

Reduced-Noise Gas Flow Design Guide Developed as a Noise-Control Design Tool for Meeting Glenn's Hearing Conservation and Community Noise Goals

A Reduced-Noise Gas Flow Design Guide has been developed for the NASA Glenn Research Center at Lewis Field by Nelson Acoustical Engineering of Elgin, Texas. Gas flow systems are a significant contributor to the noise exposure landscape at Glenn. Because of the power of many of these systems, hearing conservation and community noise are important issues. The purpose of the Guide is to allow Glenn engineers and designers to address noise emission and control at the design stage by using readily available system parameters. Although the Guide was developed with Glenn equipment and systems in mind, it is expected to have wide application in industry.

The Guide addresses several noise-generating gas flow processes, including

- Gas and steam discharge vents, ambient air intake vents, and inlet debris screens
- Compressors, exhausters, fans, and blowers
- Turbomachinery components such as inlet fans and compressors, combustor cores, turbines, exhaust jet mixing, and exhaust jet shock cells
- Flow noise from pipe walls and at fittings
- Control valves
- Orifices and venturis

The Guide also addresses the noise control performance of elements typically associated with gas flow systems:

- The walls of pipes, ducts, and vessels
- Vent silencers and inline silencers
- Intake and discharge duct openings with flow
- Acoustical lagging

The Guide consists of two parts: a written manual and a Microsoft Excel (Microsoft Corporation) workbook. The manual explains the mechanisms of noise generation, provides low-noise design guidelines, lists design parameters required for noise estimation,

and describes applicable noise control methods. The parameters of the predictive equations consist of readily available design information such as mass flow rates, gas properties, pipe diameters, and wall thickness. No manual calculations are necessary because the noise emission estimates are implemented in an easy-to-follow spreadsheet format in the accompanying software workbook.

The workbook consists of 16 spreadsheets that implement the noise-emission and noise-reduction estimates, 2 spreadsheets that perform computations for an elementary gas flow system, and a handy gas flow parameter calculator spreadsheet that includes unit conversions, decibel mathematics, ideal gas equations, and isentropic expansions and contractions. Two linked spreadsheets that combine estimates from the individual source noise estimation spreadsheets are used to model noise emission from a gas flow system. The gas flow system also addresses radiation from pipe openings, pipe walls, and extended surfaces; the benefit of inline silencers and pipe lagging; and the influence of reverberation on indoor sound levels.

Noise emission estimates generated by the workbook are compared directly with maximum noise-emission criteria determined in accordance with Glenn's "Buy Quiet" Program. The ability to predict sound levels at any point in a gas flow system greatly facilitates the development of noise-control strategies for new experimental research facilities and support systems, thus promoting compliance with hearing conservation and community noise goals.



The Reduced Noise Gas Flow Design Guide enables the development and implementation of noise-control strategies such as this silencer, which reduces the noise generated by the multiple pressure relief valves associated with Glenn's Central Process Air System. This system provides high-pressure processed air and exhaust to support Glenn's experimental facilities.

Find out more about Glenn Research Center resources for noise control
<http://www.grc.nasa.gov/WWW/AcousticalTest/>.

Bibliography

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