

NONDESTRUCTIVE TESTING HANDBOOK

FOURTH EDITION

VOLUME 2

LEAK TESTING

DIETMAR F. HENNING,
TECHNICAL EDITOR

The American Society for Nondestructive Testing

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ASNT exists to create a safer world by advancing scientific, engineering, and technical knowledge in the field of nondestructive testing.

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In memory of
Patrick O. Moore
(1951 – 2017)

FOREWORD

AIMS OF NDT HANDBOOK

The publication of another volume in the *NDT Handbook* is a good occasion to reflect on the goals of that series.

Handbooks exist in many disciplines of science and technology, and certain features set them apart from other reference works. A handbook should ideally give the basic knowledge necessary for an understanding of the technology, including both scientific principles and means of application. Handbooks are reference documents, rarely read cover to cover but consulted for specific information.

The *NDT Handbook* is written for a broad audience but includes technical details up through college physics. Assumptions about the reader vary according to the subject in any given chapter. Computer science requires a different sort of background from nuclear physics, for example. It is not possible for the handbook to give all the background ancillary to nondestructive testing.

A handbook offers a view of its subject at a certain period in time. Even before it is published, it starts to get obsolete. The authors and editors do their best to be current but the technology will continue to change even as the book goes to press. Moreover, the *NDT Handbook* reflects technology that is being used by industry, not every undeveloped idea that might be implemented.

Standards, specifications, recommended practices, and inspection procedures may be discussed in a handbook for instructional purposes, but at a level of generalization that is illustrative rather than comprehensive. Standards writing bodies take great pains to ensure that their documents are definitive in wording and technical accuracy. People writing contracts or procedures should consult real standards when appropriate.

Those who design qualifying examinations or study for them draw on the *NDT Handbook* as a quick and convenient way of approximating the body of knowledge. Committees and individuals who write or anticipate questions are selective in what they draw from any source. The parts of the *NDT Handbook* that give scientific background, for instance, may have little bearing on a practical examination. Other parts of a handbook are specific to a certain industry. The *NDT Handbook* cannot include everything on its subject but does try to cover as much as practical.

Volunteer activity including peer review draws on the expertise in ASNT's Technical and Education Council and is coordinated through the Handbook Development Committee.

Richard H. Bossi
Handbook Development Director
August 2017

PREFACE

LEAK TESTING METHOD

Since 1900, several generations of technicians have developed nondestructive test techniques and applied them to the needs of industry. A handful of technicians founded ASNT in 1941. In the years that followed, they and their successors spread nondestructive testing in the various industries and established its methods. One way to achieve that goal was the development of handbooks that describe the state of the art and cover the range of applications. Starting in 1959 with two volumes by ASNT's founding father Robert McMaster, the handbook has become a multimethod, multivolume set. This leak testing volume is the second volume in ASNT's *Nondestructive Testing Handbook*.

Like any other volume, the *Leak Testing Handbook* is a collective achievement of members and friends of the American Society for Nondestructive Testing and is updated in years that follow. A separate handbook volume on leak testing began the second edition in 1982 and the third edition in 1998. For leak testing, this development of was driven by eminent personalities like Charles Sherlock. Today, ASNT has committees for each method where the technicians who implement industrial applications meet to refine and share their knowledge and skill. The Leak Testing Committee and its members were of utmost importance in updating this volume, and members invested many hours to make it a success. Moreover, a long list of people from various industries worked directly with the editors for special contributions. Every chapter of the preceding handbook has been updated: parts of the volume had to be completely rewritten; other parts remain with slight modifications.

The following updates and improvements shall be explicitly highlighted: The physics background, especially important for this method, got its own chapter. Todd Sellmer deserves special thanks for his updates on pressure and vacuum techniques and his reviews of almost every chapter. Gerry Elder's systematic improvements made the chapter on helium mass spectrometry much better. The chapter on thermographic leak testing was completely revised and updated. This volume also features completely new parts on blower door and solid state hydrogen techniques.

The names of the contributors can be found on the first page of each chapter. The names refer to the latest update and do not mean that every paragraph or sentence was originally written by those people. Again, this handbook is a collective effort of several generations of members of the American Society for Nondestructive Testing. In effect, the Society as an entity has always been and will remain the author of this handbook. We trust that a next generation will provide further improvements and updates of the handbook for many years.

Dietmar Henning

ACKNOWLEDGMENTS

The fourth edition of the *Nondestructive Testing Handbook* continues with the volume Leak Testing. This fourth edition volume is indebted to preceding editions in many ways. However, much of the text has been revised, reedited, and updated so that the book now reflects current techniques, equipment, and technology.

The Technical Editor is indebted to the committee members, contributors, and reviewers who volunteered to help assemble this book. As Coordinator, Todd E. Sellmer played a significant role in assuring the volume's successful publication. The aim was to build on the work of those who contributed to previous editions, reorganizing, updating, and refining the technical content, while maintaining the integrity of the structure.

The technical content of this fourth edition volume differs in several ways from that of the third. (1) The chapter on physics has been extensively revised and includes new equations. (2) Chapters on safety, pressure, and vacuum and bubble testing have been significantly updated. (3) New sections on blower doors and designing for leak testing have been added. (4) Chapters covering helium, mass spectrometry, thermography, halogens, acoustics, and hermetic seals have been expanded and updated. (5) Citations to applicable standards have been updated throughout. (6) Wherever possible, black and white photographs have been replaced with color. There are more than 100 new color photographs, including some from ASNT members overseas. Sources of illustrations are listed in the back of the book.

The contributors and reviewers all brought their gifts individually to this project — collectively they made it better than a product of one person could be. The guidance and assistance of the ASNT staff is also gratefully acknowledged. ASNT is indebted to all the technical experts listed at the end of this preface. People listed as contributors were also reviewers but are listed only once, as contributors.

The working group honors the service of Patrick O. Moore (1951-2017) to ASNT and the entire nondestructive testing community. His decades-long contribution as editor of the *Nondestructive Testing Handbook* helped create volumes that offer the clear, accurate, readable text and illustrative figures that are the hallmark of a quality reference.

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Technical Editor
August 2017

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