Using Simulation to Optimize Muffler Performance for Transport Industry Vehicles

Nelson Global, a company renowned for its worldwide engineering, manufacturing, and distribution of clean and efficient subsystems for vital industries, seeks to revolutionize the refrigerated transport sector. Facing challenges in muffler design and performance optimization for their products in transport vehicles, Nelson Global turned to Ansys simulation software to streamline their product development process. This case study explores how Ansys simulation empowered Nelson Global to overcome muffler-related challenges, leading to enhanced efficiency, reduced emissions, and greater customer satisfaction in the refrigerated transport industry.

Challenges

One of Nelson Global's key product lines includes mufflers for transport vehicles, which plays a pivotal role in maintaining temperature control, reducing emissions, and ensuring the integrity of transported goods. In designing and developing two versions (P1 & P2) of the muffler for the customer, new requirements were provided where the customer needed better SPL at low speed and achieve more than 3 dB reduction on low frequency range below 1000Hz. The objective was to design two new versions (P3 & P4) to fulfill those requirements and perform transmission loss analysis to predict the sound performance of the designs.

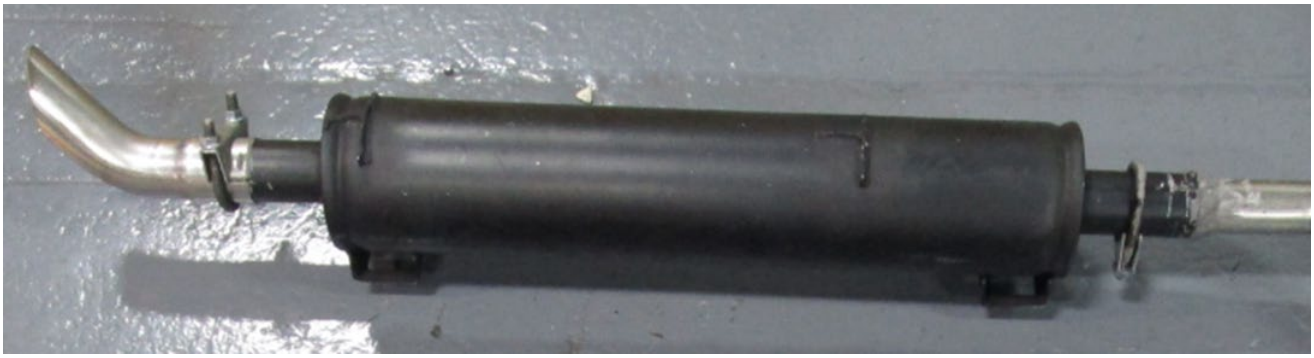

Figure 1. Photo of Muffler from Refrigeration Unit

Simulation Solution

Nelson Global leveraged Ansys simulation software to address these challenges. Ansys offered comprehensive simulation capabilities, enabling the company to analyze and optimize muffler designs with precision. Without the use of Ansys, engineers would have to perform manual hand calculations, with significant assumptions, and conduct time consuming, iterative physical tests.

> *"Through the use of ANSYS CFD we can refine and validate muffler designs early in the engineering process. I can evaluate my muffler designs in less than half the time it takes for physical tests."*
>
> - Shishuo Sun, Nelson Global

Simulation Process

A typical muffler internal configuration looks as shown in Figure 2 below. The baffling and bleeder tubes inside the muffler cause wave destruction and reduce low- and mid-frequency noise.

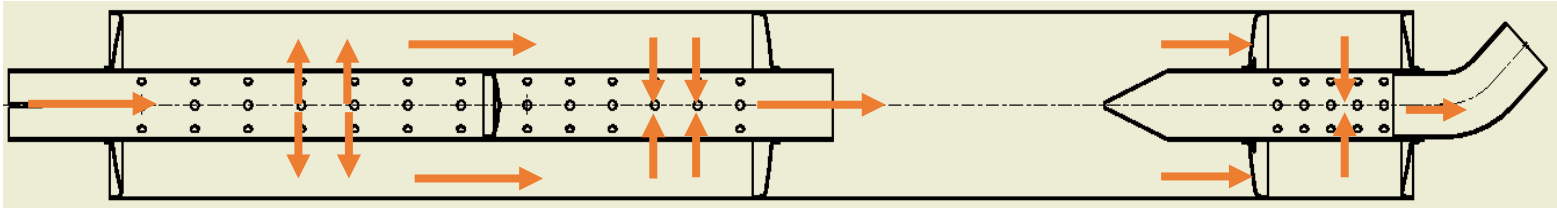

Figure 2. Typical muffler geometry

By conducting a transmission loss analysis, Nelson Global optimized the muffler's internal geometry to reduce noise emissions, meeting regulatory requirements and predicting the sound performance.

Ansys simulations allowed for fine-tuning of muffler parameters such as size, shape, and placement of internal baffles. This optimization process ensured that the muffler maintained peak performance without occupying excessive space.

It took a week for engineers to physically prototype the sample, set up the testing and review the data that was acquired. The simulation itself takes 2-3 days at most from start to finish to complete with Ansys.

Simulation Model and Results

A 3D Ansys CFD model was developed, and pressure levels were calculated throughout the model to determine the transmission loss. Various geometry configurations within the muffler were examined to optimize performance. Figure 3 shows representative geometry that was tested, and Figure 4 shows a comparison of the Ansys simulation data versus the experimentally measured data. Good correlation can be identified between the charts where frequencies with peak transmission loss occurs.

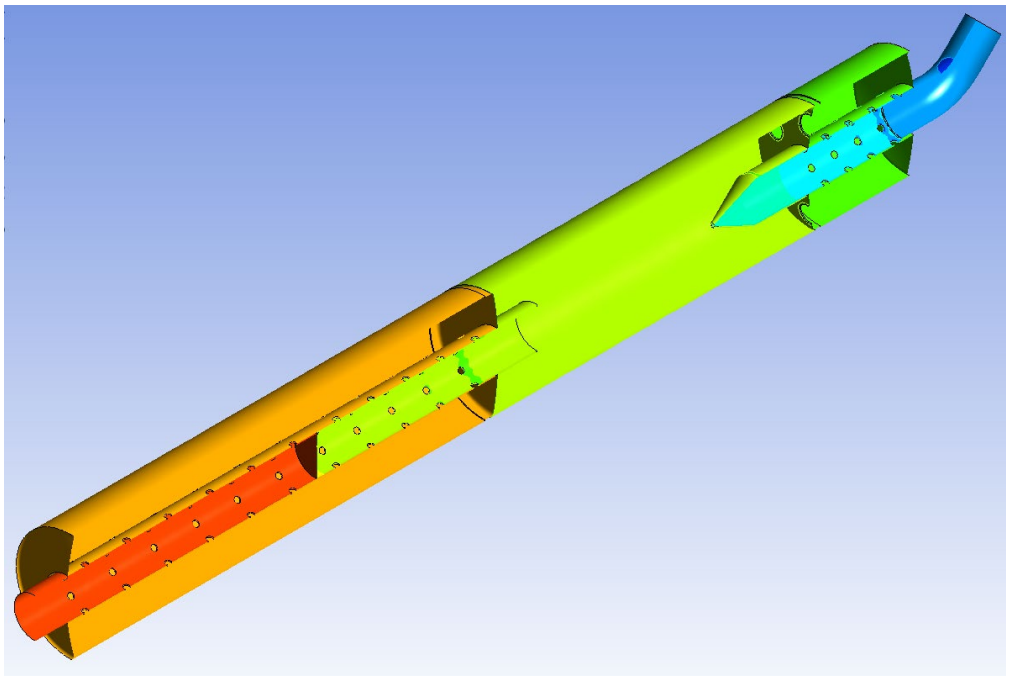

Figure 3 Representative Geometry and Pressure Levels Throughout Muffler

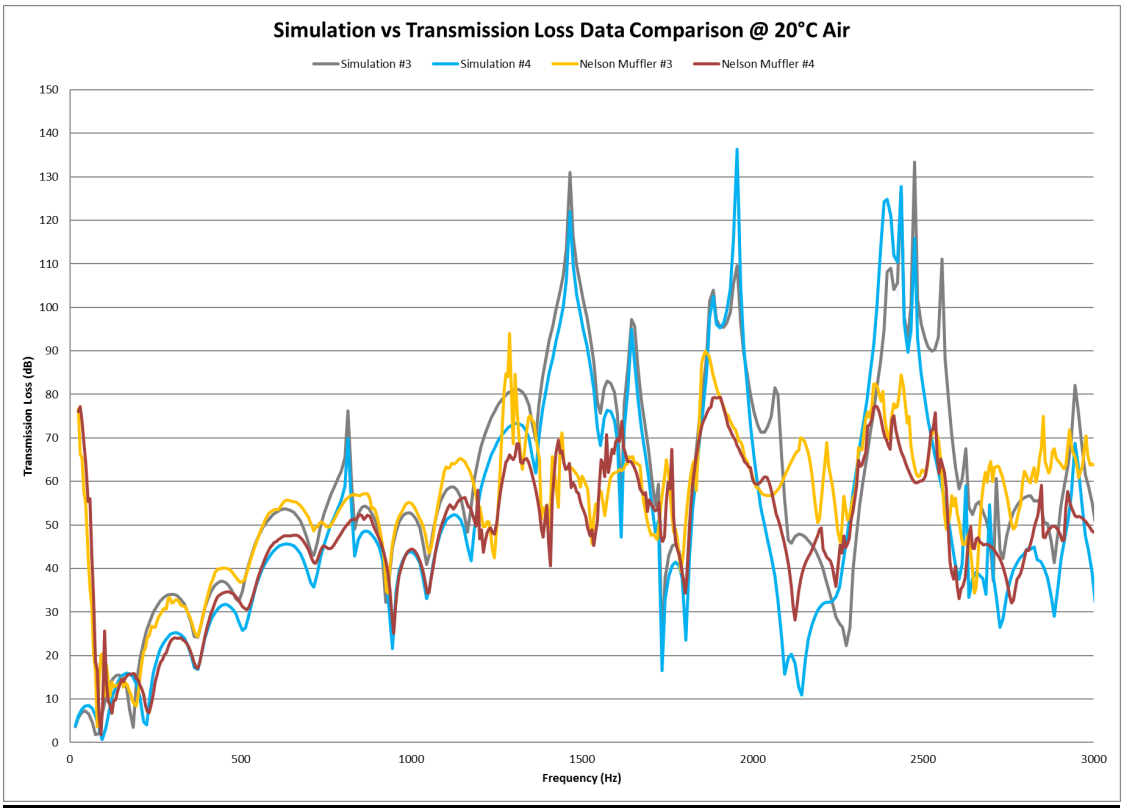

Figure 4 Simulation vs Transmission Loss Data Comparison

Conclusion

Nelson Global's use of Ansys simulation software was instrumental in overcoming challenges in the design and optimization of muffler performance and in reducing time and costs of marketing and prototyping. Nelson Global was able to numerically determine before testing that their new designs would have a higher transmission loss value and to deliver a working product to their end customer in a timelier fashion. This case study highlights how simulation-driven engineering can drive innovation and improve overall customer satisfaction in crucial industries.