

# **KINETICS Noise Control**

# **SEISMIC DESIGN MANUAL**

COPYRIGHT©2003  
All Rights Reserved

Kinetics Noise Control, Inc.  
6300 Irelan Place, Dublin, Ohio 43017  
USA  
Ph 614.889.0480, Fax 614.889.0540

3570 Nashua Drive  
Mississauga, Ontario L4V 1L2  
Canada  
Ph 905.670.4922, Fax 905.670.1698

[www.kineticsnoise.com](http://www.kineticsnoise.com)

**Member VISCMA**  
(Vibration Isolation and Seismic Control Manufacturers Association)

Except as noted under Reprint Permission, no part of this book may be reproduced, stored in a retrievable system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of Kinetics Noise Control, Inc.

## Forward

An industry leader, Kinetics Noise Control has engineered and manufactured vibration isolation, noise control products and seismic restraint systems for over 40 years. With the advent of recent changes to the building codes, in particular with respect to a building's ability to survive seismic events, there is a new focus on the proper design, application and installation of equipment restraint componentry.

To address this need, Kinetics Noise Control has taken a more active role in the development of new restraint devices that are more effective than those produced by the industry in the past. In conjunction with the development of hardware, this manual has been published as an aid to project specifiers, architects, engineers, and installation contractors.

The primary focus of this manual is to offer a guide to meeting the different requirements specified in the various building codes in ways that are more easily understood than in the original code format. The key to the manual is its ability to link both code and project requirements to products and design solutions with a minimum of effort.

Often raised questions and frequently encountered field problems are addressed in the earlier segments of this manual. Prior to designing or installing a restraint system, those parties involved should read and become familiar with these sections. A full understanding of them will allow an installation to move ahead smoothly with a minimum of difficulty.

Interpretations of code language are included for areas in which there is often confusion. Because this manual is focused on the restraint of equipment, large segments of the existing code language intended to address items beyond the scope of the mechanical system, and generally not of interest to those using this manual, have been reduced to a more manageable size.

Piping and duct restraint is covered in detail because of the high level of input and guidance needed at the field level. Addressed in this section are piping, conduit and ducting systems, cable and strut restraint arrangements, and various anchorage systems.

This manual was written to allow the user to maintain compliance with SMACNA to the maximum extent possible. When there are areas where safe, functional systems can be installed at a lower cost or level of effort than is dictated by the SMACNA guidelines, these are pointed out as possible options. It is not the intent of this manual to be fully SMACNA compatible, however, and when SMACNA is specified the end user should obtain and reference their manual as well.

Also included in this manual are guidelines for determining the level of restraint required and the quantity of restraint components needed for various pieces of equipment in various locations. Different types of restraints are identified with explanations as to which ones might be the most appropriate for particular situations and why.

Design and sizing information for interfacing items such as anchorage components and housekeeping pads are addressed as well.

## Kinetics Noise Control Qualifications

In addition to a staff of non-licensed Engineers, Kinetics Noise Control employees include eight licensed Professional Engineers, including three with PhD's and four with Master's degrees. Kinetics Noise Control holds and maintains P.E. licenses in over 30 seismically active or high wind probability states, as well as portions of Canada.

In addition, Engineers from Kinetics Noise Control participate at the national level in the following organizations: BSSC (Building Seismic Safety Council), ASCE (American Society of Civil Engineers), FEMA (Federal Emergency Management Agency), ACI (American Concrete Institute), ASHRAE (American Society of Heating, Refrigeration and Air-conditioning Engineers) - TC-2.6 (Sound and Vibration), TC-2.7 - (Seismic Restraint), ASHRAE/ANSI Standard 171 Development - (Testing Standards for Seismic Devices) and VISCMA (Vibration Isolation and Seismic Control Manufacturers Association).

Kinetics Noise Control has been an active supporter and a leader in developing tools to aid contractors and designers in designing and specifying appropriate restraint devices. Recent accomplishments include authorship of the ASHRAE 2003 HVAC Applications Handbook's Seismic chapter and generation and presentation of several papers on seismic subjects for ASHRAE at the national level and many more at the local chapter level. Kinetics Noise Control supported the development of FEMA's (3) pocket seismic installation guides at both the basic drafting and oversight levels and has authored papers for VISCMA publication, clarifying IBC code provisions.

Kinetics Noise Control offers extensive practical experience in both design and application. Combined, the licensed Professional Engineers of Kinetics Noise Control have a total of over 200 years of experience in the design of components and systems and of this, over 125 years is directly linked to seismic, vibration and sound control systems.

Kinetics Noise Control is an innovative company. Working over the broadest range of markets of anyone in our industry, Kinetics has designed and provided solutions to a large variety of problems or situations. Some of the markets served include:

HVAC Equipment and Piping	Molded Elastomeric Components
Industrial Vibration Systems	Mobile Equipment Applications
MRI Scanners/Electron Microscopes	Acoustic Test Chambers
Architectural Noise Separation	Pipe Flexes
Interior Wall Treatments	Riser System Support
Rigid and Curtain Wall Enclosures	Seismic Restraint Systems
Whole Building Isolation	Bomb Blast Mitigation
Tuned Mass Damping Systems	Rail Isolation Systems
Duct Silencers	Coordinate Measuring Machines
Jet Engine Testing Silencers	Dynamometers

In developing solutions to these and other design challenges, Kinetics Noise Control and/or its employees hold, or have pending, 16 patents. Of these, seven are directly linked to seismic restraint, vibration, and sound control systems.

## About the Authors

Paul Meisel, PE, Vice President of Engineering, currently maintains P.E. licenses in ten states. Mr. Meisel has been with Kinetics for over 12 years and prior to that was involved in the design of mining equipment for 17 years. He is an active member of ASHRAE and the author of the ASHRAE 2003 Handbook Seismic Restraint chapter. He is a past member of FEMA's BSSC TS-8 (Restraint of Non-structural Components) Task Group. Mr. Meisel is a regular speaker at ASHRAE functions and the author of two ASHRAE publications related to seismic restraint issues. Mr. Meisel holds or has pending four patents, three directly related to the vibration and seismic control industry.

Richard Sherren, MS, PE, Chief Mechanical Engineer, currently maintains licenses in ten states. Mr. Sherren has been with Kinetics for three years and prior to that worked as an engineering consultant for five years and in the design of heavy construction and mining equipment for 17 years. He is an active member of ASHRAE and a past instructor of college-level engineering, management and CAD courses. Mr. Sherren is a member of ASHRAE committees TC 2.7 (Seismic Restraint) and SPC-171 (Testing of Seismic Restraint Devices). He is author of a paper issued through VISCMA on the interaction between internal and external isolation systems on packaged air handling systems. Mr. Sherren has pending one patent on an innovative method for the seismic restraint of equipment.

Scott Campbell, PhD, PE, Chief Civil/Structural Engineer, currently maintains licenses in seven states. Dr. Campbell has been with Kinetics for three years and has been involved in design, teaching, and research in dynamics for over 18 years. Specializing in nonlinear analysis of structures, a significant amount of the work that Dr. Campbell has done throughout his career has been in the field of blast and seismic design. He is an active member of ASHRAE, ASCE, and ACI and is a current member of FEMA's BSSC TS-8 (Restraint of Non-structural Components). In line with his specialty, Dr. Campbell is also the author of numerous papers and presentations on nonlinear analysis and design for seismic, blast, and vibratory loads.

David Meredith, MS, PE, Export Manager. Mr. Meredith has held his current position since 1994 and is responsible for the design of custom noise and vibration control systems sold by the company. He is also responsible for export sales and marketing, working with the company's overseas sales offices. Prior to assuming his current duties, Mr. Meredith was Chief Engineer for the company. He joined Kinetics Noise Control in 1978 and has recently presented papers and technical lectures at seminars sponsored by the Society of Manufacturing Engineers (Nashville), the International Conference on Structural Dynamics, Vibration, Noise and Control (Hong Kong) and InterNoise '96 (Liverpool, U.K.). Mr. Meredith is a member of the American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc. (ASHRAE), the Acoustical Society of America (ASA), and the Institute of Noise Control Engineers (INCE).

## **Interpretation of this Publication**

Referenced in this publication is information on various Codes and Standards provisions, design and installation procedures and guidelines for satisfying these Codes and Standards. The included information was carefully developed using sound engineering principles to meet these guidelines: however, the final authority and responsibility as to specific design, installation, approval and/or Code interpretations addressed herein rests with the engineer or architect responsible for the specific design. Kinetics Noise Control, Inc., and all contributors to this publication assume no liability for the specific installation of its products or the design, application, approval or interpretation of the requirements or guidelines contained in this publication. It is recommended that all users of this publication, under all circumstances, consult with competent design professionals as well as applicable federal, state, local and contract regulations on requirements for specific installations.

## **Reprint Permission & Restrictions**

Nonexclusive royalty-free permission is granted to government and private sector users of this publication to reproduce unaltered abstracts from this publication for their use relating to the specific design, specification, installation or approval of this document. Reproduction for the purpose of its sale is prohibited. Any other use of any other portion of this publication must be first approved in writing by Kinetics Noise Control, Inc. Anyone reproducing these documents assumes all liability for the specific application of such information, including errors or omissions in reproduction.

## **Amendments and Updates**

Kinetics Noise Control reserves the right to periodically update this document as well as to offer formal interpretations as questions arise. Prior to using this document it is the responsibility of the user to verify that the segment being used is the latest release. Updates can be found on the web at [www.kineticsnoise.com](http://www.kineticsnoise.com).

## **Proprietary Products**

This manual assumes the use of Proprietary Products as provided by Kinetics Noise Control or otherwise identified herein. As not all components have equal capacities, Kinetics Noise Control cannot support or authorize the use of materials that are not under the direct control of Kinetics. Any liability that may result from the application of this manual to materials procured from other sources is not the responsibility of Kinetics Noise Control or its employees.