

# **NOISE EMISSIONS MEASUREMENTS NEAR TIGHT CURVES**

A Presentation to the TRB 88<sup>th</sup> Annual Meeting  
Wayside Transit Noise and Vibration Methodologies and Criteria  
Workshop

Michael A. Staiano

11 January 2009

**STAIANO ENGINEERING, INC.**

# FTA Manual Guidance

## ***Step 1: Source SELs at 50 feet***

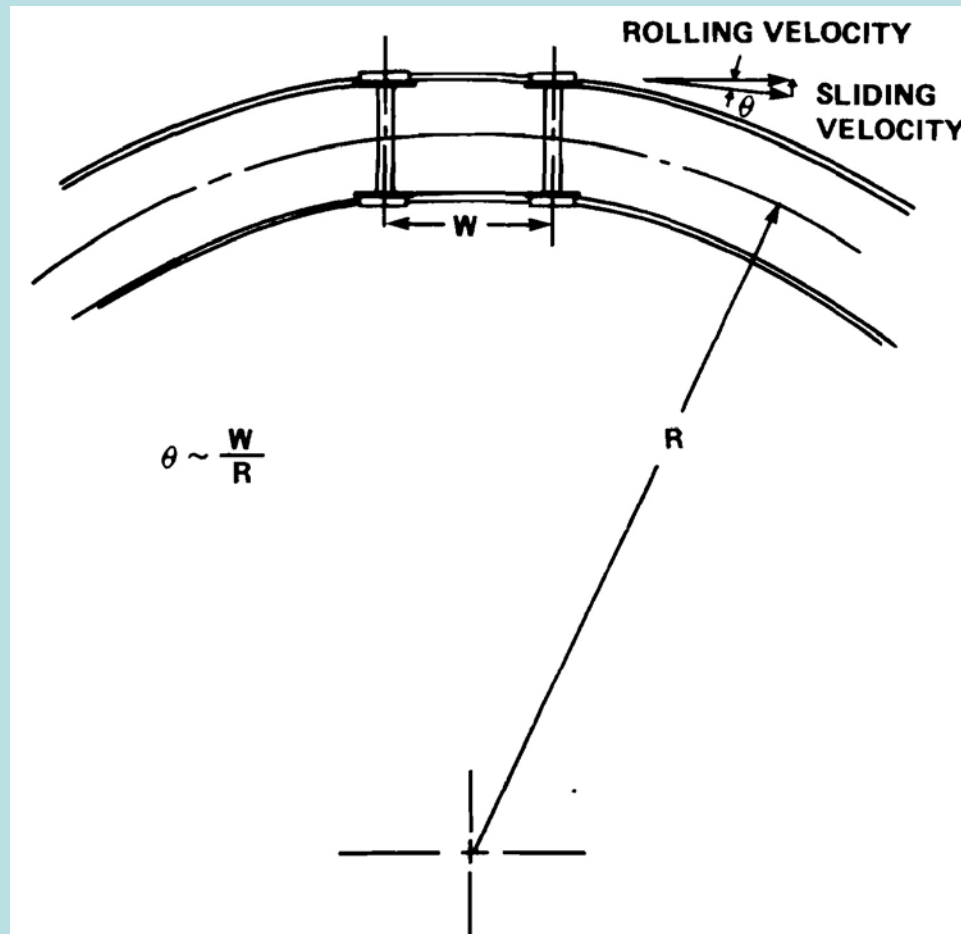
Determine the reference SEL at 50 feet for each major source, either by measurement or by table look-up. Table 6-7 provides guidance on which method is preferred for each source type. In general, measurements are preferred for source types that vary significantly from project to project. For example, curve squeal is highly variable depending on weather conditions, curve radius, and train speed. In general, a standard steel wheel on steel rail system will tend to initiate curve squeal at curves with radii less than 100 time the truck wheelbase. Table look-up is adequate for source types that do not vary significantly from project to project (crossing signals, for example). Ferry boat landings are included in

**Table 6-7. Source Reference SELs at 50 Feet:  
Stationary Sources**

Source	Reference SEL (dBA)	Approximate $L_{max}$ (dBA)	Prefer Measurements?
Auxiliary Equipment	101	65	YES
Ferry Boat Fog Horn	90	84	NO
Track Crossover	100	90	NO
Track Curve Squeal	136	100	YES
Car Washes	111	75	YES

For most sources where table look-up is indicated in Table 6-7, the table provides appropriate reference SELs for one typical noise event at 50 feet and of 1-hour duration (3600 seconds). For ferry boats and

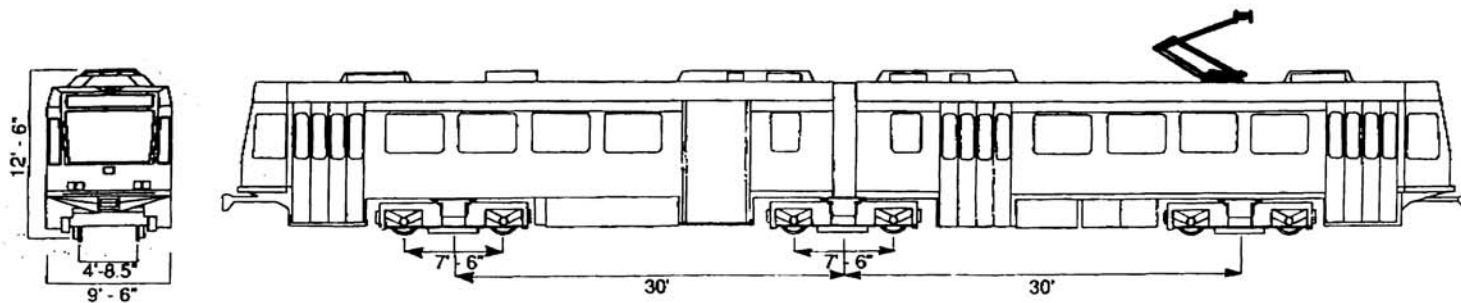
# Squeal Excitation Geometry



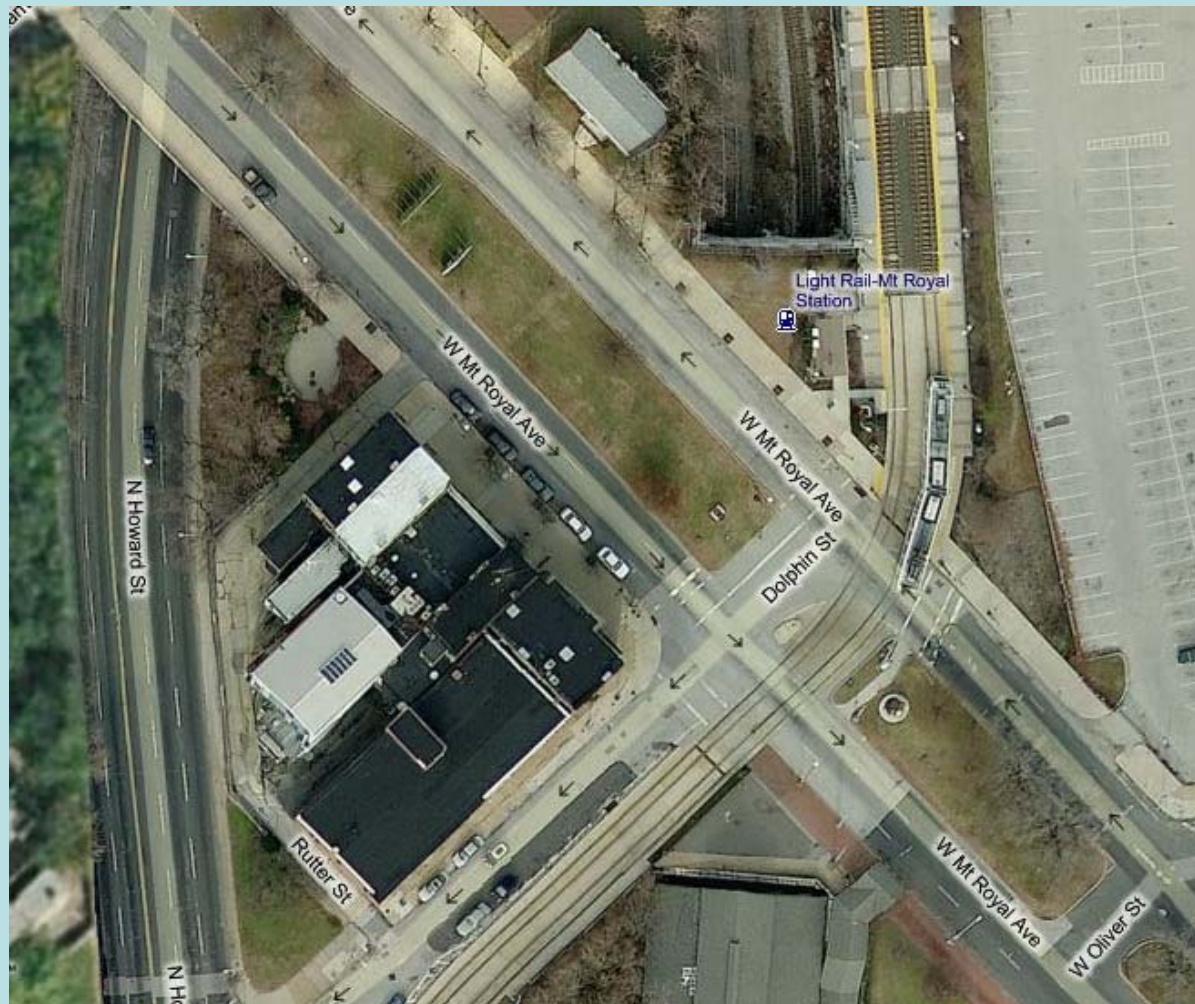
# Baltimore Light Rail Line Vehicle



- ABB Traction, Inc.
- 95-ft long, 109,000-lb
- 84 seats/172-person capacity
- Resilient wheels
- First delivered in July 1991



# TEST SITE



STAIANO ENGINEERING, INC.

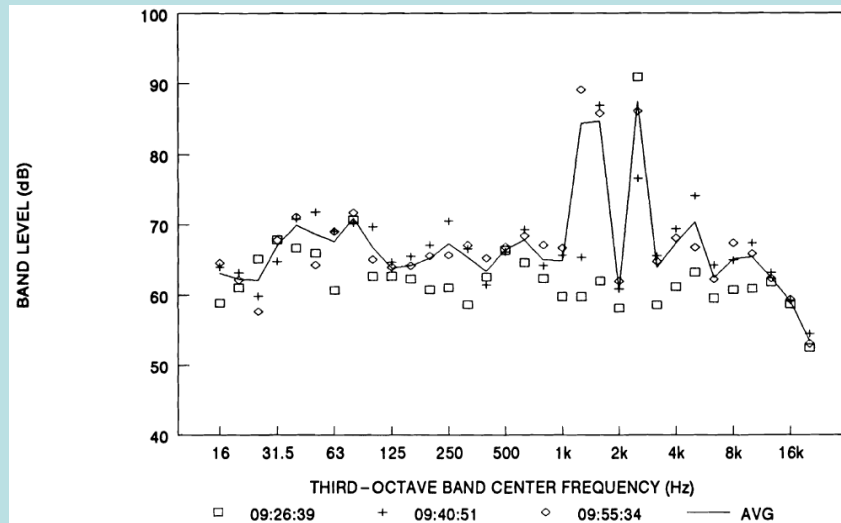
# STAIANO ENGINEERING, INC.

# TEST SITE DETAIL

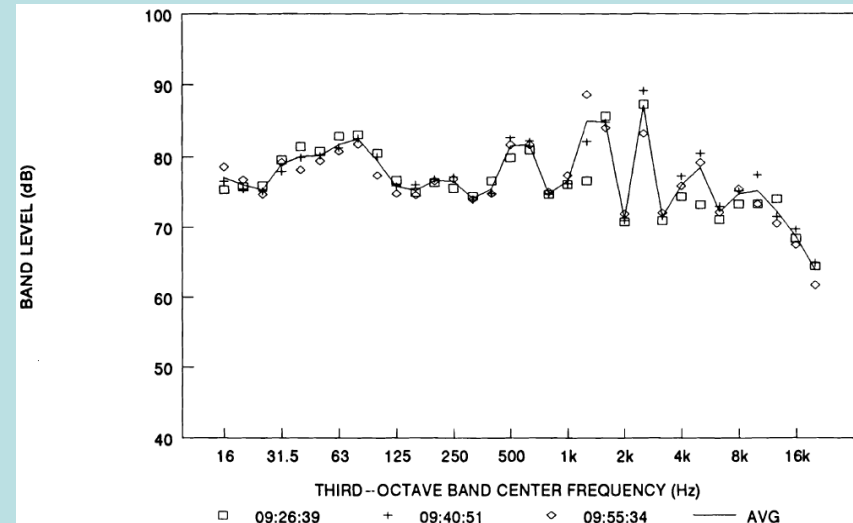
---



# Measured Frequency Spectra Southbound Trains/Outside Curve

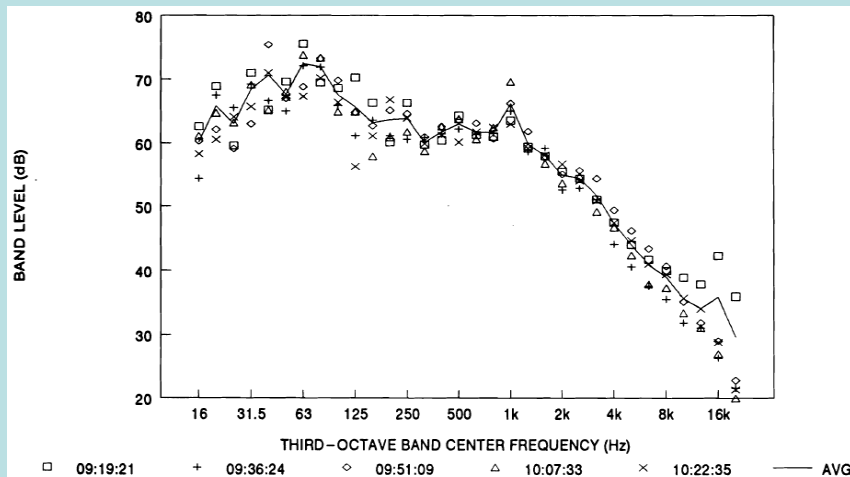


$L_{Amax}$

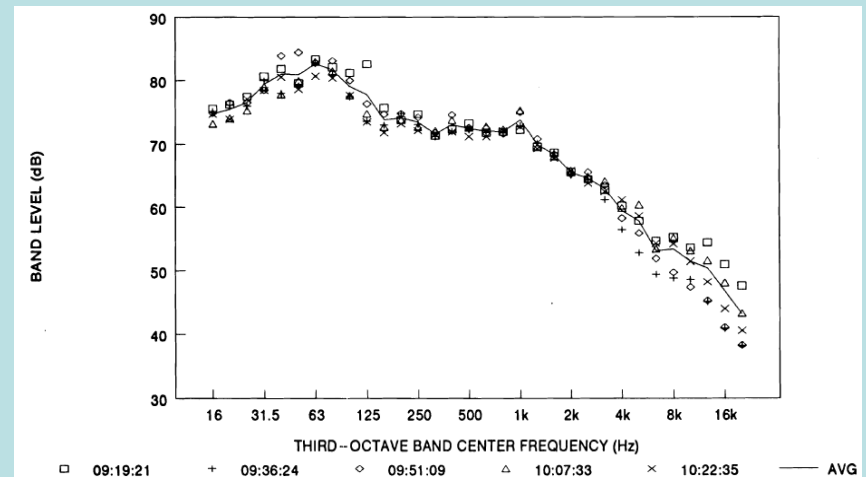


$L_{SE}$

# Measured Frequency Spectra Northbound Trains/Outside Curve

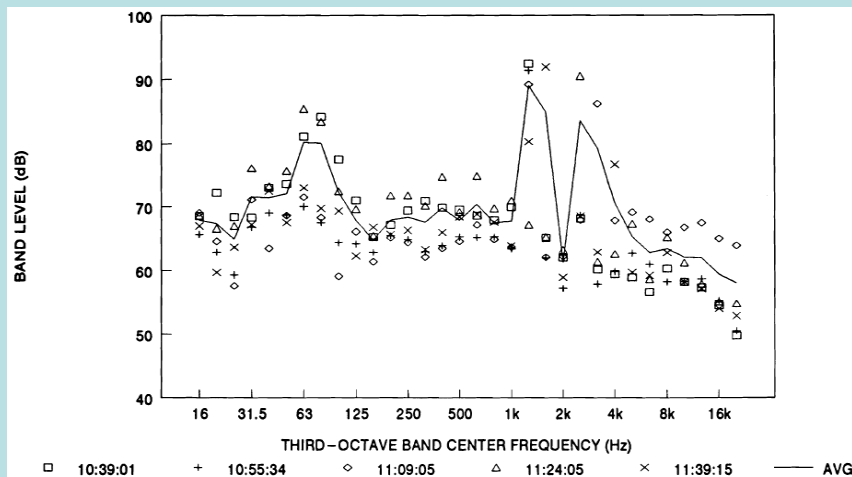


$L_{Amax}$

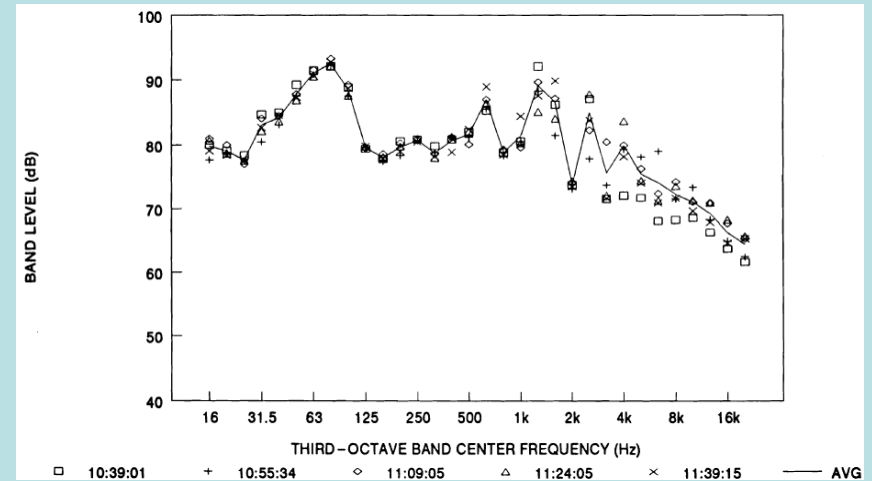


$L_{SE}$

# Measured Frequency Spectra Southbound Trains/Inside Curve

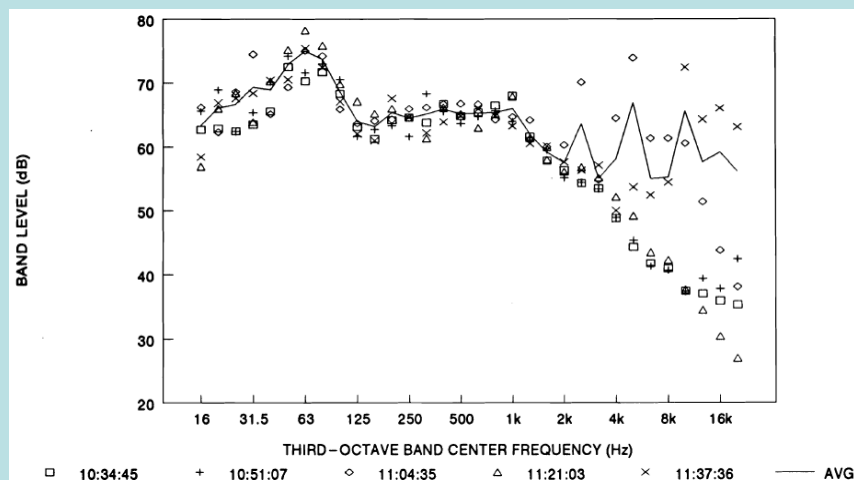


$L_{Amax}$

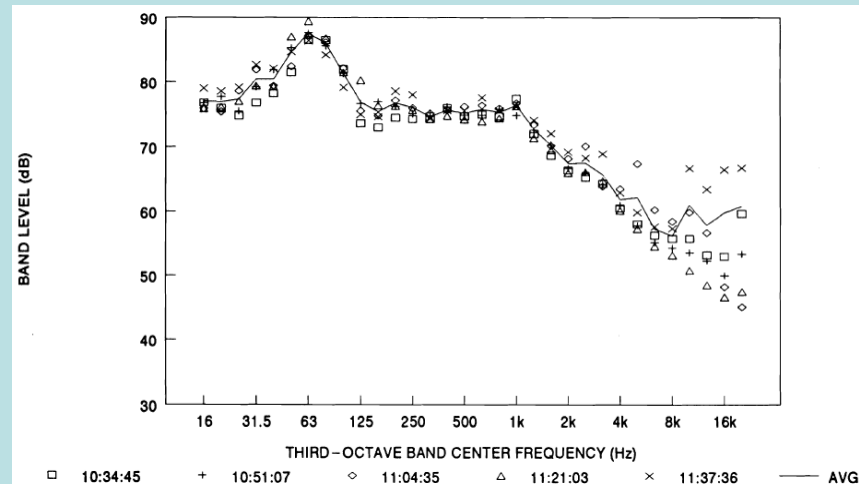


$L_{SE}$

# Measured Frequency Spectra Northbound Trains/Inside Curve



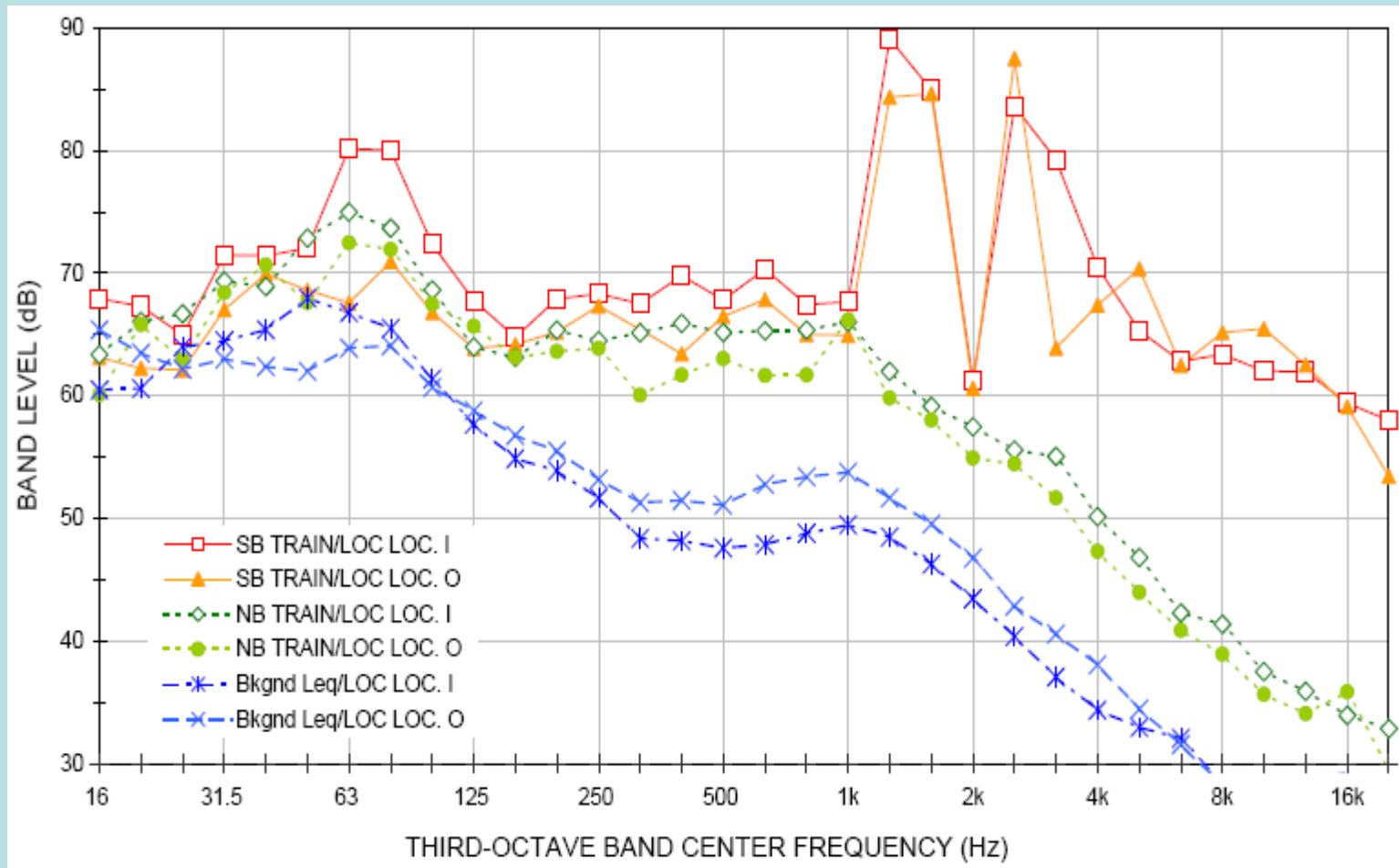
$L_{Amax}$



$L_{SE}$

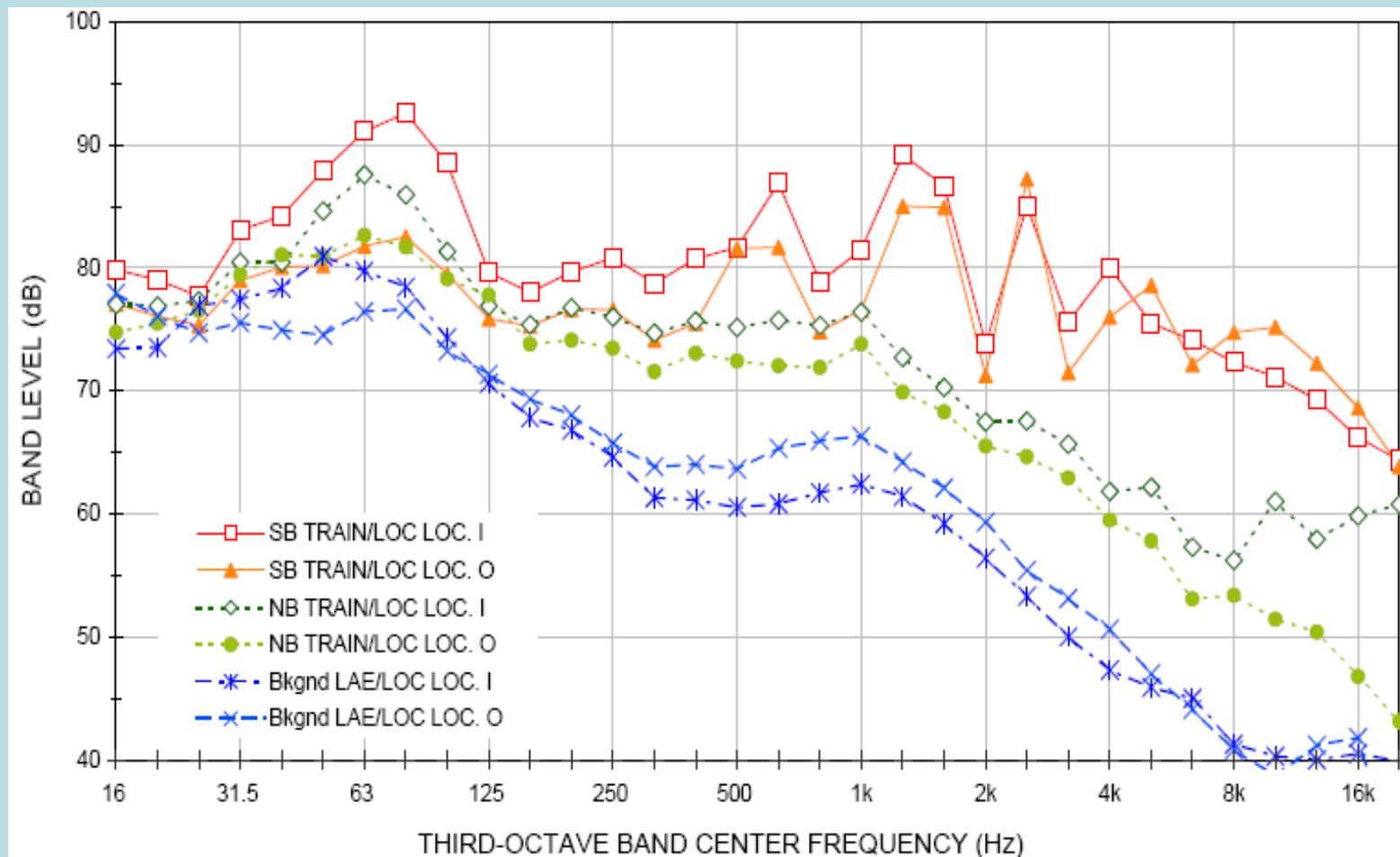
# MAXIMUM A-WGTD SOUND LEVELS

## Pass-By Average



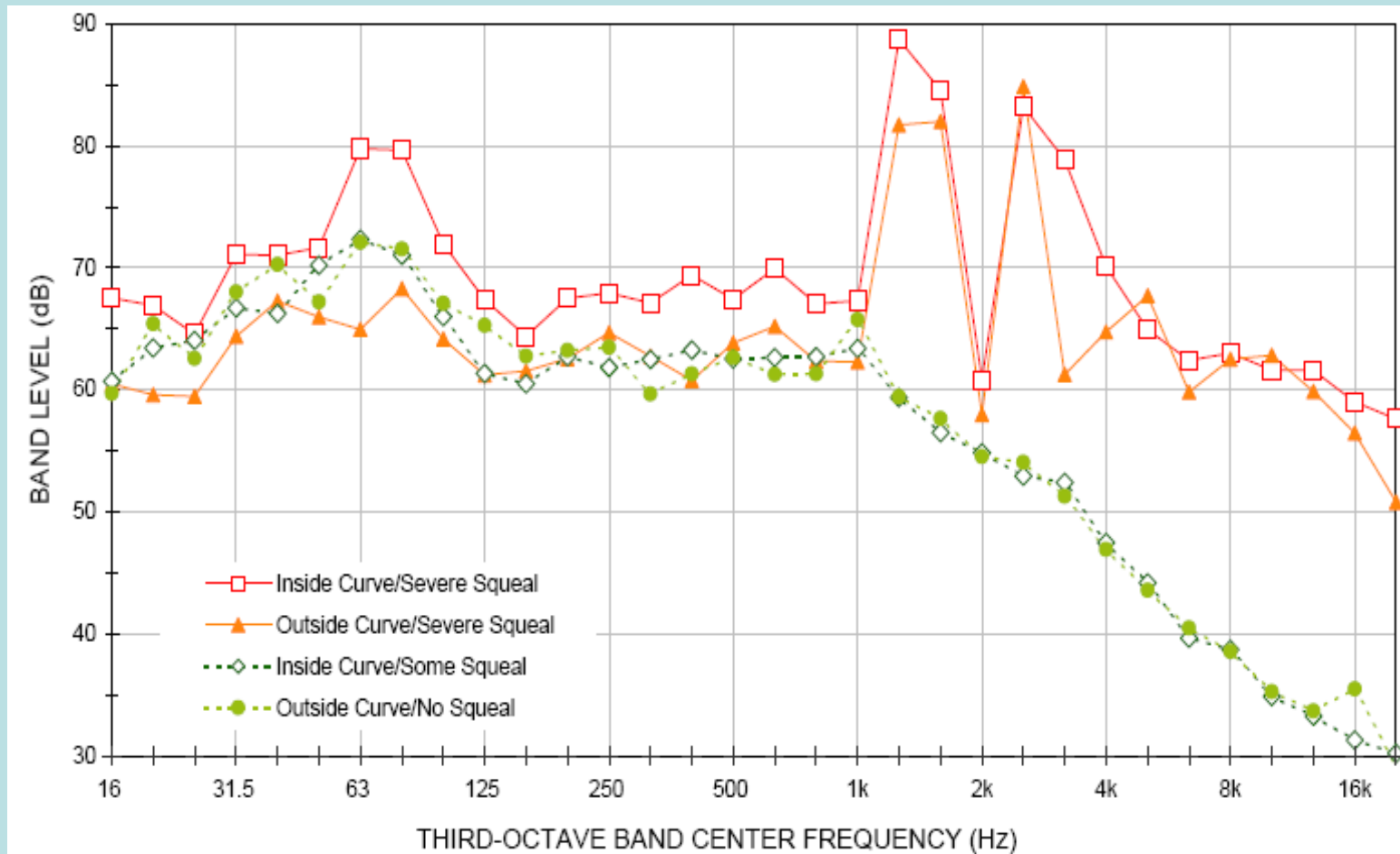
# SOUND EXPOSURE LEVELS

## Pass-By Average



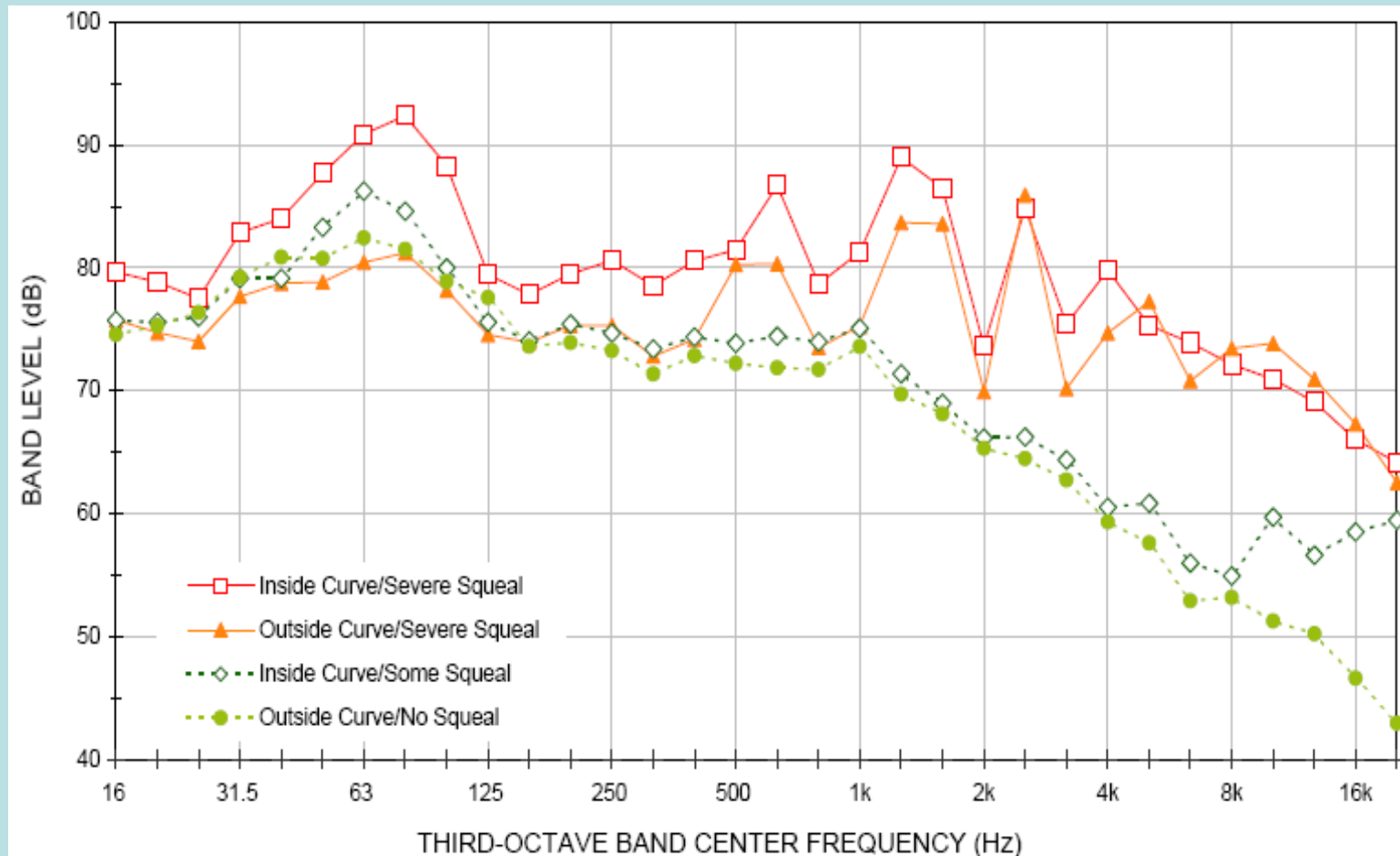
# MAXIMUM A-WGTD SOUND LEVELS

## Pass-By Average—Normalized



# SOUND EXPOSURE LEVELS

## Pass-By Average—Normalized



# MEASURED OVERALL A-WGTD SOUND LEVELS

	OUTSIDE LOCATION				INSIDE LOCATION			
	Northbound		Southbound		Northbound		Southbound	
	no squeal		squeal		some squeal		squeal	
	$L_{Amax}$	$L_{SE}$	$L_{Amax}$	$L_{SE}$	$L_{Amax}$	$L_{SE}$	$L_{Amax}$	$L_{SE}$
Mean Measurement	71	80	92	93	75	83	93	95
Measured Background $L_{Aeq}$	61		61		58		58	
Calculated Background $L_{SE}$		73		73		71		71
Background Adj. Measurement	71	80	92	93	75	83	93	95

# NORMALIZED OVERALL A-WGTD SOUND LEVELS

	OUTSIDE LOCATION				INSIDE LOCATION				FTA MANUAL	
	Northbound		Southbound		Northbound		Southbound		Reference	
	no squeal		squeal		some squeal		squeal		squeal	
	L <sub>Amax</sub>	L <sub>SE</sub>	L <sub>Amax</sub>	L <sub>SE</sub>	L <sub>Amax</sub>	L <sub>SE</sub>	L <sub>Amax</sub>	L <sub>SE</sub>	L <sub>Amax</sub>	L <sub>SE</sub>
Background Adj. Measurement	71	80	92	93	75	83	93	95		
Distance Normalized Emissions	71	80	94	94	77	84	93	95	100	113
Location Differential (In - Out)	6	5	-1	1						
Measured Squeal Increment			23	15			15	11		
Measured - FTA			-6	-19			-7	-18		