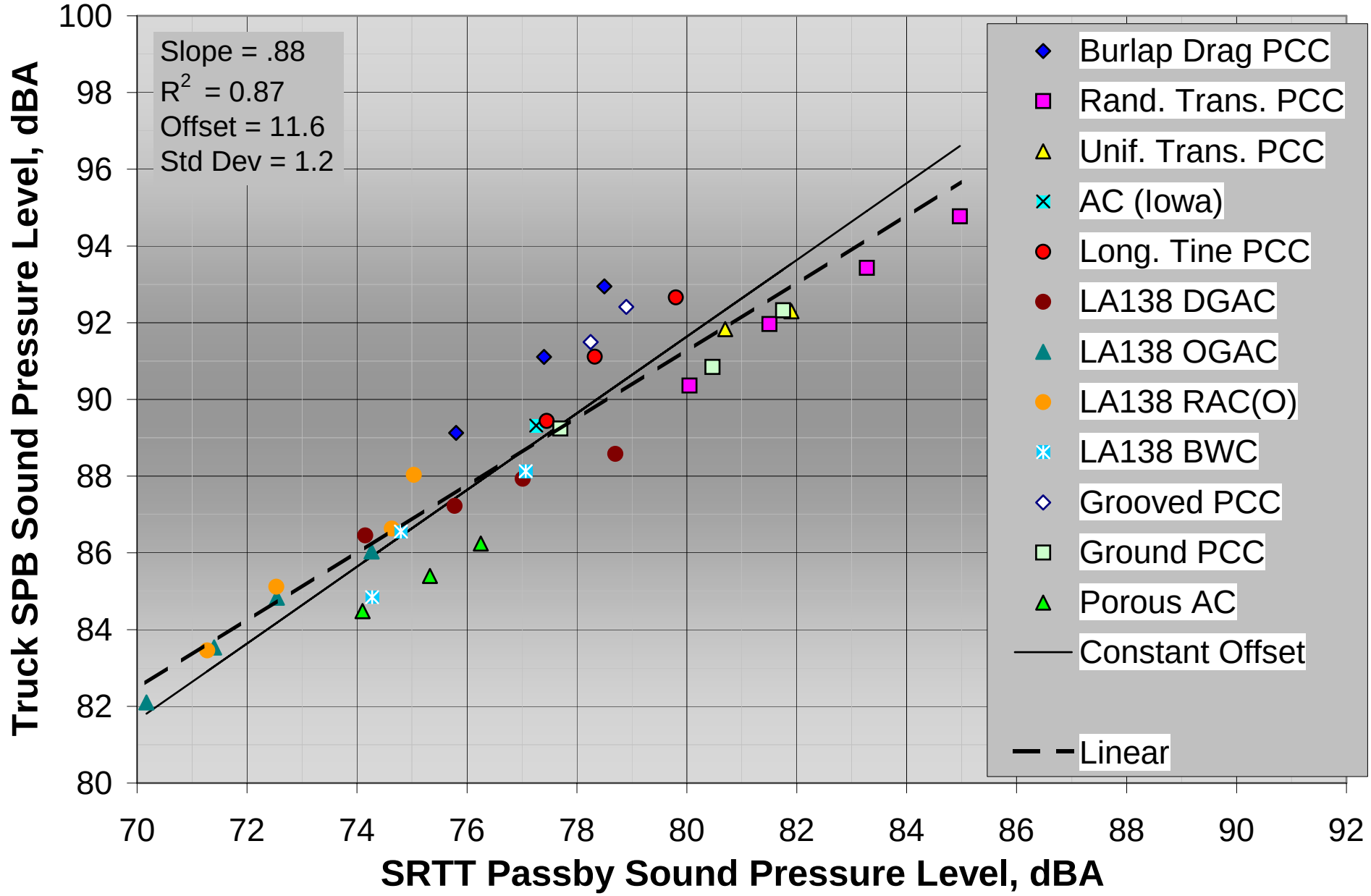
# Lt Vehicle SPB vs. SRTT OBSI



# Normalized Lt Vehicle SPB vs. SRTT OBSI



# Heavy Truck SPB vs. SRTT CPB



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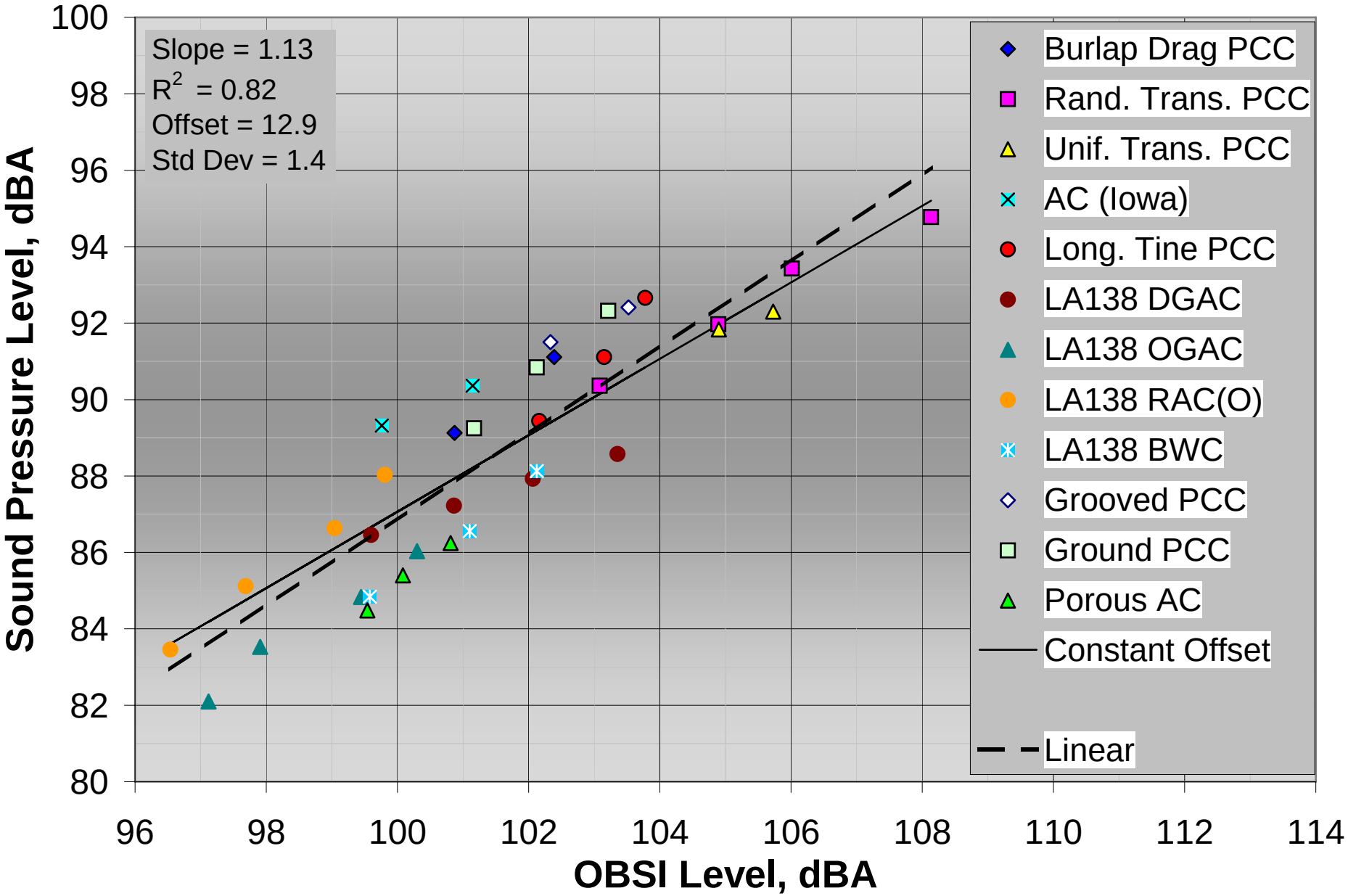
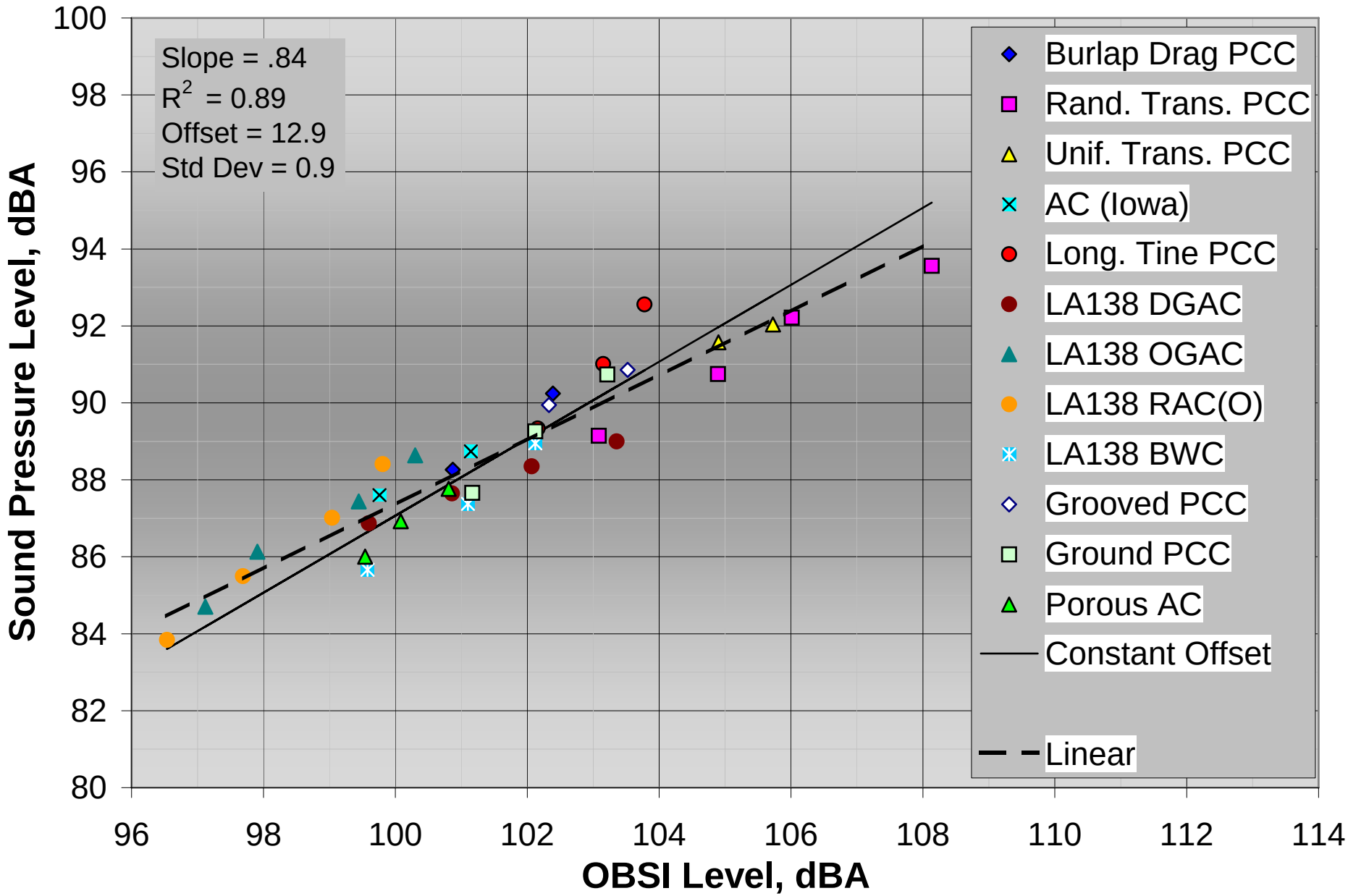


# Normalized Heavy Truck SPB vs. SRTT OBSI



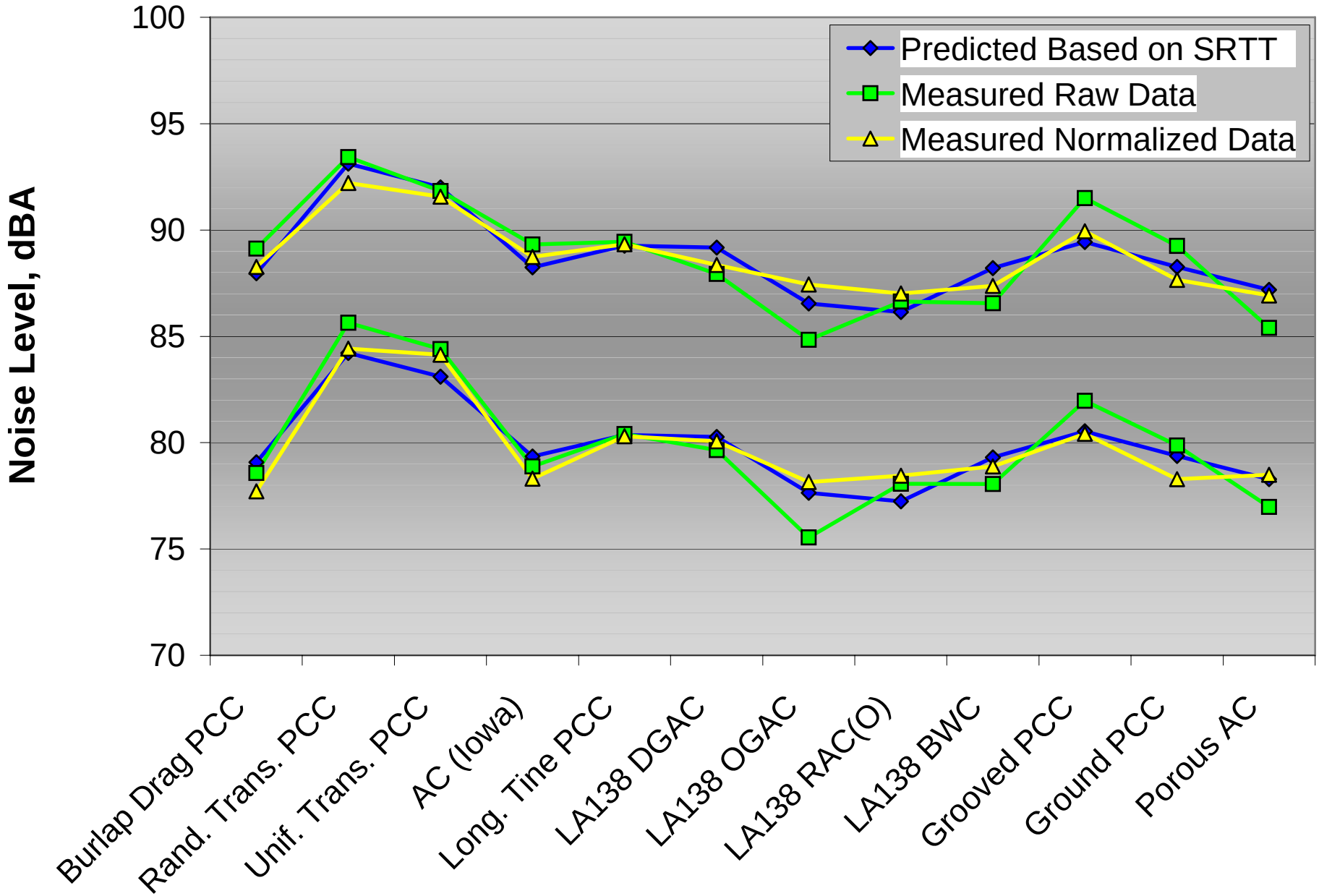
# Prediction of SPB Levels from OBSI

| Application | Offsets from SRTT OBSI level | Site Average Standard Deviation | Specific Site Standard Deviation |
|---|---|---|---|
| Light Vehicles at 25 ft | 21.8 | 0.8 | 1.3 |
| Heavy Trucks at 25 ft | 12.9 | 0.8 | 1.4 |
| Light Vehicles at 50 ft | 28.3 | 0.8 | 2.1 |
| Heavy Trucks at 50 ft | 19.2 | 1 | 1.8 |

Based on:

- 1343 Light vehicle passbys
- 528 Heavy truck passbys
- 12 Sites – 6 PCC & 6 AC
- Speed range – 50 to 65 mph

# Comparison – Predicted vs. Actual



# Conclusions

- Prediction of SPB from SRTT CPB
  - Light vehicles - Add 2.7 dB to SRTT CPB, standard deviation = 0.9 dB
  - Heavy trucks - Add 11.6 dB to SRTT CPB, standard deviation = 1.2 dB
- Passby site-to-site variation can be 3 to 4 dB at 25 ft, even more (up 6 dB) at 50 ft
- Site effects can be normalized using the difference in CPB and OBSI levels
- Both light vehicle & heavy truck SPB can be predicted with OBSI data (std dev of 0.8 dB)
- Surrogate truck test tire is not needed
- Stricter requirements on SPB sites should be considered along with 25 ft microphone location

# Acknowledgements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- Chris Peters, I&R Staff