



NVH Application Note

NVHAN-063 NVH Dynamometers at Link Testing Laboratories

Link Engineering has over 25 years of experience in Noise, Vibration, and Harshness (NVH). Whether you need a complete NVH test system, a laboratory screening of brake system NVH performance, vehicle subjective testing, or a fundamental NVH investigation, we have the experience and expertise to assist you. Please do not hesitate to contact Jim Thompson at 734-453-0800 or sales@linkeng.com. To learn more about our NVH activities and expertise, visit our website at www.linkeng.com.



Introduction

The Noise, Vibration, and Harshness (NVH) performance of vehicle braking systems is a critical aspect of the customer's perception of the vehicle. As such, it is crucial that NVH evaluations be able to replicate noise performance on the vehicle. At the same time, brake NVH dynamometers must permit detailed studies of the braking dynamics and noise generation process to provide the information necessary for improving performance.

There are few such facilities open for contract use and independent studies. Link has installed several state-of-the-art NVH dynamometer in its Detroit, Michigan Testing Laboratories. They provide the capabilities to perform all current and planned brake NVH test protocols.

Brake NVH Tests

Performing tests that replicate the NVH performance of braking systems on vehicles is a complex task. It is often necessary to explore a wide array of operating parameters to identify those where noise issues occur.

Disclaimer:

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Microphones and accelerometers are most often used to quantify the brake noise and vibration during such operations. An enclosure is built around the braking components to permit accurate noise measurements without interference from other sources. In addition, these enclosures are designed to represent the on-vehicle environment with a reflecting floor plane and absorptive walls to simulate a free field over a reflecting plane as found on the open road.

There are two internationally recognized brake noise evaluation standards. One is known as the AK Noise Procedure. This protocol requires over 1000 brake applications and is composed of deceleration and drag segments in an attempt to elicit a wide array of brake noises.

The second major brake NVH test standard is SAE J2521. This procedure is still in draft form, but it is being utilized around the world for noise evaluations. This protocol utilizes a wider array of braking operations and is the product of the latest knowledge on brake noise generation.

Not only can Link's new NVH dynamometer be used for all the above tests, it can also be used for custom investigative programs. Using its advanced ProLink (Microsoft® Windows XP® based) programming environment, custom test protocols can be quickly formulated and implemented. A wide array of control and measurement algorithms can be utilized.

Typical System Capabilities

The basic capabilities of the dynamometer system are summarized below:

- 0 – 2000 rpm
- Up to 5600 Nm of torque
- Inertia 10-200 kg-m²
- Air/Oil Brake Apply
- Max Brake Pressure:200 bar

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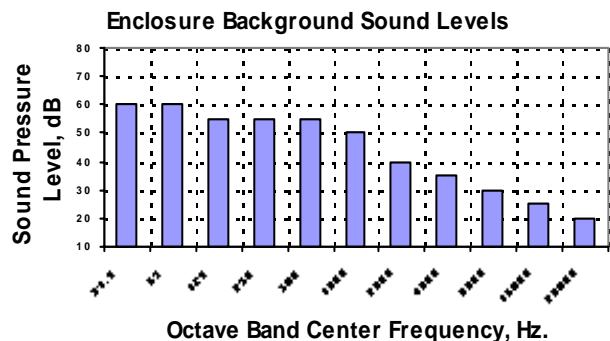
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- Max Pressure Increase:500 bar/sec
- Full axle and suspension capability
- Noise Chamber: 3.4m x 2.1m x 2.2m, thermal & acoustic insulation
- Automated and manual operation
- Torque, pressure, temperature, time and deceleration control
- Drag, full stop, and other test sequences

1. Acoustics Enclosure

Combining both Noise Reduction and Sound Absorption treatments, an acceptably low interior-background sound level can be achieved which will permit accurate measurements of all brake noise issues from 500 to 20,000 Hz. A typical background noise spectrum is shown below.



In addition the enclosure is mounted to provide full vibration isolation from the rest of the dynamometer and other mechanical energy sources in the building. One is truly able to measure the noise and vibration that is due to the braking system.

Cooling air is provided in the enclosure to reduce cycle times and to maintain a stable environment in the enclosure. The cooling air speed can be adjusted to maximize cooling and minimize extraneous noise for a given measurement scenario.

2. Inverted Tailstock

A key feature of this dynamometer is the ability to mount a full vehicle corner section or rigid axle. To accurately recreate vehicle noise issues, especially those at lower frequencies, it is necessary to test with the actual vehicle suspension. The dynamometer provides the capability to mount the suspension system with the brake driven from the spindle or the lug side of the rotor.

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3. Data Acquisition and Analysis System

A Bruel & Kjaer PULSE Analyzer System, Link Model 7704, is dedicated to this NVH dynamometer. This computer monitoring and noise recording system is capable of data acquisition, measurement, post-processing, documentation and analysis with simultaneous measurement of exponential, linear, peak and averaged spectrum. The system provides custom software for noise analysis, time data saving and order tracking.

- Real time measurements on all channels to 25 kHz
- Microphones and accelerometers to perform all standard tests procedure and more complex investigative studies

A complete state-of-the-art Link Engineering dynamometer control and data acquisition system is a key component in this dynamometer. The Pro-Link software package, running under Windows XP, provides maximum speed and flexibility in the capture and retention of all relevant test data. Monitored parameters include speed, torque, up to 8 temperatures, relative humidity, apply pressure, and many other parameters.



Please contact us to learn how we can help you with test system development and engineering services related to NVH.

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